

Asia's Energy Trends and Developments

Innovations and Alternative Energy Supplies

volume

1



Mark Hong
Amy Lugg
Editors



 World Scientific

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FOREWORD

This book continues the sterling work published by the Institute of Southeast Asian Studies (ISEAS) of the ISEAS Energy Studies' Books series. They are based on lectures delivered at the ISEAS Energy Forum, which was launched in June 2004, and ended in September 2011, having organized 135 energy seminars and conferences. This volume also includes papers contributed by invited writers, who are experts on various energy issues. These books serve to capture in a permanent book format the knowledge and data which were delivered in the Forum lectures, and might serve to help educate and sensitize the public about energy issues, as well as the persons who for some reason or other, had missed the lectures.

Energy issues, such as energy security, energy efficiency and related subjects, such as climate change, global warming and global competition for resources, are still salient on the international agenda. The global financial crisis serves to underline the key roles that dependable, affordable and accessible energy resources play in the global economy. Global economic recovery would be difficult if oil and gas prices should reach the spike in energy prices seen in 2008. China's continuing high growth rates in the past few years, which have enabled China to play the role of global economic locomotive at a time when the G3 economies, namely, USA, EU and Japan were all simultaneously suffering from low growth, also depend on affordable energy prices.

What is remarkable about this book is the wide range of energy issues addressed therein. From climate change to clean energy; from energy innovation to Nano-energy, this volume ranges far and wide. It provides much useful data and expertise on energy issues. Readers all over the world might benefit by careful reading of this publication.

The book concludes with a special section on nuclear energy issues in Asia. It is important to note that at the time of submission of the nuclear papers, the Fukushima disaster had not yet happened and it is clear that since that tragic event, there has been a severe rethink about nuclear safety.

This section examines the potential role of nuclear power in Asia as a whole and in some individual Southeast Asian countries. It also describes the possibilities for cooperation in terms of the regulatory infrastructure and safeguards that need to be put in place, and soberly assesses all the various risks involved in building and operating nuclear power plants.

We are happy to contribute to the global debate on energy issues via this volume and this series. Finally, we would like to thank all contributors for their immense patience and understanding throughout the publications process.

Mark Hong & Amy Lugg
Editors

July 2012

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PART I

**INNOVATIONS AND ALTERNATIVE
ENERGY SUPPLIES**

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CHAPTER 1

CLIMATE CHANGE: A GLOBAL ISSUE

Tan Yong Soon

*Former Permanent Secretary, National Climate Change,
Prime Minister's Office
1 July 2010 -1 October 2012*

ABSTRACT

As a small and low-lying island state, Singapore is vulnerable to the impact of climate change. Therefore, we work closely with other stakeholders to address this global challenge. Singapore plays a constructive role in international climate change negotiations under the United Nations Framework Convention on Climate Change (UNFCCC). We have pledged to reduce emissions by 16% below 2020 Business as Usual (BAU) levels, contingent on a legally binding global agreement. Ahead of this, measures are being implemented to reduce our emissions by 7% to 11% below 2020 BAU. Singapore is also building capabilities to adapt to the impact of climate change, harness green growth opportunities as well as forge partnerships on climate change action.

1.1 BACKGROUND

The National Climate Change Secretariat (NCCS) was set up on 1 July 2010 as a dedicated agency under the Prime Minister's Office

to coordinate Singapore's domestic and international climate change strategies. NCCS has launched the National Climate Change Strategy 2012 (NCCS-2012) to explain Singapore's plans to address climate change. A multi-agency working group has also been formed under the Inter-Ministerial Committee on Climate Change to study how Singapore can stabilise its long term emissions.

Climate change is one of the most important and pressing challenges facing the international community. As is known, the UN Climate Change Conference in Copenhagen last December did not result in a global legally binding agreement to address climate change. However, it is not easy to reach an agreement to address climate change as the issues are complex and the politics inherently divisive. Many governments are reluctant to sacrifice current economic growth as the most severe consequences of climate change will only be evident over the long term, spanning many election cycles and changes of leadership, while the economic costs of preventive actions are huge and must be paid upfront.

For Singapore, climate change and its associated impacts are of concern. As a small and low-lying island state, we are vulnerable to the impacts of climate change. A rise in sea level and temperature can have significant consequences for us. Now, if Singapore were to stop emitting carbon tomorrow, it would do little to alleviate climate change. After all, our contribution to global emissions is minuscule, at less than 0.2 percent of the global total. So for us, we have a stake in seeing the issue effectively addressed. It is important to have an agreed global regime that commits everyone to take action.

We must not lose sight of the end goal of reaching a global legally binding agreement on climate change with comprehensive targets for all countries. Without such a global regime, every country would act for itself, promoting undesirable unilateral actions. Carbon tariffs would offer an inevitable backstop against those countries that fail to take adequate action to curb their emissions. This will provoke retaliations that will severely undermine global economic trade and growth. It is only with open trade and economic growth that countries muster the resources to deal with the challenge of climate change effectively.

Against this backdrop, the EU's efforts to address climate change, despite the effects of the economic crisis, are commendable. Europe is not letting up its efforts to contribute to climate change actions, and is contributing towards climate change action in Southeast Asia.

1.2 SINGAPORE'S ROLE

Singapore has been very active in the UN negotiations to arrive at a new global framework for long-term cooperation to address climate change, participating in both the ministerial and official tracks. As a member of the Group of 77 (G77/China) as well as the Alliance of Small Island States (AOSIS), and also given our unique position as a small but successful developing country, Singapore has tried to play a constructive and moderating role in the negotiations.

Even now, in the aftermath of Copenhagen, we have actively participated in the discussions of the UN Secretary-General's High-Level Advisory Group on climate change finance and different partnerships on reducing emissions from deforestation and forest degradation (REDD) and measurement, reporting and verification (MRV) to move the process forward. ASEAN countries are vulnerable to climate change. Singapore will do its part in promoting greater awareness of the issues involved, as well as to encourage closer cooperation and common understanding on the issue of climate change and its impact. In 2009, the ASEAN Working Group on Climate Change was launched during the ASEAN Ministerial Meeting on the Environment in Singapore. This Working Group will seek to build a common understanding of climate change issues, and enhance regional sharing of information on vulnerability risks and adaptation measures to climate change.

1.3 SINGAPORE IS SERIOUS ABOUT CLIMATE CHANGE

The Singapore government is serious about our domestic efforts to address climate change. Before Copenhagen, Singapore had announced that we would undertake actions to reduce our emissions by 16 percent below business-as-usual (BAU) levels in 2020, contingent on a legally binding global agreement and all countries implementing their commitments in good faith. This is a significant contribution, given our constraints in switching to non-fossil alternatives to reduce emissions from the power sector. Our early actions in the past, such as our policy to limit car population growth and our switch from oil to natural gas for electricity generation, have also limited our ability to further reduce emissions.

To ensure that Singapore is prepared and ready for climate change threats and opportunities, we have set up a dedicated National Climate Change Secretariat (NCCS), which I head, under the Prime Minister's Office with effect from 1 July 2010. The NCCS will coordinate climate change policies across government agencies and ensure that plans are prepared and progress tracked and monitored. The NCCS is set up not only to support the international negotiations but also to coordinate our domestic mitigation and adaptation responses to climate change.

1.4 DOMESTIC MITIGATION AND ADAPTATION MEASURES

While Singapore is working on the international front to secure a global agreement, we have also started to look at what can be done now, especially on the mitigation and adaptation fronts. As the conference organisers have identified, the responses post-Copenhagen will need to focus on what actions we can take now, even as intense and difficult negotiations are ongoing to achieve a global legally binding agreement.

1.4.1 Mitigation

On mitigation, we have already started to undertake various initiatives domestically. With limited access to alternative energies, we have fewer options to reduce emissions compared to better-endowed countries. Our approach to reducing emissions is primarily to improve energy efficiency in all sectors. At the same time, we have put in resources to testbed alternative energy sources so that Singapore will be better positioned to adopt these technologies when they improve and their costs come down.

The Sustainable Singapore Blueprint (SSB) launched in April 2009 represents a major national effort to reduce our energy intensity. It lays out measures to reduce emissions up to 2030 and sets targets of reducing our energy intensity and emissions in four key sectors of our economy — industry, transport, households and buildings. The National Environment Agency (NEA) also recently set up the Energy Efficiency National Partnership (EENP) in April 2010. The intent is to help engage the industry and allow for specific industry groups to interact

with energy efficiency experts and learn about best practices to reduce emissions. The government has announced plans for an Energy Conservation Act to come into effect in 2013 to facilitate a coordinated approach to standards for energy efficiency and energy management for companies that consume significant amounts of energy. Effective processes for energy management in turn will enable companies to better manage costs and profits. The measures under the SSB will contribute to a 7% to 11% reduction in emissions growth below 2020 Business as Usual (BAU) levels.

Singapore businesses have already started taking steps to run energy-efficient operations and facilities. That is not to say that it is all smooth sailing. For energy efficiency, there are low-hanging fruits, but there are also barriers to higher efficiency which could be due to a multitude of factors. For example, lack of cost analysis on a life-cycle basis where the upfront cost may be high but the pay-off over the operation of the equipment may only be apparent over a longer period, lack of management attention and focus on energy efficiency practices, split incentives where developers may not be incentivised to put in more efficient equipment due to costs or lack of expertise, leaving tenants to bear the higher energy cost.

We have also been actively investing in the R&D and testbedding of alternative sources of clean energy. With limited scope for wind, geothermal and tidal energies, solar energy is the alternative energy source that presents more opportunities. The Clean Energy Programme Office under the Economic Development Board (EDB) has launched a Clean Energy Research and Testbedding Programme to support the testbedding of clean energy applications in government buildings. As part of its solar capability building programme, the Housing and Development Board (HDB) recently announced an initiative to install solar panels in six public housing precincts across Singapore. By far the single largest solar panel procurement in Singapore to date, this green initiative will power common service areas such as lifts and will benefit 3,000 households.

1.4.2 Adaptation

Apart from mitigation, we must also start thinking about adaptation. We have undertaken vulnerability studies to better understand our long-term

physical impacts such as sea-level rise, temperature profile and wind. Preliminary results indicate that our existing infrastructure is sufficient to address the risks in the short to medium term. Studies on secondary impacts such as biodiversity, energy demand and public health implications are also ongoing.

However, uncertainties remain about the extent of climate change and the timing with which it will unfold. Making sense of these uncertainties will require risk assessments and regular reviews and updates of our design parameters as global models and the understanding of climate science improves.

1.5 NEW OPPORTUNITIES

We should also seize new opportunities arising from addressing climate change. While Singapore is a small player, we have sought continually to stay relevant. We have been successful in turning challenges and potential adversities into opportunities. For instance, with the development of NEWater, we have stayed at the forefront of water technology.

Singapore is also a living laboratory for testing new technologies and new business models to accelerate the deployment of exportable low-emission technologies. The Electric Vehicle (EV) Taskforce co-chaired by the Energy Market Authority (EMA) and the Land Transport Authority (LTA), and the Intelligent Energy Systems Taskforce chaired by the EMA are looking into possible urban solutions for the deployment of electric vehicles and smart grids respectively.

With advances in technology, Singapore will be well placed to turn our disadvantage in alternative energy into a competitive advantage in the long run. We can be a reference site for emerging ideas to be tested before larger cities adapt and adopt similar practices. Although alternative energies are unlikely to form a significant part of our fuel mix in the near term, testbeds are ongoing in HDB estates and key installations so that we can better understand the technologies and be better prepared to adopt them on a larger scale when technology improves. I am happy to note that this conference will be covering both energy efficiency and alternative energies.

1.6 CONCLUSION: WORKING TOGETHER

Singapore's Prime Minister Lee Hsien Loong has articulated Singapore's commitment to climate change through his active involvement since the negotiations in Bali in 2007. Singapore has declared an emissions target, which can only be met with concerted and sustained efforts from all sectors and stakeholders, and which will be meaningful when other countries who have pledged targets join in to implement their targets and actions under a global legally binding agreement.

Climate change affects us all. Government actions alone will not be sufficient. The government working in collaboration with our partners in the public, private and people sectors can together come up with efficient solutions and share best practices as part of the global effort to address climate change. For example, businesses can ensure they run energy-efficient operations and facilities. Academia can highlight solutions to barriers. NGOs and grassroots organisations can drive action by spreading the message on energy efficiency at the local level. For the general public, simple energy-saving gestures help to save costs and reduce the environmental impact.

Prime Minister Lee Hsien Loong has placed the National Climate Change Secretariat under his Office and appointed Singapore's Senior Minister S. Jayakumar to advise on climate change policies. Senior Minister Jayakumar chairs the Inter-Ministerial Committee on Climate Change, whose members are the Ministers for Finance, Trade and Industry, Foreign Affairs, Transport, National Development, and the Environment and Water Resources. I am privileged to be part of this Secretariat, and at the same time humbled as climate change is one of the most difficult challenges facing Singapore and, indeed, the global community.

We will need ideas, innovation and to make some trade-offs. I believe we can, and must, succeed in balancing our fight against climate change and in ensuring a high standard of living with good jobs for all. Singapore has always taken a balanced approach to growth and sustainability and we have been reaping the fruits of our ongoing efforts as a reference site for other countries and cities. Only by us working together, can we have a chance of success. The NCCS and agencies will engage the general public, companies, NGOs and academia to drive actions in Singapore.

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CHAPTER 2

GROOMING CLEAN ENERGY AS A KEY GROWTH AREA FOR SINGAPORE

Goh Chee Kiong

ABSTRACT

In 2007, the Singapore government endorsed the clean energy industry as a key economic growth area and allocated S\$350 million funding to build R&D and manpower capabilities. In 2011, the National Research Foundation (NRF) further injected S\$195 million of R&D funding for industry development as well as S\$300 million under the National Innovation Challenge for “Energy Resilience for Sustainable Growth”.

Singapore has a comprehensive industry development plan focused on four key ingredients: technology, market access, capital and talent. Today, we are home to a vibrant ecosystem comprising multinational companies, start-ups, international organisations, financing firms, test-bed platforms and R&D centres. Industry, government agencies and research institutes can easily collaborate and co-create new ideas across the entire research, innovation and commercialisation continuum. Companies can also use Singapore as a “Living Lab” to develop, test and commercialise innovative solutions before scaling them globally.

The multi-agency Energy Innovation Programme Office (EIPO) was established to plan and execute strategies to position Singapore as a global clean energy hub where products and services are developed here for global markets. EIPO had also set up key industry-oriented research centres, namely Solar Energy Research Institute of Singapore (SERIS) and Energy Research Institute at Nanyang Technological University (ERI@N).

By 2015, the Clean Technology industry, comprising clean energy, environment and water, is expected to contribute S\$3.4 billion to Singapore's gross domestic product and employ some 18,000 people. Given the initial private sector investments and strong governmental commitment, Singapore is well positioned to ride the growth of the clean energy sector and serve as a hub to reach global markets.

2.1 INTRODUCTION

In the face of continued global challenges arising from climate change and environmental degradation, coupled with robust growth in energy demand, the quest for cleaner energy solutions remains unabated. This need is amplified by rapid urbanisation across the world, particularly in Asia. Today, more than half of the world's population lives in cities. The world's urban population is expected to double from 3.3 billion people in 2007 to 6.4 billion by 2050, with more than half of this increase coming from Asia. Given the higher standards of living and therefore increased energy usage per capita, cities and governments are naturally turning to innovative clean technologies and solutions to maximise the use of resources and improve the quality of life for their residents.

Recognising these trends, the Research, Innovation and Enterprise Council (RIEC) chaired by our Prime Minister, Mr. Lee Hsien Loong, endorsed the clean energy industry as a key growth area for Singapore's economy in 2007. The National Research Foundation (NRF) consequently allocated a funding of S\$170 million to build R&D and manpower capabilities in clean energy. Combined with the funding from other agencies, the whole-of-government funding came up to S\$350 million. In 2011, the NRF also approved S\$300 million under the National Innovation Challenge for "Energy Resilience for Sustainable Growth" which aims to develop cost-competitive energy solutions for deployment within 20 years to help Singapore improve energy efficiency, reduce carbon emissions and increase energy options.

Singapore has developed a comprehensive industry development plan focused on developing four key ingredients: technology development, markets access, ease of raising capital and talent development.

Today, we are home to a vibrant clean energy ecosystem comprising multinational companies, start-ups, international organisations, financing firms, test-bed platforms and R&D centres. We believe that this clustering is a unique differentiator for Singapore, in that the industry, government agencies and research institutes can easily come together to collaborate and jointly create new ideas. Companies here are also supported by conducive business environment which includes Singapore's top-ranked position in the protection of intellectual property. These factors help companies to co-create new solutions and push the boundaries of innovation in a vibrant business integrated environment, build a track record and use Singapore as a reference site to launch into growth markets in Asia and beyond.

2.2 ENERGY INNOVATION PROGRAMME OFFICE

The multi-agency Energy Innovation Programme Office (EIPO), formerly known as Clean Energy Programme Office (CEPO), was established in 2007 to synergise the whole-of-government's efforts to develop the clean energy industry. Co-led by the Singapore Economic Development Board (EDB) and the Energy Market Authority (EMA), EIPO also comprises key government agencies such as the Agency for Science, Technology and Research (A*STAR), Building and Construction Authority (BCA), International Enterprise (IE) Singapore, National Environment Agency (NEA) and Ministry of Trade and Industry (MTI). EIPO is responsible for planning and executing strategies to develop Singapore into a global clean energy hub where clean energy products and services are developed here for global markets. By 2015, the entire Clean Technology (or Cleantech in short) industry, which comprises clean energy, environment and water, is expected to contribute S\$3.4 billion to Singapore's gross domestic product and employ some 10,000 people.

The clean energy industry encompasses a wide range of areas spanning solar energy, wind energy, biomass and biofuels, fuel cells, energy efficiency green building and carbon services. EIPO has identified solar energy as one key focus area for industry development, for two main

reasons. First, the manufacturing of solar wafers, cells and modules builds on our existing capabilities in the semiconductor and other high-end electronics sectors in Singapore. Singapore also has all-round capabilities in precision engineering and chemicals which are highly applicable to the solar industry. Second, Singapore is located in the tropical sun-belt region which receives about 50 percent more solar radiation than the temperate regions where the major markets are today. The Asian sun-belt region has been identified as one of the first solar markets to experience strong growth without subsidies, when grid parity is reached. Our excellent supply chain capabilities and extensive linkages in the region make us an efficient base for companies to serve the Asian sun-belt. In addition, there are about one billion people in the region without access to grid electricity. Singapore-based companies can develop off-grid clean energy solutions tailored to this large under-served market.

2.3 HOME FOR INNOVATION

Singapore has identified R&D as a growth driver for our economy. Building on this, Singapore aims to be a home for innovation where companies can conduct activities along the entire research, innovation and commercialisation continuum. Today, clean energy companies in Singapore enjoy a wide array of options to forge research collaborations with our local research and educational institutions. (Figure 1).

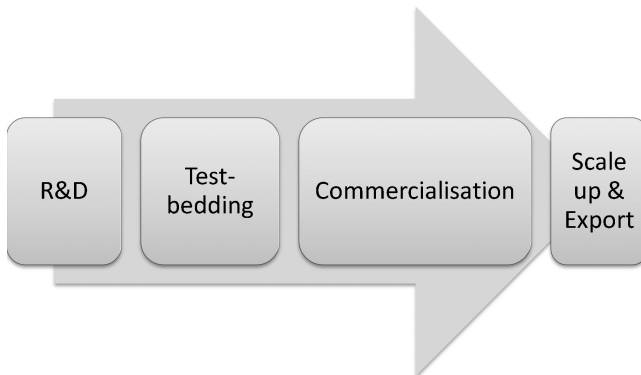


Figure 1 Research, Innovation and Commercialisation Continuum

Source: Economic Development Board (EDB), Singapore.

Our solar energy research activities received a major boost with the establishment of the Solar Energy Research Institute of Singapore (SERIS) in 2008. Located at the National University of Singapore (NUS), SERIS will spearhead solar energy research in Singapore in a few areas, namely silicon-based solar cells, solar modules, system integration, new solar concepts and integration of solar technologies into green buildings. With an investment of S\$130 million over five years, SERIS conducts world-class industry-oriented R&D and train specialist manpower for the solar energy sector. The first CEO cum founder was Professor Joachim Luther, former Director of the Fraunhofer Institute for Solar Energy Systems, and a renowned technology leader in this field. Following in the footsteps of Professor Luther, SERIS has attracted other leading scientific talent, including Professor Armin Aberle, who has taken over as the new CEO in 2012. To date, SERIS has entered into research collaborations with many leading solar companies such as Renewable Energy Corporation and Trina Solar.

SERIS is well complemented by the Energy Research Institute at Nanyang Technological University (ERI@N), which has a comprehensive focus on sustainable energy, energy efficiency and infrastructure, and socio-economic aspects of energy research. With a five-year budget of S\$200 million, ERI@N will develop and strengthen its expertise in wind energy, marine energy, energy storage, electric mobility, smart grids and fuel cells. They have already established research collaborations with leading companies such as Vestas, Bosch IBM and Rolls Royce.

The Energy Innovation Research Programme (EIRP) is another major initiative to develop our clean energy R&D capabilities. Structured as a competitive funding programme, EIRP is open to educational and research institutes, private sector companies and not-for-profit research laboratories. The programme has successfully funded 29 projects in areas ranging from building-integrated photovoltaics and novel thin-film solar cells to storage systems for renewable energy during the 2007–2011 period.

Startup companies in the clean energy space are also contributing to new innovations in this rapidly changing industry. As part of our goal to increase the commercialisation avenues in Singapore, EIPO is also

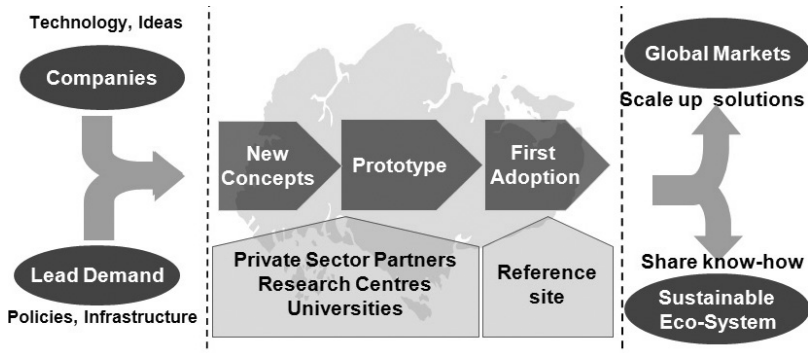


Figure 2 Singapore as a Living Lab

Source: Economic Development Board (EDB), Singapore.

actively nurturing early-stage companies in parallel with the establishment of a network of cleantech incubators in Singapore to support the growth of these companies. In addition, EIPO administers the Quick-Start programme which offers repayable grants of up to S\$500,000 to help Singapore-based early-stage companies to develop innovative clean energy technologies and solutions to serve global markets.

Cleantech companies can also use Singapore as a “Living Lab” to develop, test and commercialise innovative green solutions before scaling them up for Asia and beyond (Figure 2). Examples of such platforms in Singapore include Punggol Eco-Town, CleanTech Park, Jurong Lake District, electric vehicles testbed and the Intelligent Energy System (IES) testbed. In particular, CleanTech Park will serve as a large-scale integrated “Living Lab” for the experimentation of system-level clean technology solutions. As Singapore’s first eco-business park, it is an ideal business location for companies in the Cleantech business or companies which have embraced sustainability as a means to differentiate their businesses. The CleanTech Park will house a core nucleus of clean energy activities which will serve as an epicentre for research, innovation and commercialisation. When fully built in 2030, the Park will have a working population of 20,000. (Figure 2).

Due to the rapid growth rate of the clean energy industry, there is a global shortage of specialised manpower. The development of skilled manpower for the clean energy industry would therefore provide

Singapore with a differentiating advantage and support the innovation aspirations of the industry. Recognising this, EIPO ran the Clean Energy Graduate Scholarship programme to develop future research leaders for the industry. The scholarship supported post-graduate degree courses in clean energy related areas in leading universities such as Stanford, MIT, Cambridge, NUS and NTU. Along with other initiatives like the Workforce Development Agency's (WDA) Continuing Education and Training programmes, the government expects to train over 2,000 clean energy specialists over five years.

2.4 HOME FOR BUSINESS

Singapore is emerging as a global clean energy hub that is home to a vibrant ecosystem of international companies and serves as a springboard to key markets in Asia. The range of business activities includes R&D and engineering, regional headquarters and high-value manufacturing. Examples of key companies are as follows:

Atlantis Resources Corporation, one of the world's leading tidal energy companies, has its Global Headquarters and innovation centre in Singapore to take advantage of Singapore's pro-business environment, excellent logistics connectivity, respect for intellectual property and innovation capability.

China Guangdong Nuclear Power Holding Corporation (CGNPC) recently established its integrated biomass-solar power generation plant, fuelled by wood and horticultural waste, with a sizeable solar installation on the rooftop. CGNPC also set up its Regional Headquarters for its renewable energy operations in Singapore.

DNV, a leading testing and professional services company from Norway, operates the Clean Technology Centre (CTC) in Singapore. The CTC covers diverse sectors such as renewable energy, shipping, oil and gas, and sustainable cities.

GreenWave Reality, a building and grid-level energy management systems company, has established its Global Headquarters and R&D Centre in Singapore. The R&D centre will further develop the energy management software and hardware for smart grid applications and LED lighting.

Panasonic set up an energy solutions R&D centre in Singapore. This is a key part of Panasonic's global strategy to grow revenues from eco-friendly products and solutions. In partnership with government agencies in Singapore, Panasonic will also conduct a first-of-its kind test-bed of these total energy systems and solutions, before commercialising these solutions globally.

Phoenix Solar, a leading photovoltaic solutions provider from Germany, established its Asia Pacific hub in Singapore. Phoenix Solar has been using Singapore as the springboard to become the market leader in PV system integration in Singapore and the region.

Renewable Energy Corporation (REC) established one of the world's largest integrated solar manufacturing complexes in Singapore. The company has invested some S\$2.5 billion in its first phase expansion, which would provide 800MW of wafers, cells and modules. The Singapore facility currently employs about 1,500 employees.

Trina Solar, a leading integrated manufacturer of solar photovoltaic (PV) products, has established its Asia-Pacific, Middle-East and Africa regional headquarters in Singapore to strengthen its growing customer base in the region. This comes on top of Trina Solar's existing collaboration with SERIS to develop high-efficiency back-contact solar cells.

Vestas, the world's largest supplier of wind power systems, has chosen Singapore as the base for a global wind R&D centre with expertise including grid management.

2.5 CONCLUSION

Given the initial wave of entrants in the clean energy ecosystem and strong governmental commitment, Singapore is well positioned to ride the growth of the clean energy sector and serve as a hub to reach global markets.

CHAPTER 3

NANOENERGY IN SINGAPORE

Hiranmayee Vedam

ABSTRACT

Climate change and energy in terms of resources and therefore supply present one of the greatest global challenges. One possible solution could be nanotechnology and energy or “nanoenergy”. At the time of writing in 2009, nanoenergy was still in its infancy. However nanotechnology itself had already proved its commercial viability in other sectors such as electronics, healthcare and information storage to name a few. In Singapore, the energy industry has been dominated by oil and gas companies, however in 2007, the Government established programmes to expand the range of energy sources to include solar, biofuels and other energy solutions. The nanotechnology industry in Singapore has been increasing with two dedicated research departments, one at Nanyang Technological University, the other at the National University of Singapore, and other research institutes and government linked organisations, as well as private sector participation. Examples of how nanotechnology contributes to electricity generation, distribution and storage are provided and how nanotechnology is acknowledged as a key factor in the sustainable development of the Singapore economy.

3.1 INTRODUCTION

Of all the current challenging issues in the world, there are few as difficult to rectify as the climate change–energy link. Much has been stated about the grave need to create a less carbon-intensive global economy. Of course there is no single, silver bullet solution. The nearest remedy could be the marriage between nanotechnology and energy.

Imagine the synergy that could arise when micro-mini machines, products and processes are made possible by the application of nanotechnology to manufacturing and other processes. How much less energy could be used to power such microscopic production, how much less pollution and less consumption of resources and fewer emissions of greenhouse gases (GHGs) could occur? Nanotechnology has already seen commercial success in multi-billion-dollar industries such as the electronics and information storage industries, petroleum, chemical and healthcare industries, amongst others. It is still at an embryonic stage but development is fast moving.

In the 4 July 2009 issue of *The Economist*, in the Science and Technology section, an article “The Power of Being Made Very Small” described how nanotechnology will assist in the production of new materials, which in turn will help produce big improvements in energy production. Scientists will build these new materials on a nanoscale, where things are measured in billionths of a metre. On this nanoscale, materials can have unique properties.

A US team at the Massachusetts Institute of Technology (MIT), led by Dr. M. Demkowicz, working with the Los Alamos National Laboratory, is seeking to quicken research into energy technologies. This team is researching material which will resist damage from radiation, which will extend the working life of the reactor and allow it to operate more efficiently by burning a larger percentage of nuclear fuel. The team is looking for a new type of nanocomposite material.

A second example is the search for nanoengineered materials which will play an important role in the more efficient generation of solar cells. This is done by the manufacture of multi-junction solar cells, in which each layer captures energy from a specific colour in the light spectrum. This is more efficient than a conventional solar cell which converts energy from only part of the spectrum. Such a cell will have an efficiency of over 40 percent, much higher than the 20 percent of conventional cells.

A third example is the possibility of incorporating solar cells into the structure of buildings, including windows. These three examples illustrate how nanotechnology can boost energy efficiency and help combat climate change.

3.2 SINGAPORE ENERGY POLICIES

The energy industry encompasses all organisations involved in generating, storing and distributing energy. As in the rest of the world, this industry in Singapore is currently dominated by the oil and gas companies, which account for nearly 5 percent of its gross domestic product (GDP). However, in 2007, the Singapore government recognised energy as a strategic sector and embarked on new programmes to broaden the base of this industry by exploring growth opportunities in solar power, fuel cells, biofuels and energy management solutions.

The Singapore energy policy report¹ that was released in 2007 set a goal of increasing the value added by the energy sector from S\$20 billion to around S\$34 billion by 2015, and tripling the employment generated by this sector from 5,700 in 2007 to 15,300 by 2015.

The policy also outlined strategies to intensify energy R&D efforts in areas where Singapore has expertise or a competitive advantage. As part of this strategy, the Singapore Initiative in New Energy Technologies (SINERGY) Centre² was set up. It will provide technical infrastructure such as a micro-grid and a command and control facility to facilitate research on clean and sustainable energy solutions. The Centre also has in-house expertise in systems integration, testing and evaluation of energy technologies. In addition, the Agency for Science, Technology and Research (A*STAR), an umbrella agency within the Ministry of Trade and Industry (MTI), which encompasses 11 different research institutes in Singapore, has established an Energy Technology R&D programme³ to

¹Ministry of Trade and Industry Singapore. "Energy for Growth: National Energy Policy Report", November 2007.

²Agency for Science, Technology and Research (A*STAR). *SINERGY Centre*. <http://energy.astar.edu.sg/cos/o.x?c=/wbn/pagetree&func=view&rid=10123> [Accessed July 2009].

³Agency for Science, Technology and Research (A*STAR). *Energy Technology Research and Development Centre*. <http://energy.a-star.edu.sg/> [Accessed July 2009].

integrate and expand existing knowledge and work in areas such as fuel cells, alternative fuels and next-generation solar technologies.

3.3 BUILDING THE NANOTECHNOLOGY SECTOR IN SINGAPORE

Since the late 1990s, in response to the increasing interest in nanotechnology worldwide, Singapore government agencies, including the Ministry of Education (MOE) and A*STAR, have increased their emphasis on nanoscience and nanotechnology research. In the recent report by the MTI, titled the Science and Technology Plan 2010, nanotechnology was repeatedly emphasised. The main practitioners in nanotechnology research are the two main Singapore universities, Nanyang Technological University (NTU) and the National University of Singapore (NUS), which have set up the Nanoscience and Nanotechnology Cluster (NanoCluster) and Nanoscience and Nanotechnology Initiative (NNI) respectively, in response to the emphasis on nanotechnology.

Apart from the private sector, there are many research institutes, schools and government bodies conducting cutting-edge R&D in this field. From A*STAR's Institute of Materials Research and Engineering (IMRE) to the National University of Singapore, there is a considerable amount of research activity in this field; excluding corporate research labs, there are currently 15–20 other research centres engaged in nanotechnology projects. It is estimated that the number of researchers and engineers working in nanotechnology-related fields in the Republic, in both the public and private sectors, totals about 1,000.

There are also commercial companies which help researchers make the transition into the market with their business support and incubation services. These include the Nanyang Technological University-owned R&D and business incubation company called NanoFrontier. More foreign venture capitalists have also been entering the scene in recent years, such as the American company, Innosight and the 50 per cent German funded Nanostart Asia Pacific Pte Ltd, joining Singapore's emerging Nanotech industry. Dr. Lerwen Liu, Director of NanoGlobe, says:

In the past five years, we are seeing an increasing growth of nanotech start-ups in Singapore and in the Asia-Pacific region. Also, due to the rising

number of foreign venture capitalists entering the market, increased government incentives and more networking platforms such as NanoEquity Asia, we expect to see further growth in the number of start-up projects in the near future.

3.4 NANOTECHNOLOGY IN ENERGY

Nanotechnology is the technology of creating and applying materials and structures with at least one critical dimension below 100 nanometres, which leads to new functionalities and properties.⁴ Nanoscale materials and structures exhibit many novel properties, such as electric conductivity, magnetism, fluorescence, hardness and strength changes, which are significantly different from their macroscale counterparts. Due to these new functionalities, nanotechnology has a profound impact on the generation, storage, distribution and utilisation of energy. The following section describes the numerous ways that nanotechnology contributes to electricity generation, distribution and storage.

3.5 ENERGY GENERATION

3.5.1 Photovoltaic Cells

Photovoltaic (PV) cells that convert sunlight into electricity face two key challenges, namely low efficiency and high cost of production. Inefficiency in conventional PV cells arises since the incoming photons must have energy equivalent to the band gap energy of silicon. This accounts for a loss of 70 percent of radiant energy incident on the cell. Nanotechnology can help increase the efficiency of solar cells via multiple techniques. For example, creating nanostructures such as quantum dots can help optimally adjust the semiconductor band gaps and improve conversion efficiency. Anti-reflective coatings using photonic crystals or non-metallic nanolayer systems can also improve efficiency. The use of plasma-aided procedures is another approach to optimise the cell structures of all solar cell types and thus increase efficiency.

⁴Luther, Wolfgang. "Application of nanotechnologies in the energy sector", Volume 9, *Aktionslinie Hessen-Nanotech*, August 2008.

With the use of nanotechnology, it is also possible to manufacture inexpensive solar cells with the same efficiency as current technology. For example, semiconductor nanorods or organic semiconductors can be embedded within a polymer matrix to create flexible and low-cost solar cells. Thin-layer solar cells also have the potential to reduce costs due to material savings, low-temperature processes and integrated cell insulation. Dye-sensitised solar cells made using titanium dioxide nanoparticles doped with dye molecules can be screen-printed, thus reducing manufacturing costs, and they can generate energy even from diffused light.

3.5.2 Fuel Cells

A fuel cell is an electrochemical conversion device that produces electricity from fuel on the anode side and an oxidant on the cathode side, which react in the presence of an electrolyte. Key challenges in a fuel cell system are the high costs of producing and storing hydrogen. Apart from that, the fuel cells use precious metal catalysts that are expensive and can be spoilt easily. Second, the membranes used in the fuel cells cannot operate at temperatures that are optimal for maximising energy generation. Third, it is also critical to measure the temperature profile inside a fuel cell in a robust and cost-effective manner.

Hence, apart from PV cells, nanotechnology has the most impact on this energy sector. For example, nanoporous materials such as complex hydrides, for instance LiBH_4 , and nanoporous metal-organic compounds are being developed to store hydrogen in solid-state fuel tanks. Ceramic nanopowder based on yttria-stabilised zirconia (YSZ) is used to increase ion conductivity in solid oxide fuel cells (SOFCs).

Nanotechnology enables the use of low-cost metal oxides to produce photo-electrodes that can increase the efficiency of water decomposition. Nanotechnology can also enhance the activity of electrode materials and noble metal catalysts for electrochemical conversion of hydrogen. The temperature stability of membranes in the fuel cells can be enhanced through the application of inorganic-organic nanocomposites such as functionalised polymers with inorganic nanoparticles. Nanotechnology can also help overcome the key challenge of the need for hydrogen as a feed, as nanocatalysts can be mobilised to directly activate hydrocarbons

in the fuel cells. Microfuel cells with higher energy density than current batteries are also possible because of nanotechnology.

3.5.3 Wind Energy

Wind energy provides less than 1 percent of worldwide energy needs, but it is growing more rapidly than other energy sources. Key challenges faced by this energy source are low efficiency and reliability of the turbines and difficulty in generating high-quality energy at low cost. Nanotechnology can improve the efficiency of turbines through nanocomposite materials, based on carbon nanotubes that can be used to make lightweight and high-strength rotor blades. Nanoscale coatings for bearings can also improve the efficiency of wind turbines.

3.5.4 Fossil Fuels

Fossil fuels currently provide more than 80 percent of the energy needs in the world. As oil reserves become depleted, methods to extract more oil from existing reserves and new sources of oil such as shale oil are being explored. Nanotechnology is being increasingly utilised by this industry to increase production and efficiency. For example, nanosilicate particle suspensions are used for viscosity control in oil production. Nanoporous materials are also used for the separation of contaminations in oil deposits and to increase yield. Another application of nanotechnology in fossil fuel production is the use of nanolubricants to reduce mechanical wear of drill probes used in exploration.

3.5.5 Others

Nanotechnology also has a strong impact on energy generation, using other sources such as geothermal and coal-fired power plants. For example, nanostructured membranes can be used for separating carbon dioxide in carbon-neutral coal-fired power plants. Another example is the use of plasma coating processes which can be used for thermal barrier layers in gas turbines. Nanoparticulate coating materials can also be used as ceramic anti-adhesive layers to reduce caking in heat exchangers in coal-fired power plants.

3.6 ENERGY STORAGE

3.6.1 Lithium-Ion (Li-Ion) Batteries

The Li-ion batteries that are ubiquitous in the market today have relatively high energy densities, but high/low temperatures affect their capacity permanently. Also, the shelf life of the battery irrespective of use causes its capacity to deteriorate. None of the existing electrode materials and electrolytes can deliver optimal performance in conditions of high capacity, high operating voltage and a long cycle life. Nanocomposite structures such as lithium titanate are being explored for use as anode material in these batteries. Similarly, electrolytes containing nanoparticles are being developed to enhance the capacity of these batteries. These nanostructured materials also enhance the safety of Li-ion batteries, which can potentially explode at high temperatures or when exposed to stress.

3.6.2 Supercapacitors

A supercapacitor is a device which consists of two electrodes surrounded by an electrolyte, separated by a membrane, and which stores energy by charge transfer at the boundary between the electrode and electrolyte. The amount of energy stored is a direct function of the available electrode surface. Hence, using nanostructured materials like carbon aerogels, activated carbon or carbon nanotubes can significantly enhance the performance of a supercapacitor.

3.7 ENERGY DISTRIBUTION

As energy costs continue to escalate, the power industry is looking for ways to reduce transmission costs while ensuring availability and flexibility. Nanocomposite materials like aluminium conductor composite reinforced wire or carbon nanotube composites have 5–10 times more capacity than wire such as aluminium conductor steel reinforced wire which is currently used in the market. This will lead to a smaller footprint and lower construction/maintenance costs. Nanotechnology can also potentially help reduce the cost of high-temperature superconductor (HTS) wires that carry more power than the current-generation HTS

cables and have lower maintenance costs. Fluids containing nanoparticles can cool HTS transformers more efficiently without the need for flammable liquids, increasing the flexibility in locating the transformers. Magneto-resistive nanosensors based on magnetic nanolayers and power electronic components are potentially self-calibrating and self-diagnosing, enabling remote monitoring of infrastructure on a real-time basis. This would help decrease losses and increase availability and flexibility.

3.8 ENERGY UTILISATION

Apart from enabling energy generation, storage and transmission, nanotechnology has a marked impact on increasing the efficiency of energy utilisation in different industry sectors.

3.8.1 Transportation

Nanotechnology affects energy utilisation in the transportation industry via nanocatalysts in fuels, nanolubricants to reduce friction, more efficient batteries and lightweight nanocomposite materials that do not compromise on strength. Nanoparticles made of cerium oxide which catalyse the combustion between diesel fuel and air have been shown to increase fuel efficiency by up to 10 percent in field trials by Oxonica in 2006. Nanolubricants based on boric acid have the ability to reduce frictional losses by as much as 80 percent while increasing component durability and reliability. Nanostructured metal matrix composites and polymer composites can reduce the overall weight of vehicles. In addition, miniaturisation of components through use of nanosensors can further reduce the overall weight of the vehicles.

3.8.2 Building

The most significant contribution of nanotechnology to the building industry is enabling the development and use of energy-efficient light-emitting diodes or LEDs, based on inorganic and organic semiconducting materials. A quantum dot is a semiconductor whose excitons are confined in all three spatial dimensions. As a result, they have properties that are between

those of bulk semiconductors and those of discrete molecules. They are also known as nanocrystals, a non-traditional type of semiconductor with limitless applications as an enabling material across many industries.

Quantum dots can help improve the energy efficiency and light yield of existing LEDs by minimising scattering effects. Nanotechnology can have a significant impact on organic LEDs by optimising the field carrier materials, succession and thickness of layers, application of dopants and the purity of materials used. Nanocomposites made of polymers reinforced with carbon nanotubes can lead to ultra-light high-stability construction materials. Heating and cooling of buildings account for a significant share of energy consumption worldwide. Nanoporous materials, such as porous aerogels based on silicon dioxide and nanoporous polymer foams that have smaller pore size than the average free path length of a gas molecule, can help reduce these costs.

3.8.3 Manufacturing

Nanotechnology can increase the energy efficiency of industrial processes through better insulation materials, as discussed earlier. Nanostructured catalysts with larger surface areas per unit volume can increase yield and give us the ability to synthesise materials in new, energetically favourable ways. Nanoscale powders can reduce sintering temperatures in high-temperature manufacturing processes like ceramics, due to their large surface area and natural tendency to coalesce. Another way to increase the energy efficiency of manufacturing is to use micro-reactors where heat and mass can be controlled more optimally.

3.9 NANOENERGY IN SINGAPORE

Nanotechnology is recognised as a key enabler to sustain the future development of the Singapore economy. Singapore agencies have put more and more emphasis on it since the late 1990s in response to the growing awareness of nanotechnology worldwide. The Singapore government spent about US\$300 million between 2003 and 2007 on nanotechnology-related R&D and manpower development. It is estimated that the number of researchers and engineers working in nanotechnology-related fields in

the Republic, in both the public and private sectors, totals almost 1,000. Singapore is an active member of the Asia Nano Forum (ANF) as well as a participating member of the International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) technical committees on nanotechnology. Singapore also chairs the standardisation working group in the ANF. The remainder of the paper will discuss some key developments in Singapore in this area.

3.10 PHOTOVOLTAIC (PV) CELLS

PV cells are a strategic area of growth for Singapore. With its strong experience in the semiconductor industry, it has the engineering knowledge, infrastructure and experienced people required for the silicon-based PVs. It is also well positioned to integrate PVs into urban buildings. To capitalise on these advantages, in August 2007, the Singapore Economic Development Board (EDB) launched the Clean Energy Research and Testbedding (CERT) programme which will provide S\$17 million in funding to testbed PV technologies. The National Research Foundation (NRF) of Singapore has also set aside S\$170 million to boost Singapore's clean energy R&D efforts, starting with a focus on solar technologies and fuel cells. In February 2008, the National University of Singapore set up a new national solar research institute called SERIS, to develop critical technological capabilities to drive the solar energy sector in Singapore. As part of its sustainable development programme, Singapore has earmarked S\$31 million to install rooftop solar panels in 30 public housing precincts.

3.11 FIRST-GENERATION PV CELLS

Norway's Renewable Energy Corporation (REC) has set up the world's largest solar manufacturing complex in Singapore. NorSun has set up a major mono-crystalline wafer manufacturing facility in Singapore. Eco-Solar and Solar Power (acquired by Solar-Fabrik) have set up solar panel manufacturing in Singapore. Also, clean energy companies such as SolarWorld and Conergy have set up their Asia-Pacific headquarters in Singapore.

3.12 NEXT-GENERATION PV CELLS

3.12.1 Dye-Sensitised PV Cells

Researchers at NUS are investigating the use of diameter-controlled anatase TiO_2 nanofibres in dye-sensitised solar cells. They are also researching the impact of electrospinning and hot pressing one-dimensional metal oxide nanorods onto substrates as guides for electron transport. Initial results indicate that they can produce dye-sensitised solar cells with conversion efficiencies of ~6 percent. Another group at NUS is investigating mesoscopic metal oxide electrodes (TiO_2 , Al_2O_3 , etc.) and their assemblies with functional molecules to produce high-efficiency, low-cost dye-sensitised and three-dimensional solar cells. Other groups are investigating the use of conjugate polymers and nanocrystalline inorganic materials for solid-state dye-sensitised solar cells. At NTU, researchers have developed dye-sensitised solar cells based on ZnO nanoflowers with a conversion efficiency of 1.9 percent.

3.12.2 Organic PV Cells

A*STAR's IMRE has developed translucent organic solar cells that can be easily printed on flexible substrates. These solar cells can not only be produced cheaply but also have a wider variety of applications, from window panes to portable electronics. At NTU, researchers are incorporating silver nanoprisms as median layers between the electron and hole to increase the amount of light absorbed and enhance charge transport. Bosch has set up a S\$30 million R&D facility in Singapore and will collaborate with NTU to reduce the cost of their organic PVs while raising their efficiency and service life. At NUS, platform technologies such as advanced nanometal inks, deep ultraviolet (DUV) and i-line cross-linkable formulations for producing organic transistors and novel columnar heterostructures for highly efficient PVs are being developed. Researchers at NUS are also investigating production of low-cost, high-quality graphene by chemical exfoliation and its use in transistors and solar cells.

Commercial activity in this area is just getting started in Singapore. Oerlikon has set up manufacturing and R&D facilities related to its thin-film silicon solar panels. NanoBright Technologies Pte. Ltd., a spin-off

from NUS, is increasing the efficiency of silicon-based solar cells, using their up- and down-conversion materials. Mentarix, another startup from Singapore, also uses quantum dots and photonic technologies to enhance the efficiency of all types of solar cells.

3.12.3 Fuel Cells

Singapore is one of the leading countries in fuel cell research.⁵ The technology scan done by A*STAR in 2005 as part of developing the Singapore Science and Technology Plan 2010⁶ included hydrogen production and storage and fuel cell-based energy conversion technologies as two of the high-priority research areas in the energy sector for Singapore.

NTU has had an ongoing strategic programme on fuel cells⁷ for more than 10 years to develop next-generation fuel cells, more specifically high-performance solid oxide fuel cells (SOFCs) that can operate at lower temperatures of around 600 °C and membrane electrode assembly for low-temperature proton-exchange membrane fuel cells (PEMFCs).⁸ Key achievements of this work include the synthesis of ultra-dense high ionic conductivity YSZ electrolyte of 0.17 S/cm, design of an anode-supported fuel cell, development of a PEMFC model that is validated experimentally, modelling of an autothermal fuel reformer and hybrid gas turbine SOFC for high-efficiency power generation.

NTU is also developing power electronics for power conversion and power conditioning in fuel cell systems. Among the A*STAR institutions, IMRE is developing new proton-exchange membrane electrolytes and small PEM fuel cell stacks.

The Institute of High Performance Computing (IHPC) has research in computational modelling and analysis of PEM and solid oxide fuel cells, fuel cell materials and associated electrochemical and chemical processes.

⁵Naumanen, Mika. "NanoRoadMap Project", VTT Technology Studies, October 2004.

⁶Ministry of Trade and Industry Singapore. *Other Publications*. <http://app.mti.gov.sg/default.asp?id=885> [Accessed July 2009].

⁷Ho, Hiang-Kwee, Siew-Hwa Chan, and San-Ping Jiang. "Fuel cell research, development and demonstration activities in Singapore", *Fuel Cells Bulletin*, June 2004.

⁸Nanyang Technological University. *School of MAE – Fuel Cell SRP*. <http://www3.ntu.edu.sg/mae/Research/Programmes/Fuelcell/intro.htm> [Accessed July 2009].

The Singapore Institute of Manufacturing Technology (SIMTech) is developing microfuel cells and new manufacturing technologies for fuel cells. The Institute of Chemical and Engineering Sciences (ICES) has research in fuel processing, fuel cell catalysts and hydrogen storage.

NUS is developing nanostructured catalysts and methanol-blocking proton-conducting polymer electrolyte membranes to overcome the challenges of catalyst deactivation and methanol cross-over from fuel electrode to air electrode in direct methanol fuel cells.

In the commercial world, DaimlerChrysler along with BP and Michelin has announced a fuel cell demonstration project along with installation of hydrogen refuelling stations by BP. Rolls-Royce has set up an advanced technology centre to collaborate with A*STAR institutions and Advanced Materials Technologies to develop automated fuel cell manufacturing technology. Rolls-Royce also formed a partnership with a Singapore consortium led by Enertek Pte. Ltd. to form Rolls-Royce Fuel Cell Systems Pte. Ltd., in order to develop a 1-megawatt (MW) hybrid SOFC that meets electrical power system requirements. The EDB has set up a Singapore Fuel Cell Community, led by Temasek Polytechnic, to support the commercialisation of fuel cell technologies.

3.12.4 Li-Ion Batteries

Research in Li-ion batteries in Singapore, although world renowned, is a very niche area, with only one major group at NUS working on it. NUS has an advanced battery research group⁹ which focuses on the preparation and characterisation of nanomaterials for Li-ion and lithium polymer batteries. They are formulating new transition metal oxide composites and modifying known oxide components ($\text{LiNi}_{1-x}\text{Co}_x\text{O}_2$ and $\text{LiNi}_x\text{Mn}_x\text{Co}_{1-2x}\text{O}_2$ doped with Al and Mg) as cathode materials. These new materials can potentially result in batteries that are robust to cycling and elevated temperatures. The group is also investigating composite alloys such as nanocrystalline CaSnO_3 , carbon-coated CaMoO_4 , tin oxides with hollandite crystal structure, metal oxyfluorides TiO_2 and NbO_2F and thin films

⁹NUS Advanced Batteries Laboratory. *Advanced Batteries Laboratory*. <http://www.physics.nus.edu.sg/solidstateionics/> [Accessed July 2009].

made of Fe_2O_3 and NiO nanoflakes and nanowalls as anodes. They have found that nanophase ZnCo_2O_4 material is the best oxide material to use as anode material for Li-ion batteries. The group is also investigating polyethylene oxide (PEO)-Li-salt complexes as solid electrolytes in crystalline, glassy and polymeric form. In terms of commercial activity in this area, Sony announced the opening of a new Li-ion battery plant in Singapore in August 2008.¹⁰

3.12.5 OLEDs

OLEDs are light-emitting diodes that generate light in a film of organic compounds. A significant benefit of OLED displays over traditional liquid crystal displays (LCDs) is that OLEDs do not require a backlight to function.

IMRE and NUS researchers have developed a technology to fabricate all-in-one white light LEDs by growing multiple quantum wells using InGaN/GaN on sapphire substrate. This is an important milestone in obtaining white light LEDs that are cheaper, more stable and less complex without using phosphors. Another research group at IMRE is developing top-emitting OLEDs on flexible substrates and has developed robust plastic substrates with effective barriers against oxygen and moisture to increase their lifetime. They have also achieved significant improvement in electro-luminescent efficiency in top-emitting OLEDs by overlaying an optical coupling layer on a semitransparent cathode.

Researchers at IMRE have also developed blue emitters with increased lifetime and efficiency that is solution-processible, making them cheap to produce. In 2008, there was an increasing emphasis on utilising the knowledge from this research in PV development, due to the strategic emphasis placed on PVs in Singapore. Singapore also has a lot of commercial activity in this area. BASF set up an organic electronics R&D laboratory in Singapore and will include collaborative projects on organic PVs with A*STAR's IMRE. Ness Display has set up organic LED manufacturing operations and conducts research in

¹⁰MIS-Asia. *Sony opens lithium-ion battery plant in Singapore*. <http://www.mis-asia.com/news/articles/sony-opens-lithium-ion-battery-plant-in-singapore> [Accessed July 2009].

large-scale display technologies in Singapore. Hyundai LCD Inc. has a collaboration with A*STAR's SIMTech to develop and commercialise display manufacturing technologies for PM/AM OLEDs and flexible OLEDs for mobile and automotive applications. AMR International Corp. has an ongoing collaboration with NTU to develop indium tin oxide (ITO) transparent electrodes for OLED applications.

3.13 CONCLUSIONS

Nanotechnology has a profound influence on all aspects of energy generation, storage, distribution and utilisation. Singapore has world-renowned research programmes in the areas of fuel cells and Li-ion batteries and is fast becoming a hub for research activity in PVs. Although this growth has attracted multinationals to conduct research and manufacturing in Singapore, the local industry's ability to capitalise on this expertise is just beginning to emerge. Perhaps the establishment of a dedicated Nanotechnology Institute in Singapore might provide the catalyst and organisational synergy needed to raise the level of research and application in this vital and high-potential sector. There is of course the Singapore Institute of Bioengineering and Nanotechnology (IBN), whose director is Professor Jackie Ying, ex-MIT. Established in 2003, IBN became the first A*STAR research institute with the most primary patents filed per budget dollar, attesting to its innovativeness. To date, the Institute has filed over 692 patent applications, including 188 primary patents, on its technologies.

As always, the key to success is funding. Jonathan Kua, Director of the New Businesses Group, EDB, says:

Nanotechnology has enormous commercial potential because it impacts almost every industry. Yet in order to have useful applications, there must be adequate funding to commercialise the technology coming out of research labs, and close the gap to market.

CHAPTER 4

INNOVATION WITH ENERGY AND ENERGY WITH INNOVATION

Geoffrey C. Nicholson

ABSTRACT

The interdependence of energy and innovation is explored in this chapter and is based on the author's 40-year experience at 3M Company, a leader in innovation. Subjects tackled include imbuing an "innovation culture" and how to go about doing this, using 3M as the case study, the importance of innovation to a company and not forgetting the importance of the consumer or end-user of the product as the centre of all innovation. The significance of innovation to energy is also discussed particularly in the context of rising demand and finite supply, and how to increase efficiency while decreasing ecologically detrimental effects.

4.1 INTRODUCTION

Innovation and energy are two key subjects at the centre of strategic thinking and planning in countries, companies and enterprises. This article will deal with these subjects. They may appear to be separate subjects and yet they are interdependent. Anyone who has been involved with innovative

products and business models knows well the challenges one has to overcome to make them successful. One needs passion, commitment and personal energy to succeed.

Similarly, energy is faced with challenges, with the need for responsible and ecologically acceptable development of energy sources, as well as more productive uses of existing energy sources. There is a need for innovative business models as well as products. And so I ask the following questions:

- How do you define innovation?
- Is it part of your business plan?
- Is it the responsibility of all disciplines in your organization?
- Do you provide the resources to do it?
- Do you measure it?
- Are long-term research groups in touch with the customer?
- What volunteer employee activities foster innovation?
- How do you encourage volunteers?
- Does your organization have a history of stories that helps employees learn about innovation?
- Does the organization recognize innovative achievements?

This article will attempt to answer these questions, based on my experience during an almost 40-year career at the innovative 3M Company. I am not suggesting that all of the aspects and characteristics of 3M can be adapted or adopted into your company, but I am suggesting that some of them may have benefit for your company. There are sections on the innovative culture, the Chief Executive's role, hiring innovative people, benefits of a global technical community, examples of 3M innovation and some conclusions.

4.2 THE INNOVATIVE CULTURE

I would like to bring your attention to a paper titled "Innovation Nations" written by Ambassador Mark Hong and published in September 2008. He quotes Curtis Carlson: "A developed country's competitiveness now comes primarily from its innovation capability. It is the only path to growth, prosperity, environmental sustainability and national security."

Ambassador Hong also brings to our attention that Singapore has pursued four strategies to build knowledge; that is, investment in education, encouragement of free flow of information, awareness of global technology advances and maximizing the cross-fertilization of technologies.

It is also interesting that IBM's global innovation study in 2006 indicated that the creation of new and significantly differentiated products is an activity which requires a great deal of cross-fertilization between individuals. Thus it is not an individual activity but a group activity which involves the interaction of many technologies. I agree with these observations.

In order to put innovation in context at 3M, it is necessary for us to look at the company overview and our business sectors.

3M company overview:

- Sales: \$24.5 billion
- Net income: \$4.1 billion
- International sales: \$15.5 billion (63 percent of company total)
- Companies in more than 60 countries
- Sales in nearly 200 countries
- Over 76,000 employees
- Over 55,000 products
- 45 established technology platforms
- 571 US patents issued in 2007
- 45,000 issued and pending patents worldwide

Six market-leading businesses:

- Consumer and office
- Display and graphics
- Electro and communications
- Safety, security and protection services
- Health care
- Industrial
- Transportation

The importance of the technology platforms and how they are linked to different markets and products is clearly shown in Figure 1.

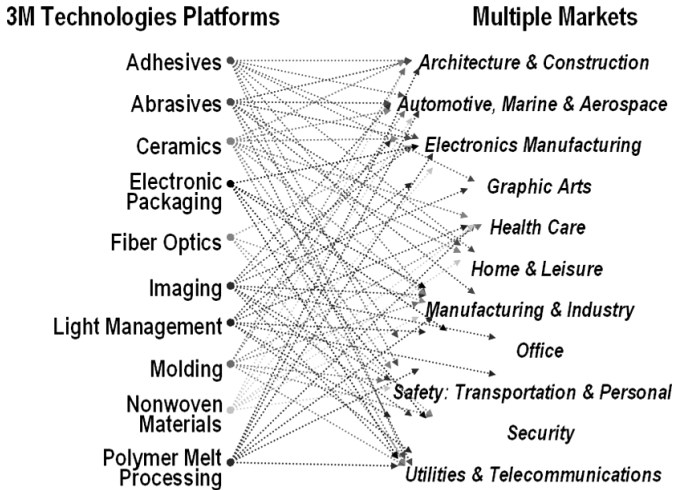


Figure 1 Linkages of 3M Technology Platforms and Markets

Source: 3M.

The culture of innovation at 3M is the responsibility of all 3M employees.

3M culture of innovation:

- Over 7,000 technical employees around the world
- R&D at ~6 percent of sales
- Technical depth and breadth
- Bringing multiple technologies to each customer
- Entrepreneurial culture
- Individual initiative: 15 percent of their time to work on new product ideas
- Legacy of boundary-less culture

The sharing of technologies, and the fact that the technology belongs to the company and not to a specific business unit, is a vitally important part of the culture of 3M. This will be discussed later in this article. And so to the definition of innovation in a corporation like 3M: “Research is the transformation of money into knowledge. Innovation is the transformation of knowledge into money.” The customer must be at the center of this and it is indeed the circle of life of a company.

Why is innovation important to a company? Innovation brings growth. Innovation is a survival issue, for without it ultimately the company will die. Innovation also brings competitiveness to the company, and on a personal level, innovation brings satisfaction to the people who participate. Technical plans are driven by business plans, but the question is, “Is innovation part of your business plan?” It should be. As we have defined innovation, we must measure its success. This measure can take various forms in companies. One measure is the sale of new products and the profitability of those products. Thus we ask, “Do you support and encourage innovation in your company or enterprise?”

We must be driven to solve customer problems in order to be a successful enterprise. These problems are either perceived by the customer or unperceived by the customer. Perceived problems are those which the customer identifies to you, while the unperceived problems are the result of observing the activities of the customer and bringing new thoughts to the customer from your technology base.

The customer is at the center of all innovation. The customer determines whether your product is successful and has value, whether it is a physical product or a new business model. The customer, as you see in Figure 2, has perceived needs and unperceived needs. The customer asks the supplier for a product, and if 3M succeeds in producing it, 3M has satisfied the customer.

Of course, the customer, rightly so, asks for this product from several suppliers, and there is immediate competition. Such products tend to be

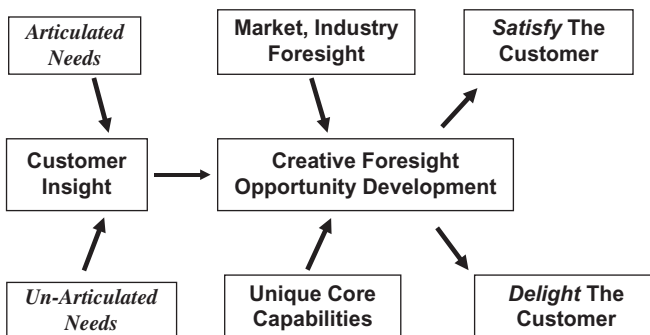


Figure 2 Customer-Inspired Innovation

Source: 3M.

evolutionary and are needed by any business. However, there are also the unperceived needs, or unarticulated needs, of the customer. These are most likely to be found when your company's technical people spend time with the customer. Your technical people should have a good breadth of knowledge of your company's technologies. The customer has a limited capability because he tends to base his needs on incremental changes in existing technology. Thus, if 3M introduces a very unique product, which is revolutionary to the customer, then 3M has the opportunity to delight the customer. The customer then can make a dramatic impact on his own business opportunities with this significant advance. 3M truly delights the customer and the employees of 3M. Remember the customer pays your salary, not your employer.

Now, I would like to discuss how one brings an environment to a laboratory that encourages creativity. Locating the laboratories close to each other does the following:

- Facilitates technology sharing
- Simplifies employee transfers
- Stimulates innovation
- Exposes customers to the breadth of 3M technology and encourages their inputs through the development of Customer Innovation Centers
- Build Customer Innovation Centers

In the United States the primary 3M laboratories, which consist of technology centers and business laboratories, are on our campus in St. Paul, Minnesota.

What is the environment in which one can encourage innovation in the laboratories? The location of laboratories close to each other has an important benefit. Such proximity of laboratories facilitates technology sharing which brings unique solutions to customer problems. It also simplifies the transfer of employees from one business laboratory to another business laboratory. Whereas we may think that written reports or technical meetings transfer technology, the transfer of employees is one of the most effective ways of transferring technology around the company. The opportunity for promotion of employees is available and easily accomplished. It stimulates innovation and provides customers with an incredible breadth of technology.

Another way to put the customer at the center of the innovation process is through our Customer Innovation Centers. Perhaps you have read about such

centers in recent publications, with one being established in Dubai. In fact, it was our laboratories outside the United States which championed and developed this idea. When I was the head of our Japanese laboratory in 1978 to 1980, I asked that we have a room within our laboratory into which we would be proud to bring our customers. I did *not* want it to be a product display area. Yes, products would be displayed, but I wanted it to be a working laboratory where customers could use our products and be exposed to the variety of technologies that were used in the products. We would stir their imagination and their interest. It worked so well that when I was responsible for all of our laboratories outside the United States, we established such Customer Innovation Centers around the world. They are in Singapore, China, India, Korea, Germany, the UK, Mexico and Brazil, to name a few. 3M Indonesia has taken the same principles in a limited space with a small technical team to set up interactive displays of 3M technology and products throughout. And now we have a Customer Innovation Center in the US.

One of the challenges is that laboratories around the world are physically separated from each other. Fortunately there is a revolution in communication. There is the availability of video-conferencing, e-mail and reporting of activities to each other via other electronic means. I would note, however, that these are no substitute for the personal interaction that you have by visiting and spending time in each other's laboratories. The temporary transfer of employees between laboratories in different countries is considered training, but I believe that technology transfer is the key benefit. Moving employees from one laboratory to another, particularly those coming from our laboratories outside the United States, allows them to experience firsthand the informality of management with employees, and the multiple technologies that are available for them to use. They have the opportunity to meet product champions, champions who are usually self-appointed, and to experience the stories of failures that are told by employees and management, but failures which were learning experiences.

There are several requirements for new product success. The keys to success are as follows:

- Innovation culture
- New product expectation
- Permissive attitude of management
- Needs that are technology driven

- Product champions
- Multiple technologies
- Technical assessment
- 15 percent rule or bootleg slack, boundary crossing
- Recognition and rewards

There is a culture of sharing technology, which we have just described. There is a new product expectation in terms of sales and profits. The permissive attitude of management is the tolerance for failure and the learning experience of failure, which does not take away from the expectation of new product results. In any new product success, there is always a product champion. This champion is not necessarily appointed by management. Indeed the better champions are self-appointed because they take ownership and have a passion for the success of the project. Many of these products are combinations of several different technologies which are available to our technical employees.

Products may belong to operating business units, but technology belongs to the whole corporation. There is no cost of transferring technology from one business unit to another. And, of course, there is that rule we have, called the 15 percent rule, also known as bootleg slack or boundary crossing. We never measure the 15 percent. It is a strong message. The employee is encouraged to explore, encouraged to network and collaborate, and encouraged to experiment. We say to our technical employees that they have 15 percent of their time in which they can work on any project of their own choosing without supervisor or management approval. When you look at major successes at 3M Company, you see that, while they were within the general businesses of the company, they were not forecast or predicted in the business plan. They became a business plan. One of the most difficult parts of our culture to explain to visitors is this 15 percent rule, particularly when we say we never measure it. It is a clear message to employees that they have the freedom to explore new business opportunities and products for 3M Company.

As we look at the process of innovation as illustrated in Figure 3, at the beginning of the innovative process, there is high risk. It is individual risk with potential high failure with very little management involvement. There is no schedule; there is no discipline. Indeed you might describe it as chaos.

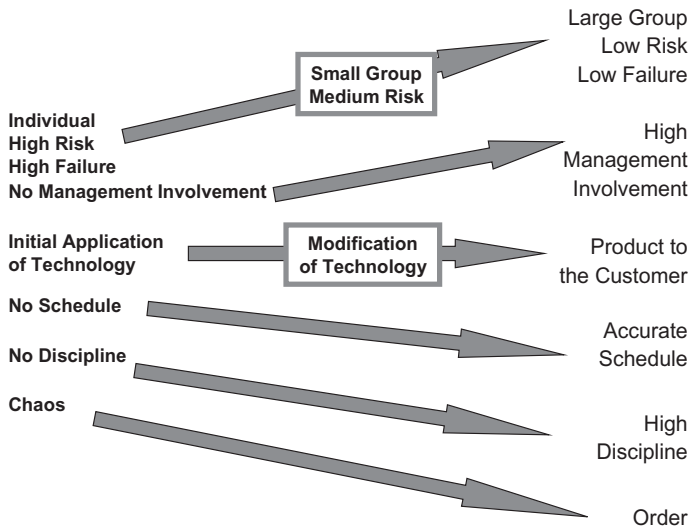


Figure 3 The Innovation Process and Risk Level

Source: 3M.

However, that environment allows the birth of new ideas without fear of failure and the opportunity to grow into significant new businesses.

As we proceed to the end of the process, with the product being delivered to the customer, large groups of people are involved, the risk is low, and the failure rate is low. There is high management involvement as they provide significant resources, accurate scheduling, and good discipline. During the process we must constantly look at the customer needs, both perceived and unperceived, to determine whether or not our solution fits the needs of the customer and brings value to the customer. I will also add that we tell our employees, “If you are going to fail, please fail quickly.”

There are rules for avoiding innovation. The working environment can inhibit, or even kill, innovation. If management is always suspicious of every idea which originates below them, people will not bring their fresh ideas to management’s attention. This is also true if we insist that people go through all levels of management with any new idea. If we express criticism and withhold praise, it kills initiative. If the attitude of management is that people at the top know everything, this will inhibit the expression of ideas, because of fear of failure.

Rules for avoiding innovation:

- Be suspicious of every idea that originates below you
- Insist that people go through all levels with a new idea
- Express criticism and withhold praise
- Make a decision to reorganize in secret and maximize surprise
- Be control conscious
- Never forget that people at the top know everything

Statements made by management can inhibit the expression of new ideas and the process of bringing them successfully to the market.

Wrong management signals:

- “It’ll never work.”
- “We explored that thoroughly 10 years ago.”
- “OK, if we can get somebody else to pay for it.”
- “We’re too short-handed to work on blue sky ideas.”
- “It’s not in the business plan.”
- “It’s not your job to talk to customers.”

I have heard some of these in many companies — and at 3M. Notice the statement by management that “It is not in the business plan.” It is true! New ideas are not in specific business plans. They are ideas which are being developed and become business plans in the future. We believe that it is always better to ask for forgiveness than to ask for permission. If management insists that you always ask for permission, you will finally find someone in a higher management position than yourself who will say that it is a bad idea and therefore you will have someone to blame for stopping the program. Discoveries and inventions are made in the laboratory by experimentation, not on computer screens. Computers give us the knowledge so that we can make discoveries.

4.3 CHIEF EXECUTIVE’S ROLE

In the process of innovation, you cannot manage creativity. You must be a leader that provides the environment and the encouragement for the

process of idea generation, as well as for the innovative process to bring the idea to a successful conclusion. The role of the CEO is vital. They must provide that leadership and that environment which increases the probability of success. A former 3M CEO, Mr. Lew Lehr, stated, “The ordinary manager has a craving for order. The leader understands that innovation is almost always an untidy process. The ordinary manager wants proof of an idea before taking action. The leader understands the value of the power of faith.”

That was a statement from the CEO in 1980, and today our CEO, Dr. George Buckley, originally from the UK, recently shared his views on innovation in a company publication. He stated:

Creativity and imagination have to be managed differently than other aspects of the business. No matter who invests in the technology, it is communal property. We have many processes for sharing ideas in technology among the technical community. You cannot make creativity a process; it is more a process of controlling chaos. Process may constrain the people and kill the very thing that you want to achieve.

And so you see the importance of the role of the leader, the CEO, in encouragement and understanding. Understanding the need for creative ideas and providing the opportunity for the process of innovation to succeed, as well as the necessary resources, is essential. If our leaders and management are to activate innovation within their organization, they must embrace these traits:

VISION FORESIGHT STRETCH GOALS EMPOWERMENT
 COMMUNICATION NETWORKING RECOGNITION

We must clearly define the vision that we have for our company. We need to know where we need to go. If you do not know where you are going, it does not matter which road you take. To be successful, we must know where the rest of the world is going, get there before they do, and provide products to help them be successful. Also, we must have ambition, that is, stretch goals, necessary and clearly defined results that are expected from the organization. If we are to empower people, we must

insist upon freedom in the workplace to pursue innovative ideas. Such empowerment is achieved by having something like the 15 percent rule, recognizing that it is always better to ask for forgiveness rather than permission, and learning to live with failure and yet never to accept it.

Networking is an essential part of an organization's strength. We are able to draw from the experience and knowledge of others as well as use their equipment. Networking is not a waste of time; it is an effort to improve the operations of our business area and learn new techniques, technologies and processes. And, finally, we must be rewarded for our efforts. There is nothing more rewarding than recognition from our peers and management.

3M has a variety of Rewards and Recognition Programs:

- Carlton Society
- Circle of Technical Excellence and Innovation
- Innovator Award
- Dual-ladder structure

These are not monetary rewards but recognition rewards. The Carlton Society is the highest technical recognition in the company. In the history of 3M, there have been just over 100 people who have been awarded this honor. Every year the worldwide technical community nominates their peers. They have to provide specific data on the contribution of the individuals. It is expected that the nominees will have spent time mentoring other employees and will have been strong advocates in successfully sharing technology around the company. There is a voting process which identifies the winners, and once per year in front of a global 3M audience, the Chairman of the Board makes a presentation to those who have been chosen. The winners are not aware that they have been chosen until that moment.

All of our laboratories around the world participate in the Circle of Technical Excellence and Innovation program. Nominations for these awards are also prepared by their peers, not by management.

The company has a dual-ladder system where people are promoted on the basis of technical excellence and not necessarily to management. Promotion to management may require a separate skill set. Salary and

benefits on either side of the ladder are the same. Therefore, if we promote a technical person to management purely on their technical record, we have the possibility of losing an excellent technical person and gaining a very poor manager.

4.4 HIRING INNOVATIVE PEOPLE

During the 1990s, the Chairman of the Board asked me to put together a small team so that we could study the characteristics of successful innovators at 3M, and hence have a better probability of success in hiring good innovators for the company. We interviewed some successful innovators at 3M so that they could tell us their background and careers *prior* to them joining the company. It was apparent that these people were very practical people. Typically they were from an agricultural background, as Minnesota has an agricultural economy. They were used to tackling problems and doing things themselves. In other words, if the tractor stopped during their work period, they would jump off the tractor and try to make the repair themselves. They did not have cell phones in those days to call the repair man. They were the repair people.

We found the primary characteristics of successful innovators, which they showed *before* they joined the company. It was then up to the current management to provide the environment for them to be creative and innovative. Our human resources and technical interviewers would look for these characteristics in potential new employees, as well as looking for technical capability.

Traits and characteristics of 3M innovators:

- Creative
- Broad interests
- Problem solvers
- Self-motivated, energized
- Strong work ethic
- Resourceful

Innovators are creative, they are inquisitive, they ask questions, they look for solutions, they are intuitive thinkers, ideas flow easily and they

are visionary. When we interview these technical people we would give them a small problem and watch how they tackle it.

Innovators have broad interests, they are eager to learn, they explore ideas openly with others. They have a variety of hobbies, and they are often multi-disciplinary. Innovators are problem solvers. They have an experimental style — they try it first and explain it later. They tinker with things, they are hands-on, they are not afraid to make mistakes, they are willing to do the unobvious, they are very practical. They take multiple approaches to a problem, but at the same time they are very technically competent.

Innovators are self-motivated and energized. They are driven, they are results-oriented because they are doers, they are passionate about what they do, they have an urge to succeed and accomplish the objective. They are emotional and enthusiastic. They have a sense of humor. They also have a sense of social responsibility. They want to contribute and they look for the contribution to have value and purpose.

Also, very importantly, they are courageous and self-confident. They take the initiative. If they are given the freedom to be creative and innovative, they must have the courage to accomplish the program as they will run into many challenges and difficulties. These difficulties may be technological, but many times they involve resistance from management and colleagues. Another characteristic of an innovator is that they have a strong work ethic. They are committed and hardworking. They work in cycles and have flexible work habits. They drive towards work completion, they are dedicated to results. They are tenacious.

Finally, innovators are resourceful, they network with others because they can get things done through others. They are looking for both the expertise of their colleagues as well as the time their colleagues may use to help them. They are also looking for the free use of equipment. Again, that time can be available because their colleagues have 15 percent of their time in which they can work on any project they want, without management approval. It is good to get a group of these people together to work on problems which can have a major impact on both the business and the environment.

With this in mind, it is obvious that we can access technologies across 3M, and when we access technologies, we access the available equipment. We get back to the point that technologies belong to the company,

products belong to business units. Integrating 3M technologies helps us to create new innovative products that change the basis of competition.

4.5 BENEFITS OF A GLOBAL TECHNICAL COMMUNITY

I referred to culture. One of the primary benefits of having laboratories around the world is the different backgrounds and cultures they bring to the company. I am sure that all of us, at some time, have said, “Why didn’t I think of that? Why didn’t I think of the Post-it Note?” The technology had been around for about 10 years.

I would suggest that you just had not looked at the technology with the right perspective. I strongly believe that as we provide our technologies to different countries with different experiences and cultures, they will see 3M’s technologies from different perspectives. The laboratory in Germany will look at the technology differently compared to the laboratory in the UK, or in China or Brazil. I remember when we provided the resources for a few people to go to China to demonstrate their technology. In a few days they produced several records of inventions, and their patents provided sales in China that would not have occurred without this technology sharing — yet another example that networking is *not* a waste of time. When we see things differently, then we put ourselves in a position to create something new and something of value.

These ideas are summarized as follows:

- Leveraging across technologies: Integrating 3M technologies to create new innovative products that change the basis of competition
- Leveraging across countries: Applying 3M technological breakthroughs in as many geographic areas as possible

The benefits of having laboratories outside the United States are as follows:

- Serving our customers
- Growing our business
- Knowing the competition
- Access to global technology
- The innovation factor

The final point is the innovation factor which we have seen dramatically demonstrated in our laboratories outside the United States. The evolution over time of laboratories outside the United States can be outlined as follows:

Evolution of 3M laboratories outside the United States:

- Technical service
 - Product training
 - Product performance auditing
 - Comparative product analysis
 - Recommending product change for market fit and new market
- Product engineering
 - Technical support for manufacturing
 - Raw material standards
 - Cost reduction by raw material substitution
- Product modification
 - Modifying existing products to meet local market needs
- Product development
 - Innovating and developing new products using technology from 3M and other sources
 - Searching out new business opportunities consistent with company objectives and resources
- Technology development
 - Developing new technology to meet local customer needs
 - Developing technology based on availability of technology in country

Laboratories outside the US should be part of the company in that country. As you look at the evolution of a laboratory, you can see that the first activity of the laboratory is to conduct technical service for the products that are sold in that country. This provides product training and performance auditing for that country. It is customer focused. The second activity of that laboratory is the support of manufacturing, such as raw material substitutions, and drive towards reduced costs of manufacturing.

The third activity of the laboratory would be product modification to meet the needs of the local market.

That knowledge will come only from good technical service that has been provided by the laboratory. They will know what aspects of performance need to be improved. The fourth activity of the laboratory is product development, in which they are expected to innovate and develop new products using technology from 3M or from other sources such as universities and research institutes. They have a responsibility to search out new business opportunities which are consistent with the company's objectives and resources. Finally, after a laboratory has developed this kind of expertise, they are in the position and mature enough to start developing new technology to meet the future corporate needs. That technology will be based on the country's technology capability and availability. You will notice immediately we do not advocate putting research laboratories into countries, but we do advocate putting laboratories that will evolve into a research capability once they know the connection with the customers, local raw materials and technologies that are in that country.

4.6 ENERGY WITH INNOVATION

In this section we will deal with examples of innovation in the energy sector. There is a critical need for innovations in the energy sector in order to meet the challenges of ecology, the demand for increased energy, and the need for more productive products which do not require as much energy. I would like to refer you to a presentation that was given by Jon Brodd, CEO of Cima NanoTech, at the June 2009 meeting of the Institute of Southeast Asian Studies (ISEAS). In particular, I refer you to Figure 4, which shows the various resources that are being used to increase the capacity for energy.

You will see that a major part of that potential resource is in the solar area. Cima NanoTech Company¹ has discovered a technology in the production of high-volume, low-cost silver nanoparticles. These particles can be coated to form a self-assembling, transparent conductive coating. They can also be ink-jet printed for front electrodes on silicon cells.²

¹For more information on the products and technologies of Cima NanoTech, see <http://www.cimananotech.com/>.

²<http://www.cimananotech.com/silvernanoparticles.aspx>.

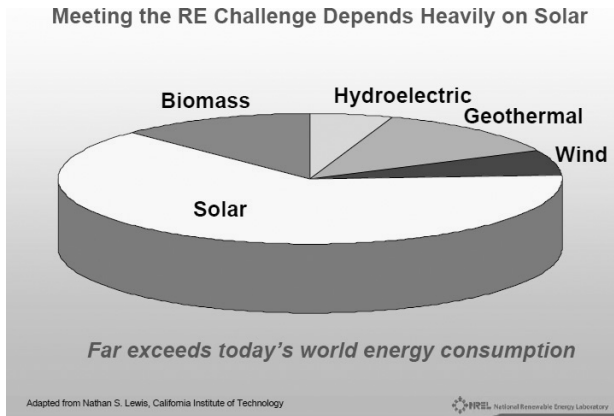


Figure 4 Worldwide Renewable Resources Potential

Source: 3M.

This unique technology truly changes the basis of competition. Cima NanoTech, Toda Kogyo and Toray Industries launched the production of this technology in the first quarter of 2009. The product has better properties with a 50 percent lower production cost than current film technologies. Nanomaterial production has been established in Japan and Cima NanoTech's film sales have already commenced. With regard to ink-jet printing on solar cells, the current screen printing method has a larger than 1 percent breakage of the solar cells. Ink-jet printing is a non-contact technique, and hence a non-breaking technique. It can also allow for thinner silicon wafers to be used, which can result in a 50 percent reduction of the direct cost of a silicon wafer.

Current line widths are 120 microns, whereas ink-jet printing will provide line widths of 40 microns, thus with improved and demonstrated productivity. We are looking at a two times faster throughput using this process. Again, I suggest you look at the paper that was given by Jon Brodd to ISEAS in June 2009 to learn more about this exciting technology. It changes the basis of competition and industry has recognized Cima NanoTech.

Industry recognition for Cima NanoTech:

- 2008 World Economic Forum Technology Pioneer
- Top 10 percent of Technology Pioneers, Davos, 2008

- Top 10 Greentech/Cleantech Award
- Participant in 2009 Asian Summit
- Invited speaker on nanotechnology
- World Economic Forum New Champions, Tianjin, China, 2008
- Japan Nanotechnology Conference, 2007 and 2008
- SEMICON West, “Self Assembling Electronics”, 2009

4.7 EXAMPLES OF 3M INNOVATIONS

3M is also involved in many products in the energy area. For example, 3M, over a period of years, has launched many films which have been used as brightness enhancement materials in televisions, laptop computers and cellular phone systems. Although one of the primary benefits of using these films has been in brightness enhancement of the images, a significant benefit has been the reduction in the amount of energy required to drive these products. There is a continuing demand for low-power TVs without sacrificing performance. Recently 3M received the Alliance to Save Energy’s Star of Energy Efficiency Award for its potential to save billions of kilowatt hours (kWh) in liquid crystal display TVs and monitors. This was awarded at a ceremony in Washington, DC.

In order to focus on the opportunities of renewable energy, 3M, with its strategic vision, has established a new business unit, the Renewable Energy Division.³ When one sets up a business unit with that name, it focuses the attention of the business on those opportunities in that area. It focuses the technical community on products which may benefit the renewable energy business. The 3M Renewable Energy Division is looking at solar, biofuel and wind energy. The focus of the business activities is on products that reduce the cost per watt of renewable energy — as both components (films, tapes, adhesives, coatings) and consumables (filtration, abrasives, safety, etc).

In the solar energy area, I will focus on just a few products which benefit that energy source. For more than a decade 3M has been a trusted supplier of advanced materials to the solar industry. Today 3M offers a

³ For more information on the products and technologies of the 3M Renewable Energy Division, see http://solutions.3m.com/wps/portal/3M/en_US/Renewable/Energy/.

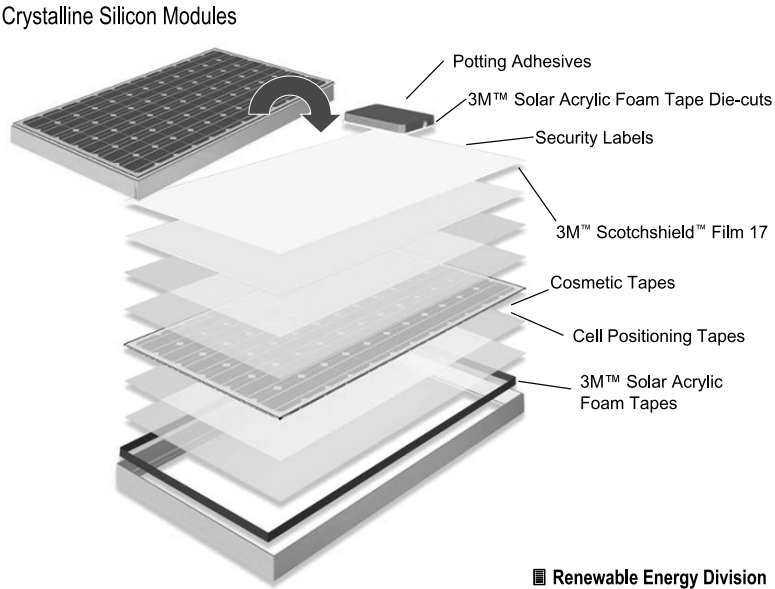


Figure 5 Crystalline Silicon Modules Design Used in Solar Energy

Source: 3M.

broad range of products and technologies designed to enhance product performance, improve reliability, and drive down the cost per watt. In Figure 5 you will see the general design of crystalline silicon modules that are used in solar energy.

As part of that structure, I would particularly draw your attention to the 3M Scotchshield Film 17. The technical community has experience in materials that provide barriers to oxygen and moisture in precision-coated, multi-layer films that are tuned to transmit or reflect specific wave lengths. The barrier film technology offers outstanding resistance to moisture and oxygen permeation. It is used to encapsulate sensitive components from the elements. It can provide a cost-effective solution for extended system life and reliability. The properties are outlined in Table 1.

As one looks at the materials that are used in this film, you see the use of fluoropolymers; fluorochemistry has been an important technology at 3M for decades. Fluoropolymers have excellent resistance to degradation from sources such as UV, heat and moisture. Their weather resistance

Table 1 Properties of Dyneon™ Scotchshield™ Film 17 Durable, a Fluoropolymer Backsheet with Tri-laminate Construction THV/PET/EVA

Requirement	Status	Test standard
Cut-through	Pass	UL 1703/IEC 61730
Hot spot	Pass	IEC 61215, ed 2
Damp heat	Pass	IEC 61215, ed 2
Thermal cycling	Pass	IEC 61215, (w/constant I,V)
Humidity freeze	Pass	IEC 61215, ed 2
Mechanical load	Pass	IEC 61215, ed 2
Robustness of termination	Pass	IEC 61215, ed 2
TÜV partial discharge	Pass	(1100 V) IEC 60664-1

Source: 3M.

exceeds that of non-fluorinated materials. The high-durability, UL- and IEC-certified 3M Scotchshield 17 Backsheets represent 3M's solar investments in Singapore and are now manufactured at the Tuas facility in Singapore.

In the area of wind energy, there are a number of opportunities for improvement of products in wind turbines. For example, when a turbine blade is moving at up to 300 km/h at the tip, it is affected by sand, rain and hail. This debris can cause significant erosion and pitting at the leading edge of the blade. This not only reduces the aero-dynamic efficiency, but can also lead to blade failure due to water penetration. Wind tapes based on the same technology used for over 40 years to protect helicopter blades and aircraft radomes can be applied to the leading edges of these blades to minimize the damage. These high-performance polyurethane tapes have proved their ability to maintain turbine efficiency, reduce downtime and maintenance, and extend the useful life of turbine blades, even in the harshest of environments. These tapes can be applied either at the manufacturing facility or in the field.

Finally, I would like to introduce you to a product that you would probably least expect to come from a company like 3M. I am referring to a high-voltage electrical transmission cable that is used in the electrical grid and utilizes new technology. This product illustrates many of the principles I have discussed in this paper on innovation, and the environment which encourages it to occur. How did this innovation occur?

This was not a product that management or marketing asked the technical people to develop. The idea for this product occurred during a fishing trip in Canada. This group of technical people was working on composites for aerospace applications. They were unable to overcome some of the technical challenges in that particular development. They began to explore the use of aluminum composites in other markets. On the fishing trip, they noticed a large transmission grid over water in Canada. What if they could reduce the number of towers that were required to carry such small cables?

The result was that they developed a composite material suitable for high-voltage transmission electrical cables. A key technical challenge was to have a very strong bond between the aluminum oxide fiber and the aluminum metal. Failure of that bond would cause catastrophic failure of the cable. Remember that these cables run at high temperatures. Again, through networking of the technical people, we became aware of a technology in the former Soviet Union, and were able to incorporate this into the cables.

Figure 6 shows the structure of these cables and Figure 7 illustrates the technology — wetting the fibers — that lead to significantly increased capacity without increasing the sag. Refer to Table 2 for related data.

Thermal upgrades are the primary applications for the use of this new cable. You get two to three times the gain in capacity with the restringing on existing structures. It is a quick and simple solution and there is no visual change or environmental impact.

Now, over 600 miles of these cables are installed in various parts of the world. It was recently announced that Indian power company Tata will install 3M's cable to boost electricity transmission near Mumbai. A 3M conductor will be installed in place of existing conductors. The right-of-way available was inadequate and the 3M conductor can be installed without the need to construct new transmission towers. The innovative lightweight sag-resistant overhead conductor can carry two to three times the amount of electricity compared to the conventional original steel conductors of the same diameter.

This product development illustrates many of the principles that were discussed at the beginning of this paper on the subject of innovation.



Figure 6 3M Aluminum Conductor Composite Reinforced, An Innovative Lightweight Conductor

Source: 3M.

Key to Innovation – Technology of Wetting Fibers

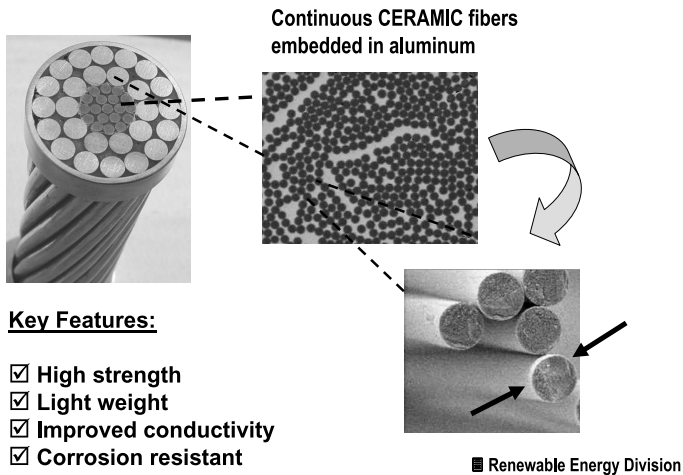


Figure 7 Aluminum Conductor Composite Reinforced: Technology of Wetting Fibers

Source: 3M.

Table 2 3M ACCR Significantly Increases Ampacity Without Increasing Sag

Temperature	795 ACSS	Height above ground (ft)	3M 795 ACCR	Height above ground (ft)
240 °C	2,274 amp	33	2,274 amp	36
125 °C	1,585 amp	27	1,585 amp	33
75 °C	1,096 amp	22	1,096 amp	31
50 °C	670 amp	15	670 amp	27
	Reached sag limit at 75 °C		Reached sag limit at 240 °C	

Source: 3M.

4.8 CONCLUSIONS

At the beginning of this paper, I asked a number of questions with regard to innovation. We define innovation as the process of taking a good idea and turning it into something of value to the customer. We asked if it was part of your business plan. Unless the need for innovation is part of the business plan, there will be little focus on it. Is it the responsibility of all disciplines in your organization? Yes, it certainly is. Without the input and participation of all disciplines, you risk failure because of lack of commitment.

Do you provide the resources to do the job? Yes, you must do this in order to have the organization believe that you are committed to innovative products. That is one of the reasons 3M allows 15 percent of time, particularly of the technical community, to investigate high-risk ideas. One never knows who will be the inventor.

Do you measure innovation? It must be measured in terms of new product sales, profitability and growth of your business. You have to provide the opportunity for your research groups to be in touch with and spend time with the customer.

What volunteer employee activities do you have that foster innovation? Do you have the freedom to allow your people to network and not consider it a waste of time? How do you encourage volunteers?

Do you have organizational activities which allow the employees to participate in networking?

Do you encourage the telling of stories that help employees learn about innovation? Does your management tell of their failures, as well as their successes?

Does the organization recognize innovative achievements? Do you have awards that are given to teams as well as individuals? Are they nominated by their peers?

Understand your customer and his needs. The technical community must know that it is not the company that pays their salary, but the customer who pays their salary.

Bring your technologies to bear on customer needs, both articulated needs and unarticulated needs. Network across the whole organization, and share technology that can be used by other business units.

And most importantly, have the courage of your convictions. If you are given the freedom to innovate, I assure you that it will take courage in order for you to succeed. There are many hills to climb and challenges of technology and management to overcome, but success is for those who are persistent with knowledge and courage. And so, innovate with energy, and innovate in the energy business.

I leave you with this message: No matter where you are...

Innovate for the customer! Network across the globe! Have courage!

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CHAPTER 5

HYDROPOWER IN SOUTHEAST ASIA

Erik Knive

ABSTRACT

Energy demand in Asia is growing exponentially and with it the inevitable increase in carbon dioxide emissions. Renewable forms of energy have the potential to reduce these emissions and promote energy security throughout the region. Norwegian-owned SN Power with its expertise in hydropower as an energy source and investment capabilities has an important role to play in the power deregulated markets that have the potential to benefit the region and by extension the globe, through the development of clean sustainable energy.

5.1 INTRODUCTION

In 2008, Southeast Asian countries were riding high on unprecedented global commodity prices as economic growth for the region was even adjusted upwards to 5.6 percent at the peak of oil prices. Countries blessed with natural resources switched focus from plans for new gas-fired power

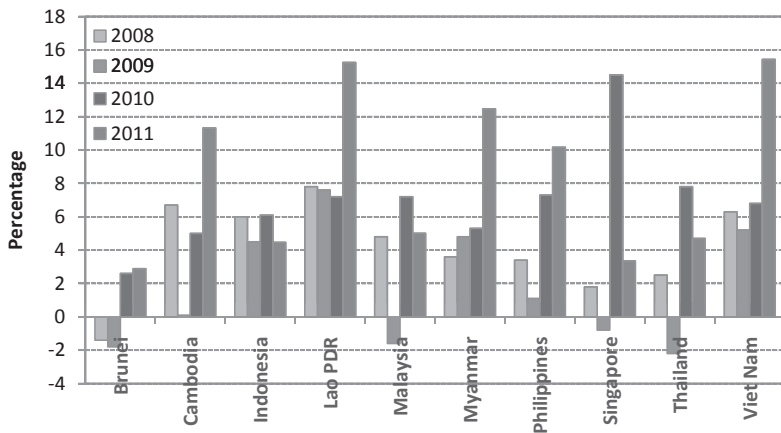


Figure 1 Association of Southeast Asian Nations (ASEAN) Gross Domestic Product Growth 2008 to 2011

Source: ASEAN key economic indicators and 2011 from Global Insight.

plants to coal-fired plants, anticipating better profits in selling gas as a commodity, and revived their renewable energy plans. When the global financial crisis hit in the later part of the year, the export-orientated group of nations fell into a recession. Affluent governments followed the lead of Europe and America in rolling out stimulus packages. Despite its initial euphoria, Southeast Asia grew at an average rate of 4.4 percent in 2008 (Figure 1).

The slowdown in economic activities in 2009 provided opportunities for a few to revisit their power development policies. Indonesia passed a new electricity act, Singapore invested heavily in renewable energy R&D, Malaysia commenced construction on hydropower projects in its northern states, Thailand adjusted its demand projections to more sobering rates instead of an exponential growth path, as Asia's rising star, Vietnam went full steam ahead with its power development plans.

The past two years saw economic growth rebounding strongly as did energy commodities prices such as oil and coal. While oil prices in 2011 and 2012 did not reach the highs of 2008, the annual average price was above \$100 per barrel compared to the volatile 2008 which averaged \$97 per barrel. The supercool Liquefied Natural Gas (LNG) price similarly crept up, and leaped to over \$16 per mmbtu in the aftermath of

the Fukushima nuclear crisis, as the future of nuclear power in the generation mix hangs in uncertainty.

5.2 ELECTRICITY MARKETS OVERVIEW

On the world stage, the International Energy Agency (IEA) in its World Energy Outlook 2011 estimates in its New Policy Scenario, that the demand for electricity will grow from 17,200 TWh to over 31,700 TWh, at an annual growth rate of 2.4 percent, between 2009 and 2035. On the supply side, coal remains the largest source for electricity generation with coal-fired power growing from 8,118 TWh in 2009 to 12,035 TWh in 2035. A significant increase in electricity generation from non-hydro renewable sources coming from wind, biomass, geothermal and solar power is expected, eight times the 2009 generation to 5,212 TWh in 2035.

However, the share of coal-fired power plants in the global generation capacity mix is expected to fall in the long run, from 32 percent to 26 percent in 2035, as renewable sources gaining a higher share, driven mainly by government policies. Gas-fired and hydropower are broadly expected to maintain their shares in the generation mix. Natural gas has the advantage of being widely available in many of these economies, and environmentally preferable to coal, since its greenhouse gas emissions are generally lower. Despite policy changes in some countries over the safety of nuclear power, nuclear is also likely to retain its share of global electricity generation mix from expansion in power hungry China and India.

Coal is by far the dominant source of fuel for electricity generation in Asia and is expected to be even more so. Coal similarly, has the advantage of being widely available and relatively inexpensive in many economies, some even subsidizing coal supply. China was the world's largest market for wind power in 2010, adding a staggering 16.5 GW of new capacity, and slipped past the U.S. to become the world's leading wind power country. At the end of 2011, the country has installed about 1,056 GW in generation capacity, however only less than 5 percent of which are wind power, while 72 percent of which are coal-fired capacity.

The other member of the billionaire club in terms of population, India is also highly coal dependent. With almost 200 GW in total installed generation capacity, 56 percent of which are coal-fired capacity. The country's plan to

meet its burgeoning power deficits is through 12 Ultra Mega Power Projects (UMPP), all of which are coal-fired with a capacity of 4,000 MW per project. The first UMPP was successfully synchronized to the grid in early 2012.

The share of coal-fired capacity in China and India is expected to fall from present levels to 49 percent and 42 percent respectively in 2035. Nevertheless, their share of coal-fired generation is estimated to make up over 60 percent of the world’s coal-fired generation. Globally, the trend towards greater diversity in the generation mix favoring renewable generation sources (Figure 2).

The global energy-related carbon-dioxide (CO₂) emissions reached 30 Gt in 2010, some 5.3 percent increase from 2009, representing almost unprecedented annual growth. In 2011, a record 31Gt was emitted globally. It seems that patterns in the global energy-related CO₂ emissions, mirrors that of the global economic conditions. In the IEA’s New Policies Scenario, CO₂ emissions continue to increase, reaching 36 billion tones (Gt) in 2035, and leading to an emissions trajectory consistent with a long-term global temperature increase of more than 3.5°C. This expected warming of more than 3.5° would have severe consequences: a sea level rise of up to 2 meters, causing dislocation of human settlements and changes to rainfall patterns, drought, flood, and heat-wave incidence that would severely affect food production, human disease and mortality.

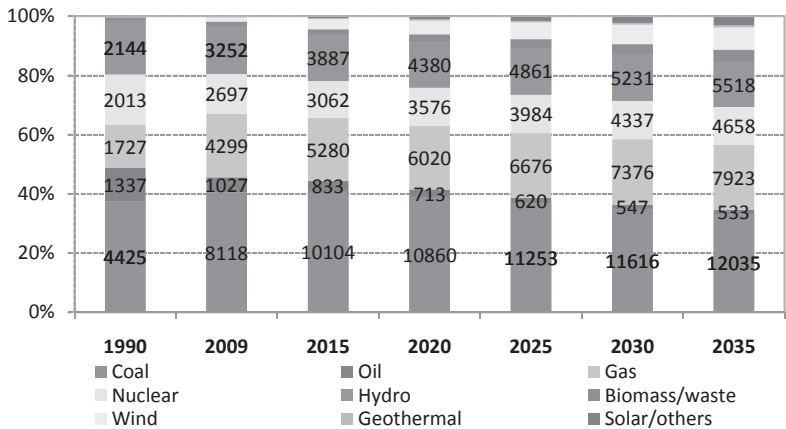


Figure 2 World Generation Mix (in TWh) in the New Policy Scenario
Source: IEA, World Energy Outlook 2011.

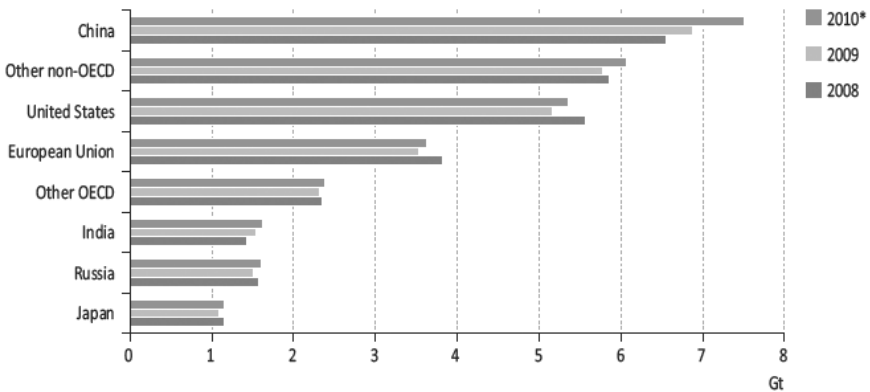


Figure 3 Energy-Related CO₂ Emissions by Country, 2008–2010

Source: IEA, World Energy Outlook 2011.

To bring CO₂ emissions back to historical levels, the world needs to reduce electricity generation from coal-fired plants, while renewable energy generation should double. The problem however, with most renewable generation sources such as wind and solar power, is that they are intermittent in nature and that electricity cannot be stored, a load balancing technology is required to react quickly to changing grid conditions.

The Asian economies account for almost half of the world CO₂ emissions from the combustion of fossil fuels. It is therefore, no exaggeration that what happens in Asia will largely determine what happens in the world. CO₂ emissions from the Asian economies are projected to increase to 35 Gt in 2035 from their present levels (Figure 3). Coal accounted for over 70 percent of CO₂ emission in the power generation sector, and is likely to retain this share in the longer term.

5.3 ELECTRICITY IN SOUTHEAST ASIA

A similar picture is painted for Southeast Asia. The region's CO₂ emissions are expected to double by 2030 to about 2 Gt, with power generation expected to be the major source of growth accounting for over half the increase, according to the IEA (Figure 4).

In Vietnam's Power Development Plan VII, over 30,000 MW of coal-fired capacity are planned to meet its projected demand by 2020. This

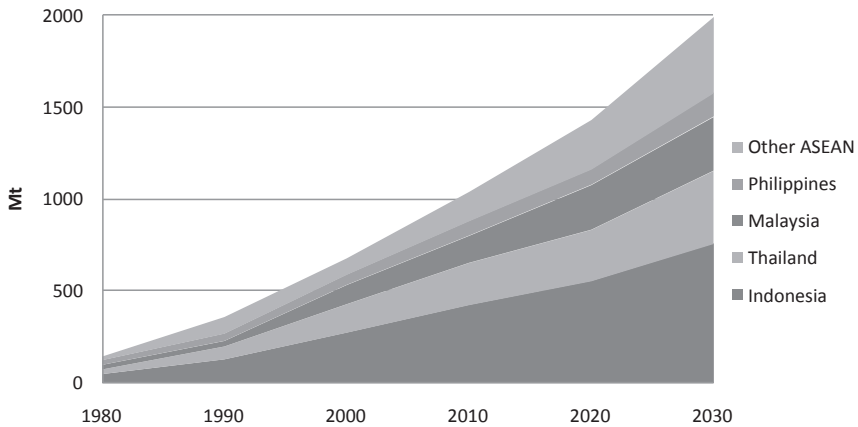


Figure 4 ASEAN Energy-Related CO₂ Emissions by Country

Source: IEA, World Energy Outlook 2009.

means an additional 100 million tons of coal will be required to fire up these power plants. As the second largest net exporter of coal, Indonesia is and will likely be the dominant supplier of coal for power generation to the region. It plans for some 4,000 MW of new coal-fired capacity in the country under the second phase of the 10,000 MW Fast Track Program, according to the latest 2011–2020 Electricity Power Supply Business Plan.

These projected scenarios will potentially lead to disastrous climate change consequences. Research shows that despite the global recession in 2009, total CO₂ emission crept up by 2% adding to the dire Global Carbon Project's data which shows that between 2000 and 2008, emissions rose by 29%. Clearly, this scenario is not sustainable and incompatible with APEC (Asia Pacific Economic Cooperation)'s commitment to "... prevent dangerous human interference with the climate system." With this linear pattern of growth, and increase of 5 to 6 degrees Celsius warming may be a likely plausibility, unsustainable even by conservative standards (Figure 5).

The Southeast Asian region encompasses a diverse set of economies in terms of energy demand and supply patterns, demand growth potential, and natural resource endowment. The Philippine is operating near full capacity, Thailand is dependent on imports from its neighbor's, Cambodia's power system is still rather backward, Singapore runs almost exclusively

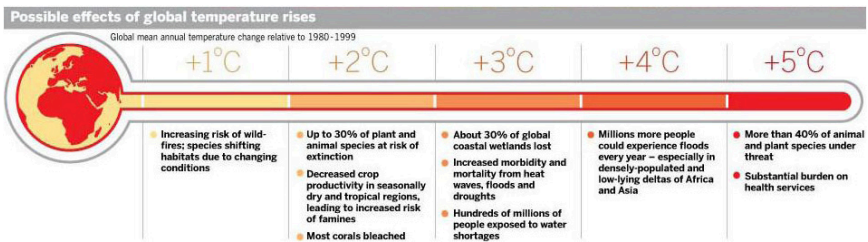


Figure 5 Possible Effects of Global Temperature Rises

Sources: Financial Times.

on gas-fired power plants with surplus capacity, Malaysia is predominantly based on subsidized natural gas with some excess capacity, and Lao PDR is contracted to export its generation, exclusively from its hydropower capacity to Thailand and more recently to Vietnam for the much needed revenue.

Electricity costs in Cambodia are among the highest in the world. The high cost is due to the country's almost total reliance on fuel imports firing-up more than 95% of the country's electric power generation from fuel oil or diesel power plants. The geography of energy supply options however, should not correspond to national boundaries. Opportunities exist to reduce the overall energy costs by exploring supply beyond borders since individual markets may be too small to justify large-scale investments to achieve scale efficiency.

On the demand side, GDP growth in the region is expected to grow on average of over 5 percent annually over the next five years. Vietnam and Indonesia are expected to grow at a faster rate, compared to more developed countries like Singapore and Malaysia. The Electricity-GDP elasticity measures the relation between the growth of the GDP and the growth of the electricity demand. The relationship can be explained by the increase electricity consumption in the production sectors and also on the demand side (households) as GDP increases. The elasticity of GDP electricity intensity decreases as economies industrialize due to demographic shifts from rural to urban areas, structural economic changes towards lighter industry, growth of the services, and the increased use of energy efficient devices and equipments.

The differences in economic growth rates and the uneven distribution of natural resources in the region provide an opportunity for greater electricity trade and cross-border exchanges. Power exchange is good economics, as it can result in benefits such as reduced costs of electricity supply and improved electricity availability. Countries such as Lao PDR which generates exclusively from hydropower can as well import electrical energy from neighboring Thailand's existing thermal power plants to supply its baseload demand in dryer months instead of investing in expensive coal-fired power plants for the same purpose. Cross-border energy supply additionally, provides diversification of sources and this is vital for energy security.

Two-way bilateral exchanges are the simplest form of trading arrangement currently in place among some countries in the region, Small-scale volumes cross the borders between Singapore–Malaysia, Thailand–Malaysia, Thailand–Lao PDR, Thailand–Myanmar, Lao PDR–Vietnam. With the commissioning of two large hydropower projects, the 1,070 MW Nam Theun 2 in 2010 and the Theun-Hinboun Expansion project (bringing the project to a new total of 500 MW) in Lao PDR towards the end of 2012, power flow from Laos to Thailand is expected to increase by over 6.5 TWh per annum. The relative simplicity of these arrangements and the benefits that can accrue to participating parties has encouraged increased cross-border electricity exchange in the region. The possibility of a Malaysia–Indonesia power exchange through a 275 kV undersea interconnection line may also be in the works as both countries signed a memorandum of understanding in June 2012.

System harmonization between economies is a more advanced trading arrangement. It involves the establishment of a common operating environment through the synchronization of member electricity systems and harmonization of financial, legal, political, social and environmental frameworks. This creates a huge single market with common procedures and standards for arranging electricity sales, day-to-day operations, dispute settlement, maintenance, system expansion, and governance. A feature of this arrangement is that the independent systems are managed by a single market operator and governed by a common body. This trading arrangement can bring greater benefits than cross-border exchange, but requires a coordinated approach by participating economies, which is challenging to achieve in a group of countries as economically, culturally and socially diverse in Southeast Asia.

There are plans to harmonize the electricity grid by ASEAN members (Brunei Darussalam, Singapore, Malaysia, Philippines, Indonesia, Thailand and Vietnam). The ASEAN Power Grid energy plan 2010–2015 aims to encourage “interconnections of 15 identified projects, first on cross-border bilateral terms, then gradually expand to sub-regional basis and, finally to a totally integrated Southeast Asian power grid system”. As beneficial as these plans may seem, most will likely remain on the backburners for some time due to political challenges and energy security concerns. Feasibility may be another issue, take the 670 km undersea cable plan under the South China Sea to transport 2,400 MW hydro generated power from East Malaysia to Peninsular Malaysia at an estimated cost of about US\$ 4.5 million per km. This costly and demanding endeavor was shelved in 2010 as the eastern state is expected to absorb all the power generated due to rapid industrial development. Nevertheless, the option is still open for the future as the state has the potential to generate upto 20,000 MW of hydropower.

Similarly, the Asian Development Bank (ADB) has been actively promoting the Greater Mekong Sub-region (GMS) Program focusing on energy as one of its priority sector. The sub-region comprises of five countries and two provinces in the People’s Republic of China sharing the Mekong River: Cambodia, Lao PDR, Myanmar, Thailand, Vietnam, Yunnan Province and Guangxi Zhuang Autonomous Region in China. The challenges facing the GMS in the energy sector are not unique: high economic growth of the region is driving the demand for energy whereas almost 50 million people in the GMS lack access to electricity at present. The GMS Regional Trading and Environmentally Sustainable Development of Electricity Infrastructures aim to cope with the strong demand through improving electricity infrastructure and promoting trade whilst limiting the environmental impacts and promoting energy efficiency. A study by the ADB’s Regional Technical Assistance Project simulated cross-border energy flows among countries in the GMS region, concluding that cross-border trading will reduce CO₂ emission, investment costs needed and operation costs (Figure 6). These improvements in efficiencies will further reduce tariffs to end customers in an environmentally sustainable manner.

GMS Power Systems

Year 2012

ENERGY BALANCE [Avg TWh]

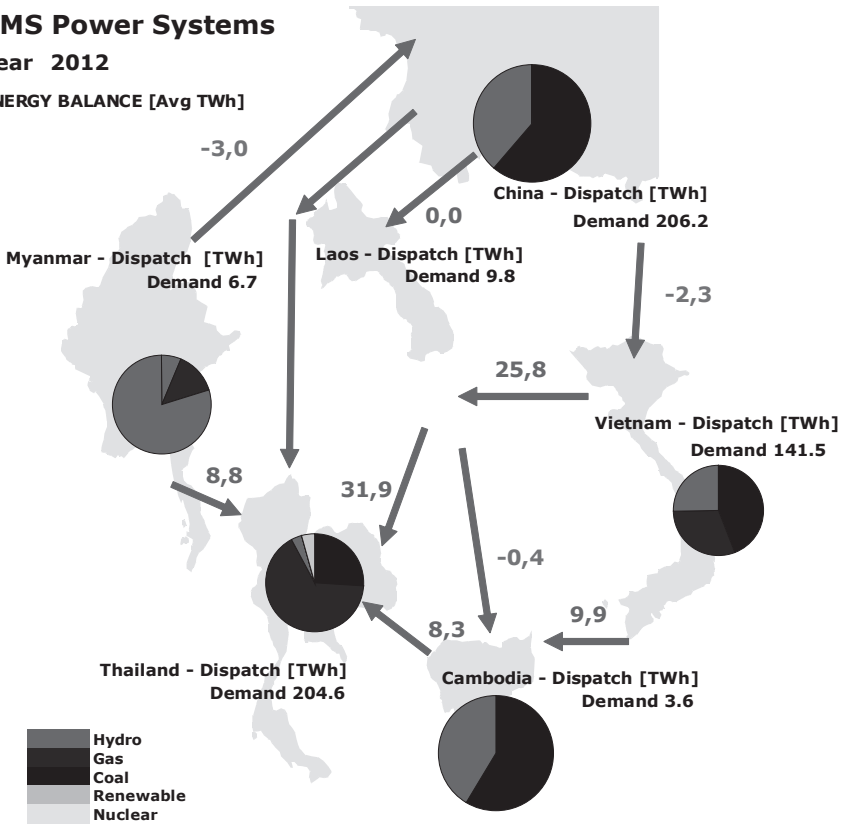


Figure 6 Simulated Average Net Cross-Border Energy Flows

Source: “Regional Power Trade Coordination and Development”, Mercados EMI and Indra Sistemas S.A., 2008.

5.4 ENERGY SECURITY

Energy security is an important policy concern in the Southeast Asian region given the high and volatile fuel prices, and its heavy dependence on fossil fuels. Furthermore, all these non-renewable resources are finite and will ultimately be depleted. There are also environmental and social costs associated with meeting the region’s rapidly rising energy demand. The exchange of power alone is not going to make a difference in global greenhouse emissions should countries continue to install new generating capacities according to the traditional rate of generation mix, largely of

thermal or fossil fuels. The need therefore exists to integrate environmental sustainability issues in the design of the Southeast Asian energy strategy so as to reduce overall costs of energy.

5.5 RENEWABLE ENERGY: HYDROPOWER

Renewable energy has the potential to produce clean energy. Renewable energy systems help reduce greenhouse gas emissions and are being recognized as a major source of energy for the 21st century and beyond. Classified as a clean, renewable energy source, hydropower reduces the net production of greenhouse gases by displacing other forms of power generation. In contrast to most other renewable sources of electricity, hydropower can supply a significant portion of Southeast Asia's electricity needs.

The Southeast Asia region has a cumulative installed capacity of over 150 GW, of which hydropower makes up some 17% of the generating capacity. The region has potentially over 150 GW of hydropower capacity (Table 1).

Southeast Asia has immense growth potential in the hydroelectric sector, in particular within the GMS and Indonesia. Given that the region at present is highly dependent on fossil fuels to meet the majority of its power needs, a shift towards renewable power sources is inevitable. Fiscal and financial incentives provided and supported by the World Bank and

Table 1 Hydropower Potential in Southeast Asia

Country	Hydropower potential
Cambodia	7,000 MW
Lao PDR	18,000 MW
Myanmar	46,000 MW
Indonesia	37,000 MW
Malaysia (East)	28,000 MW
Vietnam	20,000 MW

Source: SN power team analysis.

ADB has led to many initiatives and action plans in the energy sector, including the development of several hydropower projects in the sub-region in recent years.

5.6 COMPETITIVE POWER MARKETS

While the Philippine began commercial operation of its Wholesale Electricity Spot Market in June 2006 and Singapore's National Electricity Market being Asia's first liberalized electricity market commenced trading in January 2003, Vietnam commercially operated its Competitive Generation Market on July 1, 2012, the first of its three phase process towards a fully competitive power market, and part of its major effort to deregulate its power market (Table 2).

The full benefits of comparative advantage can be observed as economies with an advantage generating from hydro, trades with economies generating from fossil fuels. The liberalization of power markets furthermore, brings down barriers of entry, surreptitiously attracting private investors to fill in supply gaps in the system, and consumers paying real prices based on the marginal costs of production.

The energy sector has environmental implications beyond national boundaries which need to be integrated in energy planning to achieve sustainable development. Developing economies in the region could

Table 2 Power Exchanges in Asia

						
Country	Korea	Singapore	Japan	Philippines	India	Vietnam
Electricity exchange	KPX	NEMS	JEPX	WESM	IEX	VCGM
Established (year)	2001	2003	2005	2006	2008	2012
Population (million)	49	5	128	92	1,155	87
Consumption 2011 (TWh)	481	42	1,070	50	755	90
Market – origin	Generation	Wholesale	Wholesale	Wholesale	Wholesale	Generation
Market – present	Generation	Wholesale	Wholesale	Wholesale	Wholesale	Generation
Market – objective	Retail (Restructuring Act expired in 2009)	Retail / Financial	Wholesale	Retail	Financial	Retail

leap-frog from hard and costly lessons learnt from industrialized nations, through developing clean hydropower, cross-border exchanges, and establishing a competitive power market. While huge challenges exist from the diverse stages of economic and political development in the Southeast Asian region, the necessity and benefits should provide development towards a cleaner environment, more energy efficient, secure and sustainable development in the future.

5.7 THE ROLE OF SN POWER

SN Power is at the crossroads of two mega-trends, namely, the demand for renewable energy and the growth in emerging markets (Figure 7). Its business model is based on active ownership, the transfer of Norwegian hydropower expertise, and responsible, sustainable development of renewable energy. SN Power has expertise in hydropower plant design and development as well as working in deregulated/emerging markets. It followed solid business principles, adopting the following investment criteria: industry returns, project finance, active ownership, solid partnership, balanced portfolios, and environmentally and socially manageable projects. SN Power will continue to combine profitability with responsible operations, be a pioneer in deregulated markets, engage the government and private sector and be innovative.

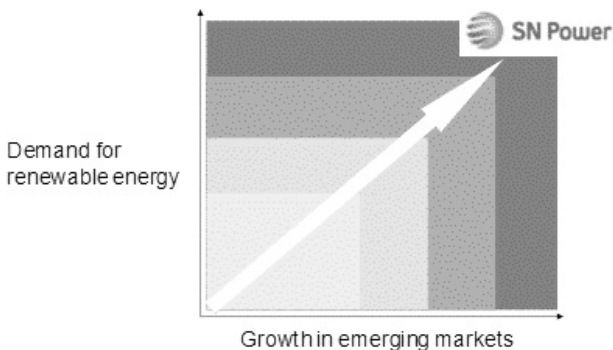


Figure 7 SN Power, Demand for Renewable Energy and Growth in Emerging Markets

Source: SN Power.

5.8 CONCLUSION

The consensus among climate scientists is that the world must cut emissions now. Rich countries cannot do it alone, and targets will fail unless developing countries contribute their share in reducing CO₂ emission. SN Power's presence in a region with huge hydropower potential coupled with a dire need for it puts it in a very interesting position. Its expertise in hydropower and deregulated markets allows it to help the region to build, manage and operate hydropower projects in an environmentally friendly and optimizing manner, reducing CO₂ emission by reducing energy costs overall through power exchange in a deregulated market.

CHAPTER 6

PHILIPPINE EXPERIENCES WITH GRID-CONNECTED RENEWABLE ENERGY POWER SYSTEMS

N. A. Orcullo, Jr.

ABSTRACT

The efforts of the Philippine government in developing the potential of renewable energy-based energy systems is discussed given the variety of legal mandates and programs/projects designed to address the long-term energy development agenda of the country. Focus is made on renewable energy POWER system of private investors producing relatively high capacity output and supplied or directly connected to the grid and distribution system serving a particular area. The particular projects cited include the 1 MW photovoltaic power plant of Cagayan Electric Power and Light Company (CEPALCO) which is tied up to its distribution system, the wind power systems of NorthWind Power Development Corporation (NPDC) with an aggregate capacity of 35 MW from which is supplied to a provincial electric cooperative (Ilocos Norte Electric Cooperative) and the garbage-based methane power plant installed in a landfill complex operated by the Montalban Methane Power Corporation (MMPC), whose output is directly connected to the Manila Electric Railroad and Light Company

(MERALCO), the biggest electric power distributor in the country, operating in Metro Manila region and the nearby provinces.

All three projects cited are just part of the many renewable-energy projects in the country and are owned and/or operated by private investors. These private companies are motivated by the Philippine government's energy plan and incentives to power producers to use renewable energy sources and supply power in their respective areas by way of supply agreements signed with clients. The exception being CEPALCO's photovoltaic power plant which sells the electric power output in its franchised area as it is an authorized electric power distributor. The particular projects cited appear to be operating profitably and plans are underway to expand the capacity of their respective power plants, hopefully giving impetus to the grand agenda of the Philippine government in the renewable energy sector which listed a number of projects including those meant to produce bio-fuels as mandated by law.

6.1 BACKGROUND

The energy crisis of the early 1970s made the world realise that the development of nations and volatile market prices of petroleum-based products are intertwined. Leaders of both developed and developing countries realised that something had to be done to address this concern and reality. The volatility of market prices of petroleum-based fuels in the global markets and its use as a political as well as economic tool among the major oil producers made it clear to world leaders that strategic decisions had to be made to cushion the implications of erratic prices of crude products and their derivatives.

The Philippine government accepted the reality and in the mid-1970s, then President Marcos reacted by putting in place a government corporation (Philippine National Oil Company) and established Petrophil Corporation (the successor of Esso Philippines). Realising the importance of energy as a dominant commodity with a pivotal role in the Philippines' economy, a Presidential Decree (PD) was issued creating the Energy Development Board (EDB) and PD 1206 creating the Department of Energy (DOE), thus having a cabinet-level post for energy matters. During the administration of President Marcos, an ambitious energy plan and policy was put in place and this included developing alternative sources of energy such as solar power, wind power, hydropower and

geothermal power, if only to cushion the impact of high costs of imported oil, particularly on the country's foreign exchange reserves. Eventually, the National Energy Plan was crafted under the auspices of the DOE and its attached agencies. The development of the Philippine Energy Plan was institutionalised and it required a series of parallel programmes/projects to address energy supply amidst threats of a global energy crisis. Non-petroleum energy sources like geothermal power and hydropower were developed to the fullest extent and petroleum exploration in the domestic scene became a vibrant industry.¹

6.2 LEGAL MANDATES ESTABLISHED

Over the last three decades commencing in the early 1970s when the Philippine government reacted to the global energy crisis brought by the unilateral moves of oil-exporting countries and the OPEC oil embargo, a number of decrees and laws were put in place. The relevant decrees and laws that resulted in a number of power development projects, including efforts related to renewable energy development, are shown in Table 1.

In the renewable energy sector, PD 1068 was issued in 1977, mandating wider and organised efforts in the development, promotion and commercial utilisation of non-conventional energy sources. The Non-conventional Energy Resources Development Program (NERDP) of the DOE was in the forefront of the efforts to develop the potential of renewable energy technologies, triggering research and development projects dealing with solar, wind and biomass energy sources. A number of academic institutions as well as research organisations were involved in various research and development efforts funded under the NERDP. A variety of undertakings were pursued, from research to technology promotions, all aimed at developing the potential of biomass-based resources and technologies, eventually popularising the use of biogas, gasifiers, solar water heaters, wind-powered pumps, wind power conversion systems, bioethanol, coco-diesel and most recently biodiesel in the form of crude methyl ester.

¹A personal account of the author, who was one of the pioneering technical staff of the Non-conventional Energy Resources Division of the DOE and a part of the DOE circa 1979–1990.

Table 1 Legal Mandates and Motivating Laws and Policies

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1. Presidential Decree 910 (Energy Development Board)–1976
 2. Presidential Decree 1206 (DOE Charter)–1976
 3. Presidential Decree 1068 (NERDP Program)–1977
 4. Foreign Investment Act (RA 7042/RA 8719)–1991
 5. Executive Order 215 (BOT projects)–1995
 6. Executive Order 462/AEO 232–1997
 7. DOE New Charter (RA 7638)–1992
 8. BOT Law (RA 6967/RA 7718)–1994
 9. Clean Air Act (RA 1234)–1999
 10. Ecological Solid Waste Management Act (RA 9003)–2000
 11. EPIRA Law (RA 9136)–2001
 12. Biofuels Law (RA 9367)–2006
 13. Renewable Energy Law (RA 9513)–2008
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Source: Karunungan, E. “Renewable Energy Fuels: Key to Energy Independence and Security”, Department of Energy, Makati City, Philippines, 2008.

This series of efforts led to administrative and legal frameworks being put in place. Major policy decisions were made by the government leadership and landmark laws were put in place via a decree during a period of martial law as well as Executive Orders and by acts of Congress. The Foreign Investment Act (Republic Act 7042 as amended by RA 8719) served as encouragement for many local and foreign investors due to the incentives it promised, and the investors in the power generation sectors took advantage of it. The issuance of Executive Order 215 that eventually resulted in the enactment of the Build-Operate-Transfer Law (RA 6957 as amended by RA 7718) resulted in a large number of private sector–financed power generation plants, once a major responsibility and monopoly of the government which later became a budgetary burden. Moreover, the enactment of the Clean Air Act (RA 8749) and Ecological Solid Waste Management Act (RA 9003) also gave a push and served as the motivator for investors to consider green, renewable and clean energy technologies. Furthermore, the enactment of the Electric Power Industry Reform Act (RA 9136), the Biofuels Act of 2006 (RA 9367) and most recently the Renewable Energy Act of 2008 (RA 9513) are developments that further

triggered private sector investments in power generation as well as transmission and many looked at this particular law as a great booster for inviting more local and foreign investments in renewable energy projects.

Prior to the enactment of the aforementioned laws, investments in energy projects/ventures were included in the investment priorities programme of the Board of Investments, thus entitling investors to a number of incentives such as tariff/duty privileges as well as tax holidays. As a result of the political will of the government leadership as well as management initiatives of concerned government agencies, the renewable energy sector is now a vibrant sector of the economy. Several renewable energy companies are now serving the market and more conspicuous are the megawatt-level business projects in wind and solar photovoltaics that are now part of the electrical grid system.

6.3 RENEWABLE ENERGY RESOURCES AND POLICIES²

The country is endowed with natural resources which have allowed it to develop its potential and in many ways contributed a lot to the power supply of the country. In a study released by the National Renewable Energy Laboratory (NREL) of the United States, the following potentials of renewable energy were identified:

- a) Wind resources — over 10,000 km² with 76,000 MW of potential installed capacity.
- b) Micro-hydro applications — potential capacity of at least 500 kW in Luzon and Mindanao islands.
- c) Solar radiation nationwide — an annual potential average of 5.0–5.1 kWh/m²/day.
- d) Mini-hydro applications — potential capacity of 1,784 MW for 888 sites.
- e) Ocean energy resources — potential capacity of about 170,000 MW.
- f) Biomass (Bagasse) — total potential of 235 MMBFOE.

²Karunungan, E. “Renewable Energy Fuels: Key to Energy Independence and Security”, Department of Energy, Makati City, Philippines, 2008.

To enable the development of the potential of its renewable energy resources, the Philippine Energy Plan enshrined a commitment to a renewable energy policy development as follows:

- a) Renewable energy policy framework launched in 2003.
- b) Policy bias towards the development and utilisation of renewable energy:
 - i) Promote more private sector participation in RE development.
 - ii) Encourage the use of renewable energy in rural and off-grid electrification.
 - iii) Renewable energy projects given “priority” for special incentives.
- c) Having a renewable energy law to promote the development and utilisation of clean energy (enacted in 2008 as RA 9513)

Giving it substance and concrete meaning, the renewable energy development policy framework was translated into long-term objectives as follows:

- a) Increase renewable energy-based capacity by 100% — “100–10”.
- b) Be the number one geothermal energy producer in the world.
- c) Be the number one wind energy producer in Southeast Asia.
- d) Double hydro-electric capacity.
- e) Be the solar cell manufacturing hub in ASEAN.
- f) New contribution of biomass, solar and ocean energy of more than 100 MW.
- g) Increase non-power contribution of RE to energy mix by 10 MMBFOE within the next 10 years.

The concrete results of the long-term objectives, set forth as various completed and ongoing undertakings, are summarised in Table 2.

6.4 MARKET SYSTEM FOR ELECTRIC POWER

The monopoly of power generation by the National Power Corporation (NPC) under Presidential Decree was dismantled through a privatisation policy. This policy statement tempered with the enactment of the Electric Power Industry Reform Act or EPIRA (RA 9136) resulted in a new market system for the electric energy sector. The electric power sector in

Table 2 Renewable Energy Development Status

Resource	Existing capacity (MW)	Number of plants in operation	On-going projects
Geothermal	2,027.07	14 geothermal plants	10 projects offered to private investor (300–500 MW) thru Contracting Round
Hydro	3,367.07	21 large hydro, 52 mini-hydro, 61 micro hydro	4 mini-hydros, 14 large hydro under evaluation
Wind	33.2	33 MW In Ilocos Norte, 5 KW Camarines in 180 KW in Batanes, 6 KW in Boracay	NPDC wind farm, 7 sites on resource assessment
Solar	5.161	960 KW — CEPALCO, Cagayan e Oro 729 KW Camarines Sur	Sunpower Phil Solar Plant/rural electrification projects
Biomass	20.93		1 MW Isabela
Ocean			R & D activities — Demo projects in Leyte/Mindanao

Source: E. Karunugan (Department of Energy)/Philippine Daily Inquirer.

particular was transformed from a monopolistic market to a free market system open to any interested parties, limited only by ownership structure as mandated by the Philippine Constitution.

The developments in the power generation sector resulted in a new market system as shown in Figure 1.

The National Power Corporation is still presented as a power generator or generating company (GENCO) pending its full privatisation. However, private sector investments in power generation are now in place as evidenced by the growing number of independent power producers (IPPs). Another significant development in the new market system is that electricity distribution companies (i.e. privately owned utilities and electric cooperatives) are now authorised to develop and produce their electric power, thus allowing backward integration opportunities not only for economic but also for technical reasons.

Adding more incentives to both the generators and buyers of electric power is the provision in the EPIRA which mandates the establishment of

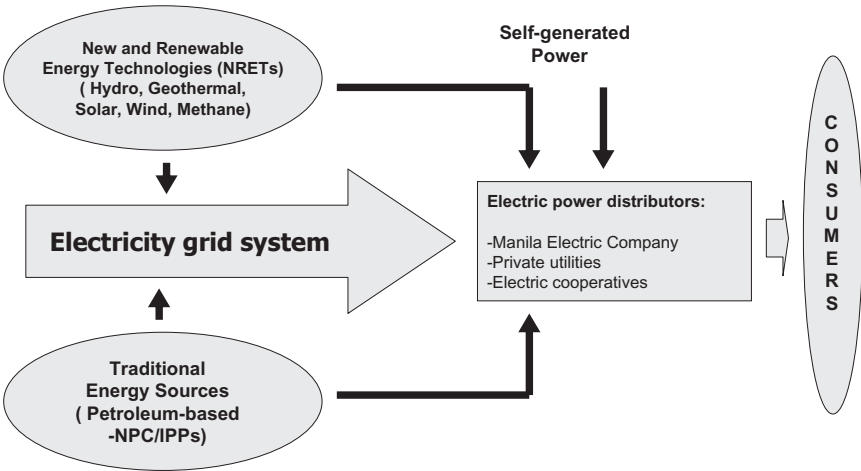


Figure 1 The Electrical Grid and Distribution System in the Philippines

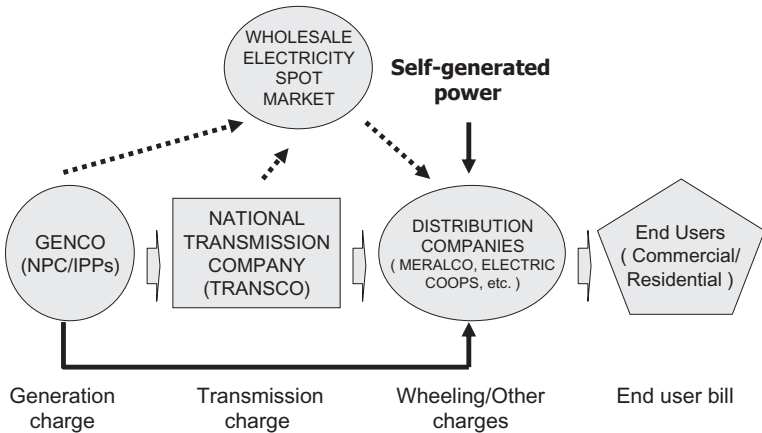


Figure 2 The Power Distribution System and the WESM

the Wholesale Electricity Spot Market (WESM). The spot market is a platform that simulates a free market system that can work to the advantage of both the GENCOs and the distribution companies, or in certain cases, to the contrary. It is hoped that the new market framework illustrated in Figure 2 will result in benefits to end users in the form of affordable or cheaper tariffs for electric power.

The variety of laws and policies set forth by the government ensure and allow the free market system to work thus giving market competition to play and set prices of products in the market. With new and renewable energy technologies (NRET) pitted against petroleum-based power plants, with more incentives favouring the former, it is hoped that new and renewable energy businesses and industry will emerge and flourish.

6.5 THE ELECTRICAL GRID SYSTEM

To ensure connectivity and markets for the output of commercial power generation projects large and small, the country operates an electrical grid system. This grid scheme was in place even at the time when power generation and region-wide distribution was the responsibility of the NPC. There is a grid for the major islands of Luzon, Visayas and Mindanao where provincial-level power distributors (e.g. electric cooperatives) can source their power for retail to institutional and residential consumers.

As mandated by the EPIRA, the grid and Grid Code were put in place. As defined in the EPIRA, the grid refers to the high-voltage backbone system of interconnected transmission lines, substations and related facilities. The EPIRA espouses a Grid Code referring to the set of rules and regulations governing the safe and reliable operation, maintenance and development of the high-voltage backbone transmission system and its related facilities.³

Also forming part of the provisions of the EPIRA, a National Transmission Corporation (TransCo) was organised to acquire all the transmission assets of the NPC. TransCo was specifically organised to assume the electrical transmission function of the NPC, and have all the powers and functions granted unto it. TransCo assumes the authority and responsibility of the NPC for the planning, construction and centralised operation and maintenance of high-voltage transmission facilities, including grid interconnections and ancillary services.

With the regional grid system now in place, sufficient infrastructural provisions are also in place for any generation company using renewable energy sources to connect with the electrical grid, thus ensuring a ready market for its output. It is just a matter of the renewable energy power

³ Electric Power Industry Reform Act of 2001 (RA 9513).

generator delivering an electrical energy output consistent with the voltage levels of the power grid nearest to it or to the specific demand of its buyer/user, should it opt to directly supply its output to the distribution system of the utility company.

The grid system at the regional level allows the transport of indigenous and renewable energy to other parts of island in the country, thus enhancing efficiency and maximising the use of the energy output, and at the same time providing electricity supply to areas with insufficient generation capacity. This is the particular case in Negros island where excess capacity from geothermal plants was transmitted to Cebu island (both in the Visayas region) using the submarine cable that connects these two islands.

Following the mandate under the EPIRA, there is now a Philippine Grid Code promulgated by the Energy Regulatory Commission (ERC) which it approved per Resolution No. 115.

6.6 THE RENEWABLE ENERGY ACT OF 2008

Giving inspiration and impetus to the development of the renewable energy sector of the Philippines are the administrative policies/directives set forth and various laws enacted as earlier mentioned, as well as the political will to undertake the specific programmes and projects.

After a series of programmes, projects and a variety of initiatives to develop, promote and commercialise the use of renewable energy in the country, landmark legislation for the renewable energy sector was put in place by Congress. This was the enactment of RA 9513, otherwise known as the Renewable Energy Act of 2008.

The Renewable Energy Act made a number of significant provisions to address the development, financing and marketing of electricity as well as incentives for renewable energy-based power generation systems. Under the provisions of the Renewable Energy Act, general incentives have been accorded to investors in renewable energy projects as stipulated under Chapter III of the said act. In particular, the said act provides for the following:

Section 15. Incentives for Renewable Energy Projects and Activities. — RE developers of renewable energy facilities, including hybrid systems, in proportion to and to the extent of the RE component, for both power and

non-power applications, as duly certified by the DOE, in consultation with the BOI, shall be entitled to the following incentives:

- (a) Income Tax Holiday (ITH) — For the first seven (7) years of its commercial operations, the duly registered RE developer shall be exempt from income taxes levied by the national government.

Additional investments in the project shall be entitled to additional income tax exemption on the income attributable to the investment: *Provided*, That the discovery and development of new RE resource shall be treated as a new investment and shall therefore be entitled to a fresh package of incentives: *Provided, further*, That the entitlement period for additional investments shall not be more than three (3) times the period of the initial availment of the ITH.

- (b) Duty-free Importation of RE Machinery, Equipment and Materials — Within the first ten (10) years upon the issuance of a certification of an RE developer, the importation of machinery and equipment, and materials and parts thereof, including control and communication equipment, shall not be subject to tariff duties: *Provided, however*, That the said machinery, equipment, materials and parts are directly and actually needed and used exclusively in the RE facilities for transformation into energy and delivery of energy to the point of use and covered by shipping documents in the name of the duly registered operator to whom the shipment will be directly delivered by customs authorities: *Provided, further*, That endorsement of the DOE is obtained before the importation of such machinery, equipment, materials and parts is made.

Endorsement of the DOE must be secured before any sale, transfer or disposition of the imported capital equipment, machinery or spare parts is made: *Provided*, That if such sale, transfer or disposition is made within the ten (10)-year period from the date of importation, any of the following conditions must be present:

- (i) If made to another RE developer enjoying tax and duty exemption on imported capital equipment;
- (ii) If made to a non-RE developer, upon payment of any taxes and duties due on the net book value of the capital equipment to be sold;
- (iii) Exportation of the used capital equipment, machinery, spare parts or source documents or those required for RE development; and
- (iv) For reasons of proven technical obsolescence.

When the aforementioned sale, transfer or disposition is made under any of the conditions provided for in the foregoing paragraphs after ten (10) years from the date of importation, the sale, transfer or disposition shall no longer be subject to the payment of taxes and duties;

- (c) **Special Realty Tax Rates on Equipment and Machinery.** — Any law to the contrary notwithstanding, realty and other taxes on civil works, equipment, machinery, and other improvements of a Registered RE Developer actually and exclusively used for RE facilities shall not exceed one and a half percent (1.5%) of their original cost less accumulated normal depreciation or net book value: *Provided*, That in case of an integrated resource development and generation facility as provided under Republic Act No. 9136, the real property tax shall only be imposed on the power plant;
- (d) **Net Operating Loss Carry-Over (NOLCO).** — The NOLCO of the RE Developer during the first three (3) years from the start of commercial operation which had not been previously offset as deduction from gross income shall be carried over as a deduction from gross income for the next seven (7) consecutive taxable years immediately following the year of such loss: *Provided, however*, That operating loss resulting from the availment of incentives provided for in this Act shall not be entitled to NOLCO;
- (e) **Corporate Tax Rate** — After seven (7) years of income tax holiday, all RE Developers shall pay a corporate tax of ten percent (10%) on its net taxable income as defined in the National Internal Revenue Act of 1997, as amended by Republic Act No. 9337. *Provided*, That the RE Developer shall pass on the savings to the end-users in the form of lower power rates.
- (f) **Accelerated Depreciation.** — If, and only if, an RE project fails to receive an ITH before full operation, it may apply for Accelerated Depreciation in its tax books and be taxed based on such: *Provided*, That if it applies for Accelerated Depreciation, the project or its expansions shall no longer be eligible for an ITH. Accelerated depreciation of plant, machinery, and equipment that are reasonably needed and actually used for the exploration, development and utilization of RE resources may be depreciated using a rate not exceeding twice the rate which would have been used had the annual allowance been computed in accordance with the rules and regulations prescribed by the Secretary of the Department of Finance and the provisions of the National Internal

Revenue Code (NIRC) of 1997, as amended. Any of the following methods of accelerated depreciation may be adopted:

- i) Declining balance method; and
- ii) Sum-of-the years digit method

- (g) Zero Percent Value-Added Tax Rate — The sale of fuel or power generated from renewable sources of energy such as, but not limited to, biomass, solar, wind, hydropower, geothermal, ocean energy and other emerging energy sources using technologies such as fuel cells and hydrogen fuels, shall be subject to zero percent (0%) value-added tax (VAT), pursuant to the National Internal Revenue Code (NIRC) of 1997, as amended by Republic Act No. 9337.

All RE Developers shall be entitled to zero-rated value added tax on its purchases of local supply of goods, properties and services needed for the development, construction and installation of its plant facilities.

This provision shall also apply to the whole process of exploring and developing renewable energy sources up to its conversion into power, including but not limited to the services performed by subcontractors and/or contractors.

- (h) Cash Incentive of Renewable Energy Developers for Missionary Electrification — A renewable energy developer, established after the effectivity of this Act, shall be entitled to a cash generation-based incentive per kilowatt hour rate generated, equivalent to fifty percent (50%) of the universal charge for power needed to service missionary areas where it operates the same, to be chargeable against the universal charge for missionary electrification;
- (i) Tax Exemption of Carbon Credits — All proceeds from the sale of carbon emission credits shall be exempt from any and all taxes;
- (j) Tax Credit on Domestic Capital Equipment and Services. — A tax credit equivalent to one hundred percent (100%) of the value of the value-added tax and custom duties that would have been paid on the RE machinery, equipment, materials and parts had these items been imported shall be given to an RE operating contract holder who purchases machinery, equipment, materials, and parts from a domestic manufacturer for purposes set forth in this Act: *Provided*, That prior approval by the DOE was obtained by the local manufacturer: *Provided, further*, That the acquisition of such machinery, equipment, materials, and parts shall be made within the validity of the RE operating contract.

In addition to the aforementioned incentives under Section 15 of the law, Section 21 provides incentives for commercialisation of renewable energy technologies to cover all manufacturers, fabricators and suppliers of locally produced RE equipment and components duly recognised and accredited by the DOE (in consultation with DOST, DOF and DTI), and the project duly registered with the Board of Investment (BOI). This particular provision identified the renewable energy sector as a priority investment sector that will regularly form part of the country's Investment Priorities Plan. As such, all entities duly accredited by the DOE under the Renewable Energy Act are entitled to all the incentives such as the following:

- (a) Tax and Duty-free Importation of Components, Parts and Materials. — All shipments necessary for the manufacture and/or fabrication of RE equipment and components shall be exempted from importation tariff and duties and value added tax: *Provided, however*; That the said components, parts and materials are: (i) not manufactured domestically in reasonable quantity and quality at competitive prices; (ii) directly and actually needed and shall be used exclusively in the manufacture/fabrication of RE equipment; and (iii) covered by shipping documents in the name of the duly registered manufacturer/fabricator to whom the shipment will be directly delivered by customs authorities: *Provided, further*; That prior approval of the DOE was obtained before the importation of such components, parts and materials;
- (b) Tax Credit on Domestic Capital Components, Parts and Materials. — A tax credit equivalent to one hundred percent (100%) of the amount of the value-added tax and custom duties that would have been paid on the components, parts and materials had these items been imported shall be given to an RE equipment manufacturer, fabricator, and supplier duly recognized and accredited by the DOE who purchases RE components, parts and materials from a domestic manufacturer: *Provided*, That such components, and parts are directly needed and shall be used exclusively by the RE manufacturer, fabricator and supplier for the manufacture, fabrication and sale of the RE equipment: *Provided, further*; That prior approval by the DOE was obtained by the local manufacturer;
- (c) Income Tax Holiday and Exemption. — For seven (7) years starting from the date of recognition/accreditation, an RE manufacturer,

fabricator and supplier of RE equipment shall be fully exempt from income taxes levied by the National Government on net income derived only from the sale of RE equipment, machinery, parts and services; and

- (d) Zero-rated Value Added Tax Transactions. — All manufacturers, fabricators and suppliers of locally produced renewable energy equipment shall be subject to zero-rated value added tax on its transactions with local suppliers of goods, properties and services.

6.7 FEED-IN TARIFF SYSTEM FOR RENEWABLE ENERGY SOURCES

Ensuring a market outlet for the renewable power generation project is vital to the development of the renewable energy sector. To have this scenario and to encourage proliferation of energy from renewable energy sources, particularly those intended for connection with the regional electrical or utility grid, Section 7 of the Renewable Energy Act has made specific provisions as follows:

Section 7. Feed-In Tariff System. — To accelerate the development of emerging renewable energy resources, a feed-in tariff system for electricity produced from wind, solar, ocean, run-of-river hydropower and biomass is hereby mandated. Towards this end, the ERC in consultation with the National Renewable Energy Board (NREB) created under Section 27 of this Act shall formulate and promulgate feed-in tariff system rules within one year upon the effectivity of this Act which shall include, but not limited to the following:

- (a) Priority connections to the grid for electricity generated from emerging renewable energy resources such as wind, solar, ocean, run-of-river hydropower and biomass power plants within the territory of the Philippines;
- (b) The priority purchase and transmission of, and payment for, such electricity by the grid system operators;
- (c) Determine the fixed tariff to be paid to electricity produced from each type of emerging renewable energy and the mandated number of years for the application of these rates, which shall not be less than 12 years;

- (d) The feed-in tariff to be set shall be applied to the emerging renewable energy to be used in compliance with the renewable portfolio standard as provided for in this Act and in accordance with the RPS rules that will be established by the DOE.

The Renewable Energy Market (REM) is likewise established to facilitate compliance with the provisions of the law. The Department of Energy is tasked to establish the REM and shall direct the Philippine Electric Market Corporation (PEMC) to implement changes to the WESM Rules in order to incorporate the rules specific to the operation of the REM under the WESM.

6.8 NET-METERING MECHANISM

To have a certain or captive market for the electrical energy output of renewable energy projects, particularly in situations where there is excess power at the level of institutional consumers who ventured into self-generation, there has to be a mechanism to address the possibility of selling extra output to the electrical grid system. This predicament has been addressed by the provisions of the Renewable Energy Act on net metering and this in fact is one of the unique provisions of the law.

The net-metering scheme provided for under Section 10 reads as follows:

Section 10. Net-metering for Renewable Energy. — Subject to technical considerations and without discrimination and upon request by distribution end-users, the distribution utilities shall enter into net-metering agreements with qualified end-users who will be installing RE system.

The ERC, in consultation with the NREB and the electric power industry participants, shall establish net metering interconnection standards and pricing methodology and other commercial arrangements necessary to ensure success of the net-metering for renewable energy program within one (1) year upon the effectivity of this Act.

The distribution utility shall be entitled to any Renewable Energy Certificate resulting from net-metering arrangement with the qualified end-user who is using an RE resource to provide energy and the distribution utility shall be able to use this RE certificate in compliance with its obligations under RPS.

The DOE, ERC, TRANSCO or its successors-in-interest, DUs, PEMC and all relevant parties are hereby mandated to provide the mechanisms for the physical connection and commercial arrangements necessary to ensure the success of the Net-metering for Renewable Energy program, consistent with the Grid and Distribution Codes.

The net-metering mechanism stands to benefit electricity distributors and institutional consumers with the potential to generate their own electricity, whose excess power capacity can be sold back to the grid system. The importance of the net-metering scheme lies in the fact that the renewable energy plant capacity can be maximised by users and distributors so that there is a guaranteed market for surplus energy production.

6.9 ROLE OF GOVERNMENT AGENCIES

Under the stated deregulation policy in the energy sector, private investors are given plenty of leeway and privilege in doing their business, particularly with prices of petroleum-based products which are left to market conditions. This is not the case, however, with the electrical power sector where certain controls and regulations are put in place, but still give investors in the power generation and distribution business the opportunity to recoup their investments plus reasonable returns, while at the same time addressing the concerns of end users of electrical power. Concerns are addressed by way of a series of public or consultative hearings whenever there are tariff rate changes.

The Electric Power Industry Reform Act of 2001 (RA 9136) has given government agencies like the Department of Energy and Energy Regulatory Commission a specific mandate. These agencies have substantial authority to protect the various stakeholders, such as the investors in the electrical power sector, including the interests and concerns of the public at large. Generators of power from whatever sources, including renewable energy resources and systems/technologies, have to apply for and be cleared and/or endorsed by the DOE. Final authority (i.e. Certificate of Compliance) to market the output of generation companies as well as distribute the same at certain prices or tariffs is left to the judgment of the ERC guided by the provisions of the EPIRA and its

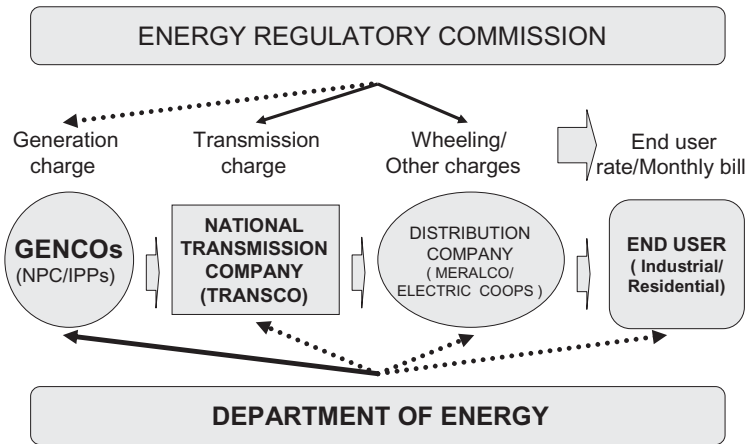


Figure 3 The Electric Power Industry of the Philippines

Implementing Rules and Regulations. Deregulated as it is, the electric power industry is fully monitored by the DOE and ERC as diagrammatically shown in Figure 3.

6.9.1 Role of the ERC in the EPIRA Regime

Among others, the privatisation policy of the government gave the private sector the privilege and right to invest in the power generation sector under the Build-Operate-Transfer (BOT) Law, particularly in the early 1990s when the country experienced acute power outages. This scenario gave the distributors and users of electrical power an option of whom to buy from or source their electricity from, which they will eventually distribute in their respective franchise or service areas. This scenario has also given some power distributors the option to go into horizontal and backward integration, thus making the price of electrical power competitive and hopefully benefiting end users.

Added to this scenario is the creation of the Wholesale Electricity Spot Market which further gives the institutional buyers (i.e. utility companies/ electric cooperatives) the option of where to buy from or source their power from at any given time of day which they believe is advantageous. This scenario is explained by Figure 4.

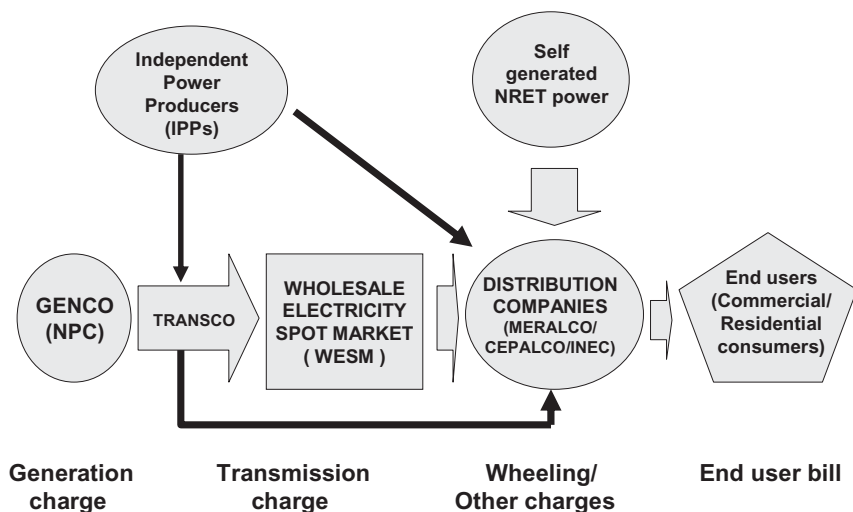


Figure 4 Power Sourcing Options for Electric Power Distributors

Given the liberalised scenario in power generation and the options available to distributors of electricity at the end user level, the ERC plays a critical role given its mandate to address the interest of the consumer — the public at large — without jeopardising the return on investment and profit motives of the generation companies and the investors in general.

Under the EPIRA, prices charged by generation companies are not categorically stated as subject to regulation by the ERC; however, generation companies are required to submit their financial statements (to the ERC) to address market power abuse or anti-competitive behaviour. Unlike generation companies, transmission of electrical power is by regulated common electricity carriers and subject to the rate-making powers of the ERC. The distribution of electricity (by private utilities and electric cooperatives) to end users/consumers is subject to regulation by the ERC, hence tariff rates and other charges have to be approved by the ERC.

The critical role played by the ERC in the electricity rate- or tariff-making process is shown in Figure 5.

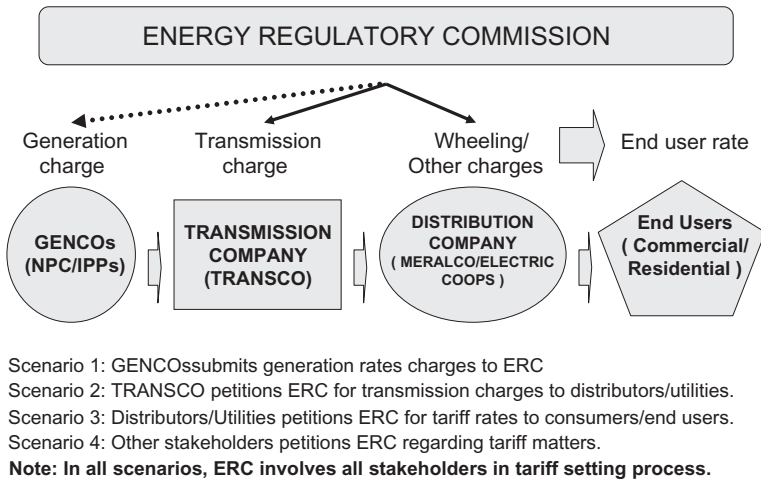


Figure 5 Electricity Tariff-Setting Process in the Philippines

6.9.2 Role of the WESM in Electricity Trade

The EPIRA established the Wholesale Electricity Spot Market, giving further options to concerned parties to get the most out of the benefits of a free market enterprise. As referred to under the EPIRA, the DOE is mandated to establish a wholesale electricity spot market composed of the wholesale electricity spot market participants.

As provided for under the EPIRA, the DOE facilitated the creation of the Philippine Electricity Market Corporation (PEMC). The PEMC undertook the preparatory work and initial operation of the WESM. The PEMC was established to maintain, operate and govern an efficient, competitive, transparent and reliable market for the wholesale and purchase of electricity and ancillary services in the Philippines in accordance with applicable laws, rules and regulations. The Articles of Incorporation and By-Laws of the PEMC were finalised in collaboration with the WESM Technical Working Group. The PEMC is a duly incorporated non-stock, non-profit corporation registered with the Securities and Exchange Commission (SEC) on 18 November 2003.

Simply put, the WESM mechanism runs similar to a stock market wherein instead of trading shares of stocks, electricity as a commodity is

placed on the trading floor for any interested parties to grab. The WESM shall provide the mechanism for identifying and setting the price of actual variations from the quantities transacted under contracts between sellers and purchasers of electricity.

6.9.2.1 *Membership in the WESM*

To be a player in the wholesale spot market, both generation companies and distributors (private utilities and electricity cooperatives) have to be accredited by the PEMC who run/manage the WESM.

The number of parties directly and indirectly involved in WESM operations to date is given in Table 3. As shown in the table, 30 generators have been accredited to sell their electricity. Seven electric power distributors/retailers including Manila Electric Company (MERALCO) have been accredited to source their power using the WESM system. Four generators and one supplier have expressed their intention to be accredited. Nine organisations have filed their applications with the WESM.⁴

6.9.2.2 *How Does the WESM Work?*

The WESM is a system of electronically connected market players who sell and buy their needs for electricity at any time of day. The WESM does

Table 3 List of Accredited WESM Participants

1. Generators	30
2. Distribution utilities	1
3. Electric cooperatives	6
4. Suppliers	5
5. Indirect participants	16
6. Intending participants	5
7. Applicants	9

Source: Wholesale Electricity Spot Market (www.wesm.ph, 13 March 2009).

⁴Wholesale Electricity Spot Market. www.wesm.ph.

this by scheduling electricity generation and dispatch while balancing demand at all times. A typical trade takes place as follows:

Step One: Trading participants submit hourly bids stating their price of, and demand for, electricity. Bids are submitted to the Market Operator (MO). Price bids reflect only the energy costs.

Step Two: The MO matches bids using the Market Dispatch Optimization Model (MDOM), which takes into account market requirements and physical system constraints. As such, the MO first dispatches generators with the lowest offers until demand is fully met at the market clearing price.

Step Three: The MO submits the dispatch schedule to the System Operator (SO) for implementation.

Step Four: Suppliers and buyers settle respective payments through the WESM. Under its price determination methodology, the total cost of electricity is computed using the market clearing price (spot price), market fees and charges for ancillary services. In the case of bilateral power supply contracts, however, the involved trading participants have the option of settling directly with their contracting parties.

This system allows for transparency wherein electricity is provided at its true cost, based on the economic principles of supply and demand.

6.10 CAGAYAN ELECTRIC POWER AND LIGHT COMPANY, INC

Cagayan Electric Power and Light Company (CEPALCO) is based in Cagayan de Oro City in Northeastern Mindanao. The company is one of those enterprising and socially conscious organisations which took advantage of the benefits of a deregulated electrical power sector by generating electricity using renewable energy technologies such as hydro as well as solar energy sources.

The company began its operations in 1952 with a modest power-generating capacity of 5,000 kW and a customer base of only 750. The company was granted congressional franchise on 17 June 1961. Today, CEPALCO has over 100,000 residential, commercial and industrial customers within its franchise area that covers Cagayan de Oro City and the municipalities of Tagoloan, Villanueva and Jasaan, all in the province of

Misamis Oriental, including the 3,000-hectare PHIVIDECE Industrial Estate.⁵

CEPALCO is now the third-largest electricity distribution company in the Philippines, behind Manila Electric Company, the biggest distributor. The company's growth in energy consumption has consistently been among the highest in the country. Modern facilities and equipment as well as an efficient service network have made CEPALCO one of the most reliable electricity service companies in the country. The company's distribution network includes 138 kV, 69 kV, 34.5 kV and 13.8 kV systems.

The company is a privately owned company, where the Abaya family is the founder and major shareholder. The four top shareholders (Fullmax Philippine Development, LLC, Abaya Investments Corporation, Breavel, Inc., and the Abaya family) together own 63.1 percent of the company.

6.10.1 CEPALCO's Solar Photovoltaic (PV) Plant

CEPALCO made a major and innovative decision by venturing into investments in renewable energy technology, particularly with its photovoltaic (PV) facility. The site of the PV plant is on a two-hectare site and construction of the PV power plant, which started in August 2003, was handled by Sumitomo Corporation. The PV plant was finished in April 2004. It is this particular project of CEPALCO that drives the publicity of the company, not only in the Philippines but globally, as it puts the country among the major generators of solar power among developing countries.

The plant's 1 MW capacity consists of 6,480 Sharp ND-Q7E6Z PV modules/panels designed to provide up to 1,500 MWh of electricity annually. The solar PV modules are manufactured by Sharp Japan with inverters manufactured by Sansha and all other components made locally.

The PV plant of CEPALCO started its commercial operations on 26 September 2004. After a period of three years of commercial operations, the International Finance Corporation (IFC) of the World Bank reported that the PV plant had operated with greater than expected annual

⁵ CEPALCO. www.cepenco.com.ph.

energy production. Since the start of its commercial operations, the plant has exported to CEPALCO a total of 4,169,100 kWh. At its current generating capacity, the PV plant supplies the equivalent requirement of no less than 900 CEPALCO residential customers.

The CEPALCO PV power plant generates 1.1 MW of power and is currently the 133rd-largest solar power plant in the world. The PV plant puts the Philippines at number nine among the countries in the world having the largest solar power plants. The Philippines is behind solar powerhouse Germany (which has 64 out of the top 100 largest solar power plants), Portugal, Spain, Japan, the US, Italy, the Netherlands and South Korea.

6.10.2 Project Cost of the PV Plant

The total project cost of the PV plant of CEPALCO is about US\$8 million funded under the Global Environment Facility (GEF) through the International Finance Corporation (IFC) including the US\$4 million grant from the World Bank. The GEF support is a loan that turns into a grant after five years of successful operations of the plant by CEPALCO. The co-financing component of the project from CEPALCO is US\$3–4 million.

According to the IFC, the purpose of the project was to demonstrate the effectiveness of solar PV (through a conjunctive-use application) in addressing distribution capacity issues. The IFC funds were used to build a 1 MW distributed generation solar PV plant, which is integrated into the 80 MW distribution network of CEPALCO, and operated in conjunction with an existing 7 MW mini-hydro electric plant. The plant has operated without incident since its inauguration in 2004. It appears to have been successful in proving solar PV to be an effective and technically reliable technology to address peak-load energy supply issues. The IFC reported that the solar PV plant operated by CEPALCO is a strong technical case as the project has resulted in a significant reduction in greenhouse gas emissions.⁶

The PV project is categorised by the World Bank's IFC as a Category B project according to the Procedure for Environmental and Social Review

⁶ World Bank International Finance Corporation (IFC) Project No. 502486

of Projects, because a limited number of specific environmental and social impacts may result, which can be avoided or mitigated by adhering to generally recognised performance standards, guidelines or design criteria. The project was funded in the context of technical, environmental and social information submitted by the company.

6.10.3 Generation Cost of the PV Plant

The PV power plant is a project of CEPALCO as part of its investment. As such, and having no separate organisation or personnel for the PV plant itself, the generation cost of the PV facility on a per watt or kilowatt basis is somehow difficult to compute or estimate and is confidential. As a commercial organisation, however, it is presumed that the operation of the PV facility is deemed to be profitable, given the fact that the project is to be replicated on a larger scale.

6.10.4 Non-Energy Benefits from the PV Plant

The electrical energy output of CEPALCO's PV plant may be considered small compared with other sources like large-scale hydropower plants and petroleum-based power plants. However, the contribution of the PV plant to the climate change initiatives is substantial. The solar PV plant of CEPALCO is expected to displace 24,000 tonnes of CO₂ over its lifetime.

Being one of a kind, CEPALCO's PV plant has already been visited by over 13,000 students and visitors, both local as well as foreign renewable energy enthusiasts, since it started operations.

The facility was even visited by the judges of the Court of Appeals in the hope that the agency could consider the project one of its models or inputs in the construction of its upcoming building.

6.10.5 Energy Supply Mix of CEPALCO

CEPALCO is making every possible effort to improve the company's independence from its major electricity supplier (NPC) and this is supported by the fact that the company has now four sources of power

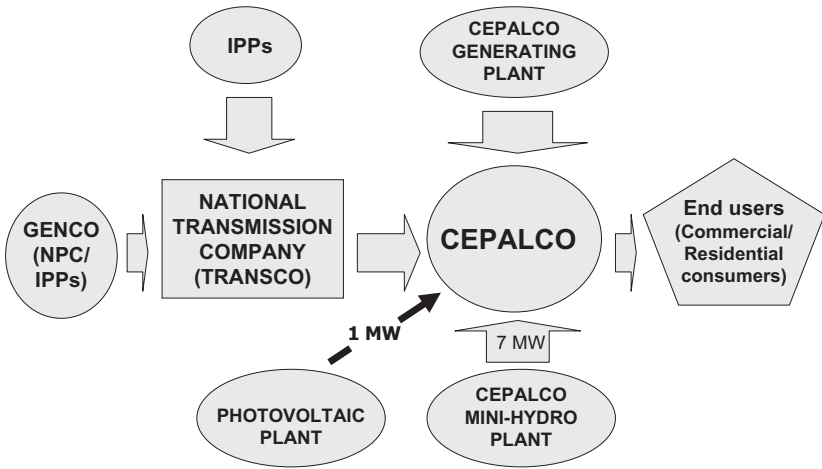


Figure 6 CEPALCO Energy Sources

(see Figure 6), three of which are from their own power plants. The entrepreneurial decision of the management of CEPALCO to venture into the PV project resulted in a variety of energy sources and flexibility. The energy supply mix of CEPALCO is shown in Figure 6. CEPALCO sources its power externally (from NPC/TransCo Mindanao grid) and also internally, from its own electricity-generating facility, mini-hydro plant and the 1 MW PV facility.

6.10.6 Expansion of the PV Plant

Given the positive and encouraging experience from the existing PV facility, CEPALCO now plans to embark on an even larger solar park within its service territory. The envisioned solar park shall make use of a 30-hectare lot within the First Cagayan de Oro Business Park in Villanueva Oriental, some 30 minutes east of Cagayan de Oro City, its base of operation.

A feasibility study of the proposed PV plant expansion indicates that it will be able to supply the CEPALCO distribution network with no less than 14,000,000 kWh of electricity annually, which is equivalent to no

less than 30,000 barrels of fuel oil per year. The proposed PV plant, with a total installed capacity of at least 10 megawatt-peak (MWp), shall be constructed over a period of at least five years and shall use the best available solar technology in the market. The phased-in construction strategy will enable CEPALCO to capitalise on the increasing efficiency and decreasing costs of solar cells which currently command no less than 60 percent of the PV plant's installed costs. It will also cushion the impact of generation costs on CEPALCO's customers.

If implemented according to plan, the first phase of the proposed 30-hectare solar park shall be commissioned by 2012 to augment the expected shortfall in firm capacity in the Mindanao grid.

6.11 NORTHWIND POWER DEVELOPMENT CORPORATION (NPDC)

The Philippines has been found to have a potential wind power of 76,600 MW, leading other wind power-producing countries such as Germany (14,000 MW potential wind power), Spain, the US (6,000 MW each), Denmark (3,000 MW) and India (2,100 MW). A wind mapping study conducted by the United States National Renewable Energy Laboratory has found Bangui Bay in Ilocos Norte to be one of the areas across the country where 10,000 km² of windy land exists with good to excellent wind resource potential.

The NorthWind Power Development Corporation (NPDC) is a relatively new business organisation involved in power generation, capitalising on wind potential in the Bangui Bay off Ilocos Norte in Northern Luzon. The wind farm project in Ilocos Norte was drawn up in 1996 though a wind resource analysis and mapping study conducted for the Philippines by the NREL. The study showed that various areas spread around the Philippines are receptive to wind power installations. These areas include Bangui and Burgos towns in Ilocos Norte, Batanes and Babuyan islands also north of Luzon and the higher interior terrain of Mindoro, Samar, Leyte, Panay, Negros, Cebu, Palawan and eastern Mindanao.

The NPDC took advantage of the wind power potential of the country, particularly the Ilocos region, by investing in the first wind farm in

Table 4 Specifications of NorthWind Power System

Turbine’s hub height	— 70 meters
Blade length	— 41 meters
Rotor diameter	— 82 meters
Windswept area	— 5,281 sq. m.
*** Ground level to center of nacelle	
The turbine are oriented facing the sea, effectively eliminating windbreaks and achieving terrain roughness of class 0.	
Annual generation capacity	— 74,482 MWh
Wind turbine arrangement	— Single row
Spacing	— 326 meters
Orientation	— North
Prevailing wind direction	— Northeast

Source: NorthWind Power Development Corporation, Makati City, 2010.

the country and in Southeast Asia. The wind farm established by the NDPC in Bangui, Ilocos Norte, uses wind turbines arranged in a single row stretching along a 3 km shoreline off Bangui Bay facing the South China Sea. The wind farm uses 1.65 MW Vestas V82 wind turbines supplied by Vestas Asia Pacific A/S, the leading supplier of wind turbines in the world. The turbines are onshore and arranged in an arc spaced about 326 m apart. Other technical details of the wind turbines are shown in Table 4.

Harnessing the strong winds coming from the north-northeast of the country, the wind farm is the largest wind power project in Southeast Asia. A first in Southeast Asia, the wind power plant is now comprised of 20 turbines, each standing at 70 m or equal to the height of a 23-storey building. The wind farm can generate a maximum capacity of 33 MW. The company is considering another 40 MW wind power project in Cagayan province, also in Northern Luzon, in the next two years.

The first phase of the project started with 15 wind turbines in 2000 with an aggregate capacity of 25 MW and a 69 km transmission line to Ilocos Norte Electric Cooperative in Laoag City. In June 2008, the NPDC added five more turbines, raising the wind farm’s capacity to 33 MW.

6.11.1 Funding the NPDC Project

Initially, the funding that was provided by the NPDC was for five turbines, which is equivalent to a capacity of 8 MW. Eventually, the Danish International Development Agency (DANIDA) partially funded the first phase of the Bangui Bay project. All 15 wind turbines under the Phase 1 project are connected to the Luzon grid, and have been delivering power to Ilocos Norte Electric Cooperative. The second phase comprising an additional five turbines is funded by an additional investment by the NPDC, amounting to US\$13 million, and the total project cost amounts to US\$50 million.⁷

In all, DANIDA funded \$29.35 million of the \$50-million project cost through a zero-interest mixed-credit facility, which was complemented by a guarantee from the Philippine Export-Import Credit Agency. About \$10.5 million came from grants, while the balance was put in by NPDC shareholders. NorthWind's major shareholders include Moorland Phils., Phildane Resources Corp. and Fabmik Construction and Equipment Corporation.

6.11.2 NPDC Expansion and Creation of a New Subsidiary

To handle its expansion project, the NPDC has created a new subsidiary to take charge of its expansion programme in the Cagayan area, worth \$95 million. The NPDC put up a 40 MW wind farm project in Aparri, Cagayan, in 2009. The company is bullish in expanding their capacity with the passage of the Renewable Energy Act. For its expansion projects, the NPDC may tap the Danish government and other investors and creditors for the Cagayan wind project. The company also expects to tap Japanese and Spanish investors and creditors. Former Energy Secretary Vincent Perez, now of Alternergy, said with the growing interest in renewable power sources, an increase in foreign investment is projected for renewable projects in emerging countries. Perez, who is Chairman of energy advisory firm Merritt Partners and Managing Director of renewable power developer Alternergy, said that investments in renewable energy sources such as wind, hydro and solar power are expected to pick up. After

⁷ www.northwindpower.com.

an extensive road show in the US, Middle East and Europe, Perez's group were able to source \$150 million in an equity commitment to Alternergy from foreign investors primarily, for wind power development.

6.11.3 Sale Price of NPDC Power Output

The only market for now for the electricity output of the NPDC is Ilocos Norte Electric Cooperative (INEC) which has an existing Renewable Energy Sales Agreement (RESA). The distribution system of the NPDC's wind farm is embedded in the INEC grid and thus negates the power-delivery charges of the National Transmission Corporation (TransCo), which is considered a saving for INEC. The NPDC has a pending accreditation with the WESM where, other than INEC as a market, excess power output of the NPDC can be sold in the spot market being administered by the WESM.

As stated in the RESA, the NPDC will extend a 7 percent discount to INEC benchmarked against the rate of the National Power Corporation. This pricing scheme will reduce the power charges being paid by Ilocos residents. The wind energy produced by the Bangui wind farm of the NPDC translates to a 7 percent reduction in power costs from prevailing rates or a 5 percent discount of the weighted average price in the Wholesale Electricity Spot Market.

On top of reduced power rates, the wind farm will pave the way for the entry of additional investment opportunities whose operations depend on good power quality. The province's unstable power would force the Coca-Cola Bottling Company to avoid switching to INEC's power line due to low voltage between 5 pm and 10 pm. The bottling company is one of the few huge power-dependent companies in the province.

The Bangui Bay wind farm project sells electricity to Ilocos Norte Electric Cooperative and it now provides 40 percent of the power requirements of the province of Ilocos Norte, gradually increasing to 70 percent once Phase 2 is completed.

6.11.4 Carbon Credits for the NPDC

The electricity that the NPDC generates will displace greenhouse gas emissions such as carbon dioxide by approximately 65,000 tonnes per year. It is the first to be registered with the executive board of the Kyoto Protocol to the United Nations Framework Convention on Climate

Change. When carbon credits are duly accredited and issued the appropriate Certified Emission Reductions (CERs), the same can be traded in the carbon market. CERs are the carbon offset credits generated under the UN Clean Development Mechanism for emissions reduction investment in developing countries. CERs are bought by developed countries and their firms to count towards their own domestic emissions targets.

The price of Certified Emission Reductions in the global carbon markets ranges from US\$10 to US\$30 per tonne. In Europe, the carbon price was around €9.60 as of December 2008.⁸

If the CER of the NPDC is sold at a low market price of US\$10 per tonne, the annual carbon equivalent production of the NPDC translates to US\$650,000 per year or estimated to be US\$6.5 million over a 10-year period.

The ERC lauded the NPDC for investing in eco-friendly renewable energy projects for cheaper electricity services as well as a clean and green environment. With its compliance to the technical, financial and environmental standards set by law, electricity consumers in the area are assured that the ERC has carefully reviewed the safety and reliability of the NPDC's wind farm facilities.

6.11.5 Local Government Unit's Efforts Paid Off

The electricity supply from the NPDC was a welcome development by the local government unit and the provincial officials. Already, business developers have started discussing potential industries with the provincial government, ranging from glass to cement plants in eastern Ilocos Norte towns. It was Ilocos Norte Governor Ferdinand Marcos, Jr., who, as a congressman back in the 1990s, aggressively pursued the development of a power plant in the province. The governor had previously disclosed that Ilocos Norte had let loose potential investors in the past due to poor power quality in the province. Governor Marcos had always complained then for the NPC to do something about its power service, but to no avail. At present, Ilocos Norte is most affected during power outages because it is found at the end of the power grid which comes all the way from Bauang, La Union.

⁸ Carbon Positive. <http://www.carbonpositive.net/viewarticle.aspx?articleID=137>.

6.11.6 Contribution of the NPDC to the Grid

The NPDC's aggregate installed capacity of 33 MW is only 0.33 percent and 0.25 percent of the Luzon grid and the national grid, respectively. This share provided by wind energy in terms of generation capacity is way below the current limit set by the ERC. These figures may be considered minuscule but when one looks at the fact that the electricity production of the NPDC supplies 40 percent of the power needs of INEC with the potential to supply up to 70 percent of the province's needs, the contribution of the NPDC is substantial.

The ERC determines the compliance of a generating company to the market-share limitations by determining the maximum load-carrying capability of the facility operated by the generation company on a yearly basis. To prevent anti-competitive behaviour, the ERC ensures that an electricity generation company does not exceed the market share limitations in the grid where it operates (set at 30 percent) and in the national grid (set at 25 percent).

6.12 ILOCOS NORTE ELECTRIC COOPERATIVE

Ilocos Norte Electric Cooperative is a consumer-level electrical power provider in the northern-most province of Luzon province, which once sourced its electricity from the National Power Corporation. INEC has a power demand of 32.42 kW (substation capacity) with a load factor of 58.76 percent. As of 29 February 2008, INEC has energised all 21 municipalities of Ilocos Norte, including Laoag City and City of Batac, posting a record of 100 percent energisation of the province and 100 percent of the province's 557 villages (barangays).

The electricity cooperative used to source its power from the Luzon grid of the NPC which provides electrical power all over the Philippines. In 2001, INEC linked up with the NorthWind Power Development Corporation — the first wind power producer in the Philippines. At the time of initial link up in 2001, the NPDC had a rated capacity of 24.75 MW from its 15 wind turbines. This capacity increased to 33 MW with the addition of five more turbines. The Bangui Bay wind farm of the NPDC generates power at wind speeds averaging 7 m/s. The NPDC's

wind farm can help reduce INEC's system loss by improving its stability and electricity quality and reinforcing its transmission system through a 50 km, 69,000 V line constructed by the NPDC.

6.12.1 Energy Supply Mix of INEC

The availability of wind power-based electricity provided by the NPDC made it possible for INEC to diversify its power sources outside the NPC and its own mini-hydropower plant. The energy supply mix of INEC as of the end of 2005 is shown in Figure 7. From zero contribution in the early part of 2005, the contribution of wind power rose to 25 percent by year-end 2005. As power from INEC sourced from wind resources increased to 25 percent, electricity power sourced from the NPC was reduced to only 71 percent from 93 percent in early 2005, as shown in Table 5.⁹

The details of the energy supply mix of INEC are shown in Table 5. The energy sourced from its own mini-hydropower plant appears to be fluctuating, and in fact reducing in terms of share. Clearly increasing in terms

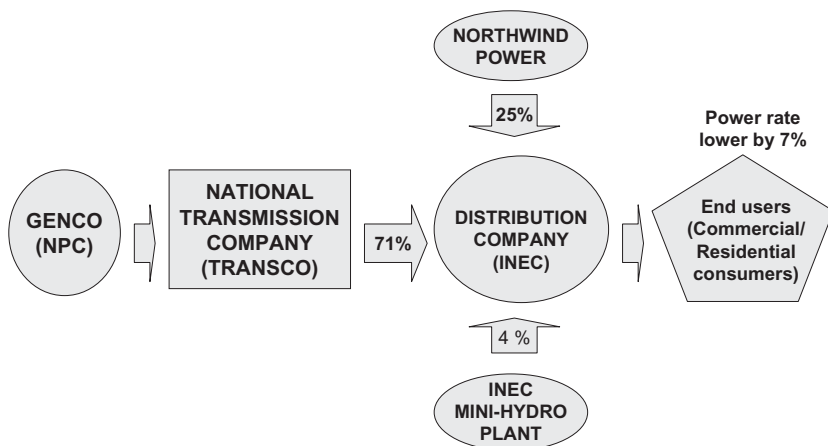


Figure 7 The INEC Energy Supply Mix (As of December 2005)

⁹ Energy Regulatory Commission. www.erc.gov.ph. ERC Case No. 2005 019 RC, p. 9.

Table 5 Energy Supply Mix of INEC (2005)

Month	Mini Hydro (kWh)	% share	NPC (kWh)	% share	NorthWind (kWh)	% share	Total (kWh)
Jan	906,220	7%	11,961,974	93%	0	0.00%	12,868,194
Feb	587,200	4%	12,743,614	96%	0	0.00%	13,330,814
Mar	657,670	5%	11,943,508	95%	0	0.00%	12,601,178
Apr	450,060	3%	15,762,013	97%	20,789	0.13%	16,232,862
May	249,180	1%	15,660,217	93%	849,165	5.07%	16,758,562
Jun	201,600	1%	14,500,913	91%	1,268,114	7.94%	15,970,627
Jul	138,600	1%	13,738,983	87%	1,850,940	11.77%	15,728,562
Aug	195,300	1%	13,487,345	87%	1,769,442	11.45%	15,452,087
Sep	174,300	1%	12,795,817	86%	1,826,552	12.34%	14,796,669
Oct	137,600	1%	11,176,063	78%	3,037,368	21.16%	14,351,031
Nov	319,200	2%	11,497,740	76%	3,404,884	22.37%	15,221,824
Dec	621,600	4%	9,930,433	71%	3,442,196	24.60%	13,994,229
Total	4,638,530		155,198,620		17,469,450		177,306,600
Average		2.75%		87.51%		9.74%	

Source: Energy Regulatory Commission (www.erc.gov.ph)

of magnitude and percentage share is the energy supplied by wind power through the NPDC, indicating the critical role played by wind energy technology.

6.12.2 INEC Benefits from Wind Power

It is indeed a blessing for INEC to be the beneficiary of the electricity from wind sources, owing to the following benefits:

- a) It is a source of electricity cheaper in acquisition costs by about 7 percent than its usual source of energy (i.e. National Power Corporation). This lower rate is passed on to the consumers of INEC's electricity power.
- b) Savings on the part of INEC on account of transmission costs usually budgeted or paid to TransCo. The NPDC's power output is

embedded into the INEC transmission system, thus negating TransCo fees. The connection and power sourcing from the wind farm project generated savings of approximately \$2.54 million for the consumers of INEC in 2006 and 2007. The savings occurred since the NPDC was embedded in the INEC grid and thus negated the power-delivery charges of TransCo.

- c) The assurance of a localised energy source with the potential to distribute up to 70 percent of INEC's power demand, which hopefully means more long-term monetary benefits to INEC and its customers.
- d) The energy from the wind farm of the NPDC supplies the energy needed by INEC, thus addressing the voltage fluctuation problem in the INEC service area which in the past they complained about.

6.12.3 INEC's Concerns about the Spot Market

The EPIRA called for the establishment of the Wholesale Electricity Spot Market wherein a fraction of the electricity requirements of electricity cooperatives have to be purchased from the spot market through electronic bidding. In its initial implementation, INEC has applied to be one of the pilot electricity distribution utilities and the first electricity cooperative to participate in the WESM. However, INEC appears not to be so excited about this possibility.

As per the WESM Rules, electricity cooperatives are required to purchase at least 10 percent of their energy requirements from the spot market. At present, INEC's energy requirements are purchased from the NPC and the NPDC as well as INEC's own mini-hydropower plant. During the trial operation by INEC personnel with the WESM system, it was observed that there are times when the price of electricity in the spot market is higher than the NPC price but there are also times when the price of electricity is lower. In the WESM operation, distribution utilities are required to submit their bids for their energy requirements one hour ahead, thus the price of electricity that INEC purchases from the spot market will change every hour. To monitor closely the prices of electricity in the spot market, there is a need to man the INEC Energy Trading Office 24 hours a day. This project is a new concept in the Philippine electricity industry

but it aims to reduce the rate of electricity because of the competitive bidding. To date, several assets of the NPC have already been privatised, the most recent of which is Magat Hydroelectric in the province of Isabela acquired by the Aboitiz Group of Companies. Given this scenario, it is possible that the 7 percent discount rate from the NPDC and the spot market prices as well as renewable energy sales agreements with the NPDC may have complications that can potentially jeopardise the concern of INEC to serve its customers at affordable prices.¹⁰

According to the ERC legal office, there is now a legal case filed by the NPDC regarding the refusal of INEC to settle the entire bill submitted by the NPDC to INEC.¹¹

6.13 MONTALBAN METHANE POWER PROJECT

Other than the solar photovoltaic plant of CEPALCO and wind-powered generation system of the NPDC, the Philippines takes pride in the methane-powered facility that is connected to the distribution utility (MERALCO). In previous years, the country had a number of biogas/methane projects considered commercial in scale but none of these projects was ever connected to the electrical grid. The Montalban Methane Power Corporation (MMPC) is a project of First Balfour, Inc., one of the power/energy companies belonging to the Lopez Group. The project makes use of the garbage from Metro Manila that is dumped at the landfill facility located in Montalban, Rizal. The MMPC has secured an agreement with the local government of Rizal province to build the country's first waste-to-energy power plant at the Rodriguez (formerly Montalban) landfill site. The MMPC will capture the landfill gas or methane from the 14-hectare landfill to produce enough electricity to provide 15,000 households with power. The methane-powered facility began operations in July 2008 and President Gloria Macapagal Arroyo launched the project.

The project is a build-own-operate (BOO) project and Monark Equipment Corporation (MEC) was commissioned to put up the power plant for the project. First Balfour will be responsible for the installation of nine units

¹⁰ Ilocos Norte Electric Cooperative. <http://www.inec.gov.ph>

¹¹ Phone conversation with Atty Adriano of ERC Legal Office, 23 March 2009.

of generator sets with 2 MW capacity each but derated at 850 kW using methane as fuel. The project scope included construction of the powerhouse building, equipment foundations, piping works for fuel/gas header, condensate and cooling water, cabling works, small power and lighting, plumbing, ventilation system and monitoring system.¹²

Methane-based projects in the Philippines are not really new but this particular scale and type of project is the first of its kind in the Philippines and one of the largest in Asia. With an estimated construction cost of \$30 million, it is expected to generate 15 MW of power over 10 years. MMPC officials said that at least 1,500 metric tonnes of garbage would be needed to sustain the plant's operations. Increasing the volume of trash to 2,500 metric tonnes can extend production to 10 years instead of just five years.

The company plans to sell its power to Manila Electric Co. and the Wholesale Electricity Spot Market. The project expects to generate an income of US\$50 million. In addition, it can earn more once it qualifies as a Clean Development Mechanism project under the United Nations Kyoto Protocol, and will generate at least 500,000 Certified Emission Reductions.

The methane gas facility of the MMPC follows the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC) initiative and provides carbon credits for developed countries under a category of projects that reduce emissions in developing economies under the Clean Development Mechanism. Furthermore, the power plant project is a candidate for Gold Standard Clean Development Mechanism status.

6.14 MORE WIND POWER PROJECTS

San Carlos Wind Power Corporation, a Filipino-Danish joint venture, is investing P2.987 billion for the construction of a 30 MW wind power project. This is the third new and renewable energy project approved by the Board of Investments. The project will be located around Mount Malindog in Barangays, Linubagan and Prosperidad, San Carlos City, Negros Occidental, which is 700–800 m above sea level. The Board of Investments

¹² First Balfour. www.firstbalfour.com.

approved pioneer status for the project, it having met the minimum investment requirement for wind technologies at \$1.25 million.

For the development of the project, the partnership between Smith Bell Wind Technologies, Inc., and Global Renewable Energy Partners was put together to establish and organise the San Carlos Wind Power Corporation. The San Carlos wind farm will comprise 16–20 wind turbine generators each with a capacity of 1.5–2 MW, with a total rated capacity of 30 MW. When operational, San Carlos intends to sell the generated power to the electric distribution facilities in the Negros and Panay sub-grids. Of the total cost, the firm intends to spend P1.7 billion for the acquisition of turbines, while the rest will be used for the construction and development of the facilities. The bulk of the cost at P2.2 billion is expected to come from loans, while the rest from equity. The project is also seeking Danish foreign aid in the form of grants on interest payments, and from European banks.

San Carlos is the third wind power project to be registered with the Board of Investments. The other two projects, also granted with pioneer status by BOI, are the 40 MW project of Northern Luzon Wind Power Project of PNOC Energy Development Corporation (PNOC/EDC) and another project by NorthWind Power Development Corporation.

6.15 WIND POWER CONTRACTING ROUND

To further entice investors in renewable energy technologies, the Department of Energy has employed creative means fashioned after the oil concession system. The DOE launched the Wind Power Contracting Round that offered 16 wind sites. Three companies that were earlier awarded pre-commercial contracts (PCCs) to harness the country's wind energy are now conducting actual wind assessments under their respective work programmes. Philippine Hybrid Energy Systems, Inc., was awarded three PCCs for wind projects in Marinduque; Baleno, Masbate; and Tablas, Romblon; with a combined capacity of 30 MW. Trans-Asia Renewable Energy Corporation was also awarded a contract for a potential 30 MW wind project in Sual, Pangasinan, and San Carlos Wind Power Corp. for a 25 MW wind farm in San Carlos City, Negros Occidental.

Companies that bid for the 11 other sites are now in the process of securing PCCs from the Department of Energy.¹³

6.16 FINANCIAL SUPPORT MECHANISM FOR NRETS

With many renewable energy technologies now in the mature and commercial stage, particularly solar and wind technologies, the next constraints and obstacles to their widespread use are more financial and economic considerations.

It is therefore important to provide a financial support scheme and incentive to address investors' concerns. It is along this premise that renewable energy development programmes in the Philippines have put substantial emphasis on the financial support scheme, particularly on credit availability, as well as incentives in the form of duty-free imports and tax holidays. Aside from the pre-operating incentives, renewable energy projects in commercial operations are given additional incentives when the project is covered by the Incentives Act or the Investment Priorities Plan (IPP) being administered by the Board of Investments.

These concerns are given even more emphasis in the form of financial support schemes, as well as incentive measures enshrined under the Renewable Energy Act of 2008. The following are some elaborations in this regard.

6.16.1 Financial Support Under the Renewable Energy Act

To encourage investors to venture into renewable energy projects, the Renewable Energy Act made specific provisions on financing commercial projects under Section 29 as follows:

Section 29. Financial Assistance Program. — Government financial institutions such as the Development Bank of the Philippines (DBP), Land Bank of the Philippines (LBP), Phil-Exim Bank and other government

¹³ Department of Energy, 2008.

financial institutions shall, in accordance with and to the extent allowed by the enabling provisions of their respective charters or applicable laws, provide preferential financial packages for the development, utilisation and commercialisation of RE projects as duly recommended and endorsed by the DOE.

The Development Bank of the Philippines has financing packages under its Wind Energy Financing Program, RE Project Preparation Revolving Fund, Rural Power Project for Type A Beneficiaries, Rural Power Project for Type B Beneficiaries and CDM Initiatives.

Philippine Export-Import Credit Agency (PhilExim), for its part, provides loan guarantees to selected wind power projects such as the Bangui Bay wind farm.

6.16.2 Available Financing from the Private Sector

Even prior to the enactment of the Renewable Energy Act, the commercial banking system in the Philippines made available commercial loans and financing schemes, given the fact that products of energy-based projects are always in demand.

It is a matter of practice among private commercial banks to support and finance renewable energy projects that are bankable or whose cash flow and income stream support the business venture.

6.16.3 Financial Support from External Parties

Large-scale or commercial renewable energy-based power generation technologies are expensive and come with techno-economic apprehensions. Hence, the support of external parties, both from bilateral and multilateral sources, is considered of great help.

Other than the availability of domestic funds from the banking and financial system, international or foreign-based sources also offer financial assistance such as the Global Environment Facility (GEF) and International Finance Corporation (IFC) of the World Bank which provided the funds for the photovoltaic power plant of CEPALCO in Cagayan de Oro City.

The United Nations Development Programme GEF also offered assistance in project preparation and in securing loan guarantees for the project.

Developed countries and donor organisations noticed the growing energy demand, hence the Asian Development Bank (ADB) and its development partners are setting up a facility that would provide seed capital for renewable energy and energy efficiency projects in the Asia-Pacific region.

The ADB said it would develop the Seed Capital Assistance Facility that would be initially funded by a \$4.2-million grant from the GEF, a global partnership established in 1991 to help developing countries fund projects that protect the global environment. The Seed Capital Assistance Facility would be jointly managed by the ADB and United Nations Environment Programme. The ADB said the facility would

provide technical assistance to private equity fund managers and entrepreneurs to develop sustainable clean energy funds and financing for the early stages of such projects, share in the costs of development and transactions, and encourage taking riskier portfolios through a seed capital return enhancement offered on a per-project basis.

It further noted that the facility would increase access to financing at the early stages of sustainable energy enterprises and projects around the Asia-Pacific region. With increased experience among financiers in investing in small-scale renewable energy and energy efficiency projects, mainstream energy investors would be encouraged to invest more in clean energy enterprises and projects.¹⁴

6.17 TECHNICAL AND ECONOMIC EFFICIENCY

Renewable energy technologies in general suffer the perception of relatively low technical efficiency and hence low economic/financial efficiency. The technical efficiency of a solar PV system stands at just a little above 10 percent, with wind energy conversion systems limited by the

¹⁴ Asian Development Bank. www.adb.org.

Betz coefficient that leads to a maximum theoretical efficiency below 60 percent. Adding demerit to this low technical efficiency is the fact that these systems produce a direct current (DC) type of electricity as opposed to the alternating current (AC) type demanded by grid and system loads. Outputs of solar PV and wind power systems have to be converted to AC electricity, thus increasing initial system costs and thus affecting financial/economic efficiency computations even though the inputs (sun and wind) are available for free.

The policy of the Philippine government, as enshrined in the Renewable Energy Act and other laws earlier enacted provide a venue for investments deemed attractive for energy system generators and providers. Outputs of renewable energy systems can be connected to the regional electrical grids, hence allowing the supply of NRET-generated power to be distributed or sold elsewhere too far away from the point of power production — realities which could have been too costly for alternative/renewable power generation systems due to technical losses. This interconnection scenario, therefore, takes care of the limitations and low competitiveness of the NRETs vis-à-vis the traditional petroleum-based power generation system. It is in this light that renewable energy-based power generation systems become somehow competitive as they can even serve to balance voltage instability in some areas served by the grid, as in the case of the situation of Ilocos Norte province.

With the output of the PV plant of CEPALCO forming part of the power supply and distribution lines of the company, as well as the electric power output of the NPDC embedded in the distribution grid of INEC, the question of low technical efficiency is now a foregone conclusion as, in fact, the outputs of these facilities serve as voltage stabilisers besides the financial/economic benefits they provide, on top of saving some operating expenses on account of savings from wheeling charges from TransCo.

6.17.1 Margin Advantage for NRET Electricity

Unlike tariff rates charged by distribution utilities and electric cooperatives which are explicitly regulated under the provisions of the EPIRA and other ERC regulations, electricity outputs or rates of power generators from renewable energy sources are treated differently though they are

regulated under the rate-setting mandate of the ERC. As such, the profitability of operations of renewable energy-based companies is not controlled or curtailed, and hence is very attractive and motivating for investors. It can be said then that, potentially or in reality, financial/economic attractiveness or efficiency is expected to be relatively high on account of the expected higher return on investment levels that can be set as compared to electricity distribution businesses, a scenario that favours the investors in NRET-based projects.

This notion is explained by the current situation of both CEPALCO and INEC. The PV system of CEPALCO is part of its power plant's distribution utility as well as its generating utility. The company owns and operates hydro and PV plants whose output is part of the electricity it supplies to its institutional/residential consumers. This being the case, CEPALCO is not necessarily required to divulge the costs and returns of the PV generation facility, hence there is really no way of knowing whether the price charged by the PV facility is too high or not. The same is true with the electric power from the NPDC which is sold to INEC by way of an Energy Sales Agreement (ESA). The ESA ensures for the NPDC a market outlet and guaranteed price benchmarked against the NPC rate at a discount rate of 7 percent. It was INEC which filed the petition with the government's Energy Regulatory Commission (ERC) and the ESA between INEC and NPDC that is valid for 20 years is deemed clear to both parties. When the NPC is fully privatised, the same discount rate will apply but benchmarked against the going electricity rate in the province as the buyer of NPC interest inherits the provisions in the ESA. What is not factored in the determination of the cost of electricity sold by the NPDC to INEC is the money equivalent of the CERs which the NPDC can sell to the carbon market. This is somehow a grey area, which in the view of the author is favourable to the renewable energy generators like CEPALCO and the NPDC.

A very important aspect and motivating factor in constructing and operating a renewable energy-based company is that aside from sales from electricity, the generator can earn a substantial income from the sale of carbon credits if the firm is duly certified by appropriate bodies to be qualified for Certified Emission Reductions. These credits are substantial and more than enough to offset whatever inefficiencies NRET technologies

may have. This appears to be an advantage that provides economic or financial efficiency and advantage as it steps up early recovery of investment apart from helping the host country improve its contribution to the Kyoto Protocol.

6.18 MORE INVESTMENTS IN RENEWABLE ENERGY NEEDED AND EXPECTED

Envisioning a goal of having a 4,500 MW capacity of new renewable energy in the next 10 years, the renewable energy sector will need some \$8.5 billion in fresh investments. This investment required is an estimate on the conservative side. Director Mario Marasigan of the Department of Energy's Energy Utilization and Management Bureau expressed confidence saying that investors would find the renewable energy sector quite lucrative, particularly when the Implementing Rules and Regulations of RA 9513, or the Renewable Energy Act of 2008, are finalised.

Right now, the DOE may not have an exact handle on the number of investors that are seriously interested in investing in renewable energy projects. What the department knows at this point is that the renewable energy projects are most attractive to potential investors. Most of these investors are looking at wind, hydro, geothermal and biomass, including solid waste-to-energy concepts, and biofuels. At least one company is interested in ocean energy thermal conversion.¹⁵

The finalisation of the Implementing Rules and Regulations of the Renewable Energy Act should prompt potential investors to finalise their investment plans in the sector. The Implementing Rules and Regulations are expected to be completed by June 2009, ahead of the July deadline set by the law. The law is widely expected to spur investments in the renewable energy sector, due mainly to incentives that are offered to potential investors. Some of these incentives are exemptions from tariff duties and zero-rated value-added tax for the importation of machinery and equipment for the first 10 years of an operating contract, as well as tax credit on domestic capital equipment and services.

¹⁵ Ho, A. "\$8.5B in renewable energy investments needed", *Philippine Daily Inquirer*, 23 March 2009.

Special realty tax rates will also be imposed on equipment and machinery to be used for renewable energy development. An income tax holiday will also be granted to potential investors for the first seven years of operation.

6.19 SUCCESS FACTORS IN THE PHILIPPINE NRET PROGRAMMES/PROJECTS

Whatever experiences and successes as well as failures the Philippines may have had in NRET matters is a combination of products and results and political will in developing the continually updated National Energy Plan. This would have been impossible were it not for a variety of legislations and administrative provisions to support the attainment of the vision set forth in the energy plan.

The global development and volatility of the global markets for petroleum products was a dilemma but in some ways served as a reminder of the need to continually pursue efforts in developing the potential of renewable energy sources as a component of the projected generation capacity and eventually the energy supply mix. The efforts made in the area of commercialising the gasification technology, commercial experiences in biogas technology, the progress made in developing coconut-based fuel from a pure CNO-diesel fuel mix to coconut methyl esters (biodiesel), the initial failures in small-scale wind power projects as well as the pilot projects in the area of PV all contributed to the initiation of and commercial-scale ventures in solar and wind power projects that are now generating megawatt-level capacities already connected to the grid system.

The following factors may have greatly contributed to the commercial use and megawatt-level power generation projects using renewable energy sources:

- a) Availability and abundance of natural resources (e.g. solar, wind, biomass).
- b) Political will and government policy pronouncements on private sector participation in the area of power generation, resulting in a privatised power generation system.

- c) Commitment to pursue research and development as well as promotional development efforts to popularise and commercialise the use of renewable energy sources.
- d) Existence of a number of laws and administrative interventions, principally incentive schemes, thus favouring investments and private business ventures in the power sector.
- e) Availability of foreign/local financing support schemes (e.g. loans and grants from DBP, LBP, IFC, DANIDA) to augment local financial limitations.
- f) Existence of guaranteed or captive markets as well as government assurance to ensure reasonable returns to private investors.
- g) Support of local government units in cementing the intents and purposes built into the national energy plan.
- h) External pressures in terms of volatile global markets and environmental concerns (e.g. Kyoto Protocol) that favourably offset the economic disadvantages of some renewable energy technologies.
- i) Existence of mature and commercial technologies using renewable energy sources.
- j) Willingness of local and foreign investors as well as concerned entrepreneurs who care about clean energy and environmentally friendly power generation technologies.

6.20 SUMMARY AND CONCLUSIONS

If there is any success in the development of renewable energy technologies in the Philippines resulting in the establishment of megawatt-level capacity power plants, this can be traced to a number of incentives and mandatory provisions of laws as well as a series of efforts made by the government commencing in the late 1970s to the present date. The variety of laws, for example the Investment Act, BOT Law, Biofuels Law, EPIRA, Clean Air Act, Ecological Solid Waste Management Act, and most recently, the Renewable Energy Act, are indications of the commitment of the Philippine government to make renewable energy take on a role in the country's energy generation capacity down to the energy supply mix. These efforts appear to have been well received by the private

sectors, such that ownership and management of power generation is now largely in the hands of the private sector. A number of investments have been made by foreign or international organisations, including the World Bank's International Finance Corporation which supported the CEPALCO PV project and DANIDA which partly financed the NPDC's wind power project.

The 33 MW production of the NPDC using the wind energy potential of Bangui in Ilocos Norte is the biggest in Southeast Asia and the first venture accredited with Certified Emission Reductions. Its connection to the electrical grid with a potential to supply up to 70 percent of the electricity demand of the province of Ilocos Norte is worth noting and encouraging for prospective investors. The company's plan to put up more wind generators of 40 MW in Cagayan province, also in Luzon, is proof that the wind energy conversion system is indeed a mature technology and one that is now tested successfully in the Philippines.

For solar energy technology by PV, the 1 MW solar PV plant is another first of its kind in Southeast Asia. It is also connected to the grid and is now playing a key role in supplying the electricity needs of the service area of CEPALCO. No less than the World Bank's IFC has given a positive endorsement to the project for its success. The plan of CEPALCO to put up a much bigger solar park capable of generating 10 MW is an indication of encouraging financial returns to the company.

Being a new project and unique in the sense that power generation is part of CEPALCO's business activities and with the RESA scheme to guarantee a market for the electricity output of the NPDC, the true costs and returns of the two NRET power plants (by CEPALCO and the NPDC) remain confidential, given that these organisations are private commercial ventures. Nonetheless, the expansionary attitude these companies have is indicative of a bright future for these ventures, given that outputs of their plants can be easily sold or disposed through the electrical grid system.

The annual climate change mitigation contribution of the three major projects mentioned is 65,000 tonnes of carbon equivalent for the NPDC. Throughout the project's lifetime, the MMPC expects to produce an equivalent of 500,000 tonnes with CEPALCO which stands to produce 10,000 tonnes equivalent. When traded in the carbon exchange market, it means additional income for the three companies which also means

compliance to the Kyoto Protocol on the part of the Philippines. Investment wise, it meant an investment of about US\$88 million for the three NRET-based power projects alone.

All three renewable energy projects (CEPALCO, NPDC, MMPC) connected to the electrical grid are supported by private investors with funding support from international financing institutions (e.g. IFC and DANIDA) and local investors as well. This is an indication that even without financial support from government financial institutions as mandated by the Renewable Energy Act, renewable energy projects connected to the electrical grid can take off, and in fact, the existing projects are expansionary ventures.

In the meantime, the full implementation of the Renewable Energy Act with its Implementing Rules and Regulations are now being discussed, and given the fact that the law mandates government financial institutions to make available its financial resources along with a variety of incentives to private investors, there is a reason to be optimistic for local and foreign investors, and the government as well.

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CHAPTER 7

THE LIQUEFIED NATURAL GAS (LNG) BUSINESS: FROM EVOLUTION TO REVOLUTION

Steve Puckett and Tony Regan

ABSTRACT

This chapter charts the history of liquefied natural gas (LNG) from its earliest discovery and evolution over a period of 50 years, through to its current phase of revolution, which has major implications for the size and profile of the industry. It concludes with an outlook for the industry to 2020.

7.1 INTRODUCTION

Natural gas liquefaction dates back to the 19th century when British chemist and physicist Michael Faraday experimented with liquefying different types of gases, including natural gas.

German engineer Karl von Linde built the first practical compressor refrigeration machine in Munich in 1873. The first liquefied natural gas (LNG) plant was built in West Virginia in 1912 and began operation in 1917. The first commercial liquefaction plant was built in Cleveland, Ohio,

in 1941. The LNG was stored in tanks at atmospheric pressure. The liquefaction of natural gas raised the possibility of its transportation to distant destinations. In January 1959, the world's first LNG tanker, The Methane Pioneer, a converted World War II liberty freighter containing five 7,000-barrel aluminum prismatic tanks with balsa wood supports and insulation of plywood and urethane, carried an LNG cargo from Lake Charles, Louisiana, to Canvey Island, United Kingdom. This event demonstrated that large quantities of LNG could be transported safely across the ocean.

Over the next 14 months, seven additional cargoes were delivered with only minor problems. Following the successful performance of The Methane Pioneer, the British Gas Council proceeded with plans to implement a commercial project to import LNG from Venezuela to Canvey Island. However, before the commercial agreements could be finalised, large quantities of natural gas were discovered in Libya and the gigantic Hassi R'Mel field in Algeria, which are only half the distance to England compared to Venezuela. With the start up of the 260-million-cubic-feet-per-day (MMcfd) Arzew GL4Z or Camel plant in 1964, the United Kingdom became the world's first LNG importer and Algeria the first LNG exporter. Algeria has since become a major world supplier of natural gas as LNG.

In 1970, the Marsa El Brega liquefaction plant came on stream in Libya and gradually other European countries and the US became LNG importers (Barcelona, Spain, in 1969; La Spezia, Italy, and Everett in the US in 1971; and Fos, France, in 1972).

7.2 EVOLUTION

The development of an LNG business in the Atlantic Basin was slow due to competition from cheaper US domestic and North Sea gas production and pipeline supply but the LNG business came of age with the development of an Asian market. Japan, with very little indigenous energy supply, was a major importer of oil and coal and was keen to gain access to natural gas. Tokyo Gas and Tokyo Electric opened the first Japanese LNG terminal at Negishi in 1969, followed by Osaka Gas's Senboku terminal in 1971. The first supply to Japan came from the Kenai plant in Alaska but an Asian LNG business was born when Brunei LNG brought on stream the first Asian LNG train in 1972.

Japan, Korea and Taiwan were all potentially large gas markets. Unlike Europe and the US they had no indigenous or piped supply and it was this factor that underpinned the rapid development of LNG in Asia. Indonesia brought on stream the Bontang LNG plant in 1977, followed by Malaysia LNG in 1983 and Australia's North West Shelf in 1989. The Bontang LNG facility was expanded to eight trains and, until the recent development of Qatar, was by far the largest LNG liquefaction plant in the world. Korea opened its first LNG terminal in 1986 and Taiwan in 1990, and when total sales of LNG hit 100 million tonnes in 2000, 73 percent was going into Asia (Figure 1).

Strong Asian demand and the potential of significant US demand led to another phase of LNG liquefaction development with Atlantic LNG in Trinidad and NLNG in Nigeria coming on stream in 1999, followed by Oman LNG in 2000.

Sales grew steadily but slowly, reaching 50 million tonnes in 1990 and 100 million tonnes in 2000. Gas price increases and technological

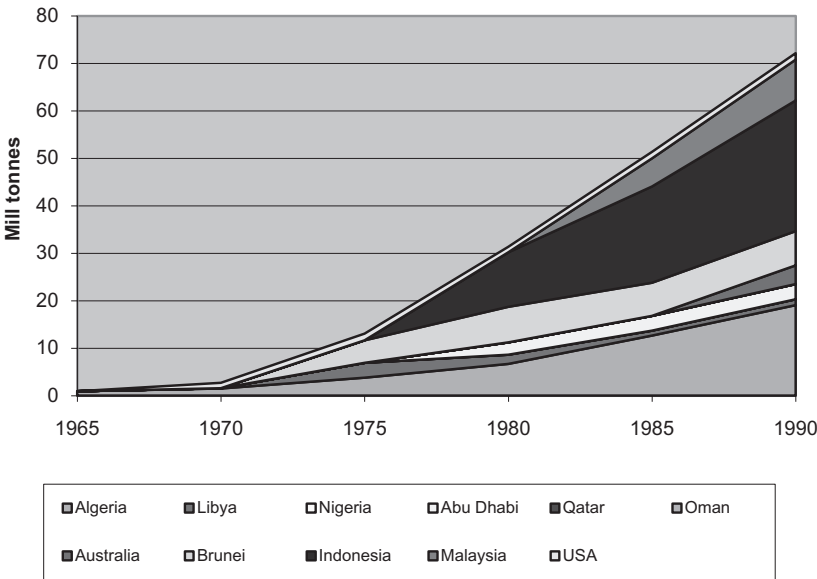


Figure 1 LNG Sales (Billion cubic metres) 1965–1990.

Source: Cedigaz.

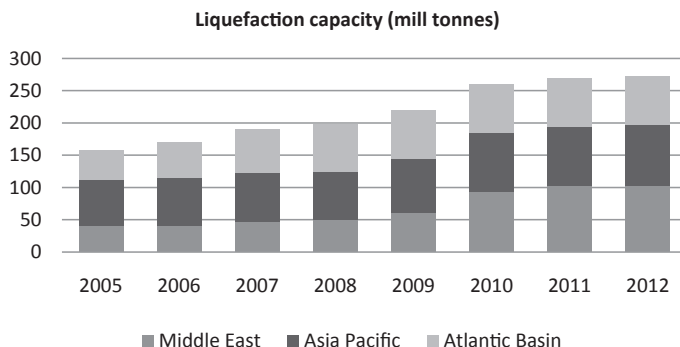


Figure 2 Global Liquefaction Capacity (Million Tonnes)

Source: Cedigaz.

advances that drove down liquefaction costs increased the attractiveness of LNG to gas producers but cross-border piped supply grew faster, reducing the call for LNG outside Asia. Thus, although LNG supply doubled between 1990 and 2000, the share of LNG in the total gas market remained very small, rising from 3.5 percent in 1990 to about 5.6 percent by 2000.

This suddenly changed in 2009 and 2010, when, 50 years after the first commercial cargo, an unprecedented number of new LNG liquefaction plants came on stream, increasing the LNG supply capacity by 32 percent and leading to LNG's share of the gas market increasing to almost 10 percent (Figure 2).

7.3 FROM EVOLUTION TO REVOLUTION

After 50 years of evolution the LNG industry is now going through a period of revolution which will substantially change the size and profile of the industry. Dramatic change is occurring.

LNG liquefaction:

- Liquefaction trains double in size — but mini trains also introduced
- Mega producers — Qatar and shortly Australia
- Floating LNG will speed up project implementation and enable the development of small gas fields

LNG receiving terminals:

- Re-gasification vessels radically speed up entry of new buyers
- Huge expansion of re-gasification capacity with new terminals in South America, Europe and the Middle East

Massive expansion of the LNG fleet:

- Vessels double in size — introduction of the Q-Max
- Surplus vessels — spurs conversion to storage or re-gasification

New entrants:

- 20 new players enter the business
- Multinationals make further major commitments to LNG

New gas supply:

- CBM/shale gas to LNG — from 0 to 40 million tonnes in five years!
- Very significant potential from unconventional gas

A look back at the LNG market of 2005 compared to the likely market of 2015 puts this revolution in perspective. In 2005 14 countries imported LNG, with just four really significant players. In 2010 21 countries were importing LNG and re-gasification capacity had almost doubled. With the industry focusing on supply, it is often not appreciated just how fast the customer base is growing and just how dramatic the changes that are underway. If current plans and ambitions are fulfilled, by 2015 40 countries, including Singapore, will be importing LNG and the LNG liquefaction capacity is expected to be about 360 million tonnes compared with 157 million tonnes in 2005 (Figures 3 and 4).

7.4 REVOLUTION: INTRODUCTION OF MERCHANT TRAINS

Traditionally the LNG business was integrated from wellhead to burner. A producer only committed to develop an LNG project if they had firm off-take commitments from buyers who simultaneously made commitments to build

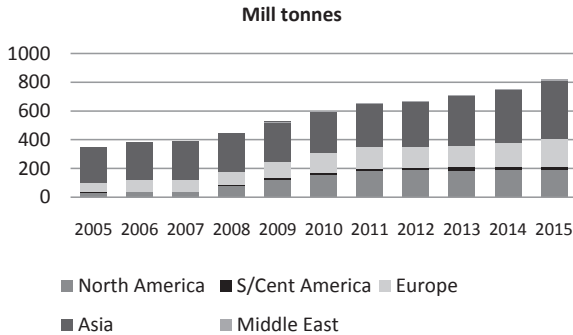


Figure 3 Global Re-gasification Capacity, 2015 vs. 2005.

Source: Cedigaz/Tri-Zen International.

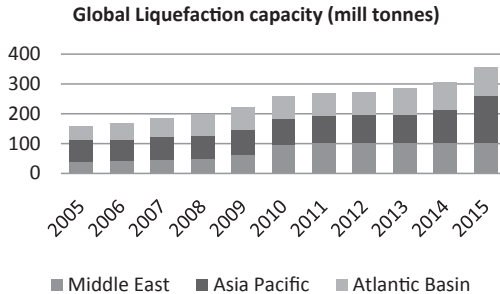


Figure 4 Global Liquefaction Capacity, 2015 vs. 2005.

Source: Cedigaz/Tri-Zen International.

the receiving facilities and entered into long-term sales contracts to supply the power, industrial or city gas markets. This changed in 2005 when Atlantic LNG in Trinidad and Egypt LNG brought on stream LNG trains without having off-take agreements and established the principle of “merchant” trains.

The first spot sales of LNG were made in 1993 but, as most production had been committed to term contracts, there were very few spot transactions until about 2000 when about 4 percent of LNG was traded on the spot market. Merchant trains created far more “liquidity” in the market; and led to a sharp increase in the number of spot transactions, taking the spot market from about 10 percent of LNG transactions in 2005 to 21 percent by 2010 (Figure 5).

In addition to stimulating an embryonic LNG spot market, it led to the globalisation of the trade, with LNG cargoes moving from Norway and

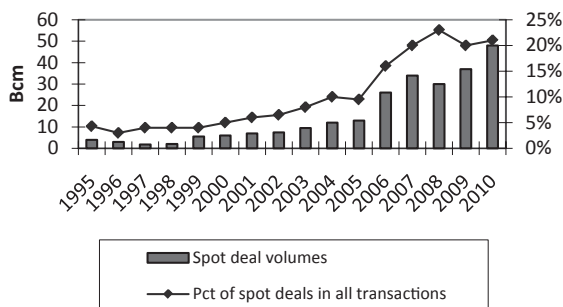


Figure 5 Percentage of Spot Transactions.

Source: Cedigaz.

Trinidad to Japan and from Sakhalin to the Middle East, and increased availability encouraged more buyers to enter the market. In 2011, 61 million tonnes of LNG was sold under spot or short term contracts, 26% of the market.

7.5 REVOLUTION: INTRODUCTION OF MEGA VESSELS

The first LNG vessels had carrying capacities of 50,000 to 70,000 m³ and a typical modern LNG vessel has a carrying capacity of 135,000–140,000 m³ and costs about US\$200 million.

Nakilat (Qatar) has recently introduced vessels that are referred to as Q-Flex and Q-Max vessels and have capacities of between 209,000 and 266,000 m³ (and cost US\$250–285 million each). Nakilat did not exist in 2005 but they now own 54 LNG vessels, making it the largest LNG ship owner in the world.

7.6 REVOLUTION: HUGE EXPANSION OF LNG RE-GASIFICATION CAPACITY

Between 2005 and 2015 the LNG re-gasification capacity at import terminals is set to almost treble to 930 million tonnes. This is being driven by the following:

- US natural gas production was declining and on the assumption that additional demand would be primarily met by importing LNG, new

import terminals were built and earlier ones expanded. Re-gasification capacity rose from 38 million tonnes in 2005 to reach 163 million tonnes in 2011, by which time it had become clear that very little LNG was going to be needed due to rising production of domestic shale gas. Only 3.5 million tonnes of LNG was imported in 2012, utilising less than 2.5 percent of terminal capacity.

- The UK has turned to LNG to replace declining North Sea production and two large terminals were commissioned in 2009 at Milford Haven. Phase 3 of the Grain LNG terminal expansion was completed in 2010 and there is now sufficient LNG re-gasification capacity to meet almost 50 percent of the UK's gas demand. Capacity has grown from three million tonnes in 2005 to 37 million tonnes in 2012.
- Concern about long-term gas supply security has led most European countries to consider an LNG option. Fifteen countries have built, or are planning to build, LNG terminals. The Rotterdam terminal in the Netherlands and the Nynashamn terminal in Sweden came on stream in 2011 and Poland, Croatia, Estonia and Lithuania, are all planning to start importing LNG within the next five years.
- The introduction of floating re-gasification vessels in 2007 has had a dramatic impact on the market by significantly reducing the time taken to build import capacity. Argentina, Brazil, Chile and Kuwait have all been able to bring on stream import capacity within about 18 months. Other Central and South American countries are considering LNG imports and this region has the potential to become a significant market (Figure 6).

7.7 THE GAME CHANGER: FLOATING RE-GASIFICATION VESSELS

Floating re-gasification terminals are either vessels (LNG carriers that have been converted by installing re-gasification equipment on the bow of the vessel) or purpose-built floating platforms such as Adriatic LNG, off Rovigo in Italy, that was commissioned in August 2009.

The attraction of floating re-gasification vessels is that they enable a speedy low-cost entry as they can be brought on stream in less than a year compared with 3–4 years for a conventional onshore terminal. They also

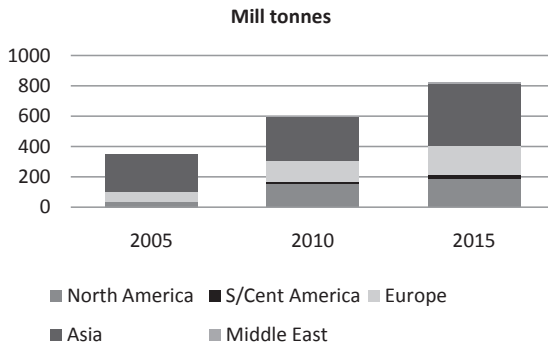


Figure 6 Revolution – Huge Expansion of Re-gasification Capacity

Source: Tri-Zen International.

enable LNG to reach smaller markets that may only need 0.5–1.0 million tonnes per annum and can be a “get you started” solution whilst a larger onshore terminal is being planned and built.

The main proponents of floating re-gasification vessels have been Excelerate Energy and Energy Golar LNG and Hoegh LNG. The first floating re-gasification terminal, Excelerate Energy’s Gulf Gateway in the US, was commissioned in 2005 followed by Teesside GasPort in the UK in 2006. There are two main concepts: Excelerate Energy’s “Energy Bridge” concept has re-gasification vessels discharging offshore via a submerged turret loading buoy, with the re-gasified LNG being dispatched onshore via submarine lines. The other concept has the vessels going to a port and either discharging over the berth directly into gas trunk lines or via another moored storage and re-gasification vessel.

During 2009, floating re-gasification vessels went into service in Brazil (Petrobras Pecam, January 2009; Petrobras Rio, March 2009), Kuwait (operates during the summer to support peak generating demand) and the US (Northeast Gateway, April 2009). Golar/Shell provided a floating re-gasification vessel in Dubai in 2010 and Malaysia and Indonesia became LNG importers in 2012 using floating storage and re-gasification units (FSRUs). There are now 13 floating terminals in operation and although the initial concept was based on the conversion of LNG carriers, 15 new build FSRUs have been ordered for delivery between 2013 and 2015 by Excelerate, Golar and Hoegh LNG and BW.

The fast pace of re-gasification terminal development is unprecedented in the 50 years of history of the industry. Having moved from only six significant LNG importing countries five years ago, the industry has gone global with South America and the Middle East joining the club and most Asian and European countries now seeking to import LNG.

Seventy percent of re-gasification capacity was in Asia in 2005; in 2010 it looked as if it could drop to less than 40 percent with the Atlantic Basin becoming the larger market by 2015. However, low domestic gas prices in Europe and greater use of coal in power generation has led to interest in LNG waning and several import terminal projects in Italy and Germany being cancelled. Europe switched from being the fastest growing LNG market in 2010 to the one with the largest decline in demand in 2012.

Potentially there could be 930 million tonnes of re-gasification capacity in operation by 2015, which is vastly more than the LNG supply capability.

Unfortunately for LNG liquefaction sponsors, re-gasification capacity does not correlate directly with LNG demand. For example, Japan imported 87 million tonnes of LNG in 2012 and has a re-gasification capacity of 220 million tonnes a year. However, the rapid expansion of re-gasification capacity gives a very clear indication of the significant potential LNG demand.

7.8 EVOLUTION TO REVOLUTION: LNG LIQUEFACTION CAPACITY

A steady focus on capturing economies of scale led to gradual increases in train size over the first 40 years of the LNG business. Typical LNG liquefaction train capacities were 1.3 million tonnes in early plants (Kenai) and then 2–3 million tons per year during the 1990s.

This suddenly changed and liquefaction train sizes doubled over the five years from 2004 to 2009. Five-million-tonne trains were introduced at Atlantic LNG (Trinidad) and SEGAS (Egypt) in 2005 and Qatar brought on stream six mega trains of 7.8 million tonnes per year in 2009/10.

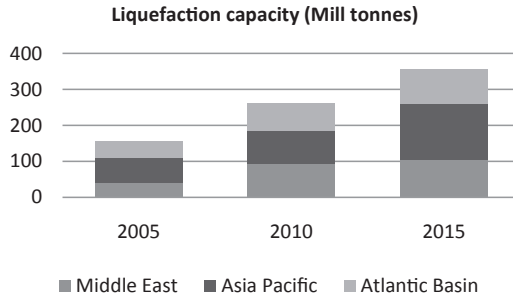


Figure 7 Huge Expansion of Liquefaction Capacity

Source: Tri-Zen International.

LNG liquefaction capacity grew gradually from less than 1 million tonnes in 1965 to 132 million tonnes in 2004 but then expanded by 100 million tonnes between 2005 and 2010 with new greenfield projects coming on stream in Australia (Darwin LNG), Russia (Sakhalin LNG), Indonesia (Tangguh LNG) and Yemen. Of particular significance was the expansion of Qatargas and RasGas in Qatar which lead to the country becoming the largest LNG supplier. In 2010 Qatar completed the construction of all its trains and now has 77 million tonnes of LNG liquefaction capacity making it the largest LNG exporter. (Figure 7).

An unprecedented 75 million tonnes of new liquefaction capacity came on stream in 2009/10, increasing global liquefaction capacity by 38 percent. Although this led to surplus capacity in 2010/2011, no new capacity came on stream in 2011 and there is now insufficient new capacity coming on stream. The final investment decisions (FIDs) for both PNG LNG in Papua New Guinea and Gorgon in Australia was made in 2009 and six more projects in Australia took FID between 2010 and 2012. In addition, Mitsubishi took FID on Donggi Senoro in Indonesia in 2011 and Cheniere Energy sanctioned the first four trains at Sabine Pass in 2012. These will increase LNG liquefaction capacity by about 30 percent and although this will mean LNG liquefaction capacity will have increased from 157 million tonnes in 2005 to 370 million tonnes in 2016 it is unlikely to be sufficient to meet all demand. (Table 1)

Table 1 Liquefaction Capacity Under Construction 2013

Project	Country	mtpa	Start Up	Operator
Skikda replacement	Algeria	4.5	2012	Sonatrach
Arzew	Algeria	4.7	2013	Sonatrach
PNG LNG	Papua New Guinea	6.3	2014	ExxonMobil
Qld Curtis	Australia	8.5	2014	BG
Donggi-Senoro	Indonesia	2	2014	Mitsubishi
Australia Pacific T1	Australia	4.5	2014	Origin/CP
Pacific Rubialas FLNG	Colombia	0.5	2014	Exmar
Gorgon T1	Australia	5	2015	Chevron
Gladstone LNG	Australia	7.8	2015	Santos
Gorgon T2	Australia	5	2015	Chevron
Sarawak FLNG	Malaysia	1.2	2015	Petronas
MLNG Train 9	Malaysia	3.6	2015	Petronas
Gorgon T3	Australia	5	2016	Chevron
Prelude	Australia	3.6	2016	Shell
Wheatstone	Australia	8.6	2016	Chevron
Ichthys	Australia	8.4	2016	INPEX
Australia Pacific T2	Australia	4.5	2016	Origin/CP
		83.7		

Source: Tri-Zen International Pte Ltd.

7.9 REVOLUTION: LNG LIQUEFACTION GAME CHANGERS

Just as re-gasification ships have changed the game with respect to LNG terminals there are also some “change the game” cards that are about to be played on the liquefaction side:

CBM to LNG:

- Coal bed methane (CBM) production in Queensland has increased rapidly over the past few years and as reserves are far in excess of Australian gas demand, a number of producers considered exporting CBM as LNG.

This attracted the interest of international LNG players and five CBM-to-LNG projects have been proposed based around the port of Gladstone. It is most unlikely that five separate projects will go ahead. Three are under construction and LNG Ltd hopes to reach FID on its Fisherman's Landing project in 2013. Shell/PetroChina are developing the fifth project, an eight million tonnes per annum plant (mtpa) and they also hope to take FID in 2013 for a 2018 start-up. By 2015, 25 mtpa of LNG could be exported from Gladstone from the first three projects.

CBM is also going into LNG in Indonesia. VICO (BP/ENI) is supplying CBM from the Sanga-Sanga block in East Kalimantan into the existing Bontang LNG plant.

Small CBM-to-LNG plants are already operating in China where they provide a way to quickly monetise early CBM production ahead of completion of pipelines to the local markets.

Shale gas to LNG:

- The U.S. Energy Information Administration projects U.S. natural gas production to increase from 23.0 trillion cubic feet (tcf) in 2011 to 33.1 tcf in 2040, a 44 percent increase. Almost all of this increase in domestic natural gas production is due to projected growth in shale gas production, which grows from 7.8 tcf in 2011 to 16.7 tcf in 2040.

Canadian natural gas production is forecasted to decline — from 5.3 tcf a year in 2012 to 4.8 tcf/year in 2019 due to declining demand from the USA. However potential demand from LNG projects is leading to increased investment particularly in the shale gas reserves in the Montney Basin, Horn River and Laird Basin in British Columbia and Alberta. Five shale gas-to-LNG projects are under development on the British Columbia coast which could lead to the production of about 48 million tonnes of LNG by 2020.

In the US, sixteen liquefaction projects have been proposed that could potentially produce 180 million tonnes of LNG from shale gas. Not all of these will go ahead.

Australia has huge shale gas resources, development of which is just starting. Production could rapidly exceed Australian demand and therefore it is expected that some of this will be exported as LNG.

Floating LNG production:

- Floating re-gasification units were an industry game changer that enabled LNG buyers to install LNG receiving facilities at a fraction of the cost of building conventional onshore LNG terminals and to be operating in months rather than years. Floating liquefaction will be another game changer of potentially even greater impact. In May 2009 Shell took the Final Investment Decision on a huge FLNG facility to develop the Prelude field and has an agreement with Samsung to build a further nine. The massive structure weighing around 600,000 tonnes, roughly six times as much as the largest aircraft carrier, will be located over 450 km northwest of Broome, Western Australia to process gas initially from seven subsea wells in the Prelude field in the Browse Basin and, in a second phase, from the Concerto field. Later in the project life, gas is also expected to come from the Crux field.

Shell's FLNG plant will produce about 3.6 million tonnes per annum of LNG. About 1.3 million tonnes of condensate and 400 million tonnes per annum of LPG will also be produced. The LNG will then be transferred to conventional LNG carriers for delivery to customers across Asia. Analysts estimate that the capital cost of Shell's Prelude FLNG facility will be just over US\$6 billion or about US\$1,700 per tonne of capacity. This compares favourably with conventional onshore projects and the sponsors of the smaller vessel based FLNG units are forecasting capital costs below US\$1,000 per tonne of capacity for their units.

FLNG will be an industry game changer. It will enable the development of stranded gas reserves and by locating the facilities above the field; it reduces cost by removing the need for gas compression stations; long subsea pipelines to shore; a jetty for loading vessels and onshore facilities including roads, storage yards and accommodation facilities.

Floating LNG is now gaining traction with greater variation in scope than originally envisaged. Originally offshore, there is now growing interest in inshore and even berthed facilities and smaller units.

Exmar recently announced a 0.5 mtpa Floating Liquefaction Re-gasification & Storage Unit (FLRSU) for Pacific Rubialas in

Colombia. This will be a static liquefaction unit, a floating storage vessel with 140,000 cubic metres of storage and a second vessel able to act as a floating re-gasification vessel delivering LNG to Caribbean markets. Start up is scheduled for Q4 2014 and this could be the first FLNG unit to go into commercial production.

Petronas has sanctioned its first FLNG unit that will be located 180 km off Bintulu in Sarawak. An EPCIC contract has been awarded to Technip and DSME for a 1.2 mtpa unit that is scheduled for start up in late 2015. Petronas is developing a second 1.5 mtpa FLNG unit for use off Sabah and this could be in operation by 2016.

The attraction of floating liquefaction plants is that they offer developers a lower-cost alternative for gas field development and faster monetisation of assets. They also enable the development of small stranded gas reserves that would otherwise be uneconomical to develop. There are circa 90 gas fields in the 1–3 Tcf range that are suitable for development by small LNG FPSOs and about 30 in the 3–10 Tcf range suitable for large-scale LNG FPSOs.

A particular issue with small-scale LNG FPSOs is the need to reduce the weight and footprint aboard ships. This requires some compromises and simpler liquefaction processes and leads to another significant differentiator between the classes — having to use simpler processes (single mixed refrigerant, dual expander processes) compared with the larger class which can use baseload-type liquefaction processes adapted for offshore applications (e.g. Shell or APCI's dual mixed refrigerant, a single mixed refrigerant or the mixed fluid cascade technology).

Three FLNG units are under construction and another six projects hope to take FID shortly. Potentially almost 20 million tonnes of LNG production could be coming from FLNG units by 2018. The total volume of firm, planned and proposed FLNG projects has now reached 36 million tonnes from 14 projects.

7.10 LNG LIQUEFACTION: THE GREAT LEAP FORWARD

Having factored in capacity currently under construction there will be about 370 million tonnes of LNG supply from 2016 compared with 273 million

tonnes today. An unprecedented number of 47 projects are expecting to reach Final Investment Decision in the next couple of years. Many will not be sanctioned but if all were to go ahead they would add a further 390 million tonnes of liquefaction capacity by 2020. In addition, there are a considerable number less advanced or speculative proposals. If all the proposed projects were to go ahead liquefaction capacity would exceed 700 million tonnes. This won't happen, but potentially there could be 500 million tonnes of liquefaction capacity by 2020.

Australia has taken the great leap forward and North America is poised to follow.

Also unprecedented are the number of projects under construction in Australia and, if all are completed on schedule, Australia will overtake Qatar as the largest LNG producer in 2017. 60 million tonnes of new capacity is currently under construction. The list includes three projects that will utilise coal bed methane as the feedstock and Shell's first floating LNG vessel at Prelude (Figure 8).

In addition, Australian project sponsors are offering a further 50 million tonnes by the end of this decade but not all of the proposed projects will go ahead. A particular issue in 2012 has been the huge cost overruns of several of the projects under construction in Australia and Papua New Guinea, whilst considerable progress has been made in developing

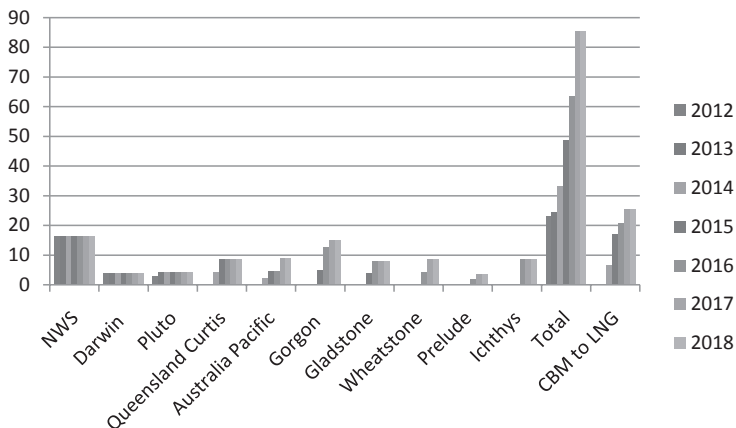


Figure 8 Australian LNG Liquefaction Capacity (mpta)

Source: Tri-zen International Pte Ltd

what are expected to be substantially cheaper major LNG projects in Canada and East Africa. This has drawn attention to the fact that Australia stands out as a particularly expensive location to build liquefaction plants and led to doubts about whether any of the proposed future LNG projects in Australia will go ahead.

When several of the projects listed above took FID in 2010/11 they were almost the “only show in town” as the recession had led to sponsors of other projects putting the brake on sanctioning projects. Since that time the world has changed dramatically with a flood of new offerings from the USA, Canada and East Africa.

New LNG capacity is also under construction in Malaysia, Indonesia and Papua New Guinea and brownfield expansion is being considered in Brunei, Indonesia and Russia (Sakhalin). Two major new LNG sources, Canada and East Africa, could also be supplying Asia Pacific demand before the end of the decade.

The LNG world needed Australian supply in 2010–11 but looking further out, buyers have vastly more choice and it looks increasingly difficult to make the case for a second phase in Australia.

Bonaparte LNG will be FLNG, so will be lower cost than conventional onshore projects, and Gorgon Train 4 and Wheatstone Train 3 will be Brownfield expansion projects, so these may go ahead. However Browse and Shell/PetroChina’s Arrow LNG project looks particularly vulnerable unless they can find a way to substantially reduce cost. Potentially this could be done by turning Browse into an FLNG project and for Shell/PetroChina to seek hospitality from one of the three projects under construction at Curtis Island rather than building a separate green-field plant at the same location.

Can North America make a great leap?

Of particular significance are developments in North America. Low gas prices and the availability of a large number of underutilised LNG receiving terminals have triggered an interest in building liquefaction capacity. Not all of these will go ahead but already three Canadian projects have received export licences and hope to move to Final Investment Decision this year. In the USA, Cheniere has received permission to export to

non-FTA countries and has taken FID on the first phase (two trains) of its Sabine Pass liquefaction project.

The sheer scale of what is proposed is unprecedented with about 260 mtpa of new capacity being proposed from North America. This is greater than current global LNG production.

In Canada, declining natural gas exports to the USA are driving gas producers to seek new markets. Six export projects have been announced all of which are in British Colombia; except for one proposed in Nova Scotia, utilising US shale gas. The BC projects will be targeting the premium price North East Asia LNG market.

The projects have been particularly successful in attracting the leading LNG players/buyers as investors and are located reasonably close to some of Canada's prime shale gas resources in the Montney Basin and Horn River.

Potentially Canada could be exporting about 40 mtpa of LNG by 2020 for an expenditure of about \$100 billion (liquefaction, pipelines and upstream CAPEX).

The total volume of proposed US LNG projects has now reached 210 million tonnes. The submission of a report to the US DoE by NERA forecasting, that LNG exports would not have a significant impact on domestic gas prices, has raised expectations that the DoE will shortly start issuing licences to export LNG to non FTA countries, clearing the way to rapid development of the proposed projects.

However, the focus on export applications and the comparison of US costs with those of the Australian projects has led to unrealistic expectations regarding the potential for US LNG exports. To be viable, a project needs far more than an export licence, in particular it needs customers. So far, there is buyer interest in less than 20 percent of the proposed capacity and only one project has been sanctioned. Many of the projects will not go ahead but the USA could be exporting about 40 million tonnes of LNG 2020.

7.11 REVOLUTION: THE INDUSTRY PLAYERS

In 2005 there were 17 liquefaction projects, 39 players and a global capacity of 157 million tonnes. The market was dominated by national oil companies and multinational companies such as Shell and ExxonMobil. By 2015 there are expected to be 40 liquefaction projects with a global

capacity of 360 million tonnes, including 42 million tonnes from unconventional gas. The number of companies with investments in LNG will have increased substantially to 64 participants.

Although the market will still be dominated by national oil companies with Qatar Petroleum at the top of the list, some of the NOCs have dropped down in the ranking in the face of strong growth by the multinational oil companies (NOCs). Shell is the dominant multinational with about 8.5 percent of global LNG capacity (39 operating trains) and

Table 2 Liquefaction Capacity by Equity Share — Top 20 Players

Million tonnes	2005		2015
Sonatrach	20.30	Qatar Petroleum	50.96
Petronas	18.83	Shell	29.05
Qatar Petroleum	16.21	Sonatrach	28.80
Pertamina	15.46	Petronas	27.86
Shell	10.78	Chevron	23.55
BP	8.71	ExxonMobil	21.43
ExxonMobil	6.98	Cheniere	18.00
BG	5.62	BG	16.32
ENI	5.21	Total	16.18
Total	5.17	NNPC	14.29
Oman Govt	5.07	BP	12.49
Mitsubishi	5.00	ConocoPhillips	7.51
NNPC	4.66	Mitsubishi	7.51
JILCO	4.22	Woodside	6.55
ADNOC	3.99	ENI	6.43
Brunei Govt	3.60	Inpex	6.37
Mitsui	2.65	Pertamina	6.08
Repsol	2.29	Oman Govt	5.10
Union Fernosa	2.23	Gazprom	4.80
Woodside	1.98	Mitsui	4.52
	148.96		313.80

Source: Tri-zen International Pte Ltd.

both Chevron and ConocoPhillips have entered the top 20, with Chevron becoming the sixth-largest producer when it brings Gorgon and Wheatstone on line (Table 2).

7.12 OUTLOOK

The pace of change and development in the LNG industry is unprecedented compared with the first 40 years and there is every likelihood that the business in 2020 will look considerably different from that foreseen in current forecasts. It is unlikely that all of the currently proposed LNG liquefaction plants will go ahead and that those that do go ahead will start up as currently scheduled.

The customer base is substantially larger than just a couple of years ago and therefore future growth will be built on a much larger base. LNG is moving away from being a modest contributor to total gas supply and by 2015 might represent about 15 percent of global gas supply.

Although global LNG consumption fell slightly in 2012 compared with 2011 we forecast that demand will double between 2010 and 2020 and reach 450 million tonnes.

Asian LNG consumption is growing strongly and almost every country in Asia is becoming an LNG importer. We forecast that Asian LNG consumption will double by 2020 reaching 310 million tonnes, substantially more than current LNG production capability. Actual consumption will depend on the speed of infrastructure development and progress towards market pricing of gas.

South East Asia is emerging as a significant new market. PTT opened the 5 mtpa Map Ta Phut LNG terminal at Rayong in Thailand in 2011 and forecasts demand of 20 million tonnes by 2020. Indonesia became an importer in May 2012 when Nusantara Regas (an FSRU) came on stream in West Java. Pertamina is converting the Arun liquefaction plant to a receiving terminal and a second FSRU is scheduled to start up Lampung in South Sumatra in 2014, under a contract between Hoegh LNG and PGN.

Petronas will shortly commence commercial operations of its first import terminal at Malacca and is proposing to build one with a capacity of 3.8 mtpa at Pengerang in Johor. Vopak and the Dialog Group are also

proposing to build a terminal at Pengerang. This will be smaller at 0.7 mtpa and both terminals hope to be completed by 2016. Petronas has also proposed import terminals at Lahad Datu, Sabah and Lumat.

The 3.5 million tonne capacity Singapore LNG terminal on Jurong Island is scheduled to come on stream in 2013. When a third tank is completed in 2014, capacity will increase to 6 mtpa and then 9 mtpa in 2017 when a fourth tank is completed.

Vietnam and the Philippines also have plans to import LNG and by 2015 South East Asia could be importing as much as 20 million tonnes of LNG.

Demand is also growing in South America and the Middle East but there is considerable uncertainty about European demand. Natural gas demand fell in 2011 and 2012 and the IEA forecast that European demand will remain below 2010 levels until 2017. There is potential for faster growth in Europe but this looks unlikely whilst coal prices remain much lower than natural gas. Generators have been attracted to cheaper coal, and imports have increased considerably from the US, Colombia and South Africa. LNG imports fell in 2012 to 52 million tonnes compared with 67 million tonnes in 2011, with the biggest drop in the UK where imports fell by 44 percent. Sweden opened its first terminal in 2011 and the Gate terminal in Rotterdam came on stream in 2012. Poland's first import terminal is scheduled to be completed in 2014 and Croatia, Cyprus, Estonia, Lithuania and the Ukraine all have plans for import terminals. Potentially Europe could be importing 90 million tonnes of LNG by 2020 but there is probably a plus/minus 25 percent sensitivity around this number particularly whilst the energy policy of the European Community remains uncertain.

Potentially global demand could be considerably higher than the 450 million tonnes that we are forecasting for 2020. Rising gas prices have obscured the fact that both gas and LNG are very competitive when compared with competing petroleum fuels. Term LNG contract prices in Asia tend to be linked to the Japanese Crude Cocktail or Brent and the formula used guarantees that LNG will be priced slightly lower than crude and considerably lower than petroleum products. LNG is cheaper than fuel oil and products such as diesel and LPG can be about 60 percent more expensive than the landed cost of LNG. This point is just beginning to be appreciated by industry and the transportation fuel sector.

America's Natural Gas Highway® (ANGH), a network of liquefied natural gas truck fuelling stations to support long-haul trucking along major interstate corridors throughout the United States is going into place. Clean Energy Fuels has completed 70 new LNG truck fuel stations and plans to build a further 70 to 80 LNG fuel stations adjacent to long-haul trucking routes and around major warehouse distribution centres in North America. Shell has agreed with Travel Centres of America, the largest full service truck stop operator in the US, to install more than 200 LNG fuel lanes at about 100 Travel Centre sites and Petro Stopping Centers throughout the US interstate highway system.

In Canada, Shell is working on the Green Corridor project with Flying J Inc. to supply 250,000 tons of LNG a year to trucks along the 1,600 kilometre highway from Alberta to the Pacific coast in Canada. However this is dwarfed by China where by 2015 the number of LNG filling stations is expected to reach 3,000 and 220,000 heavy trucks are expected to be LNG fuelled. Australia is also starting to show interest and we may now be seeing the emergence of a significant new market for LNG as a truck and marine fuel.

LNG is being introduced as a marine fuel across northern Europe and we expect to see a significant increase in demand for LNG after Europe and North America phase out fuel oil from their bunker markets in 2015 and ship owners are faced with a choice of LNG, or much more expensive diesel.

Whilst the number of LNG liquefaction projects under construction and expecting to be sanctioned in the next couple of years looks impressive, we anticipate that it will be insufficient and there will still be unmet demand in 2020.

We expect Australia to bring on 60 million tonnes of new capacity by 2018, the US and Canada about 40 million tonnes each by 2020, and East Africa about 20 million tonnes. East Africa is emerging as a major new gas source. Reserves in Mozambique and Tanzania already exceed 100 tcf and potentially these two countries could support LNG exports of 50–60 million tonnes per annum in the longer term.

An additional 160 million tonnes by 2020 is not enough and therefore there remains a considerable incentive to bring on LNG from projects

proposed in other countries such as Brunei, Indonesia, Nigeria and Russia.

7.12.1 What about China and India?

Both countries imported about 14 million tonnes of LNG in 2012. Chinese LNG demand is increasing only slowly due to low domestic gas prices. Domestic natural gas and LNG production is rising, imports from Central Asia will exceed LNG imports in 2012 and China is about to start importing gas from Myanmar. Synthetic gas production from coal is forecast to reach 80 Bcm by 2020 and production of coal bed methane and shale gas could be significant by 2020. China has a wide choice of gas sources and is not going to be as dependent on LNG as Japan, Korea and shortly, India. Despite this we anticipate that China will be importing 45 to 50 million tonnes per annum by 2020. China's gas market has huge potential for further growth so there is further upside to these figures.

There is far greater uncertainty about Indian demand due to policy uncertainties and far greater price sensitivity than China. Despite that, gas demand is expected to continue to grow at about 4.5 percent per annum. Distribution infrastructure has improved significantly over the last few years and a number of new LNG terminals are under development. However, perhaps the main driver behind increased LNG imports has been the unexpected decline of domestic gas production since 2010. It is hoped that domestic production could recover post 2015 but LNG imports are expected to increase from 14 million tonnes in 2012 to reach 25 million tonnes in 2020. Potentially they could reach as much as 40 million tonnes but this depends on a significant degree of price liberalisation and regulators accepting the principal of market pricing.

7.13 CONCLUSION

Thus whilst in the early days it was demand from Japan and Korea that underpinned the early development of the LNG industry it will be China and India that support “the great leap forward” and the huge expansion in supply proposed for 2015–2020.

Asia Pacific is regarded as the cradle of the LNG industry and although we now have three production zones (Asia Pacific, Middle East and Atlantic Basin) the pendulum will swing very much back to Asia Pacific with about 50 percent of global liquefaction capacity and about 60 percent of demand being in the Asia Pacific by 2017.

CHAPTER 8

DEVELOPING RENEWABLE ENERGY AND CARBON ABATEMENT PROJECTS IN ASIA

William I. Y. Byun

ABSTRACT

For a range of differing policy reasons from energy security to industrial development, national goals in various Asian countries now emphasise developing renewable energy power generation. However, the form of the renewable energy projects being developed, such as wind or biomass, reflects the specific characteristics of the national policies which favour certain forms over others. Also, there are practical challenges in developing renewable energy projects due to their specific geographic and size profiles, in particular due to the smaller nature of each individual project. As a result, renewable power development tends to be very local in outlook and the more successful programmes have tended to reflect local climate as well. Finally, the current development of renewable energy projects is now seen as intimately tied to the global markets for carbon offsets and the additional revenue streams from such offsets. Looking ahead, the direction of such carbon markets in turn influences the future direction and nature of the implementation of renewable energy projects in Asia. The picture then becomes much more fragmented and again tied to individual countries' policy frameworks rather than to broad market-based drivers or global carbon initiatives.

8.1 OVERVIEW OF RENEWABLE ENERGY

Renewable energy is now often in the news and, despite the current global economic downturn, has been recession-resistant, with governments across the region and globally using the renewable energy sector as one of the main fiscal drivers for economic pump-priming. In addition to these various national recession-specific stimulus packages for renewables, across Asia, for differing policy reasons, national goals in various Asian countries have emphasised developing renewable energy power generation, be it in financing for wind farms, subsidies for solar energy plants, or incentives for promoting various upstream “clean” technologies.

Renewable energy is simply defined as energy generated from resources that are naturally replenished. Within renewable energy, the sources can be further divided into the conventional renewables which have traditionally been utilised, such as hydroelectric, biomass, and geothermal, and the new cleantech sources, such as solar, wind, and ocean/wave. Other individual renewable segments include waste-to energy (municipal solid waste incineration) and recovered gas from landfills or coalmines.

However, the form of the renewable energy projects being developed, such as wind or biomass, depends significantly in turn on the specific characteristics of the national policies which favour certain forms over others. Rather than following global trends, each national policy is inextricably tied into and organically derived from the specific characteristics of each nation’s economic characteristics rather than from its inherent suitability for different renewable fuels. Therefore, solar energy promotion is a policy priority in relatively sunless Korea as opposed to biomass, while the opposite holds true in Thailand.

Also, because there is the very practical challenge of developing renewable energy projects due to their specific geographic tie-in and small size, a necessary adjunct to the way such renewable energy project developments are being pursued is that they are now inextricably tied into the global markets for carbon offsets and the additional revenue streams from such offsets.

Looking ahead, the direction of such carbon markets in turn influences the future direction and nature of the implementation of renewable energy projects in Asia. The picture then becomes much more fragmented and the various uncertainties in such global carbon frameworks mean that

renewable energy projects are again being primarily driven by each individual country's policy frameworks rather than broad market-based drivers or global carbon initiatives.

8.1.1 The Challenges of Renewables

Renewable energy development is fundamentally different from that of other electricity generation fuel sources. While its market behaves differently from the other fuel sources, the initial, visibly stark distinction is due to its very different size profile. The overwhelming majority of global electric power generation is provided by the fossil fuels of coal, oil, and gas. As a rule of thumb, 1 megawatt (MW) of power supplies electricity to about 10,000 homes. Coal plants typically produce around 1,000 MW and China adds about 50,000 MW of capacity every year. Taken together, that points to a heavy dependence on coal for power generation, particularly in non-Organisation for Economic Co-operation and Development (OECD) Asia where coal is cheap, high in calorific value (energy), and plentiful.

As shown in Figure 1, the actual implementation of renewable energy is a tiny fragment compared to the political and media hype. At present, only 8 percent of global energy comes from renewable sources.

Even within the overall category of renewable energy, a closer look reveals that despite the disproportionate visual emphasis on wind turbines, solar farms, and other aesthetically politically correct imagery in the media, the bulk of renewables is comprised of hydro and biomass which, by definition, encompass the masses of “backward” burning of traditional biowastes and small dams or water mills.

Then, looking beyond the media glamour and high-tech imagery and marketing terms such as “cleantech”, etc., renewable energy as a sector for electric power generation is still fairly embryonic (Figure 2).

Worse still, renewable energy in comparison to fossil fuels is generally not cost competitive and, without a specific policy subsidy for the feed-in tariff, is not a financially viable investment alternative. Whereas coal-fired power plants can generally achieve break-even at a tariff revenue of about 3–4 US cents/kilowatt hour (cents/kWh), biomass would usually require about 6–8 cents/kWh to break even, with wind higher and solar significantly higher. These numbers deceptively narrow the gap

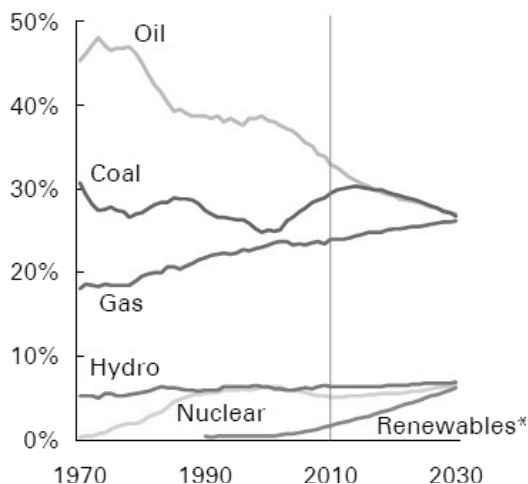


Figure 1 Shares of World's Primary Energy Supplies

Source: BP Energy Outlook 2030.

further in that in terms of overall capital expenditure (CAPEX), the economies of scale from a 1,000 MW coal plant are not possible for renewables projects which tend to be much smaller. While costs are coming down for technologies such as solar or wind, without a specific policy tariff accumulator to the purchase price of electricity generated, renewables-fueled electric power plants currently are not financially viable. This is especially significant in the current global economic downturn where government budgets are strained by financing the necessary fiscal stimulus and additional spending for such feeder tariffs may seem a luxury.

However, coal production and utilisation is increasingly difficult, due to both domestic political and social opposition and global criticism from anti-pollution and anti-global warming activists. Following places such as California where there has not been a new fossil baseload power plant in over 20 years due to social resistance, increasingly, it is becoming practically impossible to obtain local licensing for large coal baseload plants in places such as Korea and Thailand where the environmental non-governmental organisation (NGO) movements are taking hold, and even more so in China.

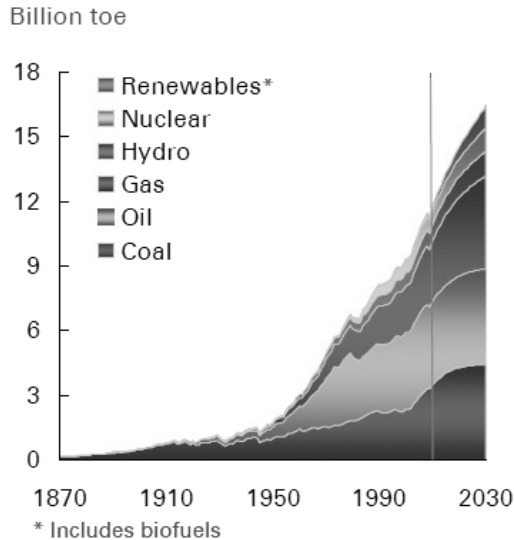


Figure 2 World Commercial Energy Use

Source: BP Energy Outlook 2030.

Gas and oil usage is equally challenging for most Asian countries due to their energy security issues, since access to such fuels is often by import from distant, possibly unreliable sources or due to other policy needs and uses. Because each country faces different fuel security profiles and different economic profiles, their approaches to policies for renewable energy incentives also differ. We now look at three different renewables markets in Asia for a comparative overview.

8.1.2 Overview of Energy in Asia: Selected Country Case Studies

In reviewing the renewable energy landscape in Asia, it may be helpful to take a couple of countries as illustrative examples of how their policy formulations reflect specific local issues and concerns as opposed to broader global trends. Here, Indonesia, Thailand, and Korea are compared.

Examining population compared to installed electricity capacity in many of these countries highlights the oftentimes limited availability of

energy in Asia. It is also a strong indicator of the quality of life and the development economics of the country. Specifically, Indonesia has a population of 245 million people — four times that of Thailand’s 65 million people — yet it has about 17 percent less installed electricity capacity (25 gigawatts (GW) versus 30 GW). This highlights both the less developed economic status of Indonesia and also what may be a key inhibitor to such development due to the distinct electricity supply shortages that currently exist in Indonesia.

Indonesia has rather diversified potential energy sources because it is very rich in natural resources. Although it is now a net oil importer, it was historically an OPEC country due to the volume of oil produced. In a pure assessment, the proportion of renewables seems comparatively large in the electricity generation fuel mix, occupying 13.8 percent of the fuel mix. However, this outlook is also somewhat distorted due to several large hydroelectric power plants on the remote island of Papua (Figure 3).

Thailand is heavily reliant on gas as an energy source (due to the availability of offshore sources in the Gulf of Thailand) and because of this imbalance in its energy portfolio, the government has been driving investment into and drafting policies to encourage alternative energy sources (Figure 4).

Korea (reflecting its relatively developed status as an OECD country — although it is not classified as a developed country for the purposes of the Kyoto Protocol) has 25 percent less people than Thailand (49 million compared to 65 million) yet twice the installed capacity. Korea has over

Indonesia

Indonesia-Electricity Generation by Fuel

GDP : \$430 billion

Population: 245 million

Total installed
electric capacity:
25,000 MW

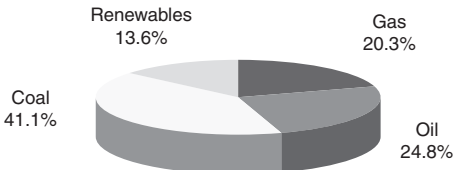


Figure 3 Indonesia: Electricity Generation by Fuel

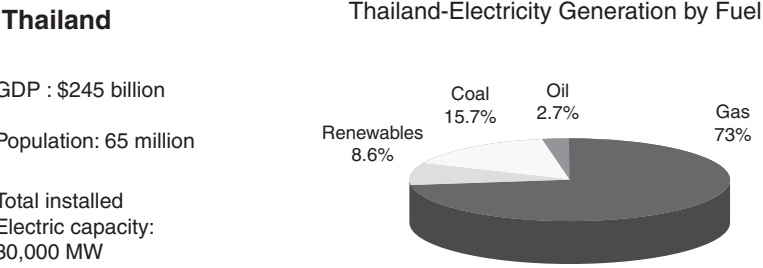


Figure 4 Thailand: Electricity Generation by Fuel

66 GW installed whereas Thailand only has 30 GW. However, Korea lacks its own energy sources — it is the fifth-largest importer of oil and the second-largest importer of liquefied natural gas (LNG), behind Japan in the Asia-Pacific region.

Hence, the government has invested heavily in securing their energy supply, oftentimes sending companies overseas to gain control of different energy commodities. Another result of the limited domestic energy sources has been a funneling of investments into building nuclear power plants. The chart in Figure 5 for Korea is distorted by the inclusion of nuclear into the renewables sector as nuclear accounts for 97 percent of all installed renewable energy capacity.

Looking deeper into each country’s profile, the direction of their renewable energy policy then becomes clearer as a reflection of the local economic profile.

8.1.2.1 Renewable Energy Development in Indonesia

Indonesia’s geography creates certain challenges to central electrification — the country is composed of hundreds of thousands of tiny islands, with roughly half of the national population living on the main island of Java. This has led to a concentration on increasing supply on the Java-Bali grid, which makes up 77 percent of the installed national electricity capacity (Table 1).

Indonesia has an installed electric capacity of 25 GW, with renewable energy making up only 2.7 GW of that pie. The actual renewable energy potential has been measured at over 140 GW.

South korea

GDP : \$1.2 billion
Population: 49 million
Total installed
electric capacity:
66,180 MW

South Korea-Electricity Generation by Fuel

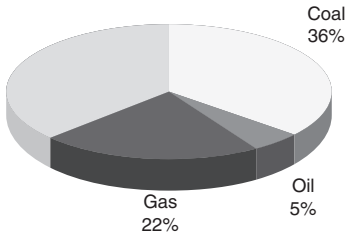


Figure 5 South Korea: Electricity Generation by Fuel

Source: Asia Renewables.

Table 1 Composition of Power Capacity on Major Islands in Indonesia (MW)

Composition of power capacity on major islands (MW)				
	Outer Islands	%	Java-Bali grid	%
Renewables	644	11	2751	14
Non-renewables	2617	46	16626	85
Diesel	2441	43	109	1

Source: Asia Renewables.

Indonesia has passed some legislation to support renewable energy development, including legislation which in theory has PT PLN (Persero), the national utility company, entering into power purchase agreements with renewables producers at a premium. The following laws provide such a framework:

1. Ministerial Decree No. 1122/2002 outlined new Power Purchasing agreements.
2. Law No. 27/2003 allows for private sector development of geothermal energy projects.
3. Regulation No. 3/2005 allows for private sector partnerships with PLN.
4. Ministerial Decree No. 002/2006 defines pricing for renewable energy Independent Power Providers (IPPs).

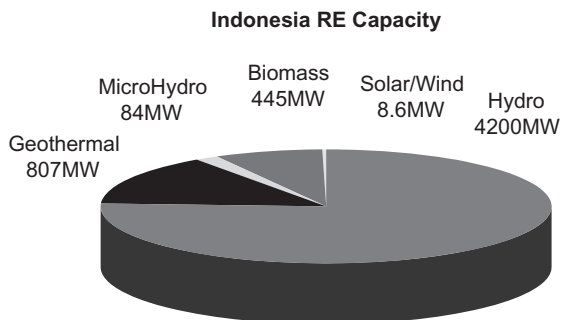


Figure 6 Indonesia's Renewable Energy Capacity

The initiatives in 2005 and 2006 sought to allow private players to develop smaller-scale projects (under 10 MW) quickly by providing for a “short-form” Power Purchase Agreement (PPA) template, faster approval time, and a PLN obligation to purchase. The PPAs are to have an extendable 10-year contract for projects under 10 MW with a guaranteed electricity off-take. Such laws were exactly what the market needed to help the development of renewables in Indonesia where much of the demand is spread across a vast geography and dovetails well with having many small plants to serve the distributed island populations (Figure 6).

However, at the same time, these new investment laws also managed to effectively stall any actual implementation of the law by prohibiting foreigners from taking an equity stake in any projects smaller than 10 MW. Such a prohibition not only directly limits foreign investment equity from going into a sector in need of such funds, but also casts a chilling pall over any foreign financing for such projects. Since financing often requires recourse against a project's equity, by closing such an option, debt financing is also affected. Especially in an environment where such projects are already challenging due to their small size and country risk, such new uncertainty adds another factor to encourage investors and financiers to invest elsewhere. Presently, while such a prohibition is under review, the uncertainty of such a review and timeframe has, in effect, stalled all such small-scale power projects in Indonesia.

Already, the exacerbations from government legislation have meant that the scoreboard for new electricity generation (Greenfield IPPs) in

Indonesia — for all power, not just for renewables — has been zero since 1997. Given that neither economic growth nor population growth had been at a standstill since 1997, such a lack of new capacity classically illustrates how economic growth is hobbled by a lack of sufficient infrastructure capacity, resulting in breakdowns and severe strains in supply.

Because of the huge shortfalls in capacity, the national government and PLN have been focusing their attention and resources on bolstering the main demand located on Java Island at the expense of the demand from the thousands of other islands with their scattered populations. To compound the frustration of logic, it is exactly in those scattered “outer islands” that there is significant untapped renewable energy potential that could be developed to satisfy just such unmet demand (Figure 6).

8.1.2.2 *Renewable Energy Development in Thailand*

Thailand is perceived in the markets as having the most comprehensive and investor-friendly renewable energy framework in Southeast Asia and has been the most successful in utilising policy instruments to incentivise private investment to implement projects. There are set PPAs for small-scale (less than 10 MW) plants and 5–25-year PPAs for projects between 10 MW and 80–90 MW. There are also Board of Investment (BOI) incentives such as temporary income tax exemption to ease cost of capital, subsidies to cover capital costs, and clear, high attractive tariffs under the Governments subsidized feed-in tariffs under their VSPP and SPP programs. Based on these factors, renewable energy projects have taken off in Thailand more than in any other Southeast Asian country.

Overall, Thailand has a 97 percent electrification rate, no acute shortage of energy, and a good grid network for transmission and distribution. However, there are also implementation difficulties. Specifically, the sale of energy is to the provincial authorities and not the national authority, which creates pricing and deal execution issues as there is no standardised process. This form of PPA is also not flexible for deal specifics, which rules out more creative deal structuring. Lastly, tariff resets add risk because they increase the risk and unpredictability of revenue.

However, the overall market perception is that the existence of such specific issues itself reflects the level of specificity in the legislative

framework and is a challenge to the project itself rather than a structural roadblock. Finally, too, the sale being to the provincial authority, the Provincial Electricity Authority (PEA), rather than to the national utility, the Electricity Generating Authority of Thailand (EGAT), actually helps renewables projects in that it keeps the oversight and management of renewables at the provincial level where the demand for such small-scale electricity and other stakeholders such as biomass providers are centred, rather than at the “distant” national utility level where the focus and attention may be on huge 1,000+ MW plants rather than the 10 MW plants.

8.1.2.3 *Renewable Energy Development in Korea*

As an OECD country, South Korea is at a higher level of economic development, but also shares with other Asian countries the policy emphasis on renewable energy. Korea is an extreme example of the pressure for renewable energy due to the almost complete lack of domestic fuel sources for power.

South Korea has the highest installed capacity at 66.18 GW, with renewables only making up 1.32 GW (solar, wind, mini-hydro, biomass/biogas), excluding nuclear. Due to the lack of natural resources, the government has been very proactive in building nuclear power plants and nuclear capacity is estimated to be around 22 GW or one third of total installed capacity, with many more plants planned in the next five years. South Korea’s renewable energy potential is estimated to be 80 GW (Figure 7).

Unlike Indonesia, given its compact size and homogeneous infrastructure, South Korea’s national government targets are easily implemented. Unlike Thailand, its government has one of the largest current account surpluses in the world and therefore has a tremendous amount of room to deploy financial support and incentives.

Korea currently has a renewable energy target of 5 percent by 2011 (currently 2.5 percent) and the government has proactively passed legislation and provided funding to support the achievement of this goal. Specifically, the government manages a Carbon Fund and Credit Fund that develops renewable energy projects and buys and sells those credits on the secondary market, respectively. The funds invest in renewable energy projects in the region in addition to domestic markets. Other legislation support includes differentiated feed in tariffs, with solar being the

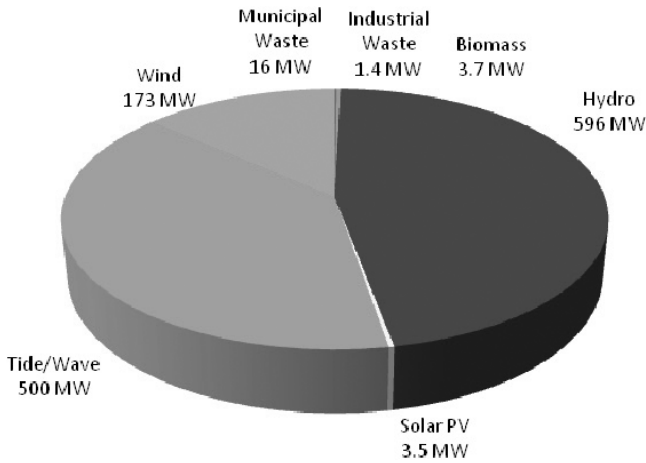


Figure 7 South Korea's Renewable Energy Mix

Source: South Korea's Renewable Energy Mix

highest at 0.70 cents/kWh, subsidies and tax incentives (which are up to 100 percent of costs for solar thermal/photovoltaics (PV)), and other national initiatives such as the Renewable Portfolio Standards and Voluntary Agreements. Current PPAs guarantee fixed rates for five years for small hydro and biomass/waste projects and for 15 years for solar PV and wind projects (Figure 7).

The implementation difficulties in Korea have reflected those overall for investments into Korea, namely technical specifics such as a cap on distributed feed-in tariffs (250 MW for wind and 20 MW for solar projects) and a lack of resources and land to build renewable energy projects. There has been progress on the second challenge that includes ongoing feasibility research with regard to the tidal and wind resources along the coast.

Despite these implementation difficulties, the programmes implemented thus far have had some results and, moving forward, there are also opportunities for private investors in the green tech sector. The government has declared that it wants to position itself as a green tech manufacturing export leader in Asia and has announced that it wants to invest 107 trillion Korean won (KRW), \$85.77 billion or 2 percent of the annual GDP, in green sectors. With regard to results, the differentiated feed-in tariffs that were

implemented in 2002 have led to the installation of 110 MW from over 40 power plants. The government has paid out KRW 11.7 billion so far (2006 Est.). The Voluntary Agreements Program implemented in 1998 to the present, which allows companies to voluntarily commit to limiting carbon emissions and increasing energy efficiency in return for tax breaks and other accounting benefits, has seen the participation of 1,288 companies, saving over 1.76 million tonnes of oil equivalent (MTOE) through energy efficiency programmes. The government has spent KRW 645.2 billion on incentives for the energy efficiency incentives under this programme. Overall, the commitment, especially financial, of the government is clear and has been a strong source of comfort to the investment community.

8.1.3 Practical Challenges to Developing Renewable Energy Projects

The reality is that while renewable energy has positive attributes for both the environment and energy security, there are clear reasons too why it is not more readily prevalent. There are a couple of key bottlenecks that often prevent the implementation of projects.

Renewable energy is considered a more “diluted” form of energy, for example it requires roughly four truckloads of biomass to achieve the same amount of energy that could be extracted from one truckload of coal. Such a challenge also means that sourcing and fuel supply chains are more dilute, for example many more truckloads of biomass would need to be brought in than for a comparable amount of coal-fired power generation.

Scale is also a challenge in that renewable energy projects tend to be small and thereby lose the economies of scale that large fossil fuel plants achieve. Large billion-dollar turbine orders for fossil fuel plants do clearly achieve preferential queue places for orders over a small 10-million-dollar order, resulting in months of delays (and lost revenues). For financial institutions, the same transaction costs for paperwork etc. apply for the billion-dollar-coal plant as for a 10-million-dollar biomass plant. Size matters.

Environmental safety and impacts are not neutral. Although renewable energy is generally thought of as “clean”, there are some adverse environmental impacts that can occur when building power plants. For example, the Three Gorges Dam has led to the displacement of people and destruction of

much of the ecosystem in the rivers. Even wind farms are meeting increasing community resistance due to their visual impact on the landscape.

Renewables also tend to be much more tied into geographical and seasonal factors. Renewables cannot generate electricity 100 percent of the time because the resources themselves are intermittent. Renewables are weather and geography dependent and not consistent. For example, wind farms cannot function on calm days and solar plants cannot generate electricity on cloudy days.

Finally, the overwhelming barrier is economic. Renewable energy is much more expensive than traditional fossil fuel plants. Even if costs per installed MW can be similar over the lifetime of the plant (such as coal and geothermal), the upfront or front-load nature of the costs for renewable energy development is much higher in terms of financial risk. For example, geothermal energy has virtually no fuel costs for the lifetime of a plant. On the other hand, all the fuel-related costs are upfront, including the roughly US\$3 million per drilled well (including dry wells) in sourcing the steam. Hence the financial expenditure profile for geothermal is far more expensive than a coal-fired plant where fuel costs are spread over decades. Hence, globally, renewables are overall not as economical, in terms of a developer's or investor's bottom line, as fossil fuel plants. While there are some debates about how the full social cost of fossil fuels is not included in the pricing of fossil fuel plants, nonetheless, for current developers and investors, the total expenditure is less economical for renewables.

8.1.4 Climate Change as a Driver of Renewable Energy Development

A recent development in the global renewable energy markets has been the rise of climate change considerations, namely the global market for climate change-related carbon offsets. The largest of these markets is that related to the United Nations Kyoto Protocol-related carbon credits, the Clean Development Mechanism (CDM) markets. All of these markets are tied to the various regulatory regimes in the world and the prices for tonnes of carbon in such markets. The price per tonne in the various markets ranges from US\$1 to US\$20 per tonne. Since 1975, there have been roughly 150 billion tonnes of carbon released into the atmosphere, with

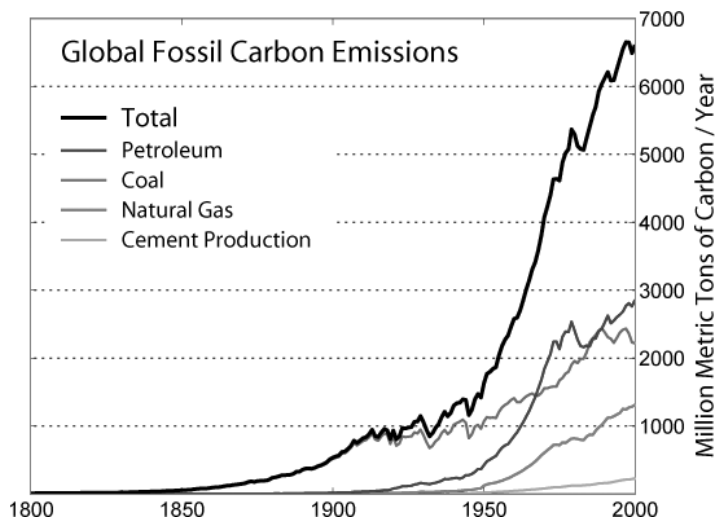


Figure 8 Global Fossil Carbon Emissions

Source: Wikipedia (2004), Global Carbon Emission by Type.

over 2 billion tonnes of carbon emitted from fossil plants yearly in the United States alone (Figure 8).

The Kyoto Protocol took effect in February 2005 and required certain countries classified as developed (Annex I) to meet certain targets, reducing their carbon output to below 1990 levels. Countries classified as developing countries, covering most of Asia excluding Japan, do not have to meet specific reduction targets, but for projects which generate reduction units, they can sell them to developed countries. There are six gases that are designated as greenhouse gases:

1. Carbon dioxide (CO_2)
2. Methane (CH_4)
3. Sulfur hexafluoride (SF_6)
4. Nitrous oxide (N_2O)
5. Hydrofluorocarbon (HFC)
6. Perfluorocarbon (PFC)

The Kyoto Protocol in effect created a cap-and-trade greenhouse gas market between the developed (Annex I) and developing (non-Annex I)

countries where units of carbon are traded, measured in tonnes of carbon equivalent. Practically, it created a mechanism for developed countries to invest in carbon reduction projects (energy efficiency, renewable energy projects) in developing countries and to translate the carbon saved from those projects into measurable carbon credits called Certified Emission Reduction (CER) units (1 tonne of carbon) that can then be exchanged in the markets for monetary gain (current prices at year-end 2009 are about US\$15 per tonne). The Protocol essentially transformed carbon into a commodity and created a marketplace for these CERs where companies that emit more than their allowance can buy and those that emit less can sell their allowance.

The impact on renewable energy projects has been that whereas previously such projects were deemed small, localised investment projects, a whole new category of potential developers and investors saw them as potential sources of CERs and their revenue streams. For finance purposes, the CERs are revenues from a global source rather than local ones which helps to make the revenue streams less risky as well.

Since 2005 when the Kyoto Protocol entered into force as international law, there has been a significant rise in global interest in small, localised renewable energy projects in Asia. As a rule of thumb, 1 MW of renewable energy generates roughly 5,000 tonnes of CERs. For a 10 MW renewable energy project then, it means roughly 50,000 CERs or, at 2009 prices, an additional revenue stream of US\$750,000 per year. Considering that a 10 MW project would cost roughly US\$15–20 million, the additional revenue source is a material one. As a result, developers have made CER generation considerations an integral part of any renewable energy project review in Asia.

8.2 “ON THE GROUND”

To look closer at how the various national systems and incentives and the CER markets are affecting renewable energy development in Asia, we will consider as an example one of the most popular forms of renewable energy in the region — biomass.

Biomass is especially relevant to most of Asia since it is often tied in a close relationship to large national agricultural sectors. Biomass is a strong example for the renewables sector because of such tie-ins, rather

than other renewables which are much narrower in terms of such national and societal tie-ins in Asia. For example, in Korea, solar has been highly supported due to its emphasis on technology, a priority policy area for the Korean government's growth policies. Wind is supported in China due to the presence of strong wind-related manufacturers but those same sectors are not well supported in other countries which do not have such a tie-in with national policy. Biomass generally cuts across all Asian geographies due to its ability to affect significant populations of agricultural producers and farmers as well.

Example: Biomass (Landscape)

Global biomass electricity capacity is 47 GW and makes up 7 percent of total renewable energy investment.

There has been a proliferation of small biomass projects in emerging Asia. This has been driven by several factors:

1. Strong economic growth and power demand.
2. Abundant resources, with more than 30 percent of the world's total biomass resources in Asia.
3. Governments across Asia have set ambitious targets which lead to funding and legislation support.
4. Large untapped potential, given that this is a growing and emerging sector with many of the opportunities yet to be tapped.

For example, there has been roughly 3,000 MW of biomass for power utilised in Southeast Asia and 2,200 MW utilised in China. While these numbers may look poor as they are out of a potential of 56,000 MW for Southeast Asia and 24,000 MW for China, because biomass plants tend to be small (less than 10 MW each), these utilisation numbers actually mean that there are large absolute numbers of plants.

8.2.1 Investment Considerations

In order to determine if a project is suitable, there are a couple of key factors that need to be checked. First, there needs to be a partner with knowledge of the local business environment. Second, the utilisation of existing and proven technologies decreases risk. The project must also qualify for

a stable PPA so that cash flows are less risky. It is also beneficial to have potential Kyoto Protocol financing (money from the sale of CERs) to help boost and stabilise investment returns. Lastly, the project should enjoy support from the local community and government to ensure that there are no implementation complications.

If those conditions are met and there is a solid project base, a private sector developer can then proceed to develop and invest in a renewable energy project. The project should yield revenue from three channels: 1) electricity sales, 2) fly ash sales (post-burning/fertiliser), and 3) CER sales. There is upward pressure on tariff prices and revenue generated from electricity sales in Asia because of the high economic growth and supply shortage. Indonesia's forecasted energy demand is 7–9 percent and Thailand's is around 6–8 percent. With regard to variables that can affect revenue from CER sales, one has to look at supply/demand and regulation which essentially controls demand in the market. Current CER demand is around 788 million to 1.1 billion tonnes of carbon dioxide equivalent per year.

Case Study: Biomass Power

Biomass combustion is one of the oldest and simplest forms of energy production. It is considered renewable and carbon neutral as it prevents the methane release that would have occurred had the waste been left to rot rather than be burned.

A typical illustrative biomass project is now shown.

Greenfield 12 MW Power Plant

Location: Southern Thailand

Fuel source: coconut residue

Fuel: at project site, owned by project owner

Technology: circulating fluidised bed boiler

Its financial projections are given in Table 2. Key assumptions in this project are as follows:

1. There is no alternative use for the fuel, no fuel transport costs, no grid connection costs.

Table 2 Financial Projections and Metrics

Financial Projections & Metrics		
Total CAPEX	US\$ 20 mil	
Post –Tax NPV@12%	US\$430,000	
Post –Tax IRR	26%	
Average annual electricity revenue	US\$ 7 mil	
Average annual CERs	57,300	
Average annual CER revenue	US\$ 1 mil	

Sensitivity Analysis: Change (%) of NPV @ 12%		
	10% Improvement	10% Deterioration
CER Price	3.9%	-3.9%
Power Sale Price	26.0%	-26.0%
Fuel Cost	5.6%	-5.6%
O&M Cost	8.3%	-8.3%

Source: Asia Renewables, internal financial model template.

2. No problems in issuing CERs.
3. PPA is renewed for 20 years.
4. Energy Performance Certificate (EPC) per MW is US\$1.4 million.
5. Operations and maintenance is 1.5 cents/kWh.

In terms of timing, running costs¹, permitting, etc., are expected to take 1–1.5 years; construction will take 16 months.

There are numerous underlying variables that are assumed and controlled in the financial analysis but generally the internal rate of return (IRR) is relatively high at 26 percent and there are opportunities to generate gains in this sector if projects are implemented properly.

¹“Running costs” are those which are incurred every month during construction. In other words, before there is any revenue. Therefore, having a longer construction period means there is a longer period of uncovered running costs which means more difficulty in staying afloat until the plant can actually run and generate revenues.

8.2.2 Practical Choke Issues

While there are no major specific hurdles to such a small-scale project and the financial profile looks attractive, actual implementation (the actual build-up of the plant) is often difficult and, with the majority of projects under development in the emerging markets of Asia, tends to be quite low. Development timelines which should be a matter of months often stretch to several years, if the projects are even completed.

Figure 9 demonstrates all the issues at each stage of the project implementation value chain that need to be addressed. If such issues are not secured, they can “choke” or prevent the project from being implemented. As can be seen, the main challenges for a biomass power plant are not necessarily technology-specific ones or matters tied to the nature of biomass itself, but rather those related to any implementation of smaller-sized projects in developing markets.

The main choke point is financial. The financial considerations are not unusual and at first glance the project appears financially attractive with a high IRR of 26 percent and a positive net present value (NPV). However, these numbers may be more fragile than they appear, in that fuel prices are

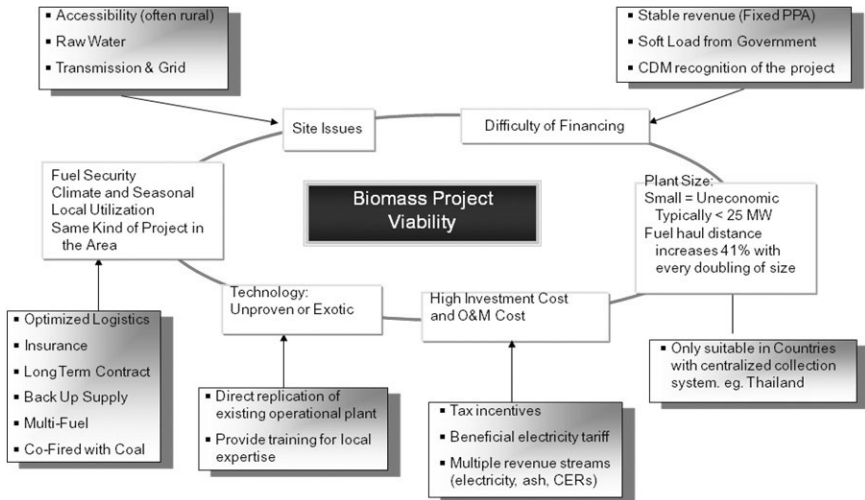


Figure 9 Biomass Project Viability

Source: Asia Renewables.

volatile and their logistics are delicate. Since biomass is more diluted than, say, coal, a much larger quantum of biomass is needed and the shipping and transport then becomes a critical issue. Also, most biomass plants tend to be located near their fuel sources, i.e. in the countryside, which poses additional difficulties of remoteness from supporting infrastructure, and the need to put up expensive grid connections to the nearest suitable transmission lines.

Finally, the nature of the financing required also poses a challenge in that whereas for a larger fossil fuel plant, project financing is an option, for such smaller plants where the capital expenditure (CAPEX) is US\$20 million or less, bank financing becomes difficult. Whereas a larger plant may only need to put up 30 percent of the CAPEX as equity and rely on 70 percent bank financing, for smaller plants all US\$20 million may need to be put up as equity, thereby making the cost of the smaller plant much dearer in terms of equity. This is especially so for smaller companies which may be engaged in such a sector rather than larger companies engaged in larger fossil fuel plants. These smaller companies already facing a higher cost of equity would now have to face an even higher threshold as the smaller biomass plant would require all equity financing from the company's own balance sheet rather than through non-recourse bank financing.

As is, while projects such as this particular biomass one looks financially attractive, since a snapshot of metrics such as NPV and IRR and the challenges of implementation and build-out do not highlight any one crippling hurdle, the reality is that due to the insufficient financial structure (how to finance the building of the plant and being able to get to the point where IRR and NPV are actually being generated), this project and others like it across emerging markets in Asia are simply not being built and are being regularly rejected by financial institutions and investors. In turn, notwithstanding the grand rhetoric of policy targets, the reality of renewable energy development reinforces the tiny sliver of the overall electricity markets being held by renewables. Simply, renewables are a small market segment for good reason.

8.3 CARBON NEXUS

As seen earlier, the main deterrent to the development of more renewable energy projects is structural in nature, i.e. financial returns are not

sufficiently attractive for small-scale projects, country risk in emerging markets, and renewable energy characteristics such as diffuse and sensitive fuel supply considerations. For governments, the main tool against such hurdles has been to provide a higher tariff for electricity sales and to try to streamline taxes and other regulatory hurdles. Thus far, individual national incentives and systems for renewables have been generally insufficient in generating more renewable energy project developments in Asia. To achieve the policy aims for renewables development and other objectives such as fuel security, the national governments in Asia then face the challenge of further increasing tariffs and improving other incentives. However, in a time of global economic challenges and downturns which put pressure on fiscal budgets everywhere, and with the inward-turning orientation by the developed nations to focus on their own economic issues and renewables challenges, a further systemic boost from outside their national confines may be needed. Coupled with such tools at a national level are the new carbon-related ones, which are seen in the emerging markets of Asia as possibly being an additional boost.

The CER markets under the Kyoto Protocol were specifically structured to provide an additional boost to a project's financials by introducing an entirely new revenue stream and also a whole new class of potential investors with international risk profiles.

8.3.1 Overview of CER Generation Mechanism

To simplify the process, there should be an underlying project whose activity generates CERs. Then there is a documentation procedure to certify the CERs and this step spans local government approval, third-party confirmation, and then UN approval. The CER generation process is an administratively long and complex procedure, and depending on the type of renewable energy project it is (unproven methodologies can take up to two or three years to get approved), there is a range of timeframes for carbon financing that can be secured.

This lengthy process has given rise to the carbon consulting industry, which is composed of firms that purely consult developers with regard to the process of certifying their carbon emissions. There are currently 1,785 projects registered, with only 7.3 percent of those projects from Southeast Asia.

Table 3 Southeast Asia: Average Annual CER Reductions and Registered Projects by Host Party

South East Asia: Average Annual CER Reductions		South East Asia: Registered Projects by host party	
Indonesia	3,337,551	Malaysia	46
Malaysia	3,111,479	Philippines	27
Philippines	1,367,251	Indonesia	24
Thailand	1,287,486	Thailand	17
Viet Nam	889,577	Viet Nam	5
Singapore	15205	Singapore	1
SE Asia Total	10,008,549	SE Asia Total	120
% of global	3.316712768	% of total	7.303712721

Total projects registered:	1,909 projects 325 million CERs
Average number of projects approved:	200 projects per year
Average size of CER per project:	170,326.5 CERs
Estimated 2012 annual global demand:	2 billion metric tonnes

Source: United Nations Framework Convention on Climate Change, <http://www.unfccc.org>.

A look at Table 3 highlights Southeast Asia's relatively small market share of annual CER reductions. Table 4 shows the number of projects in validation compared to registered (far outnumbered) and also highlights the administrative bottleneck and the subsequent long queue of projects.

While the CDM system is therefore working mechanically, these numbers of projects highlight that the raw, absolute numbers of projects

Table 4 State of the CER Pipeline (2005 to March 2009): Number of Projects at Each Stage

State of the CER pipeline, 2005-March 2009 number of projects at each stage				
Data:				
Units: number of projects				
Year	Issuing	Registered	At validation	
2005	4	64	494	
2006	104	471	870	
2007	281	898	1734	
2008	441	1325	2709	
2009	473	1421	2766	

Source: New Carbon Finance.

qualifying as CDM projects and thus providing a supply of CERs is still rather low and potentially inadequate to meet the demand.

8.3.2 Reality of the CDM Universe

Is the CDM market sufficiently robust then to satisfy the need of the renewable energy development sector in Asia to boost overall construction and build-out levels? Due to a variety of bottlenecks, including the CER generation mechanism and other challenges to developing renewable energy projects listed previously, there has been a very limited increase in the supply of carbon credits to the primary market. At the same time, governments are passing more ambitious carbon emission and renewable energy targets, driving up demand for these credits. These two forces — driving supply down and demand up — have increasingly widened the gap between supply and demand in the carbon credit market.

Worse still, the Kyoto markets have inherent systemic faultlines. A sample of various countries' positions highlights how far countries are from meeting their Kyoto Protocol targets (Table 5).

Countries such as Canada and Spain are far from being able to meet their 2012 targets and have even indicated that they would not be able to meet such targets. As there is no punishment mechanism under the Kyoto Protocol, failure to meet targets does not carry specific and meaningful risks. Further, due to a historical quirk whereby many former Soviet bloc

Table 5 Sample of Projected 2012 Positions for Various Countries

Sample of Countries' Positions projected 2012	
EU-15	−5.1% (−217 Mt Co2 equiv)
Russia	−33.8%
Italy	−0.2%
Spain	−0.4%
UK	−9.6%
Canada	32.2%
Japan	15.1%

countries are below their 2012 target levels due to a deterioration of their own economies after the collapse of the Soviet Union, there is actually a large supply overhang of carbon offset units (called Assigned Amount Units or AAUs) which could, on paper, satisfy all CER demand globally without making any impact on actual carbon reductions. Due to the lack of CERs, critics have derided AAUs as “hot air”, citing a massive global surplus and arguing most were generated through restructuring in Eastern Europe in the 1990s, when polluting industries in ex-communist countries were shutting anyway, rather than through new investment. This is directly evident in Ukraine’s and Russia’s positions which are both in the negative.

Currently, the average annual demand for CERs is about five times more than the annual supply estimated in Phase 1 of the Kyoto Protocol. At current rates, the UN would need to approve 1,000 projects per year to meet the demand. However, currently only 500 projects per year are approved. As seen in Figure 10, the current rate of project approval (i.e. market supply) is far less than would be needed by 2012 and any straight-line projection between them would be quite an optimistic one.

The reality in the UN’s Kyoto carbon markets has been the opposite: waiting times, project uncertainty in the approval process, and rejection rates with no recourse or even explanations, have all increased, thereby further depressing prices for carbon. Further, the continuing uncertainty over the nature of the successor to the Kyoto Protocol (expiring in 2012) has also cast a pall on how to judge any future revenue stream

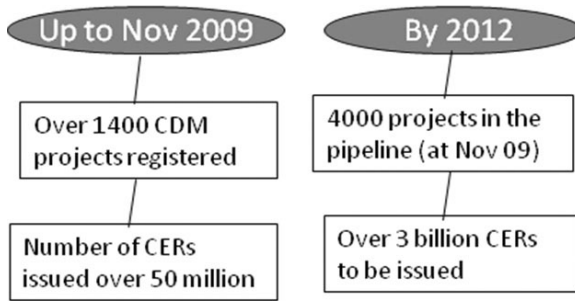


Figure 10 CER Projections

Source: United Nations Framework Convention on Climate Change and Author's Projections.

post-2012. The gaps and uncertainties exacerbate the reality that the carbon markets are failing to provide assurances to the renewable energy development market that carbon revenues could be the boost it needs to overcome its own challenges of insufficient renewable energy project build-outs.

8.4 CRYSTAL BALL

8.4.1 Looking Ahead

Looking ahead in the renewable energy sector, while there is strong policy support at present among the various countries in Asia, the current systems of industry, regulatory, and financial supports have not been adequate to significantly increase the number of projects being actually built out. The challenge is not in technology but rather finances. The challenge of supporting small-scale projects has not been sufficiently dealt with to overcome the hurdle of reluctance among financial investors to invest in such a sector when there are many other sectors in the same emerging markets which may seem more attractive. The emphasis on cleantech as a solution to the lack of actual project construction is misguided. Indeed, new or advanced technology presents more of a hurdle in providing financial comfort to investors who prefer tried-and-tested technologies to anything new and potentially unworkable. Even in the carbon markets, any new technologies require additional methodology review procedures which add several years of approval uncertainties and investment delays

to a project. The problem remains that to actually build out a project requires more financial support, especially at the construction phase.

In terms of the global carbon markets, there had been strong expectations that such markets could provide the boost that the renewables sector required to overcome the initial hesitance about projects to be funded during construction. Since carbon buyers and investors are international ones, their risk and funding profiles are expected to be different from those local financing options which have thus far been reluctant to fund local small-scale infrastructure. However, the long lead times and increasing levels of uncertainty in the Kyoto market system itself have meant that the carbon markets are as yet not ready to bridge that financing comfort gap.

Although there has been an enormous amount of expectations about positive synergies between the Asian renewable energy development market and the global carbon offset (Kyoto) market, to date they have not yet been realised and both are now at a crossroads where several additional questions arise.

On the carbon market side, there is still the need for further clarity on how a post-2012 carbon offset market will look and how it could be structured. While there are specifics still to be sorted out, major conceptual changes would also need to be addressed, such as coupling more systems of carbon offset generation with the need to promote small-scale project challenges and reducing timeline uncertainties which hurt any financial benefits which the carbon revenues could potentially provide.

From the local perspective, rather than waiting for global carbon markets to provide an external solution, national governments must continue with the unglamorous but necessary steps to tighten and strengthen their policy frameworks, not only increasing tariffs, but lessening red tape, increasing local financial support and bank loans, speeding up various permits and licensing steps, etc. In Asia already, some of these steps have worked such as localised approvals and PPA processes in Thailand, the high solar tariff structure in Korea, the new legal framework for renewables in the Philippines, and, with some revision on foreign investment, the new regional small-scale renewables framework in Indonesia.

As yet, renewable energy development in Asia remains small, but with a continued, disciplined approach, there are no critical hurdles which should prevent a deepening of the growth of that market.

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PART II

NUCLEAR ISSUES IN ASIA

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CHAPTER 9

POWER DEVELOPMENT PLAN AND STATUS OF NUCLEAR POWER PLANT (NPP) DEVELOPMENT IN INDONESIA

Djoko Prasetyo

ABSTRACT

Electricity demand in Indonesia has been growing rapidly, and to meet the future demand, large scale power plants have been planned, mostly coal power plants for baseload generation along with considerable amount of geothermal and hydro power. The national electricity company, however, has yet to plan any nuclear energy, as the government's national electricity general plan did not indicate any nuclear power. The paper reports the efforts that have been made by Indonesia over the years to develop the nuclear industry, including to prepare nuclear power projects. The paper also provides some highlights from the media coverage, which act as exhibits as to whether Indonesia will develop nuclear power. The paper reports the preparedness of Indonesia in preparing nuclear infrastructure for pre-project phase as per the IAEA's INIR evaluation.

9.1 INTRODUCTION

Indonesia is recognised as one country in the Association of Southeast Asian Nations (ASEAN) that could embark into nuclear power, and this

paper will report the status of nuclear power plant development in Indonesia. The paper will first highlight the current situation of the country's electricity supply and demand, followed by a brief description of the power development plan that has been prepared by PT Perusahaan Listrik Negara (PLN) Persero (the national electricity utility). The paper will then revisit the historical efforts by Indonesia over the years to develop the nuclear industry as well as to prepare nuclear power projects, along with some highlights from the media coverage. Finally, the paper rounds off with a summary and conclusion of the International Atomic Energy Agency's (IAEA) integrated nuclear infrastructure review (INIR) mission conducted in 2009.

9.2 THE “THREE A’S” SITUATION OF THE ELECTRICITY SECTOR

The vast geographical condition of Indonesia's archipelago which spans three time zones and comprises many thousands of islands presents Indonesia as a unique country in terms of electricity provision. Almost 60% of the population resides in Java Island, where most of the economic activity of the country is concentrated; hence about 75% of the national electricity provision is located in the most populous island of Java, as shown in Figure 1. Java's Bali power system has now developed into a mature and modern power system which has a large power grid and large-scale power plants.

Typically for a developing country, the electricity demand in Indonesia is growing very fast. It is estimated that for the gross domestic product (GDP) to grow by 1% annually, the economy will need electricity input to grow by 1.5–2%. Therefore when the government set the target of GDP growth at 6–7% annually, it is expected the electricity demand will grow at 9–11% per year. Consequently, the electricity demand for western Indonesia, eastern Indonesia and Java-Bali will grow from 21 terawatt hours (TWh), 11 TWh and 115 TWh respectively in the year 2010 to 54 TWh, 28 TWh and 252 TWh, as shown in Figure 1.

Borrowing the World Energy Council's criteria of “three A's”, i.e. Availability, Accessibility and Acceptability, Indonesia's current situation in its power sector is markedly challenged.



Figure 1 National Electricity Provision: Centred around Java Island

Source: PT PLN (Persero), *Rencana Usaha Penyediaan Tenaga Listrik PT PLN (Persero) 2010–2019*, Jakarta, 2010, ISBN 978-979-1203-14-2.

In terms of availability, electricity supply in many islands, especially those outside Java and Bali, has been constrained along the years due to capacity shortages. Those capacity shortages have been mainly caused by insufficient capacity development due to under-investment, especially since the East Asian economic crisis in 1997 that caused cancellations and delays of many power projects. Only in 2006 did the government initiate a fast-track programme to build 10,000-megawatt (MW) coal power plants to overcome the electricity crisis happening across the country, as well as to replace costly oil combustion for power generation with coal. This was recently followed by the second phase of the fast-track programme in which Indonesia is to add another 10,000 MW in capacity, comprising coal, geothermal, gas and hydropower projects.

In terms of accessibility, only about 65% of people currently have access to electricity, while the remaining 35% or approximately 80 million people have yet to enjoy electricity. The vast geographical coverage of the country contributes to the slow progress of the rural electrification programme, especially in remote areas and outer islands. The government and PLN have strived to increase the electrification ratio by developing

locally available renewable energy resources, installing numerous solar home systems and building grid extensions, yet the insufficient budget and limited power generation capacity have made the progress rather slow.

In terms of acceptability, Indonesia's decision to continuously develop large-scale coal power plants in the future perhaps needs better understanding from the international community regarding the greenhouse gas (GHG) emissions. However, the decision is quite natural, considering coal supply is domestically available in abundance. Indonesia actually understands and addresses climate change seriously; therefore in some important climate change events Indonesia has expressed its intention to cut its emissions by a certain amount from the baseline. One of the most notable programmes in the national agenda is the development of large-scale geothermal power plants wherever they are available.

9.3 POWER DEVELOPMENT PLAN

Endowed with quite large coal reserves and geothermal potential and some gas reserves as well as hydropower, Indonesia has intentions of developing a mix of energy for power generation, as shown in Figure 2.

One can see from the figure that Indonesia is going to utilise renewable energy wherever it is available and whenever it is ready, especially geothermal and hydropower. Still, coal will largely dominate the fuel mix for baseload generation.

One can also see in Figure 2 that nuclear power is not included in the power development plan prepared by PLN, because in the planning process PLN is required by the regulations to refer to the national electricity general plan Rencana Umum Ketenagalistrikan Nasional (RUKN) issued by the Ministry of Energy and Mineral Resources, and this planning document does not contain any mention of nuclear power plants.

9.4 NUCLEAR POWER DEVELOPMENT IN INDONESIA

Indonesia has come a long way in the use of nuclear technology for peaceful purposes. It started almost 60 years ago when in 1954 the government set up a committee for radioactivity, as shown in Table 1.

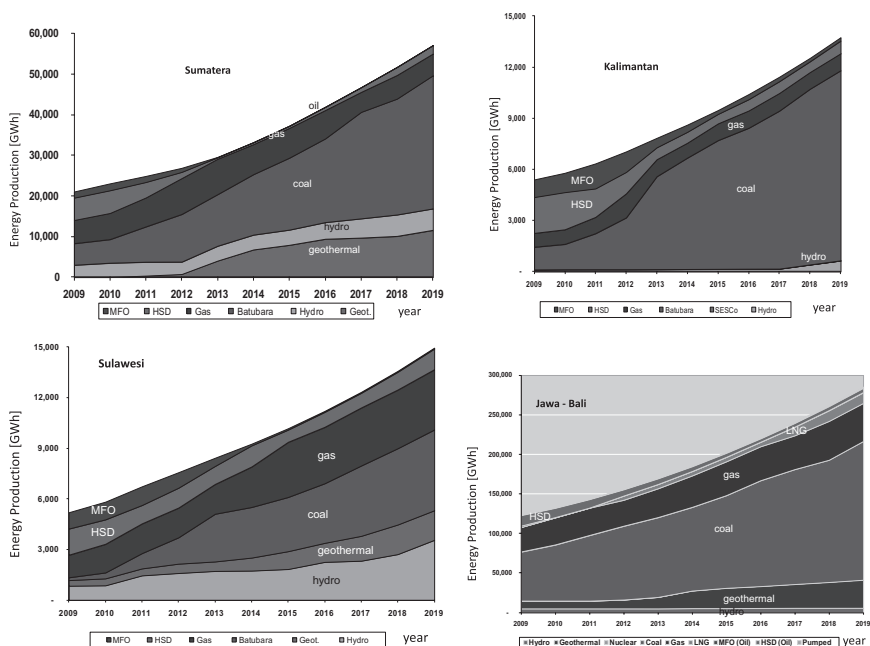


Figure 2 Projection of Fuel Mix for Major Power Systems in Indonesia 2010–2019

The milestones that signify the development of nuclear power plants are shown in *italics* in Table 1. It was in 1991 when the government assigned BATAN (the National Nuclear Energy Agency of Indonesia) to conduct a feasibility study (FS) of a nuclear power project located in Jepara regency of Central Java province, and the FS was completed in 1996. Then in 1997, Law No. 10 regarding nuclear energy was enacted in the midst of the economic crisis. Under this law, the Nuclear Energy Control Board (BAPPETEN) was established, and BATAN as we know it today was also established.

A comprehensive energy planning study called CADES (Comprehensive Assessment of Different Energy Sources for Electricity Generation in Indonesia) was carried out between 2000 and 2002 involving many stakeholders in the energy sector, namely the Ministry of Energy, Agency for the Assessment and Application of Technology, Directorate General of Oil and Gas, Directorate General of Electricity,

Table 1 History of Nuclear Industry in Indonesia

1954: Establishment of State Committee for Radioactivity
1958: Establishment of Atomic Energy Council and Atomic Energy Agency
1964: Establishment of BATAN (National Atomic Energy Agency)
1975: Operation of Triga Mark II research reactor (250 kW)
1970: GOT signed NPT
1971: Operation of Triga Mark II research reactor (1 MW)
1972: Establishment of Commission for preparation of NPP construction
1978: Ratification of NPT by Parliament
1979: Operation of Kartini research reactor (100 kW)
(1986: Chernobyl)
1987: Operation of RSG research reactor (30 MW)
1988: Operation of radioactive waste management facility
1989: GOI decision to build NPP
1991: <i>Start of NPP FS</i>
1995: Whole Indonesian core of 30 MW research reactor
<i>1996: FS completed</i>
<i>1997: Nuclear Energy Act No. 10 of 1997 (also start of Economic Crisis)</i>
<i>1998: Economic crisis continued, establishment of BATAN and BAPETEN</i>
2000: Operation of Triga Mark II research reactor (2 MW) advanced SI reactor
<i>2000: Start of comprehensive assessment of national energy planning</i>
<i>2002: Study completed, NPP was feasible in 2016, submitted to the President in 2003</i>
<i>2005: NPP was included in the RUKN 2005–2025 by MEMR</i>
<i>2006: National Energy Policy 2005–2025 Presidential decree 6/2005(nuclear energy will be a part of national energy mix)</i>
<i>2007: National Long-Term Development Planning 2005–2019, Law No. 17/2007 (NPP maybe utilized in a period of 2015–2019)</i>
2008: RUKN 2009–2027: NPP not included.
<i>2010: National Mid-term Development Plan 2010-2014, Presidential Decree No. 5/2010 (BATAN to carry out FS of NPP at new sites and to conduct socialization).</i>

Source: Adiwardoyo, *Energy Situation and Nuclear Power Development in Indonesia*, presentation material at Tsuruga Summer Institute on Nuclear Energy 2008, Tsuruga, Japan, September 2008.

State Electricity Company, Bureau of Statistics, non-governmental organisations (NGOs) and IAEA. It is in this study that nuclear power plants were said to be feasible to be introduced in 2016, and subsequently nuclear power plants were included in the RUKN, the national electricity general plan, for 2005–2025.

Another milestone is Law No. 17 of 2007 about national long-term development planning in which nuclear power may be utilised in the period between 2009 and 2019. However, we are now already in the year 2010, and the government has yet to announce or appoint the entity that will assume responsibility for building and running nuclear power projects. Considering the long lead time in the preparation and construction of nuclear power projects, it is considered no longer possible for Indonesia to have its first nuclear power plant running earlier than 2021.

There are at least two current documents showing the intention of Indonesia to build nuclear power projects. One is Law No. 17/2007 regarding National Long-term Development Plan 2005–2019 and the other is Presidential Decree No. 5/2010 regarding National Mid-term Development Plan 2010–2014. In the first document it is said that Indonesia might use nuclear energy from 2015–2019. In the second document the government assigned BATAN to conduct new feasibility studies of nuclear power plants at new sites, and to carry out socialisation and public awareness campaigns, with both assignments being supported by a considerable state budget.

9.5 HIGHLIGHTS OF MEDIA COVERAGE OF NUCLEAR POWER DEVELOPMENT

In general there has not been a clear statement made by the national leaders on whether Indonesia will develop nuclear power. Every now and then one can only find scattered media reports on statements made by government officials in seminars, NGOs or ministers. The following are some examples of media coverage of nuclear power development in Indonesia.

Government indecisiveness in deciding who would own and run nuclear projects was highlighted in a seminar in March 2010, as seen in Figure 3. As will be discussed in another section of this paper, an IAEA integrated nuclear infrastructure review mission which took place last November also noted the need for Indonesia to establish a nuclear energy programme implementing organisation (NEPIO).

Indonesia's plan to establish nuclear power plants remains unclear due to government indecision over who should operate them. BATAN admitted the absence of a definitive decision on operators had hampered discussions on the plants.

"No decision has been made on which organization will be responsible for owning and operating nuclear power plants," BATAN chairman, Hadi Hastowo, told a seminar on the prospects of nuclear electricity in Indonesia on Thursday.

Authorities have long argued that, nuclear plants are needed to tackle expected energy shortages as the country's fossil fuels continue to decrease.

However, a coalition of activists, including Greenpeace Indonesia, the Anti-Nuclear Society (Manusial) and the Civil Society Forum (CSF) have rejected the proposal, saying the projects are too risky in a country that lacks the technology to treat hazardous waste.

(The Jakarta Post, Fri, 03/19/2010).

Figure 3 Government Indecision Hampered Nuclear Power Discussion

Source: Adianto P. Simamora (2010), *Plans for nuclear power stalled due to govt 'indecisiveness'*, The Jakarta Post, March 19.

This indecision would have definitely delayed the timing of the first nuclear power plant in Indonesia (see Figure 4). It is now no longer possible for Indonesia to keep the previous schedule of having the first unit running in 2016.

In February 2010, five pro-nuclear NGOs organised an event in Jakarta, during which they declared their support for the government's effort to build nuclear power.

A positive support from the parliament was apparent when Commission VII, which is in charge of energy policy, urged the government to speed up the development of nuclear power (Figure 5). In another media article, it is reported the first nuclear power project in Indonesia might be situated outside Java island, with Bangka — Belitung area cited as one of the safest site for nuclear power projects in Indonesia (Figure 6).

The examples mentioned in this paper give some understanding of the discourse happening between the government, politicians, NGOs and public in general about nuclear power. One can observe from the media reportage that a firm declaration from the national leaders that "Indonesia is going nuclear" is lacking. In fact, the government seems quiet.

Indonesia is now definitively planning to have a nuclear power plant some time between 2018 and 2020, instead of in 2016 as previously scheduled, National Nuclear Power Agency (Batan) chief Hadi Hastowo said.

“It has been postponed to 2018–2020 because it is not possible to build it in 2016,” Hadi said at a discussion themed “Remembering the Chernobyl Disaster 24 Years Ago” here Friday.

He said the Indonesian public should know that the country’s need for electricity is to soar drastically in the future and that building a nuclear power plant must be included in the national energy development plan if future electricity shortages would be prevented.

“A nuclear power plant will not negate other alternative energy sources because it will only be a supplement to ensure the constant availability of electricity. All the other alternative energy sources such as geothermal, hydro, wind, solar and biomass will remain in the national development plan,” he said.

(Antara News, May 1, 2010)

Figure 4 Nuclear Power Development in 2016 is No Longer Possible

Source: *RI nuclear power project’s timeframe pushed back to 2018–2020*, Antara News, 1 May 2010, Jakarta.

In a major new policy direction, an important parliamentary panel in Indonesia has strongly recommended that the government move toward speedy development of nuclear power plants as part of the country’s efforts to reduce oil dependency.

“The Indonesian parliament’s Commission VII, which focuses on energy and mining sector policies, Wednesday said it was in favor of developing nuclear power as an alternative energy source. “It’s a promising energy

[source] amid Indonesia’s oil and gas shortage. It’s urgently needed, so the feasibility study should be done as soon as possible,” commission member Satya Widya Yudha told reporters Wednesday.

[businessweek.com/asian-energy-17 Mar 2010].

Figure 5 Politicians in Parliament Support Nuclear Power Development

Source: Anita Nugraha (2010), *Indonesia Parliamentary panel urges speedy move into nuclear power*, <http://bx.businessweek.com/asian-energy-business/>, 17 March.

Indonesia probably will build a nuclear plant in outside Java islands.

Indonesia will build nuclear plant electricity in outside Java island, one of the safeties place were Bangka-Belitung and Kalimantan islands, sources in Jakarta on Thursday, April 29, 2010.

The first plan of Indonesian nuclear electricity plant was in Muria Mount areas in Central Java, but the plan were opposed by local peoples, and other Green activist that Java islands is a populated and dangerous areas.

The only islands in Indonesia that could not have a negative impact from the earthquake is Kalimantan (Borneo) Islands.

“The International Atomic Energy Agencies (IAEA) was did the possibility studies in Bangka-Belitung areas for the next Indonesian Nuclear electricity plants. But we will see the result next 6 years in order to know weather the Bangka-Belitung islands provinces are the most safeties places for Indonesian first nuclear plants or not,” Indonesian Mineral and Energy Resources Ministry Bangka Belitung branch Chief Noor Nedi said in Pangkalpinang.

<http://www.allvoices.com/contributed-news/5700848-indonesia-probably-will-builld-a-nuclear-plant-in-outside-java-islands>.

Figure 6 Indonesia Considers Building Nuclear Power Outside Java

Source: Allvoices.

9.6 PREPAREDNESS OF INDONESIA IN NUCLEAR INFRASTRUCTURE ISSUES

As shown in Table 1 earlier, Indonesia’s nuclear industry has come a long way since the 1950s, and many infrastructure issues in nuclear power have been addressed over the years. Nevertheless Indonesia needs to examine the preparedness of the development of national infrastructure for nuclear power according to the IAEA’s 19 milestones, as described in the IAEA’s document NG-G-3.1. Therefore the government of Indonesia, represented by BATAN, in 2009 requested the IAEA to send an INIR mission to evaluate the status of nuclear infrastructure issues and to identify areas needing further attention during the building of national infrastructure, as well as to assist Indonesia in preparing plans of action to address areas for further improvement. The INIR mission took place between 23 and 27 November 2009, and the Agency sent a team of IAEA and international experts.

The scope of the mission was to review the current status of infrastructure development in Indonesia, discuss actions from previous missions, and consider an Indonesian action plan and possible international assistance.

The INIR mission evaluated the progress in each of the 19 infrastructure issues for Phase 1 (pre-project) and Phase 2 (project decision making), with respect to the specific guidance. The following are some of the conclusions made by the INIR mission:

- **National position:** There is national understanding that nuclear power is a part of the future energy mix and that considerable activities have been completed to prepare the infrastructure needed for a nuclear power programme. Yet the mission could not see “the overall picture as to what extent the activities were well coordinated”. The mission reckons Indonesia needs to establish a well-coordinated implementation programme and identify the role and responsibilities of the different organisations involved in the nuclear power programme. The mission proposed a national team be established with the following tasks: i) creation of an action plan for infrastructure building; ii) coordination, oversight, monitoring and steering in order to ensure balanced and coordinated development of national infrastructure; iii) defining the responsibilities by clarifying “who is responsible for what part of the nuclear energy programme”; and iv) full development of policy and strategy over the 19 issues of the milestone document.
- **Nuclear safety:** Milestone 1 was achieved for nuclear safety.
- **Management:** Indonesia has taken into account in great detail the different management issues, such as studies on national energy strategy and the possible role of nuclear power, including assessing national criteria and general specifications for an NPP, but these studies need to be updated. Ownership options and operational responsibilities have been considered, but no decision has been made on which organisation will own and operate the NPPs. Identification of the owners/operators of NPPs and determination of their responsibilities in the development of the nuclear power infrastructure are recommended by the mission.

- **Funding and financing:** Indonesia understands fully the different funding and financing aspects, but no decision has been made, because there has not been a decision on the owners/operators. The mission recommends that Indonesia identify the appropriate funding scheme for the selected owner/operator, and develop a funding method for long-term waste and decommissioning liabilities.
- **Legislative framework:** Indonesia understands the international legal regime concerning nuclear power, and has plans to review the national laws governing its nuclear power programme. They recommend that Indonesia review the nuclear and relevant non-nuclear legislation that will affect the nuclear power project, and finalise the ratification process for the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.
- **Safeguards:** Indonesia understands the safeguards requirements concerning nuclear power. No further recommendation is made.
- **Regulatory framework:** The regulatory framework is in place and no major gaps were identified with respect to Phase 1. The mission recommends an IAEA integrated regulatory review service (IRRS) mission to be considered at an appropriate time.
- **Radiation protection:** Indonesia is well prepared in the field of radiation protection, consistent with the level of development of the NPP project.
- **Electrical grid:** The considerations of the grid for the nuclear power project are well understood by PLN. PLN considers itself to have the capability to analyse the implications of installing NPPs in its network, including alternative sites.
- **Human resources:** Indonesia has done human resource development (HRD) for Phase 1, and has a solid foundation for preparing for Phase 2. The HRD Blueprint has not been developed. The mission recommends involving owner/operator candidate organisations as soon as possible in planning for HRD.
- **Stakeholder involvement:** Stakeholder involvement and communication is a weak point in the preparations for a nuclear power programme in Indonesia and there is a need to strengthen these activities.
- **Site and supporting facilities:** The site selection process is consistent with the level of development of the programme, but certain questions

remain. The team concluded that Indonesia has a good understanding of the issues.

- **Environmental protection:** Work has been initiated in a manner consistent with the development of the nuclear power programme.
- **Emergency planning:** Indonesia understands the need for emergency planning but that additional coordination with local and governmental authorities needs to be conducted.
- **Security:** Indonesia is well positioned to meet the security requirements for Phase 1. Implementation of the recommendations in the Integrated Nuclear Security Support Plan and the report from the sustainability mission in 2009 should provide a solid nuclear security foundation in Indonesia, meeting the requirements of Phase 1 and preparing it to move substantially toward meeting Phase 2 security requirements.
- **Nuclear fuel cycle:** The planning for fuel cycle activities is consistent with the level of development of the programme.
- **Radioactive waste:** The actions are consistent with the development of Indonesia's nuclear power programme. Waste management for the research reactor is well developed. Some activities normally covered in the next phase have already been done, including defining a national waste management organisation and some preliminary site investigations for low-level waste disposal.
- **Industrial involvement:** The actions in this area are consistent with the development of the national nuclear power programme.
- **Procurement:** The actions in this area are consistent with the development of the national nuclear power programme.

9.7 CONCLUSION

Driven by economic and population growth as well as the extension of access to the people, the electricity demand in Indonesia has increased strongly in the past few decades. The Java-Bali power system has now developed into a mature and modern power system having a sizeable power grid with large-scale power plants. To meet the future demand, PLN has made a comprehensive long-term power development plan. In the plan, Indonesia is going to build a large number of coal power plants

for baseload generation, and also to utilise renewable energy wherever it is available and whenever it is ready, especially geothermal and hydro-power. Nuclear power is not included in the power development plan, because PLN is required to refer to the government's electricity master plan which did not indicate any nuclear power.

Interestingly, in Law No. 17/2007 regarding the National Long-term Development Plan 2005–2019, there is a line saying that Indonesia might use nuclear energy from 2015–2019. Also, in Presidential Decree No. 5/2010 regarding the National Mid-term Development Plan 2010–2014, it is indicated that the government has assigned BATAN to study new sites for nuclear power plants, and to carry out socialisation campaigns, both supported by a considerable state budget.

There has not been a clear statement made by the national leaders on whether Indonesia will develop nuclear power, with only scattered media reports on statements made by government officials in seminars, NGOs or ministers.

Indonesia's nuclear industry has come a long way since the 1950s, and many infrastructure issues in nuclear power have been addressed along the years. According to the results of an INIR mission to evaluate the status of nuclear infrastructure issues, Indonesia has shown considerable efforts in preparing the nuclear infrastructure for Phase 1 (pre-project phase).

CHAPTER 10

KOREAN NUCLEAR POWER TECHNOLOGY

Hae Ryong Hwang and Shin Whan Kim

ABSTRACT

Three decades after the first introduction of commercial nuclear power, Korea has emerged as the most competitive nation in the commercial nuclear power market. Over the past 20-plus years, Korea has successfully achieved technology self-reliance in the commercial nuclear power plant area and has developed indigenous technologies such as the Optimised Power Reactor (OPR) 1000 and the Advanced Power Reactor (APR) 1400. In December 2009, a Korean consortium led by Korea Electric Power Corporation (KEPCO) won a contract to build four nuclear plants in the United Arab Emirates (UAE), which is the single largest nuclear power plant construction contract. This paper presents the status of nuclear power in Korea, its importance to the Korean economy and the experience of technology self-reliance and the development of technologies. In addition, the competitiveness of the Korean nuclear technology and industry in terms of technology, commercial aspect, vendor capability for a long-term partnership and human resource development is presented. This explains how the KEPCO team won the UAE contract. Finally, the paper discusses how the KEPCO team can support other countries planning to introduce commercial nuclear power plant by sharing its experience.

10.1 INTRODUCTION

Three decades after the introduction of commercial nuclear power, Korea became the world's sixth-largest nuclear power-producing nation. It now operates 23 nuclear reactors for electricity generation, which combine to provide about 30% of its total electricity demand.

Over the past 20 years, Korea has successfully achieved technology self-reliance in the commercial nuclear power plant area and has become a success model in introducing nuclear technology to a developing country. During this period, Korea developed its own brand model of the OPR1000 based on the technologies transferred by foreign vendors, and after that it even made a great stride to develop an advanced light water reactor (ALWR) model, the APR1400. Currently, four units of the improved OPR1000 type are in operation and one OPR1000 unit and four APR1400 units are under construction.

On 27 December 2009, a Korean consortium headed by KEPCO won a contract to build four nuclear plants in the UAE. The selection of the contractor was made following a comprehensive review of three internationally recognised bidders, focused on safety, deliverability, human resource development and commercial competitiveness. By winning the contract, the competitiveness of Korean nuclear technology has been demonstrated, and Korea, 30 years after it first introduced commercial nuclear power, transformed itself from a nuclear technology-importing country to a technology-exporting country.

This paper presents the importance of nuclear power in the Korean economy and the history of commercial nuclear power plant developments in Korea, including localisation, technology transfer and technology self-reliance. Also presented are brief introductions of Korean reactor models, OPR1000 and APR1400, and the competitiveness of the Korean nuclear industry. Finally, the paper discusses how, based on its experience in continued construction, operation and technology development, the Korean industry can support other countries planning to introduce commercial nuclear power plants by sharing its experience.

10.2 IMPORTANCE OF NUCLEAR POWER IN KOREA

Since the first commercial operation of Kori Unit 1 in 1978, nuclear power has been one of the most important sources of energy in Korea. The role

of nuclear power has been to minimise dependence on energy resource imports, to secure the country's rapid economic development by supplying low-cost electricity and to reduce greenhouse gas emissions from energy production.

As one of the poorest countries in the world in terms of natural resources, especially for energy, the selection of nuclear power as a major energy source in the 1970s in Korea was not an option but an inevitable choice to secure a stable and economic energy supply in pursuing national economic growth. Over the past three decades, Korea's annual gross domestic product (GDP) growth has averaged 8.6%, with a corresponding growth in electricity consumption — 33 billion kilowatt hours (kWh) in 1980 to 439 billion kWh in 2007. At present, 23 nuclear power plants accounting for 28.5% of the installed capacity provide 36% of the country's electricity generation. A further five plants are under construction and four plants are in the planning phase. The generation share of nuclear power is projected to reach 59% of electricity supply by 2030. In 2007, nuclear power reduced the amount of total energy imports by 15%.

Nuclear power has contributed to the country's economic development by maintaining low costs of electricity generation. Since 1982 and for 26 years from 1982, consumer prices have increased by 178% while electricity rates only increased by 5.4%. Nuclear power costs are the lowest in Korea: the rate of electricity produced by nuclear power in 2009 was 39 Korean won (KRW), compared with coal at 51 KRW, oil at 192 KRW, liquefied natural gas (LNG) at 164 KRW and hydro at 134 KRW, as published by the Ministry of Knowledge Economy (MKE) in 2009.

Nuclear energy is clean, cost-effective, reliable and safe. In particular, it is recognised as a practical solution to the dilemma of reducing greenhouse gas emissions while supplying the world's increasing demand for energy. As of 2008, 439 nuclear power plants operating worldwide prevented more than 2 billion tonnes of the annual carbon dioxide (CO₂) emissions — equivalent to 10% of the total CO₂ emissions in the world. In Korea, CO₂ emissions due to electricity generation account for 24% of the total annual CO₂ emissions and are expected to gradually increase as the electricity demand increases. In 2008, nuclear power prevented 140 million tonnes of CO₂ emissions in Korea (MKE, 2009).

10.3 HISTORY OF COMMERCIAL NUCLEAR POWER PLANTS IN KOREA

The genesis of the Korean nuclear industry can be traced to 1957 when it became a member of the International Atomic Energy Agency (IAEA) and immediately implemented a nuclear research programme. The country's first nuclear reactor, a small research unit, achieved criticality in 1962. Thereafter, its first commercial power plants were developed by foreign contractors, with Kori 1 being the first to supply electricity from April 1978. Korea's almost 40-year history of commercial nuclear power plants can be divided into four phases: introduction of nuclear power, promotion of localisation, technology self-reliance and advanced reactor development.

In the first phase, marked as the introduction of the nuclear power period, from the early 1970s to the late 1970s, the construction of nuclear power plants was fully dependent on foreign technology. Starting with Kori Unit 1 in 1978, two more units, Kori Unit 2 and Wolsong Unit 1, were constructed based on a turnkey contract with foreign suppliers. Kori Units 1 and 2 are pressurised water reactors (PWRs), and Wolsong Unit 1 is a CANDU-type reactor. The foreign suppliers had overall responsibility for the design, procurement, construction and commissioning operation. Involvement of local industries was limited to civil and architectural work in service facilities. Major goals for technology self-reliance in this period were to identify available items to be localised and to imitate the construction technology of the suppliers.

The second phase took place from the late 1970s to the mid-1980s when six more PWRs were constructed based on the component contract with foreign prime contractors for the nuclear steam supply system (NSSS) and balance of plant (BOP). In this phase Korean utility KEPCO, with the assistance of a foreign architectural and engineering (A/E) company, managed the construction projects. Local suppliers were subcontracted for detailed design especially in the BOP design, site design and BOP equipment procurement. During this phase local participation was gradually increased and basic foundations for technology self-reliance were prepared as well.

The period from the late 1980s to the mid-1990s is marked as the technology self-reliance phase. In the mid-1980s the Korean nuclear industry

embarked upon a plan to standardise the design of nuclear plants and to achieve much greater self-sufficiency in building them. In 1987 the industry entered a 10-year technology transfer programme with foreign suppliers, to achieve technical self-reliance. As the first project in the plan, construction of Yonggwang Nuclear Units (YGN) 3 & 4, the reference model for the OPR1000, was started. In the project KEPCO assumed overall responsibility by making prime contracts with local suppliers, with foreign suppliers serving as subcontractors to local firms. The base of Korean nuclear power technology self-reliance was established and was promoted early in this phase through technology transfer and joint design contracts made between local and foreign suppliers. After the successful construction of YGN 3 & 4, construction of Ulchin Nuclear Units (UCN) 3 & 4, which are the first OPR1000-type units, was started. Unlike in the previous project, the local suppliers took overall responsibility in all aspects of project implementation, and the role of foreign suppliers was reduced to limited consulting due to successful implementation of the technology self-reliance programme.

A sidetrack from the development of the OPR1000 was the ordering of three more CANDU-6 pressurised heavy water reactor units to complete the Wolsong power plant. These units were built with substantial local input and were commissioned between 1997 and 1999.

In the late 1990s, to meet evolving requirements, a programme to produce an improved OPR1000 was started. This programme involved design improvements of many components, improved safety and economic competitiveness, and optimising plant layout with streamlining of the construction programme to reduce capital cost. Shin-Kori 1 & 2, which are in operation at present, will represent the first units of the improved OPR1000 programme. Beyond this, development of an advanced light water reactor, APR1400, was started in 1992. The basic design was completed in 1999. It offers enhanced safety and a 60-year design life. Shin-Kori 3 & 4 will be the first APR1400-type plants and their construction will be completed by 2014. The period from the late 1990s to now is designated as the advanced reactor development phase.

Self-reliance in nuclear technology for Korea was successfully achieved. A series of OPR1000 plants now operating are among the world's best plants in performance. The technology made great strides to develop an

advanced light water reactor model. There were many factors which made the current success in Korea possible. Among others, strong support by the Korean government, preparation of infrastructure, and teamwork during the implementation of the self-reliance programme were the key elements for the success.

Introducing commercial nuclear power plants requires vast amounts of initial investment. Therefore, it was very difficult for the industry to lead the initial stage, and strong support from the government with a strong commitment to technology self-reliance was a key factor to the success. The primary roles of the government were to establish the national nuclear energy programme, policy making, funding of the programme, teaming for the programme and regulation. The programme included plans to establish infrastructure necessary to adopt the new technology. These involved, among others, preparing human resources and letting local firms gradually participate in construction projects to acquire the necessary technical basis. Implementation of such a big programme required the involvement of many domestic organisations. Therefore, it was very important to clearly define the responsibilities of each of the participating entities and manage them in an integrated and coordinated manner. Teamwork based on a smooth inter-organisational relationship toward a common target was another key factor to the success.

10.4 DESCRIPTIONS OF THE OPR1000 AND APR1400 DESIGNS

10.4.1 OPR1000 Design Features

The design of YGN 3 & 4, the reference design for the OPR1000, was mainly based on the Combustion Engineering System 80 NSSS design. The first OPR1000-type nuclear units, UCN 3 & 4, were designed with the aim of improved performance and safety by adopting various design improvements as well as complying with the new, elevated safety requirements. The next OPR1000 plants, YGN 5 & 6 and UCN 5 & 6, continued to improve plant performance and safety by incorporating the construction and operating experience gained from the previous plants and by adopting advanced design features. Major design objectives of the OPR1000 are

Table 1 Major Design Features for OPR1000 and APR1400

Items	OPR1000	APR1400
Capacity	2825 MWt	4000 MWt
Plant design lifetime	40 years	60 years
Seismic design	SSE 0.2 g/OBE 0.1 g	SSE 0.3 g/OBE 0.1 g
Safety requirements		
— Core damage frequency	$<10^{-4}/\text{RY}$	$<10^{-5}/\text{RY}$
— Containment failure frequency	$<10^{-5}/\text{RY}$	$<10^{-6}/\text{RY}$
— Occupational radiation exposure	$<1.2 \text{ man}\cdot\text{Sv}/\text{RY}$	$<1 \text{ man}\cdot\text{Sv}/\text{RY}$
— Operator action time	Min. 10 minutes	Min. 30 minutes
— SBO coping time	Min. 4 hours	Min. 8 hours
— Thermal margin	8%	More than 10%

presented in Table 1 as compared to those of the APR1400 (Lee *et al.*, 1992; Lee *et al.*, 1998).

The primary loop configuration of the OPR1000 has two reactor coolant loops. The NSSS is designed to operate at a maximum core thermal output of 2,815 megawatts thermal (MW_t) to produce an electric power output of 1,050 megawatts electric (MW_e) in the turbine/generator system. The major components of the primary circuit are the reactor vessel; two reactor coolant loops, each containing one hot leg and two cold legs; one steam generator and two reactor coolant pumps; and a pressuriser connected to one of the hot legs. All components are located inside the containment vessel. The two steam generators and four reactor coolant pumps are arranged symmetrically. The steam generators are located at a higher elevation than the reactor vessel for natural circulation purposes.

The plant power control system is capable of daily load-following operations with a load variation profile typical in Korea: 16 hours at 100% and 4 hours at 50%, with 2-hour ramps for power decreases and increases. The reactor core control should be capable of a step power change of 10% and ramp changes of 5% per minute without detrimental effects on the fuel rod integrity. The load rejection capability at rated power is also incorporated. Thus the reactor will not be automatically tripped in the

event of a turbine trip if the transient causing the turbine trip is limited to the secondary system.

The reactor protection system and other safety-related systems are designed to meet the strict regulatory codes and standards that have been issued for digital safety systems. A high degree of reliability is required in safety-related systems, and therefore design methodologies such as redundancy, diversity and self-diagnostics have been incorporated in order to achieve both the desired reliability and availability of the systems.

The safety concept of the OPR1000 is based on the multiple-level defence-in-depth approach: prevention of accidents or deviations from normal operation, detection of accidents through monitoring, control of accidents to prevent their propagation into severe accidents, and mitigation of severe accidents. This safety objective is pursued by compliance with deterministic requirements, supplemented by probabilistic methods. Later, various design changes were made to the OPR1000 for improved safety and economic competitiveness. Moreover, the plant layout was optimised with streamlining of the construction programmes to reduce capital cost.

10.4.2 APR1400 Design Features

The APR1400, a standard advanced light water reactor, had been developed for 10 years starting from 1992, as one of the G-7 long-term government projects. The design was based on the experience that had been accumulated through the construction and operation of the OPR1000. Moreover, the APR1400 incorporates a number of design modifications and improvements to meet utility requirements (KEPCO, 1999) for enhanced safety and economic goals and to address the new licensing issues such as the mitigation of severe accidents.

Since the APR1400 is an evolution from its predecessor, the OPR1000, the basic configuration of the NSSS is the same, i.e. it has two steam generators with four reactor coolant pumps in an arrangement with two hot legs and four cold legs. However, the APR1400 has many advanced features such as the direct vessel injection (DVI) of the safety injection system, in-containment refuelling water supply system, advanced safety depressurisation system and systems for severe accident mitigation. The NSSS configuration is

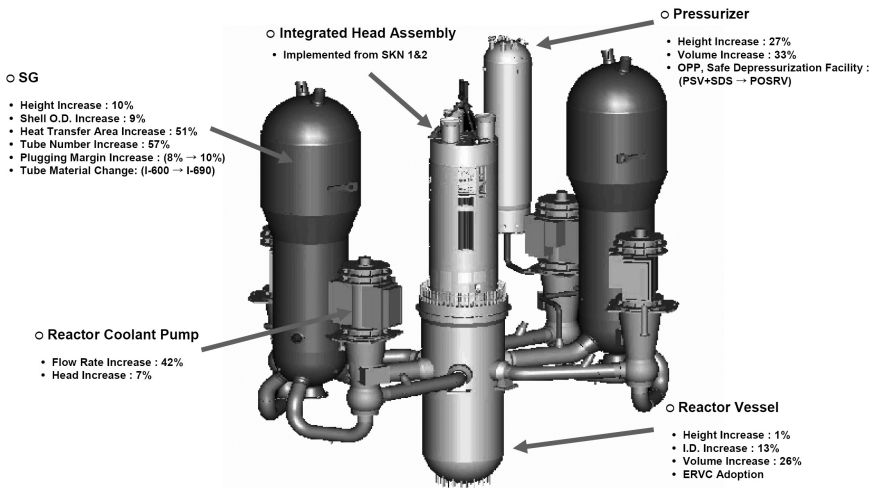


Figure 1 Design Improvements for APR1400 Reactor Coolant System

schematically presented in Figure 1, and design improvements compared with the OPR1000 can be seen in Table 1 (Kim and Kim, 2002).

The power level of the APR1400 is around 1,450 MWe with a thermal power of 4,000 Mw_t, which is 40% higher than that of the OPR1000. The main control room, designed with the human factors and digital instrumentation and controls in mind, is another example of the design improvement. Specifically, the general arrangement has been improved by reflecting on the operation and construction experiences of the OPR1000. Currently, a construction project to build the first APR1400 in Korea is in progress with the goal of commercial operation of the first unit in 2013.

10.5 COMPETITIVENESS OF KOREAN NUCLEAR TECHNOLOGY

On 27 December 2009, the Emirates Nuclear Energy Corporation (ENEC) of the UAE announced that it had selected a Korean consortium led by KEPCO to design, build and help operate civil nuclear power plants for the UAE peaceful nuclear energy programme. The decision was made following a comprehensive and detailed review of three bids from EPR of Areva, ABWR of the GE-Hitachi consortium and APR1400 of the KEPCO team.

In the selection, ENEC focused on five core criteria in reaching its final decision: safety, deliverability, contract compliance, human resource development and commercial competitiveness (WAM, 2009).

As stated in the media, the competitiveness of Korean nuclear technology can be summarised as follows:

- Recognition of KEPCO as a world leader in safety and plant reliability and efficiency, as assessed by the World Association of Nuclear Operators (WANO); KEPCO currently receives among the highest scores in the WANO Performance Indicator Programme, which quantifies performance standards of nuclear operators around the world.
- KEPCO's strong record in constructing nuclear power plants that meet stringent industry quality standards and are delivered on time and on budget.
- KEPCO's capability to supply the full scope of works and services for the UAE civil nuclear power programme, including engineering, procurement, construction, nuclear fuel and operations and maintenance support with the assistance of other Korean members of the KEPCO team.
- Design of the APR1400 as a Generation III, 1400 MW_e nuclear power plant with evolutionary improvements in safety, performance and environmental impact that meet the highest international standards for safety and performance.
- Design to meet heightened safety goals developed in accordance with the latest international safety standards, which aim to secure an additional margin of safety to protect the public health.
- Incorporation of more than 30 years of operational learning and the resulting enhancements of safety, reliability and efficiency into the design.
- Design features to prevent or mitigate severe accidents by ensuring reactor shutdown, removing decay heat, maintaining the integrity of the containment facility and preventing radioactive releases.
- Dedication of a highly experienced team to the project and a commitment to transferring the knowledge gained from Korea's 30 years of successful nuclear industry operation to the UAE programme.

10.6 SHARING THE EXPERIENCE OF THE KOREAN NUCLEAR INDUSTRY

In a nuclear power programme, basic policy mistakes can be exceedingly costly due to the capital intensiveness of the technology. Therefore, it is very important to refer to best practices of and also problems faced by others in formulating the nuclear power programme.

As presented in the previous sections, the achievement of the Korean nuclear industry is exceptional, considering the rather short period of time since its first steps into the commercial nuclear power. Given its success, the Korean nuclear industry can be a role model for countries contemplating the introduction of commercial nuclear power plants. Based on its experience, the Korean nuclear industry can assist other countries preparing to introduce commercial nuclear power plants. Potential areas of assistance include the establishment of a nuclear power programme, feasibility studies, preparation of infrastructure, development of human resources and training, planning localisation and site selection.

10.7 CONCLUSION

Nuclear power has been and will continue to be an important energy source in Korea. With few natural resources, nuclear energy provides a means to secure Korea's economic development.

Three decades after the introduction of commercial nuclear power, Korea has emerged as the most competitive nation in the commercial nuclear power market. Over the past 20-plus years, Korea has successfully achieved technology self-reliance in the commercial nuclear power plant area and has developed indigenous technologies such as the OPR1000 and the APR1400. As a Generation III reactor model, the APR1400 provides a high level of safety and economic advantages over other reactor models as demonstrated by its winning a contract in December 2009 to build four nuclear plants in the UAE.

Given the success of the Korean nuclear industry in the introduction and development of nuclear power technology, it can be a role model for countries contemplating the introduction of commercial nuclear power plants, and it is ready to share its experience with them.

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CHAPTER 11

MALAYSIAN PERSPECTIVES, PLANNING AND PROBLEMS WITH REGARD TO NUCLEAR ENERGY

Shahidan Radiman

ABSTRACT

Malaysia plans to have its first nuclear power plant by 2021. With the establishment of a Nuclear Steering Committee and three working committees by the Cabinet in 2009, the original plan from the early 1970s for nuclear power has been revived. This paper briefly describes the country's plan, roadmap and possible problems in human capacity building in achieving nuclear power status post 2020.

11.1 INTRODUCTION

The generation of electricity from fossil fuels is a major and growing contribution to carbon dioxide (CO₂) emissions, which contributes significantly to global warming. There are only a few realistic options to reduce CO₂ emissions produced by electricity generation, namely:

- Increased efficiency in electricity generation and end-use;
- Introduction of carbon capture and sequestration at fossil fuel plants on a massive scale;

- Expanding the use of renewable energy resources, such as wind, solar, biomass and geothermal;
- Increased use of nuclear power.

It is likely that we shall need all of these options and, accordingly, it would be a mistake at this time to exclude any of these four options from an overall carbon emissions management strategy.

11.2 THE EVOLUTION OF NUCLEAR POWER

Nuclear power plants have evolved from Generation 1 in the 1950s, which consisted of prototype reactors; to Generation 2 in the 1970s and 1980s, which comprised of commercial reactors, such as CANDU and light water reactors (LWRs); to Generation 3 in the post-2000 period to 2010, including advanced LWRs; to Generation 4 in the post-2010 period. Generation 5 in the post-2030 period is expected to consist of nuclear energy systems which are highly economical, have enhanced safety features, minimise waste and are proliferation-resistant.

11.3 THE GLOBAL ENERGY CHALLENGE

Energy and global economic growth are clearly linked. As the United States and other countries advance economically, there is bound to be greater competition for energy resources. China's relentless quest for energy resources is a good example of this competition. The question is: how will the US and other great powers be able to satisfy growing energy demand in a tightening global energy marketplace? It is now time to step up again to the next great challenge facing the world: energy security.

11.4 CURRENT MALAYSIAN ENERGY SITUATION

Figure 1 shows the projected Malaysian energy load from 2008 to 2030.

Figure 2 shows the Malaysian power generation mix forecast (until 2030). It illustrates the "unhealthy" energy mix, which depends very much on coal and natural gas. It is hoped that nuclear energy will alleviate this problem together with energy stability and security.

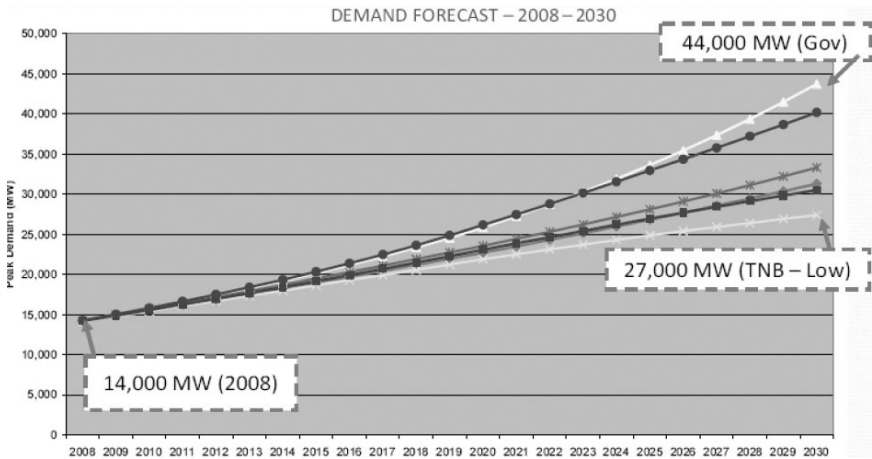


Figure 1 Malaysia Load Projection (2008–2030)

Source: Tenaga Nasional Berhad

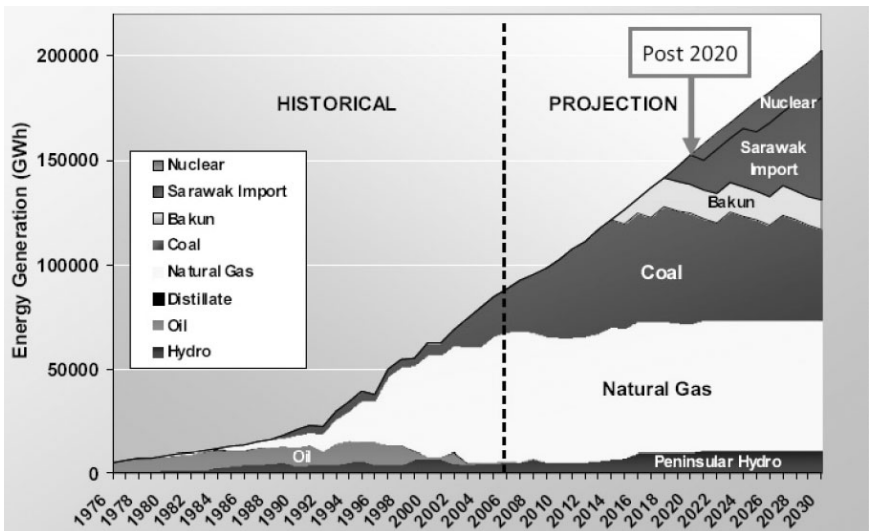


Figure 2 Malaysia Generation Mix Forecast (until 2030)

Source: Tenaga Nasional Berhad

11.5 MALAYSIA PLANS FOR NUCLEAR POWER BY 2021

An Agence France-Presse (AFP) report dated 4 May 2010 stated that Malaysia had announced that it aimed to build its first nuclear power plant by 2021, as this was the only solution to the country's growing energy needs. Mr. Peter Chin, Minister for Energy, Green Technology and Water, said that there would be a lead time of 10 years to prepare. The state energy company Tenaga has stated that it could construct Malaysia's first 1,000-megawatt (MW) nuclear power plant at a cost of US\$3.1 billion. The Malaysian government had asked Tenaga to review the situation during a period of increasing global oil prices and in view of the country's limited supply of oil and natural gas. Currently, half of Malaysia's power plants run on gas, and the rest run on coal and hydropower. Nuclear power is the only viable energy option for Malaysia, said Minister Peter Chin. Malaysia has looked at South Korea, France, Japan and China as possible sources of nuclear technology. Newspaper reports indicate that the Port Dickson area is a possible site for a nuclear plant. Electricity usage is currently 14,000 MW, whilst total capacity is 23,000 MW. By 2017, Malaysia will hit critical levels of power consumption. It is a costly exercise to turn to nuclear power, but there is no choice.

11.6 PLANNING FOR A NUCLEAR OPTION

The Malaysian government took several steps as preparation for the nuclear option:

- 26 June 2009: The Cabinet decided to include nuclear power as an energy option in the post-2020 period, with the establishment of a Nuclear Steering Committee and three Working Committees.
- The Cabinet also approved the allocation of RM 25 million for planning and preparation purposes over three years (2010–2012).
- 29 August 2008: The Board of the national energy company, Tenaga Nasional Berhad (TNB), agreed to form a Nuclear Energy Unit and a Nuclear Pre-project Team; the TNB Board also approved a budget of RM 2 million for planning and preparation.
- June 2009: TNB and Korea Electric Power Corporation (KEPCO) signed an agreement for KEPCO to carry out over 12 months a Nuclear

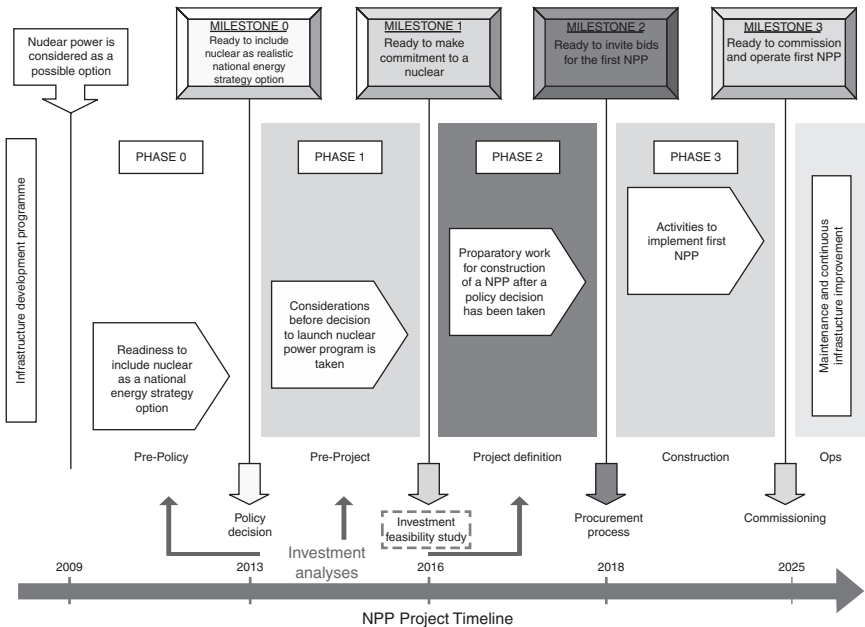


Figure 3 Proposed Malaysia Nuclear Roadmap

Source: Tenaga Nasional Berhad, Nuclear Roadmap for Malaysia, 2009

Preliminary Feasibility Study, including training of TNB staff in nuclear technology. See Figures 3 and 4 for the proposed Malaysia nuclear roadmap, and the five-step plan for the development of nuclear power.

11.7 NUCLEAR ENERGY HUMAN RESOURCES DEVELOPMENT

Several Malaysian agencies are involved in developing human resources for nuclear energy, some of which are as follows:

- The Atomic Energy Licensing Board, which trains staff in safety, safeguards and security, and also in regulation, multilateral agreements and protocols.
- The Ministry of Energy, Green Technology and Water, responsible for implementation of the energy protocol and which acts as the service regulator.

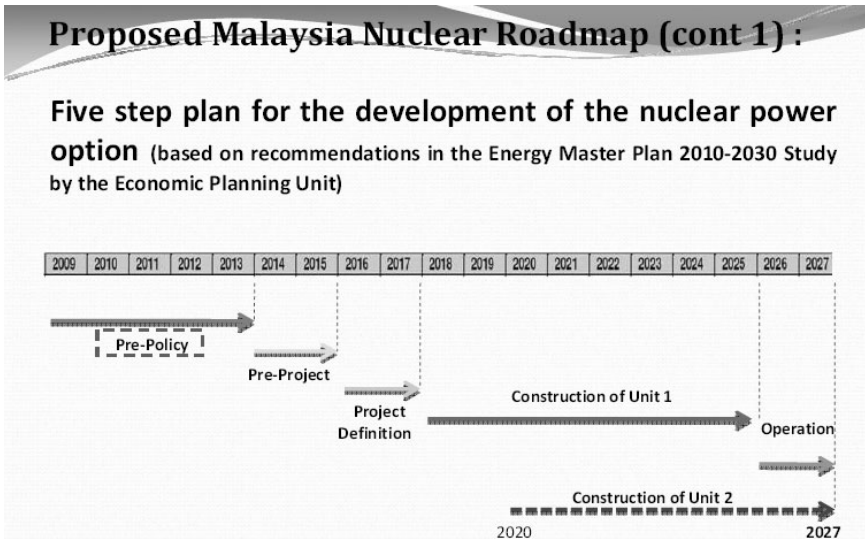


Figure 4 Five-Step Plan for Development of Nuclear Power Option

Source: Tenaga Nasional Berhad, Nuclear Roadmap for Malaysia, 2009

- The Energy Commission and the Energy Planning Unit, working in the Prime Minister's Office; the latter will assist in the implementation of the nuclear programme, especially in the introduction of nuclear power and the transfer of nuclear technology.
- The Ministry of Higher Education; this ministry approved Universiti Teknologi Malaysia (UTM) to start its undergraduate nuclear engineering programme, whilst Universiti Sains Malaysia concentrates on health physics and nuclear medicine; meanwhile, Universiti Kebangsaan Malaysia (UKM) deals with nuclear science, and Universiti Tenaga Nasional (UNITEN) handles nuclear engineering.
- The Malaysian Nuclear Agency is responsible for educating the public on nuclear energy, with plans to upgrade its Triga Mark II Reactor for research and training.

Figure 5 shows Malaysia's nuclear human resources currently available at the Malaysian Nuclear Agency, where it is estimated that three to four times this number of people is required. Universities and the Atomic Energy Licensing Board should also pursue a reasonable competency for research, licensing and regulating a nuclear power plant facility by 2020.

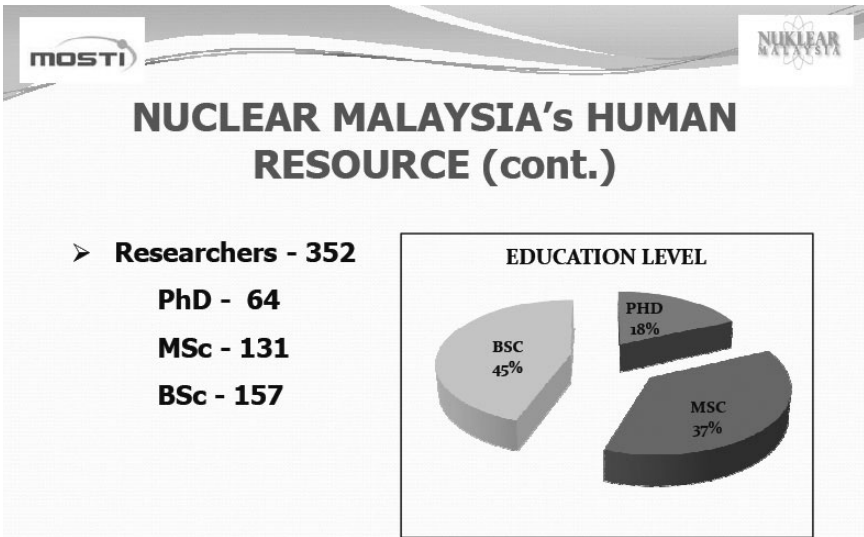


Figure 5 Malaysia's Nuclear Human Resources

Source: Malaysian Nuclear Agency

The Faculty of Science and Technology at Universiti Kebangsaan Malaysia, which has been offering degrees in nuclear sciences since the 1970s, has an undergraduate enrolment of 40 to 50 students per year, and a postgraduate enrolment of 10 to 15 students per year. Since 1980, 1,057 Bachelors of Science in Nuclear Science have been awarded, and 87 students with Masters and PhDs in nuclear sciences have graduated. The UKM Faculty of Engineering and Built Environment is currently aiming to offer nuclear engineering degree programmes within one to two years.

11.8 EDUCATING AND ENGAGING THE MALAYSIAN PUBLIC ON NUCLEAR ISSUES

There have been several efforts and measures to engage the public. One was setting up the Malaysian Nuclear Society in 1989, with the aim of promoting the peaceful use of nuclear science and technology. Another step was to organise the Malaysian Nuclear Conference 2010 on the UNITEN campus in Kajang, Selangor. Winter and summer schools have also been organised at UKM in various nuclear sciences, with foreign professors teaching at these winter schools and delivering public lectures.

11.9 NON-PROLIFERATION TREATY (NPT) AND MALAYSIA

Malaysia is member to the NPT, which has 189 members. Malaysia has also adopted a Strategic Trade Bill in 2010, which aims to curb the illicit trafficking of weapons of mass destruction.

11.10 PROBLEMS FACING THE MALAYSIAN NUCLEAR PROGRAMME

Some of the problems include the following:

- Stakeholders — less than 50% can be made up by the government, but since integrity is of the utmost importance, the Cabinet has to be hands-on;
- Competence of regulatory body — it is very important to have competent manpower to issue licensing and regulate controls on the safety of the nuclear power plant;
- Research and development in nuclear power technology — issues of waste management, integrity of reactor core materials, test rigs, etc., need to be developed in-house by local bodies;
- Competence in nuclear laws and technology transfers, involving relevant government agencies and universities;
- Back-up support for facility installations;
- Commitments from stakeholders and investors;
- Public awareness and acceptance;
- Consistent government policies and political will;
- Safety work culture which must be emphasised at all levels;
- Long-term target and development of nuclear power plants, involving education bodies, training agencies and public funding;
- Continuous manpower training and development since a typical nuclear power plant can operate for up to 60 years.

11.11 CONCLUSIONS

The Malaysian government is now engaged with many nuclear power plant developers, such as Areva and KEPCO, in order to implement its

plan to build its first nuclear plant by 2021. Several universities, such as UKM, UNITEN and UTM, are involved in developing human resource capabilities, for example nuclear engineers. Also, several mass media channels are involved in educating the public about nuclear energy. Finally, it appears that nuclear energy is the only clean or carbon-free, renewable and reliable energy option to increase the supply of energy for the country to achieve the status of a developed nation by 2020.

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CHAPTER 12

THE ASIAN DEVELOPMENT BANK'S REGIONAL PERSPECTIVES, POLICIES AND ISSUES REGARDING NUCLEAR ENERGY AND SUSTAINABLE DEVELOPMENT IN SOUTHEAST ASIA

*Anthony J. Jude*¹

ABSTRACT

Providing a background to the concept of “sustainable development”, this chapter explores the interlinked concepts of energy demand and financing needs with specific focus on regional electricity demand and the energy supply situation. Energy resource options including hydropower, natural gas, coal, and geothermal are discussed and the specific question of nuclear energy versus regional cooperation is addressed. Finally, the chapter explores the long-term planning that is needed for nuclear energy development and the role of the Asian Development Bank in this process.

¹The author of this paper is Director, Energy and Water Division, Southeast Asia Department of the Asian Development Bank. The views expressed in this paper are his views based on his experience and working knowledge of the region and do not reflect the views of the Asian Development Bank.

12.1 SUSTAINABLE DEVELOPMENT

Sustainable development was defined in 1987 by the Brundtland Commission, known formally as the World Commission on Environment and Development, as “...development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. This definition emphasises the importance of economic development to satisfy needs, and the importance of the natural environment as both a resource provider and waste absorber.

Five years after the Brundtland Commission’s report, the United Nations Conference on Environment and Development (UNCED) was held in Rio de Janeiro. Among other things, UNCED produced the UN Framework Convention on Climate Change (UNFCCC) and Agenda 21. The latter is a comprehensive action plan for sustainable development. It is effectively UNCED’s translation of the Brundtland Commission’s definition into more specific policy directions. It has 40 chapters on all aspects of sustainable development and covers energy issues, but has no separate chapter dedicated to energy.

The UN established the Commission on Sustainable Development (CSD) that meets annually to address selected topics covered by Agenda 21. Energy was addressed for the first time at the ninth session of the CSD (CSD-9) in 2001. The CSD-9 decision on energy was thus the first dedicated effort by the CSD to further translate the Brundtland Commission’s definition of sustainable development into specific policy directions with respect to energy.

Nuclear power was a particularly controversial topic during the preparatory process of the CSD-9. There was a long debate on nuclear energy between countries that considered nuclear an essential component of their sustainable development strategies and countries that considered nuclear power incompatible with sustainable development. The 2002 World Summit on Sustainable Development (WSDD) in Johannesburg called all relevant regional and international organisations, governments, and other relevant stakeholders to implement the recommendations of the CSD-9. The Johannesburg Plan of Implementation (JPOI) called for actions to promote widespread availability of clean and affordable energy, specifically the promotion of renewable energy resources, efficiency improvements, and advanced energy technologies, including cleaner fossil fuel

technologies (clean coal technologies). Nuclear energy was included in the category of advanced energy technologies.

12.2 ENERGY DEMAND AND FINANCING NEEDS

Projections of global energy demand show large increases to 2030 and scenarios have been modelled to slow this growth in demand. The principal drivers are global population and economic growth, especially in developing countries. The world population currently at 6.5 billion is projected to grow to more than 9 billion by 2050. Energy is central to achieving the goals of sustainable development but is also the primary engine for economic development. Over time energy systems have grown more complex, particularly urbanisation and industrialisation. Modern manufacturing, service industries, agriculture, and today's urban environments all rely on electricity. All demographic projections show continued urbanisation which coupled with economic development will cause increases in electricity demand.

Access to good infrastructure is an important enabler of growth in all types of economies. This is particularly relevant in the current global financial climate where infrastructure-based economic stimuli are being pursued by governments all over the world. The Asian Development Bank's (ADB) long-term strategic framework² identifies infrastructure as one of the nine leading challenges facing the region's future. The framework identifies several causes for the infrastructure deficit, including (a) low levels of public sector revenue mobilisation; (b) comparatively weak institutions; (c) regulatory failures; and (d) under-developed financial systems, resulting in barriers to the flow of long-term private capital.³

The bottlenecks in the energy sector infrastructure are an issue within the Asia-Pacific region as this constrains growth. The energy demand growth within the Asia-Pacific region is projected to grow 2.4% per annum.⁴ This translates into investments of US\$7–10 trillion in the energy

²ADB, *Strategy 2020: The Long-Term Strategy of the Asian Development Bank, 2008–2020* (Manila: ADB, 2008).

³Ibid.

⁴ADB, "Energy Investment Outlook" (draft), 2010.

sector up to 2030. Electricity generation will account for the lion's share of this investment (64%) followed by the oil and gas sector (18%), coal development (12%), and domestic oil and gas trade infrastructure (6%). Within the Asia-Pacific region, the largest share (49.6%) of the investments will be in East Asia (People's Republic of China); followed by South Asia (15.8%), the Developed Group (Australia, Japan, Korea, and New Zealand, accounting for 15.1%), Southeast Asia (12.8%), Central Asia (6.2%), and the Pacific region (0.5%).⁵

12.3 REGIONAL ELECTRICITY DEMAND AND ENERGY SUPPLY SITUATION

The International Energy Agency (IEA) base case scenario shows that electricity demand is growing at 2.4% per annum within the Asia-Pacific region. To meet this demand growth, the world electricity generation capacity needs to increase from 4,000 gigawatts (GW) to 7,800 GW by 2030. This means almost doubling the installed generation capacity between now and 2030. Therefore, the equivalent of today's capacity must be newly constructed over the next 20 years, and additional capacity must also be built to replace many of today's power plants that will be retired during the same period. The IEA projects that the Association of Southeast Asian Nations (ASEAN) will see an average annual increase of 2.5% in its primary energy demand until 2030. The IEA estimates ASEAN electricity demand to increase 76% between 2007 and 2030. Meeting the ASEAN countries' electricity demand will require investing more than \$1.1 trillion in the next 25 years.

In meeting the region's growing demand for energy, it is important to recognise that each country uses a different mix of energy, and that all countries are different. Each country uses a different mix of energy sources for a number of reasons and there is no right mix for each country. It depends on how fast the country's economy is growing and one has to look first into the available resources within the country as well as the alternative sources of supply to meet the projected demand growth. The available financing options may determine the level of investment in a deregulated market that would provide a higher investment to a private

⁵Ibid.

investor or to the utility. There are tradeoffs among issues such as environment versus cheap electricity, job creation, import dependence, energy security, and climate change that are all personal and national preferences that need to be resolved by the countries themselves.

In the case of Thailand, no new coal power plants can be built as the general public and the non-governmental organisations are against such projects. For this reason, 75% of Thailand's power generation is based on natural gas, partly from domestic resources and partly from imported natural gas (from Myanmar). Thailand has taken a decision that it will import low-cost electricity generated by hydropower plants located in Lao PDR and Myanmar. Hydropower is clean but the construction of the plants themselves will need to take into consideration sustainable development of the affected people living in the project area and ensure that livelihood components built around the project are sustainable in the long term. It has also taken measures to promote the use of renewable energy such as solar-, wind-, and biomass-based generation for grid application and has promulgated the Renewable Energy Law with appropriate feed-in tariffs to get private sector participation.

The fastest growing economy within Southeast Asia has been Viet Nam, averaging 9% growth per annum over the past 10 years.⁶ This has resulted in a power demand growth of 15% per annum over the past decade. Power demand growth in the first seven months of 2010 was 17%. This demand growth is emerging as a result of economic reforms (Doi Moi policy) initiated in 1986. Increased foreign direct investments, coupled with industries moving from countries where the cost of doing business was getting expensive to Viet Nam, where labour and electricity costs were low, has contributed to this demand growth. Also, the service sector has improved over the past 10 years, resulting in an increase in tourists.

12.4 ENERGY RESOURCE OPTIONS IN SOUTHEAST ASIA

12.4.1 Hydropower

The Southeast Asian region is rich in energy resources but the level of resources varies among the 10 ASEAN countries. Hydropower potential

⁶ADB, "Viet Nam Country Operations Business Plan (2010–2012)", 2009.

within the region is the largest in Myanmar, which has a potential of 110,000 megawatts (MW), followed by Laos (55,000 MW), Malaysia (25,000 MW), Cambodia (8,000 MW), and Viet Nam (3,000 MW). Only 10% of this potential has been developed by these countries, with the exception of Viet Nam.

Cambodia's power demand is growing as the economy develops. The hydropower potential identified by the Mekong River Commission is mostly along the main Mekong River, with some on the tributaries. Developing a hydropower plant on the main Mekong within Cambodia will have serious consequences for the water flow regimes downstream, fisheries and also Tonle Sap, the largest freshwater lake in the region. The Cambodian government is cognisant of this fact and has only agreed to develop hydropower on the tributaries of the Mekong and other river systems not part of the Mekong.

Viet Nam has developed most of its large hydropower resources and only small and medium-sized sites are left. Hydropower is capital intensive but has low operating costs and no fuel costs. The gestation period is long (six to seven years) for a hydropower plant compared to a conventional thermal power plant (four years). Viet Nam used to have more than 60% of its electricity generation from hydropower, which had lower generation costs (3.0–4.5 US cents/kilowatt hour (kWh)) than thermal plants, but these hydropower plants could not meet the demand during the dry season, resulting in power outages. The government has taken measures to increase the proportion of thermal plants (coal and gas-fired) in the generation mix. Hydropower in the generation mix is around 37% and projects with a capacity of about 3,300 MW are under construction. One of the largest hydropower plants in Viet Nam is the 2,400 MW So La Hydropower Plant that will be commissioned in 2012.⁷

Myanmar has the largest hydropower resources within Southeast Asia with less than 5% of the country's potential developed. The largest plant under construction by a consortium of Chinese and Thai investors is the 7,000 MW Tasang Hydropower Project.⁸ About 10% of the electricity generated will be consumed within the country, while the remaining power will be exported to Yunnan Province and Thailand.

⁷ Viet Nam, "Sixth Power Development Master Plan", 2007.

⁸ ADB, "Regional Power Development Master Plan for GMS", 2008.

Lao PDR began developing its hydropower potential in the 1950s with the planning of Nam Ngum 1 Hydropower Plant which was built in phases, initially with a 30 MW capacity in 1971 to a final installed capacity of 150 MW. In 1987, Laos began developing the Xeset Hydropower Plant (45 MW),⁹ which was commissioned in 1992. The surplus electricity from these two power plants is sold to Thailand. This put in place policies and a legal framework within which private sector developers could participate in developing Laos's hydropower potential for export to Thailand and Viet Nam. As such the Theun Hinboun Expansion Project, Nam Ngum 2, Nam Ngum 3, Nam Ngiep 5, and Xe Kaman 1 are all in different phases of development. Nam Theun 2 (1,058 MW) was recently commissioned with 95% of the electricity being exported to Thailand and 5% being consumed locally. Laos has signed agreements with both Thailand and Viet Nam to export about 6,000 MW and 5,000 MW, respectively.

Most of Malaysia's hydropower resources are located in Sarawak, Borneo. The largest hydropower plant here is the 2,400 MW Bakun Hydropower Project which is scheduled for commissioning in phases from 2011. The Sarawak state government's plan is to develop renewable energy sources to meet the demand growth from its planned industrial zones. There are several other hydropower plants where feasibility studies are being prepared. Eventually most of the power generated will be exported via high-voltage direct current (HVDC) undersea cables to Peninsular Malaysia. This is a strategic decision of the government to use more of its renewable energy resources, while still earning foreign exchange revenues from export of its natural gas resources.

12.4.2 Natural Gas

Natural gas resources are mostly located in Indonesia (112 trillion cubic feet (Tcf)) and Malaysia (84 Tcf). Most of the gas from these two countries is exported as liquefied natural gas (LNG), while some is used for power generation. Myanmar and Viet Nam both have about 18 Tcf, while the Philippines has about 4 Tcf. Myanmar has more gas than it can currently utilise for its own use and hence is exporting natural gas to Thailand

⁹The ADB, Xeset Hydropower Project, 1987, is the name of the project.

and more recently to Yunnan Province, People's Republic of China. This brings in much-needed foreign exchange earnings for the country. Explorations ongoing in Cambodia have shown some promise of natural gas deposits but further drilling and analysis is needed. The development of a natural gas field is expensive and there needs to be an anchor such as a power project to justify the investment costs.

In Viet Nam most of the natural gas produced from the offshore Nam Con Son Basin and PM3 is used for power generation. The natural gas from Block PM3 is a joint production sharing agreement with Malaysia that is used both for power generation and fertiliser production. The Block B/52 offshore gas field, currently being developed by PetroVietnam and Chevron, is for power generation. About 3,600 MW of new gas-based generation will be put into operation in southern Viet Nam from 2014–2016.

Lao PDR does not have any proven gas reserves but there are two sites that could have gas. The government plans to begin drilling on the site. If there is natural gas, this can be used for baseload generation which Laos will use to fill the generation gap during the dry season. Indonesia on the other hand has sufficient natural gas but most of the gas is contracted in long-term LNG contracts to Japan, Korea, and Taipei. Historically, Indonesian natural gas production has been geared toward export markets, but the country has made an effort to shift natural gas toward domestic uses in recent years as a substitute for the country's declining oil output. However, Indonesia's limited natural gas transmission and distribution network remains an obstacle to further domestic consumption. Indonesia's two major LNG production plants, Arun and Bontang, have experienced declining production in recent years. To help make up for this shortfall, Indonesia has vigorously engaged in natural gas exploration activities, as it strives to meet its long-term LNG contract obligations and also to satisfy increasing domestic demand. Several new projects are under development, the most high profile of which is the Tangguh LNG project in West Papua.

After several delays, the first shipment from Indonesia's \$5 billion Tangguh LNG project finally set sail for South Korea in July 2009. But the future of other proposed LNG projects is uncertain, as debate continues over whether the country's natural gas reserves should be retained for

domestic consumption rather than exported. The BP-operated Tangguh project will help Indonesia maintain its position among the world's largest LNG exporters — the country sits in second place, behind Qatar, in terms of capacity, but has slipped to third after Malaysia in terms of traded volume. But the project has suffered a series of delays, caused by issues ranging from technical problems at the export plant, to the failure of China National Offshore Oil Corporation's (CNOOC) re-gasification facility in Fujian, China, to be ready on time.

12.4.3 Coal

Indonesia has the largest coal resources (1.7 billion tonnes) within the region, followed by Viet Nam (150 million tonnes). Most of Indonesian coal is bituminous and sub-bituminous coal which is good for power generation. However, given climate change issues and sustainable development, there is a need for Indonesia to consider using cleaner coal technologies for power generation. Some options are to stop building coal power plants using conventional pulverised coal technology and to use supercritical or ultra-supercritical boiler technologies that have higher thermal efficiencies and use less coal to generate 1 kW of electricity, resulting in lower carbon dioxide (CO₂) emissions.

Asia cannot do away with coal in its generation mix as it is a cheap energy source and produces electricity at an affordable cost to many poor people within the region. It is estimated that about 1.6 billion in the world are without electricity connections and 80% of these people are in Asia. Given this scenario, coal will continue to be in Asia's energy mix.

Viet Nam's coal is mainly anthracite, which is good quality coking coal (6,000–8,000 kcal/kg) used for steel manufacture. Only the waste coal (lower quality), mixed with a little higher quality coal, is being used for power generation. Anthracite coal is hard and difficult to burn in supercritical and ultra-supercritical power plants. Hence, local coal is used mainly in pulverised coal power plants. Viet Nam, cognisant of the climate change impacts on its delta area in southern Viet Nam, is taking measures now to build new supercritical power plants to reduce CO₂ emissions from the power sector. Given a power demand growth averaging

15% per annum over the past decade, renewable energy based on biomass, wind, and solar cannot meet this demand growth.

Malaysia and Laos do have some coal resources. Malaysia's coal resources, located in Sarawak, are a mix of peat and sub-bituminous coal which is sufficient for generation within Sarawak. Coal-based power plants in Peninsular Malaysia use imported coal from Indonesia. Laos has lignite resources (80 million tonnes) in northern Laos. As such a 1,670 MW lignite power plant is being constructed, of which about 100 MW will be consumed locally in northern Laos.

12.4.4 Geothermal

The Philippines and Indonesia are the two countries within the region with significant amounts of geothermal resources. Indonesia's geothermal energy potential, estimated to be about 27,000 MW,¹⁰ is the world's largest. Currently, the installed generating capacity is 1,050 MW, accounting for just over 4% of the total potential. Presently, there is about 1,000 MW of unexploited geothermal power potential under private control and over 3,000 MW with state-owned enterprises. About half of these resources are in fields that are currently producing electricity or with confirmed reserves ready for further expansion. The government has intensified its efforts to revive and scale up geothermal development in the past few years. In 2003 the Geothermal Law (ref. 23/2003) was promulgated, making this form of renewable energy the only one to be governed by its own law. The Law, among other things, mandated that future geothermal fields must be transparently and competitively tendered for development. In 2004, the Ministry of Energy and Mineral Resources issued a Blueprint for Geothermal Development in Indonesia which was intended as a road-map for the development of another 6,000 MW by 2020. It should be noted, however, that government regulations complementing the Law were only issued in 2007 (ref. PP-59/2007), and other related regulations were developed later in 2009.

¹⁰ Indonesian Ministry of Finance, "Ministry of Finance Green Paper: Economic and Fiscal Policy Strategies for Climate Change Mitigation in Indonesia", Ministry of Finance, and Australia Indonesia Partnership, Jakarta, 2009.

The government has intensified its efforts to revive and scale up geothermal development in the past few years. In terms of development relevant to the private sector, the Ministry of Energy and Mineral Resources issued a Ministerial Decree (No. 30, issued in 2009) recognising the high costs associated with geothermal power development in Indonesia relative to coal-based power, and guided Perusahaan Listrik Negara (PLN), the state electric company of Indonesia, to consider paying a power purchase price of as much as \$0.097/kWh.¹¹ The government of Indonesia is also considering arrangements for sharing the upstream risks¹² and field development costs to further stimulate investment. For example, the Ministry of Finance has developed a proposal for the establishment of a revolving fund¹³ that will help lower exploration risks on greenfield sites. Once an adequate pricing and incentive programme is implemented, an increasing number of independent power producers will be able to develop their geothermal concessions since they will be able to secure a return on their investments commensurate with the risks they face in the sector.

The estimated potential in the Philippines is 7,000 MW and about 1,935 MW¹⁴ is currently in operation. The first area to be explored was the Tiwi geothermal area in southern Luzon. The government's strategy of offering prospective geothermal sites wherein earlier studies have been

¹¹ However, the government is still in the process of developing a set of sources for funding these higher costs. This has led to an initial reluctance on PLN's part to enter into power purchase agreements (PPAs) with the independent power producers.

¹² Steam resource assessments involve several steps, including aerial surveys, seismic surveys, detailed site-level geological characterisation and, finally, drilling of exploration wells. These assessments are expensive. For example, each test well could cost up to \$5 million. At each step, there is considerable risk that the investments may not yield an economically viable steam resource.

¹³ The fund would pay for initial geological assessments and exploration drilling across a range of greenfield sites. For sites where an economically viable resource has been established, the government of Indonesia would provide the resource data to all potential IPP bidders, and the winning bidder would be required to reimburse the fund for exploration expenses. Thus the "revolving" nature of the fund allows for exploration to occur on additional greenfield sites.

¹⁴ F. M. Dolor, "Phases of Geothermal Energy Development in the Philippines", paper presented at the Workshop for Decision Makers on Geothermal Projects and Management, organised by UNU-GTP and KenGen in Naivasha, Kenya, 14–18 November 2005.

conducted through open and competitive bidding under the Philippine Energy Contracting Round has provided opportunities to secure additional geothermal investments.¹⁵ The passage of the Renewable Energy Law also provided further opportunities for existing service contractors to undertake expansion and optimisation projects. The Renewable Energy Law envisions a feed-in tariff for geothermal power; however, the specific rates are being negotiated and are expected to be announced by the end of 2010. About 1,200 MW of new power plant capacity will be offered to private investors by 2013.

12.5 WHY NUCLEAR ENERGY? WHY NOT STRENGTHEN REGIONAL COOPERATION?

Given the energy resource potential within the Southeast Asian region, the question that needs to be asked is why nuclear energy? Are there no other alternatives or have all other alternatives been examined and exhausted? A number of ASEAN countries have recently been indicating through press releases their plan of having nuclear power by 2020–2025. Why are these countries planning to build nuclear power plants and what is driving this thinking? Is it energy security and self-reliance or is it because of climate change concerns and the need to reduce CO₂ emissions as part of country commitments/pledges made at the Copenhagen meeting?

Clearly, Cambodia and Laos will not need nuclear power to meet their electricity needs. Cambodia can easily meet its power needs by importing low-cost electricity in the short to medium term from Laos, Thailand, and Viet Nam. In the longer term, it should be looking at developing both hydropower- and coal-based generation to provide a mix of peaking and baseload generation in its power system as grid expansion occurs. Laos has adequate hydropower resources to meet its demand growth. But in the longer term, as Laos extends its transmission and distribution grids to achieve 90% electrification by 2020, it will need coal-based generation as

¹⁵C. Tiangco, “Geothermal Energy Development in the Philippines”, presentation made to the Mapua Institute of Technology, School of Mechanical Engineering, and the Philippine Institute of Mechanical Engineering Educators, Inc. (PIMEE).

baseload generation to even out the low hydro output during the dry season.

Malaysia and Thailand could be thinking about nuclear energy in the longer term to ensure security of supply as gas and oil resources decline. In recent years, we have seen fluctuations in energy markets (price swings) and these countries may be trying to be more prepared. Also, given the energy resources available in Peninsular Malaysia and in Sarawak, nuclear should be a long-term option. However, if Malaysia's oil and gas resources are declining and the government wants to maximise revenues from the sale of LNG, then it does make sense to be forward looking. In that case, the government should be looking at a series of nuclear plants and not just a single nuclear power plant.

Thailand on the other hand may find it difficult to convince its people that nuclear energy is good for the country, since 71%¹⁶ of generation in Thailand is already based on natural gas, which is cleaner than coal. The government aims to achieve 10% of power generation from renewable energy (solar, biomass, and wind). Besides, Thailand is already importing electricity from Lao PDR and will be importing electricity from Myanmar from 2017 onwards.

Indonesia has also given some thought to having a nuclear power plant built by 2021 and has started building institutions to help support this development. However, again given the potential indigenous energy resources available, efforts would be better placed to develop those. For this to happen, resource mobilisation will be required and incentives for renewable energy development, such as geothermal (pricing and upfront drilling risks), solar and wind, need to be addressed. Lastly, given the vast geographical spread of Indonesia, it is also important to address the expansion and upgrading of transmission and distribution systems within the country.

The countries should also explore implementation of energy efficiency and demand-side management, which could help forego investments in new generation. The author would strongly support regional cooperation within Southeast Asia or ASEAN. There are commitments and planned

¹⁶Electricity Generating Authority of Thailand, "Thailand Power Development Masterplan", 2010.

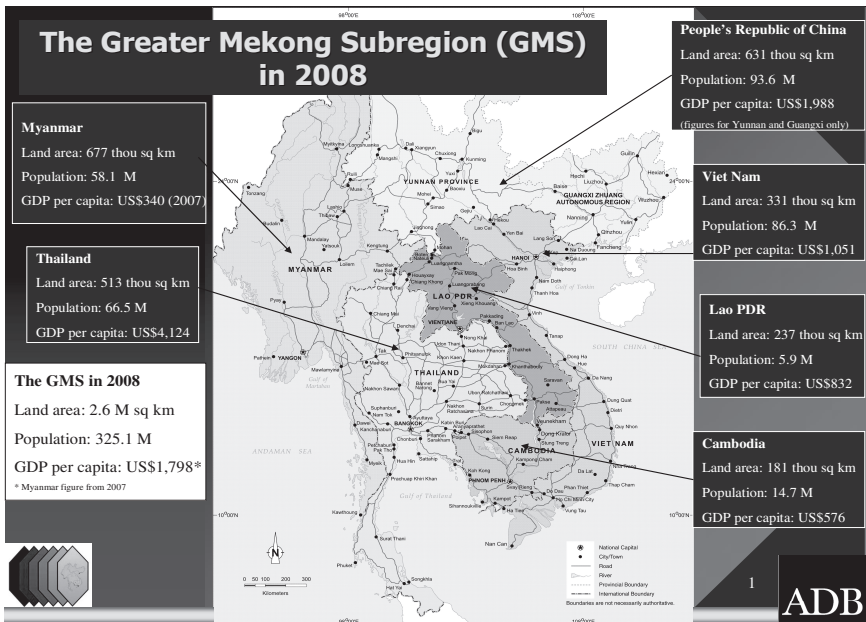


Figure 1 Greater Mekong Subregion Map

Source: ADB.

projects for sharing energy resources within ASEAN and the Greater Mekong Subregion¹⁷ (Figure 1).

A number of power interconnections have taken place within GMS states (Cambodia, Lao PDR, provinces of Yunnan and Guangxi in the People's Republic of China, Myanmar, Thailand, and Viet Nam; see Figure 1) but only a few have emerged between Malaysia and Thailand, Malaysia and Singapore, Malaysia and Indonesia, Indonesia and Singapore, and Malaysia and Brunei.

See Figure 2 for planned interconnections by 2015. These countries have the potential to share energy resources among themselves as there is not only a one-hour time difference between Malaysia and Indonesia but also differences in peak power demand. If surplus energy is available that could be shared or traded between the countries, it could also help save these countries' investments in new generation capacity. However,

¹⁷ADB, *Greater Mekong Subregion*, www.adb.org/gms/.

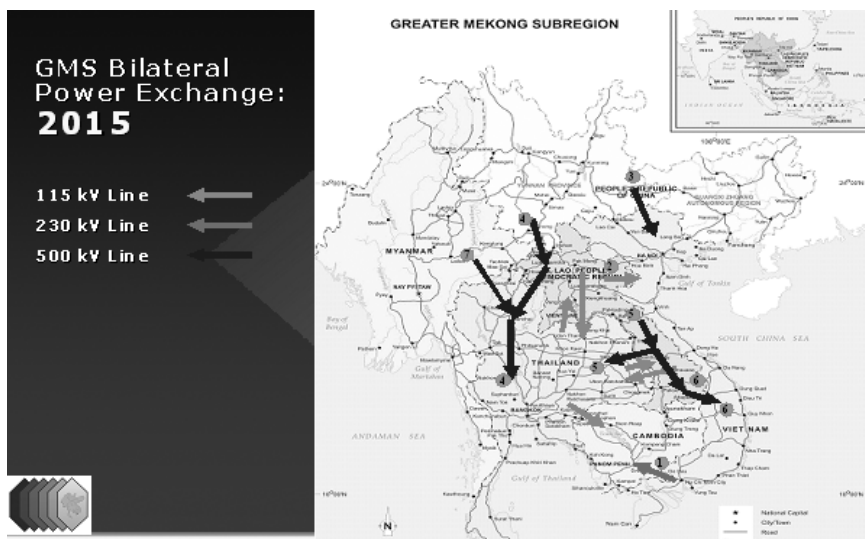


Figure 2 Power Trading within the GMS

Source: ADB.

investments in power interconnections will need to be made which will help pay for these investments within three years. The 275-kilovolt (kV) interconnection between Sarawak and West Kalimantan¹⁸ is a good example of a cross-border energy exchange which benefits both countries.

12.6 LONG-TERM PLANNING NEEDED FOR NUCLEAR ENERGY DEVELOPMENT

The only country within ASEAN or Southeast Asia that has really thought through the need for nuclear energy is Viet Nam. Viet Nam is way ahead of all the ASEAN countries in terms of planning as it had been thinking about the option 15 years ago. Development of nuclear energy requires long lead times and countries need to put in place policies, regulations, and a legal framework that will support nuclear energy development. If countries are thinking about nuclear energy, they will need to

¹⁸Trans Borneo Power Grid: Sarawak to West Kalimantan Link (Malaysia Section) –275 kV Transmission Line project, July 2011.

plan for a series of nuclear plants as fuel processing plants and storage will cost more or less the same for one or two plants. Countries will need to develop and strengthen the high-voltage power transmission lines to evacuate the power to load centres. Given that nuclear power plants cannot be shut down like a coal- or gas-fired power plant, it is essential to ensure that the energy generated at night is used efficiently. In some large power systems, it makes economic sense to build pumped-storage power plants that could use this surplus electricity for pumping at night and for the pumped-storage plants to be used during peak power periods to generate electricity. This will enable the shutdown of expensive peaking power plants within a system that is based on fuel oil, diesel, or gas turbines. The skills required and skills development of a country need to be thought through very carefully. Countries will also need to think in terms of developing a curriculum on nuclear energy within local universities that will support the nuclear industry. Countries need to address some of the following critical questions before embarking upon a nuclear programme:

- **Policy-related barriers:** How can ASEAN governments formulate a clear and stable policy commitment to nuclear energy as part of the overall energy strategy?
- **Industrial capacities and skilled human resource barriers:** In order to build, operate, and maintain nuclear plants, are the country's industrial capacity and human resources adequate? If not, how can this be improved over the next few years to support nuclear energy development?
- **Financial barriers:** Should governments support nuclear investment through measures such as loan guarantees or invite investments on a government-to-government basis from countries that have the technology?
- **Public acceptance barriers:** What measures can ASEAN governments take to gain greater public acceptance for nuclear programmes? Will it be through the media, schools, and/or public disclosures?
- **Advanced disposal of high-level radioactive waste:** What management and disposal strategies should be adopted for spent nuclear fuel?

- **International system of safeguards to prevent proliferation of nuclear fuels and technology:** These need to be maintained and strengthened where necessary. If the capacity is not there within the country, how will this shortcoming be addressed?

12.7 NATIONS PLANNING PEACEFUL NUCLEAR POWER DEVELOPMENT

Almost one quarter of global electricity could be generated from nuclear power by 2050,¹⁹ the International Energy Agency said in a report published on 16 June 2010. According to the IEA forecast, nuclear capacity could grow to 1,200 gigawatts electric (GW_e) by 2050, providing 24% of global electricity, if fully supported and well developed. The foreseeable expansion of nuclear generation capacity will contribute to a 50% cut in energy-related CO₂ emissions by 2050, as stated by the IEA. In the same report the IEA claims the expansion of nuclear generators presents no technological challenges; however, these challenges need to be addressed.

A number of Middle East and North African countries have taken steps to make nuclear power part of the generation system. The reason for this shift is to diversify their energy resource dependence but also to continue exporting oil and gas resources to earn foreign exchange. Some of the plans are as follows:

- **Saudi Arabia:** Has established a New Energy Centre for nuclear and alternative energy technologies.
- **UAE:** Planning for 14 nuclear power plants. Three plants to be operational by 2020. In 2009, the UAE awarded a \$20 billion contract to a South Korean consortium (KEPCO) to construct four plants (5,600 MW).
- **Jordan:** Prepared a nuclear programme that will provide 30% of electricity by 2040. It plans to issue the tender in 2010. Jordan currently imports over 95% of its energy needs, and with increasing and fluctuating oil prices, its dependence on energy imports is becoming

¹⁹“World Energy Outlook 2010.” International Energy Agency.

a huge burden on the economy and is hindering its development and economic growth.

- **Kuwait:** Established a nuclear committee in 2009 and signed a nuclear cooperation agreement with France in early 2010.
- **Algeria:** Recently announced a new centre for nuclear and alternative energy technologies.
- **Tunisia:** Feasibility study to be completed by 2012.
- **Egypt:** Identified El-Dadaa, a coastal town, as the site for its first nuclear power plant. It aims to have four plants in operation by 2025, with the first plant in 2019.
- **Syria:** Announced in March 2010 its intention to develop nuclear energy for power generation.
- **Turkey:** Plans to build 3,000–10,000 MW of nuclear capacity. South Korea and Russia have expressed a keen interest in working with Turkey on its civilian nuclear power programme. In May 2010, Russia signed an agreement to build and operate Turkey's first nuclear power plant, a project estimated to cost up to \$20 billion.
- **Morocco:** Plans to begin construction of its first nuclear plant in 2016–2017 and has begun drafting legislation.

Nuclear power project financing and understanding the risks involved and how to mitigate them are perhaps the most important aspects of which countries planning to embark on a new nuclear build should have a clear and comprehensive understanding. Financing also plays an important role in deciding which technology to adopt. For many of the countries, financing will be a deciding factor in selecting technology for their first commercial nuclear reactor. A sustainable funding scheme will be a major consideration in selecting an international company to build the country's first nuclear power plant.

12.8 SALIENT POINTS ABOUT NUCLEAR ENERGY AND PLANS IN DEVELOPED COUNTRIES

- The US enacted a law in 2005 to encourage new nuclear power plants. Twenty-four applications have been submitted but even after five years, no project has obtained statutory clearance (indicative of the strict scrutiny that all nuclear projects come under).

- Germany's policy is to phase out nuclear power reactors (17 reactors with an aggregate power generation capacity of 20 GW). It has added 20 GW of wind power capacity but these plants only produce 170 terawatt hours (TWh), whereas the nuclear power plants produce 355 TWh annually.
- Sweden also has a policy to phase out nuclear power plants (10 reactors, 9 GW) but has not taken any action to close them.
- The gas fields in the United Kingdom have declining yields and the government is talking about nuclear energy. The UK Sustainable Development Commission recommended against nuclear energy given that the waste disposal and decommissioning of these plants is expensive. Still, the UK government has decided to build new nuclear plants but identifying the sites has been difficult.
- Of the 49 reactors under construction, two are in OECD Europe (one each in France and Finland), two in Canada, one in the US, nine in Russia, 31 in Asia (regional developing member countries (DMCs)), one in South America, one in the Middle East, and two in Eastern Europe.
- The time available to adequately address greenhouse gas (GHG) emissions is running out. The recent economic downturn may have provided a small window of opportunity to put in place significant policy initiatives that could result in stabilising the atmospheric GHG at 450 parts per million (PPM). The Pacific countries are concerned about this target and want it to be lowered. If global GHG emissions rise to 550 PPM, this will have a devastating impact because of sea-level rises.
- Nuclear energy is one of several options to optimally reduce GHG emissions. If any of the options were to be discarded, the overall cost of mitigation would increase.
- There has been a resurgence and about 60 countries (30 countries already use nuclear energy) have approached the International Atomic Energy Agency (IAEA) to better understand the nuclear energy option.
- Nuclear power is not universally economical and depends on the situation (e.g. renewable resources, rate of growth of demand). It meets baseload demand (unlike wind and solar which are weather

dependent), it is expensive to build but cheap to run (like renewables). The “cost charts” are deceptive because they do not compare all costs and benefits, e.g. the cost of the price volatility of oil and other fuels, the protection a nuclear power plant offers against fuel price increases over 40–50 years.

- GHG emission reduction options include carbon capture and storage (CCS). While most of the linked technologies are already in use, the largest commercial-scale CCS project in operation is only 10 MW. There are significant uncertainties and if found to be unfeasible, the pressure on developing nuclear energy will increase. Similarly, improving energy efficiency involves low costs but politicians are generally biased towards visible, greenfield project investments and favour cost reductions less. The implementation of wind power has been successful in Germany but has required annual subsidies of €4–6 billion and even now supplies only 7% of the country’s demand.
- Adding large wind capacity has technical issues, as was observed in Denmark. It has 3,180 MW of wind capacity that supplies about 7 TWh out of the total annual demand of about 43 TWh. However, when the wind resource is good, it meets nearly all of Denmark’s demand and some wind power is even exported. In early 2009, a wind farm with a large capacity was in operation when a wind shear suddenly occurred, the wind speed over the country increased within minutes, and the wind turbines cut out (the blades stalled on high wind speed to protect the equipment). The sudden loss of wind power supply to the grid led to significant changes in power flow in the transition period, which could have resulted in large blackouts in Denmark; however, as it happened over the weekend when demand was not high, the protection and control systems acted properly and an incident was avoided.
- Project financing has not been used for nuclear power plants. It is implemented by utilities with large financial resources as they also want low-cost power over very long periods.
- Generally markets want short-term results; this tends to support investments that have low capital costs even when operating costs are high — typically for gas-based and other fossil fuel-based power

plants. Therefore, the government support for nuclear power is seen as addressing a “market failure”.

- While multilateral development banks (MDBs, such as the ADB, World Bank, European Investment Bank, European Bank for Reconstruction and Development, and African Development Bank) directly contribute, if any policies change towards supporting nuclear energy, their financial support will remain relative to the share of total capital investment required. However, their participation could reduce risk perception and help mobilise commercial financing at an affordable cost.
- Developing nuclear energy project proposals are increasingly facing not-in-my-backyard (NIMBY) resistance. The location of nuclear power plants requires extra effort in consultations and obtaining support from the local population.
- The IAEA provides advice, technical support, and capacity building to member countries, but it is not a global “regulator”. Its advice is not binding, but it encourages countries to publish its advice.
- The IAEA cannot judge the performance of member countries (e.g. if safety standards are being implemented properly). The PRC held a conference on nuclear energy in April 2009 and around the same time there was a media report quoting the PRC regulator that more assistance was needed to support the country’s aggressive nuclear capacity addition. The PRC planned to add about 20,000 MW of new nuclear generation capacity by 2025. Subsequently, the IAEA was formally approached to provide peer review and capacity building assistance.
- Decisions to support or not support nuclear energy need not be taken by the government on economic and technical bases alone; it is usually a matter of preference and taste of the government concerned (e.g. how much does the electorate value safety?).

12.9 ROLE OF THE ADB

The ADB’s Board approved a new ADB energy policy²⁰ in 2009 to guide ADB operations in the energy sector. The 2009 Energy Policy aligns the

²⁰ADB, “Energy Policy”, 2009.

ADB's energy operations to meet energy security needs, facilitate a transition to a low-carbon economy, and achieve the ADB's vision of a region free of poverty. The new energy policy is congruent with the draft energy strategy developed in consultation with internal and external stakeholders, and is aligned with the ADB's long-term strategic framework for 2008–2020, Strategy 2020. It represents a coherent translation of important elements of Strategy 2020 that prioritise energy-related objectives and identify the institutional capabilities needed for the future within a changing regional, global, and technological context. The ADB's new energy policy aims to help DMCs to provide reliable, adequate, and affordable energy for inclusive growth in a socially, economically, and environmentally sustainable way. However, this policy does not support nuclear energy projects. The ADB does not have the relative advantage in nuclear energy where the investment needs are huge and it does not have the technical capacity that the IAEA has in dealing with the technical issues as well as the non-proliferation issues.

The ADB's sustainable development goal is to support the development of energy sources to ensure that its member countries do have an adequate supply of electricity to meet the economic development needs but also to ensure that the unconnected rural population is connected to the grid. The ADB will also continue supporting its DMCs in formulating energy policies that would help limit GHG emissions. Some of these policies will be in the areas of (a) energy efficiency; (b) fuel diversification, from coal to gas or other cleaner fuels such as renewable energy (wind, solar, and biomass), and natural gas; and (c) clean coal technologies such as supercritical and ultra-supercritical boiler technologies, and carbon capture and storage.

CHAPTER 13

BIRTHING AN ASEAN NUCLEAR ENERGY COOPERATION REGIME: DRIVERS, STATUS AND WAY FORWARD

Francisco G. Delfin Jr.

ABSTRACT

The creation of an ASEAN regional nuclear energy cooperation regime is driven by inter-related concerns on energy, the environment, and supra-national governance. How this regime will be crafted and operated will present major challenges to ASEAN given the varying levels of commitment to nuclear power by individual governments, challenges posed by NGOs and religious groups, and regional nuclear technological capability. Several meetings held on the proposed ASEAN nuclear energy cooperation network since 2007 have not finalised the terms of reference and work plan. Some member states have been sensitive to proposed regime elements that are seen to diminish internal nuclear policies and programmes. This highlights the need for a gradual approach that anticipates a civilian nuclear industry emerging in ASEAN by 2020 rather than for the immediate formation of a full-blown legal regime.

13.1 INTRODUCTION

Anticipating the inevitability of a civilian nuclear power industry in the region, ASEAN heads of states during the 12th ASEAN Summit in Cebu,

the Philippines, called for the formation of a regional nuclear energy regime that will govern the safe use of nuclear energy within ASEAN. The establishment of a Nuclear Energy Cooperation Sub-Sector Network (NEC-SSN) became the responsibility of the ASEAN Senior Officials on Energy (SOE) through the ASEAN Ministers on Energy Meeting (AMEM) framework. The administrative support for this undertaking comes from the Jakarta-based ASEAN Centre for Energy (ACE).

This chapter starts with an examination of the energy, environmental, and governance factors driving nuclear power use and regulation in the region. It then summarises the status of national nuclear energy programmes and describes ASEAN's effort to craft a NEC regime and the challenges facing this effort. Building on such constraints, the chapter ends by exploring how this regime can be developed.

13.2 ENERGY, ENVIRONMENTAL, AND GOVERNANCE DRIVERS

The creation of an NEC (originally called nuclear energy safety or NES) regime is driven by several factors related to energy supply and demand, environmental concerns, and supra-national governance.

13.2.1 Energy Drivers

Energy supply uncertainty, highlighted by volatile world oil prices, is arguably one of the strongest factors prodding ASEAN nations to undertake or revive nuclear power programmes. Although Indonesia, the Philippines, and Thailand had established nuclear power programmes dating back to the 1960s (Alexandra, 2009; Delfin, 2008; Takabut, 2007), and the Philippines actually completed the 620 MW Bataan Nuclear Power Plant (NPP) in 1985 (Figure 1), these programmes were terminated or deferred in the mid-1980s for several reasons, including abundant and cheap oil supply. In 2007 when crude prices topped \$60/barrel, the pace of ASEAN policy pronouncements and activities on nuclear energy quickened, especially with the 12th ASEAN Summit Cebu Declaration expressing openness to nuclear energy use.

Exploring the nuclear option is just one mode of fuel diversification to enhance national energy security. Meeting this objective often includes

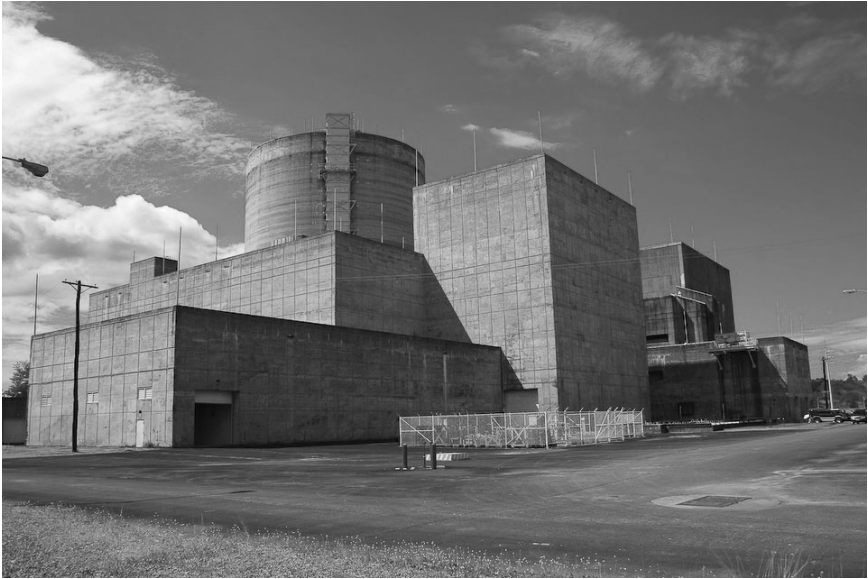


Figure 1 The 620 MW Bataan NPP Completed in 1985 But Mothballed by the Aquino Government

Source: NPC

some of the following measures: 1) a cutback in fossil fuel consumer subsidy, 2) reserving fossil fuel production for exports rather than for power generation, 3) promoting biofuels in the transportation sector, 4) more aggressive development of renewable energy for power generation, and 5) going nuclear.

Growing electricity demand, fuelled by continuing economic growth and prosperity in the region, is another major driver for nuclear power. Recent electricity outages in the urban centres of Indonesia, the Philippines, and Vietnam (Alexandra, 2009; Quiros, 2009; Tuan, 2009) show that current power capacities in these countries are unable to meet rising needs. Electricity demand is forecasted to grow 4.8% annually, tripling from 37.9 million tonnes of oil equivalent (Mtoe) in 2005 to 123.1 Mtoe by 2030, necessitating major investments in new generation facilities (ADB, 2009).

Another factor that promotes the region's long-term nuclear energy use and regulation is the ASEAN power grid project (APGP) (Figure 2). Aimed for initial operation by 2015 (Chonglertvanichkul, 2007),

Result of ASEAN Interconnection Master Plan Study

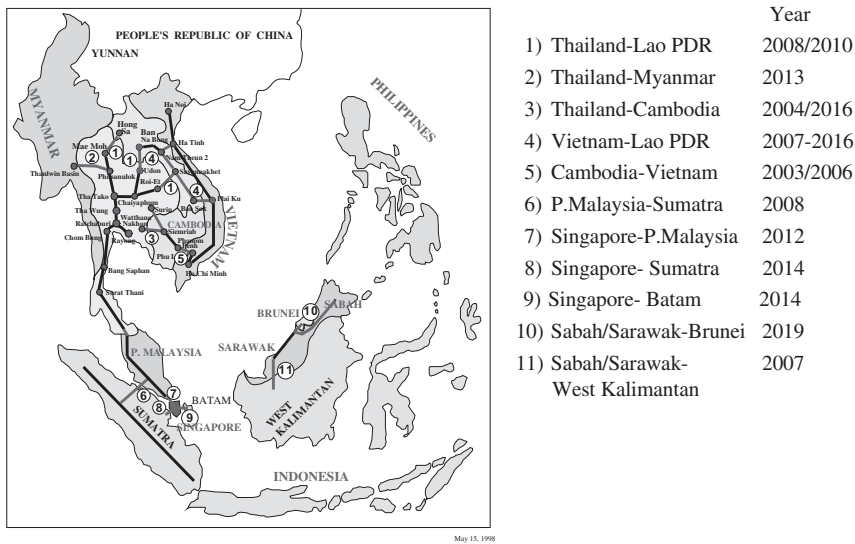


Figure 2 ASEAN Power Grid Components and Estimated Linkage Dates
Source: P. Chonglertvanichkul, 2007

interconnecting national power grids involves both physical linkage of facilities and harmonisation of grid operations and policies. Excess power supply in one national grid system can thus be transmitted to those with power deficit. The wider electricity market to be provided by the APGP enhances the economic viability of large-capacity nuclear plants. The 2015 scheduled operation of the APGP will be very timely for the first nuclear power stations of the region coming on stream around 2020 (Figure 2).

13.2.2 Environmental Drivers

The use of nuclear power, with its low greenhouse gas (GHG) emissions, has been revived by global warming concerns. Nuclear power plants have the least direct and total life cycle CO₂ emissions (9–21 grams of CO₂ equivalent per kWh) compared with plants using coal (966–1,306), natural gas (439–688), solar (100–280), hydro (4–236), and wind (10–48)

(Spadaro *et al.*, 2000). Nuclear power plants currently in operation effectively reduce global CO₂ emissions by 1,600 million tonnes per year (IAEA, 2008). And despite ASEAN's modest contribution to global GHG emissions, it is a strong supporter of the Kyoto Protocol; ASEAN's 2007 Declaration on Environmental Sustainability called for increased cooperation in climate change-mitigating strategies and implicitly acknowledged nuclear power's role in this strategy.

On the other hand, regional regulation of nuclear power is driven by lingering doubts about the hazards of nuclear power. Member states which may not necessarily use nuclear energy are understandably concerned about the effects of nuclear accidents in one state spilling over to their territories. Such cross-border externalities were vividly illustrated by the 1997 Indonesian forest fires. In that disaster, haze drifted to neighbouring Brunei, Malaysia, and Singapore and even to parts of Thailand, Vietnam, and the Philippines (Figure 3) and had varying environmental and health impacts (Frankenberger *et al.*, 2005). It is thus understandable why Singapore and Malaysia which previously opposed nuclear power have become advocates of regional nuclear cooperation.

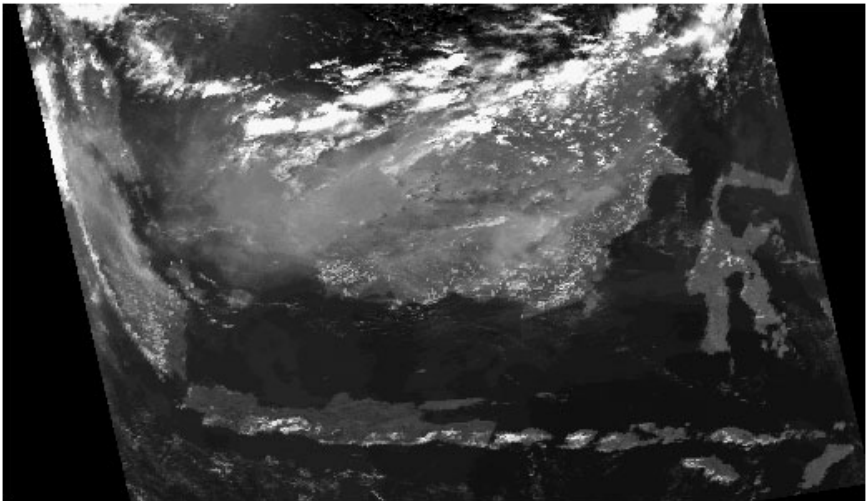


Figure 3 Satellite Image of Haze Spreading from the 1997 Indonesian Forest Fires

Source: <http://www.fao.org/ag/againfo/programmes/en/lead/toolbox/Indust/BioBurEA.htm>

13.2.3 Governance Drivers

Several regional and global regimes also favour the use and regulation of civilian nuclear power in ASEAN. First, the Southeast Asian Nuclear-Weapon-Free Zone (SEANWFZ) Treaty signed in 1995 obligated members to refrain from producing and possessing nuclear weapons and from discharging radioactive material into the sea or atmosphere. This addresses both security fears that civilian nuclear technology may be diverted for weapons purposes and the environmental worry about potential nuclear waste dumping into the region’s commons. Second, all ASEAN members have ratified the Nuclear Non-Proliferation Treaty (NPT) and many members have also ratified or signed other conventions of the International Atomic Energy Agency (IAEA) pertaining to nuclear materials, accidents, and liability (Table 1).

Third, the ASEAN Regional Forum (ARF) July 2004 Statement on Non-Proliferation further encourages ASEAN members to comply with

Table 1 Status of Signing and Ratification by ASEAN States of Key International Nuclear Treaties

Treaty/Convention	BRU	CAM	IND	LAO	MAL	MYN	PHI	SIN	THA	VIE
Non-Proliferation Treaty ¹	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA
Nuclear Safety ²			RA				SG	RA		
Nuclear Material Protection ³		RA	RA				RA			
Notification of Accident ⁴			RA		RA	RA	RA	RA	RA	RA
Assistance in Accidents ⁵			RA		RA		RA	RA	RA	RA
Spent Fuel Management ⁶			SG				SG			
Civil Liability ⁷							RA			

RA: Ratified or acceded; SG: Signed.

¹Nuclear Non-Proliferation Treaty;

²Convention on Nuclear Safety;

³Convention on the Physical Protection of Nuclear Material;

⁴Convention on Early Notification of a Nuclear Accident;

⁵Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency;

⁶Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management;

⁷Vienna Convention on Civil Liability for Nuclear Damage.

international non-proliferation obligations to enhance the region's security. Finally, the signing of the ASEAN Charter in 2005 and the aim of establishing an ASEAN Economic Community by 2015 will speed up economic integration that favours regional cooperation and standard setting on a host of issues, including presumably nuclear energy use.

13.3 THE ASEAN NEC-SSN: STATUS AND CHALLENGES

The pace and direction of regional nuclear cooperation depend also on the state of individual national nuclear energy programmes. Vietnam is widely regarded to be on track to commission its first 4,000 MW NPP by 2020 (see Table 1). Vietnamese officials are so confident about their legal, technical, safety, human resource, and financial preparations that they recently upgraded their nuclear goal to 16,000 MW by 2030 (AFP, 2010). Malaysia may be the second ASEAN country to tap nuclear power after its Cabinet in 2010 approved the operation of its first NPP by 2021 (AP, 2010), although it is likely to face more internal debate than Vietnam. And, though Singapore has declared nuclear power is unlikely to be used even within 10 years, its decision to start a careful economic and technical feasibility study of nuclear power (Iswaran, 2010) raises the possibility that Singapore may go nuclear earlier than expected.

In contrast, nuclear power programmes in Indonesia and the Philippines have suffered political and legislative setbacks as shown in Table 1 that may complicate their NEC-SSN involvement. Recent media reports about Myanmar's alleged secret nuclear weapons deal with North Korea (Macdonald, 2009) will surely bring added scrutiny, if not urgency, to NEC-SSN formation.

13.3.1 Status of the NEC-SSN

The NEC-SSN's terms of reference (TOR) and work plan were drafted by host Singapore during the November 2007 SOE meeting. In that draft, the proposed regime included five key elements: 1) a legal framework for implementation of standards, 2) a mechanism for peer review and inspection of facilities, 3) joint research, 4) a regional radiation monitoring network, and 5) a system for early notification and provision of assistance

during accidents. The work plan, on the other hand, called for information sharing, personnel exchanges and site visits, and joint research and conferences among the region's scientists and policy makers.

Despite the mandate from the ASEAN heads of states and the broad consensus among the energy ministers to form the NEC-SSN, the Senior Officials on Energy have not been able to finalise the documents after almost three years of work and meetings (see Table 2). The last AMEM in July 2009 in Mandalay encouraged them to finalise the documents for approval during the next AMEM in 2010.

Table 2 Chronology of Major Milestones in ASEAN Nuclear Energy Development (1986–2010)

Date	Event
April 1986	Philippine President Aquino mothballs newly completed 620 MW Bataan NPP.
September 1989	Indonesia's National Energy Coordination Board decides new NPP feasibility study is needed.
December 1995	Southeast Asian Nuclear-Weapon-Free Zone Treaty (Treaty of Bangkok) is signed.
May 1996	Final feasibility report confirms Muria peninsula as best site for Indonesia's first NPP.
March 2002	Vietnam forms Nuclear Energy Programme Implementing Organization (NEPIO).
January 2006	Vietnam approves long-term strategy for nuclear development to 2020 and beyond.
January 2007	12th ASEAN Summit in Cebu calls for creation of a regional nuclear energy safety regime.
April 2007	Thailand approves 2007–2022 Power Development Plan which includes the first 2,000 MW of nuclear power by 2021.
May 2007	Myanmar signs deal with Russian atomic agency Rosatom to build 10 MW nuclear research reactor.
June 2007	Vietnam's Prime Minister approves nuclear energy master plan to 2020.
September 2007	Indonesian Muslim clerics and scholars declare <i>fatwa</i> on planned Muria NPP.

(Continued)

Table 2 (Continued)

November 2007	Special ASEAN Senior Officials Meeting on Energy (SOME) in Singapore endorsed in principle the draft terms of reference (TOR) for the Nuclear Energy Safety Sub-Sector Network (NES-SSN).
January 2008	First meeting of the NES-SSN in Singapore fails to finalise TOR and work plan. IAEA mission reviews the Philippines' plan to rehabilitate the Bataan NPP.
June 2008	Vietnam's National Assembly passes Atomic Energy Law.
August 2008	26th ASEAN Ministers of Energy Meeting (AMEM) in Bangkok tasked the SOME to complete the TOR of the NES-SSN in time for the 14th ASEAN Summit.
September 2008	Cambodian government announces plan to build first NPP by 2020.
October 2008	The Philippines' National Power Corp. (NPC) signs cooperation agreement with South Korea Electric Power Company (KEPCO) for a feasibility study on BNPP rehabilitation.
March 2009	14th ASEAN Summit Chairman's Statement does not mention the proposed NES-SSN.
May 2009	Special SOME in Chiang Mai endorses name change to Nuclear Energy Cooperation Sub-Sector Network (NEC-SSN) to denote larger sphere of cooperation.
June 2009	KEPCO submits feasibility report to the Philippine Congress, NPC, and DOE stating that the BNPP may be successfully rehabilitated.
July 2009	27th AMEM in Mandalay endorses name change to NEC-SSN and encourages the SOE to finalise TOR and report to the next AMEM.
November 2009	Vietnam's National Assembly endorses operation of first 4,000 MW NPP by 2020.
February 2010	14th Congress of the Philippines fails to pass bill for Bataan NPP rehabilitation and commissioning.
April 2010	Singapore Prime Minister declares government will begin careful study of nuclear energy.
May 2010	Malaysia's Cabinet approves operation of the 1st NPP by 2021.
June 2010	Myanmar denies secret nuclear weapon cooperation programme with North Korea. Vietnam increases nuclear power target to 16,000 MW installed capacity by 2030.

13.3.2 Challenges to the NEC-SSN

Concerns about potential diminution of national nuclear policies appear to be the biggest barrier to NEC-SSN formation. Specifically, the proposed promulgation of regional legal standards to govern national nuclear power industries are seen by Indonesia and Vietnam as problematic. This is understandable given the need to protect decades-long investments and emplaced standards on national programmes made by these countries. A related but less valid concern is that peer review and inspection of facilities impinge on members' national security. Given that all ASEAN countries have ratified the NPT which mandates IAEA inspection of nuclear facilities, the objection to ASEAN-level inspection is somewhat illogical. But this concern raises a third and broader issue among members — that the NEC-SSN will be duplicating functions and mandates already exercised by the IAEA. In addition, the IAEA-supported Asian Nuclear Safety Network (ANSN), which counts six ASEAN countries as members (Indonesia, Malaysia, the Philippines, Thailand, Singapore, and Vietnam), already exists to promote nuclear safety through capacity building on a voluntary basis.

ASEAN officialdom will also need to respond in a transparent, credible, and sustained manner to civil society opposition to nuclear power if a regional nuclear regime is to be successful. Although Western environmentalists are now split on nuclear energy, with Greenpeace founder Patrick Moore and the US-based Environmental Defense Fund among the prominent endorsers of nuclear energy, most ASEAN environmental organisations are likely to continue the 1970s and 1980s ethos of opposing anything nuclear.

Some religious elements will add their voice against nuclear energy even if environmentalists begin to acknowledge the climate benefits of nuclear power. The political clout of religious groups is demonstrated by the deferment of the Muria power station due to a *fatwa* issued by Indonesia's Islamic clergy and scholars (Tanter, 2007) and by the defeat of the congressional bill reviving the Bataan nuclear plant, supported by a network of Philippine civil society groups, including elements of the Catholic Church (M. Cojuangco, personal communication, 2010; Punzalan, 2010).

Another challenge to NEC-SSN formation and implementation also comes from ASEAN's still modest nuclear science and technology

capacity. Much of the work envisioned in the NEC-SSN TOR and work plan will require advanced theoretical and experiential understanding of the entire nuclear fuel cycle. In the short term, this can be addressed by engaging experts from the IAEA, business vendors, and foreign governments marketing their nuclear technology such as France, Japan, or South Korea. Over the long term, the region's universities should ultimately produce the necessary human resources for the emerging ASEAN nuclear energy industry. Academic departments that may benefit from the use of nuclear power such as engineering, physics, mathematics, and some natural sciences may seize the opportunities provided by the NEC-SSN to build up their curricula, faculty, and facilities.

13.4 SKETCHING A WAY FORWARD

Rather than aiming for a comprehensive and full-blown legal regime now, ASEAN can proceed along a more gradualist approach. A three-stage process can be envisioned whereby most of the NEC-SSN goals may be achieved by 2020, or in time for the anticipated operations of the region's first nuclear power stations. It can start by framing the NEC-SSN to focus initially on a more restricted sphere of cooperation such as building a regional radiation monitoring network and a system for nuclear accident notification and emergency assistance. By focusing on the limited scientific and safety aspects of cooperation, ASEAN members can nurture trust, communication, and reciprocity on a highly charged subject. Regional cooperation can then move in the medium term to a higher and more technical sphere such as creating a platform for national regulatory agencies and implementing organisations to share policies, practices, and personnel. This should help strengthen the institutional independence and technical competence of ASEAN nuclear regulators which are central to a safe and secure nuclear industry in the region (Fitzpatrick, 2009). Discussions on common standards, joint research, and facilities inspection can also begin at this time. The last stage is envisioned to be where agreements can be started, if not reached, on more politically contentious but critical areas such as a possible common regional repository for nuclear wastes, joint contracts with vendors on nuclear fuel supply, and sanctions on non-compliant or erring member states.

The energy, environmental, and governance imperatives sweeping the region and the globe that increasingly favour using low-carbon nuclear energy can only be ignored at the peril of ASEAN's continued prosperity, harmony, and security. Creating a regional nuclear cooperation regime that meets ASEAN's unique needs will not be easy, popular, or inexpensive but it is needed if only to prevent the nuclear self-interest of nations from fracturing and endangering ASEAN.

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CHAPTER 14

SHOULD ASEAN GO NUCLEAR?

Lee Yoong Yoong

ABSTRACT

Over the years, energy security has become a key economic and strategic issue in ASEAN. Though rich in energy resources — nine ASEAN Member States have proven oil and/or gas resources or other natural resources — ASEAN is not totally immune from the impact of rising oil prices or other external shocks to energy supply. Such a threat is further magnified by the pace of progress and growth of Asia in the global economy. Amid such circumstances, one way forward for the grouping is to address its own energy security. One outcome is to make diversification of energy supply resources a principal policy agenda, such as investing in renewable energy. A number of ASEAN Member States have in reality gone a step further and contemplate the option of civilian nuclear power. While such nuclear power ambitions are not actually new, there remains the concern of safety and security. This paper examines the pros and cons as well as the costs and benefits for ASEAN to go nuclear. In conclusion, the paper would highlight that, though it is a controversial issue, ASEAN, as a region, seems to

gradually embrace the notion and the use of nuclear power to address the energy security dilemma. This is evident through the incorporation of the use of civilian nuclear energy in its latest plan of action for energy cooperation. It will be fascinating, after all, to see how the ambition of nuclear energy would eventually evolve into the reality of ASEAN.

14.1 INTRODUCTION

Energy security has, in recent years, become a key economic and strategic issue. Defined as the securing of reliable, adequate and affordable sources of energy, energy security is a critical issue for almost every state and government because it plays an essential role in accomplishing strong and sustainable socio-economic growth.

Global energy supply is a direct corollary of the worldwide energy demand and consumption, which increase with population growth. It is reported that over 1.6 billion people, equivalent to about 36% of the developing world's population,¹ are living without access to electricity, power and energy. Predictions of energy demand for the next 50 years vary, though experts anticipate that providing an acceptable quality of life for the majority of the world requires thrice the energy consumed in the early years of this millennium,² highlighting the close linkage between poverty eradication and energy demand.

14.2 ENERGY SECURITY IS CRITICAL TO ASEAN

After the Asian financial crisis in 1997–1998, Southeast Asian countries promoted new investments and consumer confidence, resulting in a decade of strong growth since. As a result, the energy sector is racing to keep up with the speed of growth, creating varying opportunities from country to country in the region. The 10 member states of the Association of

¹Global Network on Energy for Sustainable Development, “Reaching the Millennium Development Goals and Beyond: Access to Modern Forms of Energy as a Prerequisite”, 2007, p. 5.

²Ryoichi Yamamoto and Masayasu Kitagawa, “Science on Sustainability”, Research on the Scientific Basis for Sustainability, 2006.

Southeast Asian Nations (ASEAN)³ represent one of the world's rapidly growing regions, and one that has a rapidly rising energy demand driven by economic and demographic development.

ASEAN's primary energy requirement was projected to triple between 2005 and 2030 (reference scenario).⁴ Meeting such energy needs — with unprecedented increases in coal use, oil and gas imports, as well as greenhouse gas (GHG) emissions — will be the acid test. The challenge to ensure a secure regional energy supply is an overriding concern.

The ASEAN region is rich in energy resources. Nine member states have proven oil and/or gas resources or other natural resources, such as coal, hydro and biomass (see Figure 1), with two of the states, Brunei Darussalam and Indonesia, ranked among the world's top liquefied natural gas (LNG) producers.⁵ ASEAN also produces nearly 40% of the oil and gas resources in the Asia-Pacific rim. Oil and gas contribute an approximate value of US\$48 billion to ASEAN economies annually.⁶

³The Association of Southeast Asian Nations, commonly abbreviated ASEAN, is a geo-political and economic organisation of 10 countries in Southeast Asia. It was founded on 8 August 1967 by Indonesia, Malaysia, the Philippines, Singapore and Thailand. Since then, membership has expanded to include Brunei Darussalam (entered in 1984), Cambodia (1999), Laos (1997), Myanmar (1997) and Viet Nam (1995). Its aims include the acceleration of economic growth, social progress, cultural development among its members, protection of the peace and stability of the region, and provision of opportunities for member countries to discuss differences peacefully.

⁴The ASEAN Secretariat, "ASEAN Plan of Action for Energy Cooperation (APAEC) 2010–2015: Bringing Policies to Actions — Towards a Cleaner, More Efficient and Sustainable ASEAN Energy Community", p. 5. ASEAN's energy demand is expected to hit 1,252 Mtoe (million tonnes of oil equivalent) in 2030 from 474 Mtoe in 2005, an increase with an average annual growth rate of 4%. This is higher than the world's average growth rate of 1.8% for primary energy consumption through 2030.

⁵Weerawat Chantanakome and Akhmad Nidlom, "The Role of Energy Cooperation in ASEAN Region: Challenges and Opportunities towards Enhanced Energy Security", presented at the 2007 Annual Conference, "Energy Security: Visions from ASIA and Europe", Centre for Strategic and International Studies (CSIS) and Research Unit on International Security and Cooperation (UNISCI), Complutense University of Madrid, Jakarta, 8–10 November 2007.

⁶26th ASEAN Ministers on Energy Meeting (AMEM), Bangkok, Thailand, 7–8 August 2008, http://www.information.gov.bn/VER2/index.php?option=com_content&task=view&id=213&Itemid=93.

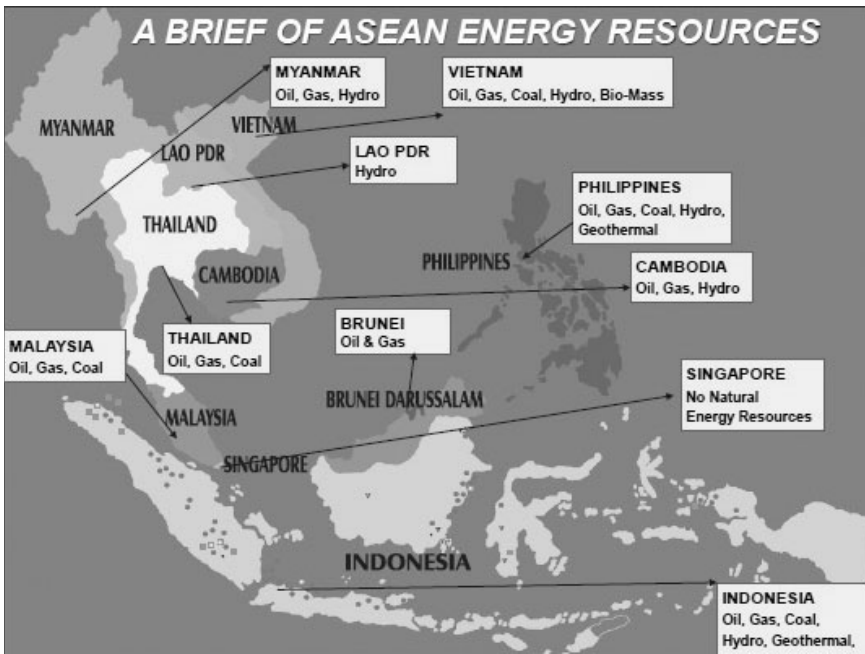


Figure 1 Overview of ASEAN Energy Resources

Source: ASEAN Council on Petroleum (ASCOPE)

Undoubtedly, energy plays an imperative role in the integration and prosperity of ASEAN. It is a constituent that binds the ASEAN member states to one another, and is an equally crucial component in ensuring the transformation of the region into an economically competitive, resilient and secure community by 2015.

With a vast reserve of 22 billion barrels of oil, 227 trillion cubic feet (Tcf) of natural gas, 46 billion tonnes of coal, 234 gigawatts (GW) of hydropower and 20 GW of geothermal capacity,⁷ member states are relentlessly forging cooperation for the utilisation of the region's energy potential (Figure 1).

Still, despite boasting such impressive energy reserves, ASEAN was not totally immune from the impact of rising oil prices. Member states, such as the Philippines, Singapore and Thailand, remain particularly

⁷The ASEAN Secretariat, "ASEAN Plan of Action for Energy Cooperation (APAEC) 2004–2009", p. 2.

vulnerable to disturbances in energy supply given that their economies are intensely dependent on oil imports. Such a threat was further magnified by the breakneck pace of progress and growth of Asia compared to other continents in the world.

For one, the rising energy demand has led to ASEAN member states scouting and contending for every available energy resource — either for consumption or, more significantly, for sale-export to fellow Asian neighbours such as China, India and Japan, all of which are economic powerhouses also looking to strengthen their own energy security. To complicate the situation, ASEAN's projected reliance on fossil fuels means that the region has incidentally become a large contributor to global warming. ASEAN member states are at risk from the impact of climate change as several of them have limited technical ability and capacity to cope with its effects. Some of them, faced with financial constraints, are also likely to be confronted with additional costs associated with climate change mitigation and adaptation in the future.

Amid such circumstances, a way forward for ASEAN is to address the growing challenge of energy security while preventing irreversible damage to the environment. A number of initiatives have been developed to raise awareness and to prepare for mitigation and adaptation. One example is the Singapore Declaration on Climate Change, Energy and the Environment, signed and adopted at the Third East Asia Summit (EAS) by the leaders of the 16 countries — the 10 ASEAN member states, Australia, China, India, Japan, Korea and New Zealand — which expressly underscored that East Asia “will urgently act to address the growth of global greenhouse gas emissions”.⁸

The upward trend in demand makes it critical for ASEAN to have its arms open to all accessible and possible sources of energy to sustain its growth trajectory. One outcome is to make diversification of energy supply resources a principal policy agenda. Apart from conventional natural gas and fossil fuel, it would be a strategic realignment by ASEAN to invest in renewable energy. This should provide the region with an adequate foothold in the international energy arena. It was with this in mind that a number of ASEAN member states have, in recent years, adopted proactive policies towards renewable energy utilisation, and energy efficiency and conservation. A handful of them went a step further, by opening doors anew to civilian nuclear power.

⁸Singapore Declaration on Climate Change, Energy and the Environment, Singapore, 21 November 2007, <http://www.aseansec.org/21116.htm>.

14.3 OUTLOOK FOR NUCLEAR ENERGY

Within ASEAN, Indonesia, Malaysia, Myanmar, the Philippines, Thailand and Vietnam have all, at different times, announced their sombre intention to execute/reignite their national nuclear programmes, although more often than not, funding challenges and changing priorities have resulted in holdups and project deferrals. It was reported that these ASEAN member states had notified the International Atomic Energy Agency (IAEA) of their proposals to operate nuclear power plants as an alternative to non-renewable energy resources.⁹

Regional nuclear power ambitions are actually not new. Undersized nuclear research reactors were constructed in the early 1960s in several Southeast Asian countries, namely, Indonesia, the Philippines, Thailand and the then South Vietnam (backed by the Atoms for Peace programme launched by the United States). One perspective was that investment in nuclear energy would enable newly independent states to achieve advanced industrial status quickly.¹⁰

While the rest of ASEAN — Brunei Darussalam, Cambodia, Lao People's Democratic Republic and Singapore — may not be in the vanguard in pushing for a national nuclear energy policy, the reality is that these four smaller member states are receptive to working together with the rest of the region to fortify energy security. This was evident at the convening of the 25th ASEAN Ministers on Energy Meeting (AMEM) in Singapore, in August 2007, where the ministers

in-principle agreed to the establishment of an ASEAN Nuclear Energy Safety Sub-Sector Network to explore nuclear safety issues.¹¹ The Ministers also tasked the senior energy officials to determine the Terms of Reference and composition of the network.¹²

⁹Phir, "ASEAN's Path to Energy Security: Not without the Hidden Cost", Singapore Institute of International Affairs, 2009.

¹⁰Andrew Symon, "Nuclear Power in Southeast Asia: Implications for Australia and Non-Proliferation", Lowy Institute for International Policy, April 2008.

¹¹The ASEAN Nuclear Energy Safety Sub-Sector Network (NES-SSN) is now renamed the ASEAN Nuclear Energy Cooperation Sub-Sector Network (NEC-SSN).

¹²Joint Ministerial Statement of the 25th ASEAN Ministers on Energy Meeting (AMEM), Singapore, 23 August 2007.

On the whole, it is expected that up to as many as eight ASEAN member states may well possess some form of nuclear power generation capabilities by 2025 (Table 1).

The burning question remains: Should ASEAN go nuclear? A useful way to answer this is to look at two perspectives: pros versus cons, benefits versus risks (Table 2).^{13–17}

Based on this analysis, there are two primary apprehensions as the temptation to use nuclear energy spreads in ASEAN, namely:

- (a) The dilemma of “safety and security issues”. A nuclear power plant in ASEAN could be easy prey for terrorists. The risk is potentially greater for a small country with limited territorial expanse or where the urban population is very close to the nuclear facility.
- (b) The concern over nuclear waste disposal. Are the ASEAN member states willing and prepared to pump in vast amounts of investments to manage the waste from nuclear plants? Given the geographic proximity of neighbouring states, the challenge is to have waste management which appeases the next-door countries.

The other debatable point is whether nuclear energy can really achieve energy independence from fossil oil and natural gas, and combat rising energy costs. Most countries are not able to reduce their dependence on oil by building nuclear power plants. Nuclear energy — because it currently only produces electricity — is intrinsically imperfect in its ability to reduce this dependence. Oil and natural gas are consumed in much

¹³Sharon Squassoni, “Nuclear Energy: Rebirth or Resuscitation?”, Carnegie Endowment for International Peace, 2009.

¹⁴Sueo Machi, Forum for Nuclear Cooperation in Asia (FNCA) Coordinator of Japan and former commissioner of the Japan Atomic Energy Commission. He spoke at the Public Seminar on Nuclear Energy organised by FNCA at the Philippine Nuclear Research Institute (PNRI) headquarters in Quezon City, January 2010.

¹⁵Ralph Kinney Bennett, “Nuclear Power in Perspective”, *Reader’s Digest*, June 1981, pp. 131–137.

¹⁶Time for Change, *Pros and Cons of Nuclear Power*, 11 January 2007, <http://timeforchange.org/pros-and-cons-of-nuclear-power-and-sustainability>.

¹⁷Michael Richardson, “Nuclear Energy: The Options for Singapore”, *The Straits Times*, 1 March 2010, p. 22

Table 1 ASEAN Member States' Nuclear Status

ASEAN Member State	Nuclear Status
Brunei Darussalam (Not IAEA member)	Has no nuclear energy plans but neither has it ruled them out. May not see real need for nuclear energy in the short term as it has considerable oil and natural gas resources.
Cambodia [Joined IAEA in November 2009]	Has no nuclear infrastructure; no nuclear facilities; no organisational structure or the skilled manpower trained to operate, manage or regulate nuclear programmes. However, Prime Minister Hun Sen announced in September 2008 that his administration would build nuclear power plant to tackle future energy needs and reduce the dependency on oil. Expected to focus on developing the infrastructure and investing in forms of renewable energy in the short term. <i>Hopeful of acquiring basic nuclear capacity by 2020.</i>
Indonesia (IAEA member since 1957)	Arguably the most -determined ASEAN member state to possess civilian nuclear facilities. In the mid-1990s, it conducted a feasibility study on constructing 12 nuclear power plants. However, the project was postponed due to condemnations from environmentalists cum the occurrence of the Asian Financial Crisis. A decade on, Jakarta has once more expressed the intention to build its first major nuclear power plant — on Muria Peninsula, Central Java, by 2015. However, no decision has been finalised. Once again, the plan was severely censured by environmental organisations. There are also plans to construct a 70MW floating nuclear plant in Gorontalo, North Sulawesi. Three trial nuclear reactors have already been built in Yogyakarta, Central Java, and in Serpong and Bandung, both in West Java. Several motivations for desiring nuclear reactors: • Domestic energy consumption is growing rapidly, • Indonesia has become a net importer of oil. Nuclear energy will reduce dependence on oil. • Producing renewable energy from other sources, such as wind power and solar power, is far more costly. • If domestic energy consumption can be met through nuclear energy, it would be possible to export more oil. • States such as Japan, where earthquakes frequently occur, have already several nuclear reactors.

(Continued)

Table 1 (Continued)

ASEAN Member State	Nuclear Status
	Indonesia has at least two uranium mines, the Remaja-Hitam and Rirang-Tanah Merah mines, both in West Kalimantan. Also has option of importing uranium from friendly nations. Australia, one of its nearest neighbours, has indicated willingness to supply uranium for peaceful purposes. Jakarta also signed several treaties on nuclear cooperation with Australia, Korea, Russia, and the JSA in 2006.
Lao PDR (not IAEA member)	<i>Estimated date of acquiring nuclear capacity is 2016.</i> Has no nuclear programme, facilities or bureaucracy of any kind. Has never expressed any concrete interest in nuclear power. Main energy opportunity remains hydropower, which already provides for about 97% of its electricity. A large share of the economic revenue derives from export of hydropower to nearby Thailand and Viet Nam, and possibly to Guangxi, China. May see no gripping need for nuclear energy in the short run, given its hefty proven hydropower capabilities.
Malaysia (IAEA member since 1969)	Has shown signs of considering the nuclear option by establishing a nuclear agency, Nuclear Malaysia, in 1972, and the Atomic Energy Licensing Board, under the Ministry of Science, Technology and Innovation (MOSTI), in 1985. Acknowledged that its gas resources are diminishing — probably depleted by 2017. Currently it is a net exporter of oil, although by 2012, it would likely become a net oil importer if no new oil and gas fields are discovered and developed. With this in mind, PETRONAS, its state-owned oil and gas company, has entered into several agreements with regional countries to buy gas for electricity generation. 60% of its power needs are met by burning gas. In 2009, Tenaga Nasional Berhad, its largest electric utility company and also the largest power company in Southeast Asia with MYR69.8 billion worth of assets, expressed its intention to hire Korea Electric Power Corporation to

(Continued)

Table 1 (Continued)

ASEAN Member State	Nuclear Status
	help it prepare a preliminary feasibility study for the first nuclear plant. Tenaga wants the government to approve the study, as it would take a lengthy timeframe and process to get a reactor up and running by 2020. <i>Estimated date of acquiring nuclear capacity: Around 2020.</i>
Myanmar (IAEA member since 1957)	While it is resource-rich and does not actually require nuclear energy for power-generation purposes, it is embarking on a small research reactor, built with technical assistance and guidance from Rosatom Nuclear Energy State Corporation of Russia. In 2007, both countries signed an agreement for Russia to design and build a nuclear studies centre to manage a 10MW light water reactor and facilities for processing and storing nuclear waste. Has assured its ASEAN neighbours that it is not producing nuclear weapons. At the national level, a Department of Atomic Energy was created in the Ministry of Science and Technology in 1997 to do R&D, and training in the field of atomic energy, to ensure the safety of the radiation sources and protection from nuclear radiation hazards. <i>Estimated date of acquiring nuclear capacity: Uncertain.</i>
The Philippines (IAEA member since 1958)	Probably the first Southeast Asian state to initiate a nuclear programme with the formation of an atomic Energy Commission in 1958. President Marcos, in July 1973, announced plans to build a nuclear power plant, in response to the 1973 oil crisis. Construction on the Bataan Nuclear Power Plant (BNPP) began in 1976, and it was designed to produce 621 MW of electricity. Following the 1979 Three Mile Island accident, BNPP construction halted. Among the issues raised was that BNPP was built too near to a major earthquake fault-line. By 1984, when BNPP was nearly completed, building costs hit US\$2.3 billion. With the departure of President Marcos from power and the Chernobyl disaster — both in 1986 — the succeeding administration of President Aquino decided not to operate the BNPP. Debt repayment on BNPP became the biggest sole national obligation. The compensation was eventually

(Continued)

Table 1 (Continued)

ASEAN Member State	Nuclear Status
Singapore (IAEA member since 1967)	completed in 2007. While successive administrations evaluated proposals to modify BNPP for other energy productions, all have been deemed not commercially viable. In 2004, President Arroyo, in outlining the energy policy, highlighted plans to convert BNPP to a gas-powered facility.
	Worthy to note is that the BNPP, despite never been commissioned, has remained intact and is in well-maintained condition. Merely a question of seeking funding to re-launch it.
	<i>Estimated date of acquiring nuclear capacity: Uncertain.</i>
	Handicapped by resource constraints and technical complications in pursuing nuclear energy. Choosing a safe site for a nuclear power reactor in a compactly inhabited islet-nation is a big challenge.
	Prime Minister Lee Hsien Loong, in December 2008, stated that he “does not rule out the possibility of Singapore having a nuclear power plant in the long term, (although) there would be difficulties...due to scale of such a project”. He acknowledged that “there would be safety issues...but technology may evolve so that such challenges can be resolved.”
	The Economic Strategies Committee (ESC), in February 2010, also proposed that Singapore should examine the feasibility of nuclear energy in the long term as a way to meet its energy needs. In the short to medium term, Singapore could look into generating energy from coal and importing electricity from neighbouring countries.
As an energy-disadvantaged country, it cannot rule out the nuclear energy option. Recognising that investments in energy R&D can lead to new energy solutions, it has been focusing on developing energy technologies.	Perceived as the only ASEAN member state that is publicly advocating nuclear safety and adherence to IAEA safeguards. It lobbied ASEAN to establish a nuclear energy safety network at the 25th AMEM in 2007.

(Continued)

Table 1 (Continued)

ASEAN Member State	Nuclear Status
Thailand (IAEA member since 1957)	Declared its intention to pursue nuclear energy only recently. The state-owned Electricity Generating Authority intends to build its first two nuclear power plants — 1 GW in 2020 and 1GW in 2021 — subject to the Cabinet’s approval in the first half of 2011. Such a decision was condemned by Greenpeace, which suggested that the country should focus on alternative power supplies from hydropower (from Lao PDR) and smaller bio-fuel plants. Plans to establish safety and regulatory infrastructure by 2014 and has commissioned a three-year feasibility study early in 2008. Current political instability seems to stall the process of going nuclear. <i>Estimated date of acquiring nuclear capacity: Between 2020 and 2021.</i>
VietNam (IAEA member since 1957)	Undertook two preliminary nuclear power studies in the 1980s, stressing the need to introduce nuclear energy for satisfying the growth in electricity demand. Approved a national energy plan which envisages a 2000MW nuclear power plant, the work on which would start by 2010. South Korea signed a deal in 2006 for long-term nuclear energy cooperation, including developing power plants First nuclear power plant likely to be commissioned by 2017. Also plans to build four nuclear power plants at 1GW each in 2020 and 2021. Will determine the design of the power plants based on the preliminary feasibility study. To ease public and international concerns, national power utility, Electricity Vietnam, the Ministry of Industry and Trade and Vietnam Atomic Energy Commission (Vinatom) hold public exhibitions on nuclear energy and power generation in the major cities. Regulatory frameworks are being created. A law on nuclear energy is before the national legislature. <i>Estimated date of acquiring nuclear capacity: 2017.</i>

Source: Contents and projected nuclear timelines are based on a compilation of governments’ assessments, media reports and evaluations by experts.

Table 2 Pros and Cons of ASEAN Going Nuclear

Pros/Benefits	Cons/Risks
Carbon emission: As demand for electricity soars, the pollution produced from fossil fuel-burning plants is heading towards dangerous levels. Coal-, gas- and oil-burning power plants are responsible for half the air pollution of economic giants like the USA and China. Burning coal produces carbon dioxide (Co2), which depletes the protection of the ozone. The soft coal, which many power plants burn, contains sulfur. When gaseous byproducts are absorbed into clouds, precipitation becomes sulfuric acid. Coal also contains radioactive material. Coal-fired power plants emit more radiation into the air than nuclear power plants, although the entire life cycle of producing electricity from nuclear power does emit Co2. This is comparable to the emissions of other zero-carbon sources, such as wind, hydro and photovoltaics.¹⁴ To give a better illustration, for the operation of a 1,000MW power plant for one year, a nuclear-powered plant emits 0.15 million tonnes of Co2, while one powered by coal emits 6.51 million tonnes of Co2. Replacing a 1GW coal-power plant with nuclear power saves 6.4 million tonnes of Co2 a year. In Japan, the operation of 55 nuclear power plants has reduced Co2 emission by about 20%.¹⁵	Contamination of the environment: ASEAN is a region prone to acute natural catastrophes. ASEAN member states that have pronounced their nuclear ambitions must deal with the challenge of seismic perils and danger of radiation seepage. Although most nuclear plants would be designed to endure the natural disasters, much would still ride on the sufficient safety standards placed in areas such as radiation defence, crisis vigilance, and disposal management. The Chernobyl disaster will always be a blemish in the chronicle of nuclear energy development. There is a risk of such a disaster re-occurring and destroying everything in its wake at all times. The designing and maintenance of nuclear reactors is critical in preventing such mishaps. No nuclear energy plant in the world could hold out against an attack similar to the 9/11 terrorist destruction of the World Trade Center in New York. Such an act would have catastrophic consequences for the world. It is also true that the results of a compromised reactor core can be disastrous, but the precautions that check this from happening prevent it well. Each year, 10,000 to 50,000 US nationals die from respiratory diseases due to the burning of coal, and 300 are killed in mining accidents. In contrast, no Americans have died or been badly hurt because of a reactor accident or radiation exposure from nuclear power plants.¹⁶

(Continued)

Table 2 (Continued)

Pros/Benefits	Cons/Risks
Reliability: Nuclear power is possibly one the safest methods of producing energy. Nuclear power plants need little fuel, so they are less vulnerable to shortages due to workers' strikes or natural disasters. International politics may bear little effect on the fuel supply to the reactors because uranium — the feedstock of nuclear energy — is found in various places around the world. However, the supply of uranium is reportedly to last for the next 30 to 60 years, pending actual demand.¹⁷ Energy security and energy efficiency: Nuclear energy is essentially seen to be (a) sustainable by combating rising energy cost; (b) a means of strengthening energy security; and (c) a diversification of reliance on fossil fuels. When it comes to efficiency output, nuclear power has more “pluses” than other alternative power sources, such as wind, solar, hydro etc. Compared to energy output by a nuclear reactor, output from these alternative sources is relatively small. With the rise in energy demand by an increasing population, renewable sources beyond nuclear energy may not yield the desired quantity in the coming years. Low operating cost: One of the attractions of nuclear power is that although the capital cost is high, the running cost is low.	Lengthy process: The timeframe needed for formalities, planning and building of a new nuclear power generation plant is in the range of 25 to 30 years.¹⁸ In other words, nuclear power plants cannot be constructed quickly. Very often, when a nuclear plant is commissioned, the relevant technology has become dated and this has a cost impact on the operation of the nuclear facility. Public reaction may turn sour and it would undermine the value of this alternative source of energy. Nuclear meltdowns: A nuclear meltdown happens when there is an acute shortage of coolant water in the nuclear reactor. This can lead to disastrous consequences, exposing the world to high dosages of radioactivity. Although accidents are rare, human errors and technical faults cannot be eliminated. High capital cost: Studies have shown that the construction of a nuclear power plant is much more expensive, i.e. higher capital cost, compared to the construction of solar panels and wind turbines.

(Continued)

Table 2 (Continued)

Pros/Benefits	Cons/Risks
Stability of nuclear energy prices: A country (or a utilities company) can buy years of supply of uranium when the price is low; it doesn't take up much space-area and can be easily stockpiled until needed. Most uranium is purchased using long-term contracts, making it less susceptible to price fluctuations. In contrast, most countries (or utilities companies) do not have storage capacity for more than 3 months' supply of fossil fuels. Not much land needed: Investment in solar energy is very costly as it requires a relatively big space and layout area for the photovoltaic panels. Similarly, in the case of wind power, the space required is three times more due to construction of windmill generators. Nuclear plants, in comparison, do not require a large area of land to generate power.	Radioactive concerns: The hazards of radioactive exposure during mining and extraction of uranium-like ores have emerged in developing countries. The radioactive shards and fragments left after mining, if not properly handled, can lead to ailments such as cancer. Safe disposal of radioactive waste is thus a tricky issue. According to the US Environmental Protection Agency standards, nuclear waste has to be warily looked after for "thousands of years". During the operation of nuclear power plants, radioactive waste is produced, which in turn can be used for the production of nuclear weapons. In addition, the same know-how used to design nuclear power plants can to a certain extent be used to build nuclear weapons. Nuclear weapon proliferation: More often than not, nuclear reactor programmes are disguises for the development of nuclear weapons. There is no guarantee that nuclear fuel supplied to a country would not be used to produce weapons of mass destruction. This could lead to nuclear weapon proliferation and the associated dangers to international peace and stability.

Source: Multiple sources of reports, technical studies and publications.

larger proportions in industry and transportation, and for residential and commercial heating worldwide.¹⁸ Countries that have turned to nuclear power to reduce their dependence on fossil fuel have largely been unsuccessful.¹⁹ In fact, it is said that “energy independence” is a myth because even oil-producing giants such as Saudi Arabia and Iran import gasoline.

Similarly, while nuclear power could provide a greater diversity of energy resources, it will not solve ASEAN’s dilemma of dependence on foreign oil. In other words, until electricity can fully replace fossil fuels or produce hydrogen, nuclear energy will not be able to substitute oil, and dependence on foreign energy sources will continue. In fact, ASEAN should expect more interdependence when it comes to nuclear energy because of the existing supply structure and location of uranium (in Australia, Africa, etc.).

14.4 CONCLUSION

The sharp rise of global oil prices in the past four decades has pushed governments worldwide to scramble for alternative sources of fuel. With the impact of climate change, confirming that carbon dioxide emissions from fossil fuels cause global warming, the search for alternative and renewable energy sources has been preoccupied with clean fuels. This has prompted the use of renewable energy sources such as biofuels and hydropower. Nuclear power, practically ignored for two decades after the Three Mile Island and Chernobyl accidents, has re-emerged as an attractive option. The IAEA reported that nuclear energy produces only 2–6 grams of carbon per kilowatt hour, about the same as wind or solar power, and less than 1% of the amount of carbon produced by coal, oil or natural gas.²⁰

Nuclear power is a controversial issue. Having said that, whatever the ultimate choice is for ASEAN and its member states, there is no doubt that

¹⁸ Squassoni, *op. cit.* In the United States, 40% of the energy consumed comes from oil, yet oil produces only 1.6% of electricity. Natural gas usage in the US is split almost evenly among industrial uses, residential and commercial heating, and electricity generation.

¹⁹ Squassoni, *op. cit.*

²⁰ The International Atomic Energy Agency, “Sustainable Development & Nuclear Power”, 1997.

the region, on the whole, is gradually moving towards embracing civilian nuclear power. ASEAN member states are no longer shying away from the mention of “nuclear”. The best evidence came at the 27th AMEM convened in Myanmar in July 2009 when the ASEAN Energy Ministers adopted the ASEAN Plan of Action for Energy Cooperation (APAEC) 2010–2015, which would serve as guiding principles for regional energy cooperation to support the realisation of the ASEAN Economic Community (AEC).

The APAEC 2010–2015 consists of seven programme areas, of which one is civilian nuclear energy. This is where member states agreed to cooperate, on a voluntary and non-binding basis, and share and exchange information and knowledge, technical assistance, networking and training on nuclear energy for power generation. The cooperation will be achieved progressively:

in accordance with the laws and regulations of the respective member states and the relevant international agreements, co-operation and standards within the framework of existing international and regional organisations and cooperation on nuclear energy, i.e. IAEA, Asian Nuclear Safety Network, Forum for Nuclear Cooperation in Asia, among others.

Perhaps this is the most apt way to go forward at the moment — confidence and capacity building; sharing and exchanging information; and networking among officials, experts and the private contractors involved. It is not wrong to highlight that almost every ASEAN member state lacks the technical expertise and knowledge for nuclear power generation and its aftermath, such as waste management. It is also not incorrect to stress that nuclear energy could bring positive advantages to ASEAN member states. The quandary is that a need for clean renewable energy does not imply an unreserved compromise for nuclear energy. Therefore, it would be fascinating to see how the nuclear energy ambitions evolve into reality in ASEAN.

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CHAPTER 15

MYANMAR AND THE NUCLEAR OPTION

Thaung Tun

ABSTRACT

Nuclear energy is a possible option for all countries in ASEAN and at one time or another; all countries within ASEAN have explored the possibility of nuclear power, except Brunei, Cambodia and Laos. When this paper was written in 2010, Myanmar was under suspicion of developing a nuclear weapons programme with the government that was in power then denying the allegations. Since the time of writing, Myanmar has undergone a political transformation and this paper serves as a commentary on the period before the changes took place.

There is currently no nuclear power plant operating in any ASEAN country. But considering that the demand for clean energy in ASEAN is growing by leaps and bounds, the situation is likely to change in the near future. There is already a palpable move forward. At the 28th ASEAN Ministers on Energy Meeting held in Viet Nam on 23 July 2010, Prime Minister Nguyen Tan Dung of Viet Nam, the current Chairman of ASEAN, urged member countries to consider nuclear energy as an alternative source to sustain the region's rising economic growth.

Nuclear energy presents an important option for ASEAN. In the past, the discussions on nuclear energy were tentative but with the rising cost of fossil fuels and the debate on global warming, the situation has changed and the discussions have become more serious.

All ASEAN member countries, save Brunei, Cambodia and Laos, have at one time or another expressed interest in harnessing nuclear power for peaceful purposes, particularly to meet the growing energy demand. Only one among them, Myanmar, is alleged to be harbouring plans to develop a nuclear weapons programme. Allegations first surfaced in 2001, when Myanmar sought the assistance of the International Atomic Energy Agency (IAEA) in acquiring a research reactor. In May 2002, *The Moscow Times* confirmed that Myanmar had been negotiating with Russia for the supply of a nuclear research reactor. Subsequently, the Myanmar Ministry of Science and Technology and Russia's Atomstroyexport, a joint stock company under the Russian Federation Ministry of Atomic Energy, were reported to have signed a contract for a reactor complex that includes a 10-megawatt thermal-research reactor, two laboratories and facilities for disposal of nuclear waste. Russia has since been training Myanmar scientists in fields related to the construction and operation of the nuclear reactor.

Various dissident groups and foreign researchers allege that covert nuclear facilities already exist in Myanmar and that they include nuclear reactors, uranium mines and enrichment facilities. Some speculate that Myanmar may be using its North Korean connection to acquire sensitive nuclear material and dual-use state-of-the-art industrial equipment. They point to the growing ties between the two countries, particularly following the visit of General Thura Shwe Mann, Chief of Staff of the Myanmar Army, Navy and Air Force, to North Korea in November 2008, at the invitation of his North Korean counterpart, Staff General Kim Gyok Sik. They also cite as evidence the reported presence in Myanmar of officials from Namchongang Trading, a North Korean trading company that is included in the United Nations sanctions list. A 2004 *Asian Times* article also claims that a nuclear reactor deal was signed by Myanmar and North Korea that year. But such claims remain unsubstantiated.

The allegations that Myanmar is secretly acquiring key components for a nuclear weapons programme are largely based on interviews with a

Myanmar Army major who defected last year and analysis of the information and photographs he provided. However, the sheer number of alleged secret sites posited by the defector boggles the mind and casts doubts on the claim that Myanmar is actively pursuing a nuclear weapons programme. It is unlikely that such attempts would go unnoticed by non-partisan organisations, such as the Washington-based Institute for Science and International Security (ISIS), which is dedicated to stopping the spread of nuclear weapons and bringing about greater transparency of nuclear activities worldwide. According to ISIS, Myanmar has little known indigenous nuclear infrastructure and expertise to support the construction of nuclear facilities. The institute employed satellite imagery to assess the veracity of the reports and confirmed that specific sites claimed to be nuclear were not. It also looked into the news article that was carried by the *Sydney Morning Herald* about a covert uranium mine and mill near Mandalay. It considers the mill to be too large to be a clandestine uranium operation and found that the photographs matched those of an established commercial cement plant rather than a nuclear facility. According to some European sources, Russia is reported to be assisting Myanmar in exploring and extracting uranium. However, the project is said to be small and has not extended to the construction of mills to process uranium ore. The Myanmar Ministry of Energy itself lists five areas, mainly near the town of Mogok, as having potential for uranium mining.

Myanmar will likely remain under the microscope as the world attempts to fathom the motives behind Myanmar's decision to procure a research reactor together with sophisticated, high-precision, dual-use industrial equipments that include computer numerically controlled (CNC) machine tools. The CNC equipment is considered to be too large for the declared purpose of use in the manufacture of diesel locomotive engines. In this circumstance, suspicions will linger. But it is evident that the charges made by various dissident groups and the methods used so far to identify nuclear facilities in Myanmar are too simplistic and do not inspire confidence. A more professional approach than is currently employed would be required.

The Myanmar government has firmly denied that it has any ambitions to develop a nuclear weapons programme. In January 2002, U Khin Maung Win, Deputy Minister for Foreign Affairs, confirmed reports of

negotiations between Myanmar and Russia on the purchase of a research reactor but stressed that the reactor was intended for research and training purposes and for the production of radioisotopes to be used in the fields of medicine and agriculture. He said the Myanmar government had informed the International Atomic Energy Agency (IAEA) of its decision and that it would carry out its nuclear programme systematically. He denied that Myanmar had provided sanctuary to two Pakistani nuclear scientists, Suleiman Asad and Muhammed Ali Mukhtar, who left Pakistan in late 2001 and are wanted by the United States authorities for questioning. He stressed that Myanmar's interest in nuclear power was neither new nor fleeting. He recalled that Myanmar became a member of the IAEA when it was founded in 1957 and that Myanmar trainees had profited from the Agency's training programmes. He also drew attention to the fact that Myanmar, in addition to being a party to the Nuclear Non-Proliferation Treaty, was also a signatory of the Southeast Asian Nuclear-Weapon-Free Zone (SEANWFZ), which obliges members not to develop, manufacture or otherwise acquire, possess or have control of nuclear weapons. More recently, the leader of the Myanmar delegation to the 54th Annual Regular Session of the General Assembly of the IAEA held in Vienna reiterated on 23 September 2010 that the application of nuclear science and technology in Myanmar was solely for peaceful purposes and that Myanmar would never engage in activities related to the production and proliferation of nuclear weapons.

The present-day Myanmar nuclear programme has its genesis in the modernisation drive initiated in the 1950s by then Deputy Prime Minister, U Kyaw Nyein. As part of the industrialisation plan, the Union of Burma Applied Research Institute (UBARI) was established in 1953 in collaboration with the Armour Research Foundation of the United States. Two years later the Atomic Energy Centre and the Atomic Minerals Department followed and dozens of promising Myanmar scholars and engineers were dispatched to the United States and a few other countries for postgraduate studies in nuclear physics, mining, metallurgy, engineering and technical training in nuclear instrumentation. Upon their return to their homeland, they joined the elite group that ran the Atomic Energy Centre. However, the nascent nuclear programme soon floundered as Deputy Premier U Kyaw Nyein fell from grace and the country's priorities shifted under the

government led by General Ne Win. The head of the Atomic Energy Centre, U Hla Nyunt, himself left the country to take up a senior position at the IAEA headquarters in Vienna, as the interest of the government in atomic energy waned. Notwithstanding the setbacks, the scholars maintained their interest in nuclear science. They continued their applied research work and taught nuclear physics at the undergraduate and post-graduate levels at universities. They were instrumental in the setting up of a nuclear laboratory at the Rangoon Arts and Science University in the early 1960s with technical support from the IAEA and assistance from friendly countries. Subsequently, in the 1970s, the idea of acquiring an American-built mini research nuclear reactor suitable for training and the production of radioisotopes was mooted but died a natural death due to lack of funding. The idea has now been revived by the Ministry of Science and Technology as the country is buoyed by significant income from the export of natural gas and the prospect of increased revenue from the Myanmar-China oil and gas pipeline.

Energy plays a vital role in the development of countries. It should therefore cause no surprise that ASEAN sees merit in adding nuclear power to its electricity generation mix. Viet Nam has announced plans to build eight nuclear plants by 2030 and Thailand is reported to have plans to build two by 2022. Indonesia, Malaysia, the Philippines and Myanmar will all likely follow suit. Even Singapore, with its small size and densely populated urban centres, is keeping its options open. In his speech at the third Singapore International Energy Week on 1 November 2010, Prime Minister Lee Hsien Loong reminded the nation that Singapore could not afford to dismiss the option of nuclear power altogether.

The Nuclear Non-Proliferation Treaty recognises the inalienable right of sovereign states to use nuclear energy for peaceful purposes, as long as they can demonstrate that their nuclear programmes are not being used for the development of nuclear weapons. In these circumstances it is inevitable that the inexorable march of ASEAN countries, including Myanmar, towards acquiring and operating nuclear power stations will continue. However, as the commercially popular light water reactor nuclear power station uses enriched uranium fuel, it is understandable that some countries are concerned about the possibility of the spread of enrichment and reprocessing capabilities. To allay the fears of those countries, ASEAN

states opting to add nuclear power plants to their existing energy generation mix must be prepared to demonstrate their readiness to abide by the regulations to maintain international standards of nuclear safety and non-proliferation.

Given the fact that it is in the interest of all countries to forge consensus on nuclear non-proliferation and climate change, the nuclear energy field is one area that is ripe for cooperation.

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volume

2



Mark Hong
Amy Lugg
Editors



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FOREWORD

Volume 2 of this compilation is the result of a number of lectures that have been delivered at the ISEAS Energy Forum during 2009 and 2010. It takes a more regional approach, initially examining oil, gas and coal in Southeast Asia, then moving to East Asia and the need for cooperation in the face of competition for resources with Japanese and Russian energy relations. Next it examined the Japan-China relations in terms of energy policy. South Asia and specifically India's pipeline potential, which has links to the Caucasus and Central Asia are also explored, rounding off with the complexities of diplomacy among the Arab states relating to gas pipelines.

It is hoped that with this volume of the ISEAS Energy series of books, readers will have gained a comprehensive knowledge of all aspects of global and regional energy security. Energy issues are constantly moving and developing, being impacted by the latest political unrest in the Middle East or the latest energy technology development, oil prices rising, etc. It is necessary to update ourselves with an ever-changing energy story.

As with any publication that has multiple contributors, there are inevitable delays in collating the papers, therefore we wish to thank the patience and understanding of the contributors whose time they have contributed in order to help to enlarge public knowledge on vital energy issues.

Mark Hong & Amy Lugg
Editors
July 2012

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CHAPTER 1

THE LOGIC OF ENERGY POLICY: THE CASE OF UPSTREAM OIL, GAS, COAL AND DOWNSTREAM OIL SECTORS IN SOUTHEAST ASIA

Ridwan D. Rusli

1.1 INTRODUCTION

Energy inputs such as electricity and fuels are essential to facilitate industrial, commercial and household activities. The characteristics of electricity and fuel demand are determined by the objectives of the main users: households need affordable, steady and safe availability, while commerce and industry demand an economically competitive, secure and sustainable supply of electricity and fuel. Thus the price and availability of energy are important determinants of economic competitiveness (through lower inputs, production and transport costs), energy supply security (to ensure stable industrial, commerce and household activities) and sustainable development (through sustainable management of natural resources, energy efficiency, environmental and climate control measures).¹

¹The Ministry of Trade and Industry of Singapore, in its recent *National Energy Policy Report*, listed economics, security and environment as the three objectives of energy

Among primary energy feedstocks, fossil fuels make up the largest components of total primary energy supply (TPES). The International Energy Agency (IEA) forecasts that the share of oil, natural gas and coal in world TPES in 2030 will range from 67.1% to 80.5%.² In the year 2008, the share of oil, natural gas and coal in Southeast Asian TPES ranged from 91.1% to 100%, compared to 85.7% in Japan, 92.6% in China and 93.2% in India.³ While the share of fossil fuels in TPES is expected to be higher in developing countries, Southeast Asian economies' near total reliance on oil, natural gas and coal is much higher than the average of 83.6% in the more developed European Union, 85.4% in OECD⁴ countries and 87.0% in North America. Interestingly, the share of fossil fuels in Latin America of 72.9% is considerably lower, which could be partially a result of its significant use of hydroelectricity.

Given the critical importance of oil, natural gas and coal to the industrial and economic development of Southeast Asian countries, fossil fuels play a critical role in regional- and national-level energy policy. Oil, natural gas and coal endowments have a critical impact on the economic competitiveness, socio-political security and stability, as well as sustainable development in the region. It is therefore disconcerting that the region, after decades of having Indonesia and Malaysia among the world's important crude oil exporters, has seen Indonesia become a net importer of oil, despite the country's resource potential. Although Singapore re-exports a significant amount of the fuel products from its world-class refineries, the region

policy. We elaborate on these three objectives in Figure 1 of Section 1.2 Objectives of Energy Policy. See Singapore Ministry of Trade and Industry (MTI), *National Energy Policy Report* (Singapore: MTI, 2008), p. 23.

²The IEA defines two scenarios: a Reference Scenario based on current policies and a 450 Policy Scenario based on a plausible post-2012 climate-policy framework to stabilise the concentration of global greenhouse gases at 450 parts per million (ppm) carbon dioxide (CO₂) equivalent. See IEA, *Key World Energy Statistics 2009* (Paris Cedex: IEA, 2009), p. 47.

³Southeast Asian countries listed in BP's TPES table include Indonesia, Malaysia, Thailand, the Philippines and Singapore. Average share of TPES of oil, gas and coal for the entire Asia Pacific was 91.7% in 2008. See BP, *Statistical Review of World Energy June 2009* (London: BP, 2009), p. 41.

⁴Organisation for Economic Co-operation and Development.

will import larger volumes of crude oil in the future.⁵ The region's hope thus rests with future crude oil production growth from newly developed or yet-to-be-discovered fields in Vietnam, Malaysia and Indonesia.

The situation looks comparatively less worrisome in natural gas and coal. In natural gas, Indonesia and Malaysia continue to be among the world's largest exporters of liquid natural gas (LNG). The largest LNG consumers are Japan, South Korea and Taiwan. Nevertheless, while new future demand could originate from China, India and the Pacific West Coast, competition from Australia, the Middle East, e.g. Qatar, enhanced by the development of a global LNG spot market, as well as domestic gas resources in India and China, would intensify competition in the regional LNG market.⁶ Thailand has successfully built an extensive infrastructure for the domestic production and transport of natural gas, its most abundant domestic resource.⁷ Myanmar, historically a limited exporter of gas to Thailand, has discovered several large gas fields that can be developed in the course of the next decade. At the same time extensive exploration activity and several discoveries have been observed in Vietnam and, more recently, Cambodia.⁸ In coal, though Indonesia was the world's largest exporter of thermal coal for power generation in 2008, Australia's production capacity is continuously being

⁵ See Ong Eng Tong, "The Singapore Oil Situation", in ISEAS, *Energy Perspectives on Singapore and the Region* (Singapore: ISEAS, 2007); Cheng Hong Kok, "Singapore Petroleum Company: Adding Value to the Singapore Oil Industry", in ISEAS, *Energy Perspectives on Singapore and the Region*; Yoshikuni Yamakawa, "Outlook of Products Supply & Demand in Asia by Country and by Product", presented at Northeast Asia Petroleum Forum 2009 (Tokyo: Institute for Energy Economics, Japan (IEEJ), 2009).

⁶ For reviews of regional and world gas and LNG markets, see IEA, *Natural Gas Market Review 2008* (Paris Cedex: OECD/IEA, 2008); and Allison Ball, Karen Schneider, Lindsay Fairhead and Christopher Short, *The Asia Pacific LNG Market, Issues and Outlook* (Canberra: Australian Bureau of Agricultural and Resource Economics, 2004).

⁷ See National Energy Policy Council (NEPC), *Thailand's Energy Policy and Development Plan under the Administration of Prime Minister General Surayud Chulanont* (Bangkok: NEPC, 2006); and PTT Plc, *Annual Report 2008* (Bangkok: PTT Plc, 2009).

⁸ See Pou Sothirak, "An Overview of the Cambodian Energy Sector", in *Energy Essays on the Asia-Pacific Region*, co-edited by Amy V. R. Lugg and Mark Hong (Singapore: ISEAS, 2009), pp. 57–96.

increased.⁹ In both natural gas and coal Southeast Asian exporters cannot afford to become complacent, since competition from Australia and the Middle East will intensify in the future.

Energy policy must facilitate environmentally sustainable development and growth of electricity and fuel supply infrastructure. How governments can best develop and implement energy strategies and policies to achieve the three goals of energy policy, namely economic efficiency and competitiveness, energy supply security and environmental sustainability, is a function of each country's demographics (total and per capita income, education, lifestyle), geography (natural resource endowment, location of demand versus supply centres, country size and geographic spread, environmental factors), socio-political (sector development and history, social and political institutions), as well as industrial and economic structure (manufacturing, agricultural versus service sectors, entry and competition policy, trade, investment and fiscal policy). The goal of supply-side energy policy in Southeast Asia should be to reduce import dependence and increase fuel sourcing flexibility in crude oil, to maximise cost efficiency and competitiveness across the oil, gas and coal value chains, i.e. exploration, production and processing, to develop an efficient transport and distribution infrastructure, as well as to diversify electricity and fuel production using non-fossil fuel and alternative energy sources to help preserve the environment. On the demand side, efficiency improvement measures across commercial, industrial and household activities, as well as energy conservation programmes, will require extensive investments in education and infrastructure.

This chapter describes a logical, normative framework for energy policy making in selected Southeast Asian countries, with emphasis on the fossil fuel-based oil, natural gas and coal industries. It focuses on the interaction between two of the three main objectives of energy policy, economics and security. This normative framework can be extended to other alternative energy sources and fuel types, as well as to target more specifically the interdependence between economic competitiveness, energy security and politics, as well as environmental sustainability. The emphasis is on the

⁹Energy Information Administration (EIA), *International Energy Outlook 2009* (Washington, DC: EIA, 2009), p. 55.

growing Southeast Asian economies that, not unlike China and India, are becoming increasingly dependent on imported energy feedstock, particularly crude oil. It complements the already rich literature on Southeast Asia's increasing energy import dependence, vulnerability to high oil price shocks, energy security and supplier concentration risk, as well as interaction with other large energy consumers across Asia.^{10–12}

¹⁰ For summaries of Southeast Asian energy sector challenges and energy security, refer to Dr. Andrew T. H. Tan, "The ASEAN Countries' Interest in Asian Energy Security", in Lugg and Hong, *Energy Essays on the Asia-Pacific Region*, pp. 1–20; Vince S. Pérez, "Who Wins the Asian Scramble for Oil?", in ISEAS, *Energy Perspectives on Singapore and the Region*, pp. 249–265; Steve Puckett, "The Outlook for Gas in Southeast Asia", in *Energy Perspectives on Singapore and the Region*, pp. 317–336; Kang Wu and Caleb R. O'Kray, "The Implications and Impacts of China's Oil Demand on the Asia Pacific", in ISEAS, *Energy Perspectives on Singapore and the Region*, pp. 142–155; Christopher Len, "Energy Security Cooperation in Asia: An ASEAN-SCO Energy Partnership?", in *Energy Perspectives on Singapore and the Region*, pp. 156–175; Mark Hong, "New Partnerships in Energy Security in Asia: Between India, ASEAN and Singapore", in Lugg and Hong, *Energy Essays on the Asia-Pacific Region*, pp. 113–131.

¹¹ For a comprehensive overview of the state of world energy, see Vaclav Smil, *Energy at the Crossroads: Global Perspectives and Uncertainties* (Cambridge: The MIT Press, 2003); for general discussions on energy security indicators, see Nicolas Lefèvre, "Measuring the Energy Security Implications of Fossil Fuel Resource Concentration", *Energy Policy*, 38 (2010), pp. 1635–1644; and Andreas Löschel, Ulf Moslener and Dirk T. G. Rübbelke, "Energy Security: Concepts and Indicators", *Energy Policy*, 38 (2010), pp. 1607–1608.

¹² For overviews of sector challenges and energy security in China, India and Japan, see Henry Leong, "China's Energy Security: Geopolitics versus Interdependence", in ISEAS, *Energy Perspectives on Singapore and the Region*, pp. 176–196; Dr. Wenran Jiang, "China's Global Quest for Energy Security", in Lugg and Hong, *Energy Essays on the Asia-Pacific Region*, pp. 132–164; Michael Richardson, "Energy & Geopolitics in the South China Sea", in Lugg and Hong, *Energy Essays on the Asia-Pacific Region*, pp. 165–191; Ligia Noronha, "India's Energy Situation: The Need to Secure Energy Resources in an Increasingly Competitive Environment", in ISEAS, *Energy Perspectives on Singapore and the Region*, pp. 132–141; Rajiv Sikri, "India's Energy Challenges", in Lugg and Hong, *Energy Essays on the Asia-Pacific Region*, pp. 97–112; Hisane Masaki, "Japan's New Energy Strategy", in ISEAS, *Energy Perspectives on Singapore and the Region*, pp. 228–248; Yuji Morita, "Japan's Energy Supply-Demand Situation and Energy Conservation Policy and Challenges for Japan", in Lugg and Hong, *Energy Essays on the Asia-Pacific Region*, pp. 205–236.

The section following this introduction describes the main objectives of energy policy. The next section discusses the demographic, geographic, socio-political and economic determinants of energy policy, according to which countries can be categorised into several groups. The subsequent section summarises the key instruments of energy policy and identifies a possible normative grid of energy strategies and policies consistent with the characteristics of each country grouping. The normative policy grid derived is compared in the next section with the actual energy policies observed in Indonesia, Thailand and Malaysia. This comparative analysis of normative versus observed policy instruments includes industry regulation, trade, investment and fiscal policy, as well as the institutional dynamics and implementation track record across the selected Southeast Asian countries. The final section summarises and concludes. Lastly, the end-notes provide commentaries, guidance to references and other relevant works.

1.2 OBJECTIVES OF ENERGY POLICY

As depicted in Figure 1, the three main goals of energy policy are inter-dependent and must be addressed simultaneously. Economic competitiveness, supply security and flexibility are driven by several common factors. The availability of energy feedstock such as crude oil, natural gas and coal at competitive prices is required to ensure the competitiveness of industrial, agricultural and commercial activities, and to help increase household purchasing power and living standards. Supply security and flexibility can be addressed through fuel diversification strategies, while efficient transport and logistics infrastructures are needed to bring energy feedstock to the domestic fuel and electricity generating companies, as well as manufacturing goods and agricultural products to domestic consumers and export markets. Furthermore, efficient, environmentally sustainable and reliable technologies, facilities and operations are equally important to convert energy feedstock and production inputs into marketable products that can be enjoyed by the consumers. To ensure appropriate incentives and rewards for industrial, commercial and household

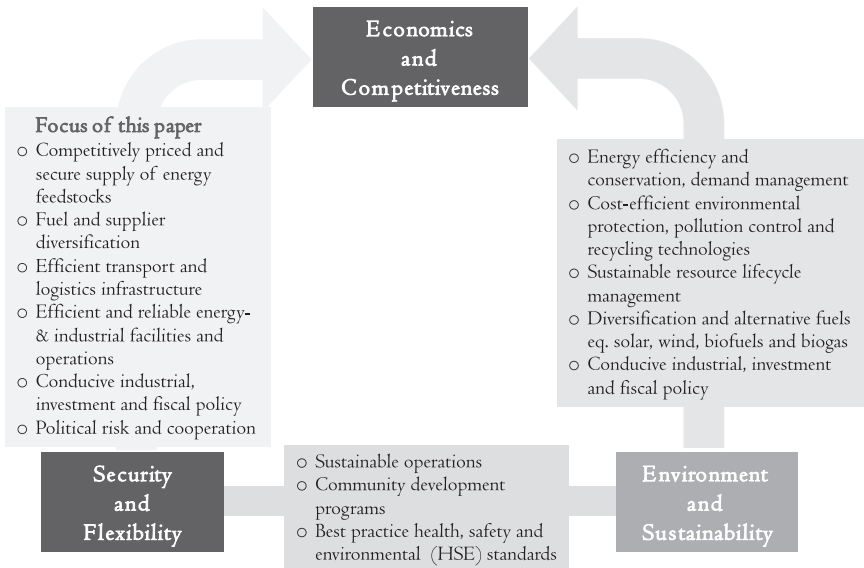


Figure 1 Three Objectives of Energy Policy

Source: Author's analysis based on the policy objectives laid out in Singapore Ministry of Trade and Industry (MTI), National Energy Policy Report (Singapore: MTI, 2008), p. 23.

investments of capital and effort into the realisation of these energy-related projects, supportive industrial, investment and fiscal policies, together with a functioning financial sector, also contribute to the overall economic competitiveness and socio-economic development of a country.

Economic competitiveness and environmentally optimal management of natural resources and industrial pollution are crucial to ensure long-term and sustainable industrialisation, income growth and socio-economic development. Energy efficiency and demand management must be encouraged and promoted, not only to reduce cost and improve competitiveness, but also to ensure long-term sustainable growth in productive output and income levels.

Measures such as optimal and cost-effective energy conservation, energy efficiency and pollution control technologies and work processes,

as well as optimal natural resource extraction and lifecycle management¹³ must be undertaken. The introduction of alternative, non-fossil fuel energy inputs such as solar, wind, biofuels and biogas need to be encouraged.¹⁴ Since the implementation of these alternative solutions must take into account the commercial objectives of the industrial and agricultural sectors, appropriate industrial, trade and fiscal policies must be fine-tuned to help achieve these multiple objectives. At the same time, to ensure stable and sustainable output growth, industrial and commercial activities need to be conducted in consideration of local community and socio-economic factors. Best practices in the areas of health, safety, natural resource and environmental pollution management must be introduced and implemented.

In summary, while energy policy must take into account these three interdependent objectives, each country and government must tailor their policy instruments to fit their country-specific historical, institutional and natural environments. A country's or region's determinants of energy policy can be examined along four dimensions, which are characterised by distinct demographic, geographic, socio-political and economic-industrial factors.

1.3 DETERMINANTS OF ENERGY POLICY

The choice of optimal energy policy instruments depends on a combination of supply- and demand-side factors. On the supply side, geography and resource endowment are key, the latter encompassing oil, gas and coal

¹³For conceptual overviews of the sustainable management of mining and extractive industries, see Mining, Minerals and Sustainable Development North America (MMSD), *Toward Change: The Work and Results of MMSD-North America* (Winnipeg: International Institute for Sustainable Development (IISD), 2002); and Eleodoro Mayorga Alba, "Extractive Industries Value Chain: A Comprehensive Integrated Approach to Developing Extractive Industries", *Extractive Industries for Development Series*, no. 3 (Washington, DC: The World Bank, 2009).

¹⁴For a broad overview of non-fossil energies see Smil, *Energy at the Crossroads: Global Perspectives and Uncertainties*, pp. 239–316; while biofuels offer promising fuel diversification potential, especially for agriculturally endowed Southeast Asia, the debate regarding its impact on future arable land for food production is ongoing. See for example David Pimentel *et al.*, "Food versus Biofuels: Environmental and Economic Costs", *Human Ecology*, 37 (2009), pp. 1–12.

reserves.¹⁵ On the demand side, demographic, geographic, economic and socio-political factors determine a country's primary energy mix. While demographic factors include age, income distribution, industrial and household behaviour, each country's geography influences the spatial distribution of natural resources, population and economic activity, as well as the need for factor mobility and transportation of semi-finished and finished manufacturing goods and agricultural products.

Socio-political factors include for example a government's and society's bias towards consumer welfare (versus firm or industry profits), which is reflected in the choice of industrial policies,¹⁶ and the importance of environmental protection in that country. Together with an economy's unique pattern of agricultural, industrial, investment, consumption and financial sector activities, the demographic, geographic and socio-political characteristics determine the demand for transportation fuel and electricity.

All these factors are critical to the prioritisation of energy policy objectives and formulation of a normative energy sector strategy. In particular, most countries face a certain imbalance between resource endowment and primary energy consumption. Some countries end up becoming net importers, others net exporters of fuel and energy.¹⁷ In terms of prioritisation of objectives, fuel- and energy-importing countries are typically more concerned about energy supply security, fuel diversification and economic competitiveness. Generally they will be focused on energy conservation, improving energy efficiency and industrial competitiveness as a buffer against unpredictable world energy supply and prices. On the other hand, fuel- and energy-exporting countries concentrate their efforts on maximising resource production, improving international competitiveness and promoting world trade. Lastly, some countries, especially in both fuel- and energy-importing groups, have

¹⁵ This chapter focuses on key fossil fuel inputs for transportation fuel, electricity generation and petrochemicals, as relevant.

¹⁶ The formulation and implementation of industrial and energy policy is of course significantly influenced by the political actors and decision makers (see discussion in section 1.3.7 Regional Summary).

¹⁷ Oil and coal are generally more easily tradable and transportable, natural gas is mainly traded through long-term pipeline (usually shorter distances) or LNG contracts (short and long distances). While active markets for pipeline gas exist in the more inter-connected Western Europe and North America, the global spot market for LNG is only gradually developing.

successfully shifted their focus towards environmental protection and alternative energy technologies and power generation.¹⁸

Normatively, each country's government will direct investment, industrial development, technology and skill accumulation in accordance with its energy priorities and strategies. However, to ensure the effective implementation of a country's energy strategy, three more factors are of utmost importance. First, a set of detailed implementation rules and regulations are required to provide guidelines to the country's energy sector and related institutions.¹⁹ Next, the investment and funding environment is crucial. In many cases, energy sector investments necessitate the concurrent development of efficient funding and capital markets, and under certain conditions, targeted fiscal subsidies. Third, as will be discussed later, the formulation of an energy strategy and its associated implementing rules and regulations needs to take into account, and is largely determined by, the country's political and institutional foundations.

1.3.1 Geography and Resource Endowment

The proven crude oil reserves in Southeast Asia are concentrated in Malaysia, Vietnam, Indonesia and to a lesser extent in Brunei and Thailand (Figure 2). Indonesia and Malaysia have historically been net exporters of crude oil, but due to declining domestic crude oil production and growing domestic demand for fuel products, Indonesia has become a net crude and fuel product importer while Malaysia, which faces a growing deficit in refined products, is still able to balance its net fuel imports with net crude exports, at least for another few years (Figure 3). Vietnam's growing role as the region's fourth-largest oil producer is a result of the

¹⁸ Examples include countries such as Japan, and in Southeast Asia, to a lesser extent, the Philippines.

¹⁹ This chapter interchangeably uses the term "institution" to represent both institutions and organisations. North defines "institutions" as "the rules of the game in a society or humanly devised constraints that shape human interaction", and "organisations" as "groups of individuals bound by some common purpose to achieve objectives". Thus organisations could include political, economic, social and education bodies. See Douglas C. North, *Institutions, Institutional Change and Economic Performance* (Cambridge: Cambridge University Press, 1990).

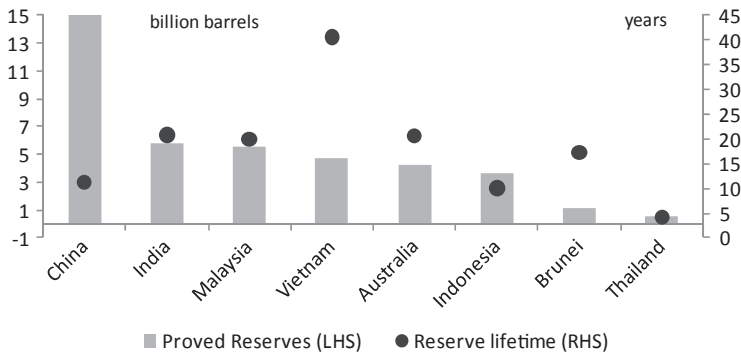


Figure 2 Asia Oil Reserves and Lifetime 2008

Source: BP Statistical Review of World Energy, June 2009.

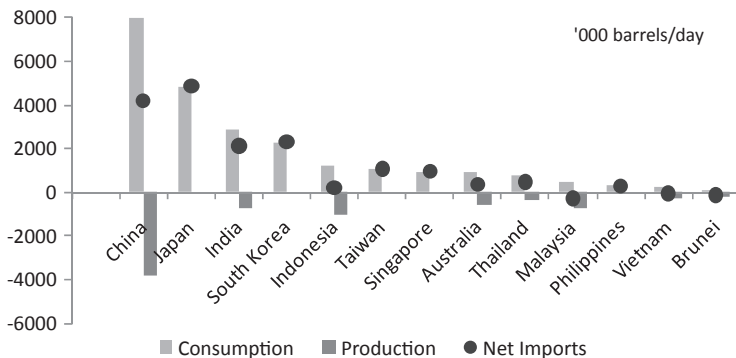


Figure 3 Asia Oil Consumption, Production and Net Imports 2008

Source: BP Statistical Review of World Energy, June 2009; EIA, *International Energy Outlook*, 2009.

significant increase in oil and gas exploration activity in recent years, with potential for new oil and gas discoveries.²⁰

The region will need to import larger volumes of crude oil from the Middle East in the future. Its hope thus rests with future crude oil production growth from newly developed or yet-to-be-discovered fields in Vietnam, Malaysia and Indonesia. Singapore, the most industrialised

²⁰ Energy Information Administration (EIA), *Vietnam: Country Analysis Briefs* (Washington, DC: EIA, 2007).

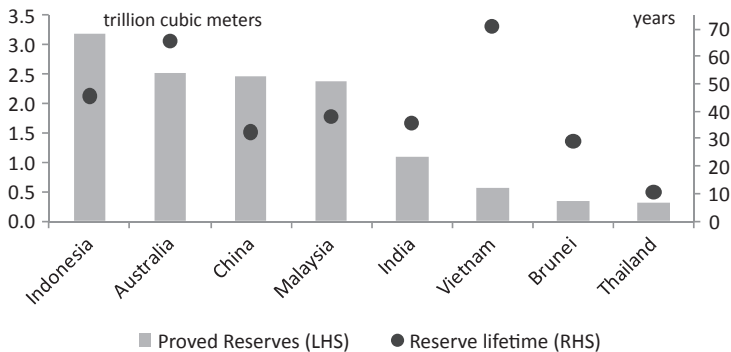


Figure 4 Asia Natural Gas Reserves and Lifetime 2008

Source: BP Statistical Review of World Energy, June 2009.

country in Southeast Asia, imports all of its crude oil and natural gas requirements, and re-exports a significant amount of the fuel products from its world-class refineries. As will be elaborated later, the city state has successfully developed the third-largest oil refining centre in the world.

The situation looks comparatively less worrisome in natural gas and coal. The region's existing proven natural gas reserves are located in Indonesia, Malaysia, Vietnam and Brunei (Figure 4). Indonesia and Malaysia are among the world's top three exporters of liquid natural gas (LNG), with growing domestic gas demand, while Brunei exports LNG as well (Figure 5). The largest LNG consumers are currently Japan, South Korea and Taiwan. While additional future demand could arise from China, India and the Pacific West Coast, competition from Australia, the Middle East, e.g. Qatar, enhanced by the development of a global LNG spot market, as well as domestic gas resources in India and China, would intensify competition in the regional LNG market.²¹

Myanmar, historically a limited exporter of gas to Thailand, has seen several major gas discoveries, although commercialisation and start-up will take some time. Its gas discoveries will only be categorised as proven once clear off-take contracts and development plans are in place. Vietnam

²¹ IEA, *Natural Gas Market Review 2008*; and Ball *et al.*, *The Asia Pacific LNG Market, Issues and Outlook*.

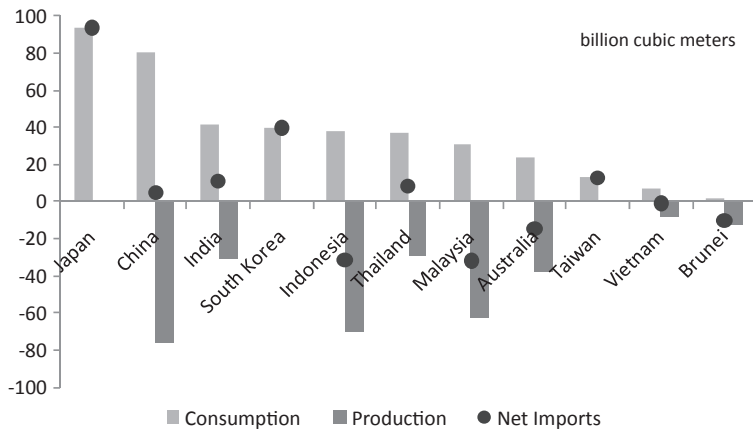


Figure 5 Asia Natural Gas Consumption, Production and Net Imports 2008

Source: BP Statistical Review of World Energy, June 2009; EIA, *International Energy Outlook*, 2009.

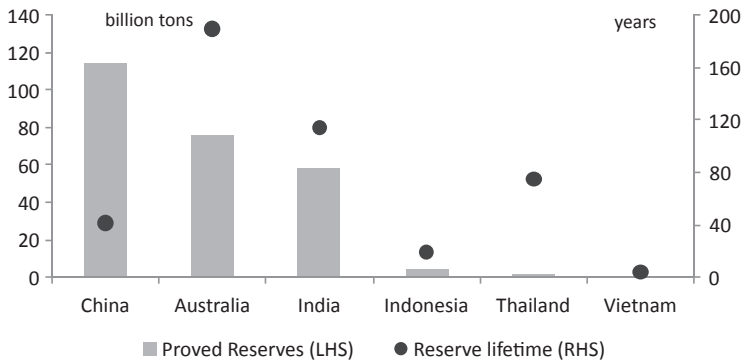


Figure 6 Asia Coal Reserves and Lifetime 2008

Source: BP Statistical Review of World Energy, June 2009.

is also expected to experience rapid growth in gas production, starting from its currently low base (Figure 6). Significant exploration activity is being conducted by several international oil majors and exploration and production (E&P) independents. Thailand is already a significant domestic consumer and producer of natural gas, and has successfully built an extensive infrastructure for the domestic production and transport of its

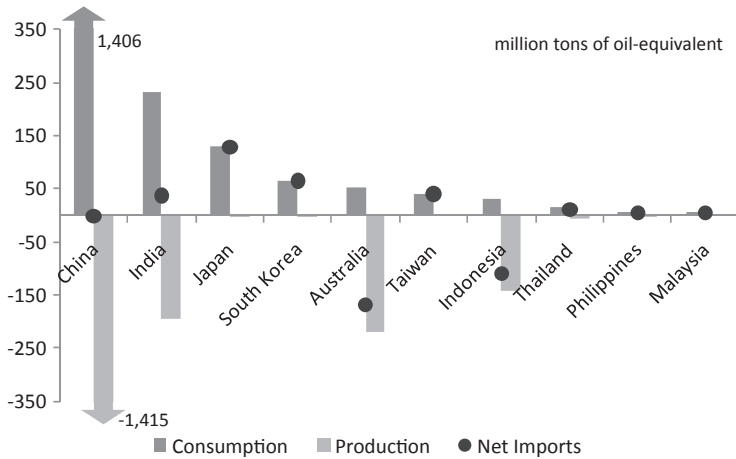


Figure 7 Asia Coal Consumption, Production and Net Imports 2008

Source: BP Statistical Review of World Energy, June 2009.

most abundant domestic resource.²² Among Southeast Asian countries, Thailand, Malaysia and Singapore have a well-developed domestic gas infrastructure. However, Thailand's gas reserves are depleting, and just like Singapore, the country is planning for future LNG imports. The Philippines has found one major offshore gas field that now supplies three power plants. The biggest challenge the country faces is that most of its larger potential oil and gas deposits are located in deepwater areas, and thus costly and difficult to explore and develop. Therefore, Indonesia, Malaysia and in the future Myanmar and Vietnam will be the region's largest natural gas and LNG exporters, while Singapore, the Philippines and in the future Thailand will be importing the bulk of their gas from their neighbours.

China, India and Japan are the largest coal consumers in Asia (Figure 7). China is relatively self-sufficient in both thermal and coking coal, India imports higher-quality thermal and coking coal while Japan

²² See National Energy Policy Council (NEPC), *Thailand's Energy Policy and Development Plan under the Administration of Prime Minister General Surayud Chulanont* (Bangkok: NEPC, 2006); and PTT Plc, *Annual Report 2008* (Bangkok: PTT Plc, 2009).

and South Korea are the region's biggest importers. The strong demand from Northeast Asia benefited Indonesia, the world's largest exporter of thermal coal, as well as Australia (the latter is the world's leading coking coal exporter).

Thailand, Malaysia and the Philippines are growing importers, while Vietnam may soon see its domestic coal production insufficient to cover demand from its growing electricity generation capacity.²³ This raises the question of long-term coal supply security. Despite the transport cost advantages, these countries are competing with Asia's largest coal importers, Japan, South Korea, India and Taiwan, for several international coal suppliers. There is only one regional supplier of coal, Indonesia. While China has sufficient coal deposits, the growing Chinese demand for lower-ash and lower-sulphur thermal and coking coal keeps producers focused on their own domestic markets, at least for the foreseeable future. Although Indonesia was the world's largest exporter of thermal coal for power generation in 2008, benefiting from the relatively low sulphur and ash content of its coal, Australia's production capacity is continuously increasing.²⁴ Indonesia's main challenge is the capacity and infrastructure constraints in coal mining, processing and transport infrastructure.

A summary of the oil, natural gas and coal sector potential in Southeast Asia is given in Table 1. In both natural gas and coal Southeast Asian exporters cannot afford to become complacent, since competition from Australia and the Middle East will intensify in future.

1.3.2 Demographics, Economic and Industrial Development, Geography and Population Distribution

Figure 8 shows that demand for primary energy is positively correlated with per capita income. This is consistent with studies conducted by various authors.²⁵ As an economy grows and develops its manufacturing and agricultural sectors, industrial fuel, electricity and feedstock consumption

²³ Barlow Jonker, *Coal Profile — Vietnam 2007* (Sydney: Barlow Jonker, 2007).

²⁴ EIA, *International Energy Outlook 2009*, p. 55.

²⁵ Smil, *Energy at the Crossroads: Global Perspectives and Uncertainties*, p. 66.

Table 1 Summary of Southeast Asian Oil, Gas and Coal Sector Potential

	Crude oil		Fuel products		Natural gas		Coal	
	Domestic	Trade	Domestic	Trade	Domestic	Trade	Domestic	Trade
Indonesia	Significant but gradually declining production	Net importer since 2008	Insufficient refinery capacity, growing demand	Importer of products, exporter of LPG and fuel oil	Growing demand from power sector	Global top 3 LNG exporters	Growing demand from power sector	#1 global exporter of thermal coal in 2008
Malaysia	Significant production	Net exporter	Insufficient refinery capacity	Net importer	Several gas-fired power plants	Global top 3 LNG exporters		Importer of thermal coal
Thailand	Small production	Import dependent	Established refinery sector	Net exporter of products	Currently self-sufficient, established pipeline grid	Some import from Myanmar, future LNG importer	Some local production	Net importer

(Continued)

Table 1 (Continued)

	Crude oil		Fuel products		Natural gas		Coal	
	Domestic	Trade	Domestic	Trade	Domestic	Trade	Domestic	Trade
Philippines		Import dependent	Growing domestic household demand, insufficient refinery capacity	Net importer	One major project	Future LNG imports?	Small production	Net importer
Singapore		Import dependent, large trading hub	Large-scale refining and trading hub	Net exporter of refined products, importer of fuel oil		Import from Indonesia, Malaysia, future LNG		
Brunei	Limited domestic demand	Net exporter		Import dependent	Limited domestic demand	Net exporter		

Source: Author's own analysis based on statistical data presented and discussed in previous sections.

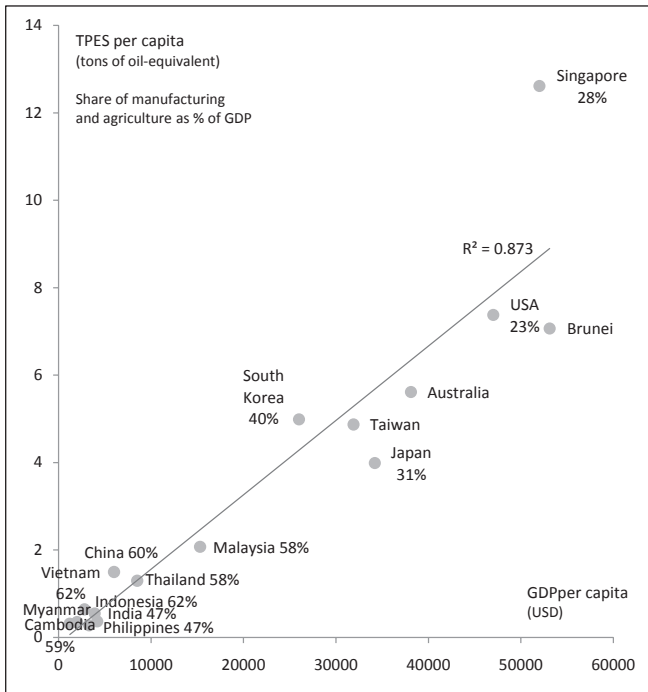


Figure 8 Total Primary Energy Supply (TPES) versus Per Capita Gross Domestic Product (GDP) 2008

Source: BP Statistical Review of World Energy, June 2009; EIA, *International Energy Outlook*, 2009; United Nations Development Programme (UNDP), *World Population by Country 1950–2050* (New York: UN Population Division, 2009); The World Bank, *World Development Report 2010: Development and Climate Change* (Washington, DC: The World Bank, 2010), pp. 384–385.

as well as increasing disposable income and household modernisation result in growing demand for primary energy.²⁶ In terms of energy intensity, i.e. the ratio between TPES and GDP per capita, Southeast Asian countries are in the middle of the range. This is compared to Japan, globally one of the most energy-efficient economies, and to the comparatively less efficient China. Figure 8 also shows that less-developed countries

²⁶ The agricultural sector would also require more energy inputs once modernisation takes place, i.e. through automation, high productivity seeds, large-scale irrigation and water pump technologies. For just one example, see Juan Pablo Rud, *Electricity Provision and Industrial Development: Evidence from India* (London: London School of Economics, 2009).

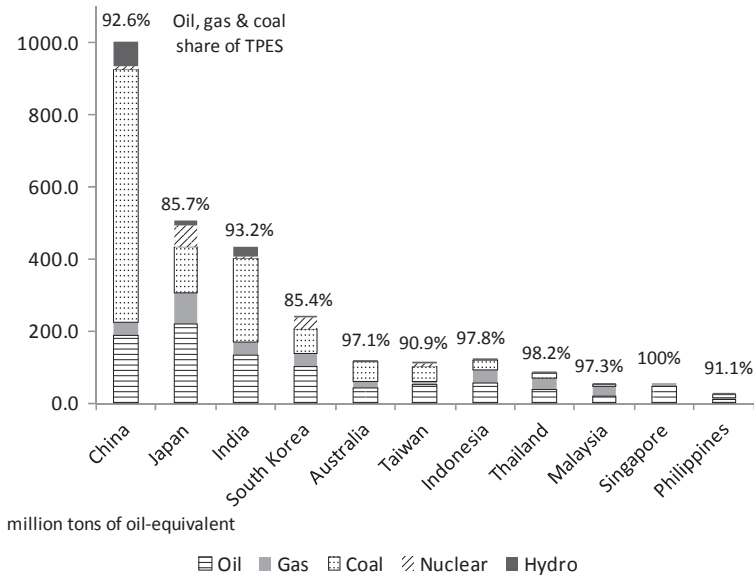


Figure 9 Primary Energy Consumption by Fuel Type

Source: BP Statistical Review of World Energy, June 2009; EIA, *International Energy Outlook*, 2009.

with high shares of manufacturing and agriculture as a percentage of GDP tend to consume higher levels of TPES and are more energy intensive. Singapore's and South Korea's high energy intensity are primarily driven by the significant fuel product re-exports from their refineries.

Figure 9 depicts the breakdown of primary energy consumption by fuel type and country. It can be seen that in Southeast Asia, Indonesia is the largest market for energy. The country consumes comparable amounts of oil, gas and coal, mainly for transportation fuel and electricity generation. The country's state-owned electricity company, PLN, is suffering from high fuel oil and diesel prices, and is aggressively diversifying away from liquid fuels to gas, coal and, in future, renewable energy. Thailand consumes its oil primarily for fuel and petrochemical feedstock. The Thai government has successfully implemented an industrialisation policy that optimises the use of the country's domestic gas potential.²⁷ Applications include the use

²⁷ NEPC, *Thailand's Energy Policy and Development Plan*.

of natural gas for light petrochemicals, i.e. ethylene, as well as liquid petroleum gas (LPG) and compressed natural gas for transport fuel.

The development of electricity generation capacity drives the demand for fuel oil, diesel, natural gas and coal. The low per capita GDP levels and geographic characteristics in Southeast Asia result in transport and electricity costs making up a relatively high percentage of household and industrial disposable income. The only exception is Singapore, a city state with one of the world's highest per capita GDP levels.

Furthermore, geography and population distribution significantly influence the need to transport feedstock and manufacturing goods, both to domestic markets and demand centres as well as to regional and international export markets. Indonesia and the Philippines, being two major archipelagos with hundreds of domestic demand centres, large and small, face more logistical constraints and challenges than the smaller, more localised countries like Malaysia, Thailand, Vietnam and of course Singapore. The transport of fuel products and energy feedstock to remote islands in Indonesia and the Philippines results in high costs of fuel and electricity generation, in turn affecting local competitiveness and development.

1.3.3 Refinery Sector and Fuel Distribution

Refinery facilities of an efficient scale require large capital investments. The sector's profitability margins are volatile and simple refining margins can at times be minimal.²⁸ Coupled with the importance of fuel prices for general transport, power generation and industrial consumption, as well as the sensitivity surrounding political decision making and regulatory capacity, the sector has historically seen a large role played by government-controlled state-owned enterprises (SOEs). While the role of SOEs in China, India and Southeast Asia has been important, each country in Asia has followed a distinct development path. Moreover, sector liberalisation

²⁸ "Simple" refineries typically comprise atmospheric, maybe vacuum distillation and produce lower-value-added fuel oil, heavier fractions and middle distillate products such as diesel and kerosene. In contrast, "complex" refineries (with a higher Nelson complexity index) include hydro and or catalytic crackers that reduce the proportion of heavier products and improve the yield of medium and light products such as gasoline, naphtha, diesel, kerosene and jet fuel.

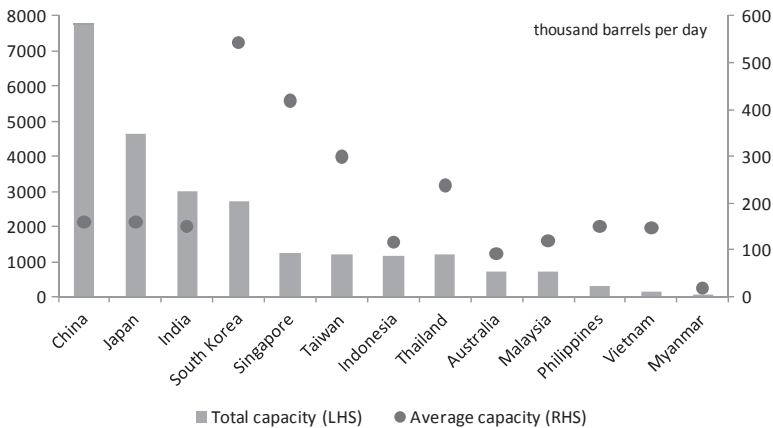


Figure 10 Total and Average Capacity of Asian Refineries

Source: BP Statistical Review of World Energy, June 2009; Worldwide Refinery Survey, *Oil & Gas Journal*, 2006.

during the last two decades has introduced private, domestic and/or foreign competition in many countries.

Figure 10 shows that, in terms of average capacities, the South Korean, Taiwanese, Singaporean and Thai refineries are the most efficient in the region. It should be noted that to achieve the minimum efficient scale, the consensus is that minimum crude processing capacities of about 150,000–200,000 barrels per day (bpd) are required. In comparison, in South Korea SK Corporation's Ulsan refinery has a capacity of 850,000 bpd, while Reliance Industries's two refineries will have a combined capacity of more than 1.2 million bpd. Thus it is apparent that the average refinery size in Southeast Asia, especially in Vietnam and Cambodia, is generally below the efficient scale.²⁹ In terms of the Nelson complexity index, which characterises the complexity, i.e. proportion of higher-value-added products such as lighter gasoline, diesel and kerosene, of a refinery's overall production output, only Singapore and Malaysia refineries achieve average or above average complexity in Southeast Asia (Figure 11). In terms of industry development, Indonesia's refinery and distribution sector has

²⁹ The exceptions include the larger-capacity Melaka II refinery in Malaysia, Petron refinery in the Philippines, and Cilacap and Balikpapan refineries in Indonesia.

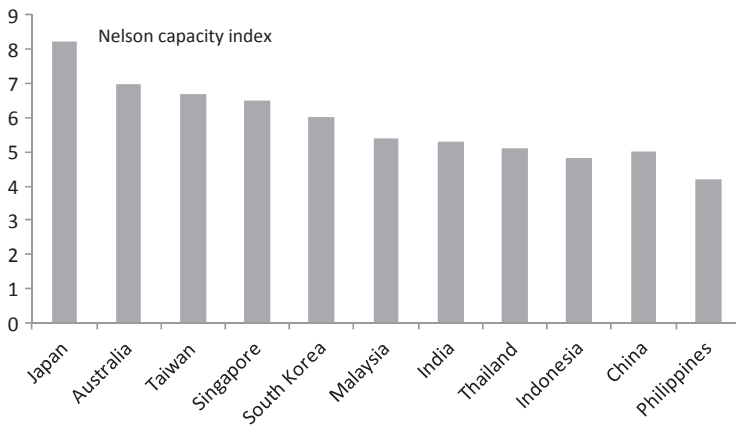


Figure 11 Refinery Nelson Complexity Index

Source: Worldwide Refinery Survey, *Oil & Gas Journal*, 2006.

been and still is dominated by its SOE, Pertamina. This is historical as well as a result of the low subsidised fuel prices, which renders it less profitable for private refiners. With the extreme increase in crude prices between 2005 and 2008, subsidies have been abolished for industrial customers and for high octane gasoline. SOE-multinational refinery joint ventures (JVs) are actively competing with refineries and retail stations owned by other multinationals in Malaysia, Thailand and the Philippines. In Vietnam and Myanmar the SOEs own one small refinery each.

In comparison, in China, most major refineries, following industry restructuring in the 1980s, are controlled and owned by state-owned Sinopec and CNPC-PetroChina.³⁰ China National Offshore Oil Corporation (CNOOC) is planning one major refinery and petrochemical complex, while the fourth government-controlled SOE, Sinochem, partially owns one Chinese-foreign refinery JV in Northern China. While historically Chinese refineries are small and less complex, the size and complexity of newly built and planned refineries, some of which are JVs between

³⁰ Although still government-controlled, all three major SOEs, Sinopec, PetroChina and CNOOC (just like ONGC in India, PTT Plc and several of its upstream and downstream subsidiaries and affiliates in Thailand), have been partially privatised and are now publicly listed on international stock exchanges.

Chinese SOEs and multinational oil majors, are increasing. This is driven by the need to refine heavier Middle Eastern crudes and to achieve better efficiencies of scale and scope.³¹ In India, government-controlled Indian Oil Corporation, Bharat Petroleum and Hindustan Petroleum are facing strong competition from Reliance Industries, which has started operation of its first large-scale refinery and is about to double its capacity in a few years.³² In South Korea and Japan, on the other hand, the refinery sector was developed with the help of large domestic business groups, some of which decided to form JVs with foreign strategic and financial partners.

It is noteworthy that there seems to be a rough correlation between the size and/or complexity of refinery sectors and the domestic crude availability across the countries. As Figure 12 indicates, countries that are heavily dependent on crude imports such as Japan, South Korea, Taiwan and

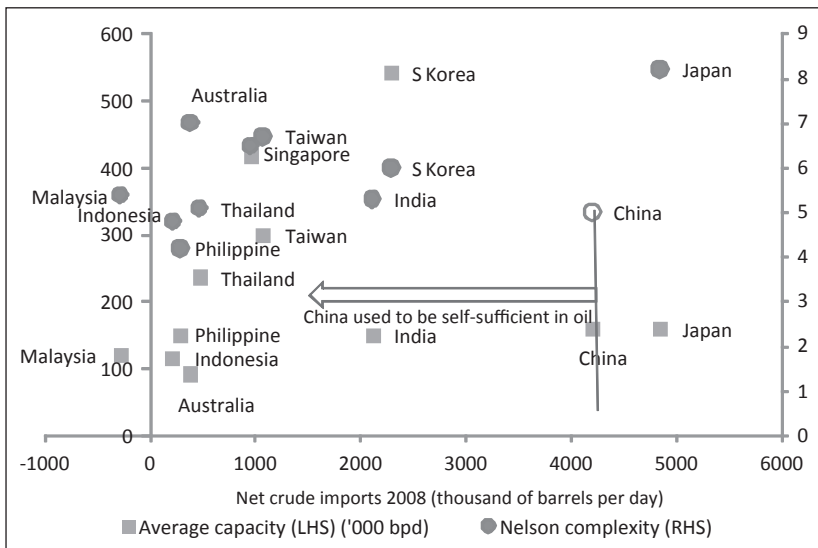


Figure 12 Refinery Size and Complexity versus Oil Import Dependency

Source: BP Statistical Review of World Energy, June 2009; EIA, *International Energy Outlook*, 2009; Worldwide Refinery Survey, *Oil & Gas Journal* 2006.

³¹ Historically Chinese refineries have refined domestic crudes, e.g. from PetroChina's Daqing and Sinopec's Shenli fields, which are of lighter grades.

³² Bharat and Hindustan are also publicly listed and thus partially privatised.

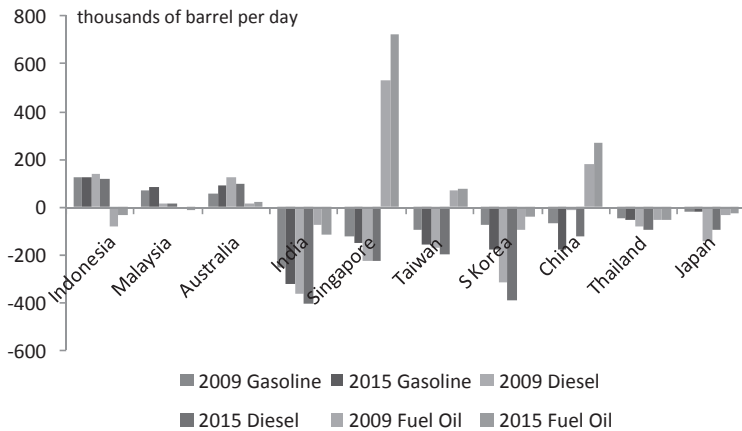


Figure 13 Net Imports of Diesel, Gasoline and Fuel Oil, 2009 and 2015

Source: Yamakawa, "Outlook of Products Supply & Demand in Asia by Country and by Product".

Thailand have generally built more complex and larger refineries, whereas countries that had (at least historically) a surplus of domestically produced crude oil, including China, Indonesia and Malaysia, have been "less forced" to do so. While it is conceivable that countries that import crude oil may have to focus more on achieving feedstock flexibility, margin protection and higher economies of scale and scope than countries with secure domestic crude availability, this apparent correlation may need to be examined in future studies.

The regional forecasted 2009 and 2015 net import figures for gasoline, diesel and fuel oil are depicted in Figure 13. In terms of domestic supply demand balance, only Indonesia and Malaysia need to import transport fuels. Given the lower average complexity of Indonesian refineries, however, the country is and will remain a net exporter of fuel oil for power generation and cracking. Thus, in principle the country could build additional cracking capacity to produce higher-value-added diesel, gasoline as well as kerosene and jet fuel. Singapore imports large volumes of fuel oil which its refineries crack into higher-value-added products, which it then exports Asia-wide.

After the closure of one refinery in the Philippines, the country is now relatively self-sufficient, while Vietnam and Myanmar are also forecasted to import lighter fuels until further refinery capacity comes on stream.

1.3.4 Energy and Fuel Subsidies

Governments in low-income countries frequently subsidise fuel and electricity prices. This is done to assist industrial consumers to become more competitive or to help domestic households improve their purchasing power. Figure 14 depicts the relationship between Asian countries' per capita GDP and domestic retail diesel and gasoline prices. While the logic of favouring low-income consumers renders subsidies in lower-income countries socially desirable, the correlation is far from perfect. The reason is that subsidy decisions are costly, especially in developing countries with constrained public budgets, and therefore politically controversial.³³

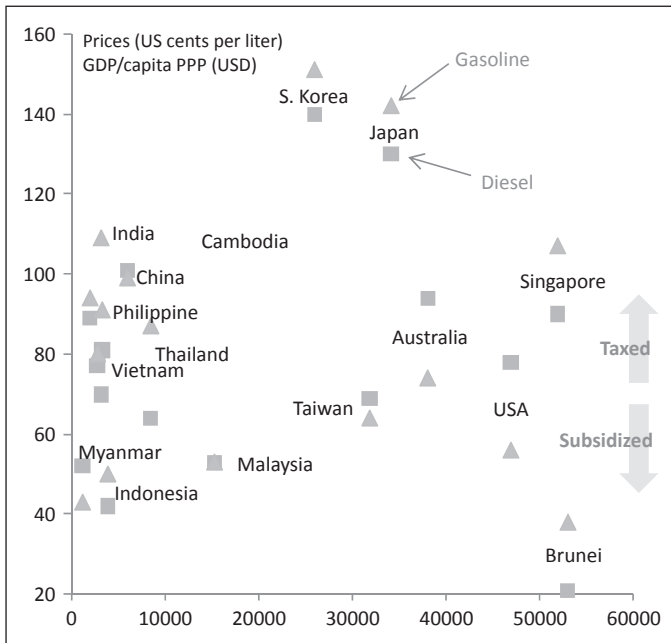


Figure 14 Per Capita GDP versus Diesel and Gasoline Retail Prices

Source: CIA, *The World Factbook* (2008 estimate); GTZ, *International Fuel Prices* 2009.

³³The government soft budget constraint issue is a subject of extensive research. See for example János Kornai, "Ten Years After the Road to a Free Economy: The Author's Self Evaluation", in *Annual Bank Conference on Development Economics 2000*, edited by Boris Pleskovic and Nicolas Stern (Washington, DC: The World Bank, 2000), pp. 49–66.

Furthermore, retail price subsidies are often criticised for benefiting middle- and higher-income households as well, which runs counter to the original concept of redistribution.³⁴ It should be noted that retail prices in the United States are considered thresholds that allow average refiners to recover their crude price input and production cost, and still enjoy normal returns, while a 10% fuel tax is charged to help fund road and highway development and operational costs.³⁵ Thus, to make simplifying assumptions about general refining and distribution costs and margins, countries with retail prices above US levels generally extract taxes from consumers, while those below offer retail price subsidies. Figure 14 indicates that Indonesia, Malaysia and Brunei still offer fuel subsidies, while retail fuel prices in Thailand and the Philippines are generally in line with regional levels.³⁶

Figure 15 depicts the development of diesel prices since 2000 across Asia. Interestingly, China, a country that has been criticised for maintaining below-market retail prices in the past, together with Vietnam and the Philippines, has allowed its fuel prices to gradually increase, somewhat in tandem with the oil price increase between 2005 and 2008. Chinese retail fuel prices are now higher than levels in the US. While Thailand and India also allowed their domestic retail prices to increase until late 2007, during the oil price peak in the first half of 2008, these countries “encouraged” their refineries to share at least part of the cost of subsidies and keep prices below market levels. Indonesia, on the other hand, has gradually phased out its fuel subsidies, with the only subsidies remaining for standard diesel, gasoline and kerosene for retail and households. As can be seen, consumers in the more advanced countries of Singapore, Australia, China, Japan and South Korea pay higher retail price levels as a result of higher levels of fuel taxes.

³⁴ See for example IEA, *Energy Policy Review of Indonesia* (Paris Cedex: IEA, 2008); from a theoretical point of view, optimum subsidies are most effective if directly targeted at the main beneficiaries, e.g. specific industries and sectors, low-income households. See Dani Rodrik, “Policy Targeting with Endogenous Distortions: Theory of Optimum Subsidy Revisited”, *The Quarterly Journal of Economics*, 102 (1987), pp. 903–911.

³⁵ See GTZ, *International Fuel Prices 2009* (Eschborn: GTZ, 2008), pp. 3 and 64.

³⁶ See for example Neil Atkinson, *Subsidised Oil Prices: Are They Sustainable?* (Manila: Department of Energy, 2008).

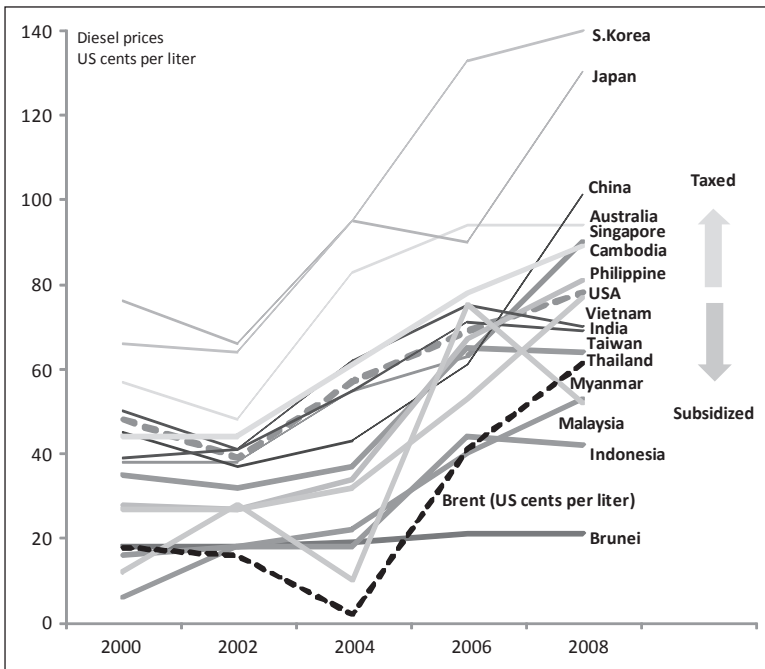


Figure 15 Diesel versus Crude Oil Prices 2000–2008

Source: GTZ, *International Fuel Prices 2009*.

1.3.5 Institutional History and Foundation

As many researchers have demonstrated, economic policies cannot be effective unless a country's socio-political, institutional history and foundation are all aligned. Taking the case of industrial policy, for example, the experience in East Asia has shown that industrial policy has been successful when those in power who have implemented the policy have either themselves wished for industrialisation to succeed, or have been forced to act in this way by the incentives generated by political (and socio-historical) institutions.³⁷

³⁷ James A. Robinson, "Industrial Policy and Development: A Political Economy Perspective", *2009 World Bank ABCDE Conference* (Seoul: The World Bank, 2009).

The policies of Southeast Asian governments for their oil, gas and electricity industries have been shaped not only by each country's resources, i.e. energy feedstock endowments, geography and demographics, but by their institutional history and socio-political dynamics as well. Only the three examples of Indonesia, Thailand and Malaysia will be elaborated. Since the formulation and implementation of energy policy is a gradual, evolutionary process, the institutional backdrop and historical energy sector development significantly influence, and often limit, the flexibilities and policy options that each successive government in these countries are able to formulate and, in particular, implement. Here we mainly look at the institutional background in Indonesia, Thailand and Malaysia.

1.3.5.1 *Indonesia*

In Indonesia, Southeast Asia's oldest and largest oil- and gas-producing country, industry and regulation have evolved in several stages.³⁸ Starting in the early days of production sharing contracts (PSCs) about four decades ago, Indonesia became one of the developing world's most actively explored and developed oil and gas markets. In 1970 the government created a unified national oil and gas company (NOC), Pertamina, which was to be controlled by and managed under the Ministry of Mines and Energy. While the government, through Pertamina, continued to engage in various cooperation contracts (including PSCs) with domestic and foreign oil operators, Pertamina was not given sufficient freedom to develop independent and commercial operations.

This was only addressed following the 1997 Asian crisis, the 1998 fall of the Suharto government and the 1999 decentralisation laws. In 2001 the Indonesian government introduced a new oil and gas law that provided the basis for a more commercial and transparent industry and regulatory structure, independent upstream and downstream regulatory bodies and for a more commercially nimble, corporatised Pertamina.³⁹ In

³⁸ For a review of Indonesian energy policy, its oil, gas and coal industry and the country's need to prioritise institutional improvements such as policy coordination and decision making, regulatory independence and sustainable development, see IEA, *Energy Policy Review of Indonesia*.

³⁹ See IEA, *Energy Policy Review of Indonesia*, pp. 105–120.

the country's more fragmented mining sector, on the other hand, a new mining law was introduced in 2009, which introduced a more decentralised industry structure and licensing regulations.⁴⁰

Among the problems facing the Indonesian oil, gas and mining sectors are the comparatively less attractive oil and gas fiscal regimes, a complex sector bureaucracy and the prevalence of corruption and special interest groups. Coupled with institutional weaknesses at the regional government level following the country's extensive 1999 decentralisation laws, this has resulted in a less conducive investment environment and declining oil and gas production in recent years.

1.3.5.2 *Thailand*

The structure, regulation and SOE privatisation policies in Thailand's gas and electricity sectors have been heavily debated along two dimensions. First, the proponents of market competition and unbundling (e.g. of the downstream gas and electricity sectors) have been pitted against the supporters of large, efficient and integrated "national champion" SOEs. Second, the proponents of (partial) SOE privatisation have been battling consumer groups and non-governmental organisations who see more disadvantages of privatisation.⁴¹ Nevertheless, most parties seem to agree on the need to maximise the country's utilisation of its domestic natural resources for the production and distribution of transport fuel and electricity, with the ultimate goal of driving the country's industrialisation and development.

One successful case study is the privatisation of the Thai NOC, PTT Plc (formerly Petroleum Authority of Thailand). While the government of the

⁴⁰ For an overview of Indonesia's coal sector, see IEA, *Energy Policy Review of Indonesia*, pp. 153–169; for a discussion on the new Mining Law, also see Balbir Bhasin and Sivakumar Venkataramany, "Mining Law and Policy: Replacing the Contract of Work System in Indonesia", CEPMLP Research (2008), pp. 1–16, available from <http://www.dundee.ac.uk/cepmlp/>.

⁴¹ On the debate about industry structure and privatisation, see Puree Sirasontorn and John Quiggin, "The Political Economy of Privatization in the Thai Electricity Industry", *Journal of the Asia Pacific Economy*, 12, no. 3 (2007), pp. 403–419; for an overview of the Thai oil and gas sector policy and history, see NEPC, *Thailand's Energy Policy and Development Plan under the Administration*; and PTT Plc, *Annual Report 2008*.

late 1990s, working with the National Energy Policy Office (NEPO), preferred a more competitive, unbundled and privatised industry, following the change in government in 2001 and the PTT Plc initial public offering (IPO) the company maintained its quasi-monopoly of the gas transmission grid. As part of its restructuring and corporatisation in preparation for the privatisation, it was stipulated that PTT subsequently carve out and unbundle its gas transmission and distribution (T&D) business.

The country's downstream oil refinery and petrochemical industry was developed via the formation of JV companies between PTT's subsidiaries and domestic or multinational partners. Some of these JV affiliates have subsequently been consolidated and/or partially privatised via stock market listing. This strategy has helped PTT join Singapore and Malaysia as one of Southeast Asia's most efficient refinery and petrochemical locations.

Thailand's and PTT's main challenge is the potentially depleting domestic gas resources, and PTT's aggressive acquisition of domestic gas and oil reserves and engagement in regional and international oil and gas projects is part of their strategy to mitigate future dependence on imported gas.⁴² PTT has also been mandated to plan a future LNG receiving terminal. On the renewable energy side, the government is pursuing fuel diversification strategies, particularly into biofuels and biomass, as well as hydro, wind and solar power.⁴³

1.3.5.3 Malaysia

Malaysia, on the other hand, pursued an oil and gas strategy centred on Petroliaam Nasional Berhad (PETRONAS). PETRONAS has evolved to

⁴² For analysis of Thailand's future gas import dependence, energy security and fuel diversification plan, see Thanawat Nakawiro and Subhes C. Bhattacharyya, "High Gas Dependence for Power Generation in Thailand: The Vulnerability Analysis", *Energy Policy*, 35 (2007), pp. 3335–3346; and Thanawat Nakawiro, Subhes C. Bhattacharyya and Bundit Limmeechokchai, "Electricity Capacity Expansion in Thailand: An Analysis of Gas Dependence and Fuel Import Reliance", *Energy*, 33 (2008), pp. 712–723; for a summary of the Thai Ministry of Energy's alternative energy policy, see Areerat Yoohoon, "Low Carbon Economy", presented at the Asia Pacific Forum on Low Carbon Economy (Beijing: Department of Alternative Energy Development and Efficiency, Ministry of Energy of Kingdom of Thailand, 2009).

⁴³ Yoohoon, "Low Carbon Economy".

become one of Southeast Asia's most successful and internationally diverse oil and gas SOEs. It started when then Prime Minister Mahathir invited a group of professionals under the leadership of Hassan Marian to build a world-class oil and gas SOE.⁴⁴ PETRONAS top management was given full discretion to recruit and train the best oil and gas professionals and executives. More importantly, the government gave PETRONAS the authority and independence to conduct its business in the most technically and commercially optimal manner, with minimum government intervention. The company thus managed to become an international LNG player (the only one among Asian SOEs), an efficient and dominant domestic upstream and downstream operator, and an active explorer across Africa, Southeast and Central Asia, with growth strategies in the European and North American gas markets. Domestically, the 1974 Petroleum Development Act gave PETRONAS the exclusive rights to explore and develop prospective oil and gas fields, either by themselves or in cooperation with appropriate multinational or domestic industrial partners.

1.3.6 Upstream Fiscal Policy

Analysing the oil and gas sector competitiveness and investment attractiveness across countries requires a comparison of not only aggregate fiscal policy but also the relative reservoir, topographic, climate and market conditions.⁴⁵ Thus, comparing average, aggregate fiscal regimes only is a gross simplification. Moreover, there are a wide variety of different contract types, many of which combine elements of revenue royalty (e.g. first tranche petroleum and domestic market oil and gas) with profit and corporate taxations. These contractual elements interact with the aforementioned geographic, reservoir and market variables, resulting in a complex, country-specific risk and return profile which changes over time with the actual portfolio of projects in each country.

⁴⁴ See Fred R. von der Mehden and Al Troner, *PETRONAS: A National Oil Company with an International Vision* (Houston: The James A. Baker III Institute for Public Policy and Japan Petroleum Energy Center, Rice University, 2007).

⁴⁵ See Cambridge Energy Research Associates (CERA), *A Comparison of Fiscal Regimes* (Cambridge: CERA, 2007).

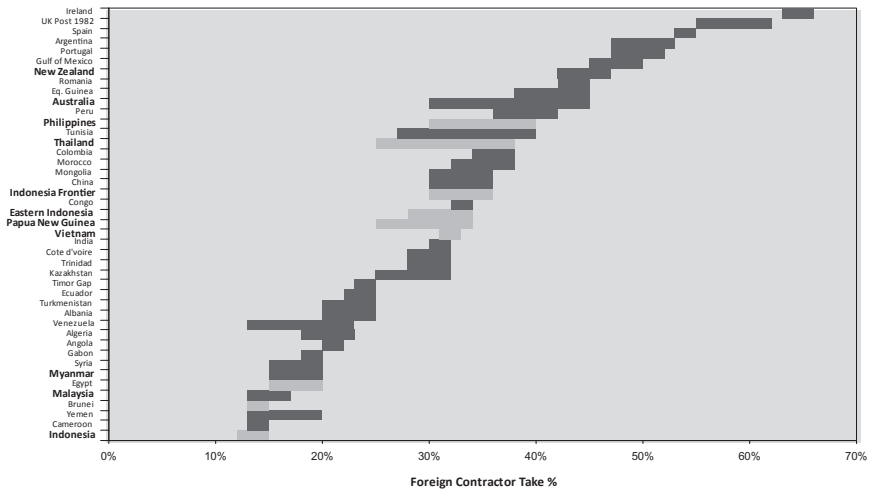


Figure 16 World Oil and Gas Fiscal Comparison

Source: IHS Energy Group.

Nevertheless a simple comparison of aggregate contractor versus government take as in Figure 16 could provide a rough idea of where Southeast Asian countries stand vis-à-vis the region's global competitors. The latter nowadays primarily comprise offshore West and North Africa, Central Asia and Brazil, as well as Australia.

Figure 16 shows that frontier (generally including gas) and eastern Indonesia, Vietnam, Thailand and the Philippines are on average in the middle of the worldwide fiscal regime scale. However, judging from recent large-scale discoveries in West and North Africa, and Brazil, as well as the investment activity involving large fields in Central Asia, these countries' lower or similar foreign contractor takes (e.g. about 20% in Angola and Gabon, 30% in Kazakhstan) seem to be over-compensated by these regions' higher reserves and resource potential. It is well known that the fiscal regime in Australia is comparatively more contractor-friendly, which coupled with the very large potential for gas and LNG and low political risk, makes it highly competitive.⁴⁶ Add to this the fact that future exploration activity in

⁴⁶ Upside potential exists for future LNG expansion in Australia, despite possible delays due to the financial crisis, forecasted medium-term over-supply and environmental regulation. See EIA, *International Energy Outlook 2009*, p. 43.

Southeast Asia, driven by both geological and local-political factors,⁴⁷ will focus increasingly on higher cost and risk offshore projects, it could be inferred that improving the contractor share may provide additional incentives for both foreign and domestic exploration activities.

On the coal side, the key competitors in international and regional export markets are Indonesia and Australia. Australia's coal royalty regimes, while varying across states, range from 3.5% in Southern Australia to around 7% in Queensland and New South Wales.⁴⁸ This is lower than the 13.5% level of central government royalties charged to Coal Contracts of Work (CCOW) and the 7% historical range for local concessions in Indonesia.⁴⁹

1.3.7 Regional Summary

Each country in Southeast Asia faces a distinct combination of geographic, demographic, economic and socio-political characteristics that help determine the potential future of the country's energy sector. These determinants of energy policy are summarised in Table 2.

This creates unique opportunities and challenges for each country. While almost all countries in Southeast Asia are already or will become dependent on imported oil in the future, Indonesia, Malaysia, Brunei, as well as possibly Vietnam and Myanmar, could become future suppliers of gas to both regional and international LNG and pipeline gas consumers.

⁴⁷ For example, in Indonesia, lower-cost and -risk onshore basins, especially in western Indonesia, have been extensively explored, while large potential is still anticipated for offshore discoveries in eastern Indonesia. In terms of project implementation the current decentralised political environment has resulted in a multitude of local policy problems, e.g. bottlenecks in land clearing, the proliferation of local regulations, taxes and duties as well as social issues, which could be partially addressed in the case of offshore projects.

⁴⁸ Craig Bowie, *A Review of Mining Royalties in Australia* (Brisbane: Minter Ellison Lawyers, 2009). In Western Australia, the royalty for domestically supplied coal is A\$1/tonne, whereas in Queensland an additional 3% royalty is paid on the value of the coal price exceeding a price of A\$100/tonne, while in New South Wales royalties vary between 6.2% and 8.2% depending on project characteristics.

⁴⁹ Ministry of Energy and Mineral Resources (MEMR), Republic of Indonesia. Aggregate fiscal terms in Indonesia's coal and mining sector may also change with the introduction of the Mining Law and the increased devolution of power to local district and municipal governments.

Table 2 Summary of Determinants of Energy Policy

	Geography and resource endowment	Demographics	Economy and industry	Institutions
Indonesia: oil and fuel importer, gas and coal exporter, weaker institutions and investment climate	Large archipelago with more than 17,000 islands, rich agricultural soil Exporter of gas and coal, import dependent in crude and fuel products. High exploration potential in gas and coal, medium in oil, high potential for alternative energy including biofuels, ⁵⁰ hydropower, geothermal, solar.	Lower per capita GDP (US\$3,900). Population of 227 million.	Large agriculture sector, primarily labour-intensive industries and selected manufacturing (including basic chemicals, tires, plastics textiles), growing power and fuel demand, insufficient funds for pollution control and new energy technologies, ⁵¹ insufficient refinery capacity, subsidised retail gasoline and diesel. TPES including oil, gas, coal and hydro; geothermal and biofuels potential.	Established legal and regulatory base but weak enforcement, gradually stronger SOE, conflicts and special interests, difficult investment environment, less favorable fiscal regime. ⁵²

(Continued)

⁵⁰ Djatnika S. Puradinata, "The Biofuels Industry in Indonesia: Opportunities and Challenges", in Lugg and Hong, *Energy Essays on the Asia-Pacific Region*, pp. 42–55.

⁵¹ See Hermawan and Sudarto P. Hadi, "Existing Sustainable (Renewable) Energy System in Indonesia", presented at The 2nd Joint International Conference on Sustainable Energy and Environment (SEE 2006) (Bangkok, 2006).

⁵² IEA, *Energy Policy Review of Indonesia*, pp. 26–27 (Executive Summary), pp. 29–52 (Government Policy, Structure and Process).

Table 2 (Continued)

	Geography and resource endowment	Demographics	Economy and industry	Institutions
Malaysia: fuel importer, oil and gas exporter, strong SOE and established institutions	Peninsula, rich agricultural soil. Exporter of LNGs and oil, importer of fuel products and coal, top 2 producers of palm oil, high potential for alternative energy including biofuels, solar, hydropower.	Medium per capita GDP (US\$15,300). Population of 27 million	Established agricultural and manufacturing sectors (latter including higher-value-added plastics, microelectronics), insufficient refinery capacity, subsidised fuel and gas. TPES including oil, gas, coal and hydro, biofuels. ⁵³	Established legal and regulatory base, strong NOC with international presence, incumbent political party.

(Continued)

⁵³ Also see Abdul Hamid Jafar, Abul Quasem Al-Amin and Chamburi Siwar, “Environmental Impact of Alternative Fuel Mix in Electricity Generation in Malaysia”, *Renewable Energy*, 33 (2008), pp. 2229–2235.

Table 2 (Continued)

	Geography and resource endowment	Demographics	Economy and industry	Institutions
Thailand: oil importer, future gas imports, stronger SOE	Mid-size, Asian mainland, rich agricultural soil and offshore resources. Currently self-sufficient in gas, import dependent in oil, net importer of coal, future need for gas imports including LNG, potential for alternative energy including biofuels, wind, solar	Medium per capita GDP (US\$8,500). Population of 67 million	Established mid-stage manufacturing sector, large agricultural sec- tor (established exporter of agricultural products). TPES including gas, oil, coal and hydro.	Strong publicly-listed NOC, established legal and regulatory base, privatisation polemic.

(Continued)

Table 2 (Continued)

	Geography and resource endowment	Demographics	Economy and industry	Institutions
Philippines: oil, gas and coal importer, weaker institutions and investment climate	Mid-size archipelago with more than 7,000 islands, rich in agricultural soil. One major gas production site, import dependent in oil and coal, region's key geothermal power producer, offshore exploration potential, high potential for alternative energy including bio-fuels, solar, hydropower.	Lower per capita GDP (US\$3,300). Population of 90 million	Established agricultural sector, lower manufacturing share (primarily labour-intensive industries), insufficient funds for pollution control. TPES including oil, coal, gas, hydro and geothermal. ⁵⁴	Established legal and regulatory base but weak enforcement, diversified multi-subsidiary NOC, unbundled electricity sector, conflicts and special interests, difficult investment environment.

(Continued)

⁵⁴ See Department of Energy (DOE), *2007 Philippine Energy Plan* (Manila: DOE, Republic of Philippines, 2007).

Table 2 (Continued)

	Geography and resource endowment	Demographics	Economy and industry	Institutions
Singapore: oil and gas importer, strong refining sector, strong institutions	Small island city-state Import dependent on crude oil and gas, large trader of crude and worldwide exporter of fuel products, lack of land area	High per capita income (US\$52,000, 2nd after Brunei). Population of 4.6 million	Most advanced economy in Southeast Asia, high share of service sector, higher-tech industries (e.g. microelectronics, pharmaceuticals, diversified chemicals), among top 3 refining centres worldwide, ability to finance alternative energy projects and pollution control technologies. TPES including gas and oil.	Strong legal and regulatory base, unbundling and competition focus, privatised sector partially owned by government and multinationals, conducive investment environment.

(Continued)

Table 2 (Continued)

	Geography and resource endowment	Demographics	Economy and industry	Institutions
Vietnam: growth potential in oil and gas, future importer of coal, developing institutions	Mid-size, Asian main- land, rich agricultural soil and offshore resources Small historical produc- tion but significant growth potential and resource base in oil and gas, soon to become net importer of thermal coal potential for alternative energy including biofuels.	Low per capita GDP (US\$2,800). Population of 87 million.	Growing domestic demand for oil and coal, potential for gas power plants, large agriculture sector, growing labour- intensive manufacturing base, insufficient refin- ery capacity, insuffi- cient funds for pollution control. TPES including oil, coal, gas and hydro.	Developing sector regula- tion and legal base, attractive investment environment, growing NOC.
Brunei: limited domestic market, oil and gas exporter	Small land area in north- ern part of Borneo. Exporter of gas and oil, importer of fuel products.	Highest per capita GDP in the region (US\$53,100). Population of 392 thousand.	Primarily services, signif- icant fuel subsidies, limited domestic energy demand, mainly fuel and electricity for households	One NOC.

Additionally, Indonesia has the potential to maintain its role as one of the world's main exporters of thermal coal for power generation. Besides oil import dependence, the challenges of Indonesia and the Philippines are institutional in terms of attracting private domestic and foreign investment in the sector. Thailand and Malaysia must be prepared to start importing gas and particularly oil in the near future, while Vietnam, Myanmar and Cambodia have to further develop their oil and gas sector regulatory framework and institutions to maximise the potential of their nascent upstream sectors. Singapore, on the other hand, needs to continue its fuel diversification programme, not only involving oil and gas but also to function as a catalyst to the regional development of alternative energy technologies.

1.4 POLICY INSTRUMENTS AND NORMATIVE ENERGY POLICY GRID

In an ideal setting, governments would formulate their energy sector strategies and policies by taking into account the outlined geographic, demographic, socio-political and institutional characteristics. While each country will tailor its energy policy to work within the boundaries and constraints of its natural and economic characteristics, the socio-political and institutional backdrop is an essential factor to be considered in devising the policy implementation programme. To be successful, a holistic approach needs to be pursued comprising industrial and energy sector strategy and regulation, trade policy as well as fiscal and investment policy.

1.4.1 Industrial, Trade, Investment and Fiscal Policy

Based on the country's geography, demographics and institutional history, a government would select certain target industries that it wishes to develop and promote.⁵⁵ In the context of, for example, energy sector

⁵⁵ For a brief discussion on industrial policy, see for example Ha-Joon Chang, "Industrial Policy in East Asia: Lessons for Europe", presented at the EIB Conference in Economics and Finance (Luxembourg: European Investment Bank, 2006); on the complementarities between industry targeting and cluster strategies, see Douglas Woodward, "Porter's

and fossil fuel-based chemicals and plastics industry policy, this involves identifying the country's comparative advantage in domestically available feedstock and related factors of production. Following this, an analysis of scale economies, technology and product linkages with existing production facilities and related industries, transportation and infrastructure requirements, trade opportunities and thus production capacity objectives for each target industry can be undertaken.

A preliminary commercial feasibility study can thus be conducted, to assess the potential economic viability and attractiveness for these target industries. In addition to these industries' potential profitability, the country's overall investment climate and financing environment are very important. The aggregate industrial policy across target industries will form a basis for more accurate energy and fuel demand requirements, and the overall energy policy for the country. The government could then introduce appropriate fiscal policies, including taxations, royalties and/or subsidy instruments to support these target industries, and to assist in the provision of necessary energy infrastructure.⁵⁶ The latter would include upstream and downstream oil, gas and coal sector infrastructure and capacities.

1.4.2 Energy Sector Regulation and Policy

Once the country's short- and long-term energy, i.e. fuel and electricity, requirements have been established and the required infrastructure and capacities determined, the optimal energy sector regulation and policy grid must provide the most cost- and time-effective regulatory framework and institutional foundation to attract investment into the targeted energy sub-sectors. These include questions of industry structure and entry, i.e. competition versus (regulated) monopolies across sub-sectors and segments along the energy value chain, and fair yet sufficiently attractive and transparent

Cluster Strategy versus Industrial Targeting", presented at the ICIT Workshop (Orlando: ICIT, 2004).

⁵⁶ See for example Ridwan Rusli, "Time to Invest in Indonesian Oil and Gas Sector", *The Jakarta Post*, 30 June 2009.

tariff and pricing formulae.⁵⁷ To facilitate sector development and project implementation, competitive and transparent licensing and auction procedures as well as efficient cost monitoring and control mechanisms would be required. Many countries have also introduced independent regulatory agencies to oversee bidding, licensing and cost monitoring activities.

Furthermore, the question of investment incentives will depend on the inherent profitability of each sub-sector. While in general, notwithstanding exploration and construction risk, the upstream oil, gas and coal sectors are profitable, downstream refinery and distribution margins, especially in countries still maintaining residual fuel subsidies, can be quite volatile. Here the question of providing possible subsidies to either low-income households or to the refinery industry, as alternatives to historical retail price caps, must be weighed against the potential budget constraints of the government.⁵⁸

Trade policy needs to be tailored to the specific conditions in the sector. While energy feedstock-importing countries may choose to pursue liberal trade policies and allow import competition, temporary tariff protection and export subsidies may help stimulate refinery sector investment.⁵⁹ However, in the latter case the problems of complacency, capture and possible retaliation have to be anticipated. In summary, each country's trade

⁵⁷ In the upstream oil and gas industry this often involves cost recovery, i.e. reimbursement schemes that would render strict cost monitoring and control mechanisms and independent, credible regulatory agencies necessary.

⁵⁸ For a discussion on the possible trade-off between subsidising and privatising (less-) profitable yet strategic industries, see Emmanuelle Auriol and Pierre M. Picard, "Infrastructure and Public Utilities Privatization in Developing Countries", *The World Bank Economic Review*, 23, no. 1 (2009), pp. 77–100. The model predicts that in developing countries with tight budget constraints, privatisation and price liberalisation may be optimal for low-profitability industries but suboptimal for more profitable industries. However, without a credible regulatory agency, regulation is better achieved by public ownership.

⁵⁹ Import protection is certainly a controversial policy, although there are examples where these could be successfully implemented if the disadvantages such as efficiency losses can be mitigated, for example through domestic competition and/or credible regulations. See for example Robinson, "Industrial Policy and Development: A Political Economy Perspective", pp. 3–4; and Paul R. Krugman, *Rethinking International Trade* (Cambridge: The MIT Press, 1990), pp. 113–114.

and investment policy, as well as financial sector regulation, must be sufficiently conducive to attract and finance investments in the sector.⁶⁰

1.4.3 Role of SOEs and NOCs

Another question concerns the potential use of oil, gas and/or mining SOEs to promote or catalyse investment in these strategic sectors. Many studies have debated the potential trade-off between private sector governance and commercial efficiency versus the potentially less efficient, policy-tainted SOE performance.⁶¹ One possible way to look at this question is to examine the trade-off between the government budget constraint and fiscal policy.⁶² Simplistically, for example, one could distinguish between the upstream oil, gas and coal industry, which can be assumed to be quite a profitable business despite project-specific exploration risk, and the downstream processing and distribution infrastructure, which is mildly profitable, or at times unprofitable during industry down cycles.

For the profitable upstream sector, where royalty and taxation payments and the regulatory frameworks are relatively well established in mature oil and gas sectors such as in Indonesia, Malaysia and Thailand, it can be welfare enhancing to allow both SOE and private firms to manage and operate projects. This is despite the typical institutional challenges, information asymmetry and corruption problems.⁶³ On the other hand, in the

⁶⁰ See IEA, *Energy Policy Review of Indonesia*, pp. 53–62.

⁶¹ For an extensive review see William Megginson and Jeffrey Netter, “From State to Market: A Survey of Empirical Studies on Privatisation”, *Journal of Economic Literature*, 39 (2001), pp. 321–389; Auriol and Picard in “Infrastructure and Public Utilities Privatization in Developing Countries” also predict that profitable industries in developing countries can either remain state-owned, or under well-functioning regulatory regimes, be privatised or outsourced to private operators who then pay appropriate taxes, royalty and or franchise fees to the government. This could potentially include upstream oil, gas and mining SOEs, which are generally quite profitable.

⁶² See Auriol and Picard, “Infrastructure and Public Utilities Privatization in Developing Countries”.

⁶³ For general discussions on the resource curse, institutional weakness and corruption, see Tim Hartford and Michael Klein, “Aid and the Resource Curse: How Can Aid Be Designed to Preserve Institutions?”, *Public Policy for the Private Sector*, note no. 291 (Washington, DC: The World Bank, 2005); Thomas I. Palley, “Lifting the Natural Resource Curse”,

mildly profitable downstream sector, where cost monitoring is equally difficult but regulatory and monitoring institutions are often less established than in the upstream sector, and considering the possibility of privatisations generating lower than expected proceeds,⁶⁴ SOEs could play a more major role in helping to facilitate investments.

This implies that in advanced economies with stronger and more transparent regulatory sectors and monitoring institutions, the question of SOE versus private sector investment is less relevant in the face of efficient taxation and more sophisticated regulatory regimes.⁶⁵ In the larger, more competitive and developed markets, the relative roles, strengths and capabilities of firms matter more than ownership. In addition, the potential profitability and attractiveness of the oil, gas and coal sectors for private sector investor entry and participation are determined more directly by the geological potential and the purchasing power of industrial and household consumers in these countries.

Foreign Service Journal, 80 (2004), pp. 54–61; Richard M. Auty, “The IMF Model and Resource-Abundant Transition Economies: Kazakhstan and Uzbekistan”, UNU World Institute for Development Economics Research (UNU-WIDER), Working Papers 169 (UNU-WIDER, 1999); as well as IEA, *Energy Policy Review of Indonesia*, pp. 26–27 (Executive Summary), pp. 29–52 (Government Policy, Structure and Process). On corruption and institutional weakness in Southeast Asia, see Ari Kuncoro, “Corruption, Decentralisation and Democracy in Indonesia”, *East Asian Economic Perspectives*, 17, no. 2 (2006), pp. 25–39; Iwan Azis, “Institutional Constraints and Multiple Equilibria in Decentralization”, *RURDS*, 20, no. 1 (2008), pp. 26–27; Bhasin and Venkataramany, “Mining Law and Policy: Replacing the Contract of Work System in Indonesia”; Transparency International, *2008 Report on Revenue Transparency of Oil and Gas Companies* (Berlin: Transparency International, 2008).

⁶⁴ Compared to upstream oil and gas companies, refinery privatisations are often more difficult to execute and generate comparatively lower proceeds. For more general empirical evidence on under-valued privatisations see Nancy Birdsall and John R. Nellis, “Winners and Losers: Assessing the Distributional Impact of Privatization”, Working Paper 6 (Centre for Global Development, 2002); John R. Nellis, “Privatisation in Developing Countries: A Summary Assessment”, *SAIS Review*, 27, no. 2 (2007), pp. 3–29.

⁶⁵ Competition and credible regulation reduces information asymmetry between (public or private) company management on one hand and regulatory agency fiscal offices on the other. Auriol and Picard in “Infrastructure and Public Utilities Privatization in Developing Countries” indicate that even duopoly competition helps to reduce information asymmetry (at least through the “benchmark competition”-type effect).

1.4.4 Normative Energy Policy Grid

In principle, a normative energy policy makes use of a combination of industrial, energy sector, trade, investment and fiscal instruments to maximise investment incentives in the relevant energy sub-sectors. In addition, an appropriate regulatory framework must be in place to induce and regulate state-owned and private investors and energy operators to make their investments and operate in a socially and environmentally sustainable manner. Table 3 summarises recommended normative policy grids for countries with a distinct set of energy sector challenges. It should be noted that this framework can also be extended to address the objectives of environmental sustainability and political security.

The principles outlined are as follows:

- **Net exporters of oil, gas and coal:** Target industrial sectors that maximise the consumption of indigenous commodities, while still engaging in fuel and energy efficiency programmes to allow maximum export volumes and revenues. Promote competition between private domestic and foreign and SOE producers, as well as open trade policies, to ensure sector-wide efficiency. Offer competitive fiscal and investment regimes.
- **Net importers of crude and fuel products:** Focus on less energy- and fuel-intensive manufacturing and agricultural sectors. Diversify power generation to other available feedstock, i.e. gas and coal, light petrochemicals using gas and condensate, and renewables. Diversify crude import sources and contracts, including spot versus long-term, with the appropriate use of hedging arrangements. In countries with sufficiently high demand for additional refinery capacity, build complex and efficient-scale refineries, as well as flexible oil and fuel product storage and transport infrastructure, to allow distribution flexibility and mitigate margin volatilities. Consider offering fiscal incentives to build and/or expand refinery and distribution infrastructure, coupled if necessary with temporary import protection. On the other hand, for countries with insufficient incremental domestic demand, the decision whether to build new refinery capacity should depend on the state of refinery technology and infrastructure. For Thailand and Singapore, the experience base and export market presence could make it feasible to expand capacity further.

Table 3 Summary of Policy Instruments and Normative Policy Grids

	Industrial policy	Energy sector regulation and policy	Trade and investment policy	Fiscal policy	Relevant countries
Net exporter of oil, gas and or coal	Focus on sectors that add value to domestic resources (e.g. chemicals, plastics); fuel efficiency and conservation programmes to increase commodity export potential	Promote private and SOE competition, direct power generation sector towards long-term self-sufficiency and fuel diversification, sector-wide efficiency programmes	Promote competition through open trade, invite foreign investment	Attract domestic and multinational investment through competitive royalty and tax regime	Indonesia (gas, coal) Malaysia (oil, gas) Vietnam, Brunei (oil, gas)

(Continued)

Table 3 (Continued)

	Industrial policy	Energy sector regulation and policy	Trade and investment policy	Fiscal policy	Relevant countries
Net importer of crude	Focus on agriculture and less oil-intensive manufacturing industries Fuel efficiency and conservation programmes Diversify to available feedstock, e.g. gas and condensate for basic petrochemicals ⁶⁶	Maximise exploration and growth potential for domestic production (if any); balance spot and long-term import supply contracts Diversify power generation to available domestic feedstock (i.e. gas and/or coal) Build large and complex refineries, efficient crude storage and transport infrastructure	Ensure open and competitive crude import markets	A. If there is domestic resource and production growth potential: competitive royalty and tax regime, offer fiscal incentives for SOEs (and possibly multinational investor-SOE JVs) B. If no or insufficient domestic resources: support crude importers Encourage SOE or private investment in crude storage and transport infrastructure	A. Indonesia, Thailand, Singapore, Malaysia (future) B. Philippines

(Continued)

⁶⁶ For countries with depleting crude but large gas and coal reserves, diversifying to gas and condensate as feedstocks for basic petrochemical production are feasible alternatives. However, the use of coal for chemical and synthetic oil production is technologically possible but economically not yet feasible. A good example is Sasol of South Africa.

Table 3 (Continued)

	Industrial policy	Energy sector regulation and policy	Trade and investment policy	Fiscal policy	Relevant countries
Net importer of fuel products	Fuel efficiency and conservation programmes Expand or build refinery capacity with scale and complexity (provided majority of output can be consumed domestically)	Balanced spot and long-term fuel import supply contracts (incl. crude if to be imported for new refining capacity) Support SOE and private investment in refinery sector, incl. product export contracts (to gain scale economies through larger refinery capacity), and/or crude import or partnership contracts; build efficient fuel product storage, transport and distribution infrastructure	A. Temporary fuel import limitations to support new refinery B. Open trade if require continued product imports	Potential subsidy for refinery and infrastructure investments by SOE and/or private investors Support SOE or private investment in product storage and transport infrastructure	Indonesia, Malaysia, Vietnam

(Continued)

Table 3 (Continued)

	Industrial policy	Energy sector regulation and policy	Trade and investment policy	Fiscal policy	Relevant countries
Net importer of gas	Diversify fuel mix for industrial consumers and power generation, but keep share of gas given environmental advantages	Sign long-term supply contracts for LNG and pipeline gas (pipeline more vulnerable and less flexible than LNG but cheaper for limited volumes) Optimise network and regulation of pipeline grid to improve domestic transport efficiency	Mix of bilateral LNG and pipeline gas contracts	Support SOE or private investment in gas import pipelines and LNG receiving terminal, as well as domestic pipeline network	
Net importer of coal		Cater fuel mix for power generation depending on availability of oil and/or gas: if domestic or import gas feasible, reduce future dependence on coal for environmental reasons		Support SOE or private investment in coal handling, processing, storage and transport infrastructure	

Source: Author's own analysis

- **Net importer of gas:** In Southeast Asia this group overlaps with oil-importing countries, i.e. the Philippines, Singapore and potentially in the future Thailand. Diversify between LNG and pipeline imports. Negotiate long-term LNG supply contracts with at least two regional and/or international suppliers. Import pipeline gas from Malaysia and Indonesia. Build an efficient domestic pipeline network to reduce local transmission and distribution costs with appropriate sector regulation based on market size and the capabilities of incumbents and potential entrants.
- **Net importer of coal:** Depending on domestic availability, direct the fuel mix for power generation towards environmentally cleaner and regionally available gas and, possibly in a smaller proportion, oil.

Based on this analysis we anticipate that countries with more established regulatory and legal infrastructure, and more conducive financial and lending markets, will develop a more sophisticated private energy sector. In such an environment, oil-importing countries will build large and complex refineries. On the other hand, lower-income countries with relatively weaker and less independent regulatory institutions may opt to promote stronger state-owned oil, gas and mining companies. Having stronger SOEs would also allow governments in low-income countries, to the extent they have the financial resources or are net feedstock exporters, to potentially offer fiscal assistance in a targeted manner.

1.5 ANALYSIS OF ENERGY POLICY IN SOUTHEAST ASIA

Numerous studies have reported on energy policy across Asia. The instruments of energy policy examined in this chapter include industry regulation, trade and fiscal policy. In addition to strategy and policy, the observed institutional dynamics and implementation track record is analysed as well.

1.5.1 Observed Policy Grid

Table 4 depicts the summarised energy policy grid for the region. The main focus of analysis will be on the observed policy grids in Indonesia,

Table 4 Comparative Overview of Observed Energy Policy Grids

	Indonesia	Malaysia	Thailand	Philippines	Singapore	Vietnam
Industrial policy and energy strategy						
Target industries	Agriculture, labor-intensive industries, petrochemicals, tires	Agriculture, mid-level manufacturing, palm oil	Refinery and petrochemical, plastics, automobile	Agriculture, labour-intensive manufacturing	High value added fuel exports, technology-intensive manufacturing	Agriculture, labor-intensive industries
Fuel mix for power generation	Approx. 59% coal, 26% gas, rest hydro, geothermal and fuel oil (2010E)	40% gas, 30% hydro, 29% coal (government target 2020)	68% gas, 12% coal, 2% liquids, 15% hydro (2011)	32% gas, 26% coal, 18% geothermal, 16% hydro, 8% liquids (2008)	89% gas, 8% liquids, 3% waste incineration (2020E)	28% hydro, 27% gas, 30% coal, 8% imported electricity, 3% renewable, 3% nuclear (2020 plan)

(Continued)

Table 4 (Continued)

	Indonesia	Malaysia	Thailand	Philippines	Singapore	Vietnam
Stated alternative energy strategy	Reduce oil share of TPES from 40% down to 20%, replace with renewable (biofuels, hydro/ solar/wind, geothermal) 5% of TPES from biofuels by 2025 (direct or max. 10% blended into gasoline and diesel), grow hydropower			Alternative Fuels Program incl. biodiesel, bio ethanol, gas- based vehicles and autogas	Waste-to-energy, energy technology industry incl. R&D (solar, biofuels, fuel cells), trading (LNG, biofuels, carbon credits) Comprehensive energy efficiency program	Growth in hydropower, renewables (wind, solar, geothermal, biomass, etc.) and higher share of nuclear

(Continued)

Table 4 (Continued)

	Indonesia	Malaysia	Thailand	Philippines	Singapore	Vietnam
Energy sector structure and regulation						
Upstream oil and gas	Competitive, NOC (Pertamina) and private domestic, foreign, JVs	NOC (Petronas) dominates, directly or via JVs with multinationals	NOC (PTT) dominates, directly or via JVs with multinationals	PNOC JV with Shell, Chevron	n/a	NOC (PetroVietnam) plus JVs
Coal	Competitive, private and SOE (Bukit Asam, Aneka Tambang)	Industrial imports	Banpu and industrial importers	Competitive, private and SOE	n/a	Vinacomin plus JVs
Refinery	Integrated SOE plus 1 affiliate	Integrated SOE plus SOE JVs and multinational competition	4 SOE JVs plus multinational competition	SOE JV plus 1 multinational	Government-multinational JVs	Integrated NOC (PetroVietnam)
Gas T&D	Duopoly SOE & independents, bilateral off-take contracts	Monopoly SOE, bilateral off-take	Third-party access, dominant SOE, bilateral off take	SOE-multinational JV, bilateral off take	Unbundled, competition	PetroVietnam.

(Continued)

Table 4 (Continued)

	Indonesia	Malaysia	Thailand	Philippines	Singapore	Vietnam
Electricity	Single buyer integrated SOE, private generation with long-term contracts	Single buyer integrated SOE, competitive generation with long-term contracts	Single buyer integrated SOE, competitive generation with long-term contracts	Unbundled, competitive generation sector	Unbundled, competition on all levels	Single buyer integrated SOE
Fuel distribution	Competitive for industrial and unsubsidised household gasoline, subsidised retail fuels	Competitive, subsidised prices	Competitive, market pricing (at times, implicit pricing guidance)	Competitive, market pricing (at times, implicit pricing guidance)	Competitive	Competitive, subsidised prices
Petrochemical	SOE & competition	SOE and JVs	SOE JVs & independent	Independent	Independent JVs	SOE

(Continued)

Table 4 (Continued)

	Indonesia	Malaysia	Thailand	Philippines	Singapore	Vietnam
Institutional framework						
Regulatory body	Independent upstream (BP Migas) and downstream (BPH) regulators	Ministry of Energy, Water and Communications as regulator of oil, gas, power sectors	Independent Energy Regulatory Commission (ERC) for electricity and gas	Ministries (oil & gas, mining) Independent Energy Regulatory Commission (ERC) for electricity	Independent Energy Market Authority (EMA)	Non-independent (ministries)
Policy	Ministry of Energy and Mineral Resources (MEMR)	Policies set by planning units reporting to Prime Minister	Policies by Energy Policy and Planning Office (EPPO) under Ministry of Energy	Department of Energy (DOE) for oil and gas Mines and Geosciences Bureau under Department of Environment and Natural Resources (DENR)	Ministry of Industry	Ministry of Industry

(Continued)

Table 4 (Continued)

	Indonesia	Malaysia	Thailand	Philippines	Singapore	Vietnam
State-owned enterprises (SOE)	NOC Pertamina, state-owned gas company PG N, state-owned mining Bukit Asam and Aneka Tambang, private competition in all sectors Electricity SOE (PLN), private competition in generation	Integrated NOC (Petronas) exclusivity for all upstream oil and gas projects (own and JV) Electricity SOE (Tenaga), private competition in generation	Listed NOC PTT Plc, with upstream and downstream affiliates and JVs (many publicly listed) Electricity SOE EGAT, private competition in generation	Oil, gas and coal holding SOE (PNOC), listed business-level JVs with private firms, private competition Electricity SOE Napocor, unbundled privatisation plus competition in all segments	Publicly listed electricity T&D, privatised gencos, unbundled privatisation plus competition in all segments	Integrated NOC (PetroVietnam) exclusivity for all upstream oil and gas, Vinacomin for mining projects (own and JV)

(Continued)

Table 4 (Continued)

	Indonesia	Malaysia	Thailand	Philippines	Singapore	Vietnam
Fiscal regime	PSC with revenue royalty, profit tax and cost recovery Aggregate roughly 30% post-tax contractor take Local government ownership, levies and duties	PSC with revenue royalty, profit tax and cost recovery 15–25% local ownership rights through SOE	8.8–12.5% revenue royalty, 50% profit tax, no cost recovery	PSC with revenue royalty, profit tax and cost recovery Aggregate roughly 40% post-tax contractor take	Only downstream sectors available: corporate taxes	PSC with revenue royalty, profit tax and cost recovery 20–30% SOE ownership (frontier), 40–50% SOE (standard)
Trade policy	Open trade, some Domestic Market Obligation (DMO)	Open trade, some DMO			Open markets	

(Continued)

Table 4 (Continued)

	Indonesia	Malaysia	Thailand	Philippines	Singapore	Vietnam
Implementation outcome						
Investment activity and industry development	Insufficient investment SOEs and private	Petronas plus multinationals	PTT dominant	Insufficient PNOC and multinationals	Multinationals and JVs of government-linked firms Active promoter role of government	Active exploration and development PetroVietnam, Vinacomin and multinationals
Institutional challenges	Regulatory structure and procedures, decentralization and local autonomy	Continued dominance of NOC	Dominance of NOC along the gas chain	Limited domestic economy of scale	Competition from regional NOCs and SOEs	Newly developing SOEs and sector infrastructures

Thailand and Malaysia. Other selected Southeast Asian countries are introduced for comparison purposes, given the somewhat comparable development and growth trajectory of their economies and energy sectors, and their unique positions as competing importers of oil, gas and coal in Asia.

1.5.2 Normative versus Observed Energy Policy Grids

1.5.2.1 *Industrial Policy and Energy Strategy*

As summarised in Table 4, the industrial mix and general energy strategy, i.e. target fuel mix for power generation and primary energy mix of Southeast Asian countries, are in line with the logic outlined before. All governments target fuel diversification programmes based on each country's energy feedstock availability, and encourage the development of renewable energy sources. All countries are reducing the share of liquid fuels, i.e. fuel oil and diesel feedstock, for power generation. Indonesia is aiming for a diversified mix of TPES between gas (30%), coal (33%), oil (20%) and renewable energy (17%) by 2025. Malaysia is focusing on gas, hydro and coal for power generation, Thailand on gas, coal and hydro. The Philippines on the other hand is successfully establishing its share of hydro and geothermal power, and is promoting biodiesel and bioethanol. Thailand and Singapore, being the region's main future importers of gas, are actively planning LNG import terminals and pursuing new contracts to diversify their gas base. Last but not least, Singapore is leveraging on its location and legal-commercial infrastructure and pursuing a technology-intensive strategy to become a major player in energy trading and in the research and development (R&D) of future energy technologies.

1.5.2.2 *Industry Structure and Sector Regulation*

The upstream oil and gas sectors generally have an established regulatory framework. The role of SOEs, i.e. the respective NOCs in Malaysia, Thailand and Vietnam, is by design still dominant, while the market is quite competitive for the NOCs in Indonesia and the Philippines. The downstream oil sector is generally competitive,

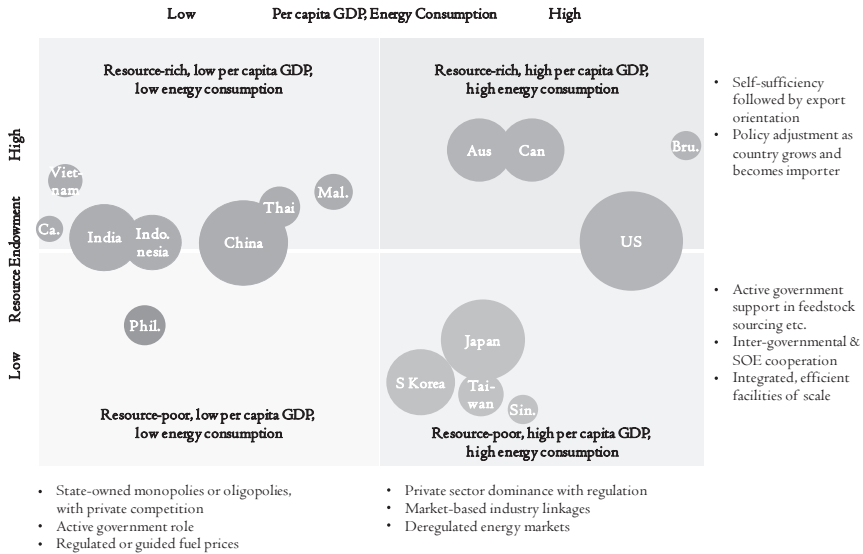


Figure 17 Country Comparison and Normative Energy Sector Policies

although the scale and ability to produce higher-value-added products is still limited in certain countries. The downstream gas sector, however, is still rather dominated by NOCs and SOEs in the three countries. Figure 17 summarises selected structural features of the oil and gas industry across Asia, while categorising each country within the appropriate resource endowment and per capita income quartile. Per capita income is assumed to serve as a very rough proxy for the government budget constraints, the degree of sophistication of domestic regulatory and monitoring institutions,⁶⁷ as well as the technology and funding capability of energy sector firms.

As anticipated, higher-income countries, such as Japan, South Korea and the US, with stronger regulatory and monitoring institutions see a

⁶⁷ This is a very crude way of characterising the region's regulatory institutions, given the institutional and historical differences. Nevertheless, despite these monitoring agencies being either independent (in Indonesia), under the NOC (Malaysia) or the Ministry (Thailand), the upstream oil and gas sectors are generally relatively well regulated.

larger participation of private sector companies as well as deregulated, competitive energy markets, while lower-income countries often require a comparatively larger role of sector SOEs, i.e. NOCs and the government. Additionally, countries constrained in natural resources, such as Japan, South Korea and Taiwan, which have the capability to build large-scale processing facilities, are faring much better than lower-income import-dependent economies, such as the Philippines, with limited ability to fund large-scale projects. Finally, low-income countries, especially those with strong public finances, such as China, or those that enjoy revenues from their commodity exports, such as Indonesia, Malaysia and Brunei, subsidise their fuel consumers. Thailand and the Philippines, on the other hand, allow market-based fuel pricing combined with “informal price management” during periods of very high oil prices.

1.5.2.3 Trade, Investment and Fiscal Policy

In general, policy is geared towards open trade and foreign competition in the downstream oil sector. The upstream oil, gas and coal sectors are open to foreign investors, although in Malaysia and Thailand the NOCs play a much more dominant role and participate in most projects in their country through the use of NOC-multinational JVs. In general this sector has been funded commercially, with minimal subsidies except for the aforementioned fuel distribution in selected countries. Investment laws are in place, dividend repatriation is generally free. The institutional challenges that somewhat mitigate foreign investor appetite in Indonesia and the Philippines are covered in the next section.

1.5.3 Implementation and Institutional Challenges

The main problem facing the region’s governments is not so much the lack of coherent energy strategies and policies. The question seems to be whether or not the governments in a few countries could incentivise their current and future industry participants to take the risk and invest in frontier and new basin exploration and development projects, as well as in the required infrastructure and facilities.

In Indonesia this means that the oil and gas sector regulatory and monitoring procedures, and the tax reimbursements, must be processed more efficiently. Moreover, moves by special interest groups have delayed a number of upstream and downstream projects. Due to the lack of transparency and coherence in investment regimes, tendering and approval processes in the oil, gas, coal and general mining industries require better coordination between central and local governments and various parts of the government, in terms of cost recovery calculations, land clearing, local regulations, levies and duties.⁶⁸

At the same time, better coordination amongst the region's NOCs and governments, beyond the usual rhetoric, could be advantageous. In Malaysia and Thailand, notwithstanding Petronas' and PTT's successes both domestically and internationally, their continued dominance in the domestic market make it more difficult for domestic players to develop their full technical and commercial potential. While in Malaysia this is observed both in the upstream and downstream oil and gas sectors, in Thailand this is more pronounced along the upstream and midstream gas chains. Singapore has build a highly efficient infrastructure that caters to its open market policy, but faces the growing threat of regional competition.

Moreover, in the resource industries in the Philippines, Vietnam and Cambodia the regulatory regimes, sector infrastructure and SOEs are still being developed. On the one hand, in the Philippines, this is driven by the country's limited resource prospectivity and import dependence. On the other hand, sector liberalization and exploration activity in Vietnam, and particularly in Cambodia, started accelerating more recently. For example, given that Malaysia imports increasing volumes of fuel products annually, PETRONAS and Pertamina could theoretically team up in building a new, more complex refinery capacity. Pertamina could enjoy enhanced credit by signing a product supply off-take agreement with

⁶⁸ See IEA, *Energy Policy Review of Indonesia*, pp. 26–27 (Executive Summary), pp. 29–52 (Government Policy, Structure and Process); as well as Ana Duek and Ridwan Rusli, "Democratised Indonesia and the 'Big Bang' Decentralization: The Impact on the Natural Resource Industry", unpublished research article, (Asia Competitiveness Institute, 2009).

PETRONAS for part of its output, while the partners could jointly negotiate long-term crude purchase agreements with appropriate suppliers. The same logic applies to the possible joint construction of an LNG terminal in Java, which could purchase domestic, Malaysian and/or international LNG to diversify Java's gas supply. This reduces its future dependence on the Sumatra-Java and possible future Kalimantan-Java pipelines.

1.5.4 More on Institutional Weaknesses

Several international surveys might help in better identifying the institutional factors that hamper the implementation of energy policies. First, a comparison of the quality of government institutions across countries is regularly undertaken by the World Bank through its Worldwide Governance Indicators (WGI) studies.⁶⁹ Figure 18 summarises the WGI for government effectiveness, regulatory quality, rule of law and corruption control. Although these are not sector-specific studies the results are indicative and consistent with the qualitative observations in the Southeast Asian oil, gas and mining sectors.

Figure 18 shows that within Southeast Asia, the legal and regulatory institutions are comparatively weak across the various criteria examined in Indonesia, Vietnam, Cambodia and particularly Myanmar. Rule of law is weak in the Philippines, and corruption control is still a problem in Thailand. As expected, Singapore scores very highly, in line with its worldwide reputation as an efficient and corruption-free government.

Second, in terms of ease of doing business, compared with over 180 countries worldwide Southeast Asian countries rank number 12 (Thailand), 23 (Malaysia), 93 (Vietnam), 122 (Indonesia), 144 (Philippines), 145 (Cambodia), while Singapore ranks number one.⁷⁰ This World Bank survey compares countries using multiple criteria such as ease of company

⁶⁹ Daniel Kaufmann, Aart Kraay and Massimo Mastruzzi, "Governance Matters VIII: Aggregate and Individual Governance Indicators 1996–2008", World Bank Policy Research Working Paper 4978 (The World Bank, 2009).

⁷⁰ See World Bank, *Doing Business 2010: Measuring Business Regulations* (Washington, DC: The World Bank Group, 2009).

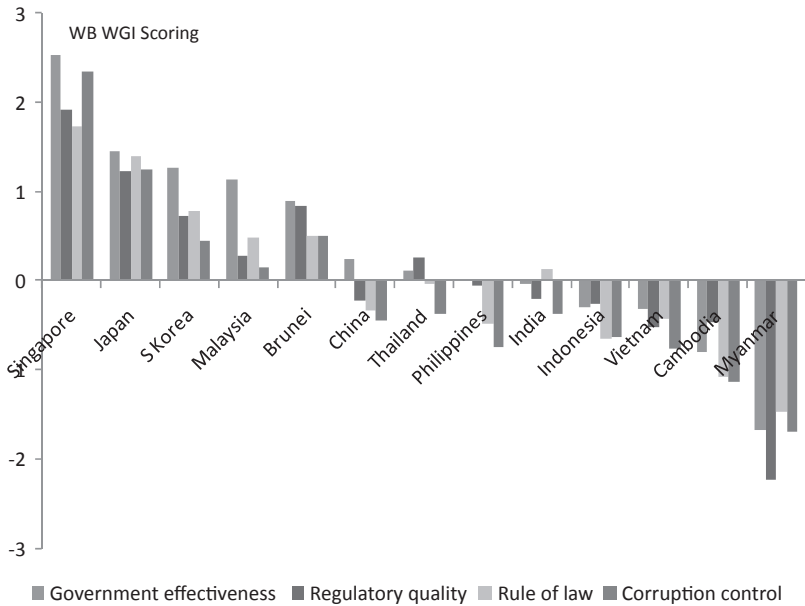


Figure 18 World Bank Worldwide Governance Indicators (WGI) 2008

Source: Kaufmann *et al.*, "Governance Matters VIII: Aggregate and Individual Governance Indicators 1996–2008".

start-ups and licensing, employing workers, property protection, investor protection, trade and capital mobility, fiscal bureaucracy and contract enforcement. The results are generally consistent with the WGI outlined before. However, the report does acknowledge selected reform successes in Indonesia (ease of business start-ups and registering property), the Philippines (ease of getting credit, closing businesses), as well as in Malaysia (improved contract enforcement) and Thailand (business start-ups).

1.5.5 Commercial Strategy and Government Role

One approach that countries in Southeast Asia could adopt is to support more proactively its SOEs and NOCs, as well as their multinational JV partners in commercial strategy development and implementation. The case of the government-linked Economic Development Board (EDB) in Singapore is one example. Starting in the turbulent 1960s, the EDB has

helped to attract numerous multinationals to invest in Singapore over the past five decades. In the energy-related field the EDB has helped nurture Singapore's refinery sector and made it among the world's most important refining centres.⁷¹

Each Southeast Asian country needs to find its own way of helping to attract foreign direct investment and nurture strategic industries. In the context of Southeast Asian countries' energy sector challenges, such a competent and commercially savvy government agency could for example help the respective NOCs and their partners, either evaluate and structure or by evaluating and structuring works I think? optimal government support alternatives including (i) potential seed investment money and fiscal support, (ii) technical, managerial and financial structuring assistance and (iii) advice on transaction structuring and negotiations of long-term contracts with foreign crude suppliers or LNG buyers, engineering, procurement and construction (EPC) contracts, etc. It should be noted that such advice is more relevant for the less commercially experienced SOEs and NOCs. For the more sophisticated ones like PETRONAS and PTT, such government support could also help create market buying power (*vis-à-vis* counter-parties, i.e. suppliers or buyers), through increased intra-regional coordination and cooperation.

In Indonesia, for example, the request by several multinational gas and LNG project operators for improved fiscal terms and or contract extensions could be addressed by *quid pro quo* requests for accelerated expansion programmes, stronger involvement of Pertamina and long-term crude supply contracts from the multinational partners' global crude supply portfolio. However, this means that the government decision-makers must be able to work in unison, in the interests of the country, and not be influenced by excessive "rent seeking" from special interest groups.⁷²

⁷¹ Singapore Economic Development Board (EDB); company website: <http://www.sedb.com/edb/sg/>.

⁷² Again consistent with Robinson's argument that a country's politics and political institutions determine whether or not (industrial) policy has a chance of succeeding. See Robinson, "Industrial Policy and Development: A Political Economy Perspective".

1.6 SUMMARY AND CONCLUSION

The chapter describes a logical, normative approach to energy policy making. Starting with a set of country-specific geographic, demographic, socio-political and economic-industrial determinants, a normative policy grid is derived which helps prioritise the strategies and programmes required to address a country's energy policy opportunities and challenges. The normative approach was examined using the examples of the upstream oil, gas and coal and downstream oil sectors in Indonesia, Thailand and Malaysia, referring to other Southeast Asian countries as selected comparables.

Unsurprisingly, the challenge in Southeast Asian energy policy making is not so much the formulation but the implementation of energy policy. The latter requires synchronisation between industry regulation, trade, investment and fiscal policy, and thus necessitates close coordination across various government ministries and regulatory agencies. Only with concerted efforts geared towards realising a country's economic, security and sustainability objectives can a national energy policy succeed. Given the limitations in financial and institutional resources in selected countries, carefully structured and mutually beneficial arrangements between the government, relevant SOEs and multinational partners are necessary. This requires commercial thinking from the side of the relevant government agencies, which are geared towards the country's overall objectives of industrialisation and development.

CHAPTER 2

EAST ASIA'S ENERGY CHALLENGES: GENERAL ENERGY COOPERATION AND THE QUESTION OF COMPETITION

Christopher Len

2.1 INTRODUCTION

The first East Asia Summit (EAS) was held in Kuala Lumpur, Malaysia, in December 2005. Geographically, this group consists of the 10 Association of Southeast Asian (ASEAN) member countries of Southeast Asia; the three Northeast Asian countries of ASEAN Plus 3, China, Japan and South Korea; as well as Australia, New Zealand and India. It has been described as “a historical event whose future is likely to be as significant as the first Association of Southeast Asian Nations (summit) held in Bali in February 1976”.¹

The aim of the EAS group is to enable dialogue on political, economic and strategic issues for the region. Collectively, this group is meant to

¹Barry Desker, “Why the East Asian Summit Matters”, *Asia Times*, 13 December 2005, http://www.atimes.com/atimes/Southeast_Asia/GL13Ae02.html [Accessed 13 December 2005].

represent a new outward-looking and inclusive regionalism trend within Asia through the membership of all the key Asian economies, with ASEAN at the core. It also covers the important energy importers and exporters within the region and has issued two summit declarations on energy during the second and third East Asia Summits held in the Philippines in January 2007 and Singapore in November 2007 respectively.

This chapter will start by outlining the profiles of the key energy and economic countries within East Asia. It will then demonstrate that analysis of energy developments in East Asia would benefit from Jaewoo Choo's conceptual distinction between general energy cooperation and energy security cooperation. Such a differentiation would help clarify the nature of cooperation over energy issues that are currently underway among East Asian states. The conclusion of this study is that East Asian countries have consistently focused on general energy cooperation, rather than energy security cooperation. Furthermore, it is noted that this emphasis has been the consistent theme for East Asian cooperation over energy issues since 2001, and most recently reflected in the EAS declarations in Cebu and Singapore in 2007.

2.2 ENERGY PROFILES OF KEY COUNTRIES IN EAST ASIA

This section explains the energy profiles of key East Asian countries. The first part focuses on the key energy-importing non-ASEAN countries of the EAS group, namely, China, India, Japan and South Korea. The second part provides a brief overview of the energy profiles of ASEAN member countries, followed by more detailed examinations of the energy profiles of key ASEAN member countries, which have been identified based on the size of their respective populations and economies.

2.2.1 Key Non-ASEAN Member Countries: China, India, Japan and South Korea

Figure 1 shows the growing energy consumption patterns of the non-ASEAN major economies within the East Asia group which are net energy importers, namely China, India, Japan and South Korea. Energy

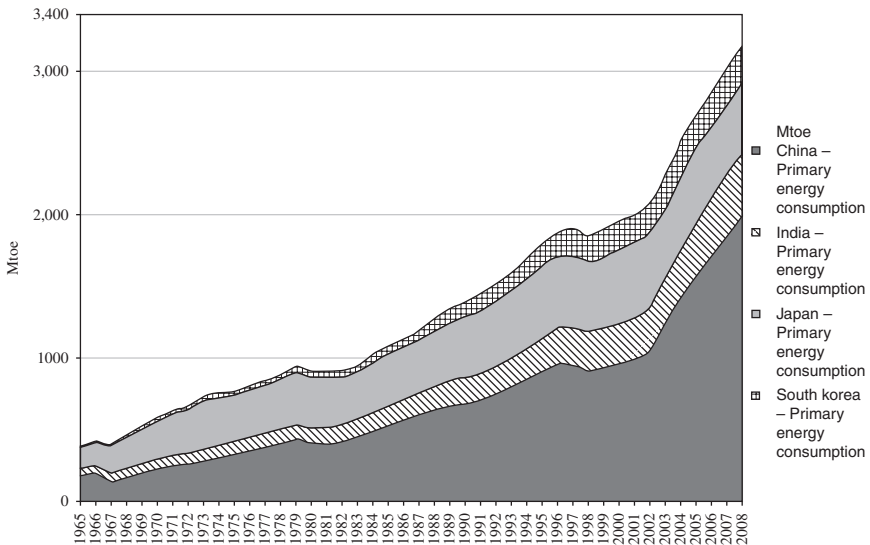


Figure 1 Primary Energy Consumption (Mtoe) of China, India, Japan and South Korea
 Source: BP Statistical Review of World Energy, 2012.

consumption in these countries has grown rapidly as a result of their economic development and industrialisation over the decades.

China is shown to register the highest primary energy consumption growth rate in Figure 1. It is today one of the world's most dynamic economies and the world's most populous country with nearly one fifth of the world's total population. As of 2009, it is estimated that China ranks third in GDP (purchasing power parity), behind the European Union and the United States.² It registered an average growth of 10% between 2000 and 2008 and its economy grew by 8.7% in 2009 despite the global financial crisis caused by the credit crunch.³

Coal makes up 70% of China's total primary energy consumption and the country is the world's largest producer and consumer of coal. It started to import coal in 2002 and some projections indicate that it could become

²Central Intelligence Agency, *CIA — World Factbook*, 2009, <https://www.cia.gov/library/publications/the-world-factbook/rankorder/2001rank.html> [Accessed 20 January 2010].

³“China Grows by 8.7 Percent in 2009”, CNN, 20 January 2010, <http://www.cnn.com/2010/BUSINESS/01/20/china.GDP.annual/index.html> [Accessed 21 January 2010].

a net coal importer in the years ahead. However, it should be specified that China's coal imports are not driven by the lack of domestic coal reserves, but are largely due to the price spread between local and international coal prices, including international freight rates.⁴

Oil is the second-largest source, accounting for 20% of China's total energy consumption. China grew from being a net importer of oil in 1996 to become the third-largest importer by 2006. It is the world's second-largest consumer of oil behind the United States. The US Energy Information Administration (EIA) forecasts that China's oil demand will continue to grow, with oil demand reaching 8.3 million barrels per day (bbl/d) in 2010, up from 7.8 million bbl/d in 2008. This represents 31% of the projected world oil growth in non-OECD countries from 2008 to 2010. The Middle East remains China's largest source of oil imports. The EIA cited FACTS Global Energy statistics indicating that in 2008, 50% of China's imports came from the Middle East, 30% from Africa. Saudi Arabia and Angola are the two largest sources of oil imports, accounting for over one third of China's total crude oil imports. In order to diversify its import sources, China has actively worked to connect international oil pipelines from neighbouring countries such as Kazakhstan, the Russian Far East and Myanmar to its domestic network.⁵

China is also looking to expand natural gas usage through pipelines and liquefied natural gas (LNG) imports. The Chinese anticipate that the share of natural gas as part of total energy consumption will increase to 10% by 2020. China recently opened a gas pipeline, which connects Turkmenistan through Uzbekistan and Kazakhstan to China's Xinjiang.⁶ Another gas

⁴Kate Mackenzie, "Could China Fall out of Love with Coal?", *Financial Times*, 14 January 2010, <http://blogs.ft.com/energy-source/2010/01/14/could-china-fall-out-of-love-with-coal/> [Accessed 15 January 2010]; Andrew Peaple, "Will China Light a Fire under Coal Price?", *Wall Street Journal*, 21 August 2009, <http://online.wsj.com/article/SB125078103759846543.html> [Accessed 15 January 2010]; "China's Coal Imports Predicted to Decline in 2010", *Xinhua*, 3 December 2009, <http://www.iStockanalyst.com/article/viewiStockNews/articleid/3687142> [Accessed 15 January 2010].

⁵Energy Information Administration (US), *China*, July 2009 version, <http://www.eia.doe.gov/emeu/cabs/China/pdf.pdf> [Accessed 15 October 2009]; APERC, *APEC Energy Overview 2008* (Tokyo: Asia Pacific Energy Research Centre, 2008), pp. 47–49.

⁶"China Opens Turkmenistan Gas Pipeline", BBC News, 14 December 2009, <http://news.bbc.co.uk/1/hi/8411204.stm> [Accessed 15 December 2009].

pipeline project to transport gas in Western Siberia into Western China has stalled due to financing and gas pricing issues between Russia's Gazprom and China's China National Petroleum Corporation (CNPC). The country also has a deal to pipe gas from Myanmar. China's imports of LNG started in 2006 and Chinese national oil companies have looked to import LNG from Australia, Indonesia, Malaysia and Qatar through long-term supply contracts and spot cargoes. This puts China in growing competition with the neighbouring Asian economies of Japan, South Korea and Taiwan, which are all heavily reliant on LNG.⁷

India is the second-most populous country in the world, behind China. It is experiencing high economic growth rates like China, posting an average growth rate of 6.6% between the 1988/1999 and 2008/2009 financial years.⁸ India is estimated to rank fifth, just behind Japan in global GDP (purchasing power parity) in 2009.⁹ Despite a recent slowdown in the economy, India's energy use continues to increase. The country is dependent on coal for half of its total energy consumption, followed by oil (31%), natural gas (8%) and hydroelectric power (6%).¹⁰

Of its total energy requirements 30% are met through imports, with the country being increasingly dependent on imported oil. In 2007, India was the world's fourth-largest global consumer of oil at 3 million bbl/d in 2008, after the US, China and Japan. India imported 1.8 million bbl/d of oil in 2007, which constituted 68% of its oil consumption. Around 75% of imported oil originated from the Middle East. India was ranked sixth among global net oil importers in 2008. The EIA estimated that India will become the fourth-largest global net importer of oil by 2025, behind the US, China and Japan.¹¹

⁷China, op. cit.; *APEC Energy Overview 2008*, op. cit., pp. 47–49.

⁸Arvind Panagariya, "Building a Modern India", in *Business Standard — India 2010*, edited by T. N. Ninan (New Delhi: Business Standard Books, 2009), p. 1.

⁹CIA *World Factbook*, op. cit., 2009.

¹⁰Energy Information Administration (US), *India*, March 2009 version, <http://www.eia.doe.gov/emeu/cabs/India/Full.html> [Accessed 15 October 2009].

¹¹*India*, op. cit.; Energy Information Administration (US), *World Regions — Imports: Top World Oil Net Importers, 2008*, <http://tonto.eia.doe.gov/country/index.cfm> [Accessed 5 December 2009].

Import demand for LNG is also climbing. The power and fertiliser sectors account for nearly 75% of natural gas consumption, and demand for natural gas is expected to grow considerably. India became a net importer of natural gas, imported as LNG, in 2004, and has since relied on both long-term contracts and spot cargoes to secure supplies. In 2006, India was the seventh-largest global importer of LNG, with Qatar being the largest supplier, accounting for nearly 86% of India's LNG imports in 2006. To help meet this growing demand, India has also been considering a number of import schemes via pipelines, namely the Iran-Pakistan-India Pipeline, Turkmenistan-Afghanistan-Pakistan-India Pipeline and pipelines from Myanmar, though all of the projects remain at the proposal stage. The country continues to suffer from electricity shortages. According to the World Bank, roughly 40% of the residences in India are without electricity, while blackouts are common in the main cities.¹²

Both the Chinese and Indian leaderships are faced with the additional challenge of ensuring social stability and this has added to their sense of political urgency to secure adequate supplies from overseas. Both are developing economies faced with rising social expectations from their populations. The two governments are thus under extreme pressure to ensure employment for fear of social unrest erupting, which may spread and disrupt the respective government's overall development efforts. It is therefore especially important to avoid energy supply disruption as this would restrict their economic activities and affect job creation. The two governments have thus become more active in their political and diplomatic roles to secure energy supplies from abroad, with China being particularly expeditious. Furthermore, energy demand in these two countries is also expected to grow significantly since the Chinese and Indian populations have growing aspirations for a higher quality of life. Demand for electrical household items such as television sets, fridges and cars, all of which consume energy and lead to greater energy demand, are expected to grow significantly in the coming years.

Japan is estimated to rank fourth globally in GDP (purchasing power parity), just behind China, in 2009.¹³ Japan imports almost all of its crude oil (99%), coal (99%) and natural gas (96%). In 2006, it was the

¹² *India*, op. cit.

¹³ *CIA World Factbook*, op. cit., 2009.

third-largest consumer of crude oil, after the US and China, of which 80% was imported from the Middle East. In 2008, it remained the second-largest importer of oil, after the US. It is the world's largest importer of coking coal for steel production, and steam coal for power generation and pulp and paper and cement production. Natural gas is almost entirely met through LNG imports at 76 million tonnes of oil equivalent (Mtoe). This makes it the world's largest importer of LNG, most of which is from Indonesia (23% in 2005), Australia (20%), Malaysia (19%), Qatar (12%) and Brunei (10%). Japan has one of the world's lowest energy intensities among the developed world economies. This is due to the high levels of investment into research and development of energy-efficient technologies at the start of the 1970s. While the East China Sea is believed to contain abundant oil and gas deposits, the exploration and development of such fields have been hampered by territorial disputes with China.¹⁴

South Korea is estimated to rank 14th in global GDP (purchasing power parity) in 2009.¹⁵ Although oil consumption has remained relatively flat since 2000, South Korea remained the ninth-largest global consumer of oil, and the fifth-largest net importer of oil in 2008, with oil shipped in by tankers, 80% of which was from the Middle East. About a quarter of its oil imports are re-exported as refined petroleum products, mostly to other East Asian countries. Since the introduction of LNG in 1986, the use of natural gas has grown rapidly. In 2006, the country was ranked the world's second-largest LNG importer at 28 Mtoe. Korea is also the world's second-largest importer of both steam and coking coal, after Japan, with imports from China, Australia, Indonesia, Canada, Russia and the US.¹⁶

Overall, these four major economies share a significant common feature in that they are all highly dependent on imported energy supplies, at

¹⁴Energy Information Administration (US), *Japan*, September 2008 version, <http://www.eia.doe.gov/emeu/cabs/Japan/pdf.pdf> [Accessed 15 October 2009]; *APEC Energy Overview 2008*, op. cit., pp. 81–83; *World Regions — Imports: Top World Oil Net Importers*, op. cit.

¹⁵*CIA World Factbook*, op. cit., 2009.

¹⁶Energy Information Administration (US), *South Korea*, June 2007 version, http://www.eia.doe.gov/emeu/cabs/South_Korea/Full.html [Accessed 15 October 2009]; *APEC Energy Overview 2008*, op. cit., pp. 89–90; *World Regions — Imports: Top World Oil Net Importers*, op. cit.

affordable prices, to keep their economies functioning. As a result of the high level of import dependence, energy has thus become an important national security issue for their governments.

2.2.2 Key ASEAN Member Countries

ASEAN member countries present a rather varied profile due to their diverse political, economic and social development models. The total population of the ASEAN region, which represents about 8.7% of world population, accounts for 3.3% of the world's total primary energy consumption.¹⁷ It has been noted that some of the economies remain pre-industrial, and many households still rely heavily on biomass for cooking and heating. However, commercial consumption is expected to grow over the next two decades because of the general regional trend towards modernisation, industrialisation and urbanisation.¹⁸ The natural energy resource endowment of the member countries also differs vastly, with Singapore having virtually none, while Brunei and Indonesia are rich in such resources. Table 1 provides an overview of the region's energy consumption patterns vis-à-vis their social and economic profiles.

This study will not detail the energy profiles of all 10 ASEAN member countries. Instead, it will highlight the profiles of key ASEAN member countries Thailand, Indonesia, Vietnam, the Philippines and Malaysia. These countries have been selected based on the size of their populations and economies.

Thailand is highly dependent on energy imports though it used to be even more so. Net energy imports went down from 96% in 1980 to 58% in 2006. Its total primary energy supply was 83,863 kilotonnes of oil equivalent (ktoe) in 2006, the top three energy types being oil (57%), gas (26%) and coal (14%). Oil accounted for 62% (34,451 ktoe) of total energy consumed in 2006.¹⁹ The country has implemented a series of

¹⁷Elspeth Thomson, "Southeast Asia's Energy and Security Challenges", in *Energy and Security Cooperation in Asia: Challenges and Prospects*, edited by Christopher Len and Alvin Chew (Nacka-Stockholm: Institute for Security and Development Policy, 2009), p. 22.

¹⁸Thomson, op. cit. pp. 22–23.

¹⁹APEC *Energy Overview 2008*, op. cit., pp. 167–168.

Table 1 ASEAN Energy and Economy Indicators in Perspective

	Total Primary Energy Consumption 2006 (Quadrillion BTU)	Population 2007 estimates (Million)	Population Growth 1997–2007 (%)	Per Capita Energy Consumption 2005 (Million BTU)	Per Capita Energy Consumption Growth 1997–2007 (%)	Agricultural Sector, % Total Value Added 2006	Industrial Sector, % Total Value Added 2006	Service Sector, % Total Value Added 2006	Per Capita GNI (US\$) 2003
Brunei	0.177	0.37	2.20	482.1	11.48	1.1	67.9	31.0	20,823
Cambodia	0.010	14.00	1.79	0.7	0.43	29.6	29.2	41.2	245
Indonesia	4.149	234.69	1.41	17.9	3.76	13.7	42.4	44.0	599
Laos	0.023	6.52	2.51	3.6	2.77	46.8	27.6	25.7	
Malaysia	2.557	24.84	1.95	104.8	3.49	8.8	50.0	41.2	3,312
Myanmar	0.236	47.37	5.03	5.0	8.44	52.6	13.4	34.0	
Philippines	1.271	91.08	2.00	14.2	3.09	14.2	32.1	53.7	920
Singapore	2.142	4.55	1.80	476.8	5.62	0.1	33.0	66.9	20,066
Thailand	3.741	65.07	0.76	57.9	6.33	10.7	44.6	44.7	1,838
Vietnam	1.404	85.26	1.14	16.6	10.99	21.7	40.2	38.0	392

Source: EIA website <http://www.eia.doe.gov/emeu/international/populationandgdgdp.html> and www.eia.doe.gov/emeu/international/energyconsumption.html (February 27, 2009); Economic and Social Commission for Asia and the Pacific, *Statistical Yearbook for Asia and the Pacific 2007* (New York: United Nations, 2007), p. 88; CIA World Factbook and Nationmaster at www.nationmaster.com/graph/eco_gro_nat_inc_percap-gross-national-income-per-capita (accessed February 27, 2009).

Source: Thomson, op. cit., p. 36.

energy policies aimed at reducing its heavy reliance on energy imports while also ensuring a sound environmental energy strategy.

Measures include acceleration of domestic exploration and development of oil, gas and electricity; enhancement of relations with energy-exporting countries (including its neighbours Myanmar, Cambodia and Indonesia); undertaking a feasibility study of nuclear energy's potential; diversification of fuel types to mitigate risk; promotion of the petrochemical and oleochemical industry for integration with biofuels development in order to generate new industries; promotion of research and development of all forms of alternative energy such as biofuels (gasohol, biodiesel) and natural gas for vehicles (NGV), and renewable energy; support for the Clean Development Mechanism (CDM) to reduce greenhouse emissions; and energy market reform to ensure transparency and fairness and reduce distortions in domestic energy pricing.²⁰

Indonesia is rich in natural resources and oil, gas and coal have traditionally played an important role in its economy, particularly as a foreign exchange earner. In 2006, the total primary energy supply of Indonesia was 130,520 ktoe, comprised mainly of oil (44.7%), natural gas (29.4%) and coal (20.9%).²¹ It became a member of the Organization of the Petroleum Exporting Countries (OPEC) in 1962, but withdrew in 2008 due to the decline in its production of oil. In 2007, Indonesia enacted its first legislation on energy, designated the Energy Law. The law made clear the government's principles "with regard to utilisation of energy resources and final energy use, security of supply, energy conservation, protection of the environment with regard to energy use, pricing of energy, and international cooperation".²² Prior to the Energy Law, the government drafted energy policies (National Energy Policy) through public consultation before legislation and promulgation. The National Energy Policy detailed the country's energy policy in its Blueprint for National Energy Management 2005–2025, which was issued in July 2005. The document focused on ensuring supply of energy through domestic supply, optimising energy production and implementing energy conservation; energy efficiency and

²⁰Ibid., pp. 168–175.

²¹Ibid., p. 65.

²²Ibid., pp. 67–80.

diversification; pricing energy at economic levels with due regard to the needy members of society; and protection for the environment. The country's basic strategy is to encourage self-reliance by encouraging domestic exploration and exploitation of oil, gas, coal and geothermal sources.²³

The government has also implemented energy conservation measures with the National Master Plan for Energy Conservation enacted in 1995. The plan included programmes for training, efficiency awards, energy management and industrial audits. It also provided tax reductions and soft loans as incentives. In 2000, it announced a target to reduce energy intensity by 1% per year. Indonesia, along with all other ASEAN member countries, except Brunei, adopted a voluntary building energy code initiated in 1992.²⁴

In recent years, the country has also been looking into biofuels, renewable energy, energy efficiency and nuclear power. In 2006, the President mandated (Presidential Decree No. 10/2006) the formulation of a blueprint on biofuel development and in 2008 issued a regulation (Ministerial Regulation No. 32/2008) regarding the supply, use and commerce of alternative biofuels as an alternative energy. Special Biofuel Zones (SBZs) have been designated, covering at least 10,000 hectares in Java and 100,000 hectares outside Java, for the cultivation of crops to be used for biofuel. It has also taken measures to invest in renewable energy, particularly solar, and expanded efforts in recent years to improve energy efficiency (Presidential Instruction No. 2/2008). In 2007, the government prepared a Nuclear Power Development Preparatory Team to prepare for and work towards the country's aim to build nuclear power plants.²⁵

Vietnam began market reforms in 1986 and this led to rapid economic development. Energy is a crucial factor in Vietnam's economic development plan since its growth is increasingly reliant on its industrial base. Its total primary energy supply in 2006 was 43,628 ktoe, which was an increase of 7.05% from the previous year. Its energy mix consists of oil (29.3%), coal (20.7%), natural gas (11.8%) and other sources (34.1%).

²³ Ibid., pp. 71–78.

²⁴ Ibid., pp. 70–71.

²⁵ Ibid., pp. 78–79.

The country is rich with diverse fossil energy resources such as oil, gas and coal, as well as renewable energy such as hydro, biomass, solar and geothermal. The country became a net exporter of energy in 1990 with crude oil and coal being the main exports. Vietnam also has gas reserves that are said to be more promising than its oil reserves. However, its gas potential has been complicated by its protracted offshore territorial disputes in the South China Sea with China.²⁶

The country is expected to transform from being a net exporter of energy to a net importer beyond the year 2010 as consumption is expected to rise by 4.3 times in the coming two decades.²⁷ As a result, the government has been preparing a long-term policy to ensure its supply of energy. This consists of implementing energy efficiency and conservation initiatives, increasing the country's ability to carry out domestic exploration so as to reduce reliance on imports, supporting Vietnam's national oil company in expanding its oil and gas activities overseas, and developing clean fuels, particularly from nuclear and renewable sources (wind, solar and hydropower).²⁸

The Philippines' total primary energy supply, excluding traditional biomass fuels, was 31,126 ktoe, of which 54.7% (17,019 ktoe) was imported. In 2006, its energy sources were oil (68.1%), others (23.6%), coal (8%) and gas (0.3%). The 2006 Philippine Energy Plan indicates that from 2007 to 2014, the economy will grow by 3.3% annually, with petroleum making up the bulk of the final energy demand with an average share of 39%. This will be closely followed by biomass with a 38% share.²⁹ In order to become less reliant on energy imports, the government has targeted a 60% energy self-sufficiency level by 2010, which is to be maintained through 2014. It is thus increasing indigenous oil and gas exploration and coal production. It is also looking to increase renewable energy capacity (biomass, wind and solar), together with the use of alternative fuels (biofuels) and research into nuclear energy.

²⁶Ibid., pp. 188–191.

²⁷"Vietnam to be Net Importer by 2015", VietNamNet Bridge, 24 January 2008, <http://english.vietnamnet.vn/biz/2008/01/765806/> [Accessed 5 December 2009].

²⁸APEC Energy Overview 2008, op. cit., pp. 192–200.

²⁹Ibid., pp. 131–132.

Energy efficiency and conservation programmes will also be further developed.³⁰

Malaysia's total energy supply in 2006 was 59,318 ktoe with oil (44%), gas (44%) and coal (10%) being the main fuel types. While it remains a net energy exporter, it is aware that its oil and gas reserves will be depleted soon and is therefore looking at energy-efficient initiatives and the development of viable alternative energy sources, such as solar, wind, biofuels and nuclear.³¹

Another country worth mentioning is Myanmar. While it has notable oil and gas deposits, international investors and neighbouring governments generally avoided dealing with the country because of the military regime in place. With the election of President Thein Sein and reforms taking place since March 2011, this could well change.

2.3 DISTINGUISHING GENERAL ENERGY COOPERATION FROM ENERGY SECURITY COOPERATION

The importance of recognising the different types of cooperation being undertaken in Asia was first pointed out by Jaewoo Choo in his study on Northeast Asian energy cooperation. He did so by highlighting the conceptual distinction between general energy cooperation (GEC) and energy security cooperation (ESC).³² In his study, Choo distinguished the former as being broader and more technical in scope, while the latter concept more constricted and politically sensitive. Thus, GEC may include energy security issues, but energy security issues would not cover interest in other energy issues, such as renewable energy, energy technology and the environment.³³

He noted that governments have tended to refer to general energy cooperation and energy security cooperation interchangeably when referring to their long-term energy policy statements. As a result, "improperly

³⁰ Ibid., pp. 132–140.

³¹ Ibid., pp. 97–100.

³² Jaewoo Choo, "Energy Cooperation Problems in Northeast Asia: Unfolding the Reality", *East Asia*, 23, no. 3 (2006), pp. 91–106.

³³ Ibid., p. 92.

understood and ill-defined concepts (ideas) inevitably and easily result in misconceived policy, orientation, and implementation". This makes the search for common ground difficult due to misunderstandings on what each party is prepared to commit to, leading to the impression of cooperation as "unthinkable, if not impossible, among these states".³⁴

By distinguishing the two concepts, he argued that a clearer picture emerges as to the types of cooperation governments would be willing to engage in, with whom and why. Choo defined energy security as "the maintenance of sufficient energy supplies, prices commensurate with purchasing power, and guaranteed safe delivery of energy resources".³⁵ He pointed out that the concept does not merely refer to economic interests. Rather, it has been securitised at the national level and is today part of a state's national security interests, particularly with respect to Asian governments. As a result, "economic value has lost ground in foreign-policy making communities of the regional states".

Some Asian countries thus regard energy security interests in zero-sum calculations due to the existing inter-state political rivalry and distrust within the region.³⁶ From this, one could deduce that ESC is essentially about the allocation of energy supplies between different state actors. While it would make sense to governments of importing countries to engage in such cooperative arrangements with suppliers, they are less willing to do so with other importing countries because of their zero-sum mentality.

Choo's idea of GEC meanwhile is drawn from Michael Jefferson's chapter on energy policies for sustainable development in a UNDP report published in 2000.³⁷ Energy cooperation within Jefferson's context is "more concerned with the provisions of energy services through improved management of international energy markets, wider availability and higher quality of energy resources and the expansion of choices in order

³⁴ Ibid., pp. 92–93.

³⁵ Ibid., p. 93. Choo drew this definition from Philip Andrews-Speed, "Energy Security in East Asia: A European View", paper presented at the Symposium on Pacific Energy Cooperation, Tokyo, 12–13 February 2003.

³⁶ Choo, op. cit., p. 95.

³⁷ Michael Jefferson, "Energy Policies for Sustainable Development", in *World Energy Assessment: Energy and the Challenge of Sustainability*, edited by José Goldemberg (New York, NY: United Nations Development Programme, 2000), pp. 415–452.

Table 2 The Need for a New Energy Paradigm

Traditional Paradigm	Emerging Paradigm
Energy considered primarily as a sectoral issue	Greater consideration of social, economic, and environmental impacts of energy use
Limitations on fossil fuels	Limitations on the assimilative capacity of the earth and its atmosphere
Emphasis on expanding supplies of fossil fuels	Emphasis on developing a wider portfolio of energy resources, and on cleaner energy technologies
External social and environmental costs of energy use largely ignored	Finding ways to address the negative externalities associated with energy use
Economic growth accorded highest priority (even in prosperous economies)	Understanding of the links between economy and ecology, and the cost-effectiveness of addressing environment impacts early on
Tendency to focus on local pollution	Recognition of the need to address environmental impacts of all kinds and at all scales (local to global)
Emphasis on increasing energy supply	Emphasis on expanding energy services, widening access, and increasing efficiency
Concern with ourselves and our present needs	Recognition of our common future and of the welfare of future generations

Source: Michael Jefferson, "Energy Policies for Sustainable Development", in *World Energy Assessment: Energy and the Challenge of Sustainability*: <http://bbs.cenet.org.cn/uploadimages/20053810181399130.pdf>, p. 418.

to achieve sustainable growth".³⁸ It therefore has an expanded scope of energy policy goals, which incorporates sustainable growth imperatives at the local, regional and global levels. Table 2 summarises Jefferson's changing energy paradigm, and shows how energy policy concerns have been expanding to include sustainable development considerations.

Such an expanded conceptualisation of interests with the new and expanded focus facilitates cooperation dynamics. For instance, it has provided a new rationale for countries with the know-how to help other

³⁸Choo, op. cit., p. 93.

countries, particularly those within the same region, to upgrade their oil refinery technologies to reduce inefficiencies and pollution. Such technical cooperation does not undermine one's own fundamental energy security interests, but is aimed at addressing transnational energy-related problems.

GEC is thus suitable for addressing common energy-related problems through synergies, for example joint research in developing alternative fuels, or in drawing financial capital for projects because of the enlarged market size. It is believed that such a process could provide momentum for greater socialisation, further expanding the scope of energy cooperation, and potentially — though not always the case — lead towards energy security cooperation between the parties.³⁹ Understood as such, GEC could play a functionalist role, providing the first practical steps which could help facilitate ESC; although whether ESC does take place would depend on a host of other issues, which could propel or obstruct such cooperation.

2.4 EAST ASIA'S FOCUS ON GENERAL ENERGY COOPERATION

In this section, the author will demonstrate that the cooperation framework currently underway within the EAS grouping is in fact general energy cooperation, not energy security cooperation. The purpose is not to analyse the viability or the follow-up measures undertaken by the respective governments following the Cebu and Singapore declarations. Instead, it is to clarify the nature of cooperation that is currently underway, and to enable us to make better sense of the political intentions and priorities of cooperation among East Asian countries.

Energy has been cited as an avenue for cooperation within the East Asian context from as early as 2001. The East Asian Vision Group (EAVG), set up in 1998, and composed of members from ASEAN Plus 3, submitted a vision report, "Towards an East Asian Community", to the ASEAN Plus 3 leaders in October 2001.⁴⁰ In its key recommendations, it

³⁹ Ibid., p. 94.

⁴⁰ *Towards an East Asian Community: Region of Peace, Prosperity and Progress*, East Asian Vision Group Report, 2001, <http://www.mofa.go.jp/region/asia-paci/report2001.pdf> [Accessed 1 December 2009].

stated that one dimension of environmental cooperation should include "... joint development and exploration of new sources and supplies of energy within the region and embarking on efficient use of energy".⁴¹ The main report was very much focused on cooperation to develop cleaner forms of energy. This was noted in paragraph 70:

The Vision Group proposes an environmentally friendly and sustainable East Asia. It calls upon leaders to strengthen and increase efforts towards institutionalizing environmental and energy cooperation in the region.

Paragraph 86 further advocated that

Research and development should be stimulated for the exploration of alternative sources of cleaner energy, including renewable energy generation. Given the drawbacks of fossil fuels, East Asian countries should cooperate for the development of solar, wind, hydroelectric and nuclear fusion energy. There should be more cooperative regional efforts to establish renewable energy generation systems.

In January 2002, Japanese Prime Minister Junichiro Koizumi announced Tokyo's intention to form an East Asian Energy Community, using the ASEAN Plus 3 framework. This was meant to enhance Japan's leadership role with ASEAN on non-traditional security issues within East Asia.⁴²

In November 2002, the East Asia Study Group (EASG), set up in 2000, submitted a document during the ASEAN Plus 3 summit, titled, "Final Report of the East Asian Study Group".⁴³ Besides emphasising the ASEAN energy networks, the EASG authors reiterated the conclusions of the earlier EAVG group, and framed East Asia's proposed energy

⁴¹ *Towards an East Asian Community*, op. cit., p. 4.

⁴² Gaye Christoffersen, "East Asian Energy Cooperation: China's Expanding Role", *China and Eurasia Forum Quarterly*, 6, no. 3 (2008), pp. 150–151.

⁴³ *Final Report of the East Asian Study Group, ASEAN + 3 Summit*, 4 November 2002, Phnom Penh, Cambodia, http://www.aseansec.org/pdf/east_asia_vision.pdf [Accessed 10 July 2007].

strategy within the environmental context. Paragraph 37 of the Final Report stated that

The EASG attaches importance to energy security for the sustainable development of the East Asian economy through cooperation among East Asian countries. Although there is no plan as yet for cooperation on nuclear energy, comprehensive cooperation through a framework policy will greatly enhance cooperation among East Asian countries in consideration of their existing national policies. Cooperation in research and development of alternative and/or cleaner energy sources can be included in the comprehensive strategy and policy on energy development in the East Asian region.

In 1998, ASEAN adopted the Hanoi Plan of Action as part of its ASEAN Vision 2020 target which was introduced in 1997. This included a strategic plan of action for energy cooperation known as the ASEAN Plan of Action for Energy Cooperation (APAEC) 1999–2004 in order to facilitate energy cooperation among ASEAN members. In 2004, ASEAN issued a follow-up APAEC 2004–2009.⁴⁴ APAEC 2004–2009 spoke of an “evolving plan of action”, making reference to the ASEAN Vision 2020 which called for, among other things, first, the establishment of the ASEAN Power Grid and Trans-ASEAN Gas Pipeline; second, promotion of cooperation in energy efficiency and conservation, as well as development of new and renewable energy resources. It also envisioned “a clean and green ASEAN with fully established mechanisms for sustainable development to ensure protection of the environment, the sustainability of its natural resources, and the high quality of life of its peoples”.⁴⁵ The document went on to frame a new plan of action “in the context of sustainable development” as echoed during the UN World Summit on Sustainable Development in Johannesburg, South Africa, in 2002. Thus, the document, in reflecting the sentiments from the World Summit, considered probable mid-term scenarios in the

⁴⁴ASEAN *Plan of Action for Energy Cooperation (APAEC)*, 2004–2009, <http://www.aseansec.org/pdf/APAEC0409.pdf> [Accessed 5 December 2009].

⁴⁵Ibid., p. 3.

ASEAN region, based on the combination of “economic, social and environmental” considerations.⁴⁶

Significantly, APAEC 2004–2009 indicated ASEAN's intention to tap external bilateral and multilateral partners for its regional energy initiatives, namely the European Union, Japan, the ASEAN Plus 3 parties, Australia and the Energy Charter Secretariat. It was affirmed that the programme areas of APAEC 1999–2004 would be maintained, namely (1) the ASEAN Power Grid, (2) the Trans-ASEAN Gas Pipeline, (3) institutionalisation, improvement and promotion of coal usage, (4) energy efficiency and conservation, (5) renewable energy, while a new (the sixth) programme called Regional Energy Policy and Planning (REPP) was also incorporated.

Despite the fact that the US was not identified as a partner in the APAEC 2004–2009 document, ASEAN nonetheless approached it to be a partner for its regional energy initiative. During the 19th ASEAN-US Dialogue held in May 2006, ASEAN urged the US to promote cooperation in the field of energy efficiency, and in affordable technologies for renewable and alternative energy. This led to a five-year action plan in July 2006 with energy cooperation listed as one area of collaboration.⁴⁷

In January 2007, the Cebu Declaration on East Asian Energy Security was announced at the second EAS.⁴⁸ It emphasised energy policies based on sustainable development and presented a broad outline of intended measures focused on the following: the promotion of alternative clean and renewable energy, reduction of emissions through use of technology, improvement of energy efficiency and conservation, use of clean coal and clean coal technologies, strategic fuel stockpiling, engagement in both bilateral and regional research and development, and exploring means for financing such projects.

According to one author, this declaration “underscores the fact that the search for alternative fuel sources has been prompted by an awareness of the diminishing supply of fossil fuels, the unstable global prices of oil and

⁴⁶ Ibid., p. 4.

⁴⁷ Christoffersen, *op. cit.*, p. 151.

⁴⁸ Cebu Declaration on East Asian Energy Security, Cebu, The Philippines, 15 January 2007, <http://www.aseansec.org/19319.htm> [Accessed 9 December 2009].

the worsening problems of the environment".⁴⁹ The Cebu Declaration has been criticised for being a "zombie initiative" because only a broad set of intended measures were announced without any concrete mechanisms being set.⁵⁰ Nonetheless, it reinforced the ideational theme and intention of the East Asian leaders on the form of energy cooperation to be carried out within the East Asian framework, which was consistent with the proposals set forth by the EAVG and EASG.

The emphasis on GEC was again evident at the third EAS held in Singapore in November 2007, with attention focused on the threat of climate change. The Singapore Declaration on Climate Change, Energy and the Environment acknowledged climate change as a shared concern for EAS members and stressed "the important role that the EAS can play in carrying out collective action to address these challenges for mutual benefit and the common good".⁵¹ The Singapore Declaration focused on measures that would mitigate the environmental costs of energy consumption, promote sustainable environmental initiatives, and better manage the risks of environmental disasters by building contingencies. It even set the goal of implementing measures "recommended by the EAS Energy Ministers, including the formulation of voluntary energy efficiency goals by 2009". It also tasked the relevant member countries to follow up on the summit declaration at the inaugural EAS Energy Ministers' Meeting held in Singapore in August 2007.

What then of energy security cooperation with the EAS group? Some may point to the Trans-ASEAN Gas Pipeline Infrastructure Project (TAGP) as an example of ESC at work within ASEAN. The TAGP plan is to construct an integrated natural gas pipeline network to connect gas reserves in the Gulf of Thailand, Myanmar and Indonesia to the rest of the ASEAN region. This is supposed to be a multi-billion-dollar project to build a series of natural gas pipelines spanning the 10 ASEAN countries

⁴⁹ Renato Cruz de Castro, "Assessing the Cebu Declaration on East Asian Security: Issues and Challenges in Regional Energy Cooperation", in *Energy and Security Cooperation in Asia: Challenges and Prospects*, edited by Christopher Len and Alvin Chew (Nacka-Stockholm: Institute for Security and Development Policy, 2009), p. 271.

⁵⁰ Christoffersen, op. cit., p. 152.

⁵¹ Singapore Declaration on Climate Change, Energy and the Environment, Singapore, 21 November 2007, <http://www.aseansec.org/21116.htm> [Accessed 9 December 2009].

to connect a population of 677 million people spread across 4.5 million km² of land. The idea was first discussed by individual member countries in 1986, with formal plans announced in 1990. However, feasibility plans only started in 1998, and it was only in 2002 that ASEAN signed a memorandum of understanding binding ASEAN countries to construct the TAGP.

Southeast Asian countries have to date invested US\$14 billion to construct 4,000 km of pipelines. Some advocates have even argued that the network could connect gas markets in China, Japan and India to create the largest gas network in the world, constituting US\$93.6 billion worth of investments.⁵²

However, Sovacool has pointed out that the TAGP has encountered a wide range of problems in its implementation due to technical, economic, legal, social and environmental reasons.⁵³ One significant observation he made was that ASEAN countries are becoming more protectionist and nationalist in their attitude towards energy resources. The notable trend has been to shift towards domestic control and usage of energy resources, instead of exporting them for trade.⁵⁴ He described the TAGP as “less of a concrete idea and more an evolving concept” and noted that “if there is a single concise, and overarching conclusion about the TAGP, it is that the project remains still in its formative stages, despite the past two decades”.⁵⁵

2.5 CONCLUDING THOUGHTS: ENERGY SECURITY COOPERATION AND COMPETITION IN EAST ASIA

There is no denying that a multilateral approach is needed in response to today's energy security challenges. However, what this study has demonstrated is that the East Asian countries have consistently focused

⁵² Benjamin K. Sovacool, “Energy Policy and Cooperation in Southeast Asia: The History, Challenges, and Implications of the Trans-ASEAN Gas Pipeline (TAGP) Network”, *Energy Policy*, 37 (2009), pp. 2356–2358.

⁵³ *Ibid.*, pp. 2362–2365.

⁵⁴ *Ibid.*, p. 2365.

⁵⁵ *Ibid.*, p. 2364.

on general energy cooperation as a means to address their energy and environmental concerns. Cooperation in this area seems more palatable since it often focuses on technical and scientific issues, with less strategic and political implications.

Energy security cooperation, on the other hand, is, and will continue to be, more exclusive and limited since states, particularly those in Asia, tend to think of cooperation within this sphere as having greater strategic implications for national security. This is primarily associated with the acquisition and transport of natural energy resources. Cooperation will largely remain bilateral, between importer and exporter.

The basic problem for the EAS members is the general sense of distrust that continues to pervade among member states, and this is set to hamper multilateral energy security cooperation, particularly among the energy-importing members, in the years ahead. Energy security cooperation will only develop if there are (1) strong and reciprocal political personalities driving the agenda; (2) economic viability and incentives to justify such projects; (3) strong investor confidence to fund such projects; and (4) social legitimacy in ensuring that the projects can proceed without disruption by the local populations.

Instead of ending the chapter sounding fatalistic, the author would like to point out that given the current conditions in East Asia, it should be acknowledged that while competition is currently inevitable, not all forms of competition are bad. In fact, this author argues that competition is an inherent feature within all societies, including international society. Therefore, state leaders should be nuanced in their thinking and be careful not to mistake their role as being to “eradicate competition”.

Competition has a functioning role within economic activity as a means to improve efficiency, innovation and choice, all of which are ingredients that facilitate progress. From social and international relations perspectives, it also enables actors to learn to interact and relate to one another, and help decision-makers set and prioritise their goals. The act of competition in fact allows actors to come into contact with, and develop, social rules and international norms as a means of engagement.

The objective should therefore not be to end energy-related competition, but to address zero-sum thinking in such engagements. In this aspect, political leaders should focus more on laying down the rules of regional

engagement, strengthen preventive diplomacy and confidence-building mechanisms and be prepared with coordinated responses for conflict management in the event of crisis situations. This is to ensure that competition over access to energy resources does not spiral into political brinkmanship or military conflict, leading to a destabilised region.

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CHAPTER 3

CONTEMPORARY JAPANESE-RUSSIAN ENERGY COOPERATION: PROBLEMS, CURRENT DEVELOPMENTS AND PERSPECTIVES

Svetlana Vassiliouk

3.1 INTRODUCTION

Given the geographical proximity, complementary economic needs, and desire to diversify their respective energy policies, Japan (one of the world's top energy consumers) and Russia (one of the world's top energy producers) should naturally seek to expand their energy relations with each other. The development of Russia's rich energy base and infrastructure in the remote areas of Eastern Siberia and the Far East to open up new export markets in Asia has become an important direction for Russia's overall economic policy as stipulated in the Eastern Gas Program and Energy Strategy to the year 2030. This strategically critical, yet enormous task requires a long-term financial commitment and extensive technological investment, which is difficult for the Russian government to tackle on its own. Furthermore, given the deteriorating demographic situation and growing Russian apprehension toward Chinese expansion in this area, Japan could become a natural partner in the development of these

regions. Russia's convenient location and natural resource endowment could greatly benefit Japan, which is focusing on securing reliable alternative energy supplies in close proximity. Moreover, as both Japan's and Russia's national energy strategies stress similar goals, such as the improvement of energy efficiency, promotion of renewable energy resources, conservation of energy resources, and advancement of clean technologies to facilitate emission reductions, the two countries are now presented with new opportunities to expand their bilateral energy cooperation in these areas, in addition to traditional trade in oil and natural gas.

It is important to examine the historical precedents of bilateral cooperation between the two countries, focusing on major joint projects, as the lessons learned from these energy cooperation initiatives could provide important insights for the realisation of ongoing and future joint projects. However, the assessment of their energy cooperation should also include a brief analysis of their political and diplomatic bilateral relations as well as the developments in their respective relations with other important players in the international arena (particularly China and the United States), since all of these factors have important implications for the realisation of their joint initiatives in the energy field.

Contemporary Japanese-Russian relations, including bilateral energy cooperation, have undoubtedly had a very complex and contentious history and have been affected, to a certain degree, by the developments in their political relations. Thus, while the two countries' trade and economic ties have recently been enjoying robust growth,¹ they are yet to reach their full potential as each country's share in the other's total trade turnover is still very low. Moreover, Japanese-Russian political relations remain hostage to the unresolved dispute over the four Kuril Islands off Hokkaido as a notorious legacy from the WWII period. Despite Japan and the Soviet Union signing a joint declaration and de facto normalising their diplomatic relations in 1956, the two countries, having failed to conclude their peace agreement and final border settlement, are still at odds and yet to fully normalise their relations with each other.

¹Despite the setbacks caused by the financial crisis in late 2008, trade between Japan and Russia has been steadily growing, reaching the \$30 billion mark by the end of 2009 (Bloomberg, 17 February 2009). However, in 2009, in terms of exports to and imports from Japan, Russia's rankings were 27th and 17th respectively; whereas Japan has become one of Russia's top largest Asian trade partners (JETRO, 2009).

Based on the close linkage between politics and economics in the two countries' contemporary energy policies, it is plausible to argue that through expansion of their energy cooperation, Japan and Russia should be able to improve their political relations. Unlike in the Cold War era, unresolved political problems do not seem presently to have a significant effect on Japan-Russia economic and trade cooperation. These political hurdles are not the only obstacles that the two countries must overcome to reach full potential in their bilateral economic relations, including energy cooperation. It is crucial to continue expanding bilateral relations at various levels, thereby creating opportunities for both countries to deepen their dialogue in search of timely, effective, and mutually acceptable solutions to their outstanding problems, including the Kuril territorial dispute. Furthermore, building their relations based on mutual trust and removing the remaining obstacles to better understanding would help improve bilateral relations in all other spheres as well, including deeper economic integration and energy cooperation.

3.2 HISTORY OF BILATERAL COOPERATION: LESSONS AND PROBLEMS FROM THE PAST

In spite of various political, strategic, and economic concerns that were especially evident during the Cold War period, Japan and the former Soviet Union had begun discussions about the possibility for joint development of energy resources, particularly in the Soviet Far East and Western Siberia, in the late 1960s.² In addition to the development of crude oil and gas in the region, early bilateral initiatives focused on development projects in transport, infrastructure, and the mining industry, especially coal.

The first Soviet-Japanese joint energy project proposals materialised in the early 1970s. The proposals focused mainly on joint development of energy resources in Western Siberia (for example the Yakutiya Natural

² The author of this presentation has written an extensive account of early joint initiatives for energy cooperation in her doctoral dissertation "Energy Politics in Japanese-Soviet/Russian Relations: From Cooperation Initiatives in the 1970s to Cautious Engagement in 1990s" (Hosei University, Tokyo, March 2006) and in related articles, such as "Energy Politics in Japanese-Soviet Relations in the 1970s: Complementarity and Conflict", *Russian and Eastern European Studies*, vol. 35 (March 2007).

Gas and Tyumen Oil Development projects) and the Soviet Far East (for example the Sakhalin Continental Shelf Oil and Gas Exploration Project).

However, with the exception of the Sakhalin oil and gas project, the realisation of these projects failed due to a number of factors. In particular, political tensions and strategic considerations incited by the Cold War rivalry between the Soviet Union and the United States played the most critical role in derailing bilateral energy initiatives and projects (Table 1).

Although Japan was interested in expanding its energy collaboration with the neighbouring USSR, as a US military ally, it also had to consider, and often side with, the US stance on its foreign and economic policy vis-à-vis the Soviet Union. These considerations, exacerbated by the unresolved Kuril Islands dispute (Figure 1), resulted in the shift of Tokyo's policy toward politicisation of its trade and energy cooperation with Moscow, which by the early 1980s evolved into the so-called policy of *seikei fukabun* (inseparability of politics and economics).

Another external political factor that cast a shadow on Japanese-Soviet energy cooperation in the 1970s was the US and Japan's political rapprochement with China in 1972, which the Soviet Union viewed as a direct threat to its strategic interests in East Asia. Not only did China support Japan's territorial claim in the Kuril dispute, but it (along with the US) put pressure on Japan to withdraw from the energy projects in Eastern Siberia (particularly the Tyumen Oil Development Project), arguing that such collaboration would grant the Soviets strategic advantage in the region.

Japan saw US participation as its "insurance policy" to share large-scale credit and investment risks and also sought US political support for its territorial claims in its relations with the Soviet Union. The failure to secure the backing of the United States tapered Japanese enthusiasm for participation in joint energy initiatives with the Soviet Union. Finally, after the 1979 Soviet invasion of Afghanistan, the United States and its allies launched the ideologically driven "economic Cold War" against the USSR. The US immediately reacted by imposing a trade embargo on the USSR (subsequently adopted by the Japanese government), which, in addition to the technological embargo introduced in 1978, further undermined the feasibility of Japanese-Soviet energy cooperation.

In addition to the aforementioned political and ideological factors, numerous problems with project financing due to difficult loan and credit negotiations between Japan and the USSR, a lack of sufficient technology

Table 1 Japan-USSR Joint Energy Initiatives in the 1970s

	Yakutiya Natural Gas Project	Tyumen Oil Development Project	Sakhalin Continental Shelf Oil and Gas Exploration Project
Initiation date	Joint agreement signed in 1974; expected start date: 1982	Initially discussed in February 1972; expected start date: 1981	Joint agreement officially signed in January 1975
Primary project signatories and developers	USSR: Ministry of Foreign Trade Japan: Tokyo Gas, Natural Gas Kondankai US: El Paso Natural Gas and Occidental Petroleum	USSR: Ministry of Foreign Trade Japan: Petroleum Committee (US declined to participate)	USSR: Ministry of Foreign Trade Japan: SODECO (created in October 1974 especially for this project; currently a member of Sakhalin-1 consortium) and JNOC US: US Gulf Oil as a minor shareholder
Net total investment	Exploration stage investment: Japan and US to invest US\$25 billion each	Japan was expected to provide bank loans of US\$1.3–1.7 billion	US\$237.5 million dollars, including US\$150 million in commercial credit for the first 5 years

(Continued)

Table 1 (Continued)

	Yakutiya Natural Gas Project	Tyumen Oil Development Project	Sakhalin Continental Shelf Oil and Gas Exploration Project
Project description	25-year term; joint development of Yakutiya gas reserves and related infrastructure; construction of gas pipeline to port Olga on the Sea of Japan and a related LNG plant; Primary target customers are Japan and the US West Coast (LNG).	Japan was expected to supply all necessary equipment for oil exploration, drilling, and delivery of crude and to construct a seaport facility for crude shipments from Russia; in exchange, Japan would be compensated with 25 million tonnes of crude annually for 25 years	One of the first compensation-based projects; initial term was set at 10 years; Japan was expected to provide capital investment and commercial credit to finance Soviet drilling and exploration activities in Sakhalin; in compensation, the Soviet side would provide Japan with 50% of the obtained oil during the loan term and for another 10 years after its expiration
Status/ Outcome	Due to various (mostly political) considerations, the trilateral joint venture was officially dismantled in 1980	Excessive project costs, especially for infrastructure development and great distances, made this project prohibitive; strategic and political reasons (protests by the US and China regarding the BAM railroad construction to deliver crude oil to the Pacific coast) also prevented this project from materialising and led to its abandonment by the mid-1970s	Due to political, economic, and technical considerations (such as lack of necessary drilling equipment and prohibitive oil extraction costs), the project had stumbled by the late 1970s (especially after the Soviet invasion of Afghanistan and subsequent US trade embargo policies); it was not completely abandoned and instead re-emerged during the mid-1990s as the Sakhalin-1 project

supplier and the top non-Middle Eastern supplier. In July 2010, Russia's crude oil supply to Japan rose 93% to reach 1.61 million kilolitres (approximately 10.13 million barrels), constituting 9% of Japan's total crude imports.³ In early April 2009, Japan received its first LNG shipments from the Sakhalin-2 project, and in December 2009, three major Japanese refiner companies contracted purchases of Eastern Siberia-Pacific Ocean (ESPO) pipeline crude oil cargoes from the export terminal at Kozmino Bay near Nakhodka in Russia's Far East.

At the institutional level, in 2008, the Japanese government (the Japanese Ministry of Economics, Trade and Industry's (METI) Agency for Natural Resources and Energy (ANRE)) signed a memorandum of understanding (MoU) with Russia's largest oil company Rosneft, laying the ground for energy cooperation in a number of sectors. Similar agreements were concluded later between ANRE, Itochu Corporation, Japan Petroleum Exploration Company (JAPEX), and Russia's (and one of the world's) largest energy company Gazprom in May 2009. Several important intergovernmental agreements in various sectors, including banking, nuclear power, and energy efficiency, were also signed during Prime Minister Putin's visit to Tokyo on 12–15 May 2009. Furthermore, after signing the memorandum of cooperation in the field of energy efficiency and renewable energy in May 2009, the two countries have intensified their cooperation in these areas by concluding a number of important agreements among related agencies and conducting annual bilateral seminars to facilitate information exchange and collaboration in energy efficiency and conservation.

Despite the considerable potential for Japanese-Russian energy cooperation, presently there are only a small number of projects and initiatives that have been, or are in the process of being, fully realised. Most of these bilateral projects are geographically limited to the aforementioned Sakhalin Island (the ongoing Sakhalin-1 and Sakhalin-2 projects; see Table 2 for an overview of the projects) and Eastern Siberia, including the Primorsky District (the ESPO pipeline and related projects), and focus on the development of oil and gas in these regions. Due to the remaining political hurdles, lack of mutual trust, and other outstanding problems, investment and joint projects in Russia have mainly been undertaken by

³ Risa Maeda, "Japan Almost Doubles Russia Crude Imports in Aug", Fox Business, 30 September 2010.

Table 2 Overview and Current Status of Sakhalin-1 and Sakhalin-2 Projects

Name	Sakhalin-1	Sakhalin-2
Primary project developers	US: Exxon Neftegas (30%); Japan: SODECO consortium (30%); India: ONGC Videsh (20%); Russia: Sakhalinmorneftegaz (Rosneft-Sakhalinmorneftegaz Subsidiary, 11.5%), and RN Astra (Rosneft Subsidiary, 8.5%)	Russia: Gazprom (50% + 1), Sakhalin Energy Investment Company: Shell (27.5%); Japan: Mitsui (12.5%), Mitsubishi (10%)
Oil reserve estimate	2.3 billion barrels	1–1.2 billion barrels
Natural gas reserve estimate	485 billion cubic metres	507 billion cubic metres
Net total investment	US\$5 billion at the initial stage; US\$12 billion in total	US\$4.5 billion at the initial stage; US\$20 billion during the second stage over following 4–5 years
Current & expected production level	PSA signed in June 1995; the project focuses on the development of three fields — Chayvo, Odoptu, and Arkutun-Dagi. The initial stage of the project (2002–2006) focused on the development of the Chayvo field; oil production of around 50,000 barrels of oil a day started in October 2005 for delivery to the Russian Far East domestic market. Commercial oil export started in August 2006, reaching a peak rate of 250,000 barrels of oil a day in February 2007.	PSA signed in June 1994; the project has been developed in two phases. Phase 1 (1999–2003) involved oil production from an offshore platform at the Piltun-Astokhskoye field in 1999. Phase 2 (2003–2008) focused on the installation of additional platforms, construction of offshore and onshore oil and gas pipelines, an onshore processing facility, an oil export terminal and Russia’s first LNG plant.

(Continued)

Table 2 (Continued)

Name	Sakhalin-1	Sakhalin-2
	Natural gas production, averaging 1.7 million cubic metres a day, began in October 2005 to meet the needs of domestic customers in the Khabarovsk Region. It reached a peak rate of 5.85 million cubic metres a day in January 2008. In December 2009, the Sakhalin-1 natural gas supplies to the Khabarovsk Region reached 5 billion cubic metres.	Commercial oil production: since December 2008 (150,000 barrels a day). LNG production: since March 2009. LNG supplies to Japan currently stand at about 5 million tonnes a year, constituting about 65% of Sakhalin-2's total LNG production. Since the LNG plant reached its full capacity (9.6 million tonnes a year) at the end of 2010, it is currently producing about 5% of global LNG supplies.
Target markets & consumers	Following the signing of the MoU on gas supplies with China's CNPC in October 2006, Exxon was at odds with the rest of the project developers over the Sakhalin-1 gas export strategy. While Exxon preferred pipeline exports to China (as well as Japan and Korea), other shareholders (as well as Gazprom) insisted on giving the priority to piping to the LNG terminal at Sakhalin-2 or to the domestic market in the Russian Far East (particularly the Khabarovsk Region). The issue of gas marketing and export routes from Sakhalin-1 was partially resolved in May 2009 when the project shareholders came to an agreement to sell 20% of its gas production starting in 2012 to Gazprom for delivery to the Russian domestic market.	Oil and LNG exports: primarily Japan, other markets in Asia (Korea), as well as North American (including Hawaii and Mexican west coast) markets.

(Continued)

Table 2 (Continued)

Name	Sakhalin-1	Sakhalin-2
Status/notes	In May 2009, the next phase of the Sakhalin-1 project was signified with the start of drilling at the Odoptu field; commercial production is expected to begin at the end of 2010. In July 2010, oil production stood at over 270 million barrels, while natural gas deliveries to the domestic market in the Russian Far East reached 6 million cubic metres. The future phases of the project focus on the development of Chayvo gas reserves for export as well as development of the Arkutun-Dagi oil and gas field (expected to begin production in 2014).	On 29 March 2009, the first LNG cargo from Sakhalin was loaded from the Sakhalin-2 LNG plant for delivery to Japan's Tokyo Gas and Tokyo Electric companies. In October 2009, as additional US\$1.4 billion was secured in project financing in order to advance the drilling programme of Phase 2 of the project.

Source: The Sakhalin-1 project website (<http://www.sakhalin1.com/Sakhalin/Russia-English/Upstream/about.aspx>) and Sakhalin Energy website (http://www.sakhalinenergy.com/en/atagance.asp?p=aag_main&s=14).

relatively large Japanese firms and corporations capable of securing Japanese government financial and diplomatic support.

3.3.1 Sakhalin Projects

Historically, Sakhalin oil and gas development has not only been an attractive area for Japanese business involvement, but also the Japanese government (the projects are among the most extensive and largest commitments made by the government). For the Sakhalin-1 project, Japan is represented by a consortium made up of the Sakhalin Oil and Gas Development Company (SODECO), along with Itochu and Marubeni corporations, holding a 30% share. The Japanese members of the Sakhalin-2 consortium are the Mitsui Bussan and Mitsubishi Shoji corporations, holding 12.5% and 10% of the project shares, respectively. Both Sakhalin-1 and Sakhalin-2, which are among the world's largest oil and gas integrated projects, hold extensive recoverable gas and oil reserves, the development of which requires tens of billions of US dollars in investment based on production-sharing agreements between the Russian government and participating businesses.

The Japanese government has strongly supported Japanese business participation in both projects. It has also been actively involved in providing financial assistance to the Sakhalin-2 project, focusing on the construction of the first Russian LNG terminal located in southern Sakhalin, signalling the growing significance of Russian LNG in Japan's energy import diversification strategy. According to Sakhalin Energy's statement on 16 June 2008, the Japanese Bank for International Cooperation (JBIC) along with a banking consortium of international (mainly Japanese) banks agreed to provide a US\$5.3 billion financial package. The funds helped finance the final stages of the LNG construction project in Prigorodnoye, located in Aniva Bay of the Korsakov District of the Sakhalin Region.

Russian President Dmitry Medvedev and then Prime Minister of Japan Taro Aso both attended the ceremony launching Russia's first LNG plant on 18 February 2009, thereby underlying the significance of the project to the two countries and the Asia-Pacific region as a whole. At the opening ceremony, the two leaders pledged to apply a new, "innovative and unconventional" approach to solve the territorial dispute in a timely manner,

while continuing to expand their ties in the energy, infrastructure, and environmental sectors. However, it is important to note that the Sakhalin Region holds an administrative jurisdiction over the disputed Kuril Islands and is known to be a region with a highly unyielding public opinion on the territorial dispute. Aso's visit, which was the first visit to Sakhalin by a Japanese leader since WWII, stirred a lot of controversy among Japanese conservatives pushing for the revival of the *seikei fukabun* policy toward Russia.

Despite the global financial crisis, falling energy prices, and falling demand that have cast a dark shadow on Moscow's energy ambitions in the region, there are still fears in Tokyo that Russia may gain the upper hand vis-à-vis Japan, by expanding its role in the gas and LNG markets in Japan and the Asia-Pacific region as a whole. Some raise concerns that Russia, while asserting its role in the region and expanding its energy relations with Japan, has been effectively focusing only on the economic aspects of bilateral cooperation, thereby pushing the Kuril territorial dispute off the negotiation table and hence hindering the normalisation of political relations with Japan. In response to the Japanese voters' conservative sentiment, Aso reiterated his commitment to pursue the solution to the territorial dispute based on Japan's official policy of insisting on the attribution of all four islands. During a press conference on the expected results of the May 2009 Japanese-Russian summit meeting, then Japanese Foreign Minister Hirofumi Nakasone stressed, "from Japan's perspective, the most important issue between Japan and Russia [was] the issue of the Northern Territories... and the conclusion of the peace treaty"; thus it was critical for the Japanese government to advance its negotiations on the territorial dispute to keep the level of importance in line with the negotiations on bilateral economic cooperation.⁴

Despite the remaining political problems and concerns, in early 2009, Russia successfully realised its entry into the world and Asian LNG market. LNG production from the Sakhalin-2 project at the new terminal began on 5 March, with the first shipment of LNG (4.8 million tonnes)

⁴ Japanese Ministry of Foreign Affairs (MOFA), Press Conference by Minister for Foreign Affairs Hirofumi Nakasone, 12 May 2009, www.mofa.go.jp/announce/fm_press/2009/5/0512.html [Accessed 14 October 2009].

reaching Japan in early April 2009. According to Sakhalin Energy's official statement, as of late December 2010, the LNG plant has reached its full production capacity of 9.6 million tonnes a year, constituting 5% of the world's LNG market and about 4.3% of Japan's LNG imports. About 65% of the total capacity has been contracted on a long-term basis to eight Japanese companies, including Tokyo Gas (TOGAS) and Toho Gas, and the remaining 35% to the South Korean and US markets. It has been recently reported that the Japanese government is planning to increase purchases of Russian LNG in 2011 to help diversify its LNG imports.⁵

New opportunities for bilateral cooperation in this region include the Gazprom-led Sakhalin-3 project. Given the success of their partnership with Gazprom in the Sakhalin-2 project, Gazprom CEO Alexei Miller, during his visit to Japan in 2009, personally invited Japan's Mitsubishi and Mitsui corporations to take part in the Sakhalin-3 and possibly Sakhalin-4 projects on a "financial, technological, and to some extent, operating level", stressing that Gazprom's existing partners would be given an advantage.⁶

Another possible energy-related joint project involves the construction of the 1,350 km Sakhalin-Khabarovsk-Vladivostok gas pipeline, which commenced in July 2009 and is expected to operate at capacity by 2011. According to recent reports, Japanese steel producers, through the JBIC, have been negotiating a financial assistance package to Russia (reportedly a US\$1 billion commodity loan tied to the supply of about 300,000 tonnes of Japan-produced steel pipes) for the construction of the pipeline.⁷ Upon its completion, the pipeline will transport Sakhalin's offshore natural gas to the Vladivostok terminal for deliveries to Japan, China, and other consumers in the Asia-Pacific region. In addition, in July 2010 the Japanese and Russian governments reached a preliminary agreement on the construction of a new LNG terminal near Vladivostok in Russia's Far East in order to deliver LNG from Sakhalin and Eastern Siberia to Japan and

⁵ "Japan Mulls Hiking LNG Imports from Russia in 2011", IHS Global Insight, 5 October 2010.

⁶ "Russia: Gazprom Mulling Invitation to Foreign Partners for New Sakhalin Projects", IHS Global Insight, 3 September 2009.

⁷ See also *Russia and CIS Oil and Gas Weekly*, no. 34 (27 August–2 September 2009), p. 15; and IHS Global Insight, 3 September 2009.

other Asian customers. JAPEX, jointly with Gazprom, have also launched a feasibility study on the construction of a related gas chemical plant and LNG facility in the region. By assisting Russia in these infrastructure projects, the Japanese government would help to boost gas supplies to the Pacific Coast in the Russian Far East, thereby ensuring shipments to Japan and other markets in the Asia-Pacific region.

Japanese companies, such as Mitsui Bussan Corporation, have shown interest in joining Gazprom in the development of gas fields not only in Eastern Siberia, for example the Chayandinskoye gas field with estimated gas reserves of 1.2 trillion cubic metres (Tcm) of gas, but also gas fields including LNG projects in the European part of Russia. One such project is the Gazprom-led Shtokman project, which includes the development of a giant gas field in the Barents Sea and the planned construction of a 7.5-million-tonne-per-year LNG plant. Another project is the Nord Stream gas pipeline project, which would link Russia and Germany and would help transport Russia's natural gas to the rest of Europe. In late January 2010, Japanese Sumitomo won a tender, along with Russia's United Metallurgical Company (OMK) and Germany's Europipe, to supply pipes (10% of 1 million tonnes in total) for the second stage of this project.⁸

3.3.2 The Eastern Siberia–Pacific Ocean Pipeline and Related Projects

In addition to the Sakhalin projects discussed earlier, there are a number of prospective joint projects that focus on the development of energy resources in Eastern Siberia and Russia's Far East. One of these projects is the construction of the Eastern Siberia–Pacific Ocean pipeline and development of the related regional infrastructure required to bring Russian oil to the Asia-Pacific market (Figure 2).

This large-scale project was divided into two construction phases. Phase 1, which focused on the construction of the 2,757 km Taishet-Skovorodino branch to deliver around 600,000 barrels of oil a day, was completed and became operational on 28 December 2009. Prime Minister Putin,

⁸ "OMK, Europipe Sumitomo to supply pipes for phase two of Nord Stream," *Russia and CIS Oil and Gas Weekly*, no. 3 (920) (21 January–27 January 2010), p. 26.

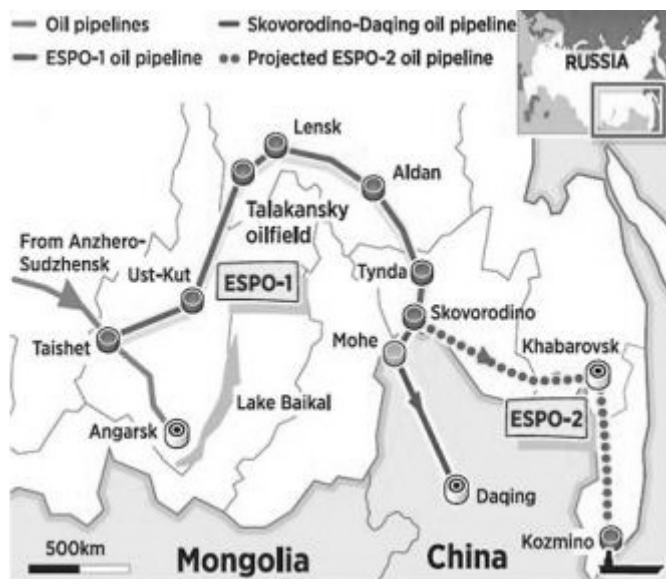


Figure 2 Eastern Siberia-Pacific Ocean Pipeline

Source: "Russia turning to China's huge energy thirst." The Telegraph Online Supplement by Rokiyskaya Gazeta, October 29, 2010. <<http://www.telegraph.co.uk/sponsored/russianow/business/8097658/Russia-turning-to-Chinas-huge-energy-thirst.html>>. Accessed on December 14, 2010.

who attended the ESPO pipeline and oil terminal launching ceremony, stressed the critical strategic importance of this multi-billion-dollar project. The shipment of the first crude supply from the new oil terminal at Kozmino Bay (the final point of the ESPO pipeline near Nakhodka City, Primorsky District) took place in January 2010, thereby officially launching ESPO Blend exports to the Asia-Pacific market.

In February 2010, a joint venture between trading house Mitsui and ExxonMobil won a bid for the delivery of a 730,000-barrel ESPO crude cargo to Japan's refineries.⁹ Upon the completion of Phase 2 of the ESPO pipeline project in 2014, which would connect Skovorodino with Russia's Pacific Coast (about 2,100 km), crude oil from the Siberian fields will be delivered to the Kozmino Bay terminal at a total capacity of 1.6 million barrels a day. This project, which mainly targets Russia's East Asian customers, is also considered indispensable for the economic development of Russia's Far East.

⁹ "Russia to Export East Siberian Crude Oil to Japan", IHS Global Insight, 26 February 2010.

Japanese energy companies have long been eyeing a direct participation in the development of Russia's natural resources in Siberia and the Far East. In late April 2008, Japan's state-run Oil, Gas and Metals National Corporation (JOGMEC) obtained access to Russian oil resources in Eastern Siberia by acquiring the rights to develop the Severo-Mogdinsky oil and gas block in the Irkutsk Region (the block, with a total area of 3,747 km², is located 150 km southeast of the planned route for Phase 2 of the ESPO pipeline). The Japanese side agreed to explore and develop the acquired block together with Russia's Irkutsk Oil Company (IOC) by establishing a joint venture — IOC-Sever — and jointly investing US\$95.8 million in this project.¹⁰ Under the agreement, JOGMEC will provide the latest technology, in particular for seismic studies, exploration, and development of the block. In June 2009, it was reported that the drilling and assessment work in the block had successfully begun.

In addition, on 1 September 2008, JOGMEC and Russia's United Oil Group Ltd. (UOG) signed a joint venture agreement (in which UOG will have 51% and JOGMEC 49%) to implement projects in the sphere of oil and gas prospecting, exploration, and production in Russia. The priority areas for this project are Russia's Krasnoyarsk Territory, Irkutsk Region, and Sakha Republic (Yakutiya). The parties announced in May 2009 that a joint five-year feasibility study and prospecting work had begun. It expected that the crude oil production in this area would be tailored mostly to satisfy the demand of the Japanese market.

JOGMEC's presence in the Russian Far East energy market further expanded after signing another important agreement during Prime Minister Putin's visit to Japan in May 2009. According to this agreement, JOGMEC and IOC established a new joint venture IOC-Zapad and agreed to explore the two additional blocks of Bolshetirsky and Zapadno-Yaraktinsky in the same region. By taking part in these upstream projects,¹¹ Japanese energy-related businesses not only aspire to boost their

¹⁰ Following the Putin-Abe Summit in June 2007, the Irkutsk Oil Company and JOGMEC formed a 51:49 joint venture (INK-Server Ltd.) in order to launch joint development of the Severo-Mogdinsky oil and gas block.

¹¹ The upstream sector refers to the exploration and production (E&P) sector of energy operations. It involves searching for, recovering, and producing crude oil and natural gas.

operations in the Russian energy market, but also to ensure the Russian government's commitment to the timely and successful completion of Phase 2 of the ESPO pipeline.

Japan and Russia have recently discussed a number of projects for Eastern Siberian downstream sector development.¹² One project (discussed during the Governor of Primorsky District Sergei Darkin's visit to Japan on 12 May 2009) involved the construction of Rosneft's planned 200,000- to 400,000-barrel-per-day refinery near the Kozmino Bay terminal. Located at the final destination point of the ESPO pipeline, this large-scale refinery would provide many economic benefits to the Russian Far East.

Gazprom has also been considering a number of projects to build gas chemical facilities in Eastern Siberia to complement the development of the area's gas resources. These large-scale projects would most likely require multilateral participation of foreign partners, including Japanese companies that have already shown interest in a joint project focusing on the construction of a gas chemical plant in the Republic of Sakha (Yakutiya) and other areas in Eastern Siberia.¹³ In November 2009, the IOC and JOGMEC signed an agreement to prepare the feasibility study for the creation of gas-to-liquid (GTL) capacity in Russia, particularly in Eastern Siberia and the Russian Far East.¹⁴ Such projects will utilise the investment and technological potential of Japanese partners, while providing them with access to the Russian downstream sector and other possible benefits of joint development of energy resources in this region.

Apart from the oil and gas sectors, Japan and Russia have also recently become engaged in bilateral negotiations on enhancing their cooperation in other fields, such as nuclear and renewable energy resources as well as environmental protection, energy efficiency and conservation. Since Russia lacks experience in these areas, except the nuclear sector, Japan could contribute its expertise, advanced technology, and know-how.

¹² The downstream sector refers to the refining of crude oil as well as the sale and distribution of natural gas and products derived from crude oil (such as liquefied petroleum gas (LPG), gasoline or petrol, jet fuel, diesel oil, other fuel oils, asphalt and petroleum coke).

¹³ "Japan, Russia's Rosneft Agree on Energy Cooperation", Reuters UK, 21 March 2008.

¹⁴ *Russia and CIS Oil and Gas Weekly*, no. 47, (26 November–2 December 2009), p. 15.

In the nuclear energy sector, Japan's Toshiba Corporation entered into a joint agreement with Russia's state-owned Atomenergoprom on 20 March 2008 to promote bilateral civilian nuclear energy projects, including joint uranium enrichment initiatives. According to the Director General of Atomenergoprom, Sergei Kiriyenko, Japanese-Russian energy cooperation in the nuclear sector would be "beneficial not only to the employees of [the two] companies, but also to users of products and services related to [the] nuclear cycle throughout the world".¹⁵ The Toshiba press release announced that the agreement would contribute to the "stable and secure supply" of nuclear fuel cycle services in Japan, the US, and elsewhere. Furthermore, it would also help strengthen the "complementary relations" that would "lead to the establishment of a bilateral strategic partnership".¹⁶

Starting in early in 2009, the Russian state nuclear corporation, Rosatom (which is the de facto Russian agency for nuclear energy and has been looking to increase Russia's participation in the growing nuclear energy market in the Asia-Pacific region) was in negotiations with the Japanese government about signing a joint cooperation agreement in the field of nuclear energy. A joint agreement, which was finally concluded during Russian Prime Minister Putin's visit to Japan in May 2009, provided for the delivery of Russian supplies of low-enriched uranium to Japan and the construction of a depot for its storage on Japan's territory, while Japan would supply Russia with advanced nuclear power plant technology in exchange. It also envisioned increasing the share of Russia's presence in Japan's nuclear energy market from its current 15% to 25% in the near future.

In addition to bilateral cooperation in the nuclear energy field, during Prime Minister Putin's visit to Tokyo in May 2009, METI and the Russian Ministry of Energy signed an MoU to boost their cooperation in the field of energy efficiency and renewable energy at the institutional

¹⁵ "Toshiba, AtomEnergoProm Sign Framework Agreement", World Nuclear News, 20 March 2008.

¹⁶ Toshiba Corporation, Press Release, "Toshiba Signs General Framework Agreement with Atomenergoprom to Explore Collaboration in Civilian Nuclear Power," 20 March 2008, http://www.toshiba.co.jp/about/press/2008_03/pr2001.htm, accessed on 12 December 2010.

(government) and private-sector levels, including the establishment of the International Partnership for Energy Efficiency Cooperation (IPEEC) and participation in a number of joint research projects and capacity-building initiatives. The MoU stressed that the two countries' cooperation in these sectors could help stabilise the overall energy balance not only in Japan and Russia, but also in the Asia-Pacific region as a whole.¹⁷ In addition, the newly established Russian Energy Agency (REA) has been actively involved in a number of joint activities for the promotion of energy efficiency and energy conservation policies with Japanese public and private organisations, including Japanese Business Alliance for Smart Energy Worldwide (JASE World); JBIC; JETRO; the Institute of Energy Economics, Japan (IEEJ); Energy Conservation Center, Japan (ECCJ); and others. On 27 October 2010, JETRO — in partnership with JBIC, REA, and Russia's Sberbank — organised a joint seminar in Moscow on "Possibilities for Enhancing Japanese-Russian Environmental Cooperation".

3.4 PROSPECTS FOR FUTURE JAPAN-RUSSIA BILATERAL ENERGY COOPERATION

Despite the remaining obstacles and political problems, Russia and Japan are moving toward a new stage in their relations. The bilateral economic ties and trade relations have been dramatically improving, and the two countries have been expanding their cooperation in various sectors of the energy field. The governments of the two countries have come to realise that further development of complementary economic relations with each other, focusing on energy development in Russia's Eastern Siberia and Sakhalin, as well as improvement of mutual ties in all other areas, is critically important to both Russia and Japan. In addition to the realisation of the mutually beneficial aspects of improved bilateral relations, another factor that could bring the two countries closer together is the political and economic expansion of China in the Asia-Pacific region, which has caused

¹⁷ The full text of the MoU is available at the Ministry of Energy of Russian Federation webpage (in Russian), <http://minenergo.gov.ru/documents/soglasheniya/1145.html> [Accessed 20 October 2009].

growing concerns in both Japan and Russia. As such, full normalisation of Japanese-Russian relations is a welcome development that would greatly contribute to the economic and political stability as well as energy cooperation and security of the entire Asia-Pacific region.

The Russian Energy Strategy to 2030 adopted by the Russian government in November 2009 stressed the importance of energy cooperation with many foreign economic partners, including Japan, which represent a lucrative export market for Russian crude oil, nuclear fuel, natural gas, and LNG, as well as petrochemical products. Presently Russia views its political presence in the Asia-Pacific region (via APEC; the annual meeting in 2012 will be held in Vladivostok) as very important and regards the Asia-Pacific market as one of the most attractive due to its growing energy demand (including crude oil and LNG), stable energy prices, great potential for growth, and other business and cooperation opportunities in the field of energy.

The most recent successful developments in bilateral energy cooperation were the inauguration of the Prigorodnoye gas liquefaction plant in late March 2009 under the Sakhalin-2 project and the December 2009 launch of the Kozmino Bay oil terminal under the ESPO pipeline project. They were important milestones that helped bring Japanese-Russian energy cooperation to a new level, marking the beginning of large-scale energy exports from Russia to Japan and opening Russia's access to Asia-Pacific markets.

The growing interest within Japanese business circles in ongoing and planned projects in Russia's Far East and Eastern Siberia underscores the view that the energy resources of these nearby regions could serve as an important strategic reserve for Japan in its quest to secure long-term supply sources. In addition, a number of new opportunities for potential bilateral cooperation have recently presented themselves with the two countries adopting more assertive policies in the fields of energy conservation and efficiency, promotion of nuclear and renewable energy resources, and advancement of clean energy technologies with the aim to address worldwide concerns about climate change and environmental protection.

The growing Japan-Russia economic ties and energy cooperation have been welcome developments, given that the two countries' relations have been historically tainted by their outstanding political problems. Today, the international circumstances as well as present political and economic situation in the two countries' relations seem to favour the development

and feasibility of their energy cooperation. Unlike during the ideology-driven Cold War, the problems related to the acquisition of funds for project financing or technological assistance are no longer subject to political considerations or the objections of strategic allies. However, the two countries are presently facing the necessity of building political trust with each other and focusing on finding mutually acceptable solutions to their remaining hurdles.

Although ideological disagreements no longer seem to affect Japanese-Russian cooperation, political tensions (including the unresolved territorial dispute) and a lack of clear and constructive long-term policies toward each other continue to cast a shadow over their economic relations, including their energy cooperation. As Dmitri Trenin and Vasily Mikheev of the Moscow Carnegie Center point out in their report, "Russian and Japanese leaders need to recognise that not having any form of a solution to the territorial problem could harm both countries, at the very least in the form of failed opportunities and untapped potential".¹⁸

Thus, despite expanding their bilateral trade and energy cooperation, Japan and Russia are yet to maximise and exploit the fruits of their full-fledged energy cooperation. The remaining problems and concerns may delay or put the feasibility of the proposed joint development initiatives and projects at risk. In order to boost the chances for the realisation of bilateral energy projects, the following issues, in addition to the outstanding political problems such as the territorial dispute, have to be addressed as effectively as possible:

- **Short- to medium-term issues:** Russia's prohibitive tax regime, lack of transparent business environment and effective regulatory regime; shortage of large-scale capital investment and other project financing problems; shortage of necessary technology and equipment as well as a skilled labour force; lack of infrastructure, difficult weather/climate conditions in Russia, and great distances.

¹⁸ D. Trenin and V. Mikheev, "Russia and Japan as a Source for Mutual Development: A 21st -Century Perspective on a 20th-Century Problem" (Carnegie Endowment for International Peace, Moscow Center, 2005), p. 19.

- **Long-term issues:** Russia's endemic corruption, prohibitive tax regime, and lack of efficient structure in energy strategy (especially vis-à-vis foreign investors); domestic and international political tensions (possibly for both Russia and Japan); Japan's cautious business tactics in Russia; the rising cost estimates of joint projects; energy market fluctuations (such as staggering demand and/or inefficient supply); and others.

Notwithstanding the fact that Russia would greatly welcome Japanese investment and technology for the development of Sakhalin and Siberian energy resources, the Japanese government, citing a lack of progress on the Kuril territorial dispute, has been displaying a cautious attitude toward increased participation by Japanese firms in Sakhalin and expansion of their partnership with Gazprom, thereby adhering to a wait-and-see approach for the time being.

On 25 November 2009, it was reported that the Institute of Marine Geology and Geophysics of the Russian Academy of Sciences (Far Eastern branch) had recently published a report on the geological potential of the oil and gas reserves in the Middle Kuril curve, which stretches between the disputed islands of Shikotan and Kunashir. While the news of potentially large oil and gas reserves (estimates stand at 1.2–1.6 billion tonnes of fuel equivalent¹⁹) are welcome in Russia, particularly in the Sakhalin region, it may raise many concerns in Japan that the likelihood of the return of the disputed islands may now be greatly undermined. While the report strongly recommended the Russian government look seriously at the matter, if the two countries could move beyond their political contentions, this discovery might present a unique opportunity for them to put their efforts together for a joint geological study and future development of the Kuril resources.

Furthermore, President Dmitry Medvedev's brief visit to Kunashir (one of the disputed Kuril Islands) on 1 November 2010 only added to the existing bilateral tensions. This visit had a special significance not only because it was the first official visit to the disputed territory by the top leader in the history of the Soviet Union and Russia, but also because,

¹⁹ See *Russia and CIS Oil and Gas Weekly*, no. 46, (19–25 November 2009), p. 11.

while in Kunashir, President Medvedev announced that the Russian government would provide necessary investment to boost local economic development in the Kuril Islands. While the Russian government insisted that there was no connection between the President's visit to Kunashir and Russian-Japanese relations, the Japanese government reacted immediately by issuing an official protest and even temporarily recalling the Japanese ambassador from Moscow. The conservative circles in Japan, citing the Japanese government's inability to reach a common understanding with Russia on the territorial issue, have begun pressuring the government to review Japan's economic relations with Russia until there is a breakthrough on the territorial issue.²⁰

Notwithstanding the ongoing tensions in their political relations, the top leaders in both Japan and Russia managed to prevent the recent conflict from escalating. While "agreeing to disagree" on their respective positions in the Kuril dispute, they chose to focus on future mutual benefits for both nations. When Prime Minister of Japan Naoto Kan met with the Russian President on the sidelines of the recent APEC summit meeting in Yokohama on 13 November 2010 (Figure 3), the two leaders reiterated their will to build a stable trust-based relationship between their countries and resolved to boost their economic cooperation, which in turn would help improve their political relations focusing on the Kuril territorial dispute. They also agreed to hold a summit meeting early next year in Russia to continue their bilateral talks for the conclusion of a peace treaty.²¹

The search for solutions to the aforementioned outstanding problems requires effective and timely issue-specific approaches introduced at the government level in Japan and Russia. Furthermore, in order to effectively overcome the obstacles and minimise the associated risks, it is essential for the two countries' leaders, through their political will and determination, to continue their diplomatic dialogue, while striving to expand bilateral relations in all spheres. If they succeed in their efforts, there would be a greater chance for full-fledged Japanese-Russian cooperation that would greatly benefit both countries. In this respect, Japanese-Russian energy

²⁰ Yuka Hayashi and Gregory L. White, "Visit Pits Japan, Russia", *The Wall Street Journal*, 2 November 2010.

²¹ "Kan, Medvedev Discuss Disputed Isles", *Japan Today*, 13 November 2010.

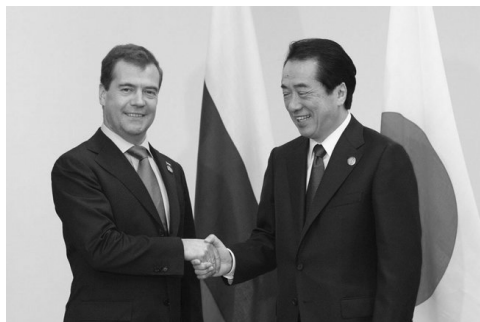


Figure 3 Japanese PM Kan and Russian President Medvedev at the November 2010 APEC Meeting in Yokohama, Japan.

Source: “Meeting with PM Naoto Kan: APEC Summit in Yokohama.” Official Website of the Russian President. November 13, 2010. <<http://www.kremlin.ru/visists/9506>>. Accessed on December 14, 2010.

collaboration has a lot of potential based on complementary needs realised in a number of ongoing and prospective projects. Russia and Japan are important players in the world energy market, particularly in the Asia-Pacific region. A successful energy collaboration between the two countries would not only serve their respective economic and energy needs, but would also improve their bilateral ties as a whole. Finally, it would contribute greatly to the strengthening of energy security and cooperation in the Asia-Pacific region.

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CHAPTER 4

ENERGY-RELATED POLICY ISSUES IN TERMS OF JAPAN-CHINA RELATIONS

Yuji Morita

4.1 INTRODUCTION

The People's Republic of China celebrated its 60th anniversary on 1 October 2009. It was in October 1949, 60 years ago, when Mao Zedong announced the founding of China at the Tiananmen Square in Beijing. The first 30 years after the founding of China were marked by many political conflicts caused by the Cultural Revolution initiated by Mao Zedong with the aim of establishing a socialist system and thereby increasing productivity. As a result, the country became ravaged instead. With the death of Mao Zedong in September 1976 and the end of the Cultural Revolution, a new political direction was adopted with an emphasis on economic growth.

The reform and opening-up policies initiated by Deng Xiaoping, a realist who consolidated his leadership in December 1978, virtually abandoned socialist ideas. In order to rebuild the national economy ruined by the Cultural Revolution, China began exporting its vast energy resources

as a means of obtaining foreign currencies. Against this background, oil accounted for approximately 20% of its total exports in the early 1980s. At the same time, China promoted opening-up and took measures to build its domestic industry.

For Japan, which needs to import vast quantities of energy from overseas, the first oil crisis was an event that increased the importance of China as a new oil supply source. It took place immediately after Japan had established diplomatic relations with China in 1972 following the end of the Second World War in 1945 and the Korean War in 1953. In 1979, Japanese oil companies started oil exploration and development activities in China to look for Chinese oil resources.

In China, as a result of the belt-tightening policies adopted to restrain rapid liberalisation, the Tiananmen Incident took place in June 1989 in which the army killed students and civilians. However, thereafter, reform and opening-up continued. The dissolution of the Soviet Union in 1992 provided an opportunity for China to pursue a market economy. With an expansion of scope of the opening-up policies, together with a surge in direct investment from overseas, China entered into a new era and came to enjoy double-digit economic growth. The gross domestic product per capita rose from \$190 in 1978 to \$3,266 in 2008.

With economic development, energy consumption also increased. Although its domestic oil resources were being explored and developed with utmost effort, the demand for oil came to exceed its domestic production. Its scarce natural gas resources could not make up for the lack of domestic oil supply. As a result, China became a net oil importer in 1993. As for coal, domestic coal resources are abundant, but the transport capacity of the railway to carry coal to the market was poor. Therefore, it became necessary to invest and expand the railway transport infrastructure.

Under these circumstances, it became a critical issue for China to ensure energy resources — stable oil supply in particular — to sustain its economic development. At about the same time, the Japanese Prime Minister paid a visit to the Yasukuni Shrine, where those soldiers who died in the Second World War are commemorated and worshiped. This resulted in the rapid deterioration in Japan-China relations. Japan and China competed against one another to secure energy resources abroad and had turbulent relations with occasional serious confrontations.

In the August 2009 general election, the Democratic Party of Japan (DPJ) defeated the long-governing Liberal Democratic Party (LDP). With the change of the Japanese government, relations between Japan and China improved once again. It seems that both countries are trying to promote energy savings through technical cooperation and looking for ways to consolidate the bilateral relations in the international fight against global warming.

4.2 CHINA'S ENERGY DEMAND

4.2.1 Energy Consumption in China

Energy consumption in China is increasing sharply, reflecting its high economic growth in recent years. Its average annual growth rate from 1990 to 2007 was 5.9%, which substantially exceeded the world average of 1.9%. The annual growth rate from 2000 to 2007 was 10.2% and the amount of its energy consumption reached 1,761 million tonnes of oil equivalent (Mtoe) in 2007. China became the second-largest energy consumer in the world, after the United States (Figure 1).^{1,2}

The breakdown of energy consumption by source indicates that coal had a very large share of total energy consumption in 2007, i.e. 73.0%. Among other energy sources, oil accounted for 20.2%, natural gas for 3.4%, nuclear energy for 0.9%, and hydropower for 2.4%. The amount of natural gas consumption was not substantial. In terms of the growth rates since 1990, China has seen a high growth in the consumption of oil, natural gas, and hydropower — 7.1%, 9.4%, and 8.2%, respectively — against the 5.4% growth in coal consumption. Since its introduction in 1993, the

¹ On the other hand, energy consumption in Japan has remained more or less unchanged for several years, due to the economic slowdown and as a result of the implementation of energy-saving measures. The average annual growth rate from 1990 to 2007 was 0.9%. The annual growth rate since 2000 has been -0.1%.

² 1 Mtoe equals 1 million tonnes of oil. 1 toe = 1×10^7 kcal. The data used in this paper are primarily from the *Energy Balances of Non-OECD Countries and Energy Balances of OECD Countries* compiled by the IEA. The data, however, do not include non-commercial energy consumption in non-OECD countries.

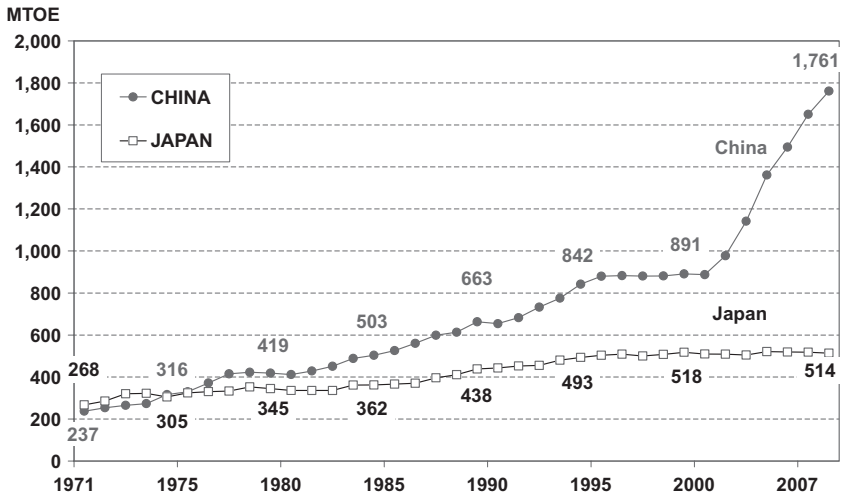


Figure 1 Primary Energy Consumption in China and Japan

Source: IEA, *Energy Balances of Non-OECD Countries*; *Energy Balances of OECD Countries*.

consumption of nuclear power has increased at a rate of nearly 30% per year (Figure 2).³

4.2.2 China's Energy Output

With regard to China's energy production, it produced 32 million tonnes of coal in 1949. The oil output was merely some 120,000 tonnes (2,400 barrels per day). In 1978, when the reform and opening-up began, China produced 618 million tonnes of coal and 104.05 million tonnes of oil (2.09 million barrels per day). Since then, its energy production had increased to produce 2.793 billion tonnes of coal and 190.02 million tonnes of oil (3.82 million barrels per day) in 2008. Production of coal, oil, and natural gas in 2008 was 4.5 times, 1.8 times, and 5.9 times the production in 1978, respectively. Capacity of the electric power facilities and the production of electricity had also increased by 13.9 times and 13.5 times,

³The breakdown of energy consumption by source in Japan indicates that oil accounts for 44.8%, coal for 22.3%, natural gas for 16.2%, nuclear power for 13.4%, and hydropower for 1.2%. The growth rate since 1990 in consumption of oil was -0.5%, coal 2.5%, natural gas 3.8%, nuclear power 1.6%, and hydropower -1.1%.

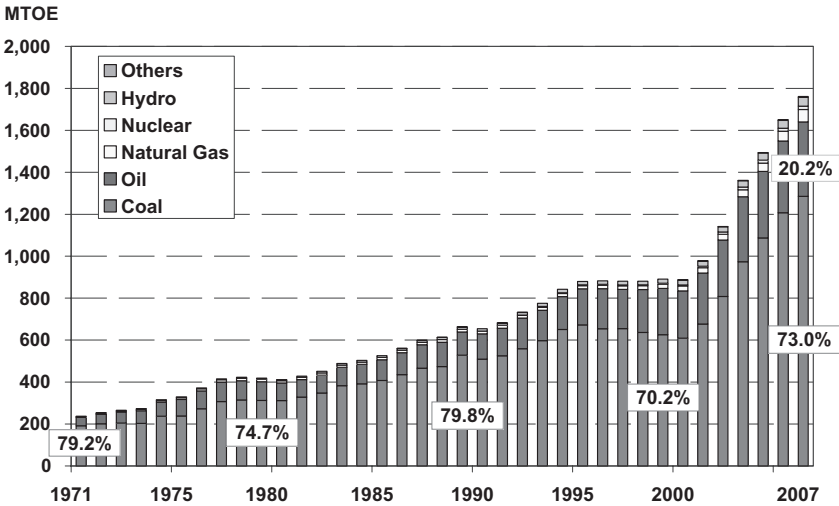


Figure 2 China's Primary Energy Consumption by Energy Type

Source: IEA, *Energy Balances of Non-OECD Countries*; *Energy Balances of OECD Countries*.

Table 1 China's Energy Production

		1949	1978	2008
Coal	Million Ton	32	618	2,793
Oil	Thousand Ton	120	104,050	190,020
	Thousand B/D	2.4	2,090	3,820
Natural Gas	Million m3	10	13,730	80,510
Power Generation Capacity	GW	1.85	57.12	792.53
Electricity Production	Twh	4.3	256.6	3,466.9

Source: National Bureau of Statistics of China, *China Statistical Yearbook*; Statistical Communiqué of the People's Republic of China on the 2008 National Economic and Social Development, 26 February 2009; and others.

respectively. This indicates that an increase in energy output corresponds to the growth of the economy (Table 1).⁴

⁴On a global scale, China is the fifth-largest oil producer after Saudi Arabia, Russia, the United States, and Iran, and it is the biggest coal producer. China is also on the list of the 10 biggest natural gas producers.

4.2.3 Energy Supply and Demand

If a country's self-sufficiency ratio is to be calculated by dividing domestic energy output by domestic energy consumption, China's energy self-sufficiency rate became less than 100% in 2002 and continued to decline since then to 92% in 2007. In other words, it has had little energy export capacity in recent years. Instead, China has become dependent on import for certain energy sources. Although it produces sufficient coal to meet domestic demand, China depends on imports for oil and natural gas. As at 2008, China is 53% self-sufficient in oil and 98% self-sufficient in natural gas (Figure 3).

4.3 CHINA'S DEMAND FOR OIL

4.3.1 Development of Domestic Oil Resources

The biggest slogan in the exploration and development of domestic oil resources in China is "Stabilise the East, Develop the West". Most of the oil output is from oil fields in the eastern part of China, e.g. Daqing,

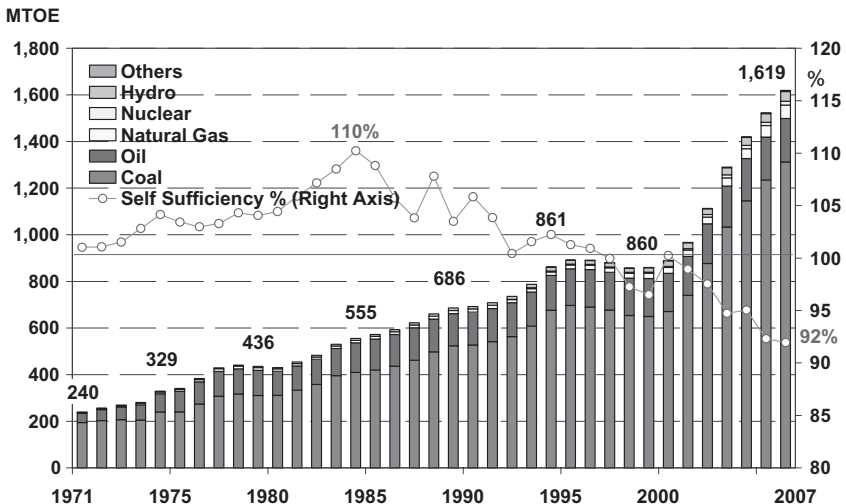


Figure 3 China's Energy Production

Source: IEA, *Energy Balances of Non-OECD Countries*.

Liaohe, and Shengli Oil Fields. However, as these major fields have been in operation for quite a number of years, their output capacity has already passed their peak. Thus, China is struggling to maintain the productivity and to extend the life of these mature oil fields.⁵

Exploration of oil resources in the western part of China started in the 1950s. Though exploration activity began with assistance from the former Soviet Union, it was fatally dashed in the face of the deterioration of Sino-Soviet relations and the Cultural Revolution in the 1960s. During the period from 1983 to 1988, full-scale exploration work was resumed, with a focus on the development of resources in the three basins in Xinjiang Uyghur Autonomous Region, i.e. Jungar, Tarim, and Turpan Basins, as well as in the Ordos Basin in Gansu Province. In 2008, the output of China National Petroleum Corporation (CNPC) at Xinjiang Oil Field (in the Jungar Basin), Tarim, Turpan-Hami, and Changqing Oil Fields (in the Ordos Basin) accounted for 18% of China's total oil production, a substantial increase from 10% in 1995 and 13% in 2000. In particular, from 2007 onwards, the output at both Xinjiang and Changqing Oil Fields exceeded the production at the Liaohe Oil Field (Figure 4).

The majority of onshore oil and gas field exploration and development projects in China have been carried out by CNPC. China National Offshore Oil Corporation (CNOOC), founded in 1982, has been in charge of offshore oil fields. China Petrochemical Corporation (Sinopec), also founded in 1982, has been in charge of the downstream oil sector, i.e. oil refineries, marketing, and petrochemical plants. CNPC used to be placed under the supervision of the Division of Energy — the equivalent of the Ministry of Energy — which was abolished in March 1993 and then came under the direct supervision of the State Council. As part of the restructuring of the oil industry associated with the administrative reforms in 1998, CNPC exchanged some of its oil fields and refineries for those of Sinopec, whereby two major oil groups in charge of all sectors of the industry, from

⁵For example, the Daqing Oil Field, which began production in 1959 and which had maintained a capacity of over 50 million tonnes per year during the period from 1979 to 2003, produced only 40.20 million tonnes (approx. 800,000 barrels per day) in 2008. The combined output at these three top oil fields in 2008 accounted for 42% of the total oil production, a substantial decline from 68% in 1995 and 59% in 2000.

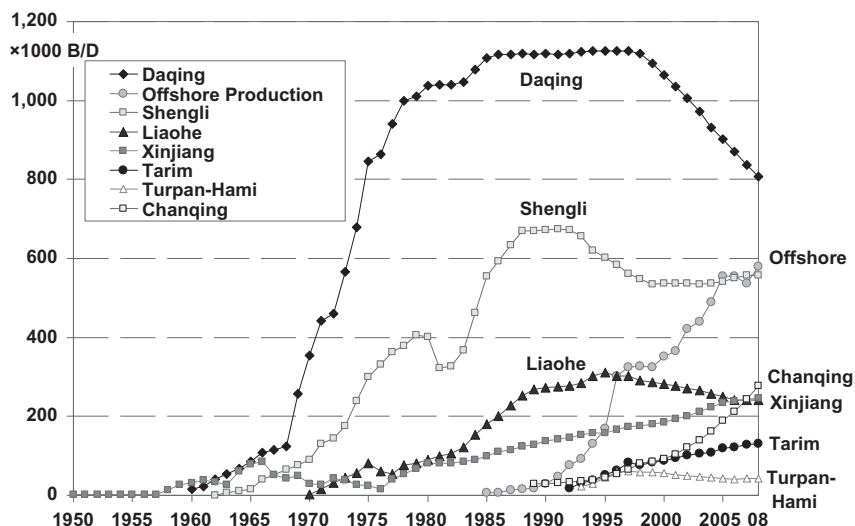


Figure 4 China's Petroleum Production from Major Oil Fields

Source: Compiled based on China's Council of International Petroleum Economics, *International Petroleum Economics Monthly*.

field exploration to refining and marketing, were created in July 1998. Through this mutual exchange of assets, Sinopec acquired the Shengli Oil Field in the Bohai Bay Basin.

CNOOC is mainly in charge of offshore crude oil and natural gas exploration and development.⁶ Offshore oil output is increasing, especially in the Bohai Bay area, with the discovery of the Peng Lai Oil Field by ConocoPhillips in 1999. Thereby the share of CNOOC in China's total oil output increased from 6% in 1995 to 11% in 2000 and 15% in 2008.⁷

⁶At the moment, all of China's state-owned oil companies are able to obtain a license for both onshore and offshore exploration and development. However, against the historical background of onshore exploration and development above a depth of 5 m being allocated to CNPC and offshore exploration and development below a depth of 5 m to CNOOC, onshore development is mainly done by CNPC (PetroChina) and offshore by CNOOC.

⁷The output of CNOOC in 2008 was 195.4 million barrels of oil equivalent (boe), a 14% increase from 2007. CNOOC built the 240,000 b/d Huizhou refinery in China's southern Guangdong Province. The refinery is designed to process sour, heavy crude from

A priority mechanism has been set for drawing foreign investments into China's oil industry. The utmost priority has been given to offshore oil field exploration and development projects that have the largest amount of risk, followed by onshore oil field exploration and development projects, joint venture refineries, oil terminals, the wholesale sector, and lastly the retail sales sector of the industry. The government has granted PetroChina (a holding subsidiary of CNPC) and Sinopec the rights to conclude an onshore oil agreement with foreign companies, and granted CNOOC the rights to conclude an offshore oil agreement with foreign companies.⁸

4.3.2 Oil Imports

China imported 178.9 million tonnes (3.59 million barrels per day) of crude oil in 2008, a 9.6% increase from 163.2 million tonnes (3.28 million barrels per day) in the previous year. Together with its imports of petroleum products of 41.5 million tonnes (0.83 million barrels per day), 51% of China's oil consumption depends on imports. On the other hand, it exported 3.73 million tonnes of crude oil (75,000 barrels per day) in 2008, a 2.5% decrease from 3.83 million tonnes (77,000 barrels per day) in the previous year. As a result, the net import amount in 2008 was 198.9 million tonnes (4.00 million barrels per day), a 9.7% increase from 181.4 million tonnes (3.64 million barrels per day) in the previous year (Figure 5).

With the increase in its crude oil imports, it has become a critical issue for China to secure a stable supply of imported oil. According to the 2008 data on the crude oil import share per region, the Middle East supplied 50.1% of China's total imports, with 20.3% of the total (730,000 barrels per day) coming from Saudi Arabia. In 2005, the Middle East region

CNOOC's offshore blocks in China's northern Bohai Bay. It began commercial operations in May 2009.

⁸In October 1993, international bidding took place for five areas in the Tarim Basin in the western part of China, whereby onshore oil-prospecting areas were opened to foreign capital for the first time.

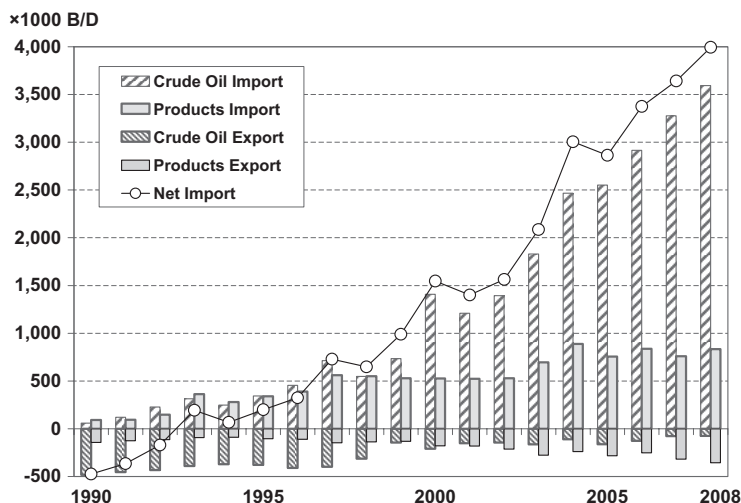


Figure 5 China's Petroleum Balance

Source: Compiled based on China's Council of International Petroleum Economics, *International Petroleum Economics Monthly*.

supplied 47.2% of the total oil imports. China is becoming more and more dependent on the Middle Eastern oil supply. Crude oil from the Middle East includes imports from Iran, which is placed under international sanctions for its nuclear programme. China's petroleum import volume from Iran reached 428,000 barrels per day in 2008, 11.9% of its total oil imports.⁹

The second-biggest source region is Africa, providing 30.2% of the total crude oil imports in 2008. The breakdown shows that Angola supplied 600,000 barrels per day, taking the second-biggest share of 16.7% after Saudi Arabia in China's total crude oil imports. Sudan, which

⁹ Sinopec entered into a US\$2 billion memorandum of understanding with Iran in 2004 for the development of the Yadavaran Field. Sinopec converted it into a contract in December 2007. The first-phase production rate target is 85,000 b/d by 2011, which ultimately is believed to be 300,000 b/d. First production from Yadavaran came on stream in the middle of 2009 at a rate of 20,000 b/d. In August 2009, Sinopec secured a \$3 billion refining deal with the state-owned National Iranian Oil Products Distribution Company (NIOPDC) to construct a 360,000 b/d Greenfield refinery and upgrade the Abadan refinery's current 460,000 b/d nameplate capacity by 2013.

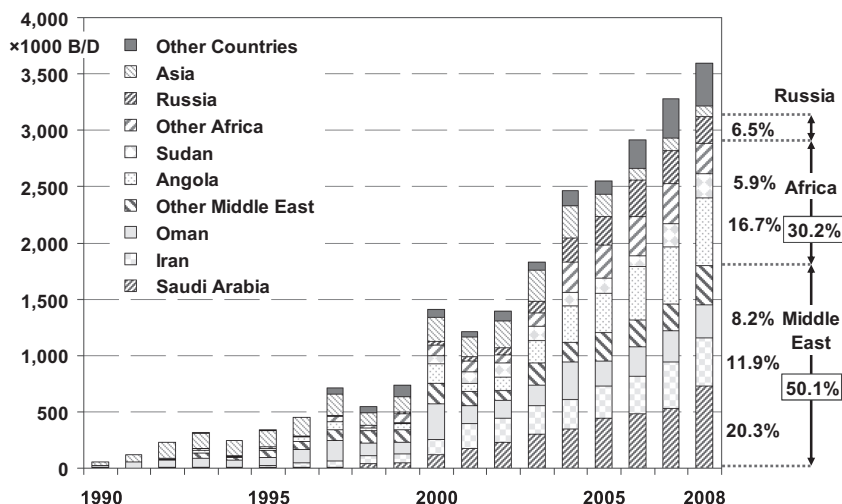


Figure 6 China's Crude Oil Imports

Source: Compiled based on China's Council of International Petroleum Economics, *International Petroleum Economics Monthly*.

provoked an international outcry over genocide in its Darfur region, also supplied 211,000 barrels of crude oil a day, 5.9% of the total imports. It was a substantial increase from 133,000 barrels a day in 2005 (Figure 6).¹⁰

One of the elements which have given rise to the situation described is the loss of exporting capacity by traditional major oil supply countries in Asia, such as Vietnam, Malaysia, and Indonesia, while Chinese oil imports continued rising every year. In recent years, in addition to imports from the Middle East and Africa, oil imports from Russia have been increasing. The import amount in 2008 was 234,000 barrels per day, accounting for 6.5% of the total oil imports. There used to be no pipelines between the two countries, and as such, under the supply contract entered into in January 2005 between Rosneft and CNPC, China's crude imports

¹⁰ CNPC has a 40% equity interest in the Heglig and Unity Oil Fields in Blocks 1, 2, and 4 and in producing Nile Blend crude oil. CNPC, Sudapet (Sudan's national oil company), and other international investors have also produced crude oil from Blocks 3 and 7 since 2006. CNPC pumps oil from the Fula Oil Field as an operator and sends the oil through a pipeline to the 100,000 b/d Khartoum refinery, a 50:50 joint venture between CNPC and Sudapet.

were all delivered by railway via major rail loading facilities in two Sino-Russian towns, Zabaikalsk and Naushk.¹¹ In November 2007, an agreement was reached between Russia and Kazakhstan to transport 100,000 barrels of Russian crude oil per day to China via the Atasu-Alashankou pipeline. In 2008, TNK-BP and Gazprom Neft began crude shipments to China from their facility in West Siberia through this pipeline.

4.3.3 Overseas Equity Procurement

CNPC and Sinopec, both state-owned oil companies with strong support from the government, have been actively looking for overseas oil resources. In recent years, CNOOC has also taken steps to expand overseas. Some examples of their activities in recent years are as follows:

- In June 2009, Sinopec bought Swiss oil giant Addax Petroleum for C\$8.27 billion (US\$7.2 billion). Addax Petroleum has oil operations in West Africa and the Middle East. It produced in West Africa, including Nigeria, 134,700 barrels of oil per day during the first quarter of 2009. However, the Iraq government decided in October 2009 to strip Sinopec of the right to take part in a second round of bidding for its major oil fields, on the grounds that Addax Petroleum was developing the Taq Taq Oil Field in Iraq's autonomous Kurdish region. The central government of Iraq has branded all Kurdistan Regional Government oil contracts illegal. The large-scale acquisition strategy by Sinopec is causing some friction.
- In July 2007, together with CNOOC, Sinopec also bought a 20% stake in an Angolan offshore deepwater block from US oil major Marathon Oil. The offering price is estimated to have been \$1.3 billion. CNPC also proposed in July 2009, together with CNOOC, to bid an estimated \$17 billion for Spanish oil major Repsol YPF's Argentinean unit.

¹¹The contract provided for Rosneft to supply 366.5 million barrels of crude oil to China till 2010. It was renewed in February 2009 and Rosneft expects to supply 300,000 barrels of crude oil per day to China under the new deal beginning in January 2011 for 20 years. In return, China Development Bank agreed to loan to Rosneft and pipeline company Transneft \$15 billion and \$10 billion, respectively, over a 20-year period.

- In May 2009, PetroChina acquired Keppel Corporation's entire 45.51% stake in Singapore Petroleum Company (SPC) for \$1.02 billion, a 24% premium to SPC's closing price. PetroChina acquired more shares in SPC and boosted its stake in this Singaporean company to 70.13% in July 2009. SPC is an energy company involved in refining as well as exploration and production of petroleum in Indonesia, Vietnam, Australia, and China. Singapore Refining Company (SRC), a joint venture between SPC and Chevron and in which SPC has a 50% stake, has a total capacity of 290,000 barrels per day. It is one of the three major petroleum refiners in Singapore, the other two being ExxonMobil and Shell.
- Furthermore, in September 2009, China Investment Corp. (CIC), a sovereign wealth fund responsible for managing China's huge foreign exchange reserves, purchased 11% of the global depository receipts of Kazakhstan-based KazMunaiGas Exploration & Production (KMG EP) for \$939 million. KMG EP is a subsidiary of the National Company KazMunaiGas (NC KMG) and is involved in exploration and development. The government of Kazakhstan offered 39% of KMG EP's shares in 2006. The output of KMG EP in 2008 reached 11.95 million tonnes.

4.3.4 Measures to Secure Oil and Gas Transportation Routes

As noted earlier, the Middle East and Africa accounted for 50% and 30%, respectively, of China's total oil imports in 2008. The majority of these oil imports are transported by tanker vessels from the Strait of Hormuz through the Indian Ocean via the Strait of Malacca to the Chinese coast. These sea lanes, via the politically unstable Strait of Hormuz in the Middle East and the busy Strait of Malacca, are making it more and more difficult for very large crude carriers to go through. These choke points pose an extremely high risk for China in its efforts to secure a stable crude oil supply.¹²

¹²The Strait of Malacca links the Indian Ocean to the South China Sea and Pacific Ocean. It is the shortest sea route between oil-producing countries in the Persian Gulf and oil-consuming countries in Asia. The Strait of Malacca is only 2.7 km wide at its narrowest

This is why measures are being implemented to secure onshore transportation routes in addition to offshore routes, including a shift in transportation medium of Russian crude oil from railway to pipeline and the construction of a new pipeline transportation route in Xinjiang Uyghur Autonomous Region to import Central Asian crude oil from Kazakhstan and others. In addition, in order to avoid transportation via the Strait of Malacca, consideration is being given to develop a pipeline transportation route from Myanmar to Kunming in Yunnan Province in China. In June 2009, CNPC and Myanmar's Ministry of Energy signed a memorandum of understanding on the joint development of the 771 km cross-country pipeline that will ultimately have an annual transmission capacity of 22 million tonnes (440,000 barrels per day).

As for natural gas transportation, a gas pipeline is under construction by CNPC from Turkmenistan via Uzbekistan and Kazakhstan to China. Construction in Uzbekistan and in Turkmenistan was completed in September and October 2009, respectively. The length of the pipeline is 188 km in Turkmenistan, 530 km in Uzbekistan, and 1,300 km in Kazakhstan. The pipeline has the capacity to transport up to 40 billion cubic metres of natural gas annually. The whole pipeline will be completed in December 2009, and the CNPC plans to construct a 4,500 km pipeline in China for the second stage of the project.

4.3.5 Strategic Oil Reserves

Oil stockpiles are important in order to respond to emergencies. The government plans to increase its strategic petroleum reserve by 2.6 times to 270 million barrels over five years. The construction of the four first-phase national oil stockpile terminals located in Zhejiang Province and others began in 2003 and were nearly completed in 2009. These terminals have been filled

point, which creates an opportunity for shore-based pirates to attack vessels. As Japan's economy heavily depends on the safe passage of vessels through the Strait, Japan has long cooperated with Singapore, Malaysia, and Indonesia in the area of navigation safety through joint research, sharing of equipment, mapping water depth charts, training, etc. Japan has also aided civilian law enforcement capabilities through its Coast Guard vessels. Japanese Coast Guard vessels have patrolled and carried out joint exercises with civilian maritime counterparts.

with 120 million barrels of crude oil.¹³ The second phase of the work will commence before the end of 2009 in eight locations to construct national oil reserve terminals. Their total capacity will amount to 169 million barrels, with an estimated investment of \$4.39 billion. With the completion of the first phase of construction of strategic oil reserves, China came to have a 20-day supply of crude oil stockpiles. The government plans to have enough strategic oil reserves to last 90 days, on a par with other developed countries.

4.4 TRADE WITH JAPAN

4.4.1 Resumption of Trade between Japan and China: L-T Trade

In 1949, when the People's Republic of China was founded, Japan was occupied by the Allied Forces and was under the control of the General Headquarters (GHQ). Japan was not granted the authority to decide whether to recognise the Republic of China (Taiwan) or the People's Republic of China (China) as a sovereign state. In September 1951, the San Francisco Peace Treaty between the Allied Forces and Japan was signed in San Francisco by 49 nations. At the same time, the Security Treaty between Japan and the United States was also signed, whereupon Japan built an alliance with the United States.¹⁴

The Korean War broke out in June 1950 and the Chinese troops intervened in October the same year. Therefore, it became impossible to have formal contact with China and only unofficial exchanges through the Japan-China Friendship Association established in 1950 remained. In December 1950, a total ban was placed on exports to China, though some representatives in the Japanese government strongly argued that trade relations with China should be maintained.¹⁵

¹³These terminals are located in Zhenhai and Zhoushan in Zhejiang Province, in Huangdao in eastern Shandong Province, and Dalian in northeastern Liaoning Province.

¹⁴As a result, it would not be an option for Japan to establish diplomatic relations with Communist China, i.e. People's Republic of China. The Sino-Japanese Peace Treaty was signed in 1952 between Japan and Taiwan (Republic of China).

¹⁵In May 1945, bodies such as the Japan-China Trade Promotion Association and the Parliamentary Leagues for the Promotion of Trade between Japan and China came into

With the ceasefire that ended the Korean War being reached in July 1953, both houses of the Diet, i.e. the House of Representatives and the House of Councillors, adopted a “resolution favouring an increase of trade with the People’s Republic of China”. In October the same year, the second Japan-China private trade agreement was concluded, whereby trade with China at the private-sector level commenced. However, in the wake of the Nagasaki National Flag Incident in May 1958, China strongly criticised the action taken by the Japanese government in response to the incident and trade between Japan and China was completely severed for two and a half years.¹⁶

On the basis of the separation of politics and economics, a theory of separating political interests from economic interests, Japan continued negotiations for reopening trade. However, China did not concede the principle of non-separation of politics and economics. After the collapse of the Kishi administration, which had practised hard-line policies towards China, the Ikeda administration took office in July 1960 and actively explored the possibilities of reopening trade between Japan and China. In response, Zhou Enlai, the Premier of China, announced the “Three Principles of Trade”, which paved the way for the resumption of trade on the basis of the so-called “friendly trading companies formula”.¹⁷

A Memorandum on Comprehensive Trade between Japan and China signed in November 1962 was a semi-private, long-term barter formula. This memorandum was signed by Tatsunosuke Takasaki of the Liberal Democratic Party, who led the Economic Mission to China, and Liao Chengzhi, Chairman of the Asia and Africa Unity Committee of China.

being. In June 1952, Japan-China Trade Promotion Association members visited Beijing. They signed the first Japan-China private trade agreement against the policy of the Japanese government, which caused much controversy.

¹⁶ Mobs belonging to a rightwing Japanese political group stormed a Chinese products fair held in the city of Nagasaki and dragged down and caused damage to a Chinese national flag.

¹⁷ Trade agreements on a government-to-government level (all agreements can provide security only when signed by both governments), contracts on a private basis, export of specific items by special arrangement from China to Japan.

This agreement was called “L-T Trade” after their surnames.¹⁸ The L-T Trade Agreement also functioned, to a certain degree, as an official point of contact between Japan and China for negotiations until the normalisation of relations in 1972.

Under the L-T Trade Agreement, the scope of trade activities between the two countries expanded at once to reach a total of US\$200 million in 1966, accounting for over one third of total trade between Japan and China. In 1968, one year after the expiration of the five-year L-T Trade Agreement period, the Sino-Japanese Memorandum Trade Meeting Communiqué was signed, and thereafter a memorandum was signed every year by representatives of both countries in charge of negotiations. This trade relation continued until 1973, one year after the normalisation of relations, and played a role in promoting economic exchanges between Japan and China.

4.4.2 Normalisation of Relations between Japan and China

In the late 1950s, with the campaign against Stalin by Nikita Khrushchev, Premier of the Soviet Union, relations between the Soviet Union and China deteriorated over ideological differences as well as territorial issues. In 1969, tensions between the two countries culminated in armed clashes over Damansky Island located on the Ussuri River on the border between the two countries, raising the spectre of an all-out war between China and the Soviet Union. Mao Zedong, Chairman of the Communist Party of China, ready to confront the Soviet Union, approached the United States for a closer partnership. This resulted in the visit of US President Richard Nixon in 1972 to China as a step in improving relations between the United States and China.¹⁹

¹⁸ Japan would export chemical fertilisers, steel, pesticides, agricultural machinery, plants, etc. China would export coal, iron ore, maize, beans, etc. The period from 1963 to 1967 was the first five-year trade period, aimed at an average annual trade of £36 million. Although there was no formal diplomatic relation between the two countries, liaison offices were set up, through which semi-private trade was carried out with government guaranteed loans. Large-scale plants, such as Baoshan Iron & Steel and Daqing Petrochemical Company, were granted long-time credit under this L-T Trade Agreement.

¹⁹ US President Richard Nixon visited China in February 1972 at the invitation of Premier Zhou Enlai of the People's Republic of China. He met with Chairman Mao Zedong of the

In these circumstances, the question of normalisation of Sino-Japanese relations became a major issue for general elections within the Liberal Democratic Party, pro-American conservative administration. In 1972, Kakuei Tanaka became Prime Minister on a manifesto promising the normalisation of relations between Japan and China.²⁰ In September of the same year, the Joint Communiqué of the Government of Japan and the Government of the People's Republic of China was signed in Beijing between him and Zhou Enlai, Premier of the State Council.

The Communiqué stated,

Japan and China are neighbouring countries, separated only by a strip of water with a long history of traditional friendship. In spite of the differences in their social systems existing between the two countries, the two countries should, and can, establish relations of peace and friendship. The normalisation of relations and development of good-neighbourly and friendly relations between the two countries are in the interests of the two peoples and will contribute to the relaxation of tension in Asia and peace in the world.

It also confirmed nine issues, including the following:

- The abnormal state of affairs that has hitherto existed between Japan and the People's Republic of China is terminated on the date on which this Joint Communiqué is issued.
- The government of Japan recognises the government of the People's Republic of China as the sole legal government of China.
- The government of the People's Republic of China reiterates that Taiwan is an inalienable part of the territory of the People's Republic of China. The government of Japan fully understands and respects this stand of the government of the People's Republic of China, and it firmly maintains its stand under Article 8 of the Potsdam Proclamation.

The Chinese side argued that Taiwan was a part of China and claimed the right to annex Taiwan. The Japanese government did not agree with

Communist Party of China and the Joint Communiqué of the United States of America and the People's Republic of China was issued in Shanghai.

²⁰ His term of office was from July 1972 to December 1974.

this Chinese position and used the wording “understand and respect” instead of “recognise”,

Thereafter, the Trade Agreement between the government of Japan and the government of the People’s Republic of China took effect in June 1974. In August 1978, in light of the Joint Communiqué of the Government of Japan and the Government of the People’s Republic of China, the Treaty of Peace and Friendship between Japan and the People’s Republic of China was concluded.

4.4.3 Progress in Trade between Japan and China

The total amount of trade between Japan and China was US\$1.1 billion in 1972, when the relations between the two countries were normalised. After 1978, when China adopted the reform and opening-up policies, the scale of trade between Japan and China surged to reach over US\$10 billion in 1981. As a result, each came to assume a very important position in the trade and economy of the other, thereby further deepening economic interdependency.

The trade surplus between Japan and China continued for Japan until the mid-1980s. However, from the late 1980s onwards Japan ran a trade deficit with China. Since 2001, when China became a member of the World Trade Organization, the share of China in Japan’s total trade has surged. It exceeded the amount of trade between Japan and the United States in 2007. One major factor which underlay the expansion of trade between Japan and China was the fact that Japanese companies had shifted their production bases to China. These accelerated trends that China would import core parts it could not procure domestically from Japan while Japan would import from China final products. Exports of products to Japan by foreign companies based in China and Chinese companies are also increasing. The trade between Japan and China rose to US\$266.3 billion in 2008 (up 12.5% from the previous year), hitting a record high for 10 straight years and exceeding the trade between Japan and the United States for two consecutive years. Of the US\$266.3 billion in 2008, exports and imports accounted for US\$124 billion (up 13.7%) and US\$142.3 billion (up 11.5%), respectively (Figure 7).

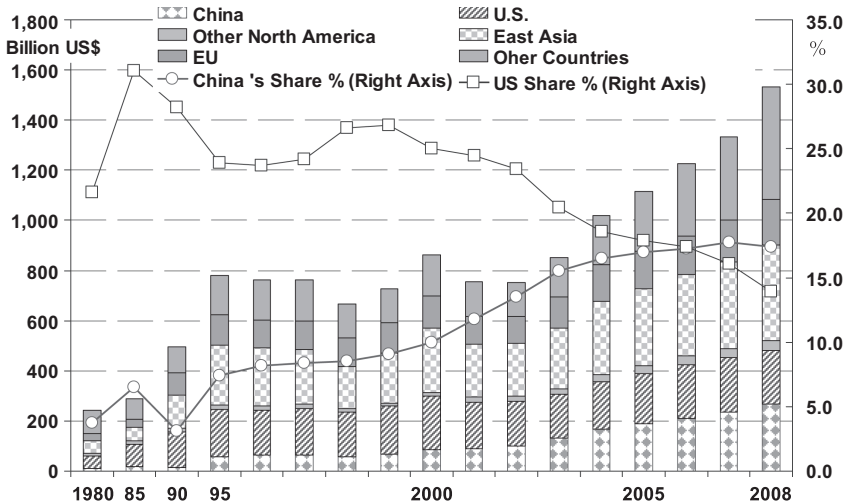


Figure 7 Japan's Foreign Trade

Source: Japan External Trade Organization (JETRO).

On the other hand, the share of Japan-China trade in China's total trade was the highest in 1978 but dropped in the 1980s. From 1992 onwards, Japan's share had increased again, only to be back on a downward track in August 2001 when Prime Minister Koizumi visited the Yasukuni Shrine and invited a strong backlash from China. Japan's share has declined since then. In 2002, trade with the United States exceeded trade with Japan. In 2008, Japan accounted for 9.2% of China's total trade, while the share of the United States reached 12.9% (Figure 8).

4.5 ENERGY TRADE BETWEEN JAPAN AND CHINA

4.5.1 Oil Trade

The supply of Daqing crude oil to Japan started in April 1973 when the first oil crisis broke out. Since 1978, when the Treaty of Peace and Friendship between Japan and the People's Republic of China was concluded, the export of Daqing crude oil to Japan played the role of a so-called facilitator of trade between the two countries. China wanted to obtain enough foreign currency, which was necessary for its economic

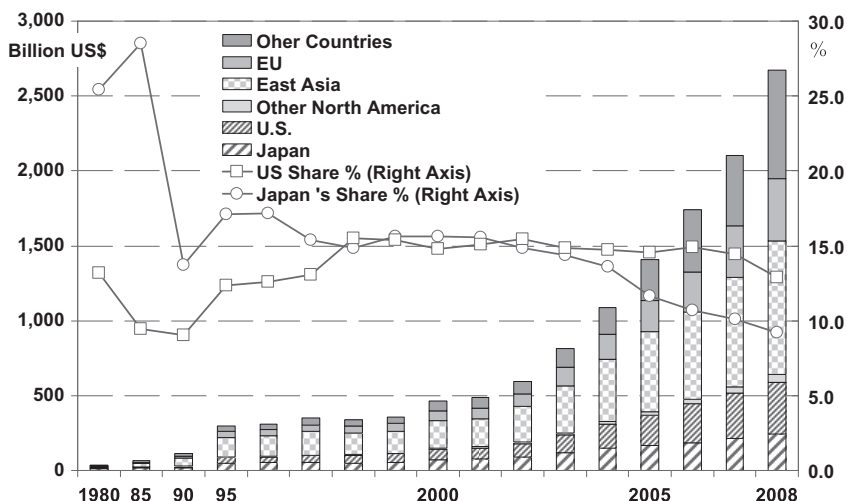


Figure 8 China's Foreign Trade

Source: JETRO.

development but had been in short supply since the Sino-Soviet dispute, by exporting its abundant energy resources to Japan.

Although China became a net importer of oil in 1993, China exported low-sulphur and high-priced Daqing crude oil to get foreign currency, while importing high-sulphur and less expensive Middle East crude oil for processing. The agreement with Japan for the period from 1996 to 2000 provided that China should export 6–8.5 million tonnes of crude oil. Accordingly, China exported 8 million tonnes of oil in 1997 and 6 million tonnes in 1998. However, Daqing crude oil production diminished after the peak, and domestic oil prices in China became higher than oil export prices. China's export volume in 1998 was no more than the lowest limit specified in the agreement and supply has been interrupted since January 2004 (Figure 9).

On the other hand, in the wake of the first oil crisis in 1973, having been heavily dependent on the Middle East, Japan diversified and extended oil supply sources to regions other than the Middle East in an effort to ensure a stable oil supply. The normalisation of relations between Japan and China in 1972 provided the best opportunity for Japan to increase oil imports from China. The amount of oil imported from China

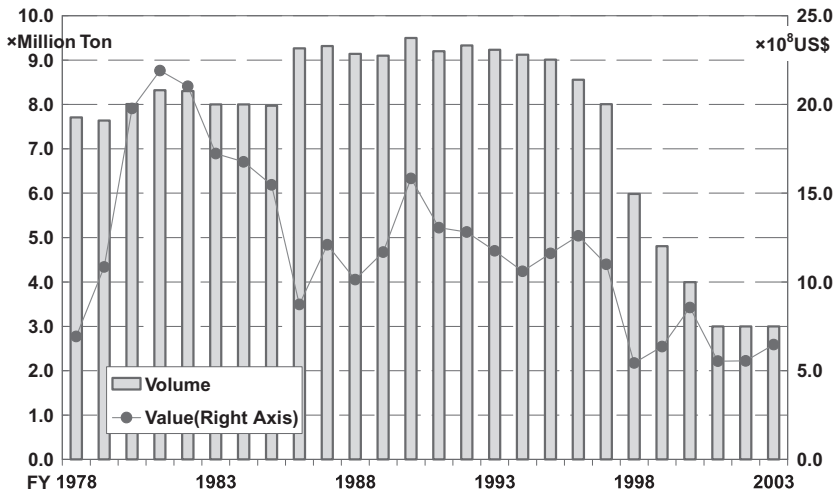


Figure 9 Japan's Crude Oil Imports from China through L-T Trade Agreement

Source: JETRO.

was 23,000 barrels per day at the beginning of 1973. Two years later, in 1975, the amount reached 163,000 barrels per day, and China's share in Japan's total oil imports increased to 3.6%.

At the same time, Japan tried to switch from oil to other energy resources, such as coal, natural gas, and nuclear, whereby its oil imports started to decline after the second oil crisis in 1980. However, Japan maintained a certain volume of crude oil imports from China. Therefore, China's share reached 7.9% in 1987. Subsequently, the oil demand in Japan once again started to grow, while China's oil export capacity continued to decline as stated before. Accordingly, China's share continued to decline to 7,000 barrels per day in 2004, i.e. virtually 0% in terms of the share in Japan's total oil imports, a year after the suspension of imports under the L-T Trade Agreement (Figure 10).

In addition to the imports of Daqing crude oil under the L-T Trade Agreement, supply was also made from Bohai Light Crude Oil in Bohai Bay operated by Japanese oil development companies, Nanhai Medium and Nanhai Blend, and Lu Feng in Pearl River Mouth in southern China. Imports of oil from these fields, however, became nil when the projects came to an end. Currently, Chinese oil is being supplied only on a

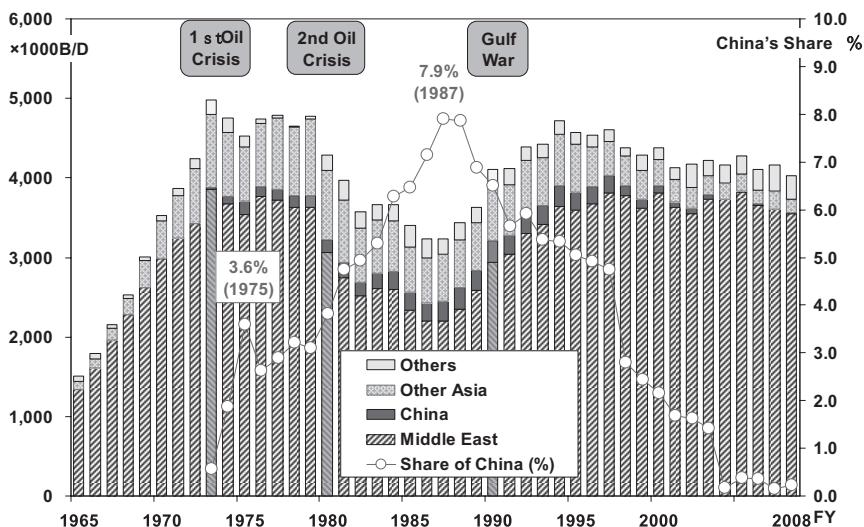


Figure 10 Japan's Crude Oil Imports

Source: METI, *Yearbook of Mineral Resources and Petroleum Products Statistics*.

commercial basis from Panyu (Hong Kong), Xijiang (Hong Kong), CFD (Bohai Bay), and Peng Lai (Bohai Bay) Oil Fields operated by CNOOC and oil development companies with foreign capital.

4.5.2 Coal Trade

China has a vast amount of coal resources and produced 47% of the world coal production in 2008, i.e. 2,761 million tonnes out of 5,845 million tonnes. It is the biggest coal producer in the world. Coal accounts for approximately 73% of China's primary energy supply, and 2,760 million tonnes of coal were consumed in 2008. In China, coal is mainly used for electricity generation. About 80% of the total amount of electricity was generated at coal-fired power plants in 2007 (Figure 11). Therefore, the domestic demand for coal is increasing along with an increase in domestic demand for electricity. Most of the coal mines are located in inland China, e.g. Shanxi, Shaanxi, and Inner Mongolia. On the other hand, power stations are located closer to the market of electricity along the coast. Coal is transported to these power stations mainly by railway.

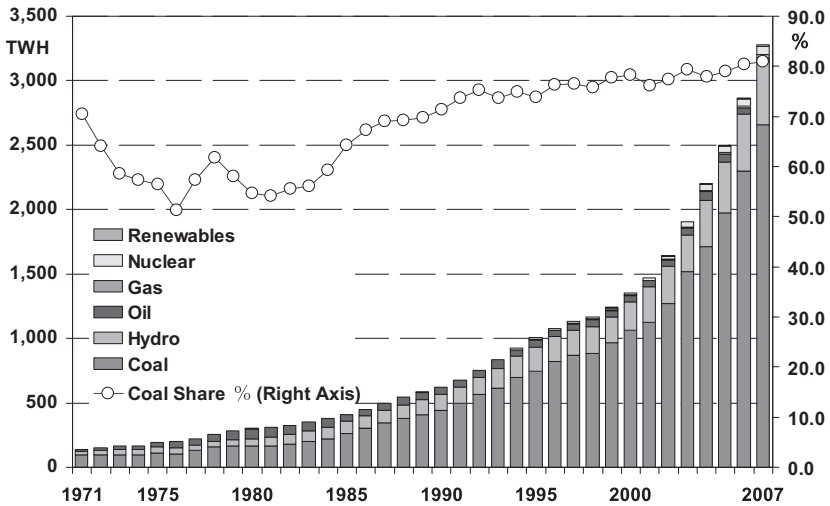


Figure 11 China's Electric Power Generation by Type of Energy

Source: IEA, *Energy Balances of Non-OECD Countries*.

Consequently, the expansion of railway transportation capacity has also become an issue.²¹

Coal exports have been a major contributor for China in getting foreign currency. However, its export capacity started to decline after the peak in 2003. Giving priority to fulfilling the domestic demand for coal, the Chinese government introduced a coal export quota. In 2004, the export licensing system was implemented to regulate its annual total coal export volume. China's coal export volume in 2008 was 47.4 million tonnes, a decrease of 6.3 million tonnes from 53.7 million tonnes in the previous year.²²

On the other hand, coal imports from overseas by coal-fired power plants along the coast in southern China had increased sharply to reach 45.6 million tonnes in 2008. Against this background, coal exports to Japan under the L-T Trade Agreement also dropped after the peak of

²¹ Coal accounted for approximately 49% of China's total volume of railway cargo transportation, i.e. 1.544 billion tonnes out of 3.142 billion tonnes in 2007.

²² The maximum quota was 80 million tonnes in 2006, which dropped to 70 million tonnes in 2007 and 53 million tonnes in 2008.

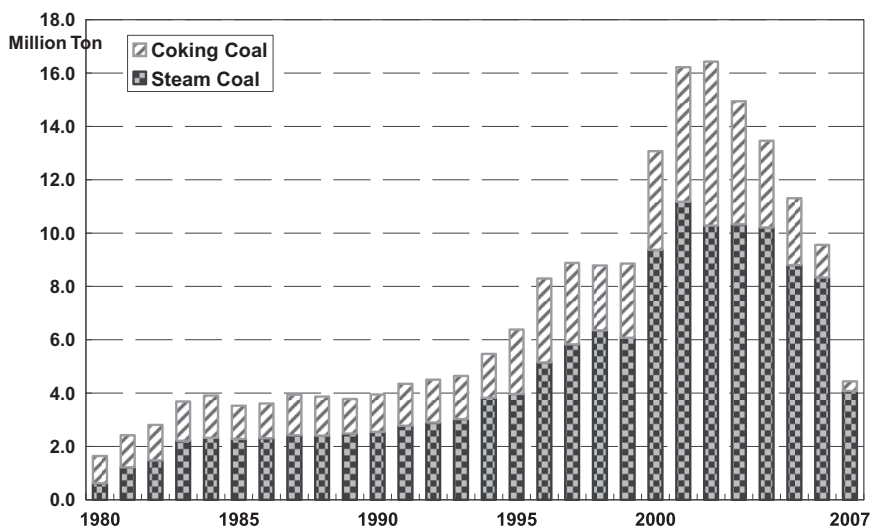


Figure 12 China's Coal Exports to Japan through L-T Trade Agreement

Source: JETRO.

16.4 million tonnes in fiscal year 2002 to 4.4 million tonnes in fiscal year 2007 (Figure 12).²³

Combining the volume of coal imports through general transactions with that of coal imports under the L-T Trade Agreement, Japan's total coal imports from China reached their peak of 28.2 million tonnes in 2003, i.e. 17.4% of Japan's total coal imports. Japan's total coal imports from China fell only 5.6% to 10.3 million tonnes in 2008 (Figure 13).

4.6 OIL EXPLORATION COOPERATION BETWEEN JAPAN AND CHINA

4.6.1 Exploration and Development of Bohai Bay Oil Field

In December 1978, the 11th Central Committee of the Communist Party of China held its third plenary session. The meeting decided to stop taking

²³The volume is on a fiscal year basis, i.e. from April to March. The contracted volume was 4.91 million tonnes for the fiscal year 2007, 5.21 million tonnes for the fiscal year 2008, and 1.33 million tonnes for the fiscal year 2009.

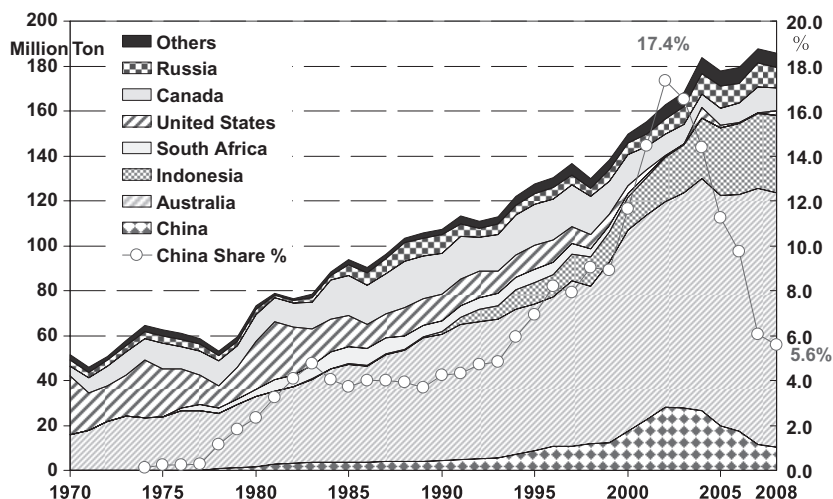


Figure 13 Japan's Coal Imports by Country

Source: Ministry of Finance, Trade Statistics of Japan.

class struggle as the key policy and shift the working focus to reform and opening-up, to meet the needs of modernisation. However, economic development was indispensable for China in order to promote its modernisation. Therefore, it was necessary to actively promote the open-door policy to bring in advanced technology, production equipment, capital, and management methods from overseas. Simultaneously, it became necessary for Japan to diversify its energy supply sources to ensure a stable supply of energy.

In July 1978, when the delegation of Japan National Oil Corporation (JNOC) visited China, cooperation between Japan and China was agreed upon as the first stage in opening oil-prospecting areas in China to overseas capital. They agreed to cooperatively explore and develop areas in the south of Bohai Bay, in Western China, and Chengbei Oil Field.²⁴ In May 1979, a memorandum on a line of credit of JPY 420 billion (US\$2 billion) was signed between Export-Import Bank of Japan and Bank of China, which stated that necessary capital would be provided for projects

²⁴ In December 1979 and February 1980, JNOC (at the time) and the Offshore Branch of Petroleum Company of the People's Republic of China signed a basic agreement.

implemented by China to develop onshore oil fields on the coast of Bohai Bay (Huabei Oil Field and Shengli Oil Field) and develop coal mines at Baodian in Shandong Province.

In order to promote oil exploration and development projects at the offshore Bohai Bay as Japan's national project led by the Japanese government, two companies — Japan-China Oil Development Corporation (JCO) and Chengbei Oil Development Corporation — were set up in April 1980 with investment from JNOC and 47 private companies. These two companies were funded with 100% risk guarantee capital from the Japanese stakeholders. It was agreed that the necessary costs of \$100–200 million would be invested in exploration works, and upon the success of these works, development works (at an estimated cost of \$1 billion) would be carried out jointly by Japan and China.²⁵ From 1980 onwards, seismic surveys of areas covering 25,000 km² were conducted, 38 exploration wells were drilled, and 25 wells were successfully found, thereby resulting in the discovery of 11 oil prospects.

Development work was started on three oil fields, i.e. Chengbei, BZ28, and BZ34 Oil Fields. However, as the oil layers are segmented with faults, the development of these fields proved to be very difficult.²⁶ Originally, the two oil companies — JCO and Chengbei Oil Development — were required to keep separate accounting records, but the latter was obliged to merge with JCO in 1989. However, due to falling crude oil prices and an overvalued yen, the business performance of JCO had also worsened so

²⁵ At this stage of development, Japan and China would bear 49% and 51% of the capital, respectively. With regard to the capital injection by China, a loan of JPY 105 billion (approximately US\$460 million at the exchange rate fixed according to US\$1.00 = JPY 230.0) was provided to China from Export-Import Bank of Japan in accordance with the memorandum signed in May 1979. It was planned that, during a period of 15 years when commercial oil production started, 57.5% of crude oil would be allocated to China and 42.5% be supplied to Japan, and the capital injected by Japan would be recovered over 15 years from the proceeds of the sale of its 42.5% of the oil.

²⁶ Production at Chengbei Oil Field began in September 1985, BZ28 Oil Field in July 1989, and BZ34 Oil Field in July 1990. At the peak of oil production, the daily output from BZ28 Oil Field and BZ34 Oil Field was about 5,200 and 5,800 barrels, respectively, and Chengbei Oil Field produced some 5,600 barrels of oil per day. However, due to the complicated structure of the oil seams, the volume of recoverable reserves turned out to be less than originally estimated. BZ28 Oil Field stopped production at the end of September 1994.

much that it eventually posted an estimated annual loss of over JPY 1 billion.²⁷ In June 2000, JCO agreed with the Chinese side that it would withdraw itself from the project at the end of September of the same year at the expiry of the oil contract for the Chengbei Oil Field.

In October 2000, JNOC announced that it would dissolve JCO. With its debts exceeding assets, JCO approved its dissolution and submitted applications for commencement of special liquidation proceedings in the Tokyo District Court.²⁸ JNOC posted losses totalling JPY 139.2 billion in loans and investments, and the invested capital of approximately JPY 50 billion from 45 private companies became unrecoverable. At the time of JCO liquidation, JNOC posted losses totalling JPY 156.4 billion including a loss of JPY 38.7 billion from amortisation of claims for indemnity raised during the course of providing other debt guarantees.²⁹

However, when CNOOC formed a partnership with ConocoPhillips and redirected its target of exploration from the 2,000 m depth layer below the seabed to the upper depth layer of 1,000 m below the seabed, it discovered oil reserves in 1999. Thereafter, Shell joined forces with them in 2002, and oil reserves were discovered one after another in the areas abandoned by Japan. This made it possible for CNOOC to establish a solid revenue base.³⁰

²⁷The new Japan-China Offshore Oil Company was established in September 1992 and started new exploration activities, including two exploration well drillings. The work, however, did not lead to any commercial discovery. The company was wound up in October 1995.

²⁸JCO was established with JPY 100 billion in capital, of which JPY 64.5 billion was injected by JNOC and the remaining JPY 35.5 billion by private companies. The amount of accumulated deficit was JPY 50.4 billion. It had borrowings of JPY 74.1 billion (of which JPY 39.7 billion had been borrowed from JNOC) and owed JPY 45.6 billion in unpaid interest. As borrowings of JPY 13.4 billion from JNOC were waived, its actual deficit was a total of JPY 109.4 billion (JPY 50.4 billion + JPY 45.6 billion + JPY 13.4 billion) and exceeded its assets.

²⁹JNOC's loss was calculated at JPY 156.4 billion in total, with its breakdown being JPY 64.5 billion in capital invested in JCO, a loan of JPY 53.1 billion (JPY 39.7 billion + waived JPY 13.4 billion), and JPY 38.7 billion in debt guarantee for borrowings from other banks. This excludes JPY 34.7 billion in unpaid interest.

³⁰CNOOC submitted a bid in June 2005 to take over US Unocal at US\$67 per share, totalling US\$18.5 billion. The bid, however, met with political opposition from the US political circle which viewed the proposed merger as a threat to the US. In August 2005, CNOOC announced that it had withdrawn its offer for Unocal.

Apart from the activities indicated, Japanese oil companies also carried out other exploration and production projects in China, which are listed here. All these projects have already been terminated. Currently, no exploration or production activity is being carried out by Japan in China.

- **Oil development in the South China Sea:** In the second round of bidding in 1984 for areas in the South China Sea, Block 16/06 located in the Pearl River Mouth Basin was granted to Japan. New Nanhai Oil Development Co., Ltd., New Huainan Oil Development Co., Ltd., and NMC Pearl River Mouth Oil Development Co., Ltd., jointly set up JHN Oil Operating Company. JHN discovered in February 1987 the Lu Feng 13-1 Oil Field which came into operation in November 1993. At the peak of oil production, 25,000 barrels of crude oil were produced daily from this oil field. Its accumulated crude oil production till February 2009, when the production period under the contract came to an end, was approximately 70 million barrels. At the expiry of the production period, the project was wound up, and the operation was transferred to the Chinese side.
- **Oil development in the Tarim Basin:** In the first round of bidding in 1993 for Chinese onshore oil-prospecting areas, Japanese companies secured the license to Block 1 in the Tarim Basin jointly with Italian company Agip. Upon conclusion of a contract with CNPC in February 1994, the exploration work began in May 1994. Following another round of seismic surveys, exploration well drillings were conducted, which did not result in the discovery of oil. The area was abandoned in April 1998.

Japanese companies together with US ExxonMobil also won the bid for Block 3 located in the southeastern part of the Tarim Basin and carried out exploration and development activities. However, no oil was discovered and they withdrew from the project in March 1998.

- **Oil development in the East China Sea:** In the fourth round of bidding in December 1993 for offshore oil-prospecting areas, Teikoku Oil Co., Ltd., and Japan Petroleum Exploration Co., Ltd., won Blocks 41/17 and 42/03 in the East China Sea. In February 1995, exploration well drillings were carried out for one well on each of these blocks, but no oil was discovered.

4.7 CONFLICT OF INTEREST BETWEEN JAPAN AND CHINA OVER MEASURES TO SECURE ENERGY SUPPLY

4.7.1 Eastern Siberia–Pacific Ocean (ESPO) Pipeline

In 1998, a specific plan was drawn up between Yukos (Russia), Transneft (Russia), and CNPC (China) to construct a pipeline to transport West Siberian oil from Angarsk in Russia to Daqing in China (2,260 km long Daqing route). In February 1999, a framework agreement was signed to investigate its commercialisation. The plan was agreed upon in July 2001 between the Chinese and the Russian governments.

However, in January 2002, as an alternative to the proposal from Yukos, Transneft submitted to the government a plan to construct a crude oil pipeline leading into the Sea of Japan from Angarsk to the port in Perevoznaya in the Hasan district in the Maritime region.³¹ The proposal from Transneft received strong support from the Russian government as it entailed the possibility of long-term economic development as well as the opportunity to enhance economic relations with the Asia-Pacific region. In consequence, a contract for the construction of a pipeline bound for China was not agreed at the Sino-Russia Summit in December 2002.

On the other hand, when Prime Minister Koizumi visited Russia in January 2003, an idea was presented to construct a pipeline from Angarsk to Nakhodka (4,000 km long Nakhodka route), and Transneft showed its strong interest therein. The Japan-Russia Action Plan was agreed upon by Japan and Russia, whereby the Japanese government pledged its support and financial assistance to resource development in Sakhalin and Siberia and for the construction of the pipeline. Therefore, it became unlikely that the Yukos plan would be adopted.³²

³¹ For Russia, the Daqing route had certain benefits in that its share of construction costs would be smaller. However, as the destination of this route would be limited to China, Russia was concerned that it might thus lose control over the price.

³² Subsequently, Mikhail Borisovich Khodorkovsky, Yukos's founder and CEO (at the time), was arrested in October 2003 on charges of corporate and income tax evasion. In December 2004, Yukos was bought by state-owned Rosneft.

The Russian government announced in May 2003 the construction of a crude oil pipeline with a feeder line leading to Daqing. In 2004, the site for the starting point was changed from Angarsk to Taishet. The Russian government decided in April 2005 to construct the 4,700 km long pipeline in two phases: in inland Russia during Phase 1 and from inland Russia to the Pacific Ocean during Phase 2. In the initial phase, a 2,400 km long pipeline from Taishet to Skovorodino would be laid (with the capacity to transport 600,000 barrels per day), while Phase 2 entails a line extending further from Skovorodino to Kozmino at Perevoznaya Bay in the vicinity of the Pacific Ocean port of Nakhodka.³³

Subsequently, the relationship between Russia and China improved and, with the conclusion of a long-term oil supply contract between Rosneft and CNPC in January 2005, Russia decided to prioritise the construction of the line leading to China.³⁴ In October 2006, China and Russia began a feasibility study on the construction of a proposed oil pipeline spur from Skovorodino to the Chinese border. Transneft started in April 2009 the construction of the 64 km long feeder line leading to the border with China, which was completed in October 2009. It has the capacity to deliver 15 million tonnes per year (300,000 barrels per day). The delivery will start in October 2010 when the construction of the Chinese section of the feeder line is completed. On the other side, the construction of the main line leading to the Pacific Ocean has been delayed due to a subsequent sharp price rise of materials, and the work is expected to be completed around 2012 at the earliest. Until then, 300,000 barrels of oil per day will be transported by railway from Skovorodino to Kozmino, and it is expected that exports from Kozmino will start in December 2009³⁵ (Figure 14).

³³ In September 2006, the north route away from Lake Baikal was adopted, and the construction of the pipeline from Taishet started in April 2006.

³⁴ A shortage of crude oil to be transported is also pointed out. While the pipeline has the capacity to deliver 80 million tonnes per year, only 30 million tonnes of crude oil are available for transportation. Therefore, there may be certain reasons that oblige Russia to give priority to the transportation for China. The Chinese section of this feeder line is 965 km long.

³⁵ In October 2009, 72 railway tank wagons, each loaded with 60 tonnes of oil, arrived in Kozmino.



Figure 14 Eastern Siberia-Pacific Ocean (ESPO) Pipeline

Source: U.S. DOE/EIA, Country Analysis Brief, Russia, <http://www.eia.doe.gov/cabs/Russia/Full.html>.

4.7.2 Development of Gas Fields in the East China Sea

In June 2006, under the administration of Prime Minister Koizumi (who was in office from April 2001 to September 2006), the issue concerning development of gas fields in the East China Sea surfaced when it was confirmed that China had started development work in the area close to the “median line between Japan and China”. The line divides the Exclusive Economic Zone (EEZ) and the continental shelf in the East China Sea between Japan and China.³⁶ During the conference of the Japanese and Chinese foreign ministers in June 2004, Japan asked China to disclose details of China’s exploration data such as demarcation of the gas-prospecting areas on the Chunxiao Oil and Gas Fields. In response, the Chinese side avoided making specific reference to the submission of data and consistently maintained that it would not accept the median line that Japan unilaterally regards as the sea boundary between the two sides.

³⁶The Chunxiao Oil and Gas Fields are located in the southeast of Shanghai. In July 1995, the first exploration well drilling ended successfully. They are comprised of four gas fields, i.e. Chunxiao (known as Shirakaba in Japan), Tianwaitian (known as Kashi in Japan), Longjing (known as Asunaro in Japan), and Duanqiao (known as Kusunoki in Japan). A comprehensive plan to develop the Chunxiao Oil and Gas Fields was approved by the State Planning Commission and officially announced in March 2002.

In April 2005, Japan published the result of its own investigation that the geological structures of the Shirakaba (Chunxiao in China), Asunaro, and Kusunoki fields extended into the Chinese side. In July of the same year, the right was granted to Teikoku Oil Co., Ltd., to carry out exploration well drillings in gas fields on the Japanese side of the East China Sea. On the other hand, China also started, in September 2005, drillings at Tianwaitian (known as Kashi in Japan) Gas Field. In August 2006, Koizumi paid his sixth visit to the Yasukuni Shrine on the anniversary of Japan's Second World War surrender, thereby resulting in rapid deterioration of the relationship between Japan and China.³⁷

Prime Minister Abe (who was in office from September 2006 to September 2007), having taken over from Prime Minister Koizumi, in an effort to rebuild relations with China, chose China as the destination of his first official overseas trip in October 2006 and met with Chinese President Hu Jintao and Chinese Premier Wen Jiabao. Both sides agreed to make efforts to build a “mutually beneficial relationship based on common strategic interests” and cooperate in various fields, such as energy, trade, and global warming. With regard to the dispute between Japan and China over exploration of gas fields in the East China Sea, a joint statement was subsequently issued:

Both sides reaffirmed that, in order to make the East China Sea a “Sea of Peace, Cooperation and Friendship”, both sides should firmly maintain dialogue and consultation, and resolve appropriately difference of opinions. Both sides confirmed that they would accelerate the process of consultation on the issue of the East China Sea, adhere to the broad direction of joint development and seek for a resolution acceptable for the both sides.

³⁷ Given that Japan had stepped up its efforts to become a permanent member of the United Nations Security Council, and a school textbook on Japan's history for junior high schools and high schools, written by the New History Textbook Movement, which includes views that can be interpreted as glamorising the history of the Japanese colonial occupation of Asia, had been approved by the Ministry of Education, Culture, Sports, Science and Technology, anti-Japanese protests erupted in April 2005 in various parts of China with the slogan “Patriotism is Innocent”. A boycott of Japanese goods followed, and protesters threw stones at Japan's Embassy.

In May 2008, Chinese President Hu Jintao visited Japan and met with Prime Minister Fukuda (who was in office from September 2007 to August 2008). The joint statement between the two governments on comprehensive promotion of a Mutually Beneficial Relationship Based on Common Strategic Interests was issued. It was resolved that both Japan and China would actively engage in negotiations to set out a new global framework to tackle global warming from 2013, which is after the end of the first commitment period of the Kyoto Protocol in 2012, and promote cooperation in developing energy-saving and other technologies as well as in the transfer of such technologies.

Following this joint statement, it was agreed in June of the same year that, with regard to the East China Sea gas dispute, a joint development area should be established by the Japanese and Chinese governments in the area covering the median line.³⁸ However, with regard to the Kashi Gas Field (known as the Tianwaitian Gas Field in China), Japan demanded that China end its development, while China maintained its right of unilateral development. Consequently, the question of joint development of this field was left unresolved.

On 21 September 2009 Prime Minister Yukio Hatoyama, who was in New York to attend the United Nations Summit on Climate Change, met with Chinese President Hu Jintao.³⁹ At the meeting, touching on the

³⁸As for the joint development of the Shirakaba Gas Field, Thailand-Malaysia joint development of oil reserves in the Gulf of Thailand, and Australia–East Timor sharing of maritime oil resources are good examples of the challenge. In 1990, the Malaysia-Thailand Joint Authority (MTJA) was established as a statutory body under the laws of Malaysia and Thailand in 1991 to assume all rights and responsibilities on behalf of the two governments to explore and exploit natural resources in the overlapping area known as the Joint Development Area (JDA). In January 2006, Australia and East Timor brought into force the Treaty on Certain Maritime Arrangements in the Timor Sea (CMATS Treaty) and agreed in March 2003 and brought into force in February 2007 the International Unitization Agreement for Greater Sunrise (IUA). These treaties establish a framework for the exploitation and the equal sharing of the Greater Sunrise gas and oil resources.

³⁹Prior to this meeting, a delegation of the Japan-China Economic Association, including Japan Business Federation Chairman Fujio Mitarai, met with Premier Wen Jiabao on 9 September 2009. It was agreed to further promote economic cooperation between Japan and China in the fields of environmental protection and energy-saving technologies. However, with regard to environmental technology transfer to China, Japanese companies

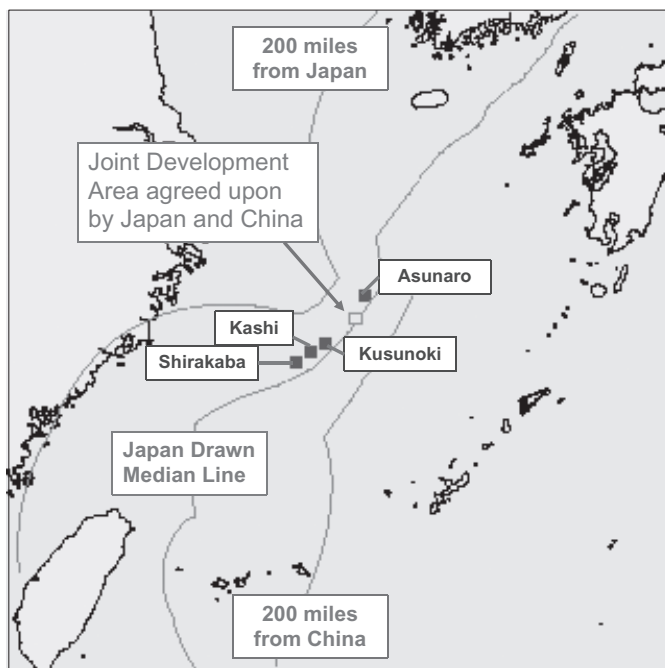


Figure 15 Disputed Oil and Gas Fields in the East China Sea

Source: The map was made by author based on information from Japanese Government (METI, Ministry of Economy, Trade and Industry).

dispute over the Shirakaba Gas Field (known as the Chunxiao Gas Field in China), which China had agreed to develop jointly with Japan, Prime Minister Hatoyama expressed concern over actions taken by China that could be seen as preparations to develop this gas field. Both sides agreed to proceed with preparations at the working level to forge a treaty on the agreement on joint development of gas fields in the East China Sea (Figure 15).

4.7.3 Oil Development in Iran

In February 2004, Japan's government-backed Inpex Corporation signed a US\$2 billion deal with the National Iranian Oil Company (NIO) to develop

expressed strong concern about possible technology outflow and pointed out once again problems associated with intellectual property protection in China.

the Azadegan Oil Field after four years of negotiation. Inpex has a 75% stake, while state-owned NIO holds the remaining 25% stake. Azadegan is Iran's largest onshore oil field with estimated reserves of 26 billion barrels located on the Iraq border. Despite a US warning against doing business with Iran, Japan was largely inspired by the failure of Japan's Arabian Oil Co. to renew its concession for the Khafji Oil Field in the neutral zone between Saudi Arabia and Kuwait in 2000 and 2002, respectively.

Azadegan was expected to begin production of 150,000 barrels per day by mid-2008, rising to 260,000 barrels per day by early 2012, and Japan hoped to import two thirds of the output. The work had been due to start by March 2005. However, Inpex was forced to put off development of the field under pressure from the US, but also because the site was still littered with landmines from the 1980–1988 Iran-Iraq War. And more recently, talks on the project had stalled over international tensions surrounding Tehran's nuclear programme.

Consequently, and as Iran wanted to develop this oil field as soon as possible, Inpex had its share reduced by Iran to 10% in 2006. In August 2009, it was reported that CNPC had taken steps to acquire 70% of the 90% share held by the Iranian company. CNPC is said to have agreed to cover 90% of the development costs of \$2.5 billion.

4.7.4 Energy Cooperation between Japan and China

China suffered serious shortages of electricity in 2004 and certain parts of southern China such as the province of Guangdong, one of the country's most heavily industrialised regions, have continued to face a shortage of electricity supply since 2008. The installed power capacity of China reached 710 million kilowatts (kW) at the end of 2007, 1.6 times the maximum demand of electric power. Therefore, its generating capacity itself is not insufficient. The shortages of electricity were due to deteriorating profits from the power generation business and a shortage of electricity transmission capacity. While all power generation costs surged with the liberalization of coal price in 2006, the government imposed price restraints on electricity. Therefore, the profit margin of electricity companies has stayed low, and the operating rates of power plants have gone down. The overall impact was that industry consumers decided to ensure

their own supply through the use of diesel generators and thus further boosted domestic oil and oil product demand.⁴⁰

In October 2005, the Chinese government led by Premier Wen Jiabao advocated in the proposal on the Eleventh Five-Year Program for National Economic and Social Development until 2010 a switch to a domestic demand-led economy and implementation of energy-saving measures to “change development patterns”. With regard to energy saving, China pledged to cut energy consumption per unit of gross domestic product (GDP) by 20% by 2010, and a 10.1% reduction was achieved by 2008.

Against this background, with a view to facilitating energy-saving behaviour among the partners, the Asia-Pacific Partnership on Clean Development and Climate (APP) was set up in July 2005 with seven partner countries, i.e. Japan, China, the United States, Australia, Canada, South Korea, and India. More than 50% of global CO₂ emissions come from these seven countries. In order to reduce greenhouse gas emissions more effectively by facilitating the development, deployment, and transfer of cleaner and more efficient technologies, the partners have approved eight public-private sector task forces, covering aluminium, buildings and appliances, cement, cleaner fossil energy, coal mining, power generation and transmission, renewable energy and distributed generation, and steel, thereby promoting the transfer of energy-saving technologies. In the steel sector, some positive results have been achieved, such as the installation of coke dry quenching equipment (CDQ) at ironworks in China.⁴¹

⁴⁰ China's electricity output in 2008 was 3.40 TWh, a 5.5% increase from 2007. However, electricity companies suffered a loss of RMB 70 billion (US\$10.3 billion). Therefore, the Chinese government put in RMB 10 billion (US\$1.46 billion) to bail out five electricity companies and two electric power transmission companies.

⁴¹ CDQ is the equipment which quenches red-hot coke in the cooling process by means of circulating inert gas in a quenching chamber, instead of conventional water quenching, and recovers waste heat for power generation use. Shougang Group Corp. switched to the CDQ system during the period from fiscal year 1997 to fiscal year 2000 from the traditional coke wet quenching (CWQ) system. Therefore, energy consumption at its works was reduced and led to an energy-saving effect equivalent to 24,700 tonnes of crude oil per year. Convinced of the effectiveness of the CDQ technology from this result, the Chinese government referred to the introduction of CDQ equipment in its Comments on the Implementation of Ten Key Projects in the 11th Five-Year Program for National Economic and Social Development starting in 2006.

In September 2009, 140 delegates from the Japan-China Economic Association visited China and met with Chinese Premier Wen Jiabao. He expressed his belief that, on the basis of the bilateral relations already established in the past, relations between the two countries could be further promoted. He presented his basic view that the green economy should be further developed to serve as the key to economic exchange between the two countries and positioned energy savings and the environment as the most pressing issues.

4.8 CONCLUSION

In January 2007, the Cebu Declaration on East Asian Energy Security was signed by 16 nations — the 10 member countries of the Association of Southeast Asian Nations (ASEAN), Australia, China, India, Japan, Korea, and New Zealand. The countries have agreed to promote energy security and listed a series of goals aimed at providing “reliable, adequate and affordable energy supplies” for strong and sustainable economic growth and competitiveness. The goals include improving the efficiency and environmental performance of fossil fuel use, reducing dependence on conventional fuels through intensified energy efficiency and conservation programmes, and mitigating greenhouse gas emissions through effective policies and measures, thus contributing to global climate change abatement.

On 24 September 2009, Prime Minister Yukio Hatoyama delivered an address at the United Nations General Assembly session and proposed to build an East Asian Community to consolidate cooperation among Asian nations. In his speech, he said that “today, there is no way that Japan can develop without deeply involving itself in the Asia and the Pacific region”. In close coordination and cooperation with the Asian and Pacific countries, Japan can also help itself by reducing the effects of climate change and by exporting Japanese technology and know-how. He went on to say that

[he] looks forward to an East Asian community taking shape as an extension of the accumulated cooperation built up step by step among partners who have the capacity to work together, starting with fields in which we can cooperate — Free Trade Agreements, finance, currency, energy, environment, disaster relief and more.

Since the Hatoyama administration has been in office, relations between Japan and China have rapidly improved. Prime Minister Hatoyama, who pledged not to visit the Yasukuni Shrine, said he stands by then Prime Minister Tomiichi Murayama's official 1995 apology for Japan's colonialism and military aggression. At the summit meeting with Chinese President Hu Jintao in September 2009, Prime Minister Hatoyama stated that he hoped to "build the community based on the relationship of trust which will be realised by both Japan and China acknowledging the differences between the two countries". Chinese President Hu made five proposals: increasing the frequency of visits of leaders of the two countries, strengthening and developing economic and trade relationships, improving public sentiments, cooperating in dealing with international issues including those concerning Asia, and resolving the differences between the two countries in an appropriate way. It seemed possible that, with the Hatoyama administration having taken office, both Japan and China would strive to advance bilateral ties with a focus on energy saving and environmental cooperation.

At the meeting with Chinese President Hu Jintao, Prime Minister Hatoyama asked the Chinese side for their cooperation toward the establishment of an East Asian Community. However, it should be noted that, while the size of the Japanese and Chinese economies is more or less the same, there is a big gap between the two countries in terms of GDP per capita. There exist differences between the two countries with regard to the political structures, as China adopts the socialist system under the leadership of the Communist Party of China. Furthermore, on the security side, potential tensions still remain between China and the Japan-US alliance. Hatoyama indicated that the US is a potential member of his envisaged regional grouping, and it will, therefore, be essential to liaise with the United States and others to implement the concept of the community.

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CHAPTER 5

INDIA'S PIPELINES: PARADOX, PROBLEMS AND POSSIBILITIES

Marie Lall

India's principal foreign policy aim has always been to be a recognised global power. From independence onwards foreign policy was developed in line with Nehruvian ideals and rooted in the paradigm of a multi-polar world. Over time and especially since the economic reforms after 1991, the methods to achieve this aim have changed — but the objective remains the same. Today economic growth and a close relationship with the US have been driving foreign policy — and both in turn are linked to energy security. This chapter will discuss how India's search for energy has shaped and changed Indian foreign policy making, both at a regional and at a global level, by focusing on three proposed transnational gas pipelines. It will also discuss how the search for energy, in particular for natural gas, has been hampered by domestic and international factors.

5.1 THE CENTRALITY OF THE QUESTION OF ENERGY SECURITY

India needs energy security first and foremost to ensure economic growth at 8–9% and at a rate which outstrips population growth, even in the current economic slump. India's growing population is expected to reach 1,180 million by 2010, 1,362 million by 2020 and 1,573 million by 2030, i.e. a more than 50% increase in less than 30 years. Since India is an energy supply-constrained economy, the sustainability of development and growth will depend on the availability of affordable, adequate and reliable energy and massive investments in social and physical infrastructure. Compared to its neighbours India's projected energy needs are huge (Figure 1).

Indian primary energy demand will grow proportionately to both population growth and economic growth. Coal is the largest source, constituting 51% of the total primary energy basket; the rest includes oil (36%), gas (9%) and nuclear and renewable (4%).¹ India currently imports 75% of its oil per annum, raising India's vulnerability to volatile oil markets. The Reserve Bank of India reports that every US\$1 rise in the international price per barrel of crude oil adds US\$600 million (around Rs 28 billion) to the country's import bill.² According to the International Energy Agency, a US\$10 rise in crude prices would reduce India's GDP by 1%.³ Hence there is an acute need to diversify the type as well as regional source of energy to ensure continuous

¹M. Lall and I. Lodhi, "The Political Economy of the Iran-Pakistan-India Pipeline", ISAS working paper 26 (Institute of South Asian Studies, 2007), <http://www.isn.ethz.ch/isn/Digital-Library/Publications/Detail/?ots591=0C54E3B3-1E9C-BE1E-2C24-A6A8C7060233&lng=en&id=96164>.

²Paranjoy Guha Thakurta, "High Oil Prices Would Hit Indian Economy", *Business Line*, 20 March 2004, <http://www.thehindubusinessline.com/2004/03/20/stories/2004032000240800.htm> [Accessed 5 July 2007]; Asian Development Outlook 2006, *Economic Trends and Prospects in Developing Asia* (Manila: ADB, 2006).

³Federation of Indian Chambers of Commerce and Industry (FICCI), "Emerging Oil Price Scenario and Indian Industry", December 2004, <http://www.ficci.com/surveys/FICCI-oil-survey-dec2004.pdf> [Accessed 5 July 2007].

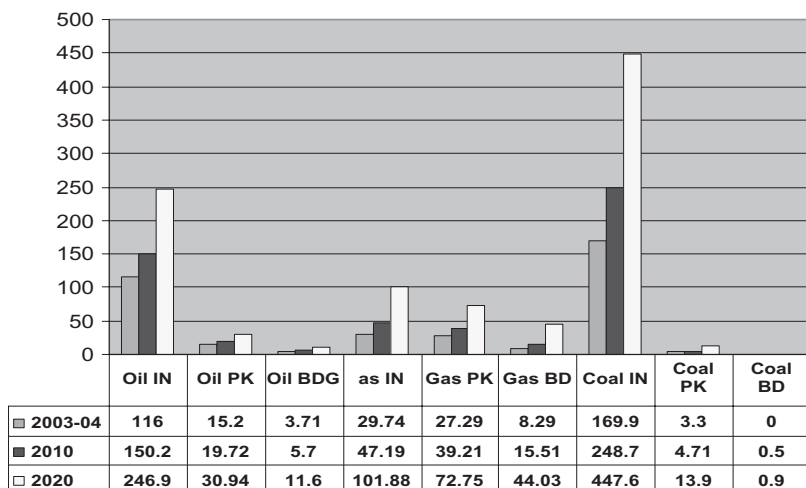


Figure 1 Energy Needs (Oil, Gas and Coal) in India, Pakistan and Bangladesh

Source: M. Lall (ed.), *The Geopolitics of Energy in South Asia* (Singapore: ISEAS, 2009).

availability of energy at affordable prices.⁴ Natural gas and nuclear energy have been the logical areas to expand and develop. With regard to increasing nuclear energy, in particular for electricity production, India negotiated the Indo-US civilian nuclear deal between 2007 and 2009, which now allows India to buy nuclear fuel, technology and other related materials despite India not being a signatory to the Non-Proliferation Treaty (NPT). India aims to expand the number of its reactors dramatically over the next 20 years. However, even a dramatic expansion is unlikely to yield enough energy to ensure the required economic growth.

⁴A slightly different scenario is painted by the US Energy Information Agency in whose reference case scenario the primary energy demand in India is expected to grow by 3.6% per year, doubling from 537 Mtoe in 2005 to 1,299 Mtoe in 2030. India will need to quintuple its electricity generation capacity from 1,600 GW to nearly 8,000 GW (A. Cohen, L. Curtis and O. Graham, "The Proposed Iran-Pakistan-India Gas Pipeline: An Unacceptable Risk to Regional Security", The Heritage Foundation, <http://www.heritage.org/Research/AsiaandthePacific/bg2139.cfm> [Accessed 8 February 2010]).

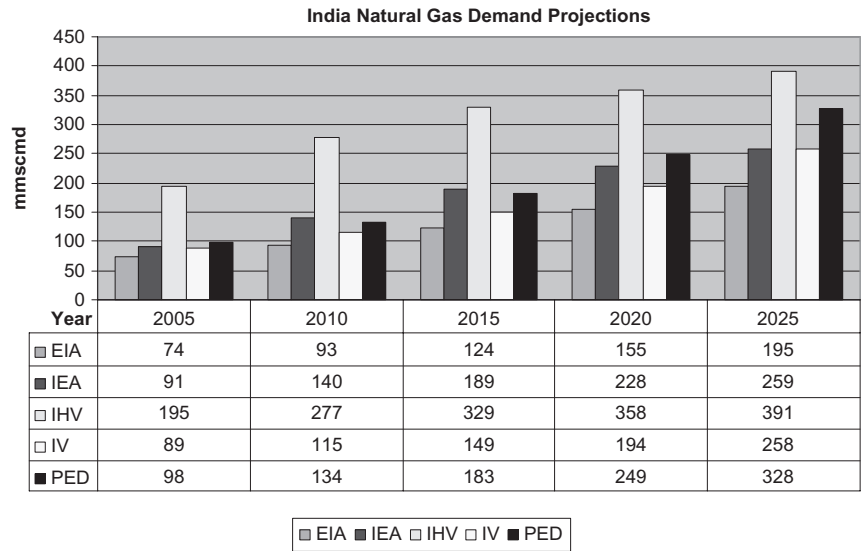


Figure 2 India Gas Demand Projections

Source: M. Lall and I. Lodhi, “Political Economy of Iran-Pakistan-India (IPI) Gas Pipeline”, ISAS Working Paper No. 26, Institute of South Asian Studies, 23 October 2007, p. 9.

With regard to gas, India has had to look abroad to supplement local reserves, which despite recent discoveries are not sufficient. India’s proven natural gas reserves are 38 Tcf (or 1.075 Tcm).⁵ India produces 85 million metric standard cubic metres per day (MMscmd) or 1.08 Tcf per annum of natural gas.⁶ The natural gas demand is expected to reach about 400 MMscmd by 2025 (Figure 2).⁷

⁵ 1 trillion cubic feet (Tcf) = 0.0283 trillion cubic metres (Tcm).

⁶ S. Srivastava, “India Grapples with Energy”, *Asia Times*, 24 March 2007, http://www.atimes.com/atimes/South_Asia/IC24Df01.html [Accessed 5 May 2007].

⁷ There have been two contentious and important issues in India in the context of gas and pipeline imports: demand/supply projections and pricing. Much of the controversy over demand/supply estimates, besides political motivations, arises from employing different econometric models and the inherent price sensitivity of the gas market. However, there is no substantial difference in the projections from different agencies except India Hydrocarbon Vision (IHV 2025). The IHV projections (see Figure 2) are substantially higher vis-à-vis other models, because they take into account the existing supply and demand gap which other models do not incorporate. The Eleventh (XI) Five-Year Plan

Given the need for increased natural gas, importing it became crucial. In February 2005 the Indian government approved plans for talks with six countries on the construction of gas pipelines that would pass through Iran, Afghanistan, Pakistan, Myanmar, Bangladesh and Turkmenistan. This new “pipeline diplomacy” was seen as a key foreign policy priority. However, the policy failed to bear the expected results. The next section will give details of the three pipelines which had been planned and the stage at which they are currently stuck.

5.2 THE PROPOSED PIPELINES

5.2.1 Iran-Pakistan-India (IPI) Pipeline

Iran has proven reserves of about 971.2 Tcf, the second-largest in the world after Russia. The IPI pipeline's source, the Pars field, contains 300 Tcf with a current production capacity of 3.1 Bcf/d. The Iran-Pakistan-India (IPI) pipeline was first discussed in the late 1980s. After four years of different studies, India signed an MoU in 1993 with Iran.⁸ However, due to security concerns, especially with regard to the route through Pakistan, the project was shelved and only re-emerged later.⁹ A agreement between heads of state was signed in June 2005 for the \$4.5 billion pipeline project and in August 2005 the Indo-Iran joint working group met in New Delhi. The meeting in Islamabad in May 2006 saw the trilateral meeting at second secretary level.¹⁰

(2007–2012) acknowledges this gap which is currently managed by arbitrary rationing, resulting in an underutilisation of the installed capacity in the fertiliser as well as the power sector (Planning Commission, Government of India, Draft Report of Expert Committee on Integrated Energy Policy 2005, pp. 34, 49).

⁸S. Pandian, “The Political Economy of Trans-Pakistan Gas Pipeline Project: Assessing the Political and Economic Risks for India”, *Energy Policy*, 33 (2005), pp. 659–670.

⁹India also explored the feasibility of offshore, deep-sea and shallow-sea pipelines as alternatives to crossing through Pakistani territory. However, the technological problems of a deep-sea (2,400 m) pipeline were difficult to overcome with the given technology. The shallow-sea option along Pakistan's coastal line, which would have had to cross Pakistan's exclusive economic zone (EEZ), was rejected by Nawaz Sharif's government due to Pakistani security concerns.

¹⁰“Gas pipeline from Myanmar likely to bypass Bangladesh”, *Financial Express*, New Delhi, 16 May 2006, <http://www.financialexpress.com/news/gas-pipeline-from-myanmar-likely-to-bypass-bangladesh/169582/1#>.

The meeting discussed the technical, financial and legal aspects of the project besides issues of project structure, and a feasibility study including the route.¹¹ During his visit to Iran in May 2007, the Indian foreign minister Mr. Mukherjee reiterated the Indian commitment to the project.

With a total length of 2,775 km and at an estimated cost of \$7.4 billion, the pipeline was meant to change the face of regional politics in South Asia. The gas pipeline would be expected to pump 60 MMscmd into Pakistan whilst India would receive 90 MMscmd. The pipeline was supposed to start from Assaluyeh, South Pars, stretching over 1,100 km, in Iranian territory before entering Pakistan and travelling through Khuzdar, with one section of it going south to Karachi on the Arabian Sea coast, and the main section travelling to Multan. From Multan the pipeline would link to Delhi. The pipeline would be running 1,115 km within Iran (Assaluyeh to the Pakistan border) and 898 km within Pakistani territory and another 740 km within India. A segmented construction approach had been agreed so that each country would build the pipeline within its own territory and would have proprietary rights. Concerns regarding gas price, transit fees and security were discussed bilaterally and trilaterally, and played their part in delaying and hampering the project. Yet the real obstacle arose through India's rapprochement with the US. In late April 2008, India and Pakistan held ministerial-level talks on both the Iran-Pakistan-India and the Turkmenistan-Afghanistan-Pakistan-India (TAPI) pipeline projects. India's Minister for Petroleum and Natural Gas Murli Deora said that both pipelines were equally important to Indian energy interests.¹² The TAPI project is discussed further, but for all intents and purposes the IPI project seems to have been shelved. In the meantime Iran and Pakistan have continued working on a pipeline without Indian cooperation.

5.2.2 Turkmenistan-Afghanistan-Pakistan-India (TAPI) Pipeline

Turkmenistan's gas reserves have been a debated subject for a number of years. For years Russia peddled the myth that there were insufficient

¹¹ "Accord on early IPI has pipeline work", *Dawn the Internet Edition*, Islamabad, 23 May 2006, <http://archives.dawn.com/2006/05/23/top9.htm>.

¹² Cohen, Curtis and Graham, 2010.

reserves to supply both Eastern and Western demand. However, in recent years, it has emerged that the reserves are indeed substantial, resulting in China pursuing a gas deal. (It is estimated that Turkmenistan has 10–14 Tcm of reserves, which are however not all certified.)

Also called the Trans-Afghanistan Pipeline, it was planned to transport Caspian Sea natural gas from Turkmenistan through Afghanistan into Pakistan and then to India. The Afghan government is expected to receive 8% of the project's revenue. The original project started in March 1995 when an inaugural MoU between the governments of Turkmenistan and Pakistan for a pipeline project was signed. By October 1997 Unocal established the Central Asian Gas Pipeline consortium to build the Turkmenistan-Pakistan segment of the pipeline at an estimated cost of US\$2 billion (US\$2.7 billion if extended to India). Construction was scheduled to begin as early as 1998, but the ongoing civil war in Afghanistan obstructed any opportunities for financing the project. After the withdrawal of two major financiers, Russian Gazprom and Unocal, the consortium was dismantled. After the United States invasion of Afghanistan in 2001, the TAPI project received a new impetus with the removal of the Taliban regime in Afghanistan, following a summit between the leaders of Turkmenistan, Afghanistan and Pakistan in May 2002. The parties affirmed their decision to revive the project and established a Steering Committee to oversee its implementation. At its first meeting in July 2002, the Steering Committee invited the Asian Development Bank (ADB) to play the role of development partner and help prepare the feasibility study for the project. In December 2002, the ADB approved a \$1 million technical assistance grant for undertaking a feasibility study. India was officially invited in 2005, and India agreed.¹³

The 1,680 km (1,040 mi) pipeline would run from the Dauletabad gas field to Afghanistan. From there the TAPI pipeline would be constructed alongside the highway running from Herat to Kandahar, and then via Quetta and Multan in Pakistan. The final destination of the pipeline would be the Indian town of Fazilka, near the border between Pakistan and India. The cost of the pipeline was estimated at US\$7.6 billion. Eleven high-level planning meetings have been held during the past

¹³ M. Lall (ed.), *The Geopolitics of Energy in South Asia* (Singapore: ISEAS, 2009).

seven years, with Asian Development Bank sponsorship and multilateral support.¹⁴

In April 2008, Pakistan, India and Afghanistan signed a framework agreement to buy natural gas from Turkmenistan. India discussed the pipeline project in September 2008 during meetings External Affairs Minister S. M. Krishna had with Turkmenistan President Gurbanguly Berdimuhamedow, Deputy Prime Minister in charge of oil and gas Baymyrat Hojamammedow and Foreign Minister Rasit Meredow in Istanbul.¹⁵ Given that the TAPI project is supported by the US in light of the Afghanistan reconstruction, there is more political will behind the project than with the IPI project. However, there are other issues and misgivings about the TAPI project which are discussed in the next section.

5.2.3 Myanmar-Bangladesh-India Pipeline

Myanmar has large gas reserves — according to data released by the Myanmar Oil and Gas Enterprise (MOGE) recoverable natural gas resources are around 51 Tcf due to two large offshore fields opposite Thailand and Bangladesh.¹⁶ The first offshore gas project, Yadana, was developed at a cost of \$1.2 billion off Moattama (blocks M5 and M6). It started to export gas to Thailand in 1988. The second, Yetagun, has cost about \$700 million and is off the Tanintharyi coast in the southeast (Blocks M12, M13 and M14). The reserves are estimated at 3.2 Tcf. The third site is called Shwe, off the Rakhine coast, and is just being developed. It could yield around 4.2–5.8 Tcf.

Today India's interests lie in A-1 and A-3, offshore blocks in Shwe. India's state-owned ONGC Videsh Limited (OVL) holds 20% and the

¹⁴A Review, "Gas-rich Turkmenistan and TAPI Pipeline May Bring Peace to Kabul", <http://areview.co.cc/mfarhanonline/featured/gas-rich-turkmenistan-and-tapi-pipeline-may-bring-peace-to-kabul/> [Accessed 5 February 2010].

¹⁵"Krishna Discusses TAPI Pipeline Project with Turkmenistan", *The Economic Times*, <http://economictimes.indiatimes.com/news/news-by-industry/energy/oil-gas/Krishna-discusses-TAPI-gas-pipeline-project-with-Turkmenistan/articleshow/5031220.cms> [Accessed 5 February 2010].

¹⁶Tin Maung Maung Tan, "Myanmar's Energy Sector: Banking on Natural Gas", in *Southeast Asian Affairs 2005*, Singapore: Institute of Southeast Asian Studies, 2005, pp. 257–289.

Gas Authority of India (GAIL) and KoGas (Korea Gas Corporation) each hold 10% of the equity stakes in both the A-1 and A-3 blocks, which are close to India. Daewoo International holds 60% of the stakes in the project. The exploration rights for blocks A-2 and L have been acquired by Essar, a private firm. Further deep-sea blocks have been auctioned to China and India and await certification and development.

As of 2005 India was planning to build a pipeline to bring Myanmar gas to eastern India. Several routes were considered — the most likely ones through Bangladesh, although at first the underwater option was considered and then dropped due to the high cost levels. Both routes through Bangladesh, one following the Kaladan River and travelling through Tripura and Mizoram, and one entering Bangladesh without going through India, were costed at \$1 billion.

A pipeline between Myanmar and India always depended on the quantity of gas available on the Rakhine coast, as well as the cost of bringing the gas back to India. The end-user price was also an issue as the price would reflect the cost of laying the pipeline and other costs such as transit fees. Whilst price and security were genuine issues, the dialogue went astonishingly well. India had arrived at the penultimate stage and was getting the framework signed. Bangladesh's extra demands remained problematic but the transit fee would have mitigated the balance of payments issue. The issue of the trade and energy corridor between Bangladesh, Nepal and Bhutan delayed India's final offer to Myanmar. Mani Shankar Aiyar's plans included a special diplomatic effort so that the chief ministers of the northeast could improve relations with Bangladesh and restore the status quo ante of 1965 with East Pakistan when goods could be traded freely. Due to the negotiation problems with Bangladesh, another route through India's northeast, bypassing Bangladesh, was also studied. The cost would have been \$3 billion.¹⁷

However, as New Delhi took time to get back to MOGE, China got involved. China's PetroChina signed a gas export memorandum of understanding with Myanmar early in 2006 and completed the survey for a

¹⁷M. Lall, "Indo-Myanmar Relations, a Shifting Geopolitical Scenario", ISAS working paper 29 (Institute of South Asian Studies, 2007), <http://www.isasnus.org/events/working-papers/28.pdf>; and Lall (ed.), 2009.

2,389 km pipeline from Kyaukphyu (which will be developed as a deep-sea port) in Myanmar to China's Yunnan Province. The MoU envisages 6.5 Tcf being supplied from A-1 for 30 years. In return China will make available an \$84 million soft loan.¹⁸

There is not enough gas for both China and India from both these blocks. The in-place reserves from the A-1 block in the Shwe field have been assessed by Houston-based consulting firm Ryder Scott at 2.88–3.56 Tcf.¹⁹ Today the deal lies shelved although the press is still talking about a potential pipeline through Mizoram linked to the Kaladan multimodal transport project. It will in essence depend on the amount of gas available from the Essar Oil's stakes in Myanmar's offshore block A-2 and onshore block L. Essar hopes to start production by 2013.

5.3 PROBLEMS WHICH HAVE FRUSTRATED THE DEVELOPMENT OF THE PIPELINES

Despite India's need for natural gas and negotiations stretching over years, the three pipelines have not come to fruition. Reasons for this are to be found both in the foreign policy as well as the domestic realm. This section will explore how India's foreign relations have contributed to frustrating the projects before analysing the domestic issues which have also played a role. It is also clear that India's foreign relations have been profoundly marked by the search for energy security — in most cases to the detriment of good regional and neighbourly relations. The balance of power is shifting towards China as it sucks up all regional energy resources which can be piped back over land. The shift from self-sufficiency to competitive alliance politics is leading to a new great game encompassing the whole of South Asia with the US and China, but increasingly Russia is playing out its global power politics in the region as well.

¹⁸ Sanjay Dutta, "Gas pipeline: Myanmar takes India for a ride", *Times of India*, 26 March 2006, http://articles.timesofindia.indiatimes.com/2006-03-26/india-business/27796160_1_gas-pipeline-china-s-yunan-export-pipeline.

¹⁹ Anand Kumar, "India-Myanmar Gas Pipeline: Disentangled at Last", Paper no. 1822 (South Asia Analysis Group, 2006).

5.3.1 Foreign Policy Issues

More than anything else the Manmohan Singh Congress-led government staked its foreign policy around the improvement of relations with the United States. Central to this was the negotiation of a civilian nuclear deal allowing India to buy nuclear fuel and technology despite not being a signatory to the NPT. The deal was finally agreed in 2008 with some follow-up legislation such as the Nuclear Liability Act still being put in place in 2010. The conditions associated with the deal have had an impact on the “independence” of India’s foreign policy decision making as the 123 Agreement specifically states that the deal can be cancelled if either state undertakes any action seen by the other as affecting the other’s national security. This has given the US a stake in Indian decision making and influencing India on its Iran policy has been a priority. The US has put pressure on India not to buy natural gas from Iran, which it considers a pariah state (or a member of the “axis of evil”).²⁰ The role of the US has had further impacts on the development of the IPI pipeline, in particular with regard to the financing. This has proved problematic due to the US sanctions regime on Iran. Yet despite the Iran and Libya Sanctions Act of 1996 and the pending Iran Counter-Proliferation Act of 2007 by the US Congress, companies have been doing business with Iran much beyond the limit of \$20 million mentioned in these Acts. A consortium was also under discussion among BHP (Australia), NIGC (Malaysia), Total (France), Shell (Netherlands) and BP (UK) in addition to Iranian, Pakistani and Indian national gas companies.²¹ Russian Gazprom has also expressed interest despite the sanctions regime, especially since Russia would prefer the gas not to flow to Europe. Despite all this economic goodwill the financing has not come together, and having successfully influenced

²⁰In January 2006, the US ambassador to India explicitly linked progress on proposed United States–India civil nuclear cooperation with India’s upcoming vote against Iran, saying if India chose not to side with the United States, he believed the US-India initiative would fail in Congress. The United States officials repeatedly and unequivocally expressed their opposition to the IPI gas pipeline.

²¹S. Shahid, “Iran-Pak-India Gas Pipeline: Implications and Prospects”, *Business & Finance Review*, 15 January 2007.

New Delhi to put the deal on the backburner, the US is now leaning on Pakistan not to buy gas from Iran either. The TAPI pipeline on the other hand is part of Afghanistan's 2008 budget and has had US support since the 1990s. The aim is to stabilise Afghanistan and is therefore being pushed as a viable alternative for India's gas supply by US policy makers.

Relations with India's neighbours were supposed to improve dramatically through the interdependence created through the pipelines — this was particularly expected with the IPI pipeline. Tying India's energy security in with Pakistan was expected to help with the peace process through increased trade as well as help boost the confidence-building measures. However, issues which were not resolved between Pakistan and India included the transit and tariff fees levied by Pakistan for the IPI pipeline. Pakistan initially asked \$1 per MBtu as a transit fee and \$1.57 per MBtu for transportation (and tariff) while India was not willing to pay more than \$0.15 and \$0.40 respectively. Pakistan offered India the alternative option to buy gas at the Pakistan-India border from Pakistan and let Pakistan and Iran deal with the pipeline, but India felt this would give Pakistan too much leverage.²² Beyond leverage, security in Pakistan was of paramount importance to India. The IPI pipeline would pass through Balochistan where an insurgency has already led to attacks on the Pakistani pipeline grid. New Delhi's security establishment is not confident that Pakistan can guarantee the security of a pipeline in that region. There are similar issues between both countries with the TAPI pipeline but they are yet to be addressed.

Indo-Bangladesh relations have also been strained in the past and energy interdependence was seen as a way to balance out India's hegemonic position. The proposed pipeline from the Shwe gas field to Kolkata would have earned Bangladesh about \$125 million annually in transit fees, improving the balance of payments difference between the two countries. Dhaka had agreed in principle and a tripartite deal was to be sealed in the course of 2005. The Bangladeshi government wanted the pipeline to be laid along Bangladesh's existing roads and highways to make it

²² S. Srivastava, "India Weighs the Pipeline Odds", *Asia Times*, 19 April 2007, http://www.atimes.com/atimes/South_Asia/ID19Df01.html [Accessed 5 May 2007].

easier to manage. It also wanted India to allow it to use the pipeline to export gas to India or import gas from Myanmar. Whilst India would be responsible for building the \$1 billion gas pipeline, Bangladesh's state-owned Gas Transmission Company would be responsible for managing the part of the pipeline based in its country. In July 2005 the Bangladeshi government made three further demands: the provision of transit facilities through India to facilitate transmission of hydro-electricity from Nepal and Bhutan to Bangladesh; to be allowed to utilise the corridor for trading between Bangladesh and Nepal/Bhutan through Indian territory; and an initiation of measures to reduce the \$2 billion trade imbalance between Bangladesh and India. The Indian government opposed these conditions, as they did not want to make bilateral issues part of a trilateral agreement. Given this, the possibility of bypassing Bangladesh by taking the pipeline from Myanmar into Mizoram and onwards to Assam and culminating in West Bengal, a distance of 1,400 km, was explored as an alternative. In the end Mani Shankar Aiyar, the minister responsible at the time, managed to negotiate a deal with Bangladesh; however, both the Indian Army and the Ministry of External Affairs vetoed the pipeline through Bangladesh on security grounds. The whole process had taken so long that in the meantime China had made an alternative offer to Nay Pyi Taw and both countries agreed that the gas from A-1 and A-3 of the Shwe fields would be piped to Kunming instead. This was not the first time that India had lost a gas deal to China and it has not helped improve Indo-Chinese relations.

Relations between India and China have been problematic since the 1962 war, which India lost. Since then China has been seen as the only "real" threat that India faces. There has been fierce competition for energy resources, especially in Central Asia and Myanmar.²³ Indian and Chinese firms have cooperated in some cases, in order to avoid driving up the price in the bidding war; however, this has only ever been the case when the gas was "overseas" and could not be repatriated to China over land. China's ability to pay higher prices and for its representative teams to close deals with governments without having to go back to Beijing also give

²³M. Lall, "The Geopolitics of Energy in Asia: Indo-Chinese Competition over Myanmar's Gas Reserves", *Panorama*, 2 (2007), pp. 35–47.

the country an edge over its Indian counterparts. China's hydrocarbon companies also have political muscle in Beijing, unlike their Indian counterparts in Delhi.²⁴ China not only secured Myanmar gas but has also expressed an interest in Iranian gas from the Pars field (originally intended for the IPI pipeline) and signed a deal with Turkmenistan for gas which is earmarked for the TAPI pipeline. India now feels that China's string of pearls strategy means it is surrounded by Chinese allies. Relations have worsened with the arguments around the border of Arunachal Pradesh and China's disapproval of the Indo-US nuclear deal.

Relations with India's other neighbour, Myanmar, remain good, despite the fact that the pipeline was not realised. India's aim still is to cooperate with the Myanmar government in anti-insurgency campaigns on the north-eastern joint border as well as to open up a trade corridor with Southeast Asia, tying itself closer to the ASEAN countries. India's energy companies are still involved in various gas fields — both the original ones and some new ones — and there is still hope in Delhi that with new gas finds a pipeline could be viable one day. This in turn would strengthen Indo-Myanmar ties.

Further afield relations for India have also become problematic — whilst Iran and India have had improved relations since the Islamic revolution, India's increasingly pro-American stance has complicated things. In the early 1990s Iran and India both supported the Northern Alliance as opposed to Pakistan's support for the Taliban in Afghanistan. Later both countries supported the United States military-led ousting of the Taliban regime. India and Iran have more recently cooperated in the Afghanistan reconstruction activities. Tehran sees India and China as its potential customers for oil and gas as well as a way out from the US attempts to isolate Iran. The years 2003–2005 saw a further deepening of India-Iran ties. The IPI pipeline discussions were renewed in the same period and a US\$40 billion LNG deal was signed to supply 7.5 million tonnes of liquefied natural gas (LNG).

The recent nuclear deal between the United States and India has put some pressure on India-Iran relations. However, prior to the nuclear deal,

²⁴ Bo Kong, "The Geopolitics of the Myanmar-China Oil and Gas Pipelines", *Pipeline Politics in Asia: The Intersection of Demand, Energy Markets and Supply Routes*, The National Bureau of Asian Research, NBR Special Report #23, (September 2010), pp.55–67.

there were two major issues regarding the IPI pipeline: the price of gas and the financing of the construction of the pipeline. Gas prices proposed by Iran were more than double what Pakistan and India were willing to accept. India wanted to pay a fixed amount per unit delivered to its border, but Iran wanted the cost to be linked to the fluctuating international energy prices, saying the prices offered by Pakistan and India were only half of what it was looking for.²⁵ Given that the IPI pipeline is at least provisionally shelved, relations are sensitive as India is increasingly seen as taking the US side on the international stage.

India has been, for a number of years now, interested in increasing its influence in Central Asia. Whilst relations with Iran are more complicated these days, India has improved its relationship with post-Taliban Afghanistan by becoming heavily involved in the reconstruction efforts. India is keen to maintain good relations as a counterbalance to Pakistan and fears a return of the Taliban once the US and coalition troops leave, whom they believe would be in alliance with Pakistan. A pipeline through Afghanistan is not only favoured by Washington but would also further strengthen Indo-Afghan relations. However, given the current security situation and the terrain the pipeline would have to traverse, such a pipeline seems to be more of a political plan rather than an impending reality. Beyond the situation in Afghanistan there are also issues pertaining more directly to Turkmenistan and the availability of Turkmen gas. There is a huge issue around the question of whether Turkmenistan has overcommitted its gas supplies:

Russia has a virtual monopoly over exports from Turkmenistan with Gazprom allowed to take up to 50 bcm of gas annually for another two decades. China has been promised 30 bcm from 2009 and Iran 8 bcm. Berdymukhamedov is

²⁵Price negotiations in the IPI context are quite complex. Iran had initially demanded \$7.20 per million British thermal unit (MBtu) linked with a price escalating component (10% of Brent Crude Oil) that was almost double the \$4.25 which India offered on its border. Both Pakistan and India rejected this offer, after which a consultancy firm, Gaffney, Cline & Associates, was hired to give a workable formula. The local gas production price in India and Pakistan is approximately \$3 after subsidies. According to the new formula the price of gas was to translate to \$4.93 per MBtu that is linked to the Japan Crude Cocktail price. Khaleeq Kiani, "ECC approves price formula: Work on IPI pipeline to begin next month", *Dawn the Internet Edition*, 11 April 2007, <http://archives.dawn.com/2007/04/11/top1.htm>.

also reported to have signed another 10 bcm to the European Union, bringing its projected gas exports to over 100 bcm annually.²⁶

Russia is heavily involved in the Turkmenistan gas deals and would prefer to see India opt for the IPI as opposed to the TAPI pipeline. Russia remains the most influential player on the Turkmenistan stage and India has now to contend with both Chinese and Russian policy if it wants to source gas for the TAPI pipeline.

5.3.2 Domestic Constraints

Looking at the complex foreign policy issues, it is easy to forget that domestic policies also play a role in securing energy resources. India's prime problem has been the lack of a long-term energy security vision as well as the coordination of the various ministries and government departments to secure such a vision. Given the democratic structure and the devolved state government power base where local priorities play an increasingly important role, domestic opposition at the local, regional and national levels has also played a part.

India's lack of vision and failure to prioritise is very different from China's world plans. Since India is a democracy all things are subject to negotiation and compromise. This has been increasingly so since the mid-1990s when coalition governments have ruled in New Delhi. As a result policies rarely are sustained beyond the term of one administration and likely to fall prey to interparty negotiations even within a term. Whilst India has a clear vision of its position in the world it has not yet developed a strategy to succeed in this aim. Part of the problem is governmental and ministerial non-coordination and non-cooperation. This is exemplified by the failure of the India-Myanmar pipeline where the various ministries could not agree — that is if they were even talking to each other.²⁷ The Ministry of External Affairs and the Ministry of Defence were against the project, citing security reasons, whilst the Ministry of Commerce and the Department

²⁶L. Jishnu, "Is IPI Pipeline Less Risky than TAPI Line?", Rediff, 31 May 2008, <http://www.rediff.com/money/2008/may/31guest.htm> [Accessed 6 February 2010].

²⁷Lall, 2007.

for Northeastern Affairs were for the pipeline. The part of the Energy Ministry dealing with gas²⁸ was caught in the midst of a turf war. During this time the Prime Minister's Office was negotiating the nuclear deal and the pipeline from Myanmar was therefore not on the high priority agenda. Consequently China was able to step in and negotiate a deal.²⁹

Beyond the ministries there is domestic opposition to politically sensitive engagement (with an active press keeping the level of public opinion and information raised) as well as ambivalence across domestic political circles.

5.3.3 The Future: The Need for a Policy Turnaround

Given the failure of securing three transnational pipelines and the lessons hopefully learnt in the process, India's energy policy is in dire need of revision. The Indian government needs to develop a strategy which matches a long-term vision (20+ years) linking economic and political drivers with regard to relations in the region and across the globe. Domestic ambivalence and the focus on winning the next elections will always mean that India will lose out to China. Energy security policy has to be at the heart of this. As a result different ministries need to work together with the same goals and visions. The Prime Minister's Office cannot be the only place where strategic decisions are made and pushed through; it also needs to lead the other ministries and harmonise their working with the government. Party politics and regional politics need to be put on the backburner when dealing with such complex issues which are however of prime national importance. Beyond domestic reform both the Ministry of External Affairs and the Indian Army need to gain a more in-depth understanding of China's *modus operandi* in order to develop a long-term plan for what to do regarding China and China's encroaching presence in the region.

²⁸The fact that India's Ministry of Energy has been split into three ministries is not of help either.

²⁹Lall, 2007.

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CHAPTER 6

THE CAUCASUS: CONFLICT, INSTABILITY AND FOSSIL ENERGY EXPORT ROUTE

Hooman Peimani

6.1 INTRODUCTION

As a bridge between Asia and Europe, the Caucasus¹ has historically been important for regional and non-regional powers. Especially over the past 3,000 years, this region has been a scene of rivalry between and among these powers seeking to dominate or control it in one form or another. In addition to its agrarian, mineral and energy (mainly oil) richness, its major attraction for them has been its importance as an intercontinental land link. This geographical reality is a major contributing factor to its strategic significance. The latter has become especially prominent in the post-Soviet era when the regional countries, namely Armenia, Azerbaijan and Georgia, gained independence after about two centuries of forced

¹Throughout this chapter, the Caucasus refers to Azerbaijan, Armenia and Georgia. Hence the Russian North Caucasian republics (e.g. Chechnya, Dagestan and Ingushetia) are excluded.

membership in the Russian and Soviet states. That the Caucasus neighbours Iran and Russia, two sources of concern for the Western countries for different reasons, has also made this region crucial for their “containment” policy.

The post-Soviet era has not been peaceful for any of the Caucasus's forming states. On the contrary, to a varying extent, intra- and inter-state wars have hurt them all, adding new problems to those political, economic, social, military/security and environmental ones inherited from the Soviet era. Georgia experienced two devastating civil wars instigated by the bid for independence of its two breakaway republics of South Ossetia and Abkhazia. Respectively, they ended in 1992 and 1993, only to leave those republics practically independent, a status which has lasted to this day (February 2010). Begun in the last years of the Soviet era, the efforts of the Armenian Karabakhs to separate their region (Nagorno-Karabakh) from Azerbaijan and reunite this predominantly Armenian region with Armenia instigated a civil war in Azerbaijan upon its independence in 1991; it pitted Azerbaijan against Armenia, the main backer of the Armenian Karabakhs. A ceasefire agreement ended the conflict in 1994 without addressing its main cause. The Armenian Karabakhs have since controlled that region and the adjacent land connecting it to Armenia. About 20% of the Azeri territory has since been out of Baku's control.

The Caucasus has also experienced a major inter-state war in its independence era. The August 2008 military attack of the Georgian government on South Ossetia did not bring about the desired result for Tbilisi. Instead of securing its control over the breakaway republic, it provoked a Russian military response in support of its protégé. The Russian military devastated the Georgian military and destroyed almost the entire Georgian military industry throughout the country. The development provided the opportunity for Moscow to recognise Abkhazia's and South Ossetia's declared independence as demanded by their governments.

The Caucasus has therefore had more than its fair share of armed conflicts and instability since its independence. Today the region is not engulfed in any armed conflict or major internal unrest affecting its forming states, but it is also far from becoming a stable region. In fact, it is now prone to instability as Azerbaijan's and Georgia's territorial loss and the

continuity of a no-war-no-peace situation between them and their breakaway regions have planted the seeds of armed conflicts in the region. To this also should be added the prevailing hostile relations between Georgia and Russia over the latter's backing of the former's breakaway republics and of course the humiliating memory of a military defeat in Georgia. To put it briefly, the situation is ripe for a new round of intra- and inter-state armed conflicts. Their outbreak could well drag in the regional (Iran and Turkey) and non-regional (the US and the European Union (EU)) powers in support of one side or another, given their established pattern of relations with the Caucasian countries.

Although independence has not brought peace and prosperity for the Caucasus, this region could potentially have a much better future. In part, this is because of Azerbaijan's fossil energy resources, particularly oil, whose exports have provided since the second half of the 1990s a degree of financial strength for Azerbaijan, the only regional country with significant oil and gas reserves. However, as Azerbaijan's fossil energy deposits are not large enough to grant it a long-term export capability at a significant scale, the energy-related prosperity of the region is linked to its functioning as a major transit route for the Caspian region's oil and gas exports. It should therefore play this role for Kazakhstan and Turkmenistan, two Caspian countries with, respectively, substantial oil and gas reserves that ensure their export capability for two or three decades depending on the volume of their annual exports.

Thanks to its geographical location, this possible role if it becomes a reality in a sustainable manner creates an economic ground for a more prosperous future for the Caucasus. In fact, the efforts to that effect, translated particularly into oil/gas pipeline construction since the 1990s, have made this possibility more realistic. However, among other factors, there are doubts about this scenario coming true owing to the aforementioned sources of instability and armed conflicts in addition to the internal sources of social and political instability, particularly in Azerbaijan and Georgia. Consequently, the long-term oil/gas-related prosperity of this region will require peace and security, which, in turn, demand settling in a satisfactory manner for all concerned parties the existing inter- and intra-state conflicts. Against this background, certain factors capable of preventing the region's desired export role warrant elaboration.

6.2 OIL AND THE CAUCASUS

The importance of oil for the Caucasus is twofold. On the one hand, the region is rich in oil thanks to Azerbaijan's substantial oil reserves, the bulk of which is concentrated in its Caspian offshore oil fields. This reality has been the single major reason for the interest of the Western countries in Azerbaijan, especially the United States. Along with many European oil companies, American oil companies have practically dominated the fossil-energy sector of Azerbaijan, like those of other newly emerged Caspian oil exporters: Kazakhstan and Turkmenistan. Azerbaijan's proven oil reserves are estimated to be 7 billion barrels.² On the other hand, the Caucasus could play a major role as a transit route for oil and also gas exports from the Caspian region.

The entire Caspian region has a much smaller amount of recoverable oil than suggested by the very unrealistic estimates of the 1990s, e.g. over 200 billion barrels.³ Its proven oil reserves, including those of Azerbaijan, Turkmenistan and Kazakhstan, excluding the non-Caspian oil reservoirs of the two other Caspian littoral states (Iran and Russia), is a fraction of those estimates, i.e. between 17 and 44 billion barrels, based on a 2006 estimate.⁴ The recent discoveries have slightly pushed up its reserves to 47.4 billion barrels as of 2009.⁵

Within this context, Azerbaijan cannot possibly turn itself into a major long-term energy exporter given its fossil energy reserves (being mainly oil and, to a much smaller extent, gas) are too small. The evidence today substantiates this claim. Through various pipelines and by rail, its oil exports of about 211,000 barrels per day (bpd) in 2004⁶ increased to

²BP, "Oil: Proved Reserves", *BP Statistical Review of World Energy* (London: BP, June 2009), p. 6.

³Bijan Mossavar-Rahmani, "The Challenge of the US Caspian Sea Oil Policy", *Motaellat-e Asyaie Markazi va Ghafghaz* [Central Asia and the Caucasus Review], 28 (Winter 2000), p. 51. Quoted in Hooman Peimani, *The Caspian Pipeline Dilemma: Political Games and Economic Losses* (West Port, CT: Praeger, 2001).

⁴Energy Information Administration, *Country Analysis Brief: Caspian Sea — Oil*, 2006, <http://www.eia.doe.gov/emeu/cabs/Caspian/Oil.html> [Accessed 10 December 2009].

⁵The figure is equal to the combined oil reserves of Azerbaijan, Kazakhstan and Turkmenistan as provided by BP, "Oil: Proved Reserves", p. 6.

⁶Energy Information Administration, *Country Analysis Brief: Azerbaijan*, June 2005, <http://www.eia.doe.gov/emeu/cabs/azerbjan.html> [Accessed 10 December 2009].

749,000 bpd in 2008, the most recent year on which statistics are available. At this small rate of export compared to the major international oil exporters such as Iran (about 2.6 million bpd), the country's oil reserves will be depleted in about two decades unless major new oil fields are discovered.

Currently, Azerbaijan has a much larger capacity for export because of its two major export pipelines (Baku-Supsa, in operation since the 1990s, and Baku-Tbilisi-Ceyhan (BTC), which went online in 2006). The BTC pipeline has provided additional capacity for the Azeris to export of about 1.2 million bpd, to be increased to 1.6 million bpd by the end of 2010 as announced in July 2009. As it is unlikely for Azerbaijan to achieve that export capability, it is necessary for the survival of the pipeline to be used also by other Caspian oil exporters, primarily Kazakhstan, which has the region's largest oil reserves of 39.8 billion barrels,⁷ and Turkmenistan and Uzbekistan, which have small oil export capabilities. Yet, to date, there has not been any strong evidence that these exporters, especially Kazakhstan, are willing to commit themselves to export via Azerbaijan and particularly the BTC pipeline on a long-term basis and at a large scale. As the most recent example, in October 2009, Azerbaijan and Kazakhstan signed an energy agreement whose specifics are yet to be released. However, while such agreement could increase Kazakhstan's oil exports via Azerbaijan, at the end of 2009 only about 100,000 bpd of oil was moving "via the BTC pipeline and by rail to Georgia's Black Sea ports" through Azerbaijan.⁸

Against this background, Azerbaijan's capability to function as a new oil supplier for the global economy, whose energy requirements are increasing on a steady basis, currently qualifies it as an oil exporter of international significance, though a short-term one, despite its aforementioned characteristic. In particular, concerns over heavy reliance on the Persian Gulf fossil energy resources whose exports could be sharply reduced or cut due to a major conflict has made many economies, including the Western ones, China, Japan and South Korea, to seek to diversify

⁷BP, "Oil: Proved Reserves", p. 6.

⁸Energy Information Administration, *Country Analysis Briefs: Azerbaijan*, October 2009, <http://www.eia.doe.gov/emeu/cabs/Azerbaijan/Full.html> [Accessed 27 January 2010].

their energy suppliers. That objective has created interest in Azerbaijan as a supplier and also as a backup source for those depending on the Persian Gulf, mainly the Western economies. This is notwithstanding Azerbaijan's small oil resources compared to those of the Persian Gulf, which contains about 60% of the world's proven oil deposits and has phenomenal gas reservoirs (accounting for about 40% of the global deposits). Iran and Qatar, respectively, are the second-largest (29.61 trillion cubic metres (Tcm))⁹ and third-largest (25.46 Tcm)¹⁰ possessors of gas, with Russia (43.4 Tcm)¹¹ ranking first.

Consequently, the interest of the regional powers (Iran and Russia) and the non-regional ones (the US and EU), added to those of the Central Asian energy exporters (chiefly Kazakhstan and Turkmenistan), in the Caucasus lies in its potential as a land link between Asia and Europe and thus as an export route for the oil and gas resources of Central Asia, Iran and Russia. Needless to say, these countries have other interests such as stakes in developing and exporting its energy resources (the US and EU) and supplying fuel to Georgia (Iran) and Armenia (Russia and Iran).

For Iran and Russia to access international oil markets via their territorial waters, using the Caucasus for fossil energy exports is not vital. However, the situation is different for Central Asia and the United States, which have to rely on Iran and/or Russia for such exports. Accessing the Caucasus via the Caspian Sea will provide them with another export route. This is an especially important prospect for the Americans who wish to bypass Iran and Russia for exporting Central Asian and also Azeri oil and gas.

Compared to the Caucasus, Central Asia, which is prone to inter- and intra-state conflicts like the former, has much larger oil and gas deposits. Its two major fossil energy exporters, Kazakhstan (mainly oil) and Turkmenistan (mainly gas), have large energy resources. Their proven reserves in 2010 are respectively estimated at 39.8 billion barrels of oil¹²

⁹ BP, "Gas: Proved Reserves", *BP Statistical Review of World Energy* (London: BP, June 2009), p. 22.

¹⁰ Ibid.

¹¹ Ibid.

¹² BP, "Oil: Proved Reserves", p. 6.

and 1.82 Tcm of gas¹³ and 0.6 billion barrels of oil¹⁴ and 7.94 Tcm of gas.¹⁵ These resources have enabled them to be players in the international markets for over three decades or so. Another regional state, Uzbekistan, possesses significant proven oil and gas reserves, i.e. 0.6 billion barrels of oil¹⁶ and about 1.58 Tcm of gas,¹⁷ enough to make it a major regional gas exporter as its oil production barely meets its domestic consumption. Energy resources are practically Central Asia's engine of growth and the main reason for the interest in that region of non-regional states, mainly the United States and the EU countries, although the region's border with two nuclear states (China and Russia) and a regional power (Iran) provides additional strategic interest.

Since their rise as oil and gas exporters in the post-Soviet era, the three Central Asian countries, which lack access to open seas, have relied on neighbouring Russia for their major exports through its extensive pipeline network inherited from the Soviet era. Yet, their almost exclusive reliance on Moscow for their vital energy exports have put the Russians in a position to exercise influence and impose any transit fee as they wish on the Central Asian exporters. Concerned about losing their real, but not nominal, independence, they have sought since the mid-1990s to find additional and/or alternative export routes to decrease their dependency on Russia. The recent instances of the latter cutting its gas exports via pipeline to Ukraine and Georgia in January 2006,¹⁸ its piped oil exports to Belarus in January 2007¹⁹ and again to Ukraine in January 2009²⁰ for a short while clearly indicated one thing. The Russians could use their oil and gas export infrastructure

¹³ BP, "Gas: Proved Reserves", p. 22.

¹⁴ BP, "Oil: Proved Reserves", p. 6.

¹⁵ BP, "Gas: Proved Reserves", p. 22.

¹⁶ BP, "Oil: Proved Reserves", p. 6.

¹⁷ BP, "Gas: Proved Reserves", p. 22.

¹⁸ "Russia Blamed for Gas 'Sabotage'", BBC News, 22 January 2006, <http://news.bbc.co.uk/2/hi/europe/4637034.stm> [Accessed 19 January 2010].

¹⁹ "Russian Flows Via Belarus Halted", *Upstream*, 8 January 2007, <http://www.upstreamonline.com/live/europe/article125800.ece> [Accessed 9 September 2008].

²⁰ "The Gas Wars", *Newsweek*, 26 January 2009, <http://www.newsweek.com/id/181720> [Accessed 1 February 2010].

through which other countries also export (e.g. Azerbaijan, Kazakhstan and Turkmenistan) or import (Georgia and Ukraine) energy as a means to exert pressure on those dependent on such networks. The completion of the first phase of the Central Asia–China Gas Pipeline in December 2009 connecting Turkmenistan to China via Uzbekistan and Kazakhstan, through which the three countries can export gas to China, ended Russia's monopoly on the Central Asian large gas exports, and added to the two Turkmen–Iranian short gas pipelines.²¹ Yet, the regional gas exporters still conduct the bulk of their international exports via Russia.

Neighbouring Central Asia with its long border with Turkmenistan, Iran is the logical export route for the Central Asians as Russia is for its geographical location. It offers the shortest, the securest and the least expensive route to the international markets through its extensive oil export infrastructure. However, for obvious political reasons, Washington's opposition to Iran as a major or *the* major export route has forced the Central Asians to limit their oil exports through that country to swap deals of about 80,000 bpd in 2007,²² the most recent year on which reliable statistics are available. Accordingly, Central Asia supplies Iran with their crude oil at Iran's Caspian Sea port of Neka, to be used by the Iranian oil refineries in the north, in return for the equivalent amount of Iranian crude oil delivered to designated customers at one of the Iranian Persian Gulf oil terminals.

Given that Iran is practically out of the question for Central Asia, the Caucasus's geographical location qualifies it as a potential transit route for not only Azerbaijan, but also for Central Asia. This is notwithstanding its being much longer, more expensive and less safe than the Iranian route. Since the required infrastructure could also be used for oil exports from Central Asia whose proven resources are much larger than those of Azerbaijan, the possibility of oil exports from Azerbaijan through Georgia (having access to the Black Sea) and its neighbouring Turkey (with access

²¹ "China Opens New Central Asia Gas Pipeline", Reuters, 14 December 2009, <http://uk.reuters.com/article/idUKLDE5BD02E20091214> [Accessed 1 February 2010].

²² Energy Information Administration, *Country Analysis Brief: Caspian Sea*, January 2007, <http://www.eia.doe.gov/cabs/Caspian/Full.html> [Accessed 12 January 2010].

to the Mediterranean Sea) makes such exports even more interesting for the Azeris and the Georgians.

However, the wisdom of exporting oil and gas via the Caucasus, passing through Georgia as the region's connection with Azerbaijan, Turkey and the Black Sea, has been questioned in the aftermath of the August 2008 Georgian-Russian war.

Owing to the depth of hostility between Georgia and Russia and the unsettled issue of Georgia's two breakaway republics backed by Russia, Georgia could well be dragged into another war in which all pipelines passing through its territory could be damaged or destroyed with the effect of ending oil/gas exports for an unpredictable period of time. In fact, while BP denied any damage to its pipelines passing through Georgia during the August conflict, it accepted the closure of its major pipelines for unspecified reasons.²³ This included the closure of the Western Route Export Pipeline (WREP), which takes crude oil from Baku to the Georgian Black Sea port of Supsa, and the suspension of gas being pumped from Azerbaijan's Shah Deniz field into the South Caucasus Pipeline connecting Azerbaijan to Turkey via Tbilisi. BP attributed the closure of its main oil pipeline, the Baku-Tbilisi-Ceyhan, linking Azerbaijan to Turkey via Georgia, to "a fire".

With the strong possibility of intra- and inter-state conflicts, the Caucasus was not a desired route for energy exports even before the Georgian-Russian war. Today the argument in favour of this route is even less convincing in the wake of that war. Nevertheless, since the US opposition to the Iranian route is especially strong today, the Caucasus is the only remaining option for Central Asia to reduce its heavy dependency on Russia. Yet, large and long-term exports in this case require building a very expensive and difficult-to-maintain undersea oil pipeline to connect Central Asia to the Caucasus via the Caspian Sea. Any land pipeline would have to pass through either Russia or Iran which neighbour the two regions in the north and in the south, respectively. While an onshore pipeline is out of the question for the aforementioned reasons, there is no serious plan for a predictably very expensive offshore pipeline, a very

²³ Daniel Fineren, "Conflict Stems Georgia Oil, Gas Pipeline Flows", Reuters, 12 August 2008, <http://uk.reuters.com/article/gc07/idUKLC53581720080812> [Accessed 14 January 2010].

controversial project due to its apparent environmental damage to the already highly damaged environment of the Caspian Sea. To this, one should add the fierce opposition of Iran and Russia to such a pipeline, not just for its anticipated environmental hazards, but also because it would undermine their national interests, depriving them of oil/gas exports through their countries.

Operating in this reality, Central Asian oil exports via the Caucasus are currently limited to those possible by using small oil tankers operating between the two regions across the Caspian Sea. However, the United States, whose oil companies dominate the Caspian oil industry, has been trying to convince the Central Asians to increase their exports via the Caucasus as part of its objective of bypassing Iran and Russia for Caspian oil and gas exports.

6.3 THE SALIENCE OF THE MAJOR CAUCASIAN PIPELINE PROJECTS

6.3.1 Azeri Pipelines

For the purpose of turning the Caucasus into a major transit route, certain pipelines have been constructed by the mainly Western oil/gas corporations. Being parallel pipelines constructed in the same corridor, the Baku-Tbilisi-Ceyhan oil pipeline and the Baku-Tbilisi-Erzurum (BTE) gas pipeline, also known as the South Caucasus Pipeline and the Shah Deniz Pipeline, are especially noteworthy because of their political and economic significance.

BTC pipeline: After years of negotiations which started in the 1990s, the 1,768 km pipeline project was completed on 25 May 2005.²⁴ Connecting Azerbaijan's oil fields to Turkey's Mediterranean port of Ceyhan via Georgia by land, the \$3.7 billion BTC pipeline's construction was controversial given its heavy cost with no strong economic justification, its insecurity thanks to its passage through two countries (Georgia and Turkey) with serious sources of instability, including armed conflicts,

²⁴Hydrocarbons Technology, *Baku-Tbilisi-Ceyhan (BTC) Caspian Pipeline*, <http://www.hydrocarbons-technology.com/projects/bp/> [Accessed 14 January 2010].

and its extensive social and environmental damage on the affected countries. With an initial capacity of 1 million bpd, the pipeline went online on 13 July 2006. As stated earlier, its capacity is set to increase to 1.6 million bpd by the end of 2010.

Apart from its importance as an export pipeline, the BTC pipeline's significance lies in its political dimension. Accordingly, it is a blatant manifestation of the policy of bypassing Iran and Russia for Caspian oil exports. In particular, the US-backed pipeline project is meant to eliminate Iran as a logical export route for neighbouring Azerbaijan and to weaken its presence in Azerbaijan's oil industry as a means, among others, to eventually exclude Iran from the strategically important Caucasus. The American pressure on the Central Asian oil exporters to use the BTC pipeline for their oil exports also aims at denying Iran both economic and political gains in Central Asia. No wonder that the BTC pipeline is a potential source of dispute for Iran in its ties with Azerbaijan, Georgia and Turkey, through which the pipeline passes. The BTC pipeline is currently the most important one in the Caucasus for these reasons.

BTE pipeline: This is a major gas pipeline connecting Azerbaijan to Turkey via Georgia (442 km in Azerbaijan and 248 km in Georgia). The BTE pipeline links Azerbaijan's Caspian gas field of Shah Deniz to Turkey's gas pipeline network near its border with Georgia to initially supply customers in Azerbaijan, Georgia and Turkey.²⁵ Given the limited capacity of Turkey for additional imported gas, it is expected to eventually function mainly as an export route for Azeri gas. The \$1 billion pipeline whose construction began in the fourth quarter of 2004 went online in July 2007.²⁶ The BTE pipeline is capable of carrying up to 7 Bcm of gas each year, with the possibility of doubling its capacity in the future. However, many technical problems have so far resulted in its numerous closures.

Other noteworthy Azeri pipelines passing through the Caucasus include a few shorter pipelines. Many of them are primarily meant to facilitate Azerbaijan's exports, such as the Baku-Supsa and Baku-Novorossiysk

²⁵ Kildrummy, *The South Caucasus Pipeline (SCP)*, 2006, <http://www.kildrummy.com/about/casestudy.asp?csid=2> [Accessed 14 January 2010].

²⁶ Hooman Peimani, "A Global Update", *World Pipelines*, vol. 7, no. 12 (December 2007), p. 14.

pipelines connecting Azerbaijan's oil fields to the Georgian and Russian Black Sea ports, respectively.

6.3.2 Armenian Pipelines

Unlike Azerbaijan, Armenia and Georgia do not have any major oil and gas reserves to meet their own demand to a significant extent and export. Consequently, they have to rely on large oil and gas imports from the regional suppliers, Iran, Russia and Azerbaijan. Given this reality, the Caucasus has become attractive for these suppliers, especially Iran and Russia. They have practically started a quiet competition, oversupplying these Caucasian states, providing them with not only revenue, but also political influence. Hence, Russia's loss of market share enables Iran (having the world's second-largest oil and gas reserves) to fill the gap as a neighbouring state with friendly ties with both Georgia and Armenia.

Moreover, the geographical location of the Caucasus as a land link between Asia and Europe offers Iran an opportunity to use the region for energy exports to Europe via pipeline, a means to end its current reliance on Turkey for any such project in the future. As conflicts and wars in the Caucasus remove such opportunities altogether, Iran has a large stake in the region's stability. Among many other factors, including its friendly relations with Georgia, despite Georgia's pro-American orientation, and its concerns about Russia's resurrection, notwithstanding their current friendly relations, concerns about long-term instability in the Caucasus motivated Iran not to take sides with Russia in its August 2008 war with Georgia. Iranian Foreign Affairs Minister Manouchehr Mottaki's visit to Tbilisi following the war when Moscow was seeking Georgia's isolation manifested Iran's stake in the Caucasus's stability.²⁷

Within this context, there are certain pipeline projects with the potential to develop into major ones. They include the Iran-Armenia pipeline for supplying Armenia with Iranian gas. The 142 km pipeline, of which

²⁷"Mottaki: Tehran Closely Following up Caucasus Events", IRNA, 17 September 2008, <http://www1.irna.ir/en/news/view/line-17/0809172789195647.htm> [Accessed 18 January 2010].

42 km is laid in Armenia, was inaugurated in March 2007.²⁸ Yet, the actual exports started in May 2009.²⁹

Through the pipeline connecting the Iranian gas export infrastructure near the Iranian city of Tabriz to the Iranian-Armenian border, Iran supplied its neighbour with up to 1.1 Bcm of natural gas in the first year. However, the pipeline is capable of handling up to twice as much in the future. Thus, it will enable Iran to export 36 Bcm of gas to Armenia over a 20-year period after the pipeline's second phase, which is currently underway, is completed. To that effect, Iran will increase the volume of its gas exports to 1.5 Bcm per year by 2011 to gradually be increased to 2.3 Bcm per year by 2019.³⁰

The \$220 million pipeline ends Armenia's heavy dependence on Russia for its gas imports, through a neighbour with friendly relations with the Armenians. This is especially important for Yerevan which is concerned about the tension-prone Georgian-Russian relations. In particular, in the post-Georgian-Russian war era, Georgia's hostile ties with Russia are predicted to last a long time, which makes it unwise for Armenia to depend on Russian gas supplies available via Georgia, which neighbours both Russia and Armenia. The gas provided through the Iran-Armenia pipeline is favourable for Armenia as Yerevan pays for it with electricity generated by the fifth unit of the Armenian Hrazdan power station, which was constructed and fully financed by Iran.³¹

In terms of its income-generating potential, the pipeline can be hooked up through a short link to Georgia and even be extended to Ukraine via Russia, a project in which both Tbilisi and Kiev have expressed interest to rid themselves of the heavy reliance on Russia for piped gas. Washington's

²⁸ "Iran-Armenia Gas Pipeline Inaugurated", IRNA, 19 March 2007, <http://www2.irna.ir/en/news/view/line-18/0703190191144210.htm> [Accessed 24 January 2010].

²⁹ "Iran Begins Gas Export to Armenia: NIGEC Managing Director", *Tehran Times*, 14 May 2009, http://www.tehrantimes.com/index_View.asp?code=194557 [Accessed 1 February 2010].

³⁰ "Iran-Armenia Pipeline Expected Online Soon", UPI, 19 May 2009, http://www.upi.com/Science_News/Resource-Wars/2009/05/19/Iran-Armenia-pipeline-expected-online-soon/UPI-40571242740949/ [Accessed 27 January 2009].

³¹ Hooman Peimani, "The Iran-Armenia Pipeline: Finally Coming to Life", *Central Asia-Caucasus Analyst* (Washington, DC), 22 September 2004.

opposition aside, the Georgians and the Ukrainians must be very interested in the project now, what with the Georgian-Russian war of 2008 and deteriorating Russian-Ukrainian relations, which make Iran a very plausible energy supplier for both of them.

Finally, a major Iran-Armenian pipeline project, important for its political and energy dimensions, was concluded in December 2008. Accordingly, Tehran and Yerevan agreed to build a 300 km pipeline to transfer processed oil from Iran's Tabriz refinery to Araskh (Yeraskh) in Armenia.³² Set to begin in the first half of 2010,³³ the US\$200–240 million project will satisfy Armenia's annual requirements of 450,000–500,000 tonnes of fuel. Meeting all of Armenia's needs in imported processed fuels, the pipeline will practically end Russia's role as the supplier of such products along with its corresponding political influence in Armenia. The project once fully operational will certainly lift Iran's influence in neighbouring Armenia.

6.3.3 Georgian Pipelines

Georgia has been heavily dependent on Russia as its main supplier of fossil energy, particularly gas, since its independence in December 1991. The deteriorating relations between the two sides, especially since the Rose Revolution of 2003, have created serious doubts in Georgia about its continued dependency on Russia. Moscow's ending such exports in the aftermath of the Georgian-Russian war of August 2008 clearly revealed the depth of the problem.

It is no surprise that Tbilisi has been considering alternatives to Russia since 2004 in particular. As the construction of the Iranian-Armenian gas pipeline started in 2005, the development created a realistic ground for Tbilisi's optimism that its extension to that country could well become

³² Hooman Peimani, "Middle Eastern Progress", *World Pipeline*, vol. 9, no. 5 (May 2009), p. 14.

³³ "Construction of Iran-Armenia Oil Pipeline to Start in 2010 — Minister", Arminfo, Yerevan, 20 November 2009, http://nl.newsbank.com/nl-search/we/Archives?p_product=NewsLibrary&p_multi=BBAB&d_place=BBAB&p_theme=newslibrary2&p_action=search&p_maxdocs=200&p_topdoc=1&p_text_direct=0=12C1A21C67FF3A30&p_field_direct=0=document_id&p_perpage=10&p_sort=YMD_date:D&s_trackval=GooglePM.

feasible thanks to its neighbouring Armenia and being on good terms with both Tehran and Yerevan. The latter was reflected in Georgian Prime Minister Zurab Noghaidei's reported discussion in March 2005 with his Armenian counterpart, Andranik Margarian, regarding connecting the Iranian-Armenian pipeline to Georgia.³⁴ Apart from Tbilisi's initial interest in diversifying its gas suppliers, the growing tension in Georgian-Russian relations prompted an expression of interest in the pipeline project.

The ascension to power of Georgian President Mikheil Saakashvili in January 2004 and his increasing the pro-American orientation of Georgia have contributed to deteriorating Georgian-Russian relations. This reality has made imprudent the current heavy reliance of Georgia on Russian piped gas, while making gas imports from Iran more attractive. It has been especially so since late January 2006 when the Russian-Georgian conflict over Russia's gas exports to Georgia unintentionally created a strong incentive for Georgia to view Iran, this time very seriously, as a necessary gas supplier, perhaps the one to replace Russia as the main supplier.

The Russian inability for about a week to supply gas to Georgia because of an "accident", claimed to be planned by the Georgians, forced them to sign a contract to immediately import gas from Iran via a pipeline (connecting Iran to Georgia via Azerbaijan) left idle for about three decades.³⁵ Iran started its exports on 29 January and Iranian gas (2 million cubic metres per day) entered the Georgian pipeline network the day after. Russia's resumption of gas exports on the same day did not change Georgia's plan of importing Iranian gas. While the unexpected expansion of the gas market was a sweet surprise for the Iranians, the real prize for Iran was the stronger-than-ever interest of Georgia to act on its long-discussed plan to import Iranian gas on a much larger scale by connecting its pipeline network to the Iranian-Armenian pipeline.

³⁴ Hooman Peimani, "Georgia and Ukraine: Buying Iranian Gas?", *Central Asia-Caucasus Analyst* (Baltimore), 6 April 2005, http://www.cacianalyst.org/view_article.php?articleid=3197 [Accessed 28 January 2010].

³⁵ "Caucasus: Georgia, Armenia Consider Options after Russia Pipeline Explosions", Radio Free Europe/Radio Liberty (RFE/RL), 1 February 2006, <http://www.rferl.org/featuresarticle/2006/02/d2074170-d820-4948-812e-69551d17c950.html> [Accessed 28 January 2010].

Obviously, Russia has used its gas exports to press for extracting concessions from the regional states with growing ties with Washington, as evidenced in its short-term announced closure of its gas pipeline to Ukraine in January 2006 over price disputes and its "forced closure" of its pipeline to Georgia because of an "accident". To this end, the closure of its pipelines to Belarus (2007) and to Ukraine (2009) should be added.

Unsurprisingly, Georgia has every incentive to end its heavy reliance on Russia for gas. Having had tension-free relations with Georgia since its independence in 1991, Iran is the best available regional gas supplier to help Georgia achieve that objective. This state of relations has continued despite the pro-American direction of the new Georgian government led by President Mikheil Saakashvili.

Iran and Georgia have therefore discussed further cooperation on energy, building on Iran's large exports to Georgia, on many occasions since 2006. Thanks to the existence of a Soviet-inherited gas pipeline network in Georgia, exporting Iranian gas to Georgia via Armenia would not require large investments as linking the Iranian-Armenian pipeline to that network would only involve a short connecting pipeline and a relatively small investment in other required infrastructure. Given the limited capacity of the Iranian-Georgian pipeline via Azerbaijan, Georgia's option of linking its gas pipeline network to the Iranian-Armenian pipeline seems too tempting to be resisted, especially when Tbilisi has no other serious option.

Given the circumstances, Washington's unhappiness with Tehran cannot be a very strong disincentive for the Georgians to prevent them from turning their pipeline dream into a reality. However, in the absence of a concrete agreement to date, the Georgians are yet to go beyond an expression of interest in the gas pipeline project, reach an agreement with Iran and Armenia, and ignore the expected American opposition to such agreement with its economic and political rewards for Washington's enemy, Tehran.

Finally, Russia's gas giant, Gazprom, opened a 150 km (Dzuarikau-Tskhinval) controversial gas pipeline in August 2009. It connects the Russian north Caucasus to South Ossetia, the breakaway region of

Georgia now recognised as an independent state by Russia.³⁶ This was notwithstanding Georgia's opposition to the pipeline, which further strengthens the region's dependency on Russia and consolidates the power and authority of the South Ossetia government while further weakening the breakaway republic's ties with Georgia. Through the pipeline, South Ossetia will annually import up to 252.5 million cubic metres of gas through the pipeline, which will end its dependence on Georgian gas supplies.³⁷

6.4 BARRIERS TO THE CAUCASUS'S EMERGENCE AS A LONG-TERM EXPORT ROUTE

The Caucasus has the potential to benefit from oil as an exporter and/or a transit route. However, that possibility demands the prerequisite of durable peace and security to ensure the continued oil export from and through the Caucasus. In reality, all the regional countries have the seeds of inter- and intra-state instability, which could even spill over into neighbouring powers or which could drag them into armed conflicts in one form or another. Among various potential sources of instability, the following are prominent.

6.4.1 Potential for Armed Conflicts

Civil wars: The three Caucasian countries faced major armed conflicts upon independence. In Georgia, the rise of the two breakaway republics of South Ossetia and Abkhazia instigated bloody civil wars which ended in their practical, but not official, independence as ceasefire agreements terminated the conflicts in 1992 and 1993, respectively. Armenia and Azerbaijan found themselves on hostile terms as a dispute over the independence from Azerbaijan of Armenian-dominated Nagorno-Karabakh

³⁶“Gazprom Brings Onstream Dzuarikau — Tskhinval Gas Pipeline”, *Gazprom News*, 26 August 2009, <http://www.gazprom.com/press/news/2009/august/article67101/> [Accessed 27 January 2010].

³⁷ Ibid.

backed by Armenia escalated into a civil war in the post-independence era. Another ceasefire agreement ended the conflict in 1994, leaving 20% of the Azeri territory under the control of Nagorno-Karabakh's Armenian separatists. Owing to a prevalent sense of dissatisfaction with the status quo on both sides of the conflicts in all three countries, instability could well engulf the region. The fact that ceasefire agreements, instead of peace treaties to address their root causes, were used to stop the armed conflicts has been alarming. Such unsettled conflicts could and, if the current situation continues, will likely lead to another round of civil wars.

The unresolved territorial dispute between Armenia and Azerbaijan over Nagorno-Karabakh makes this scenario feasible. The frustration of both sides could lead to the resumption of civil war, pitting the Azeris against the Karabakhi Armenians to escalate the war between Armenia and Azerbaijan, both of which share borders with Iran. The Iranians could not be indifferent to such a war for many reasons, including their ethnic ties with both countries and the possible expansion of the war into Iranian territory adjacent to those countries. Moreover, this scenario, even in the absence of such expansion, would create serious challenges to Iran's border security, including an expected flow of arms into Iran. The inflow of war refugees would also be a source of concern for the Iranians, both for the financial costs and also the security implications of predictable weapon and drug smuggling into Iran from the belligerent countries as well as for its possible radicalising impact on the Iranians.

In the case of civil wars in the Caucasus, other regional powers (Russia and Turkey) and a non-regional power (the US) could well be dragged into the conflict in some form in support of one side or another. Given the growing dissatisfaction among the regional peoples with their ruling governments, intra- and inter-state wars could therefore engulf the entire Caucasus since a variety of unresolved ethnic and territorial issues have prepared the ground for such expansion, in addition to the existence of Azeris, Armenians and Georgians as minorities in their non-native regional countries. Iran could not remain impartial in a military conflict along its borders or somewhere in the proximity of its bordering region, a scenario which could drag Iran into a war with a strong possibility of resulting in a major regional war pitting Iran in some way against Turkey and the United States.

Conflict with Russia: Georgia and Russia have experienced unstable relations since the fall of the Soviet Union. They have become more unstable and hostile since the election of pro-American President Mikheil Saakashvili. The three major sources of tension in their bilateral relations have been Russia's role in Georgia's breakaway republics of Abkhazia and South Ossetia as their main backer, Tbilisi's demand for the closure of the Russian military bases in Georgia, and Russia's concern over the growing American military presence in Georgia. The Russian backing of those republics and the presence of the Russian forces there as peacekeepers have been the main obstacles facing the Georgian government in restoring its sovereignty over those regions.

In the post-Georgian-Russian war era, the Russian military bases in Georgia no longer constitute the main source of conflict in Georgian-Russian relations, since the last Russian base located in Georgia is already evacuated. However, the issue has turned into a far more important one for Georgia. Russia has since increased its military presence to 4,000 personnel in both Abkhazia and South Ossetia, a sharp increase from its former presence limited to a few hundred troops stationed in each of them as peacekeepers. Given the heavy presence of the Russian military in Abkhazia and its leadership's close ties to Russia, using Sukhumi's deep-water port as a base for the Russian Black Sea fleet is a distinct possibility for Russia, given its current unfriendly ties with and thus the uncertain status of its rental base at Sevastopol located in Ukraine's Crimea.³⁸ However, the situation will likely change for the better for Russia, considering the humiliating defeat of pro-American President Viktor Yushchenko in the 2009 presidential election. In the scheduled 7 February 2010 run-off presidential election, both contenders (Viktor Yanukovich and Yulia Volodymyrivna Tymoshenko) advocated ending hostility with Russia and expanding their bilateral relations.³⁹ Hence Russia may not need Sukhumi for its navy, at least in the foreseeable future.

³⁸ Author's note: This chapter was written three years ago when a pro-American/anti-Russian president was in power. At the time, Russian-Ukrainian ties were unfriendly and even hostile in some cases.

³⁹ "Ukrainian PM to Face Old Rival in Runoff Election", Reuters, 18 January 2010, <http://www.reuters.com/article/idUSTRE60H3OU20100118> [Accessed 1 February 2010].

Being aware of his country's weaknesses vis-à-vis Russia, President Saakashvili has tried to use his government's growing ties, including those in the military field, with Washington to secure its pressure on Russia to end its backing of the breakaway republics and close its military bases. Keeping that idea in mind, in his address of 19 April 2005 to law students at Tbilisi State University, Georgian President Mikheil Saakashvili expressed his hope of ending Russia's influence in his country: "This year, for the first time in 200 years, we [the Georgians] can resolve the issue of pulling the Russian troops out of Georgia and Georgia's de-occupation once and for all".⁴⁰

Two major factors deteriorating Moscow-Tbilisi relations since 2004 have been Russia's backing of Abkhazia and South Ossetia and Georgia's growing cooperation with the United States. In August 2008 the two countries fought a war, Russia recognised the declared independence of Abkhazia and South Ossetia, and Moscow and Tbilisi severed just about all their relations to become fully fledged enemies.

Given the prevailing animosity, Tbilisi's apparent intention to exploit a favourable international environment and particularly Washington's backing to force Moscow to withdraw its troops from Georgia's breakaway republics will likely lay the ground for a potentially dangerous escalation of another round of hostility between Russia and Georgia. Such a situation will have major implications for the stability of the Southern Caucasus and could well pull in, in one form or another, all the regional and non-regional powers with stakes in the Caucasus (Iran, Turkey, the US and EU).

6.4.2 Potential of Internal Instability

The threat of civil wars, while important, is not the only source of internal instability in the Caucasus. In particular, the growing popular discontent in Georgia and Azerbaijan is creating a suitable ground for social and political unrest. It is not a secret that the Azeri and Georgian governments

⁴⁰Eurasianet, *RFE/RL: Georgian President Anticipates Decision on Closure of Russian Bases This Year*, 20 April 2005, <http://www.eurasianet.org/resource/georgia/hypermail/200504/0037.shtml> [Accessed 30 January 2010].

do not have a strong and reliable social basis. This reality opens the gates for the rise in various forms of civil unrest to destabilise the countries from within.

6.4.3 Potential Oil-Related Sources of Instability

The civil wars of the 1990s and the devastating Georgian-Russian war of August 2008 clearly indicated the conflict-prone nature of the Caucasus. The unresolved status of the disputes that prompted those conflicts makes the outbreak of new armed conflicts a distinct possibility in the foreseeable future. Against this background, energy-related issues could well add to the possibility of conflicts erupting in the region under certain conceivable scenarios. One is the continuation of a mainly Western, but not exclusively American, plan to exclude Iran and Russia from the region's energy industry, for instance by constructing pipelines through the Caucasus to bypass them for Caspian energy exports (e.g. the BTC pipeline). Added to many other sources of grievances in Tehran and Moscow in their relations with Washington, this could provoke them to make those pipelines unusable in some overt or, more likely, covert violent manner. That scenario could likely provoke a violent response to instigate a potentially major regional conflict. Another scenario is the conflict between Georgia and Russia over the latter's alleged intentional gas cuts to the former as experienced in January 2006. Of course, this requires as prerequisites the resumption of normal relations between the two countries, which were severed in August 2008, an unlikely scenario in the near future, as well as normal Russian gas exports to Georgia. As of February 2010 the fate of the Russian gas pipeline to Georgia and any Russian gas exports to that country is unknown.

Lastly, the absence of a legal regime in the Caspian Sea could well prompt conflicts. Since the 1990s, such absence has prepared the grounds for multiple ownership claims by the littoral countries on certain Caspian offshore energy fields, which developed into ownership disputes. As a clear example, the dispute between Azerbaijan and Turkmenistan has provoked a mini arms race between the two countries, while causing major diplomatic quarrels evident in them summoning their ambassadors from each other's capital. In addition, disputes between Iran and Azerbaijan over an oil field in 2001 had the clear potential of escalating into a military

confrontation.⁴¹ The Americans have since sought to beef up Baku's military. Added to the growing American military presence in the region and increasing hostility between Tehran and Washington, the persistence of ownership disputes has created a fragile situation conducive to armed conflicts backed by regional and non-regional powers.

6.5 CONCLUSION

The Caucasus has had more than its fair share of conflict and instability since the disintegration of the Soviet Union. The region could well witness a new round of intra- and inter-state armed conflicts potentially even more destructive than what it experienced in the early 1990s should the current course of events continue. Although this grim prediction could well become a reality, the Caucasus could also achieve a constructive and potentially prosperous future geared towards its oil and gas resources and also those of other Caspian states, namely Kazakhstan and Turkmenistan. Having brought a small degree of prosperity for Azerbaijan, the Azeri fossil resources will have a more tangible positive impact on the country as the Azeris increase their oil and gas exports. However, those resources are not large enough to secure Azerbaijan a long-term role as a major oil and gas exporter. Nonetheless, if invested wisely, their generated revenues will help, as a major factor, the Azeris address their various social, economic, military/security and environmental problems which were inherited from the Soviet era or which emerged in the post-independence era.

Moreover, oil-related projects could also significantly improve the lot of the entire region. Accordingly, large-scale Azeri and Central Asian oil and gas exports via the Caucasus, if they happen, will translate into various projects such as pipeline construction to generate income and employment for the entire region, directly and indirectly. Nevertheless, making this potential a reality will require addressing the looming threat of conflict and instability in the Caucasus. This is an absolute prerequisite as the highly realistic outlook of wars and civil wars in this region will

⁴¹Hooman Peimani, "Light at the End of Baku-Ashghabad Tunnel?", *Central Asia-Caucasus Analyst* (Baltimore), 16 July 2003, http://www.cacianalyst.org/view_article.php?articleid=1571 [Accessed 2 January 2010].

only discourage its use as a major transit route for Caspian oil and gas exports for all concerned parties, the Central Asian exporters and the major energy corporations operating in the region, alike.

As a result, unless the root causes of all regional disputes are addressed, the prospect of a regional oil boom prompted by major long-term Caspian oil and gas exports via the region will not be conceivable. Rather, war and instability will likely swallow up the whole region in the foreseeable future with the great possibility of dragging the regional and non-regional states that have a vested interest in the Caucasus into armed conflicts.

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CHAPTER 7

KAZAKH GAS POLICY IN THE CENTRAL ASIAN REGION: PROBLEMS AND PROSPECTS

Zhanibek Saurbek

7.1 INTRODUCTION

Following the demise of the Union of Soviet Socialist Republics (USSR) in 1991, 15 new independent states emerged. All relished the opportunity to operate as independent countries and to develop their economies in accordance with their own understanding of market structure. These new republics chose different paths towards the improvement and rehabilitation of the existing economies in their homelands. Naturally, after more than a decade, the resulting development levels of these economies are varied.

For the purpose of this article, an analysis of the relations between Kazakhstan and the main Central Asian republics in the energy sector will be provided. Moreover, other nuances such as political aspects will also be considered as politics and energy issues are closely interrelated, at least in the Central Asian region. Among the Central Asian republics which have been considered, we will discuss Kazakhstan, Uzbekistan



Figure 1 Commonwealth of Independent States: Central Asian States

Source: The University of Texas at Austin, University of Texas Libraries, Russia and the Former Soviet Republics Maps, http://www.lib.utexas.edu/maps/commonwealth/central_asian_common_2002.jpg.

and Turkmenistan. There are many reasons for cooperation between the Central Asian countries. Primarily, they are all linked geographically (Figure 1). Moreover, the previous Soviet economic and industrial structure of the market bound these nations within the USSR tightly together.

A good example, which characterised the Soviet economy, has been stated by energy experts:

Political criteria such as integration of the political space of the Soviet Union played an important part (for instance when oil equipment industries were located in Azerbaijan to supply extractive industries in Western Siberia). Transport was essentially provided for free. Vocational decisions therefore could not reflect the costs of the transport, which — once priced

at cost and under constraints of a capitalist market economy — would have made many operations uneconomic.¹

So, the economies of these republics were linked closely and the demise of the Soviet Union was painful for the newly emerged states as they were unfamiliar with the realities of the market.

Another reason for prospective cooperation is the cultural, ethnic and religious background common to the Central Asian nations. In addition, these countries have mineral resources and they were forced to cooperate with each other in one way or another in order to transport their energy sources to international consumer markets.

Among a number of energy sources, gas was considered as a case study. Why have relations between Kazakhstan and other Central Asian republics been examined with regard to the gas sector? Gas issues were chosen as a means of analysing the policy of Kazakhstan due to the fact that nowadays this source of energy is extremely politicised. The well-known Russian-Ukrainian gas conflict and so-called “gas wars” in 2006 and 2009 give a perfect example of how an energy source can be used as a political tool within mutual relations. Taking into consideration the fact that gas plays a significant role in Kazakh domestic consumption as well as in the international market, potential disputes and conflicts with Central Asian countries may arise in the very near future.

Analysis of these relations has been made through the tool of legal instruments: bilateral treaties, agreements and covenants. The effectiveness and implementation of these legal instruments help to demonstrate the genuine level of such cooperation and assist in understanding the intentions of both parties for future development.

7.2 KAZAKHSTAN

Kazakhstan is one of the fastest-growing economies in the Central Asian region among the post-Soviet republics. The republic possesses vast

¹T. W. Wälde and C. von Hirschhausen, “Regulatory Reform in the Energy Industry of Post-Soviet Countries”, *CEPMLP Journal* (1998), p. 5.

mineral resources, in particular oil, gas, coal, uranium and other sources.² At the same time, Kazakhstan faces the problem of how to deliver all those commodities to the international consuming markets, as the Kazakh network of gas pipelines is dependent on the Russian network.

Kazakhstan likes to regard itself as a regional leader among the other Central Asian republics due to a number of factors: large reserves of oil and gas in western Kazakhstan; soft investment climate; stability of the political, fiscal and legal regimes; and absence of ethnic conflicts and civil wars.

Kazakhstan chose a “multivectoral policy”, which means it endeavours to shape good relations with the US, Europe, the Arab world and China at the same time as it enjoys excellent relations with Russia. In this context, Kazakhstan has developed some level of relationship with the main geopolitical powers of the world. It has concluded a number of agreements and treaties with different countries and became a member of various international organisations and initiatives. In other words, Kazakhstan is eager to be an active political and energy player and demonstrate to other neighbours in the Central Asian region its advanced position in the international community. As a result of such intensive participation in various organisations (in addition, Kazakhstan has been appointed Chairman of the Organization for Security and Co-operation in Europe (OSCE) in 2010), the conclusion of bilateral and multilateral agreements along with its investment climate and political and fiscal stability, a broad and extensive presence of different international energy players in Kazakhstan can be observed.

However, relations with its closest neighbours in the Central Asian region have a complex nature and demand a thorough analysis and knowledge of the real situation together with the historical background. An overview of the energy sector and analysis of the gas policy of Kazakhstan towards Uzbekistan and Turkmenistan helps us to see Kazakhstan's energy picture and to identify the genuine level of relations between these countries.

²For example, in 2008, the estimate of proved natural gas reserves in Kazakhstan was 100 trillion cubic feet (Tcf), which makes the country on a par with Turkmenistan — refer to the link <http://www.eia.doe.gov/emeu/cabs/Kazakhstan/NaturalGas.html> [Accessed 29 July 2009].

7.3 OVERVIEW OF THE GAS INDUSTRY OF KAZAKHSTAN

Kazakhstan has relatively large gas reserves in the western and southern parts of the country, with the most proven reserves being situated in the Karachaganak field. This oil and gas condensate field reportedly has proven natural gas reserves of 48 trillion cubic feet (Tcf). The consortium developing Karachaganak expects to produce 900 billion cubic feet (Bcf) by 2012.

Kazakh gas pipelines also lie mainly in the west. Generally, they are underdeveloped and indicate a lack of relevant infrastructure for domestic consumption:

Through several pipelines originating in Turkmenistan and Uzbekistan passing through western Kazakhstan to Russia, the cities of Aktyubinsk, Uralsk, Kustanai and Rudny are supplied with Uzbek gas. These main transmission lines from Turkmenistan in particular are potentially available for access by producers in Kazakhstan to export gas to Russia or Europe. The majority of the gas shipped in these two main pipeline routes are transported into the Russian Gazprom system.³

The lack of gas supply infrastructure was justified by the fact that

the pipelines were designed to meet the needs of industry and those of the residents of Kazakhstan were met only in the cities and towns along the transit pipelines. As a result Kazakhstan imports much of the gas it consumes.⁴

In addition:

The trunk pipelines in Kazakhstan are not technologically linked, which prevents their use to pump inexpensive gas produced in the western regions of the country to the southern and northern regions of the country. This is especially a problem for consumers in southern regions and the city of Almaty.⁵

³K. Ostrander-Krug, "An Overview of Oil and Gas Pipelines in Kazakhstan", Denton Wilde Sapte report, 2002, p. 4.

⁴"Outlook for Kazakhstan's Gas Industry", *Alexander's Oil and Gas connections Journal*, 20 September 2006, <http://www.gasandoil.com/goc/news/ntc54177.htm> [Accessed April 2008].

⁵Ibid.

The domestic gas pipeline infrastructure serves only a few regions in the country, hence the majority of cities in the centre and north of Kazakhstan remain unconnected to the infrastructure.

As a result, those areas are vulnerable in terms of gas supply and serious problems were identified in domestic energy policy. Moreover, the south of Kazakhstan is a densely populated area, so the supply of gas to this region presents a significant challenge to the Kazakh government.

Another serious problem is the obsolete condition of the existing network of gas pipelines which needs to be modernised, replaced or reconstructed. In addition, new gas pipelines are of crucial importance for the government to diversify routes, develop infrastructure and connect to international markets. Fortunately, new pipeline projects to China (Turkmenistan-Kazakhstan-China) and to Russia (Turkmenistan-Kazakhstan-Russia) are being discussed and agreed between the parties and are likely to be realised in the medium term. The amount of gas transported is planned to be increased due to the soaring development of gas fields in the near future (Table 1).

Regarding domestic gas policy and supply, in its early days of independence, Kazakhstan had a bad experience with foreign management. After the breakup of the Soviet Union, the Kazakh economy was in a transition period with a number of different problems. One serious test for the newly emerged state was that of domestic gas consumption and gas supply. The gas pipeline infrastructure and supply literally were a burden to the state and it could not properly allocate funds and manage this asset as well as fulfilling its investment obligations and social responsibilities. In addition to those difficulties, consumers failed to pay promptly for their gas and the situation became disastrous.

Table 1 Volume of Gas Transported by Pipeline in Kazakhstan, 2002–2007

	2002	2003	2004	2005	2006	2007
Gas transportation by pipeline (Bcm)	110.5	12.1	121.6	13.2	121.4	124.8

Source: Presentation by K. Rakhmetova, Head of Transportation Dept., NOC KazMunaiGaz, on 8 November 2007 at a conference organised by ECT.

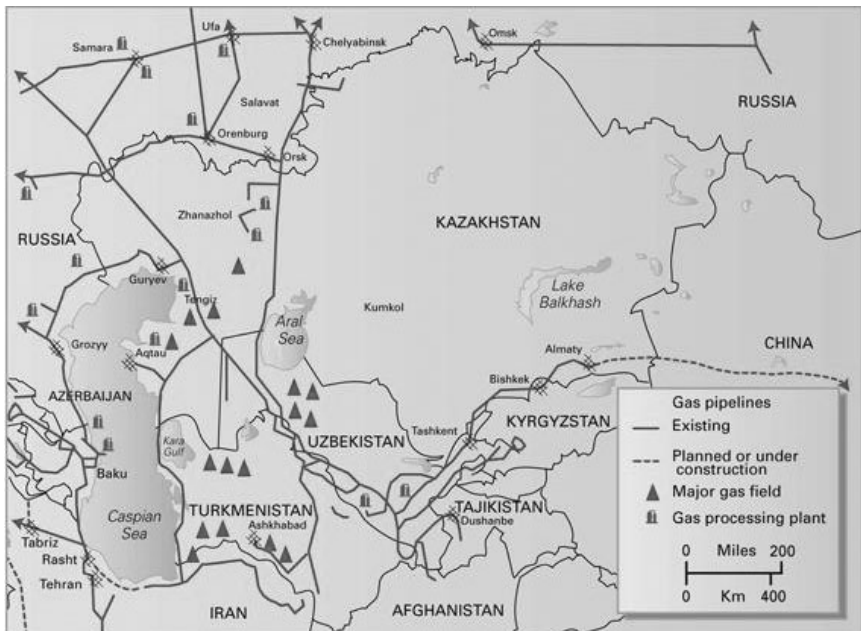


Figure 2 Natural Gas Infrastructure in Former Soviet Union (FSU) Central Asia

Source: Energy Information Administration (EIA) Statistics, *International Energy Outlook 2004: Natural Gas*, http://www.eia.doe.gov/oiaf/archive/ieo04/nat_gas.html [Accessed July 2009].

The Kazakh government decided to sell its gas trunk pipelines to a Western management operation (Belgian company Tractebel AC). This was in 1996–1997. Unfortunately, it was an unsuccessful experience because of the deterioration in the quality of the services they provided, drastic reduction in income for the state, decline in domestic gas consumption, and constant increase in tariffs for domestic consumers.

After long negotiations, the gas industry was taken back under state control and regulated through a specially formed gas company, KazTransGas (KTG). This company, together with other newly emerged companies, now controls the flow of gas through pipelines in Kazakhstan.⁶ As can be seen from Figure 2, all the main gas pipeline routes from

⁶The official website of the company with historical background is available at http://www.kaztransgas.kz/article.php?article_id=667&mid=31 [Accessed April 2008].

Uzbekistan pass through the territory of Kazakhstan in a westerly direction, by passing the south, centre and north of the country. The west of Kazakhstan is a relatively self-sufficient region and is supplied by its own resources: Kazakh gas oil fields and pipeline routes from Russia and Asian republics (swap systems in both cases). So, the gas pipeline industry and gas supply are a priority for the energy sector of Kazakhstan. The Kazakh government approved the Strategy of the Gas Industry up to Year 2015, which emphasises the importance of the gas sector and identifies the main gaps and strategic decisions for the next decade to improve the industry.

To sum up with an overview of the gas industry, Kazakhstan possesses mineral resources including gas, but it suffers from a lack of gas supply to particular regions. The Kazakh gas pipeline network was mainly designed and constructed as part of the Soviet export system without consideration of domestic needs. Moreover, it depends on the Russian system of pipelines which acts as a barrier to any launch for international markets or the option of any alternatives. In addition, Kazakhstan suffered from the effects of its bad experience under foreign management for its domestic supply and so established a new national gas company. The legal background of the country within the gas sector is mainly oriented towards the satisfaction of domestic needs and reducing dependency on an external supplier. Among those external suppliers are Russia and Uzbekistan.

7.4 UZBEKISTAN

7.4.1 Historical Background

Uzbekistan is a close neighbour in terms of its common historical background, language, religion and geographical location. The two states have much in common as well as many differences. Initially, both Kazakhstan and Uzbekistan had similar conditions under which to develop their countries, but they chose different paths towards growth. Now their economic situations are quite different because Kazakhstan is more advanced with its economic reforms in such areas as foreign investment legislation, tax legislation, banking system reform and higher levels of investment and

business. At the same time, “Uzbekistan’s lack of progress in these reform areas has affected the level of investment in the country”.⁷ Uzbekistan has many peculiar features as part of its developmental and evolutionary process.⁸ However, the two countries are interdependent in many areas, including the energy sector, so they are forced into a cooperative relationship.

In addition, Uzbekistan must cooperate with Kazakhstan because of the beneficial geographic location of Kazakhstan within the Central Asian region. Moreover, Uzbekistan has no physical links to Russia, which is a geopolitical power in the region as well as a former ally in the Soviet Union era.

7.4.2 Key Problematic Issues in Kazakh-Uzbek Relations

First, many problems related to regulations and political relations between the two republics can be identified. Kazakhstan depends on Uzbek gas in terms of the domestic gas supply to its southern region. Taking into account the inconsistency of the Uzbek position as a supplier, the process of gas supply to the southern part of Kazakhstan was, is and will be a very sensitive aspect of international relations over the next decade.

The south, centre and north of Kazakhstan are poorly served by the existing gas pipeline infrastructure. Moreover, there is no domestic pipeline from the western oil fields. Therefore, southern, central and northern Kazakhstan are dependent on external suppliers who are, as practice

⁷P. Blackmon, “Divergent Paths, Divergent Outcomes: Linking Differences in Economic Reform to Levels of US Foreign Direct Investment and Business in Kazakhstan and Uzbekistan”, *Central Asian Survey*, vol. 26, no. 3 (September 2007), pp. 355–372.

⁸For an analysis of the characteristics of political elites within the country and its impact on the development of political institutions, see L. Adams, “Cultural Elites in Uzbekistan: Ideological Production and the State”, in *The Transformation of Central Asia: States and Societies from Soviet Rule to Independence*, edited by Pauline Jones Luong (Ithaca: Cornell University Press, 2003), pp. 93–119; A. Ilkhamov, “The Limits of Centralization: Regional Challenges in Uzbekistan”, in *The Transformation of Central Asia: States and Societies from Soviet Rule to Independence*, pp. 159–181; for complicated relations of Uzbekistan with the US and policy, see S. Akbarzadeh, *Uzbekistan and the United States: Authoritarianism, Islamism and Washington’s New Security Agenda* (New York: Zed Books, 2005); for the place and role of Uzbekistan in the dimension of the international community, see M. Kirimli, “Uzbekistan in the New World Order”, *Central Asian Survey*, vol. 16, no. 1 (1997), pp. 53–64.

shows, unpredictable, especially in the winter months and just as importantly in terms of tariffs.

The domestic consumption of gas is about 8 billion cubic metres (Bcm) per year. Consumption in the southeast and north of the country is catered for by imports from Uzbekistan (1.4 Bcm) and Russia (1.2 Bcm). Uzbekistan, in turn, is dependent on Kazakhstan due to the fact that the Central Asia–Centre pipeline runs through the territory of Kazakhstan. So, both countries are dependent on each other in one way or another. However, the dynamic of international relations does not show the positive changes in their mutual cooperation. Both leaders have their own views regarding the development of their relationship; however, it is difficult to say that those views entirely coincide. There is no doubt that in the Central Asia or post-Soviet political landscape much is dependent on the political and personal interaction between the leaders of states. History presents many cases where a political approach and good relationships can resolve issues without the additional mitigation of problems being required. Establishing mutually beneficial cooperation to the satisfaction of both parties is a very difficult task and as a result, many issues arise between the states in various areas.

Kazakhstan, within its associations with Uzbekistan, plays an unusual role: it plays the importer role rather than the exporter. This is quite unfamiliar to Kazakhstan, so it should learn from the lessons of international practice and identify the main priorities for developing its relationships with its closest neighbours.

No doubt, all arguable issues should be considered carefully and in a positive way. One of the ways to understand their mutual cooperation and to predict its future progress is to analyse the legal background between the parties. The level of achievement often can be observed from the agreements concluded between the states and the implementation of such agreements shows the intentions and motives of both parties.

7.4.3 Legal Instruments and Their Impact on Kazakh-Uzbek Relations

Due to the development of new oil and gas fields in Kazakhstan, improvements to and construction of new gas pipelines, providing gas to the south

and centre of the country, as well as difficulties with existing contracts with Uzbekistan, the Kazakh government approved in 2002 domestic strategy principles called The Policy on the Development of the Gas Industry of the Republic until 2015 (decree no. 25) and The Program for the Development of the Gas Industry of the Republic of Kazakhstan until 2010.⁹ Although gasification of the southern region was not stated there, many norms affect it indirectly, such as the development of the Amangeldy oil field (Zhambyl region) and the supply to the south of the country.

Paradoxically, a limited number of specific agreements were signed with regard to the gas supply to the south of Kazakhstan with Uzbek officials:

- The agreement between the government of Kazakhstan and the government of Uzbekistan on clearing off debts for fuel-energy resources for the years 1995–1996, and on the transit-and-swap system for the years 1996–1997.¹⁰
- The Protocol between the Customs Control Committee under the Ministry of State Income of Kazakhstan and the State Customs Committee of the Republic of Uzbekistan on customs control of natural gas, transferring through the customs border.¹¹

Unfortunately, these and other documents failed to identify serious gaps between the two states on a political as well as a legal level.

In summary, with respect to gas, it should be noted that the south of Kazakhstan is and probably will continue to be dependent on foreign suppliers such as Uzbekistan and Russia due to a number of reasons such as undeveloped gas pipeline routes, the dispersal of gas to a third destination rather than for domestic consumption, etc. The situation with Uzbekistan will be complicated during the next three to five years. No new gas fields have been discovered and Kazakhstan is still vulnerable in that matter.

Another point to note is the possible routing of a gas pipeline to China from western Kazakhstan (with Turkmen and Uzbek involvement) and this could change the situation precipitately (Figure 3). The technical-economic

⁹Entered into by Decree of the Government No. 669, 18 June 2004.

¹⁰Made in Tashkent (Uzbekistan) on 18 November 1996.

¹¹Signed in Tashkent on 26 November 2002.



Figure 3 Gas Infrastructure in Kazakhstan with the Proposed Route of the Kazakh-Chinese Gas Pipeline Project

Source: Ministry of Energy and Mineral Resources of the Republic of Kazakhstan, <http://www.memr.gov.kz> [Accessed June 2009].

feasibility of the project is considered possible by the construction of a branch of the trunk pipeline to Almaty (which is dependent from Uzbek gas) and some southern cities. In addition, a domestic pipeline will be built during the next three years to other southern cities to cover demand for natural gas. This project will be constructed using state investment.¹² Here Kazakhstan could use its advantage as a transit/supplier country to satisfy its own demand in gas. Kazakhstan could fulfil its own needs and also reap the profits from the transit and delivery of gas to China.

A further point is the potential for a liquefied natural gas (LNG) market which is, certainly, at this stage undeveloped. There are other risks, such as competing with existing players in the market and securing a relatively small share of the whole gas market. Perhaps it would be more profitable to extend this sort of business in the north and centre of Kazakhstan. Relations with Uzbekistan can be defined as a problem at a micro-economic level, because it mainly supplies gas for domestic consumption together with a small share through the Central Asia–Centre gas pipeline.

¹²This pipeline will be analysed later where the involvement of private participants, assumption of risk by the government and other issues are being considered.

Relations between Kazakhstan and Uzbekistan reflect their low level of mutual cooperation and weak legal background, because of complicated political relations, and as a result it influences the legal instruments and agreements. Kazakhstan, as well as Uzbekistan, is mainly oriented towards its own concepts and strategies to solve domestic problems. It is likely that the Asian gas pipeline project (Kazakhstan-China) will link all the parties involved in this project and may prove a connection for the further development of mutual relations.

The conclusion of various legal instruments and memoranda cannot promote economic activity or facilitate the easing of abrasive relations between the countries. That is why Kazakhstan's model of approaching domestic problems still centres on self-sufficiency and domestic-oriented policy rather than development of relations with Uzbekistan and the use of its energy resources.

The situation with Uzbekistan is of particular interest since its relationship with another Central Asian state, Turkmenistan, is quite different.

7.5 TURKMENISTAN

Turkmenistan is part of Central Asia and is an unusual country. Until recently, Turkmenistan chose a unique way to develop its economy and the welfare of its people, according to its own understanding of governance of the country.¹³

It was a closed country with its own prejudices, norms, regulations and morals for a long time after the Soviet Union's collapse. In addition, it is one of the countries which adopted political neutrality.¹⁴ This country has

¹³ Some recent discussions can be found in the following articles: A. Kuru, "Between the State and Cultural Zones: Nation-building in Turkmenistan", *Central Asian Survey*, vol. 21, no. 1 (2002), pp. 71–90; J. Anderson, "Authoritarian Political Development in Central Asia: The Case of Turkmenistan", *Central Asian Survey*, vol. 14, no. 4 (1995), pp. 509–528; International Crisis Group, "Cracks in the Marble: Turkmenistan's Failing Dictatorship", International Crisis Group Asia Report 44, 2003.

¹⁴ Turkmenistan reaffirmed its neutral status on 12 December 1995 at the UN General Assembly. Please check the UN website or the official site of the former Turkmen President, <http://niyazov.sitcity.ru> [Accessed April 2008].

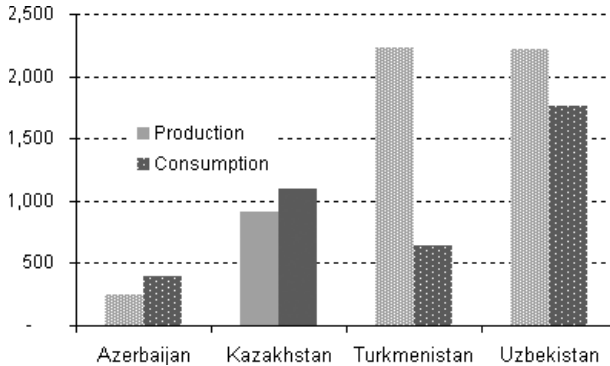


Figure 4 Central Asia Natural Gas Balance 2006 (Bcf)

Source: Energy Information Administration (EIA), *Natural Gas*, www.eia.doe.gov [Accessed July 2009]

huge gas reserves¹⁵ (Figure 4) and also shares its borders with other Caspian littoral states.

The geographical location of Turkmenistan is significant because it offers a route into the international markets in a southerly direction. Kazakhstan has concluded several agreements with regard to oil and gas cooperation with Turkmenistan.¹⁶ One of the first bilateral agreements was the Agreement on Collaboration in the Area of the Oil and Gas Industry between the Republic of Kazakhstan and Turkmenistan.¹⁷ Then the presidents of both states agreed and signed A Joint Statement on Issues Associated with the Caspian Sea on 27 February 1997. Those agreements were mostly political-declarative in character and did not produce practical results.

Now Turkmenistan has changed dramatically after the demise of its first president, S. Niyazov, and the election of a new head of the country,

¹⁵Obtaining proper data on Turkmen gas reserves is highly difficult since state officials provide inaccurate figures; thus this is an unreliable source of information. But in accordance with BP, gas reserves are approximately 102,370 Tcf.

¹⁶For a full description of the legal regime in Turkmen's energy sector, see J. Hines and A. Marchenko, "Turkmenistan's Oil and Gas Sector: Overview of the Legal Regime for Foreign Investment", *JENRL*, vol. 24, no. 4 (November 2006), pp. 495–522.

¹⁷The agreement was signed in Ashgabat, on 19 May 1993 and came into force once signed.

G. Berdymukhammedov. Turkmenistan decided to open the country to positive relations with the international community and “stepped up a gear in its effort to deepen relations with the west in the wake of the death of the country’s autocratic former president last December”.¹⁸ But Turkmenistan, at the same time, is trying to develop its relations with Russia and Kazakhstan.

As a result, Turkmenistan signed a number of bilateral agreements in different sectors with Kazakhstan¹⁹ and became a strategic partner of Kazakhstan and Russia in respect of gas issues.²⁰ The recent signing of an agreement concerning gas transportation from Turkmenistan to Russia through the territory of Kazakhstan shows this new stage in relations between those three states.

Turkmenistan is a key producer of gas in Central Asia. Kazakhstan may be poised to act as a transit country to transport their resources in different directions, for example to China.²¹ Thus, Kazakhstan needs to pay more attention to developing its relations with Turkmenistan and to transport its gas through their own territory. Turkmenistan, in its turn, has alternative options, such as Iran, for the transportation of its resources in different directions.²² This would certainly be an undesirable option for the Kazakhs. In addition, the reverse might be a possibility where Turkmenistan

¹⁸“Turkmenistan Opens Gas and Oil Fields to the West”, *Financial Times*, 27 September 2007.

¹⁹“Turkmen, Kazakh Presidents Sign a Number of Bilateral Agreements in Astana”, 29 May 2007, http://www.turkmenistan.ru/?page_id=3&lang_id=en&elem_id=10145&type=event&sort=date_desc [Accessed April 2008].

²⁰For a detailed analysis of Turkmen gas policy and the main challenges to this country, see M. Olcott, “International Gas Trade in Central Asia: Turkmenistan, Iran, Russia and Afghanistan”, in *Natural Gas and Geopolitics: From 1970 to 2040*, edited by D. Victor, A. Jaffe and M. Hayes (Cambridge: Cambridge University Press, 2006).

²¹The Kazakhstan-China gas pipeline is also under construction; Turkmenistan and Uzbekistan are also involved into the project as additional suppliers. China has signed an agreement with Turkmenistan to produce gas there and transport it via a new pipeline that could open up the first non-Russian route for gas exports out of landlocked Central Asia. Please see “China in Gas Deal with Turkmenistan”, *Financial Times*, 18 July 2007.

²²For interesting opinions on the options of Turkmen gas in the context of the Turkey-Russia-Iran triangle, refer to R. Cutler, “Turkey and the Geopolitics of Turkmenistan’s Natural Gas”, *The Review of International Affairs*, vol. I, no. 2 (Winter 2001), pp. 20–33.

might act as a transit country with regard to the transport of Kazakh and Turkmen gas to Azerbaijan as an alternative route to Western markets.²³

7.6 CONCLUSION

The international legal regime in Kazakhstan, as in other countries, cannot be operated in isolation of politico-economic, geopolitical, legal, cultural and other factors. All those components are integrated parts of the whole system of rules and principles, which reflect the will of the state.

Kazakhstan is pursuing its aim of becoming a regional leader through its reforms, by developing the level of its economy and democratic civil society. In addition, its mineral resources, international treaties, legal agreements and participation in different international initiatives, serious foreign investment and general approval of its current policy by the main geopolitical powers of the world, allow Kazakhstan to seek to be a significant independent energy player internationally, in general, and in Central Asia, in particular.

The Kazakh international legal framework includes various agreements and treaties with particular countries, international organisations and multilateral agreements. The main bias of the Kazakh energy transportation strategy is the creation of a multivector policy and the development of new alternative routes of transportation by pipeline or other methods.²⁴ Therefore, Kazakhstan is making significant steps towards the realisation of this concept. On the other hand, aiming to achieve such principles may lead to imminent conflicts of interest with different parties or geopolitical powers. However, it is worth noting that Kazakhstan is still dependent on

²³For details of this specific project, see V. Socor, "Interest Rebounds in Trans-Caspian Pipeline for Turkmen Gas", *Eurasia Daily Monitor*, vol. 3, no. 16 (2006), http://www.jamestown.org/edm/article.php?article_id=2370697 [Accessed April 2008]; M. B. Chariyev, "Priority is Now Given to the Transcaspian Project", *Caspian Energy*, <http://www.caspenergy.com/no4rus9.html> [Accessed April 2008].

²⁴The "Kazakhstan-2030" Strategy outlined a long-term way of development of the sovereign republic, directed at transforming the country into one of the safest, most stable, ecologically sustained states of the world with a dynamically developing economy. http://www.akorda.kz/en/category/gos_programmi_razvitiya.

its northern neighbour, Russia. Large investments from the US and the EU are another reason to create an effective model of relations. Kazakhstan also shares a border with rapidly growing China and its increasing demand for energy is a point difficult to ignore.

In fact, Kazakhstan has set an ambitious task — to keep a proper balance of interests in the region whilst retaining its own economic and political dividends at the same time. For instance, Kazakhstan aims to be a key player in the system of transportation of hydrocarbons in Central Asia–Europe and Central Asia–China. But in negotiations with Ukraine, Kazakhstan has avoided committing to exact dates for the conclusion of any practical steps. As one expert correctly noted:

Thus, Astana is always manoeuvring between Ukraine and Russia, aiming to consider its own interests in the energy sector. We may say that diversification of the market “in Kazakh” is an orientation towards Russia as the major transport corridor for oil and, simultaneously, launch in the markets of countries–consumers of oil and gas for the realisation of own projects. Hence, there are complicated combinations of issues for the Government of Kazakhstan.²⁵

In addition to that statement, Kazakhstan is manoeuvring not only in that situation but in many others such as signing the Ankara declaration and joining the Baku–Tbilisi–Ceyhan system; the construction of the Kazakh–China oil pipeline; and giving consideration to the Trans–Caspian project. All alternative routes, as it can be seen, bypass Russia and reduce the dependency on its territory which in turn will reduce the influence of Russia on the energy policy of Kazakhstan.

With regard to the support of US interests in the region, it should be noted that the US is the largest investor in Kazakhstan. Astana signed the Ankara declaration and joined the Baku–Tbilisi–Ceyhan project. In addition, it allowed American companies to develop major oil fields in the western part of the country.²⁶

²⁵N. Kharitonova (2006). *Energeticheskii “treugolnik”*: Rossiya–Kazakhstan–Ukraina. (Energy “triangle”: Russia–Kazakhstan–Ukraine), Lomonsov Moscow State University Faculty of History Journal, http://www.hist.msu.ru/Departments/CIS/Publ/2006_01_4.htm [Accessed April 2008].

²⁶The Tengiz oil field was/is developed by the Chevron company.

Unfortunately, such an intensive dynamic cannot be seen in its relations with Uzbekistan. Turkmenistan is markedly different as views on and projects with Turkmenistan largely lie in the scope of mutual cooperation in alliance with Russia. Again, Turkmenistan has a significant geographical location and the ability to launch to the Iranian energy market. Iran plays a significant role in Kazakh energy transportation policy. Iran has a developed network of pipelines and a route to capacious international markets. Moreover, the uncertainty of a legal regime for the Caspian Sea where Iran is a littoral state, a new political regime and the prospect of an escalation of potential conflicts make this state of strategic importance. Iran could possibly be a strategic and tactical partner in the long term for Kazakhstan.

To sum up all those components, Kazakhstan with its geostrategic location in the Central Asian region could be a junction for the main transport routes through the Caspian states and one of the producers for the West and the East. That is why, at the moment, the most important thing is the development of a strategic partnership with Russia, China and other neighbours. Those countries and regions would have a high priority in the policy of transportation of hydrocarbons.

First, Kazakhstan should support the transportation of oil in multiple directions, develop an energy infrastructure, in general, and new routes and alternatives, in particular. Of course, it is a complicated and onerous task because it requires substantial financing and investment. But a regional and global cooperation with developed countries would partially solve this problem. As was mentioned, the "willingness of China, the US and Turkey (the EU position is yet to be seen) to pay for their 'strategic' interests by assuming the cost risks of pipeline infrastructure, cost overruns and external and internal security risk is well known. This would diminish the risk premium required for Kazakhstan projects".²⁷

Second, one of the decisions may involve the usage and promotion of international legal instruments. For example, one international initiative which, without a doubt, will be useful and beneficial to Kazakhstan is the Energy Charter Treaty (ECT). The ECT has many positive effects and influences in the energy sector. As Kazakhstan is a country with an

²⁷M. Ogutchu, "Kazakhstan's Expanding Cross-border Gas Links: Implications for Europe, Russia, China and other CIS Countries", *CEPMLP* (27 September 2006).

economy in transition, the level of political risk is still high and tangible. That is why the mechanisms of the ECT can regulate and mitigate potential disputes for foreign investors.²⁸ The role and effect of the ECT can be divided into two parts: for transit countries and for producing countries. Kazakhstan can be both. The ECT can give to Kazakhstan guarantees and benefits as a transit state.

In particular, it should be noted that different transport routes are being considered at present: Turkmenistan-Kazakhstan-China (gas pipeline) and Turkmenistan-Kazakhstan-Russia (also gas pipeline). Kazakhstan should coordinate and manage its mutual collaborations with regional states and partners more closely. The basis for further collaboration already exists. So the improvement of cooperation seems a strategic and significant goal. The progressive principles of the ECT were adopted and ratified by Kazakhstan, Uzbekistan and Turkmenistan. But instability in the political lives and regimes of neighbouring countries may reduce and delay further development of any projects, in particular, pipelines.

Third, Kazakhstan needs to improve its legal framework and develop legal mechanisms to avoid possible future disputes and even conflicts. All legal mechanisms such as participation in different organisations, initiatives and multi-bilateral agreements and treaties will only stabilise and improve any future collaboration. But the development of national legislation and modification in accordance with international norms and standards are an important and crucial aim.

Fourth, Kazakhstan has a strong position in terms of its location. None of the Central Asian republics have a physical border with Russia. By contrast, Kazakhstan has the longest border line with Russia in the world of 7,591 km. So, Kazakhstan should properly use this opportunity as a transit state. The agreements with Russia and Turkmenistan show the potential for Kazakhstan as a transit country. This role is a familiar one for Kazakhstan as it was a transit republic during the Soviet era and now must use this ability prudently.

²⁸For detailed analysis of the investment process, refer to A. Seck, "Investing in the Former Soviet Union's Oil Industry: The Energy Charter Treaty and Its Implications for Mitigating Political Risks", in *The Energy Charter Treaty: An East-West Gateway for Investment and Trade*, edited by Thomas Walder (London: Kluwer Law International, 1996).

Lastly, experience with foreign management in the early days of independence forced the Kazakh government to open a new national gas operating company, which became a relatively successful entity in the country and now often operates as an independent player in international infrastructure projects. Perhaps it was a worthwhile lesson to understand that Kazakhstan should develop its own management with ideas learned from international practice.

To conclude, it is worth noting that Kazakhstan has a number of different problems in the gas sector, from difficulties in its relations with its closest neighbours and a weak legal background, to its dependency on a single country to provide gas for domestic consumption and the unsatisfactory technical conditions of its pipelines. However, Kazakhstan does have positive prospects in the gas sector from its excellent geographic location to future tangible gas projects. In that sense Kazakhstan should use those advantages in order to solve its domestic problems.

CHAPTER 8

THE THEORY OF STABLE ARAB GAS DIPLOMACY: REGIONAL ENERGY SECURITY THROUGH THE ARAB GAS PIPELINE

Mary E. Stonaker

8.1 INTRODUCTION

The role of infrastructure is striking in the emerging energy security cooperation between Middle Eastern nations. This correlation stems from factors that propel demand for geopolitical, economic and logistical integration on national and regional levels. Energy security encompasses traditional security on both levels as well. Through the establishment of physical cross-boundary infrastructure such as the Arab Gas Pipeline, energy security in the Middle East has been and will be encouraged.

There are currently two modes of transportation for natural gas; pipelines carry dry natural gas while ships and trucks carry liquefied natural gas (LNG). The stability of the pipelines as transit infrastructure serve better than ships or trucks to influence cooperation between nations despite tensions, conflicts or wars. Additionally, according to the International Energy Agency (IEA) and the Organisation for

Economic Co-operation and Development (OECD), “Long-term contracts [such as those signed when pipelines are choice of transit] have been a useful instrument to create a stable balance between gas exporters and importers”.¹

Though both modes of transportation are necessary to ensure diversified energy transport, there exist several reasons to favour pipelines as an accelerant to regional integration and stability. The security of pipelines can be controlled to a much greater extent than other vehicles of transit. In the event of an attack, the fallout from an “injured” pipeline will be much less than if the attack hit a truck or ship, especially when the latter vehicles pass through highly populated areas. Supply flow through a damaged pipeline may simply be turned off to prevent further leakage and repairs are often expedient.

This chapter will demonstrate that significance, defining a new theory called Stable Arab Gas Diplomacy (SAG Diplomacy), to investigate the role of pipelines in regional energy security as a powerful incentive. It will trace the history and current status of one such pipeline, the AGP.² Obstacles and risks faced by the countries involved in its genesis will be examined before evaluating its present status in the region. Market snapshots will summarise domestic natural gas markets in order to identify trends of increased natural gas consumption in relevant Middle Eastern nations. These increases unmistakably illustrate the growing incentive for regional cooperation. The prospects of the AGP will be looked at through the lens of current bilateral and multilateral discussions. Final remarks will collate the information presented into an analysis of the region's integrated energy security through the theory of Stable Arab Gas Diplomacy. The evaluation will conclude with a pivotal examination of inter-state tensions, conflicts and wars of such nations to provide a clear understanding of current regional energy security in the Middle East. It will be shown that, although the AGP will not provide a cure-all for Middle Eastern

¹ International Energy Agency, *Security of Gas Supply in Open Markets: LNG and Power at a Turning Point* (Paris: OECD/IEA, 2004), p. 23.

² The AGP was signed into existence in 2001, though the first operational leg was completed in 2003.

tensions, it will contribute to the alleviation of such tensions by encouraging regional integration.

8.2 THEORY

The various spheres of energy security produce many theories to explain and categorise national and international exchanges relevant to energy. There are three main strands from which these theories arise: international relations (IR), political science and economics. When narrowing focus regionally to the Middle East and topically to pipelines *as a source of diplomatic motivation* it becomes evident that, despite the wealth of theories existent in today's environment, there is not one that clearly applies to this hypothesis. According to one analyst, "Energy security analysis should be able to capture and combine both economic and political aspects of energy security as well as the perspectives of both energy producers and customers".³

Such an analysis is summarised succinctly as follows:

- **The theory of Stable Arab Gas Diplomacy**

Assuming energy sectors are deregulated, transnational energy infrastructure is a striking incentive for Middle Eastern diplomatic integration. Such integrating infrastructure creates a stable and unified exporting market which produces positive externalities. Positive economic, political and social externalities from such an exporting market incubate stronger domestic economies. Over the long run, rather than turning inwards to compete over resources, the Middle East has been and will be drawn towards diplomatic cooperation to eliminate the economic, and perhaps eventually the political, sources of tension across the region.

It is important to note when evaluating the theory of Stable Arab Gas Diplomacy throughout this paper that it is a specialised look at one aspect

³Mikko Palonkorpi, "Energy Security and the Regional Security Complex Theory", University of Helsinki, 2007, <http://busieco.samnet.sdu.dk/politics/nisa/papers/palonkorpi.pdf> [Accessed 31 August 2010].

(transnational infrastructure) of one sub-sector (natural gas) of one sector (energy) of one region (the Middle East). The infancy in which the externalities from the AGP currently exist qualifies this as a preliminary look at best, the beginning of a generation-long investigation into the correlation between transnational infrastructure and regional integration. To sum it up, "The success of any integration scheme [...] enhances competition and efficiency within the integrated area, through increased specialization, and generally ensures better allocation of scarce resources into the most productive areas".⁴

8.3 ORIGINS OF THE ARAB GAS PIPELINE

While eyeing regional energy security integration, it is crucial that nations examine and enhance domestic security as well. Through sound energy security policies, which mandate deregulated energy sectors, the Middle East and its regional members will experience positive externalities. These include higher standards for services (for example, electricity), higher worker productivity and a stronger economy, which will lead to improved and increased economic and social infrastructure. Regionally deregulated sectors may also experience lower prices in the long term due to efficient market competition. On the other hand, if market competition is government regulated, countries will experience negative externalities due to such policies. Under regulation, prices are kept low as reserves and supplies are depleted at a faster rate, worker productivity decreases, infrastructure is left undeveloped or unused and such technical obstacles perpetuate the negative externality cycle. Without developing and maintaining a network of transnational infrastructure such as pipelines, regional integration and improved energy security is impossible.

There exists an argument amongst scholars as to whether external (extra-national) forces or internal (domestic) forces influence regional integration to a greater extent. The external forces argument holds that economies dependent on trade will visibly boost regional integration. Applying that argument to the Middle East, the construction

⁴Sunday Kachima McDonald Anadi, "Regional Integration in Africa", University of Zurich, April 2005, http://www.kfpe.ch/download/PhD_thesis_Anadi.pdf [Accessed 2 September 2010], pp. 26–27.

of transnational infrastructure and long-term bilateral and multilateral contracts will lead to greater regional integration. Alternatively, the internal forces argument cites a neo-classical theory: countries which adopt free-trade policies achieve high long-term growth which will spur regional integration. Working backwards, if nations aspire to regional integration, they should develop and adhere to similar frameworks in order to standardise bureaucracy and promote integration. For the purpose of this analysis, the first argument, the external forces argument, is more applicable.

The concept of a transnational natural gas pipeline originating in Egypt can be traced back to 1995. It was then that foreign oil companies were given permission to actively explore and drill for natural gas in the fields of Egypt in order to meet domestic consumption, standing at 439 billion cubic feet (Bcf) per year. In 1999, the Egyptian government declared that supplies of natural gas were being met. Egypt urged companies drilling for natural gas there to find an export market. The first export market for Egyptian natural gas was found in Jordan. After many logistical and cooperative discussions, it was decided through a memorandum of understanding (MoU) in 2001 that the Arab Gas Pipeline would be built to provide natural gas from Egypt to Jordan, Syria and Lebanon. Concurrently, an agreement with Israel found an offshoot of the AGP headed to Ashkelon, Israel, from Arish, Egypt. The AGP, which is 1,200 kilometres long and has a diameter of 36 inches, currently exports Egyptian natural gas and is divided into four segments. The first, from Arish to Aqaba in Egypt, was completed in 2003; the Aqaba-Amman-El Rehab section in Jordan in 2006; and the section from El Rehab, Jordan, to Damascus, Syria, and Homs, Syria, in February 2008. The Arish-Ashkelon extension of the AGP pipeline was also completed in the same month.

The AGP delivered its first 12 Bcf of Egyptian natural gas to Jordan in 2003. Since then Egypt's total exports of natural gas have risen nearly 500% to 598 Bcf in 2008 with the completion of further extensions to the pipeline along with completion of LNG infrastructure.⁵

⁵For more statistical data on Egypt's natural gas sector, please refer to Table 1.

8.4 OBSTACLES FACED BY THE ARAB GAS PIPELINE

There are several common barriers to investment and challenges faced during the genesis of the AGP project, including those that may be classified as market, regulatory, technical and political in nature.

Market risks faced by investors include the long payback period on the pipeline as an investment. The regional nature of this project poses risks because the investment is subject to the volatilities of many economies. There is no one international market for natural gas. As such, negotiations tackle the further chore of price-setting in addition to ownership/responsibility of gas while in transit. There are no international cartels or organisations governing the sale and purchase of natural gas either. A particular challenge to the AGP negotiations of 2000/2001 was the attacks of 11 September 2001. This event in the Western hemisphere changed the perceived economic landscape of the Middle East and dampened the investment spirits of American and European businesses in the region. Such events may be considered a political risk as well as a market risk.

Another market risk to investment is the degree of government regulation through mechanisms such as subsidies, which tend to be quite high in the Middle East.

In terms of regulatory risks, there exists no internationally binding legal framework governing the sale, transit and acquisition of natural gas in the Middle East. Although there are several frameworks currently being developed by the World Trade Organization and the Energy Charter Secretariat, none are binding as of publication date. Consequently, the nature and terms of natural gas agreements must be decided upon separately during each negotiation. Since 2000, negotiations have been undertaken in order to provide such a framework, known as the Transit Protocol,⁶ by the Energy Charter Secretariat located in Brussels, Belgium. These negotiations have often been tabled due to disputes between the European Union and Russia.

⁶For more information on the Transit Protocol, please visit <http://www.encharter.org/index.php?id=37>

Technical issues that the AGP participants tackled include environmental challenges as well as the construction, maintenance and security of the physical pipelines and stations. These issues challenged not only the construction companies but remain an issue for all parties involved in the transit of natural gas through the AGP. A technical problem surfaced in 2008; Jordan was confronted with a sizeable shortage of natural gas when a pipeline malfunction disrupted supply. Jordan uses natural gas to run thermal power plants which generate electricity, the lifeblood of its economy. Due to this necessity for fuel to generate electricity, Jordan was forced to import heavy-oil fuel from Saudi Arabia in order to supply electricity grids of the country until the AGP once again became operational.

Political tensions of the region hindered negotiations during the creation of the AGP. These tensions will be examined later along with the AGP's positive effects on such tensions.

8.5 PRESENT STATUS OF THE ARAB GAS PIPELINE

Major shareholders in the Arab Gas Pipeline are EGAS⁷ (Egyptian Natural Gas Holding Company) of Egypt, ENPPI⁸ (Engineering for the Petroleum and Process Industries) of Egypt, PETROJET⁹ (The Petroleum Projects and Technical Consultations Company) of Egypt, GASCO¹⁰ (Egyptian Natural Gas Company) of Egypt and SPC¹¹ (Syrian Petroleum Company) of Syria. Other subsidiaries and companies with smaller shares come from the United States, Britain, Germany, Canada and Russia.

The volume of Egyptian natural gas flowing through the AGP is currently at 140 million cubic feet per year (MMcf/y) while its capacity is 350 MMcf/y.¹² In tandem with anticipating and urging the expansion of

⁷For more information, see Egyptian Natural Gas Holding Company (<http://www.egas.eg>).

⁸For more information, see Engineering for the Petroleum and Process Industries (<http://www.enppi.com/>).

⁹For more information, see The Petroleum Projects and Technical Consultations Company (<http://www.petrojet.com.eg>).

¹⁰For more information, see Egyptian Natural Gas Company (<http://www.gasco.com.eg/>).

¹¹For more information, see Syrian Petroleum Company (<http://www.spc-sy.com>).

¹²Cristina Gallardo, "Shell Calls for Iraq's Gas Potential to be Unlocked", *Ordons News*, 5 April 2010, <http://www.ordons.com/201004053857/shell-calls-for-iraqs-gas-potential-to-be-unlocked.html> [Accessed 23 August 2010].

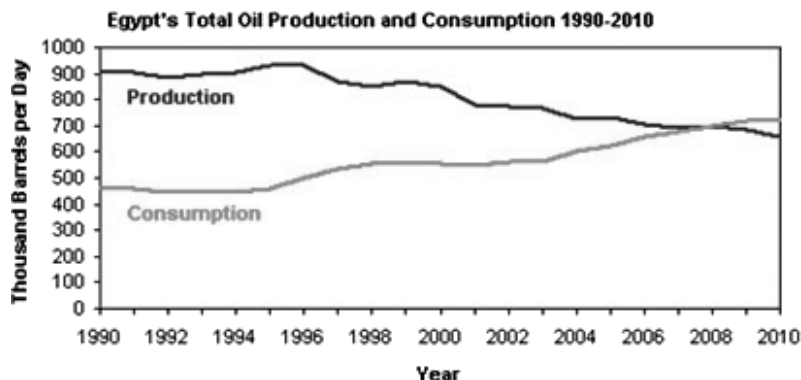


Figure 1 Egypt's Natural Gas Production and Consumption

Source: http://www.egyptoil-gas.com/read_article_issues.php?AID=477.

the AGP, connected countries will need to develop and/or streamline domestic infrastructure within a deregulated economic atmosphere in order to reap the greatest benefits from participation in the AGP project.

Figure 1 illustrates the surplus (exports) Egypt experienced, by year, in terms of its natural gas production and consumption. During 2008, Egypt was producing approximately 1.9 trillion cubic feet (Tcf) while consuming 1.1 Tcf.¹³ Egypt possesses the third-highest estimated natural gas reserves at 58.5 Tcf in Africa, after Nigeria (185 Tcf) and Algeria (159 Tcf).¹⁴ In 2009, Egypt exported 646 Bcf. Of the exports, 30% flowed out through pipelines while 70% was exported as LNG. Through the physical infrastructure of the AGP, Egypt is continually securing markets for export of its natural gas surplus in the Middle East as it eyes the markets of Europe.

8.5.1 Egypt

The Arab Gas Pipeline was born out of Egypt's Integrated Gas Strategy introduced by Sameh Fahmi who became Petroleum Minister in 1999.¹⁵ It

¹³US Energy Information Agency: Independent Statistics and Analysis, *Natural Gas, Egypt*, June 2010, <http://www.eia.gov/emeu/cabs/Egypt/NaturalGas.html> [Accessed 20 August 2010].

¹⁴Ibid.

¹⁵"EGYPT — Integrated Gas Strategy; Exports Won't Exceed 25% Of Output", *APS Review Gas Market Trends*, 17 January 2000, www.allbusiness.com/mining/oil-gas-extraction-crude-petroleum-natural/409253-1.html [Accessed 3 September 2010].

was by the encouragement of Fahmi that President Mubarak diversified the energy sector through the construction of LNG ports and dry natural gas pipelines, including the transnational AGP.

Egypt discovered its large natural gas reserves in 1995 following permission granted to foreign companies to actively drill for hydrocarbons. In 1995, proven reserves stood at 25.20 Tcf. In August 2001, EGAS was incorporated as a state-owned entity. While many sectors of Egypt's economy have been deregulated since the 1990s, the energy sector remains under tight control with price ceilings and floors in place. Despite controls, foreign companies do have a presence in both the upstream and downstream sectors of natural gas in Egypt.

The AGP memorandum of understanding was signed in 2001 between Egypt, Jordan, Lebanon and Syria to provide an export market for Egypt's dry natural gas. The pipeline's construction was completed in different phases in 2003, 2006 and 2008.

Since 1994, proven Egyptian reserves have increased 400% from 19.2 Tcf to 77.20 Tcf in 2009; production of natural gas has risen 350% from 549 Bcf in 1995 to 1,935 Bcf in 2008; consumption of natural gas has risen 260% from 423 Bcf in 1995 to 1,108 Bcf in 2008; and exports of natural gas have risen from 0 Bcf in 1995 to 598 Bcf in 2008 (Table 1).¹⁶

Energy subsidies provided by the government defy the public sector and contribute to the instability of Egypt's energy sector. An example of such instability can be found in the blackouts (electricity failures) during the month of Ramadan in 2010. As a result of low prices, natural gas supplies were drained by the thermal power plants (generating electricity) and demand could not be met. Until Egypt allows prices to be regulated by the market, its domestic market will continue to face such shortages. Adjusting the volume set aside for domestic consumption may be necessary but before such measures are taken the market *must* be deregulated to allow for the most accurate assessment of domestic energy needs. Currently, thermal power plants in Egypt have switched from oil to natural gas and consume 65% of Egypt's total domestic natural gas supplies.¹⁷

¹⁶ IEA country profile.

¹⁷ MBendi, *Natural Gas Liquid Extraction*, http://www.mbendi.com/indy/oil/gas/_af/eg/p0005.htm [Accessed 3 September 2010].

Table 1 Egypt, Natural Gas Volumes Per Fiscal Year

Year	Proven Reserves (TcF)	Produced (Bcf)	Consumed (Bcf)	Exported (Bcf)	Imported (Bcf)
2009	77.2	NA	NA	NA	NA
2008	75.95	1935	1108	598	0
2007	72.3	1872	1082	560	0
2006	68.2	1176	999	597	0
2005	66.3	1660	1208	293	0
2004	65	1296	1111	39	0
2003	59.4	1216	1046	12	0
2002	55.9	1107	883	0	0
2001	53.1	1083	867	0	0
2000	44.9	860	646	0	0
1999	36.4	694	518	0	0
1998	31	645	485	0	0
1997	27.6	641	477	0	0
1996	24.2	631	473	0	0
1995	25.2	563	439	0	0
1994	19.2	549	423	0	0

Table 1 is derived from information provided by the U.S. Energy Information Administration.

Note: Values set at zero are representative of the effects of proper infrastructure on exports (the AGP became operational in 2003) as well as the complete lack of imports.

Source: US Energy Information Administration.

8.6 SNAPSHOTS OF DOMESTIC NATURAL GAS SECTORS

Equally as important as Egypt's exports are to SAG Diplomacy are the domestic sectors of natural gas in the nations connected to the AGP. Despite the fact that there are forms of renewable energy being pursued in the Middle East, natural gas is the best candidate to replace oil and coal consumption, in the near future and on a large scale, due to its properties discussed at the beginning of the paper along with its cleaner burning properties with low carbon dioxide (CO₂) emissions. Especially relevant to Middle Eastern countries aiming to become net exporters, or increase net exports, of petroleum, shifting consumption to natural gas will allow these nations to export a greater amount of that more expensive fuel. The more oil available for export translates into more foreign currency injected

into the national economies, an especially enticing prospect for these developing economies. Across sectors and borders, proper infrastructure and frameworks need to be created and upheld first in order to ensure sustainable growth. Only with such infrastructure will political tensions be eased, circumstances which will be analysed in a later section.

8.6.1 Jordan

Jordan lacks noteworthy petroleum and natural gas resources and therefore relies heavily on imports from its neighbours.¹⁸ While continuing to search for investors to explore for greater reserves, Jordan transformed its electric power plants into natural gas-powered plants from diesel-powered in 2003. This swell in consumption can clearly be seen in Table 2; consumption jumped from the 2002 level of 11 Bcf to 23 Bcf in 2003, 55 Bcf in 2005 and 105 Bcf in 2008.

In 2001, the memorandum of understanding promised Jordan 1 Bcf/y of Egyptian gas (through the AGP which began operations in 2003); 96 Bcf worth of imports in 2008 supplemented the 9 Bcf produced by Jordan. Jordan has signed a US\$3 billion 20-Year National Energy Development Plan which will deregulate its energy sector along with removing fuel subsidies.¹⁹

The added demand from Jordan's energy sector combined provides excellent incentive for integration and cooperation beyond its borders. A stable and prosperous Jordan will help ease tensions in the Middle East, especially the demarcation of borders. It will also ensure greater regional energy security and thereby ensure itself sufficient energy supply.

8.6.2 Syria

Syria, while pursuing potential investors to develop its own gas fields, has imported natural gas from Egypt through the AGP since 2008. Syria's

¹⁸Jordan has one developed gas field, near its border with Iraq.

¹⁹Encyclopedia of Earth, *Energy Profile of Eastern Mediterranean*, http://www.eoearth.org/article/Energy_profile_of_Eastern_Mediterranean [Accessed 25 August 2010].

Table 2 Jordan, Natural Gas Volumes per Fiscal Year

Year	Proven Reserves (Tcf)	Produced (Bcf)	Consumed (Bcf)	Exported (Bcf)	Imported (Bcf)
2009	0.213	NA	NA	NA	NA
2008	0.213	9	105	0	96
2007	0.213	9	92	0	83
2006	0.22	11	79	0	68
2005	0.22	10	55	0	45
2004	0.22	11	50	0	39
2003	0.23	11	23	0	12
2002	0.23	11	11	0	0
2001	0.23	10	10	0	0
2000	0.24	10	10	0	0
1999	0.245	10	10	0	0
1998	0.2	10	10	0	0
1997	0.2	10	10	0	0
1996	0.2	10	10	0	0
1995	0.2	10	10	0	0
1994	0.2	10	10	0	0

Table 2 is derived from information provided by the U.S. Energy Information Administration.

Note: The AGP became operational in 2003, an event marked by the sudden increase in imports. The table also explicitly outlines the absence of exports and trace amounts of proven reserves.

Source: US Energy Information Administration.

proven reserves have stalled at 9 Tcf since 1999 while its production and consumption have steadily increased (Table 3). Similar to its neighbours' policies, Syria has been attempting to shift domestic energy consumption from petroleum to natural gas to free up oil for export.²⁰ The AGP will serve to provide the necessary infrastructure to allow Syria's economy to develop beyond its own natural resources.

With political tensions stemming from the leadership of Syria, attracting investors has proved difficult though not impossible. In 2006,

²⁰ "The Energy Base of Syria", *APS Review Downstream Trends*, 8 March 2010, <http://www.allbusiness.com/energy-utilities/oil-gas-industry-oil-processing/14068620-1.html> [Accessed 20 August 2010].

Table 3 Syria, Natural Gas Volumes per Fiscal Year

Year	Proven Reserves (Tcf)	Produced (Bcf)	Consumed (Bcf)	Exported (Bcf)	Imported (Bcf)
2009	9	NA	NA	NA	NA
2008	9	208	213	0	5
2007	9	212	212	0	0
2006	9	221	221	0	0
2005	9	215	215	0	0
2004	9	251	251	0	0
2003	9	242	242	0	0
2002	9	240	240	0	0
2001	9	197	197	0	0
2000	9	215	215	0	0
1999	9	213	213	0	0
1998	8	203	203	0	0
1997	8	161	161	0	0
1996	7	142	142	0	0
1995	7	104	104	0	0
1994	7	134	134	0	0

Table 3 is derived from information provided by the U.S. Energy Information Administration.

Note: The AGP became operational in Syria in 2008, an event marked by the sudden increase in imports. The table also explicitly outlines the absence of exports. Despite high domestic consumption, Syria has exported small amounts of gas to Lebanon.

Source: US Energy Information Administration.

US-based Marathon Oil Corporation signed a gas (and oil) exploration deal with Syria. However, political tensions with the US and the speculation of sanctions caused Marathon Oil to sell its shares to Petro-Canada only months later in 2006. The estimates for the fields of Al Shae'r and Al Sharyfa stand at 80 MMcf/d with reserves of about 500 Bcf.²¹ Petro-Canada has stated 2010 as the target on-stream date.²² While exploration continues, the ability to tap into the permanent infrastructure of the AGP will provide Syria with a platform for stable development. Other factors

²¹ Suncor, *International, Offshore*, <http://www.suncor.com/en/about/919.aspx> [Accessed 20 August 2010].

²² Ibid.

would need to be considered in a future investigation to determine if Syria will effectively utilise such a platform for sustainable growth.

8.6.3 Lebanon

Lebanon was operationally linked to the AGP in 2006. Despite consuming and producing very little natural gas (Table 4), Lebanon is currently in the process of converting its power plants to run on natural gas from petroleum-based products. In 2006, Syria promised to supply Lebanon with 1.5 MMcf/d for 10 years. However, Syrian shortages of domestic supplies may hamper the fulfilment of that promise. Israel's offshore discoveries of

Table 4 Lebanon, Natural Gas Volumes per Fiscal Year

Year	Proven Reserves (Tcf)	Produced (Bcf)	Consumed (Bcf)	Exported (Bcf)	Imported (Bcf)
2009	0	NA	0	0	0
2008	0	0	0	0	0
2007	0	0	0	0	0
2006	0	0	0	0	0
2005	0	0	0	0	0
2004	0	0	0	0	0
2003	0	0	0	0	0
2002	0	0	0	0	0
2001	0	0	0	0	0
2000	0	0	0	0	0
1999	0	0	0	0	0
1998	0	0	0	0	0
1997	0	0	0	0	0
1996	0	0	0	0	0
1995	0	0	0	0	0
1994	0	0	0	0	0

Table 4 is derived from information provided by the U.S. Energy Information Administration (EIA).

Note: This table is provided, despite the utter lack of activity, to illustrate Lebanon's current standing in the region with regard to natural gas. Although consumption is slowly climbing, it is not climbing enough to register on the EIA's surveys.

Source: US Energy Information Administration.

natural gas fields may prove beneficial to Lebanon, if the maritime border dispute can be solved permanently.

Regionally, Lebanon holds a very critical geopolitical position, in large part due to the border it shares with Israel as well as the presence of Hezbollah. Hezbollah is backed by the Syrian government yet operates out of this small Mediterranean nation. Lebanon will play a key role in regional stability if reform and deregulation occur in its energy sectors. The creation of strong national energy security policies coupled with good governance reforms in Lebanon could help lead Middle Eastern regional integration in the right direction.

8.6.4 Israel

Rising Israeli demand for natural gas may be just what the region needs to provide a strong incentive towards regional integration for both Israel and its Arab neighbours. With steadily increasing production and consumption (Table 5), Israel may literally be sitting on a very powerful tool in terms of regional reconciliation. Of course, while it would be naïve and short-sighted to ignore the many other political issues to be settled between Israel and the Palestinian territories before full regional reconciliation could take place, integrating energy sectors would be a very strong step in the right direction. When approaching its newly discovered offshore gas fields, Israel must be careful to finalise maritime borders with Lebanon and Palestine before drilling. If it does not acknowledge its influential role in regional security by settling borders with Lebanon through the gas fields, Israel could very well further disrupt Middle Eastern regional stability beyond energy security.

Israel currently feeds about half of its domestic natural gas consumption, fuelling the other half through the Arish-Ashkelon pipeline. With a capacity of 335 MMcf/y, this pipeline stretches 100 km under the Mediterranean to connect Israel to the AGP. The pipeline was constructed and is operated by the East Mediterranean Gas Company (EMG). EMG is a multinational gas company and a joint effort of the Egyptian General Petroleum Corporation (EGPC) with 68.4% of shares, Merhav, an Israeli company, with 25% and the Ampal-American Israel Corporation with the remaining 6.6% of shares. The MoU signed between Egypt and Israel promised 63.45 MMcf/y; however, this has

Table 5 Israel, Natural Gas Volumes per Fiscal Year

Year	Proven Reserves (Tcf)	Produced (Bcf)	Consumed (Bcf)	Exported (Bcf)	Imported (Bcf)
2009	1.075	NA	NA	0	0
2008	1.075	99	42	0	0
2007	1.275	97	40	0	0
2006	1.375	35	34	0	0
2005	1.375	27	26	0	0
2004	1.375	28	28	0	0
2003	1.375	1	1	0	0
2002	1.47	(s)	(s)	0	0
2001	1.47	(s)	(s)	0	0
2000	0.01	(s)	(s)	0	0
1999	0.011	(s)	(s)	0	0
1998	0.011	1	1	0	0
1997	0.012	1	1	0	0
1996	0.013	1	1	0	0
1995	0.013	1	1	0	0
1994	0.014	1	1	0	0

Table 5 is derived from information provided by the U.S. Energy Information (EIA).

Note: Although consumption and imports are high, the EIA surveys do not reflect that. Such discrepancies may be a result of “regulatory risks” whereby the reporting of numbers is skewed or inaccurate because no legally binding framework exists within which to operate.

(s) — Numbers too small to represent in decimal format in the space allotted.

Source: US Energy Information and Administration.

since been increased to 78.65 MMcf/y through 2028. The original agreement sold the natural gas to the Israel Electric Corporation (IEC). In late 2009, EMG signed deals promising an additional 74.65 MMcf/y to private companies in Israel. IEC, on its corporate website, has predicted annual consumption will rise gradually until it reaches import levels of 149–223 MMcf annually.

8.6.5 Turkey

Turkey plays the role of infrastructural hub between Africa (Egypt), the Middle East, Europe and the Caspian Sea region. With the recently signed

MoU between Egypt and Turkey, the AGP will supply 100–400 MMcf/d to Turkey along with 203–608 MMcf/d to Eastern Europe, most likely through connecting to existing or developing pipelines such as the Nabucco Pipeline. The actual data is predicted to run at the low end of these promised volumes until recently discovered offshore fields come on-stream. Supplies may also be supplemented by other fields such as those in the Arabian Gulf and Iraq. This monumental agreement will no doubt be heralded by Egyptians but Turks as well. The Middle East's regional energy security will be strengthened significantly if Middle Eastern gas gains access to the European market. Such is the vital importance of developing permanent infrastructure to encourage long-term multi-regional energy security.

Turkey is motivated to participate in the AGP and Nabucco projects because it lacks any major proven reserves of natural gas (0.3 Tcf in 2009) and has very high consumption rates (1,238 Bcf in 2009) (Table 6). Turkey's economy will experience many positive externalities associated with pipeline construction and usage because it operates within a deregulated national energy sector.

8.7 EMERGING HORIZONS OF THE ARAB GAS PIPELINE

The future is bright — US\$9 billion and 5 Tcf bright — for Egyptian natural gas, the Arab Gas Pipeline and regional energy security.²³ It was reported in July 2010 that BP and German RWE Dea will develop five offshore gas fields which will supply 1 Bcf/d with a target on-stream date of 2014. Rather than taking a percentage of total production as Egypt has done in past agreements with foreign companies, Egypt will pay two royalties for the gas; BP and RWE Dea will sell the gas to EGAS. The additional supply from these offshore fields will supplement other Egyptian natural gas production to boost supply to the domestic grid and the surplus will be exported through the AGP. Discoveries such as this coupled with the flexibility displayed by the Egyptian government will no doubt have a positive effect on regional energy security and integration.

²³“More Gas for Egypt after BP, RWE Deal”, *International Business Times*, 22 July 2010, <http://www.ibtimes.com/articles/37592/20100722/more-gas-for-egypt-after-bp-rwe-deal.htm> [Accessed 15 August 2010].

The AGP has also courted connections with other exporters and importers of natural gas. The exporting pipelines of Iraq (a deal signed in 2004 in tandem with Turkey) and the possibility of supplying the 3,300 km²⁴ European Nabucco Pipeline project²⁵ in conjunction with the future prospect of linking to the exporting Dolphin Gas²⁶ pipelines of Qatar and the United Arab Emirates will allow the region of the Middle East to target European natural gas markets as a stable and united net exporter. Working towards such levels of integrated regional cooperation signals that energy security may be the beginning of sustainable regional stability in the Middle East.

8.8 THE FIRST INDICATORS OF STABLE ARAB GAS DIPLOMACY

This section will collate the expansive set of information provided thus far with current snapshots of bilateral and multilateral interactions in the Middle East. This analysis of information will demonstrate the nascent correlation between the transnational infrastructure (AGP) and the long-term regional integration and energy security. While still in its infancy, the AGP has already shown signs that it is able to provide incentives for tension-bound neighbours to cooperate. Additionally, these nations need to view interdependence as a tool for regional growth rather than a national security threat. Aiming towards European markets, the AGP and the Middle East as a political, economic and cultural region will witness sustained growth *only* if it is interconnected and stable. The ability of the nations, including Israel, in this historically volatile area to collaborate on such a grand scale has already shown positive externalities.

²⁴“Arab Gas Pipeline Approved by Turkey-EU”, *Daily World EU News*, 6 May 2008, <http://www.turks.us/article.php?story=20080506092427239> [Accessed 12 August 2010].

²⁵“Minister: Egypt Considers Possibility of Transporting Its Gas on Nabucco through Pan-Arab Pipeline”, *Trend*, 10 July 2010, <http://en.trend.az/capital/engineering/1718563.html> [Accessed 14 August 2010].

²⁶Dolphin Energy, *Dolphin Gas Project*, 2009, <http://www.dolphinenergy.com/Public/facilities/facilities-gas-pipeline.htm> [Accessed 14 August 2010].

The present status of regional affairs dictates further development of the AGP. In Egypt, it is an election year and a controversial one at that. Power cuts have plagued the country during the month of Ramadan and have prompted debates about the usefulness of the AGP and all natural gas exports. Water disputes between Syria and Jordan continue as cooperation on the AGP persists. Border rows between Jordan, Syria, Lebanon, Israel and Egypt linger in the background of energy talks. The sustained cooperation on joint energy security via the AGP clearly demonstrates the positive relationship between the stable infrastructure of the pipeline (and the natural gas it carries) with improved regional integration. Although there are still many tensions existing in other realms of the relationships of the region, the fact that all governments are cooperating on a project of this magnitude confirms progress in the right direction.

8.8.1 Close Neighbors Economic and Trade Partnership Council (CNETAC)²⁷

On 10 June 2010, four of the five nations attached to the AGP (Turkey, Jordan, Syria and Lebanon) signed a free trade agreement, dubbed the Close Neighbors Economic and Trade Partnership Council (CNETAC). The CNETAC aims to “strengthen the existing cooperation, develop long-term strategic partnership and solidarity, and further improve the economic integration”.²⁸ The first committee meeting will be held in September 2010 in Amman, Jordan, to sketch a roadmap of aims prior to the first ministerial meeting planned for Damascus, Syria, in December 2010.

This clear step towards regional integration supports the Stable Arab Gas Diplomacy theory as all countries are connected via transnational energy infrastructure. Turkish Foreign Trade Minister Zafer Çağlayan wrote in an official statement, With this close cooperation, our goal is to increase and diversify trade and investments among the four countries by

²⁷“Turkey, Syria, Jordan, Lebanon on First Step to Set Up Mideast’s ‘EU’”, *World Bulletin*, 1 August 2010, http://www.worldbulletin.net/news_detail.php?id=62093 [Accessed 29 August 2010].

²⁸ Ibid.

creating a liberal trade and investment environment with a *modern infrastructure at the international level*, free from all tariff and non-tariff barriers, encompassing a geography feeding a population of 105 million and, as of 2009, having a combined gross domestic product [GDP] of \$723 billion, imports amounting to \$176 billion and exports to \$131 billion.²⁹ (Italics inserted by author.)

8.8.2 Regional Israeli Relations

Although Israel's neighbourhood relations have been stressed to say the least since its controversial creation, there are signs to indicate Israel is seeking détente. Pragmatically, this détente could be attributed to a series of shifts or events; however, it does coincide with the creation and evolution of the AGP as its consumption of natural gas well exceeds its domestic production. Spanish Foreign Minister Miguel Angel Moratinos acted as liaison between Israel and the states of Syria and Jordan through the media in May 2010. Following a tour of the Middle East, Moratinos was quoted as saying, "Israeli authorities asked me to convey a message to Syria and Lebanon, which is that they seek to ease tension, and they expressed their willingness for negotiations".³⁰ Israel began receiving imports through the AGP on 1 May 2010.³¹

In the spirit of unbiased evaluation, it is also critical to acknowledge the continuing existence of deep-set tensions in the region. The recent discovery of major gas fields offshore from Israel has stirred up tensions with its neighbour Lebanon and the militant group Hezbollah which resides in Lebanon. Executive Director of the Institute for the Analysis of Global Security, Gal Luft, recently wrote, "As a militarized non-state actor,

²⁹ "Major Step Taken towards M. Eastern Economic Union", *Today's Zaman*, 2 August 2010, <http://www.todayozaman.com/tz-web/news-217874-105-major-step-taken-towards-meastern-economic-union.html> [Accessed 29 August 2010].

³⁰ "Israel Seeking to Ease Tension with Lebanon, Syria: Spain", *EU Business*, 13 May 2010, <http://www.eubusiness.com/news-eu/mideast-diplomacy.4p5> [Accessed 4 September 2010].

³¹ Israel Electric Company, *Fuel*, <http://www.iec.co.il/bin/ibp.jsp?ibpDispWhat=zone&ibpDisplay=view&ibpPage=IRRWPPage&ibpDispWho=FuelIRR&ibpZone=FuelIRR> [Accessed 7 September 2010].

Hezbollah has already demonstrated its capability to push an independent agenda which serves its patrons Iran and Syria, not the people of Lebanon”.³² At the same time, he wrote, “Israel has already announced its willingness to use force to protect its natural gas finds”.³³

8.8.3 Syrian-Lebanese Relations

In early September of this year, Lebanese Prime Minister Saad al-Hariri retracted his charges against Syria for the death of his father, Rafik al-Hariri, in 2005. Outcries from local and international populations prompted Syria’s President Bashar al-Assad to withdraw Syrian troops from Lebanon in the same year. This unthawing of relations between the two countries is encouraged by small amounts of Syrian natural gas exported to Lebanon through the AGP. (Lebanon also receives Egyptian gas through the AGP.) An Al-Jazeera correspondent in Beirut commented on the recent developments, saying, “Now Syria has emerged from its isolation as a very strong player in the region ... and so he [Hariri] has to adjust.”³⁴ This shift in regional politics coincides with the on-stream status of the AGP since 2005, along with PM Hariri’s election to office in that same year.

Without overstating the symbolic and pragmatic importance of the AGP in regional security, the recent warming of relations between Syria and Lebanon will continue to be encouraged by the physical infrastructure supplying countries the lifeblood of any economy: energy. The management of such resources both nationally and regionally is a topic for another day.

8.8.4 Syrian-Turkish Relations

Turkish-Syrian tensions centre around two issues: the Kurdistan Workers’ Party (PKK) rebels and water rights. The southern neighbour showed the

³²Gal Luft, “Hizballah Takes Aim at Israel’s Natural Gas Discovery”, *The Washington Times*, 13 July 2010.

³³Ibid.

³⁴“Lebanon PM Retracts Syria Charge”, *Al Jazeera English*, 6 September 2010, <http://english.aljazeera.net/news/middleeast/2010/2010/2010/2010/09/201096114429752335.html> [Accessed 6 September 2010].

first signs of rapprochement in 1998 when Syria deported PKK leader Abdullah Ocalan. More recently, Syria's recent offer to give asylum to 1,500 PKK rebels if they renounced their armed conflict was another sign of improving relations.³⁵ In a 2009 meeting, the two nations addressed the water dispute with a "friendship dam agreement" although tensions still exist today over volumes reaching Syria.

8.9 CONCLUSION

While nations around the world are shifting from petroleum to natural gas consumption (at least in part), it is crucial that the Middle East integrate as a region to capitalise on this demand. Having long-term terrestrial access to the markets of Africa, Asia and Europe, the Arab Gas Pipeline is poised to be a great diplomatic tool for the Middle East to unite around a common interest. It is important to keep in mind that it is difficult, if not impossible, to divorce the economic features from the political aspects of energy security. Overall, the AGP has and will continue to produce positive externalities domestically and regionally for the Middle East and its member nations. The diplomatic incentive is the tool focused on in this paper through the definition of a new theory, the theory of Stable Arab Gas Diplomacy.

SAG Diplomacy is dependent on deregulated energy sectors, of which the Middle Eastern nations may not fully possess. However, it is still appropriate to begin tracking the effects of transnational infrastructure as these energy sectors and economies slowly move towards integration with the constant incentive of permanent infrastructure linking the nations. The AGP will provide the most incentive if and when nations adopt deregulated energy sectors. Nevertheless, it is evident that SAG Diplomacy is already at work in the region.

The best example of SAG Diplomacy, to date, is the formation of the CNETAC, a multilateral (regional) free trade agreement. Although also in its infancy, the CNETAC provides definitive support to the theory proposed in this paper. Other examples provided earlier in the paper

³⁵ "Turkey and Syria Signal Improved Relations", *New York Times*, 13 October 2009, <http://www.nytimes.com/2009/10/14/world/europe/14turkey.html> [Accessed 29 August 2010].

illustrated bilateral signs of the beginning of appeasement. An example of simple positive externalities of the construction and maintenance of the AGP is the creation of jobs which has injected spending power into the economy.

Secure energy infrastructure causes demand to increase, which in turn will create more jobs and a stronger economy. These stronger economies will be in a position to produce strong political bureaucracies which will serve to spur further investment into the region. Some risks discussed include the lack of binding regulatory bodies. Such frameworks, which have begun and continue to develop, will increase investor confidence in the region.

Through greater regional stability and integration, the Middle East will position itself to capitalise on access to foreign markets, especially in Europe. As Europeans fret over a lack of diversification in gas supply routes, the AGP now has perfect timing for Middle Eastern gas to “walk through that open door”.³⁶

While the diplomatic weight of regional energy security is heavy, it is not enough on its own to fully ease tensions of the region, in particular political tensions. This chapter has illustrated the platform created by the Arab Gas Pipeline, through the eyes of SAG Diplomacy, on which agreements such as the CNETAC have been made.

³⁶For an analysis of European concerns, see Kevin Rosner, “Closing the Gap between Energy and National Security Policy”, *Journal of Energy Security* (18 May 2010), http://www.ensec.org/index.php?option=com_content&view=article&id=245:closing-the-gap-between-energy-aamp-national-security-policy&catid=106:energysecuritycontent0510&Itemid=361 [Accessed 29 August 2010].

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