Scenario Analysis of Energy Security in the East Asia Summit Region

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This report was prepared by the Working Group for the 'Scenario Analysis of Energy Security in the EAS Region' under the Economic Research Institute for ASEAN and East Asia (ERIA) Energy Project. Members of the Working Group, who represent the participating East Asia Summit (EAS) region countries, discussed energy security issues by using the scenario planning approach. The scenarios were developed not for commercial or business use, but for deriving policy implications. The Working Group, therefore, is not responsible for any losses that may be caused by the use of these scenarios.

The findings, interpretations, and conclusions expressed herein do not necessarily reflect the views and policies of the Economic Research Institute for ASEAN and East Asia, its Governing Board, Academic Advisory Council, or the Institutions and governments they represent.

Preface

Energy security, needless to say, is an indispensable element of energy policy in every East Asia Summit country. In the past three years, a change was tried to quantify the status of energy security of each country—past and future—and our efforts succeeded in deriving some useful policy recommendations. At the same time, it was noted that this approach has a limitation. This is due to the fact that history sometimes changes in a discontinuous manner. For instance, this was observed in the oil crisis event in the 1970s.

The scenario planning method is one of the approaches that can describe a discontinuous future. For this year, this method was utilised to study the future state of the global and regional market, and to generate implications for energy policies that can be used.

It is my hope that the outcome of this study will serve as a point of reference for policymakers in East Asian countries and contribute to the improvement of energy security in the region.

Ichiro Kutani
Leader of the Working Group
June 2015

Acknowledgements

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Ichiro Kutani
Leader of the Working Group
June 2015

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List of Abbreviations

ASEAN	Association of Southeast Asian Nations
BAU	Business-As-Usual
EAS	East Asia Summit
IEA	International Energy Agency
OECD	Organisation for Economic Co-operation and Development
OPEC	Organization of the Petroleum Exporting Countries

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Chapter 1

Introduction

1.1. Background and Objective of the Study

Energy security is a key concept of energy policy in all East Asia Summit (EAS) countries. To ensure energy security, possible changes in domestic and overseas markets must be foreseen and appropriate policies with long-term viewpoint must be adopted.

The first thing that needs to be done is to analyse the measures to be used in the future under the assumption that the future will be an extension of the present trends. This analysis can be conducted by using energy supply and demand outlooks, and other relevant data, as was done in the FY2013 Energy Security Index (ESI) Study.

However, as past developments indicate, energy markets behave in a discontinuous manner, and changes occur due to various factors. While it is difficult to anticipate and respond to such discontinuous changes, it is possible, to some extent, to brace for such changes by anticipating possible future energy market changes and identifying their predictors.

In this study, the scenario planning approach will be used to analyse multiple possible scenarios and extract possible threats for energy security in the EAS region. Policies to avoid or prepare for these threats will also be investigated. This study aims to contribute to the efforts of improving energy security for the EAS region in the future.

1.2. Study Method

Study Method and Work Stream

Based on the results of the ESI study in 2011, it was decided that the study on energy security of the region has to be extended and deepened in the following manner:

A. Reassess the energy security situation in the region.

This study will use indicators developed in the ESI study for reviewing energy security conditions in the region. Through this process, the study will reaffirm scenarios of the future as an extension of the present trends and energy security challenges.

B. Extract future threats to energy security by using the scenario planning method.

Using scenario planning, this study will depict multiple energy-related environmental changes that could take place in the EAS region. Based on the depicted scenarios, the study will pinpoint possible threats to energy security in the region.

C. Draw policy recommendations for avoiding/preparing for future crises.

The study will analyse and propose policy measures required to avoid or prepare for possible crises.

Country Coverage

This study covers all member countries of the Economic Research Institute for ASEAN and East Asia (ERIA).

What is Scenario Planning?

- The scenario planning method is a form of strategy preparation and organisation learning approach in which people make multiple scenarios of possible environmental changes in a bid to enhance their foresight and imagination and brush up on their organisational decision-making capabilities to respond to uncertainties. It is used for business strategy development, project planning, crisis and risk management, stock and economic analyses, reorganisation, consciousness reforms, and others.
- Enterprises and other organisations usually make business plans based on the latest results and trends. An approach in which the future is viewed as an extension of the past and present may fail to appropriately respond to discontinuous environmental changes. Scenario planning allows decision-makers to prepare (including mental ones)

for changes, identify predictors of changes, and respond to uncertainties by virtually experiencing possible future changes in the scenario development process.

- Scenario planning for enterprises' business plan development originates from the scenario method used for considering and working out military strategies and tactics, foreign policy, and others. Today, scenario planning is considered a group learning process in which enterprise administrators and leaders deepen their understanding of the uncertain actual world and share the understanding with others within their organisations.

Source: Author.

1.3. Working Group Activities in 2014

To conduct the abovementioned study, the Working Group was organised. The Working Group members consist of experts from the region and The Institute of Energy Economics, Japan (IEEJ) research team serves as the secretariat.

In 2014, the Working Group met twice. The first meeting was held in October 2014 in Jakarta, Indonesia, while the second was held in March 2015 in Bangkok, Thailand.

The first Working Group meeting lasted for two days. Past examples of energy security risks and the outline of scenario planning were reported on the first day. This was followed by presentation by participants of future uncertainties (issues) on the energy market, and discussions to put these issues in order and to cluster them. On the second day, the extracted clusters were mapped and, finally, two scenarios were created.

During the first meeting, many participants expected that the crude oil price would remain high. However, the possibility that the crude oil price would remain low arose after the first meeting. Therefore, low oil price scenarios were discussed at the second meeting. Finally, policy implications were discussed based on these scenarios.

Chapter 2

History of Energy Security in the Region

It is important to anticipate risks and prepare the responses to improve energy security. Some risks affect global energy supply chains while others affect domestic energy supply chains. In the past, risks were brought about by geopolitical events, such as wars. In recent years, however, they were caused in many cases by natural disasters, economic situations, and human errors.

Risks to energy security may substantially change the energy market. In order to improve energy security, therefore, it is necessary to anticipate how the energy market will change, as well as to assume only the events that may bring in these risks.

The Working Group intends to assess various future energy security risks and study measures to respond to them using the scenario planning approach. To do this, it is significant to analyse energy security risks that occurred in the past, analyse earlier events, the measures taken, and the energy market that underwent a change as a result. This is the objective of this chapter.

The two oil crises practically made the world understand the importance of energy security. This chapter discusses the following events that happened after these oil crises. To recognise that risks may abruptly occur and that events of different natures may take place at the same time, similar cases will be analysed in a time series without being grouped.

Oil crises (1973, 1979)	geopolitical risk
Persian Gulf War (1990)	geopolitical risk
California electricity crisis (2000)	regulatory failure
General strike in Venezuela (2002)	geopolitical risk
Iraq war (2003)	geopolitical risk
Hurricane Katrina/Rita (2005)	extreme climate
Heavy snow in China (2008)	extreme climate
Bankruptcy of the Lehman Brothers (2008)	economic crisis
Crude oil spills in the Gulf of Mexico (2010)	accident
Arab springs (Libya, 2011)	geopolitical risk
Flood in Australia (2011)	extreme climate

Earthquake and tsunami in Japan (2011)	extreme climate
Blackout in India (2012)	fragile infrastructure
Typhoon in the Philippines (2013)	extreme climate

2.1. Increasing Understanding of the Importance of Energy Security

The concept of energy security was spawned after the Industrial Revolution in the 18th century. The invention of the steam locomotive allowed coal to supersede wood and charcoal as energy sources, and energy was increasingly recognised as an element critical for people to live and for national defence. When battles expanded in scale in World War I and technology intensiveness rose, it was increasingly recognised that security and energy were inseparably connected, and the concept of energy security took on strategic importance.

When petroleum took over the leading role from coal, the strategic importance of oil increased in modern wars. Oil became an essential commodity to continue a war as tanks and aircraft were developed. In World War II, oil was used as a strategic commodity as demonstrated by the oil embargo imposed on Japan.

As demand for oil rose, the United States (US) became an oil importer in the 1960s. Around this period, it was acknowledged that, in order to ensure energy supply to its militaries deployed overseas, energy and security were inseparable.

Even in industrialised nations other than the US, awareness was heightened—that oil was a critical commodity for sustaining and developing the social economy, people's way of living, and for national defence, and that a shortage of its supply would directly lead to serious outcomes.

2.2. Oil Crises (1973, 1979)

The oil crises of 1973 and 1979 against this background forced each nation to become aware of the importance of energy security. They were important events in that they substantially changed the oil market.

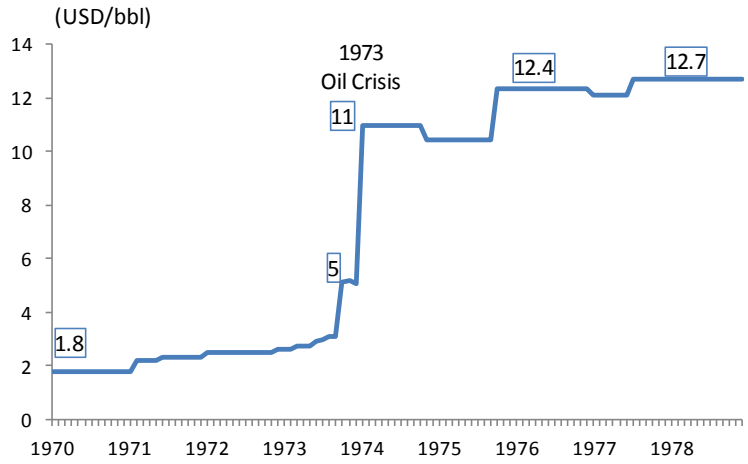
2.3. 1973 Oil Crisis

2.3.1. Steep increase in crude oil prices

In October 1973, the fourth Middle East war broke out. In response to this, six oil-producing countries in the Persian Gulf that were members of the Organization of the Petroleum Exporting Countries (OPEC) raised crude oil prices. The Organization of the Arab Petroleum Exporting Countries (OAPEC) decided to reduce oil production in stages and to impose an oil embargo on countries supporting Israel, including the US and the Netherlands.

Before the first oil crisis in 1973, crude oil prices were decided by the Oil Majors, but the oil-producing countries took that role after the 1973 oil crisis. As a consequence, crude oil prices surged fourfold, dealing a heavy blow to the world economy.

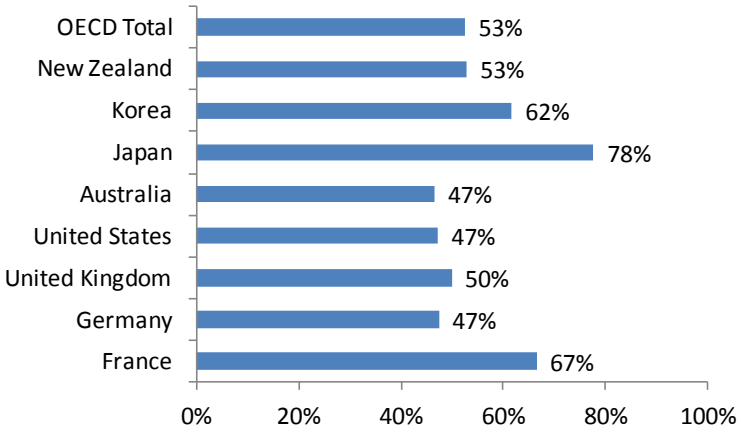
Figure 2-1. Arabian Light Crude Oil Prices (1970–1978)



Source: The Institute of Energy Economics, Japan (IEEJ).

Major industrial nations were heavily dependent on oil to supply their energy before the first oil crisis erupted in 1973. In particular, 78 percent of Japan's total primary energy supply was dependent on oil, most of which was imported.

Figure 2-2. Oil Dependence of Selected Countries (1973)



OECD = Organisation for Economic Co-operation and Development.

Source: *Energy Balance of OECD Countries 2014*, International Energy Agency (IEA).

2.3.2. Response of major industrial nations (such as Japan)

In November 1973, the Government of Japan announced the outline of emergency measures that included a 10 percent cut in oil and electricity consumption—to prevent a surge in commodity prices and shortage of goods. The specific measures included saving or less oil consumption at government agencies, setting room temperature to an appropriate level, voluntary restraint on illumination for advertisements and embellishments, reducing unnecessary and not-urgent business trips, and promotion of a movement to help a five-day workweek take root.

The government also issued an administrative guidance to encourage large-lot industrial oil consumers to curb consumption of oil and electricity, the general public to refrain from using private cars, for commercial transportation systems to save on oil consumption, restaurants and department stores to shorten business hours, and late-night TV broadcasting and advertisement towers to shorten their business hours.

In the second half of January 1974, the target of oil savings was raised from 10 percent to 15 percent. The government issued an administrative guidance to lower the retail price of residential use kerosene.

After that, the Japanese government enacted the following legislations:

Dec. 1973	'Petroleum Supply and Demand Optimization Law' and 'Emergency Measures concerning the Stabilization of National Life Law' were enacted.
Dec. 1975	Oil stockpiling law was promulgated and stocking of oil started.
June 1979	Energy Conservation Law was established.
May 1980	Law Concerning the Promotion of the Development and Introduction of Alternative Energy (other than oil) was established.

Major industrial nations other than Japan raised oil prices, hiked taxes, or controlled production with an eye to reducing oil consumption, thereby minimising the influence of the first oil crisis.

2.3.3. Establishment of the International Energy Agency

In 1974, the International Energy Agency (IEA) was established in response to the 1973/74 Oil Crisis to help countries coordinate a collective response to major disruptions in the oil supply through the release of emergency oil stocks to the markets.

In 1984, the IEA reached an agreement on Co-ordinated Emergency Response Measures (CERM), where member nations would cooperate and release their oil stockpiles in case of an emergency that would or might disrupt the oil supply. CERM aimed to prevent or quell a panic in markets that might take place at the initial stage of an emergency of oil supply disruption.

The IEA also recommended its member countries to stockpile oil equivalent to 90 days or more of their imports in preparation for an emergency.

2.4. 1979 Oil Crisis

2.4.1. Iranian Revolution

The 1979 oil crisis was triggered by the Iranian Revolution. In January 1978, demonstrations against the Shah by dissidents against the rapid modernisation of Iran spread nationwide, leading to strikes at major national and private businesses, and

movements by Muslim fundamentalists for the expulsion of non-Muslims and foreigners. At that time, Iran was the world's third-largest oil-producing country, exporting about 4.5 million barrels of crude oil a day. The revolution affected the oil production sites as well, temporarily stopping crude oil export. In response to the supply shortage of crude oil due to suspension of crude oil export from Iran, OPEC decided to raise crude oil prices by 10 percent on average per annum and in stages, starting from 1979. The decision was made at the general assembly in December 1979.

Right after that, crude oil export from Iran had been totally suspended until February 1980. In addition, a war broke out between Iran and Iraq in September 1980. From that point on, Iran hardly produced oil for about eight years until a ceasefire was reached in August 1988.

During this period, a situation of quantitative shortage of crude oil—like the 1973 oil crisis—was avoided because Saudi Arabia, Iraq, Kuwait, and the North Sea increased their oil production, making up for the decrease in crude oil export from Iran. However, oil prices rose again, seriously impacting the world economy, which was on the verge of recovery.

2.4.2. Responses of major countries

During the first oil crisis in 1973, major industrial nations adopted regulatory measures in various fields, as well as in the energy field, resulting in stagnation of the economy. Against this background, many countries refrained from taking a strong demand control policy at the time of the second oil crisis in 1979.

2.5. Changes in Oil Market Brought about by the Oil Crises

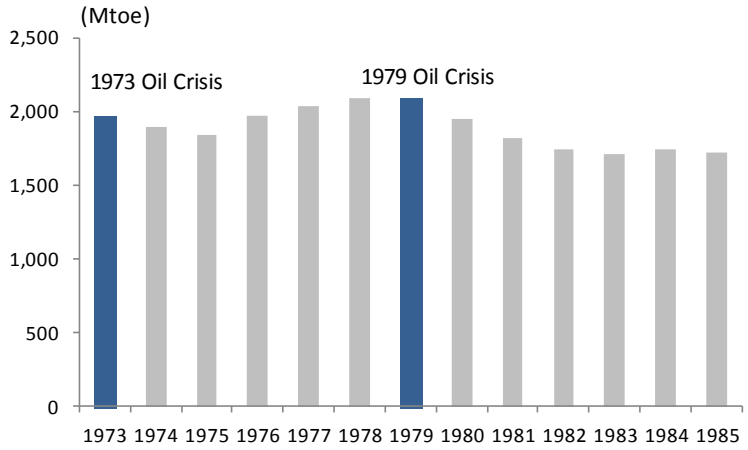
The two oil crises substantially changed the conventional oil market. The oil market underwent a significant change again in the 1990s as oil production by non-OPEC nations rose.

The following sections outline the oil demand from 1973 to 1985.

2.5.1. Decrease in oil demand

Figure 2.3 shows changes in oil demand of member nations of the Organisation for Economic Co-operation and Development (OECD) from 1973. Rise in crude oil prices due to the 1973 oil crisis had an influence on the economies of the major industrial countries where oil demand dropped. Oil demand in OECD countries showed a recovery after that, but started declining again when the 1979 oil crisis drove up crude oil prices.

Figure 2-3. Oil Demand of OECD Total (1973–1985)

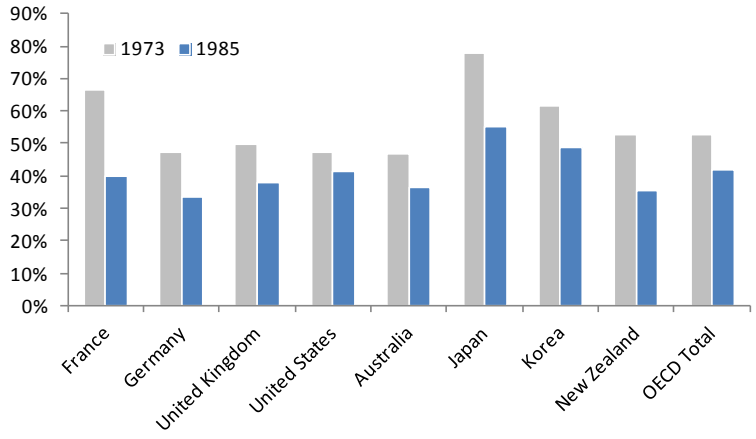


Mtoe = million tonnes of oil equivalent, OECD = Organisation for Economic Co-operation and Development.
Source: *Energy Balance of OECD Countries 2014*, International Energy Agency (IEA).

2.5.2. Decrease in oil dependence

After the first oil crisis in 1973, major industrial countries exerted efforts to decrease their dependence on oil by saving on oil consumption and using alternative energy. As a result, oil dependence of these countries fell.

Figure 2-4. Oil Dependence of Selected Countries (1973 vs. 1985)



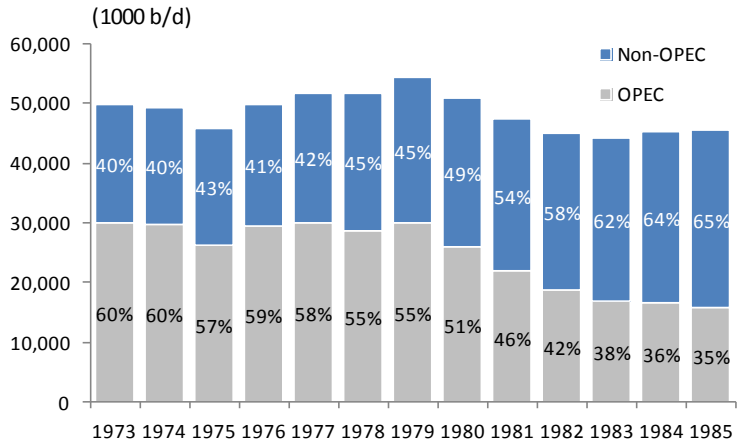
OECD = Organisation for Economic Co-operation and Development.

Source: *Energy Balance of OECD Countries 2014*, International Energy Agency (IEA).

2.5.3. Increase in oil production by non-OPEC countries

The hiking of crude oil prices by OPEC nations prompted non-OPEC countries to improve their oil development efforts. Non-OPEC nations made progress in their oil development, thus increasing their production and decreasing their demand from OPEC nations.

Figure 2-5. World Oil Production (1973–1985)

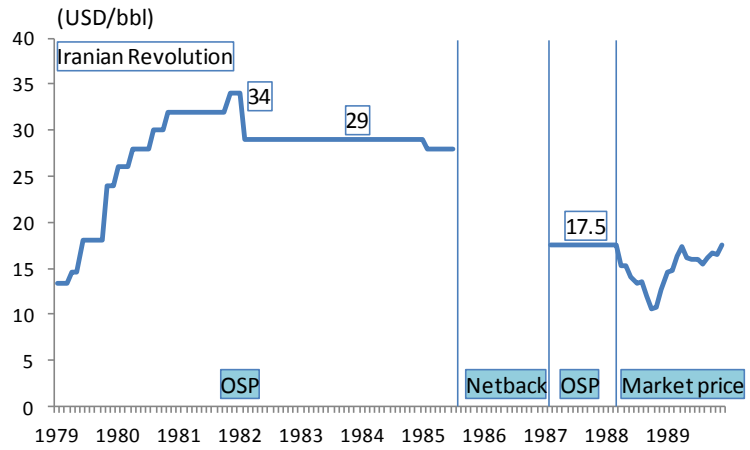


Source: BP Statistical Review of World Energy, June 2014.

2.5.4. Crude oil pricing from oil-producing countries

Around this period, Saudi Arabia acted as a so-called swing producer, adjusting its oil production for all OPEC member nations. However, because the cut in Saudi Arabia's production alone had a limit, Saudi Arabia announced in July 1985 that it would stop playing the role of swing producer. It also adopted a netback pricing system—starting from October 1985—that would set the price of oil by calculating back from the selling prices of oil products in consumption areas. This netback system, which had been employed when non-OPEC nations were increasing their production, brought a decline in oil demand and resulted in a steep fall of crude oil prices. Facing a sense of crisis due to the fall of oil prices, OPEC countries reinforced their policy of reducing production again from July 1986, and urged non-OPEC nations to follow suit. As countries other than OPEC members demanded stable crude oil prices, Saudi Arabia adopted a fixed-price system again in February 1987 by setting the official selling price (OSP). In 1988, Saudi Arabia relinquished its right of pricing and decided on floating prices for long-term contract prices.

Figure 2-6. Arabian Light Crude Oil Prices (1979–1989)



Note: Crude oil prices during the netback period are unknown.

Source: The Institute of Energy Economics, Japan (IEEJ).

2.5.5. Commodification of oil

Oil production by non-OPEC nations increased as crude oil prices were set by the market, new oil development technologies were developed, and the price competitiveness of non-OPEC nations was strengthened. This eroded the power of OPEC nations to set oil prices.

Oil was commodified when crude oil was listed on the New York Mercantile Exchange (NYMEX) in May 1983. Soon, a crude oil futures market was formed and oil became an object to invest in.

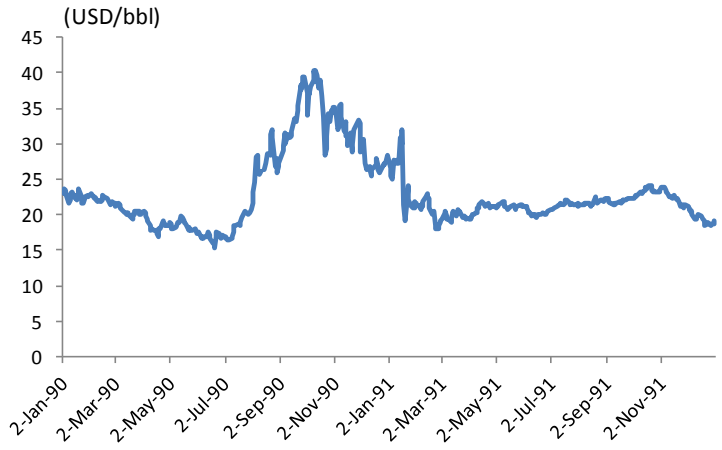
Around 2001, the US adopted a low-interest rate policy and a measure to weaken the dollar. Consequently, the dollar with a low-interest rate flooded the market, causing hedge fund and pension function, which increased the total amount of funds, to flow into the crude oil futures market in large quantity. In the past, crude oil prices had been determined mainly by a fundamental element of correlation between demand and supply, but they have increasingly been affected by speculative funds since the middle of 2004.

2.6. Persian Gulf War (1990)

On 2 August 1990, Iraq invaded its neighbour Kuwait, triggering the breakout of the Persian Gulf War. Iraqi troops flew out to crude oilfields in the Persian Gulf and destroyed oilfields in Kuwait. This drove up crude oil prices, which had been around US$15–US$17 per barrel, to as high as US$40 per barrel at its peak.

The IEA decided to implement CERM—to supply about 2.5 million barrels of stockpiled oil to the market per day. As a result of the CERM, which lasted for about one month, crude oil prices that had risen steeply settled down, resulting in a limited impact to oil-consuming economies.

Figure 2-7. West Texas Intermediate Crude Oil Prices (1990–1991)



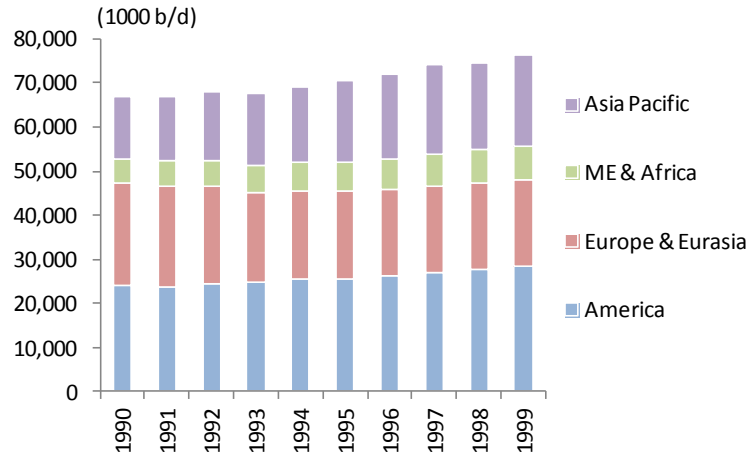
Sources: United States Department of Energy (DOE) and US Energy Information Administration (EIA).

2.7. Energy Security in the 1990s

In the 1990s, crude oil prices were stable, at around US$20 per barrel, except during the period of the Persian Gulf War. A feature of the 1990s was that the society, which had been oriented towards energy conservation, transformed itself into a society that consumed a lot of oil since oil was now a 'cheap energy source'. In the 1990s, after the Persian Gulf War, no risks that would threaten energy security occurred and people's awareness of the importance of energy security started waning.

During this period, oil development companies improved their production efficiency and went ahead to develop innovative technologies. New technologies, such as horizontal drilling, were developed. On the other hand, the development of new oilfields did not make much progress as the investment did not pay off, which was partially responsible for the subsequent tight supply–demand balance and a spike in oil prices.

Figure 2-8. World Oil Demand (1990–1999)



b/d = barrels per day, ME = Middle East.

Source: BP Statistical Review of World Energy, June 2014.

2.8. California Electricity Crisis (2000)

The commodification of oil was promoted and the energy market was liberalised in the 1990s. In 2000, however, an electricity crisis erupted in California, stemming from liberalisation of the electricity market.

Such liberalisation started in California in 1996. Retailing electricity was also liberalised in 1998, but the retail prices of electricity-selling companies were fixed. In addition, the large-scale, electricity-selling companies were obliged to procure electricity from the wholesale market. They were also obliged by the environmental regulations of California to purchase electric power that had little impact on the environment in fixed quantity and at a high price. For these reasons, generation companies were reluctant to construct new generation plants because it would be costly to meet the strict environment regulations of California.

The wholesale power price started rising in the summer of 2000 due partly to an increase in natural gas prices and partly to a long heat wave. Unable to put an increase in wholesale prices on consumers, electricity-selling companies suffered a loss. Generation companies, which felt that it is difficult to collect payment from selling companies, hesitated to sell electricity to them. No longer being able to procure sufficient electricity from the generation companies, the selling companies started large-scale rolling blackouts.

This is an example of an energy security risk that was brought about by an imperfect

system of liberalisation.

Although it is important for oil to have stability and to be safely imported to enhance energy security, this example of the electricity crisis in California can be classified as a case where domestic factors brought risks to energy security.

2.9. General Strike in Venezuela (2002)

Advocating socialism and backed by the low-income bracket of the population, Hugo Chavez was elected president of Venezuela in 1999. People opposing the socialistic policy promoted by then President Chavez went on general strike that lasted for as long as two months, starting in December 2002. Oil production in Venezuela came to a halt because workers of the Petróleos de Venezuela, S.A. (PDVSA), a Venezuelan state-run oil company, participated in the strike.

In response, OPEC increased oil production, avoiding a situation of a tight balance of supply and demand.

2.10. Iraq War (2003)

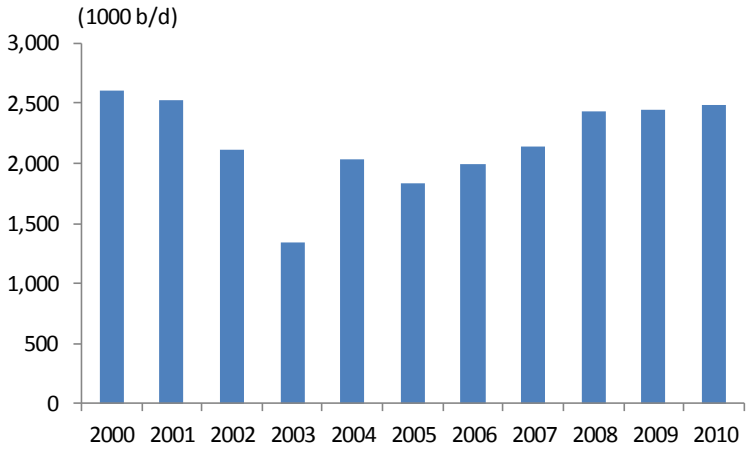
A ceasefire resolution that Iraq accepted in the wake of the Persian Gulf War in 1991 obliged Iraq not to possess weapons of mass destruction. After receiving simultaneous terrorist attacks in September 2011, the US determined to stand up to terrorism, regarded Iraq as a nation supporting terrorism, and strongly demanded the then Saddam Hussein administration of Iraq for inspection and abandonment of weapons of mass destruction.

Iraq disregarded this demand and the US, along with multinational forces that included the United Kingdom, launched military attacks on Iraq, driving Hussein out of power in March 2003.

OPEC's oil production had already been at a high level because of the general strike in Venezuela, but oil-producing nations, in collaboration with IEA, got ready to release their oil stockpiles at any time in case of a disruption of the oil supply from Iraq. Eventually, however, oil stockpiles were not released during the Iraq war, but the collaboration between IEA and oil-producing countries had an effect of giving some sense of security to the oil market.

Although the war in Iraq ended shortly, the political situation got chaotic, and the country took a long time to restore its oil production to pre-war level (about 2.5 million barrels a day).

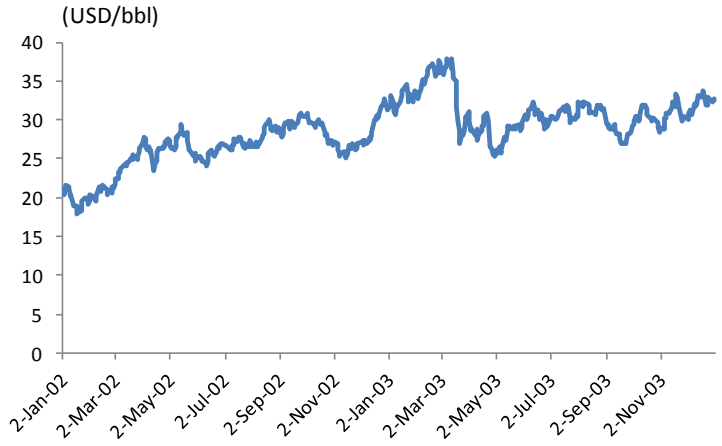
Figure 2-9. Iraq Oil Production



b/d = barrels per day.

Source: BP Statistical Review of World Energy, June 2014.

Figure 2-10. West Texas Intermediate Crude Oil Futures Price (2000–2003)



Sources: United States Department of Energy (DOE) and US Energy Information Administration (EIA).

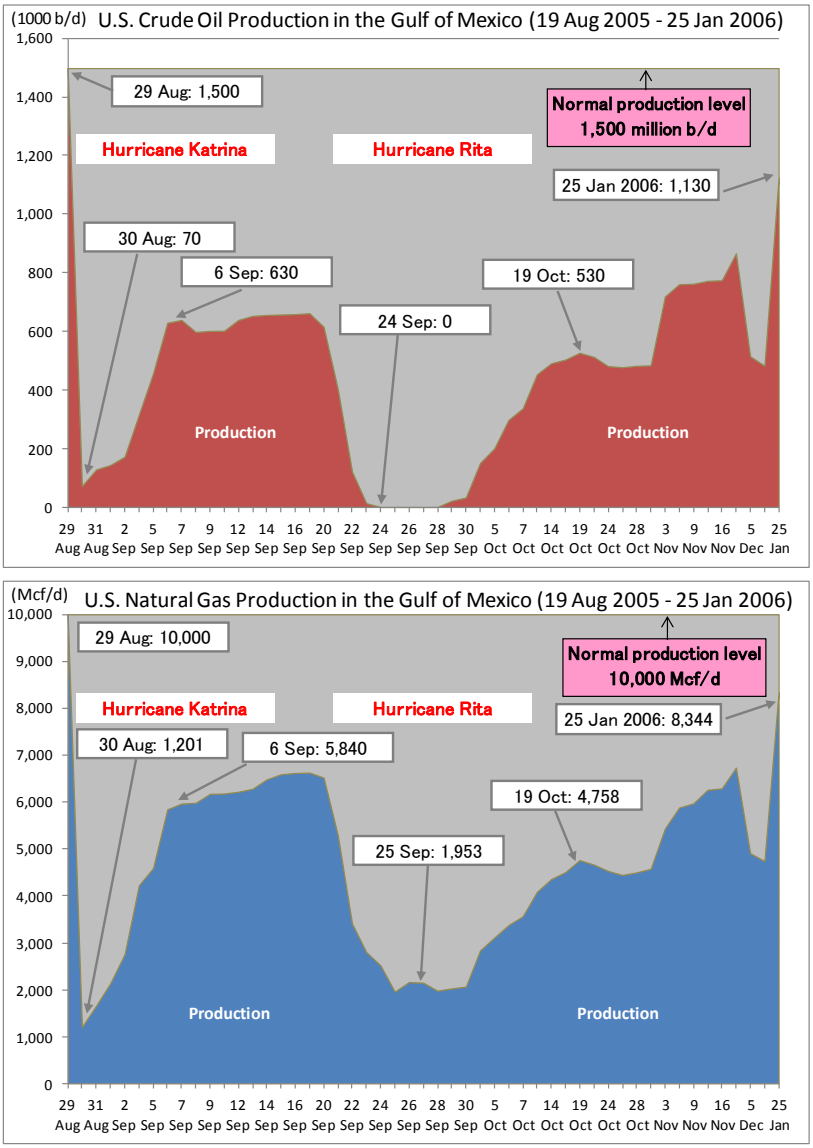
2.11. Hurricane Katrina/Rita (2005)

Super hurricane Katrina, which occurred in August 2005, flooded 80 percent of New Orleans, US, and left almost 2,000 persons killed or missing and severely damaged a wide area along the coast of the Gulf of Mexico. This area accounts for about 30 percent of crude oil production, 20 percent of natural gas production, and 50 percent of oil refineries of the US; it is also an import base of crude oil. In the past, large-scale hurricanes did have an influence on the production of oil and natural gas. But Katrina destroyed many oil refineries and natural gas production facilities in this area, forcing about 90 percent of oil production (1.4 million barrels per day), 80 percent of natural gas production (8,000 cubic feet [Mcf] per day), and eight oil refineries (1.8 million barrels per day) to stop. This gave rise to concerns over the stable energy supply in the US and led to a surge in crude oil prices. The West Texas Intermediate (WTI) crude oil futures price at the New York Mercantile Exchange (NYMEX) recorded US$69.8 per barrel in 30 August 2005—a record high for 2005.

In response to this situation, IEA decided on 2 September 2015 to release oil stockpiles as an emergency measure for the first time in 14 years since the Persian Gulf War. Specifically, it decided to release oil reserves of 2 million barrels a day over 30 days, and requested 26 member nations, including Japan, for cooperation. In response to IEA's decision, Japan released private stockpiles of about 7.3 million barrels to the market. For oil-producing countries, OPEC took actions to stabilise the supply by releasing the necessary amount of oil from its reserves for three months starting in October 2005.

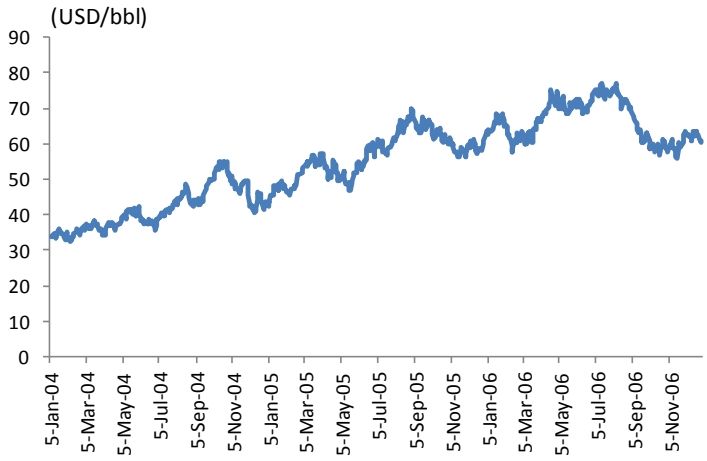
At the end of September 2005, Rita, a hurricane as big as Katrina, hit the Gulf of Mexico area again. These two hurricanes devastated the area, damaging submarine pipelines, and recovery took a long time. This is an example of risk to energy security caused by natural disasters.

Figure 2-11. Affected Crude Oil and Natural Gas Production by Hurricanes



Sources: United States Department of Energy (DOE) and US Energy Information Administration (EIA).

Figure 2-12. West Texas Intermediate Crude Oil Futures Price (2004–2006)



Sources: United States Department of Energy (DOE) and US Energy Information Administration (EIA).

2.12. Heavy Snow in China (2008)

From the end of January to the beginning of February 2008, transport systems were paralysed in a wide area of southern and central China by heavy snow, ice, and low temperature. This meant that the transport of coal, fuel for electric power generation, was disrupted, forcing China to suffer from an electricity shortage. It should be noted that the electricity shortage was caused not by insufficiency in power generation capacity but by the disruption of the supply chain of coal. This is another example of risk to energy security due to a natural calamity

2.13. Bankruptcy of the Lehman Brothers (2008)

In 2007, a subprime mortgage problem occurred in the US and asset prices took a nosedive in various fields. The Lehman Brothers incurred heavy loss and filed for Chapter 11 bankruptcy protection on 15 September 2008. This caused a ripple effect with grave impact to companies holding bonds and investment trusts issued by Lehman Brothers and to their partners. In addition, because of the slow response by the US Congress and the government, concerns over the US economy arose and the bankruptcy of the Lehman Brothers developed into a global financial crisis.

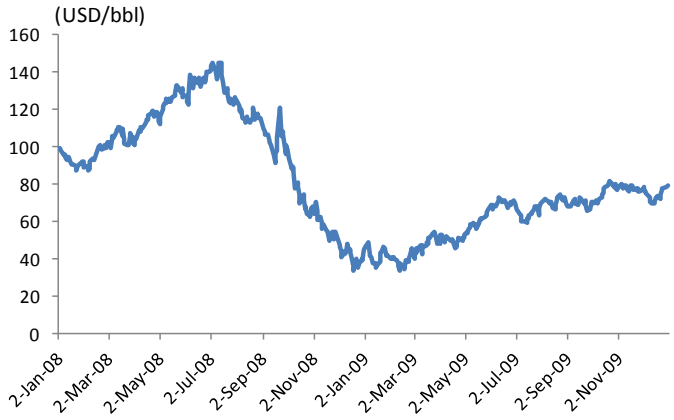
Crude oil prices, which remained sluggish in the 1990s, started rising in the 2000s and WTI crude oil future prices recorded an all-time high of US$140 per barrel in July 2008.

Although oil prices later fell, they remained at around US$100 per barrel. However, with the bankruptcy of the Lehman Brothers, oil prices fell sharply and WTI crude oil future prices dropped to as low as US$30 per barrel from December 2008 to February 2009.

The global financial crisis seriously affected the world economy and oil demand. Consequently, oil demand, which had been on the rise since the end of the Persian Gulf War, declined in 2008 and 2009. By region, America, Europe, and Eurasia have not yet recovered to the level of oil demand in 2007 as of 2013. In Europe and Eurasia, the economy is sluggish and demand for both oil and natural gas is on the decline partly because of the debt problem of Greece.

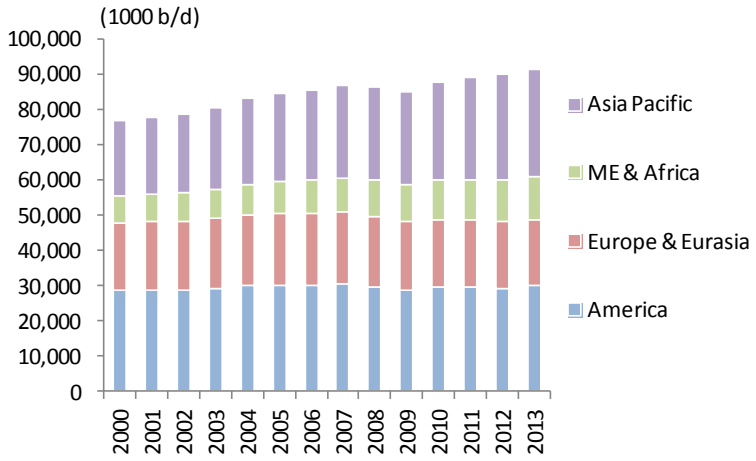
This is an example of risk to energy security due to economic activities and indicates that economic situations have significant and lasting influence on energy demand.

Figure 2-13. West Texas Intermediate Crude Oil Futures Price (2008–2009)



Sources: United States Department of Energy (DOE) and US Energy Information Administration (EIA).

Figure 2-14. World Oil Demand (2000–2013)



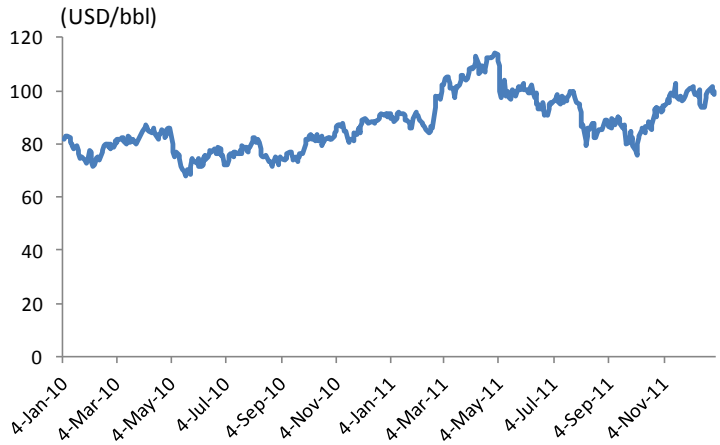
Source: BP Statistical Review of World Energy, June 2014.

2.14. Crude Oil Spills in the Gulf of Mexico (2010)

The Gulf of Mexico is a major oil-producing area that produces nearly 30 percent of oil in the US. In April 2010, a rig that was drilling at Macondo Prospect in the deep water of the Gulf of Mexico, which was operated by BP, exploded and fell, spilling the largest amount of oil in history. Because the drilling point was at a depth of about 1,500 metres and the crack of the oil rig from which crude oil spilled was close to the bottom of the sea, stopping the oil spill was extremely difficult; it took almost three months to completely stop it.

This accident raised concerns over the crude oil supply from the Gulf of Mexico but crude oil prices in the end were hardly affected because the US had a large stockpile of oil due to the sluggish demand for oil brought on by an economic recession. Nevertheless, crude oil drilling in deep waters bore the brunt of public criticism in the US; even now, the deep water of the Gulf of Mexico is not thriving as it was before the accident.

Figure 2-15. West Texas Intermediate Crude Oil Futures Price (2010–2011)



Sources: United States Department of Energy (DOE) and US Energy Information Administration (EIA).

2.15. Arab Springs (Libya, 2011)

The Tunisian Revolution that erupted in December 2010 led to large-scale anti-government demonstrations in the Arab world through 2012. In February 2011, a demonstration in Libya demanded the resignation of the dictator Muammar Gaddafi. A civil war followed. At that time, Libya produced crude oil of about 1.6 million barrels a day and natural gas of about 1.6 million cubic metres (Bcm), exporting them mainly to Europe. The civil war in Libya stopped its oil production and export, raising a concern that the global oil supply would be seriously affected. IEA, with agreements from member nations, decided to take a cooperative action to release 60 million barrels of oil stockpiles from all the member countries combined. This was considered a stop-gap measure until increased production by the oil-producing countries reached the market.

After the oil crises, developed countries established the IEA to compete with OPEC. It should be noted, however, that after about 40 years, both organisations have come to act jointly to stabilise the oil market.

2.16. Flood in Australia (2011)

From December 2010 to January 2011, Queensland, a major coal production region of Australia, suffered from heavy rains. More than 80 percent of the coal mines in Queensland were flooded and many of them declared force majeure. During the same

period, railroads that transported coal stopped their service and did not recover until March. In 2011, many coal mines in Queensland could not go into full-swing operation. This is an example of risk to energy security due to a natural calamity.

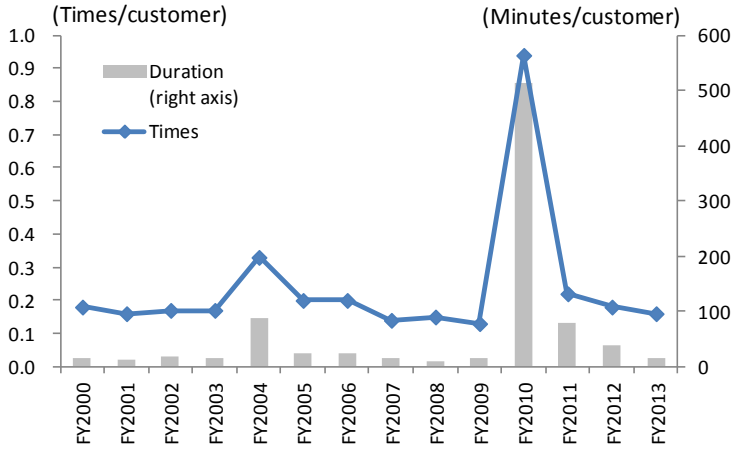
2.17. Earthquake and Tsunami in Japan (2011)

A gigantic earthquake occurred in the Pacific Ocean, off the northeast coast of Japan on 11 March 2011, triggering tsunami as tall as 10–40 metres, depending on the location. The Pacific coast of East Japan was devastated. In addition to the huge tsunami, the tremors of earthquake, liquefaction, land subsidence, and collapse of dams damaged a wide area from the south coast of Hokkaido to the Bay of Tokyo, and their infrastructure. Power plants and transmission and distribution lines were also heavily damaged. On top of that, a hydrogen explosion occurred at the Fukushima Daiichi Nuclear Power Plant. This is an example of risk to energy security due to a natural disaster.

Figure 2-16 shows the number of times and duration of blackouts throughout Japan in each year. In this figure, the earthquake and tsunami are indicated by the curve of FY 2010 (from April 2010 to March 2011).

Figure 2-16. Blackouts in Japan

(including maintenance and accident blackouts)



Note: Total of 10 utilities (All Japan).

Source: Federation of Electric Power Companies of Japan.

2.18. Blackouts in India (2012)

India went through large-scale blackouts for two days on 30–31 July 2012. The 30 July blackout occurred during commuting hours, stopping traffic signals and trains and creating a chaotic situation. The blackout on the next day occurred at daytime, resulting in trains to stop. In addition, an elevator at a coal mine was also stopped, trapping mine workers underground. These blackouts occurred because the distribution companies did not cut demand even though the demand for power exceeded the amount of power generated and because some transmission lines failed.

This is an example of risk to energy security caused by vulnerable power infrastructure and their inappropriate operation.

2.19. Typhoon in the Philippines (2013)

Strong typhoons Haiyan and Yolanda hit the Philippines in November 2013. Many buildings in the Visayan Islands were destroyed and many people were killed, injured, or went missing. The Philippines has not yet recovered from the damage. This is an example of risk to energy security due to a natural disaster.

2.20. Risk to Energy Security that Are Under Way

From the geopolitical viewpoint, Islamic States in Syria and the Ukrainian situation can be cited as cases that pose risks to energy security.

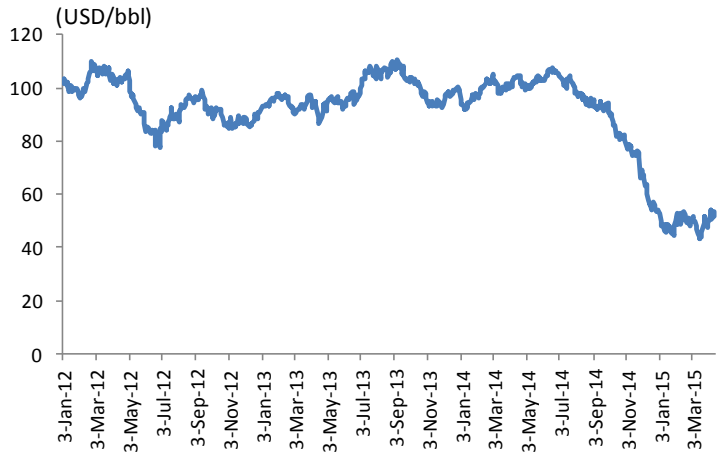
In 2013, the political situation in Syria became unstable and the Syrian government's military force began oppressing the civilians with military power. In the meantime, of the anti-government forces generated in Syria, Islamic States, an Islamic extremist organisation derived from Al-Qaida, invaded Iraq, capturing a large swath of Iraq in June. The problem of the Islamic States is still going on.

In March 2014, Russia advanced to and then annexed the Crimean Peninsula, a Ukrainian territory. European Union nations and the US strongly opposed this move and slapped sanctions on Russia. Even today, the east part of Ukraine is occupied by pro-Russian

groups. Although a ceasefire agreement has been reached, sporadic battles are continuing.

Against this background of heightening geopolitical risks, crude oil prices started rising in 2014. After that, however, prices gradually fell since the end of July when demand declined due to concerns over the deceleration of the world economy and the third monetary easing measure of the US that came to an end in stages because speculative funds decreased.

Figure 2-17. West Texas Intermediate Crude Oil Futures Price (2012–2015)



Sources: United States Department of Energy (DOE) and US Energy Information Administration (EIA).

Chapter 3

Future Threat on Energy Security

This chapter presents future energy security risk scenarios for the EAS region that were drawn out through a scenario planning approach.

The Working Group created three scenarios: (i) supply uncertainty in the Middle East and Russia, (ii) low oil price, and (iii) cheap coal utilisation. For each scenario, a scenario in addition to a business-as-usual (BAU) scenario was also created.

3.1. Procedure of the Scenario Planning Method

The following actions were undertaken in the scenario planning:

Item	Action
(a) Raise the issues [Identification of all future risk factors]	• Fill in all the future risk factors in the respective issue cards.
(b) Clustering [Classification of future risk factors]	• Group the issue cards by category. • Pick up a key issue card that acts as a 'driving force'.
(c) Mapping [Prioritising future risk factors]	• Evaluate the driving force of the key issue card based on 'importance' and 'uncertainty'. • Find out what makes it the 'most important' key issue card and/or why it has high uncertainty. Understand the relationships amongst the issue cards.
(d) Structuralise the scenario [Discussing the scenario structure]	• Organise a basic structure of the scenario by using findings through clustering and mapping work.
(e) Scenario building	• Expand the scenario structure by adding issue cards, along with a timeline. • Draw up a scenario.
(f) Implication	• Discuss the implications from this scenario planning, as applicable for each country.

(a) Raise the issues

First, participants will identify all possible future uncertainties. The scope of study will include all fields and regions; events that have a possibility of changing the energy security in the future, both at home and abroad, will be identified. The participants will write the events on cards to create issue cards.

(b) Clustering

This involves classifying future risks. The participants will classify the future risks written on issue cards into related categories and pick up major issues that may be considered ‘driving forces’.

(c) Mapping

This involves ranking the future risks. The participants will assess the major ‘driving forces’ from the viewpoints of ‘importance’ and ‘uncertainty’. Next, they will create an issue card that reflects the most important and/or highly uncertain issue. Finally, they will discuss the relationships amongst the issue cards.

(d) Structuralise the scenario

This involves discussing the structure of a scenario. Through clustering and mapping, the basic structure of a scenario will be drawn up.

(e) Scenario building

This involves creating a scenario. The participants will expand a scenario by adding new issues in accordance with a timeline. Eventually, a final future scenario will be drawn up.

(f) Implication

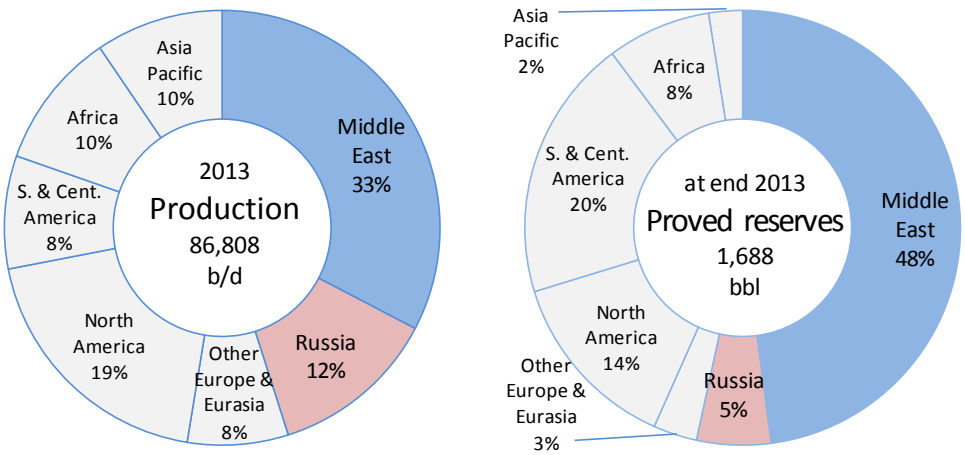
This involves discussing the implications to be drawn out from a future scenario. The participants will discuss implications from the created scenarios, and how these can be applied to their countries.

3.2. Scenario 1: Supply Uncertainty in the Middle East and Russia

3.2.1. Background of the scenario

In this scenario, a possibility that crude oil prices will surge around 2020, triggered by uncertainties in the Middle East and Russia, which are major oil-producing regions of the world, is assumed as a turning point in the future. As of 2013, the two regions account for 45 percent of the world's oil production and 53 percent of proved oil reserves of the world. If these regions are unstable, the crude oil supply will be unstable, substantially affecting oil supply and demand in the world. Should the oil supply from these regions decrease for some reason, it can be easy to imagine that the market will immediately react and oil prices will surge.

Figure 3-1. Share of Middle East and Russia in Global Oil Supply



Source: BP Statistical Review of World Energy, June 2014.

Chapter 2 has cited geopolitical issues, natural disasters, lack of infrastructure, quota agreement amongst the OPEC nations, and uncertainty in demand as the possible backgrounds of uncertainties in the Middle East and Russia, and of crude oil prices going

up again. Over the medium to long term, there are concerns that depletion of resources might occur. It is also highly possible that prices of oil and natural gas will go up around 2020. These factors are taken into account in the BAU scenario.

3.2.2. Business-As-Usual scenario

The following scenario was drawn up for the supply uncertainty in the Middle East and Russia:

Outcomes of crude oil price hike:

- Development of renewable energy will increase its price competitiveness and climate change policy will be globally reinforced in 2020 and onwards. Development of renewable energy will proceed in the years following 2025.
- Development of new resources will be encouraged as oil and natural gas prices rise.
- Use of coal will be promoted because its price attractiveness will heighten. At the same time, use of nuclear power will also be promoted by strong climate change policies, with an eye to curbing the carbon dioxide (CO_2) emitted by coal.
- In the transport sector, the introduction of new energy, such as hydrogen, will be accelerated in 2030 and onwards.
-

As a result of these, oil and natural gas demand will diminish over the long term. Declining oil and gas demand will harm these industries both in exporting and importing countries, with less earning and less employment in the sector. In the meantime, jobs will be created by the promotion of development of renewable energy, introduction of new energy, and development of new technologies, and the economy will be revitalised after 2030.

3.2.3. Scenario other than Business As Usual

What will be happen if crude oil prices do not rise and remain at about US$80 per barrel?[1] Reinforcement of the climate change policy will be the driver of development of renewable energy and new technologies. The reinforcement of the climate change policy

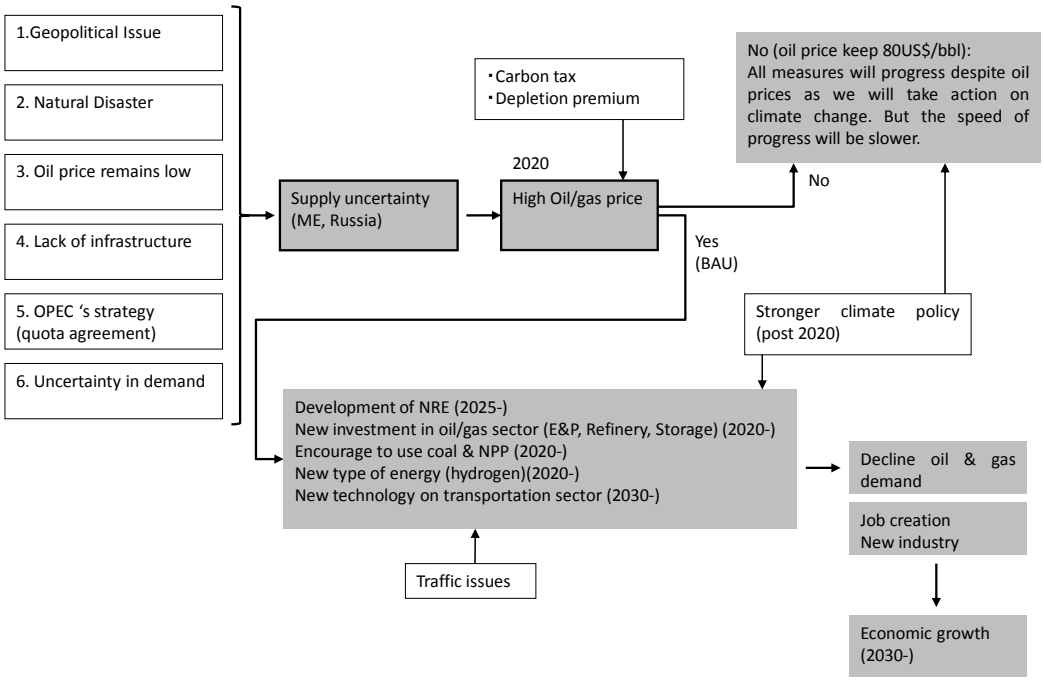
[1] The crude oil price was about US$80 per barrel when this scenario was created. Before that, US$80 per barrel was considered to be at low level because the oil price was at a range higher than US$100–US$120 per barrel.

is considered highly probable and it is forecast that its speed is slower than the BAU scenario, or a similar change to occur as the oil price is low.

3.2.4. Summary of the scenario

The above supply uncertainty in the Middle East and Russia scenario is summarised in Figure 3-2.

Figure 3-2. Scenario of Supply Uncertainty in the Middle East and Russia



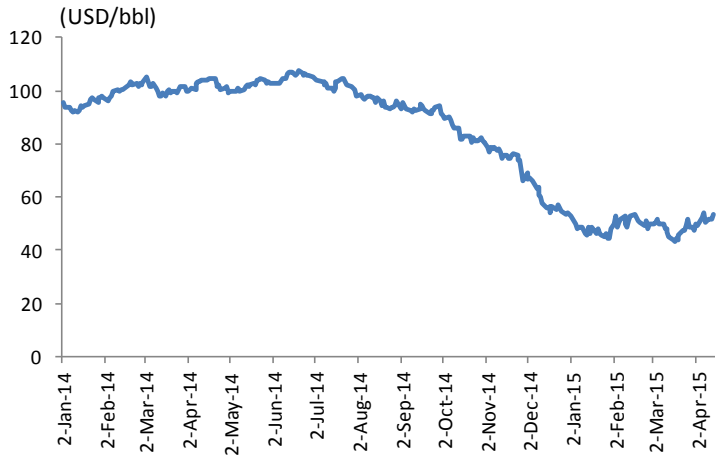
Source: Author's scenario assumption.

3.3. Scenario 2: Low Oil Price

3.3.1. Background of scenario

This scenario was added at the second Working Group meeting. Crude oil prices, which were at around US$100 per barrel until July 2014, started falling in August. As of October, when the first Working Group meeting was held, they were still at US$80 per barrel, and it was still not actually felt that the oil prices were low. However, the crude oil prices kept declining after that, and fell below US$50 per barrel in January 2015, and there is a dominant perspective that the low oil price would continue.

Figure 3-3. West Texas Intermediate Crude Oil Futures Price (2014–2015)



Sources: United States Department of Energy (DOE) and US Energy Information Administration (EIA).

Both oil-producing and oil-importing countries coexist in the EAS region. Some nations in this region export or import liquefied natural gas (LNG) at oil index price; the influence of the low oil price is not limited to oil. Hence, the Working Group created a BAU scenario where crude oil prices will remain at US$50 per barrel until 2020.

3.3.2. Business-As-Usual scenario

The following scenario was drawn up for the BAU low oil price scenario:

Against the background of low oil prices, the demand for oil and natural gas will increase.

- It will have a favourable influence on the economy of oil-importing countries so they will continue their growth.
- Europe, where the economy is slowing down, and China, whose economic growth is decelerating, will be revitalised.
- China will increase its oil stockpile to improve energy security, and refrain from the use of coal but increasingly rely on the use of natural gas as a countermeasure against air pollution.

On the other hand, the supply of oil and natural gas will drop because of the low oil price.

- Existing oilfields will be depleted.
- Production of unconventional resources will decrease in the US.
- Investment in the upstream sector will decline.
- Exploration and production and the research and development (R&D) of oil and natural gas in the unconventional and frontier areas will be delayed and investment in R&D of renewable energy will also be delayed.

As a result, the supply–demand balance of oil and natural gas will be tightened and oil prices will rise to a level of US$80–US$100 per barrel in 2020 and onward.

As a risk factor, a situation where the expansion of the region dominated by Islamic States has a significant influence on oil production is conceivable. In addition, it would also be possible that a large amount of speculative fund flows into the oil market. In case such a situation does happen, extremely high oil prices of US$150–US$200 per barrel in 2020 or later are possible.

The scenario in an extremely high oil price scenario is as follows:

- Oil-importing countries will be significantly affected economically.
- Exploration and production of oil and natural gas will be promoted.
- Use of coal will increase and competitiveness of nuclear power generation will rise.
- Price competitiveness of renewable energy will increase and its development will be moved forward.
- Contingency measures, such as stockpiling of oil, will be reinforced.
- Efficiency of energy use will improve.
- R&D of new technology will be promoted.

As a result, the demand and supply of oil and natural gas will be relaxed and oil prices will fall to a level of US$80–US$100 per barrel around 2030. Depending on the degree of the events assumed above, however, oil prices may be somewhere between the low oil price scenario and extremely high oil price scenario.

3.3.3. Scenarios other than Business As Usual

Aside from the BAU scenario, other scenarios are also conceivable, such as one where the demand and supply is relaxed because supply increases while demand is sluggish.

Weak demand:

- China's economic adjustment will continue until 2020.
- China's gross domestic product (GDP) growth rate will drop to 5 percent and oil demand will decline as the nation will increasingly use natural gas as an energy source.
- Retail price will rise and demand will decline as energy subsidy will be abolished sometime between 2015 and 2020.
- In exporting countries, which have seen rapid domestic economic growth due to high oil prices, the economy will be decelerated because of low oil price.
- A climate change policy for 2020 or later will be agreed on at a session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) and a movement towards reduction of oil consumption will be accelerated.

Strong supply:

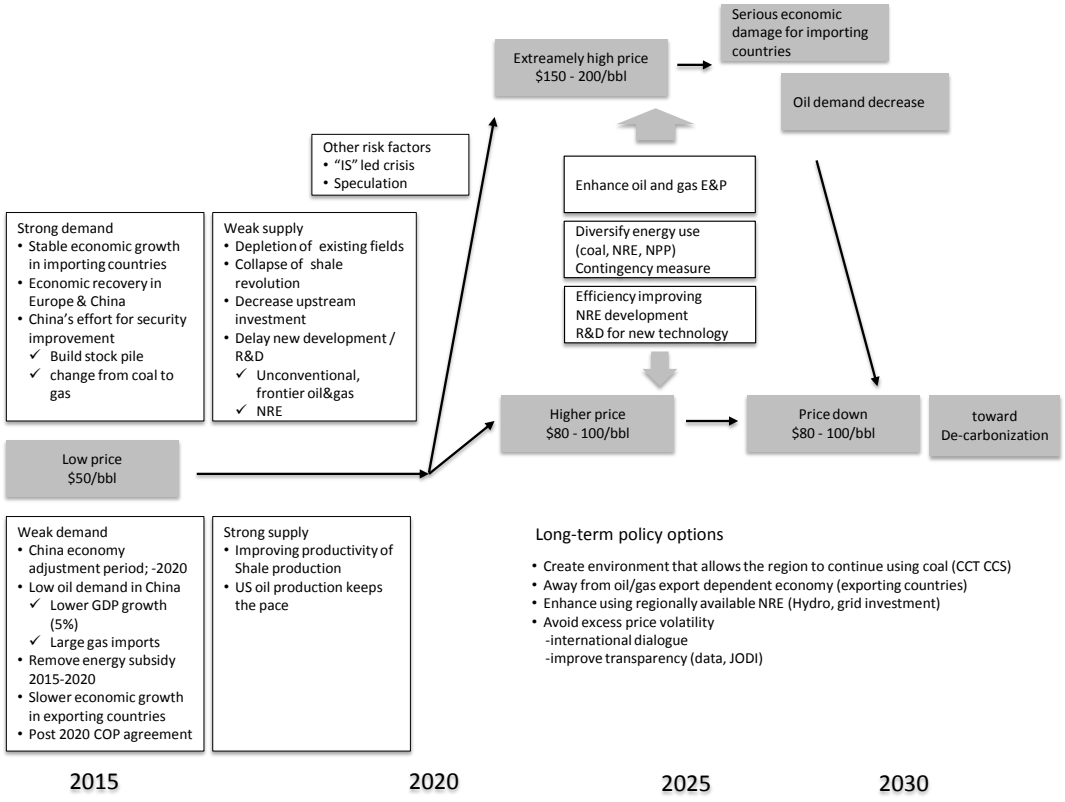
- Production efficiency and thus price competitiveness of shale oil and gas will improve and oil production of the US will not decline even though the price is low.

In this scenario, the current low oil price will be adjusted as a whole and crude oil prices will gradually go up, though not to the level of the BAU scenario. In this case, changes similar to the BAU scenario will occur but their degree will be less than the BAU scenario.

3.3.4. Summary of scenario

Figure 3-4 summarises the low oil price scenario:

Figure 3-4. Low Oil Price Scenario



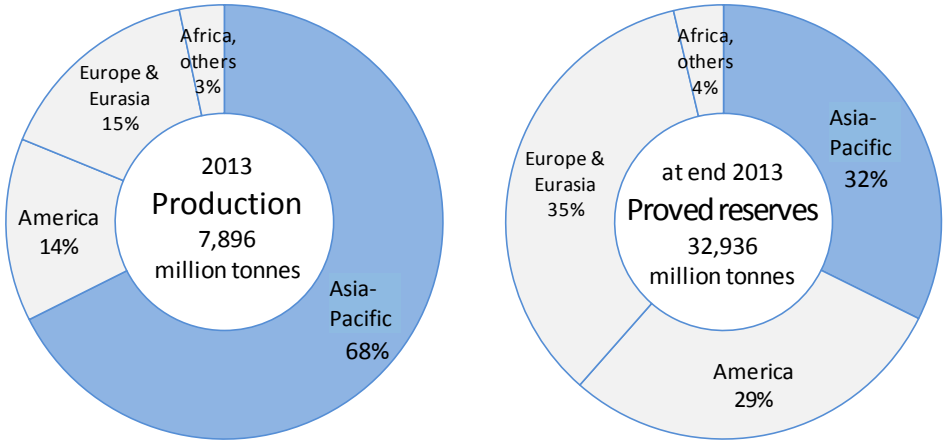
bbl = billion barrels, COP = Conference of Parties, E&P = exploration and production, GDP = gross domestic product, IS = Islamic States, NPP = non-petroleum products, NRE = new renewable energy, R&D = research and development.
Source: Author's scenario assumption.

3.4. Scenario 3: Cheap Coal Utilisation

3.4.1 Background of scenario

The Asia-Pacific region, where the EAS region belongs, accounts for 68 percent of the world's coal production and 32 percent of proved coal reserves of the world, as of 2013. It is also the region where coal is used most in the world. The EAS region can supply coal to itself, unlike oil and natural gas. Therefore, coal is an energy source preferable for the region from the viewpoint of energy security.

Figure 3-5. Share of Asia–Pacific in Global Coal Supply



Source: BP Statistical Review of World Energy, June 2014.

In this scenario, whether an environment where abundant cheap coal reserves in the EAS region can be utilised in large quantity can be created or not is assumed as a turning point in a vision of the future. Considering the importance of coal for the EAS region, the possibility that coal will be continuously used in the future is presumably high. Therefore, such an environment was assumed in creating a BAU scenario.

The following provides the background where coal will be needed in the EAS region:

- The EAS region's economy is growing and living standard is improving. Consequently, demand for electricity is growing, and demand for inexpensive base load power sources is high.
- Inexpensive coal is highly demanded also in industrial sectors, such as iron and

steel, and cement.

- Clean coal technology to cleanly use coal has been put into practical use.
- Demand for natural gas is growing at the same time. But demand for inexpensive coal is outpacing it because natural gas is relatively expensive.
- Energy prices are on the rise because subsidy is abolished, and pushing down the energy supply cost is strongly demanded.

3.4.2. Business As Usual scenario

Use of cheap coal will be accelerated by economic growth and technological innovation in the EAS region. Over medium and long terms, however, coal prices will rise because demand for coal will increase. In the meantime, demand for natural gas will fall and natural gas prices will drop because coal will be the major energy source in the region. As a result, the difference in price between coal and natural gas will be reduced, lowering the price competitiveness of coal; the role of natural gas will also possibly expand around 2030.

Appropriately financing the investments over the short and medium term is important for this scenario. Because coal emits large amounts of air pollutants, the use of high-efficiency and clean technology is desirable. This means that the initial investment, which is larger than for natural gas, is further driven up. Thus, access to funding by international financial institutions should be secured and lenders should be responsible for introducing appropriate technology.

For the medium and long term, it will be necessary to create a system that encourages the clean use of coal by, for example, (i) setting forth a standard of efficiency; (ii) developing an advanced coal utilisation technology; and (iii) having a mechanism to finance CO_2 emissions reduction, such as a clean development mechanism (CDM).

3.4.3. Scenario other than Business As Usual

A scenario where the use of coal—an inexpensive energy source that can be procured in the region—becomes difficult for some reason is also conceivable.

In this case, more natural gas will be used as an alternative to coal. Altogether, energy prices will rise. Consequently, economic growth will be pushed down, and the shift

to renewable energy will be accelerated with the expensive energy price as the driving force, and energy efficiency will be enhanced. Over the medium and long term, electricity transaction will become faster to fully use the renewable energy that is usable in the region. Although the use of nuclear power generation will be promoted, the share of nuclear power is expected to be minor.

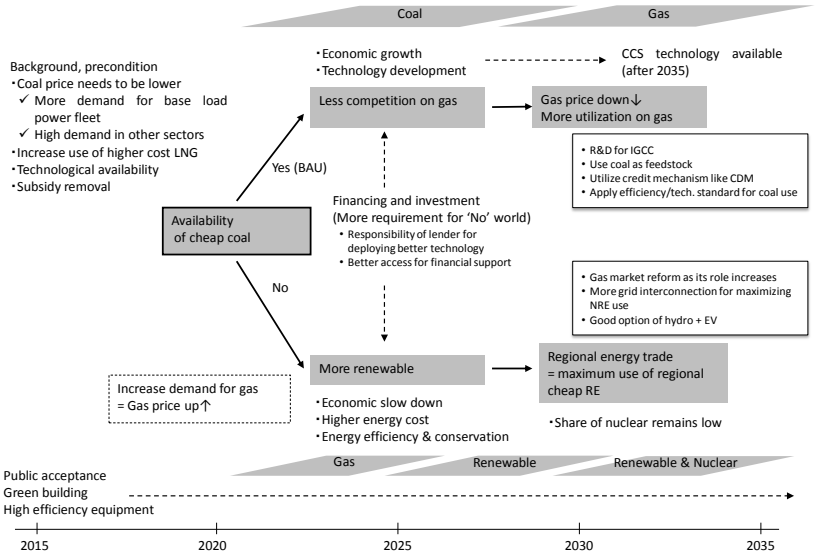
In this scenario, financing is as important as in the BAU scenario. However, much more funds are needed than in the BAU scenario because investment in expensive renewable energy is required. In addition, a reform of the gas market will also be required to use natural gas in place of coal, and this will play an important role in energy supply at as low a price as possible.

To fully utilise the usable renewable energy, a power transmission network that ensures electricity transaction within the region must be reinforced. If the possibility of using renewable energy increases, the spread of electric vehicles that use clean electric power may be an alternative worth considering.

3.4.4. Summary of the scenario

Figure 3-6 summarises the cheap coal utilisation scenario:

Figure 3-6. Cheap Coal Utilisation Scenario



BAU = business-as-usual, CCS = carbon capture and storage, CDM = clean development mechanism, EV = electric vehicle, IGCC = integrated gas combined cycle, LNG = liquefied natural gas, NRE = new renewable energy, RE = renewable energy, R&D = research and development.

Source: Author's scenario assumption.

Chapter 4

Major Findings and Policy Implications

4.1. Major Findings

In this study, three future risk scenarios were created by using the scenario planning approach. Scenario planning aims to extract, through the exchange of opinions and discussion amongst participants, events that are considered to have high uncertainty in the future but with significant influence on the energy market. The turning points of the extracted three scenarios can be broadly divided into 'crude oil price level' and 'restrictions on the use of coal'. In other words, these two elements are highly uncertain and have a possibility of significantly influencing the energy security of the EAS nations.

Scenario		Turning point
1-1	Supply uncertainty in the Middle East and Russia	Uncertainty in the Middle East and Russia, and increase in crude oil prices caused by that uncertainty
1-2	Low oil price	Increase again in crude oil prices
2	Cheap coal utilisation	Restrictions on the use of coal stemming from supply–demand balance and environmental regulations

4.1.1. Crude oil price level

Uncertainties in the future of crude oil prices and the degree of influence they bring are easy to understand. Crude oil prices have been repeatedly observed to change abruptly in the past, for example, in the oil crises in the 1970s and the global financial crisis triggered by the bankruptcy of the Lehman Brothers in 2008. In addition, oil prices have steeply decreased for a year or so. Factors that determine oil prices vary. Recently, geopolitical risks have increasingly become prominent; climatic conditions have been changing causing severe weather conditions, such as hurricanes; and linkages amongst financial markets have been reinforced. All these have an impact on the supply–demand balance of oil. Hence, oil prices substantially affect the global economy and the investment activities of all

participants in these transactions. As it may not be possible to understand all the causes of these events, and due to these uncertainties, forecasting crude oil prices is difficult.

It is easy to imagine the extremely large influence of oil because oil accounts for more than 30 percent of the primary energy supply of the world. Oil takes on an overwhelmingly dominant position as fuel for automobiles and any fluctuation of its price directly impact car users. Of the fossil fuels, oil is the most expensive (when compared by heat equivalency) and is widely traded. Consequently, changes in oil prices have a significant impact on the economy of both oil-exporting and oil-importing countries.

In light of these facts, it becomes inevitable that crude oil prices were selected as an element that significantly influences the future energy security of EAS nations.

4.1.2. Restrictions on the use of coal

Due to the unique background of EAS nations, restrictions on the use of coal were identified as an element that may significantly change their vision of the future. Coal accounts for 29 percent (IEA, 2012) of the total primary energy consumed in the world as of 2012. But this percentage jumps to 52 percent in the EAS region. This is because a huge amount of coal is used to generate electric power in China and India, which are members of the EAS. In addition to China and India, many members of the Association of Southeast Asian Countries (ASEAN) have been increasingly using coal to ensure a stable and economical supply of electricity and to reduce risks that may result from the diversification of energy source. For these nations, therefore, whether they can continue using coal at low prices or not has a significant influence on their future vision of energy security.

In the meantime, the importance of combating pollution and climate changes has been increasing. From this viewpoint, it is vital to reduce the use of coal because it is the energy source that emits the most pollutant. Regulations on environmental pollution have been increasingly tightened and, as for greenhouse gas (GHG) emissions, discussions on international frameworks are going on, embroiling developing countries as well. In addition, some international financial institutions are limiting their loans intended for coal-fired power plants. The environment that allows the use of coal has been rapidly changing. It can be understood that restrictions on the use of coal were undertaken because of the uncertainty of the future of the environment if the world continues to use coal.

4.2. Policy Implications

The policy implications for each country, based on the three generated scenarios, are discussed in the following sections.

4.2.1. Two different preferences for future crude oil price

Two viewpoints emerged concerning preference for crude oil prices. One adheres to the idea that as-low-as-possible crude oil prices are desirable because of concerns over increases in energy cost and economy in oil-importing countries. By contrast, the other viewpoint believes that oil-exporting countries welcome high oil prices are welcome by oil-exporting countries in order to maintain profits and for development incentive, and that even oil-importing countries prefer high oil prices to a certain extent because they wish to push forward structural reforms in their markets and to accelerate the development of renewable energy.

Of these two viewpoints, the one that believes that even oil-importing countries prefer oil prices at a specifically high level is to be noted. Many EAS countries import oil. Simply viewed, lower oil prices would appear better for them. However, while low oil prices may appear more attractive for oil-importing economies, they could be an obstacle to reforms over the medium to long term. This is clear from the experience during the oil crises 1970s, which served as impetus for developed nations to begin the use of alternative energy to oil, and to dramatically improve energy efficiency. Bold structural reforms need a powerful driving force. In this sense, oil prices that are high, to some extent, can be tolerated or are even required.

4.2.2. Implication of oil price scenario

Both the scenarios that use crude oil prices as a turning point indicate a high possibility that crude oil prices will rise again in the future. Then what is the sign that could point or predict an increase in crude oil prices? Unfortunately, there is no clear answer to this question. As in the past, future changes in crude oil prices will be influenced by complicated factors, such as geopolitical risks, climate, and economic problems. Not even one of these factors would sufficiently indicate a sign of a price hike in the future.

What should be learned from these scenarios is probably that extremely low or high

crude oil prices are not sustainable. Extremely low oil prices will cause stagnation of new investment in exploration and production. On the other hand, extremely high oil prices cause stagnation of the economies of importing countries and a fall in oil demand. Therefore, the prices will need to be adjusted sometime. In other words, an oil price level that exporting countries or importing countries feel is unsustainable will be inevitably adjusted.

Then what should be done if crude oil prices continue changing in the future? The answer is clear. There is a need to create a healthy and resilient energy supply–demand structure that can withstand changes in crude oil prices. In oil-importing countries, such structure is but a diversified energy mix that reduces dependence on oil. It means that importing countries should aim to expand the use of renewable energy, improve self-sufficiency rate by enhancing energy efficiency, and expand the use of energy other than oil. For oil-exporting countries, this means establishing a diversified oil export target (country) and an economic structure that does not rely on oil export. The goal is to develop the manufacturing and service industries to make up for a decrease in earnings from oil export with other industries.

These planned actions may be easy to understand, but what should be noted is that it takes a long time, possibly in about 10 years, to achieve these targets. The economic structure and energy supply–demand structure of one country cannot be changed within a short period regardless of how audacious the policy taken. Even if it can be done, the side effect will be enormous. Structural reforms require a long time; hence, policymakers need to make decisions based on a long-term vision, and make diligent and steady efforts towards achieving such reforms.

4.2.3. Implications of the coal scenario

What will bring a change that could substantially restrict the use of coal? What will possibly cause a drastic change in the near future is probably a discussion on a framework that will restrict greenhouse gas emissions starting 2020. If international society agrees on an ambitious target, rigid restrictions will be imposed on the use of coal-fired power generation. It is, therefore, important to carefully monitor such a discussion.

How should we react to the possibility of a change that can take place in the future?

One way is to promote the construction of an energy supply–demand structure that does not rely on coal, as described in subsection 4.2.2. For example, increasing the use of natural gas, renewable energy, and nuclear power generation can be cited. As these changes take a long time to happen, maybe in about 10 years, the action taken should also adopt a long-term view.

On a shorter time frame, the cleaner use of coal, specifically the aggressive promotion of development and use of high-efficiency power generation technology and environmental protection technology can be cited. Coal is unpopular from the environmental viewpoint but highly desirable in terms of stable supply and economy. Ensuring energy supply and economy are important elements, especially for developing economies, and it would be a great loss not to utilise this supremacy of coal. The cleaner use of coal is a practical alternative for balancing these and should be positively studied. While aiming at a cleaner structure in the long run, the gap must be bridged by the cleaner use of coal over the short or medium term as it takes a long time to complete such fundamental structural change. Policymakers who are responsible for industries and the lives of people in their countries will be required to take practical approaches, taking reality and the long-term ideal vision into consideration while aiming at the cleaner structure. In that sense, the cleaner use of coal can be said to be an appropriate choice especially for developing countries.

4.3. Conclusion

This chapter presented the policy implications based on three future scenarios generated by using a scenario planning approach. During the scenario planning, both the present situation and future prospect were analysed from various angles, but the certainty of the vision of the future drawn by the scenarios is not necessarily high. The energy market is always changing and each country continues to take measures against that change. Consequently, a scenario that may be adopted in the future will also change. In the world where everything changes rapidly, the scenarios drawn from this study may quickly become obsolete. It may be required to extract new scenarios in accordance with the changes in the energy market and to analyse policy implications from other angles.

Reference List of Raised Implications

Country	Implication
Cambodia	• Cheaper oil price is better. • High oil price affects electricity retail price. • Renewable energy cost is still higher but hydro contributes to reducing electricity price.
China	• Stable and cheap oil price is better. • Domestic energy market reform is needed. • The use of more gas and electricity, and improvement in the quality of oil products is needed in the transport sector. • Lower-priced coal is preferred but there is a need to impose carbon tax to improve the environment. • Improved new technology is needed. • Sustainable use of renewable energy is required.
Indonesia	• The country prefers a higher oil price scenario at US$80–US$100/bbl. • Introduce other energy sources, new renewable energy (NRE), nuclear, and others. • Utilise cheap coal domestically, export the high-grade coal. Low-quality coal can also be used for the chemical industry. • A shift to electric vehicles in the transport sector will increase coal consumption. • Implement deep decarbonisation, such as carbon capture and storage (CCS)/clean coal technology (CCT). • International policy change, moving away from coal, will affect Indonesia's coal export.
South Korea	• The lower oil price the better, but US$80–US$100/bbl should be kept. • Continuous policy implementation is needed, regardless of oil price change. • Coal is important in South Korea, but cleaner use should be pursued. • Research and development and new technology are keys to energy security.
Lao PDR	• The country prefers low oil price, lower than US$50/bbl. • Increase coal utilisation in the electricity sector. • Promote electric mobility/vehicles.
Malaysia	• The country prefers a stable and reasonable price, at US$80–US$100/bbl. • Increase the utilisation of NRE. • Increase coal in energy mix, but should impose a higher standard technology (e.g., CCT and CCS), and of emission standard. • Undertake subsidy removal from electricity price to promote and enhance energy efficiency (EE) and NRE.

Country	Implication
	• Consider long-term (2035) decarbonisation, and nuclear power.
Myanmar	• Prefers an import oil price of US$80–US$100/bbl. • Needs to reduce oil import requirement. • Onshore exploration and production • Increase NRE. • Use of gas, CNG, for the transportation sector. • New technology for coal power plant, increase importation of coal.
Singapore	• Oil prices affect the Singapore oil sector, thus, the lower the better. • High oil price may positively impact the transportation sector, electric vehicles • Solar PV use, but remain at small share
Viet Nam	• Prefers an oil price of US$80–US$100/bbl. • Promote NRE and EE. • Remove subsidy, domestic market reform is required. • Promote coal blending—high quality and low quality. • Implement CCT. • Interconnect the electricity grid.