

Chapter 1

Crisis Scenario

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CHAPTER 1

Crisis Scenarios

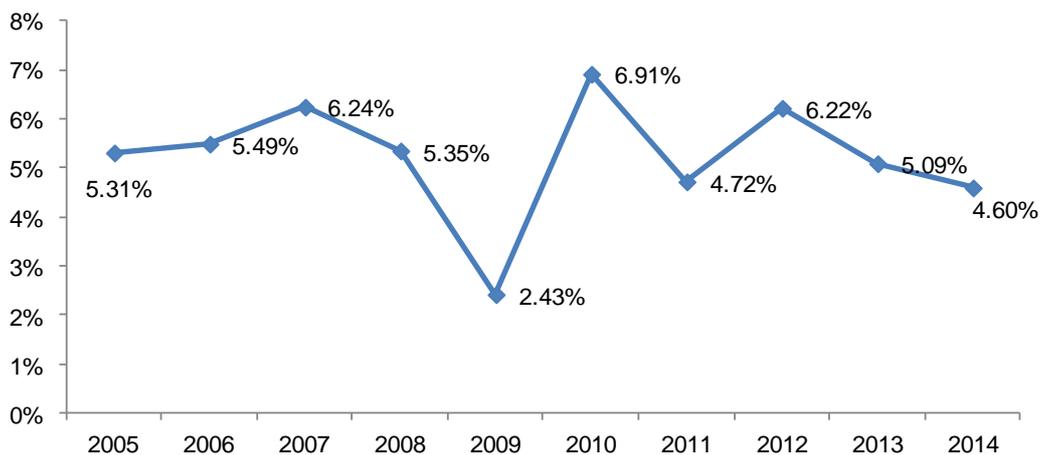
This chapter provides two potential crisis scenarios related to oil supply disruption, with a particular focus on ASEAN countries.¹ The scenarios aim to describe what would happen if an unexpected oil supply disruption were to occur in a country with no official stockpiling system.

1-1 Scenario of a Domestic Natural Disaster (The Case of Large Earthquake)

1-1-1 Assumptions of the scenario

Country A is a hypothetical country in Southeast Asia. The country was seriously hit by the Asian Economic Crisis that occurred in the late 1990s. Since then, however, the country's economy has grown at an annual average rate of 5 percent or higher through the steady development of various manufacturing industries, particularly boosted by its abundant natural resources. The country is leading other countries in the ASEAN region due to the recently booming Asian markets (Figure 1-1).

Figure 1-1. Economic Growth Rates of Five Major ASEAN Countries



Note: The five major ASEAN countries are Indonesia, Malaysia, the Philippines, Singapore, and Thailand.
Source: International Monetary Fund, World Economic Outlook Database.

¹ As mentioned in the Foreword, this report mainly deals with stockpiling development

While its economy continues growing at a rapid pace, Country A has seen its domestic energy demand increase at the same time. Over the past 10 years from 2005 to 2014, the country's energy demand has increased at an average annual growth rate of nearly 4 percent. While managing to meet the demand with coal and natural gas, the country has been a net oil importer since the 2000s.

With respect to oil supply and demand conditions, Country A is an oil-producing country, pumping as much as 800,000 barrels per day (b/d) of crude oil, most of which is exported without being refined domestically. This is because the crude oil produced in the country is of high quality with a low sulphur content, and is traded at high prices in the Asian markets as fuel for power generation and gasoline feedstocks. Instead, Country A imports high-sulphur crude oil from the Middle East, which is refined at its local refineries. The locally produced oil products are supplied to its domestic market. However, with the continuing depletion of its oil fields, the country's crude oil output has been decreasing each year. For this reason, while domestic oil demand increases, the demand for imported oil outpaces the increase of domestic oil demand.

Country A's government has a 100 percent national-owned oil company that plays a significant role in its oil industry. The company operates its upstream sector by inviting Western and other Asian companies for the purpose of introducing their advanced technologies and capital investments. But the national oil company almost completely monopolises oil refining, logistics, and distribution businesses, and foreign companies are not allowed to be involved, with very few exceptions.

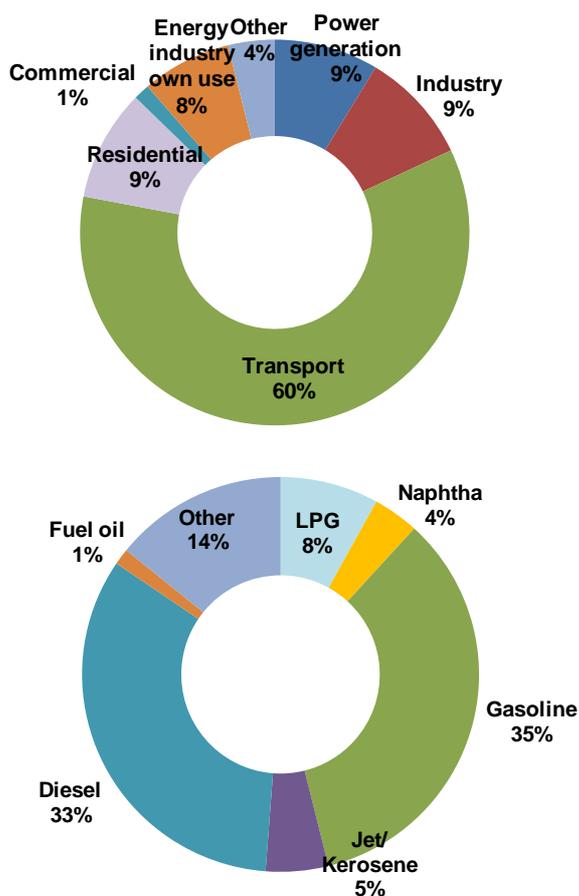
While domestic demand for oil has been increasing, the construction of domestic refineries to satisfy the rising demand has been put on the back-burner. As a natural consequence, imports of oil products have continued to increase. The country's newest refinery was built in the mid-1990s, and despite an almost doubling of domestic demand for oil, no new refinery has been built since then. It is widely known that international crude oil prices are extremely volatile, but international oil product prices are even more volatile than crude oil prices. Country A, which is increasing its imports of oil products, rather than imports of crude oil, is exposed to far more oil price volatility than other countries. For this reason, in addition to securing physical oil supplies, Country A will have to solve the problem of how to manage violent price volatility as major challenges for its oil policy.

To support the market, Country A has subsidised domestic oil product prices for many years so that price volatility in the international market is not directly reflected in domestic market prices. With such a subsidy system in place, the country's national oil company, which is a main product importer and a product supplier to the domestic market, has been absorbing price volatility in the international market. This is one of the reasons why no new refineries have been built over the past 20 years. The government subsidy helped to keep domestic oil product prices low and the construction of new refineries was not economically justifiable.

Country A is known for its large number of islands, and the majority of oil products are hauled to domestic consumption areas mainly via naval transportation. On the main islands, where refineries are operating, oil products are delivered domestically to local oil depots by coastal tankers, barges, railroads, tank lorries, etc., and to filling stations and end user locations by tankers. On the other hand, on the small islands, where there are no refineries, oil products are hauled from refineries mainly by coastal tankers. Restricted by such complicated geographic conditions, domestic pipelines for oil products have not been well developed.

In Country A's oil demand mix by application, transportation accounts for the largest share (60%) of the total oil demand. Transportation is followed by industry, power generation, and residential use, each with a share of 9 percent. In Country A's oil demand mix by product, the percentages of gasoline and diesel oil are increasing. Country A has also been converting kerosene to liquefied petroleum gas (LPG) as part of its domestic program to cut subsidies for oil products.

**Figure 1-2. Oil Demand Mix in Southeast Asia
(top: by application; bottom: by product)**

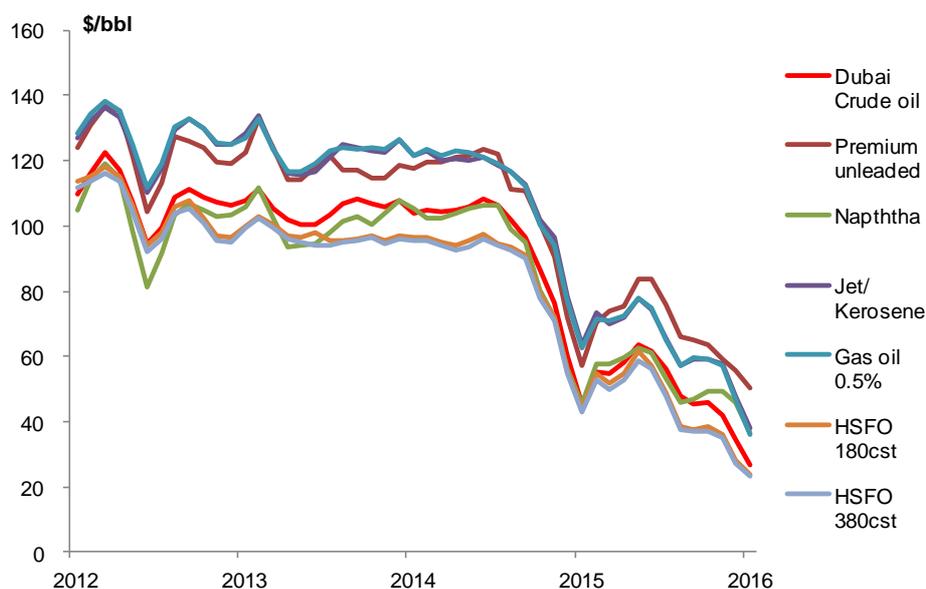


LPG = liquefied petroleum gas.

Source: International Energy Agency, Energy Balances of non-OECD Countries 2015 edition.

From the standpoint of energy security, Country A has been raising concerns about the increase in domestic oil demand and the rise in oil product imports. To address these concerns, the country has discussed the development of national oil stockpiling as well as the expansion of domestic oil refining capacity. While oil refining is positioned as part of oil business, oil stockpiling itself requires only operational costs, with no profit produced. Furthermore, constructing oil stockpiling facilities would require a huge amount of money for building oil storage tanks and procuring oil to be stored. Although the government of Country A and its national oil company are fully aware of the need to stockpile oil, they have not taken any concrete action toward the development of oil stockpiling facilities. Rapid economic growth has been continuing, but the development of not only oil but all forms of social infrastructure, such as electric power supply, roads, and telecommunications, has not been able to catch up with the pace of Country A's expanding domestic economic activities. In allocating its limited national budget and domestic resources, the country has tended to put slow-acting programs, such as the development of oil stockpiling, on the back-burner. Additionally, falling crude oil prices and the moderated supply-demand balance of oil products in the Asian market since 2014 (Figure 1-3) have somewhat decreased Country A's awareness of the importance of oil products, which is one of the reasons why the development of oil stockpiling has been delayed.

Figure 1-3. Prices of Crude Oil and Major Oil Products in the Asian Market



Source: International Energy Agency. *Oil Market Report*. Various editions.

Under such circumstances, emergency oil stockpiling has not existed in Country A. The only oil stock that existed in the country was the commercial stock held by the national company, at a volume of only around 3 weeks' worth. As only its domestic oil demand was increasing, the country did not construct additional refineries or oil tank sites and as a consequence, the country's domestic oil storage capacity did not increase. While domestic oil demand was increasing, inventory days, the volume of domestically stocked oil divided by the country's

daily consumption, were gradually declining. However, the country could not make the necessary investments to expand the storage capacity of the domestic oil tank sites. As a result, oil products were supplied to their distribution infrastructures at higher turnover rates than ever before.

1-1-2 Development of the scenario

In the summer of 201X, a massive magnitude-eight earthquake occurred off the coast of Country A. The violent shaking from the huge earthquake caused considerable damage to the country. At the same time, subsequent large-scale tsunamis had devastating impacts on the coastal areas of the country.

The disaster occurred at the worst time in terms of the oil supply and demand of Country A. Domestic oil demand peaks in the summer, so the impact of the oil supply disruption was greater than it would have been in any other season. As mentioned, Country A uses large quantities of oil for electric power generation, and its electricity demand peaks in the summer, too. The supply disruption of an oil product impairs the operation of oil-fired thermal power generation and has a direct impact on the electricity supply, which is a major energy source for people's lives. Furthermore, the demand for automotive air conditioning is also higher in the summer than any other season. As such, unfortunately, the disaster happened when the domestic oil supply–demand balance was the tightest in the year.

The earthquake and the subsequent tsunamis devastated the country's oil-related infrastructure, including refineries and oil tank sites in the coastal areas. Immediately after the earthquake occurred, refining operations had to be shut down at three refineries with a combined capacity of 500,000 b/d, equivalent to more than half the country's total domestic oil refining capacity of 800,000 b/d. The disaster-stricken refineries were located near the metropolitan area, where oil demand is concentrated. The actual impact of the supply disruption was larger than could have been assumed from the capacity.

Many refineries were forced to stop operations because their processing plants were damaged by the earthquake. Some refineries had to stop operations when continuous strong shaking caused oil products to leak from floating roof tanks and some product tanks even caught fire. At many refineries, the tsunamis damaged the loading arms, which load and unload products for ocean transportation. As a result, these refineries were unable to unload crude oil and semi-products from incoming tankers, or load their end products onto outgoing tankers.

The national oil company, which single-handedly operated all the oil refining businesses in the country, made the following official statements: 1) three refineries had to be shut down immediately after the earthquake, with a combined oil refining capacity of half the country's

total; 2) one refinery, with a refining capacity equivalent to a quarter of the country's total, could be back in operation in a week; 3) repairing one of the two other refineries would take a month; and 4) the last refinery was damaged by a serious fire incident and would take more than a year to restart operations.

As with the oil refineries, the country's crude oil and natural gas production facilities were also affected by the natural disasters. Fortunately, the impact of the earthquake and tsunami on these upstream oil assets was found to be relatively limited. The national oil company said that it would take between one week and one month for the production outputs at each facility to return to their pre-earthquake levels.

The tsunami caused by the earthquake affected not only the assets of refineries but also other assets in the oil supply chain. The tsunamis washed away many of the tank trucks used to transport oil products from refineries and oil tank sites. To make the matters worse, the strong shaking of the earthquake and the tsunami also damaged trunk roads and railroads in the coastal areas, making land transportation means very difficult.

Table 1-1. Impacts of the Damage

Item	Impact	Time Required to Restore
Oil production	100,000 b/d of production is stopped	1 week to 1 month
Refining	500,000 b/d of refining capacity is stopped	1 week for 150,000 b/d 1 month for 150,000 b/d 1 year for 200,000 b/d
Distribution	10% of total tank trucks are lost Railroads and highways for transporting oil products are damaged	

b/d = barrels per day.

Source: Authors.

1-1-3 Possible oil supply problems

As a result of the unprecedented natural disaster, Country A is now challenged by serious problems in every aspect of its economy and society. In the wake of the earthquake, Country A's capability of supplying oil products decreased significantly. If adequate levels of oil product stockpiles had existed and been released to the market immediately, the country might have been able to minimise the negative impact of such a natural disaster. As demonstrated in recent examples, such as the Great East Japan Earthquake in 2011 and Hurricane Sandy, which hit the East Coast of the United States (US) in 2012, it is possible to secure adequate levels of oil product supplies by releasing domestically stocked products to the market in a timely manner, even under situations where the area is hit by a natural disaster and the supply of oil products is disrupted.

But what kinds of problems happened in Country A without such emergency stockpiles?

(a) Decreased oil product supplies in the event of refinery shutdowns

Immediately after the earthquake occurred, operations were stopped at some domestic refineries, with a combined refining capacity of 500,000 b/d. As a result, there were significant shortages of domestically produced oil products. A shortage of domestic oil refining capacity had already existed, and Country A was importing oil products to balance the supply and demand. In the wake of the earthquake, the country had to reduce the quantity of domestically produced oil products even further. Under these conditions, the national oil company, which monopolised the supply of oil products in Country A, had no option other than to satisfy its immediate supply needs by increasing imports of oil products (which will be described later). At the same time, the company had to reduce the volume of its commercial stock held at its refineries and oil tank sites as much as possible. The company held a total of only 3 weeks' worth of commercial oil stock, and the level of the stock of gasoline, which has peak demand in the summer, was undoubtedly less than that.

(b) Panic buying at filling stations

The earthquake and tsunamis had a strong impact on domestic economic activities, disrupting the country's entire logistics functions. As a result, there were serious shortages of daily commodities in some areas of the country. People panicked and rushed to stores to buy food, consumables, medicines, drinking water, and other basic daily supplies. These supplies disappeared from store shelves almost instantly.

This was also the case with oil products. People waited in long lines to buy gasoline at every filling station. Not only regular drivers but also consumers who drove only on weekends and even elderly people who seldom drove long distances all scrambled to panic-buy gasoline in the worry of short-term supply shortages. Many people were misinformed that the country had only 2 weeks' worth of oil product stockpiles, and that the government would have to start rationing oil products in a few days. Such information spread across the country through the Internet and social media, fuelling the panic buying.

Panic buying such as this tends to create another round of panic buying, eventually leading to a vicious cycle. Many consumers rushed to filling stations in towns, forming long lines in front of gas pumps. Seeing this caused consumers who would not even regularly drive to feel anxious and to want to emulate the same behaviour. Filling stations that were unable to receive additional supplies after the earthquake and tsunami ran out of gasoline in a short time. Again, seeing this reinforced the perception among consumers that the risk of an oil supply disruption was real. The reality was that the country's existing commercial stock had simply been transferred temporarily to consumers' gas tanks, but the consumption behaviour of many people made consumers feel as though the gasoline supply had suddenly tightened.

(c) Impacts on industrial activities

Automobile fuels were not the only products that faced such supply shortages. Oil was widely used in Country A as a fuel for industrial and power generation, and its shortage caused many problems for industrial plants and electric power stations. In the wake of the earthquake, many plants could not continue operating due to the damage to their facilities. Because of the fuel supply disruptions, even inland industrial facilities and power stations that were not hit by the tsunami were also forced to stop operations. The fuel supply shortage occurred in the summer, when the demand for air conditioning was particularly high and oil-fired thermal power stations were operating at their highest utilisation rates of the year. The timing of the disasters added to the severity of these problems. The main fuel used for these applications was fuel oil, but because fuel oil was produced less than gasoline or diesel oil, the quantity of its commercial stock held at refineries and oil tank sites was limited. This fact worsened the fuel supply shortage problem at industrial plants and electric power stations.

In addition, the earthquake and tsunami disrupted the supply of oil products used for transporting supplies, such as food and other daily necessities. As a result, while there were stocks of these supplies in the country, they could not be transported to the areas where they were needed, causing shortages of daily commodities in various locations.

(d) Problems at refineries

In the wake of the earthquake, refineries with a combined refining capacity of nearly half the country's total had to be shut down. In order to compensate for the lost capacity of oil products, Country A began to take various measures but encountered some problems. The country chose some domestic refineries that were operating at relatively low utilisation rates and tried to increase the supply of oil products by raising their utilisation rates as much as possible. During the state of emergency, each of the refineries raised their utilisation rates to levels close to the limit. However, in the process, equipment was overused to an extent seldom seen under normal circumstances, causing some parts of the plant to break down and stop operating. The extreme conditions also placed heavier burdens on the operators working to respond to the emergency situation. This resulted in an increase of problems due to human error.

(e) Lack of ability to deal with product import-related services

Because of the significant drop in its domestic production capacity of oil products, Country A was forced to import many more oil products than before. However, the national oil company that would have to deal with the increased quantities of imported oil products did not have a sufficient number of staff members. As a result, the shortage of such staff members capable

of doing the required jobs became a serious issue. The oil products import department of the national oil company had a minimum number of staff members required to handle product import-related services at ordinary times. For this reason, the company was not fully prepared to deal with the sharp increase in the demand for imported oil products in the wake of the earthquake and tsunami. Product import-related services are professional services that require not only a minimum level of foreign language ability but also familiarity with transaction forms and business practices for oil product trading. For this reason, there were only a limited number of human resources who could take on such professional services, even in the country's national oil company. The company was unable to allocate a sufficient number of people in response to the surge in workload after the earthquake.

Even though the country secured imports of oil products, it was not able to receive them because its unloading facilities were damaged by the tsunami. Partly because of oil product supply and demand information not being fully shared among the concerned parties amid the post-earthquake chaos, the unloading facilities had not been restored before the emergency import of oil products arrived. As a result, the tankers loaded with oil products were kept waiting off the coast for a long period of time.

(f) Identified limiting factors in logistics

Even when the imported oil products were unloaded at the country's refineries, other problems still existed. The trunk roads along the coastline of the country were damaged by the tsunami and some were completely shut down. In areas where the trunk roads were physically severed, some consumption markets were isolated due to inaccessible land. These markets relied on air transportation, such as helicopters, for the delivery of daily commodities. Where it was difficult to deliver oil products to such areas via air, coastal shipping was also used. As a result of using different logistics operations to those used under ordinary circumstances, operations on the front line were confused by conflicting information, which led to many other problems.

(g) Impact of LPG supply shortages on people's lives

In Country A, there were serious disruptions to the supply of LPG, the most widely used energy source by the public and the main source of energy for daily cooking.

The country has two supply sources of LPG. At one source, LPG is produced through fractional distillation from natural gas from domestic gas fields. At the other source, LPG is produced as a by-product when crude oil is refined at domestic refineries. The earthquake and tsunami seriously damaged both the domestic LPG supply sources, causing substantial shortages in the domestic market. Although there were LPG import facilities in Country A, the capacity of these

facilities was not more than 10 percent of the country's total LPG demand. Compared with other regular oil products, LPG is an oil product that is used by a wide range of people in the country. As a consequence of the earthquake and tsunami, the country faced severe LPG supply disruptions that were greater than those of regular oil products.

(h) Inadequate response procedures, information gathering, and emergency decision-making mechanisms

What became clear amid the post-earthquake chaos was the reality that Country A could not properly decide who should allocate the temporarily limited supply of oil products in an optimal manner, the procedures for doing so, or how to set the order of priority. The earthquake extraordinarily affected the supply of oil products in Country A, but not all oil product supplies were lost. There was a certain level of commercial stock in the country, some refineries still continued operating, and there was room to increase the imports of oil products. The real problem was the lack of a mechanism to allocate the oil product stocks, however limited they were. This also highlights the importance of being prepared for a crisis, when there may not be sufficient time to think about such issues.

The country should have been prepared to collect information on the quantities and locations of oil products stocks in the event of an emergency. At the same time, the country should have been able to estimate in a timely manner how much of them would be available in the short term. Based on that information, the country should have determined the areas to preferentially receive the stocked oil products in the short term and allocated a minimum level of oil supply. In reality, Country A could not take such actions because the government did not have enough data on the stocked oil products. The country had difficulty in estimating the quantity of stocked oil products that could be supplied in the short term, and there was no mechanism to decide the order of priority of who should receive them during the emergency. As a result, sufficient quantities of stocked oil products were not supplied to the medical vehicles, police vehicles, firefighting vehicles, or public vehicles that should have received them on a preferential basis, causing interference with the progress of the post-earthquake restoration work. Meanwhile, politicians and other influential figures representing the disaster-hit areas scrambled to ask the national oil company to supply fuel to their home bases. This also prevented stocked oil products from being allocated in an optimal manner. In either case, the problem occurred due to the lack of adequate preparation, a detailed emergency response manual, systematic organisation, and an information gathering mechanism in the country's emergency oil product supply system, particularly relating to the required statistics.

(i) Discontent of society with the fuel shortages and anti-government demonstrations

Lastly, because the shortage of oil product supplies had a great impact on people's lives and raised consumer fears, social uncertainties in Country A increased after the earthquake. Gasoline panic buying became a serious social phenomenon in the country, which caused many problems among the population. For example, at filling stations where stocks ran out, people waiting in line were frequently seen fighting with each other. There also were cases where riots occurred at filling stations. People who wanted to get gasoline swarmed around tankers heading for filling stations, causing the tankers to come to a standstill on the road. In order to prevent the recurrence of such a problem, the country had to take countermeasures by having these tankers protected by the police.² Furthermore, because of serious supply disruptions of LPG, an important oil product in the people's lives, people rebelled against the government because of its inability to take effective action. As a result, many demonstrations against government organisations broke out, increasing the country's social uncertainties.

1-1-4 How can this emergency situation be resolved?

As described, the natural disasters seriously disrupted Country A. The country took various countermeasures to manage and restore the supply of oil products that had been severed by the disasters.

(a) Oil supply cuts (introduction of oil product rationing)

In the wake of the disasters, the national oil company introduced supply cuts as a countermeasure to the depletion of its commercial stock. The company proposed the measure, which was approved by the government for implementation. Specifically, the national oil company cut the quantities it supplied through its distribution network at ordinary times by 20 percent across the board. However, official procedures for the country to authorise such supply cuts were not originally in place. Also, there was no established procedure for who should make the decisions or on what information the decisions should be based. That is why it took some time before the supply cut was actually authorised and implemented. At the same time, the rate of the supply cut was politically decided without objective evidence, and the government's unfounded decision caused unnecessary confusion among the public.

² Similar events in fact happened following the Great East Japan Earthquake in 2011.

(b) Increased imports of oil products

The country tried to solve the shortage of domestic oil product supplies through supply cuts by the national oil company as an internal measure, and by increasing the import of oil products as an external measure. In this scenario, the largest supply source was Singapore, its neighbouring country. Singapore had the world's leading oil storage facilities, and for that reason, major oil companies were operating there for oil product trading. Country A was fortunate that Singapore was located right next door.

In the wake of the earthquake, Country A imported a variety of oil products, not only from refineries in Singapore but also from many oil tank terminals located in the surrounding area. In addition to Singapore, Country A imported oil products from the Republic of Korea (henceforth, Korea), India, and even as far as from refineries in Middle Eastern countries. Furthermore, attracted by relatively higher market prices in Asia, oil products began to flow from countries in Europe and the US into the region. This movement helped ease the tight oil product supply-demand situation throughout Asia. Based on market mechanisms, price signals played the role of inviting oil product supplies from around the world.

(c) International humanitarian support

In the wake of the earthquake and the severe shortages of daily commodities, including oil products, Country A tried to solve the shortages by requesting support from other countries. However, while Country A needed oil products, other Asian countries had oil stockpiles, largely in the form of crude oil. With the oil product supply-demand balance in the entire Asian region becoming increasingly tight, only a few countries were able to supply Country A with large quantities of oil products. Another problem was that because the country's oil receiving infrastructure was damaged, it took longer than usual to receive the required oil products.

However, several countries with excess oil refining capacity supplied oil products to Country A as humanitarian assistance. The governments of the countries encouraged their oil companies to operate at full capacity in order to produce enough oil products for Country A. In ordinary circumstances, excess capacity is seen as a burden for oil companies, but in this emergency situation, it played a significant role in supporting Country A.

(d) Dysfunctional multilateral oil coordination framework

For the purpose of international cooperation, Country A had agreed an emergency oil coordination framework with its neighbouring countries. Under the framework, if the shortage of oil in a member country were to exceed a predetermined threshold, the other member countries were supposed to use their oil supplies to support the relevant country in a cooperative manner. During Country A's oil supply disruption, however, the country was

unsuccessful in actually receiving any products through the framework, despite exploring the possible ways for doing so.

One reason why the arrangement did not work properly was that the actual shortage of oil did not reach the threshold set by the framework to trigger the oil arrangement. The threshold was defined by the condition that the shortage of domestic oil exceed 10 percent of the country's demand for 30 consecutive days. Country A had already encountered many problems before reaching the 30th day, and the option of waiting until oil swapping was triggered was not realistic. Before reaching the threshold, the country could have asked the other member countries to supply oil on a voluntary basis. However, the organisation managing the framework was not influential enough to have a permanent head office, and its temporary office operated on a small budget with only a limited number of staff. Even if Country A had asked the organisation for voluntary support, the office would not have had the required authority or capacity. None of the countries covered by the framework had sufficient stockpiles of oil, so even if Country A had asked them, the physically available stocked oil products would have been limited to only small quantities.

1-1-5 Implications of the scenario

What can we learn from the above development of this scenario? The following implications can be derived from the scenario and are helpful in studying how to respond to future emergency situations, including the development of oil stockpiling.

(a) Natural disasters will not wait until an oil stockpiling system is put in place. What does it take to develop an effective oil stockpiling system as quickly as possible?

In Country A, where the import of oil products was growing at a rapid pace, the need to introduce an oil stockpiling system had originally been discussed. But the country put off the decision for various reasons, such as a lack of financial resources and the urgent need to develop other forms of infrastructure. In reality, however, natural disasters will occur regardless of the progress of such a stockpiling system. If the stable supply of oil products is questioned, the problem should be solved, or the measures to minimise the impacts should be taken as quickly as possible.

Needless to say, in the event of an oil supply disruption, the first thing we should do is to immediately secure alternative supply sources to make up for the lost supply of oil products. In other words, if we can secure appropriate alternative supply sources, we will not necessarily need to build a large-scale oil stockpiling terminal within the country, although it is desirable to have one in the long term. In this case, we will need to figure out the kinds of options

available as alternative supply sources that can be developed in a more effective, expeditious manner. This point will be discussed in the next chapter in more detail.

(b) Unlike in ordinary circumstances, a different set of regulations may be required in emergency situations. What regulations should be relaxed in such emergency situations?

The recovery of the oil supply should be prioritised in an emergency situation. In doing so, if the existing set of regulations during ordinary times hinders us from taking immediate countermeasures, it is meaningful to consider making an exception to relax part of these regulations. For example, when Hurricane Sandy hit the US in 2012, the US government temporarily relaxed the Jones Act, which allows only US-flagged vessels to transport domestic oil products. At the same time, the US government temporarily relaxed another regulation on the quality standards for oil products. These two regulations play important roles in ensuring national security and environmental protection during normal circumstances. However, the US emergency response systems are based on the notion that the limited relaxation of regulations is acceptable only for a short period of time in the event of an emergency situation, like a hurricane. In a more severe emergency where more stringent demand-side management is needed, the government will need larger authority to ensure such countermeasures, such as demand rationing.

The importance of preparation cannot be overemphasised because the occurrence of an emergency situation is unavoidable. We should not simply ignore it, thinking it is unlikely to happen. Instead, we should make sufficient preparations so that we will be able to respond when such an emergency actually happens. In particular, we should be clear on which regulations could be limiting factors in existing regulatory systems should an emergency situation happen. We should also determine who should make the decisions to relax regulations, and the procedures and criteria for doing so. As such, we need to consider whether the relevant administrative agencies should be granted additional authority in an emergency situation. If they should, we must discuss the extent to which their authority should be strengthened.

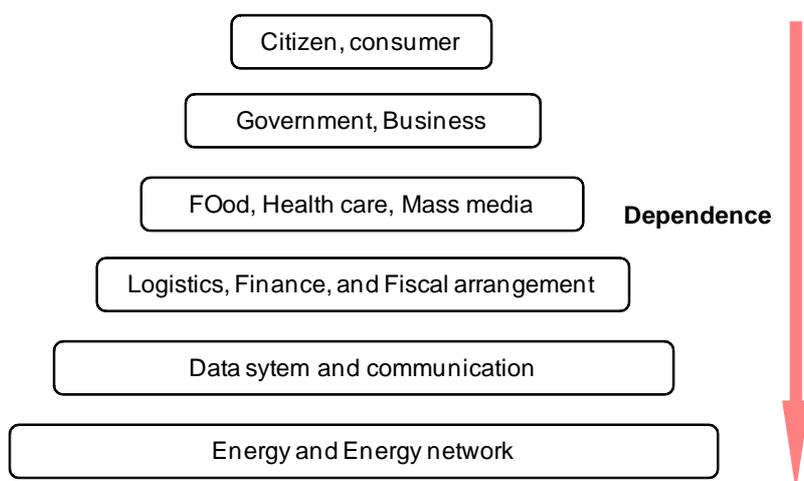
(c) What are the differences between oil and other products? Why is oil stockpiling particularly important?

Oil is a very versatile product that is used not only for transportation but also for many uses in the industrial, power generation, and consumer sectors. In addition, oil cannot be easily replaced with other sources of energy in the transportation sector. This is another reason why a certain volume of oil needs to be stockpiled to prepare for an emergency, as the impact of an oil disruption would spread over a very wide area in the industry. Especially in emergency situations, oil plays an important role as a fuel to power private electric generators at medical

and other socially important institutions, and also as a transportation fuel for the delivery of necessary rescue teams and relief supplies to the disaster-stricken areas.

From the standpoint of the effective use of limited resources in an emergency, many social functions, such as information/telecommunications and finance, should be restored on a priority basis. In the same way, there should be an order of priority for which energy sources, including oil, should be restored in the event of an emergency.

Figure 1-4. Order of Priority of the Emergency Response System of Finland



Source: Morita (2012).

In ASEAN countries, which use large quantities of oil not only for transportation and industrial purposes but also for power generation and residential use, securing the stable supply of oil products is very important for recovering activities in the energy sector. By keeping a certain level of oil stockpiling in preparation for such an unexpected situation, countries should be able to act in a more effective manner when recovering from various kinds of disruptions, not only in energy supply but also in social and economic functions.

(d) In the event of an emergency, we must have an excess capacity that is different from the excess capacity needed in ordinary circumstances. Who should store such excess capacity for emergencies?

Excess capacity during ordinary circumstances has an extremely important role in emergency situations, although the degree of excess capacity is determined by market balance and not by energy security policy itself. For example, in the wake of the Great East Japan Earthquake in 2011, Japan was able to make up for the shortage of domestic refining capacity immediately after the earthquake by taking full advantage of the excess refining capacity that existed in the

country. Conversely, if a certain supply system is kept in operation at its full capacity, and if another supply system encounters a problem, the capacity to supply additional oil is very low.

With its domestic oil production decreasing, unlike Middle Eastern oil producers like Saudi Arabia, Country A cannot afford a certain level of excess production capacity during ordinary times. As an alternative, it is desirable to stockpile oil before an emergency happens, although the immense challenge of who should bear the cost will have to be addressed. As will be discussed in Chapter 3 in more detail, there are many patterns of ownership for oil stockpiling facilities. Among the developed countries with oil stockpiling systems, such facilities are owned by governments, private companies, and oil stockpiling agencies representing multiple private companies. In some cases, a country's emergency stock is stored in another country's facilities based on government-to-government agreements. The pattern is chosen depending on various factors, such as the financial condition of the country that develops the oil stockpiling, and the relationships between companies and the government. For this reason, it is not easy to suggest which pattern is best. As described above, from the viewpoint of securing an oil stockpiling system in a more expeditious, effective manner, we need to explore the available kinds of patterns in greater detail.

(e) How should we prioritise oil product supplies in an emergency?

In this scenario, panicked people engaged in so-called panic buying when the supply of oil and other products was disrupted. As the physical supply of products stopped, the demand soared much higher than expected. The difference between supply and demand widened suddenly. This behaviour is typical in the event of a product disruption of any kind. Therefore, we need to decide in advance who should receive a limited supply of products on a priority basis when such an event actually occurs. In other words, we must make the difficult decision of whom the products will not be delivered to. This concept is similar to that of 'triage' in emergency first aid treatment. Although such prioritisation depends heavily on the situation and scale of a specific supply disruption, it may be possible to decide the order of priority beforehand as a guideline. It is generally believed that the supply of oil products should be used first for military and policing to maintain security, and then for medical use to save human lives. Next, the supply should be for the demand for oil products in power generation and consumer use. It is important to clarify the details of such prioritisation.

Needless to say, when distributing the supply of oil products on a priority basis, we must collect information in a timely manner on the quantities and locations of oil product stocks. The management and operation of such oil product stock information are equally important. Moreover, it is desirable to have more detailed information on the demand that can be expected from each of the prioritised fields. Securing such information requires the collection and use of supply and demand data from ordinary times, and also requires the accumulation of knowledge on actual consumption based on the data. Information technology may be used to help for this. Spain, for example, has a publicly accessible information database where the

operation of each retail station can be found. Such information services can help greatly in minimising confusion and panic in emergencies.

(f) It is impossible to stockpile every oil product. At what ratio should we stockpile crude oil and oil products? In doing so, what are the points we should keep in mind?

Lastly, in this scenario, some countries received emergency oil supplies from overseas. Many of those countries that provided emergency oil supplies however stockpiled oil in the form of crude oil and did not have ample oil product stockpile. How to stock crude oil and oil products is another important point in developing an oil stockpiling program. From a stockpiling cost standpoint, crude oil is more economical because it does not deteriorate in quality when stocked over an extended period of time and it can be stocked in bulk in large-scale tanks. However, it is not crude oil but oil products that are consumed immediately after an emergency happens. It can be said that stockpiled oil in the form of oil products will have more immediate effects in the event of an actual emergency. On the other hand, oil products deteriorate in quality and must be replaced with new ones every few years. Storing many different oil products obviously costs more than storing crude oil, which can be stored as a single product.

Additionally, the decision to stock crude oil or oil products will be influenced by other factors, such as the capacity of domestic oil refining and the types of crises to be considered. If the country has an adequate level of domestic refining capacity, then stockpiling crude oil will be justified. If not, stockpiling oil products would be desirable. For example, if we assume a crude oil supply disruption stemming from the political situation in Middle East, then we may want to stockpile crude oil instead of oil products.

As will be described in Chapter 3, IEA member nations are stocking different types of oil products depending on each country's situation and energy security policies³. The decision to stockpile crude oil or oil products should be made in a comprehensive manner, based on stockpiling costs, domestic refining capacity, and the expected crisis scenarios.

³ As of October 2015, the stockpiling ratio of crude oil to oil products was 59:41 (1,332.1 million bbl: 930 million bbl) in the North American OECD region, 38:62 (548.7 million bbl: 880.8 million bbl) in the European OECD region, and 68:32 (582.3 million bbl: 269.4 bbl) in the Asian and Oceania OECD region. (All the numbers include commercial oil stock.) European Union member countries of IEA also have an obligation to stockpile a minimum of one-third of their stockpiling as oil products.

1-2 Scenario of Oil Product Supply Disruptions from Overseas (The Case of a Complete Supply Disruption from Singapore)

1-2-1 Assumptions of the scenario

Country B is a relatively small hypothetical country in the ASEAN region, with a population of approximately 15 million. With the recent strong economic growth in the entire ASEAN region, Country B has grown in the past 10 years at an annual average economic growth rate of as high as around 6 percent. Although the country's gross domestic product (GDP) per capita is still low at US\$1,000, living standards have been noticeably improving. As a result, the demand for energy is increasing at a faster pace.

Oil accounts for only about a quarter of the country's primary energy supply mix and the share of traditional biomass energy sources, such as wood and coal, is still high. On the other hand, the percentage of oil-fired thermal power in the electricity generation mix is as high as 40 percent, as is the case with the transportation sector, making it an energy consuming sector highly dependent on oil. In the country's oil demand mix by product, the percentage of diesel oil is very high, accounting for half of the total domestic oil demand. Diesel oil is used mainly for transportation and power generation. The country's domestic generation capacity is smaller than its demand, which is why power outages occur frequently. The demand for diesel oil is high for powering private generation systems at plants and other large facilities. In addition, as the country's economy has grown, income has also increased. As a result, the number of automobiles has increased and the share of gasoline in the oil demand mix is gradually rising.

Country B produces no oil, and all the domestic demand for oil is supplied by imports. Since there are no refineries in the country, oil is imported in the form of oil products. Many of the oil products imported from overseas countries are transported by barges from primary import terminals located in the southern coastal area all the way to oil tank sites spotted along the rivers running through the country. From there, the oil products are hauled by tank trucks to local filling stations. Although the country has plans for building an oil refinery, there has been no clear road map toward the realisation of the plans as domestic oil demand has not yet grown to a level that can justify construction and because the country has difficulty raising the necessary funds.

As it has no stockpiling system in place, Country B has oil stock only in the form of commercial stock, as is the case with Country A. Country B's main oil storage facilities are at the oil import terminals located in the southern coastal areas and the oil tank sites in inland areas. The oil stock in the country is the commercial stock held by oil companies. As Country B does not keep adequate statistics on its oil stock, there is no way of accurately knowing the quantities of oil

products that exist. However, it is believed that the quantity of oil stock in the country is no more than 21 days' worth of domestic oil consumption.

The oil market in Country B is liberalised, which is unusual among ASEAN member nations. In Country B, which has no refineries, the country's national oil company, national oil companies in other ASEAN member nations, and European oil majors are involved in the import and distribution of oil products. Domestic oil selling prices are also liberalised, and are basically linked to the international oil trading product prices in Singapore.

In Country B, accurate statistics of domestic oil stock are not available. Among the difficulties in recording the oil supply and demand conditions in Country B is the existence of smuggling. In Country B, oil products are distributed at higher prices than those in neighbouring countries because the oil selling prices are liberalised. Smugglers procure oil products in neighbouring countries at subsidised prices and bring them into Country B for resale to profit from the high margins there. The exact quantities and original locations of the smuggled oil products are not known. The existence of this type of smuggling makes it difficult to accurately determine the oil supply and demand conditions and the quantities of stocked oil products. The smuggling also prevents us from forecasting the future oil demand in the country.

1-2-2 Importance of Singapore in the Asian market

Singapore supplies most of the oil products required by Country B. Many of the products Country B imports from Thailand and Viet Nam were originally refined or blended in Singapore. Singapore is the only country that has oil refining capability in Southeast Asia. The following table lists the country's oil refineries.

Table 1-2. Oil refineries in Singapore

Operating Company	Location	Crude oil distillation capacity (‘000 b/d)
ExxonMobil	Jurong/Pulau Ayer Chawan	593
Shell	Pulau Bukom	462
Singapore Petroleum (SPC)	Pulau Merlimau	290

Source: The Institute of Energy Economics, Japan.

Singapore is the centre of oil product trading in Asia, and oil product prices in Singapore are referenced extensively as target prices in the entire Asian region. In particular, Platts releases oil product prices on a daily basis referenced as target prices in each Asian country and has an extraordinary influence over Asian oil markets. This is why all well-known oil majors and traders have offices in Singapore to collect market information around the clock and trade oil products in the midst of the market. In Southeast Asia, there are many countries like Country B where refining capacity falls short of domestic demand, and Singapore acts as a hub to supply oil products to these countries. In the vicinity of Singapore, there are many oil tank

terminals as well as oil refineries. Many oil products are imported from all around the world to these oil tank terminals, then exported from the terminals. In the past, many of these oil tank terminals were constructed within Singapore, but recently they are also being built in nearby countries, such as Malaysia and Indonesia. At present, the total oil storage capacity in the vicinity of Singapore is estimated to exceed 9 million cubic metres or more (Table 3-1).

Table1-3. Storage Capacity in Singapore

Operator	Terminal	Capacity (cm)
Vopak	Banyan, Jurong Island	1,363,375
Vopak	Sebarok Island	1,263,079
Vopak	Jurong Rock Caverns	480,000
Oiltanking	Seraya, Jurong Island	1,265,000
Oiltanking (Helios)	Jurong Island	503,000
Hin Leong	Jurong Island	2,360,000
Horizon Singapore	Jurong Island	1,252,184
Kuo	Busing Island	1,200,000
Total		9,686,638

cm = cubic metres.

Source: *Petroleum Economist*. December 2014/January 2015: 11.

The Strait of Malacca off the coast of Singapore is known as a so-called transit chokepoint, a strategic point of ocean transportation. As much as 15 million barrels of crude oil and oil products transit through the Strait of Malacca every day and it is regarded as the world's second most critical ocean route, next to the Strait of Hormuz. The Strait of Malacca is used to transport many products including oil to not only neighbouring Southeast Asian countries but also Northeast Asian countries, like Japan and China. Because of this, the Strait of Malacca is known as the main artery of the Asian economy.

Table 1-4. Oil Transit in the Strait of Malacca

million barrels per day	2009	2010	2011	2012	2013
Total oil flows through Strait of Malacca	13.5	14.5	14.6	15.1	15.2
Crude oil	11.9	12.8	12.9	13.3	13.4
Refined products	1.6	1.7	1.7	1.8	1.8
LNG (Tcf per year)	1.6	1.9	2.5	3.2	4.2
Millino barrels per day	2009	2010	2011	2012	2013
Total oil flows through Strait of Malacca	13.5	14.5	14.6	15.1	15.2
Crude oil	11.9	12.8	12.9	13.3	13.4
Refined products	1.6	1.7	1.7	1.8	1.8
LNG (Tcf per year)	1.6	1.9	2.5	3.2	4.2

Source: Energy Information Administration (2014).

1-2-3 Events

In 201X, a very large crude carrier navigating the Strait of Malacca, loaded with 2 million barrels of Middle Eastern crude oil, accidentally collided with a product tanker in the same strait that was loaded with 400,000 barrels of fuel oil. After the accident, both tankers burst into flames, and the fire lasted for a week. To make matters worse, huge quantities of the crude oil and fuel oil loaded on both tankers spilled into the sea immediately after the collision. As a result of the tanker accident, the Strait of Malacca had to be shut down. Regulatory agencies allowed vessels navigating the strait when the accident occurred to continue, but vessels that entered after the accident were required to bypass the troubled strait.

If the loads that spilled into the sea had been light oil products, such as gasoline, they would have evaporated after a certain period of time and would not have remained on the sea surface for long. However, this accident involved crude oil, especially Middle Eastern crude oil with a high specific gravity. The fuel oil loaded on the product tankers also had a low pour point. For this reason, the huge quantities of oil spill stayed floating on the sea for a prolonged period of time.

In order to extinguish the fire on the tankers and clean up the oil spill, the Strait of Malacca was shut down for about 3 weeks. The oil spill from the tanker accident drifted down to the vicinity of the refineries and oil tank sites in Singapore, which forced the country to completely stop its imports of crude oil and exports of oil products during the 3-week period.

Table 1-5. Impacts of the Scenario

Item	Impact	Time Required to Recover
Navigation in the Strait of Malacca	Interrupted	3 weeks
Operation of refineries in Singapore	No impact (there was a limit to the volume of crude oil stock)	n/a
Imports of oil to Singapore	Interrupted	3 weeks
Exports of oil from Singapore	Interrupted	3 weeks

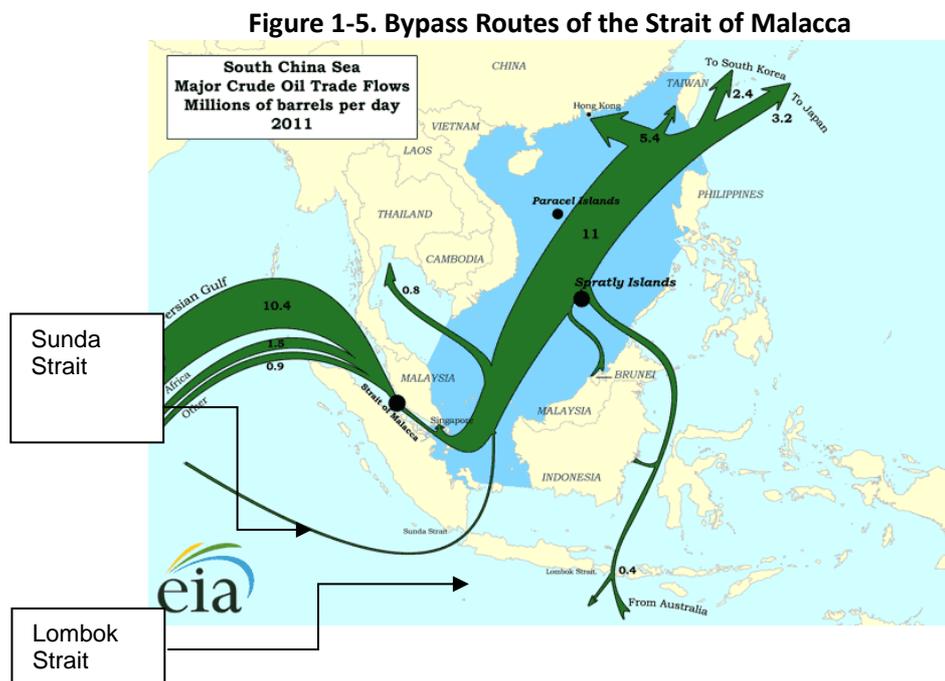
Source: Authors.

1-2-3 Possible oil supply problems

(a) Shutdown of the Strait of Malacca as a critical ocean route

One of the immediate impacts of the tanker accident was on the oil transit of as much as 15 million b/d of oil in the Strait of Malacca. The oil transit had to bypass the strait, taking tankers around an additional three days. The possible bypass routes were either the Sunda Strait or the Lombok Strait (Figure 1-5), but both routes were known as

transit chokepoints, with the potential for crowding of vessels in their vicinity. However, for Japanese and Korean oil companies importing oil via tankers navigating through the Strait of Malacca, the impact of the strait shutdown was only a 3-day delay in oil arrival to their home market. This level of delay was able to be easily absorbed by regular oil stockpiling. On the other hand, developing countries like Country B faced extremely serious consequences from the incident, as their levels of domestic oil stock were lower than that of developed countries, and their dependence on product imports from Singapore is high. f



Source: United States Energy Information Administration website.

(b) Disruptions of crude oil supply to refineries in Singapore

The disruption of crude oil supply to refineries in Singapore was another problem that affected the supply of oil products in Asian oil markets and Country B. Since the government of Singapore did not have the required official statistics, it was necessary to estimate the level of oil stock held at refineries in the country. In Singapore, only electric power companies have a legal obligation to meet 30 days' worth of fuel oil stockpiling requirements, and even oil companies do not have an obligation for oil stockpiling. Many of the refineries in Singapore are owned by major international oil companies, and their cost management is considered to be very thorough. For this reason, we believe that the refineries are operated at the lowest

possible level of oil stockpiling. We estimate that their oil inventory days are lower than those of the IEA policy target (90 days' worth), and that their commercial oil stock is set at a level of about 3 weeks' worth. Therefore, all the refineries in Singapore were forced to ramp up their operation in the wake of the tanker accident. The supply of oil products plummeted accordingly.

(c) Interrupted oil product shipments in the vicinity of Singapore

Despite the severity of the situation, refineries in the vicinity of Singapore were able to continue operations using the existing, although limited, crude oil stock. A much more serious consequence of the tanker accident was that the navigation of tankers in the Strait of Malacca was interrupted for three weeks, shutting out oil product shipments from Singapore. This prevented oil products from being shipped from the refineries and oil tank terminals in the country or its vicinity. Singapore acts as an oil blending terminal for the Asian market, and also functions as an end product shipment terminal for each Asian country's oil product market. In the wake of the tanker accident, this contributed to the worsening of the supply and demand conditions of oil products. There were in fact adequate quantities of oil product stock within the Asian region to satisfy domestic demand, but after the tanker accident, the inability of Singapore to ship oil products to other Asian countries suddenly tightened the supply and demand conditions of oil products.

(d) Price hikes in Asian oil product markets

The tightening of the supply and demand conditions of oil products caused the prices of oil products to rise sharply. The interruption of oil product supplies from Singapore, a major oil product supply hub in the Asian market, had an immense impact on international oil markets. The prices of gasoline, kerosene, diesel oil, fuel oil, and all other oil products increased sharply by about 20–30 percent. As a result of these price hikes, corresponding oil consumer prices went up, even in countries such as Japan and Korea, because their domestic prices were linked to Singapore's market prices. In countries such as Viet Nam and Myanmar, which were constantly importing oil products from Singapore, the tanker accident inflated their import prices substantially. The accident brought about significant negative impacts on the economies of both developed and developing countries.

The impact of the tanker accident on market prices in Asia reached not just the oil product market but also the entire crude oil market. The reduction in crude oil throughput in Singapore decreased the demand for crude oil and loosened the overall supply and demand conditions of Middle Eastern crude oil. Ironically, the increase in oil product prices pushed up refinery margins in Asia. Because these oil products are produced from crude oil, the appraisal value of crude oil itself increased in the market as well. Furthermore, the increase in such refinery

margins helped improve the utilisation rates of refineries in other countries, and crude oil prices rose with the increasing oil product prices.

As described above, because of the longer crude oil haul distances due to the closure of the Malacca Strait, the tanker supply and demand conditions tightened suddenly. As a result of the tight supply and demand conditions for tanker space, the freight cost of crude oil jumped by US\$1/bbl to US\$2/bbl.

(e) Decreased imports in Country B

In Country B, where oil product prices were liberalised, the tight supply and demand conditions and the price hikes initially began to be reflected directly in the domestic market, and the country saw its oil prices increase sharply. While it had sufficient amounts of foreign currency from the recent strong exports of other manufactured products, Country B had to cut the import volume of oil products by 10 percent since the import amounts were substantially exceeding the initial budget.

Since it had no local refineries, Country B had no other option but to import oil products. If the country had had a domestic refinery, and had held a sufficient level of crude oil stock to survive the impact of the oil supply disruption, the country could have minimised the impact of a complete oil product disruption from Singapore. As for crude oil sources, if the country had had trouble getting crude oil from the Middle East, then it should have been able to switch the source to another country in Southeast Asia or Russia. The main reasons why Country B was enormously affected by the supply disruption include: i) Country B had no option than to import oil products from overseas, and ii) Country B depended mostly on Singapore for its supply of oil products.

(f) Uncertain and low domestic oil stock levels

In Country B, domestic oil product inventory levels had originally been very low and oil smuggling was widespread. This made it difficult to determine the levels of domestic oil product stocks and contributed to a worsening of the situation in the country after the tanker accident. As previously mentioned, partly because oil products were distributed at international market prices in Country B, smugglers regularly brought in oil products procured in neighbouring countries at subsidised prices. For this reason, the country had difficulties in monitoring the quantity of the oil product stock in the country and the distribution channels of the illegal products. After the imports of oil products began to decrease, the national oil company's domestic stock plummeted suddenly (based on the only data the government had). At the same time, in anticipation of the increasingly rising oil product prices in Country B, oil smuggling became even more widespread. This was how the country experienced increasing problems for its oil product distribution.

Moreover, knowing that even the government of Country B did not accurately know the level of its domestic oil stock, market concerns heightened to maximum levels, leading to panic buying among consumers. The lack of transparency in oil stock statistics created additional and detrimental product demand.

(g) Heightened public dissatisfaction

As oil distribution became increasingly problematic and uncertain, public dissatisfaction of the government's oil policy also began to grow. As mentioned, oil accounted for only about a quarter of the country's primary energy supply mix, and oil was consumed by only a limited number of people in certain social classes. For this reason, the reduction in oil imports had a direct impact only on a limited number of people. However, the reduced availability of oil caused the country's overall energy prices to rise. This meant that people of lower social classes, who typically used traditional biomass energy sources, were forced to deal with indirect supply constraints and price increases.

Most of the oil consumption in Country B was of diesel oil. Because diesel oil was used mainly in the logistics field, the distribution of daily necessities, clothing, and medical supplies was partly disrupted, having a significant impact on people's lives. Many consumers stood in long lines at gas pumps and the shortage of diesel oil interfered significantly with traffic in urban areas. This was because i) in Country B, the use of oil had not spread to people's lives as widely as it had in Country A; ii) in Country B, oil products had originally been distributed at international market prices and the people had experienced considerable price changes when crude oil prices fluctuated the past; and iii) the scale of Country B is relatively smaller, and oil rationing associated with the reduced oil imports (as described earlier) was implemented in a relatively effective manner.

Furthermore, the shortage of jet fuel led to a restriction of airline services in Country B. As a result, the country's flight arrival and departure schedules had to be revised, which also affected people's lives. Tourism was one of the country's major industries, and the reduced numbers of flights and tourists visiting popular sightseeing spots caused a serious setback to the tourism industry.

1-2-4 How was the situation resolved?

Because of the time taken to clean up the spilled oil after the tanker accident off the coast of Singapore, the shutdown of the Strait of Malacca lasted as long as 3 weeks. After that time, the oil product supplies gradually recovered to their pre-accident levels. In addition, Country B took the following measures to accelerate the recovery.

(a) Introduction of oil product rationing

The country first introduced oil product rationing. As imports of oil products decreased by about 20 percent, the supply of such products in the country also dropped by the same percentage. Under the government's intervention, the national oil company decided the order of priority on how to allocate its oil products to major consumers. As Country A did, Country B tried to prioritise the supply of oil products to help the public and for administrative functions. Not having accumulated enough information on oil product stocks and distribution conditions during ordinary circumstances led to Country B sometimes mistakenly supplying oil products to locations that in fact were not prioritised, or not supplying products to locations that should have been prioritised.

(b) Functions of market mechanisms

As well as the measures described above, market mechanisms and price signals played major roles in the recovery process. In Country B, the domestic oil product market was liberalised, and oil products were distributed at selling prices linked to international oil markets. After the tanker accident, overall oil product prices in Asia went up. With the aim to make a profit through arbitrage, traders imported oil products to the Asian market from all around the world. Many countries in the ASEAN region had subsidy systems in place for domestic oil products and could not afford to import such high-priced products. On the other hand, while its ability to import oil products was limited, Country B was somewhat receptive to the inflow of additional oil products into Asia because the levels of its domestic selling prices had originally been high. This pricing structure helped Country B in securing its required oil products.

Fortunately, many foreign companies were operating in Country B because of the liberalised oil market. Many of the multinational companies were able to secure the necessary products under their international supply networks with each oil company. These companies tried to secure the necessary products by taking advantage of their own unique product supply routes. As a result, the efforts of the companies contributed significantly to Country B securing oil product supplies after the tanker accident.

(c) Internationally supported oil product supply

Despite the oil product supply disruption from Singapore, Country B was able to receive oil products under a bilateral agreement concerning emergency response with Country C. Country C supplied oil products to Country B mainly from government-held national stockpiling. As part of the agreement, Country C's private companies supplied the necessary products to support Country B. There were differences between the two countries in the quality standards for some of these products, but the government of Country B solved the

problem by temporarily relaxing their quality standards. Country C had excess refining capacity even during ordinary times. Setting aside the overall price hikes of crude oil and oil products, the impacts that Country C suffered from the tanker accident in Singapore were only slight delays in crude oil arrival. Because there was almost no physical shortage in its domestic oil product supply, Country C had the capacity to help Country B.

1-2-5 Implications of the scenario

This scenario is quite different from the scenario of Country A in both the cause of the supply disruption and the country's scale and oil consumption mix. The implications that can be derived from this scenario have some similarities with those for Country A, but at the same time some of the implications are quite different. Setting aside the overlapping parts of the two scenarios as much as possible, this section looks at some of the implications that come to mind.

(a) When securing the oil supply in an emergency, what problems will the lack of domestic refineries cause?

As mentioned in the scenario, dependence on imports of oil products for the domestic product supply, particularly from specific oil companies and countries, inevitably limits the scope of options in an emergency. Because of the large costs, the construction of a refinery is not always justifiable. Despite the existence of excess refining capacity in neighbouring countries, building a new domestic refinery could worsen the existing oversupply problem in the Asian market. For this reason, the purpose of the project should be studied thoroughly before building a refinery. If the country decides not to have a refinery, the necessary precautions should be taken against the resulting vulnerability of the country's oil product supply.

(b) What implications does a liberalised domestic market have from the standpoint of the emergency oil product supply?

The scenario for Country B showed that a liberalised domestic oil market would offer the following advantages: i) oil products can be secured at international market prices more easily; ii) people can cope with price fluctuations in a flexible manner; and iii) the domestic market can access international trading networks through the foreign companies operating in the country. Of course, in the event of such an emergency, the government is expected to have an extremely important role, including determining the supply and demand conditions throughout the country, prioritising the supply of oil products, and making detailed policy decisions when a rationing system is introduced. On the other hand, it is true that a liberalised domestic oil market offers various advantages that other countries are unable to enjoy. An example of this case is Hurricane Katrina, which struck the US in 2005, resulting in a reduction

in the country's domestic refining capacity and causing gasoline prices to soar. Many countries that had not exported oil products to the US during ordinary circumstances supplied the necessary oil products to the disaster-stricken country and helped it recover earlier than expected. It is impossible to respond to emergency situations by relying solely on market mechanisms, but such market mechanisms should be proactively pursued when they are expected to work effectively. Determining the respective roles of the government and the market is an important part of an effective emergency response.

(c) What kinds of methods or incentives should be granted to private companies and foreign companies to hold them accountable for oil stockpiling?

In a sense, the lack of appropriate oil stockpiling worsened the impact of the crisis in Country B. In Country B, where private and foreign companies supply most of the oil product supply, if the country imposed oil stockpiling obligations on companies, the country would undoubtedly see more problems than it would impose it on the national oil company. The act of oil stockpiling is synonymous with holding larger quantities of oil stock, a significant disadvantage for private companies whose mission is to maximise their profit. For this reason, if a country with an industrial structure like Country B is going to implement an oil stockpiling system, the country should take the necessary measures to reduce the burden on oil companies as much as possible, or conversely, the country should consider other approaches that would advantage these companies.

(d) When the status of the oil stock is unknown, how can we collect the necessary information to make appropriate decisions?

Due to the problem of smuggling, Country B was unable to collect accurate information on its domestic oil product stock in a timely manner. In the event of an unexpected, large-scale supply disruption as indicated in this scenario, the absence of such information can cause huge problems. Needless to say, it is important to record such statistics during ordinary circumstances, but it can take a long time to develop such measures. The government and oil companies need to maintain a network during ordinary times in preparation for emergency situations. When an emergency actually happens, an appropriate system should be set up with the help of such networks so that the concerned parties can share information on each company's oil stock status and formulate procurement plans in a timely manner. To ensure the effectiveness of the network, the country should conduct training during ordinary times as often as possible.