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Taiwan's Energy Security Issues

--Domestic Energy Policies and Transporting Energy by Sea--

MASAHIRO ATSUMI

INSTITUTE FOR INTERNATIONAL POLICY STUDIES

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The policies concerning Taiwan's nuclear power program have varied according to administration and circumstances. Since 1978, when a location for the Lungmen nuclear power plant was determined, the program has seen and on-again, off-again stance, with the ruling and opposition parties making and reversing decisions in a way that was not necessarily reflective of the will of the people.

This paper reviewes Taiwan's energy environment and policies, specifically energy self-sufficiency and supply, and energy supply and demand forecasts and policy. Following this discussion is an overview of the pillars for securing a stable energy supply and such factors a diversification of petroleum suppliers, sea lane security, and China's increasing energy imports. The final section offers policy proposals for consideration in Taiwan's efforts for securing a stable energy supply into the future. The conclusion suggests that the situation and proposals for Taiwan are applicable to another country in the region.

The battle over nuclear power

On 27 October 2000, a little over five months since his inauguration, President Chen Sui-bian announced the cancellation of the Lungmen nuclear power plant construction project. This plant, located 40 km from Taipei in Yenliao village on Taiwan's northeast coast, consists of two 1.35 MW reactors. The project was more than 30% complete, and those involved believed it was past the point of no return. However, anti-nuclear court cases had been dragging on for years, and then the Democratic Progressive Party won the general elections in March of that year with campaign promises to scrap the nuclear power program. True to his word, President Chen took office and ordered the Ministry of Economic Affairs to review the nuclear power development program. A review within the government was completed, and in October, the head of the Executive Yuan (the premier) announced the cancellation of the project.

The story leading up to the start of construction of the Lungmen nuclear power plant takes many twists and turns. The location was selected in 1978, and by 1983 a site had been acquired. However, a floundering economy and soft demand for electric power delayed construction temporarily. The Chernobyl accident in 1986 reverberated in Taiwan and fueled anti-nuclear sentiment there. In that same year, the construction budget was frozen, and by default construction was put on hold indefinitely.

Later, swift economic growth dramatically boosted demand for electric power, pushing Taiwan into a severe power shortage and seriously impacting Taiwanese industry and the lives of the Taiwanese people. As a result, the Administrative Yuan approved the revival of the Lungmen nuclear power project in February 1992. Despite a brawl in the National Assembly and clashes between anti-nuclear protestors and riot police in July of 1994, the ruling Kuomintang Party (KMT) pushed a bill through to break the construction budget freeze, and the Legislative Yuan approved it.

The bill ignited an anti-nuclear movement within the government, and in a local referendum, more than half of Taipei's residents voted against construction of the Lungmen nuclear power plant. The appearance of anti-construction supporters in the KMT caused a rift with the pro-construction members of the party, and the Nuclear Phase-out Bill was approved in the May-1996 session of the Legislative Yuan. This bill cancelled the Lungmen nuclear power plant and froze any future plans for nuclear power projects. The Administrative Yuan submitted to the Legislative Yuan a motion to overturn the decision and reinstate the Lungmen nuclear power program. The KMT had a majority in the house and they carried the motion with more than the required one-third vote. Thus, in October 1996, the reinstatement of the Lungmen nuclear power plant was officially approved. After repeating the environmental impact and safety evaluations, the Administrative Yuan's Atomic Energy Council gave the green light to construction in March 1999. Construction started on Reactor 1 in that same month, and construction on Reactor 2 began in January 2000. The project was estimated to take five years and cost approximately 170 billion Taiwan Dollars (TWD), or about US $6 billion.

After all this, the Democratic Progressive Party won the general elections on an anti-nuclear power platform and announced the cancellation of the construction project in October 2000. The Administrative Yuan gave these reasons for the cancellation.

* Enough power would be available through 2007 without the Lungmen nuclear power plant.
* Construction of LNG thermal power plants would probably replace nuclear power after 2007.
* Methods of disposing of radioactive waste were not well established.
* Nuclear accidents were a concern.
* The cost of continuing construction would exceed the limit set for canceling construction.
* Continued economic growth is possible without nuclear power, and it is important to create a peaceful, nuclear-free country for the next generation.

Dissatisfied with the Administrative Yuan's decision, the KMT led the opposition parties in demanding a complete withdrawal of the cancellation order, and the Legislative Yuan filed an objection against the Administrative Yuan. The Administrative Yuan turned the matter over to the Council of Grand Justices, which is the body that interprets Taiwan's constitution, but the opposition parties in the Legislative Yuan created political turmoil by proposing a bill to impeach the president. On November 6, President Chen made a formal apology for causing such a crisis.

On 15 January 2001, the Council of Grand Justices handed down a decision that stated "the Administrative Yuan did not follow proper procedure in overturning the decision," and the construction issue was resolved in a compromise between the Administrative Yuan and Legislative Yuan. At the end of that month, the Legislative Yuan overwhelmingly approved the resumption of construction with a 134 to 70 vote and 6 abstentions, and in February, the Legislative Yuan and Administrative Yuan conditionally agreed to resume construction of the Lungmen nuclear power plant. The main points of this agreement were as follows:

*The Administrative Yuan would immediately announce the decision to resume construction of the Lungmen power plant, and budgeting would be done based on applicable laws.

* The final objective would be a non-nuclear system, as long as it does not result in an energy shortage.

* The Administrative Yuan would propose the "Nuclear Energy Law" to define future nuclear energy plans, and refer this to the Legislative Yuan for discussion.

It was approximately another six months from the time the decision was made until construction actually began because new agreements with contractors and other preparations had to be made. As a result, the entire project was pushed back about 18 months, and Reactor 1 and Reactor 2 were expected to be completed in July 2006 and July 2007, respectively. An economic evaluation by the state-run Taiwan Power Company (Taipower) estimated that the total cost of the delay was TWD 43.6 billion (about US $1.5 billion) over and above the original cost.

The economic costs of the delay aside, there is a more important aspect to this conflict over nuclear power: the issue was never more than a political football, fought over by the ruling party and the opposition parties based only on policy differences in their stance on nuclear power. Not once was Taiwan's energy future discussed in depth. The cancellation of the Lungmen nuclear power plant by the Democratic Progressive Party administration may have been simply an effort to make good on a campaign promise. Prior to the decision handed down by the Council of Grand Justices, the China Times conducted a survey on the cancellation of the project, and 31% supported the decision, while 42% did not. Thus, the decision to cancel was not necessarily reflective of the will of the people.

The conflict in Taiwan may have been influenced by the events in Germany in 1988, when the newly formed Schroeder coalition government surprised the world with its renunciation of nuclear power. Considering the sequence of events, it is not inconceivable that the anti-nuclear movement in Germany had an effect on the nuclear policy of the Democratic Progressive Party. Of course, energy supply and demand differs from country to country, and the policies of each

country for securing a stable supply of energy over the long-term must be balanced and take a form suitable to each country's situation. Although it has its problems, nuclear power is still one energy supply option. Regardless of the arguments for or against nuclear power, it is a very limited energy resource, and if the nuclear debate in Taiwan, a country with six reactors in operation, was nothing more than a political tool, it is a very worrying situation indeed. In that light, even though Germany has a highly developed renewable energy program, the renunciation of nuclear power was rendered politically inert through compromises between the government and the power companies. In addition, the quick retreat from nuclear power was set in motion by the Green Party faction of the ruling coalition. The stark contrast with the decision in Taiwan thus becomes very interesting.

To reiterate, any country must achieve a stable long-term energy supply by searching out a path to reliable and reasonable acquisition of the necessary energy, with consideration for the country's energy environment and the ideal balance in the energy mix. This ideal should be used as a launching pad for discussion of the role of each energy source, and the means of achieving the ideal balance should then become the national energy policy.

Through discussion of the various issues Taiwan faces in securing a stable long-term energy supply, this paper attempts to point out the direction, however vague, Taiwan is taking in pursuit of their ideal energy mix. It also discusses, within this context, the problems faced in securing the sea lanes.

Taiwan's energy environment and policies

An understanding of Taiwan's current energy environment is necessary to discussing the future of Taiwan's energy security. The following discussion will describe energy production, supply, and demand in Taiwan, and then flush out the problems in achieving energy security based on the latest energy requirement forecasts put out by the Taiwanese government.

Energy production in Taiwan

Taiwan does have reserves of petroleum, natural gas, and coal, but they are very small. The geography of the country does not provide much hydroelectric power capacity, so the domestic energy production capacity is quite limited. Taiwan's energy statistics include nuclear power generation as a 100% import rather than in the domestic energy production category, but even with nuclear power, Taiwan's self-sufficiency rate for primary energy is about 10%. By 1970, Taiwan had already depleted its shallow coal beds, and the cost of domestic coal production was exorbitant compared to imports. Thus in 2001, the four remaining coal mines were closed, and there has been no coal production since. Over the past several years, there has been a slight yearly increase in oil and gas production, but with existing oil and gas fields drying up and new development stagnating, mid-term production volumes cannot help but decline. In 2002, oil production was roughly 500,000 kl, natural gas about 880,000 kiloliters oil equivalent (KLOE), and hydroelectric power about 1.5 million KLOE.

The six reactors at three power plants (for a total capacity of 51.44 million kW) produced electric power, which is 9.82 million KLOE.

The development of reusable energy in Taiwan is at the research and testing stage, and the electric power currently produced by such means is an insignificant proportion of the total primary energy supply.

Energy supply

The total primary energy supplied in 2002 was 13,270,000 KLOE—about one-fifth of the energy supplied in Japan in the same year. Taiwan's population is one-fifth that of Japan, so the per capita volume of energy supplied is about equal. The amount supplied by each energy source was as follows: hydro power 1.4%, nuclear power 8.4%, coal 33.2%, oil 49.8%, and natural gas 7.2%.

In the same year, the dependency rate on imported energy was 89.3%, even including nuclear power as a domestic energy source. With declining domestic energy production and rising energy demands, dependence on energy imports is increasing, and by 2002, the import dependency rate increased 7.4 percentage points over 1992 figures. Below is a closer look at the import-dependent energy sources of coal, oil, and gas.

Coal

The volume of coal supplied was 37.5 million KLOE, and 100% of this was imported. The amount of coal supplied has increased at a rate of 10% per year, growing 2.3 times over the last decade. These imports came from China 35.0%, Indonesia 29.3%, Australia 26.4%, South Africa 3.9%, Canada 2.1%, US 0.3%, and other countries as well, but mostly from nearby countries. This is due to transportation costs.

Oil

The amount supplied in 2002 was 55.8 million kl—an average annual growth rate of 5.7% over the last ten years, growing 1.6 times in this period. With an import dependency rate of 99.9%, it is no exaggeration to say that the entire amount was imported. Imports for 2001 were from Saudi Arabia 24.5%, Kuwait 17.8%, Iran 12.2%, UAE 4.6%, Indonesia 1.9%, Oman 1.4%, and all others 37.6%. Since 1993, low-sulfur crude oil imports from countries like the Congo and Angola have been increasing. Taiwan is dependent for 60% of its oil imports on the Middle East, which is low compared to Japan's 87.9%, and this sheds light on their efforts to diversify suppliers.

Natural Gas

The volume of natural gas supplied in 2002 was 8.6 million KLOE, representing an annual average growth of about 9.0% over the last ten years, growing 2.7 times in this period. The import dependency rate is 90%. Natural gas is imported in the form of liquid natural gas (LNG), and Taiwan has long-term contracts with the Badak III and VI projects in Indonesia, and the Malaysia II project. Both of these LNG projects use Kalimantan Island as a forwarding base, with the shipping route to Taiwan passing through the Straits of Malacca. Imports for 2001 came from Indonesia 59.6% and Malaysia 40.4%.

Energy supply and demand forecasts and energy policy

Energy policy framework

Taiwan's energy policy focuses primarily on a stable energy supply because of Taiwan's deep reliance on imports. In 1973, a firm policy aimed at securing a stable supply of energy was adopted, and the policy underwent fundamental revisions or amendments four times since then, in response to the oil crisis and other domestic or international energy situations. Taiwan's basic energy policy now consists of the following six basic objectives: a stable energy supply, improved energy efficiency, deregulation of energy production, environmental protection, increased research and development of energy technology, and promotion of energy education.

Since Taiwan relies on imported oil as its primary energy source, it has sought to lower both the percentage of oil in its energy mix and its reliance on Middle East oil by seeking out alternative energy sources and diversifying its oil suppliers. This can be seen in its continued development of hydroelectric power, promotion of coal and natural gas use, and active participation in overseas oil field development projects. Originally, moderate increases in nuclear power were part of this strategy, but as a result of the nuclear power dispute mentioned earlier, this strategy has been reversed.

The importance of maintaining appropriate stockpiles of each energy type as a hedge against unforeseen shortages was also stated in the policy. Taiwan already has a public stockpile system that requires oil importers to stockpile 60 days worth of all petroleum (crude oil as well as petroleum products). In addition, the government announced in September 2002 a plan for a strategic national petroleum stockpile, which targeted the creation of a national stockpile by 2004 of 3 million kl, enough to meet domestic petroleum demand for 30 days.

Taiwan is also working to improve energy efficiency. Under the leadership of the Ministry of Economic Affairs' Energy Commission, an energy conservation monitoring system was established, electric power consumption standards were set for electrical appliances, automobile fuel efficiency standards were set, low-interest financing and accelerated depreciation schedules were established for energy efficient equipment development and purchases, and several facilities were established for special projects, such as developing energy efficient technology. The government has targeted a 28% energy savings by 2020, and it is working hard to meet it.

The Petroleum Business Law, enacted in September 2001, liberalized petroleum product imports, and continued the process of privatizing the China Petroleum Corporation (CPC) and Taipower.

To improve environmental protection, the National Energy Conference was set up as a special agency of the Administrative Yuan in May 1998, following COP3, and basic energy objectives were established to achieve economic growth and a secure energy supply while taking into consideration environmental protection issues such as the prevention of global warming. As a

result, the government promoted the introduction of renewable energy and expanded the use of natural gas. The Energy Administration Law established a fund for renewable energy research and development that receives 0.5% of the income generated by domestic sales of petroleum or electric power. In January 2002, the Renewable Energy Development Plan was released, and this plan set development goals for each energy type, including geothermal and solar power.

Long-term energy supply and demand forecasts

Based on the energy supply and demand forecasts for the period 2002 to 2020 (see attachment), made by the Energy Commission and reflective of the expected impact of the above energy policies, the primary energy supplied in 2020 is expected to be 163 million KLOE, representing a 44% increase for the period. This figure assumes an annual average GNP growth of 3.34% over the next 18 years and continued emphasis on increased energy conservation. The energy mix expected in 2020 is coal 27%, oil 46%, natural gas 15%, hydroelectric 7%, and renewable energy 4%. Compared to the energy mix in 2002, the percentage of coal, oil, and nuclear power is lower (down 6, 2, and 2 percentage points respectively), while natural gas, and renewable energy are higher (7 and 3 percentage points respectively).

Based on these estimates, the respective annual increases in import volumes are coal 6 million KLOE, oil 20.9 million KLOE, and natural gas 14.5 million KLOE. This represents a massive increase in the scale of Taiwan's energy imports.

A comparison of the energy structure forecasted for 2020 with the current energy environment in Taiwan and energy forecasts for Asia raises some questions about Taiwan's ability to achieve its goals. Two of the most important issues follow.

Increasing renewable energy

As stated earlier, numerical targets for Taiwan's renewable energy development are set for each energy source in the Renewable Energy Development Plan, and this research and development is to be funded, at least in part, by the Energy Research and Development Fund. However, these energy development projects are only at the testing and research stage, and the process by which renewable energy will make up 4% of the national energy supply, equivalent to about 6.9 million KLOE or 30 billion KWh of electric power, is not clear. With these figures, another 5.7 million kW of renewable energy generation capacity will be required, even when using a high 60% operating capacity in calculations for these facilities. This is equivalent to the power of four new nuclear reactors.

Currently the entire world and developed nations in particular are emphasizing the development of renewable energy technology, and the various technological breakthroughs required for large-scale deployment may occur sooner than we think. Germany, the world leader in renewable energy, is planning to acquire 30% of its electric power from reusable energy sources by 2030, which suggests a large burst of development activity in renewable energy in the near future.

However, no matter what revolutionary developments there are, the character of renewable energy production facilities will keep their scale extremely small in

comparison to traditional electric power facilities, which means a great number of sites will be required to obtain large amounts of energy. Taiwan is located in the subtropical zone and along the "Pacific Rim of Fire"—the Pacific plate along which most of the world's volcanoes occur—which are prime locations for solar and geothermal energy. In addition, the average annual wind speed on the Pescadores is more than seven meters per second, which is ideal for wind power. However, since Taiwan is geographically one-fifth the size of Japan, it is probably not going to be easy to secure a large number of sites for renewable energy. Last year in Europe, there were several protests by local residents against windmill farms due to the noise and because they are eyesores.

Increasing the natural gas supply

Taiwan is focusing a great deal of attention on expanding the use of natural gas as a means of diversifying both energy sources and suppliers, and fighting global warming. Other than what little they produce domestically, Taiwan's natural gas supply comes in the form of imported LNG. There is currently only one facility in the entire country for receiving LNG, and that is the Yong An LNG plant in Kaoshsiung Province. In order to accommodate increased LNG import volumes or expansion of the existing LNG long-term purchasing contracts, the capacity of this facility was expanded over three years, and the current nominal capacity is 7.87 million tonnes per year. Further expansion of LNG use is being answered by plans to build a second LNG receiving terminal in Tao Yuan in the northern part of Taiwan. According to that plan, the facility will be in operation by 2006, and is expected to eventually have a capacity of about 7 million tonnes.

As of 2002, natural gas demand as a percentage of total electric power demand was 68%. To deal with the promotion and expanded use of natural gas and the accelerated increase in electric power demand, Taipower is planning to build and operate the Tatan LNG Thermal Electric Power Plant, with a 4.2 million kW capacity, near the LNG 2 terminal. This plant was scheduled to come on line by 2002, but the down economy of 2001 and the temporary slump in demand pushed that date to 2005.

While improvements to infrastructure continue, like that for the expanded use of natural gas, there are still some very high hurdles ahead if Taiwan plans to meet the 23.1 million KLOE natural gas supply forecast for 2020. The additional import volume in 2020 is 14.5 million KLOE, or about 10 million tonnes of LNG. The increase is huge, and would almost double Taiwan's LNG import volume.

The Asian region as a whole is converting to natural gas for electric power generation out of concern for problems in the global environment. The development of transnational natural gas pipelines in the region will probably be extremely limited, even by 2020, due to geographic and economic restrictions. Thus, it is not difficult to imagine LNG transactions becoming the mainstay of the natural gas trade. With competition from Japan, Korea, China, and other countries complicating matters further, achieving a 10 million tonne increase in LNG imports over the next 18 years will be difficult at best. Additionally, the current price of LNG in Asia is high relative to other fossil fuels, and by 2020, competition for that resource could possibly drive it higher.

> Commodity taxes on LNG imports were abolished in October 2001, and duties were abolished at the beginning of 2002. However, in the electric power generation sector, which accounts for almost 70% of the natural gas demand, use of natural gas has not grown due to the relatively high price. In 2001, the price of 1 kWh of thermal power generated by natural gas was 2.7477 Taiwan Dollars (TWD). This is relatively high compared to that same kilowatt hour generated by coal at 0.9150 TWD, or oil at 1.9297 TWD. As a result, Taiwan's natural gas power generation facilities ran at only 29.2% of capacity, an extremely low figure. Based on the above, long-term energy forecasts for natural gas demand are exceedingly large and highly unlikely to be met given current conditions.

The problems to which renewable energy and natural gas are the answer will materialize in 2020, but if demand reaches or exceeds these forecasted levels, Taiwan will have no option but to fill the power gap through additional coal or oil imports or another reversal in its policy on nuclear power.

Maintaining energy security

In light of the current energy supply and demand situation in Taiwan and the long-term forecasts, Taiwan's biggest energy security problem boils down to a very basic problem: securing a stable supply of oil resources to meet growing demand, and broadly deploying alternative energy sources. This section delves more deeply into the barriers and issues Taiwan faces in achieving a stable oil supply into the future.

Before going on, a definition of energy security is needed. Energy security for one nation means to maintain a situation in which "the required volume of energy can be provided to consumers (governments, businesses, and citizens etc.) when needed, in the required form (crude oil, petroleum products, electric power, etc.) at the required quality and at a reasonable price, whether in times of peace or war." With this in mind, the pillars of energy security are (1) maintaining energy volume, (2) maintaining a reasonable price, and (3) maintaining an efficient national energy supply system. Only when all three points are taken into consideration can a systematic energy security policy be created, but due to space concerns, this paper selects the most serious and fundamental issue on which to focus, namely securing energy volume. Though this paper does not deal with the other two points under separate headings, their economic importance in procuring energy is kept in mind throughout the discussion.

Diversifying petroleum suppliers, and reliance on the Middle East

The first thing the oil importing countries of the world, particularly those in Asia, need to consider in order to secure a stable oil supply is the diversification of suppliers. One of the peculiarities of oil as an energy source is its geographically uneven distribution and the relatively unstable political systems surrounding the large reserves in the Middle East and Persian Gulf region. Japan and other Asian countries that are highly dependent on Middle East oil production were severely and directly impacted by the two oil crises, which threw the economy of these countries into turmoil. Every country learned their lesson, and the efforts to reduce the dependency on Middle East oil continues to this day. Japan's dependency on Middle East oil in the latter half of the 1960s, when the first crisis hit, was more than 90%, and

by the latter half of the 1980s, that figure was pushed down to 68%. During this period, Japan went all out on energy saving policies, introduced LNG in 1969 as an alternative to petroleum, and developed nuclear power. However, the latter half of the 1980s saw the start of the bubble economy and a steep increase in energy demand, particularly for electric power, and this started to accelerate Japan's dependence on Middle East oil. This trend continued even after the bubble burst, and as a result, Japan was back up to 87.9% by 2001.

As a result of their policies on oil supplier diversification, Taiwan now enjoys a relatively low dependency rate of 60% on Middle East oil. However, Taiwan is expected to dramatically increase its demand for oil, and in the short run, it will probably be difficult for them to maintain the current dependency rate.

First, a recent look at world petroleum reserves by region shows that at the end of 2002, the Middle East accounted for 65.4% of the worlds oil reserves, while the second largest reserves in Central and South America trail far behind at 9.4%. This uneven distribution of accessible oil reserves is expected to cause the Middle East's proportion of the world's oil production to increase from the current 30% to 50% by 2020.

Oil exporting countries in the Asian region are expected to reduce their exports as domestic oil demand increases, and only the oil producing countries in the Middle East that have a production surplus will be able to respond to the sharp increase in oil demand in Asia. Thus, the Asian region's dependency on Middle East oil is expected to jump over the mid-term. It may be possible for countries to reduce their dependency on oil to a certain degree through expanded use of alternative energy sources, but the factors underlying Asia's healthy demand for oil will make those reductions small. The economic development in Asia has resulted in the sudden spread of motorization and the stimulation of internal overland distribution systems. Since it will take a long time to introduce gasoline alternatives for automobiles, the effectiveness of alternative energy sources in reducing dependency on oil is minimal.

The number of automobiles per 1,000 people in Taiwan was 253 in 2000, and though quite a bit more than Korea, it is less than half of Japan's 573. Considering the above and assuming that Taiwan's economic growth through 2020 is greater than the 3% forecast by the Energy Council, Taiwan's dependence on Middle East oil cannot help but increase drastically in the future. The policy strategies that address this problem are to limit the size of the increase through energy saving measures and to promote the introduction of alternative energy sources, or to deepen relations with countries in the Middle East and attempt to create a symmetrical dependency.

Sea lane security

All of Taiwan's imported energy resources, not just oil, are transported by sea. Thus, the issue of sea lane security is an important issue when discussing Taiwan's energy security. Being an Island country that depends on trade by sea for its economic development, barriers to smooth transportation by sea would be fatal, and in this respect, Japan and Taiwan are very similar. Added to this is the expected increase in energy imports, and if the sea routes become blocked for some reason and this blockage takes a long time to remove, the economic effects would be immeasurable.

From the South China Sea, where Taiwan is located, to the East China Sea, the seas is a patchwork of exclusive economic zones, and possession of many of the islands is disputed by nearby countries. As a result, the security of the sea lanes that run through this stretch of sea cannot be maintained without a cooperative system based on the mutual trust of the littoral countries. As a country that is not recognized by the governments of neighboring countries, Taiwan faces a great many difficulties in this situation that would not occur with other countries. Other viewpoints on this problem are discussed later, but in very basic terms, if Taiwan is excluded from the multilateral system for maritime security by the other countries that share the sea lanes, these other countries may end up with a gapping hole their own maritime security. Since Taiwan's Middle East oil imports will continue to increase and the ratio of these imports as a portion of the total energy supply will head into a precipitous climb, the sea lanes connecting Taiwan with the Middle East will also increase in importance.

The shortest route from the Middle East to Taiwan is through the famous choke point called the Straits of Malacca. Another influential route from the Middle East is a circuitous one, south of the islands of Sumatra and Java, through the Lombok Straits and Makassar Straits to the Celebes Sea, then traveling east, south of Mindanao Island, and to Taiwan. This sea route is often used by Japan, but sea travel from the Straits of Hormuz to Japan using this route takes four days more than then the shorter route through the Straits of Malacca. These four days represent higher charter fees, oil bunker fees, interest, and other costs, so the economic impact is not small. In addition, there are several shallow points (23 meters) in the Straits of Malacca that do not provide the clearance needed for large ships, so the very large crude carrier (VLCC) class, at over 300,000 tonnes, and the ultra large crude carrier (ULCC), at over 320,000 tonnes, have no choice but to use the Lombok Straits. However, the profits gained by using a giant tanker are largely absorbed by the economic cost of a more circuitous route, so in recent years, most oil shipments to the Far East use the relatively maneuverable 250,000 tonne VLCC and the shorter route.

Continued safe passage through the Straits of Malacca is a vital point when considering smooth navigation of the seas between the Middle East and Taiwan. Mr. Reiji Takeishi, researcher at Fujitisu Research Institute wrote a paper entitled Energy Cooperation in Asia and Japan's Role (*Economic Review*, April 2001), in which he talks at length about traffic forecasts for the Straits of Malacca. Based on the number of ships passing through this straight from January to April 2000, as reported by the International Maritime Organization (IMO), Takeishi estimates that 182 ships of 300 tonnes or greater pass through this straight each day. Based on this estimate, there are 237 ships traveling the 800 km straight at any one time, which means that ships of 300 tonnes or greater are traveling the straight at approximately 3.4 km intervals. However, with ships under 300 tonnes as well, a conservative estimate is 1,000 ships a day passing through these straits, which gives only 800 meters between ships. Since the VLCC requires 3 to 4 km to brake, the Straits of Malacca are already at capacity.

Takeishi goes on estimate the volume of freight traveling through the straits, which he says will be 2 to 2.5 times the volume of 2000, which greatly exceeds the capacity of the straits. He proposes an energy grid (pipeline network or electric power network) for the Asian region as a radical measure to avoid this choke point.

Regardless of whether a grid is required or not, the huge sums involved and the multilateral cooperation involved means it would take a long time to implement this plan. In the interim, the energy demand in the East Asian region will skyrocket, and the number of ships navigating the Straits of Malacca will increase beyond the breaking point. With these conditions, it is necessary to establish an international supervisory system involving the countries that consign the shipments and those that register the ships that ply these straits in order to ensure their safety. There have already been many discussions about building such a system of international cooperation. In Japan, the Malacca Straits Council has enlisted the support of The Nippon Foundation and is continuously working toward building this system of international cooperation. However, the countries bordering these straits—Malaysia, Singapore, and Indonesia—have continued to express disapproval of external involvement, other than technological, most likely because they want to maintain their leadership in security for the straits. The Malacca Straits Council and the Nippon Foundation have undertaken several projects, including placing beacons in the straits, building buoy tender vessels, and donating money to Malaysia.

Another threat to sea-lane security for Taiwan and the East Asian region is piracy in the Southeast Asian seas, and this threat has grown more serious in recent years.

The International Maritime Bureau (IMB), affiliated with the International Chamber of Commerce, established the IMB Piracy Reporting Centre in Kuala Lumpur, and this center has been providing information on acts of piracy throughout the world since 1991. Statistics recently released by the center show that there were 234 piracy incidents (including failed attempts) in the first half of 2003, a 37% increase over the same period last year and the highest since 1991. The greatest number of these incidents, 64, occurred off the coast of Indonesia, while 15 occurred in the Straits of Malacca. There were 53 attacks involving firearms and 80 involving bladed weapons in the same period, also the highest number ever recorded. This reflects the escalating brutality of this crime. In the same period, there were reports of 16 crew deaths, 20 missing persons, 52 injuries, and 193 hostages. The incidence of piracy or armed robbery in Asia started increasing in 1995, but it exploded in 1997, possibly as a result of the Asian currency crisis. This trend had continued even after the economic turmoil in the region has subsided.

A shocking event occurred in October 1999, when the Japanese-owned Alondra Rainbow was hijacked and the crew, including 2 Japanese, were set adrift on a raft in the Andaman Sea. This event was the impetus for the Regional Conference on Combating Piracy and Armed Robbery against Ships, held the following March and April of 2000 at the request of the Japanese government. Conference participants shared the belief that (1) multilateral, regional cooperation is necessary to countering piracy, and cooperation between the related countries, public and private groups, and international institutions is vital, (2) the initiative of Asian

countries is necessary in adopting anti-piracy measures for the Asian region, and (3) the creation of a regional agreement should be considered as a means of promoting regional cooperation. To implement the formally adopted action plan, "Asia Anti-Piracy Challenge 2000," it is important that regional cooperation in eradicating piracy in Asia become gradually more substantive.

There were representatives from ship-owner associations, private researchers, and numerous countries and organizations including the ASEAN-10, Indonesia, India, Sri Lanka, Bangladesh, Korea, China, Hong Kong, Japan, the IMO and the IMB. Since everyone agreed that "multilateral, regional cooperation is necessary to countering piracy, and cooperation between the related countries, public and private groups, and international institutions is vital," it is odd that Taiwan, the country with the most at stake, was not invited.

China's rising energy demand

Another phenomenon with tremendous impact on the energy security of Taiwan and the entire Asia region is China's skyrocketing energy demand and the subsequent increase in energy imports. The energy supply and economic state of the Asian region—and Taiwan, Japan, and Korea in particular—will be greatly affected by the approach used to deal with this problem. In a worst-case scenario, it could result in a devastating economic blow. This section examines the potential effects of China's insatiable energy demand on regional energy security.

From 1996 to 2001, the Chinese government increased internal demand and implemented aggressive financial policies, and these policies achieved a 7% average annual economic growth, mainly through economic structure adjustments, infrastructure improvements, and reforming public companies. Against this background, the 16th National Congress of the Communist Party of China held in November 2002, and there it was agreed to target GDP for 2020 at four times the 2000 level.

Despite fears of the economic fall out from the 2003 SARS outbreak, real economic growth is expected to remain high at 7.3% for the year, according to the forecast of the UFJ Institute. Though China's economic growth rate is expected to trend downwards after 2004, most forecasts are optimistic, predicting that the growth rate will exceed 6% even as late as 2030. Based on these forecasts, China stands a very good chance of achieving the goal set for 2020.

As the economy is expected to show high growth for quite some time, so too is China's energy demand expected to grow. Based on the 2002 outlook of the International Energy Agency, China's primary energy supply was 950 million petroleum-equivalent tonnes in 2000 and will reach 1.3 billion by 2010, and 2.133 billion by 2030. The average annual growth rate will be 2.7% between 2000 and 2030. The population of China in 2000 was 1.262 billion in 2000, which equals a per-capita energy consumption rate of 0.7 tonnes for that year. Taiwan's per-capita consumption for that year was 3.75 tonnes, and China's figure was not quite 1/5 of this. In other words, though China's energy demand is now exceedingly small, their robust and long-term economic growth will undoubtedly cause an exceedingly large jump.

In addition, automobile ownership in China was 13 per 1,000 people in 2000, about 1/20 of that of Taiwan, and less than 1/50 of that in Japan. The motorization of China may occur with a speed never seen before, and this alone would be linked to a sudden increase in oil demand. Based on the IEA outlook, the supply of oil is expected to increase at an annual average rate of 3% from 2000 to 2030, which predicts a 2.5 increase in the size of the demand. This will result in an increase in China's oil imports of about 5.8 times during this period, and in 2030 it will reach 10 million barrels per day (equal to an annual import volume of 580 million kl). For reference, Japan's oil import volume today is about 5 million barrels. Like Taiwan, China will probably rely on the Middle East for the lion's share of these oil imports.

In 2000, China's primary energy mix was coal 69.4%, oil 24.8%, natural gas 3.2%, nuclear 0.4%, and hydroelectric power and other types of energy 2.2%. China relies primarily on coal for its energy supply, and this basic mix is not forecast to change by 2030. However, coal use without the proper desulphurization and denitration facilities will result in serious atmospheric pollution in the near future. Thus, the Chinese government plans to expand desulphurization facilities, actively introduce clean coal technology, expand the use of natural gas, and take other measures designed to reduce atmospheric pollution. However, if these measures are not effective in the short term and the traditional environmental pollution problems associated with coal use are not improved, there will possibly be commensurate restrictions on coal use and a shift to other energy sources. The new energy source to take its place will probably be petroleum.

An explosive increase in China's oil import volumes is expected to have a large impact on the world's oil import and export balance, but the impact on oil-importing countries in the Asian region will be particularly pronounced. Not only will oil procurement for countries in the region become more difficult, the already relatively high price of oil in the Asian region will probably increase, and congestion in the Straits of Malacca will become markedly worse.

China's concern over the impending oil problem could also result in a more active and belligerent Chinese naval presence in the South China Sea and the East China Sea, primarily aimed at securing energy resources. This would be a grave situation for Taiwan, Japan, and other countries in the region.

If in an effort to avoid this situation, countries take an antagonistic stance toward China's energy procurement efforts or become territorial about energy resources, it will have the opposite effect. The power of the Communist Party of China comes not from political ideology but from economic growth, and recently there are many researchers who believe that stopping this economic growth would bring down the political system. If that is true, then energy supply shortages would act to suppress quick economic growth, and the Chinese leadership would take all measures necessary to avoid that situation. For the sake of maintaining energy security in East Asia, then, it is important for countries in the region to work with China or include China in the building of a system of regional cooperation in energy. The negative impact of China's increasing energy demands could be alleviated through region-wide cooperation, and if this could be turned into increased bargaining power for the East Asian region, it could strengthen and maintain not only energy security but also general security systems.

Securing a stable energy supply into the future

The following section discusses, in the form of policy proposals, some of the points Taiwan should consider for the purpose of maintaining energy security into the future.

Strengthening ties with oil-producing Middle East countries

Taiwan needs to strengthen ties as much as possible with Middle East oil-producing countries to ensure a stable, continuous supply of oil imports from the Middle East. It is easy to see that if Taiwan does so, Japan's policy of "promotion of dialog" and "ODA contributions" will be woefully inadequate. Strengthening of relations here means working to create "symmetrical dependency," and Japan's policy on Middle East relations to date, generally speaking, will not provide adequate guidance.

The most effective means of building a mutually dependent relationship would be massive increases in direct foreign investment by Taiwan in Middle East oil-producing countries. From the viewpoint of securing interests, this direct investment is most desirable in the field of energy development, however, investment in large-scale energy development has huge economic risks. Up to this point, the CPC has participated in oil production in the United Arab Emirates' Ras al-Khaimar offshore oil fields and acquired a 24% interest in oil production in the Mubarek offshore fields, among others. So while they have investment results in this field, they will need to increase the scale of investment to achieve a symmetrical dependency. The risks involved and which institutions should make the investment are some of the important points that must be discussed internally.

Investment in social infrastructure in addition to energy development in oil-producing Middle East countries, for instance a package deal with advanced technology and operation, would be good for business as well as building symmetrical dependency. No concrete investment proposals are offered here, but Taiwan should actively engage overseas consultants and others, and work hard to develop such proposals for the sake of Taiwan's future.

Strengthening international ties in sea-lane security

As stated previously, construction of a multilateral cooperative system in which all regional players participate is vital to the security of sea lanes in the Asian region. It goes without saying that such an international cooperative system cannot be considered complete without the participation of an important regional naval power like Taiwan. It is important for Taiwan to continue its own efforts to participate within the international framework, but for several reasons Taiwan will have a very hard time achieving this objective by itself. In this situation, Japan's role and responsibility is great, as a country that shares most sea lanes with Taiwan. For Japan to agree to exclude Taiwan from the international framework mentioned earlier, is for Japan to agree to the creation of a gaping hole in the security of the sea lanes connecting Japan with the Middle East. Whenever there are international discussions about maritime security, Japan must keep its national interests firmly in sight and make its position abundantly clear. The Japanese government should be aware that such a position is as much in the interest of Japan's national dignity as its national interest.

Furthermore, the discussion in the next section about building a system of cooperation with China is very important to relieving the congestion in the Straits of Malacca and maintaining the security of ships in the South China Sea and the East China Sea.

Constructing a system of energy cooperation with China

To stem China's increasing demand for oil, the main oil-importing countries in the Asian region—Taiwan, Japan, and Korea—must promote active international cooperation. This will not only contribute to the energy security of these three countries but also serve China's national interest by meeting an important national energy policy objective: reducing dependency on oil.

A concrete example of regional cooperation is be the active transfer of technology that promotes the efficient and clean use of coal in China. This refers to the transfer of so-called clean-coal technology. Since Japanese technology is on par with that of the US in this field, and Taiwan also has experience with the use of clean coal, both countries could make major contributions. This technology would support the stable use of coal in China through improved thermal efficiency in coal-powered electricity generation, and reduced emissions of sulfur oxide and nitrogen oxide into the atmosphere, thus helping to restrain the growth of China's oil imports and at the same time contribute to preventing environmental pollution in the region.

From a different viewpoint, technology transfers and consulting could be an easy and desirable business opportunity for Taiwanese businesses. Particularly in the area of consulting and technological guidance, Taiwan has an immeasurable advantage because they share a common language. Since the moving of production centers overseas and the hollowing out of industry is a big problem for Taiwan, it is necessary to further develop third-sector industries, which makes entrance into the consulting business even more attractive for Taiwan.

Another possibility for short-term policy on coal might be to establish a system by which Taiwan, Japan, and Korea expand their coal use and dampen demand in the East Asia region for LNG, which could be used by China. No doubt this is a very round-about system, not to mention that China would also have to make LNG infrastructure improvements before such a system could be implemented. However, there are other benefits to this system. The surplus of LNG, if it can be made large enough, would reduce oil demand in the entire region, and expanded use of coal, a relatively cheap resource, would give an economic boost to the three countries while contributing to a cleaner environment for China. Some may disagree with this plan because it would mean increased greenhouse-gas emissions in Taiwan, Japan, and Korea. However, there is no currently no energy supply and demand balance in any country in Asia or in the world that does not include extensive use of coal, and this will not change in the near future. Thus, if those countries with the proper infrastructure emphasize coal use, it may be an effective approach to dealing with regional environmental issues. The setting of greenhouse gas emission standards for each country at COP3 was an important process for the drastic reduction of global warming, but there are limits on just how far we can go in dealing with global environmental issues through a framework based on the nation as a unit.

Cooperative efforts with China to find and develop oil and natural gas resources in the coastal regions of Asia as a substitute for Middle East oil is very desirable both from the viewpoint of energy security and regional security. This is why it was such a pleasant surprise when the CPC and the China National Offshore Oil Corporation (CNOOC) agreed to the Taiwan-China Joint Resource Development Project in the Taiwan Straits and Pearl River Delta. Hopefully, joint projects between Taiwan and China will continue to emerge in number and help to further reduce tensions in the region.

The East Siberia oil and gas pipeline plan is also attracting attention as a new energy source for China. Russia is currently considering running the pipeline to the port city of Nakhodka on the Sea of Japan as well as to China's Daqing, and the Japanese government is looking at this project as one that would contribute to the diversification of their energy supply sources. Thus, the government is actively trying to persuade the Russian government to build the Nakhodka route. If the Nakhodka route is built, Taiwan will also benefit from access to the East Siberia energy resources, which could be one way they could improve their energy supply structure and mitigate the expected rise in dependency on the Middle East region.

However, even if the Daqing route is the only one built, it is expected to improve China's energy supply structure and positively influence the energy supply and demand balance for the entire East Asian region. This viewpoint may be unorthodox, but this project should not be subjected to the territorial impulses of East Asian countries. It should be re-evaluated from the viewpoint of energy security for the entire region.

Clarification of the importance of nuclear power

As stated in the introduction of this paper, long-term energy security requires that countries seek out the means of acquiring the necessary energy at a reasonable price based on the current energy supply and demand balance, and in the end, the optimum energy supply mix at any point in the future should be considered. The relative importance of each energy source should be a part of that discussion.

Taiwan made its final objective, no matter the circuitous route it took to get there, a retreat from nuclear power, but this decision was not arrived at in the manner just described.

The difficulty in dealing with waste products, a vociferous anti-nuke movement, the processing of spent fuel—these and other problems must be overcome even to run and maintain their existing nuclear power plants. However, for a country with such scarce natural resources and such a large energy demand, nuclear power is the best power source available. According to 2001 statistics, 1 kWh of electric power generated by nuclear power costs 0.7569 TWD. Producing that same power using natural gas costs 3.6 times as much, petroleum 2.5 times, and even relatively low-cost coal costs 1.2 times as much.

In addition to its low cost, nuclear power is the best source of electric power from the standpoint of global warming. The Central Research Institute of Electric Power Industry analyzed the CO_2 emissions in the lifecycle of different electric power sources, which includes emissions

from burning the fuel, mining the raw materials, building the power plant, transporting the fuel, storage, and all the emissions associated with consuming energy. That study showed that in Japan, the CO2 emissions associated with 1 kWh generated with nuclear power was 2.2% that of coal, 3.0% that of petroleum, and 3.6% that of natural gas. The figures for nuclear power include the reprocessing of spent fuel, the processing of radioactive waste, and similar costs. This same study showed that nuclear power puts out less CO_2 than solar or wind power.

Nuclear power is also ideal for stockpiling energy. A nuclear reactor can produce energy continuously for about three years on the fuel placed in the reactor. How much of each fuel would be required to run a 1 million kW power station for one year? It would take 21 tonnes of enriched uranium for nuclear power, or 2.1 10-tonne trucks; 970,000 tonnes of LNG, or 4.9 200,000-tonne tankers; 1.31 million tonnes of oil, or 6.6 200,000-tonne tankers; 2.36 tonnes of coal, or 11.8 200,000-tonne cargo ships. (Agency for Natural Resources and Energy, Nuclear Power 2002).

These are the advantages of nuclear power, but there are also some disadvantages. The selection of locations for the disposal of the highly radioactive waste products is a very difficult problem even in the US, let alone in small countries like Taiwan and Japan. Even temporary storage of low-level radioactive wastes became a problem at the Lanyu Island facilities used since 1982. In 1996 local protests and other pressures resulted in the stopping of waste shipments. Following these events, storage facilities were built at each power station as a solution. After much difficulty, an island in Kinmen Province was selected as a candidate for the final disposal site, but China has taken a strong stance against it.

In any case, it is up to the Taiwanese people to determine the need for nuclear power in Taiwan. However, a comprehensive national discussion about a stable supply of energy is a vital requirement to making such a decision. The 2000 and 2001 dispute over the retreat from nuclear power is was pitifully inadequate for this purpose. Leaders in the Taiwan government should stimulate discussion among the citizens about their energy future, and they should examine the role of nuclear power in the energy supply as part of this discussion.

Conclusion

This paper discussed Taiwan's energy security issues and the weaknesses in Taiwan's energy policy, but most of the problems and vagueness in energy policy pointed out here apply to Japan's energy security and energy policy as well. At the risk of being blunt, one could replace "Taiwan" with "Japan" without much affecting the truth of the statements made. As the final point in this paper, it must be emphasized that Japan must waste no time in examining and developing measures to combat these issues and weaknesses, because failing to do so will most likely result in a crisis situation in maintaining a stable energy supply in the near future.

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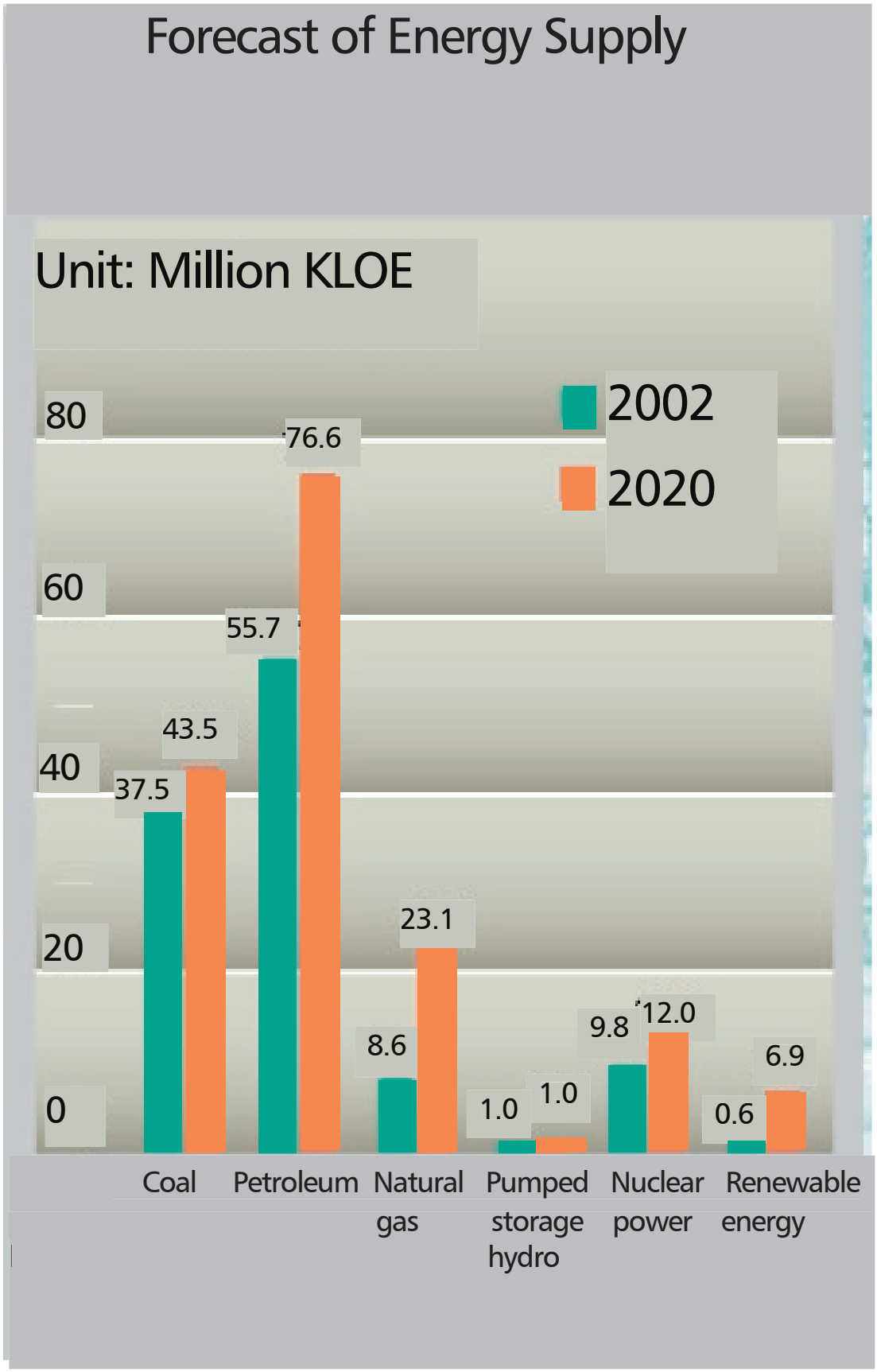

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