Chapter 1

Nuclear Energy Policy Trends in Member Countries

Study on Nuclear Safety Management in East Asian Countries Working Group

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CHAPTER 1

Nuclear Energy Policy Trends in Member Countries

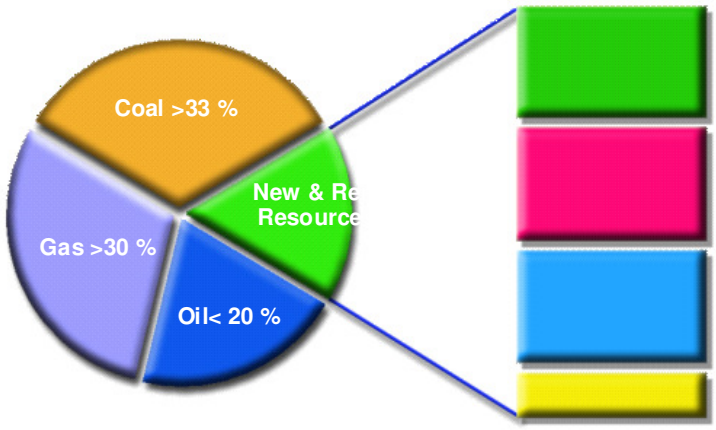
1. Indonesia

1.1 Energy demand/supply outlook

The energy needs of Indonesia have been rising due to population growth and economic progress in the last several decades. The government of Indonesia aims to apply an optimum energy mix comprising all viable and prospective energy sources.

The national energy policy, enacted as Government Regulation No. 5 of 2006, indicates the targeted energy mix until 2025. The share of nuclear energy is about 2% of primary energy, or 4% of electricity (4000 MWe). The primary energy portfolio in Indonesia as of 2005 and the projection for 2025 is shown in Figure 1.

Figure 1: Targeted National Energy Mix 2025 in Presidential Decree No. 5 / 2006



Indonesia intends to decrease the oil ratio in its energy mix to 20% or less, while depending more on gas, coal, and renewables. Indonesia has a large potential in geothermal energy and is making the most of it, while also developing biofuels, wind,

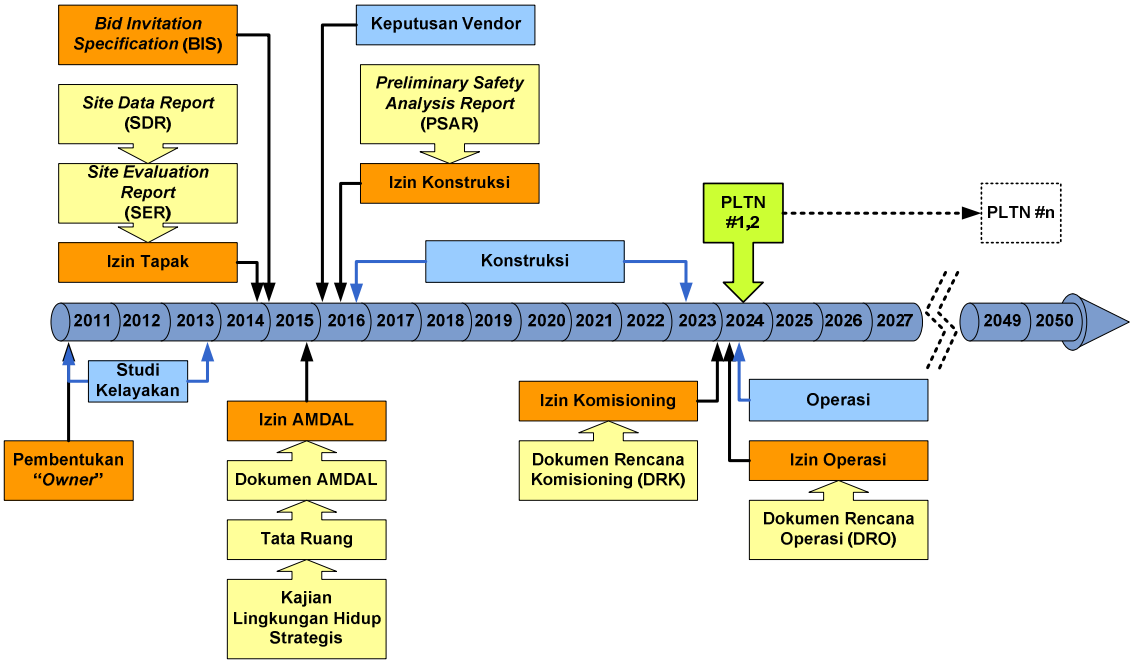
solar, and nuclear.

1.2. Nuclear Energy Policy and Development Plan

The government of Indonesia intends to introduce the first two units of nuclear power and commence commercial operation before 2020, as stated in Act No. 17 of 2007 (National Long-Term Development Planning 2005-2025). Act No. 17 also states that Indonesia will implement nuclear energy for electricity generation between 2015 and 2019, while strictly considering safety factors. Presidential Regulation No. 5 of 2010 (Mid-Term National Development Planning 2010-2014) assigned to the National Nuclear Development Authority in Indonesia (BATAN), among other things, the "preparation of the first nuclear power plant in Indonesia, which among others includes site and environmental study, as well as feasibility study." These are the legal bases for the national development plan for nuclear power in Indonesia.

The official roadmap for the introduction of commercial nuclear power plants in Indonesia is shown in Figure 2. The roadmap was initially established in 2007, based on Act No. 17 of 2007.

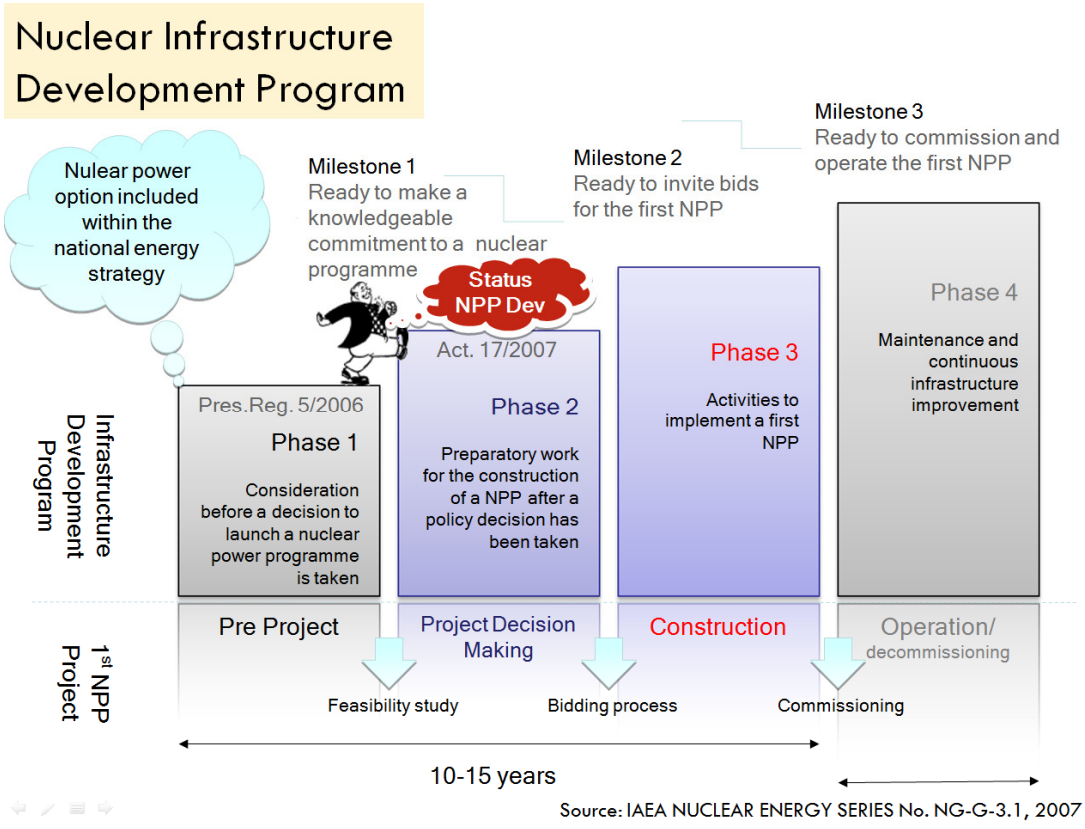
Figure 2: The Roadmap for the Introduction of Nuclear Power Plants in Indonesia



After the completion of the site study, the government of Indonesia will issue the Bid Invitation Specification (BIS) in 2014 and select the vendor in 2015. The operator will submit the safety assessment report (Preliminary Safety Analysis Report) to the national safety authority (BAPETEN). Once the license is issued, construction work will start, and in 2024 the first two units will commence operation.

However, there remain some issues to be resolved. BATAN requested that the International Atomic Energy Agency (IAEA) perform an Integrated Nuclear Infrastructure Review (INIR) mission under the framework of the Technical Cooperation (TC) program (INS/4/037), in a letter dated August 5, 2009. In response to the request, an INIR mission provided an external peer review conducted by the IAEA in November 2009. The Nuclear Infrastructure Development Plan of Indonesia, which has been reviewed by the INIR mission team, is shown in Figure 3.

Figure 3: The Nuclear Infrastructure Development Plan of Indonesia



The preparation of the nuclear infrastructure is implemented by issue-specific inter-agency teams. The institutional members of the teams are those directly related to the objectives to be achieved (for example, the institutional members of the team for human resources development are MEMR, BATAN, BAPETEN, and so on).

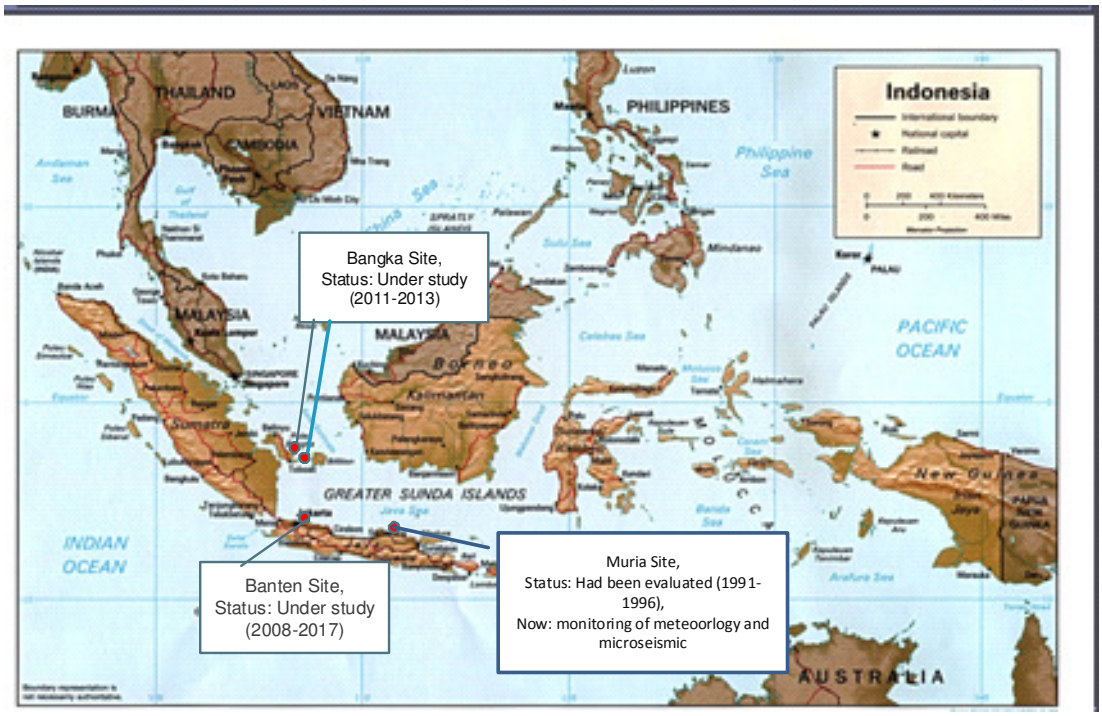
The INIR mission showed that Indonesia has done extensive preparatory work on most infrastructure issues, which would allow the country to make the decision to further consider the introduction of nuclear power (i.e., to go from Phase 1 to Phase 2 in the milestone methodology). However, since no decision has been taken by the government regarding which organization will be responsible for owning and operating the nuclear power plants, the mission suggested that some issues – mainly, those connected to the responsibilities of the owner/operator of the nuclear power plant – still require further work, most of which can be performed in parallel during Phase 2.

BATAN and related organizations in Indonesia have started preparing for the Action Plan for Phase 2 based on the review. The national development team worked on additional documents related to Infrastructure of LILW (Low and Intermediate Level Waste); conducted activities related to Public Information and Education in order to build a comprehensive understanding of nuclear power plants (NPPs) (according to Presidential Instruction No. 1 of 2010); and conducted the Pre-feasibility Study for Bangka Site from 2011 to 2013. Most important, they established the national team of human resources development (HRD) for the nuclear power plant, consisting of members from various institutes. The task and program of the team are:

- Development of an academic paper on “Preparation of Human Resource Development for the First Nuclear Power Plant in Indonesia”
- Development of a blueprint on “Human Resource Development for Nuclear Power Plant”
- Establishment of a Nuclear Training Center for NPP

There have been several site studies conducted by BATAN and related organizations in Indonesia since the late 1980s. Figure 4 shows the location and the status of the sites under investigation.

Figure 4: NPP Sites under Investigation in Indonesia



Java is the most populous island in Indonesia, holding 59% of the national population, as well as the site of major industrial activity. Two possible sites for NPP in Java are the Muria Peninsula (Ujung Lemahabang at Balong village) and Banten (Kramatwatu-Bojonegara).

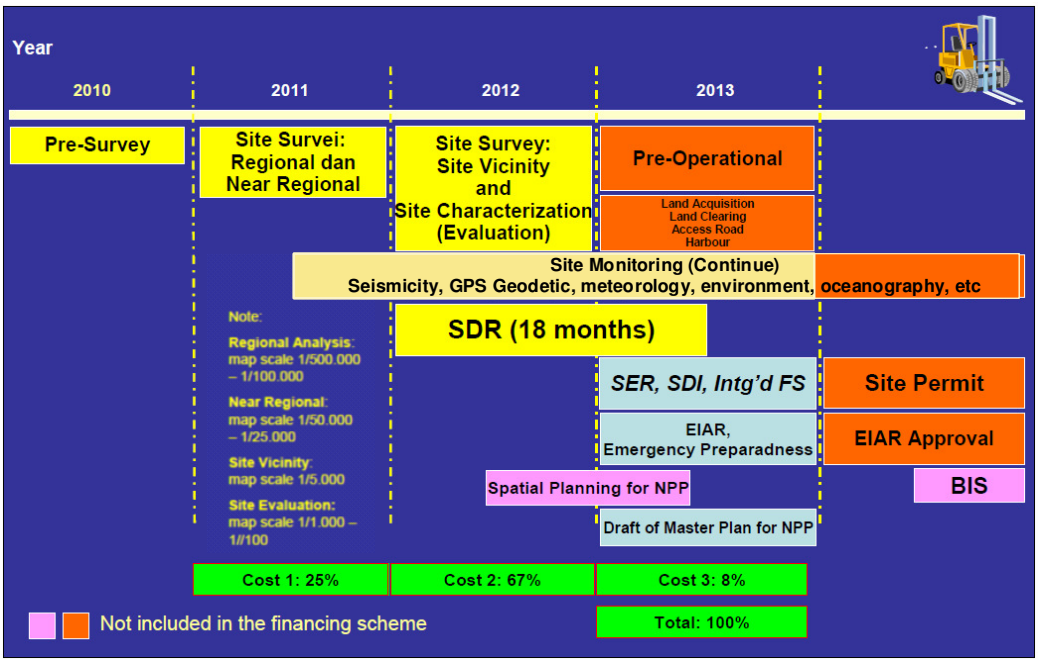
On the Muria Peninsula, the local residents in and around Balong are refusing the NPP program and all related activities, and the site investigation is not finished yet. Another 5 years will be necessary to complete the investigation but activities are now pending.

Kramatwatu-Bojonegara in Banten is another potential site. The site needs further intensive investigation, mainly in volcanology and seismic evaluation, as well as special social-economic and cultural studies due to the dense and heterogeneous population. To complete the study, at least another 7 years are needed.

The third potential site is Bangka, not too far from Jamali. Since Bangka Island is located on the Intra Plate, it is far from active volcanoes: the closest one is Mt. Lumut Balai in Lampung, ±303 km from Bangka. It therefore has a comparatively low seismic risk, and no potential tsunami hazard due to the shallow sea. The total population of Bangka-Belitung is 1,074,775, which is quite a low population density

for Indonesia. The investigation is still under way and at least 3 more years are needed. Figure 5 shows the roadmap for the site study in Bangka Island.

Figure 5: The Roadmap for the Site Study in Bangka Island



Recently, additional potential sites in East and West Kalimantan have been proposed by the government. The Kalimantan local government has submitted a proposal to the central government to build nuclear power plants in the region, and they are ready to invite local and foreign investors to join the project. In 2013, the government prepared a pre-feasibility study to initiate a review of the opportunities to build nuclear units in Borneo Island, and are now preparing to coordinate the joint work among related agencies.

1.3. Organizations

The national energy policy authority in Indonesia is the Ministry of Energy and Mineral Resources. The nuclear development policy authority is BATAN, the national nuclear energy authority. The regulatory authority is BAPETEN. These are independent of each other. Table 1shows the organizations involved in the Nuclear Infrastructure Preparation and the scope of work of each organization.

Table 1: Organizations involved in National Infrastructure Preparation and the Scope of Works

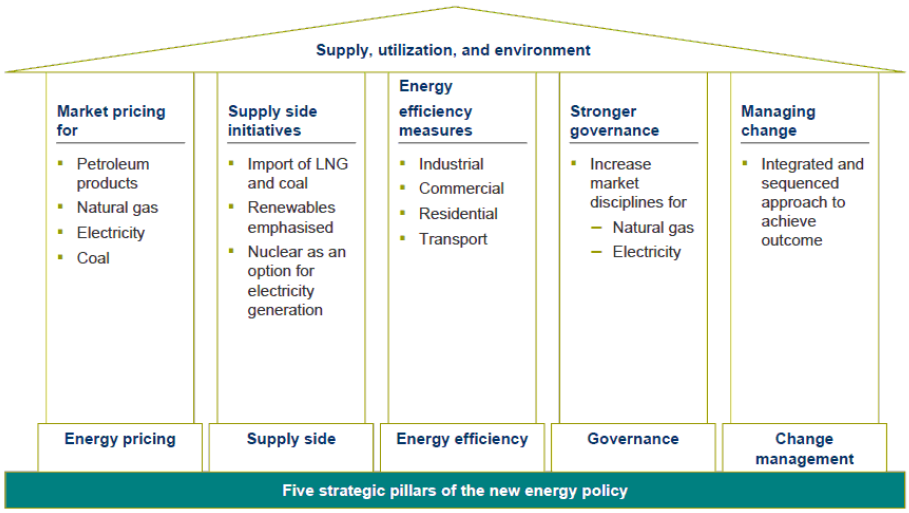
Responsible institutions	Scope of work
• BATAN (National Nuclear Energy Agency)	▪ Nuclear Safety ▪ Stakeholder Involvement (Socialization Program) ▪ Siting ▪ Fuel Cycle and Radioactive Waste ▪ Environmental Protection
▪ BAPETEN (Regulatory Body)	▪ Nuclear Safety ▪ Legislative Framework ▪ Regulation Framework ▪ Safeguard, ▪ Radiation Protection, Emergency Planning, and Security & Physical Protection
▪ Directorate General of New and Renewable Energy and Energy Conservation-Ministry of Energy and Mineral Resources ▪ Training and Education Agency-Ministry of Energy and Mineral Resources ▪ Electricity State Own Company (PLN) ▪ Ministry of Industry and Ministry of Environmental	▪ National Position ▪ Management ▪ Funding & Financing ▪ Electrical Grid ▪ Human Resources Development ▪ Stakeholder Involvement ▪ Environment Protection ▪ Industrial Involvement and Procurement.

2. Malaysia

2.1. Energy demand/supply outlook

The latest national energy policy in Malaysia is "The Tenth Malaysia Plan 2011-2015," published by the Economic Planning Unit in the Prime Minister's Department. According to this plan, GDP growth of 10.1% in the first quarter of 2010 represented the fastest quarterly growth in 10 years, and Malaysia's goal of high-income status by 2020 requires, among other things, achieving an average GDP growth of 6.0% per annum. To ensure the effective sourcing and delivery of energy, the New Energy Policy (2011-2015) emphasizes energy security and economic efficiency, as well as the impact to the environment and to society. The Policy focuses on five strategic pillars: initiatives to secure and manage a reliable energy supply; measures to encourage energy efficiency (EE); adoption of market-based energy pricing; stronger governance; and managing change, as shown in Figure 6.

Figure 6: Five Strategic Pillars of the New Energy Policy



SOURCE: Economic Planning Unit

The Malaysian government intends to enhance energy security through the development of alternative resources, particularly hydro, as well as the import of coal and liquefied natural gas (LNG) by 2015. The development of new coal-based plants would also be necessary to ensure security of supply in Peninsular Malaysia. The

application of supercritical coal technology should be explored to reduce carbon emissions. In addition, the development of NPPs as an option for electricity generation is being considered as a way to ensure a reliable and cost-effective supply in Peninsular Malaysia.

2.2. Nuclear Energy Policy and Development Plan

Malaysia's first nuclear power planning study was conducted in 1979. It was followed by a series of studies covering various planning aspects from the mid-1980s to the early 1990s, all with technical assistance from the IAEA. Consequently, the government of Malaysia decided in June 2009 to consider nuclear energy as one of the fuel options for electricity supply post-2020, especially for the Peninsula, and to include it in the country's five-year development plan (i.e., The Tenth Malaysia Plan), which is the current national plan of Malaysia.

On July 16, 2010, the government officially adopted the National Nuclear Policy as a guideline for the development of a nuclear sector for electricity generation and non-electricity generation. On October 25, 2010, the Economic Transformation Program was launched under the National Key Economics Area (NKEA). In this program, 19 Entry Point Projects (EPP) were identified under the Oil, Gas & Energy NKEA sector, including Deploying Nuclear Energy for Power Generation. In December 2010, based on the recommendation of the IAEA, a Nuclear Energy Program Implementing Organization (NEPIO) was established. The government also decided to establish a Nuclear Power Development Steering Committee, led by the Ministry of Energy, Green Technology and Water, to plan and coordinate preparatory efforts towards deploying nuclear energy for electricity generation.

2.3. Organizations

Under the Nuclear Power Development Steering Committee, established in 2010, various studies have been conducted on formulating a Nuclear Power Infrastructure Development Plan (NPIDP), which is targeted to be ready by 2013. Three Working Committees, comprising relevant ministries, government agencies and government-linked companies (GLCs), were also established under the Steering Committee:

- Nuclear Power Program Development Working Committee, led by the Malaysian Nuclear Agency (Nuclear Malaysia)
- Nuclear Power Project Development Working Committee, led by Tenaga Nasional Berhad (TNB), the electric utility for Peninsular Malaysia
- Nuclear Power Legislative Development Coordination Working Committee, jointly led by the Atomic Energy Licensing Board (AELB) and the Energy Commission (ST)

This structure, comprising the Steering Committee and its three Working Committees, could then be considered a Nuclear Energy Program Implementing Organization (NEPIO), as recommended in the IAEA document on "Milestones in the Development of a National Infrastructure for Nuclear Power" (Nuclear Energy Series No. NG-G-3.1). The formulation of the NPIDP is meant to enable the government to make appropriate decisions on the implementation of nuclear power projects.

The government also decided in December 2010 to establish a new, fully dedicated NEPIO to supersede the Nuclear Power Development Steering Committee, established by the government in June 2009, and all three of its Working Committees on Nuclear Power Program Development, Project Development, and Legislative Development Coordination. Subsequently, the new NEPIO was established as the Malaysia Nuclear Power Corporation (MNPC) under the Companies Act of Malaysia, and placed under the jurisdiction of the Prime Minister's Department in January 2011. To facilitate its functions, the organizational structure of the MNPC consists of three main divisions, identical to the three Working Committees under the Nuclear Power Development Steering Committee, which the MNPC has superseded:

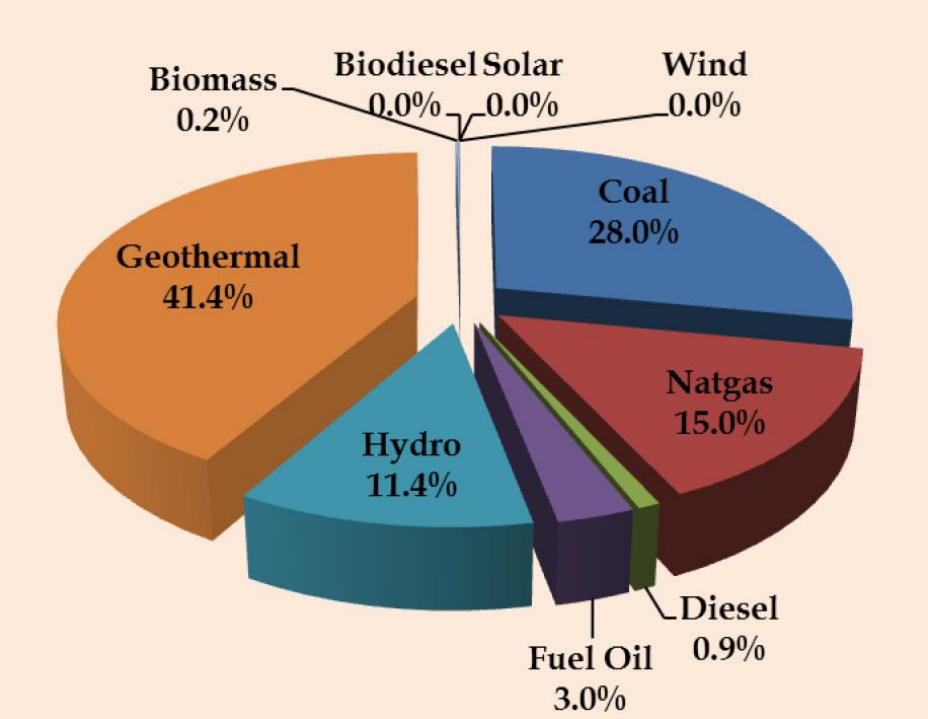
- Nuclear Power Program Development
- Legislative and Regulatory Development Coordination
- Nuclear Power Project Development

3. Philippines

3.1. Energy Demand/Supply Outlook

Energy policy in the Philippines is decided by the Department of Energy (DOE). The latest power plant development plan is the "Power Development Plan 2009-2030 (PDP2009-2030)." In 2011, the share of electric power provided by biomass was about 40%, and by hydro about 10%.

Figure 7: Fuel Input Mix for Power Generation in 2011



Electricity demand is projected to increase from 55,417 GWh in 2008 to 86,809 GWh by 2018, and up to 149,067 GWh by 2030. This translates to a rise in peak demand from 9,226 MW in 2008 to 14,311 MW by 2018, and to about 24,534 MW by 2030. According to a simulation by DOE, around 17 GW of new capacity is necessary during the period 2009-2030 in order to meet this demand. Committed power plant development projects only reach 1,338 MW (Figure 8) and the remaining capacity requirements are still open for private sector participation.

Figure 8: List of Committed Projects

Grid	Project Name	Capacity (MW)	Target Completion	Location	Proponent
Luzon	2x300MW Coal-Fired Power Plant	600	4th Qtr. Of 2012	Mariveles, Bataan	GN Power
	Sub-total Luzon	**600**			
Visayas	3x80MW CFB Power Plant Expansion Project	240	Unit I-March2010 Unit II-June 2010 Unit III-Jan 2011	Brgy. Daanlungsod, Toledo City, Cebu	Cebu Energy Development Corporation (Global Business Power Corp.)
	2x100MW Cebu Coal-Fired Power Plant	200	Unit 1-Feb 2011 Unit 2-May 2011	Naga, Cebu	KEPCO SPC Power Corporation (KSPC)
	17.5MW Panay Biomass Power project	17.5	2011	Brgy. Cabalabaguan, Mina, Iloilo	Green Power Panay Phils., Inc.
	Nasulo Geothermal Plant	20	2011	Nasuji, Valencia, Negros oriental	Energy development Corporation
	2x80MW CFB Power Plant	160	Unit I-Sep 2010 Unit II-Dec 2010	Brgy. Ingore, La Paz, Iloilo	Panay Energy Development Corporation (Global Business Power Corp.)
	Sub-total Visayas	**638**			
Mindanao	Sibulan Hydroelectric Power (Unit I-16.5MW) (Unit II-26MW)	43	Unit I-Feb2010 Unit II-Apr 2010	Sta. Cruz, Davao del Sur	Hedcor Sibulan, Inc.
	Cabulig Mini-Hydro Power Plant	8	June 2011	Plaridel, Jasaan, Misamis oriental	Mindanao Energy Systems,Inc. (MINRGY)
	Mindanao 3 Geothermal	50	July 2014	Kidapawan, North Cotabato	Energy Development Corporation
	Sub-total Mindanao	**101**			
Total Philippines		**1,338**			

Note: Mindanao 3 Geothermal Plant was moved to 2014 from its original target year of 2010

3.2. Nuclear Energy Policy and Development Plan

The use of nuclear energy for power generation remains a long-term option for the Philippines. Cognizant of the merits of nuclear energy in terms of supply security, stability and environmental considerations, the government is open to embarking on nuclear power generation plans in the future and looking at improvements in existing safety standards and technology advancement as necessary preconditions (notwithstanding opposition from various environmentalists and other interest groups).

In 2007, there was a resurgence of interest in nuclear energy in the Philippines as a result of the so-called "nuclear renaissance" that occurred in the international energy community. A Task Force on Nuclear Power Program was even established by the then DOE Secretary to serve as an interim unit within DOE to attend to nuclear-related matters. The new wave of interest also prompted a government-initiated request, in 2008, for an IAEA Mission review of the Development of Infrastructure to Support a Nuclear Power Program in the Philippines and the Feasibility of Rehabilitating the Bataan Nuclear Power Plant. Subsequently, the Mission Report led to the creation of an inter-agency core group to work on the

recommendations of the IAEA Mission, which included, among other things, conducting a Feasibility Study to verify the condition of the Bataan Nuclear Power Plant (BNPP) and establishing a strategic plan for its rehabilitation program. It also involved providing advice to the government on the general requirements for launching a nuclear power program. The scope of the 19 areas identified range from National Position, Nuclear Safety, and Regulatory Framework to Fuel Cycle and Waste Management.

Under a Memorandum of Understanding signed between the National Power Corporation (NPC) and the Korea Electric Power Corporation (KEPCO) in 2008, KEPCO conducted a feasibility study on the possible rehabilitation of the BNPP. In its official report submitted to the NPC in 2010, KEPCO concluded that BNPP rehabilitation is technically feasible at a cost of US$1 billion. The study team specifically stated that the primary system of the plant was in relatively good state while the secondary system had been corroded by saltwater and humidity. Some equipment would also have to be replaced, overhauled and updated.

In the same year, there were also initiatives to study the possible conversion of BNPP into either a coal-fired or natural gas-fed facility. Based on the initial findings, a conversion to coal appears more feasible.

The undertaking of further initiatives, however, momentarily suffered a setback following the Fukushima accident in March 2011. Just after the Fukushima accident, the Philippines Nuclear Research Institute, Department of Science and Technology (DOST-PNRI), as the competent authority on nuclear matters, undertook the following immediate measures to allay public fears on the impact of Fukushima:

- Convening of the PNRI Executive Coordinating Council with the Experts Support Team
- Deployment of radiation monitoring teams
- Activation of the National Radiological Emergency Preparedness and Response Plan (RADPLAN) by the National Disaster Risk Reduction Management Council (NDRMMC)

This enabled the government to provide timely, accurate and objective information to the public. The PNRI also produced daily information bulletins on its

website, and held press conferences and interviews with the media. The PNRI also pursued a more aggressive information campaign to promote nuclear applications.

There were varied reactions among Filipinos on nuclear energy after Fukushima. For those who perceived nuclear as an environmental hazard, Fukushima was an affirmation of their campaign against any plan to revive BNPP, let alone build a new plant. Academic discussions and public debates, using tri-media and social networking sites, deliberated the pros and cons of nuclear energy.

Be that as it may, the vast amount of information and literature available through the internet, through tri-media (both international and domestic), and partly through the efforts of the government (through its related international cooperation activities) enabled Filipinos to reach a good level of understanding and awareness on the merits of nuclear energy development. As a concrete example, in January 2012, barely two months prior to the first-year anniversary of Fukushima, an advocacy forum known as Arangkada Philippines, which is supported by top-level private sector groups such as the Joint Foreign Chambers of Commerce in the Philippines, recommended that the government "include nuclear power development in the national power development plan" and that the Philippine Congress pass a "resolution supporting the consideration of the development of nuclear energy."

Likewise, in April of the same year, one of the recommendations from the Mindanao Power Summit was the establishment of a nuclear power plant to provide long-term solutions to the region's perennial power problems, which have caused daily rotational brownouts lasting from 8 to 9 hours. Mindanao, located in the southern part of the country, sources a good portion of its power from hydropower facilities and thus is easily affected, especially during summer months and in extreme cases such as the El Niño phenomenon.

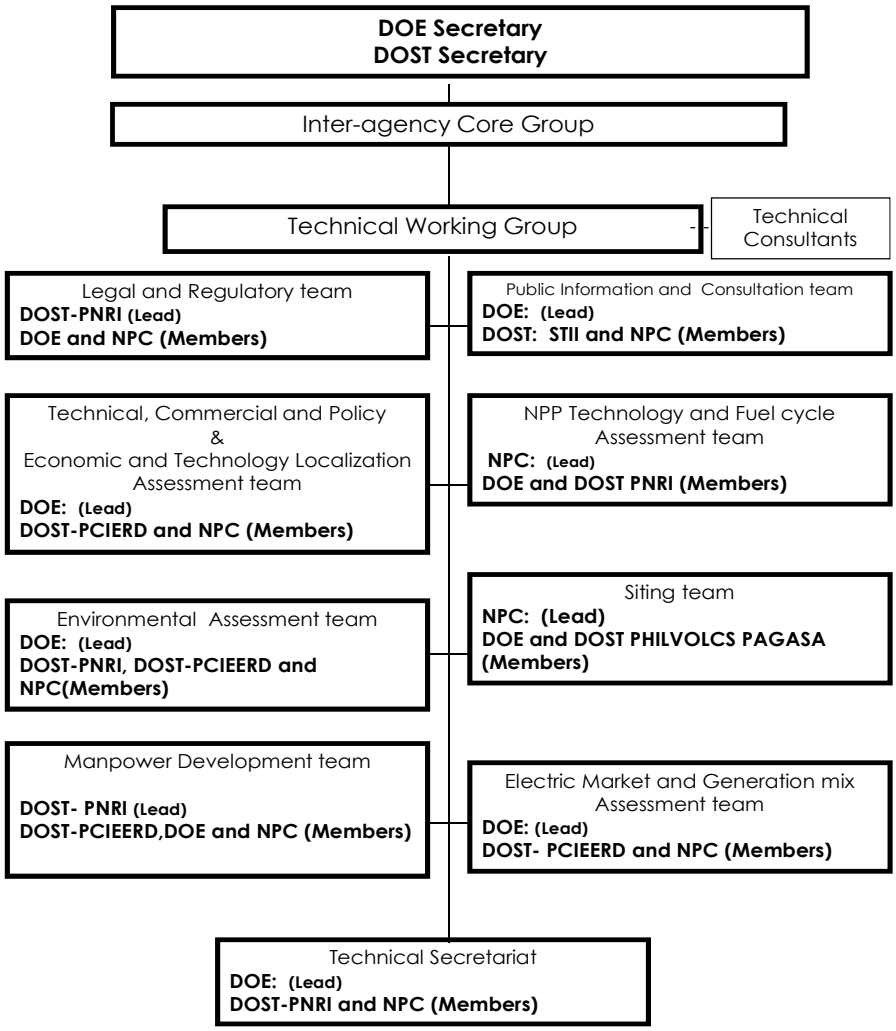
There are also sub-national government units who have manifested interest through the issuance of local resolutions enjoining the national government to study the feasibility of establishing a nuclear power facility in their respective areas.

3.3. Organizations

By virtue of an inter-departmental order between the Philippines' Department of Energy and Department of Science and Technology (DOST), the Inter-agency Core

Group on Nuclear Energy was established in 2009 with the prime objective of developing, managing and formulating policies and strategies on nuclear power generation. Part of its mandate is to undertake the feasibility study on the rehabilitation of BNPP. The Core Group was also envisioned to serve as an interim NEPIO. It is chaired by the DOE and co-chaired by the DOST. Its members include the National Power Corporation (NPC), the government agency in charge of preserving and maintaining the BNPP, and the Philippine Nuclear Research Institute. A corresponding Technical Working Group was also formed, composed of 8 study teams, to look into the 19 infrastructure requirements of a nuclear power program (Figure 9). Among the Core Group's accomplishments was the series of Information, Education and Communication (IEC) activities conducted in major cities of the country in 2010. The IEC focused on the benefits of nuclear technology applications in the Philippines, specifically in the areas of medicine, agriculture, and research, as well as the ways that nuclear safety, security, and safeguards are ensured through effective regulation. In a public perception survey conducted during the IEC sorties, more than 60% of the respondent participants expressed a willingness to support a nuclear power program. (The participants mostly comprised energy stakeholders.)

Figure 9: Inter-Agency Core Group Organizational Structure



4. Singapore

4.1. Energy Demand/Supply Outlook

Singapore is reliant on fuel imports for the country's energy needs and is alternative energy-disadvantaged due to its natural geography. Its energy dilemma lies in balancing three policy objectives: economic competitiveness, environmental sustainability, and energy security. The primary fuel for electricity generation has shifted from fuel oil to natural gas since electricity market liberalization in 2000. Currently, more than 90% of electricity generated in Singapore is from gas, as it is economically competitive and efficient compared to other fuels. It is also the cleanest

fossil fuel available today.

4.2. Nuclear Energy Policy and Development Plan

In 2010, the government embarked on a pre-feasibility study on nuclear energy in response to a recommendation by the Economic Strategies Committee. It was conducted by Singapore's Ministry of Trade and Industry with the assistance of international experts. The study was part of Singapore's efforts to continually explore all options that could help the country overcome its energy constraints and enhance its energy security. The pre-feasibility study covered a range of areas, including nuclear safety, security and risk assessment, human resource development, and nuclear energy systems and demand. The conclusions of the pre-feasibility study are:

- Nuclear energy technologies presently available are not yet suitable for deployment in Singapore. Although the latest designs of nuclear power plants are much safer now, the risks to Singapore, given that it is a small and dense city, still outweigh the benefits at this point.
- Singapore needs to continue to monitor the progress of nuclear energy technologies to keep the country's options open for the future.
- Singapore needs to strengthen capabilities to understand nuclear science and technology.
- Singapore will track related developments in areas such as emergency response and radioactive waste disposal, so as to assess the implications of evolving nuclear energy technologies and regional nuclear energy developments for the country, and strengthen the country's operational preparedness and existing capabilities in radiation and incident response.
- Singapore will support research in relevant areas of nuclear science and engineering, and train a pool of scientists and experts through education programs in local and overseas universities.
- Singapore will play an active role in global and regional cooperation on nuclear safety.

Singapore will support research in relevant areas of nuclear science and

engineering, and train a pool of scientists and experts through education programmes in local and overseas universities. We will also play an active role in global and regional cooperation on nuclear safety. Singapore is currently engaged in organizations/platforms such as the IAEA, the Asian Nuclear Safety Network, and ASEAN's Nuclear Energy Cooperation Sub-Sector Network (NEC-SSN).

4.3. Organizations

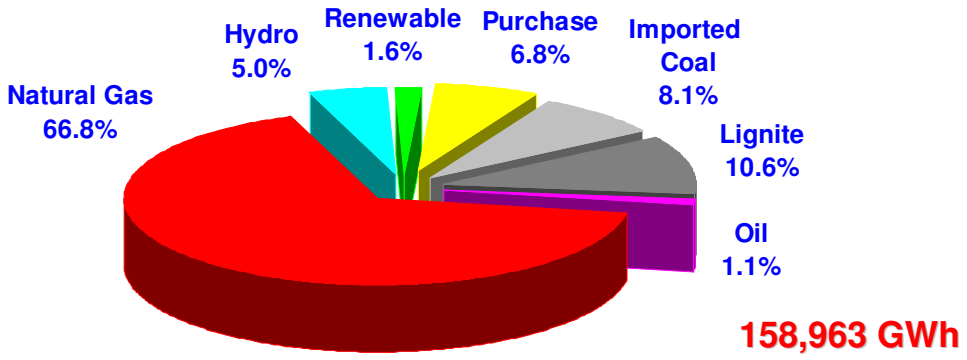
Singapore currently does not have plans to introduce nuclear energy into its fuel mix. There is no single organization responsible for nuclear-related issues.

5. Thailand

5.1. Energy Demand/Supply Outlook

In 2011, more than half of the electricity in Thailand was generated by natural gas, and one-third imported from Myanmar.

Figure 10: Electricity Generation by Fuel in 2011



In the "Thailand Power Development Plan 2012-2030" (PDP2010: Revision 3), the government has set new policies for economic stimulation, causing trajectory changes in GDP growth rate projections for the period 2012-2020. However, according to the power demand forecast for 2030, net peak demand is still 52,256 Megawatt (MW), some 3,494 MW (or 6.27%) lower than that of the previous version

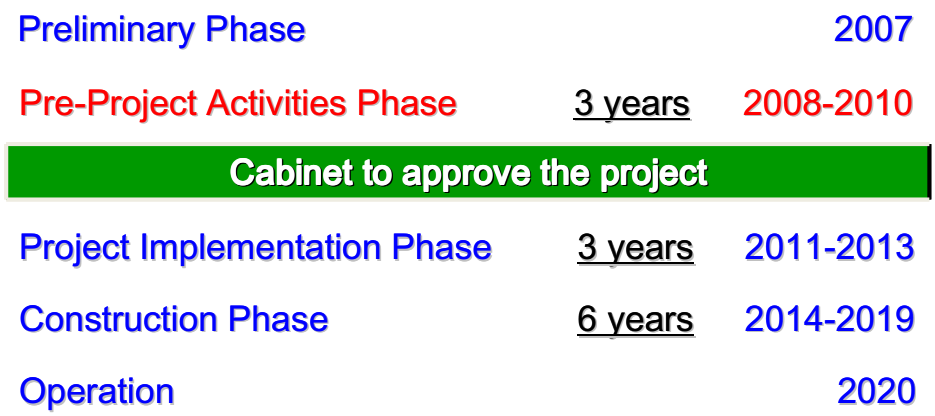
of the forecast. The total generating capacity during the period 2012 – 2030 can be summarized as follows:

- Total capacity (as of December 2011): 32,395 MW
- Total added capacity during 2012 – 2030: 55,130 MW
- Total retired capacity during 2012 – 2030: 16,839 MW
- Grand total capacity (at the end of 2030): 70,686 MW

5.2. Nuclear Energy Policy and Development Plan

The nuclear power development schedule in Thailand was approved in 2007 by the Thai Cabinet as part of a nuclear infrastructure plan, based on the IAEA document "Milestones in the Development of a National Infrastructure for Nuclear Power" (NG-G-3.1). NPP would commence operation in 2020.

Figure 11: Nuclear Power Development Schedule Approved in 2007



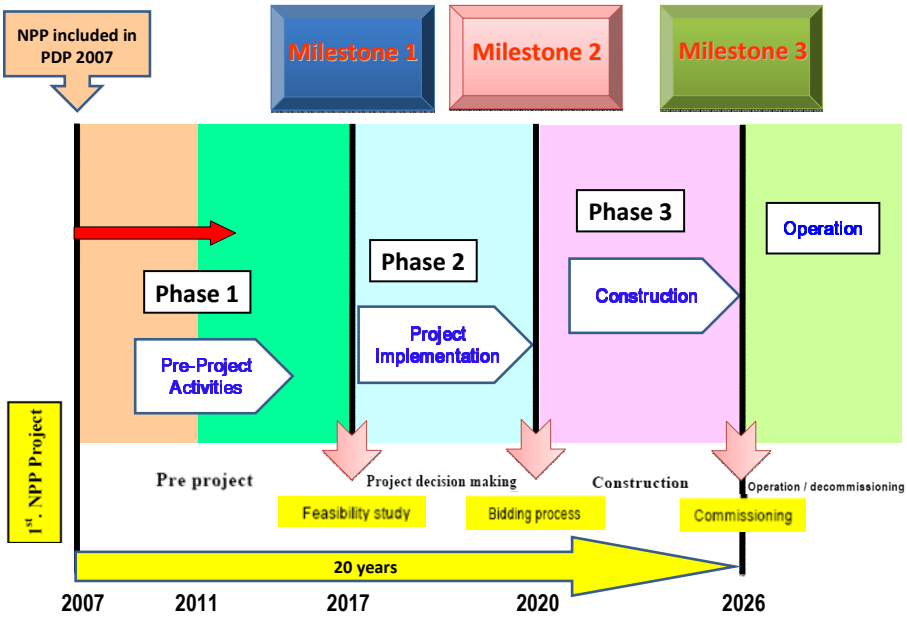
The IAEA's Integrated Nuclear Infrastructure Review (INIR) concluded that "Thailand can make a knowledgeable decision on the introduction of nuclear power." The Nuclear Power Infrastructure Establishment Coordination Committee (NPIECC) and its sub-committees prepared and submitted a readiness report to the Ministry of Energy at the end of 2010, and this report was submitted to the National Energy Policy Council (NEPC) for consideration to proceed to Phase 2 (Project Implementation).

In March 2011, the Fukushima accident occurred. In "PDP2010: Revision 3," approved by the Cabinet on June 19, 2012, the commencement of NPP operations

was postponed to 2026 and 2027. The main reasons for postponing the NPP project are:

- To review Nuclear Safety Measures and the Emergency Preparedness and Response Plan, to include lessons learned from the Fukushima accident
- To prepare infrastructure to support NPP (legislative framework, regulatory framework, stakeholder involvement, etc.)
- To promote public acceptance of nuclear power

Figure 12: Thailand NPP Project Schedule (IAEA Milestones)



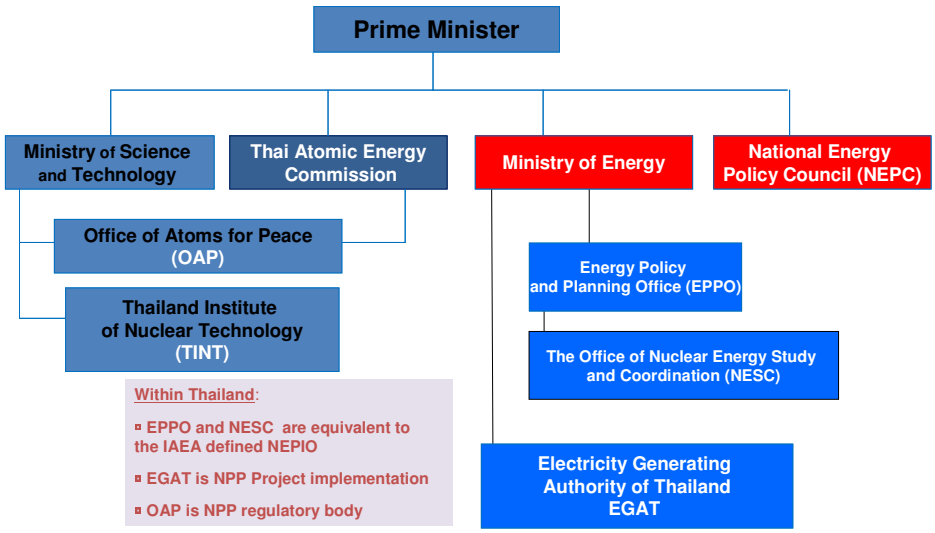
5.3. Organizations

The latest energy development policy in Thailand is "PDP2010: Revision 3," designed by the Ministry of Energy and approved by the Cabinet on June 19, 2012.

The Electricity Generating Authority of Thailand (EGAT) is responsible for the first nuclear power plant under the supervision of the Nuclear Power Utility Subcommittee, and is responsible for planning, feasibility study, site selection, project implementation, construction, operation, and decommissioning. EGAT has been working with Burns and Roe Asia to conduct a Nuclear Power Plant Feasibility Study (2008-2010).

The Thailand Institute of Nuclear Technology (TINT) is a research institute under the Ministry of Science and Technology. TINT is responsible for research and development (R&D), nuclear applications, training, and so on.

Figure 13: Organization for Planning Nuclear Power Plants



6. Vietnam

6.1. Energy Demand/Supply Outlook

According to the power sources development program, period 2011-2030 in Vietnam (Master Plan No.7), current grid capacity in Vietnam is about 22,000 MW. Demand is estimated to be 75,000 MW by 2020 and 146,800 MW by 2030. In 2030, nuclear power will account for 10.1% of total power (70 billion KWh), and the total capacity of NPPs will be about 10.700 MW/146.800 MW.

Figure 14: Electricity Portfolio of Vietnam in 2020 (Total Capacity: about 75,000 MW)

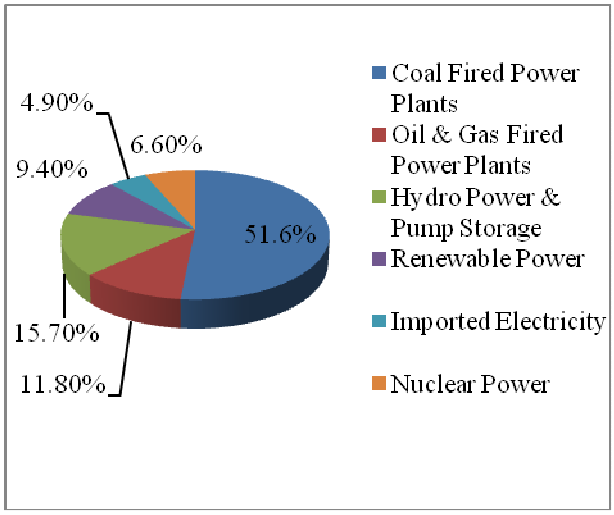
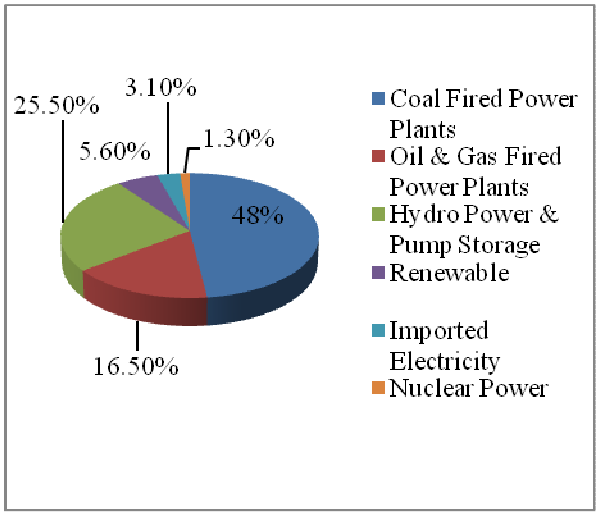


Figure 15: Electricity Portfolio of Vietnam in 2030 (total capacity: about 146,800 MW)



6.2. Nuclear Energy Policy and Development Plan

On January 3, 2006, the Prime Minister approved the Strategy on Peaceful Use of Atomic Energy up to 2020 (Decision No. 01/2006/QD-TTg). On July 23, 2007, the Prime Minister approved the Master Plan for Implementation of the Long-term Strategy on Peaceful Use of Atomic Energy up to 2020, covering all activities related to the development of nuclear infrastructures and capabilities for future self-reliance

in NP technology.

The Ninh Thuan Nuclear Power Project was approved by Resolution No. 41/2009/QH12 of the National Assembly on November 25, 2009. On March 18, 2010, the Prime Minister approved the Master Plan for Implementation of the Ninh Thuan Nuclear Power Project, Decision No. 460/TTg-KTN. On May 4, 2010, the State Steering Committee (SSC) of the Ninh Thuan Nuclear Power Project was established according to Decision No. 580/QD-TTG of the Prime Minister. The SSC is chaired by the Deputy Prime Minister of Vietnam.

On July 24, 2010, Decision No. 957/QD-TTg of the Prime Minister, on the strategy and the master plan, identified the priorities for development of atomic energy applications in the coming years, including focusing on the construction of the first and second units, for commissioning by 2020. According to the Atomic Energy Law (Article 9) and Prime Minister Decision No. 446/QD-TTg, issued in April 2010, the National Council for Nuclear Safety (NCNS) was established as a consultancy body for the Prime Minister.

On June 17, 2010, the Prime Minister approved the Orientation Planning for Vietnam NPP Development up to 2030, in Decision No. 906/QD-TTg.

Table 2: Orientation Planning to Build NPPs in Vietnam

Nuclear Power Project	Year of Commission
Ninh Thuan 1, # 1, 1000MW	2020
Ninh Thuan 2, # 1, 1000MW	2020
Ninh Thuan 1, # 2, 1000MW	2021
Ninh Thuan 2, # 2, 1000MW	2021
NPP 3, # 1, 1000MW	2022
NPP 3, # 2, 1000MW	2023
NPP 4, # 1, 1000MW	2026
NPP 4, # 2, 1000MW	2027
NPP central 1 ,# 1, 1350MW	2028
NPP central 1 ,# 2, 1350MW	2030

Current status of NPP development

According to Resolution No. 41/2009/QH12, the first nuclear power project in Vietnam will be built in Ninh Thuan province and Vietnam Electricity (EVN) is nominated as the project investment owner. This project includes 4 units with the total capacity of 4000 MW. The first two units of 1000 MW will be put into operation in early 2020.

Ninh Thuan 1 NPP Project

October 31, 2010: Russia-Vietnam Inter-Governmental Agreement on cooperation in constructing NPP in Vietnam was signed in Hanoi.

November 21, 2011: Agreements on (i) finance for Site Approval Dossier and FS of Ninh Thuan 1 NPP project, and (ii) State export credit of Russian Federation for construction of NPP in Vietnam, were signed in Hanoi.

November 21, 2011: Contract for consulting services for developing Site Approval Dossier and FS of Ninh Thuan 1 NPP project was signed in Hanoi.

Ninh Thuan 2 NPP Project

October 31, 2010: Vietnam – Japan Joint Statement with reference to cooperation in construction of NPP in Vietnam was signed in Hanoi.

September 28, 2011: Contract for consulting services for developing Site Approval Dossier and FS of Ninh Thuan 2 NPP was signed in Hanoi. Finance was provided by the Government of Japan.

September 29, 2011: MOU between EVN and JINED for cooperation in Ninh Thuan 2 NPP project was signed in Hanoi.

October 31, 2011: Arrangement for cooperation in construction of Ninh Thuan 2 NPP in Vietnam was signed in Tokyo.

The financial arrangement between Vietnam and Japan is still under negotiation.

Action plan for Nuclear Power Program after Fukushima

Consistent with the NPP development plan and selecting the most modern technology with passive safety and proven systems, the government forced the relevant organizations to prepare seriously for the NPP Project. Such actions were

taken:

- Selecting the best sites
- Strengthening safety requirements against natural hazards, and increasing the level of safety design for earthquake and for tsunami after the Fukushima accident
- Establishing regulatory policies and an effectively independent regulatory body
- Concentrating on HRD for the nuclear program, as well as motivating R&D

Relevant legislation, in particular the 2008 Law on Atomic Energy, will be revised and promulgated as soon as possible in order to ensure an effectively independent regulatory body; a clear delineation of responsibilities of authorities involved in the nuclear power program; and adequate provisions on emergency preparedness and response, radioactive waste and spent fuel management, decommissioning, nuclear security, safeguards, and civil liability for nuclear damage.

6.3. Organizations

The responsibility of the SSC is not limited to the Ninh Thuan Nuclear Project. The outcomes of the SSC are distributed to all participating organizations as government orders to take necessary actions.

The formation of the 5 Technical Sub-Committees under the SSC is on-going: the formulation of 2 sub-committees will be done by the end of the 1st quarter of 2013, and the remaining 3 sub-committees by the end of 2013. The sub-committees are for Nuclear Safety and Security, chaired by Ministry of Science and Technology (MOST); NPP Technology, Nuclear Fuel and Radioactive Waste, chaired by Ministry of Industry and Trade (MOIT); Construction, chaired by Ministry of Construction (MOC); Nuclear Power Industry Development, chaired by MOIT; and Training, Public Information and Communication, chaired by MOST.

The Permanent Office of the State Steering Committee was established and staffed (6 employees) under MOIT in 2011. Its main responsibilities are to provide advice and assistance for the SSC; to coordinate work between SSC members and the relevant ministries, agencies and local authorities; and to assist the SSC in

supervising and monitoring the implementation of the project.

The National Council for Nuclear Safety (NCNS) was established as a consultancy body for the Prime Minister on nuclear safety. VARANS, the official nuclear safety authority of Vietnam, is a standing organization of NCNS that has responsibility for the working program preparation of NCNS, including all conditions for operation of NCNS. The President of NCNS is the Minister of MOST; the Vice-presidents of NCNS are the Deputy Ministers of MOST and MOIT; the Committees include the Deputy Ministers of Security, Defense, the General Director of VARANS, and experts in the field of nuclear safety.

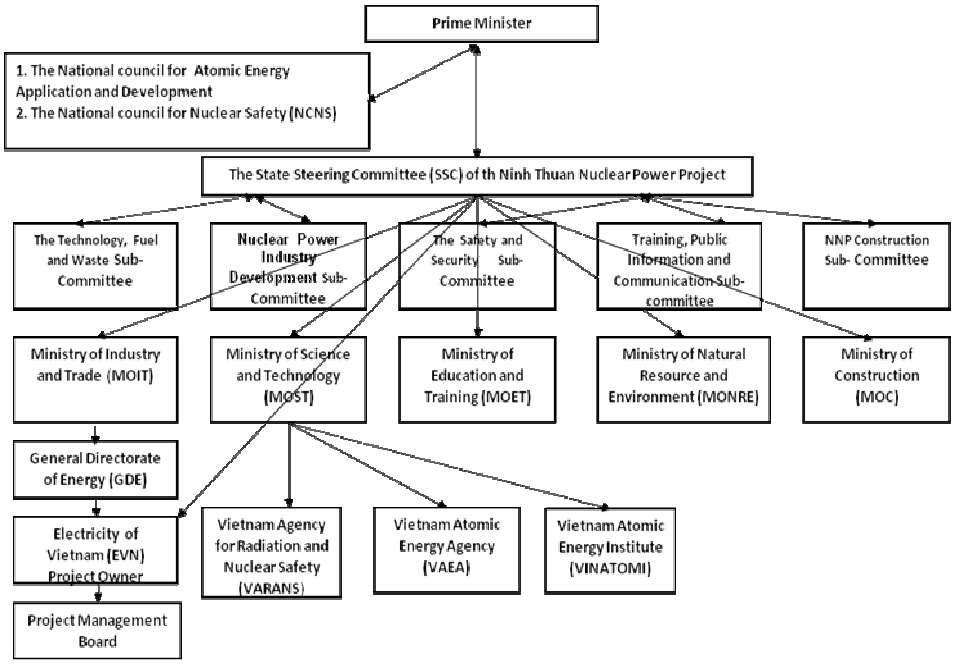
The National Council for Atomic Energy Application and Development was established as a consultancy body for the Prime Minister on atomic energy application and development for peaceful purpose.

The Ministry of Industry and Trade licenses commissioning and electricity operation based on comments from the National Council for Nuclear Safety. The Ministry of Science and Technology licenses the permission for construction of nuclear power plants based on comments from the National Council for Nuclear Safety.

The Ministry of Natural Resources and Environment cooperates with the MOST in guidance of the Energy Information Agency (EIA) for nuclear power plants, and evaluates and approves the EIA of nuclear power plant.

EVN was designated as the owner of the Ninh Thuan NPP Projects and the EVN Nuclear Power Project Management Board (EVNNPB) was established.

Figure 16: Organizational Structure for Nuclear Energy in Vietnam



7. Korea

7.1. Energy Demand/Supply Outlook

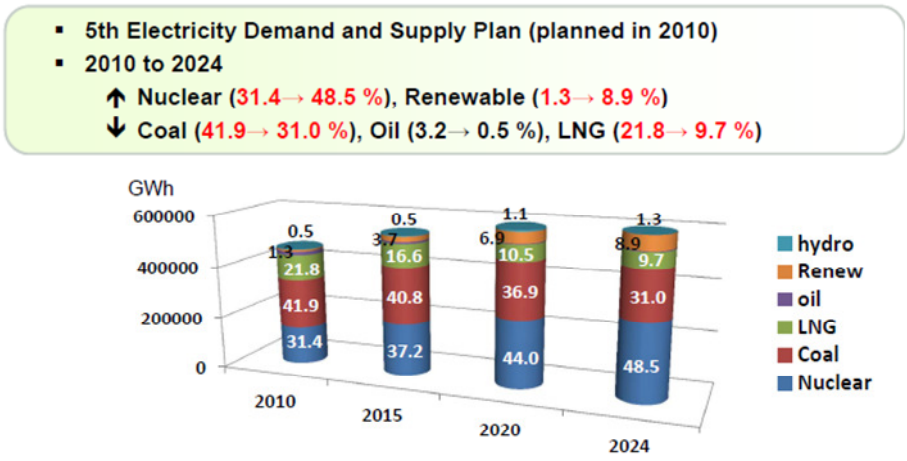
Korea adopted Long-term Vision for "Green Growth" as Basic plan for National Energy System in 2008. In this vision, the three main pillars are the expansion of nuclear and renewable, and energy efficiency. The energy mix in 2030 is shown in Table 3.

Table 3: Energy mix in 2008 and 2030

	2008	2030
Fossil energy	83%	61%
Renewables	2.4%	11%
Nuclear	14%	27.8%

In 2010, Korea announced the "National Energy Supply Plan by 2024." This plan shows the share of nuclear and renewable will be increased, while coal, oil, and LNG will be reduced. The details of the energy mix are shown in Figure 1-7-2.

Figure 17: 5th Electricity Demand and Supply Plan



GWh

Year	Nuclear	Coal	LNG	oil	Renew	hydro	Total
2010	144,856	193,476	100,690	14,693	5,949	2,084	461,747
2015	201,089	220,886	89,891	6,795	20,009	2,551	541,221
2020	259,378	217,454	62,081	3,039	40,648	6,256	588,856
2024	295,399	188,411	59,201	2,912	54,467	8,202	608,591

7.2. Nuclear Energy Policy and Development Plan

Since the introduction of the first NPP in 1978, the Korean government has maintained a consistent national policy of fostering nuclear power industries for stable energy supply, to overcome the insufficient energy resources in the country. In addition, the last Lee administration pushed the nuclear sector as a growth driver and a viable source of clean, green, and affordable energy.

With respect to Korea's energy policy, the need for national energy security to minimize dependence on oil and gas imports is a key consideration. Korea's energy policy will continue to have nuclear power as a major element of electricity production. Another important reason for the expanding role of nuclear energy is the cost advantage of nuclear energy compared to other fuels. The low cost of nuclear power comes from the economies of scale and learning effect resulting from continuous construction of nuclear power plants in Korea. The huge R&D investment in operations and maintenance process improvement also contributed to reducing cost and enhancing performance, including the utilization factor (the maximum demand of a system divided by its rated capacity) of nuclear plants, which then makes nuclear power more economical in the Korean market. As an example, nuclear power costs are the lowest in Korea: in 2008, the generation cost of nuclear was 39 won per kWh, compared with coal at 53.7 won, LNG at 143.6 won, and hydro at 162 won. As of now, nuclear power accounts for approximately 32% of the total electricity generation in Korea.

In 2008, the government finalized the first Korean National Energy Master Plan, which covers the period 2008-2030. According to the Master Plan, nuclear power would be expected to account for 59% of electricity production by 2030. To make this possible, the government will build 17 additional plants, totaling 38 NPPs by that year.

Consistent with the Master Plan, the Minister of Knowledge Economy (MKE) has to prepare and announce a Basic Plan of Long-Term Electricity Supply and Demand (BPE) on a biennial basis. The BPE provides long-term energy policy directions and information on electricity supply and demand, such as the electricity facility plan to secure stable electricity supply. Generation companies can apply for government approval of their generation business and power plant construction plans

based on the BPE.

The most recent BPE (the 5th) including nuclear power development was established in December 2010 and covers a planning period from 2010 to 2024. According to the 5th BPE, the government plans to increase the proportion of nuclear energy facilities within total energy facilities from 24.5% to 32%, and the proportion of nuclear power generation capacity within total power generation capacity from 31.4% up to 48.5%, by constructing a total of 11 NPPs by 2024 (including the 5 units (OPR1000 3 units, APR1400 2 units) that are currently under construction and an additional 6 units (APR1400) that are planned). The 6th BPE, stipulated on February 22, 2013, and covering a planning period from 2013 to 2027, has not made any decision on whether additional nuclear power plants will be constructed after 2024.

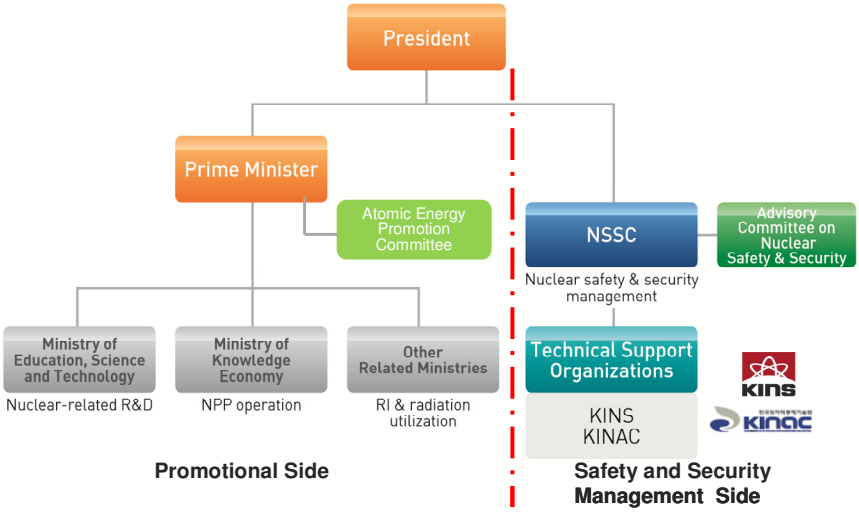
Positive anticipation is prevailing in the nuclear community that Korea will continue using and developing nuclear energy, together with strengthening the safety of nuclear power plants. There has been a general expectation that the policy on nuclear energy in the upcoming Park administration, after this February, will continue to keep the same position as in the Lee administration. It will be certainly based upon a common understanding widely distributed among the general public, even after the Fukushima accident: that is, as energy security is essential in Korea, the gradually expanding nuclear power plant policy is required. Fossil fuel has weaknesses in terms of reserves and environmental pollution, while renewable energy, such as solar, wind, and tidal power, is weak economically and in terms of energy security. Therefore, while enhancing nuclear safety step-by-step, the current nuclear policy must continue. Nuclear energy is expected to continue to have a role until nuclear fusion energy and innovative renewables become the main contributing power sources in the future.

In this regard, the second Korean National Energy Master Plan, to be announced by the end of 2013, will fully reflect the future direction of the new administration on nuclear energy policy. It will be finally determined through open and in-depth public discussion on the sustainability of nuclear energy.

7.3. Organizations

Korea's government bodies for nuclear energy are separated into a promotional side and a safety and security management side. Before Oct 26 of 2011, the Ministry of Knowledge and Economy (MKE) has responsibility for NPP operations and other energy policy. The Ministry of Education, Science and Technology has responsibility for nuclear-related R&D. As for the safety and security management side, the details are to be mentioned in Chapter 2.

Figure 18: Government Bodies for Nuclear Energy in Korea (as of 2012)



8. Japan

8.1. Energy Demand/Supply Outlook

Since the Fukushima accident on March 11, 2011, Japan's power supply portfolio has been significantly changed. Thirty-six nuclear power plants were in operation just before the accident. Ten plants were shut down directly by the earthquake; after the accident, only Ohi 3 and 4 received permission to restart. Consequently, Japan has depended heavily on thermal generation in these two years, and especially on oil and LNG. The share of thermal generation has risen from 60.25% in FY2010 to 89.62% in FY2012.

Table 4: Transition of the Power Portfolio in Japan

	Hydro	Thermal	Nuclear	Renewables
FY2010	8.08%	60.25%	31.39%	0.28%
FY2012(※)	8.18%	89.62%	1.87%	0.33%

As mentioned above, almost all NPP, which had supplied about 30% of domestic electricity, have been stopped. Japan twice experienced severe power shortages after the Fukushima accident. T o prevent blackouts, the government set strict power-saving targets for industry and households. Electric power utilities managed to secure the supply capacity by operating almost all thermal power plants and installing emergency power plants, such as gas turbines, which utilities can install in a short period. Even now, the situation where almost all NPPs are not permitted to restart has not changed, although some power plants damaged by the earthquake and tsunami have completed repair work and are now ready to come back to the grid.

Although the restart of nuclear power plants in Japan is regarded as critical in view of Japan's "3Es" (energy security, environmental protection, and economic efficiency), the necessary conditions for permission to restart the plants have continued to be uncertain since the Fukushima accident and still are not fixed as of May 2013. The new Nuclear Regulatory Authority of Japan (NRA), which was established in September 2012, states that the NRA will make technical assessments of safety for individual nuclear power plants, based on the new regulatory safety

standards. Consequently, the expected timing for restarting the nuclear power plants is still uncertain. Many experts in Japan seem to take a view that the restart may be possible in the late second half of 2013 at the earliest, as the formal process of the NRA assessment may begin after the new safety standards are established in July 2013. In these circumstances, it is quite likely that the short-term power balance in Japan will continue to be very severe for this fiscal year at least.

It is not only the short-term perspective that is uncertain: the long-term outlook is also uncertain and still subject to confused discussion. In the next section, the trends and the major issues for long-term energy and nuclear policy are discussed.

8.2. Nuclear Energy Policy and Development Plan

In 2010, the cabinet approved the Strategic Energy Plan of Japan, which described Japan's energy policy to 2030 (details shown in Figure 19). In this plan, the intention to raise the zero-emission power source ratio from 34% to about 70% and reduce energy-related CO2 emissions by 30% or more in 2030 (compared to the 1990 level) was declared. To achieve these targets, the share of nuclear power generation would be raised from 26% in 2007 to 53% in 2030.

After the Fukushima accident, the government decided to restructure the Strategic Energy Plan due to increasing public distrust of nuclear. To reconsider the energy plan, the government established three major meetings:

- Energy and Environmental Council (under the National Policy Unit)
- Planning "Innovative Strategy for Energy & Environment"
- Chaired by the Minister of State for National Policy
- Committee to Study Costs and Other Issues (under the National Policy Unit):
- Verifying the cost of generation
- Members include economists, engineers and consultants
- Fundamental Issues Committee (under METI):
- Discussing the details of the energy mix in order to make a revised Strategic Energy Plan
- Members include economists, engineers, consumer groups, environmentalists, private sector and anti-nuclear organizations

The Energy & Environmental Council adopted the "Innovative Strategy of Energy & Environment" on September 14, 2012. This strategy includes the following targets:

- Realization of a society not dependent on nuclear power:
- Strictly applying the stipulated rules regarding safety assurance and the forty-year limitation on operation
- Restarting the operation of nuclear power plants will be approved by the Nuclear Regulation Authority
- No new construction of nuclear power plants
- The government will mobilize all possible policy resources to such a level as to even enable zero operation of nuclear power plants by the 2030s
- Realization of green energy revolution
- Ensuring a stable supply of energy
- Bold implementation of reform of electricity power systems
- Steady implementation of global warming countermeasures

After announcing the zero-nuclear policy, industry and the government expressed their opinions against zero-nuclear, while the US, UK and France also expressed their concerns about zero-nuclear.

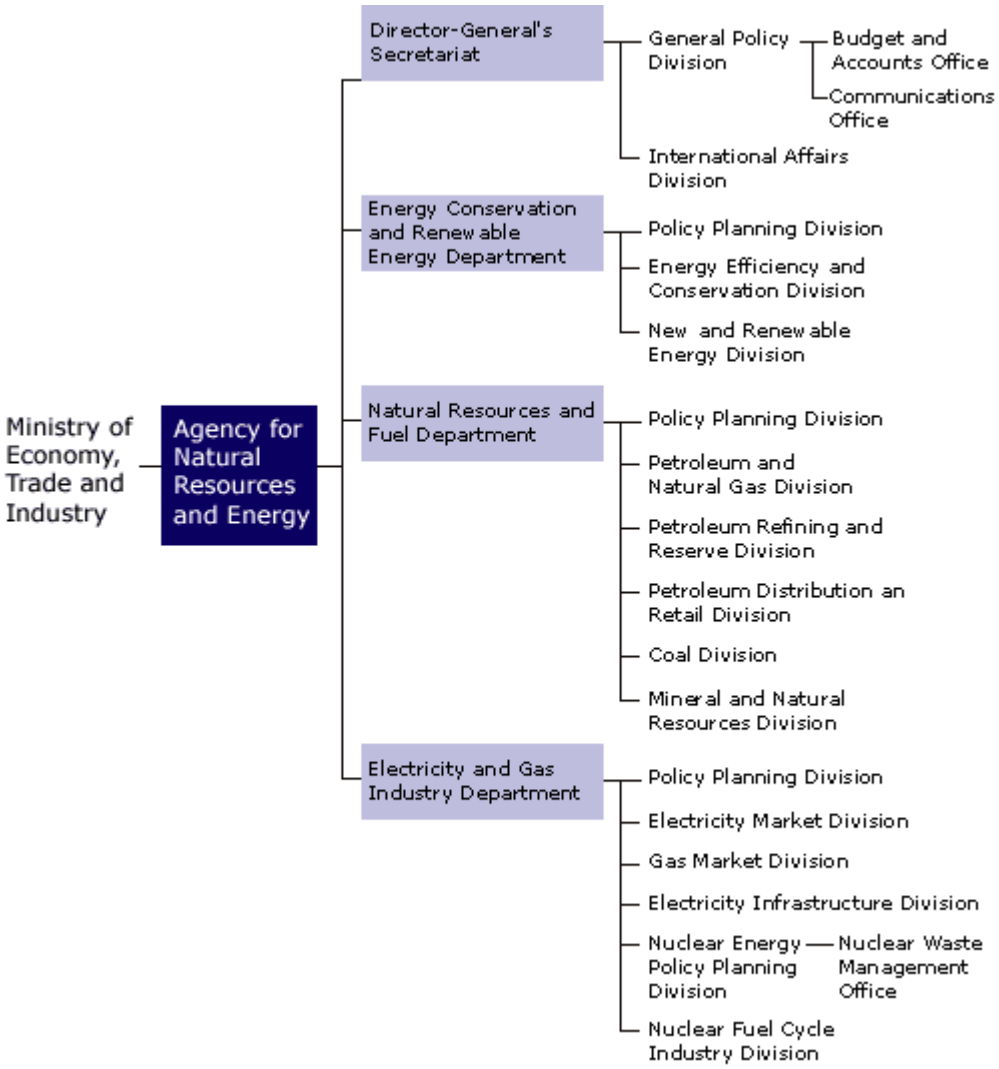
On September 19, 2012, the cabinet released a statement that "the Government of Japan will implement future policies on energy and the environment, taking into account the Innovative Strategy on Energy and the Environment," while not directly adopting the Strategy.

On December 16, 2012, the Liberal Democratic Party of Japan (LDP) won the Lower House election and the Abe Cabinet began. Prime Minister Abe said that the former DPJ cabinet's energy policy was "only a wish," and therefore he would make a firm energy policy. Soon after the election, the Abe cabinet started to reconstruct the energy policy discussion, especially on nuclear policy. In March 2013, the discussion on the long-term energy policy restarted in the General Subcommittee, an advisory committee for Natural Resources and Environment. Nothing certain has been determined as of May 2013.

8.3. Organizations

The Ministry of Economy, Trade and Industry (METI) is responsible for energy policy, including nuclear. The Agency for Natural Resources and Energy is one of the agencies within METI. The Nuclear Energy Policy Planning Division is in charge of nuclear energy policy development. Figure 19 shows the organization chart of the Agency for Natural Resources and Energy.

Figure 19: Organization Chart of Agency for Natural Resources and Energy



9. Summary and Policy Implications

Several ERIA member countries have been planning to introduce nuclear power, generally eyeing completion in the 2020s, under government initiatives derived in the light of growing electricity demand and the need for securing energy resources. In reality, however, these plans have been likely to experience delays by several years or more due to wavering discussions or concerns.

The severe accident that occurred in 2011 had a significant impact on nuclear development plans in Asian countries. In most countries the planning for introducing nuclear power is likely to be delayed or suspended. However, the delays and the ongoing discussions on introducing nuclear power have not arisen solely from the Fukushima accident. Every country has its specific situation and circumstances. Since nuclear is not the only option for securing energy and for protecting the environment, discussions toward a consensus should be continuously enhanced both domestically and cross-regionally.