ERIA Research Project Report 2012, No.24

STUDY ON THE DEVELOPMENT OF AN ENERGY SECURITY INDEX AND AN ASSESSMENT OF ENERGY SECURITY FOR EAST ASIAN COUNTRIES

Edited by
ICHIRO KUTANI

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DISCLAIMER

This report was prepared by the Working Group for the "Study on the Development of an Energy Security Index and an Assessment of Energy Security for East Asian Countries" under the Economic Research Institute for ASEAN and East Asia (ERIA) Energy Project. Members of the Working Group, who represent the participating EAS region countries, discussed and agreed to utilize certain data and methodologies to develop the energy security index. These data and methodologies may differ from those normally used in each country. Therefore, the calculated result presented here should not be viewed as official national analyses of the participating countries.

FOREWORD

Energy security is a concept that forms the basis of energy policy in every country. It goes without saying that countries must be able to provide a stable supply of energy at an affordable price, and in the quantity needed to sustain the lives of their people and economic activities. Energy security is a top priority of the policy agenda in East Asia in particular, where countries are now confronted with increasing energy demand resulting from improved living standards and economic growth, coupled with the continuation of historically high energy price namely crude oil prices. Moreover, with a majority of emissions coming from energy, including air pollutants and greenhouse gases, it is also clear that harmony with the environment has become an integral element of energy policy.

Against this backdrop, ERIA organized a working group to carry out a study aims to quantitatively assess and analyze the energy security situation in East Asian countries and to provide policy recommendations for the improvement of that situation. As a second year of a study, experts from EAS countries were gathered to discuss the correlation between past policy and transition of developed index, ESI. The working has also discussed about the way how to implement policy effectively.

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

Ichiro Kutani
Leader of the Working Group
June 2013

ACKNOWLEDGEMENTS

This analysis has been implemented by a working group under ERIA. It was a joint effort of Working Group members from the EAS Countries and the IEEJ (The Institute of Energy Economics, Japan). We would like to acknowledge the support provided by everyone involved. We would especially like to express our gratitude to the members of the Working Group, Economic Research Institute for ASEAN and East Asia (ERIA) and IEEJ's study project team.

Mr. Ichiro Kutani
Leader of the Working Group
June 2013

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LIST OF PROJECT MEMBERS

Working Group Members

MR. ICHIRO KUTANI (LEADER): Assistant Director, Senior Economist, Manager, Global Energy Group 1, Strategy Research Unit, The Institute of Energy Economics, Japan (IEEJ)

MR. MITSUO MATSUMOTO (ORGANIZER): Managing Director for Research Affairs, Economic Research Institute for ASEAN and East Asia (ERIA)

MR. BRETT JACOBS (ORGANIZER): Energy Economist, Economic Research Institute for ASEAN and East Asia (ERIA)

DR. HAN PHOUMIN (ORGANIZER): Energy Economist, Economic Research Institute for ASEAN and East Asia (ERIA)

MR. KONG PAGNARITH: Chief of Secretary, General Department of Energy, Ministry of Industry, Mines and Energy (MIME), Cambodia

DR. YUE-JUN ZHANG: Head of Energy Market and Carbon Market, Center for Energy & Environmental Policy Research, Beijing Institute of Technology, China

DR. RETNO GUMILANG DEWI: Head, Center for Research on Energy Policy, Institute of Technology Bandung (ITB), Indonesia

MR. MITSURU MOTOKURA: Senior Coordinator, Global Energy Group 1, Strategy Research Unit,The Institute of Energy Economics, Japan (IEEJ)

MR. KAZUTAKA FUKASAWA: Senior Researcher, Global Energy Group 1, Strategy Research Unit, The Institute of Energy Economics, Japan (IEEJ)

MR. KHAMSO KOUPHOKHAM: Deputy Director-General, Department of Energy Policy and Planning Ministry of Energy and Mines (MOEM), Lao PDR

MR. JAYA SINGAM A. RAJOO: Under Secretary, Regulatory and Industry Development Division, Energy Sector Ministry of Energy, Green Technology & Water (KeTTHA), Malaysia

MR. HAN TUN OO: Staff Officer, Energy Planning Department Ministry of Energy (MOE), Myanmar.

DR. JOHANNAH HELEN BRANSON: Director, Occam Economics Limited, New Zealand

MS. MA. PAMELA GRACE C. MUHI: Senior Science Research Specialist, Policy Formulation and Research Division, Energy Policy and Planning Bureau, Department of Energy, Philippines

DR. WOONGTAE CHUNG: Research Fellow, Energy Policy Research Group, Korea Energy Economics Institute (KEEI), Republic of Korea

MS. SUPIT PADPERM: Director (Acting), Energy Information Technology Development Group, Energy Forecast Information Center, Energy Policy and Planning Office (EPPO), Ministry of Energy, Thailand

DR. NGUYEN DUC SONG: Researcher, Energy Economics, Demand Forecast and DSM Department, Institute of Energy (IE), Vietnam

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LIST OF ABBREVIATIONS AND ACRONYMS

ASEAN = Association of Southeast Asian Nations
BP = BP Statistical Review of World Energy
CO_2 = Carbon dioxide
EAS = East Asia Summit
ECTF = Energy Cooperation Task Force
ERIA = Economic Research Institute for ASEAN and East Asia
ESI = Energy Security Index
E&P = Exploration & Production
GDP = Gross domestic product
GHG = Greenhouse gas
HHI = Hirschmann-Herfindahl Index
IEA = International Energy Agency
IEEJ = The Institute for Energy Economics, Japan
IMF = International Monetary Fund
LNG = Liquefied Natural Gas
ME = Middle East
N.A. = Not Available
OECD = Organization for Economic Cooperation and Development
R/C ratio = Reserve / Consumption ratio
R/P ratio = Reserve / Production ratio
SPR = Strategic Petroleum Reserve
TFEC = Total Final Energy Consumption
TPES = Total Primary Energy Supply
WG = Working group

EXECUTIVE SUMMARY

In the 16th ECTF[1] meeting held in Vientiane of Lao PDR on 25 August 2011, Japanese government proposed several new idea and initiatives for EAS energy cooperation. Responding to the proposal, the ECTF Meeting endorsed the new areas and initiatives, which included the Energy Security Index for East Asian Countries.

The Economic Research Institute for ASEAN and East Asia (ERIA) approved the proposal of the Japanese government to conduct a study on the energy security index. As a result, the Working Group (WG) for the study on development of Energy Security Index and assessment of energy security for East Asia Countries was convened.

The first objective of the study was to develop an index that quantitatively indicated the energy security situation, and could thereby, help policymakers to accurately gauge the energy security situation in their country.

The second objective was to analyze the linkages between policies and the historical trends shown in the index, and thereby assess the impact that policies have on the energy security situation.

The last objective was to propose policy recommendations to policymakers in East Asian countries on improving energy security based on the following analysis:

- What methods and approaches are effective for improving energy security
- What kinds of regional cooperation are useful for improving energy security

For this study, a Working Group was organized comprised of experts from East Asian countries. In the first year of the study (e.g. FY2011), the WG convened two times to develop indexes which is able to explain, not the all, but some aspect of

[1] Energy Cooperation Task Force under the Energy Minister Meeting of EAS countries.

energy security.

For this year, the WG convened two times to discuss the correlation between calculated ESI and past policies. In an analysis, we focused on a past transition of ESI and relevant policies in each country. Although the change of ESI can be explained by various elements including policies and economic situation, we had selected a few specific policies to simplify the assessment work. Since the purpose of the study is to find core element of correlation between the ESI and policies, this procedure does not deteriorate the analysis.

The following table shows selected policies to be analyzed.

List of policies

Description	Specific Policy
Coal	Coal mining (Indigenous) Coal use promotion Import source country diversity
Crude oil	Crude oil E&P (Indigenous) Refinery construction Import source country diversity Oil Stocks (SPR) Alternative fuel promotion (other than oil)
Natural gas	Natural gas E&P (Indigenous) Natural gas use promotion Import source country diversity
Nuclear	Nuclear development
Hydro	Hydro development
Geothermal, wind, other	Renewable energy development
Biofuels & waste	Renewable energy development
Electricity	Electrification Supply reliability
All energy	Energy conservation/efficiency
CO2 Emission	CO2 Emission reduction
Price and subsidy (incl. tax incentive)	Coal production subsidies Coal consumer price control (below international prices/import costs) Crude oil production subsidies Oil product consumer price control (below international prices/import costs) Natural gas production subsidies Natural gas consumer price control (below international prices/import costs) Electricity tariff control (below costs)

The correlation between ESI and policy is summarized in the following table. When look at the records of an assessment, in most cases there was a correlation

between past policy and change of ESI with a few exceptions. While there are ESIs directly affected by specific energy policy, there are others that are believed to be impacted multiple factors such as changes in industrial structure, economic activity, technology development and market conditions (costs and price). Hence, we should be careful to watch these assessments.

Correlation between policy and ESI (Summary)

	ESI	KHM	CHN	IDN	JPN	KOR	LAO	MYS	MMR	NZL	PHL	THA	VNM
1	TPES self-sufficiency	No	No	No	Yes	Yes	No	No	Yes	Yes	Yes	No	Yes
2	Coal self-sufficiency		No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	Yes
3	Crude oil self-sufficiency							No	Yes	Yes	Yes	Yes	No
4	Natural gas self-sufficiency			No		Yes			Yes	No	Yes	No	Yes
5	Coal R/P		No	No	Yes	Yes				Yes	Yes	Yes	Yes
6	Crude oil R/P							No	Yes			No	Yes
7	Natural gas R/P			No				No	No		Yes	No	No
8	Coal R/C		No	Yes	Yes	Yes				Yes	Yes	Yes	Yes
9	Crude oil R/C			Yes				Yes	Yes			Yes	Yes
10	Natural gas R/C			Yes				Yes	No		Yes	Yes	Yes
11	Coal import source country diversity					Yes		Yes					
12	Crude oil import source country diversity		Yes		No	No							
13	Natural gas import source country diversity					Yes						No	
14	TPES diversity	Yes	No	Yes	Yes	Yes		Yes		Yes	Yes	Yes	Yes
15	Power generation fuel diversity	Yes	No	Yes	Yes	Yes		Yes		Yes	Yes	No	Yes
16	Crude oil Middle East dependence		No		No	No							
17	Natural gas Middle East dependence					Yes							
18	Reserve margin of generation capacity		Yes	No	Yes	No		Yes	-	No	Yes	Yes	No
19	Power outage frequency			Yes	Yes	Yes		Yes		No			
20	Power outage duration			No	Yes	Yes		Yes		No			
21	Commercial energy access	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes
22	Electrification	Yes	Yes	Yes	-	-	Yes	Yes	Yes	-	Yes	Yes	Yes
23	TPES / GDP		Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
24	TFEC / GDP		Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
25	Days of on-land oil stocks				Yes	Yes			Yes	No		Yes	
26	CO2 Emissions / TPES	No	Yes	No	Yes	Yes	No	No	No	No	No	No	No
27	CO2 Emissions / Fossil fuel	No	No	No	No	Yes	Yes	No	No	No	No	No	No
28	CO2 Emissions / GDP	No	Yes	No	Yes	Yes	No	No	No	No	No	No	No
29	CO2 Emissions / Population	No	Yes	No	No	No	No	No	No	No	No	No	No

Note: KHM: Cambodia, CHN: China, IDN: Indonesia, JPN: Japan, KOR: Korea, LAO: Laos, MYS: Malaysia, MMR: Myanmar, NZL: New Zeaaland, PHL: Philippines, THA: Thailand, VNM: Vietnam

In this year, the study delivered following implications for the energy security of EAS countries.

1. Measuring the effects of policy is extremely important as a reference for future policy planning and for effectively allocating limited budgetary resources. In this sense, despite various restrictions, this research carries with it great significance because it attempts to qualitatively measure the existence of policy effects.

2. One ESI consists of multiple policies effect, making it difficult to qualitatively assess what effect which of these policies had on ESI changes. For example, changes in the TPES per GDP used to assess energy efficiency are affected by changes in energy consumption as well as changes in industrial structure.

3. However, when examining both ESI changes averaged out over a long period of time, such as five or ten years, and the existence of policy thought to be correlated to such changes, assessments showed a correlation existed between several policies and ESI.
   - Resource development promotion policy and R/C ratio
   - Oil dependence reduction policy and diversity in primary energy as well s power supply
   - Commercial energy supply policy or electrification rate improvement policy and commercial energy supply ratio or electrification rate
   - Energy saving policy and energy efficiency
   - Oil stock policy and oil stock amounts

4. Generally, policy requires a long period of time before it causes changes in the country's actual energy supply-demand situation. This is because investments in equipment and devices that use energy are typically large in nature, while such equipment and devices have a long service life, meaning that it is difficult to change energy supply-demand situation over a short period of time.

   For example, several countries are implementing policy on climate change, and such policy has only been rolled out recently. Consequently, enough time has yet

to pass until such policy has made changes in the energy supply-demand situation, making it impossible to verify the effects.

5. Conversely, there are also policy effects that cannot be verified even after a sufficient amount of time has passed since the policy was implemented. One example is dependence on the Middle East for oil supply. The study could not verify declines in dependence despite the existence of policy for such purposes. This is believed to be due to geographic reasons, or the fact that large amounts of crude oil are existing in the Middle East and that there is no other supply source in the Asia Pacific region large enough to replace the Middle East. Therefore, essentially policy effects are difficult to obtain.

6. A combination of multiple indirect methods is believed to be useful toward achieving targets for which policy has a difficulty exerting effects. For example, in the case of dependence on the Middle East for oil supply mentioned above, the fundamental purpose of policy is to avoid the serious geopolitical risks posed by the Middle East. This purpose can be achieved to a some extent by implementing multiple layers of policy, including reducing the use of oil for which the country depends on Middle East imports, preparing for supply interruption risk with the use of oil stocks, and providing support aimed at long-term stability in the Middle East.

7. The strength of regulations on the energy industries or energy markets is an important element that determines the effects of energy policy. The strength of such regulations become weaker in order of the following situations: (1) monopoly by state-owned enterprises; (2) private-sector companies play a leading role but business regulations are in place; and (3) private-sector companies play a leading role and deregulation has been implemented (market oversight remains in place using environmental / safety regulations or government administration)

   The situation where state-owned enterprises have a monopoly over energy

markets in which regulations are strong is believed to be the easiest way to reflect policy intention more directly in the market over a comparatively shorter period of time. In many of the countries studied, all or certain important parts of energy markets where monopolized by state-owned enterprises and this proved to be effective in terms of the ease of implementing energy policy.

In situations with strong regulations, however, the screening and management ability of the market regulator, government, largely determines market efficiency and the level of services provided to end consumers. Caution should also be heeded regarding the possibility that the heavy involvement of politics that typically occurs in such situations could inhibit policy execution.

8. Generally, it is believed that leaving the markets to open competition among private-sector companies will result in more diverse services at a lower cost. However, it is important to note that private-sector companies essentially do not take action beyond economic rationalities.

   For example, in the selection of power sources, if attempting purely to fulfill economic rationalities, most private-sector companies would choose subcritical pressure coal-fired power plants. However, this carries with it the potential to go against the requirements of energy security, which include risk dispersion through energy source diversification, reduced demand through improved energy efficiency, and environmental impact reductions. Energy security is a requirement of the nation that exceeds corporate behavior. As such, it is impossible to completely eliminate the involvement of the national government in a country's energy markets.

   However, it is a proven fact that incorporating the capital, human resources and innovation of private-sector companies into energy markets will provide profits for the energy markets. Consequently, an appropriate balance should be struck between the government and private-sector companies depending on the unique situation of each country.

CHAPTER 1
Introduction

1. Background of the Study

In many East Asian countries, energy demand is expected to grow continuously in the long run, with high economic growth and social development driving this trend. It is also expected that energy production, particularly fossil fuel production, in the East Asian region will not be able to keep up with the speed of energy demand growth, and that the region will have to face rising energy import dependence. At the same time, it is important to note that there are emerging challenges on the energy supply side in the world energy market which include: geopolitical risks, market power risks, natural disaster/accidental risks, under-investment, resource nationalism, and so on. Given these background factors, the enhancement of energy security is becoming one of the top priorities for each East Asian country, as all commonly need to achieve sustainable economic growth and development.

It is also essential to recognize that East Asian countries have a wide range of diversity in such areas as their energy resource endowment, economic development stage, industrial structure, stage of technology development and deployment, and so forth. Under these circumstances, it is necessary to analyze the energy security situation and policy implications in each East Asian country, with due consideration to the diversity mentioned above.

Furthermore, since East Asian countries have already deepened their economic and energy relationships in a bid to explore regional integration, it is very important

to promote the enhancement of security, not only in each country but also in the East Asian region as a whole, through regional cooperation.

Given the above recognition, we have conducted a study on the development of an Energy Security Index and have made an assessment of energy security policy for East Asian countries.

2. Objective

The first objective of the study is to develop an index that quantitatively indicated the country by country energy security situation, and could thereby, help policymakers to accurately gauge the energy security situation in their country.

The second objective is to analyze the linkages between policies and the historical trends shown in the index, and thereby assess the impact that policies have on the energy security situation.

The last objective is to offer policy recommendations to policymakers in East Asian countries on improving energy security based on the following analysis:

- What methods and approaches are effective for improving energy security
- What kinds of regional cooperation are useful for improving energy security

3. Summary of Research

Research will be conducted in three stages over a three-year period of time. The following table contains a description of the research that will be conducted as part of each stage. Stage two, or second year, research was performed in 2012.

Table 1: Time Line of the Study

1st year: Develop & calculate indicators (A) Development of Energy Security Index - Assume "Energy Security Index" be comprised of several major indicators which reflect principal component of energy security. (B) Data collection and calculation of Energy Security Index for each country - Necessary historical data will be collected for each indicator, and for each country. Publicly available statistic; IEA, IMF, BP, etc National statistic; expect to provided by each member Timeframe; 1970 - latest available Transparency of the data - Then based on the developed method mentioned in the part (A) above, Energy Security Index for each country will be calculated.
2nd year: Analyze relationship between ESI and policy **(C) Analysis of past energy security policy taken in each country** **- Past energy security policy will be examined by literature, by internet and provided by each member** **(D) Assessing the effectiveness of past policy on the status of energy security** **- Quantitative assessment of past policy** **- Relation between historical change of the Index and past policy** **(E) Drawing useful lessons from the past experiences** **- From the above analysis and exercise, policy recommendation will be drawn with regard to such areas as;** **what can be the better approach/practice to be adopted** **what will required to actually implement the identified approach/practice; etc**

4. Working Group Activities in 2011

In 2011, the WG was held for 2 times in October 2011 and April 2012, both in Jakarta, Indonesia.

During the first meeting, the WG discussed and developed the 2010 study plan and each member provided information on their country's energy security. As an overview of the study, its significance and objectives were shared, and an overall image of the multi-year project was presented. In this context, members confirmed the positioning of the work streams for the fiscal year. In the reports made by the WG members, the changes in the energy supply and demand environment in their

countries were described, along with changes in policy, the issues currently confronting their countries, etc. In addition, an ESI case example was presented, and this served as a basis for discussion. During that discussion, a wide range of views was exchanged on a variety of topics, including the selection of indicators and the data collection methods. Lastly, a request was made to WG members to provide the information essential for carrying the study forward.

During the second meeting, the WG discussed the calculation results for the ESI. During the discussion, a variety of views was exchanged on the ESI, such as the relevance of the data utilized for calculating the indices and the indicators which ought to be selected. It should be noted that missing data were supplemented and that data reliability was improved through the contribution of WG members. It was also an extremely important achievement that a wide-ranging discussion was successfully held on the approach for assessing the calculated indexes. Accordingly, it was decided that the knowledge of the WG members and the discussion outcomes would be reflected in the study report.

5. Working Group Activities in 2012

In 2012, the WG was held for 2 times in November 2012 in Jakarta and April 2013 in Tokyo.

During the first meeting the WG discussed the calculated index. Discussions revolved around the use of econometric modeling as one method for assessing the impact that policies in each country have had on changes in the index. There are a number of elements that have caused the index to change, including macro economic conditions, industrial structure and fluctuations in energy prices, but it was pointed

out that analysis using econometric modeling would make it possible to breakdown the impact from each. There are limitations, however, posed by an econometric modeling analysis. Furthermore, at least 20-years worth of accurate data would be required for such an analysis, which would be extremely difficult to collect since the number of countries that could provide such data is very limited. Additionally, it was pointed out that government policies did have an effect on changes in the index and that some sort of correlation does exist.

Next, WG members talked about the energy policy of their countries, followed by a question and answer session. During this time, the difficulty of looking into past government policies, particularly with regards to developing countries, was pointed out. In addition, members also noted the importance of policies on renewable energy and electricity, whereby confirming that the effects of these policies should be analyzed appropriately.

Given the discussion from the first meeting, an analysis was performed on the correlation between policy and ESI, and at the second meeting the WG discussed this correlation between policy and ESI. During these discussions, it was noted that there are a variety of elements affecting changes in the ESI and no single element could be used to explain all of the changes in ESI. Based on this, it was decided that consideration will be given to a variety of related elements during future analysis of the correlation between policy and ESI.

Next, a discussion was held on the impact that past government energy policies have had on the energy security situation. These discussions once again confirmed the difficult nature of assessing past government policies. Additionally, in most countries policy related to the reduction of CO2 emissions has only been enacted recently. As a result, it is too early to measure the effects of such.

CHAPTER 2
Correlation Between Policy and ESI

1. ESI

First, we will provide a summary of WG discussions on ESI from 2011. Based on these, the 2012 WG discussed the correlation between policy and ESI.

The following table shows the components, quantitative assessment and ESIs for evaluating the quantitative assessment of energy security. Electrification ESI was also added. Refer to the 2011 report for details pertaining to the definition of energy security.

Table 2-1: List of ESI

Components	Quantitative Assessment	ESIs
Development of domestic resources	1. Self-sufficiency	1-1. TPES self-sufficiency ratio (including nuclear) 1-2. Reserve/production ratio 1-3. Reserve/consumption ratio
Acquisition of overseas resources	2. Diversification of import source countries 3. Diversification of energy sources 4. Dependence on Middle East	2. Diversity of import source countries (oil, gas and coal) 3. Diversity of energy sources of TPES / electricity 4. Middle East dependence for oil and gas
Transportation risk management	-	-
Securing a reliable domestic supply chain	5-1. Reliability of energy supply 5-2. Build supply infrastructure	5-1-1. Reserve margin of generation capacity 5-1-2. Power outage frequency / duration 5-2. Commercial energy access ratio
Management of demand	6. Energy efficiency	6-1. TPES/GDP ratio 6-2. TFEC/GDP ratio
Preparedness for supply disruptions	7. Strategic reserves	7. Days of on-land oil stocks
Environmental sustainability	8. CO_2 intensity	8-1. CO_2 emissions/TPES ratio 8-2. CO_2 emissions/Fossil fuel ratio 8-3. CO_2 emissions/GDP ratio 8-4. CO_2 emissions/Capita

Note: TPES: Total Primary Energy Supply

TFEC: Total Final Energy Consumption

GDP: Gross Domestic Production.

The following table contains the ESI calculation method. Refer to the 2011 report for description of each individual ESI.

Table 2-2: Calculation of ESI

ESI	Calculation
Self-sufficiency	(Indigenous Production) / (TPES)*100
Reserve/Production (R/P) ratio	(Reserve) / (Production)
Reserve/Consumption (R/C) ratio	(Reserve) / (Consumption)
Diversity of import source countries	HHI
Diversity of energy sources	HHI
Middle East dependence	(Imports from ME) / (Total Imports) *100
Reserve margin of generation capacity	(Total Generation Capacity) / (Peak Demand) *100
Power outage duration	(Accumulated duration of power outage) / (Total number for customer)
Power outage frequency	(Outage frequency per year) / (Total number of customers)
Commercial energy access ratio	(TPES – Non-commercial energy) / (TPES) * 100 where; Non-commercial energy = (Primary supply of solid biofuels) – (Input energy for transformation purpose)
TPES/GDP	(TPES) / (GDP)
TFEC/GDP	(TFEC) / (GDP)
Days of on-land oil stocks	(Total stock) / (Forward demand) where; Total stock = industry stock + government controlled stock Forward demand = forward quarter average daily demand calculated by the IEA
CO_2 emissions/TPES	(CO_2 Emissions) / (TPES)
CO_2 emissions/Fossil fuel	(CO_2 Emissions) / (Primary supply of fossil fuel)
CO_2 emissions/GDP	(CO_2 Emissions) / (GDP)
CO_2 emissions/Capita	(CO_2 Emissions) / (Population)

Note: HHI: Hirschmann-Herfindahl Index.

The data sources used to calculate the ESI are as follows. Refer to the 2011 report for details pertaining to the data source of each individual ESI.

Energy Balance of OECD, Non-OECD Countries (IEA)
Coal Information, Oil Information and Natural Gas Information (IEA)
Monthly Oil Market Report (IEA)
World Energy Outlook (IEA)
BP Statistical Review of World Energy
WG on Analysis on Energy Saving Potential in East Asia (ERIA)
World Bank
Statistics of the "Japan Electric Power Information Center"
National statistics

2. Methodology

We identified and selected policies in order to investigate the correlation between policy and ESI. These policies are believed to have been employed similarly in each country.

In order to study the correlation between policy and ESI, we focused on policies to investigate the results of policy implementation, the fluctuation of ESI related to the policy and the impact the policy had on ESI. The assessment was not a quantitative assessment, but rather performed using a “yes/no”, “increase/decrease”, and “improved/worsened” formula.

The following table contains a list of the policies.

Table 2-3: List of Policies

Description	Specific Policy
Coal	Coal mining (Indigenous) Coal use promotion Import source country diversity
Crude oil	Crude oil E&P (Indigenous) Refinery construction Import source country diversity Oil Stocks (SPR) Alternative fuel promotion (other than oil)
Natural gas	Natural gas E&P (Indigenous) Natural gas use promotion Import source country diversity
Nuclear	Nuclear development
Hydro	Hydro development
Geothermal, wind, other	Renewable energy development
Biofuels & waste	Renewable energy development
Electricity	Electrification Supply reliability
All energy	Energy conservation/efficiency
CO2 Emission	CO2 Emission reduction
Price and subsidy (incl. tax incentive)	Coal production subsidies Coal consumer price control (below international prices/import costs) Crude oil production subsidies Oil product consumer price control (below international prices/import costs) Natural gas production subsidies Natural gas consumer price control (below international prices/import costs) Electricity tariff control (below costs)

3. Analysis of Correlation

Factors determining the correlation between policy and ESI include the existence of policy, the execution and results of policy, and the impact policy had on ESI. In addition, there is also the possibility that economic activities outside of energy policy are affecting ESI. Because of the complex nature in quantitatively analyzing these factors, we determined the correlation by simplifying these factors and using only the existence of policy and the results of ESI.

The existence of policy was measured with a “yes” or “no”, while ESI used “improved”, “worsened” or “no change”. ESI tend to repeatedly improve and worsen and in either case emphasis was placed on recent trends. Furthermore, “no change” was included in “worsened”. The existence of a correlation between policy and ESI was indicated by “yes”, “no” or “not applicable (N.A.)”. Annex 1 provides further details on the correlation between policy and policy for each ESI and country with ESI.

The 2012 WG study examined the relationship between past policy and ESI and showed that ESI potentially is not fully reflected in policy that was enacted recently.

3.1. TPES Self-sufficiency

Refer to Annex 1-1.

A variety of policies effected changes in this ESI. All country established several relevant policies, although there is a difference between countries in number of established policies.

If the ESI was improved, the correlation is “Yes.”
If the ESI was worsened, the correlation is “No.”
If the ESI was worsened then improved, the correlation is “Yes.”
If the ESI was improved then worsened, the correlation is “No.”

The results of the analysis can be found in the table below.

The reason why the correlation of resource countries China, Indonesia and Malaysia was “no” is believed to be the large increase in energy demand, which outpaced increases in production. The correlation of resource poor countries Japan and South Korea was “yes” mainly because of the increase in the use of nuclear power.

Table 2-4: Result of the Correlation (TPES Self-sufficiency)

Country	Correlation	Country	Correlation
Cambodia	No	Malaysia	No
China	No	Myanmar	Yes
Indonesia	No	New Zealand	Yes
Japan	Yes	Philippines	Yes
Korea	Yes	Thailand	No
Laos	No	Vietnam	Yes

3.2. Coal, Crude oil or Natural gas Self-sufficiency

See Annex 1-2, Annex 1-3 or Annex 1-4.

Resource mining (E&P) policy and production incentive policy effected changes in this ESI. Both policies help to improve the ESI. The ESI applies to countries which relevant statistics was available.

If a country established a relevant policy and the ESI was improved,
the correlation is “Yes.”
If a country established a relevant policy and the ESI was worsened,
the correlation is “No.”
If a country established a relevant policy and the ESI was worsened then improved,
the correlation is “Yes.”
If a country established a relevant policy and the ESI was improved then worsened,
the correlation is “No.”
If a country established no relevant policy, the correlation is N.A.

The results of the analysis can be found in the table below.

The main reason why many of the countries had a “No” for correlation with regard to coal was believed to be the increase in the import volume of coal. Assessments of Japan’s coal self-sufficiency showed a “Yes” for policy and “worsened” for coal self-sufficiency ESI. Thus, based on the determining criteria, the correlation between policy and ESI was “No”. However, the goal of Japan’s recently adopted coal mining policy is

the rationalization of coal mining, meaning that the domestic production volume of coal will be reduced. Consequently, the correlation between Japan's coal policy and ESI was "Yes".

The main reason why the correlation of crude oil was "No" for oil exporter Malaysia was believed to be the increase in the import volume of crude oil. The reason why countries besides Malaysia had a "Yes" for this correlation was thought to have been the increase, albeit small, in crude oil production domestically.

The primary reason why the correlation of natural gas was "Yes" for countries was believed to have been because of a recent increase in the domestic production of natural gas. An increase in domestic demand is believed to be the reason why this correlation was "No" for Indonesia.

Table 2-5: Result of Correlation (Coal Self-sufficiency)

Country	Correlation	Country	Correlation
Cambodia	-	Malaysia	Yes
China	No	Myanmar	Yes
Indonesia	Yes	New Zealand	Yes
Japan	Yes	Philippines	No
Korea	No	Thailand	No
Laos	Yes	Vietnam	Yes

Table 2-6: Result of Correlation (Crude oil Self-sufficiency)

Country	Correlation	Country	Correlation
Cambodia	-	Malaysia	No
China	-	Myanmar	Yes
Indonesia	-	New Zealand	Yes
Japan	-	Philippines	Yes
Korea	-	Thailand	Yes
Laos	-	Vietnam	No

Table 2-7: Result of Correlation (Natural gas Self-sufficiency)

Country	Correlation	Country	Correlation
Cambodia	-	Malaysia	-
China	-	Myanmar	Yes
Indonesia	No	New Zealand	No
Japan	-	Philippines	Yes
Korea	Yes	Thailand	No
Laos	-	Vietnam	Yes

3.3.Coal, Crude oil or Natural gas Reserve/Production ratio

See Annex 1-5,Annex 1-6 or Annex 1-7.

Resource mining (E&P) policy and production incentive policy effected changes in this ESI. Both policies help to improve the ESI.

If a country established a relevant policy and the ESI was improved,
the correlation is “Yes.”

If a country established a relevant policy and the ESI was worsened,
the correlation is “No.”

If a country established a relevant policy and the ESI was worsened then improved,
the correlation is “Yes.”

If a country established a relevant policy and the ESI was improved then worsened,
the correlation is “No.”

If a country established no relevant policy, the correlation is N.A..

The results of the analysis can be found in the table below.

The main reason why the correlation between Japan and South Korea was “Yes” for coal was believed to be because domestic production volume was negligible. The primary reason why the correlation was “No” for China was thought to be an increase in domestic production volume without an increase in reserves. The correlation was “No” for Indonesia because of the sharp increase in domestic production volume, coupled with an increase in reserves.

The main reason why the correlation of crude oil was “Yes” for Vietnam was believed to be the increase in reserves.

The correlation of natural gas was “Yes” only for the Philippines. This is believed to be because of the expansion of natural gas E&P.

Table 2-8: Result of Correlation (Coal Reserve/Production ratio)

Country	Correlation	Country	Correlation
Cambodia	-	Malaysia	-
China	No	Myanmar	-
Indonesia	No	New Zealand	Yes
Japan	Yes	Philippines	Yes
Korea	Yes	Thailand	Yes
Laos	-	Vietnam	Yes

Table 2-9: Result of Correlation (Crude oil Reserve/Production ratio)

Country	Correlation	Country	Correlation
Cambodia	-	Malaysia	No
China	-	Myanmar	Yes
Indonesia	-	New Zealand	-
Japan	-	Philippines	-
Korea	-	Thailand	No
Laos	-	Vietnam	Yes

Table 2-10: Result of Correlation (Natural gas Reserve/Production ratio)

Country	Correlation	Country	Correlation
Cambodia	-	Malaysia	No
China	-	Myanmar	No
Indonesia	No	New Zealand	-
Japan	-	Philippines	Yes
Korea	-	Thailand	No
Laos	-	Vietnam	No

3.4. Coal, Crude oil or Natural gas Reserve/Consumption rate

See Annex 1-8, Annex 1-9 and Annex 1-10.

Reserve expansion policy and demand expansion policy effected changes in this ESI. The change brought about from each related policy differs.

Reserve expansion: resource mining (E&P) policy

Demand expansion: supply expansion policy, domestic refining policy, retail price control policy

If a country established both policies, the correlation is “Yes.”

* Because, if the former policy was strong, the ESI was improved, if the latter policy was strong, the ESI was worsened.

If a country established only former policy and the ESI was improved, the correlation is “Yes.”

If a country established only former policy and the ESI was worsened, the correlation is “No.”

If a country established only latter policy and the ESI was improved, the correlation is “No.”

If a country established only latter policy and the ESI was worsened, the correlation is “Yes.”

The results of the analysis can be found in the table below.

The main reason why the correlation was “Yes” for coal was believed to be because of an increase in coal reserves, with the exception of Japan. Assessments of Japan’s coal R/C ratio showed a “Yes” for policy and “worsened” for ESI. Thus, based on the determining criteria, the correlation between policy and ESI was “No”. However, the goal of Japan’s recently adopted coal mining policy is the rationalization of coal mining, but there was no increase in coal reserves. Consequently, the correlation between Japan’s coal policy and ESI was “Yes”.

The main reason why the correlation of crude oil was “Yes” for Indonesia was believed to be the decrease in domestic consumption of crude oil.

The correlation of natural gas was “No” only for Myanmar because of an increase in the domestic consumption for natural gas.

Table 2-11: Result of Correlation (Coal Reserve/Consumption ratio)

Country	Correlation	Country	Correlation
Cambodia	-	Malaysia	-
China	No	Myanmar	-
Indonesia	Yes	New Zealand	Yes
Japan	Yes	Philippines	Yes
Korea	No	Thailand	Yes
Laos	-	Vietnam	Yes

Table 2-12: Result of Correlation (Crude oil Reserve/Consumption ratio)

Country	Correlation	Country	Correlation
Cambodia	-	Malaysia	Yes
China	-	Myanmar	Yes
Indonesia	Yes	New Zealand	-
Japan	-	Philippines	-
Korea	-	Thailand	Yes
Laos	-	Vietnam	Yes

Table 2-13: Result of Correlation (Natural gas Reserve/Consumption ratio)

Country	Correlation	Country	Correlation
Cambodia	-	Malaysia	Yes
China	-	Myanmar	No
Indonesia	Yes	New Zealand	-
Japan	-	Philippines	Yes
Korea	-	Thailand	Yes
Laos	-	Vietnam	Yes

3.5. Import source country diversity

See Annex 1-11, Annex 1-12 or Annex 1-13.

Import source country diversity policy effected changes in this ESI.

If a country established a relevant policy and the ESI was improved,
the correlation is “Yes.”

If a country established a relevant policy and the ESI was worsened,
the correlation is “No.”

If a country had no relevant policy, the correlation is N.A..

The results of the analysis can be found in the table below.

Few countries have employed policy for the diversification of resource import partners. Because the selection of import partners for resources, and especially crude oil, is largely determined by geographic location, diversification is not easily achieved. Thailand has implemented an import partner diversification policy for natural gas, but more time is required to be able to confirm the effect that this policy has on changes in ESI.

Table 2-14: Result of Correlation (Coal import source country diversity)

Country	Correlation	Country	Correlation
Cambodia	-	Malaysia	Yes
China	-	Myanmar	-
Indonesia	-	New Zealand	-
Japan	-	Philippines	-
Korea	Yes	Thailand	-
Laos	-	Vietnam	-

Table 2-15: Result of Correlation (Crude oil import source country diversity)

Country	Correlation	Country	Correlation
Cambodia	-	Malaysia	-
China	Yes	Myanmar	-
Indonesia	-	New Zealand	-
Japan	No	Philippines	-
Korea	No	Thailand	-
Laos	-	Vietnam	-

Table 2-16: Result of Correlation (Natural gas import source country diversity)

Country	Correlation	Country	Correlation
Cambodia	-	Malaysia	-
China	-	Myanmar	-
Indonesia	-	New Zealand	-
Japan	-	Philippines	-
Korea	Yes	Thailand	No
Laos	-	Vietnam	-

3.6. TPES or Power Generation Fuel Diversity

See Annex 1-14 or Annex 1-15.

A variety of policies can affect changes in this ESI.

If a country established relevant policies and the ESI was improved,
the correlation is “Yes.”

If a country established relevant policies and the ESI was worsened,
the correlation is “No.”

If a country established relevant policies and the ESI was worsened then improved,
the correlation is “Yes.”

If a country established relevant policies and the ESI was improved then worsened,
the correlation is “No.”

The results of the analysis can be found in the table below.

Both Laos and Myanmar’s TPES is mainly hydro, with each country relying upon hydro for nearly 100% of their electricity generation needs. Both countries ESI was “improved” and policy “Yes”. Based on the determination criteria, the correlation between policy and ESI was “Yes”. However, the policy enacted by both countries was hydro development only. For both Laos and Myanmar, hydro is the primary energy source and the reinforcement of hydro will not lead to energy resource diversification. Consequently, the determination of correlation between both countries’ policy and ESI was N.A (no related policy in place).

The main reason why the correlation of TPES diversity and power generation fuel diversity was “No” for China is believed to be because of an increase in consumption of coal for power generation.

Table 2-17: Result of Correlation (TPES diversity)

Country	Correlation	Country	Correlation
Cambodia	Yes	Malaysia	Yes
China	No	Myanmar	-
Indonesia	Yes	New Zealand	Yes
Japan	Yes	Philippines	Yes
Korea	Yes	Thailand	Yes
Laos	-	Vietnam	Yes

Table 2-18: Result of Correlation (Power generation fuel diversity)

Country	Correlation	Country	Correlation
Cambodia	Yes	Malaysia	Yes
China	No	Myanmar	-
Indonesia	Yes	New Zealand	Yes
Japan	Yes	Philippines	Yes
Korea	Yes	Thailand	No
Laos	-	Vietnam	Yes

3.7. Middle East dependence

See Annex 1-16 or Annex 1-17.

Import source country diversity policy effected changes in this ESI.

If a country established a relevant policy and the ESI was improved, the correlation is “Yes.”

If a country established a relevant policy and the ESI was worsened, the correlation is “No.”

If a country had no relevant policy, the correlation is N.A..

The results of the analysis can be found in the table below.

Main importing countries China, Japan and South Korea are implementing policy to reduce their dependence on the Middle East for crude oil. Because the selection of crude oil import partners is largely determined by geographic location, reducing dependence on the Middle East will not be an easy task. Japan, which is the world’s largest importer of LNG, has not enacted policy to reduce its dependence on the Middle East for natural

gas.

Table 2-19: Result of Correlation (Crude oil Middle East dependence)

Country	Correlation	Country	Correlation
Cambodia	-	Malaysia	-
China	No	Myanmar	-
Indonesia	-	New Zealand	-
Japan	No	Philippines	-
Korea	No	Thailand	-
Laos	-	Vietnam	-

Table 2-20: Result of Correlation (Natural gas Middle East dependence)

Country	Correlation	Country	Correlation
Cambodia	-	Malaysia	-
China	-	Myanmar	-
Indonesia	-	New Zealand	-
Japan	-	Philippines	-
Korea	Korea	Thailand	-
Laos	-	Vietnam	-

3.8. Reserve Margin of Generation Capacity

See Annex 1-18.

Several policies effected changes in this ESI.

If a country established relevant policies and the ESI was improved,
the correlation is “Yes.”

If a country established relevant policies and the ESI was worsened,
the correlation is “No.”

If a country established relevant policies and the ESI was worsened then improved,
the correlation is “Yes.”

If a country established relevant policies and the ESI was Improved then worsened,
the correlation is “No.”

The results of the analysis can be found in the table below.

The main reason why the correlation was was believed to be because of an increase in peak demand for Indonesia and no change in the ESI for New Zealand.

Table 2-21: Result of Correlation (Reserve margin of generation capacity)

Country	Correlation	Country	Correlation
Cambodia	-	Malaysia	Yes
China	Yes	Myanmar	-
Indonesia	No	New Zealand	No
Japan	Yes	Philippines	Yes
Korea	No	Thailand	Yes
Laos	-	Vietnam	No

3-9 Power outage

See Annex 1-19 or Annex 1-20.

Policy on the stability of electricity supply effected changes in this ESI.

If a country established relevant policies and the ESI was improved,
the correlation is “Yes.”

If a country established relevant policies and the ESI was worsened,
the correlation is “No.”

If a country established relevant policies and the ESI was worsened then improved,
the correlation is “Yes.”

If a country established relevant policies and the ESI was Improved then worsened,
the correlation is “No.”

The results of the analysis can be found in the table below.

The results noted in the table below represent a short-term assessment because of limitations experienced in obtaining past data.

Table 2-22: Result of Correlation (Power outage frequency)

Country	Correlation	Country	Correlation
Cambodia	-	Malaysia	Yes
China	-	Myanmar	-
Indonesia	Yes	New Zealand	No
Japan	Yes	Philippines	-
Korea	Yes	Thailand	-
Laos	-	Vietnam	-

Table 2-23: Result of Correlation (Power outage duration)

Country	Correlation	Country	Correlation
Cambodia	-	Malaysia	Yes
China	-	Myanmar	-
Indonesia	No	New Zealand	No
Japan	Yes	Philippines	-
Korea	Yes	Thailand	-
Laos	-	Vietnam	-

3.10. Commercial Energy Access ratio or Electrification

See Annex 1-21or Annex 22.

Several policies effected changes in this ESI.

If a country established relevant policies and the ESI was improved,
the correlation is “Yes.”

If a country established relevant policies and the ESI was worsened,
the correlation is “No.”

If a country established relevant policies and the ESI was worsened then improved,
the correlation is “Yes.”

If a country established relevant policies and the ESI was improved then worsened,
the correlation is “No.”

The results of the analysis can be found in the table below.

The commercial energy access ratio for Japan, South Korea and New Zealand is already at elevated levels and there was “No change” in ESI, indicating there was “No” correlation between policy and ESI.

Table 2-24: Result of Correlation (Commercial energy access ratio)

Country	Correlation	Country	Correlation
Cambodia	Yes	Malaysia	Yes
China	Yea	Myanmar	Yes
Indonesia	Yes	New Zealand	No
Japan	No	Philippines	Yes
Korea	No	Thailand	Yes
Laos	Yes	Vietnam	Yes

Table 2-25: Result of Correlation (Electrification)

Country	Correlation	Country	Correlation
Cambodia	Yes	Malaysia	Yes
China	Yes	Myanmar	Yes
Indonesia	Yes	New Zealand	-
Japan	-	Philippines	Yes
Korea	-	Thailand	Yes
Laos	Yes	Vietnam	Yes

3.11 TPES/GDP, TFEC/GDP

See Annex 23 or Annex 24.

Several policies, including energy conservation / efficiency policy, effected changes in this ESI. The focus of below is predominantly on the assessment of energy conservation / efficiency policy.

If a country established relevant policies and the ESI was improved,
the correlation is “Yes.”
If a country established relevant policies and the ESI was worsened,
the correlation is “No.”
If a country established relevant policies and the ESI was worsened then improved,
the correlation is “Yes.”
If a country established relevant policies and the ESI was improved then worsened,
the correlation is “No.”

The results of the analysis can be found in the table below.

The correlation in the following table was determined using the existence of energy conservation/efficiency policy and ESI trends. Energy efficiency is largely affected by changes in industrial structure and economic activity, as well as technology. Consequently, the results of the following table should be viewed as provisional.

Table 2-26: Result of Correlation (TPES/GDP)

Country	Correlation	Country	Correlation
Cambodia	-	Malaysia	No
China	Yes	Myanmar	Yes
Indonesia	Yes	New Zealand	Yes
Japan	Yes	Philippines	Yes
Korea	Yes	Thailand	Yes
Laos	Yes	Vietnam	Yes

Table 2-27: Result of Correlation (TFEC/GDP)

Country	Correlation	Country	Correlation
Cambodia	-	Malaysia	No
China	Yes	Myanmar	Yes
Indonesia	Yes	New Zealand	Yes
Japan	Yes	Philippines	Yes
Korea	Yes	Thailand	Yes
Laos	Yes	Vietnam	Yes

3.12. Days of on-land oil stocks

See Annex 1-25.

Oil stock piling policy effected changes in this ESI.

If a country established a relevant policy and the ESI was improved,
the correlation is “Yes.”
If a country established a relevant policy and the ESI was worsened,
the correlation is “No.”
If a country established no relevant policy, the correlation is N.A..

The results of the analysis can be found in the table below.

It is believed there is a strong correlation between oil reserve policy and days of on-land oil stocks ESI.

Table 2-28: Result of Correlation (Days of on-land stocks)

Country	Correlation	Country	Correlation
Cambodia	-	Malaysia	-
China	-	Myanmar	Yes
Indonesia	-	New Zealand	No
Japan	Yes	Philippines	-
Korea	Yes	Thailand	Yes
Laos	-	Vietnam	-

3.13. CO_2 Emissions

See Annex 1-26, Annex 1-27, Annex 1-28 or Annex 1-29.

Several policies effected changes in this ESI. Furthermore, attention should be paid to the fact that the direction of change on ESI differs based on the policy. CO_2 emissions are affected by not only energy policy but also changes in industrial structure and economic activity, as well as technology. As a result, it is difficult to determine the correlation between the policy of CO_2 Emissions and ESIs.

The results of the analysis can be found in the table below.

Here, the correlation with ESIs was determined with a focus on the existence of nuclear, hydro, renewable, and CO_2 reduction policies. Therefore, the results of the following table should be viewed as provisional.

Table 2-29: Result of Correlation (CO_2 Emissions/TPES)

Country	Correlation	Country	Correlation
Cambodia	No	Malaysia	No
China	Yes	Myanmar	No
Indonesia	No	New Zealand	No
Japan	Yes	Philippines	No
Korea	Yes	Thailand	No
Laos	No	Vietnam	No

Table 2-30: Result of Correlation (CO_2 Emissions/Fossil fuel)

Country	Correlation	Country	Correlation
Cambodia	No	Malaysia	No
China	No	Myanmar	No
Indonesia	No	New Zealand	No
Japan	No	Philippines	No
Korea	Yes	Thailand	No
Laos	Yes	Vietnam	No

Table 2-31: Result of Correlation (CO_2 Emissions/GDP)

Country	Correlation	Country	Correlation
Cambodia	No	Malaysia	No
China	Yes	Myanmar	No
Indonesia	No	New Zealand	No
Japan	Yes	Philippines	No
Korea	Yes	Thailand	No
Laos	No	Vietnam	No

Table 2-32: Result of Correlation (CO_2 Emissions/Population)

Country	Correlation	Country	Correlation
Cambodia	No	Malaysia	No
China	Yes	Myanmar	No
Indonesia	No	New Zealand	No
Japan	No	Philippines	No
Korea	No	Thailand	No
Laos	No	Vietnam	No

4. Summary

The correlation between policy and ESI is summarized in the following table. Viewed by ESI and country, in most cases generally there was a correlation between policy and ESI with a few exceptions. While there are ESIs directly affected by specific energy policy, there are still others that are believed to be significantly impacted by changes in industrial structure, economic activity, technology and market conditions (input costs and output prices). Consequently, analysis results showing a correlation with policy for certain ESIs should be handled as reference. Furthermore, attention

should be paid to the fact that assessments of correlation between policy and ESI represent assessments of past policy and recently implemented policy may not be fully reflected in changes in ESI.

Table 2-33 Correlation between policy and ESI (Summary)

	ESI	KHM	CHN	IDN	JPN	KOR	LAO	MYS	MMR	NZL	PHL	THA	VNM
1	TPES self-sufficiency	No	No	No	Yes	Yes	No	No	Yes	Yes	Yes	No	Yes
2	Coal self-sufficiency		No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	Yes
3	Crude oil self-sufficiency							No	Yes	Yes	Yes	Yes	No
4	Natural gas self-sufficiency			No		Yes			Yes	No	Yes	No	Yes
5	Coal R/P		No	No	Yes	Yes				Yes	Yes	Yes	Yes
6	Crude oil R/P							No	Yes			No	Yes
7	Natural gas R/P			No				No	No		Yes	No	No
8	Coal R/C		No	Yes	Yes	Yes				Yes	Yes	Yes	Yes
9	Crude oil R/C			Yes				Yes	Yes			Yes	Yes
10	Natural gas R/C			Yes				Yes	No		Yes	Yes	Yes
11	Coal import source country diversity					Yes		Yes					
12	Crude oil import source country diversity		Yes		No	No							
13	Natural gas import source country diversity					Yes						No	
14	TPES diversity	Yes	No	Yes	Yes	Yes		Yes		Yes	Yes	Yes	Yes
15	Power generation fuel diversity	Yes	No	Yes	Yes	Yes		Yes		Yes	Yes	No	Yes
16	Crude oil Middle East dependence		No		No	No							
17	Natural gas Middle East dependence					Yes							
18	Reserve margin of generation capacity		Yes	No	Yes	No		Yes	-	No	Yes	Yes	No
19	Power outage frequency			Yes	Yes	Yes		Yes		No			
20	Power outage duration			No	Yes	Yes		Yes		No			
21	Commercial energy access	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes
22	Electrification	Yes	Yes	Yes	-	-	Yes	Yes	Yes	-	Yes	Yes	Yes
23	TPES / GDP		Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
24	TFEC / GDP		Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
25	Days of on-land oil stocks				Yes	Yes			Yes	No		Yes	
26	CO2 Emissions / TPES	No	Yes	No	Yes	Yes	No	No	No	No	No	No	No
27	CO2 Emissions / Fossil fuel	No	No	No	No	Yes	Yes	No	No	No	No	No	No
28	CO2 Emissions / GDP	No	Yes	No	Yes	Yes	No	No	No	No	No	No	No
29	CO2 Emissions / Population	No	Yes	No	No	No	No	No	No	No	No	No	No

Note: KHM: Cambodia, CHN: China, IDN: Indonesia, JPN: Japan, KOR: Korea, LAO: Laos, MYS: Malaysia, MMR: Myanmar, NZL: New Zeaaland, PHL: Philippines, THA: Thailand, VNM: Vietnam

CHAPTER 3

Country Analysis

This chapter identifies the elements for each country believed to be the most critical from an energy security standpoint and analyzes the correlation between related ESI changes and policy. Analysis focuses predominantly on past policy, but recent changes are also taken into consideration when necessary.

1. Cambodia

Threats to Cambodia's energy security are believed to mainly originate from the fact that its energy supply is extremely dependent on oil and that imports account for its entire oil supply. Cambodia's heavy dependence on imports means that the country is subject to risk from energy supply stability and risk from fluctuations in energy prices on international markets. The country's extensive use of oil also increases its environmental impacts.

In response to this, the Government of Cambodia has attempted to diversify its use of energy, predominantly focused on the power sector. Specifically, Cambodia is working to diversify its portfolio of power sources, which until now have been largely dependent on oil, by promoting the development of hydro and coal-fired power plants.

Hydro power can be generated using resources found inside the country, meaning that Cambodia will be able to raise its self-sufficiency ratio as well as curb environmental impacts because such power plants do not produce air pollution. Additionally, the power supply will be less expensive to generate compared to oil-fired power plants, providing economic benefits as well. However, power generation output

is affected by rainfall amounts. Therefore, sufficient output may not be attainable depending on the season.

Meanwhile, plans call for coal-fired power plants to use domestically produced brown coal. As such, the greater use of this type of power source will help raise Cambodia's self-sufficiency ratio further. Additionally, electricity generated by coal-fired power plants is cheaper than that of oil-fired power plants, meaning the country can expect to achieve a more stable power supply. Nevertheless, coal-fired power plants generate the largest amount of air pollutants of any fossil fuel source. Consequently, increasing environmental impacts will become unavoidable.

In this regard, hydro and coal-fired power plants are both superior in terms of increasing Cambodia's self-sufficiency ratio and providing economic benefits, but they also differ in regards to power supply stability and environmental impacts. As a result, Cambodia will be able to use a combination of these power generation methods to create a more balanced portfolio of power sources.

The Government of Cambodia is promoting the development of new power sources with such features by promoting the formulation of a government-led development plan and the use of long-term power purchase agreements. The development of new power plants will be led by private-sector companies, but by using the above two methods, Cambodia will be able to raise the certainty of recovering its investment over the long term, while reaping the benefits of private sector investment at the same time.

These initiatives are already beginning to yield results, as currently there is a 200MW hydro power plant and 505MW coal-fired power plant under construction. Furthermore, by securing cheap electricity imports from neighboring countries, Cambodia is also looking to enhance power supply stability and lower electricity tariffs.

Based on the above, Cambodia is implementing measures aimed at reducing its dependence on oil and mitigating associated risks. Nevertheless, only recently has it been possible to verify the effectiveness of these measures, which means as of today, the effects of policy cannot be observed as ESI changes.

2. China

Threats to China's energy security are believed to mainly be attributed to its sharp increase in energy demand coupled with the growing supply-demand gap that has resulted from this increase. This is clearly reflected in the country's ESI, as the country's oil self-sufficiency ratio in particular has declined across all period, while R/P ratio and R/C ratio for all fossil fuels is also falling. Additionally, the increase in the use of coal predominantly in China's power generation sector is causing a drop in diversification between the primary energy supply and electricity supply, and is also leading to an increase in environmental impacts.

Until now, China has implemented a comprehensive range of measures that have included domestic resource development, securement of imports, diversification of the energy it uses, and an improved energy utilization efficiency.

For example, as for China's use of coal for power generation, transport capacity problems along the coastal region of Eastern China have resulted in an insufficient supply of domestic coal, and so it has used imported coal to ensure supply stability because of cost performance advantages. In addition, China is also moving to shutdown smaller less efficient power generation facilities in favor of larger more efficient ones. This has helped to improve the average efficiency of all the country's power generation

facilities. Furthermore, today, China now requires that existing facilities install desulfurization equipment, in an attempt to improve the air environment. From the standpoint of diversification, China is continually attempting to reduce its dependence on coal-fired power plants by expanding the use of renewable energy, such as wind farms, natural gas-fired power plants and nuclear power.

These exhaustive initiatives have primarily been implemented since the start of the 2000s. As a result, at the present time, changes have yet to be observed in indicators for improvements in self-sufficiency ratio or power source diversity.

Compared to other countries, a top-down approach has functioned more effectively in China, and there is a high degree of certainty that it will achieve its policy targets. This is believed to be because China has a highly centralized government and administrative system. Policy drawn up by the Central Government sometimes exceeds economic rationalities, but provincial governments must implement the decisions of the Central Government without fail, regardless of economic benefits. In addition, state-owned enterprises run most of the country's energy related businesses, which is believed to make it easier for policy to be actually implemented.

Based on this, China has in reality been able to fulfill the many policies that have accompanied quantitative targets set by the Central Government. In contrast, most other countries are able to reach the policy planning stage relatively steadily, but face many difficulties in actually implementing such policy. This has resulted in many examples where a country as ultimately unable to attain its initial targets. There are many views on whether highly centralized government and administrative systems or an industrial structure dominated by state-owned enterprises is the best approach. However, the fact that this system has demonstrated policy can be implemented and executed effectively in China cannot be denied.

3. Indonesia

Threats to Indonesia's energy security are believed to be predominantly caused by a decline in the country's self-sufficiency ratio for oil. This drop has brought about a greater reliance on imports for the country's oil supply and increased risks associated with oil supply stability and price fluctuations. The decline in Indonesia's self-sufficiency ratio has brought about increased demand for coal and natural gas as an alternative to oil. As a result, the stable supply of these resources has become an energy security challenge facing the country. This is clearly evident in Indonesia's ESI, as its self-sufficiency ratio of fossil fuels and indicators for R/P ratio and R/C ratio have deteriorated since the 1990s to the start of the 2000s.

Domestic energy supply is also an important element that makes up energy security. In Indonesia, the expansion of commercial energy supply regions, with the exception of Java, remains a challenge to the country's energy security.

Given this situation, it will be important to largely increase supply by promoting the development of oil resources and also curb the use of oil at the same time. From the standpoint of promoting oil resource development, the Government of Indonesia has established state-owned oil and gas company Pertamina and implemented domestic development promotion policies centered on this company. In reality, however, the R/C ratio and self-sufficiency ratio for crude oil has continually and consistently declined across all time periods, with no improvements in sight. Factors for this are believed to be the limitations of oil resource amounts and the sharp increase in demand for oil transport and oil used in industrial applications.

As a result, energy usage diversification has become a more important policy option. In this regard, Indonesia's power generation sector has taken measures to expand the use

of domestically produced natural gas or coal as well as promote the development of geothermal power plants, more recently. As such, from the 1980s to 1990s the ratio of oil in power generation declined significantly, and conversely the ratio of coal and natural gas increased, resulting in greater diversification in power supply.

In addition to the previously-mentioned Pertamina, state-owned power company PLN has also played an important role in expanding the commercial energy supply domestically. The founding of PLN brought with it a framework for centrally developing power sources and a power transmission network. Actually, although there is still room for improvement, the electrification rate has continued to increase since the 1990s when data first became available.

As for improvements in energy efficiency, indicators (TPES/GDP and TFEC/GDP) have gradually improved since the 1970s. Energy efficiency has seen an accelerated recovery especially since the latter half of the 2000s.

4. Japan

Threats to Japan’s energy security are believed to be mainly attributed to the fact that Japan produces almost no fossil fuel resources domestically, which means it has an extremely low self-sufficiency rate. Japan has needed to continually import large amounts of energy in order to satisfy its energy demand. This has become a serious risk to the country’s energy supply securement and to the stabilization of energy prices. In actuality, Japan’s self-sufficiency ratio was around a mere 10% in the 1970s.

This over-emphasis on oil for its energy supply has also made risks associated with a low self-sufficiency ratio even more serious. The ratio of crude oil to total energy

supply in the 1970s was 74% for primary energy and 63% for power generation.

In this regard, the two oil shocks of the 1970s exposed the risks brought about by low self-sufficiency ratio and an energy supply-demand structure that over emphasized oil. Concerns over energy supply stability and soaring prices caused significant economic damages to Japan at the time. Based on this experience, the country implemented important measures to reduce its dependence on oil in energy usage and raise its energy utilization efficiency. These measures now form the basis of Japan's energy supply structure today.

In terms of diversifying its energy supply, Japan implemented policies to promote the use of natural gas after the start of LNG imports and to expand the use of nuclear and coal-fired power generation. As a result, from the 1970s to 1980s, the country was able to markedly improve its indicators for diversity in primary energy supply and power generation. In addition, nuclear power has been called a "quasi-domestic energy source[1]" and the great use of this power source helped to raise Japan's self-sufficiency ratio. The rising nuclear power ratio in Japan's primary energy supply helped boost the country's self-sufficiency from 10.5% in the 1970s to around 19%.

As for improving its energy efficiency, Japan's Energy Saving Law requires industries that use large amount of energy to improve their energy efficiency. As a result, energy efficiency in the industrial sector has greatly improved since the 1980s. The scope of Energy Saving Law regulations was later expanded to the electronics,

[1] Compared to fossil fuels, the frequency of importing uranium as a fuel for nuclear power generation is extremely low. In addition, once loaded, uranium fuel does not need to be changed for several years. In this regard, nuclear power is known as a quasi-domestic energy source because compared to fossil fuels it carries with it fewer risks associated with supply and international energy prices.

automobile and construction, which has served to raise the energy efficiency of a wide swath of sectors. Additionally, unrelated to policy intentions, Japan's high energy prices have also served as an important incentive for companies to reduce their energy use, especially in the industrial sector.

The fact that energy markets and industry were subject to a stringent regulatory environment at this time is believed to have provided a positive benefit to the implementation of these policies. This is because the policy intent was to be able to reflect results directly through energy markets and industries subject to regulations, rather than encourage liberalization.

At the same time, Japan has attempted to mitigate "Middle East risk" from its crude oil supply to no avail, as its dependence on the Middle East for oil supplies remains largely intact. This is because the crude oil resources are skewed in favor of the Middle East, and there is no oil producing and exporting country in Asia that can serve as an alternative to the Middle East. Additionally, Indonesia and other oil producing countries in Asia have been very important oil importing partners for some time. However, a drop in production volume seen in Asian oil producing countries and an increase in domestic consumption reduced their export capacity, and in recent years Japan's dependence on the Middle East has risen, which is the opposite of policy intentions.

5. Korea

Threats to South Korea's energy security are believed to mainly originate from the fact that the country produces almost no fossil fuel resources domestically, which means it has an extremely low self-sufficiency rate. South Korea has needed to continually

import large amounts of energy in order to satisfy its energy demand. This has become a serious risk to the country's energy supply securement and to the stabilization of energy prices. The country's self-sufficiency ratio in the 1970s was 29% thanks to the effects of hydro power generation, but by the 1990s this fell all the way to 17% due to growing energy demand. This means that South Korea was forced to import fossil fuels from abroad in order to make up for increased energy demand.

The over-emphasis on oil for its energy supply has made risks associated with a low self-sufficiency ratio even more serious. The ratio of crude oil to total energy supply in the 1970s was 66% for primary energy and 84% for power generation.

In response to this energy security vulnerability, South Korea has implemented policies to raise its self-sufficiency ratio and reduce its dependence on oil. In terms of raising its self-sufficiency ratio and securing stable supplies, the country has acquired fossil fuel resources abroad and moved to increase the use of nuclear power. By encouraging domestic companies to acquire energy resource interests abroad, South Korea has attempted to obtain stable and cheaper energy, rather than simply increase imports from other countries. Additionally, as was noted with regards to Japan, the increased use of nuclear power helped the country increase its self-sufficiency ratio. In this regard, South Korea has taken various measures to raise its self-sufficiency ratio, and because of the high ratio of nuclear power in its primary energy supply, its self-sufficiency ratio for primary energy, which had fallen up to the 1990s, has improved after the start of the 2000s.

South Korea has also attempted to increase its use of natural gas through LNG imports and the use of nuclear and coal-fired power generation in order to reduce its dependence on oil. In particular, it has significantly increased its use of coal-fired power generation. The ratio of coal-fired power generation was 5.2% in the 1970s, but this had

risen to 42.0% by the latter half of the 2000s. Natural gas was also hardly used in 1970, but today it accounts for 12.3% of the country's primary energy supply. As a result of these initiatives, indicators on the diversity of primary energy supply have improved across all time periods. However, indicators for diversity of power supply have deteriorated since the 2000s because of the rising ratio of coal-fired power generation.

The one thing that cannot be overlooked when examining the effects of policy in South Korea is the existence of state-owned enterprises. These companies, including KEPCO for power and KOGAS for natural gas, play an instrumental role in policy execution. State-owned enterprises are considered to function effectively because they can directly reflect policy intent or collect necessary funding over a short period of time. Today, however, when many policy targets have been achieved or are about to be achieved, the role of state-owned enterprises is diminishing overall from the standpoint of improving business efficiency and encouraging market liberalization.

6. Laos

Threats to Laos's energy security are believed to be mainly attributed to the country's heavy dependence on imports for its oil supply and an insufficient commercial energy supply system.

Although not apparent in indicators since calculations in ESI account for crude oil, Laos depends completely on imports for its supply of oil products. As of today, the use of commercial energy remains scarce, indicating the ratio of oil in primary energy supply is not particularly high. Moving forward, however, if the use of commercial energy increases and the economy grows, oil consumption will increase significantly,

which is expected to increase energy security risks facing the country.

Laos' commercial energy supply remains insufficient, as seen by the fact that the ratio of biofuel & waste to total primary energy supply stood at 69.1% and the electrification rate was only 55% even in the latter half of the 2000s.

In response to this heavy dependence on imports for its oil supply, Laos is attempting to stabilize supplies through the use of oil reserves. Generally, reducing oil dependence through the diversification of energy usage is effective toward mitigating risk associated with oil imports. Laos will need to implement such policies from an early stage, but the country is landlocked and so it will have to examine efficient energy transport methods in place of ocean-going vessels.

With regards to commercial energy supply, Laos is moving to develop its wealth of hydro resources and supply this energy domestically, which suggests the electrification rate will improve going forward. Laos is considering the use of foreign capital to fund power plant development and is in the process of developing a framework to promote such investments.

In addition, hydro power output fluctuates largely depending on the season, resulting in power supply challenges during the dry season. As mentioned above, Laos has limited transport options for its energy imports. As a result, it should examine innovations to enhance its energy security while minimizing investment, which includes owning its own coal-fired and other alternative power sources as well as concluding seasonal swap agreements with neighboring countries.

7. Malaysia

Threats to Malaysia's energy security are believed to mainly be attributed to the declining trend seen in its oil and natural gas self-sufficiency ratio. Today, Malaysia has secured its status as an exporting country of these resources, but if domestic demand increases further going forward, it may face heightened energy security risks, which may force it to import oil or natural gas. In actuality, the country's oil and natural gas R/C ratio has consistently declined since the 1980s. Furthermore, Malaysia has already been exposed to a geographic supply-demand gap, where demand centers on the Malay Peninsula, but resources are located primarily in the states of Sarawak and Sabah.

In response to this, Malaysia has moved to bolster its development of domestic oil and gas resources, and to diversity its energy usage.

In terms of resource development, oil and gas industry regulations have encouraged the effective use and conservation of resources as well as contributed to the economic growth of these industries. As a result, the R/P ratio of crude oil has maintained nearly the same level since the 1980s.

Malaysia recognized the finite nature of its resources from a relatively early stage and has attempted to reduce its dependence on the use of energy derived from oil. The Four-Fuel Policy of 1980 was intended to diversify the country's energy utilization, which had been skewed toward oil, to include natural gas, coal and hydro, for a total of four main energy sources. Natural gas saw the greatest change, as the ratio of its use in power generation increased sharply from 10.8% in the 1980s to 72.1% in the early 2000s. During the same period, the ratio of oil dropped from 65.6% all the way down to 5.0%. This clearly demonstrates that in accordance with the policy of the time the country replaced oil-fired power plants with gas-fired ones. Conversely, however, the

country’s over dependence on natural gas has become an issue in question. In particular, there now concerns on the Malay Peninsula, where demand is concentrated, over supply shortages of natural gas used in power generation. Accordingly, in recent years the power sector has increased its use of coal-fired power plants, as the ratio of coal-fired power to total power generation in the latter half of the 2000s had risen all the way to 27.5%. These changes in Malaysia’s power source portfolio are clearly appearing in indicators used to show diversity in the power supply. In other words, diversity increased thanks to increases in the use of natural gas-fired power plants between the 1970s and 1990, but up until the first half of the 2000s, diversity dropped due to an over dependence on natural gas-fired power plants. Power generation diversity once again improved in the latter half of the 2000s after the country’s use of coal-fired power plants increased.

On the other hand, Malaysia has yet to implement sufficient policies on its energy efficiency, despite the expected improvement from the effective utilization and conservation of resources. Today, Malaysia is preparing legislation intended to promote energy savings, and so going forward, the country’s energy efficiency is expected to improve.

8. Myanmar

Threats to Myanmar’s energy security are believed to mainly originate from its inadequate commercial energy supply system. The ratio of biofuel and waste to total primary energy supply has declined gradually since the 1970s, but reached a relatively high 70.3% in the latter half of the 2000s. Myanmar has increased its use of domestic

natural gas for both power generation and utility gas in order to increase the commercial energy supply. Nevertheless, up until the 1990s, the dependence on natural gas of the country's power sector increased rapidly to excessive levels, while the R/P ratio and R/C ratio has declined markedly from the 1980s up until today, indicating energy security risks facing Myanmar are increasing.

In terms of commercial energy supply, Myanmar has focused great attention on increasing its electrification rate. In addition to augmenting capacity of hydro and natural gas power generation, the country is moving forward with the development of a power transmission network. As a result of these initiatives, the electrification rate has improved since the 1980s when data was first available. However, the electrification rate remained at 13.0% in the latter half of the 2000s, meaning that Myanmar will need to make investments in its transmission infrastructure and in large-scale power plant development projects going forward.

Myanmar has responded to concerns over how to secure energy by increasing its use of natural gas. Conventionally, the country mainly used hydro and oil-fired power generation, but since the 1980s it has sharply increased the use of gas-fired power plants and successfully curbed an increase in oil demand. Conversely, however, this caused Myanmar's dependence on natural gas to rise, which has meant that the indicator showing diversity in power supply has not really improved at all. Moving forward, if the country is to increase its commercial energy supply and increase power demand further, it will need to implement policy measures unlike those before it. In other words, Myanmar will need to encourage development to maximize the utilization of domestic hydro and natural gas resources, a policy it has followed until now, but also build a supply structure based on imports and implement risk mitigation measures in conjunction with increased imports. This will include using imported coal for coal-fired

power plants and strengthening its ability to make supply-demand adjustments through transmission agreements with neighboring countries.

9. New Zealand

The main threat to New Zealand's energy security lies in the dependence of its transport sector on imports of crude oil. The country has significantly expanded domestic oil production, but exports around 95% due to its high quality. It is more profitable for New Zealand to export its high value high quality domestically produced oil and to import cheaper lower grade oil for domestic use. New Zealand has potential to become a net exporter of oil in the future, subject to finding and exploiting new reserves. Further improvements in vehicle fuel efficiency and development and uptake of electric vehicles offer opportunities to improve New Zealand's energy security by reducing the dependence of its transport sector on imported crude oil.

New Zealand has continually developed domestic coal and natural gas production since the 1970s, which has enabled it to maintain more than a 100% self-sufficiency ratio throughout all periods. In particular, the country's production of natural gas increased close to six fold from the 1970s to the latter half of the 2000s, yet this entire amount was consumed domestically. The production of oil increased significantly in the 1980s and 1990s, and as a result, its self-sufficiency ratio of 9.7% in the 1970s had risen all the way to 42.3% in the second half of the 2000s.

New Zealand has reduced its relative dependence on oil by expanding the use of natural gas and indicators showing diversity in primary energy supply have improved since the 1970s. In terms of power supply, too, the country has greatly improved its

diversity by increasing the share of gas-fired and other renewable energy power plants to offset its traditionally high share of hydro power generation.

The country's expanded production of renewable energy, for which it strengthened initiatives over the 2000s, has contributed to both its self-sufficiency ratio and its energy supply diversity. Geothermal and wind power generation, in particular, grew robustly in the second half of the 2000s, as the indicator showing diversity in and the self-sufficiency ratio of primary energy improved during this same period. However, there are some policies that have only been implemented recently. Therefore, insufficient time has passed to see their full effects.

New Zealand's energy efficiency has improved since 2000 due to energy efficiency and conservation policy, aided by advances in technology and structural changes in the economy (towards less energy-intensive service-based sectors).

10. Philippines

Threats to the Philippines' energy security are believed to be mainly attributed to its heavy dependence on oil for its energy supply as well as its heavy dependence on imports for its oil supply. This has exposed the country to various risks in international markets, in terms of both supply and supply prices.

In the past, a lack of access to commercial energy was also an important policy challenge.

In response to this, the Philippines has encouraged the development of domestic oil resources and the diversification of energy usage. In terms of these oil resources, the Philippines enacted a law to promote domestic oil resource development at the start of

the 1970s. However, changes resulting from this law could not be confirmed, such as an improvement in the R/P ratio for oil supply or the self-sufficiency ratio.

With regards to energy supply diversification, the Philippines implemented measures in the latter half of the 1970s intended to encourage the development of coal resources. It has also enacted a number of laws in the middle of the 1990s concerning the development and use of natural gas. As a result, the country's use of coal has increased since the 1990s, whiles its use of natural gas has increased since the 2000s. On top of this, the Philippines was moving forward with the development of nuclear power, but as of today it has suspended these plans. The results of these measures aimed at energy supply diversification have consistently improved indicators showing diversity in primary energy since the 1970s. As such, these results are verifiable.

In terms of raising its energy efficiency, indicators showing energy efficiency have seen an accelerated improvement since the start of the 2000s. The Philippines has strengthened its efforts to improve energy efficiency since the 1990s. This improvement is believed to be attributed to these efforts.

One of the unique features of the Philippines is that, since liberalizing its oil markets with an Act in 1998 and its power markets with an Act in 2001, it has implemented energy security measures under an environment of free competition among private-sector companies. This means that when executing policy the country must consider both enhancing energy security and avoiding interference with competition among private-sector companies. Going forward, East Asian countries will likely move toward liberalizing their entire energy market. In this regard, initiatives in the Philippines may very well serve as a reference point for countries looking to liberalize their own energy market.

11. Thailand

Threats to Thailand's energy security are believed to be predominantly caused by its heavy dependence on oil for its energy supply as well as its heavy dependence on imports for its oil supply. This has exposed the country to various risks in international markets, in terms of both supply and supply prices.

While the country's oil dependence reduction policy implemented later did ensure that it achieved its initial target of reducing oil dependence in its energy supply, these same measures caused an excessive increase in its dependence on natural gas for power generation. As a result, today Thailand faces the important challenge of ensuring the security of its natural gas supply and curbing dependence on this same power source.

In response to oil dependence, which was the greatest pending question of the 1970s, and its heavy dependence on imports, Thailand has mainly made efforts to diversify energy usage. In 1972, Thailand began operating its first coal-fired power plant, and in 1981, it commenced the supply of domestically produced natural gas. The increased use of coal and natural gas successfully reduced the country's ratio of oil-fired power to total power generation from 65.7% in the 1970s to 5.2% in the 2000s. This ratio for coal-fired power has generally hovered around 20% since the 1980s, but natural gas-fired power generation sharply increased to 41% in the 1980s and nearly reached the 70% mark during the first half of the 2000s. The natural gas R/P ratio during the same period declined sharply from 246 years in 1980 to about 12 years in the latter half of the 2000s. Thailand has seen an increase in natural gas demand outside of the power sector as it is promoting the natural gas vehicles in the transportation sector. The ratio of natural gas to primary energy remained at 23.9% even in the second half of the 2000s, which is not high at all. However, Thailand began importing LNG in 2011,

which has heightened its exposure to risks from international natural gas markets in terms of mainly power supply.

In Thailand, the existence of state-owned power company EGAT can be cited as a factor behind the abovementioned rapid changes in power source portfolio. EGAT has a monopoly over Thailand's power sector. This is because the policy of power source diversification is directly reflected in EGAT's investment plan.

In terms of improving its energy utilization efficiency, Thailand has set up a fund to support energy saving activities. Viewed by indicators, the country's energy efficiency deteriorated from the 1990s to the first half of the 2000s, but later improved slightly in the second half of the 2000s. It is difficult to read a clear improvement in energy efficiency ratio from the data. This should be monitored going forward.

12. Vietnam

Threats to Vietnam's energy security are believed to mainly originate from its inadequate commercial energy supply system. The ratio of biofuel and waste to total primary energy supply has declined gradually since the 1970s, but it reached 55.1% in the latter half of the 2000s. Additionally, in recent years the country's energy demand has increased sharply. As a result, an important challenge for Vietnam will be maximizing the use of its domestic resources and finding ways to avoid an increase in dependence on imports for its energy supply.

In response to such challenges, Vietnam has established state-owned enterprises, such as state-owned power company EVN, to consolidate human resources and funds and to help expand the country's commercial energy supply. This has allowed it to build

a framework for centrally handling the development of infrastructure, such as power plants and power transmission facilities. The same can be said for VINACOAL (2005 -; VINACOMIN) for coal and Petrovietnam for oil and gas. As a result, Vietnam's access to commercial energy has improved, while its electrification rate reached a relatively high 97.6% in the latter half of the 2000s.

In the past, Vietnam did not have any domestic oil refineries, which required it to export crude oil produced domestically and import necessary oil products. However, the country's first refinery came on line in 2009 and today it can now refine crude oil produced domestically. In this regard, the fact that Vietnam can now procure some, but not all, oil products domestically means that it has taken an important step toward enhancing its energy security in terms of both supply and price stability.

VINACOAL and Petrovietnam have played instrumental roles in the development of Vietnam's domestic resources. In actuality, despite continually increasing energy demand, the country's self-sufficiency ratio for all fossil fuels, including coal, crude oil and natural gas, has consistently improved since the 1970s.

Vietnam's energy efficiency has improved across all periods. However, the country's energy consumption to GDP ratio remains high compared to other countries. This means there is much room for further improvements. In 2010, Vietnam enacted an energy saving law, which should help it to improve its energy efficiency going forward.

CHAPTER 4

Major Findings and Next Step

1. Key Findings

This year's study found the following.

1. Measuring the effects of policy is extremely important as a reference for future policy planning and for effectively allocating limited budgetary resources. In this sense, despite various restrictions, this research carries with it great significance because it attempts to qualitatively measure the existence of policy effects.

2. One ESI consists of multiple policies effect, making it difficult to qualitatively assess what effect which of these policies had on ESI changes. For example, changes in the TPES per GDP used to assess energy efficiency are affected by changes in energy consumption as well as changes in industrial structure.

3. However, when examining both ESI changes averaged out over a long period of time, such as five or ten years, and the existence of policy thought to be correlated to such changes, assessments showed a correlation existed between several policies and ESI.
   - Resource development promotion policy and R/C ratio
   - Oil dependence reduction policy and diversity in primary energy as well s power supply
   - Commercial energy supply policy or electrification rate improvement policy and commercial energy supply ratio or electrification rate
   - Energy saving policy and energy efficiency
   - Oil stock policy and oil stock amounts

Table 4-1 Correlation between policy and ESI

ESI	Number of Yes *	% of Yes ***
TPES self-sufficiency	6/12	50
Coal self-sufficiency	7/11	64
Crude oil self-sufficiency	4/6	**67**
Natural gas self-sufficiency	4/7	*57*
Coal R/P	6/8	**75**
Crude oil R/P	2/4	50
Natural gas R/P	1/6	*17*
Coal R/C	7/8	**88**
Crude oil R/C	5/5	**100**
Natural gas R/C	5/6	**83**
Coal import source country diversity	2/2	**
Crude oil import source country diversity	1/3	*33*
Natural gas import source country diversity	1/2	**
TPES diversity	9/10	**90**
Power generation fuel diversity	8/10	**80**
Crude oil Middle East dependence	0/3	*0*
Natural gas Middle East dependence	1/1	**
Reserve margin of generation capacity	5/9	*56*
Power outage frequency	4/5	**80**
Power outage duration	3/5	**60**
Commercial energy access	9/12	**75**
Electrification	9/9	**100**
TPES / GDP	10/11	**91**
TFEC / GDP	10/11	**91**
Days of on-land oil stocks	4/5	**80**
CO_2 Emissions / TPES	3/12	*25*
CO_2 Emissions / Fossil fuel	2/12	*17*
CO_2 Emissions / GDP	3/12	*25*
CO_2 Emissions / Population	1/12	*8*

* See Table 2-4-1 for the detail. "Yes" means that the country is assessed as there was a correlation between policy and ESI. Denominator represents number of countries which has relevant policy.
** sample country 2 or less.
*** **Bold** type number shows percentage of two third or more.
Italic type number shows percentage of one third or less.

4. Generally, policy requires a long period of time before it causes changes in the country's actual energy supply-demand situation. This is because investments in equipment and devices that use energy are typically large in nature, while such equipment and devices have a long service life, meaning that it is difficult to change energy supply-demand situation over a short period of time.

For example, several countries are implementing policy on climate change, and such policy has only been rolled out recently. Consequently, enough time has yet to pass until such policy has made changes in the energy supply-demand situation, making it impossible to verify the effects.

5. Conversely, there are also policy effects that cannot be verified even after a sufficient amount of time has passed since the policy was implemented. One example is dependence on the Middle East for oil supply. The study could not verify declines in dependence despite the existence of policy for such purposes. This is believed to be due to geographic reasons, or the fact that large amounts of crude oil are existing in the Middle East and that there is no other supply source in the Asia Pacific region large enough to replace the Middle East. Therefore, essentially policy effects are difficult to obtain.

6. A combination of multiple indirect methods is believed to be useful toward achieving targets for which policy has a difficulty exerting effects. For example, in the case of dependence on the Middle East for oil supply mentioned above, the fundamental purpose of policy is to avoid the serious geopolitical risks posed by the Middle East. This purpose can be achieved to a some extent by implementing multiple layers of policy, including reducing the use of oil for which the country depends on Middle East imports, preparing for supply interruption risk with the use of oil stocks, and providing support aimed at long-term stability in the Middle East.

7. The strength of regulations on the energy industries or energy markets is an important element that determines the effects of energy policy. The strength of such regulations become weaker in order of the following situations: (1) monopoly by state-owned enterprises; (2) private-sector companies play a leading role but business regulations are in place; and (3) private-sector companies play a leading role and deregulation has been implemented (market oversight remains in place using environmental / safety regulations or government administration)

   The situation where state-owned enterprises have a monopoly over energy markets in which regulations are strong is believed to be the easiest way to reflect policy intention more directly in the market over a comparatively shorter period of time. In many of the countries studied, all or certain important parts of energy markets where monopolized by state-owned enterprises and this proved to be effective in terms of the ease of implementing energy policy.

   In situations with strong regulations, however, the screening and management ability of the market regulator, government, largely determines market efficiency and the level of services provided to end consumers. Caution should also be heeded regarding the possibility that the heavy involvement of politics that typically occurs in such situations could inhibit policy execution.

8. Generally, it is believed that leaving the markets to open competition among private-

sector companies will result in more diverse services at a lower cost. However, it is important to note that private-sector companies essentially do not take action beyond economic rationalities.

For example, in the selection of power sources, if attempting purely to fulfill economic rationalities, most private-sector companies would choose subcritical pressure coal-fired power plants. However, this carries with it the potential to go against the requirements of energy security, which include risk dispersion through energy source diversification, reduced demand through improved energy efficiency, and environmental impact reductions. Energy security is a requirement of the nation that exceeds corporate behavior. As such, it is impossible to completely eliminate the involvement of the national government in a country's energy markets.

However, it is a proven fact that incorporating the capital, human resources and innovation of private-sector companies into energy markets will provide profits for the energy markets. Consequently, an appropriate balance should be struck between the government and private-sector companies depending on the unique situation of each country.

2. Next Step

This year's study looked into the past correlation between policy and ESI changes. It found that if ESI data can be obtained and organized, calculations can be made even for future situations. This means that ESI can be used to also measure the effects policy will have on the future. If the type of changes a certain policy will have on future ESI, or energy security, can be assessed, such information will be useful in making an informed decision when selecting policy.

In the next step, the first action will be to forecast demand using a measurement model and create a timeline of data that is extrapolated into the future. The demand forecast will incorporate the effects of policy implemented in the future. This will make it demand data for the future based on certain existing policy. Following this, these data will be used to calculate future ESI and analyze what type of changes policy based on demand forecasts will have on future energy security.

In selecting future policy, changes in the external environment and their impacts will need to be considered. The following are believed to be the external elements that will affect the energy security of East Asian countries in the future.

Economy

- Full recovery of the global economy and its impact
  - Will the global economy experience full recovery? When?
  - Will an economic recovery create tighter energy supply-demand conditions and cause energy prices to increase?

Supply

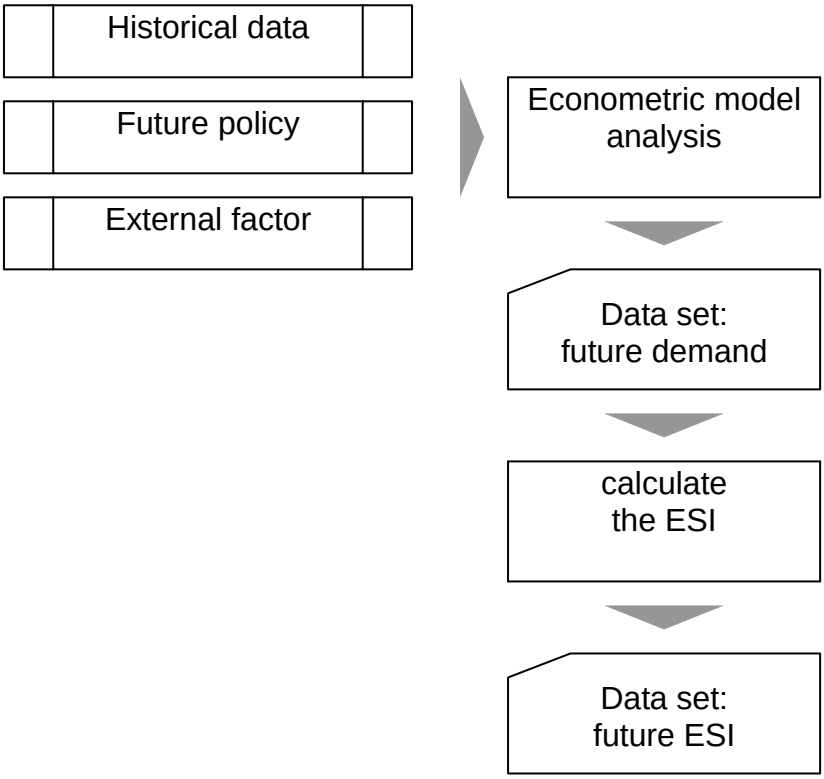
- Increase in unconventional oil and gas production and its impact
  - Will North America export large amounts of LNG to outside the region?
    → Will this bring about a loosened supply-demand balance in the global LNG market and lower prices?
  - Will other countries outside of North America, especially China, successfully develop unconventional natural gas?

Environment

- New post-Kyoto GHG emission reduction framework and its impact
  - Can a new and stronger framework be created? What status will East Asian countries be given?
  - To what extent will the greater use of non-fossil fuel energy (renewable energy and nuclear power) be encouraged?

The next important step will be to create a scenario on the changes that these external environmental factors will have and analyze the changes that future policy will have on future energy security. Based on this analysis, policy recommendations can be issued on further improving energy security of East Asian countries in the future.

Figure 4-1 Flow chart of calculation of future ESI



Annex 1
Correlation between Policy and ESI

Annex 1-1 TPES Self-sufficiency

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	Worsened	Nuclear	Nuclear development	No	**No**
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	No	
		Biofuels & wastes	Renewables development	No	
		Price and subsidy	Electricity tariff control		
Indonesia	Worsened	Nuclear	Nuclear development	No	**No**
		Hydro	Hydro development		
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development		
		Price and subsidy	Electricity tariff control		
Japan	Improved	Nuclear	Nuclear development	Yes	**Yes**
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Electricity tariff control	No	
Korea	Worsened Then Improved	Nuclear	Nuclear development	Yes	**Yes**
		Hydro	Hydro development	*Yes*	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Electricity tariff control	Yes	
Laos	Improved then Worsened	Nuclear	Nuclear development	-	**No**
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	-	
		Biofuels & wastes	Renewables development	-	
		Price and subsidy	Electricity tariff control	-	
Malaysia	Improved then Worsened	Nuclear	Nuclear development	-	**No**
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Electricity tariff control	Yes (in Sabah)	
Myanmar	Improved	Nuclear	Nuclear development	No	**Yes**
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	No	
		Biofuels & wastes	Renewables development	N0	
		Price and subsidy	Electricity tariff control	-	
New Zealand	Improved	Nuclear	Nuclear development	No	**Yes**
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Electricity tariff control	No	
Philippines	Improved	Nuclear	Nuclear development	Yes	**Yes**
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Electricity tariff control	No	
Thailand	No change	Nuclear	Nuclear development	No	**No**
		Hydro	Hydro development	No	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Electricity tariff control		
Vietnam	Improved	Nuclear	Nuclear development	Yes	**Yes**
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Electricity tariff control	Yes	

In addition to above policies, resource mining (E&P) polocies were established in resource rich countries.

Annex 1-2 Coal Self-sufficiency

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	-	Coal	Coal mining (Indigenous)	No	
		Price and subsidy	Coal production subsidies		
Indonesia	Improved	Coal	Coal mining (Indigenous)	Yes	
		Price and subsidy	Coal production subsidies		**Yes**
Japan	Worsened	Coal	Coal mining (Indigenous)	Yes	
		Price and subsidy	Coal production subsidies	Yes	**Yes**
Korea	Worsened	Coal	Coal mining (Indigenous)	Yes	
		Price and subsidy	Coal production subsidies	Yes	**No**
Laos	Worsened	Coal	Coal mining (Indigenous)	Yes	
		Price and subsidy	Coal production subsidies	Yes	**No**
Malaysia	Improved	Coal	Coal mining (Indigenous)	Yes	
		Price and subsidy	Coal production subsidies		**Yes**
Myanmar	Improved	Coal	Coal mining (Indigenous)	Yes	
		Price and subsidy	Coal production subsidies	Yes	**Yes**
New Zealand	Improved	Coal	Coal mining (Indigenous)	Yes	
		Price and subsidy	Coal production subsidies	No	**Yes**
Philippines	Relatively worsened	Coal	Coal mining (Indigenous)	Yes	
		Price and subsidy	Coal production subsidies	Yes	**No**
Thailand	Worsened	Coal	Coal mining (Indigenous)	Yes	
		Price and subsidy	Coal production subsidies		**No**
Vietnam	Improved	Coal	Coal mining (Indigenous)	Yes	
		Price and subsidy	Coal production subsidies	Yes	**Yes**

Annex 1-3 Crude oil Self-sufficiency

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	-	Crude oil	Crude oil E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Crude oil production subsidies		
Indonesia	Worsened	Crude oil	Crude oil E&P (Indigenous)		
		Price and subsidy(incl. tax	Crude oil production subsidies		
Japan	-	Crude oil	Crude oil E&P (Indigenous)	-	
		Price and subsidy(incl. tax	Crude oil production subsidies	-	
Korea	Improved	Crude oil	Crude oil E&P (Indigenous)	No	
		Price and subsidy(incl. tax	Crude oil production subsidies	No	
Laos	-	Crude oil	Crude oil E&P (Indigenous)	-	
		Price and subsidy(incl. tax	Crude oil production subsidies	-	
Malaysia	Improved⇒Worsened	Crude oil	Crude oil E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Crude oil production subsidies		**No**
Myanmar	Improved	Crude oil	Crude oil E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Crude oil production subsidies	Yes	**Yes**
New Zealand	Improved	Crude oil	Crude oil E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Crude oil production subsidies	No	**Yes**
Philippines	Improved	Crude oil	Crude oil E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Crude oil production subsidies	Yes	**Yes**
Thailand	Improved	Crude oil	Crude oil E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Crude oil production subsidies		**Yes**
Vietnam	Worsened	Crude oil	Crude oil E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Crude oil production subsidies	Yes	**No**

Annex 1-4 Natural gas Self-sufficiency

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	-	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Natural gas production subsidies		
Indonesia	No change	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Natural gas production subsidies		**No**
Japan	-	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Natural gas production subsidies	No	
Korea	Improved	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Natural gas production subsidies	Yes	**Yes**
Laos	-	Natural gas	Natural gas E&P (Indigenous)	-	
		Price and subsidy(incl. tax	Natural gas production subsidies	-	
Malaysia	-	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Natural gas production subsidies		
Myanmar	Improved	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Natural gas production subsidies	Yes	**Yes**
New Zealand	No change	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Natural gas production subsidies	No	**No**
Philippines	Improved	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Natural gas production subsidies	Yes	**Yes**
Thailand	Worsened	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Natural gas production subsidies	Yes	**No**
Vietnam	Improved	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Natural gas production subsidies	Yes	**Yes**

Annex 1-5 Coal R/P (Reserve/Production)

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	-	Coal	Coal mining (Indigenous)	No	
		Price and subsidy(incl. tax	Coal production subsidies	-	
Indonesia	Worsened	Coal	Coal mining (Indigenous)	Yes	
		Price and subsidy(incl. tax	Coal production subsidies		**No**
Japan	Improved	Coal	Coal mining (Indigenous)	Yes	
		Price and subsidy(incl. tax	Coal production subsidies	Yes then no	**Yes**
Korea	Improved	Coal	Coal mining (Indigenous)	Yes	
		Price and subsidy(incl. tax	Coal production subsidies	Yes	**Yes**
Laos	-	Coal	Coal mining (Indigenous)	Yes	
		Price and subsidy(incl. tax	Coal production subsidies	Yes	
Malaysia	-	Coal	Coal mining (Indigenous)	Yes	
		Price and subsidy(incl. tax	Coal production subsidies		
Myanmar	-	Coal	Coal mining (Indigenous)	Yes	
		Price and subsidy(incl. tax	Coal production subsidies	Yes	
New Zealand	Improved	Coal	Coal mining (Indigenous)	Yes	
		Price and subsidy(incl. tax	Coal production subsidies	No	**Yes**
Philippines	Improved	Coal	Coal mining (Indigenous)	Yes	
		Price and subsidy(incl. tax	Coal production subsidies	Yes	**Yes**
Thailand	Improved	Coal	Coal mining (Indigenous)	Yes	
		Price and subsidy(incl. tax	Coal production subsidies		**Yes**
Vietnam	Worsened	Coal	Coal mining (Indigenous)	Yes	
		Price and subsidy(incl. tax	Coal production subsidies	Yes	**No**

Annex 1-6 Crude oil R/P (Reserve/Production)

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	-	Crude oil	Crude oil E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Crude oil production subsidies	-	
Indonesia	Relatively worsened	Crude oil	Crude oil E&P (Indigenous)		
		Price and subsidy(incl. tax	Crude oil production subsidies		
Japan	-	Crude oil	Crude oil E&P (Indigenous)	-	
		Price and subsidy(incl. tax	Crude oil production subsidies	-	
Korea	-	Crude oil	Crude oil E&P (Indigenous)	No	
		Price and subsidy(incl. tax	Crude oil production subsidies	No	
Laos	-	Crude oil	Crude oil E&P (Indigenous)	-	
		Price and subsidy(incl. tax	Crude oil production subsidies	-	
Malaysia	Worsened	Crude oil	Crude oil E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Crude oil production subsidies		**No**
Myanmar	Improved	Crude oil	Crude oil E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Crude oil production subsidies	Yes	**Yes**
New Zealand	-	Crude oil	Crude oil E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Crude oil production subsidies	No	
Philippines	-	Crude oil	Crude oil E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Crude oil production subsidies	Yes	
Thailand	Worsened	Crude oil	Crude oil E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Crude oil production subsidies		**No**
Vietnam	Improved	Crude oil	Crude oil E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Crude oil production subsidies	Yes	**Yes**

Annex 1-7 Natural gas R/P (Reserve/Production)

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	-	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Natural gas production subsidies	-	
Indonesia	Relatively worsened	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Natural gas production subsidies		**No**
Japan	-	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Natural gas production subsidies	No	
Korea	-	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Natural gas production subsidies	Yes	
Laos	-	Natural gas	Natural gas E&P (Indigenous)	-	
		Price and subsidy(incl. tax	Natural gas production subsidies	-	
Malaysia	Worsened	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Natural gas production subsidies		**No**
Myanmar	Worsened	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Natural gas production subsidies	Yes	**No**
New Zealand	-	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Natural gas production subsidies	No	
Philippines	Improved	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Natural gas production subsidies	Yes	**Yes**
Thailand	Worsened	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Natural gas production subsidies	Yes	**No**
Vietnam	Worsened	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Price and subsidy(incl. tax	Natural gas production subsidies	Yes	**No**

Annex 1-8 Coal R/C (Reserve/Consumption)

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	-	Coal	Coal mining (Indigenous)	No	
		Coal	Coal use promotion	Yes	
		Price and subsidy	Coal consumer price control		
Indonesia	Worsened	Coal	Coal mining (Indigenous)	Yes	**Yes**
		Coal	Coal use promotion	Yes	
		Price and subsidy	Coal consumer price control		
Japan	Worsened	Coal	Coal mining (Indigenous)	Yes	**Yes**
		Coal	Coal use promotion	No	
		Price and subsidy	Coal consumer price control	No	
Korea	Worsened	Coal	Coal mining (Indigenous)	Yes	**No**
		Coal	Coal use promotion	Yes	
		Price and subsidy	Coal consumer price control	-	
Laos	-	Coal	Coal mining (Indigenous)	Yes	
		Coal	Coal use promotion	-	
		Price and subsidy	Coal consumer price control	-	
Malaysia	-	Coal	Coal mining (Indigenous)	Yes	
		Coal	Coal use promotion	Yes	
		Price and subsidy	Coal consumer price control		
Myanmar	-	Coal	Coal mining (Indigenous)	Yes	
		Coal	Coal use promotion	-	
		Price and subsidy	Coal consumer price control	-	
New Zealand	Improved	Coal	Coal mining (Indigenous)	Yes	**Yes**
		Coal	Coal use promotion	No	
		Price and subsidy	Coal consumer price control	No	
Philippines	Improved	Coal	Coal mining (Indigenous)	Yes	**Yes**
		Coal	Coal use promotion	Yes	
		Price and subsidy	Coal consumer price control	No	
Thailand	Worsened	Coal	Coal mining (Indigenous)	Yes	**No**
		Coal	Coal use promotion	Yes	
		Price and subsidy	Coal consumer price control		
Vietnam	Worsened	Coal	Coal mining (Indigenous)	Yes	**Yes**
		Coal	Coal use promotion	Yes	
		Price and subsidy	Coal consumer price control	Yes	

Annex 1-9 Crude oil R/C (Reserve/Consumption)

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	-	Crude oil	Crude oil E&P (Indigenous)	Yes	
		Crude oil	Refinery construction	No	
		Price and subsidy	Oil product consumer price control		
Indonesia	Worsened	Crude oil	Crude oil E&P (Indigenous)		**Yes**
		Crude oil	Refinery construction	Yes	
		Price and subsidy	Oil product consumer price contr	Yes	
Japan	-	Crude oil	Crude oil E&P (Indigenous)	-	
		Crude oil	Refinery construction	No	
		Price and subsidy	Oil product consumer price contr	No	
Korea	-	Crude oil	Crude oil E&P (Indigenous)	No	
		Crude oil	Refinery construction	Yes	
		Price and subsidy	Oil product consumer price contr	No	
Laos	-	Crude oil	Crude oil E&P (Indigenous)	-	
		Crude oil	Refinery construction	-	
		Price and subsidy	Oil product consumer price contr	-	
Malaysia	Worsened	Crude oil	Crude oil E&P (Indigenous)	Yes	**Yes**
		Crude oil	Refinery construction	-	
		Price and subsidy	Oil product consumer price contr	Yes	
Myanmar	Improved	Crude oil	Crude oil E&P (Indigenous)	Yes	**Yes**
		Crude oil	Refinery construction	-	
		Price and subsidy	Oil product consumer price contr	Yes	
New Zealand	-	Crude oil	Crude oil E&P (Indigenous)	Yes	
		Crude oil	Refinery construction	Yes	
		Price and subsidy	Oil product consumer price contr	No	
Philippines	-	Crude oil	Crude oil E&P (Indigenous)	Yes	
		Crude oil	Refinery construction	Yes	
		Price and subsidy	Oil product consumer price contr	No	
Thailand	No change	Crude oil	Crude oil E&P (Indigenous)	Yes	**No**
		Crude oil	Refinery construction	Yes	
		Price and subsidy	Oil product consumer price contr	Yes	
Vietnam	Worsened	Crude oil	Crude oil E&P (Indigenous)	Yes	**Yes**
		Crude oil	Refinery construction	Yes	
		Price and subsidy	Oil product consumer price contr	Yes	

Annex 1-10 Natural gas R/C (Reserve/Consumption)

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	-	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Natural gas	Natural gas use promotion	No	
		Price and subsidy	Natural gas consumer price control		
Indonesia	Relatively worsened	Natural gas	Natural gas E&P (Indigenous)	Yes	**Yes**
		Natural gas	Natural gas use promotion	Yes	
		Price and subsidy	Natural gas consumer price control		
Japan	-	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Price and subsidy	Natural gas consumer price contr	No	
Korea	-	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Price and subsidy	Natural gas consumer price contr	Yes	
Laos	-	Natural gas	Natural gas E&P (Indigenous)	-	
		Natural gas	Natural gas use promotion	-	
		Price and subsidy	Natural gas consumer price contr	-	
Malaysia	Worsened	Natural gas	Natural gas E&P (Indigenous)	Yes	**Yes**
		Natural gas	Natural gas use promotion	Yes	
		Price and subsidy	Natural gas consumer price contr	Yes	
Myanmar	Worsened	Natural gas	Natural gas E&P (Indigenous)	Yes	**No**
		Natural gas	Natural gas use promotion	-	
		Price and subsidy	Natural gas consumer price contr	-	
New Zealand	-	Natural gas	Natural gas E&P (Indigenous)	Yes	
		Natural gas	Natural gas use promotion	No	
		Price and subsidy	Natural gas consumer price contr	No	
Philippines	Improved	Natural gas	Natural gas E&P (Indigenous)	Yes	**Yes**
		Natural gas	Natural gas use promotion	Yes	
		Price and subsidy	Natural gas consumer price contr	No	
Thailand	Worsened	Natural gas	Natural gas E&P (Indigenous)	Yes	**No**
		Natural gas	Natural gas use promotion	Yes	
		Price and subsidy	Natural gas consumer price control		
Vietnam	Worsened	Natural gas	Natural gas E&P (Indigenous)	Yes	**No**
		Natural gas	Natural gas use promotion	Yes	
		Price and subsidy	Natural gas consumer price contr	Yes	

Annex 1-11 Coal import source country diversity

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	-	Coal	Import source country diversity	No	
Indonesia	-	Coal	Import source country diversity	No	
Japan	Worsened	Coal	Import source country diversity	No	
Korea	Relatively improved	Coal	Import source country diversity	Yes	**Yes**
Laos	-	Coal	Import source country diversity	-	
Malaysia	Improved	Coal	Import source country diversity	Yes	**Yes**
Myanmar	-	Coal	Import source country diversity	-	
New Zealand	Worsened	Coal	Import source country diversity	No	
Philippines	-	Coal	Import source country diversity	No	
Thailand	-	Coal	Import source country diversity		
Vietnam	-	Coal	Import source country diversity	-	

Annex 1-12 Crude oil import source country diversity

Country	ESI	Policy			**Correlation**
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	-	Crude oil	Import source country diversity	No	
Indonesia	-	Crude oil	Import source country diversity	No	
Japan	No change	Crude oil	Import source country diversity	Yes	**No**
Korea	Relatively worsened	Crude oil	Import source country diversity	Yes	**No**
Laos	-	Crude oil	Import source country diversity	-	
Malaysia	-	Crude oil	Import source country diversity	-	
Myanmar	-	Crude oil	Import source country diversity	-	
New Zealand	Improved	Crude oil	Import source country diversity	No	
Philippines	-	Crude oil	Import source country diversity	No	
Thailand	Improved	Crude oil	Import source country diversity		
Vietnam	-	Crude oil	Import source country diversity	-	

Annex 1-13 Natural gas import source country diversity

Country	ESI	Policy			**Correlation**
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	-	Natural gas	Import source country diversity	No	
Indonesia	-	Natural gas	Import source country diversity	No	
Japan	Improved	Natural gas	Import source country diversity	No	
Korea	Improved	Natural gas	Import source country diversity	Yes	**Yes**
Laos	-	Natural gas	Import source country diversity	-	
Malaysia	-	Natural gas	Import source country diversity	-	
Myanmar	-	Natural gas	Import source country diversity	-	
New Zealand	-	Natural gas	Import source country diversity	No	
Philippines	-	Natural gas	Import source country diversity	No	
Thailand	No change	Natural gas	Import source country diversity	Yes	**No**
Vietnam	-	Natural gas	Import source country diversity	Yes	

Annex 1-14 TPES diversity

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	Gradually improved	Coal	Coal use promotion	Yes	**Yes**
		Crude oil	Alternative fuel	No	
		Natural gas	Natural gas use promotion	No	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	No	
		Biofuels & wastes	Renewables development	No	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Indonesia	Improved	Coal	Coal use promotion	Yes	**Yes**
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development		
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development		
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Japan	Improved	Coal	Coal use promotion	No	**Yes**
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Natural gas consumer price contro	No	
		Price and subsidy	Electricity tariff control	No	
Korea	Improved	Coal	Coal use promotion	Yes	**Yes**
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes	
Laos	Improved	Coal	Coal use promotion	-	
		Crude oil	Alternative fuel	-	
		Natural gas	Natural gas use promotion	-	
		Nuclear	Nuclear development	-	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	-	
		Biofuels & wastes	Renewables development	-	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Natural gas consumer price contr	-	
		Price and subsidy	Electricity tariff control	-	

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Malaysia	Improved	Coal	Coal use promotion	Yes	**Yes**
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development		
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes (in Sabah)	
Myanmar	Improved	Coal	Coal use promotion	-	
		Crude oil	Alternative fuel	-	
		Natural gas	Natural gas use promotion	-	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	No	
		Biofuels & wastes	Renewables development	N0	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Natural gas consumer price contr	-	
		Price and subsidy	Electricity tariff control	-	
New Zealand	Improved	Coal	Coal use promotion	No	**Yes**
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	No	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Philippines	Improved	Coal	Coal use promotion	Yes	**Yes**
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy(incl. tax	Coal consumer price control	No	
		Price and subsidy(incl. tax	Natural gas consumer price contr	No	
		Price and subsidy(incl. tax	Electricity tariff control	No	
Thailand	Improved	Coal	Coal use promotion	Yes	**Yes**
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	No	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Vietnam	Improved	Coal	Coal use promotion	Yes	**Yes**
		Crude oil	Alternative fuel	-	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control	Yes	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes	

Annex 1-15 Power generation fuel diversity

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	Improved	Coal	Coal use promotion	Yes	**Yes**
		Crude oil	Alternative fuel	No	
		Natural gas	Natural gas use promotion	No	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	No	
		Biofuels & wastes	Renewables development	No	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Indonesia	Relatively improved	Coal	Coal use promotion	Yes	**Yes**
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development		
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development		
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Japan	Improved	Coal	Coal use promotion	No	**Yes**
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Natural gas consumer price contro	No	
		Price and subsidy	Electricity tariff control	No	
Korea	Relatively improved	Coal	Coal use promotion	Yes	**Yes**
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Natural gas consumer price contro	Yes	
		Price and subsidy	Electricity tariff control	Yes	
Laos	No change	Coal	Coal use promotion	-	
		Crude oil	Alternative fuel	-	
		Natural gas	Natural gas use promotion	-	
		Nuclear	Nuclear development	-	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	-	
		Biofuels & wastes	Renewables development	-	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Natural gas consumer price contro	-	
		Price and subsidy	Electricity tariff control	-	

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Malaysia	Improved	Coal	Coal use promotion	Yes	**Yes**
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development		
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes (in Sabah)	
Myanmar	Improved	Coal	Coal use promotion	-	
		Crude oil	Alternative fuel	-	
		Natural gas	Natural gas use promotion	-	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	No	
		Biofuels & wastes	Renewables development	N0	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Natural gas consumer price contr	-	
		Price and subsidy	Electricity tariff control	-	
New Zealand	Improved	Coal	Coal use promotion	No	**Yes**
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	No	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Philippines	Improved	Coal	Coal use promotion	Yes	**Yes**
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Thailand	Improved⇒Worsened	Coal	Coal use promotion	Yes	**No**
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	No	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Vietnam	Improved	Coal	Coal use promotion	Yes	**Yes**
		Crude oil	Alternative fuel	-	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control	Yes	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes	

Annex 1-16 Crude oil Middle East dependence

Country	ESI	Policy			**Correlation**
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	-	Crude oil	Import source country diversity	No	
Indonesia	-	Crude oil	Import source country diversity	No	
Japan	Worsened	Crude oil	Import source country diversity	Yes	**No**
Korea	Worsened	Crude oil	Import source country diversity	Yes	**No**
Laos	-	Crude oil	Import source country diversity	-	
Malaysia	-	Crude oil	Import source country diversity	-	
Myanmar	-	Crude oil	Import source country diversity	-	
New Zealand	Worsened then improved	Crude oil	Import source country diversity	No	
Philippines	-	Crude oil	Import source country diversity	No	
Thailand	Worsened	Crude oil	Import source country diversity		
Vietnam	-	Crude oil	Import source country diversity	-	

Annex 1-17 Natural gas Middle East dependence

Country	ESI	Policy			**Correlation**
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	-	Natural gas	Import source country diversity	No	
Indonesia	-	Natural gas	Import source country diversity	No	
Japan	Worsened	Natural gas	Import source country diversity	No	
Korea	relatively improved	Natural gas	Import source country diversity	Yes	**Yes**
Laos	-	Natural gas	Import source country diversity	-	
Malaysia	-	Natural gas	Import source country diversity	-	
Myanmar	-	Natural gas	Import source country diversity	-	
New Zealand	-	Natural gas	Import source country diversity	No	
Philippines	-	Natural gas	Import source country diversity	No	
Thailand	-	Natural gas	Import source country diversity	Yes	
Vietnam	-	Natural gas	Import source country diversity		

Annex 1-18 Reserve margin of generation capacity

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	-	Coal	Coal use promotion	Yes	
		Natural gas	Natural gas use promotion	No	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	No	
		Biofuels & wastes	Renewables development	No	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Indonesia	Worsened	Coal	Coal use promotion	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development		**No**
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development		
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Japan	Improved	Coal	Coal use promotion	No	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	**Yes**
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Korea	Worsened	Coal	Coal use promotion	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	**No**
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes	
Laos	-	Coal	Coal use promotion	-	
		Natural gas	Natural gas use promotion	-	
		Nuclear	Nuclear development	-	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	-	
		Biofuels & wastes	Renewables development	-	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Natural gas consumer price contr	-	
		Price and subsidy	Electricity tariff control	-	
Malaysia	Improved	Coal	Coal use promotion	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development		
		Hydro	Hydro development	Yes	**Yes**
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes (in Sabah)	

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Myanmar	-	Coal	Coal use promotion	-	
		Natural gas	Natural gas use promotion	-	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	No	
		Biofuels & wastes	Renewables development	N0	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Natural gas consumer price contr	-	
		Price and subsidy	Electricity tariff control	-	
New Zealand	No change	Coal	Coal use promotion	No	
		Natural gas	Natural gas use promotion	No	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	**No**
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Philippines	Improved	Coal	Coal use promotion	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	**Yes**
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Thailand	Improved?	Coal	Coal use promotion	Yes	
		Natural gas	Natural gas use promotion	Yes	**Yes**
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	No	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Vietnam	Worsened	Coal	Coal use promotion	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	**No**
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control	Yes	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes	

Annex 1-19 Power outage frequency

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	-	Electricity	Supply reliability	Yes	
Indonesia	Improved	Electricity	Supply reliability	Yes	**Yes**
Japan	Improved	Electricity	Supply reliability	Yes	**Yes**
Korea	Improved	Electricity	Supply reliability	Yes	**Yes**
Laos	-	Electricity	Supply reliability	Yes	
Malaysia	Improved	Electricity	Supply reliability	Yes	**Yes**
Myanmar	-	Electricity	Supply reliability	-	
New Zealand	No change	Electricity	Supply reliability	Yes	**No**
Philippines	-	Electricity	Supply reliability	Yes	
Thailand	-	Electricity	Supply reliability		
Vietnam	-	Electricity	Supply reliability	Yes	

Annex 1-20 Power outage duration

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	-	Electricity	Supply reliability	Yes	
Indonesia	Worsened	Electricity	Supply reliability	Yes	**No**
Japan	Improved	Electricity	Supply reliability	Yes	**Yes**
Korea	Improved	Electricity	Supply reliability	Yes	**Yes**
Laos	-	Electricity	Supply reliability	Yes	
Malaysia	Improved	Electricity	Supply reliability	Yes	**Yes**
Myanmar	-	Electricity	Supply reliability	-	
New Zealand	Worsened	Electricity	Supply reliability	Yes	**No**
Philippines	-	Electricity	Supply reliability	Yes	
Thailand	-	Electricity	Supply reliability		
Vietnam	-	Electricity	Supply reliability	Yes	

Annex 1-21 Commercial energy access

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	Improved	Coal	Coal use promotion	Yes	**Yes**
		Natural gas	Natural gas use promotion	No	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	No	
		Biofuels & wastes	Renewables development	No	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Indonesia	Improved	Coal	Coal use promotion	Yes	**Yes**
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development		
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development		
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Japan	No change	Coal	Coal use promotion	No	**No**
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Korea	No change	Coal	Coal use promotion	Yes	**No**
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes	
Laos	Improved	Coal	Coal use promotion	-	**Yes**
		Natural gas	Natural gas use promotion	-	
		Nuclear	Nuclear development	-	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	-	
		Biofuels & wastes	Renewables development	-	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Natural gas consumer price contr	-	
		Price and subsidy	Electricity tariff control	-	
Malaysia	Improved	Coal	Coal use promotion	Yes	**Yes**
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development		
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes (in Sabah)	

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Myanmar	Improved	Coal	Coal use promotion	-	**Yes**
		Natural gas	Natural gas use promotion	-	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	No	
		Biofuels & wastes	Renewables development	N0	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Natural gas consumer price contr	-	
		Price and subsidy	Electricity tariff control	-	
New Zealand	No change	Coal	Coal use promotion	No	**No**
		Natural gas	Natural gas use promotion	No	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Philippines	Improved	Coal	Coal use promotion	Yes	**Yes**
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Thailand	Improved	Coal	Coal use promotion	Yes	**Yes**
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	No	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Vietnam	Improved	Coal	Coal use promotion	Yes	**Yes**
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Price and subsidy	Coal consumer price control	Yes	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes	

Annex 1-22 Electrification

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	Improved	Coal	Coal use promotion	Yes	**Yes**
		Natural gas	Natural gas use promotion	No	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	No	
		Biofuels & wastes	Renewables development	No	
		Electricity	Electrification	Yes	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Indonesia	Improved	Coal	Coal use promotion	Yes	**Yes**
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development		
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development		
		Electricity	Electrification	Yes	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Japan	-	Coal	Coal use promotion	No	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Electricity	Electrification	-	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Natural gas consumer price contro	No	
		Price and subsidy	Electricity tariff control	No	
Korea	-	Coal	Coal use promotion	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Electricity	Electrification	Yes	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Natural gas consumer price contro	Yes	
		Price and subsidy	Electricity tariff control	Yes	
Laos	Improved	Coal	Coal use promotion	-	**Yes**
		Natural gas	Natural gas use promotion	-	
		Nuclear	Nuclear development	-	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	-	
		Biofuels & wastes	Renewables development	-	
		Electricity	Electrification	Yes	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Natural gas consumer price contro	-	
		Price and subsidy	Electricity tariff control	-	

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Malaysia	Improved	Coal	Coal use promotion	Yes	**Yes**
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development		
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Electricity	Electrification	Yes	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes (in Sabah)	
Myanmar	Improved	Coal	Coal use promotion	-	**Yes**
		Natural gas	Natural gas use promotion	-	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	No	
		Biofuels & wastes	Renewables development	N0	
		Electricity	Electrification	Yes	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Natural gas consumer price contr	-	
		Price and subsidy	Electricity tariff control	-	
New Zealand	-	Coal	Coal use promotion	No	
		Natural gas	Natural gas use promotion	No	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Electricity	Electrification	No	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Philippines	Improved	Coal	Coal use promotion	Yes	**Yes**
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Electricity	Electrification	Yes	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Thailand	Improved	Coal	Coal use promotion	Yes	**Yes**
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	No	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Electricity	Electrification		
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Vietnam	Improved	Coal	Coal use promotion	Yes	**Yes**
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		Electricity	Electrification	Yes	
		Price and subsidy	Coal consumer price control	Yes	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes	

Annex 1-23 TPES/GDP

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	Improved	All energy	Energy conservation/efficiency	No	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price control		
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Indonesia	Improved	All energy	Energy conservation/efficiency	Yes	**Yes**
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Japan	Improved	All energy	Energy conservation/efficiency	Yes	**Yes**
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Korea	Relatively improved	All energy	Energy conservation/efficiency	Yes	**Yes**
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes	
Laos	Improved	All energy	Energy conservation/efficiency	Yes	**Yes**
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Oil product consumer price contr	-	
		Price and subsidy	Natural gas consumer price contr	-	
		Price and subsidy	Electricity tariff control	-	
Malaysia	Worsened	All energy	Energy conservation/efficiency	Yes	**No**
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes (in Sabah)	
Myanmar	Improved	All energy	Energy conservation/efficiency	Yes	**Yes**
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price contr	-	
		Price and subsidy	Electricity tariff control	-	
New Zealand	Worsened then improved	All energy	Energy conservation/efficiency	Yes	**Yes**
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Philippines	Improved	All energy	Energy conservation/efficiency	Yes	**Yes**
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Thailand	No change	All energy	Energy conservation/efficiency	Yes	**No**
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Vietnam	Improved	All energy	Energy conservation/efficiency	Yes	**Yes**
		Price and subsidy	Coal consumer price control	Yes	
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes	

Annex 1-24 TFEC/GDP

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	Improved	All energy	Energy conservation/efficiency	No	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price control		
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Indonesia	Improved	All energy	Energy conservation/efficiency	Yes	**Yes**
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Japan	Improved	All energy	Energy conservation/efficiency	Yes	**Yes**
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Korea	Improved	All energy	Energy conservation/efficiency	Yes	**Yes**
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes	
Laos	Improved	All energy	Energy conservation/efficiency	Yes	**Yes**
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Oil product consumer price contr	-	
		Price and subsidy	Natural gas consumer price contr	-	
		Price and subsidy	Electricity tariff control	-	
Malaysia	Worsened	All energy	Energy conservation/efficiency	Yes	**No**
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes (in Sabah)	
Myanmar	Improved	All energy	Energy conservation/efficiency	Yes	**Yes**
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price contr	-	
		Price and subsidy	Electricity tariff control	-	
New Zealand	Worsened then improved	All energy	Energy conservation/efficiency	Yes	**Yes**
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Philippines	Improved	All energy	Energy conservation/efficiency	Yes	**Yes**
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Thailand	No change	All energy	Energy conservation/efficiency	Yes	**No**
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Vietnam	Improved	All energy	Energy conservation/efficiency	Yes	**Yes**
		Price and subsidy	Coal consumer price control	Yes	
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes	

Annex 1-25 Days of on-land oil stocks

Country	ESI	Policy			**Correlation** **(not authorized)**
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	-	Crude oil	Stock piling	No?	
Indonesia		Crude oil	Stock piling	Yes	
Japan	Improved	Crude oil	Stock piling	Yes	**Yes**
Korea	Improved	Crude oil	Stock piling	Yes	**Yes**
Laos	-	Crude oil	Stock piling	-	
Malaysia	-	Crude oil	Stock piling	-	
Myanmar	Improved	Crude oil	Stock piling	Yes	**Yes**
New Zealand	Worsened	Crude oil	Stock piling (*)	Yes	**No**
Philippines	-	Crude oil	Stock piling	No	
Thailand	Improved	Crude oil	Stock piling	Yes	**Yes**
Vietnam	-	Crude oil	Stock piling	-	

Annex 1-26 CO2 Emission/TPES

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	Worsenerd	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	No	
		Natural gas	Natural gas use promotion	No	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	**No**
		Geothermal, wind, other	Renewables development	No	
		Biofuels & wastes	Renewables development	No	
		CO2 Emission	CO2 Emission reduction	No	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price control		
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Indonesia	Worsened	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development		
		Geothermal, wind, other	Renewables development	Yes	**No**
		Biofuels & wastes	Renewables development		
		CO2 Emission	CO2 Emission reduction		
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Japan	Improved	Coal	Coal use promotion	No	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	**Yes**
		CO2 Emission	CO2 Emission reduction	No	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Korea	Improved	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	**Yes**
		CO2 Emission	CO2 Emission reduction	Yes	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes	
Laos	Worsened	Coal	Coal use promotion	-	
		Crude oil	Alternative fuel	-	
		Natural gas	Natural gas use promotion	-	
		Nuclear	Nuclear development	-	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	-	**No**
		Biofuels & wastes	Renewables development	-	
		CO2 Emission	CO2 Emission reduction	-	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Oil product consumer price contr	-	
		Price and subsidy	Natural gas consumer price contr	-	
		Price and subsidy	Electricity tariff control	-	

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Malaysia	Worsened	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development		
		Hydro	Hydro development	Yes	**No**
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		CO2 Emission	CO2 Emission reduction	-	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes (in Sabah)	
Myanmar	Worsened	Coal	Coal use promotion	-	
		Crude oil	Alternative fuel	-	
		Natural gas	Natural gas use promotion	-	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	**No**
		Geothermal, wind, other	Renewables development	No	
		Biofuels & wastes	Renewables development	N0	
		CO2 Emission	CO2 Emission reduction	No	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price contr	-	
		Price and subsidy	Electricity tariff control	-	
New Zealand	Improved then worsened	Coal	Coal use promotion	No	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	No	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	**No**
		Biofuels & wastes	Renewables development	Yes	
		CO2 Emission	CO2 Emission reduction	Yes	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Philippines	Relatively worsened	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	**No**
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		CO2 Emission	CO2 Emission reduction	Yes	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Thailand	Worsened	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	No	**No**
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		CO2 Emission	CO2 Emission reduction		
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Vietnam	Worsened	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	-	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	**No**
		Biofuels & wastes	Renewables development	Yes	
		CO2 Emission	CO2 Emission reduction		
		Price and subsidy	Coal consumer price control	Yes	
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes	

Annex 1-27 CO2 Emission/Fossil fuel

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	No change	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	No	
		Natural gas	Natural gas use promotion	No	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	No	
		Biofuels & wastes	Renewables development	No	**No**
		CO2 Emission	CO2 Emission reduction	No	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price control		
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Indonesia	Relatively worsened	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development		
		Geothermal, wind, other	Renewables development	Yes	**No**
		Biofuels & wastes	Renewables development		
		CO2 Emission	CO2 Emission reduction		
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Japan	No change	Coal	Coal use promotion	No	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		CO2 Emission	CO2 Emission reduction	No	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Korea	Improved	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	**Yes**
		CO2 Emission	CO2 Emission reduction	Yes	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes	
Laos	Worsened	Coal	Coal use promotion	-	
		Crude oil	Alternative fuel	-	
		Natural gas	Natural gas use promotion	-	
		Nuclear	Nuclear development	-	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	-	**No**
		Biofuels & wastes	Renewables development	-	
		CO2 Emission	CO2 Emission reduction	-	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Oil product consumer price contr	-	
		Price and subsidy	Natural gas consumer price contr	-	
		Price and subsidy	Electricity tariff control	-	

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Malaysia	No change	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development		
		Hydro	Hydro development	Yes	**No**
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		CO2 Emission	CO2 Emission reduction	-	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes (in Sabah)	
Myanmar	Improved	Coal	Coal use promotion	-	
		Crude oil	Alternative fuel	-	
		Natural gas	Natural gas use promotion	-	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	**Yes**
		Geothermal, wind, other	Renewables development	No	
		Biofuels & wastes	Renewables development	N0	
		CO2 Emission	CO2 Emission reduction	No	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price contr	-	
		Price and subsidy	Electricity tariff control	-	
New Zealand	No change	Coal	Coal use promotion	No	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	No	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	**No**
		Biofuels & wastes	Renewables development	Yes	
		CO2 Emission	CO2 Emission reduction	Yes	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Philippines	Relatively worsened	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	**No**
		Biofuels & wastes	Renewables development	Yes	
		CO2 Emission	CO2 Emission reduction	Yes	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Thailand	No change	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	**No**
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	No	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		CO2 Emission	CO2 Emission reduction		
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Vietnam	no change	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	**No**
		Biofuels & wastes	Renewables development	Yes	
		CO2 Emission	CO2 Emission reduction		
		Price and subsidy	Coal consumer price control	Yes	
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes	

Annex 1-28 CO2 Emission/GDP

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	No change	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	No	
		Natural gas	Natural gas use promotion	No	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	**No**
		Geothermal, wind, other	Renewables development	No	
		Biofuels & wastes	Renewables development	No	
		CO2 Emission	CO2 Emission reduction	No	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price control		
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Indonesia	Worsened	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development		
		Geothermal, wind, other	Renewables development	Yes	**No**
		Biofuels & wastes	Renewables development		
		CO2 Emission	CO2 Emission reduction		
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Japan	Improved	Coal	Coal use promotion	No	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	**Yes**
		CO2 Emission	CO2 Emission reduction	No	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Korea	Improved	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	**Yes**
		CO2 Emission	CO2 Emission reduction	Yes	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes	
Laos	Worsened	Coal	Coal use promotion	-	
		Crude oil	Alternative fuel	-	
		Natural gas	Natural gas use promotion	-	
		Nuclear	Nuclear development	-	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	-	**No**
		Biofuels & wastes	Renewables development	-	
		CO2 Emission	CO2 Emission reduction	-	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Oil product consumer price contr	-	
		Price and subsidy	Natural gas consumer price contr	-	
		Price and subsidy	Electricity tariff control	-	

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Malaysia	Worsened	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development		
		Hydro	Hydro development	Yes	**No**
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		CO2 Emission	CO2 Emission reduction	-	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes (in Sabah)	
Myanmar	Improved	Coal	Coal use promotion	-	
		Crude oil	Alternative fuel	-	
		Natural gas	Natural gas use promotion	-	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	**Yes**
		Geothermal, wind, other	Renewables development	No	
		Biofuels & wastes	Renewables development	N0	
		CO2 Emission	CO2 Emission reduction	No	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price contr	-	
		Price and subsidy	Electricity tariff control	-	
New Zealand	No change	Coal	Coal use promotion	No	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	No	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	**No**
		CO2 Emission	CO2 Emission reduction	Yes	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Philippines	Relatively worsened	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	**No**
		Biofuels & wastes	Renewables development	Yes	
		CO2 Emission	CO2 Emission reduction	Yes	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Thailand	Worsened	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	**No**
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	No	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		CO2 Emission	CO2 Emission reduction		
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Vietnam	no change	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	-	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	**No**
		CO2 Emission	CO2 Emission reduction		
		Price and subsidy	Coal consumer price control	Yes	
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes	

Annex 1-29 CO2 Emission/Population

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Cambodia	Worsenerd	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	No	
		Natural gas	Natural gas use promotion	No	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	No	**No**
		Biofuels & wastes	Renewables development	No	
		CO2 Emission	CO2 Emission reduction	No	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price control		
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Indonesia	Worsened	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development		
		Geothermal, wind, other	Renewables development	Yes	**No**
		Biofuels & wastes	Renewables development		
		CO2 Emission	CO2 Emission reduction		
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Japan	Worsened	Coal	Coal use promotion	No	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	**No**
		CO2 Emission	CO2 Emission reduction	No	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Korea	Worsened	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	**No**
		CO2 Emission	CO2 Emission reduction	Yes	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes	
Laos	Worsened	Coal	Coal use promotion	-	
		Crude oil	Alternative fuel	-	
		Natural gas	Natural gas use promotion	-	
		Nuclear	Nuclear development	-	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	-	**No**
		Biofuels & wastes	Renewables development	-	
		CO2 Emission	CO2 Emission reduction	-	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Oil product consumer price contr	-	
		Price and subsidy	Natural gas consumer price contr	-	
		Price and subsidy	Electricity tariff control	-	

Country	ESI	Policy			Correlation
	Improved/Worsened/ No change	Description	Specific policy	Yes/No	
Malaysia	Worsened	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development		
		Hydro	Hydro development	Yes	**No**
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		CO2 Emission	CO2 Emission reduction	-	
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes (in Sabah)	
Myanmar	Worsened	Coal	Coal use promotion	-	
		Crude oil	Alternative fuel	-	
		Natural gas	Natural gas use promotion	-	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	**No**
		Geothermal, wind, other	Renewables development	No	
		Biofuels & wastes	Renewables development	N0	
		CO2 Emission	CO2 Emission reduction	No	
		Price and subsidy	Coal consumer price control	-	
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price contr	-	
		Price and subsidy	Electricity tariff control	-	
New Zealand	Worsened	Coal	Coal use promotion	No	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	No	
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	**No**
		CO2 Emission	CO2 Emission reduction	Yes	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Philippines	Relatively worsened	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	**No**
		Biofuels & wastes	Renewables development	Yes	
		CO2 Emission	CO2 Emission reduction	Yes	
		Price and subsidy	Coal consumer price control	No	
		Price and subsidy	Oil product consumer price contr	No	
		Price and subsidy	Natural gas consumer price contr	No	
		Price and subsidy	Electricity tariff control	No	
Thailand	Worsened	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	Yes	
		Natural gas	Natural gas use promotion	Yes	**No**
		Nuclear	Nuclear development	No	
		Hydro	Hydro development	No	
		Geothermal, wind, other	Renewables development	Yes	
		Biofuels & wastes	Renewables development	Yes	
		CO2 Emission	CO2 Emission reduction		
		Price and subsidy	Coal consumer price control		
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price control		
		Price and subsidy	Electricity tariff control		
Vietnam	Worsened	Coal	Coal use promotion	Yes	
		Crude oil	Alternative fuel	-	
		Natural gas	Natural gas use promotion	Yes	
		Nuclear	Nuclear development	Yes	
		Hydro	Hydro development	Yes	
		Geothermal, wind, other	Renewables development	Yes	**No**
		Biofuels & wastes	Renewables development	Yes	
		CO2 Emission	CO2 Emission reduction		
		Price and subsidy	Coal consumer price control	Yes	
		Price and subsidy	Oil product consumer price contr	Yes	
		Price and subsidy	Natural gas consumer price contr	Yes	
		Price and subsidy	Electricity tariff control	Yes	

Annex 2
Policies

Annex 2-1 Cambodia

Hydro power The total potential of HPP in Cambodia is 10,000MW. To increase the energy security and reliable supply, there several domestic HPP and Coal power plant are under construction. In 2012, total existing HPP is about 200MW, while the HPP under construction is totally 750MW and coal power is 505MW that will complete in a few years later. From the PDP, the total install capacity in the country is about 6,300MW by 2020.
Resource development 2001; Royal decree NS/RKM/1701/09 dated on July 13, 2001, Law on Mineral Resource Management and Exploitation (Including petroleum, oil resources, natural gas)
Electrification 2003; No.27 dated January 28, 2003, Electricity Authority of Cambodia, Regulatory Treatment of Extension of Transmission & Distribution Grid in Cambodia. 2011; No. 1053/MIME, dated on November 30, 2011 on the establishment of strategy and plan for rural electrification development in the Kingdom of Cambodia. Based on the government target, there are two targets for providing the electricity in the whole country: 1-all villages in Cambodia have access to electricity of any type by the 2020, and 2-at least 70% of all households in Cambodia have access to grid quality electricity by the year 2030. In 2011, the electrification increased to 35%.
Supply reliability 2001; Royal Decree No. 0201/03, dated February 02, 2001 to promulgate the Electricity Law of the Kingdom of Cambodia and Establishing the Electricity Authority of Cambodia (EAC) for regulating the electricity power services, granting the right and obligation and penalize, if necessary, the supplier and consumer of electricity in relation to electricity generation and supply facilities. 2004; No.470 dated July 16, 2004, Ministry of Industry, Mines and Energy, Establishing the General Requirement of Electric Power Technical Standards of Cambodia. 2007; No. 796 dated August 9, 2007, Ministry of Industry, Mines and Energy, Amended the General Requirement of Electric Power technical Standards of the Kingdom of Cambodia issued by No. 470, dated July 16, 2004.
Electricity tariffs 2007; No.113 dated October 26, 2007, Electricity Authority of Cambodian Regulations on General Principles for Regulating Electricity Tariffs in Cambodia.

Annex 2-2 China

Coal mining 1995: Issue procedures for coal exploration and coal mining; 1996: Issue Coal Law (中华人民共和国煤炭法) 1997: Issue measures on coal mining management
Coal use promotion 2006: Energy Intensity Reduction Target 2007: National Climate Change Program 2011: The Twelfth Five-Year Plan for National Economic and Social Development of The Peoples Republic of China
Refinery construction, Natural gas use promotion 2011: The Twelfth Five-Year Plan for National Economic and Social Development of The Peoples Republic of China (Give priority to the development of large liquefied natural gas (LNG) and liquefied petroleum gas (LPG) vessels, ocean-going fishing vessels, luxury liners, and other high-tech and high-added-value vessels.)
Alternative fuel 2007: National Climate Change Program 2009: Renewable Energy Law amendments 2011: The Twelfth Five-Year Plan for National Economic and Social Development of The Peoples Republic of China
Nuclear development 2011: The Twelfth Five-Year Plan for National Economic and Social Development of The Peoples Republic of China (develop nuclear power in the eastern costal region and some areas in central China mainly).
Hydro development 1996: Brightness Programme 2001: Reduced VAT for renewable energy 2006: Renewable Energy Law 2006: Renewable Energy Development Targets 2007: National Climate Change Program
Wind energy development 1996: Brightness Programme 2001: Reduced VAT for renewable energy 2006: Renewable Energy Law 2006: Renewable Energy Development Targets 2007: National Climate Change Program 2009: Onshore wind feed-in Tariff 2009: Offshore Wind developmnet plan 2009: Renewable Electricity Surcharge 2009: Golden Sun Programme 2010: Building Integrate Solar PV Programme 2011: Solar PV feed-in tariff
Biofuel development 1996: Brightness Programme 2001: Reduced VAT for renewable energy 2006: Renewable Energy Law 2006: Renewable Energy Development Targets 2007: National Climate Change Program 2010: 2010 Biomass electricity Feed-in tariff
Electrification, supply reliability 2006: The 11th Five-Year Plan for National Economic and Social Development of The Peoples Republic of China 2006: Expansion of Local Cogeneration (CHP) 2011: The 12th Five-Year Plan for National Economic and Social Development of The Peoples Republic of China

Energy conservation/efficiency 2004: Medium and Long-term Plan of Energy Conservation: 10 Energy Conservation Programmes 2005: Vehicle Fuel Economy Standards 2006: Efficiency Upgrade for Electric Motors 2007: Retirement of Inefficient Plants
CO2 Emissions 2007: National Climate Change Program 2011: The 12th Five-Year Plan for National Economic and Social Development of The Peoples Republic of China

Annex 2-3 Indonesia

Resource Development 2006; Blue Print of National Energy Policy, 2006 - 2025, where the share of oil decreases while coal, gas, and renewable energy increase. 2006; Energy Supply Mix Target 2025; President Regulation no 5/2006, with the objective is energy security and move away from oil dependency. Crash Program I for coal power plant development and crash Program II for coal and RE (geothermal) power plant. 2010; MEMR Regulation no 3/2010 concerning allocation and utilization of natural gas for domestic consumption.
Oil stocks GOI control the oil stock for 21 days, although the definition of the oil stock has not clear yet.
Commercial energy access 1970s; Although since 1970s, GOI announce target for increasing the electricity access, however, in some area (mostly outside Java island) are still lack of access for commercial energy particularly electricity. Past development of electricity facilities focuses in Java island.
Supply reliability Lack of power supply in most area (outside Java island) of Indonesia causes the SIDI SAIFI in Indonesia power supply system are relatively high. 1965; Since the establishment of PLN (state electricity enterprises) in 1965, PLN was the only company for power generation, transmission and distribution, and electricity retails in the country. 2000; After new regulation (200), private (foreign of domestic) company are encouraged to invest in the power generation plant.
Energy conservation/efficiency 1980s; RIKEN (national energy conservation plan) has been developed since 1980s. 2010; MEMR Regulation no 14/2010 concerning energy manager of each company to manage their consumption. 2011; MEMR Regulation 06/2011 concerning energy efficient labeling. 2012; MEMR Regulation no. 13/2012 concerning efficiency in electricity demand.
CO2 Emissions 2011; GOI announce non-binding commitment to reduce 26% below BAU level of emission in 2020 with domestic budget, and further reduced until 41% if there is international support GOI produced two new regulation reducing CO2 emissions, i.e. Presidential regulation no. 61/2011 (concerning national GHG emission mitigation action plan and no. 71/2011 national GHG emission inventory).
Oil subsidies 1970s; Since 1970s, GOI gave subsidy for oil price in the country, although since 2000s, this kind of subsidy gradually decrease (only fro transportation).

Annex 2-4 Japan

Resource development 1955: Coal Mining Restructuring Law (Rationalization of coal mining had led to shift to cheaper imported coal gradually.) 2002: Subsidies for domestic production coal were eliminated.
Alternative fuel 1973: 1st Oil Shock 1979: IEA announced a policy to prohibit energy firms from building new oil-fired power plants. 1980: Law Concerning Promotion of the Development and Introduction of Alternative Energy (other than petroleum)
Import source country diversity After 1st Oil Shock, Japan adopted crude oil import source diversity policy.
Oil stocks 1971: Private Sector Stockpiling program (60 days) was announced. 1973: 1st Oil Shock 1974; IEA was founded (Japan is a founding member) 1975: Petroleum Stockpiling Law 1978: National Stockpiling program was started. 1981: 90 days Private Sector Stockpiling program was completed. 1998: National Stockpiling target (50 million kiloliters of crude oil) was completed.
Nuclear development 1955: Atomic Energy Basic Law Electricity sector is regulated by Electric Utilities Industry Law, 1949. (Standard tariff and other conditions of supply must be approved by Ministry of economy, Trade and Industry, METI. In order to be approved, the tariff for supply of electricity shall be the sum of the fair and proper cost of electricity and the fair and proper profits under efficient management.) Electricity tariff regulation is based on fully distributed cost method.
Supply reliability Electricity sector is regulated by Electric Utilities Industry Law, 1949. Electricity utilities are obliged to supply electricity for customer who require it and responsible to secure power supply for their supply area. Supply reliability is regulated by METI. Ministry ordinances set power quality standards (voltage and frequency). METI can order utilities to improve facilities if service quality to customer is impaired.
Energy conservation/efficiency 1973: 1st Oil Shock 1979: Energy Conservation Law The Government has adopted a range of tax and subsidy schemes to promote energy efficiency across sectors. Top Runner program

Annex 2-5 Korea

Resource development
1969:Law concerning promotion of Development of Coal industries(subsidies for domestic production) .
1978: 1st commercial NPP has been started to operating.
2004: Gas field in Block 6-1 in East Sea, offshore Korea which was discovered in 1998 by KNOC has started to produce.
Coal, Natural gas use promotion
After 2nd oilshock: Increasing importing coal and introduction of LNG
1986: Coal industry rationalization policy had lead to reduce coal production and close down uneconomical mines.
After financial crisis in the end of 1990s, the consumption of Anthracite turns to increasing.
Import source country diversity
After 2nd oil shock: policy for diversity of import source countries
-oil: 1981(7) -> 1986(21), -coal: 1978(3) -> 1986(8)
Alternative fuel
1987: Law concerning promotion of the development and Introduction of Alternative energy
Electricity
1961: Government established Electricity sole producer KEPCO
1967: Private sector can be permitted to generation sector due to promoting private investment
1999: Electricity Restructuring Law in order to promote competition and reduction of generation costs
Energy conservation/efficiency
1980: Law for rationalization of energy Use. KEMCO(Korea Energy management Corp) was established
2004: 3rd basic plan for rationalization for energy use (energy intensity reduction target by 2008: 0.28)
2008: 4th Basic plan for rationalization of Energy Use(2008-2012) (Energy intensity improving target from 2007 to 2012 was set by 11.3%
Oil stocks
1978: 2nd Oil Shock
1980: 1st plan for Oil stockpiling was enacted
1988: 60 days public Sector Stockpiling was completed.
1992: Private sector oil stockpiling program was started
Renewable energy development
1993: First Basic plan for Rationalization of Energy Use
1997: First Basic plan for technology development and deployment for NRE
2008: Comprehensive plan for adapting to climate Change
Hydro development
After 2nd oil shock, in mid-long term energy supply plan, Hydro development plan has been activated
2003: Small hydro was included as one of Renewable energy
Price control
1995: Oil business law was enacted
1997.1: Oil product price has been liberalized

Annex 2-6 Laos

History of the Power Sector Development in Lao PDR

- Memoranda of Understanding on the power exchange program were signed with the Royal Thai Government in 1993, 1996, 2006 and 2007 under which 7,000 MW is to be developed and supplied to Thailand by the year 2020;
- The "1995 Mekong Agreement and Procedural Rules" amongst the four Member countries of the Lower Mekong Sub-region was signed;
- In 1998 and 2006 MOUs' for 5,000 MW were signed with the Government of Vietnam;
- In 1999, Agreement on Cooperation in Power Sector was signed with the Government of Cambodia;
- First Power Sector Strategy was developed in 2000;
- National Policy on Environmental and Social Sustainability of the Lao Hydropower Sector was issued in 2006;

Note: MOU's are only long term indicative guidelines.

Objectives of Power Sector Development

- Expand Rural Electrification to promote better socio-economic conditions of people in isolated communities;
- Supply reliable and affordable power to all sectors of the domestic demand;
- Export of excess electricity to provide a source of revenues to fund economic and social development and alleviate poverty;
- Explore and exploit mutually beneficial cross border exchanges of electricity with neighboring countries of the sub-region;
- Integrate power sector with international communities through power exchange programs and foreign direct investment.

Lao PDR: National Energy Policy

- Maintain and expand affordable, reliable and sustainable electricity supply to promote economic and social development. Electrification Ratio to exceed 90% by 2020;
- Improve and expand transmission networks to support the industrialization and modernization policy, and to integrate the power sector in the ASEAN community through its power exchange programs;
- Tap the country's large hydropower potentials with the participation of private developers;
- Promotion of Renewable Energy to reach 30% by 2025 with reasonable feed-in tariff.

Annex 2-7 Malaysia

NATIONAL PETROLEUM POLICY 1975

- Aims at regulating the oil and gas industry to achieve the country's economic development needs.

1. Making available adequate supplies at reasonable prices to support national economic development objectives, thus, placing the application of oil and gas resources to serve national needs as first priority.
2. Promoting greater Malaysian representation and providing a favourable investment climate, including creating opportunities for downstream industries.
3. Effecting an optimal social and economic pace of exploration of the country's endowment of exhaustible oil and gas resources, taking into account the need for conservation of these depleting assets and the protection of the environment.

NATIONAL ENERGY POLICY 1979

1. **Supply Objective:** To ensure the provision of adequate, secure and cost effective energy supply through developing indigenous energy resources, both non-renewable and renewable energy sources, and diversification of supply sources both from within and outside the economy.
2. **Utilisation Objective:** To promote the efficient utilisation of energy and elimination of wasteful and non productive patterns of energy consumptions.
3. **Environment Objective:** To minimise the negative impacts of energy production, transportation, conversion, utilisation and consumption on the environment.

NATIONAL DEPLETION POLICY 1980

1. The national depletion policy of 1980 was aimed at safeguarding the depleting oil reserves.

FOUR-FUEL POLICY 1980

1. Complementing the national depletion policy and aimed at ensuring reliability and security of supply.
2. Designed to reduce the country's over dependence on oil as the energy source by mixing oil, gas, hydropower and coal in energy use.
3. As much as possible, local resources will be used to enhance security of supply. Though diversification away from oil has been significant, most of this has been towards natural gas.

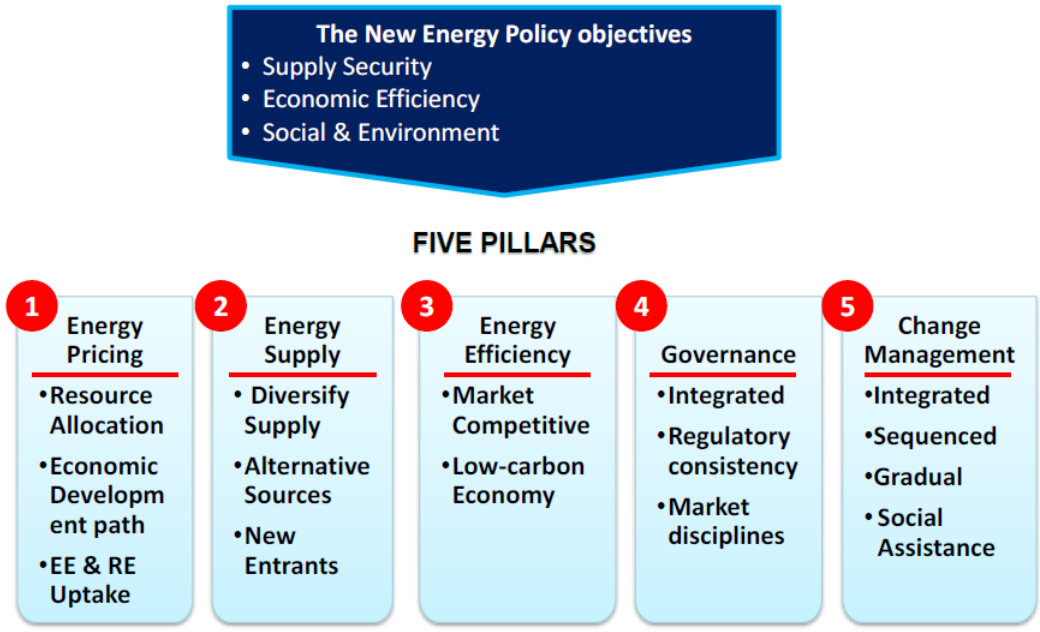
FIVE-FUEL POLICY 2001

1. A safe, cost-effective, secure energy supply which means promoting renewable, cogeneration, diversification, efficiency and using auditing, financial and fiscal incentives, technology development, and labeling.
2. Efficient utilization of energy through the introduction of new regulations and amendments to present laws.
3. Adequacy of electricity generating capacity.

RENEWABLE ENERGY POLICY 2010

1. **The Policy Vision:** Enhancing the utilisation of indigenous RE resources to contribute towards national electricity supply security and sustainable socioeconomic development.
2. **The Objectives:**
   (i) To increase the contribution of RE in the national power generation mix;
   (ii) To facilitate the growth of the RE industry;
   (iii) To ensure reasonable RE generation costs;
   (iv) To conserve the environment for future generations;
   (v) To enhance awareness on the role and importance of RE.
3. **Strategic Thrusts:**
   Thrust 1: Introduce an appropriate regulatory framework;
   Thrust 2: Provide a conducive environment for RE businesses;
   Thrust 3: Intensify human capital development;
   Thrust 4: Enhance RE research and development;
   Thrust 5: Design and implement an RE advocacy programme.

New Energy Policy 2010: 10th Malaysian Plan



Source: EPU

Annex 2-8 Myanmar

1989: Energy Policy
1. To maintain the Status of Energy Independence
2. To promote wider use of New and Renewable Sources of Energy
3. To promote Energy Efficiency and Conservation
4. To promote Use of Alternative Fuels in household
5. To Implement Effective Utilization of Discovered Crude Oil and Natural Gas Resources in the Interest of the Entire Nation including the Regions where the discovery was made.
6. To Promote more Private Participation
2000: Coal Policy
1. To implement APAEC (1999-2004), (2004-2009), (2010-2015) and AFOC work plan 2010-2011.
2. To collect on production and consumption of coal by state – owned and private sector.
3. To increase coal production and consumption so that coal based energy be increased in energy mix.
4. To control pollution caused by coal.
5. To lead and take responsibility on international cooperation on coal.
Electricity Policy (MOEP – 1)
1. To promote construction of transmission facilities of the National Grid and Substations so as to meet the expected increasing generated power due to the fifth short term five year plan
2. To provide technology and policy matters for the rural areas which are located in the off-grid areas
3. To fulfill electricity facilities to the off-grid rural areas by means of establishing mini-hydropower plants and diesel generators
4. To maintain the generated electricity quality so as to achieve stable distribution through reduced power losses
5. To generate electricity by utilizing natural gas power plants and gas turbines other than the hydropower plants
6. To employ hydroelectric power as one vital source; maintaining the natural gas power plants as short term power sources
7. To generate and distribute more electricity for economic development
8. To maintain and reduce electric power losses so as to acquire sufficient energy in future
9. To promote electricity from new and renewable sources of energy
Electricity Policy (MOEP – 2)
1. To employ the available energy resources in power generation for the sufficient supply of electricity
2. To promote the effective and efficient use of electricity for future energy sufficiency, reserves and sustainability in our nation
3. To conduct the reliable power quality to be supplied safely
4. To enhance the electricity distribution system to be developed in accordance with the advance technologies
5. To adopt the environment-friendly ways in electricity generation, transmission and distribution
6. To encourage the expansion of power transmission and distribution throughout the country and Public-Private-Participation in each other

Annex 2-9 New Zealand

Coal mining

- 1975 to 1989 New Zealand Coal Resources Survey, major government-funded coal-exploration programme, which explored almost all of New Zealand's realistic coal prospects
- 1991 Crown Minerals Act, legislative framework for permits to prospect, explore and mine Crown-owned oil, gas and minerals, sets royalty paid to government (although does not apply to privately owned coal, approx. 50%)
- 1991 Resource Management Act, legislative framework for consents to construct buildings or infrastructure, change land use or for other activities that affect the environment
- 2000s Policies that have disadvantaged energy sources that generate greenhouse gas emissions and advantaged renewables

Crude oil development

- 1988 Deregulation of the oil industry, removed price controls, government involvement in the refinery, licensing of wholesalers and retailers, and restrictions on imports of refined products
- 1991 Crown Minerals Act, governs allocation of rights to and management of all petroleum in its natural state and sets royalty paid to government
-2000s Policies that have disadvantaged energy sources that generate greenhouse gas emissions and advantaged renewables
- Also influenced by developments in transport sector, since 2007 higher oil prices, subdued economic conditions, Emissions Trading Scheme and more fuel efficient vehicles have slowed growth in transport energy demand

Oil stocks

- Since 2007, New Zealand's compliance with the IEA International Energy Programme's 90-day oil stocks obligation has been met through a combination of domestic commercial stocks and "ticket" contracts (an option to purchase stock in an IEA declared emergency) for stocks held in other IEA member countries; our government has entered into bilateral Arrangements with the governments of Australia, United Kingdom and Denmark and has concluded formal Agreements (treaties) with the Netherlands and Japan to enable stocks held in those countries to count towards New Zealand's IEA obligations.

Natural gas development

- 1987 to 1988 Gas industry reforms began, government sold off its interests in gas production, transmission and distribution
- 1991 Crown Minerals Act, governs allocation of rights to explore and exploit natural gas and sets royalty paid to government
- 1992 Gas Act, set regulatory framework for industry self-regulation
- 1993 Removal of gas price controls
- 2003 to 2004 Gas Pipeline Inquiry by Commerce Commission, resulted in application of 1986 Commerce Act to gas pipeline services (transmission and distribution), regulatory framework for preventing abuse of market power in markets where there is little or no competition
- 2004 Amendments to 1992 Gas Act, introduced co-regulatory model of gas governance following failure of industry to self-regulate
- 2008 Commerce Amendment Act, amended the 1986 Commerce Act
- 2000s Policies that have disadvantaged energy sources that generate greenhouse gas emissions and

advantaged renewables

Renewable energy development

- 1965 Government commissioned construction of under-sea transmission line between South Island and North Island, allowed strong growth in hydro capacity in South Island to serve large demand centres in North Island
- 1991 Resource Management Act, legislative framework for consents to construct buildings or infrastructure, change land use or for other activities that affect the environment
- 2002 New Zealand ratified the Kyoto Protocol to United Nations Framework Convention on Climate Change , set binding obligations to reduce emissions of greenhouse gases
- 2004 Resource Management (Energy and Climate Change) Amendment Act, amended the 1991 Resource Management Act to require decision-makers to have particular regard to benefits associated with use and development of renewable energy sources
- 2007 Government's Energy Strategy expressed preference for renewables, set target of 90% of electricity supply from renewable sources by 2025 and imposed moratorium on new thermal generation for base load supply
- 2008 New government lifted moratorium but retained renewables growth target as "aspirational"
- 2008 Emissions Trading Scheme introduced
- 2010 Emissions Trading Scheme applied to electricity generation, industrial processes and transport fuels, imposes obligation to purchase emissions entitlements to offset their greenhouse gas emissions from operation

Supply reliability

- 1950s to 1970s Construction of national transmission grid, including under-sea transmission line between South Island and North Island
- 1987 Electricity generation and transmission responsibilities transferred from government to state owned enterprise
- 1988 Generation and transmission sections separated
- 1991 Resource Management Act, legislative framework for consents to construct buildings or infrastructure, change land use or for other activities that affect the environment
- 1992 Electricity Act, regulatory framework for electricity industry
- 1994 Transmission section became independent state owned enterprise
- 1994 Metering and Reconciliation Information Agreement, established to facilitate bi-lateral trading of electricity between buyers and sellers
- 1996 New Zealand Electricity Market established, a wholesale spot market for buying and selling electricity
- 1996 and 1999 Generation section split into several businesses (three state owned enterprises and one privatised) to introduce competition
- 1998 Electricity Industry Reform Act and amendments, required the separation of generation and retail businesses from distribution business, to develop competitive retail market
- 2001 Application of 1986 Commerce Act to transmission and distribution businesses, regulatory framework for preventing abuse of market power in markets where there is little or no competition
- 2003 Electricity Governance Regulations and Rules, governing operation of electricity market and establishing Electricity Commission to manage electricity market, following industry's failure to achieve improved self-governance arrangements

- 2007 Government Energy Strategy, expressed preference for renewables, set target of 90% of electricity supply from renewable sources by 2025, retained by new government in 2008 as “aspirational” growth target
- 2008 Commerce Amendment Act, amended the Commerce Act 1986
- 2010 Electricity Industry Act, replaced Electricity Commission with Electricity Authority, tasked with governing the electricity market
- 2000s Policies that have disadvantaged energy sources that generate greenhouse gas emissions and advantaged renewables

Energy conservation/efficiency

- 2000 Energy Efficiency and Conservation Act, established the Energy Efficiency and Conservation Authority to raise public awareness, undertake research and administer regulations for minimum performance standards of appliances
- 2002 New Zealand ratified Kyoto Protocol
- 2008 New Zealand introduced Emissions Trading Scheme

CO2 Emissions

- 2000 Energy Efficiency and Conservation Act, established the Energy Efficiency and Conservation Authority (EECA) to raise public awareness, undertake research and administer regulations for minimum performance standards of appliances
- 2002 New Zealand ratified the Kyoto Protocol to United Nations Framework Convention on Climate Change , set binding obligations to reduce emissions of greenhouse gases
- 2004 Resource Management (Energy and Climate Change) Amendment Act, amended the 1991 Resource Management Act to require decision-makers to have particular regard to benefits associated with use and development of renewable energy sources
- 2007 Government Energy Strategy expressed preference for renewables, set target of 90% of electricity supply from renewable sources by 2025 and imposed moratorium on new thermal generation for base load supply
- 2008 New government lifted moratorium but retained renewables growth target as “aspirational”
- 2008 Emissions Trading Scheme introduced
- 2010 Emissions Trading Scheme came into effect for electricity generation, industrial processes and transport fuels, imposes obligation to purchase emissions entitlements to offset their greenhouse gas emissions from operation

Refinery

- 1962 National oil refinery built
- 1973 Refinery expanded
- 1981 to 1986 Refinery further expanded
- 1988 Deregulation of the oil industry included removal of government involvement in the refinery

Biofuel development

- 2007 Bill introduced to require petrol and diesel to have a percentage of biofuels added
- 2008 New government repealed parts of the Bill and removed mandatory requirement for all fuel to contain a percentage of biofuel
- 2009 to 2012 Biodiesel Grants Scheme

Annex 2-10 Philippines

Coal mining

1917: Act No. 2719 - An act to provide for the leasing and development of coal lands in the Philippine Islands.

1936: Commonwealth Act No. 137, Mining Act - An act to provide for the conservation, disposition and development of mineral lands and minerals

1995:Republic Act No. 7942 -This Act shall be known as the 'Philippine Mining Act'...instituting a new system of mineral resources exploration, development, utilization, and conservation.

1976: Presidential Decree 972, Coal Development Act of 1976 - This Act provides for the active and systematic exploration, exploitation, development, disposition and utilization of Philippine coal resources. This decree introduced the Philippine coal service contract system and established the appropriate guidelines for coal operations.

1977: Presidential Decree 1174 - This Act amends PD 972 and awards additional incentives to coal operators through the reimbursement of all operating expenses not exceeding ninety percent (90%) of the gross income after deducing all operating expenses, likewise the granting of timber and water rights within the coal contract area and access to government reserved lands subject to applicable laws and guidelines by the concerned agencies.

Crude oil development

1920: Act No. 2932 - An act to provide for the exploration, location and lease of lands containing petroleum and other mineral oils and gas in the Philippine islands.

1949: Republic Act No. 387, Petroleum Act of 1949 - An act to promote the exploration, development, exploitation, and utilization of the petroleum resources of the Philippines; to encourage the conservation of such petroleum resources; to authorize the secretary of agriculture and natural resources to create an administration unit and a technical board in the Bureau of Mines.

1971: Republic Act No. 6173, Oil Industry Commission Act - Declaring a national policy on the petroleum industry, regulating the activities and relations of persons and entities engaged therein, establishing an Oil Industry Commission to effectuate the same, and defining its functions, powers and objectives, and for other purposes.

1972:Presidential Decree No. 87 -This Act shall be known as the 'Oil Exploration and Development Act'...providing incentives for petroleum service.

2000:Department Circular No. 2000-05-009 -Establishment of a Corridor of Focus as part of the window of opportunity for Philippine Petroleum Exploration.

2003: Department Circular 2003-05-005 - Establishing procedures for contract area definition and public contracting rounds in petroleum prospective areas.

2003: Department Circular 2003-05-006, Amends to Petroleum Board Circular Nos. 15 and 2 series of 1975 and 1976 - Providing guidelines to the financial and technical capabilities of a viable petroleum exploration and production company.

Alternative fuel

2006: Republic Act No. 9367, Biofuels Act of 2006 - To direct the use of biofuels, establishing the Biofuels Program

2008: Joint Administrative Order 2008-1 - Establishing the guidelines governing the biofuel feedstocks production, and biofuels and biofuel blends production, distribution and sale under Republic Act 9367

Natural gas development

1967: Republic Act No. 5092, Geothermal Energy, Natural Gas and Methane Gas Law - An act to promote and regulate the exploration, development, exploitation and utilization of geothermal energy, natural gas and methane gas; to encourage its conservation; and for other purposes

1995:Department Circular No. 95-06-006 -Policy Guidelines on the overall development and utilization of natural gas in the Philippines.

1995: Executive Order 254 - Creating the Philippine Gas Project Task Force

1998: Administrative Order 381 - Providing for the fulfillment by the National Power Corporation of its

obligations under the agreement for the sale and purchase of natural gas dated December 30, 1997 with Shell Philippines Exploration B.V./Occidental Philippines, Inc. and the compliance of the national government, through the Department of Finance and the Department of Energy with its performance undertaking therefore and other purposes.
2000: Republic Act No. 8997 - An act granting First Gas Holding Corporation a franchise to construct, install, own, operate and maintain a natural gas pipeline for the transportation and distribution of natural gas to different areas in the island of Luzon
2001: Proclamation No. 72 - Establishing safety and exclusion zones for offshore natural gas wells, flowlines, platform, pipelines, loading buoy and other related facilities for the Malampaya Deep Water Gas to Power Project over certain waters and submerged lands adjacent to Batangas, Mindoro and Palawan, Philippines.
2002: Department Circular No. 2002-08-005 - Sets the interim rules and regulations governing the transmission, distribution and supply of natural gas.
2003: Department Order 2003-04-004 - Constituting the steering committee on the Batangas-Manila (BAT-MAN I) and Bataan-Manila (BAT-MAN II) natural gas pipeline projects.

Nuclear development

1957: Republic Act No. 1815 - To create the Philippine Nuclear Energy Commission to administer , regulate, and control the use, application, and disposition of fissionable materials; to authorize the establishment and administration of an atomic energy reactor; to determine the manner of development, use and control of atomic energy, to provide funds therefore, and for other purposes.
2007: Department Order 2007-11-0012 - Creation and composition of the DOE Task Force on Nuclear Power Program

Hydro development

1990: Republic Act No. 7156, Mini-hydroelectric Power Incentives Act - Granting incentives to mini-hydroelectric power producers and for other purposes
1977: Presidential Decree 1068 - Directing the acceleration of research, development and utilization of non-conventional energy resources and vesting in the energy development board powers and functions in connection therewith, and for other purposes.
2008: Republic Act No. 9513, Renewable Energy Act - An act promoting the development, utilization and commercialization of renewable energy resources
2009: National Renewable Energy Program -Outlines the policy framework enshrined in Republic Act 9513. It sets the strategic building blocks that will help the country achieve the goals set forth in the Renewable Energy Act of 2008.

Geothermal, other renewable energy development

1967: Republic Act No. 5092, Geothermal Energy, Natural Gas and Methane Gas Law - To promote and regulate the exploration, development, exploitation and utilization of geothermal energy, natural gas and methane gas; to encourage its conservation; and for other purposes.
1977: Presidential Decree 1068 - Directing the acceleration of research, development and utilization of non-conventional energy resources and vesting in the energy development board powers and functions in connection therewith, and for other purposes.
1978: Presidential Decree No. 1442 - An act to promote the exploration and development of geothermal resources.
1980: Proclamation No. 2036A - Establishing as reservation of PNOC Energy Development Corporation for geothermal exploration, exploitation and utilization the parcel of land situated in the provinces of Albay and Sorsogon, Island of Luzon and prohibition pof logging activities within the reservation.
1997: Executive Order No. 462 - Enabling the private sector participation in the exploration, development, utilization and commercialization of ocean, solar, wind resources for power generation and other energy uses.
2008: Republic Act No. 9513, Renewable Energy Act - An act promoting the development, utilization and commercialization of renewable energy resources

2009: National Renewable Energy Program -Outlines the policy framework enshrined in Republic Act 9513. It sets the strategic building blocks that will help the country achieve the goals set forth in the Renewable Energy Act of 2008.

Biofuel development

2000: Republic Act No. 9003, Ecological Solid Waste Management Act - It is hereby declared the policy of the State to adopt a systematic, comprehensive and ecological solid waste management program

2006: Republic Act No. 9367, Biofuels Act of 2006 - To direct the use of biofuels, establishing the Biofuels Program

2008: Joint Administrative Order 2008-1 - Establishing the guidelines governing the biofuel feedstocks production, and biofuels and biofuel blends production, distribution and sale under Republic Act 9367

2008: Republic Act No. 9513, Renewable Energy Act - An act promoting the development, utilization and commercialization of renewable energy resources

2009: National Renewable Energy Program -Outlines the policy framework enshrined in Republic Act 9513. It sets the strategic building blocks that will help the country achieve the goals set forth in the Renewable Energy Act of 2008.

Electrification

1999: Rural Electrification Program - To provide electric services to the people to yield more opportunities for improved quality of life, greater access to basic services and better infrastructure for rural development.

2001:Republic Act No. 9136 -This Act shall be known as the 'Electric Power Industry Reform Act'...ordaining reforms in the electric power industry, amending for the purpose certain laws and for other purposes.

Supply reliability

1992: Republic Act No. 7638, Department of Energy Act - to ensure a continuous, adequate, and economic supply of energy with the end in view of ultimately achieving self-reliance in the country's energy requirements through the integrated and intensive exploration, production, management, and development of the country's indigenous energy resources, and through the judicious conservation, renewal and efficient utilization of energy to keep pace with the country's growth and economic development and taking into consideration the active participation of the private sector in the various areas of energy resource development; and

- to rationalize, integrate, and coordinate the various programs of the Government towards self-sufficiency and enhanced productivity in power and energy without sacrificing ecological concerns.

2001:Republic Act No. 9136 -This Act shall be known as the 'Electric Power Industry Reform Act'...ordaining reforms in the electric power industry, amending for the purpose certain laws and for other purposes.

2011:Department Circular No. 2011-06-0006 -Creating the Steering Committee Defining the Policies for the Commencement of Retail Competition and Open Access.

Energy conservation/efficiency

1992: Republic Act No. 7638, Department of Energy Act - to ensure a continuous, adequate, and economic supply of energy with the end in view of ultimately achieving self-reliance in the country's energy requirements through the integrated and intensive exploration, production, management, and development of the country's indigenous energy resources, and through the judicious conservation, renewal and efficient utilization of energy to keep pace with the country's growth and economic development and taking into consideration the active participation of the private sector in the various areas of energy resource development; and

- to rationalize, integrate, and coordinate the various programs of the Government towards self-sufficiency and enhanced productivity in power and energy without sacrificing ecological concerns.

National Energy Efficiency and Conservation Program - Provides a framework in the government's efforts to promote efficiemt and judicious utilization of energy as an essential strategy in rationalizing the country's demand for petroleum products and eventually lessening the impact of escalating prices to the

economy.
2004: Administrative Order 110 - Directing the Institutionalization of a Government Energy Management Program
2005: Administrative Order 126 - Strengthening measures to address the extraordinary increase in world oil prices, directing the enhanced implementation of the Government's Energy Conservation Program
2008: Department Circular 2008-09-0004 - To enforce the requirement for an ESCO to apply for a certificate of accreditation with the DOE while engaging in any energy efficiency related performance contracting projects.

CO2 Emissions

2009: Republic Act No. 9729 - An act mainstreaming climate change into government policy formulations, establishing the framework strategy and program on climate change, creating for this purpose the climate change commission, and for other purposes.
2011:A Resolution approving the National Climate Change Action Plan（NCCAP）-A milestone in "green governance" that details the short, medium, and long-term plans of the government on the issue.
1992: Republic Act No. 7638, Department of Energy Act - to ensure a continuous, adequate, and economic supply of energy with the end in view of ultimately achieving self-reliance in the country's energy requirements through the integrated and intensive exploration, production, management, and development of the country's indigenous energy resources, and through the judicious conservation, renewal and efficient utilization of energy to keep pace with the country's growth and economic development and taking into consideration the active participation of the private sector in the various areas of energy resource development; and
- to rationalize, integrate, and coordinate the various programs of the Government towards self-sufficiency and enhanced productivity in power and energy without sacrificing ecological concerns.

Deregulation

1998:Republic Act No. 8479, Downstream Oil Industry Deregulation Act - to define the regulatory framework for the downstream oil industry, based primarily on the guiding principle of a truly competitive market under a regime of fair prices, adequate and continuous supply of environmentally-clean and high-quality petroleum products.

Annex 2-11 Thailand

Crude oil development 1971: Petroleum Exploration Law -In 1971, Thailand promulgated the Petroleum Act (PA) and the Petroleum Income Tax Act (PITA). -The PA established a concession system based on the Consideration Bases, and nine Ministerial Regulations were issued in 1971 dealing with major subjects under that act. -The PITA established an income tax system applicable only to concessionaires, with tax rates between 50% and 60%. A tax rate of 50% was prescribed by a Royal Decree.
Coal mining 1972: Coal-Fire plant in Maemo using domestic lignite, account for 15% share in fuel mix.
Natural gas development 1981: The First Gas Separations in Thailand using NG from Gulf of Thailand, then Thailand uses NG from it for power generation. Today NG becomes the largest fuel for power gen., using both domestic and imported NG. (1998: Myanmar–Thailand gas pipeline was completed.)
Alternative fuel, renewable energy development 1995: Renewable policy in power generation and for oil substitution under renewable plan.
Alternative fuel, biofuel development Oil substitution, Thailand turns to use other fuels to substitute some oil, which are NGV, LPG and Biofuel (Ethanol and biodiesel). - Heavy traffic jam pushes up oil demand. - The alternative energy use of the transportation section is promoted for the purpose of reduction of the oil import and reduction of the air pollution.
Energy conservation/efficiency 1992: ECON Fund act funding for saving energy, collecting the fund from tax (levy) on oil price. Energy conservation policy began in 1995, supported by ECON Fund.
Price control 1979: Oil Fund, to secure the oil price, and then 2004 the act purpose has been changed to prevent the oil shortage.
Oil stock 2000: Oil stock law, 36 days today and the target at 90 days.

Annex 2-12 Vietnam

Nuclear development 2008:Atomic Energy Law: Nuclear Power Generation Development (By 2020, plan to build a nuclear reactor.)
Resource development In December 1986, the government mandated the Doi Moi (open door) policy, shifting from a centrally planned economy to a market oriented one, inside the framework of state regulations.
Coal mining The coal mining operations are undertaken by the Vietnam National Coal Corporation (VINACOAL ; 2005～VINACOMIN) which was established in 1994 to manage both the coal production and its marketing. VINACOAL sets the sale price for domestic coal at a level where costs are equal to revenues or where firms break-even. The State Price Committee is responsible for evaluating coal prices and submitting them to the Government for approval. Roadmap to reduce subsidies of coal price for fertilizer, Pulp and paper, Cement and Power sector
Crude oil development The Vietnam Oil and Gas Corporation (Petrovietnam) is a state-owned enterprise established in 1975 and controlled by the Prime Minister's Office. Petrovietnam is responsible for crude oil and gas exploration, production and transportation.
Energy development 2007: National Energy Development Strategy of Vietnam for the period up to 2020 with outlook to 2050 -Establishment of energy market -Roadmap to reject subsidies for energy price -Diversity of energy sources
Electrification, supply reliability 2005: Electricity law
Energy conservation/efficiency 2010: Law on energy efficiency and conservation