Chapter 2

Correlation Between Policy and ESI

Study on the Development of an Energy Security Index and an Assessment of Energy Security for East Asian Countries Working Group

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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