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

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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 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 results presented here should not be viewed as official national analyses of the participating countries.

With regard to Lao PDR, although members of the Working Group provided data for the calculation of the index, this data were not utilized due to the limited time available for the preparation of the report. Data on Lao PDR provided by the World Bank and ERIA were utilized for this study.

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 acceptable 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 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 new study. The purpose of the working group was to quantitatively assess and analyze the energy security situation in East Asian countries and to make policy recommendations for the improvement of that situation. From October 2011 to June 2012, the working group worked to develop an index and gather data for a quantitative assessment of the energy security situation. The working group calculated the index and analyzed it, among other activities.

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.

Dr. Ken Koyama

Leader of the Working Group

June 2012

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.

Dr. Ken Koyama

Leader of the Working Group

June 2012

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LIST OF ABBREVIATIONS AND ACRONYMS

ASEAN = Association of Southeast Asian Nations
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
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
ktoe = Thousand tonnes of oil equivalent
Mtoe = Million tonnes of oil equivalent (1 Mtoe = 41.868 PJ)
OECD = Organization for Economic Cooperation and Development
R/C ratio = Reserve / Consumption ratio
R/P ratio = Reserve / Production ratio
TFEC = Total Final Energy Consumption
TPEC = Total Primary Energy Consumption
toe = Tonnes of oil equivalent
WEO = World Energy Outlook of IEA
WG = Working group

EXECUTIVE SUMMARY

In the 16th meeting of the Energy Cooperation Task Force (ECTF)[1] meeting held in Vientiane, Laos on 25 August 2011, the Japanese government proposed several new ideas and initiatives for EAS energy cooperation. Responding to their proposal, the ECTF meeting endorsed the new areas and initiatives, which included the creation of an Energy Security Index for East Asian Countries. The Economic Research Institute for ASEAN and East Asia (ERIA) approved the proposal of the Japanese government that a study be conducted on the energy security index. As a result, a Working Group (WG) for the development of an Energy Security Index (ESI), and assessment of energy security, for East Asia Countries was convened. Members from all the 16 EAS countries are represented in the WG, led by Dr. Ken Koyama of the Institute of Energy Economics, Japan (IEEJ).

The first objective of the study was to develop an index that quantitatively indicated the energy security situation, and could therefore 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 final objective was 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

For this study, a Working Group was organized comprised of experts from East Asian countries. The WG convened twice to discuss data collection methods and analysis approaches, and to assess the findings calculated from the index.

As a first step, the WG disaggregated energy security components and reviewed indicators that could represent the situation of each component. These considerations also took into account the feasibility of obtaining data. Next, the data necessary for calculating the index were collected. In principle, publicly available statistics were

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

utilized, such as those produced by the International Energy Agency (IEA). Missing data were supplemented with the cooperation of WG members and through other means. The collected data were then used to calculate the index and to capture the historical trends of each indicator. Based on the averages of the OECD from the 1970s to the present, the indicators were given scores, and changes in the situation of each country were analyzed.

A list of the selected indicators is shown below.

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 of oil and gas
Transportation risk management	-	-
Secure 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 demand	6. Energy efficiency	6-1. TPES per GDP 6-2. TFEC per GDP
Preparedness for supply disruptions	7. Strategic reserves	7. Days of on-land oil stocks
Environmental sustainability	8. intensity	8-1. emissions per TPES 8-2. emissions per Fossil fuel 8-3. emissions per GDP 8-4. emissions per Capita

By following this process, the study yielded the following outcomes:

1. While there are limitations to obtaining data, it is possible to develop an index which quantitatively indicates the energy security situation. For example, in the case of the indicator for the diversity of energy sources, ERIA averages show a trend toward the concentrated use of specific energy across the years. In particular, this finding is consistent with the expanded use of coal for power generation.
2. Energy security is comprised of a variety of elements. Furthermore, the perspective from which a country is assessed varies widely depending on the situation that the country is in. There is thus no single absolutely correct indicator, and it is important to assess multiple perspectives through a combination of several indicators.
3. With the cooperation of WG members, it was possible to access data which are difficult to obtain through publicly available statistics, such as statistics produced by the IEA and BP, as well as to confirm and review data. This was one of the major outcomes of this study.
4. Calculating the index using the data yielded Energy Security Index (ESI) values which were widely distributed and which reflected the diversity of the countries.
5. For example, in the case of the self-sufficiency ratio, it was possible to quantitatively confirm that despite having no domestic resources, a country could improve its self-sufficiency ratio by expanding its use of nuclear energy, and, as a result, could improve its performance in terms of ESI. It is important that such policies underpinning the changes in indicator performance are analyzed.
6. For country analyses, ESI has made it possible to quantitatively assess how the energy security situation has evolved over past decades.
7. Some indicators have a trade-off relationship, and it may therefore be difficult to improve performance across all indicators simultaneously. This is observed, for example, in the case of self-sufficiency and the diversity of energy sources.
8. Country situations shown by ESI vary depending on the country's environment, including resource endowment, and the extent of energy demand increases. Nevertheless, a number of common trends were identified:

- Many of the countries with energy resources experienced decreases in their self-sufficiency ratios or R/P ratios. It is thought, in these cases, that new resource development has not caught up with the speed of energy demand increase.
- With respect to the supply of primary energy, and the diversity of energy sources, few countries performed well compared to the OECD average. It was observed, for example, that while increasing the use of domestic resources, such as coal and hydropower, is favorable for improving self-sufficiency ratios, this also limits the diversification of energy sources.
- While access to commercial energy is improving, at the same time this is causing a further increase in energy demand, including electricity demand.
- Although efficiency in energy utilization is improving in many countries, some countries still have low efficiency compared with OECD averages, and there remains room for improvement.

CHAPTER 1

Introduction

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.

1. Rationale

The East Asia Summit (EAS) is a diverse collection of countries. There are wide variations among them in terms of per capita income, standards of living, population density, energy resource endowments, climate, and energy consumption per capita. The EAS is composed of the 10 member countries of the Association of Southeast Asian Nations (ASEAN), namely: Brunei, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam, and 6 other countries, namely: Australia, China, India, Japan, Korea and New Zealand.

Table 1: Economic and Energy Profile, 2009

	GDP (billion 2000 USD using exchange rates)	Population (millions)	Total self-sufficiency	TPES/GDP (toe per thousand 2000 USD)	TPES/population (toe per capita)
Australia	535.2	22.1	2.37	0.24	5.93
Brunei	6.8	0.4	6.06	0.46	7.81
Cambodia	7.5	14.8	0.71	0.69	0.35
China	2937. 5	1331.5	0.92	0.77	1.70
India	874.9	1155.3	0.74	0.77	0.58
Indonesia	258.5	230.0	1.74	0.78	0.88
Japan	4872.2	127.3	0.20	0.10	3.71
Korea	752.8	48.8	0.19	0.30	4.70
Lao PDR	6.3	6.4	1.02	0.00	0.44
Malaysia	137.1	27.5	1.34	0.49	2.43
Myanmar	19.9	50.0	1.48	0.76	0.30
New Zealand	67.5	4.3	0.87	0.26	4.02
Philippines	111.7	92.0	0.60	0.35	0.42
Singapore	143.5	5.0	0	0.13	3.70
Thailand	173.9	67.8	0.60	0.59	1.52
Vietnam	58.8	87.3	1.20	1.09	0.73

Note: Data for Lao PDR is from 2010.
Sources: IEA (2011) Energy Balance, IMF (2011) International Financial Statistic, Laos Ministry of Mines and Energy (2011)

The rationale of this study is derived from the 16th ECTF[1] meeting held in Vientiane, Lao PDR, on 25 August 2011. In this meeting, the Japanese Government proposed several new ideas and initiatives for EAS energy cooperation, including the following:

- Green Growth in Asia
- An Energy Security Index for East Asian Countries
- The Potential of the Asian Biofuel Market, and
- The Impact of Nuclear Policy Changes

The participants of the ECTF Meeting exchanged views on the above issues and agreed that it was time to consider new areas in addition to the current work streams, to reflect the dynamics of energy demand and supply in the East Asian region. As such, the ECTF Meeting endorsed the proposed new areas and initiatives.

The Economic Research Institute for ASEAN and East Asia (ERIA) approved the proposal of the Japanese Government to conduct a study on the creation of an energy security index. As a result, a Working Group (WG) for the development of an Energy Security Index and the assessment of energy security for East Asia Countries was convened. All of the 16 EAS countries are represented in the WG, with Dr. Ken Koyama of the Institute of Energy Economics, Japan (IEEJ) as the leader of the group.

2. Objective

The first objective of the study was 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 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 offer policy recommendations to policymakers in East Asian countries on improving energy security based on the following analysis:

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

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

3. Work Stream

The study consisted of three work streams for fiscal year 2011.

(A) Development of Energy Security Index

A quantitative analysis of the energy security situation in various countries is a challenging task, as the energy security situation can be discussed from multiple viewpoints/aspects. To provide a benchmark to assess energy security situation, the study first explored the development of an Energy Security Index for East Asian countries. To do that, we assumed that the Energy Security Index would be composed of several major indicators which reflect principal energy security components such as:

- Development of domestic resources
- Acquisition of oversea resources
- Securing a reliable domestic supply chain
- Management of demand
- Preparedness for supply disruption
- Environmental sustainability

Following this analysis, the individual major indicators could be broken down into sub-indicators in related categories. For this study, however, it was also important to note that the study might find some constraints on data and information availability when developing the Index for East Asian countries, some of which are developing countries. As the Index was used for a historical comparison, it was crucial to have appropriate and reliable data. Therefore, a very careful consideration and examination was required for the development of the Index.

(B) Data Collection and Calculation of Energy Security Indices for each country

Necessary data were collected for each indicator for each country. Given data availability issues, time series for data collection were determined later. At this moment, relevant data for each country can be collected for at least the following time period: the 1970s, the 1980s, the 1990s, the 2000s, and the latest available year. Then based on

the developed method mentioned in part (A) above, the Energy Security Index for each East Asian country was calculated.

(C) Analysis of the energy security policy of each East Asian country

Basic information on energy security policies pursued in each East Asian country since the 1970s was collected with the support of WG members, so that objectives, approaches, tools, implementations and the results of policies could be highlighted and summarized.

Reference

This study was designed as a multiple year project. With authorization from ERIA, the following work streams were planned for commencement in fiscal years 2012 and 2013.

(C) Analysis of energy security policy in each East Asian country
Detailed information on energy security policy will be collected, so that objectives, approaches, tools, implementations and the results of the policies can be highlighted and summarized.

(D) Assessment of the policy impact of analysis using the Energy Security Index
The impact of the energy security policy in each East Asian country will be assessed by analyzing the historical transition of the Index. Through this exercise, effective approaches and good practice for the enhancement of energy security suiting each country's conditions might be drawn out.

(E) Analysis of useful lessons from past experiences
From the analysis and exercise described above, policy recommendations will be created with regard to such areas as: what the best approach/practice to be adopted by each East Asian country is, so as to enhance energy security from now on; what will be required to actually implement the best approach/practice indentified in the study; etc.

(F) Projection of the Energy Security Index into the future
Making assumptions about the energy supply-demand outlook and possible policy development for the future, the Energy Security Index for each East Asian country may be calculated for the future (for example, for the year 2030) to indicate future conditions and progress related to the energy security situation. This may be useful for policy planners as a reference when considering the future energy policy options in each country.

(G) Recommendation for regional energy cooperation
The final part of the study will highlight the importance of regional energy cooperation in enhancing energy security. This part will discuss first the importance of the policies and initiatives taken by each country, emphasizing how regional cooperation compliments each country's efforts and best addresses energy security.

4. Working Group Activities in 2011

In Final Year 2010, 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.

CHAPTER 2

Developing an Energy Security Index

1. Definition of Energy Security

The definition of energy security changes depending on what the subject of energy security is ("what" is being protected), the threat to energy security ("against what" is it being protected), the measures to promote energy security ("who" "is doing what" to protect "with whom") and how these points are recognized. There is no universal definition that transcends time periods.

For this study, energy security has been defined as, "the securing of the amount of energy required for people's lives, economic, social, and defense activities, among other purposes, at affordable prices."

Figure 2-1 indicates the major components of energy security throughout the energy supply chain.

The principle is the use of risk management, focused on improving the energy security situation. Risk management includes the dispersion of risks, such as through the diversification of energy sources, the absorption of risks, for example by creating a reserve margin of power generation capacities, and preparations against unavoidable supply disruptions such as by building up strategic reserves. The improvement of energy security also includes the development of domestic energy sources and the enhancement of resource acquisition in foreign countries.

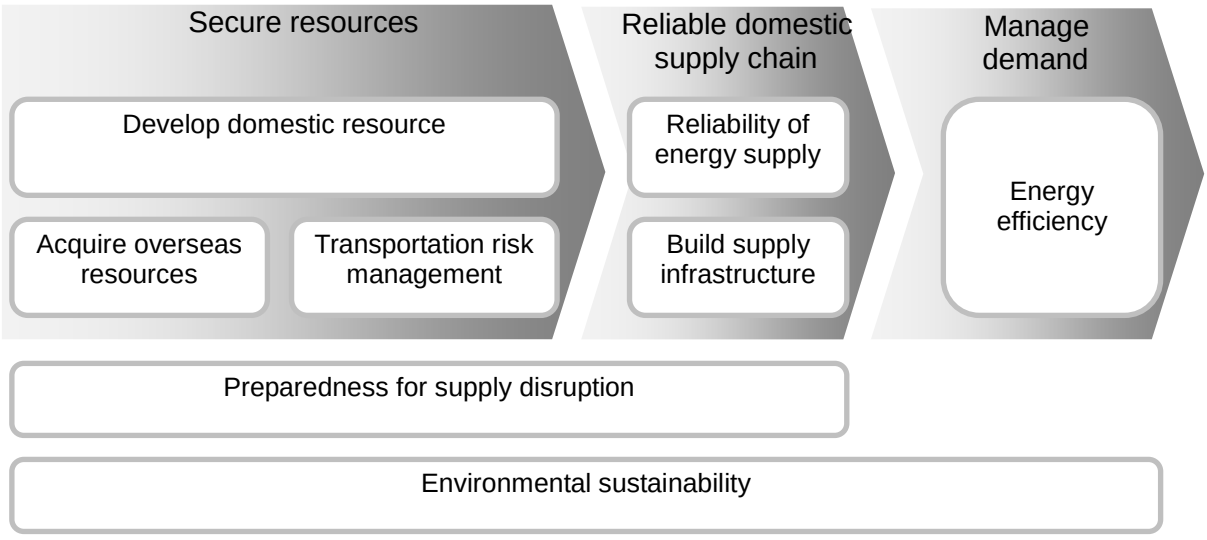
The energy supply issue consists of three stages – "secure resources" "secure a reliable domestic supply chain" and "manage demand." A generally conceivable resource-securing method is to develop or acquire resources at home or abroad and transport them to the domestic market. Therefore, the "development of domestic resources," "acquisition of overseas resources" and "transportation risk management" are deemed major items constituting the first stage of the supply chain. The "reliability

of the energy supply" and "construction of supply infrastructure" are required to "secure a reliable domestic supply chain" and are deemed major items for this stage. "Energy efficiency" is cited as a major item indicating that something is being done to "manage demand." On top of these factors, "preparedness for supply disruptions" has also to be seen as a major component of energy security.

Environmental sustainability has been added to the factors comprising the energy security issue, in light of heightened awareness of global environmental concerns. Most greenhouse gas emissions are produced by energy sources, and so it goes without saying that an important factor to ponder when thinking about energy issues is consideration for the environment, including climate change issues.

If any of these factors is dropped, it may be structurally difficult for the supply chain to maintain a stable state of energy security.

Figure 2-1: Components of energy security



2. Developing an Energy Security Index

The following proposal has been made for the creation of an Index that can quantitatively express the condition of each factor underlying overall energy security (in other words, an "Energy Security Index: ESI").

Transportation risk management has not been evaluated here, because it is difficult

to create an appropriate index, given, for example, the wide difference of evaluation factors between sea transport using ships and land transport via pipeline, railway or road.

Table 2-1: List of ESI components

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

Each ESI definition and calculation method is as follows.

1-1. TPES self sufficiency ratio (including nuclear)

This is an important measurement of the strength of a country's strength in energy security in terms of how dependant the country in for its energy resources on internal sources, regardless of whether the energy type is fossil fuel or not.

Total Primary Energy Supply (TPES) is made up of indigenous production + imports - exports - international marine bunkers +/- stock changes.

Indigenous Production is the production of primary energy, i.e. hard coal, lignite, peat, crude oil, natural gas liquids (NGLs), natural gas, nuclear, hydro, geothermal, solar

and heat the ambient environment extracted using heat pumps.

Production is calculated after the removal of impurities (e.g. sulfur from natural gas). In addition, with nuclear power stations, once the uranium has been charged, it is possible to run power stations continuously for a long period of time. Since there is no need to frequently import fuel, nuclear power can be seen as a semi-domestic energy resource.

TPES self-sufficiency ratio = (Indigenous Production) / (TPES) * 100

1-2. Reserve/Production ratio

Usually, the R/P ratio (Reserve/production ratio) is utilized as an indicator to show the remaining amount of unexploited resources a country currently posseses. The R/P ratio has been adopted as a measurement of the amount of resources held by a country.

R/P ratio = (Reserve) / (Production)

1-3. Reserve/Consumption ratio

In the context of energy security, the R/C ratio (Reserve/consumption ratio) is proposed as an additional indicator. The reason that consumption has been adopted here is, for example, to cater for the case that a portion of production is exported. From the perspective of securing a country's energy security, the halting of exports and reallocation of the energy source for the country's own use might be considered. In other words, dividing reserves by consumption, as with the R/C ratio, gives an indication of how much energy a country can use in the extreme.

R/C ratio = (Reserve) / (Consumption)

2. Diversity of import source countries

The diversity of import source countries has been adopted as a measurement of the supply security of fossil fuels. If import source countries are diversified, even if the supply from a certain country is halted, it is thought to be highly likely that the difference will be made up by other import source countries.

Here the Hirschmann-Herfindahl index has been adopted as a good measure of the scale of diversity. (see below)

HHI: Hirschmann-Herfindahl Index

HHI is defined as the sum of the squares of the individual market shares of every firm in the market. An HHI of 1 would mean there is just one firm in the market, a monopoly structure. The HHI comes closer to 0 as competition spreads. It is also called the oligopoly index. If two companies oligopolize a market with equal market shares at 50%, the HHI is "2×（0.5^2）=0.5" If 100 companies each have a 1% market share, the HI is "100×（0.01^2）=0.01."

3. Diversity of energy sources of TPES / electricity

Energy sources possess different characteristics in terms of available amounts, their ease of trading, price, and their associated environmental burdens. As no single energy resource exists that excels in all factors, each characteristic should be used tactfully. It is important to develop an energy mix with a good balance among sources. In other words, by diversifying energy sources, the merits of each energy source can be drawn out while at the same time reducing the demerits and risks of each source. Diversification of energy sources is considered both in the composition of TPES and in the power source structure.

HHI has been adopted as a measure of diversity.

4. Middle East dependence of oil and gas supply

The importation of energy from regions with high geopolitical risks can be said to pose high risks in terms of energy security. This is because of the existence of the possibility that supply will be cut off due to political pressure or environmental changes.

Geopolitical risks are seen in many regions across. In the case of oil and gas supply, however, the instability of the Middle East, which holds a large number of energy sources, is of particular importance. Thus this study explicitly considers the impact potential of Middle East dependence for oil and gas supply.

Middle East dependency = (Imports from Middle East) / (Total Imports) * 100

5. Reliable domestic supply chain

Necessary infrastructure must be developed in order to supply energy in a stable manner such that it meets domestic demand. This refers to things like fossil fuel supply chain items (e.g. tanker trucks and gasoline stands), as well as gas pipelines and power distribution networks.

Here the number of gasoline stands per capita may be used as a measurement for the coverage of the fossil fuel supply chain. However, due to differences between countries, there is no cohesive standard in the statistics on this factor. The same is true for gas pipeline networks. In consideration of the relative difficulty of collecting such data, oil and gas data has not analyzed in this study.

5-1. Reserve margin of generation capacity

There is a need to secure power generation capabilities sufficient to meet demand in order to ensure a stable supply of electric power. More concretely, a country must sustain its power generation capabilities for peak demand, including reserve capabilities in case something extraordinary happens.

Reserve margin of generation capacity
= (Total Generation Capacity) / (Peak Demand) *100

There is a need to draw attention to two points related to the evaluation of this measurement. The first is the necessity to minimize surplus capacity from an economic perspective, and thus the situation of competition in the electric power market will have an effect on this measurement. The other point has to do with low operation rates of renewable power sources, which increases the need for backup power supply sources (in other words, power supply sources with low operation rates) to cope with unstable output in the event that the power supplied from renewable energy increases in the future. Should this happen, it is expected that the reserve margin will rise far above current levels.

5-2. Power outage frequency/duration

The extent of power outages (their frequency and duration) can be said to be a measurement directly showing the level of stability of the power supply.

This study has adopted the duration of power outages per customer (minutes/year) and the frequency of such outages per customer (times/year).

Power outage duration

= (Accumulated duration of power outage) / (Total number for customers).

Power outage frequency

= (Outage frequency per year) / (Total number of customers).

5-3. . Commercial energy access ratio

The commercial energy access ratio was chosen as a measurement of the extent to which there is a system in place to supply energy domestically, apart from the electric power supply sources. The commercial energy access ratio also shows the development stage of an economy. Based on the premise that all citizens want a supply of commercial energy, the maintenance of a situation in which energy can be supplied can be said to be one of the factors that comprises energy security. Here, because the category of commercial energy is not defined on the Internal Energy Agency (IEA) statistics, etc., the following method is used for its calculation.

Commercial energy access ratio

= (TPES – Non-commercial energy) / (TPES) * 100

where;

Non-commercial energy

= (Primary supply of solid biofuels) – (Input energy for transformation purpose)

6. Energy efficiency

Demand management is one important factor in energy security. Briefly, it shows the level of efficiency of energy consumption. Two metrics are used for the measurement of the efficiency of energy consumption.

In evaluating these measurements, there is a need to pay attention to the point that the relationship between energy consumption and GDP will change based on a country's economic structure. For example, the balance of a country's energy consumption to its GDP differs between countries which focus their economy on energy intensive industries such as steel production, and countries with a focus on the financial sector.

6-1. . TPES/GDP ratio

One ratio to be considered is the TPES/GDP ratio, which uses the total primary energy supply (TPES) to show the comprehensive utilization rate for energy, including in conversion sectors such as power generation and oil production.

TPES/GDP ratio = (TPES) / (GDP)

6-2. TFEC/GDP ratio

Another metric of interest is the TFEC/GDP ratio, which uses the total final energy consumption (TFEC) to measure the energy-use efficiency at the end-user level.

TFEC/GDP ratio = (TFEC) / (GDP)

7. Days of on-land oil stocks

The existence of stocks would constitute a major response should there be a temporary halting in the supply of fossil fuels. IEA countries are supposed to maintain emergency stocks equivalent to 90 days worth of net fossil fuel imports. Days of onshore oil reserves was chosen here in consideration of the probable ease of obtaining data.

The number of days is obtained from the "Oil market report" of the IEA, and the calculation method is defined by the IEA.

reference: IEA definition)

Days of onland oil stock = (Total stock) / (Forward demand)

where;

Total stock = industry stock + government controlled stock

Forward demand = forward quarter average daily demand calculated by the IEA

8. CO_2 intensity

Issues of energy and global environmental sustainability are inextricably linked. As one important factor comprising energy security, it is thought that CO_2 intensity is an appropriate measurement in evaluating environmental sustainability, and thus four factors measuring different aspects of CO_2 intensity have been chosen.

The CO_2 emissions/TPES ratio reflects the extent to which low carbon energies are used and the consumption efficiency for energy. The CO_2 emissions/fossil fuel ratio reflects the energy mix among coal, petroleum and natural gas as well as their energy use efficiency. The CO_2 emissions/GDP ratio measures CO_2 in terms of its relationship to economic growth. The level of CO_2 emissions per capita measures the amount of fossil fuel used per person and more closely reflects the extent of economic development and its relationship to CO_2.

CO_2 emissions/TPES ratio = (CO_2 Emissions) / (TPES)
CO_2 emission/fossil fuel ratio = (CO_2 Emissions) / (Primary supply of fossil fuel)
CO_2 emissions/GDP = (CO_2 Emissions) / (GDP)
CO_2 emissions per capita = (CO_2 Emissions) / (Population)

3. Data

The results for calculations of the ESI, in principle, use common statistical data gathered from public sources in each country, with the aim of eliminating discrepancies due to statistical methods. From this perspective, the IEA statistics and the *BP Statistical Review of World Energy* were primarily used. IEA statistics include 'Coal Information,' 'Oil Information,' 'Natural Gas Information,' and 'CO2 Emissions from Fuel Combustion.'

Because data is not available for two of the above statistics for Lao PDR, Energy Balance data from the *WG on Analysis on Energy Saving Potential in East Asia* by ERIA, and the World Bank data were used.

Working group members verified and amended the data collected by the IEEJ,

which served as secretariat, and at the same time, requests were made to provide additional data to fill holes in the framework where possible, and such data were developed for the purpose of calculations. In the case of differences between IEA, BP and national statistics, national statistics were prioritized.

Statistics used to calculate ESI are as follows.

Table 2-2: ESI and Statistics

ESI	Statistics
1-1.TPES self sufficiency ratio (including nuclear)	Energy Balance of OECD, Non-OECD Countries (IEA) Cambodia: National statistics Lao PDR: WG on Analysis on Energy Saving Potential in East Asia (ERIA)
1-3. Reserve/Production ratio	Reserves: BP Statistical Review of World Energy, National statistics Production: BP Statistical Review of World Energy, National statistics
1-2. Reserve/Consumption ratio	Reserve: BP Statistical Review of World Energy National statistics Consumption: Energy Balance of OECD, Non-OECD Countries (IEA)
2. Diversity of import source countries	Coal Information, Oil Information and Natural Gas Information (IEA) National statistics
3. Diversity of energy sources in TPES / electricity	Energy Balance of OECD, Non-OECD Countries (IEA) Cambodia: National statistics Lao PDR: WG on Analysis on Energy Saving Potential in East Asia (ERIA)
4. Middle East dependence of oil and gas	Oil Information and Natural Gas Information (IEA) National statistics
5-1-1. Reserve margin of generation capacity	Statistics of the "Japan Electric Power Information Center" National statistics
5-1-2. Power outage frequency / duration	Statistics of the "Japan Electric Power Information Center" National statistics
5-2. Commercial energy access ratio	Energy Balance of OECD, Non-OECD Countries (IEA) Lao PDR: WG on Analysis on Energy Saving Potential in East Asia (ERIA)
6-1. TPES/GDP ratio	Energy Balance of OECD, Non-OECD Countries (IEA) Cambodia: TPES: National statistics Lao PDR: TPES: WG on Analysis on Energy Saving Potential in East Asia (ERIA) GDP: World Bank
6-2. TFEC/GDP ratio	Energy Balance of OECD, Non-OECD Countries (IEA) Cambodia: TFEC: National statistics Lao PDR: TFEC: WG on Analysis on Energy Saving Potential in East Asia (ERIA)

ESI	Statistics
	GDP: World Bank
7. Days of on-land oil stocks	Monthly Oil Market Report (IEA) National statistics
8-1. CO2 emissions/TPES ratio	CO2 Emissions from Fuel Combustion (IEA) Energy Balance of OECD, Non-OECD Countries (IEA) Cambodia: TPES: National statistics Lao PDR: CO2: World Bank TPES: WG on Analysis on Energy Saving Potential in East Asia (ERIA)
8-2. CO2 emissions/GDP ratio	CO2 Emissions from Fuel Combustion (IEA) Energy Balance of OECD, Non-OECD Countries (IEA) Lao PDR: World Bank
8-3. CO2 emissions per capita	CO2 Emissions from Fuel Combustion (IEA) Energy Balance of OECD, Non-OECD Countries (IEA) Lao PDR: World Bank

4. Calculating the ESI

It is possible to calculate annual ESI values. However, the purpose of this study was not to analyze changes in indices due to short-term factors such as economic fluctuations. Its purpose was to analyze changes in energy security from a longer-term perspective. Blocks of ten years were used and average values were gathered within the entire period observed. However, in the 2000s, there was striking economic growth in East Asian countries in particular, and this had a major effect on the energy environment. For this reason, this period was split into five-year periods.

Period Abbreviations

1970s	: 1970 - 1979
1980s	: 1980 - 1989
1990s	: 1990 - 1999
2000s-1	: 2000 - 2005
2000s-2	: 2006 – 2009

In addition, within this study a comparative analysis on calculated ESI with three standards was carried out. However, the comparison with the ERIA average was made only when data could be obtained from more than half of the ERIA Member Countries, in other words, eight countries or more.

Among these data, there is a need for caution when doing analysis using the OECD average by time period and the ERIA average by time period. This is because the efficiency of energy consumption in the OECD improves over time; or put another way, the principle for the comparative analysis changes, and for this reason, in doing a comparison with OECD data by time period, it is difficult to see the extent to which the efficiency of energy consumption is improving in East Asian countries.

- OECD average by time period
- OECD average for all time periods
- ERIA average by time period

e.g.)
Comparison against OECD average
= (Index A for country X) / (OECD average of Index A)

Here, depending on what ESI values are being measured, the larger values may indicate a "better situation" or the smaller values may indicate a "better situation." For this reason, in comparing between the OECD and ERIA averages, a conversion is made so that the larger values would indicate the "better situation." Concretely, inverse values are used for the measurements listed below.

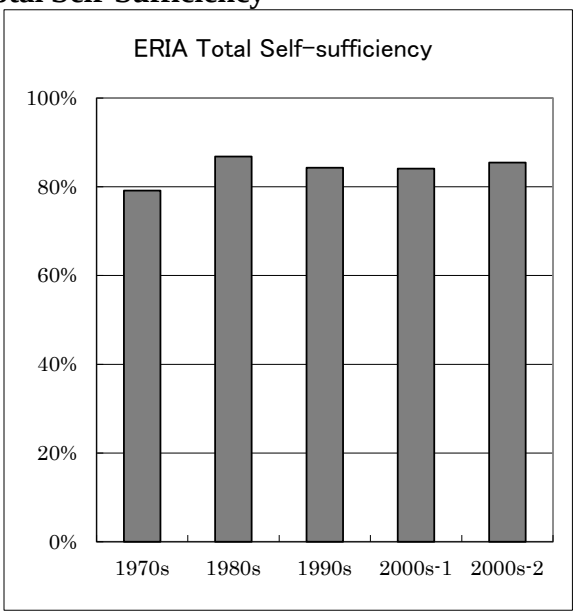
- Diversity of import source countries
- Diversity of energy sources of TPES / electricity
- Middle East dependency of oil and gas
- TPES/GDP ratio
- TFEC/GDP ratio
- CO_2 emissions/TPES ratio
- CO_2 emissions/ GDP ratio
- CO_2 emissions per capita

ESI calculation results are shown from the next section onwards. Figures show the results of ERIA average ESI calculations, while charts show comparisons among ESI calculation results for each country. Where data is not available from more than eight countries, the ERIA average is not shown in figures. Shaded areas in charts show calculations done based on received national statistics (including zero data).

4.1. Self Sufficiency

Although TPES self-sufficiency within the ERIA average has shifted a small amount, the value has basically stayed around 80%.

Figure 2-2: ERIA Total Self-Sufficiency



Looking at the data by country, there are some countries which show a trend of falling self-sufficiency through the period. The representative countries among these are China and India, which have seen energy consumption increase along with economic growth. The trend here is thought to indicate that the speed at which their domestic energy production is expanding has not kept up with consumption.

On the other hand, there are also examples of countries with increasing self-sufficiency. Among these are countries such as Australia and Myanmar, which have self-sufficiency rates above 100%. These countries are rich in fossil fuel sources, and are also thought to be advancing well toward resource development. Conversely, countries like South Korea and the Philippines with self-sufficiency ratios below 100% do not have enough fossil fuel sources to cover demand, but are thought to be heightening their self-sufficiency ratios through the use of nuclear energy, biomass and other renewable energies.

As a reference, please see the Annex for the TPES Self-sufficiency excluding nuclear energy, as well self-sufficiency rates for coal, crude oil and natural gas.

Table 2-3: Results of TPES Self-sufficiency (including Nuclear)

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	120.0%	161.9%	196.4%	232.4%	234.7%
Brunei	2186.2%	1088.5%	796.4%	837.0%	623.9%
Cambodia	-	-	82.9%	80.3%	74.8%
China	101.9%	104.9%	101.2%	97.3%	93.1%
India	91.5%	94.0%	86.9%	79.9%	75.8%
Indonesia	234.0%	194.2%	163.7%	151.2%	169.9%
Japan	10.5%	16.6%	19.4%	19.0%	18.7%
South Korea	29.0%	27.1%	16.8%	18.6%	19.7%
Lao PDR	-	-	91.7%	99.0%	92.4%
Malaysia	120.9%	205.6%	183.0%	155.5%	132.9%
Myanmar	97.8%	101.0%	98.1%	134.7%	149.3%
New Zealand	56.0%	78.7%	88.0%	81.0%	83.7%
Philippines	47.5%	62.3%	50.1%	51.2%	57.9%
Singapore	0.0%	0.0%	0.0%	0.2%	0.2%
Thailand	54.9%	62.1%	58.7%	56.8%	59.2%
Vietnam	90.6%	93.7%	116.0%	129.9%	127.0%
OECD avg.	67.0%	76.7%	75.1%	71.6%	70.7%
ERIA avg.	79.2%	86.8%	84.3%	84.1%	85.5%

Below are comparisons with the OECD average and the ERIA average. Large values show a better situation.

Table 2-4: Comparison (TPES Self-sufficiency, including nuclear)

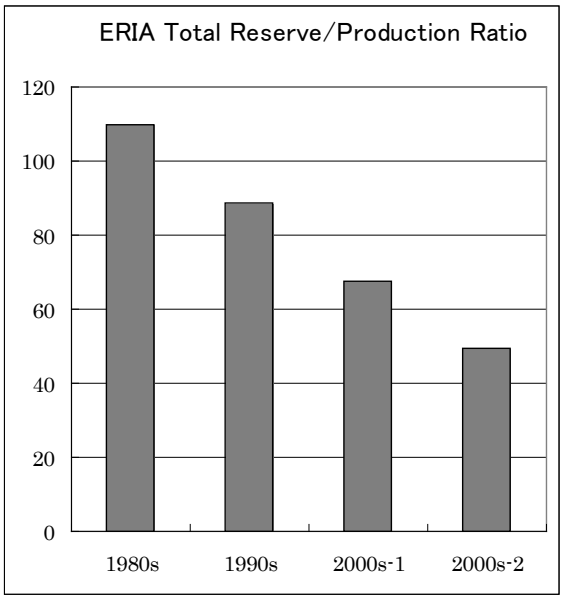
Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	1.8	2.1	2.7	3.2	3.3	1.6	2.2	2.7	3.2	3.2	1.5	1.9	2.3	2.8	2.7
Brunei	32.6	14.2	10.9	11.7	8.8	30.0	15.0	10.9	11.5	8.6	27.6	12.5	9.4	10.0	7.3
Cambodia	-	-	1.1	1.1	1.1	-	-	1.1	1.1	1.0	-	-	1.0	1.0	0.9
China	1.5	1.4	1.4	1.4	1.3	1.4	1.2	1.4	1.3	1.3	1.3	1.2	1.2	1.2	1.1
India	1.4	1.2	1.2	1.1	1.1	1.3	1.3	1.2	1.1	1.0	1.2	1.1	1.0	1.0	0.9
Indonesia	3.5	2.5	2.2	2.1	2.4	3.2	2.7	2.2	2.1	2.3	3.0	2.2	1.9	1.8	2.0
Japan	0.2	0.2	0.3	0.3	0.3	0.1	0.2	0.3	0.3	0.3	0.1	0.2	0.2	0.2	0.2
Korea	0.4	0.4	0.2	0.3	0.3	0.4	0.4	0.2	0.3	0.3	0.4	0.3	0.2	0.2	0.2
Lao PDR	-	-	1.3	1.4	1.3	-	-	1.3	1.4	1.3	-	-	1.1	1.2	1.1
Malaysia	1.8	2.7	2.5	2.2	1.9	1.7	2.8	2.5	2.1	1.8	1.5	2.4	2.2	1.8	1.6
Myanmar	1.5	1.3	1.3	1.9	2.1	1.3	1.4	1.3	1.9	2.1	1.2	1.2	1.2	1.6	1.7
New Zealand	0.8	1.0	1.2	1.1	1.2	0.8	1.1	1.2	1.1	1.2	0.7	0.9	1.0	1.0	1.0
Philippines	0.7	0.8	0.7	0.7	0.8	0.7	0.9	0.7	0.7	0.8	0.6.	0.7	0.6	0.6	0.7
Singapore	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thailand	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7
Vietnam	1.4	1.2	1.6	1.8	1.8	1.2	1.3	1.6	1.8	1.7	1.1	1.1	1.4	1.5	1.5

4.2. Reserve/Production ratio (R/P ratio)

When doing the calculations, R/P ratios were first calculated for coal, crude oil and natural gas, and then the R/P ratio for fossil fuels as a whole was calculated using a weighted average for the primary energy supply, which comprised of coal, crude oil and natural gas.

The ERIA Total R/P ratio was over 100 years for the 1980s, but fell to about 90 years in the 1990s, about 70 years in 2000s-1 and to about 50 years in 2000s-2. The reason for this is the increased speed of energy production increases more than the amount of fossil fuel reserves available due to new development.

Figure 2-3: ERIA Total R/P ratio



Looking at the data by country, there are many countries showing a a decreasing R/P ratio. This, like the trend of the ERIA average, is because the speed of energy production increases is outpacing increases in energy reserves.

Countries showing results differing from this trend are Japan, South Korea and New Zealand. Although these countries have few fossil fuel resources they are shown to have a small amount of coal reserves in BP statistics. Because the amount of energy produced from coal is falling year by year in these countries, the result is that their R/P ratios increase.

Table 2-5: Results of R/P ratio

Country	1980s	1990s	2000s-1	2000s-2
Australia	182.6	176.9	135.1	115.4
Brunei	29.8	34.2	25.7	24.5
Cambodia	-	-	-	-
China	131.9	80.6	53.3	35.3
India	87.0	158.3	133.9	84.5
Indonesia	92.4	37.5	40.3	49.1
Japan	18.2	33.0	100.5	75.9
South Korea	2.3	5.1	5.9	12.4
Lao PDR	-	-	-	-
Malaysia	330.6	38.7	29.5	24.8
Myanmar	108.6	134.8	45.8	31.6
New Zealand	11.7	6.8	17.2	24.9
Philippines	-	-	-	-
Singapore	-	-	-	-
Thailand	51.9	9.4	17.4	16.6
Vietnam	-	36.0	29.0	25.8
OECD avg.	-	66.2	60.1	52.2
ERIA avg.	109.6	88.6	67.5	49.4

The following chart shows a comparison with the OECD and ERIA averages. Larger values show a better situation.

Table 2-6: Comparison (Reserve/ Production ratio)

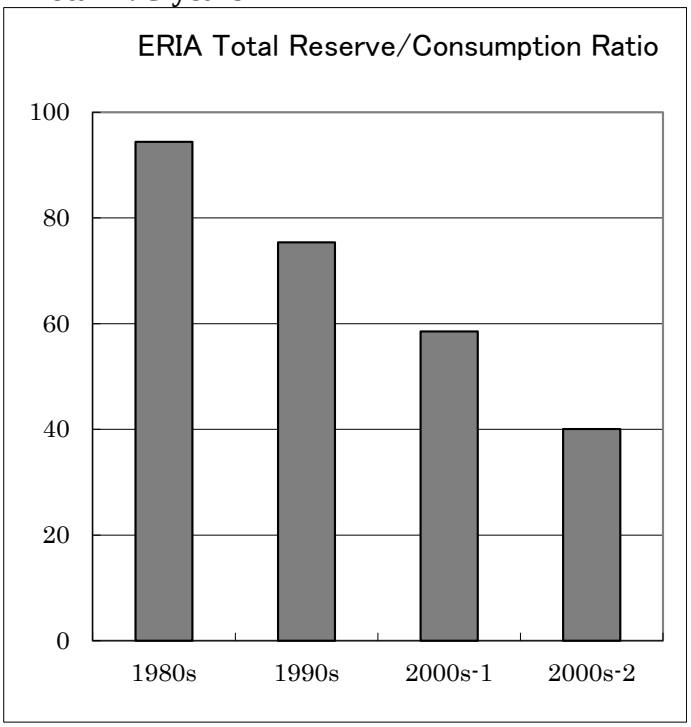
Country	vs. OECD				vs. OECD (whole periods)				vs. ERIA			
	1980s	1990s	2000s 1	2000s 2	1980s	1990s	2000s 1	2000s 2	1980s	1990s	2000s 1	2000s 2
Australia	-	2.7	2.2	2.2	-	2.8	2.2	1.9	1.7	2.0	2.0	2.3
Brunei	-	0.5	0.4	0.5	-	0.5	0.4	0.4	0.3	0.4	0.4	0.5
Cambodia	-	-	-	-	-	-	-	-	-	-	-	-
China	-	1.2	0.9	0.7	-	1.3	0.9	0.6	1.2	0.9	0.8	0.7
India	-	2.4	2.2	1.6	-	2.5	2.2	1.4	0.8	1.8	2.0	1.7
Indonesia	-	0.6	0.7	0.9	-	0.6	0.6	0.8	0.8	0.4	0.6	1.0
Japan	-	0.5	1.7	1.5	-	0.5	1.6	1.2	0.0	0.1	0.1	0.3
Korea	-	0.1	0.1	0.2	-	0.1	0.1	0.2	0.0	0.1	0.1	0.3
Lao PDR	-	0.2	-	-	-	-	-	-	-	-	-	-
Malaysia	-	0.3	0.5	0.5	-	0.6	0.5	0.4	3.0	0.4	0.4	0.5
Myanmar	-	0.4	0.8	0.6	-	2.2	0.7	0.5	1.0	1.5	0.7	0.6
New Zealand	-	0.5	0.3	0.5	-	0.1	0.3	0.4	0.1	0.1	0.3	0.5
Philippines	-	0.6	-	-	-	-	-	-	-	-	-	-
Singapore	-	0.7	-	-	-	-	-	-	-	-	-	-
Thailand	-	0.8	0.3	0.3	-	0.2	0.3	0.3	0.5	0.1	0.3	0.3
Vietnam	-	0.9	0.5	0.5	-	0.6	0.5	0.4	-	0.4	0.4	0.5

4.3. Reserve/Consumption ratio (R/C ratio)

When doing these calculations, R/C ratios were first calculated for coal, crude oil and natural gas, and then the R/C ratio for fossil fuels as a whole was calculated using a weighted average for the primary energy supply, which comprises coal, crude oil and natural gas.

There is a trend toward a decreasing R/C ratio within the ERIA average. The reason for this is the the speed of energy consumption increases is outpacing increases in fossil fuel reserves available due to new development.

Figure 2-4: ERIA Total R/C years



Looking at the data by country, there are many countries showing a trend toward a decreasing R/C ratio. This, like the trend of the ERIA average, is because the speed of energy consumption increases is outpacing increases in energy reserves.

Countries showing results differing from this trend are Indonesia and New Zealand from 2000s-1 onward. Both countries saw the addition of new fossil fuel reserves outpace the expansion of their demand for the period.

Looking at the situation in 2000s-2, Australia, Brunei, Indonesia had ratios of over 100 years, signaling that they possess rich resources in comparison to domestic energy

demand. On the other hand, although China and India possess rich resources as well, especially coal, their large energy consumption means that their R/C ratio is shrinking.

Coal, crude oil and natural gas R/C ratios are shown in the Annex.

Table 2-7: Results of R/C ratio

Country	1980s	1990s	2000s-1	2000s-2
Australia	450.2	466.3	375.0	333.4
Brunei	1,256.2	273.0	202.3	142.1
Cambodia				
China	128.3	75.5	53.0	31.5
India	81.9	148.1	114.9	69.6
Indonesia	209.3	90.2	97.0	130.5
Japan	1.5	1.0	0.7	0.4
South Korea	1.0	0.6	0.2	0.3
Lao PDR				
Malaysia	164.7	108.5	63.2	51.5
Myanmar	130.2	155.4	187.8	112.5
New Zealand	12.6	8.7	24.0	29.7
Philippines				
Singapore				
Thailand	12.6	7.1	12.9	10.3
Vietnam		304.1	75.4	72.3
OECD avg.	-	55.8	47.9	41.3
ERIA avg.	94.4	75.4	58.5	40.1

The following chart shows a comparison with the OECD and ERIA averages. Larger values show a better situation.

Table 2-8: Comparison (Reserve/Consumption ratio)

Country	vs. OECD				vs. OECD (whole periods)				vs. ERIA			
	1980s	1990s	2000s 1	2000s 2	1980s	1990s	2000s 1	2000s 2	1980s	1990s	2000s 1	2000s 2
Australia	-	8.4	7.8	8.1	-	9.1	7.3	6.5	4.8	6.2	6.4	8.3
Brunei	-	4.9	4.2	3.4	-	5.3	4.0	2.8	13.3	3.6	3.5	3.5
Cambodia	-	-	-	-	-	-	-	-	-	-	-	-
China	-	1.4	1.1	0.8	-	1.5	1.0	0.3	1.4	1.0	0.9	0.8
India	-	2.7	2.4	1.7	-	2.9	2.2	1.4	0.9	2.0	2.0	1.7
Indonesia	-	1.6	2.0	3.2	-	1.8	1.9	2.6	2.2	1.2	1.7	3.3
Japan	-	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Korea	-	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lao PDR	-	-	-	-	-	-	-	-	-	-	-	-
Malaysia	-	1.9	1.3	1.2	-	2.1	1.2	1.0	1.7	1.4	1.1	1.3
Myanmar	-	2.8	3.9	2.7	-	3.0	3.7	2.2	1.4	2.1	3.2	2.8
New Zealand	-	0.2	0.5	0.7	-	0.2	0.5	0.6	0.1	0.1	0.4	0.7
Philippines	-	-	-	-	-	-	-	-	-	-	-	-
Singapore	-	-	-	-	-	-	-	-	-	-	-	-
Thailand	-	0.1	0.3	0.2	-	0.1	0.3	0.2	0.1	0.1	0.2	0.3
Vietnam	-	5.5	1.6	1.7	-	5.9	1.5	1.4	-	4.0	1.3	1.8

4.4. Diversity of Import Source Countries

As there are countries among the ERIA member countries that are not importing coal, crude oil or natural gas, the subjects of comparison for the measurement of the diversity of import source countries is limited. The following are HHI calculation results showing the extent of the diversification of import source countries.

Diversity increased for coal in the importing countries of China, India, and South Korea, while concentration increased in Japan. For crude oil, while Australia, China, New Zealand and Thailand progressed in terms of import diversity, Japan and South Korea saw a trend toward concentration. While few countries are importing natural gas, all such countries moved toward the diversification of import sources.

Table 2-9: Result of HHI (Diversity of import source countries)

Country	Coal Imports					Crude oil Imports					Natural gas Imports				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia						2.549	2.443	1.420	1.309	1.440					
Brunei															
Cambodia															
China			4.737	2.329	2.378			1.428	1.034	1.095					5.740
India	5.630	9.104	5.991	3.798	3.294									10.000	5.831
Indonesia															
Japan	3.082	2.950	3.303	3.799	4.200	1.713	1.399	1.517	1.697	1.859	3.566	3.448	2.519	1.839	1.458
Korea	3.379	2.889	2.461	2.956	2.636			1.477	1.425	1.553		10.000	5.768	2.267	1.955
Lao PDR															
Malaysia															
Myanmar															
New Zealand				7.409	8.102		3.135	2.096	1.411	1.300					
Philippines															
Singapore															
Thailand					5.854		2.230	1.713	1.562	1.787			10.000	10.000	10.000
Vietnam															
OECD Total	1.484	1.780	1.543	1.468	1.516	983	691	696	698	704	2.459	1.660	1.531	1.135	964

The following shows a comparison with the OECD average by time period. With HHI, the better situation is shown by lower values, but as inverse numbers have been used for HHI for the purpose of this comparison, the large values here show the better situation.

Table 2-10: Comparison (Diversity of import source countries)

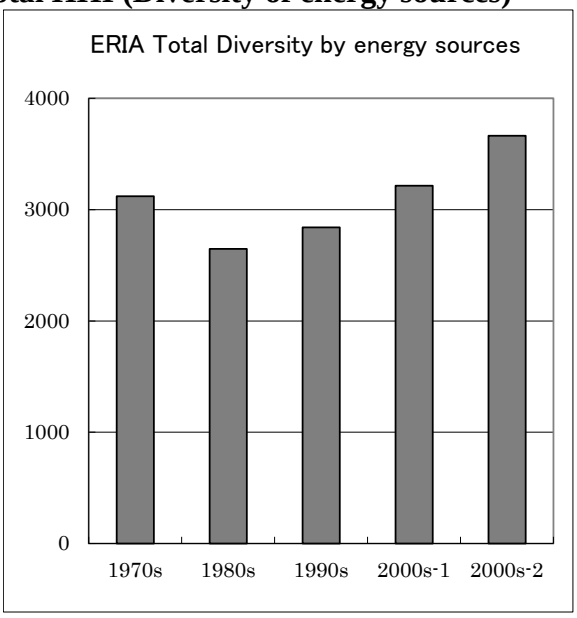
Country	Coal Imports					Crude oil Imports					Natural gas Imports				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia						0.4	0.3	0.5	0.5	0.5					
Brunei															
Cambodia															
China			0.3	0.6	0.6			0.5	0.7	0.6					0.2
India	0.3	0.2	0.3	0.4	0.5									0.1	0.2
Indonesia															
Japan	0.5	0.6	0.5	0.4	0.4	0.6	0.5	0.5	0.4	0.4	0.7	0.5	0.6	0.6	0.7
Korea	0.4	0.6	0.6	0.5	0.6			0.5	0.5	0.5		0.2	0.3	0.5	0.5
Lao PDR															
Malaysia															
Myanmar															
New Zealand				0.2	0.2		0.2	0.3	0.5	0.5					
Philippines															
Singapore															
Thailand					0.3		0.3	0.4	0.4	0.4			0.2	0.1	0.1
Vietnam															

4.5. Diversity of Energy Sources of TPES / Electricity

First the extent of diversity among energy sources in TPES and electricity were calculated, and concretely, in HHI. Next, a simple average of the two HHI values was taken, and this was used to calculate total values for the diversity of energy sources of TPES and electricity. HHI calculation results for TPES and electricity individually are shown in the Annex.

For ERIA as a whole, although diversification increased from the 1970s and 1980s, since then concentration has been progressing. One reason for this may be an increase in the consumption of coal by power stations, which resulted in a worsening in the extent of diversification of electricity supply sources.

Figure 2-5: ERIA Total HHI (Diversity of energy sources)



Excluding China and Thailand, diversification increased throughout the period of evaluation. The reason for increased concentration in China and Thailand is thought to be a surge of coal and natural gas in the power station sector. Limiting the analysis to only electricity, and excluding China and Thailand, the concentration of energy usage increased in many countries, including India, Indonesia, Japan, South Korea, Malaysia and Myanmar.

Table 2-11: Result of HHI (Diversity of energy sources)

((TPES + Generation)/ 2)

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	4,572	4,571	5,048	4,917	4,829
Brunei	9,647	8,987	8,653	7,911	8,155
Cambodia	-	-	10,000	9,637	9,589
China	4,066	4,369	5,185	5,331	5,718
India	4,286	4,217	4,175	4,079	3,984
Indonesia	5,310	3,725	2,923	2,802	2,858
Japan	5,127	2,960	2,693	2,567	2,508
South Korea	6,286	3,551	3,606	3,377	3,245
Lao PDR	-	-	8,419	8,032	7,467
Malaysia	6,293	4,432	4,020	4,708	4,198
Myanmar	5,801	5,217	5,520	5,136	4,999
New Zealand	4,350	4,082	3,756	3,203	2,882
Philippines	6,127	3,348	3,202	2,338	2,230

Country	1970s	1980s	1990s	2000s-1	2000s-2
Singapore	9,996	9,997	8,123	6,797	7,319
Thailand	5,011	3,261	3,207	4,286	4,168
Vietnam	7,148	5,440	5,869	4,188	3,580
OECD avg.	3,018	2,770	2,633	2,592	2,521
ERIA avg.	3,120	2,648	2,840	3,215	3,662

The following is a comparison with OECD and ERIA averages. With HHI, the better situation is shown by lower values, but as inverse numbers have been used for HHI for the purpose of this comparison, the large values here show the better situation. HHI calculation results for TPES and electricity individually are shown in the Annex.

Table 2-12: Comparison (Diversity of energy sources)
((TPES + Generation)/ 2)

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	0.7	0.6	0.5	0.5	0.5	0.6	0.6	0.5	0.5	0.5	0.7	0.6	0.6	0.7	0.8
Brunei	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4
Cambodia	-	-	0.3	0.3	0.3	-	-	0.3	0.3	0.3	-	-	0.3	0.3	0.4
China	0.7	0.6	0.5	0.5	0.4	0.6	0.6	0.5	0.5	0.5	0.8	0.6	0.5	0.6	0.6
India	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.6	0.7	0.8	0.9
Indonesia	0.6	0.7	0.9	0.9	0.9	0.5	0.7	0.9	0.9	0.9	0.6	0.7	1.0	1.1	1.3
Japan	0.6	0.9	1.0	1.0	1.0	0.5	0.9	1.0	1.0	1.1	0.6	0.9	1.1	1.3	1.5
Korea	0.5	0.8	0.7	0.8	0.8	0.4	0.7	0.7	0.8	0.8	0.5	0.7	0.8	1.0	1.1
Lao PDR	-	-	0.3	0.3	0.3	-	-	0.3	0.3	0.4	-	-	0.3	0.4	0.5
Malaysia	0.5	0.6	0.7	0.6	0.6	0.4	0.6	0.7	0.6	0.6	0.5	0.6	0.7	0.7	0.9
Myanmar	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.7
New Zealand	0.7	0.7	0.7	0.8	0.9	0.6	0.6	0.7	0.8	0.9	0.7	0.6	0.8	1.0	1.3
Philippines	0.5	0.8	0.8	1.1	1.1	0.4	0.8	0.8	1.1	1.2	0.5	0.8	0.9	1.4	1.6
Singapore	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.4	0.4	0.3	0.3	0.3	0.5	0.5
Thailand	0.6	0.8	0.8	0.6	0.6	0.5	0.8	0.8	0.6	0.6	0.6	0.8	0.9	0.8	0.9
Vietnam	0.4	0.5	0.4	0.6	0.7	0.4	0.5	0.4	0.6	0.7	0.4	0.5	0.5	0.8	1.0

4.6. Middle East Dependence of Oil and Gas

The number of ERIA member countries that did evaluations of oil and gas was limited.

The following shows calculation results. Japan, South Korea, and Thailand show trends toward increased dependency on the Middle East. The reason seems to be that while imports from Southeast Asia appear to be leveling out, imports from the Middle East, rich as it is in natural resources, have been increasing. On the other hand, the dependency of Australia on the Middle East for its oil decreased significantly, while China and New Zealand maintained nearly steady values.

Table 2-13: Middle East Dependence rate

Country	Crude oil					Natural gas				
	1970s	1980s	1990s	2000s-1	2000s-2	1970s	1980s	1990s	2000s-1	2000s-2
Australia	85.4%	68.4%	35.5%	20.0%	15.4%	-	-	-	-	-
Brunei	-	-	-	-	-	-	-	-	-	-
Cambodia	-	-	-	-	-	-	-	-	-	-
China	-	-	47.8%	48.3%	47.1%	-	-	-	-	4.2%
India	-	-	-	-	-	-	-	-	100.0 %	79.9%
Indonesia	-	-	-	-	-	-	-	-	-	-
Japan	77.6%	70.3%	79.1%	88.1%	88.1%	5.7%	8.7%	10.4%	22.0%	24.7%
South Korea	-	-	74.7%	77.8%	83.3%	-	0.0%	0.9%	49.0%	47.7%
Lao PDR	-	-	-	-	-	-	-	-	-	-
Malaysia	-	-	-	-	-	-	-	-	-	-
Myanmar	-	-	-	-	-	-	-	-	-	-
New Zealand	-	64.1%	70.8%	59.8%	64.1%	-	-	-	-	-
Philippines	-	-	-	-	-	-	-	-	-	-
Singapore	-	-	-	-	-	-	-	-	-	-
Thailand	-	58.0%	71.0%	77.7%	80.3%	-	-	0.0%	0.0%	0.0%
Vietnam	-	-	-	-	-	-	-	-	-	-
OECD avg.	55.1%	38.2%	39.0%	36.5%	33.2%	0.4%	1.4%	2.0%	6.2%	7.8%

The following is a comparison with the OECD average by time period. With dependency on the Middle East, the better situation is shown by lower values, but as inverse numbers have been used, the large values here show the better situation.

Table 2-14: Comparison (Middle East Dependence)

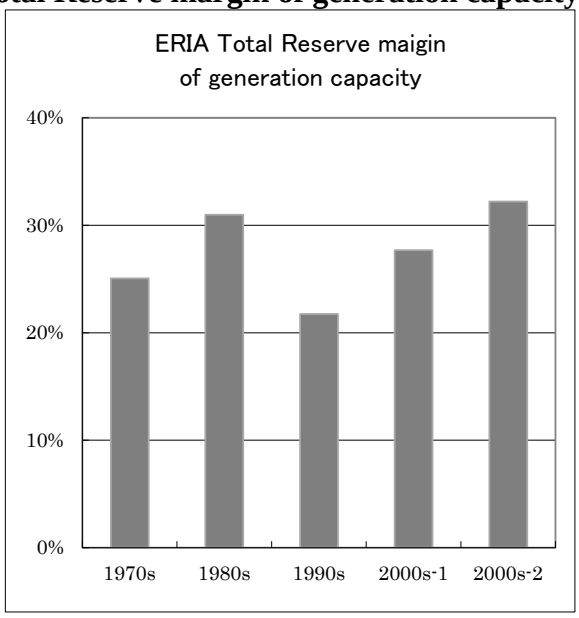
Country	Crude oil					Natural gas				
	1970s	1980s	1990s	2000s-1	2000s-2	1970s	1980s	1990s	2000s-1	2000s-2
Australia	0.6	0.6	1.1	1.8	2.1	-	-	-	-	-
Brunei	-	-	-	-	-	-	-	-	-	-
Cambodia	-	-	-	-	-	-	-	-	-	-
China	-	-	0.8	0.8	0.7	-	-	-	-	1.9
India	-	-	-	-	-	-	-	-	0.1	0.1
Indonesia	-	-	-	-	-	-	-	-	-	-
Japan	0.7	0.5	0.5	0.4	0.4	0.1	0.2	0.2	0.3	0.3
South Korea	-	-	0.5	0.5	0.4	-	-	2.3	0.1	0.2
Lao PDR	-	-	-	-	-	-	-	-	-	-

Country	Crude oil					Natural gas				
	1970s	1980s	1990s	2000s-1	2000s-2	1970s	1980s	1990s	2000s-1	2000s-2
Malaysia	-	-	-	-	-	-	-	-	-	-
Myanmar	-	-	-	-	-	-	-	-	-	-
New Zealand	-	0.6	0.6	0.6	0.5	-	-	-	-	-
Philippines	-	-	-	-	-	-	-	-	-	-
Singapore	-	-	-	-	-	-	-	-	-	-
Thailand	-	0.7	0.5	0.5	0.4	-	-	-	-	-
Vietnam	-	-	-	-	-	-	-	-	-	-

4.7. Reserve Margin of Generation Capacity

The Reserve margin of generation capacity for ERIA as a whole was above 30% in the 1980s, and then shrank to close to 20% in the 1990s. After that, it rose again to over 30% in 2000s-2.

Figure 2-6: ERIA Total Reserve margin of generation capacity



Looking at the data per country, there are variations in the trends of reserve margins. It is thought that there are a variety of reasons for such differences, including progress in policies, and investments, in power sources development, the situation of competition in the power generation field, and so on.

Table 2-15: Reserve margin of generation capacity

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	32.6%	36.5%	29.0%	27.5%	25.7%
Brunei	-	-	-	-	-
Cambodia	-	-	-	-	-
China	-	-	-	34.9%	37.0%
India	-	-	35.8%	35.5%	36.2%
Indonesia	-	-	33.6%	19.0%	10.1%
Japan	23.7%	29.2%	20.0%	24.1%	26.4%
South Korea	31.9%	37.9%	14.9%	14.5%	10.3%
Lao PDR	-	-	-	-	-
Malaysia	-	-	0.9%	26.4%	32.1%
Myanmar	-	-	-	-	-
New Zealand	-	-	31.5%	31.9%	31.3%
Philippines	-	-	41.8%	44.7%	43.4%
Singapore	-	-	-	-	-
Thailand	-	-	20.5%	24.9%	21.9%
Vietnam	-	24.3%	34.7%	18.2%	15.1%
OECD avg.	31.7%	35.3%	29.0%	29.1%	31.7%
ERIA avg.	25.1%	31.0%	21.8%	27.7%	32.2%

The following chart shows a comparison with the OECD and ERIA averages. Larger values show a better situation.

Table 2-16: Comparison (Reserve margin of generation capacity)

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	1.0	1.0	1.0	0.9	0.8	1.0	1.2	0.9	0.9	0.8	1.3	1.2	1.3	1.0	0.8
Brunei															
Cambodia															
China				1.2	1.2				1.1	1.2				1.3	1.1
India			1.2	1.2	1.1			1.1	1.1	1.2			1.6	1.3	1.1
Indonesia			1.2	0.7	0.3			1.1	0.6	0.3			1.5	0.7	0.3
Japan	0.7	0.8	0.7	0.8	0.8	0.8	0.9	0.6	0.8	0.8	0.9	0.9	0.9	0.9	0.8
Korea	1.0	1.1	0.5	0.5	0.3	1.0	1.2	0.5	0.5	0.3	1.3	1.2	0.7	0.5	0.3
Lao PDR															
Malaysia			0.0	0.9	1.0			0.0	0.8	1.0			0.0	1.0	1.0
Myanmar															
New Zealand			1.1	1.1	1.0			1.0	1.0	1.0			1.4	1.2	1.0
Philippines			1.4	1.5	1.4			1.3	1.4	1.4			1.9	1.6	1.3
Singapore															
Thailand			0.7	0.9	0.7			0.7	0.8	0.7			0.9	0.9	0.7
Vietnam		0.7	1.2	0.6	0.5		0.8	1.1	0.6	0.5		0.8	1.6	0.7	0.5

4.8. Power Outage Frequency/Duration

Data on power outage frequency and power outage duration could only be obtained from a limited number of countries. The following shows the situations for these countries.

Table 2-17: Power outage frequency

Unit: times/ year

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	-	-	--	2.24	2.10
Brunei	-	-	-	-	-
Cambodia	-	-	-	-	-
China	-	-	-	-	-
India	-	-	-	-	-
Indonesia	-	-	-	13.88	11.15
Japan	1.60	0.85	0.25	0.20	0.31
South Korea	-	4.25	1.26	0.53	-
Lao PDR	-	-	-	-	-
Malaysia	-	-	-	1.43	0.85
Myanmar	-	-	-	-	-
New Zealand	-	-	2.01	1.66	2.44
Philippines	-	-	-	-	-
Singapore	-	-	-	-	-
Thailand	-	-	-	-	-
Vietnam	-	-	-	-	-

Table 2-18: Power outage duration

Unit: minutes/ year

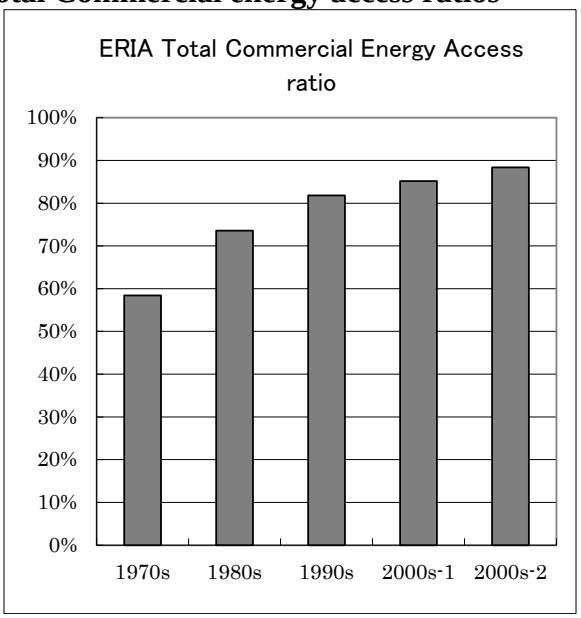
Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	-	-	-	212.1	246.4
Brunei	-	-	-	-	-
Cambodia	-	-	-	-	-
China	-	-	-	-	-
India	-	-	-	-	-
Indonesia	-	-	-	13.6	21.0
Japan	226.8	121.5	40.4	28.7	115.6
South Korea	-	494.4	122.2	19.5	18.0
Lao PDR	-	-	-	-	-
Malaysia	-	-	552.7	191.5	72.8
Myanmar	-	-	-	-	-

Country	1970s	1980s	1990s	2000s-1	2000s-2
New Zealand	-	-	5.0	4.7	21.8
Philippines	-	-	-	-	-
Singapore	-	-	-	-	-
Thailand	-	-	-	-	-
Vietnam	-	-	-	-	-

4.9. Commercial Energy Access Ratio

Access to commercial energy has improved for ERIA as a whole over all time periods.

Figure 2-7: ERIA Total Commercial energy access ratios



The trend here is similar no matter the country observed. Access to commercial energy improved in all countries.

Table 2-19: Commercial energy access ratios

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	-	98.5%	96.2%	96.3%	96.9%
Brunei	98.1%	99.6%	100.0%	100.0%	100.0%
Cambodia	-	-	21.9%	28.2%	33.7%
China	65.7%	72.6%	79.6%	85.0%	90.5%
India	40.8%	50.6%	62.9%	69.0%	73.7%
Indonesia	38.4%	54.1%	65.3%	71.0%	73.6%
Japan	-	99.5%	99.5%	99.5%	99.5%

Country	1970s	1980s	1990s	2000s-1	2000s-2
South Korea	-	-	99.8%	99.9%	99.9%
Lao PDR	-	-	25.7%	31.2%	38.3%
Malaysia	-	94.6%	96.8%	97.6%	98.0%
Myanmar	28.9%	29.5%	26.1%	31.3%	36.4%
New Zealand	97.1%	95.8%	94.9%	93.9%	94.3%
Philippines	65.0%	68.7%	77.9%	85.5%	87.4%
Singapore	99.8%	100.0%	100.0%	100.0%	100.0%
Thailand	76.9%	81.3%	89.2%	91.4%	91.3%
Vietnam	27.3%	26.7%	33.2%	49.7%	59.5%
OECD avg.	99.2%	98.8%	97.9%	97.8%	97.7%
ERIA avg.	58.4%	73.6%	81.8%	85.2%	88.4%

The following chart shows a comparison with the OECD and ERIA averages. Larger values show a better situation.

Table 2-20: Comparison (Commercial energy access ratio)

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	-	1.0	1.0	1.0	1.0	-	1.0	1.0	1.0	1.0	-	1.4	1.2	1.2	1.1
Brunei	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.7	1.4	1.2	1.2	1.2
Cambodia	-	-	0.2	0.3	0.3	-	-	0.2	0.3	0.3	-	-	0.3	0.3	0.4
China	0.7	0.7	0.8	0.9	0.9	0.7	0.7	0.8	0.9	0.9	1.1	1.0	1.0	1.0	1.0
India	0.4	0.5	0.6	0.7	0.8	0.4	0.5	0.6	0.7	0.7	0.7	0.7	0.8	0.9	0.9
Indonesia	0.4	0.5	0.7	0.7	0.8	0.4	0.6	0.7	0.7	0.7	0.7	0.7	0.8	0.9	0.9
Japan	-	1.0	1.0	1.0	1.0	-	1.0	1.0	1.0	1.0	-	1.4	1.2	1.2	1.2
Korea	-	-	1.0	1.0	1.0	-	-	1.0	1.0	1.0	-	-	1.2	1.2	1.2
Lao PDR	-	-	0.3	0.3	0.4	-	-	0.3	0.3	0.4	-	-	0.3	0.4	0.4
Malaysia	-	1.0	1.0	1.0	1.0	-	1.0	1.0	1.0	1.0	-	1.3	1.2	1.2	1.1
Myanmar	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.4	0.5	0.4	0.3	0.4	0.4
New Zealand	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.7	1.3	1.2	1.1	1.1
Philippines	0.7	0.7	0.8	0.9	0.9	0.7	0.7	0.8	0.9	0.9	1.1	0.9	1.0	1.0	1.0
Singapore	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.7	1.4	1.2	1.2	1.2
Thailand	0.8	0.8	0.9	0.9	0.9	0.8	0.8	0.9	0.9	0.9	1.3	1.1	1.1	1.1	1.1
Vietnam	0.3	0.3	0.3	0.5	0.6	0.3	0.3	0.3	0.5	0.6	0.5	0.4	0.4	0.6	0.7

In Working Group meetings, the adoption of the electrification rate was proposed instead of commercial energy access. However, it is not easy to obtain data for electrification rates in line with a cohesive definition. The IEA provided electrification rate data to the World Energy Outlook (WEO) in 2000, 2005 and 2009, and this data is shown below as a reference. The ERIA Total Electrification rate is calculated using a weighted average for population, assuming the figures for OECD countries without the IEA data for the WEO to be 100%.

Table 2-21: Electrification rate

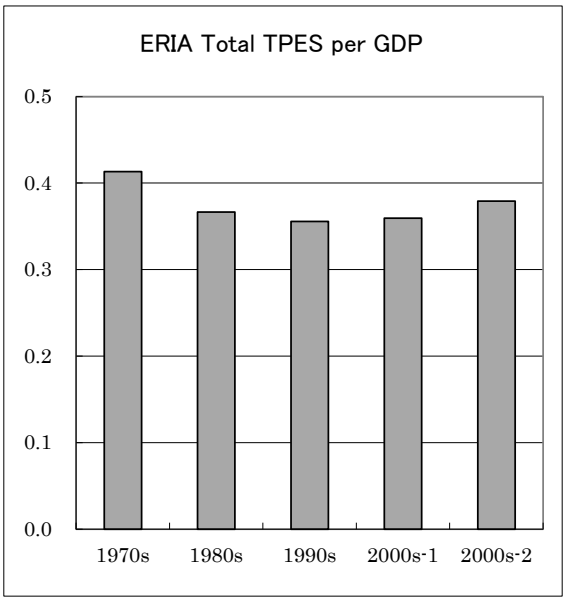
Country	2000 (WEO 2002)		2005 (WEO 2006)		2009 (WEO 2011)	
	Electrification rate (%)	Population without electricity (million)	Electrification rate (%)	Population without electricity (million)	Electrification rate (%)	Population without electricity (million)
Australia	-	-	-	-	-	-
Brunei	99.2%	0.0	99.2%	0.0	99.7%	0.0
Cambodia	15.8%	10.3	20.1%	10.9	24.0%	11.3
China	98.6%	17.6	99.4%	8.5	99.4%	8.0
India	43.0%	579.1	55.5%	487.2	75.0%	288.8
Indonesia	53.4%	98.0	54.0%	101.2	64.5%	81.6
Japan	-	-	-	-	-	-
South Korea	-	-	-	-	-	-
Lao PDR	-	-	-	-	55.0%	2.6
Malaysia	96.9%	0.7	97.8%	0.6	99.4%	0.2
Myanmar	5.0%	45.3	11.3%	45.1	13.0%	43.5
New Zealand	-	-	-	-	-	-
Philippines	87.4%	9.5	80.5%	16.2	89.7%	9.5
Singapore	100.0%	-	100.0%	-	100.0%	-
Thailand	82.1%	10.9	99.0%	0.6	99.3%	0.5
Vietnam	75.8%	19.0	84.2%	13.2	97.6%	2.1
ERIA avg.	73.5%	790.4	78.2%	683.5	86.3%	448.1

Note: WEO provided only Non-OECD Electrification rate.

4.10. TPES/GDP Ratio

The TPES/GDP ratio fell from the 1970s to the 1990s, showing, in other words, that energy efficiency was improving. However, from then through to 2000s-2, TPES/GDP ratio has increased, indicating a worsening of energy efficiency. Up until the 1990s the GDP growth rate was higher than the growth in the energy consumption rate, but since then there has been a reversal in. Reasons for the reversal are the increasing energy demand in China and the lower GDP growth in Japan. In terms of energy demand, China is dominant in the East Asia region and their share is about half. On the other hand, in terms of GDP, Japan is dominant and their share is also about half of the total. With these factors in mind the increase in East Asian energy demand, mainly led by China is higher than that of GDP growth which is dominated by Japan. Thus the ratio of TPES to GDP worsened throughout the 2000s time-period.

Figure 2-8: ERIA Total TPES/GDP ratio



The following shows the TPES/GDP ratio for ERIA member countries. Most countries show a trend of improvements in energy efficiency over the evaluation period. Brunei and Malaysia, however, showed a worsening in energy efficiency. New Zealand's energy efficiency worsened until the 1990s, and improved after that.

Table 2-22: TPES/GDP ratio

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	0.321	0.299	0.280	0.250	0.243
Brunei	0.165	0.313	0.402	0.382	0.483
Cambodia	-	-	1.158	0.879	0.665
China	3.676	2.348	1.307	0.877	0.800
India	1.322	1.248	1.102	0.913	0.776
Indonesia	1.053	0.878	0.871	0.912	0.803
Japan	0.146	0.114	0.109	0.108	0.099
South Korea	0.331	0.317	0.348	0.333	0.304
Lao PDR	-	-	1.096	0.897	0.844
Malaysia	0.417	0.463	0.492	0.514	0.511
Myanmar	2.797	2.270	1.958	1.114	0.827
New Zealand	0.269	0.287	0.328	0.286	0.255
Philippines	0.509	0.498	0.535	0.470	0.363
Singapore	0.266	0.222	0.275	0.192	0.124

Country	1970s	1980s	1990s	2000s-1	2000s-2
Thailand	0.658	0.517	0.542	0.612	0.593
Vietnam	2.178	1.911	1.369	1.168	1.074
OECD avg.	0.299	0.247	0.217	0.196	0.180
ERIA avg.	0.413	0.366	0.356	0.359	0.379

The following is a comparison with OECD and ERIA averages. With the TPES/GDP ratio, the better situation is shown by lower values, but as inverse numbers have been used for the TPES/GDP ratio for the purpose of this comparison, the large values here show the better situation.

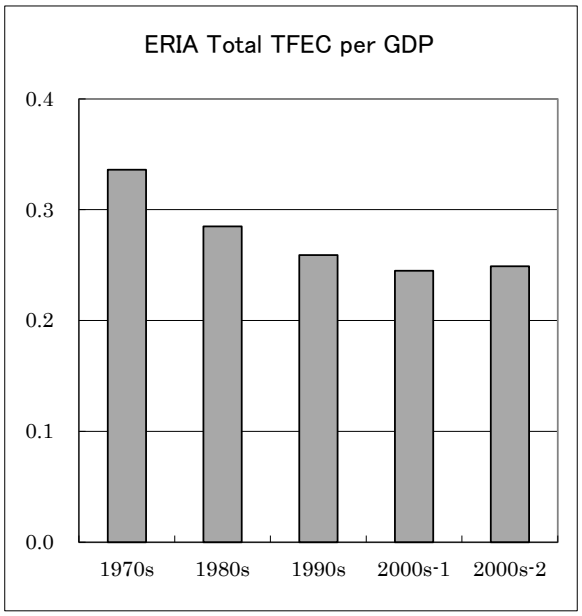
Table 2-23: Comparison (TPES/GDP ratio)

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	0.9	0.8	0.8	0.8	0.7	0.7	0.8	0.8	0.9	0.9	1.3	1.2	1.3	1.4	1.5
Brunei	1.8	0.8	0.5	0.5	0.4	1.4	0.7	0.6	0.6	0.5	2.5	1.2	0.9	0.9	0.8
Cambodia	-	-	0.2	0.2	0.3	-	-	0.2	0.3	0.3	-	-	0.3	0.4	0.6
China	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.2	0.3	0.3	0.1	0.2	0.3	0.4	0.5
India	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.5
Indonesia	0.3	0.3	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.3	0.4	0.4	0.4	0.4	0.5
Japan	2.1	2.2	2.0	1.8	1.8	1.5	2.0	2.1	2.1	2.3	2.8	3.2	3.2	3.3	3.8
Korea	0.9	0.8	0.6	0.6	0.6	0.7	0.7	0.6	0.7	0.7	1.2	1.1	1.0	1.1	1.2
Lao PDR	-	-	0.2	0.2	0.2	-	-	0.2	0.3	0.3	-	-	0.3	0.4	0.4
Malaysia	0.7	0.5	0.4	0.4	0.4	0.5	0.5	0.5	0.4	0.4	1.0	0.8	0.7	0.7	0.7
Myanmar	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.2	0.3	0.1	0.2	0.2	0.3	0.5
New Zealand	1.1	0.9	0.7	0.7	0.7	0.8	0.8	0.7	0.8	0.9	1.5	1.3	1.1	1.2	1.5
Philippines	0.6	0.5	0.4	0.4	0.5	0.4	0.5	0.4	0.5	0.6	0.8	0.7	0.7	0.8	1.0
Singapore	1.1	1.1	0.8	1.0	1.4	0.8	1.0	0.8	1.2	1.8	1.5	1.6	1.3	1.8	3.0
Thailand	0.5	0.5	0.4	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.6	0.7	0.6	0.6	0.6
Vietnam	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3

4.11. TFEC/GDP Ratio

TEC/GDP ratio shrank across all time periods, indicating progress in the improvement of energy efficiency at the end-user level.

Figure 2-9: ERIA Total TFEC/GDP Ratio



The following shows TFEC/GDP ratio for ERIA member countries. Most countries exhibited trends toward improved energy efficiency over the evaluation period.

Table 2-24: TFEC/GDP Ratio

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	0.218	0.197	0.182	0.159	0.109
Brunei	0.026	0.056	0.092	0.095	0.168
Cambodia	-	-	1.027	0.757	0.412
China	3.125	1.933	0.985	0.587	0.371
India	1.186	1.047	0.823	0.622	0.373
Indonesia	0.932	0.753	0.644	0.683	0.431
Japan	0.105	0.076	0.073	0.072	0.050
South Korea	0.258	0.223	0.246	0.224	0.148
Lao PDR	-	-	0.996	0.816	0.544
Malaysia	0.283	0.278	0.297	0.319	0.234
Myanmar	2.504	1.967	1.729	0.993	0.565
New Zealand	0.198	0.211	0.249	0.218	0.139
Philippines	0.411	0.340	0.358	0.284	0.158
Singapore	0.105	0.107	0.095	0.097	0.072
Thailand	0.841	0.608	0.630	0.603	0.385
Vietnam	2.067	1.760	1.270	1.039	0.677
OECD avg.	0.222	0.176	0.149	0.135	0.094
ERIA avg.	0.336	0.285	0.259	0.245	0.249

The following chart shows a comparison with the OECD and ERIA averages. with the TFEC/GDP ratio, the better situation is shown by lower values, but as inverse numbers have been used for the TFEC/GDP ratio for the purpose of this comparison, the large values here show the better situation.

Table 2-25: Comparison (TFEC/GDP ratio)

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	1.4	1.3	1.2	1.2	1.6	0.7	0.8	0.8	1.0	1.4	1.9	1.8	1.9	2.2	3.4
Brunei	11.4	4.5	2.4	2.1	1.1	5.9	2.8	1.7	1.6	0.9	15.6	6.6	3.8	3.7	2.2
Cambodia	-	-	0.2	0.3	0.4	-	-	0.1	0.2	0.4	-	-	0.3	0.5	0.9
China	0.1	0.1	0.2	0.3	0.5	0.0	0.1	0.2	0.3	0.4	0.1	0.2	0.4	0.6	1.0
India	0.3	0.2	0.3	0.3	0.5	0.1	0.1	0.2	0.2	0.4	0.3	0.3	0.4	0.6	1.0
Indonesia	0.3	0.3	0.3	0.3	0.4	0.2	0.2	0.2	0.2	0.4	0.4	0.5	0.5	0.5	0.9
Japan	2.9	3.3	3.0	2.7	3.6	1.5	2.0	2.1	2.1	3.1	3.9	4.8	4.8	4.9	7.5
Korea	1.2	1.1	0.9	0.9	1.2	0.6	0.7	0.6	0.7	1.0	1.6	1.6	1.4	1.6	2.5
Lao PDR	-	-	0.2	0.2	0.3	-	-	0.2	0.2	0.3	-	-	0.4	0.4	0.7
Malaysia	1.1	0.9	0.7	0.6	0.8	0.5	0.6	0.5	0.5	0.7	1.4	1.3	1.2	1.1	1.6
Myanmar	0.1	0.1	0.1	0.2	0.3	0.1	0.1	0.1	0.2	0.3	0.2	0.2	0.2	0.4	0.7
New Zealand	1.5	1.2	0.9	0.9	1.3	0.8	0.7	0.6	0.7	1.1	2.1	1.7	1.4	1.6	2.7
Philippines	0.7	0.7	0.6	0.7	1.1	0.4	0.5	0.4	0.5	1.0	1.0	1.1	1.0	1.2	2.4
Singapore	2.9	2.3	2.3	2.0	2.5	1.5	1.4	1.6	1.6	2.1	3.9	3.4	3.7	3.6	5.1
Thailand	0.4	0.4	0.3	0.3	0.5	0.2	0.3	0.2	0.3	0.4	0.5	0.6	0.6	0.6	1.0
Vietnam	0.1	0.1	0.2	0.2	0.3	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.6

4.12. Days of On-land Oil Stocks

IEA member countries are supposed to sustain emergency oil stocks equivalent to over 90 days of their net oil imports. Data on emergency stocks is available for OECD countries, but not for non-OECD countries other than Myanmar.

The following shows a comparison of days of on-land oil stocks against the OECD average. Only Japan exceeded the OECD average.

Note: This analysis is based on the data obtained from the "Monthly oil market report" of the IEA. The definition of "Days" in the "Monthly oil market report" is different from that calculated by using net imports of oil.

(See page 14)—shall adjust

Table 2-26: Days of on-land oil stocks

Country	1980s		1990s		2000s-1		2000s-2	
	Days	vs. OECD	Days	vs. OECD	Days	vs. OECD	Days	vs. OECD
Australia	64	0.7	48	0.5	40	0.5	40	0.5
Brunei								
Cambodia								
China								
India								
Indonesia								
Japan	101	1.1	103	1.2	105	1.3	122	1.4
South Korea			34	0.4	53	0.7	66	0.7
Lao PDR						0.0		
Malaysia								
Myanmar							71	0.8
New Zealand	74	0.8	69	0.8	59	0.8	50	0.6
Philippines								
Singapore								
Thailand								
Vietnam								
OECD avg.	95		88		79		89	

4.13. CO_2 Emission

The CO_2 emissions/ TPES, CO_2 emissions/fossil fuel, CO_2 emissions/GDP ratios, and CO_2 emissions per capita were adopted as measurements by which to evaluate CO_2 emissions.

ERIA's total CO_2 emissions/TPES ratio increased with time. The reason for this is thought to be an expansion in the use of commercial energy.

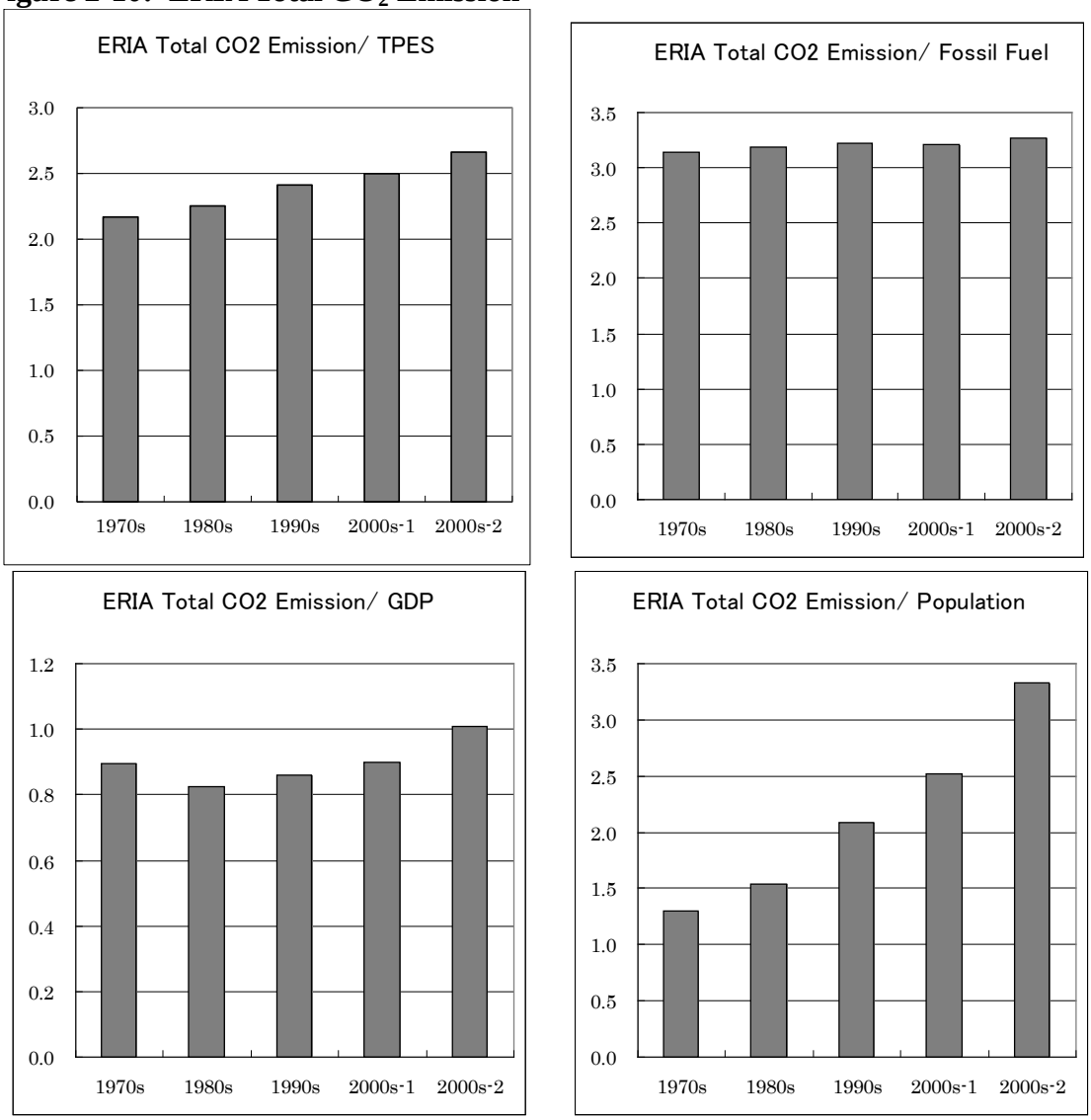
ERIA's total CO_2 emissions/fossil fuel ratio hardly changed at all, signifying that there was no major change in the composition of fossil fuel usage or energy use efficiency.

ERIA's total CO_2 emissions/GDP ratio shrank from the 1970s to the 1980s, but has basically been on an increasing trend after that. The reason for this is thought to be the dulling of economic growth which was led by a stagnant Japanese economy and, conversely, the increased speed at which energy demand expanded, dominated by China.

ERIA's total CO_2 emissions per capita increased greatly over the years. One reason

for the increase is thought to be the shift toward commercial energy from firewood and other energies calculated to have zero CO_2 emissions, along with economic growth.

Figure 2-10: ERIA Total CO_2 Emission



The following are the calculation results for CO_2 emissions per country, and their comparison with the OECD and ERIA averages. With CO_2 emissions, the better situation is shown by lower values, but as inverse numbers have been used for CO_2 emissions for the purpose of this comparison, the large values here show the better situation.

Comparing differences in CO_2 emissions per primary energy supply source in the 1970s and 2000s-2, only Japan, South Korea and New Zealand decreased CO_2

emissions. Other countries increased emissions over the period. It is thought that one reason for this is the improvement of energy use efficiency due to the increased use of nuclear energy and other non-CO_2 emitting energy sources over the period, as well as the increased use of low-carbon natural gas among fossil fuels and improved energy use efficiency.

Table 2-27: CO_2 Emissions/TPES ratio

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	2.90	2.98	3.04	3.23	3.09
Brunei	1.92	1.93	1.96	2.01	1.55
Cambodia	-	-	0.53	0.76	0.91
China	2.19	2.49	2.80	2.87	3.05
India	1.34	1.67	2.02	2.14	2.29
Indonesia	0.93	1.27	1.51	1.77	1.87
Japan	2.76	2.45	2.33	2.33	2.34
South Korea	3.07	2.76	2.41	2.24	2.22
Lao PDR	-	-	0.34	0.71	0.67
Malaysia	2.11	2.03	2.27	2.40	2.47
Myanmar	0.50	0.49	0.52	0.68	0.76
New Zealand	1.99	1.78	1.71	1.89	1.92
Philippines	1.56	1.29	1.65	1.79	1.77
Singapore	2.29	2.43	2.04	2.19	2.58
Thailand	1.37	1.63	2.17	2.23	2.24
Vietnam	0.81	0.81	0.92	1.43	1.70
OECD Total	2.71	2.55	2.42	2.38	2.34
ERIA Total	2.17	2.25	2.41	2.50	2.66

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	0.9	0.9	0.8	0.7	0.8	0.9	0.8	0.8	0.8	0.8	0.7	0.8	0.8	0.8	0.9
Brunei	1.4	1.3	1.2	1.2	1.5	1.3	1.3	1.3	1.2	1.6	1.1	1.2	1.2	1.2	1.7
Cambodia	-	-	4.6	3.2	2.6	-	-	4.7	3.3	2.7	-	-	4.5	3.3	2.9
China	1.2	1.0	0.9	0.8	0.8	1.1	1.0	0.9	0.9	0.8	1.0	0.9	0.9	0.9	0.9
India	2.0	1.5	1.2	1.1	1.0	1.9	1.5	1.2	1.2	1.1	1.6	1.4	1.2	1.2	1.2
Indonesia	2.9	2.0	1.6	1.3	1.3	2.7	2.0	1.6	1.4	1.3	2.3	1.8	1.6	1.4	1.4
Japan	1.0	1.0	1.0	1.0	1.0	0.9	1.0	1.1	1.1	3.1	0.8	0.9	1.0	1.1	1.1
Korea	0.9	0.9	1.0	1.1	1.1	0.8	0.9	1.0	1.1	1.1	0.7	0.8	1.0	1.1	1.2
Lao PDR	-	-	7.1	3.3	3.5	-	-	7.3	3.5	3.7	-	-	7.1	3.5	4.0
Malaysia	1.3	1.3	1.1	1.0	0.9	1.2	1.2	1.1	1.0	1.0	1.0	1.1	1.1	1.0	1.1
Myanmar	5.4	5.2	4.7	3.5	3.1	4.9	5.0	4.8	3.7	3.3	4.3	4.6	4.7	3.7	3.5
New Zealand	1.4	1.4	1.4	1.3	1.2	1.3	1.4	1.5	1.3	1.3	1.1	1.3	1.4	1.3	1.4
Philippines	1.7	2.0	1.5	1.3	1.3	1.6	1.9	1.5	1.4	1.4	1.4	1.8	1.5	1.4	1.5
Singapore	1.2	1.0	1.2	1.1	0.9	1.1	1.0	1.2	1.1	1.0	0.9	0.9	1.2	1.1	1.0
Thailand	2.0	1.6	1.1	1.1	1.0	1.8	1.5	1.1	1.1	1.1	1.6	1.4	1.1	1.1	1.2
Vietnam	3.3	3.1	2.6	1.7	1.4	3.1	3.1	2.7	1.7	1.5	2.7	2.8	2.6	1.7	1.6

The CO_2 emissions/fossil fuel ratio decreased in every country.in the 1970s and 2000s-2,

Table 2-28: CO_2 Emissions/Fossil fuel primary supply

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	3.15	3.20	3.24	3.43	3.28
Brunei	1.96	1.94	1.96	2.01	2.27
Cambodia	-	-	2.95	2.98	2.95
China	3.38	3.48	3.61	3.50	3.52
India	3.43	3.38	3.30	3.22	3.23
Indonesia	2.64	2.68	2.49	2.89	2.86
Japan	2.90	2.82	2.84	2.85	2.85
South Korea	3.10	3.07	2.80	2.74	2.74
Lao PDR	-	-	2.32	3.81	2.09
Malaysia	2.62	2.35	2.47	2.55	2.60
Myanmar	2.93	2.73	2.61	2.54	2.48
New Zealand	2.88	2.61	2.60	2.77	2.88
Philippines	2.93	3.15	3.03	3.11	3.12
Singapore	2.29	2.43	2.02	2.12	2.59
Thailand	2.82	2.98	2.94	2.79	2.79
Vietnam	3.48	3.62	3.40	3.25	3.20
OECD Total	2.93	2.94	2.91	2.88	2.86
ERIA Total	3.14	3.19	3.22	3.20	3.27

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	0.9	0.9	0.9	0.8	0.9	0.9	0.9	0.9	0.8	0.9	1.0	1.0	1.0	0.9	1.0
Brunei	1.5	1.5	1.5	1.4	1.3	1.5	1.5	1.5	1.4	1.3	1.6	1.6	1.6	1.6	1.4
Cambodia	-	-	1.0	1.0	1.0	-	-	1.0	1.0	1.0	-	-	1.1	1.1	1.1
China	0.9	0.8	0.8	0.8	0.8	0.9	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9
India	0.9	0.9	0.9	0.9	0.9	0.8	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0
Indonesia	1.1	1.1	1.2	1.0	1.0	1.1	1.1	1.2	1.0	1.0	1.2	1.2	1.3	1.1	1.1
Japan	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1
Korea	0.9	1.0	1.0	1.1	1.0	0.9	0.9	1.0	1.1	1.1	1.0	1.0	1.1	1.2	1.2
Lao PDR	-	-	1.3	0.8	1.4	-	-	1.3	0.8	1.4	-	-	1.4	0.8	1.6
Malaysia	1.1	1.3	1.2	1.1	1.1	1.1	1.2	1.2	1.1	1.1	1.2	1.4	1.3	1.3	1.3
Myanmar	1.0	1.1	1.1	1.1	1.2	1.0	1.1	1.1	1.1	1.2	1.1	1.2	1.2	1.3	1.3
New Zealand	1.0	1.1	1.1	1.0	1.0	1.0	1.1	1.1	1.1	1.0	1.1	1.2	1.2	1.2	1.1
Philippines	1.0	0.9	1.0	0.9	0.9	1.0	0.9	1.0	0.9	0.9	1.1	1.0	1.1	1.0	1.0
Singapore	1.3	1.2	1.4	1.4	1.1	1.3	1.2	1.4	1.4	1.1	1.4	1.3	1.6	1.5	1.3
Thailand	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.2
Vietnam	0.8	0.8	0.9	0.9	0.9	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0

The ratio of CO_2 Emissions to GDP decreased in Australia, China, Japan, South Korea, Myanmar, and the Philippines in the 1970s and 2000s-2, and increased or remained at a nearly steady level over the years in other ERIA member countries.

Table 2-29 CO_2 Emissions /GDP ratio

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	0.93	0.89	0.85	0.81	0.75
Brunei	0.32	0.60	0.79	0.77	1.10
Cambodia	-	-	0.61	0.66	0.60
China	8.07	5.84	3.66	2.52	2.44
India	1.77	2.08	2.23	1.96	1.78
Indonesia	0.98	1.11	1.32	1.61	1.50
Japan	0.40	0.28	0.25	0.25	0.23
South Korea	1.02	0.88	0.84	0.75	0.68
Lao PDR	-	-	0.37	0.64	0.56
Malaysia	0.88	0.94	1.12	1.23	1.26
Myanmar	1.41	1.12	1.01	0.76	0.63
New Zealand	0.54	0.51	0.56	0.54	0.49
Philippines	0.80	0.64	0.88	0.84	0.64
Singapore	0.61	0.54	0.56	0.42	0.32
Thailand	0.90	0.84	1.18	1.36	1.33
Vietnam	1.78	1.55	1.26	1.67	1.83
OECD Total	0.81	0.63	0.52	0.47	0.42
ERIA Total	0.90	0.83	0.86	0.90	1.01

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	0.9	0.7	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	1.0	0.9	1.0	1.1	1.3
Brunei	2.6	1.0	0.7	0.6	0.4	1.8	0.9	0.7	0.7	0.5	2.8	1.4	1.1	1.2	0.9
Cambodia	-	-	0.9	0.7	0.7	-	-	0.9	0.8	0.9	-	-	1.4	1.4	1.7
China	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.2	0.4	0.4
India	0.5	0.3	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.5	0.4	0.4	0.5	0.6
Indonesia	0.8	0.6	0.4	0.3	0.3	0.6	0.5	0.4	0.3	0.4	0.9	0.7	0.7	0.6	0.7
Japan	2.0	2.3	2.1	1.9	1.8	1.4	2.0	2.2	2.2	2.4	2.2	3.0	3.4	3.6	4.4
Korea	0.8	0.7	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.8	0.9	0.9	1.0	1.2	1.5
Lao PDR	-	-	1.4	0.7	0.8	-	-	1.5	0.9	1.0	-	-	2.3	1.4	1.8
Malaysia	0.9	0.7	0.5	0.4	0.3	0.6.	0.6	0.5	0.5	0.4	1.0	0.9	0.8	0.7	0.8
Myanmar	0.6	0.6	0.5	0.6	0.7	0.4	0.5	0.6	0.7	0.9	0.6	0.7	0.8	1.2	1.6
New Zealand	1.5	1.2	0.9	0.9	0.9	1.0	1.1	1.0	1.0	1.1	1.7	1.6	1.5	1.7	2.1
Philippines	1.0	1.0	0.6	0.6	0.7	0.7	0.9	0.6	0.7	0.9	1.1	1.3	1.0	1.1	1.6
Singapore	1.3	1.2	0.9	1.1	1.3	0.9	1.0	1.0	1.3	1.7	1.5	1.5	1.5	2.1	3.1
Thailand	0.9	0.7	0.4	0.3	0.3	0.6	0.7	0.5	0.4	0.4	1.0	1.0	0.7	0.7	0.8
Vietnam	0.5	0.4	0.4	0.3	0.2	0.3	0.4	0.4	0.3	0.3	0.5	0.5	0.7	0.5	0.6

All ERIA member countries saw increases in CO_2 emissions per capita in the 1970s and 2000s-2,. Driving this trend were increases in energy consumption per person, along with economic growth and rising living standards.

Table 2-30: CO_2 Emissions per capita

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	12.55	13.98	15.87	18.19	18.30
Brunei	8.07	13.33	14.67	13.99	19.49
Cambodia	-	-	0.15	0.23	0.30
China	1.17	1.64	2.32	2.97	4.72
India	0.39	0.55	0.82	1.00	1.24
Indonesia	0.30	0.53	1.01	1.40	1.59
Japan	7.84	7.37	8.94	9.42	9.19
South Korea	2.30	3.80	7.32	9.41	10.22
Lao PDR	-	-	0.10	0.23	0.26
Malaysia	1.32	2.04	3.82	5.23	6.30
Myanmar	0.14	0.14	0.14	0.19	0.24
New Zealand	5.64	5.80	6.92	7.97	7.70
Philippines	0.69	0.58	0.80	0.87	0.77
Singapore	4.04	5.99	10.36	10.19	9.61
Thailand	0.57	0.81	2.12	2.94	3.43
Vietnam	0.30	0.30	0.38	0.78	1.15
OECD Total	10.98	10.37	10.57	10.93	10.51
ERIA Total	1.30	1.54	2.09	2.52	3.33

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	0.9	0.7	0.7	0.6	0.6	0.8	0.8	0.7	0.6	0.6	0.1	0.1	0.1	0.1	0.2
Brunei	1.4	0.8	0.7	0.8	0.5	1.3	0.8	0.7	0.8	0.5	0.2	0.1	0.1	0.2	0.2
Cambodia	-	-	69.2	47.2	35.0	-	-	69.8	46.1	35.5	-	-	13.7	10.9	11.1
China	9.3	6.3	4.6	3.7	2.2	9.1	6.5	4.6	3.6	2.3	1.1	0.9	0.9	0.8	0.7
India	28.4	18.8	12.8	11.0	8.5	27.6	19.3	12.9	10.7	8.6	3.4	2.8	2.5	2.5	2.7
Indonesia	36.2	19.4	10.4	7.8	6.6	35.1	20.0	10.5	7.6	6.7	4.3	2.9	2.1	1.8	2.1
Japan	1.4	1.4	1.2	1.2	1.1	1.4	1.4	1.2	1.1	1.2	0.2	0.2	0.2	0.3	0.4
Korea	4.8	2.7	1.4	1.2	1.0	4.6	2.8	1.5	1.1	1.0	0.6	0.4	0.3	0.3	0.3
Lao PDR	-	-	106.0	46.8	40.8	-	-	106.8	45.6	41.3	-	-	21.0	10.8	12.9
Malaysia	8.3	5.1	2.8	2.1	1.7	8.1	5.2	2.8	2.0	1.7	1.0	0.8	0.5	0.5	0.5
Myanmar	77.0	75.5	78.0	56.4	44.4	74.8	77.5	78.6	55.0	45.0	9.1	11.2	15.4	13.0	14.1
New Zealand	1.9	1.8	1.5	1.4	1.4	1.9	1.8	1.5	1.3	1.4	0.2	0.3	0.3	0.3	0.4
Philippines	16.0	17.9	13.3	12.6	13.6	15.6	18.4	13.4	12.3	13.8	1.9	2.7	2.6	2.9	4.3
Singapore	2.7	1.7	1.0	1.1	1.1	2.6	1.8	1.0	1.0	1.1	0.3	0.3	0.2	0.2	0.3
Thailand	19.2	12.8	5.0	3.7	3.1	18.6	13.1	5.0	3.6	3.1	2.3	1.9	1.0	0.9	1.0
Vietnam	36.0	34.4	27.8	14.1	9.1	35.0	35.4	28.1	13.7	9.3	4.3	5.1	5.5	3.2	2.9

5. Conclusion

East Asia is composed of countries with very different levels of economic development and fossil fuel reserves. For the indices where data can be obtained from eight or more countries, the average, minimum and maximum values for ERIA are shown in the chart below. Great differences can be seen in these values, demonstrating the diverse situation of energy security in East Asia countries.

Table 2-31: ERIA Average, Max and Min of ESIs

ESI		1970s	1980s	1990s	2000s-1	2000s-2
TPES self-sufficiency (including Nuclear)	ERIA avg.	79%	87%	84%	84%	85%
	Max	2186%	1089%	796%	837%	624%
	Min	0%	0%	0%	0%	0%
Reserve/ Production ratio	ERIA avg.	-	110	89	68	49
	Max	-	331	177	135	115
	Min	-	0	0	0	0
Reserve/ Consumption ratio	ERIA avg.	-	94	75	59	40
	Max	-	1,256	466	375	333
	Min	-	0	0	0	0
HHI (Diversity of energy sources)	ERIA avg.	3,120	2,648	2,840	3,215	3,662
	Max	9,996	9,997	10,000	9,637	9,589
	Min	4,066	2,960	2,693	2,338	2,230
Reserve margin of generation capacity	ERIA avg.	25%	31%	22%	28%	32%
	Max	33%	38%	42%	45%	43%
	Min	24%	24%	1%	15%	10%
Commercial energy access ratio	ERIA avg.	58%	74%	82%	85%	88%
	Max	100%	100%	100%	100%	100%
	Min	27%	27%	22%	28%	34%
TPES/ GDP ratio	ERIA avg.	0.41	0.37	0.36	0.36	0.38
	Max	3.68	2.35	1.96	1.17	1.07
	Min	0.15	0.11	0.11	0.11	0.10
TFEC/ GDP ratio	ERIA avg.	0.336	0.285	0.259	0.245	0.249
	Max	3.125	1.967	1.729	1.039	0.565
	Min	0.026	0.056	0.073	0.072	0.050
CO_2 emissions / TPES ratio	ERIA avg.	2.17	2.25	2.41	2.50	2.66
	Max	3.07	2.98	3.04	3.23	3.13
	Min	0.50	0.49	0.50	0.68	0.77
CO_2 smissions / fossil fuel ratio	ERIA avg.	3.14	3.19	3.22	3.20	3.27
	Max	3.48	3.62	3.61	3.81	3.52
	Min	1.96	1.94	1.96	2.01	2.09

ESI		1970s	1980s	1990s	2000s-1	2000s-2
CO_2 smissions / GDP ratio	ERIA avg.	0.90	0.83	0.86	0.90	1.00
	Max	8.07	5.84	3.66	2.52	2.49
	Min	0.32	0.28	0.25	0.25	0.23
CO_2 smissions / capita	ERIA avg.	1.30	1.54	2.09	2.52	3.27
	Max	12.55	13.98	15.87	18.19	19.20
	Min	0.14	0.14	0.14	0.19	0.25

The following is a summary of the special characteristics of the major ESIs.

- ERIA Total TPES self-sufficiency (including nuclear) has been over 80% since the 1980s. This is natural for countries with high fossil fuel self-sufficiency ratios, and there are also countries with low fossil fuel resources that are complementing their self-sufficiency ratios with nuclear energy and other energy sources.
- There is a trend among fossil fuel rich countries toward shrinking R/P and R/C ratios. The background to this is the increase in the speed of domestic energy consumption compared with the speed of development of new energy resources.
- ERIA Total Diversity by energy sources showed a concentrating trend toward coal. The background to this is the fact that East Asian countries are rich in coal and there is an increasing use of coal, mainly in the power generation sector.
- The ERIA Total Reserve margin of generation capacity demonstrated an increasing trend, but there were also countries where this value fell greatly.
- The Commercial Energy access ratio, and the electrification rate, which is shown as a reference, rose in all countries.
- ERIA Total TPES/GDP ratio and TFEC/GDP ratio values fell, indicating an improvement in energy efficiency.
- Many countries demonstrated worsening measurements related to CO_2 Emissions. The background to this is the increasing consumption of fossil fuels along with economic growth and improving standards of living.

CHAPTER 3

Country Analysis

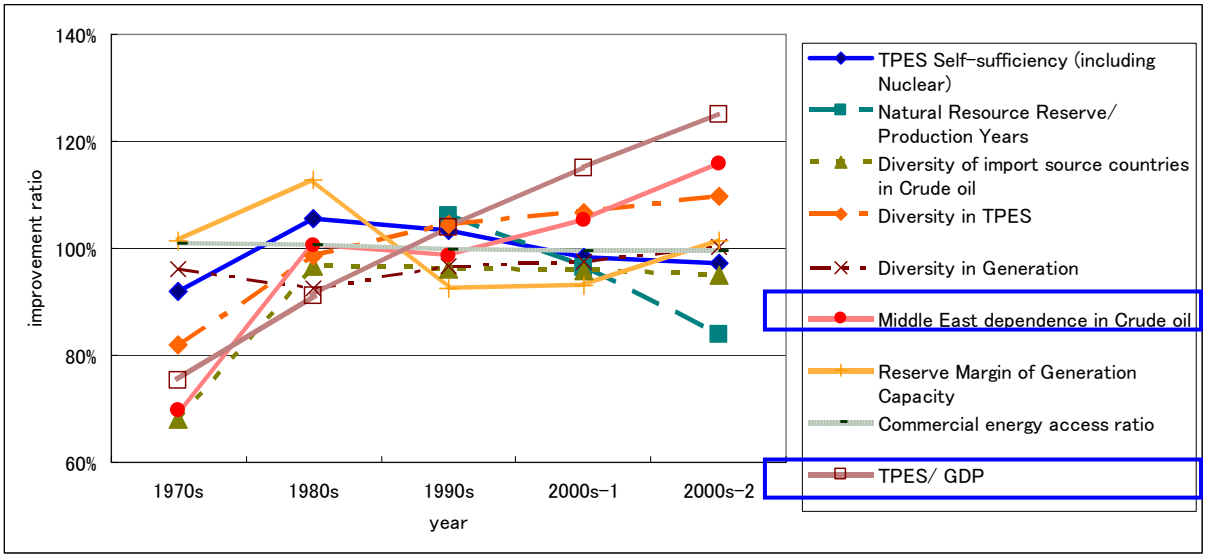
1. Methodology

The “scores” of each member country, gathered from the actual data, are described in this section. Since the purpose of this research is NOT to compare the scores of each index among member countries BUT to comprehend the strengths and the weaknesses of each of the member countries in securing energy, we have undertaken the procedures outlined below:

1) Calculation of the average indices in all OECD member countries from the 1970s to the 2000s

Figure 3-1 shows the trends of each index in OECD countries.

Figure 3-1: Trends of each index in OECD countries



There are three remarkable changes that have occurred over these 40 years in OECD countries. The first is a drastic improvement in their dependence on crude oil from the Middle East. The second is an improvement of energy intensity and total primary energy supply in proportion to GDP, meaning that energy-conservative

technologies have developed tremendously in these 40 years. The third is an improvement in the diversification of the primary energy supply. The development and commercialization of natural gas and nuclear as a power source would be the major factors for this improvement.

Domestic trends and progress in each ERIA member country should be evaluated as well, aside from these improvements in OECD countries. We have already collected average data in all OECD member countries in each index, as shown in Annex 1-8, and then we collected the average for each index throughout the evaluated period. We have selected the average throughout the evaluated period as a common base value to use for comparisons with country data.

2) Analysis of the "score" of each member country in comparison with the average in OECD countries

"Scores" are calculated as a ratio to the average value in the OECD. For example, the score for total self sufficiency (taking into account nuclear energy) in Japan can be calculated as below:

- Japan's total self sufficiency in the 1970s = 10.5%
- The average in the OECD from the 1970s to the 2000s = 72.8%
- Japan's score in total self sufficiency = 10.5% / 72.8% = 0.1

3) Consideration of the score in each member country, checking for any increases/decreases and any remarkable features

The scores in every country can be deduced if the data is sufficient. We found some remarkable increases/decreases in certain indices and tried to find any implications for efforts to secure energy and utilize resources in each country.

2. Country Analysis

In this section, the major characteristics of the indices of each member country are described.

For all calculated scores described in the following chapters, the HIGHER SCORE shows the BETTER CONDITION.

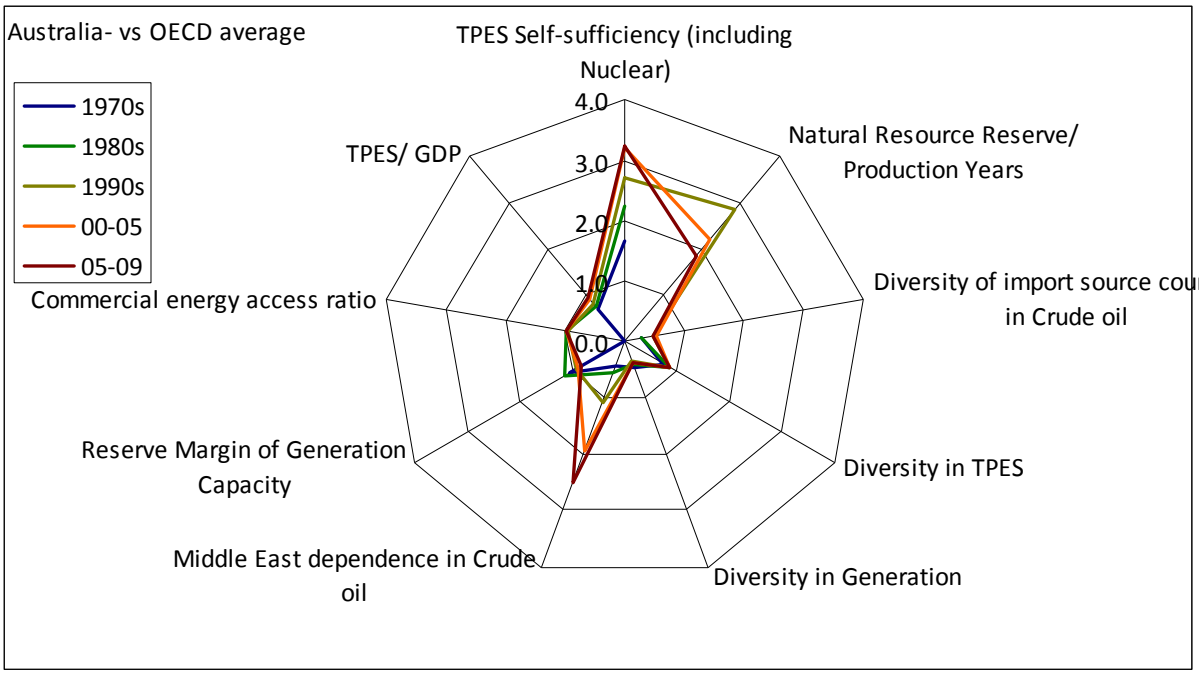
2.1. AUSTRALIA

Three major features are found in Australia. First, self sufficiency has been high in comparison with the OECD countries thanks to abundant coal and gas resources. Secondly, their power generation mix has not been diversified much, which reflects the high penetration of brown coal use in the power sector. Thirdly, dependence on oil from the Middle East has improved remarkably, and diversification was above the OECD average over the latest decade. One other thing of note is the gradually declining trend of reserve margin as a proportion of power generation capacity. The competitive electricity market structure may be able to explain one aspect of this trend.

Table 3-1: Major Indices in Australia in comparison with the OECD average

	1970s	1980s	1990s	00-05	00-09
TPES Self-sufficiency (including Nuclear)	1.6	2.2	2.7	3.2	3.2
Natural Resources Reserve/ Production Years			2.8	2.2	1.9
Diversity of import source countries in Crude Oil	0.26	0.3	0.5	0.5	0.5
Diversity in TPES	0.8	0.8	0.9	0.9	0.9
Diversity in Generation	0.5	0.4	0.4	0.4	0.4
Middle East dependence in Crude Oil	0.5	0.6	1.1	1.9	2.5
Reserve Margin of Generation Capacity	1.0	1.2	0.9	0.9	0.8
Commercial energy access ratio	-	1.0	1.0	1.0	1.0
TPES/GDP	0.7	0.8	0.8	0.9	0.9

Figure 3-2: Major Indices in Australia in comparison with the OECD average



2.2. BRUNEI

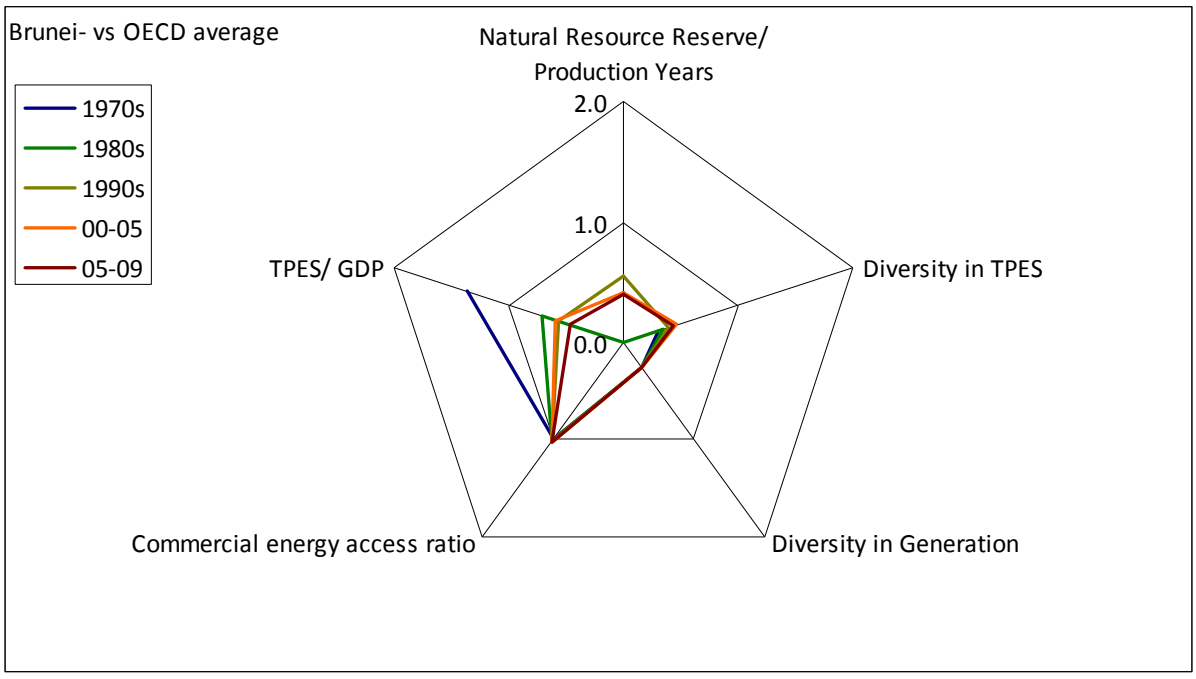
Brunei is a very rich county in natural resources and therefore its self sufficiency is one of the highest in the world. However, the self sufficiency rate has been decreasing in comparison with the OECD average, mainly due to its high consumption growth rate.

Energy efficiency, described by TPES/GDP, has been decreasing over the past 40 years. The improvement of energy efficiency while preserving fossil resources is a major issue to be addressed for the future.

Table 3-2: Major Indices in Brunei in comparison with the OECD average

	1970s	1980s	1990s	00-05	00-09
TPES Self-sufficiency (including Nuclear)	30.0	15.0	10.9	11.5	8.6
Natural Resources Reserve/ Production Years		-	0.5	0.4	0.4
Diversity in TPES	0.3	0.4	0.4	0.5	0.4
Diversity in Generation	0.3	0.2	0.2	0.2	0.2
Commercial energy access ratio	1.0	1.0	1.0	1.0	1.0
TPES/GDP	1.4	0.7	0.6	0.6	0.5

Figure 3-3: Major Indices in Brunei in comparison with the OECD average



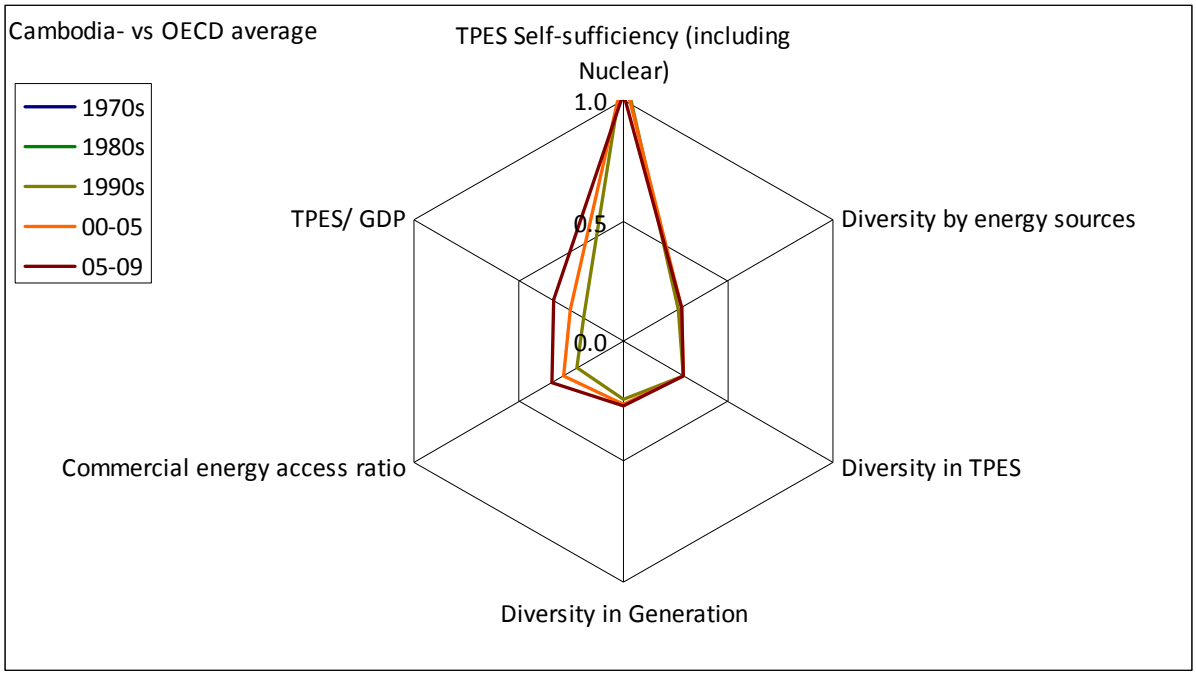
2.3. CAMBODIA

Self sufficiency in Cambodia has been higher than the OECD average over the past 40 years, mainly due to abundant hydropower and low energy demand. However, diversification is low both in terms of the primary energy supply and in terms of power generation. The energy efficiency, TPES /GDP ratio, has also been quite low in comparison with the OECD average, and thus Cambodia may possess a large potential to improve energy efficiency while increasing commercial energy access by switching from combustible bio-fuels to electricity.

Table 3-3: Major Indices in Cambodia in comparison with the OECD average

	1970s	1980s	1990s	00-05	00-09
TPES Self-sufficiency (including Nuclear)	-	-	1.1	1.1	1.0
Natural Resources Reserve/ Production Years	-	-	0.3	0.3	0.3
Diversity in TPES	-	-	0.3	0.3	0.3
Diversity in Generation	-	-	0.2	0.3	0.3
Commercial energy access ratio	-	-	0.2	0.3	0.3
TPES/GDP	-	-	0.2	0.3	0.3

Figure 3-4: Major Indices in Cambodia in comparison with the OECD average



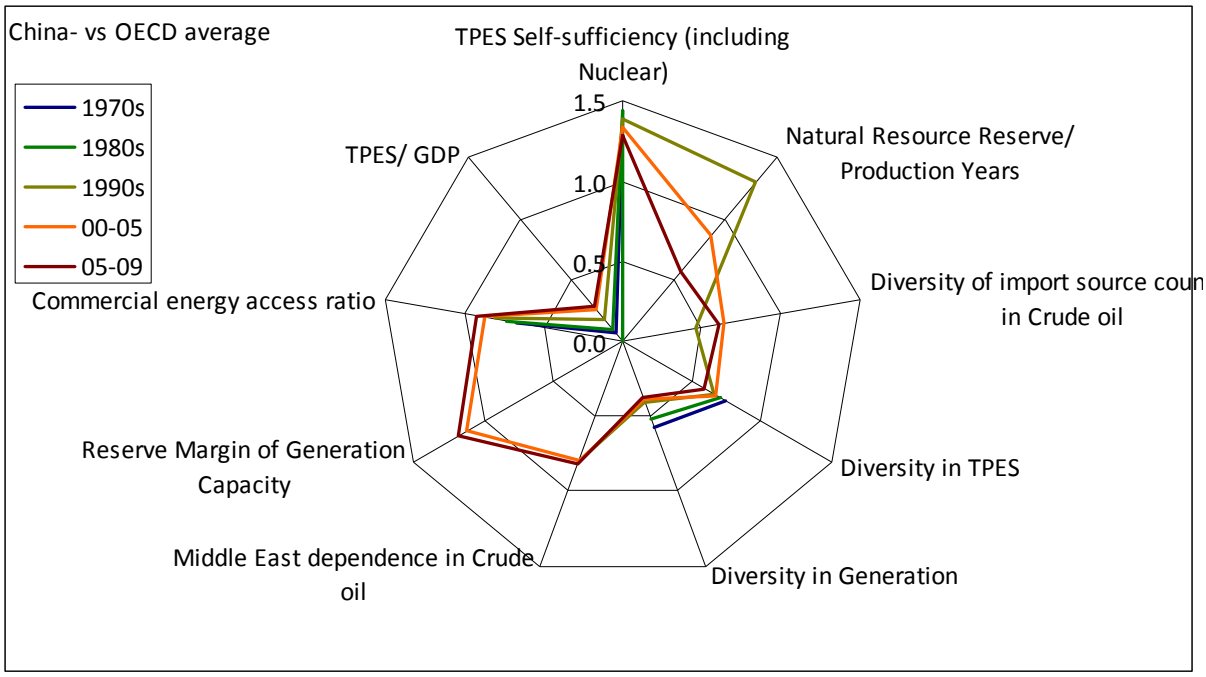
2.4. CHINA

Since China was an oil exporting country until the 1990s, they have not paid much attention to the diversification of import sources, nor to their power portfolio. Since the 2000s, however, China has been a large oil importing country and also the biggest energy consumer in the world. From the viewpoint of diversity, the increase of coal consumption in the power sector has caused the relevant scores to drop. When considering the changing situation related to imports dependency , which is only going to increase in China, diversifying import source countries and diversifying the energy portfolio (including in the power sector) as well as improving energy efficiency will be major issues to be pursued.

Table 3-4: Major Indices in China in comparison with the OECD average

	1970s	1980s	1990s	00-05	00-09
TPES Self-sufficiency (including Nuclear)	1.4	1.4	1.4	1.3	1.3
Natural Resources Reserve/ Production Years		-	1.3	0.9	0.6
Diversity of import source countries in Crude Oil			0.5	0.6	0.6
Diversity in TPES	0.7	0.7	0.7	0.7	0.6
Diversity in Generation	0.6	0.5	0.4	0.4	0.4
Middle East dependence in Crude Oil			0.8	0.8	0.8
Reserve Margin of Generation Capacity				1.1	1.2
Commercial energy access ratio	0.7	0.7	0.8	0.9	0.9
TPES/GDP	0.1	0.1	0.2	0.3	0.3

Figure 3-5: Major Indices in China in comparison with the OECD average



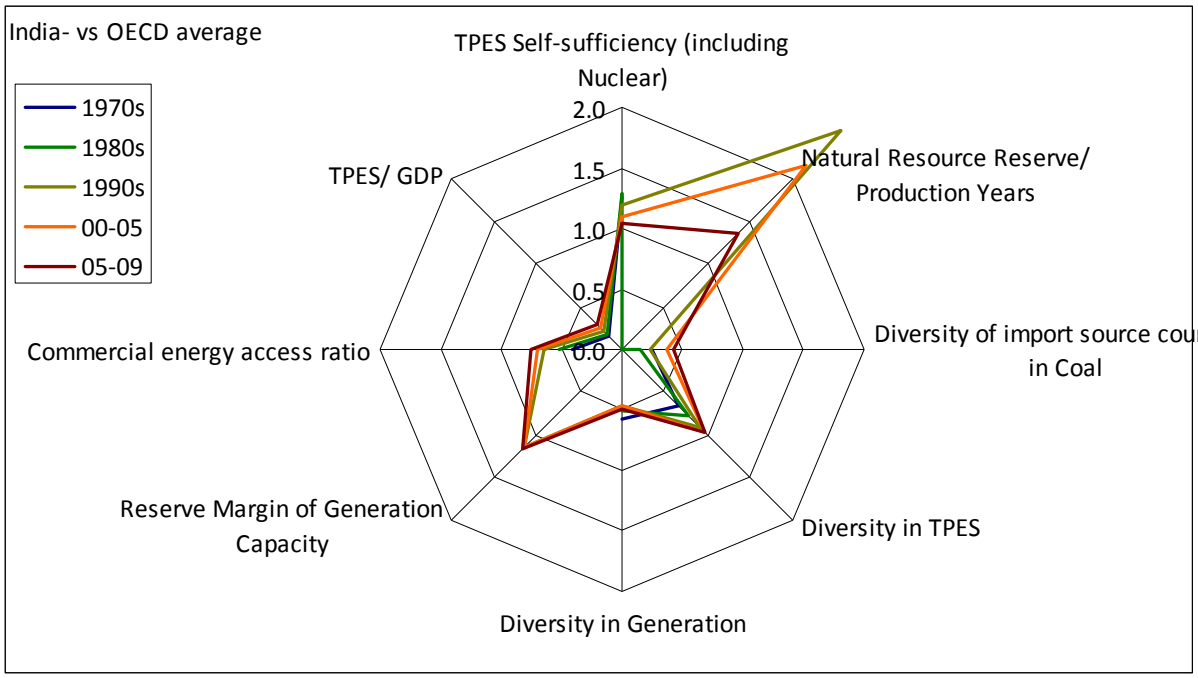
2.5. INDIA

India has abundant natural resources and has maintained relatively high self-sufficiency so far. Since the 2000s, however, energy consumption has been rapidly increasing due to high economic growth, and dependency on imports for energy supply is gradually rising to fill supply shortfalls from domestic resources. TPES is relatively well balanced here, but the power generation sector is not. The commercial energy access ratio has been rising and will surely have a positive impact on increases in electricity demand. It will be essential for the country to increase its energy efficiency from the current low level in order to both preserve domestic fossil resources and reduce import dependency.

Table 3-5: Major Indices in India in comparison with the OECD average

	1970s	1980s	1990s	00-05	00-09
TPES Self-sufficiency (including Nuclear)	1.3	1.3	1.2	1.1	1.0
Natural Resources Reserve/ Production Years		-	2.5	2.2	1.4
Diversity of import source countries in Coal	0.25	0.2	0.2	0.4	0.4
Diversity in TPES	0.7	0.8	0.9	1.0	1.0
Diversity in Generation	0.6	0.5	0.5	0.5	0.5
Reserve Margin of Generation Capacity			1.1	1.1	1.2
Commercial energy access ratio	0.4	0.5	0.6	0.7	0.7
TPES/GDP	0.2	0.2	0.2	0.2	0.3

Figure 3-6: Major Indices in India in comparison with the OECD average



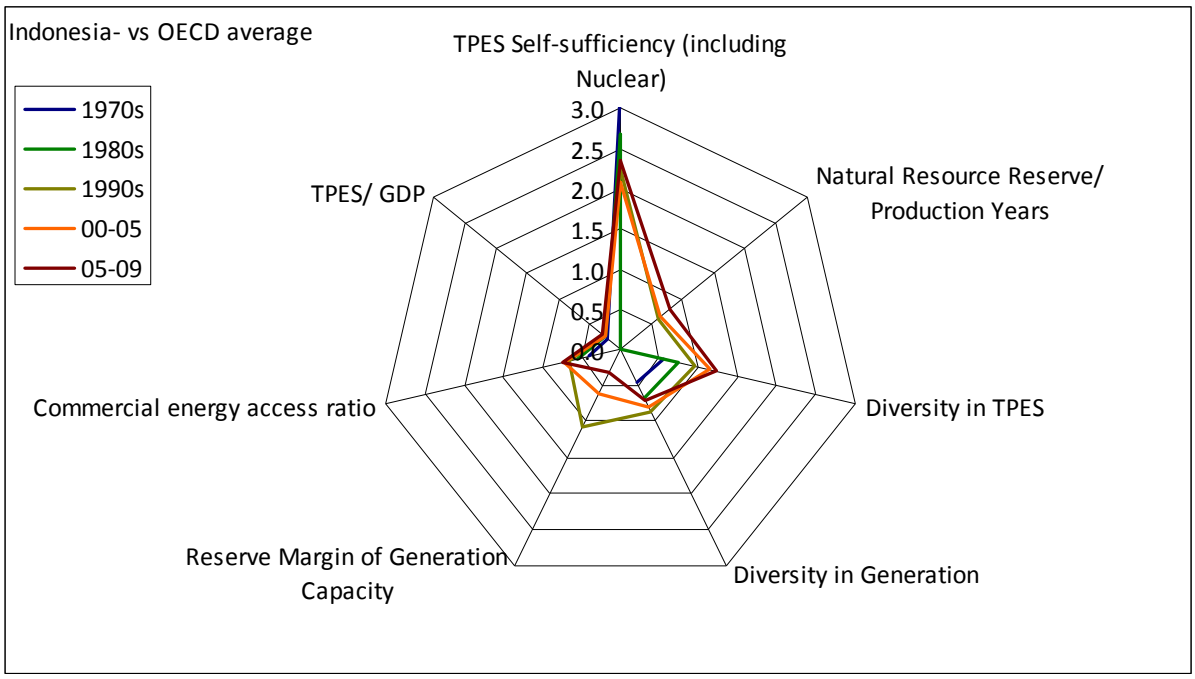
2.6. INDONESIA

The major features of Indonesia's ESI are the following three: first is a remarkably high self sufficiency thus far; second is a remarkable improvement in the energy portfolio, which has been above the OECD average over the recent 10 years; and third is falling electricity reliability, resulting in severe electricity shortages and frequent blackouts in urban areas. Appropriate investment into new power generation capacities may therefore be a key to enhancing the country's energy security. Beside these indices, it should be also noted that low energy efficiency and TPES/GDP should be urgently improved so as to help match the country's supply with its demand.

Table 3-6: Major Indices in Indonesia in comparison with the OECD average

	1970s	1980s	1990s	00-05	00-09
TPES Self-sufficiency (including Nuclear)	3.2	2.7	2.2	2.1	2.3
Natural Resources Reserve/ Production Years		-	0.6	0.6	0.8
Diversity in TPES	0.6	0.7	0.9	1.1	1.2
Diversity in Generation	0.4	0.7	0.9	0.8	0.7
Reserve Margin of Generation Capacity			1.1	0.6	0.3
Commercial energy access ratio	0.4	0.6	0.7	0.7	0.7
TPES/GDP	0.2	0.3	0.3	0.2	0.3

Figure 3-7: Major Indices in Indonesia in comparison with the OECD average



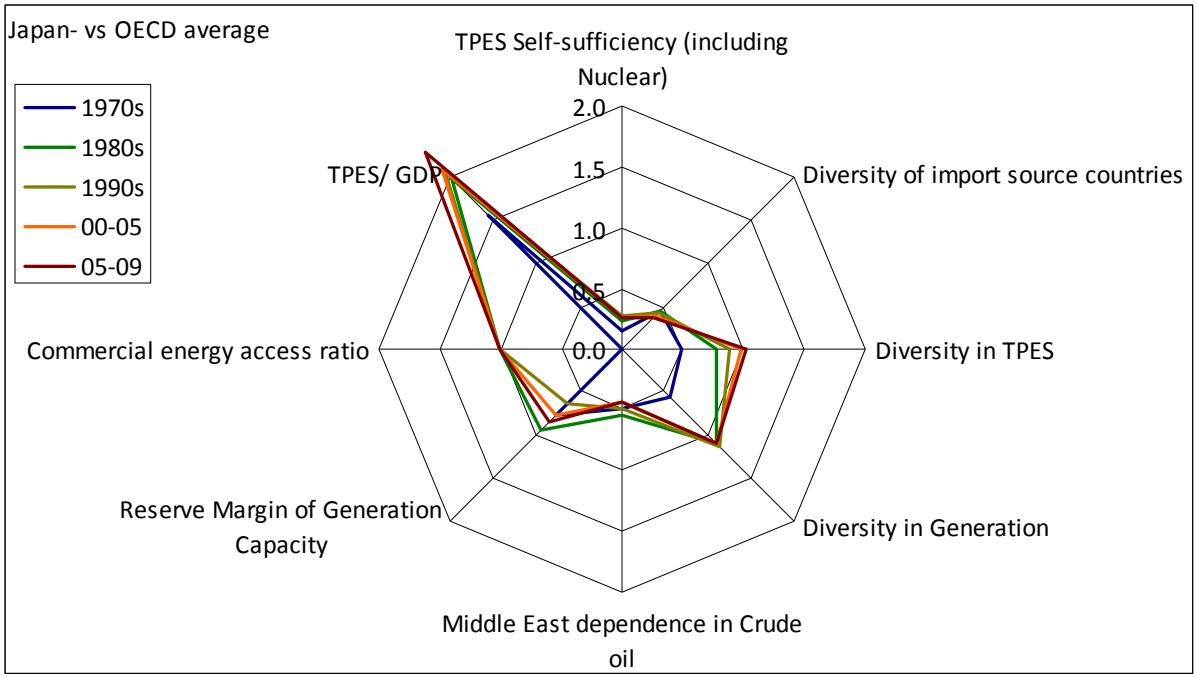
2.7. JAPAN

Japan is the third largest economy and one of the top energy demanding countries in the world. Due to a lack of fossil resources, Japan's dependence on imports for its energy supply has been quite high, resulting in apparently low self sufficiency. Most oil and gas comes from the Middle East. This situation has not changed for the past four decades; something which may be a potential threat to its energy security. Japan has decreased its dependence on oil by introducing nuclear energy and natural gas as alternative power sources, and, as a result, it has had a well diversified power portfolio since the 1980s. Furthermore, its lack of resources has encouraged the development of another positive feature in Japan – a remarkably high energy efficiency.

Table 3-7: Major Indices in Japan in comparison with the OECD average

	1970s	1980s	1990s	00-05	00-09
TPES Self-sufficiency (including Nuclear)	0.1	0.2	0.3	0.3	0.3
Diversity of import source countries	0.4	0.4	0.4	0.4	0.4
Diversity in TPES	0.5	0.8	0.9	1.0	1.0
Diversity in Generation	0.6	1.1	1.1	1.1	1.1
Middle East dependence in Crude Oil	0.5	0.5	0.5	0.4	0.4
Reserve Margin of Generation Capacity	0.8	0.9	0.6	0.8	0.8
Commercial energy access ratio	-	1.0	1.0	1.0	1.0
TPES/GDP	1.5	2.0	2.1	2.1	2.3

Figure 3-8: Major Indices in Japan in comparison with the OECD average



2.8. SOUTH KOREA

South Korea is still developing its energy security policy. Even though South Korea is the third largest economy in Asia and it has had high growth in relation to its energy demand since the 1990s, measures for energy security have only been launched in the last 10 years.

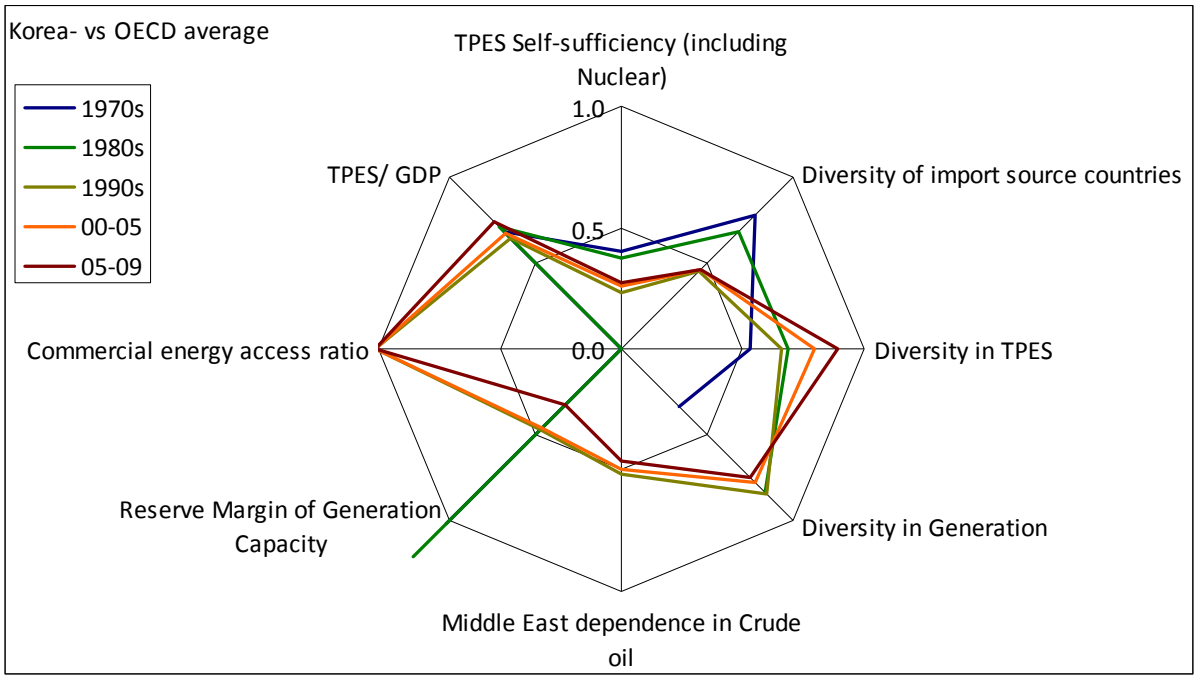
Due to a lack of domestic resources, South Korea has had to import a large amount of oil over these past 40 years and this has resulted in low self sufficiency and less diversity among its import source countries. It should also be mentioned that there is a downward trend for the reserve margin of generation capacity. The blackout which struck a large area including Seoul city in the summer of 2011 is still fresh in our minds.

Another feature of South Korea is its lower energy efficiency. The intense development of energy-saving technologies is a key measure to enhance energy security.

Table 3-8 Major Indices in Korea in comparison with the OECD average

	1970s	1980s	1990s	00-05	00-09
TPES Self-sufficiency (including Nuclear)	0.4	0.4	0.2	0.3	0.3
Diversity of import source countries	0.8	0.7	0.4	0.5	0.5
Diversity in TPES	0.5	0.7	0.7	0.8	0.9
Diversity in Generation	0.3	0.8	0.9	0.8	0.7
Middle East dependence in Crude Oil			0.5	0.5	0.5
Reserve Margin of Generation Capacity	1.0	1.2	0.5	0.5	0.3
Commercial energy access ratio	-	-	1.0	1.0	1.0
TPES/GDP	0.7	0.7	0.6	0.7	0.7

Figure 3-9 Major Indices in Korea in comparison with the OECD average



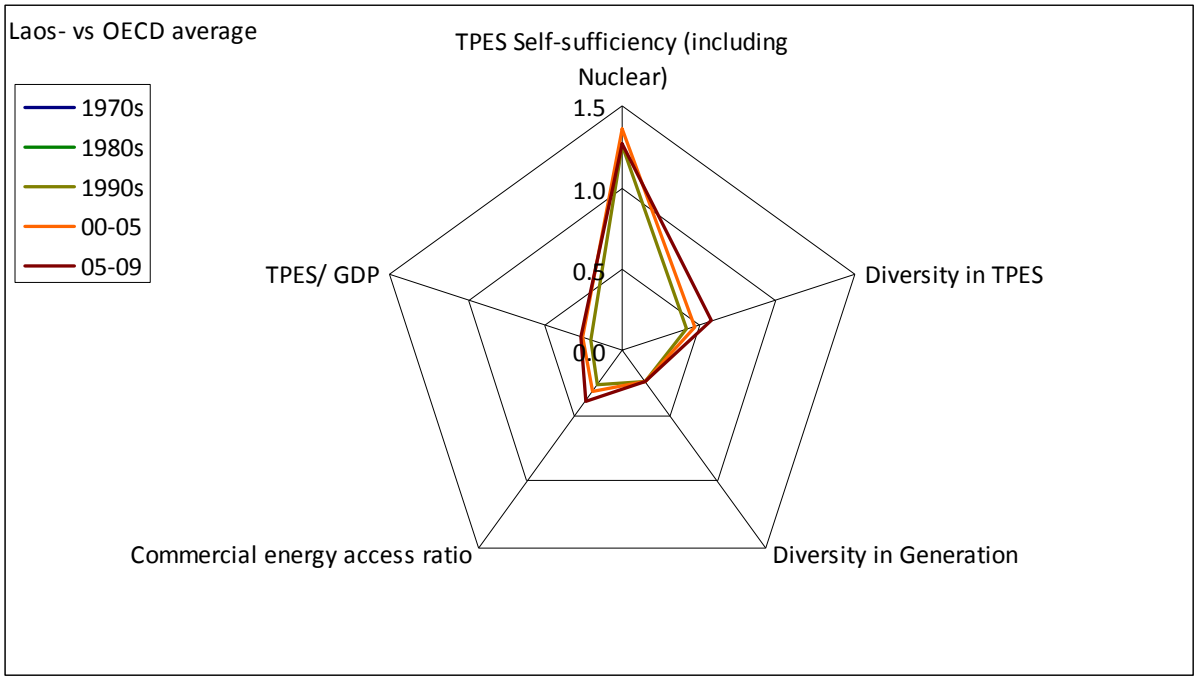
2.9. LAO PDR

Lao PDR does not possess abundant fossil resources such as oil, gas or coal. However, self sufficiency has been at a high level because of the availability of hydropower, which is sufficiently developed for power to be exported to neighboring countries. In other words, hydropower is the single source of power generation in this country, which means it faces the risk of reliance on a single source for its important energy supply. Commercial energy access ratios and energy intensity, TPES/GDP, has improved since the 1990's. However, the absolute level still remains low, thus continuous efforts may be required.

Table 3-9: Major Indices in Lao PDR in comparison with the OECD average

	1970s	1980s	1990s	00-05	00-09
TPES Self-sufficiency (including Nuclear)			1.3	1.4	1.3
Diversity in TPES	-	-	0.4	0.5	0.6
Diversity in Generation	-	-	0.2	0.2	0.2
Commercial energy access ratio	-	-	0.3	0.3	0.4
TPES/GDP	-	-	0.2	0.3	0.3

Figure 3-10: Major Indices in Lao PDR in comparison with the OECD average



Note: This analysis is based on data obtained from the World Bank and ERIA, and does not reflect data provided by a WG member from Lao PDR, because of the time limitation for preparing this report.

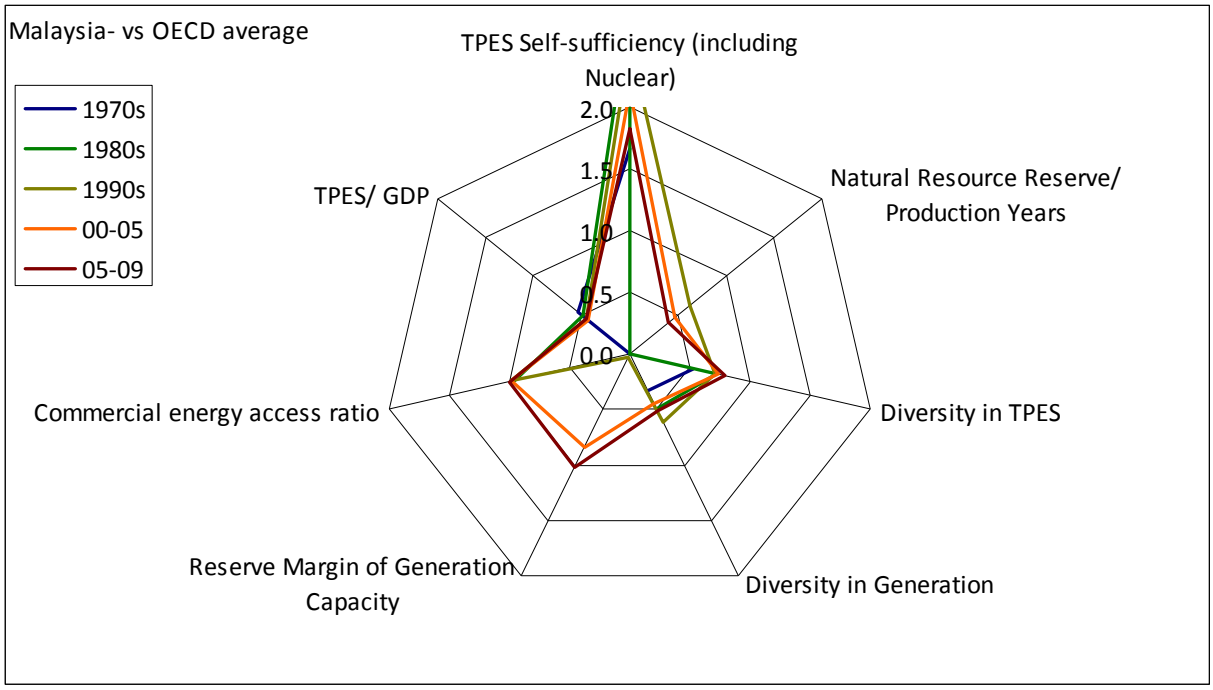
2.10. MALAYSIA

Malaysia is rich in oil and gas resources. Its self sufficiency has always been over 100% in the past 40 years, and it has been a good supplier to Japan, South Korea and so on. Its R/P ratio has been decreasing, however, mainly due to recent production increases. The conservation of natural resources to provide a sustainable and long-lasting supply of energy is a top priority in Malaysia's basic policy for energy security. At the same time, a heavy dependence on natural gas for power generation is something that poses risks, and as such the country is now pursuing the diversification of its power portfolio by employing other types of energy, such as coal, nuclear and renewable energies.

Table 3-10: Major Indices in Malaysia in comparison with the OECD average

	1970s	1980s	1990s	00-05	00-09
TPES Self-sufficiency (including Nuclear)	1.7	2.8	2.5	2.1	1.8
Natural Resources Reserve/ Production Years		-	0.6	0.5	0.4
Diversity in TPES	0.5	0.7	0.7	0.7	0.8
Diversity in Generation	0.3	0.7	0.7	0.7	0.8
Reserve Margin of Generation Capacity			0.0	0.8	1.0
Commercial energy access ratio	-	1.0	1.0	1.0	1.0
TPES/GDP	0.5	0.5	0.5	0.4	0.4

Figure 3-11: Major Indices in Malaysia in comparison with the OECD average



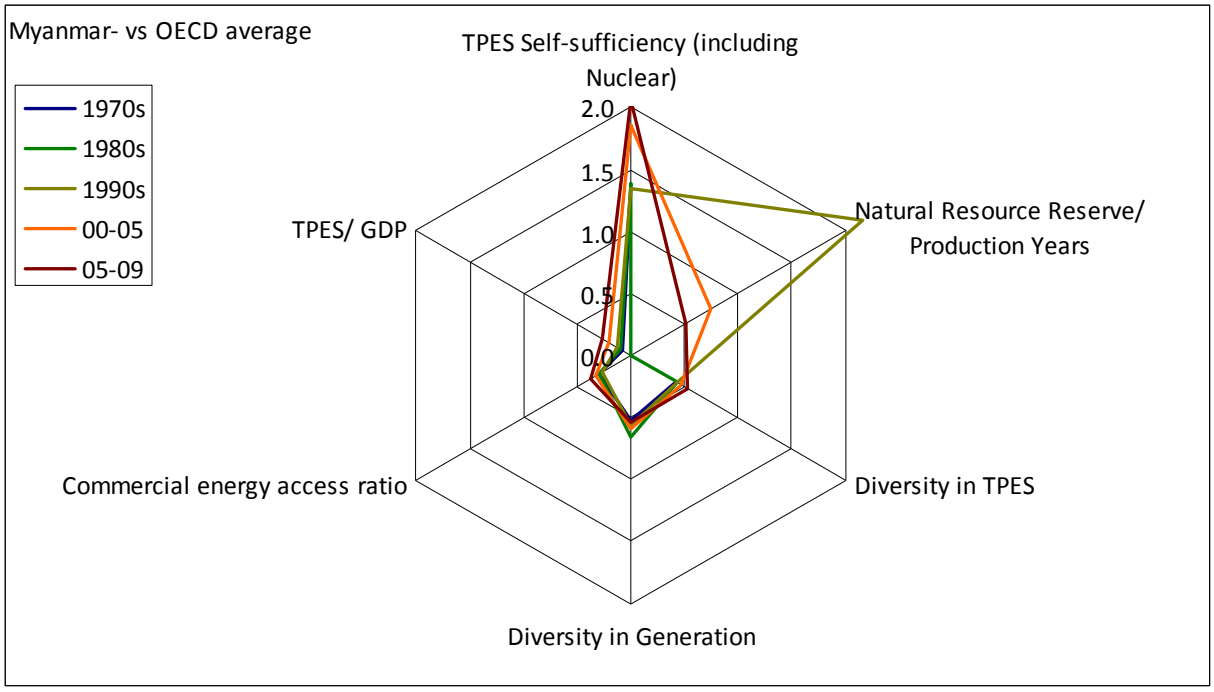
2.11. MYANMAR

Myanmar has few natural resources except for gas, but has relatively high self efficiency mainly due to abundant hydropower. Even though they are importing oil and coal for power generation, in terms of the international electricity trade they are in an exporting position. Recently, however, the commercial energy access ratio has been improving, meaning an increase in electricity demand. Diversity in TPES and in power generation are lower than the OECD average, thus they may have room to improve in these areas. While the efficiency of energy use has gradually improved after the 2000's, it still remains at the lower level, and thus is expected to be improved for the future.

Table 3-11: Major Indices in Myanmar in comparison with the OECD average

	1970s	1980s	1990s	00-05	00-09
TPES Self-sufficiency (including Nuclear)	1.3	1.4	1.3	1.9	2.1
Natural Resources Reserve/ Production Years		-	2.2	0.7	0.5
Diversity in TPES	0.4	0.4	0.4	0.5	0.5
Diversity in Generation	0.5	0.7	0.6	0.6	0.5
Commercial energy access ratio	0.3	0.3	0.3	0.3	0.4
TPES/GDP	0.1	0.1	0.1	0.2	0.3

Figure 3-12: Major Indices in Myanmar in comparison with the OECD average



2.12. NEW ZEALAND

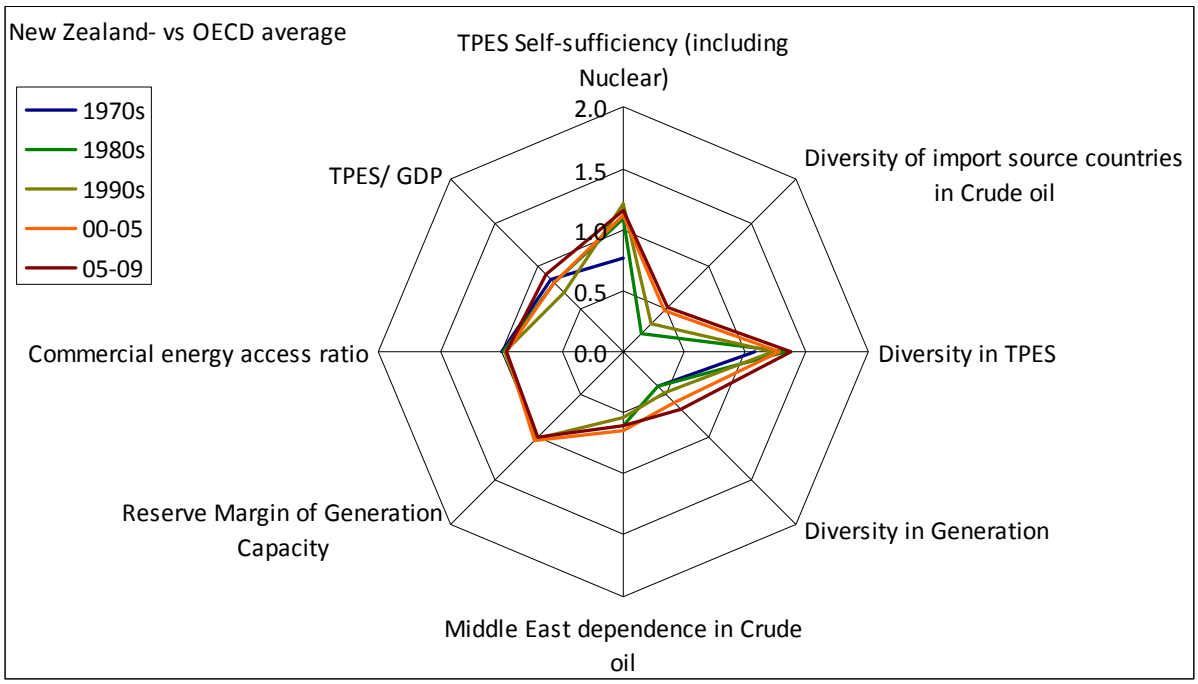
New Zealand does not have fossil resources large enough to satisfy its domestic demand for oil and gas. However, due to its large capacity for hydropower generation and rich coal resources, its self sufficiency has been relatively high in comparison with the OECD average over the past 40 years.

Another remarkable feature of the country is a well diversified primary energy portfolio. This is mainly thanks to its high ratio of renewable energies, specifically, bio-fuels for electricity and heat, and geothermal energy. Diversity in import source countries, including Middle East dependency, is a point of weakness. New Zealand may further enhance its energy security by improving these aspects of its energy supply.

Table 3-12: Major Indices in New Zealand in comparison with the OECD average

	1970s	1980s	1990s	00-05	00-09
TPES Self-sufficiency (including Nuclear)	0.8	1.1	1.2	1.1	1.2
Diversity of import source countries in Crude Oil		0.2	0.3	0.5	0.5
Diversity in TPES	1.1	1.3	1.2	1.3	1.4
Diversity in Generation	0.4	0.4	0.5	0.6	0.7
Middle East dependence in Crude Oil		0.6	0.5	0.6	0.6
Reserve Margin of Generation Capacity			1.0	1.0	1.0
Commercial energy access ratio	1.0	1.0	1.0	1.0	1.0
TPES/GDP	0.8	0.8	0.7	0.8	0.9

Figure 3-13: Major Indices in New Zealand in comparison with the OECD average



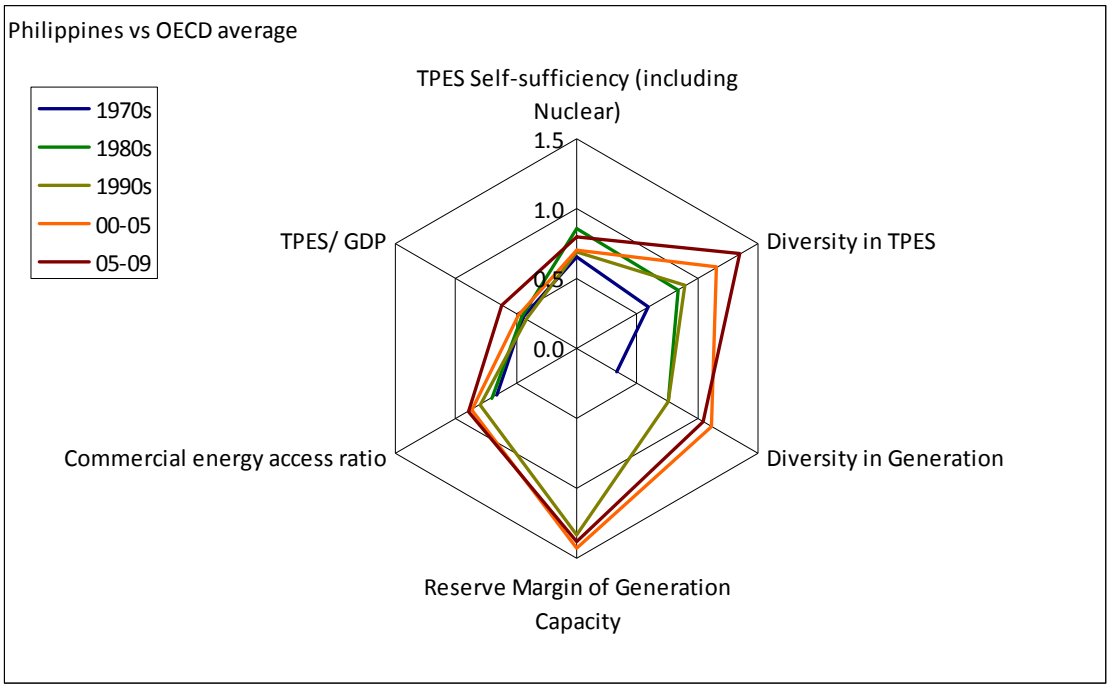
2.13. THE PHILIPPINES

The typical features of The Philippines are a well diversified primary energy supply and high reserve margin in terms of power generation capacity. Both features mainly come from abundant geothermal resources. The Philippines has developed geothermal power stations while restraining development of domestic fossil resources, and this has resulted in a low self sufficiency and high diversity for its energy and power portfolios. Improvement in the commercial energy access ratio can be observed. On the other hand, energy intensity has not changed much throughout the past four decades.

Table 3-13: Major Indices in The Philippines in comparison with the OECD average

	1970s	1980s	1990s	00-05	00-09
TPES Self-sufficiency (including Nuclear)	0.7	0.9	0.7	0.7	0.8
Diversity in TPES	0.6	0.8	0.9	1.2	1.3
Diversity in Generation	0.3	0.8	0.8	1.1	1.1
Reserve Margin of Generation Capacity			1.3	1.4	1.4
Commercial energy access ratio	0.7	0.7	0.8	0.9	0.9
TPES/GDP	0.4	0.5	0.4	0.5	0.6

Figure 3-14: Major Indices in Philippines in comparison with the OECD average



2.14. SINGAPORE

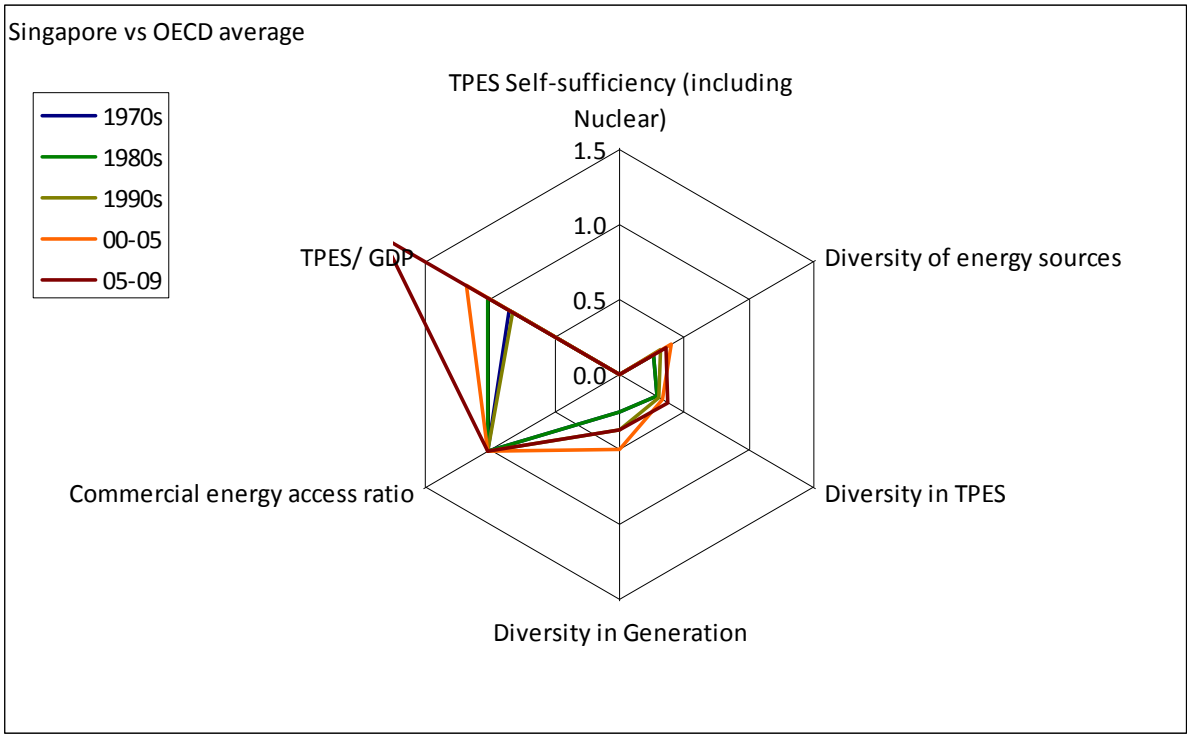
Self sufficiency in Singapore has hardly ever been more than zero, as it has no fossil fuel resources and little potential for renewable energies. However, it has developed a strong policy for securing a stable energy supply by importing oil and gas from neighboring countries, constructing an efficient energy market, and increasing energy efficiency.

The next challenge for Singapore might be the diversification of power sources as well as the development of alternative import source countries.

Table 3-14: Major Indices in Singapore in comparison with the OECD average

	1970s	1980s	1990s	00-05	00-09
TPES Self-sufficiency (including Nuclear)	0.0	0.0	0.0	0.0	0.0
Diversity in energy sources	0.3	0.3	0.3	0.4	0.4
Diversity in TPES	0.3	0.3	0.3	0.3	0.4
Diversity in Generation	0.2	0.2	0.4	0.5	0.4
Commercial energy access ratio	1.0	1.0	1.0	1.0	1.0
TPES/GDP	0.8	1.0	0.8	1.2	1.8

Figure 3-15: Major Indices in Singapore in comparison with the OECD average



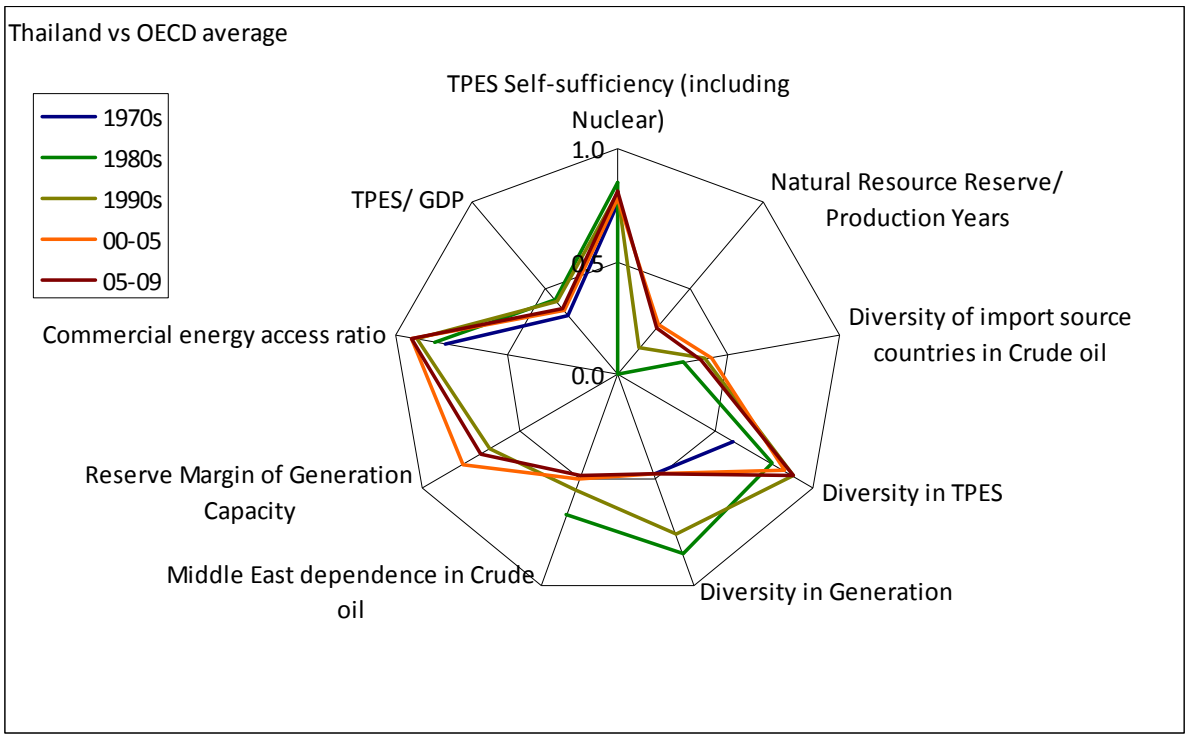
2.15. THAILAND

The fossil fuel resources in Thailand are insufficient to meet the country's growing energy demand. It has less diversification in terms of its import source countries for oil due to a high dependency on the Middle East. The diversity of power sources has been worsening since the 1990's in comparison with the OECD average. The dependence on natural gas for power generation poses concerns related to energy security, and thus Thailand is trying to utilize other energies such as coal, renewable energy and nuclear. Thailand's energy intensity has changed little since the 1980's, and as such there may be room for improvement.

Table 3-15: Major Indices in Thailand in comparison with the OECD average

	1970s	1980s	1990s	00-05	00-09
TPES Self-sufficiency (including Nuclear)	0.8	0.9	0.8	0.8	0.8
Natural Resources Reserve/ Production Years		-	0.2	0.3	0.3
Diversity of import source countries in Crude Oil		0.3	0.4	0.4	0.4
Diversity in TPES	0.6	0.8	0.9	0.9	0.9
Diversity in Generation	0.5	0.8	0.8	0.5	0.5
Middle East dependence in Crude Oil		0.7	0.5	0.5	0.5
Reserve Margin of Generation Capacity			0.7	0.8	0.7
Commercial energy access ratio	0.8	0.8	0.9	0.9	0.9
TPES/GDP	0.3	0.4	0.4	0.4	0.4

Figure 3-16: Major Indices in Thailand in comparison with the OECD average



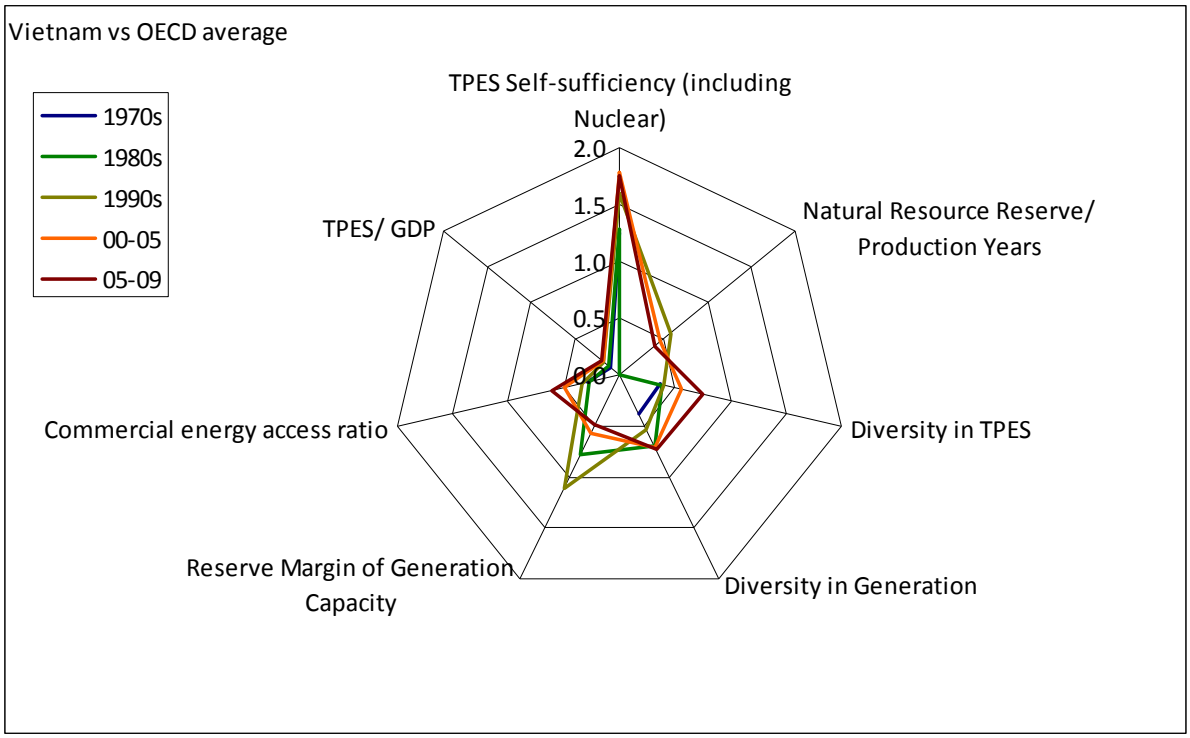
2.16. VIETNAM

Vietnam is importing oil products while exporting crude oil, since the capacity of its oil refineries is not sufficient for domestic demand. Self sufficiency has been over 100% over these past 40 years mainly because crude oil exports surpassed the import of refined oil products. As seen in the low R/P ratio, if Vietnam does not see new development, its self-sufficiency may face a critical moment in the near future. Two features of the way energy is used in Vietnam are the low commercial energy access ratio and the low energy efficiency. Improvements have been made in the past, but some continuous efforts might be required related to energy security.

Table 3-16: Major Indices in Vietnam in comparison with the OECD average

	1970s	1980s	1990s	00-05	00-09
TPES Self-sufficiency (including Nuclear)	1.2	1.3	1.6	1.8	1.7
Natural Resources Reserve/ Production Years		-	0.6	0.5	0.4
Diversity in TPES	0.4	0.4	0.4	0.6	0.7
Diversity in Generation	0.4	0.7	0.5	0.7	0.7
Reserve Margin of Generation Capacity		0.8	1.1	0.6	0.5
Commercial energy access ratio	0.3	0.3	0.3	0.5	0.6
TPES/GDP	0.1	0.1	0.2	0.2	0.2

Figure 3-17: Major Indices in Vietnam in comparison with the OECD average



CHAPTER 4

Key Findings and Next Steps

1. Key Findings

At the 2nd Working Group (WG) meeting, the members discussed the key findings of the analysis based on the calculation results for the Energy Security Index (ESI).

1. While there are limitations in obtaining data, it is possible to develop an index which quantitatively indicates the energy security situation. For example, in the case of the indicator for the diversity of energy sources, ERIA averages show a trend toward the concentrated use of a specific energy source across the years. In particular, this finding is consistent with the expanded use of coal for power generation.
2. Energy security is comprised of a variety of elements. Furthermore, the perspective from which a country is assessed varies greatly depending on the situation that the country is in. There is thus no single absolutely correct indicator, and it is important to assess multiple perspectives through a combination of several indicators.
3. With the cooperation of WG members, it was possible to access data which are difficult to obtain through publicly available statistics, such as statistics issued by the International Energy Authority (IEA) and BP, as well as to confirm and review data. This was one of the major outcomes of this study.
4. Calculating the index using the data obtained yielded ESI values which were widely distributed and which reflected the diversity of the countries.
5. For example, in the case of the self-sufficiency ratio, it was possible to quantitatively confirm that despite having no domestic resources, a country could improve its self-sufficiency ratio by expanding its use of nuclear energy, and as a result, could improve its performance in terms of ESI. It is important

that such policies underpinning the changes in indicator performance are analyzed.

6. For country analyses, the ESI has made it possible to quantitatively assess how the energy security situation has evolved over each decade.
7. Some indicators have a trade-off relationship, and it may therefore be difficult to improve performances across all indicators simultaneously. This is observed, for example, between self-sufficiency and the diversity of energy source.
8. Country situations, as illustrated by the ESI, vary depending on the country's environment, including resource endowment, and the extent of energy demand increases. Nevertheless, a number of common trends were identified:
   - Many of the resource-rich countries experienced decreases in their self-sufficiency ratio or R/P ratio. It is thought that new resource development in these countries has not caught up with the speed of increase in energy demand.
   - With respect to the supply of primary energy and the diversity of energy sources, few countries performed well compared to the OECD average. It was observed, for example, that while increasing the use of domestic resources, such as coal and hydropower, is favorable for improving the self-sufficiency ratio, this also limits the diversification of energy sources.
   - While access to commercial energy is improving, this is simultaneously causing a further increase in energy demand, including electricity demand.
   - Although efficiency in energy utilization is improving in many countries, some countries still have low efficiency compared with the OECD averages and there remains room for improvement.

2. Next Steps

At the 2nd WG meeting, members discussed the next steps of the study.

With the development of the ESI, it has become possible to quantitatively assess the energy security situation. However, this in itself is not the final objective of the study.

In the next step (tentatively called Step 2), policies underlying the changes in the indicators will be analyzed, based on the values of the developed and calculated index. Separate analyses will be conducted for each country, examining what policies caused the changes in the indicators, in other words, changes in the energy security situation.

Through this analysis work, the WG will extract policies that have the potential of changing the energy security situation for the better. In addition, key points will be extracted in order to maximize the effectiveness of these policies. Of course, the policy of one country cannot necessarily be applied as is in another country and be fully effective. Nonetheless, the WG aims to provide this information as material to help policymakers review the policy options available for the enhancement of energy security.

In terms of the way forward (tentatively called Step 3), while the study has so far assessed and analyzed past performance, in the next step it will look ahead into the future energy security situation. Step 2 will shed light on the linkages between ESI and policies. In Step 3, utilizing the outcomes from Step 2, the study will estimate what changes to policies, taken in the future, will result in changes to the energy security indicators (the energy security situation) moving forward. This work will allow policymakers to quantitatively assess the linkages between the policy options available in their country and the impact of these options on future energy security. The analysis findings will thus serve as reference information for the selection of better policies.

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ANNEX

1. Self-sufficiency

1-1 TPES Self-sufficiency (including Nuclear)

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	120.0%	161.9%	196.4%	232.4%	234.7%
Brunei	2186.2%	1088.5%	796.4%	837.0%	623.9%
Cambodia	-	-	82.9%	80.3%	74.8%
China	101.9%	104.9%	101.2%	97.3%	93.1%
India	91.5%	94.0%	86.9%	79.9%	75.8%
Indonesia	234.0%	194.2%	163.7%	151.2%	169.9%
Japan	10.5%	16.6%	19.4%	19.0%	18.7%
Korea	29.0%	27.1%	16.8%	18.6%	19.7%
Lao PDR	-	-	91.7%	99.0%	92.4%
Malaysia	120.9%	205.6%	183.0%	155.5%	132.9%
Myanmar	97.8%	101.0%	98.1%	134.7%	149.3%
New Zealand	56.0%	78.7%	88.0%	81.0%	83.7%
Philippines	47.5%	62.3%	50.1%	51.2%	57.9%
Singapore	0.0%	0.0%	0.0%	0.2%	0.2%
Thailand	54.9%	62.1%	58.7%	56.8%	59.2%
Vietnam	90.6%	93.7%	116.0%	129.9%	127.0%
OECD Total	67.0%	76.7%	75.1%	71.6%	70.7%
ERIA Total	79.2%	86.8%	84.3%	84.1%	85.5%

Comparison

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	1.8	2.1	2.7	3.2	3.3	1.6	2.2	2.7	3.2	3.2	1.5	1.9	2.3	2.8	2.7
Brunei	32.6	14.2	10.9	11.7	8.8	30.0	15.0	10.9	11.5	8.6	27.6	12.5	9.4	10.0	7.3
Cambodia	-	-	1.1	1.1	1.1	-	-	1.1	1.1	1.0	-	-	1.0	1.0	0.9
China	1.5	1.4	1.4	1.4	1.3	1.4	1.2	1.4	1.3	1.3	1.3	1.2	1.2	1.2	1.1
India	1.4	1.2	1.2	1.1	1.1	1.3	1.3	1.2	1.1	1.0	1.2	1.1	1.0	1.0	0.9
Indonesia	3.5	2.5	2.2	2.1	2.4	3.2	2.7	2.2	2.1	2.3	3.0	2.2	1.9	1.8	2.0
Japan	0.2	0.2	0.3	0.3	0.3	0.1	0.2	0.3	0.3	0.3	0.1	0.2	0.2	0.2	0.2
Korea	0.4	0.4	0.2	0.3	0.3	0.4	0.4	0.2	0.3	0.3	0.4	0.3	0.2	0.2	0.2
Lao PDR	-	-	1.3	1.4	1.3	-	-	1.3	1.4	1.3	-	-	1.1	1.2	1.1
Malaysia	1.8	2.7	2.5	2.2	1.9	1.7	2.8	2.5	2.1	1.8	1.5	2.4	2.2	1.8	1.6
Myanmar	1.5	1.3	1.3	1.9	2.1	1.3	1.4	1.3	1.9	2.1	1.2	1.2	1.2	1.6	1.7
New Zealai	0.8	1.0	1.2	1.1	1.2	0.8	1.1	1.2	1.1	1.2	0.7	0.9	1.0	1.0	1.0
Philippines	0.7	0.8	0.7	0.7	0.8	0.7	0.9	0.7	0.7	0.8	0.6.	0.7	0.6	0.6	0.7
Singapore	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thailand	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7
Vietnam	1.4	1.2	1.6	1.8	1.8	1.2	1.3	1.6	1.8	1.7	1.1	1.1	1.4	1.5	1.5

1-2 TPES Self-sufficiency (excluding Nuclear)

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	120.0%	161.9%	196.4%	232.4%	234.7%
Brunei	2186.2%	1088.5%	796.4%	837.0%	623.9%
Cambodia	-	-	82.9%	80.3%	74.8%
China	101.9%	104.9%	101.0%	96.6%	92.3%
India	91.2%	93.6%	86.3%	78.9%	75.0%
Indonesia	234.0%	194.2%	163.7%	151.2%	169.9%
Japan	8.1%	6.5%	4.7%	4.1%	4.3%
Korea	28.4%	17.6%	3.6%	2.4%	2.4%
Lao PDR			91.7%	99.0%	92.4%
Malaysia	120.9%	205.6%	183.0%	155.5%	132.9%
Myanmar	97.8%	101.0%	98.1%	134.7%	149.3%
New Zealand	56.0%	78.7%	88.0%	81.0%	83.7%
Philippines	47.5%	62.3%	50.1%	51.2%	57.9%
Singapore	0.0%	0.0%	0.0%	0.2%	0.2%
Thailand	54.9%	62.1%	58.7%	56.8%	59.2%
Vietnam	90.6%	93.7%	116.0%	129.9%	127.0%
OECD Total	64.7%	69.5%	64.4%	60.6%	59.8%
ERIA Total	78.5%	84.2%	80.4%	80.1%	82.2%

Comparison

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	1.8	2.1	2.6	3.2	3.3	1.9	2.5	3.1	3.6	3.6	1.5	1.9	2.3	2.8	2.7
Brunei	32.6	14.2	10.6	11.7	8.8	34.0	16.9	12.4	13.0	9.7	27.6	12.5	9.4	10.0	7.3
Cambodia	-	-	1.1	1.1	1.1	-	-	1.3	1.2	1.2	-	-	1.0	1.0	0.9
China	1.5	1.4	1.3	1.3	1.3	1.6	1.6	1.6	1.5	1.4	1.3	1.2	1.2	1.1	1.1
India	1.4	1.2	1.1	1.1	1.1	1.4	1.5	1.3	1.2	1.2	1.2	1.1	1.0	0.9	0.9
Indonesia	3.5	2.5	2.2	2.1	2.4	3.6	3.0	2.5	2.3	2.6	3.0	2.2	1.9	1.8	2.0
Japan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1
Korea	0.4	0.2	0.0	0.0	0.0	0.4	0.3	0.1	0.0	0.0	0.4	0.2	0.0	0.0	0.0
Lao PDR	-	-	1.2	1.4	1.3	-	-	1.4	1.5	1.4	-	-	1.1	1.2	1.1
Malaysia	1.8	2.7	2.4	2.2	1.9	1.9	3.2	2.8	2.4	2.1	1.5	2.4	2.2	1.8	1.6
Myanmar	1.5	1.3	1.3	1.9	2.1	1.5	1.6	1.5	2.1	2.3	1.2	1.2	1.2	1.6	1.7
New Zealand	0.8	1.0	1.2	1.1	1.2	0.9	1.2	1.4	1.3	1.3	0.7	0.9	1.0	1.0	1.0
Philippines	0.7	0.8	0.7	0.7	0.8	0.7	1.0	0.8	0.8	0.9	0.6	0.7	0.6	0.6	0.7
Singapore	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thailand	0.8	0.8	0.8	0.8	0.8	0.9	1.0	0.9	0.9	0.9	0.7	0.7	0.7	0.7	0.7
Vietnam	1.4	1.2	1.5	1.8	1.8	1.4	1.5	1.8	2.0	2.0	1.1	1.1	1.4	1.5	1.5

1-3 Coal Self-sufficiency

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	185.4%	266.2%	320.6%	377.9%	412.4%
Brunei	-	-	-	-	-
Cambodia	-	-	-	-	0.0%
China	100.7%	101.9%	102.8%	107.0%	102.2%
India	103.5%	102.9%	96.9%	91.3%	87.0%
Indonesia	105.8%	127.1%	363.9%	395.1%	514.5%
Japan	28.2%	13.7%	4.1%	0.5%	0.0%
Korea	82.2%	46.5%	13.0%	4.3%	2.1%
Lao PDR	-	-	24669.2%	14877.4%	2434.6%
Malaysia	0.0%	2.9%	7.6%	5.6%	9.1%
Myanmar	8.7%	24.1%	93.4%	624.8%	541.6%
New Zealand	101.1%	124.0%	164.8%	178.5%	172.3%
Philippines	48.6%	57.7%	30.5%	19.0%	29.8%
Singapore	0.0%	0.0%	0.0%	0.0%	0.0%
Thailand	87.2%	90.3%	81.6%	58.8%	37.2%
Vietnam	120.3%	114.6%	138.7%	173.2%	213.9%
OECD Total	99.7%	98.8%	95.8%	88.7%	90.6%
ERIA Total	95.3%	98.2%	101.2%	106.3%	105.9%

Comparison

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	1.9	2.7	3.3	4.3	4.5	1.9	2.8	3.4	4.0	4.3	1.9	2.7	3.2	3.6	3.9
Brunei	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cambodia	-	-	-	-	0.0	-	-	-	-	0.0	-	-	-	-	0.0
China	1.0	1.0	1.1	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.0	1.0	1.0	1.0
India	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.0	1.0	0.9	1.1	1.0	1.0	0.9	0.8
Indonesia	1.1	1.3	3.8	4.5	5.7	1.1	1.3	3.8	4.1	5.4	1.1	1.3	3.6	3.7	4.9
Japan	0.3	0.1	0.0	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.3	0.1	0.0	0.0	0.0
Korea	0.8	0.5	0.1	0.0	0.0	0.9	0.5	0.1	0.0	0.0	0.9	0.5	0.1	0.0	0.0
Lao PDR	-	-	257.5	167.7	26.9	-	-	258.1	155.7	25.5	-	-	243.7	140.0	23.0
Malaysia	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.1
Myanmar	0.1	0.2	1.0	7.0	6.0	0.1	0.3	1.0	6.5	5.7	0.1	0.2	0.9	5.9	5.1
New Zealand	1.0	1.3	1.7	2.0	1.9	1.1	1.3	1.7	1.9	1.8	1.1	1.3	1.6	1.7	1.6
Philippines	0.5	0.6	0.3	0.2	0.3	0.5	0.6	0.3	0.2	0.3	0.5	0.6	0.3	0.2	0.3
Singapore	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thailand	0.9	0.9	0.9	0.7	0.4	0.9	0.9	0.9	0.6	0.4	0.9	0.9	0.8	0.6	0.4
Vietnam	1.2	1.2	1.4	2.0	2.4	1.3	1.2	1.5	1.8	2.2	1.3	1.2	1.4	1.6	2.0

1-4 Crude oil Self-sufficiency

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	68.2%	80.2%	79.7%	91.8%	80.5%
Brunei	-	5926.0%	2648.9%	1528.4%	1293.0%
Cambodia	-	-	-	-	-
China	109.6%	121.5%	100.5%	68.1%	53.7%
India	39.2%	64.6%	51.9%	29.9%	22.5%
Indonesia	533.1%	292.7%	164.9%	118.0%	93.3%
Japan	0.3%	0.3%	0.4%	0.3%	0.4%
Korea	0.0%	0.0%	0.1%	0.5%	0.5%
Lao PDR	-	-	-	-	-
Malaysia	146.9%	297.5%	210.9%	144.3%	126.0%
Myanmar	91.5%	113.3%	63.9%	89.9%	114.7%
New Zealand	9.7%	36.3%	45.1%	28.0%	42.3%
Philippines	1.3%	4.7%	1.3%	3.8%	9.4%
Singapore	0.0%	0.0%	0.0%	0.0%	0.0%
Thailand	0.1%	9.3%	17.8%	22.0%	28.1%
Vietnam	-	-	32235.2%	3827.9%	1462.5%
OECD Total	37.6%	53.1%	48.6%	46.1%	41.9%
ERIA Total	45.1%	59.3%	48.9%	41.0%	35.6%

Comparison

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	1.8	1.5	1.6	2.0	1.9	1.5	1.7	1.7	2.0	1.7	1.5	1.4	1.6	2.2	2.3
Brunei	-	111.6	54.5	33.1	30.8	-	128.7	57.5	33.2	28.1	-	99.9	54.2	37.3	36.3
Cambodia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
China	2.9	2.3	2.1	1.5	1.3	2.4	2.6	2.2	1.5	1.2	2.4	2.0	2.1	1.7	1.5
India	1.0	1.2	1.1	0.6	0.5	0.9	1.4	1.1	0.7	0.5	0.9	1.1	1.1	0.7	0.6
Indonesia	14.2	5.5	3.4	2.6	2.2	11.6	6.4	3.6	2.6	2.0	11.8	4.9	3.4	2.9	2.6
Japan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lao PDR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Malaysia	3.9	5.6	4.3	3.1	3.0	3.2	6.5	4.6	3.1	2.7	3.3	5.0	4.3	3.5	3.5
Myanmar	2.4	2.1	1.3	1.9	2.7	2.0	2.5	1.4	2.0	2.5	2.0	1.9	1.3	2.2	3.2
New Zealand	0.3	2.7	0.9	0.6	1.0	0.2	0.8	1.0	0.6	0.9	0.2	0.6	0.9	0.7	1.2
Philippines	0.0	0.1	0.0	0.1	0.2	0.0	0.1	0.0	0.1	0.2	0.0	0.1	0.0	0.1	0.3
Singapore	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thailand	0.0	0.2	0.4	0.5	0.7	0.0	0.2	0.4	0.5	0.6	0.0	0.2	0.4	0.5	0.8
Vietnam	-	-	662.6	83.0	34.9	-	-	700.3	83.2	31.8	-	-	659.8	93.4	41.1

1-5 Natural gas Self-sufficiency

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	100.0%	100.0%	142.5%	144.8%	147.2%
Brunei	728.7%	591.4%	462.2%	545.1%	417.8%
Cambodia	-	-	-	-	-
China	100.0%	100.0%	105.1%	106.9%	98.2%
India	100.0%	100.0%	100.0%	94.3%	75.7%
Indonesia	172.1%	290.6%	207.4%	216.1%	207.0%
Japan	25.0%	6.1%	3.9%	3.7%	4.2%
Korea	-	0.0%	0.0%	0.3%	1.1%
Lao PDR	-	-	-	-	-
Malaysia	100.4%	200.8%	199.6%	181.8%	162.9%
Myanmar	100.0%	100.0%	132.9%	411.1%	348.8%
New Zealand	100.0%	100.0%	100.0%	100.0%	100.6%
Philippines	-	-	100.0%	100.0%	100.0%
Singapore	-	-	0.0%	0.0%	0.0%
Thailand	-	100.0%	100.0%	75.0%	72.6%
Vietnam	-	100.0%	100.0%	107.7%	109.3%
OECD Total	97.2%	88.5%	83.1%	77.6%	74.4%
ERIA Total	93.5%	95.7%	97.4%	92.2%	85.6%

Comparison

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	1.0	1.1	1.7	1.9	2.0	1.2	1.2	1.7	1.7	1.7	1.1	1.0	1.5	1.6	1.7
Brunei	7.5	6.7	5.6	7.0	5.6	8.6	7.0	5.5	6.5	4.9	7.8	6.2	4.7	5.9	4.9
Cambodia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
China	1.0	1.1	1.3	1.4	1.3	1.2	1.2	1.2	1.3	1.2	1.1	1.0	1.1	1.2	1.1
India	1.0	1.1	1.2	1.2	1.0	1.2	1.2	1.2	1.1	0.9	1.1	1.0	1.0	1.0	0.9
Indonesia	1.8	3.3	2.5	2.8	2.8	2.0	3.4	2.5	2.6	2.5	1.8	3.0	2.1	2.3	2.4
Japan	0.3	0.1	0.0	0.0	0.1	0.3	0.1	0.0	0.0	0.1	0.3	0.1	0.0	0.0	0.0
Korea	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0
Lao PDR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Malaysia	1.0	2.3	2.4	2.3	2.2	1.2	2.4	2.4	2.2	1.9	1.1	2.1	2.1	2.0	1.9
Myanmar	1.0	1.1	1.6	5.3	4.7	1.2	1.2	1.6	4.9	4.1	1.1	1.0	1.4	4.5	4.1
New Zealand	1.0	1.1	1.2	1.3	1.4	1.2	1.2	1.2	1.2	1.2	1.1	1.0	1.0	1.1	1.2
Philippines	-	-	1.2	1.3	1.3	-	-	1.2	1.2	1.2	-	-	1.0	1.1	1.2
Singapore	-	-	0.0	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0	0.0
Thailand	-	1.1	1.2	1.0	1.0	-	1.2	1.2	0.9	0.9	-	1.0	1.0	0.8	0.8
Vietnam	-	1.1	1.2	1.4	1.5	-	1.2	1.2	1.3	1.3	-	1.0	1.0	1.2	1.3

2. Reserve/ Production ratio

2-1 Natural Resource Reserve/ Production ratio
(Weighted Average of primary supply of Coal, Crude oil and Natural gas)

Country	1980s	1990s	2000s-1	2000s-2
Australia	182.6	176.9	135.1	115.4
Brunei	29.8	34.2	25.7	24.5
Cambodia	-	-	-	-
China	131.9	80.6	53.3	35.3
India	87.0	158.3	133.9	84.5
Indonesia	92.4	37.5	40.3	49.1
Japan	18.2	33.0	100.5	75.9
Korea	2.3	5.1	5.9	12.4
Lao PDR	-	-	-	-
Malaysia	330.6	38.7	29.5	24.8
Myanmar	108.6	134.8	45.8	31.6
New Zealand	11.7	6.8	17.2	24.9
Philippines	-	-	-	-
Singapore	-	-	-	-
Thailand	51.9	9.4	17.4	16.6
Vietnam	-	36.0	29.0	25.8
OECD Total	-	66.2	60.1	52.2
ERIA Total	109.6	88.6	67.5	49.4

Comparison

Country	vs. OECD				vs. OECD (whole periods)				vs. ERIA			
	1980s	1990s	2000s 1	2000s 2	1980s	1990s	2000s 1	2000s 2	1980s	1990s	2000s 1	2000s 2
Australia	-	2.7	2.2	2.2	-	2.8	2.2	1.9	1.7	2.0	2.0	2.3
Brunei	-	0.5	0.4	0.5	-	0.5	0.4	0.4	0.3	0.4	0.4	0.5
Cambodia	-	-	-	-	-	-	-	-	-	-	-	-
China	-	1.2	0.9	0.7	-	1.3	0.9	0.6	1.2	0.9	0.8	0.7
India	-	2.4	2.2	1.6	-	2.5	2.2	1.4	0.8	1.8	2.0	1.7
Indonesia	-	0.6	0.7	0.9	-	0.6	0.6	0.8	0.8	0.4	0.6	1.0
Japan	-	0.5	1.7	1.5	-	0.5	1.6	1.2	0.0	0.1	0.1	0.3
Korea	-	0.1	0.1	0.2	-	0.1	0.1	0.2	0.0	0.1	0.1	0.3
Lao PDR	-	0.2	-	-	-	-	-	-	-	-	-	-
Malaysia	-	0.3	0.5	0.5	-	0.6	0.5	0.4	3.0	0.4	0.4	0.5
Myanmar	-	0.4	0.8	0.6	-	2.2	0.7	0.5	1.0	1.5	0.7	0.6
New Zealand	-	0.5	0.3	0.5	-	0.1	0.3	0.4	0.1	0.1	0.3	0.5
Philippines	-	0.6	-	-	-	-	-	-	-	-	-	-
Singapore	-	0.7	-	-	-	-	-	-	-	-	-	-
Thailand	-	0.8	0.3	0.3	-	0.2	0.3	0.3	0.5	0.1	0.3	0.3
Vietnam	-	0.9	0.5	0.5	-	0.6	0.5	0.4	-	0.4	0.4	0.5

2-2 Coal Reserve/ Production ratio

Country	1980s	1990s	2000s-1	2000s-2
Australia	403.1	370.0	239.1	193.9
Brunei				
Cambodia				
China	163.4	97.2	66.6	41.8
India	121.9	243.7	228.9	135.7
Indonesia	775.0	171.5	65.8	85.8
Japan	75.0	141.9	370.8	269.9
Korea	5.7	23.0	23.5	44.0
Lao PDR				
Malaysia				
Myanmar				
New Zealand	75.3	63.8	127.1	114.6
Philippines				
Singapore				
Thailand			66.1	74.2
Vietnam			6.8	3.6
OECD Total	-	214.4	204.4	170.1
ERIA Total	186.3	154.8	112.0	71.4

Comparison

Country	vs. OECD				vs. OECD (whole periods)				vs. ERIA			
	1980s	1990s	2000s 1	2000s 2	1980s	1990s	2000s 1	2000s 2	1980s	1990s	2000s 1	2000s 2
Australia	-	1.7	1.2	1.1	2.0	1.8	1.2	1.0	2.2	2.4	2.1	2.7
Brunei	-	-	-	-	-	-	-	-	-	-	-	-
Cambodia	-	-	-	-	-	-	-	-	-	-	-	-
China	-	0.5	0.3	0.2	0.8	0.5	0.3	0.2	0.9	0.6	0.6	0.6
India	-	1.1	1.1	0.8	0.6	1.2	1.1	0.7	0.7	1.6	2.0	1.9
Indonesia	-	0.8	0.3	0.5	3.8	0.8	0.3	0.4	4.2	1.1	0.6	1.2
Japan	-	0.7	1.8	1.6	0.4	0.7	1.8	1.3	0.4	0.9	3.3	3.8
Korea	-	0.1	0.1	0.3	0.0	0.1	0.1	0.2	0.0	0.1	0.2	0.6
Lao PDR	-	-	-	-	-	-	-	-	-	-	-	-
Malaysia	-	-	-	-	-	-	-	-	-	-	-	-
Myanmar	-	-	-	-	-	-	-	-	-	-	-	-
New Zealand	-	0.3	0.6	0.7	0.4	0.3	0.6	0.6	0.4	0.4	1.1	1.6
Philippines	-	-	-	-	-	-	-	-	-	-	-	-
Singapore	-	-	-	-	-	-	-	-	-	-	-	-
Thailand	-	-	0.3	0.4	-	-	0.3	0.4	-	-	0.6	1.0
Vietnam	-	-	0.0	0.0	-	-	0.0	0.0	-	-	0.1	0.1

2-3 Crude oil Reserve/ Production ratio

Country	1980s	1990s	2000s-1	2000s-2
Australia	14.1	16.7	17.5	19.2
Brunei	22.6	18.5	15.0	16.2
Cambodia				
China	17.9	14.8	12.4	11.1
India	21.9	22.2	20.6	20.4
Indonesia	56.7	17.6	20.9	23.6
Japan				
Korea				
Lao PDR				
Malaysia	19.3	18.2	17.4	18.7
Myanmar	11.4	33.4	36.0	28.1
New Zealand				5.7
Philippines				
Singapore				
Thailand	7.1	7.4	7.1	4.0
Vietnam	10.0	13.4	19.8	32.1
OECD Total	17.1	14.6	11.3	13.1
ERIA Total	17.1	15.4	14.2	13.0

Comparison

Country	vs. OECD				vs. OECD (whole periods)				vs. ERIA			
	1980s	1990s	2000s 1	2000s 2	1980s	1990s	2000s 1	2000s 2	1980s	1990s	2000s 1	2000s 2
Australia	0.8	1.1	1.5	1.5	1.0	1.1	1.5	1.5	0.8	1.1	1.2	1.5
Brunei	1	1.3	1.3	1.2	1	1.3	1.3	1.2	1	1.2	1.1	1.2
Cambodia	-	-	-	-	-	-	-	-	-	-	-	-
China	1.0	1.0	1.1	0.8	1.2	1.0	0.9	0.8	1.0	1.0	0.9	0.8
India	1.3	1.5	1.8	1.6	1.5	1.5	1.4	1.4	1.3	1.4	1.4	1.6
Indonesia	3.3	1.2	1.9	1.8	3.9	1.2	1.4	1.6	3.3	1.1	1.5	1.8
Japan	-	-	-	-	-	-	-	-	-	-	-	-
Korea	-	-	-	-	-	-	-	-	-	-	-	-
Lao PDR	-	-	-	-	-	-	-	-	-	-	-	-
Malaysia	1.1	1.2	1.5	1.4	1.3	1.2	1.2	1.3	1.1	1.2	1.2	1.4
Myanmar	0.7	2.3	3.2	2.1	0.8	2.3	2.5	1.9	0.7	2.2	2.5	2.2
New Zealand	-	-	-	0.4	-	-	-	0.4	-	-	-	0.4
Philippines	-	-	-	-	-	-	-	-	-	-	-	-
Singapore	-	-	-	-	-	-	-	-	-	-	-	-
Thailand	0.413	0.5	0.6	0.3	0.485	0.5	0.5	0.3	0.4	0.5	0.5	0.5
Vietnam	0.6	0.9	1.8	2.4	0.7	0.9	1.4	2.2	0.6	0.9	1.4	2.5

2-4 Natural gas Reserve/ Production ratio

Country	1980s	1990s	2000s-1	2000s-2
Australia	51.8	48.6	72.2	62.3
Brunei	30.6	37.0	29.7	27.0
Cambodia				
China	64.7	72.9	39.7	31.0
India	133.0	40.3	30.4	34.0
Indonesia	112.3	42.6	59.7	58.3
Japan				
Korea				
Lao PDR				
Malaysia	943.4	73.4	48.4	37.6
Myanmar	302.0	224.1	53.4	34.0
New Zealand				9.7
Philippines				
Singapore				
Thailand	246.1	21.2	17.8	11.9
Vietnam		435.4	79.7	64.6
OECD Total	19.1	15.4	14.1	14.4
ERIA Total	95.9	50.1	48.8	41.9

Comparison

Country	vs. OECD				vs. OECD (whole periods)				vs. ERIA			
	1980s	1990s	2000s 1	2000s 2	1980s	1990s	2000s 1	2000s 2	1980s	1990s	2000s 1	2000s 2
Australia	2.7	3.2	5.1	4.3	3.2	3.0	4.4	3.8	0.5	1.0	1.5	1.5
Brunei	1.6	2.4	2.1	1.9	1.9	2.3	1.8	1.7	0.0	0.7	0.6	0.6
Cambodia	-	-	-	-	-	-	-	-	-	-	-	-
China	3.4	4.7	2.8	2.2	4.0	4.5	2.4	1.9	0.7	1.5	0.8	0.7
India	7.0	2.6	2.2	2.4	8.2	2.5	1.9	2.1	1.4	0.8	0.6	0.8
Indonesia	5.9	2.8	4.2	4.0	6.9	2.6	3.7	3.6	1.2	0.9	1.2	1.4
Japan	-	-	-	-	-	-	-	-	-	-	-	-
Korea	-	-	-	-	-	-	-	-	-	-	-	-
Lao PDR	-	-	-	-	-	-	-	-	-	-	-	-
Malaysia	49.5	4.8	3.4	2.6	58.1	4.5	3.0	2.3	9.8	1.5	1.0	0.9
Myanmar	15.8	14.5	3.8	2.4	18.6	13.8	3.3	2.1	3.1	4.5	1.1	0.8
New Zealand	-	-	-	0.7	-	-	-	0.6	-	-	-	0.2
Philippines	-	-	-	-	-	-	-	-	-	-	-	-
Singapore	-	-	-	-	-	-	-	-	-	-	-	-
Thailand	12.9	1.4	1.3	0.8	15.2	1.3	1.1	0.7	2.6	0.4	0.4	0.3
Vietnam	-	28.0	5.7	4.5	-	27.0	4.9	4.0	-	8.7	1.6	1.5

3. Reserve/Consumption ratio

3-1 Natural Resource Reserve/ Consumption ratio
(Weighted Average of primary supply of Coal, Crude oil and Natural gas)

Country	1980s	1990s	2000s-1	2000s-2
Australia	450.2	466.3	375.0	333.4
Brunei	1,256.2	273.0	202.3	142.1
Cambodia				
China	128.3	75.5	53.0	31.5
India	81.9	148.1	114.9	69.6
Indonesia	209.3	90.2	97.0	130.5
Japan	1.5	1.0	0.7	0.4
Korea	1.0	0.6	0.2	0.3
Lao PDR				
Malaysia	164.7	108.5	63.2	51.5
Myanmar	130.2	155.4	187.8	112.5
New Zealand	12.6	8.7	24.0	29.7
Philippines				
Singapore				
Thailand	12.6	7.1	12.9	10.3
Vietnam		304.1	75.4	72.3
OECD Total	-	55.8	47.9	41.3
ERIA Total	94.4	75.4	58.5	40.1

Comparison

Country	vs. OECD				vs. OECD (whole periods)				vs. ERIA			
	1980s	1990s	2000s 1	2000s 2	1980s	1990s	2000s 1	2000s 2	1980s	1990s	2000s 1	2000s 2
Australia	-	8.4	7.8	8.1	-	9.1	7.3	6.5	4.8	6.2	6.4	8.3
Brunei	-	4.9	4.2	3.4	-	5.3	4.0	2.8	13.3	3.6	3.5	3.5
Cambodia	-	-	-	-	-	-	-	-	-	-	-	-
China	-	1.4	1.1	0.8	-	1.5	1.0	0.3	1.4	1.0	0.9	0.8
India	-	2.7	2.4	1.7	-	2.9	2.2	1.4	0.9	2.0	2.0	1.7
Indonesia	-	1.6	2.0	3.2	-	1.8	1.9	2.6	2.2	1.2	1.7	3.3
Japan	-	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Korea	-	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lao PDR	-	-	-	-	-	-	-	-	-	-	-	-
Malaysia	-	1.9	1.3	1.2	-	2.1	1.2	1.0	1.7	1.4	1.1	1.3
Myanmar	-	2.8	3.9	2.7	-	3.0	3.7	2.2	1.4	2.1	3.2	2.8
New Zealand	-	0.2	0.5	0.7	-	0.2	0.5	0.6	0.1	0.1	0.4	0.7
Philippines	-	-	-	-	-	-	-	-	-	-	-	-
Singapore	-	-	-	-	-	-	-	-	-	-	-	-
Thailand	-	0.1	0.3	0.2	-	0.1	0.3	0.2	0.1	0.1	0.2	0.3
Vietnam	-	5.5	1.6	1.7	-	5.9	1.5	1.4	-	4.0	1.3	1.8

3-2 Coal Reserve/ Consumption ratio

Country	1980s	1990s	2000s-1	2000s-2
Australia	1,040.1	1,019.8	721.4	619.8
Brunei	-	-	-	-
Cambodia	-	-	-	-
China	157.6	90.2	67.0	37.9
India	118.2	231.8	203.6	120.0
Indonesia	734.2	401.9	191.0	301.2
Japan	6.1	4.4	2.8	1.4
Korea	2.4	2.7	0.8	0.9
Lao PDR	-	-	-	-
Malaysia	-	-	-	-
Myanmar	-	-	-	-
New Zealand	81.6	81.4	176.9	151.9
Philippines	-	-	-	-
Singapore	-	-	-	-
Thailand	-	-	57.0	42.6
Vietnam	-	-	9.9	6.3
OECD avg.	-	188.4	167.9	142.2
ERIA avg.	172.6	141.9	108.9	66.0

Comparison

Country	vs. OECD				vs. OECD (whole periods)				vs. ERIA			
	1980s	1990s	2000s 1	2000s 2	1980s	1990s	2000s 1	2000s 2	1980s	1990s	2000s 1	2000s 2
Australia	-	5.4	4.3	4.4	-	5.9	4.2	3.6	6.0	7.2	6.6	9.4
Brunei	-	-	-	-	-	-	-	-	-	-	-	-
Cambodia	-	-	-	-	-	-	-	-	-	-	-	-
China	-	0.5	0.4	0.3	-	0.5	0.4	0.2	0.9	0.6	0.6	0.6
India	-	1.2	1.2	0.8	-	1.3	1.2	0.7	0.7	1.6	1.9	1.8
Indonesia	-	2.1	1.1	2.1	-	2.3	1.1	1.7	4.3	2.8	1.8	4.6
Japan	-	0.0	0.0	0.0	-	0.0	0.0	0.0	-	0.0	0.0	0.0
Korea	-	0.0	0.0	0.0	-	0.0	0.0	0.0	-	0.0	0.0	0.0
Lao PDR	-	-	-	-	-	-	-	-	-	-	-	-
Malaysia	-	-	-	-	-	-	-	-	-	-	-	-
Myanmar	-	-	-	-	-	-	-	-	-	-	-	-
New Zealand	-	0.4	1.1	1.1	-	0.5	1.0	0.9	0.5	0.6	1.6	2.3
Philippines	-	-	-	-	-	-	-	-	-	-	-	-
Singapore	-	-	-	-	-	-	-	-	-	-	-	-
Thailand	-	-	0.3	0.3	-	-	0.3	0.2	-	-	0.5	0.6
Vietnam	-	-	0.1	0.0	-	-	0.1	0.0	-	-	0.1	0.1

3-3 Crude oil Reserve/ Consumption ratio

Country	1980s	1990s	2000s-1	2000s-2
Australia	12.1	14.5	17.5	17.1
Brunei	10,681.9	655.8	223.2	200.7
Cambodia	-	-	-	-
China	21.3	15.1	8.6	6.0
India	12.8	11.6	6.1	4.6
Indonesia	64.4	28.7	24.2	22.0
Japan	-	-	-	-
Korea	-	-	-	-
Lao PDR	-	-	-	-
Malaysia	58.1	49.1	27.5	26.8
Myanmar	12.6	19.7	31.6	32.3
New Zealand	-	-	-	3.0
Philippines	-	-	-	-
Singapore	-	-	-	-
Thailand	1.0	1.6	1.6	1.1
Vietnam	-	13,463.2	782.4	651.3
OECD avg.	9.2	7.3	5.4	5.7
ERIA avg.	10.6	8.2	6.5	5.6

Comparison

Country	vs. OECD				vs. OECD (whole periods)				vs. ERIA			
	1980s	1990s	2000s 1	2000s 2	1980s	1990s	2000s 1	2000s 2	1980s	1990s	2000s 1	2000s 2
Australia	1.3	2.0	3.2	3.0	1.7	2.0	2.4	2.3	1.1	1.8	2.7	3.1
Brunei	1.164	90.1	41.4	35.4	1.459	89.6	30.5	27.4	1.006	80.4	34.4	35.9
Cambodia	-	-	-	-	-	-	-	-	-	-	-	-
China	2.3	2.1	1.6	1.0	2.9	2.1	1.2	0.8	2.0	1.8	1.3	1.1
India	1.4	1.6	1.1	0.8	1.8	1.6	0.8	0.6	1.2	1.4	0.9	0.8
Indonesia	7.0	3.9	4.5	3.9	8.8	3.9	3.3	3.0	6.1	3.5	3.7	3.9
Japan	-	-	-	-	-	-	-	-	-	-	-	-
Korea	-	-	-	-	-	-	-	-	-	-	-	-
Lao PDR	-	-	-	-	-	-	-	-	-	-	-	-
Malaysia	6.3	6.7	5.1	4.7	7.9	6.7	3.8	3.7	5.5	6.0	4.2	4.8
Myanmar	1.4	2.7	5.9	5.7	1.7	2.7	4.3	4.4	1.2	2.4	4.9	5.8
New Zealand	-	-	-	0.5	-	-	-	0.4	-	-	-	0.5
Philippines	-	-	-	-	-	-	-	-	-	-	-	-
Singapore	-	-	-	-	-	-	-	-	-	-	-	-
Thailand	0.1	0.2	0.3	0.2	0.1	0.2	0.2	0.2	0.1	0.2	0.3	0.2
Vietnam	-	1.85	145.1	114.8	-	1.839	106.9	89.0	-	1.65	120.6	116.5

3-4 Natural gas Reserve/ Consumption ratio

Country	1980s	1990s	2000s-1	2000s-2
Australia	64.2	81.7	112.6	100.4
Brunei	200.2	206.5	194.3	125.0
Cambodia	-	-	-	-
China	77.1	89.8	51.0	36.6
India	141.7	45.4	32.6	28.8
Indonesia	574.1	128.8	170.9	155.7
Japan	-	-	-	-
Korea	-	-	-	-
Lao PDR	-	-	-	-
Malaysia	377.7	208.9	114.7	88.6
Myanmar	363.7	274.4	285.2	141.3
New Zealand	-	-	-	10.0
Philippines	-	-	-	-
Singapore	-	-	-	-
Thailand	-	27.5	17.3	11.7
Vietnam	-	2,485.0	99.5	79.0
OECD Total	20.0	15.2	13.0	12.8
ERIA Total	15.9	8.3	7.3	5.8

Comparison

Country	vs. OECD				vs. OECD (whole periods)				vs. ERIA			
	1980s	1990s	2000s 1	2000s 2	1980s	1990s	2000s 1	2000s 2	1980s	1990s	2000s 1	2000s 2
Australia	3.2	5.4	8.7	7.8	4.0	5.1	7.0	6.3	4.0	10	15.5	17.3
Brunei	10	13.6	14.9	9.8	12	12.9	12.1	7.8	13	25	26.7	21.6
Cambodia	-	-	-	-	-	-	-	-	-	-	-	-
China	3.9	5.9	3.9	2.9	4.8	5.6	3.2	2.3	4.8	11	7.0	6.3
India	7.1	3.0	2.5	2.2	8.8	2.8	2.0	1.8	8.9	5	4.5	5.0
Indonesia	28.7	8.5	13.1	12.1	35.8	8.0	10.7	9.7	36.1	15	23.5	26.9
Japan	-	-	-	-	-	-	-	-	-	-	-	-
Korea	-	-	-	-	-	-	-	-	-	-	-	-
Lao PDR	-	-	-	-	-	-	-	-	-	-	-	-
Malaysia	18.9	13.7	8.8	6.9	23.5	13.0	7.2	5.5	23.8	25	15.8	15.3
Myanmar	18.2	18.0	21.9	11.0	22.7	17.1	17.8	8.8	22.9	33	39.3	24.4
New Zealand	-	-	-	0.8	-	-	-	0.6	-	-	-	1.7
Philippines	-	-	-	-	-	-	-	-	-	-	-	-
Singapore	-	-	-	-	-	-	-	-	-	-	-	-
Thailand	-	1.8	1.3	0.9	-	1.7	1.1	0.7	-	3	2.4	2.0
Vietnam	-	163	7.7	6.2	-	155	6.2	4.9	-	298	13.7	13.6

4. Diverseness of energy sources

4-1 HHI (Diverseness of energy sources)
(TPES + Generation)/2

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	4,572	4,571	5,048	4,917	4,829
Brunei	9,647	8,987	8,653	7,911	8,155
Cambodia	-	-	10,000	9,637	9,589
China	4,066	4,369	5,185	5,331	5,718
India	4,286	4,217	4,175	4,079	3,984
Indonesia	5,310	3,725	2,923	2,802	2,858
Japan	5,127	2,960	2,693	2,567	2,508
Korea	6,286	3,551	3,606	3,377	3,245
Lao PDR	-	-	8,419	8,032	7,467
Malaysia	6,293	4,432	4,020	4,708	4,198
Myanmar	5,801	5,217	5,520	5,136	4,999
New Zealand	4,350	4,082	3,756	3,203	2,882
Philippines	6,127	3,348	3,202	2,338	2,230
Singapore	9,996	9,997	8,123	6,797	7,319
Thailand	5,011	3,261	3,207	4,286	4,168
Vietnam	7,148	5,440	5,869	4,188	3,580
OECD avg.	3,018	2,770	2,633	2,592	2,521
ERIA avg.	3,120	2,648	2,840	3,215	3,662

Comparison

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	0.7	0.6	0.5	0.5	0.5	0.6	0.6	0.5	0.5	0.5	0.7	0.6	0.6	0.7	0.8
Brunei	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4
Cambodia	-	-	0.3	0.3	0.3	-	-	0.3	0.3	0.3	-	-	0.3	0.3	0.4
China	0.7	0.6	0.5	0.5	0.4	0.6	0.6	0.5	0.5	0.5	0.8	0.6	0.5	0.6	0.6
India	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.6	0.7	0.8	0.9
Indonesia	0.6	0.7	0.9	0.9	0.9	0.5	0.7	0.9	0.9	0.9	0.6	0.7	1.0	1.1	1.3
Japan	0.6	0.9	1.0	1.0	1.0	0.5	0.9	1.0	1.0	1.1	0.6	0.9	1.1	1.3	1.5
Korea	0.5	0.8	0.7	0.8	0.8	0.4	0.7	0.7	0.8	0.8	0.5	0.7	0.8	1.0	1.1
Lao PDR	-	-	0.3	0.3	0.3	-	-	0.3	0.3	0.4	-	-	0.3	0.4	0.5
Malaysia	0.5	0.6	0.7	0.6	0.6	0.4	0.6	0.7	0.6	0.6	0.5	0.6	0.7	0.7	0.9
Myanmar	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.7
New Zealand	0.7	0.7	0.7	0.8	0.9	0.6	0.6	0.7	0.8	0.9	0.7	0.6	0.8	1.0	1.3
Philippines	0.5	0.8	0.8	1.1	1.1	0.4	0.8	0.8	1.1	1.2	0.5	0.8	0.9	1.4	1.6
Singapore	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.4	0.4	0.3	0.3	0.3	0.5	0.5
Thailand	0.6	0.8	0.8	0.6	0.6	0.5	0.8	0.8	0.6	0.6	0.6	0.8	0.9	0.8	0.9
Vietnam	0.4	0.5	0.4	0.6	0.7	0.4	0.5	0.4	0.6	0.7	0.4	0.5	0.5	0.8	1.0

4-2 HHI (Diverseness of energy sources :TPES)

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	3,773	3,367	3,314	3,317	3,309
Brunei	9,575	8,120	7,475	5,997	6,503
Cambodia	-	-	10,000	9,988	9,978
China	3,807	4,050	4,362	4,274	4,816
India	4,358	3,631	3,147	2,930	2,952
Indonesia	5,134	3,832	3,029	2,531	2,326
Japan	5,866	3,696	3,239	2,906	2,779
Korea	5,406	4,171	4,343	3,591	3,209
Lao PDR	-	-	6,842	6,064	4,935
Malaysia	5,358	3,956	4,084	3,908	3,595
Myanmar	6,901	6,679	6,699	6,140	5,408
New Zealand	2,669	2,148	2,337	2,226	2,086
Philippines	4,828	3,443	3,194	2,479	2,129
Singapore	9,992	9,994	9,648	8,620	7,902
Thailand	4,822	3,642	3,172	3,354	3,180
Vietnam	7,654	7,393	7,077	5,005	3,832
OECD Total	3,486	2,893	2,732	2,673	2,600
ERIA Total	3,084	2,837	2,766	2,799	3,114

Comparison

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.9
Brunei	0.4	0.4	0.4	0.4	0.4	0.3	0.4	0.4	0.5	0.4	0.3	0.3	0.4	0.5	0.5
Cambodia	-	-	0.3	0.3	0.3	-	-	0.3	0.3	0.3	-	-	0.3	0.3	0.3
China	0.9	0.7	0.6	0.6	0.5	0.7	0.7	0.7	0.7	0.6	0.8	0.7	0.6	0.7	0.6
India	0.8	0.8	0.9	0.9	0.9	0.7	0.8	0.9	1.0	1.0	0.7	0.8	0.9	1.0	1.1
Indonesia	0.7	0.8	0.9	1.1	1.1	0.6	0.7	0.9	1.1	1.2	0.6	0.7	0.9	1.1	1.3
Japan	0.6	0.8	0.8	0.9	0.9	0.5	0.8	0.9	1.0	1.0	0.5	0.8	0.9	1.0	1.1
Korea	0.6	0.7	0.6	0.7	0.8	0.5	0.7	0.7	0.8	0.9	0.6	0.7	0.6	0.8	1.0
Lao PDR	-	-	0.4	0.4	0.5	-	-	0.4	0.5	0.6	-	-	0.4	0.5	0.6
Malaysia	0.7	0.7	0.7	0.7	0.7	0.5	0.7	0.7	0.7	0.8	0.6	0.7	0.7	0.7	0.9
Myanmar	0.5	0.4	0.4	0.4	0.5	0.4	0.4	0.4	0.5	0.5	0.4	0.4	0.4	0.5	0.6
New Zealand	1.3	1.3	1.2	1.2	1.2	1.1	1.3	1.2	1.3	1.4	1.2	1.3	1.2	1.3	1.5
Philippines	0.7	0.8	0.9	1.1	1.2	0.6	0.8	0.9	1.2	1.3	0.6	0.7	0.9	1.1	1.5
Singapore	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.4
Thailand	0.7	0.8	0.9	0.8	0.8	0.6	0.8	0.9	0.9	0.9	0.6	0.8	0.9	0.8	1.0
Vietnam	0.5	0.4	0.4	0.5	0.7	0.4	0.4	0.4	0.6	0.7	0.4	0.4	0.4	0.6	0.8

4-3 HHI (Diverseness of energy sources :electricity)

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	5,371	5,776	6,782	6,516	6,349
Brunei	9,719	9,854	9,832	9,825	9,807
Cambodia	-	-	10,000	9,287	9,201
China	4,325	4,689	6,008	6,388	6,621
India	4,214	4,803	5,204	5,227	5,016
Indonesia	5,487	3,619	2,817	3,072	3,391
Japan	4,388	2,224	2,146	2,227	2,237
Korea	7,166	2,931	2,870	3,164	3,280
Lao PDR	-	-	9,997	10,000	10,000
Malaysia	7,228	4,908	3,957	5,508	4,801
Myanmar	4,700	3,755	4,341	4,131	4,590
New Zealand	6,031	6,016	5,176	4,180	3,679
Philippines	7,427	3,254	3,209	2,196	2,331
Singapore	10,000	10,000	6,599	4,975	6,735
Thailand	5,200	2,881	3,242	5,218	5,155
Vietnam	6,642	3,488	4,660	3,372	3,329
OECD Total	2,549	2,646	2,534	2,510	2,442
ERIA Total	3,156	2,459	2,913	3,631	4,211

Comparison

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	0.5	0.5	0.4	0.4	0.4	0.5	0.4	0.4	0.4	0.4	0.6	0.4	0.4	0.6	0.7
Brunei	0.3	0.3	0.3	0.3	0.2	0.3	0.2	0.2	0.2	0.2	0.3	0.2	0.3	0.4	0.4
Cambodia	-	-	0.3	0.3	0.3	-	-	0.2	0.3	0.3	-	-	0.3	0.4	0.5
China	0.6	0.6	0.4	0.4	0.4	0.6	0.5	0.4	0.4	0.4	0.7	0.4	0.4	0.6	0.6
India	0.6	0.6	0.5	0.5	0.5	0.6	0.5	0.5	0.5	0.5	0.7	0.5	0.6	0.7	0.8
Indonesia	0.5	0.7	0.9	0.8	0.7	0.4	0.7	0.9	0.8	0.7	0.6	0.7	1.0	1.2	1.2
Japan	0.6	1.2	1.2	1.1	1.1	0.6	1.1	1.1	1.1	1.1	0.7	1.1	1.4	1.6	1.9
Korea	0.4	0.9	0.9	0.8	0.7	0.3	0.8	0.9	0.8	0.7	0.4	0.8	1.0	1.1	1.3
Lao PDR	-	-	0.3	0.3	0.2	-	-	0.2	0.2	0.2	-	-	0.3	0.4	0.4
Malaysia	0.4	0.5	0.6	0.5	0.5	0.3	0.5	0.6	0.4	0.5	0.4	0.5	0.7	0.7	0.9
Myanmar	0.5	0.7	0.6	0.6	0.5	0.5	0.7	0.6	0.6	0.5	0.7	0.7	0.7	0.9	0.9
New Zealand	0.4	0.4	0.5	0.6	0.7	0.4	0.4	0.5	0.6	0.7	0.5	0.4	0.6	0.9	1.1
Philippines	0.3	0.8	0.8	1.1	1.0	0.3	0.8	0.8	1.1	1.1	0.4	0.8	0.9	1.7	1.8
Singapore	0.3	0.3	0.4	0.5	0.4	0.2	0.2	0.4	0.5	0.4	0.3	0.2	0.4	0.7	0.6
Thailand	0.5	0.9	0.8	0.5	0.5	0.5	0.8	0.8	0.5	0.5	0.6	0.9	0.9	0.7	0.8
Vietnam	0.4	0.8	0.5	0.7	0.7	0.4	0.7	0.5	0.7	0.7	0.5	0.7	0.6	1.1	1.3

5. Reserve margin of generation capacity

5-1 Reserve margin of generation capacity

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	32.6%	36.5%	29.0%	27.5%	25.7%
Brunei					
Cambodia					
China				34.9%	37.0%
India			35.8%	35.5%	36.2%
Indonesia			33.6%	19.0%	10.1%
Japan	23.7%	29.2%	20.0%	24.1%	26.4%
Korea	31.9%	37.9%	14.9%	14.5%	10.3%
Lao PDR					
Malaysia			0.9%	26.4%	32.1%
Myanmar					
New Zealand			31.5%	31.9%	31.3%
Philippines			41.8%	44.7%	43.4%
Singapore					
Thailand			20.5%	24.9%	21.9%
Vietnam		24.3%	34.7%	18.2%	15.1%
OECD Total	31.7%	35.3%	29.0%	29.1%	31.7%
ERIA Total	25.1%	31.0%	21.8%	27.7%	32.2%

Comparison

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	1.0	1.0	1.0	0.9	0.8	1.0	1.2	0.9	0.9	0.8	1.3	1.2	1.3	1.0	0.8
Brunei															
Cambodia															
China				1.2	1.2				1.1	1.2				1.3	1.1
India			1.2	1.2	1.1			1.1	1.1	1.2			1.6	1.3	1.1
Indonesia			1.2	0.7	0.3			1.1	0.6	0.3			1.5	0.7	0.3
Japan	0.7	0.8	0.7	0.8	0.8	0.8	0.9	0.6	0.8	0.8	0.9	0.9	0.9	0.9	0.8
Korea	1.0	1.1	0.5	0.5	0.3	1.0	1.2	0.5	0.5	0.3	1.3	1.2	0.7	0.5	0.3
Lao PDR															
Malaysia			0.0	0.9	1.0			0.0	0.8	1.0			0.0	1.0	1.0
Myanmar															
New Zealand			1.1	1.1	1.0			1.0	1.0	1.0			1.4	1.2	1.0
Philippines			1.4	1.5	1.4			1.3	1.4	1.4			1.9	1.6	1.3
Singapore															
Thailand			0.7	0.9	0.7			0.7	0.8	0.7			0.9	0.9	0.7
Vietnam		0.7	1.2	0.6	0.5		0.8	1.1	0.6	0.5		0.8	1.6	0.7	0.5

6. Commercial energy access

6-1 Commercial energy access ratio

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	-	98.5%	96.2%	96.3%	96.9%
Brunei	98.1%	99.6%	100.0%	100.0%	100.0%
Cambodia	-	-	21.9%	28.2%	33.7%
China	65.7%	72.6%	79.6%	85.0%	90.5%
India	40.8%	50.6%	62.9%	69.0%	73.7%
Indonesia	38.4%	54.1%	65.3%	71.0%	73.6%
Japan	-	99.5%	99.5%	99.5%	99.5%
Korea	-	-	99.8%	99.9%	99.9%
Lao PDR	-	-	25.7%	31.2%	38.3%
Malaysia	-	94.6%	96.8%	97.6%	98.0%
Myanmar	28.9%	29.5%	26.1%	31.3%	36.4%
New Zealand	97.1%	95.8%	94.9%	93.9%	94.3%
Philippines	65.0%	68.7%	77.9%	85.5%	87.4%
Singapore	99.8%	100.0%	100.0%	100.0%	100.0%
Thailand	76.9%	81.3%	89.2%	91.4%	91.3%
Vietnam	27.3%	26.7%	33.2%	49.7%	59.5%
OECD avg.	99.2%	98.8%	97.9%	97.8%	97.7%
ERIA avg.	58.4%	73.6%	81.8%	85.2%	88.4%

Comparison

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	-	1.0	1.0	1.0	1.0	-	1.0	1.0	1.0	1.0	-	1.4	1.2	1.2	1.1
Brunei	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.7	1.4	1.2	1.2	1.2
Cambodia	-	-	0.2	0.3	0.3	-	-	0.2	0.3	0.3	-	-	0.3	0.3	0.4
China	0.7	0.7	0.8	0.9	0.9	0.7	0.7	0.8	0.9	0.9	1.1	1.0	1.0	1.0	1.0
India	0.4	0.5	0.6	0.7	0.8	0.4	0.5	0.6	0.7	0.7	0.7	0.7	0.8	0.9	0.9
Indonesia	0.4	0.5	0.7	0.7	0.8	0.4	0.6	0.7	0.7	0.7	0.7	0.7	0.8	0.9	0.9
Japan	-	1.0	1.0	1.0	1.0	-	1.0	1.0	1.0	1.0	-	1.4	1.2	1.2	1.2
Korea	-	-	1.0	1.0	1.0	-	-	1.0	1.0	1.0	-	-	1.2	1.2	1.2
Lao PDR	-	-	0.3	0.3	0.4	-	-	0.3	0.3	0.4	-	-	0.3	0.4	0.4
Malaysia	-	1.0	1.0	1.0	1.0	-	1.0	1.0	1.0	1.0	-	1.3	1.2	1.2	1.1
Myanmar	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.4	0.5	0.4	0.3	0.4	0.4
New Zealand	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.7	1.3	1.2	1.1	1.1
Philippines	0.7	0.7	0.8	0.9	0.9	0.7	0.7	0.8	0.9	0.9	1.1	0.9	1.0	1.0	1.0
Singapore	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.7	1.4	1.2	1.2	1.2
Thailand	0.8	0.8	0.9	0.9	0.9	0.8	0.8	0.9	0.9	0.9	1.3	1.1	1.1	1.1	1.1
Vietnam	0.3	0.3	0.3	0.5	0.6	0.3	0.3	0.3	0.5	0.6	0.5	0.4	0.4	0.6	0.7

7. Energy Intensity

7-1 TPES per GDP

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	0.321	0.299	0.280	0.250	0.243
Brunei	0.165	0.313	0.402	0.382	0.483
Cambodia	-	-	1.158	0.879	0.665
China	3.676	2.348	1.307	0.877	0.800
India	1.322	1.248	1.102	0.913	0.776
Indonesia	1.053	0.878	0.871	0.912	0.803
Japan	0.146	0.114	0.109	0.108	0.099
Korea	0.331	0.317	0.348	0.333	0.304
Lao PDR	-	-	1.096	0.897	0.844
Malaysia	0.417	0.463	0.492	0.514	0.511
Myanmar	2.797	2.270	1.958	1.114	0.827
New Zealand	0.269	0.287	0.328	0.286	0.255
Philippines	0.509	0.498	0.535	0.470	0.363
Singapore	0.266	0.222	0.275	0.192	0.124
Thailand	0.658	0.517	0.542	0.612	0.593
Vietnam	2.178	1.911	1.369	1.168	1.074
OECD Total	0.299	0.247	0.217	0.196	0.180
ERIA Total	0.413	0.366	0.356	0.359	0.379

Comparison

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	0.9	0.8	0.8	0.8	0.7	0.7	0.8	0.8	0.9	0.9	1.3	1.2	1.3	1.4	1.5
Brunei	1.8	0.8	0.5	0.5	0.4	1.4	0.7	0.6	0.6	0.5	2.5	1.2	0.9	0.9	0.8
Cambodia	-	-	0.2	0.2	0.3	-	-	0.2	0.3	0.3	-	-	0.3	0.4	0.6
China	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.2	0.3	0.3	0.1	0.2	0.3	0.4	0.5
India	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.5
Indonesia	0.3	0.3	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.3	0.4	0.4	0.4	0.4	0.5
Japan	2.1	2.2	2.0	1.8	1.8	1.5	2.0	2.1	2.1	2.3	2.8	3.2	3.2	3.3	3.8
Korea	0.9	0.8	0.6	0.6	0.6	0.7	0.7	0.6	0.7	0.7	1.2	1.1	1.0	1.1	1.2
Lao PDR	-	-	0.2	0.2	0.2	-	-	0.2	0.3	0.3	-	-	0.3	0.4	0.4
Malaysia	0.7	0.5	0.4	0.4	0.4	0.5	0.5	0.5	0.4	0.4	1.0	0.8	0.7	0.7	0.7
Myanmar	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.2	0.3	0.1	0.2	0.2	0.3	0.5
New Zealand	1.1	0.9	0.7	0.7	0.7	0.8	0.8	0.7	0.8	0.9	1.5	1.3	1.1	1.2	1.5
Philippines	0.6	0.5	0.4	0.4	0.5	0.4	0.5	0.4	0.5	0.6	0.8	0.7	0.7	0.8	1.0
Singapore	1.1	1.1	0.8	1.0	1.4	0.8	1.0	0.8	1.2	1.8	1.5	1.6	1.3	1.8	3.0
Thailand	0.5	0.5	0.4	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.6	0.7	0.6	0.6	0.6
Vietnam	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3

7-2 TFEC per GDP

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	0.218	0.197	0.182	0.159	0.109
Brunei	0.026	0.056	0.092	0.095	0.168
Cambodia	-	-	1.027	0.757	0.412
China	3.125	1.933	0.985	0.587	0.371
India	1.186	1.047	0.823	0.622	0.373
Indonesia	0.932	0.753	0.644	0.683	0.431
Japan	0.105	0.076	0.073	0.072	0.050
Korea	0.258	0.223	0.246	0.224	0.148
Lao PDR	-	-	0.996	0.816	0.544
Malaysia	0.283	0.278	0.297	0.319	0.234
Myanmar	2.504	1.967	1.729	0.993	0.565
New Zealand	0.198	0.211	0.249	0.218	0.139
Philippines	0.411	0.340	0.358	0.284	0.158
Singapore	0.105	0.107	0.095	0.097	0.072
Thailand	0.841	0.608	0.630	0.603	0.385
Vietnam	2.067	1.760	1.270	1.039	0.677
OECD avg.	0.222	0.176	0.149	0.135	0.094
ERIA avg.	0.336	0.285	0.259	0.245	0.249

Comparison

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	1.4	1.3	1.2	1.2	1.6	0.7	0.8	0.8	1.0	1.4	1.9	1.8	1.9	2.2	3.4
Brunei	11.4	4.5	2.4	2.1	1.1	5.9	2.8	1.7	1.6	0.9	15.6	6.6	3.8	3.7	2.2
Cambodia	-	-	0.2	0.3	0.4	-	-	0.1	0.2	0.4	-	-	0.3	0.5	0.9
China	0.1	0.1	0.2	0.3	0.5	0.0	0.1	0.2	0.3	0.4	0.1	0.2	0.4	0.6	1.0
India	0.3	0.2	0.3	0.3	0.5	0.1	0.1	0.2	0.2	0.4	0.3	0.3	0.4	0.6	1.0
Indonesia	0.3	0.3	0.3	0.3	0.4	0.2	0.2	0.2	0.2	0.4	0.4	0.5	0.5	0.5	0.9
Japan	2.9	3.3	3.0	2.7	3.6	1.5	2.0	2.1	2.1	3.1	3.9	4.8	4.8	4.9	7.5
Korea	1.2	1.1	0.9	0.9	1.2	0.6	0.7	0.6	0.7	1.0	1.6	1.6	1.4	1.6	2.5
Lao PDR	-	-	0.2	0.2	0.3	-	-	0.2	0.2	0.3	-	-	0.4	0.4	0.7
Malaysia	1.1	0.9	0.7	0.6	0.8	0.5	0.6	0.5	0.5	0.7	1.4	1.3	1.2	1.1	1.6
Myanmar	0.1	0.1	0.1	0.2	0.3	0.1	0.1	0.1	0.2	0.3	0.2	0.2	0.2	0.4	0.7
New Zealand	1.5	1.2	0.9	0.9	1.3	0.8	0.7	0.6	0.7	1.1	2.1	1.7	1.4	1.6	2.7
Philippines	0.7	0.7	0.6	0.7	1.1	0.4	0.5	0.4	0.5	1.0	1.0	1.1	1.0	1.2	2.4
Singapore	2.9	2.3	2.3	2.0	2.5	1.5	1.4	1.6	1.6	2.1	3.9	3.4	3.7	3.6	5.1
Thailand	0.4	0.4	0.3	0.3	0.5	0.2	0.3	0.2	0.3	0.4	0.5	0.6	0.6	0.6	1.0
Vietnam	0.1	0.1	0.2	0.2	0.3	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.6

8. CO_2 Emissions

8-1 CO_2 Emissions per TPES

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	2.90	2.98	3.04	3.23	3.09
Brunei	1.92	1.93	1.96	2.01	1.55
Cambodia	-	-	0.53	0.76	0.91
China	2.19	2.49	2.80	2.87	3.05
India	1.34	1.67	2.02	2.14	2.29
Indonesia	0.93	1.27	1.51	1.77	1.87
Japan	2.76	2.45	2.33	2.33	2.34
Korea	3.07	2.76	2.41	2.24	2.22
Lao PDR	-	-	0.34	0.71	0.67
Malaysia	2.11	2.03	2.27	2.40	2.47
Myanmar	0.50	0.49	0.52	0.68	0.76
New Zealand	1.99	1.78	1.71	1.89	1.92
Philippines	1.56	1.29	1.65	1.79	1.77
Singapore	2.29	2.43	2.04	2.19	2.58
Thailand	1.37	1.63	2.17	2.23	2.24
Vietnam	0.81	0.81	0.92	1.43	1.70
OECD Total	2.71	2.55	2.42	2.38	2.34
ERIA Total	2.17	2.25	2.41	2.50	2.66

Comparison

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	0.9	0.9	0.8	0.7	0.8	0.9	0.8	0.8	0.8	0.8	0.7	0.8	0.8	0.8	0.9
Brunei	1.4	1.3	1.2	1.2	1.5	1.3	1.3	1.3	1.2	1.6	1.1	1.2	1.2	1.2	1.7
Cambodia	-	-	4.6	3.2	2.6	-	-	4.7	3.3	2.7	-	-	4.5	3.3	2.9
China	1.2	1.0	0.9	0.8	0.8	1.1	1.0	0.9	0.9	0.8	1.0	0.9	0.9	0.9	0.9
India	2.0	1.5	1.2	1.1	1.0	1.9	1.5	1.2	1.2	1.1	1.6	1.4	1.2	1.2	1.2
Indonesia	2.9	2.0	1.6	1.3	1.3	2.7	2.0	1.6	1.4	1.3	2.3	1.8	1.6	1.4	1.4
Japan	1.0	1.0	1.0	1.0	1.0	0.9	1.0	1.1	1.1	3.1	0.8	0.9	1.0	1.1	1.1
Korea	0.9	0.9	1.0	1.1	1.1	0.8	0.9	1.0	1.1	1.1	0.7	0.8	1.0	1.1	1.2
Lao PDR	-	-	7.1	3.3	3.5	-	-	7.3	3.5	3.7	-	-	7.1	3.5	4.0
Malaysia	1.3	1.3	1.1	1.0	0.9	1.2	1.2	1.1	1.0	1.0	1.0	1.1	1.1	1.0	1.1
Myanmar	5.4	5.2	4.7	3.5	3.1	4.9	5.0	4.8	3.7	3.3	4.3	4.6	4.7	3.7	3.5
New Zealand	1.4	1.4	1.4	1.3	1.2	1.3	1.4	1.5	1.3	1.3	1.1	1.3	1.4	1.3	1.4
Philippines	1.7	2.0	1.5	1.3	1.3	1.6	1.9	1.5	1.4	1.4	1.4	1.8	1.5	1.4	1.5
Singapore	1.2	1.0	1.2	1.1	0.9	1.1	1.0	1.2	1.1	1.0	0.9	0.9	1.2	1.1	1.0
Thailand	2.0	1.6	1.1	1.1	1.0	1.8	1.5	1.1	1.1	1.1	1.6	1.4	1.1	1.1	1.2
Vietnam	3.3	3.1	2.6	1.7	1.4	3.1	3.1	2.7	1.7	1.5	2.7	2.8	2.6	1.7	1.6

8-2 CO_2 Emissions per Fossil fuel primary supply

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	3.15	3.20	3.24	3.43	3.28
Brunei	1.96	1.94	1.96	2.01	2.27
Cambodia	-	-	2.95	2.98	2.95
China	3.38	3.48	3.61	3.50	3.52
India	3.43	3.38	3.30	3.22	3.23
Indonesia	2.64	2.68	2.49	2.89	2.86
Japan	2.90	2.82	2.84	2.85	2.85
Korea	3.10	3.07	2.80	2.74	2.74
Lao PDR	-	-	2.32	3.81	2.09
Malaysia	2.62	2.35	2.47	2.55	2.60
Myanmar	2.93	2.73	2.61	2.54	2.48
New Zealand	2.88	2.61	2.60	2.77	2.88
Philippines	2.93	3.15	3.03	3.11	3.12
Singapore	2.29	2.43	2.02	2.12	2.59
Thailand	2.82	2.98	2.94	2.79	2.79
Vietnam	3.48	3.62	3.40	3.25	3.20
OECD Total	2.93	2.94	2.91	2.88	2.86
ERIA Total	3.14	3.19	3.22	3.20	3.27

Comparison

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	0.9	0.9	0.9	0.8	0.9	0.9	0.9	0.9	0.8	0.9	1.0	1.0	1.0	0.9	1.0
Brunei	1.5	1.5	1.5	1.4	1.3	1.5	1.5	1.5	1.4	1.3	1.6	1.6	1.6	1.6	1.4
Cambodia	-	-	1.0	1.0	1.0	-	-	1.0	1.0	1.0	-	-	1.1	1.1	1.1
China	0.9	0.8	0.8	0.8	0.8	0.9	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9
India	0.9	0.9	0.9	0.9	0.9	0.8	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0
Indonesia	1.1	1.1	1.2	1.0	1.0	1.1	1.1	1.2	1.0	1.0	1.2	1.2	1.3	1.1	1.1
Japan	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1
Korea	0.9	1.0	1.0	1.1	1.0	0.9	0.9	1.0	1.1	1.1	1.0	1.0	1.1	1.2	1.2
Lao PDR	-	-	1.3	0.8	1.4	-	-	1.3	0.8	1.4	-	-	1.4	0.8	1.6
Malaysia	1.1	1.3	1.2	1.1	1.1	1.1	1.2	1.2	1.1	1.1	1.2	1.4	1.3	1.3	1.3
Myanmar	1.0	1.1	1.1	1.1	1.2	1.0	1.1	1.1	1.1	1.2	1.1	1.2	1.2	1.3	1.3
New Zealand	1.0	1.1	1.1	1.0	1.0	1.0	1.1	1.1	1.1	1.0	1.1	1.2	1.2	1.2	1.1
Philippines	1.0	0.9	1.0	0.9	0.9	1.0	0.9	1.0	0.9	0.9	1.1	1.0	1.1	1.0	1.0
Singapore	1.3	1.2	1.4	1.4	1.1	1.3	1.2	1.4	1.4	1.1	1.4	1.3	1.6	1.5	1.3
Thailand	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.2
Vietnam	0.8	0.8	0.9	0.9	0.9	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0

8-3 CO_2 Emissions per GDP

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	0.93	0.89	0.85	0.81	0.75
Brunei	0.32	0.60	0.79	0.77	1.10
Cambodia	-	-	0.61	0.66	0.60
China	8.07	5.84	3.66	2.52	2.44
India	1.77	2.08	2.23	1.96	1.78
Indonesia	0.98	1.11	1.32	1.61	1.50
Japan	0.40	0.28	0.25	0.25	0.23
Korea	1.02	0.88	0.84	0.75	0.68
Lao PDR	-	-	0.37	0.64	0.56
Malaysia	0.88	0.94	1.12	1.23	1.26
Myanmar	1.41	1.12	1.01	0.76	0.63
New Zealand	0.54	0.51	0.56	0.54	0.49
Philippines	0.80	0.64	0.88	0.84	0.64
Singapore	0.61	0.54	0.56	0.42	0.32
Thailand	0.90	0.84	1.18	1.36	1.33
Vietnam	1.78	1.55	1.26	1.67	1.83
OECD Total	0.81	0.63	0.52	0.47	0.42
ERIA Total	0.90	0.83	0.86	0.90	1.01

Comparison

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	0.9	0.7	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	1.0	0.9	1.0	1.1	1.3
Brunei	2.6	1.0	0.7	0.6	0.4	1.8	0.9	0.7	0.7	0.5	2.8	1.4	1.1	1.2	0.9
Cambodia	-	-	0.9	0.7	0.7	-	-	0.9	0.8	0.9	-	-	1.4	1.4	1.7
China	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.2	0.4	0.4
India	0.5	0.3	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.5	0.4	0.4	0.5	0.6
Indonesia	0.8	0.6	0.4	0.3	0.3	0.6	0.5	0.4	0.3	0.4	0.9	0.7	0.7	0.6	0.7
Japan	2.0	2.3	2.1	1.9	1.8	1.4	2.0	2.2	2.2	2.4	2.2	3.0	3.4	3.6	4.4
Korea	0.8	0.7	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.8	0.9	0.9	1.0	1.2	1.5
Lao PDR	-	-	1.4	0.7	0.8	-	-	1.5	0.9	1.0	-	-	2.3	1.4	1.8
Malaysia	0.9	0.7	0.5	0.4	0.3	0.6.	0.6	0.5	0.5	0.4	1.0	0.9	0.8	0.7	0.8
Myanmar	0.6	0.6	0.5	0.6	0.7	0.4	0.5	0.6	0.7	0.9	0.6	0.7	0.8	1.2	1.6
New Zealand	1.5	1.2	0.9	0.9	0.9	1.0	1.1	1.0	1.0	1.1	1.7	1.6	1.5	1.7	2.1
Philippines	1.0	1.0	0.6	0.6	0.7	0.7	0.9	0.6	0.7	0.9	1.1	1.3	1.0	1.1	1.6
Singapore	1.3	1.2	0.9	1.1	1.3	0.9	1.0	1.0	1.3	1.7	1.5	1.5	1.5	2.1	3.1
Thailand	0.9	0.7	0.4	0.3	0.3	0.6	0.7	0.5	0.4	0.4	1.0	1.0	0.7	0.7	0.8
Vietnam	0.5	0.4	0.4	0.3	0.2	0.3	0.4	0.4	0.3	0.3	0.5	0.5	0.7	0.5	0.6

8-4 CO_2 Emissions per Population

Country	1970s	1980s	1990s	2000s-1	2000s-2
Australia	12.55	13.98	15.87	18.19	18.30
Brunei	8.07	13.33	14.67	13.99	19.49
Cambodia	-	-	0.15	0.23	0.30
China	1.17	1.64	2.32	2.97	4.72
India	0.39	0.55	0.82	1.00	1.24
Indonesia	0.30	0.53	1.01	1.40	1.59
Japan	7.84	7.37	8.94	9.42	9.19
Korea	2.30	3.80	7.32	9.41	10.22
Lao PDR	-	-	0.10	0.23	0.26
Malaysia	1.32	2.04	3.82	5.23	6.30
Myanmar	0.14	0.14	0.14	0.19	0.24
New Zealand	5.64	5.80	6.92	7.97	7.70
Philippines	0.69	0.58	0.80	0.87	0.77
Singapore	4.04	5.99	10.36	10.19	9.61
Thailand	0.57	0.81	2.12	2.94	3.43
Vietnam	0.30	0.30	0.38	0.78	1.15
OECD Total	10.98	10.37	10.57	10.93	10.51
ERIA Total	1.30	1.54	2.09	2.52	3.33

Comparison

Country	vs. OECD					vs. OECD (whole periods)					vs. ERIA				
	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2	1970s	1980s	1990s	2000s 1	2000s 2
Australia	0.9	0.7	0.7	0.6	0.6	0.8	0.8	0.7	0.6	0.6	0.1	0.1	0.1	0.1	0.2
Brunei	1.4	0.8	0.7	0.8	0.5	1.3	0.8	0.7	0.8	0.5	0.2	0.1	0.1	0.2	0.2
Cambodia	-	-	69.2	47.2	35.0	-	-	69.8	46.1	35.5	-	-	13.7	10.9	11.1
China	9.3	6.3	4.6	3.7	2.2	9.1	6.5	4.6	3.6	2.3	1.1	0.9	0.9	0.8	0.7
India	28.4	18.8	12.8	11.0	8.5	27.6	19.3	12.9	10.7	8.6	3.4	2.8	2.5	2.5	2.7
Indonesia	36.2	19.4	10.4	7.8	6.6	35.1	20.0	10.5	7.6	6.7	4.3	2.9	2.1	1.8	2.1
Japan	1.4	1.4	1.2	1.2	1.1	1.4	1.4	1.2	1.1	1.2	0.2	0.2	0.2	0.3	0.4
Korea	4.8	2.7	1.4	1.2	1.0	4.6	2.8	1.5	1.1	1.0	0.6	0.4	0.3	0.3	0.3
Lao PDR	-	-	106.0	46.8	40.8	-	-	106.8	45.6	41.3	-	-	21.0	10.8	12.9
Malaysia	8.3	5.1	2.8	2.1	1.7	8.1	5.2	2.8	2.0	1.7	1.0	0.8	0.5	0.5	0.5
Myanmar	77.0	75.5	78.0	56.4	44.4	74.8	77.5	78.6	55.0	45.0	9.1	11.2	15.4	13.0	14.1
New Zealand	1.9	1.8	1.5	1.4	1.4	1.9	1.8	1.5	1.3	1.4	0.2	0.3	0.3	0.3	0.4
Philippines	16.0	17.9	13.3	12.6	13.6	15.6	18.4	13.4	12.3	13.8	1.9	2.7	2.6	2.9	4.3
Singapore	2.7	1.7	1.0	1.1	1.1	2.6	1.8	1.0	1.0	1.1	0.3	0.3	0.2	0.2	0.3
Thailand	19.2	12.8	5.0	3.7	3.1	18.6	13.1	5.0	3.6	3.1	2.3	1.9	1.0	0.9	1.0
Vietnam	36.0	34.4	27.8	14.1	9.1	35.0	35.4	28.1	13.7	9.3	4.3	5.1	5.5	3.2	2.9