# Chapter 4

# Country Analysis

October 2014

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# CHAPTER 4
# Country Analysis

## Methodology

Among self-sufficiency (including nuclear), diversity of TPES, diversity of power generation, TPES per GDP, and $CO_2$-related ESIs, $CO_2$ emission per GDP was selected and compared with the OECD Average (average for 1971-2009). The scores were then charted using a radar graph.

The radar graph took 2000s-2 as the starting point, and looked at how ESIs change for 2020 under the BAU scenario and for 2035 under the APS scenario.

## Country Analysis

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

For all calculated scores described in the following chapters, the larger score shows better conditions. Accordingly, if the circle for 2020 and 2035 are wider than the circle for 2000s-2, as shown by the dotted line, future ESIs are expected to improve. As the OECD Average is taken to be 10, if the circle in the radar graph expands beyond 10, it means that the scores exceed the OECD Average.

**Australia**
Australia is characterised by increases in the production of coal and natural gas, and high energy efficiency.

2000s-2

Coal and natural gas contribute significantly to Australia's self-sufficiency levels. The country's self-sufficiency score is more than three times higher when compared to the OECD Average. Australia's energy consumption mainly came from fossil fuels and less from renewable energy. As a result, the diversity of TPES and diversity of power generation are below the OECD Average. The TPES per GDP is equal to the OECD Average and $CO_2$ emission per GDP is below the OECD Average.

2020, 2035

As the production volume of coal and natural gas are expected to increase significantly, Australia's self-sufficiency rate will improve further and the score will reach more than six times that of the OECD Average for 2035.

Australia's renewable energy supply is not expected to increase significantly, hence, the diversity of TPES will remain below the OECD Average. While coal-fired power generation output will decline, in contrast, natural gas-fired power generation output will increase in Australia. The result will lead to an improved diversity of power generation but will remain below the OECD Average.

Improvement of energy efficiency will contribute to an improved TPES per GDP and the score will be twice that of the OECD Average.

The combination of a decrease in coal consumption and improvement of energy efficiency will lead to an improved $CO_2$ emission per GDP, and the score will improve to approximately three times higher than the OECD Average for 2035.

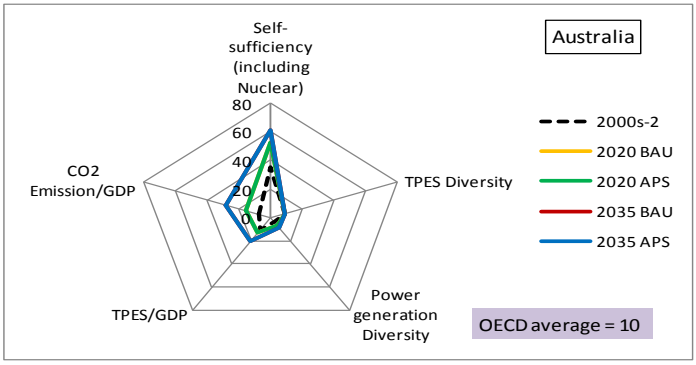
**Table 4-1: Major ESIs in Australia in Comparison with OECD Average**

| Selected ESIs | 2000s-2 | 2020 BAU | 2020 APS | 2035 BAU | 2035 APS |
|---|---|---|---|---|---|
| Self-sufficiency (including Nuclear) | 35 | 52 | 52 | 61 | 61 |
| TPES Diversity | 9 | 9 | 9 | 9 | 9 |
| Power generation Diversity | 4 | 7 | 7 | 9 | 9 |
| TPES/GDP | 10 | 13 | 13 | 21 | 21 |
| CO2 Emission/GDP | 7 | 15 | 15 | 28 | 28 |

*Note* : APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, ESI = energy security index, GDP = gross domestic product, TPES = total primary energy supply.

*Source*: Authors.

**Figure 4-1: Major ESIs in Australia in Comparison with OECD Average**




*Note* : APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

## Brunei

Brunei is characterised by natural resource endowment.

2000s-2

Since Brunei is an exporting country of crude oil and natural gas, the self-sufficiency rate is very high. In contrast, the diversity of TPES, diversity of power generation, TPES per GDP, and $CO_2$ emission per GDP are below the OECD Average.

2020, 2035

As natural gas production is expected to increase to almost twice the current level, self-sufficiency will improve in 2020, but worsen after 2020 until 2030 due to the increase in TPES.

As no renewable energy is expected to be produced, the diversity of TPES and diversity of power generation for Brunei will remain below the OECD Average.

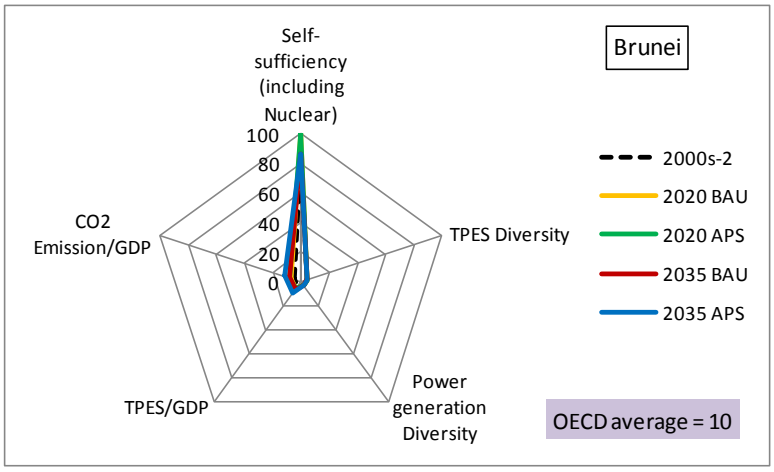
In 2035, energy efficiency will improve and the score will reach the OECD Average in an APS scenario. The result will contribute to the improvement in $CO_2$ emission per GDP.

**Table 4-2: Major ESIs in Brunei in Comparison with OECD Average**

| Selected ESIs | 2000s-2 | 2020 BAU | 2020 APS | 2035 BAU | 2035 APS |
|---|---|---|---|---|---|
| Self-sufficiency (including Nuclear) | 86 | 100 | 100 | 86 | 86 |
| TPES Diversity | 4 | 4 | 4 | 5 | 5 |
| Power generation Diversity | 2 | 2 | 3 | 2 | 3 |
| TPES/GDP | 5 | 5 | 6 | 7 | 10 |
| CO2 Emission/GDP | 5 | 7 | 8 | 8 | 12 |

*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

**Figure 4-2: Major ESIs in Brunei in Comparison with OECD average**




*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

## Cambodia

Cambodia is characterised by the promotion of electrification and the introduction of coal-fired power generation.

2000s-2

As Cambodia does not engage in the indigenous production of fossil fuels, it has a low level of self-sufficiency. The country depends mainly on petroleum for primary energy and hydropower generation for its electricity needs. As such, it has low scores for both diversity of TPES and diversity of power generation. On the other hand, its TPES per GDP exceeds the OECD

Average, and $CO_2$ emission per GDP is also close to the OECD Average level.

2020, 2035

In 2020 and 2035, there is no indigenous production of fossil fuels, nor nuclear power. Hence, self-sufficiency remains low. While Cambodia has plans to import electricity from neighbouring countries to improve electrification—which is positioned as a priority policy—electricity imports are a factor for its failure to attain improvements in self-sufficiency. To attain energy security, the decision to prioritise either self-sufficiency or electrification is likely to rely on an assessment of whether there are significant risks to importing electricity. With the ASEAN economic integration by 2015, ASEAN menbers seem to be strengthening their relationships with neighbouring countries. Taking this into consideration, it can be said that energy security risks arising from the imports of electricity are small.

As Cambodia has newly introduced coal-fired power generation, both diversity of TPES and diversity of power generation will improve.

TPES per GDP will improve further over the period 2000s-2. However, it is important to note that non-commercial energy has not been included in TPES here.

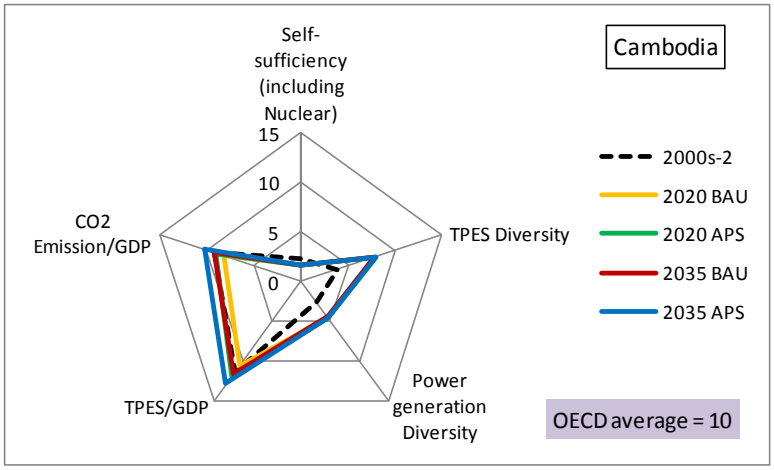
$CO_2$ emission per GDP will worsen under the 2020 BAU scenario, but will reach OECD Average levels under the 2035 APS scenario.

**Table 4-3: Major ESIs in Cambodia in Comparison with OECD Average**

| Selected ESIs | 2000s-2 | 2020 BAU | 2020 APS | 2035 BAU | 2035 APS |
|---|---|---|---|---|---|
| Self-sufficiency (including Nuclear) | 2 | 2 | 2 | 2 | 2 |
| TPES Diversity | 4 | 8 | 8 | 8 | 8 |
| Power generation Diversity | 3 | 5 | 5 | 4 | 5 |
| TPES/GDP | 11 | 11 | 12 | 12 | 13 |
| CO2 Emission/GDP | 9 | 8 | 9 | 9 | 10 |

*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

**Figure 4-3: Major ESIs in Cambodia in Comparison with OECD Average**




*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

## China

China is characterised by high energy consumption and increase in coal production.

2000s-2

Since China consumes plenty of coal, the country's self-sufficiency rate has been worsening, but still exceeds the OECD Average.

As China depends heavily on coal for TPES and power generation, the diversity of TPES and diversity of power generation are below the OECD Average.

TPES per GDP is below the OECD Average. $CO_2$ emission per GDP is also below the OECD Average due to the large consumption of coal.

2020, 2035

Fossil fuel production is estimated by making reference to the WEO 2013 data. Despite the increase in fossil fuels, nuclear, and hydropower production, self-sufficiency for China will worsen due to the high increase in energy consumption, hence, the score will be below the OECD Average.

Increase in natural gas supply will contribute to the improvement in TPES diversity and the score will reach close to the OECD Average in 2035 in an APS scenario. Increase in natural gas-fired power generation, nuclear power generation, and hydropower generation outputs will lead to changed power generation structure to improve the diversity of power generation.

Energy efficiency will improve and TPES per GDP score will reach the OECD Average in 2035 in an APS scenario.

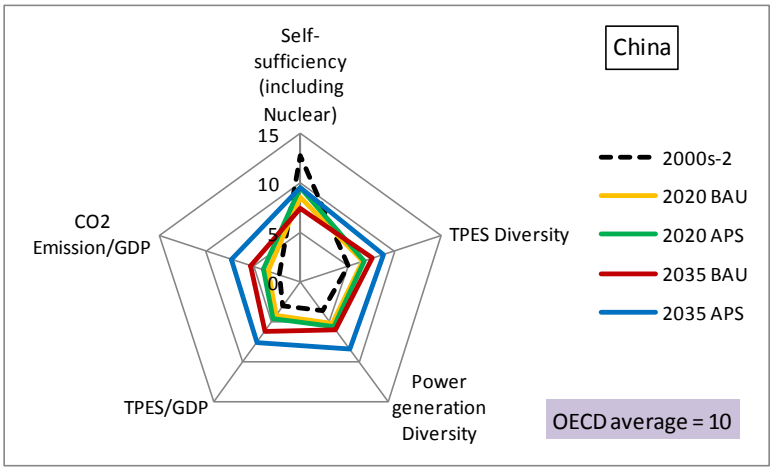
A combination of improvement in energy efficiency and an increase in low-carbon power generation output—such as natural gas, nuclear, and hydro—will contribute to improving $CO_2$ emission/GDP.

**Table 4-4: Major ESIs in China in Comparison with OECD Average**

| Selected ESIs | 2000s-2 | 2020 BAU | 2020 APS | 2035 BAU | 2035 APS |
|---|---|---|---|---|---|
| Self-sufficiency (including Nuclear) | 13 | 9 | 9 | 7 | 9 |
| TPES Diversity | 5 | 7 | 7 | 8 | 9 |
| Power generation Diversity | 4 | 5 | 6 | 6 | 8 |
| TPES/GDP | 3 | 4 | 5 | 6 | 8 |
| CO2 Emission/GDP | 2 | 4 | 4 | 5 | 7 |

*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

**Figure 4-4: Major ESIs in China in Comparison with OECD Average**




*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

## India

India is characterised by high energy consumption and an increase in coal production.

2000s-2

Although India is ranked as the third largest coal producer in the world, the country's self-sufficiency score is below the OECD Average mainly due to an increase in import dependence on crude oil and natural gas.

As India heavily depends on coal for TPES and power generation, the diversity of TPES and diversity of power generation are below the OECD Average.

TPES per GDP is below the OECD Average. $CO_2$ emission per GDP is also below the OECD Average due to the large consumption of coal.

2020, 2035

Fossil fuel production is estimated by making reference to the WEO 2013 data. While coal and natural gas production are expected to increase, crude oil production is expected to decrease. The results lead to a worsened self-sufficiency score.

Increase in natural gas and nuclear will contribute to an improved diversity of TPES, hence, the score will reach the OECD Average in 2035 in an APS scenario. Increase in natural gas-fired power generation, nuclear power generation, and hydropower generation outputs will contribute to an improved diversity of power generation.

Energy efficiency will improve and the score will reach close to the OECD Average in 2035 in an APS scenario.

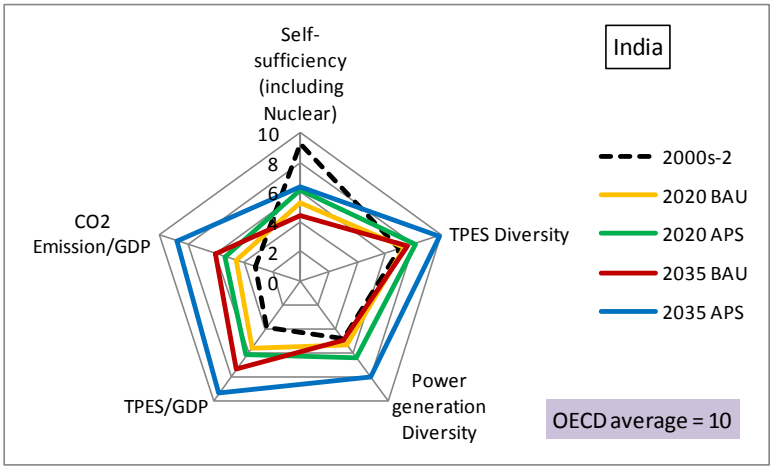
A combined improvement in energy efficiency and increase in low-carbon power generation output—such as natural gas, nuclear, and hydro—will contribute to the improvement in $CO_2$ emission per GDP, and the score will reach close to the OECD Average in 2035 in an APS scenario.

**Table 4-5: Major ESIs in India in Comparison with OECD Average**

| Selected ESIs | 2000s-2 | 2020 BAU | 2020 APS | 2035 BAU | 2035 APS |
|---|---|---|---|---|---|
| Self-sufficiency (including Nuclear) | 9 | 5 | 6 | 4 | 6 |
| TPES Diversity | 7 | 7 | 8 | 8 | 10 |
| Power generation Diversity | 5 | 5 | 6 | 5 | 8 |
| TPES/GDP | 4 | 6 | 6 | 7 | 9 |
| CO2 Emission/GDP | 3 | 5 | 5 | 6 | 9 |

*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

**Figure 4-5: Major ESIs in India in Comparison with OECD Average**




*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

## Indonesia

Indonesia is characterised by an acceleration of coal production and geothermal power.

2000s-2

As Indonesia has rich and abundant natural resources, the country has a high degree of self-sufficiency. While it does not use nuclear energy and utilises few hydropower, the use of geothermal power brings its diversity of TPES and diversity of power generation levels close to the OECD Average. On the other hand, the TPES per GDP and $CO_2$ emission per GDP are below the OECD Average.

2020, 2035

Self-sufficiency forecasts are for 2030. While production volumes for crude oil and natural gas are expected to decline, the production volume of coal is expected to increase. For this reason, the score will fall below 2000s-2 levels. However, high levels of self-sufficiency are maintained until 2020 and 2030. In an APS scenario, there are plans to introduce nuclear power, contributing marginally to improvements in self-sufficiency.

Indonesia will have low oil ratio, while the ratio of coal will be on the rise. As such, both diversity of TPES and diversity of power generation are expected to improve. In an APS scenario, the introduction of nuclear power and increases in hydropower and geothermal power will contribute to generating the score that exceeds the OECD Average.

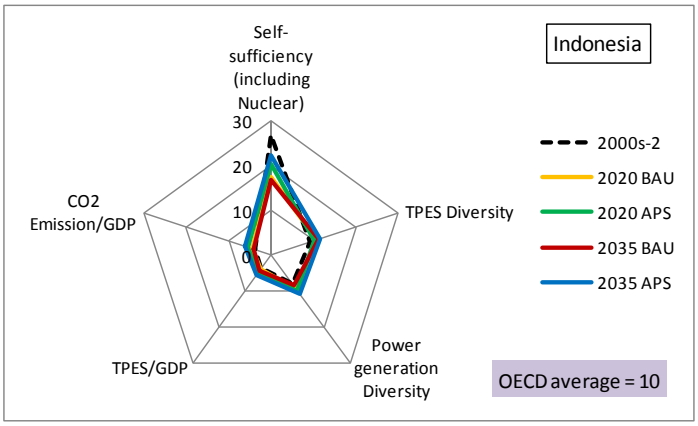
For TPES per GDP and $CO_2$ emission per GDP, while there are no changes in the BAU scenario, scores will remain lower than the OECD Average in the APS scenario. Despite this, there will be improvements when compared to the BAU scenario. On $CO_2$ emission in an APS scenario, the decline in fossil fuels consumption volume will be a contributing factor, as compared to a BAU scenario,

**Table 4-6: Major ESIs in Indonesia in Comparison with OECD Average**

| Selected ESIs | 2000s-2 | 2020 BAU | 2020 APS | 2035 BAU | 2035 APS |
|---|---|---|---|---|---|
| Self-sufficiency (including Nuclear) | 27 | 17 | 20 | 17 | 22 |
| TPES Diversity | 9 | 11 | 10 | 11 | 12 |
| Power generation Diversity | 8 | 10 | 10 | 9 | 11 |
| TPES/GDP | 4 | 4 | 5 | 4 | 6 |
| CO2 Emission/GDP | 4 | 4 | 6 | 4 | 6 |

*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

**Figure 4-6: Major ESIs in Indonesia in Comparison with OECD Average**




*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

## Japan

Japan is characterised by high energy efficiency, and future situation in nuclear power contributes to major differences in ESI for the country.

2000s-2

Although Japan has little natural resources, the country has raised its self-sufficiency level through the use of nuclear power. However, its self-sufficiency still falls far below the OECD Average.

During the oil shock that hit the world in the 1970s, the country's share of oil was extremely high. However, as a result of increasing diversification of energy sources thereafter, the diversity of TPES and diversity of power generation rose above the OECD Average in 2000s-2.

Also as a result of promoting energy conservation policies, the TPES per GDP and $CO_2$ emission per GDP are above the OECD Average.

2020, 2035

In Japan, the production of fossil fuels is not forecasted even in the future. In the BAU scenario, the amount of nuclear power generation output for 2035 will decline significantly. As such, self-sufficiency will suffer a major setback. However, as the decline in nuclear power generation output is smaller in the APS scenario than in the BAU scenario, when combined with

the decline in TPES, self-sufficiency exceeds 2000s-2 significantly. Nevertheless, it stands at a low level in comparison with the OECD Average.

Although the ratio of nuclear power declines, the increase in coal and natural gas will drive improvements in the diversity of TPES and diversity of power generation. As nuclear power is expected to increase in the APS scenario, the diversity will improve further when compared with the BAU scenario. The increase in renewable energy in the APS scenario also contributes to improvements in the diversity.

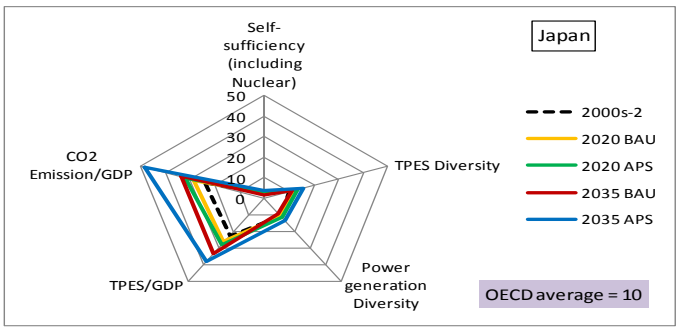
Compared with the OECD Average in 2035 in the APS scenario, scores are approximately four times for TPES per GDP, and five times for $CO_2$ emission per GDP.

**Table 4-7: Major ESIs in Japan in Comparison with OECD Average**

| Selected ESIs | 2000s-2 | 2020 BAU | 2020 APS | 2035 BAU | 2035 APS |
|---|---|---|---|---|---|
| Self-sufficiency (including Nuclear) | 3 | 2 | 3 | 2 | 4 |
| TPES Diversity | 10 | 12 | 14 | 11 | 16 |
| Power generation Diversity | 11 | 11 | 11 | 9 | 13 |
| TPES/GDP | 23 | 26 | 28 | 33 | 38 |
| CO2 Emission/GDP | 24 | 28 | 32 | 34 | 49 |

*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

**Figure 4-7: Major ESIs in Japan in Comparison with OECD Average**




*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

## Korea

Korea is characterised by a high proportion of nuclear power.

2000s-2

Although Korea has little natural resources, the country has raised its self-sufficiency level through the use of nuclear power. However, the self-sufficiency level is still far below that of the OECD Average. Although Korea used to have an extremely high ratio of oil in the past, the diversification of energy sources thereafter has brought its diversity of TPES closer to the OECD Average in 2000s-2. Both TPES per GDP and $CO_2$ emission per GDP are below the OECD Average.

2020, 2035

Even in the future, fossil fuel production is not forecasted for the country. As Korea does not use much hydropower and renewable energy, self-sufficiency is highly dependent upon the amount of nuclear power generation output.

In Korea, the share of oil is expected to decline. In addition, coal will increase in the BAU scenario while nuclear power will increase in the APS scenario. As such, the diversity of TPES will increase above the OECD Average. However, the diversity of power generation will stay at below the OECD average due to the increasing polarisation of nuclear power and coal power generation.

TPES per GDP will exceed OECD Average in 2035 in the APS scenario. On $CO_2$ emission per GDP, the score for 2035 in an APS scenario is approximately twice that of the OECD Average.

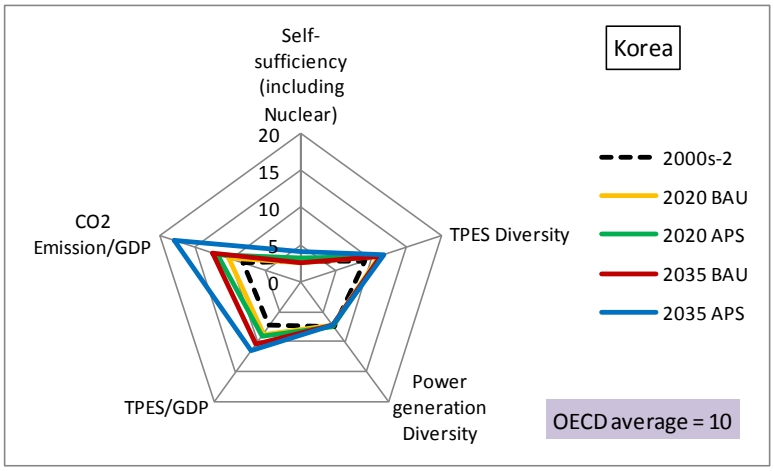
**Table 4-8: Major ESIs in Korea in Comparison with OECD Average**

| Selected ESIs | 2000s-2 | 2020 BAU | 2020 APS | 2035 BAU | 2035 APS |
|---|---|---|---|---|---|
| Self-sufficiency (including Nuclear) | 3 | 2 | 3 | 3 | 4 |
| TPES Diversity | 9 | 11 | 11 | 11 | 12 |
| Power generation Diversity | 7 | 7 | 7 | 7 | 7 |
| TPES/GDP | 7 | 9 | 9 | 10 | 11 |
| CO2 Emission/GDP | 8 | 10 | 12 | 13 | 18 |

*Note* : APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.

*Source*: Authors.

**Figure 4-8: Major ESIs in Korea in Comparison with OECD Average**




*Source*: Authors.

## Laos

Laos is characterised by the introduction of coal-fired power generation and electricity exports.

2000s-2

While Laos is engaged in the production of coal, the production level cannot contribute significantly to improvements in self-sufficiency. This is the same for hydropower. However, the country's self-sufficiency level exceeds the OECD Average. It depends solely upon hydro for power generation, and has no diversity. The TPES per GDP falls below the OECD Average. The $CO_2$ emission per GDP is on par with the OECD Average.

2020, 2035

Even in the future, Laos is not expected to increase its production of fossil fuels, thus, its self-sufficiency will depend largely on hydro. As export of electricity is expected to increase, self-sufficiency in 2020 will double. However, in 2035, as a result of an increase in domestic electricity demand, self-sufficiency will fall.

As Laos will introduce and expand coal-fired power generation use in the future, both diversity of TPES and diversity of power generation will improve after 2020.

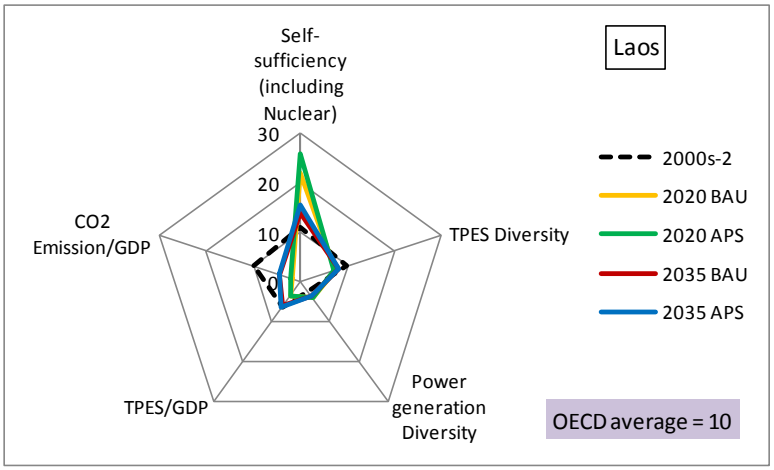
The TPES per GDP shows improvements for 2035 in an APS scenario, as compared to the OECD Average. However, $CO_2$ emission per GDP will worsen as a result of the introduction of coal-fired power generation.

**Table 4-9: Major ESIs in Laos in Comparison with OECD Average**

| Selected ESIs | 2000s-2 | 2020 BAU | 2020 APS | 2035 BAU | 2035 APS |
|---|---|---|---|---|---|
| Self-sufficiency (including Nuclear) | 11 | 22 | 26 | 14 | 16 |
| TPES Diversity | 10 | 7 | 7 | 8 | 8 |
| Power generation Diversity | 2 | 4 | 4 | 4 | 4 |
| TPES/GDP | 6 | 4 | 4 | 6 | 7 |
| CO2 Emission/GDP | 10 | 2 | 2 | 4 | 5 |

*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

**Figure 4-9: Major ESIs in Laos in Comparison with OECD Average**




*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

## Malaysia

For Malaysia, production volumes for coal and natural gas will have a major impact on the country's future situation.

2000s-2

Crude oil and natural gas contribute significantly to Malaysia's self-sufficiency levels. Its self-sufficiency score is approximately twice that of the OECD Average. While Malaysia's energy consumption had mainly come from oil and natural gas, in recent years, consumption of coal is on the rise.

As a result, the diversity of TPES is close to the OECD Average. Diversity of power generation, TPES per GDP, and $CO_2$ emission per GDP are below the OECD Average.

2020, 2035

As a production outlook data is limited, the future production of coal and natural gas is considered to be at the same level as in 2000s-2. For this reason, depending on the production of coal and natural gas, there is a likelihood that future ESIs may change significantly. Self-sufficiency is based on forecasts for 2030. Malaysia's self-sufficiency exceeds the OECD Average in 2020, but falls below the OECD Average in 2030 in an APS scenario, where the introduction of nuclear power is anticipated.

As a result of the increase in coal, both diversity of TPES and diversity of power generation will improve. However, they will remain below the OECD Average.

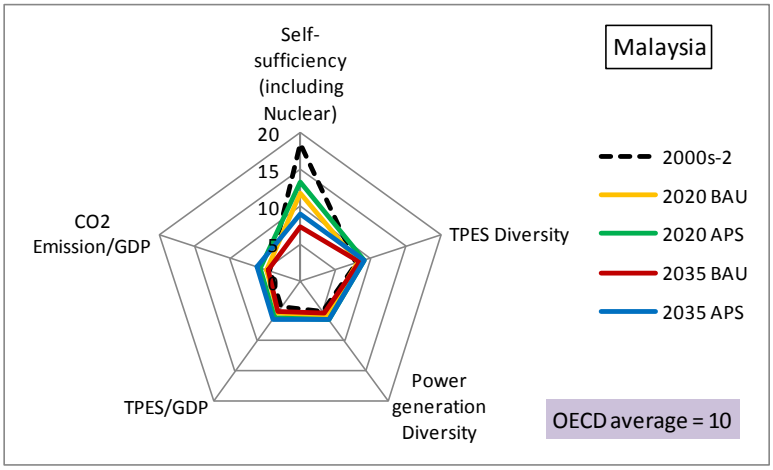
While TPES per GDP will improve, it remains below the OECD Average. In the APS scenario, the introduction of nuclear power is anticipated, and $CO_2$ emission per GDP will improve. However, it falls below the OECD Average.

**Table 4-10: Major ESIs in Malaysia in Comparison with OECD Average**

| Selected ESIs | 2000s-2 | 2020 BAU | 2020 APS | 2035 BAU | 2035 APS |
|---|---|---|---|---|---|
| Self-sufficiency (including Nuclear) | 18 | 12 | 13 | 7 | 9 |
| TPES Diversity | 8 | 8 | 9 | 8 | 9 |
| Power generation Diversity | 5 | 6 | 6 | 5 | 6 |
| TPES/GDP | 4 | 5 | 6 | 5 | 6 |
| CO2 Emission/GDP | 4 | 5 | 6 | 4 | 6 |

*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

**Figure 4-10: Major ESIs in Malaysia in Comparison with OECD Average**




*Note* : APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

## Myanmar

Myanmar is characterised by increases in the production of crude oil and natural gas.

2000s-2

Natural gas in Myanmar contributes significantly to self-sufficiency, and the country's self-sufficiency score is three times that of the OECD Average. Myanmar's energy consumption comes mainly from oil and natural gas, and both diversity of TPES and diversity of power generation are below the OECD Average. The $CO_2$ emission per GDP is close to the OECD Average.

2020, 2035

Self-sufficiency is based on forecasts for 2030. Myanmar's self-sufficiency will be dependent upon the production volume of fossil fuels. As the production of coal, crude oil, and natural gas are expected to increase, Myanmar's self-sufficiency score will maintain at approximately three times that of the OECD Average.

As a result of the increase in coal consumption, the diversity of TPES will be at about the same level as the OECD Average. Although the diversity of power generation is expected to increase, it will be remain below the OECD Average.

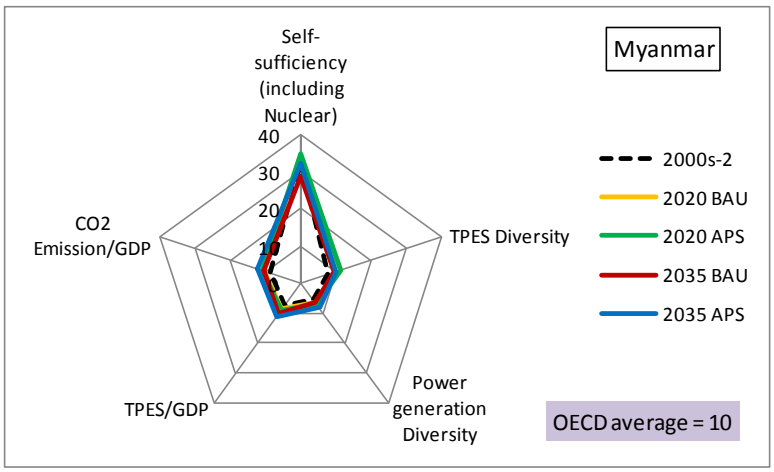
The TPES per GDP will exceed the OECD Average for 2035 in the APS scenario. The $CO_2$ emission per GDP will improve and exceed the OECD Average even in the BAU scenario.

**Table 4-11: Major ESIs in Myanmar in Comparison with OECD Average**

| Selected ESIs | 2000s-2 | 2020 BAU | 2020 APS | 2035 BAU | 2035 APS |
|---|---|---|---|---|---|
| Self-sufficiency (including Nuclear) | 33 | 34 | 35 | 29 | 32 |
| TPES Diversity | 8 | 11 | 11 | 9 | 10 |
| Power generation Diversity | 5 | 7 | 7 | 6 | 8 |
| TPES/GDP | 7 | 9 | 9 | 10 | 11 |
| CO2 Emission/GDP | 9 | 11 | 11 | 11 | 12 |

*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

**Figure 4-11: Major ESIs in Myanmar in Comparison with OECD Average**




*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

## New Zealand

New Zealand is characterised by an acceleration of renewable energy.

2000s-2

New Zealand produces coal, crude oil, and natural gas and has hydropower and geothermal power. Hence, although self-sufficiency is not 100%, the score exceeds the OECD Average. While the diversity of TPES exceeds the

OECD Average, as hydropower makes up a large proportion of power generation, its score falls below the OECD Average. The TPES per GDP is close to the OECD Average, while $CO_2$ emission per GDP exceeds the OECD Average.

2020, 2035

Due to difficulties in obtaining the coal production outlook data, the future production volume for coal is taken to be the same as for 2000s-2. In addition, self-sufficiency is based on forecasts for 2025. New Zealand's self-sufficiency will exceed 100% due to slight increases in the production volumes of crude oil and natural gas, and a significant increase in geothermal power in the APS scenario.

The diversity of TPES will improve as a result of greater use of renewable energy. Although the diversity of power generation improves, it will remain below the OECD Average.

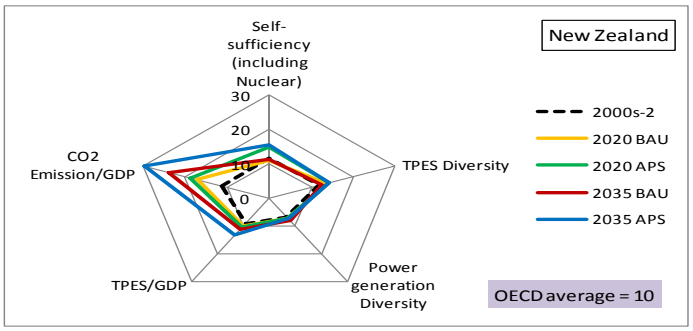
The TPES per GDP will be above the OECD Average even under a BAU scenario. As a result of greater power generation in renewable energy, the score for $CO_2$ emission per GDP is three times that of the OECD Average for 2035 in an APS scenario.

**Table 4-12: Major ESIs in New Zealand in Comparison with OECD Average**

| Selected ESIs | 2000s-2 | 2020 BAU | 2020 APS | 2035 BAU | 2035 APS |
|---|---|---|---|---|---|
| Self-sufficiency (including Nuclear) | 11 | 11 | 15 | 11 | 16 |
| TPES Diversity | 12 | 14 | 14 | 13 | 14 |
| Power generation Diversity | 7 | 7 | 7 | 8 | 7 |
| TPES/GDP | 9 | 10 | 11 | 11 | 13 |
| CO2 Emission/GDP | 11 | 17 | 19 | 24 | 30 |

*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

**Figure 4-12: Major ESIs in New Zealand in Comparison with OECD Average**




*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

## Philippines

The Philippines is characterised by an acceleration of coal-fired power generation and renewable energy.

2000s-2

With the exception of nuclear power, the Philippines is engaged in the production of a wide range of energy. Self-sufficiency is at 52%, below the OECD Average. As it uses a wide range of energy excluding nuclear power, the diversity of power generation and diversity of TPES are above the OECD Average. The TPES per GDP falls below the OECD Average, but $CO_2$ emission per GDP is close to the OECD Average due to the widespread use of renewable energy.

2020, 2035

While self-sufficiency declines in the BAU scenario, the production volume of fossil fuels will increase in the APS scenario. Increases will be also seen for hydropower, geothermal power, and other forms of renewable energy. As such, the score of self-sufficiency will be close to the OECD Average for 2035 in the APS scenario.

As a result of these changes, the diversity of TPES will improve further above the OECD Average in the APS scenario. On the other hand, as coal-fired power generation output will increase significantly, the diversity of power generation will worsen and will fall below the OECD Average.

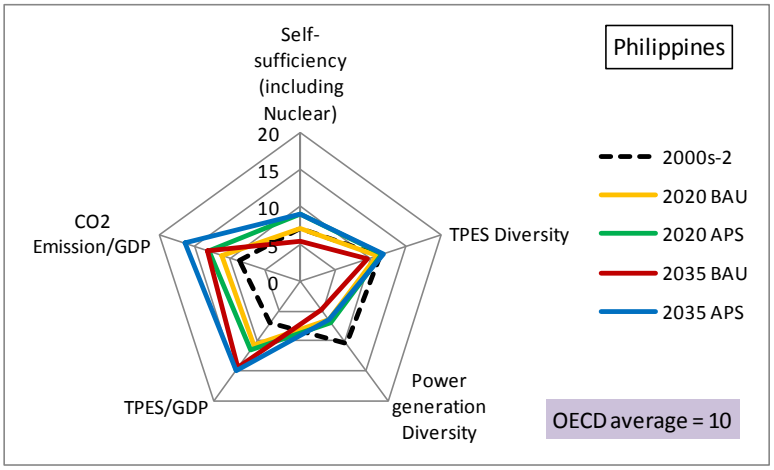
The TPES per GDP will improve above the OECD Average even under the BAU scenario. As a result of the increase in the generation of renewable energy, the $CO_2$ emission per GDP will improve above the OECD Average.

**Table 4-13: Major ESIs in the Philippines in Comparison with OECD Average**

| Selected ESIs | 2000s-2 | 2020 BAU | 2020 APS | 2035 BAU | 2035 APS |
|---|---|---|---|---|---|
| Self-sufficiency (including Nuclear) | 7 | 7 | 9 | 5 | 9 |
| TPES Diversity | 11 | 11 | 12 | 9 | 12 |
| Power generation Diversity | 10 | 6 | 7 | 5 | 6 |
| TPES/GDP | 7 | 11 | 12 | 14 | 15 |
| CO2 Emission/GDP | 9 | 11 | 13 | 13 | 16 |

*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

**Figure 4-13: Major ESIs in the Philippines in Comparison with OECD Average**




*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

## Singapore

Singapore is characterised by high energy efficiency.

2000s-2

Singapore produces no indigenous energy. The country's primary energy source and power generation fuel are oil and natural gas.

Singapore is ranked as one of the highest energy-efficient country in the EAS region. The TPES per GDP score is almost twice that of the OECD Average.

Despite the absence of renewable energy supply in Singapore, the $CO_2$ emission per GDP score is higher or almost twice that of the OECD Average due to high energy efficiency and no coal consumption.

2020, 2035

As renewable energy is expected to be produced more in Singapore, self-sufficiency will improve slightly.

As the supply structure of TPES and power generation will not change much in the future, the diversity of TPES and power generation will remain at current status.

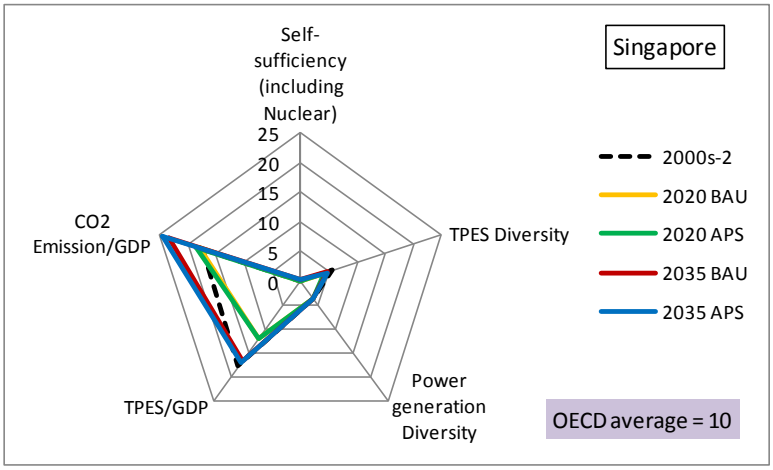
Energy efficiency in Singapore will worsen in 2020 then improve in 2035 but the score will be below the 2000s-2 level.

**Table 4-14: Major ESIs in Singapore in Comparison with OECD Average**

| Selected ESIs | 2000s-2 | 2020 BAU | 2020 APS | 2035 BAU | 2035 APS |
|---|---|---|---|---|---|
| Self-sufficiency (including Nuclear) | 0 | 0 | 0 | 0 | 0 |
| TPES Diversity | 6 | 4 | 4 | 5 | 5 |
| Power generation Diversity | 4 | 4 | 4 | 4 | 4 |
| TPES/GDP | 18 | 12 | 12 | 17 | 17 |
| CO2 Emission/GDP | 17 | 18 | 18 | 23 | 24 |

*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

**Figure 4-14: Major ESIs in Singapore in Comparison with OECD Average**




*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

## Thailand

Thailand is characterised by a high ratio of natural gas.

2000s-2

Thailand produces a wide range of energy with the exception of nuclear power and geothermal energy. Self-sufficiency is at 55%, falling below the OECD Average. Although it does not have nuclear power and geothermal energy, the diversity of TPES is close to the OECD Average. As natural gas makes up a large portion of power generation, the diversity of power generation falls below the OECD Average. TPES per GDP and $CO_2$ emission per GDP fall below the OECD Average.

2020, 2035

Despite increases in the production of natural gas and newly introduced nuclear power and geothermal power, the fall in the production of crude oil and increase in TPES will have a negative impact on self-sufficiency.

On the other hand, as a result of the introduction of nuclear and geothermal power, the diversity of TPES will exceed the OECD Average. Although nuclear power and geothermal power are added to the power generation mix, the power generation output will be small, and the share of natural gas will

remain high. Hence, the diversity of power generation will fall below the OECD Average.

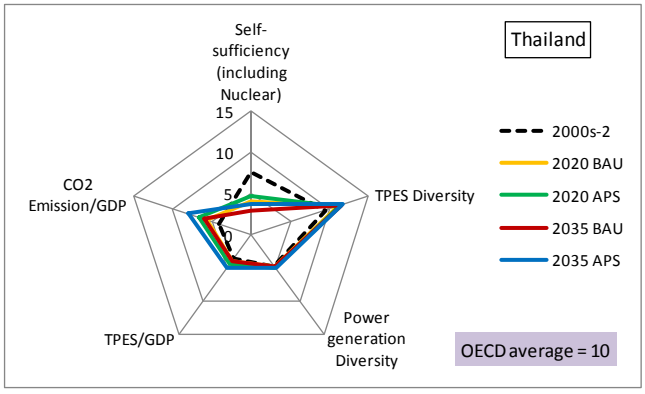
Despite improvements in TPES per GDP, the score will be below the OECD Average. As a result of the introduction of nuclear power and geothermal power, as well as increases in hydropower, $CO_2$ emission per GDP will improve, but fall below the OECD Average.

**Table 4-15: Major ESIs in Thailand in Comparison with the Average**

| Selected ESIs | 2000s-2 | 2020 BAU | 2020 APS | 2035 BAU | 2035 APS |
|---|---|---|---|---|---|
| Self-sufficiency (including Nuclear) | 8 | 4 | 5 | 3 | 4 |
| TPES Diversity | 9 | 11 | 11 | 12 | 12 |
| Power generation Diversity | 5 | 5 | 5 | 5 | 5 |
| TPES/GDP | 4 | 4 | 5 | 4 | 5 |
| CO2 Emission/GDP | 4 | 6 | 7 | 6 | 8 |

*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

**Figure 4-15: Major ESIs in Thailand in Comparison with OECD Average**




*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

**Viet Nam**

Viet Nam is characterised by an increase in the consumption of coal.

2000s-2

Viet Nam is a fossil fuel-producing country, and its self-sufficiency score is twice that of the OECD Average. Although it does not have nuclear and geothermal power, the diversity of TPES is on par with the OECD Average. As it does not have nuclear power and renewable energy, the diversity of power generation is below the OECD Average. TPES per GDP and $CO_2$ emission per GDP fall below OECD Average.

2020, 2035

Despite increases in coal production and the newly introduced nuclear power, the increase in TPES will worsen self-sufficiency, and will fall below the OECD Average.

Despite the introduction of nuclear power and increases in coal production, the diversity of TPES will fall below the OECD Average due to the increase of TPES. Even in power generation, despite the addition of nuclear power, the generation output will be low, and the share of coal will increase. As such, the diversity of power generation will fall below the OECD Average.

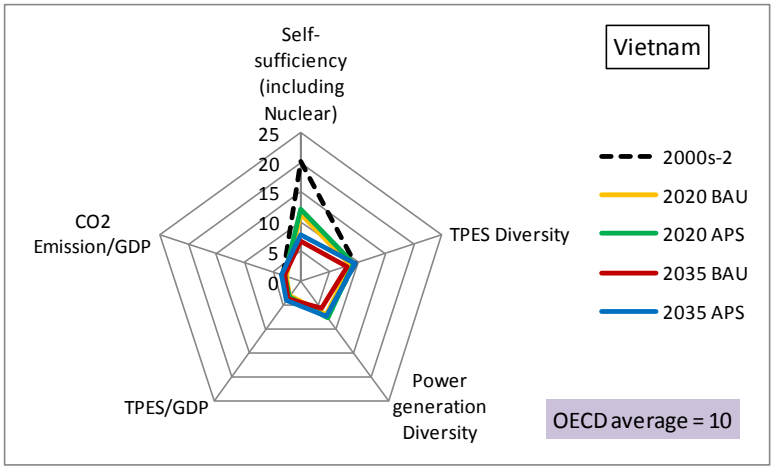
Despite improvements in TPES per GDP, it will fall below the OECD Average. Although nuclear power is newly introduced and there are increases in hydropower, as the consumption of coal increases significantly, $CO_2$ emission per GDP will fall below the OECD Average.

**Table 4-16: Major ESIs in Viet Nam in Comparison with OECD Average**

| Selected ESIs | 2000s-2 | 2020 BAU | 2020 APS | 2035 BAU | 2035 APS |
|---|---|---|---|---|---|
| Self-sufficiency (including Nuclear) | 20 | 11 | 12 | 7 | 8 |
| TPES Diversity | 10 | 9 | 9 | 8 | 9 |
| Power generation Diversity | 7 | 7 | 8 | 6 | 7 |
| TPES/GDP | 3 | 3 | 4 | 4 | 4 |
| CO2 Emission/GDP | 3 | 3 | 3 | 3 | 3 |

*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.

**Figure 4-16: Major ESIs in Viet Nam in Comparison with OECD average**




*Note* :APS = alternative policy scenario, BAU = business-as-usual, $CO_2$ = carbon dioxide, GDP = gross domestic product, ESI = energy security index, OECD = Organisation for Economic Co-operation and Development, TPES = total primary energy supply.
*Source*: Authors.