CHAPTER 17

Viet Nam Country Report

Nguyen Minh Bao

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1. Background

Viet Nam is a developing country in Southeast Asia. The total land area is 331,100 km2, 50% of which is in productive use.

In 2017, Viet Nam's population was 93.7 million, which represents an average annual increase of 1.3% (27.7 million) from its 1990 level of 66.0 million.

Viet Nam's gross domestic product (GDP) increased at an average annual rate of 6.8%, from US$29.5 billion in 1990 to US$175.3 billion in 2017 (constant 2010 US dollar value). The commercial sector contributes the most to Viet Nam's GDP (38.8%), followed by the industry sector (35.0%), agriculture (14.8%), and other activities (11.4%). GDP per capita was US$1,871 in 2017.

1.1. Energy Situation

Viet Nam possesses considerable indigenous energy resources. It has 3.39 billion tonnes of proven recoverable reserves of coal, 460 million m3 of crude oil reserves, and 610 billion m3 of gas reserves.

In 2017, 38.4 million tonnes of coal, 9.87 billion m3 of natural gas and 15.52 million tonnes of crude oil were produced. Because of limited capacity at the Dung Quat oil refinery (6.5 million tonnes a year), over 40% of produced crude oil is used for the oil refinery and the remaining part is exported. Coal is mainly used in the industry sector, while natural gas is largely used to generate electricity.

Viet Nam had around 42.4 GW of installed generating capacity and produced 193.0 TWh of electricity in 2017. The main share of electricity generation comes from thermal sources (coal, natural gas, and oil), accounting for 54.3% of total generation; the remaining is hydro (45.5%) and others (around 0.2%).

The rural electrification programme has been implemented over the past few years. According to reports by Viet Nam Electricity (EVN), by the end of 2017, 99.98% of communes and 98.83% of households have access to electricity from the national grid, higher than most countries with the same GDP in the region and in the world.

Viet Nam has a high potential for renewable energy, such as small-scale hydropower, biomass energy, wind energy and solar energy, which can be utilised to meet the national energy demand in general and the need for electricity in remote areas in particular.

1.2. Targets on Greenhouse Gas Emissions Reduction and Energy Development

Viet Nam's fast-paced economic development and GDP growth have resulted in a high energy demand, especially for electricity, in manufacturing industries and amongst residential consumers, as well as natural gas and coal for power generation. This trend is expected to continue in the future. Thus, power generation will be the main source of GHG emissions in the decades to come.

1.2.1. Targets on Greenhouse Gas Emissions Reduction

To meet this growing energy demand, Viet Nam's government recently promulgated a series of programmes and new policies that aim to increase the share of renewables in power generation and promote energy efficiency to minimise the gap between demand and supply and reduce GHG emissions. The table below summarises the targets on reduction of GHG emissions, energy savings and renewables development in the related legal documents:

1.2.2. Energy development

A reliable power supply is an important requirement for an emerging economy in Viet Nam. By the end of 2018, the total installed capacity of the power generation system of Viet Nam was around 48.6 GW, an increase of 14.6% over 2017.[1] Coal takes the largest share of 38.1% in total installed capacity, followed by hydropower with 35.1% and natural gas with

[1] EVN-Annual Report, 2018

Table 17.1. Targets on Reduction of GHG Emissions, Energy Saving and Renewables Development

Item	Targets	Legal documents
GHG emissions	• GHG reduction target of 8% from Business-As-Usual (BAU) by 2030 with domestic resources. • GHG reduction target of 25% from BAU by 2030 with international support.	Viet Nam's NDC (2015)
Renewable energy	– Biomass power: to reach 3%, 6.3% and 8.1% of total electricity output by 2020, 2030 and 2050, respectively. – Wind power: to reach 1.0%, 2.7% and 5.0% of total electricity output by 2020, 2030 and 2050, respectively. – Solar power: to reach to 0.5%, 6.0% and 20.0% of total electricity output by 2020, 2030 and 2050, respectively.	The Viet Nam Renewable Energy Development Strategy to 2030, outlook up to 2050 (2015)
	– Increase the share of renewables in power generation to 9.9% in 2020, 12.5% in 2025, and 21% in 2030 in terms of installed capacity. – Increase the share of electricity generated from renewable resources to 6.5% in 2020, 6.9% in 2025, and 10.7% in 2030.	Revised National Power Development Plan VII (Revised PDP VII) 2011–2020, with outlook to 2030 (2016)
Energy savings	• 5%–7% saving from BAU in the period of 2019–25 • 8%–10% saving from BAU in the period of 2019–30.	National Energy Efficiency Program for the period 2019–2030 (2019)

GHG = greenhouse gas.

Source: Authors, compiled from various sources.

18.5%. According to the Revised Power Development Plan VII, coal power plants will mainly contribute to the essential capacity expansion, accounting for 42.6% by 2030, followed by renewables with 21.0%, hydro with 16.9%, natural gas 14.7% and others with 4.8%. Because of the high increase of fossil-based power plants, the fossil resource demand will exceed the domestic supply and Viet Nam's fuel import dependency will increase.

In order to diversify import fuel sources, beside coal, liquefied natural gas (LNG) is considered as a major import fuel in coming years. According to the Viet Nam Gas Industry Development Master Plan up to 2035, import of LNG will be started by 2021 and demand will be increased to around 5 million tonnes by 2025, 10 million tonnes by 2030 and 15 million tonnes by 2035. To achieve this, Viet Nam will develop three or four LNG import terminal systems with a the estimated capacity of each depot 1–3 million tonnes per year in the period of 2021–25 and further five or six LNG import terminals with the estimated capacity of each terminal around 3 million tonnes per year in the period of 2026–35. Almost all LNG terminal systems will be located in the Southern Viet Nam to supply gas to domestic power plants and industrial buyers.

Besides the Dung Quat refinery, the second oil refinery of Nghi Son was put in operation in 2019, with capacity 10 million tonnes a year, thus meeting around 80% of total current petroleum demand in Viet Nam. Moreover, some other oil refinery projects are being prepared

for investment in the period 2025–30 to achieve the total capacity of around 30 million tonnes a year in 2030.

2. Modelling Assumptions

In this outlook, Viet Nam's GDP is assumed to grow at an average annual rate of 5.4% from 2017 to 2050. Growth is projected to be faster in the first outlook period, increasing at 7% per year between 2017 and 2020. For the remaining periods of 2020–30, 2030–40 and 2040–50, the country's economic growth will be slightly moderate at an annual rate of 6.2%, 5.2% and 4.2%, respectively. Population growth is projected to increase at a much slower rate, increasing by 0.5% per year between 2017 and 2050.

Future changes in crude oil prices remain highly uncertain. In this study, the crude oil price, as referred to Japan's average import price (nominal dollars per barrel), is assumed to increase from US$54 a barrel in 2017 to US$77 a barrel in 2020, US$110 a barrel in 2030, US$150 a barrel in 2040 and US$185 a barrel in 2050.

In power generation, thermal efficiencies per fuel (coal, gas and oil) in Viet Nam were projected based on the forecasts for future power plant technologies estimated by the International Energy Agency (IEA). Thermal efficiency is expected to increase considerably over time in the alternative policy scenarios (APSs) as more advanced generation technologies, such as natural gas combined cycles and supercritical coal plants, become available.

The main sources of electricity generation in Viet Nam are hydropower plants, coal and natural gas power plants. The share of electricity generated from natural gas and coal-fired power plants is projected to increase considerably in the period of 2017- 2030, while the share of electricity generated from hydropower plants will decline due to the limited development of the hydropower sources because its potential is almost fully exploited. However, the share of coal-fired power plants is intended to be reduced after 2030, with natural gas (or imported LNG) being an alternative source (to reduce dependency on imported coal). Viet Nam is expected to increase its imports of electricity, particularly from the Lao People's Democratic Republic and China.

Viet Nam's energy-saving goals are assumed to be 5%–7% of total energy consumption between 2019 and 2025, and 8%–10% of total energy consumption between 2019 and 2030,

in line with the targets on National Energy Efficiency Program. The energy savings goals are expected to be attained through energy efficiency programmes in industry, transport, residential and commercial sectors on the demand side.

On the supply side, energy efficiency improvements in power generation and development of renewables technologies, particularly small hydro, solar, wind and biomass are expected to come on line intensively from 2018, in line with the master plan on renewables development.

From above analysis, the APSs proposed are as follows: Implementation of the energy efficiency and conservation (EEC) measures on the demand side (APS1); improvement of energy efficiencies in power generation (APS2); and development of renewables sources (APS3).

APS1: Promote EEC activities in all sectors.

This is assumed that the promotion of EEC activities will achieve the level of energy reduction from BAU with 7% in 2025, 10% in 2030 and 12% in 2050.

APS2: Improve energy efficiency in thermal power plants.

The efficiencies of coal and residue fuel oil thermal power plants are assumed to increase to 42% and 37% by 2050 compared with 37% and 35% in BAU, respectively, while natural gas with combined cycle gas turbines technology's efficiency will increase to 58% by 2050 compared with 53% in BAU.

APS3: Development of renewables technologies.

Installed electricity-generating capacity from renewables is assumed to reach 60,500 MW in 2050 with solar contributing 35,000 MW; wind, 15,000 MW; small hydro, 6,200 MW; biomass, 4,000 MW; and biogas, 300 MW.

APS5: Combining APS1 to APS3.

3. Outlook Results

3.1. Business-As-Usual Scenario

3.1.1. Total final energy consumption

Viet Nam's total final energy consumption (TFEC) in 2017 was 63.8 million tonnes of oil equivalent (Mtoe), which has increased at 5.2% per year, 4.0 times more than its 1990 level of 16.1 Mtoe. On a per sector basis, the fastest growth occurred in the transport sector (8.8% per year), followed by the industry sector (7.8%) and the residential/commercial ('others') sector (1.4% per year). Non-energy use is expected to grow at 12.2% per year.

For 2017–50, the TFEC is projected to increase at an average rate of 3.8% per year under the BAU scenario. The growth is driven by strong economic growth, which is assumed to be at an average annual growth of 5.4%, and the rising population at an average annual growth of 0.5%. On a per sector basis, the strongest growth in consumption is projected to occur in transport, increasing by 4.7% per year. This is followed by the industry sector (3.4% per year) and the residential/commercial ('others') sector (3.4% per year). Non-energy use is expected to grow at 4.2% per year. Figure 17-1 shows the final energy consumption by sectors from 1990 to 2050.

Figure 17.1. Final Energy Consumption by Sector, BAU (1990–2050)
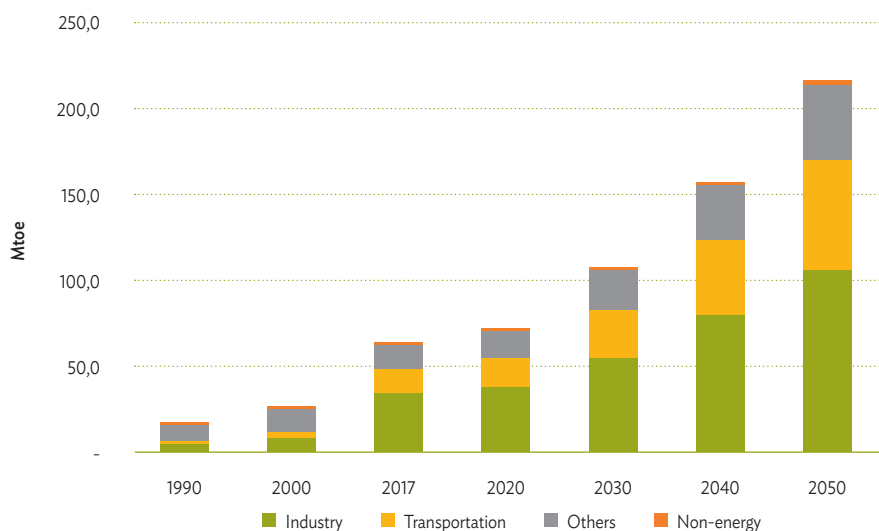
BAU = Business-As-Usual, Mtoe = million tonnes of oil equivalent.

Source: Author's calculations.

The bulk of the country's energy consumption (around 63% in 1990) comes from the residential/commercial ('others') sector, where biomass fuel used for residential cooking takes the dominant share. This share decreases to 23.2% by 2017 and to 20.6% by 2050 due to the substitution of biomass fuels by commercial fuels with higher efficiency under the effects of growing economy. Economic growth will improve the standard of living, thus increasing the transition from biomass to modern fuels such as LPG.

In 2017–50, the industry sector will keep the largest consuming sector in Viet Nam but its share of energy consumption in the industry sector will slightly decrease from 54.5% in 2017 to 49.3% in 2050. The second-largest consumer will be the transport sector and its share will increase slowly from 21.3% in 2017 to 29.0% in 2050.

Meanwhile, other fuels (mostly biomass) were the most-consumed product, accounting for 73.9% of the TFEC in 1990; however, it declined to 21.7% in 2017. Oil was the second-most-consumed product, accounting for 14.5% of the TFEC in 1990 and increasing to 29.6% in 2017. The share of coal consumption increased from 8.3% in 1990 to 23.8% in 2017. Electricity took a small share of 3.3% in 1990, but increased significantly to 23.3% in 2017.

On a per fuel basis under BAU, natural gas is projected to exhibit the fastest growth in final energy consumption, increasing at 5.4% per year between 2017 and 2050. Oil is projected to have the second-highest growth rate of 4.7% per year, followed by electricity and coal with 4.6% and 4.1%, respectively. Other fuels (mostly biomass) are projected to decrease at an annual rate of 3.9% due to the transition from biomass to modern fuels.

Oil products took the largest share of 29.6% in 2017; this share is projected to increase to 39.4% in 2050. The second-largest share of demand is coal, which is projected to increase from 23.8% in 2017 to 26.3% in 2050. This is followed by electricity, other fuels (dominated by biomass) and natural gas with their shares of 23.3%, 21.7% and 1.6% in 2017, respectively. However, the shares of electricity and natural gas will increase up to 29.9% and 2.7%, respectively, while other fuels will reduce rapidly to 1.7% in 2050 (Figure 17-2).

Figure 17.2. Final Energy Consumption by Fuel, BAU (1990–2050)
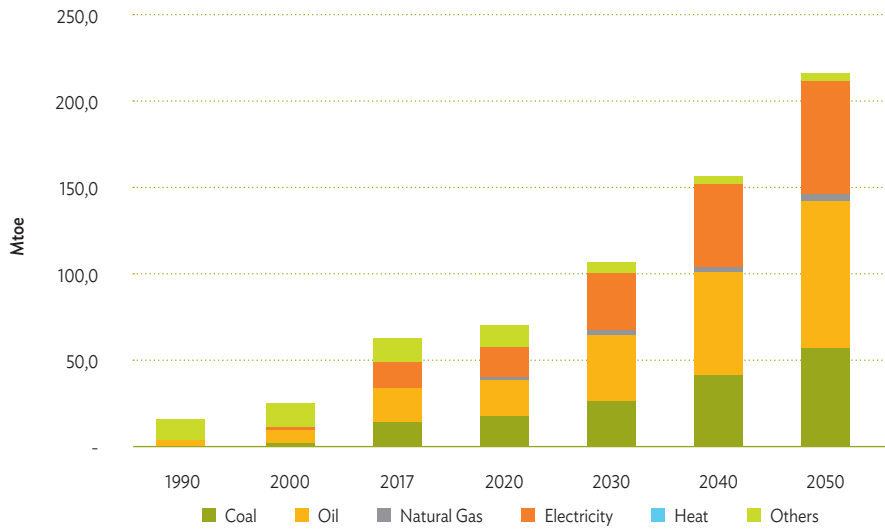
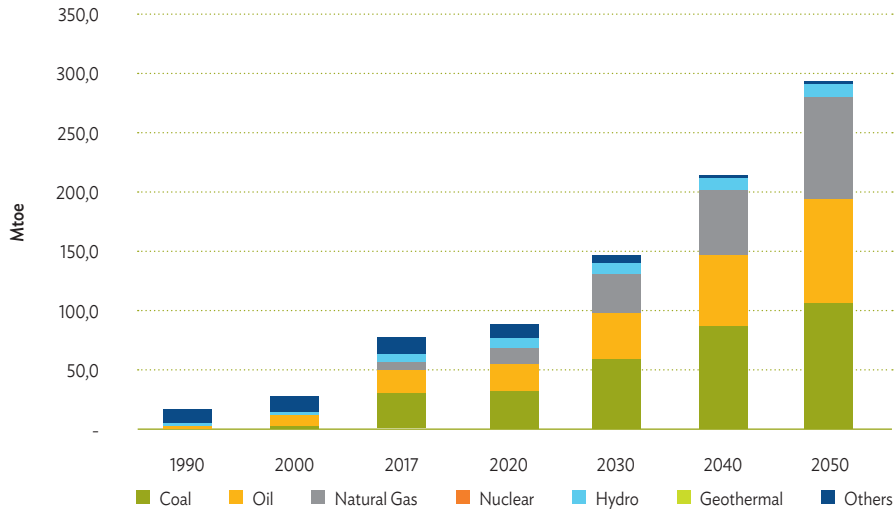BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

Source: Author's calculations.

3.1.2. Total Primary Energy Supply

Viet Nam's total primary energy supply (TPES) grew at a higher rate than TFEC; it increased at 5.7% per year, or 4.4 times, from 17.9 Mtoe in 1990 to 78.9 Mtoe in 2017. Among the major energy sources, the fastest-growing were natural gas, hydro, coal, and oil. Natural gas consumption grew at an average annual rate of 33.8% between 1990 and 2017, while hydro, coal and oil grew at 10.9%, 10.2% and 7.6% per year, respectively.

In the BAU scenario, Viet Nam's TPES is projected to increase at an annual rate of 4.1%, or 3.7 times, from 78.9 Mtoe in 2017 to 293.1 Mtoe in 2050. The fastest growth is expected in natural gas, increasing at an annual average rate of 7.5% between 2017 and 2050, followed by oil (4.6%), coal (3.9%) and hydro (1.2%), while other fuels (mostly biomass) will decrease strongly at 6.1% per year. Figure 17-3 shows the primary energy supply by source in the period 1990–2050.

Figure 17.3. Primary Energy Supply, BAU (1990–2050)

BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.
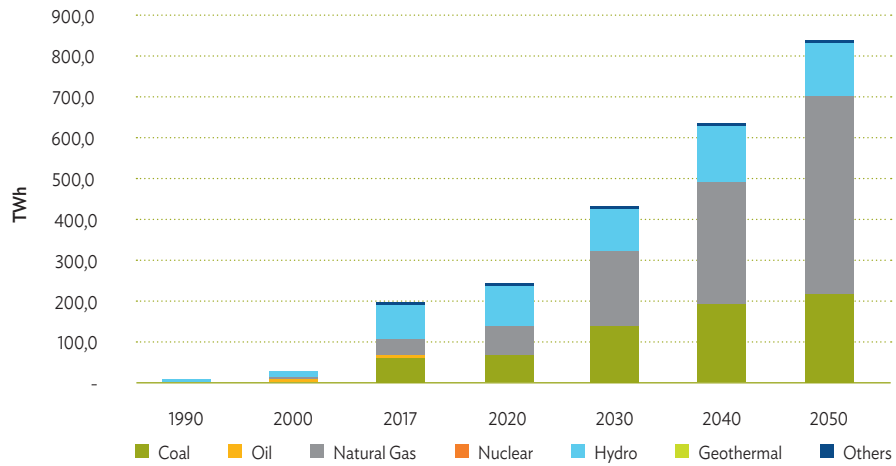Source: Author's calculations.

Coal accounted for the largest share of 38.9% of the TPES in 2017 and will slightly decrease to 36.7% in 2050. The shares of oil and natural gas are projected to increase from 25.0% and 9.9% in 2017 to 30.0% and 28.9% in 2050, respectively. This growth is due to the projected decline of hydro and others from 9.6% and 16.7% in 2017 to 3.9% and 0.6% in 2050, respectively.

3.1.3. Power generation

Power generation output increased at 12.2% per year, or 22.2 times, from 8.7 TWh in 1990 to 193.0 TWh in 2017. The fastest growth occurred in the natural gas power generation (38.7% per year), followed by coal (13.6%) and hydro power (10.9%). These fast growths are due to the high increase in electricity demand, as well as the decrease of oil power generation (2.2%).

Power generation is projected to increase at an average rate of 4.5% per year, or 4.3 times between 2017 and 2050, to meet electricity demand under the BAU scenario. The fastest growth will be in natural gas power generation (7.8% per year), followed by coal (3.8%) and other (1.6%). These fast growths are due to the low growth of hydro (1.2% per year) and the decrease of oil (3.1%). Figure 17.4 shows the power generation output by type of fuel under the BAU scenario from 1990 to 2050.

Figure 17.4. Power Generation by Type of Fuel, BAU (1990–2050)

BAU = Business-As-Usual, TWh = terawatt-hour.
Source: Author's calculations.

By the end of 2017, the majority of the country's power came from hydropower, which comprised about 45.5% of the total power generation mix. The share of coal power generation was around 32.7%, while the rest were from natural gas (21.2%), oil (0.4%) and other power generation (around 0.2%).

In BAU, natural gas will be the major fuel for power generation in 2030–50, with its share increasing from the second-largest share of 29.5% in 2020 to the largest shares of 42.9% in 2030, 48.3% in 2040 and 58.0% in 2050. On the other hand, the share of coal and hydro in the total power generation will decline from 32.1% and 24.8% in 2030 to 26.2% and 15.7% in 2050, respectively.

3.1.4. Energy indicators

From 1990 to 2017, Viet Nam's energy intensity showed a decreasing trend. Both primary and final energy intensities of the country decreased from 606 toe/million and 545 toe/million 2010 US$ in 1990 to 450 toe/million and 364 toe/million 2010 US$ in 2017, respectively. This was due to the complementary relation between modern energy and biomass. The stable economic growth will increase modern energy such as oil and electricity significantly; on the other hand biomass will be phased out because of its inconvenience. The final energy intensity under the BAU is estimated to continue the decreasing trend from 364 toe/million 2010 US$ in 2017 to 217 toe/million 2010 US$ by 2050. This decreasing trend indicates that energy will be used efficiently for economic development.

Meanwhile, primary energy per capita increased from 0.27 toe/person in 1990 to 0.84 toe/person in 2017; it will continue to increase to 2.69 toe/person in 2050. This indicates that, in the future, people's income increase will push up living standards and industrial structure change (shift from primary industry to secondary and service industries), resulting in rising the primary energy supply per capita.

Regarding GHG emissions, CO_2 intensity and CO_2 per energy increased from 160 t-C/million 2010 US$ and 0.26 t-C/toe in 1990 to 311 t-C/million 2010 US$ and 0.69 t-C/toe in 2017, respectively. In the BAU scenario, CO_2 intensity will slightly decline to 243 t-C/million 2010 US$ in 2050, while CO_2 per energy will slightly increase at around 0.83 t-C/toe in 2050. Moreover, CO_2 per capita will also significantly increase due to energy demand rising faster than population growth (Figure 17-5)

Figure 17.5. Energy Indicators (1990–2050)
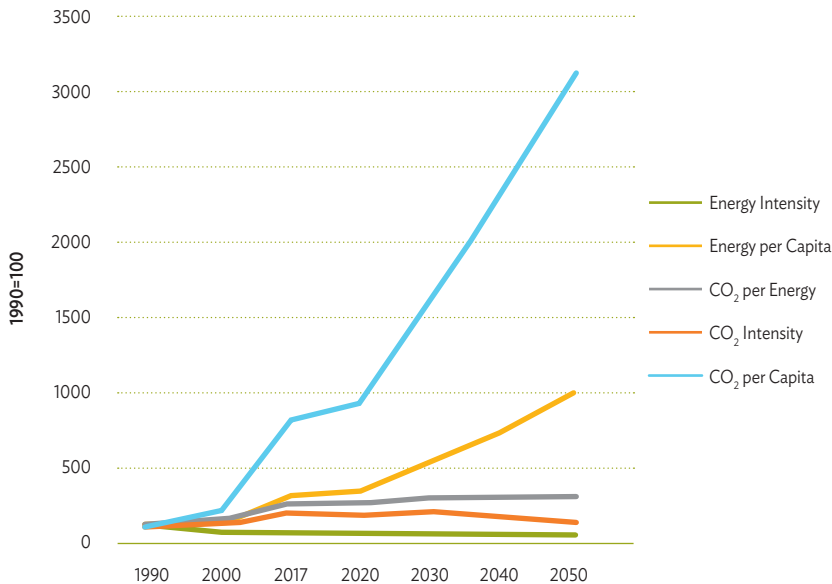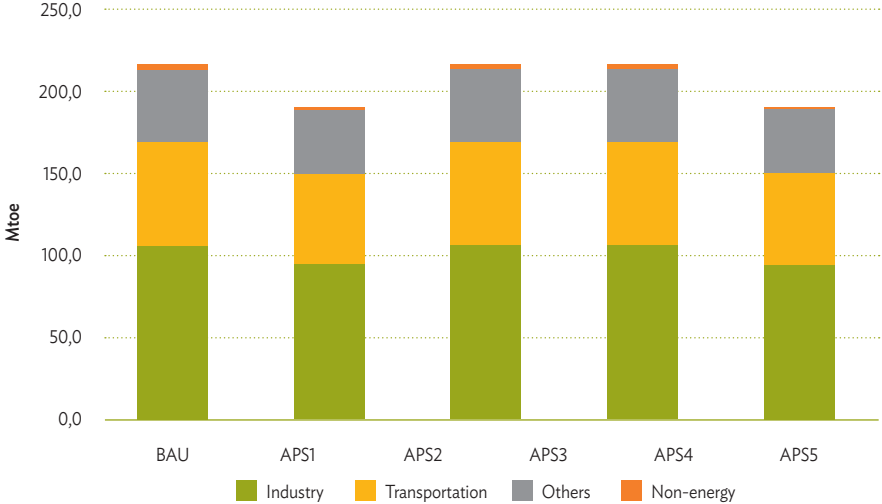

Source: Author's calculations.

3.2. Energy Savings and CO2 Reduction Potential

3.2.1. Total Final Energy Consumption

In the Alternative Policy Scenarios (APSs), the TFEC is projected to increase at a slower rate of 3.4% per year (compared with 3.8% in BAU), from 63.8 Mtoe in 2017 to 190.7 Mtoe in 2050 because of EEC measures (APS1) in the industry, transport, and 'others' (residential and commercial) sectors. APS2 and APS3 do not include EEC measures on demand-side, therefore,

are like the BAU scenario. APS5 combines all APSs; hence, it will be similar to APS1. The TFEC by sector in the BAU scenario and APSs are presented in Figure 17-6 below.

Figure 17.6. Total Final Energy Consumption by Sector in BAU and APSs

APS = Alternative Policy Scenario, BAU = Business-As-Usual.
Source: Author's calculations.

On a per fuel basis under APS5, natural gas is projected to grow at the highest average annual rate of 5.0%, compared with 5.4% in the BAU scenario. This is followed by oil with 4.3%, electricity with 4.1%, coal with 3.7% and others with -3.9%, compared with 4.7%, 4.6%, 4.1% and -3.9% in BAU, respectively, over the same period. However, energy savings potential comes mainly from oil products due to energy efficiency in the transport sector, with savings of 10.1 Mtoe in 2050, equivalent to a 11.9% decrease from the BAU scenario. This is followed by electricity, coal and natural gas with savings of 7.7 Mtoe, 6.8 Mtoe and 0.7 Mtoe, respectively, and all of these are equivalent to a 12.0% decrease from the BAU scenario in 2050. The TFEC by fuel in the BAU scenario and APSs are presented in Figure 17-7 below.

Figure 17.7. Total Final Energy Consumption
by Fuel, BAU and APS5 (2017 and 2050)
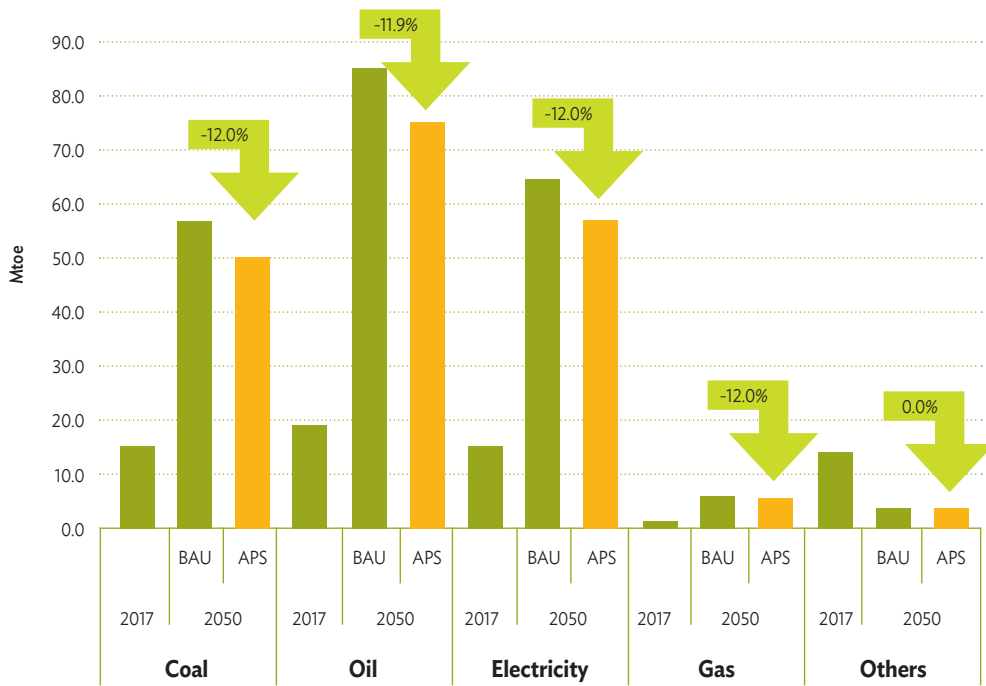
APS = Alternative Policy Scenario, BAU = Business-As-Usual.
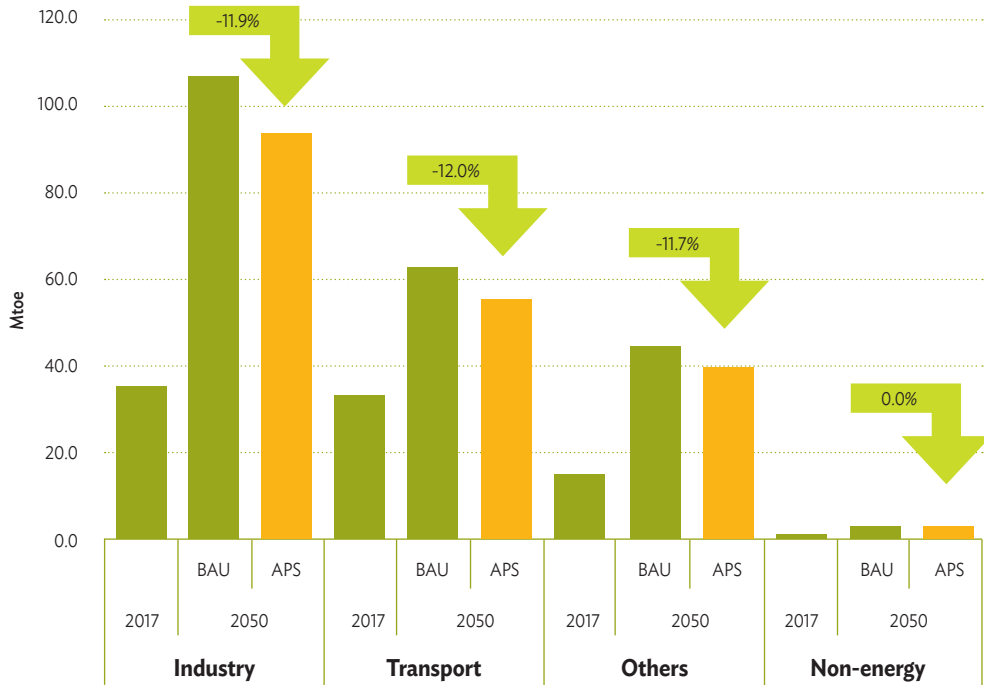Source: Author's calculations.

The bulk of the demand-side savings are expected to occur in the industry sector with 12.7 Mtoe (equivalent to 11.9% reduction), followed by the transport sector with 7.5 Mtoe (equivalent to 12.0% reduction), and the 'others' sector with 5.2 Mtoe (equivalent to 11.7% reduction).

An improvement in end-use technologies and the introduction of EEC measures are expected to contribute to the slower rate of consumption growth, particularly in the industry, transport, and 'others' (residential and commercial) sectors (Figure 17-8).

3.2.2. Total primary energy supply

In APS5, the TPES is projected to increase at a slower rate of 3.5% per year, from 78.9 Mtoe in 2017 to 243.8 Mtoe in 2050. Natural gas is projected to grow at the highest average annual rate of 6.8% compared with 7.5% in the BAU scenario. This is followed by oil (4.2%) and coal (2.4%), compared with 4.6% and 3.9% in BAU, respectively, over the same period.
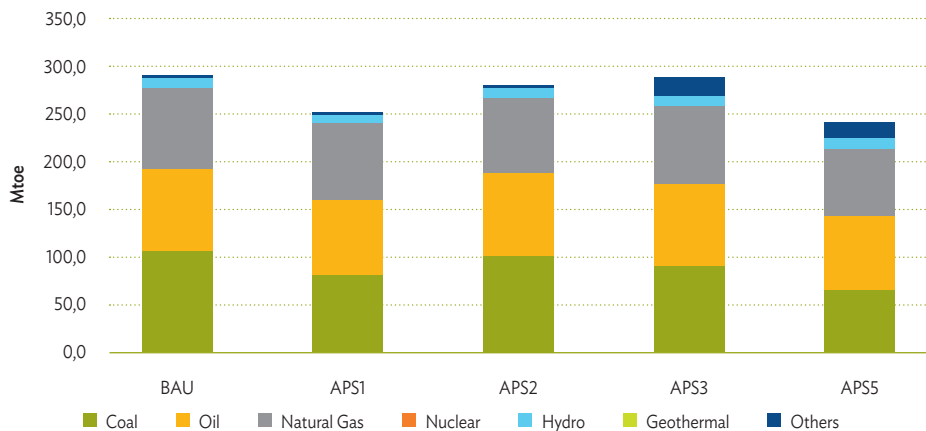
Figure 17.8. Final Energy Consumption by Sector, BAU and APS5 (2017 and 2050)

The slower growth in consumption, compared to BAU, stems from EEC measures on the demand side (APS1), and the more aggressive uptake of energy efficiency in thermal power plants (APS2) and renewables (APS3) on the supply side. The TPES by fuel in the BAU scenario and APSs are presented in Figure 17-9 below.

Figure 17.9. Total Primary Energy Supply by Fuel in BAU and APSs

Figure 17.10. Primary Energy Saving Potential by Fuel, BAU and APS5 (2017 and 2050)
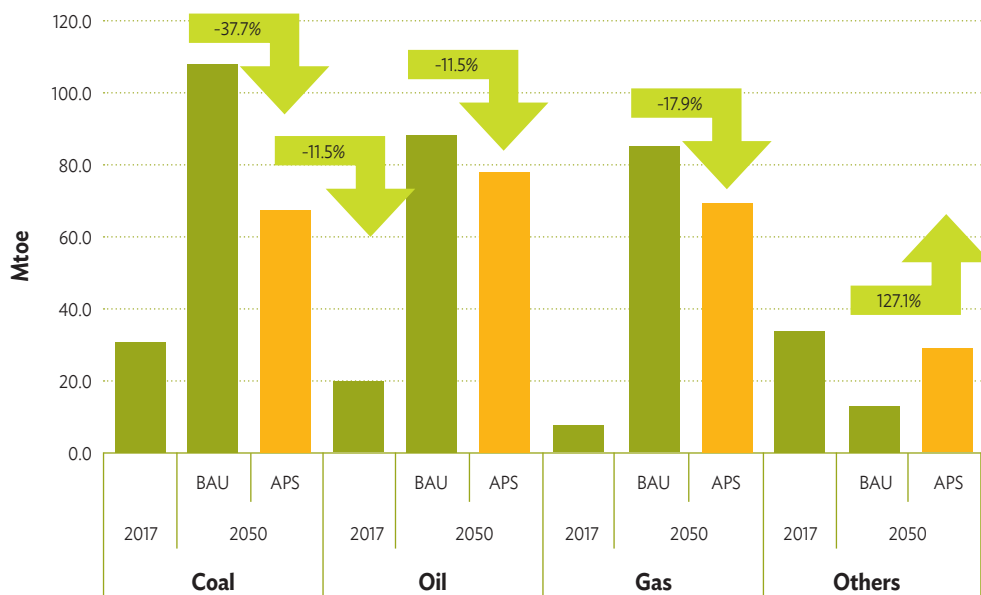
APS = Alternative Policy Scenario, BAU = Business-As-Usual.
Source: Author's calculations.

On the energy savings aspect, coal has the highest energy savings potential with 37.7%, followed by natural gas (17.9%) and oil (11.5%). The primary energy savings potential by fuel in the BAU scenario and APSs are presented in Figure 17-10 below.

The difference between TPES in the APS5 and the BAU scenario is total energy savings, amounting to 49.3 Mtoe equivalent to 16.8% of Viet Nam's TPES in 2050 (Figure 17.11). This energy savings could be achieved from demand-side EEC efforts, further improvement of thermal power plant efficiency and higher contribution of renewables resources.

3.2.3. CO2 reduction potential

CO2 emissions from energy consumption under the BAU scenario are projected to increase by 4.6% per year from 54.5 million metric tonnes of carbon (Mt-C) in 2017 to 242.4 Mt-C in 2050. Meanwhile, under APSs, the annual increase in CO2 emissions between 2017 and 2050 is projected to be 3.7% yearly, which is 0.9% points lower than BAU.

Reduced CO2 emissions are mostly derived from EEC measures on the demand side (APS1). Moreover, improvement of energy efficiency in thermal power plants (APS2) and development
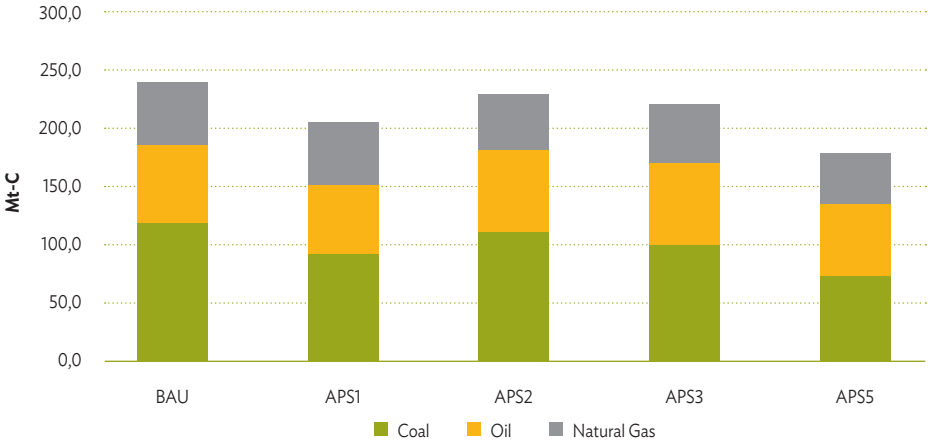
of renewables technologies (APS3) also contributed significantly to CO2 reduction (Figure 17-12).

Figure 17.11. Evolution of Primary Energy Supply, BAU and APS5 (1990, 2017, and 2050)
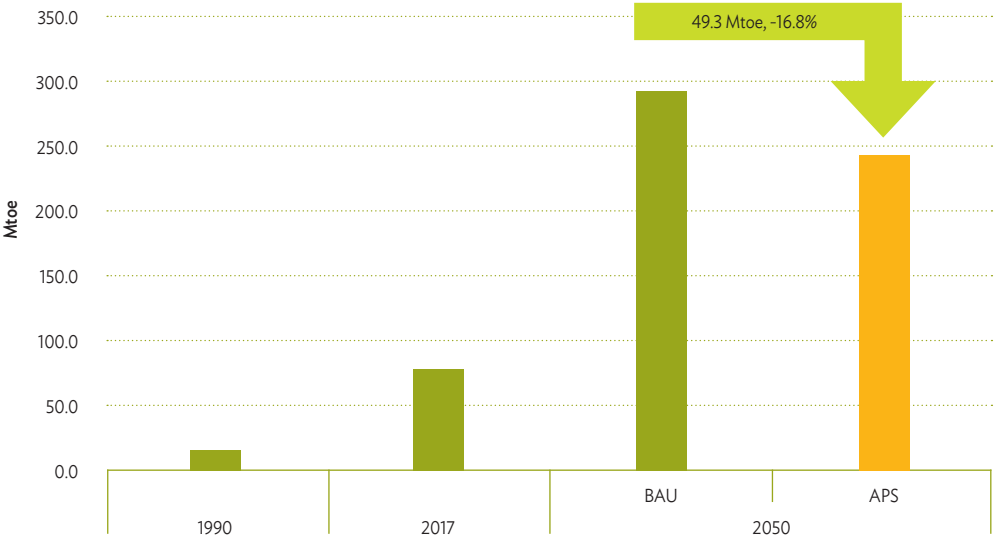
APS = Alternative Policy Scenario, BAU = Business-As-Usual.
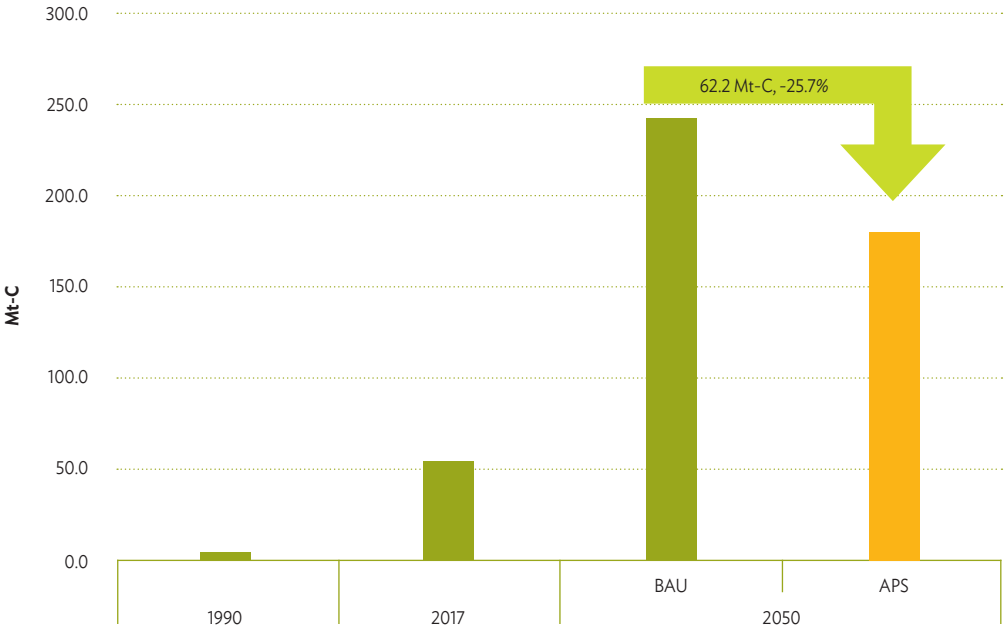Source: Author's calculations.

Figure 17.12. CO_2 Emissions by Fuel, BAU and APSs

APS = Alternative Policy Scenario, BAU = Business-As-Usual.
Source: Author's calculations.

Improvement in CO2 emissions under the APSs will be lower than BAU by 62.2 Mt-C, equal to 25.7% reduction in 2050. This indicates that the energy savings goals and action plans of Viet Nam are very effective in reducing CO2 emissions (see Figure 17-13).

Figure 17.13. **Evolution of CO_2 Emissions, BAU and APS5 (1990, 2017, and 2050)**

APS = Alternative Policy Scenario, BAU = Business-As-Usual.
Source: Author's calculations.

4. Implications and Policy Recommendations

Energy demand in Viet Nam is expected to continue to grow significantly, driven by robust economic growth, industrialisation, urbanisation, and population growth. Promoting EEC is essential for Viet Nam in order to reduceenergy consumption, especially fossil fuel consumption. The Government of Viet Nam should support implementable EEC action plans through setting up appropriate policies such as mandatory basis and incentive basics.

Coal thermal power plants areone of the major power sources to meet the growing electricity demand in Viet Nam. Because of the limitation of domestic coal sources, Viet Nam will shift to natural gas from coal forpower generation and will import natural gas or LNG. Transparent markets in Asia will surely contribute to increasing Viet Nam's LNG supply security.

The demand for petroleum products in Viet Nam will beincreasing in the coming years. Viet Nam is a net exporter of crude oil but is an importer of petroleum products for domestic

demand because of limited capacity at the Dung Quat oil refinery (6.5 million tonnes a year) that theoretically could meet around over 30% of domestic consumption. Viet Nam will expand its refinery capacity, but it will still have to import petroleum products until 2040. Petroleum products are mainly used for road transport, making shifting to efficient vehicles an important policy in Viet Nam.

Biomass will phase out of the energy market in Viet Nam due to shifts tomore convenient fuels such as LPG. However, biomass still is a major fuel until 2030, especially for household cooking in rural areas. Therefore, the application of high-efficiencybiomass cooking stoves will be an option for Viet Nam in order to reducefossil fuel consumption.

The development of renewables technologies to replace fossil fuels for power generation is an important factor for energy independence, energy security, and GHG abatement. Therefore, it is necessary to support renewables development.

In order to assess the effects ofenergy-efficient technologies, it is suggested that Viet Nam shift from a macro approach to a bottom-up approach of energy outlook modelling.

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