CHAPTER 17

Viet Nam Country Report

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1. Background

Viet Nam is a developing country in Southeast Asia. The total land area is 331,100 square kilometres, 50% of which is in productive use. In 2019, Viet Nam's population was 96.5 million, which represents an average annual increase of 1.3% (or 30.5 million) from its 1990 level of 66.0 million.

Viet Nam's gross domestic product (GDP) increased at an average annual rate of 6.1%, from $29.5 billion in 1990 to $162.2 billion in 2019 (constant 2010 US$). The commercial sector contributes the most to Viet Nam's GDP (38.7%), followed by the industry sector (36.2%), agriculture (13.6%), and other activities (11.5%). In 2019, GDP per capita was $1,681.

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 cubic meters (m3) of crude oil reserves, and 610 billion m^3 of gas reserves.

In 2019, Viet Nam produced 47.16 million tonnes of coal, 10.2 billion m^3 of natural gas, and 13.09 million tonnes of crude oil. Almost all crude oil production 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.

The country had around 55.1gigawatts (GW) of installed generating capacity and produced over 230terawatt hours (TWh) of electricity in 2019. The main share of electricity generation comes from thermal sources (coal, natural gas, and oil), accounting for 69.6% of total generation; the remaining is hydro at 24.3% and others at around 6.1%.

The rural electrification programme has been implemented over the past few years. According to reports by Viet Nam Electricity (EVN), by the end of 2019, 100% of communes and 99.25% of households had 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 and the need for electricity in remote areas.

1.2. Targets on Greenhouse Gas Emission Reduction and Energy Development

1.2.1. Mitigation Targets and Related Legal Documents

Viet Nam has committed to develop and implement strong emissions reduction measures to achieve net-zero emissions by 2050 with its own resources, along with the cooperation and support from the international community.

The Government of Viet Nam recently implemented a series of strategies and policies in the energy sector to fulfil their commitment of increasing the share of renewable energy sources in power generation, enhancing energy efficiency, and promoting fuel switching to reduce greenhouse gas (GHG) emissions. The targets for reducing GHG emissions, conserving energy, promoting fuel switching, and advancing renewable energy development, as outlined in legal documents, are summarised in Table 17.1.

Table 17.1 Mitigation Targets and Related Legal Documents

Legal Document	Mitigation Targets and Actions
The National Climate Change Strategy, Vision to 2050	Targets: Viet Nam will strive to achieve net zero emissions by 2050. • By 2030: GHG emission in the energy sector decreases by 43.5% from BAU and emissions does not exceed 457 $MTCO_2e$. • By 2050: Total national GHG emission reaches net-zero, GHG emission in energy sector reduces by 91.6% from BAU, and emissions does not exceed 101 million tonnes of CO_2equivalent.
MOIT's Action Plan for implementing the Viet Nam's commitments at COP26	• Strengthen implementation of energy efficiency measures by improving Minimum Energy Performance Standards (MEPS) • Phase out the use of fossil fuels in energy sector • Apply CCUS in industry fields such as cement, steel, and chemical industries. • Develop renewable energy projects such as solar PV, wind power, hydropower, hydrogen, CCUS, and energy storage technologies. • Promote electrification and energy efficiencies in residential, transport sectors.
Action Plan on Green Energy Transition GHG emission Reduction in Transport Sector	Target: Develop a green transport system towards net-zero emissions by 2050. • By 2030: Promote energy efficiency and encourage the switch to electricity and green energy in fields where technologies, institutions, and resources are available to fulfil the country's commitments in its NDC. • By 2050: Prioritise the development of sustainable modes of transport and achieve zero emissions by transitioning all transportation means, equipment, and infrastructure to use electricity and green energy.

BAU = business as usual; CCUS = carbon capture, utilisation, and storage; GHG = greenhouse gas; MOIT = Ministry of Industry and Trade; $MtCO_2e$ = million tonnes of carbon dioxide equivalent; NDC = Nationally Determined Contribution.

Source : Authors, compiled from various sources.

1.2.2. Energy Development

A reliable power supply is an important requirement for an emerging economy in Viet Nam. By the end of 2019, the total installed capacity of the power generation system of Viet Nam was around 55.1 GW (Viet Nam Electricity, 2021), an increase of 11.9% over 2018 (Viet Nam Electricity, 2018). Coal takes the largest share of 35.8% in total installed capacity, followed by hydropower with 31.4%, and natural gas with 13.5%. According to the Final Draft Power Development Plan VIII, renewable power plants will mainly contribute to the essential capacity expansion, accounting for 29.6% by 2030 and 53.9% by 2050; followed by coal thermal power plants with 25.8% by 2030 and 7.6% by 2050; natural gas with 22.6% by 2030 and 9.7% by 2050; hydro with 18.6% by 2030 and 5.5% by 2050; and others with 3.48% by 2030 and 23.3% by 2050.

To diversify its imported fuel sources beyond coal, Viet Nam is planning to rely on liquefied natural gas (LNG) as a major import fuel in the upcoming years. According to the Viet Nam Gas Industry Development Master Plan for the period up to 2035, the import of LNG should have started by 2021, with demand expected to increase to around 5 million tonnes by 2025, 10 million tonnes by 2030, and 15 million tonnes by 2035. Viet Nam plans to establish three or four LNG import terminal systems between 2021 and 2025, with each depot having an estimated capacity of 1–3 million tonnes per year. Additionally, the country intends to construct five or six more LNG import terminals between 2026 and 2035, each with an estimated capacity of around 3 million tonnes per year. These LNG terminal systems will mostly be in southern Viet Nam to cater to domestic power plants and industrial buyers.

In addition to the Dung Quat refinery, Viet Nam's second oil refinery at Nghi Son, with a capacity of 10 million tonnes per year, started operations in 2019. As a result, it can meet around 80% of the country's total current petroleum demand. Moreover, other oil refinery projects are being prepared for investment in the period 2025–2030 to achieve the total capacity of around 30 million tonnes a year by 2030.

2. Modelling Assumptions

In this outlook, Viet Nam's GDP would grow at an average annual rate of 5.2% from 2019 to 2050. Growth is projected to be lower in the first outlook period, increasing at 2.9% per year between 2019 and 2020 due to the impacts of the corona virus disease (COVID-19) pandemic. For the remaining periods, the country's economic growth will be slightly moderate at an annual rate of 6.2% for 2020–2030, 5.2% for 2030–2040, and 4.2% for2040–2050. Population growth is projected to increase at a much slower rate, increasing by 0.4% per year between 2019 and 2050.

The projected thermal efficiencies per fuel (coal, gas, and oil) in Viet Nam's power generation sector were based on the International Energy Agency's estimates for future power plant technologies. According to the forecasts, 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 coal, hydro, and natural gas power plants.The share of electricity generated from natural gas and coal-fired power plants is projected to increase considerably in 2017–2030, whereas the electricity generated from hydro power plants will decline. This is due to the limited development of hydropower sources since its potential is almost fully exploited. However, the share of coal-fired power plants is strongly reduced after 2030 and renewable energy sources (such as wind power and solar photovoltaics) will be the important alternative sources. Viet Nam is expected to increase its imports of electricity, particularly from the Lao People's Democratic Republic and China.

The energy sector is the primary source of GHG emissions in Viet Nam, accounting for approximately 65% of the country's total emission by 2016 (Ministry of Natural Resources and Environment [MONRE], 2020). To help achieve carbon neutrality by 2050, the energy sector intends to take significant mitigation actions. These include improving energy efficiency, promoting electrification and shifting to hydrogen, halting the installation of new coal power plants from 2030, developing renewable technologies, and utilizing Carbon Capture Utilisation and Storage (CCUS).

Based on the analysis presented above, the alternative policy scenario (APS) and low carbon energy transition (LCET) scenario are proposed as follows:

APS: Implementation of the energy efficiency and conservation (EEC) measures on the demand side (APS1); improvement of energy efficiency in power generation (APS2); and development of renewables sources (APS3).

(i) APS1: Promote EEC activities in all sectors.
This is assuming that the promotion of EEC activities will result in energy reductions from business-as-usual (BAU) levels with around 5% in 2025, 10% in 2030, and 18% in 2050.

(ii) APS2: Improve energy efficiency in thermal power plants.
It is assumed that the efficiency of coal thermal power plants will increase to 48% from 35% (in BAU) by 2050, while natural gas with combined cycle gas turbines technology will increase to 60% from 55% (in BAU) by 2050.

(iii) APS3: Develop renewable technologies.
Installed electricity-generating capacity from renewables is assumed to reach 264,468megawatts (MW) in 2050, with solar contributing 120,603 MW; wind, 130,550 MW; small hydro, 7,300 MW; and biomass, 6,015 MW.

LCET: Under the LCET, further implementation of fuel switch from fossil fuels to hydrogen, electricity, and biomass in transport and industry activities as well as application of CCUS in cement production and power generation.

(i) Fuel Switch:
In the industry sector: Starting 2035 until 2050, hydrogen will be introduced in the industry sector by replacing coal in iron and steel production and replacing diesel in other activities, reaching100% utilisation rate. In the same period, biomass will replace coal and natural gas in other activities, reaching a 95% and 90% utilisation rate, respectively.

In the transport sector: Starting 2035 until 2050, hydrogen will be introduced in freight transport, replacing diesel and residual fuel oil, reaching 100% utilisation rate. Similarly, public passenger transport will shift to electricity from diesel and gasoline, reaching a100% utilisation rate. Electric vehicles will also be introduced in the private transport, replacing diesel and gasoline starting 2025 until 2050, reaching a70% utilisation rate.

(ii) Application of CCUS: CCUS will be applied for cement production and power generation including coal and natural gas from 2041 until 2050 with the utilisation rate of 100%.

LCET is combining APS with fuel switch and CCUS.

3. Outlook Results

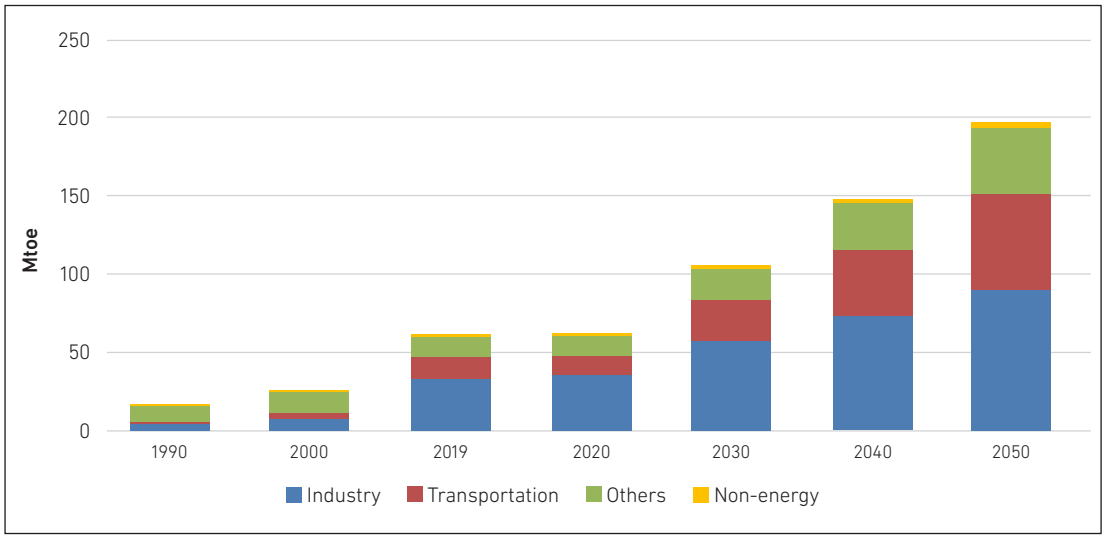
3.1. Business-as-Usual Scenario

3.1.1. Total Final Energy Consumption

Viet Nam's total final energy consumption (TFEC) in 2019 was 61.3 million tonnes of oil equivalent (Mtoe), which has increased at 4.7% per year, 3.8 times more than its 1990 level of 16.1 Mtoe. On a per sector basis, the fastest growth occurred in the transport sector (8.3% per year), followed by the industry sector (7.1%), and the residential/commercial ('others') sector (0.9% per year). Non-energy use is expected to grow at 13.9% per year.

For 2019–2050, the TFEC is projected to increase at an average rate of 3.8% per year under the BAU scenario. The increase is driven by strong economic growth, which is assumed to be at an average annual growth rate of 5.2%, and the rising population with an average annual growth rate of 0.4%. On a per sector basis, the transport sector is expected to exhibit the strongest growth in energy consumption, with an annual increase of 4.9%. This is followed by the residential/commercial ('others') sector with an annual growth of 3.9% and the industry sector with 3.3%. Non-energy use is expected to grow at 2.8% per year. Figure 17.1 shows the final energy consumption by sectors from 1990 to 2050.

Figure 17.1 Final Energy Consumption by Sector, Business-As-Usual, 1990–2050
(Mtoe)



BAU = business-as-usual, Mtoe = million tonnes of oil equivalent.

Note: 'Others' includes residential and commercial sectors.

Source: Author's calculations.

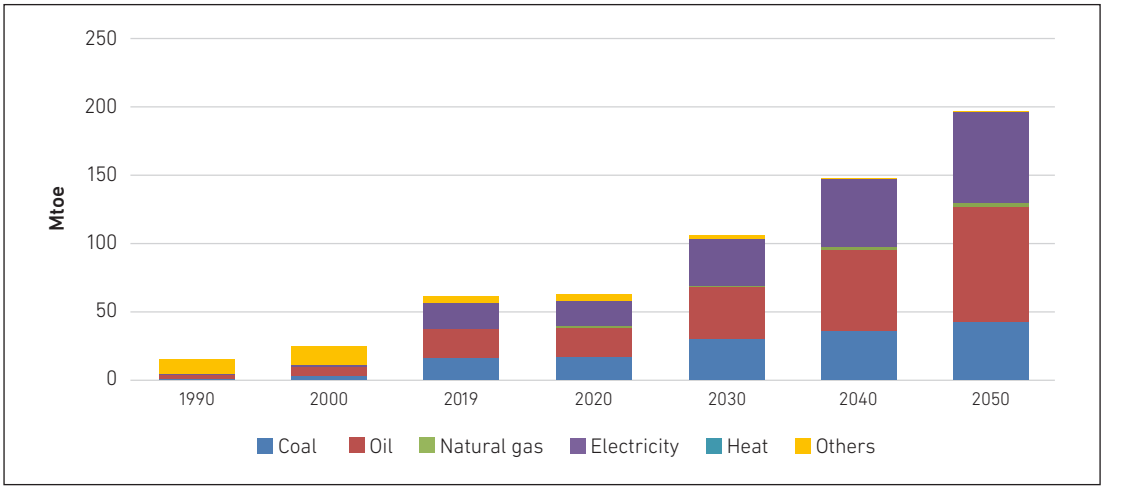
The residential/commercial ('others') sector was the primary source of the country's energy consumption in 1990, accounting for around 63%. This was mainly due to the use of biomass fuel used for residential cooking. This share decreased to 21.1% by 2019 due to the growing economy, which led to the substitution of biomass fuels with more efficient commercial fuels. Economic growth is expected to continue improving the standard of living, thus increasing the transition from biomass to modern fuels such as LPG.

During 2019–2050, the industry sector is expected to remain the largest consumer of energy in Viet Nam. However, its share of energy consumption will increase from 54.0% in 2019 to 56.2% in 2020, before slightly declining to 45.8% in 2050. Meanwhile, the transport sector will become the second-largest consumer, with its share increasing slowly from 22.9% in 2019 to 31.3% in 2050.

In 1990, other fuels – mainly biomass – had the highest consumption rate, accounting for 73.9% of the TFEC. However, this share decreased dramatically to 8.3% in 2019. Oil was the second most consumed product, making up 14.5% of the TFEC in 1990 and increasing to 34.7% in 2019. Coal consumption increased from 8.3% in 1990 to 26.7% in 2019. Electricity had a small share of 3.3% in 1990 but increased to 29.4% in 2019. On a per fuel basis under BAU, natural gas is projected to exhibit the fastest growth in final energy consumption, increasing at 5.0% per year between 2019 and 2050. Oil is projected to have the second-highest growth rate of 4.6% per year, followed by electricity with 4.3% and coal with3.1%. Other fuels (mainly biomass) are projected to decrease at an annual rate of 6.5% due to the transition from biomass to modern fuels.

In 2019, oil products held the largest share of energy at 34.7%. This share is projected to increase to 43.1% in 2050. The second-largest share of demand is electricity, which is projected to increase from 29.4% in 2019 to 33.6% in 2050. By 2050, coal will decrease from 26.7% in 2019 to 21.7% in 2050, while other fuels (mainly biomass) will decrease from 8.3% in 2019 to 0.3% in 2050. However, natural gas is expected to rise from 0.9% in 2019 to 1.2% in 2050. See Figure 17.2.

Figure 17.2 Final Energy Consumption by Sector, Business-As-Usual, 1990–2050
(Mtoe)



BAU = business-as-usual, Mtoe = million tonnes of oil equivalent.

Note: 'Others' is mainly biomass.

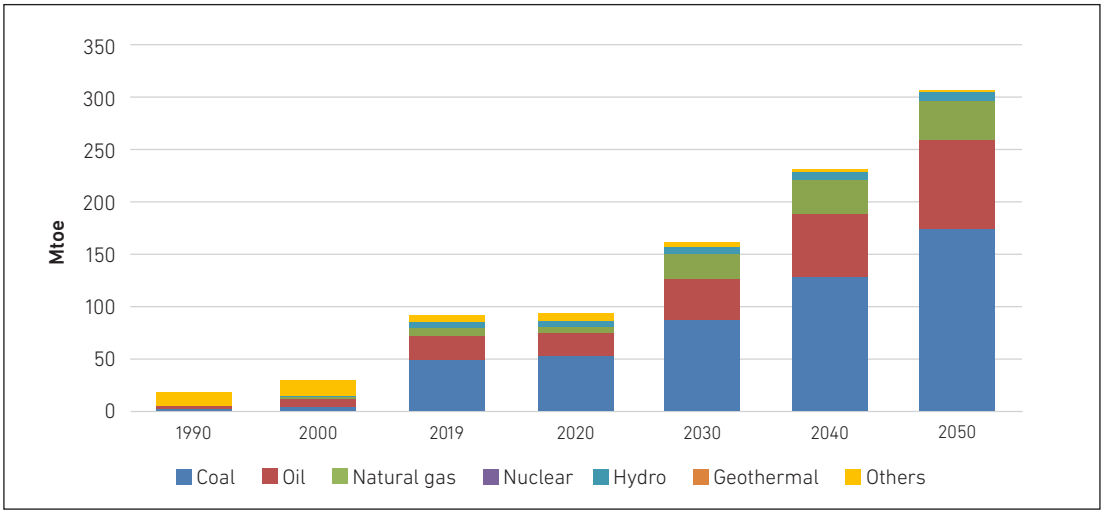
Source: Author's calculations.

3.1.2. Total Primary Energy Supply

The total primary energy supply (TPES) of Viet Nam grew at a higher rate than the TFEC. It increased by 5.8% per year, from 17.9 Mtoe in 1990 to 91.4 Mtoe in 2019. Also, between 1990 to 2019, natural gas consumption grew at an average annual rate of 31.3%; coal at 11.3%; hydropower at 9.2%; and oil at 7.5%.

In the BAU scenario, Viet Nam's TPES is projected to increase at an annual rate of 4.0%, or 3.4 times, from 91.4 Mtoe in 2019 to 307.4 Mtoe in 2050. The fastest growth is expected in natural gas, increasing at an annual average rate of 5.1% between 2019 and 2050, followed by oil at 4.5%, coal at 4.1%, and hydro at 1.0%. Meanwhile, other fuels (mainly biomass) will decrease at 3.5% per year. Figure 17.3 shows the primary energy supply by source in for 1990–2050.

Figure 17.3 Primary Energy Supply, Business-As-Usual, 1990–2050
(Mtoe)



BAU = business-as-usual, Mtoe = million tonnes of oil equivalent.

Note: 'Others' is mainly biomass.

Source: Author's calculations.

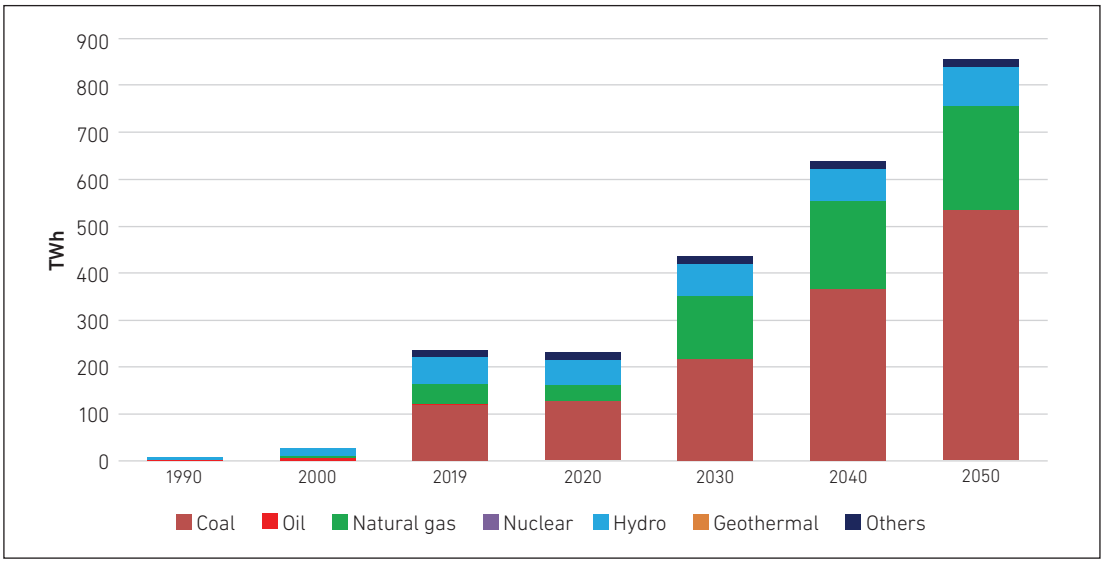
In 2019, coal accounted for the largest share of TPES at 54.2% and is expected to increase slightly to 56.7% in 2050. From 2019 to 2050, oil is projected to increase from 23.9% to 27.7%, while natural gas would increase from 8.9% to 12.2%. This growth is due to the projected decline of hydro from 6.5% in 2019 to 2.7% in 2050 and other sources from 6.5% in 2019 to 0.6% in 2050.

3.1.3. Power Generation

Power generation output increased at 12.1% per year, or 27.3 times, from 8.7 TWh in 1990 to 236.9 TWh in 2019. The fastest growth occurred in natural gas power generation (35.8% per year), followed by coal (15.2%), hydro power (8.5%), and oil power (1.7%).

Under the BAU scenario, power generation is projected to increase by an average of 4.2% per year, or 3.6 times between 2017 and 2050, to meet electricity demand. Natural gas power generation is projected to experience the highest growth rate of 5.5% per year, followed by coal (4.9%), hydro (1.1%), and others, which includes biomass, wind, solar and imported electricity (0.8%). 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, Business-As-Usual, 1990–2050
(TWh)



BAU = business-as-usual, TWh = terawatt-hour.

Note: 'Others' includes biomass, wind, solar, and imported electricity.

Source: Author's calculations.

By the end of 2019, most of the country's power came from coal, which comprised about 50.7% of the total power generation mix. The share of hydro power generation was around 24.3%, while the rest were from natural gas (18.0%), oil (0.9%), and 'others' (around 6.1%).

From 2020 to 2050, coal is projected to remain the primary fuel for power generation under the BAU scenario. Its share is expected to grow from the largest share of 55.2% in 2020 to the largest share of 62.7% in 2050. Natural gas is anticipated to be the second largest fuel, with its share increasing from 14.5% in 2020to 25.8% in 2050. The share of hydro in the total power generation will decline from 22.4% in 2020 to 9.4% in 2050.

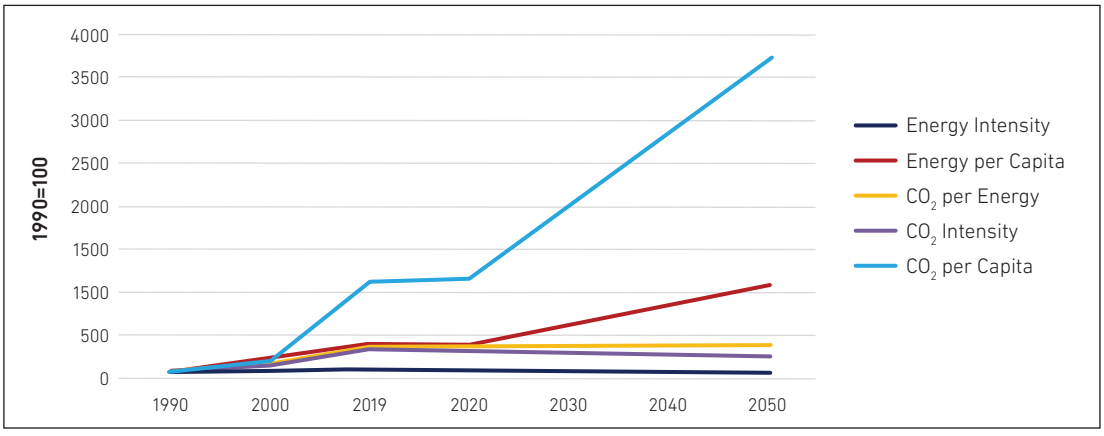
3.1.4. Energy Indicators

From 1990 to 2019, Viet Nam experienced a decline in energy intensity. The country's primary energy intensity decreased from 606 tonnes of oil equivalent (toe) per million 2010 US dollar (2010 US$) in 1990to 564 toe/million 2010 US$ in 2019. Final energy intensity decreased from 545 toe/million 2010 US$ to 378 toe/million 2010 US$. This trend was due to the growing use of modern energy sources such as oil and electricity, which complemented the use of biomass. As the economy continues to grow steadily, the use of biomass will be phased out due to its inefficiency. The final energy intensity is projected to follow a decreasing trend under the BAU scenario, dropping from 378 toe/million 2010 US$ in 2019 to 254 toe/million 2010 US$ by 2050. This indicates that energy will be used more efficiently for the country's economic development.

Meanwhile, primary energy per capita increased from 0.27 toe per person (toe/person) in 1990 to 0.95 toe/person in 2019.It will continue to increase to 2.82 toe/person in 2050. This shows that as the income of people increases in the future, it will lead to improved living standards and a shift in the industrial structure from primary to secondary and service industries, resulting in a rise in primary energy supply per capita.

The carbon dioxide (CO_2) intensity increased from 160 tonnes of carbon (t-C)/million 2010 US$ in 2019 to 484 t-C/million 2010 US$ in 2019. The CO_2 per energy increased from 0.26 t-C/toe in 1990 to 0.86 t-C/toe in 2019. In the BAU scenario, CO_2 intensity will slightly decline to 375 t-C/million 2010 US$ in 2050, while CO_2 per energy will slightly increase at around 0.95 t-C/toe in 2050. Moreover, CO_2 per capita will significantly increase due to energy demand rising faster than population growth (Figure 17.5).

Figure 17.5 Energy Indicators, 1990–2050



CO_2 = carbon dioxide.

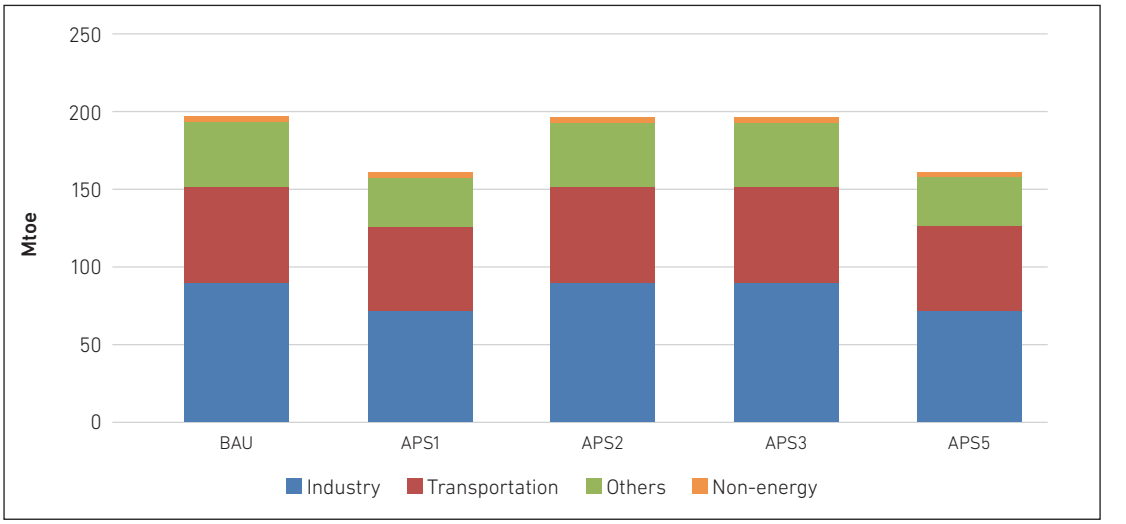
Source: Author's calculations.

3.2. Energy Savings and Carbon Dioxide Reduction Potential in Alternative Policy Scenarios

3.2.1. Total Final Energy Consumption

In the Alternative Policy Scenarios (APSs), the TFEC is projected to increase at a slower rate of 3.2% per year (compared to 3.8% in BAU), from 61.3 Mtoe in 2019 to 160.9 Mtoe in 2050 because of EEC measures (APS1) implemented in the industry, transport, and 'others' (residential and commercial) sectors. On the other hand, APS2 and APS3 do not include EEC measures on the demand side and are comparable to the BAU scenario. Since APS5 combines all APSs, it will be similar to APS1. Figure 17.6 presents the TFEC by sector in the BAU scenario and APSs in 2050.

Figure 17.6 Total Final Energy Consumption by Sector in Business-as-Usual and Alternative Policy Scenario
(Mtoe)



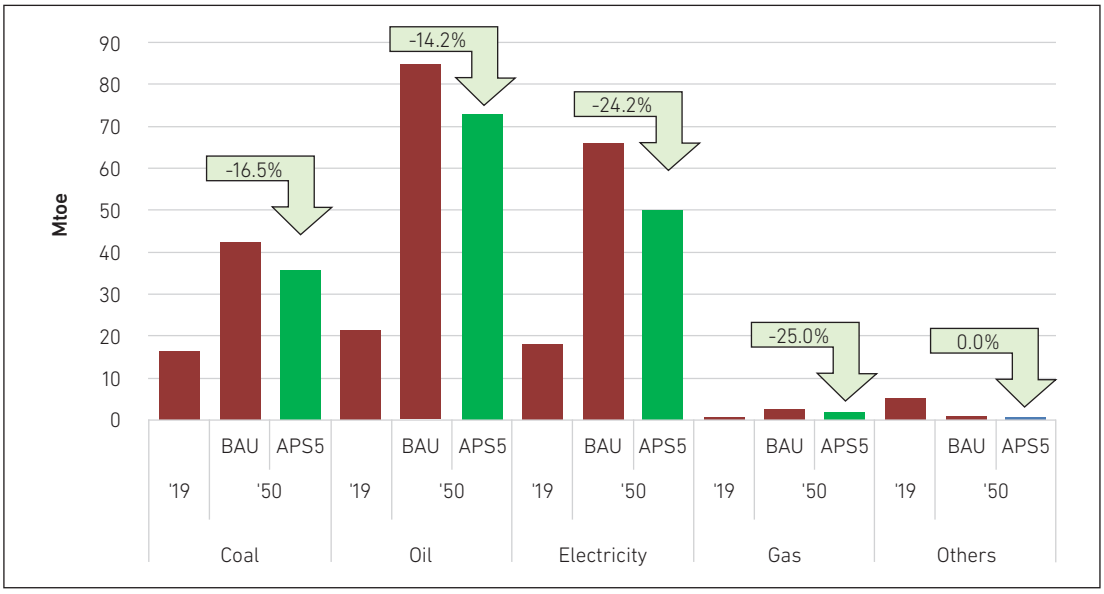
APS = alternative policy scenario, BAU = business-as-usual.

Note: 'Others' includes residential and commercial sectors.

Source: Author's calculations.

Under APS5, the highest average annual growth rate is projected for natural gas and oil at 4.0%, compared with 5.0% for natural gas and 4.6% for oil in the BAU scenario. This is followed by electricity with 3.4%, coal with 2.5%, and others with -6.5%, compared with 4.3%, 3.1% and -6.5% in BAU, respectively, over the same period. However, energy savings potential comes mainly from electricity due to energy efficiency in the industry, residential, and commercial sectors, resulting in savings of 16.0 Mtoe in 2050, which is a 24.2% decrease from the BAU scenario. This is followed by oil with energy savings of 12.0 Mtoe (14.2% decrease from BAU in 2050), coal with 7.0 Mtoe (16.2% decrease), and natural gas with 0.6 Mtoe (25% decrease). 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, Business-as-Usual and Alternative Policy Scenario5, 2017 and 2050
(Mtoe)



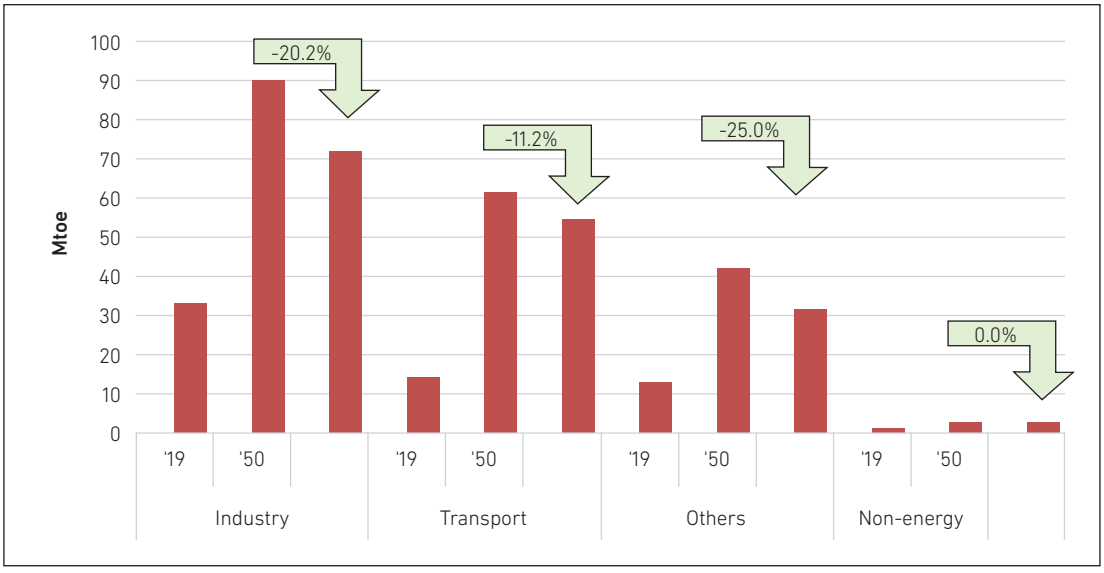
APS = alternative policy scenario, BAU = Business-As-Usual, Mtoe = million tonnes of oil equivalent.

Source: Author's calculations.

The bulk of the demand-side savings is expected to occur in the industry sector with 18.2 Mtoe (equivalent to 20.2% reduction), followed by the 'others' sector with 10.5 Mtoe (equivalent to 25.0% reduction) and the transport sector with 6.9 Mtoe (equivalent to 11.2% reduction).

Improving end-use technologies and introducing EEC measures would contribute to the slower rate of consumption growth, particularly in the industry, transport, and 'others' (residential and commercial) sectors. See Figure 17.8.

Figure 17.8 Final Energy Consumption by Sector, Business-as-Usual and Alternative Policy Scenario 5, 2017 and 2050
(Mtoe)



APS = alternative policy scenario, BAU = business-as-usual, Mtoe = million tonnes of oil equivalent.

Note: 'Others' refers to commercial and residential sectors.

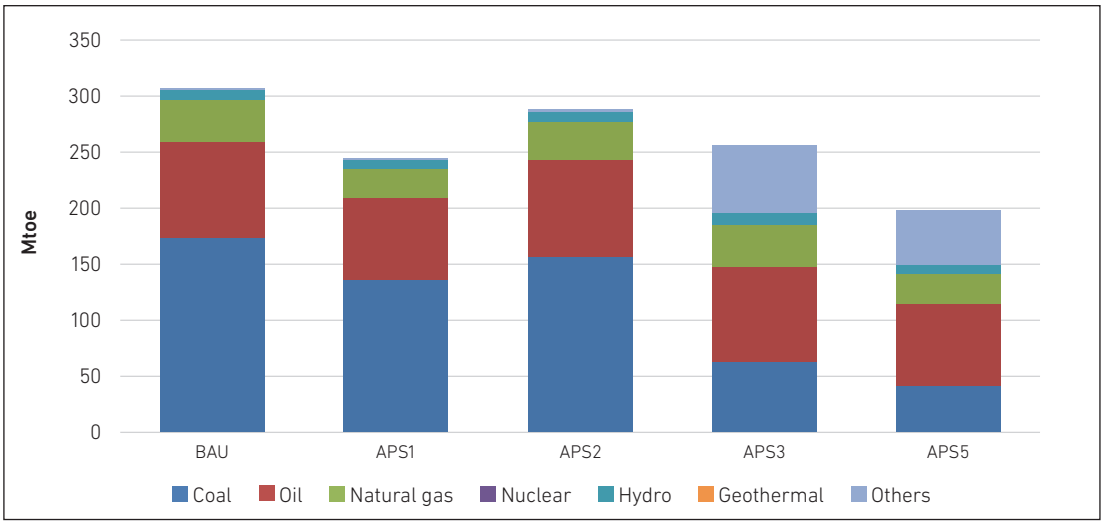
Source: Author's calculations.

3.2.2. Total Primary Energy Supply

In APS5, the TPES is projected to increase at a slower rate of 2.5% per year, from 91.4 Mtoe in 2019 to 198.4 Mtoe in 2050. Other fuels (mostly solar and wind) are projected to grow at the highest average annual rate of 7.1% compared with -3.5% in the BAU scenario. This is followed by natural gas and oil (4.0%) and hydro (0.8%), compared with 5.1%, 4.5% and 1.0% in BAU, respectively, over the same period.

The consumption growth rate is projected to be slower in the APSs compared to BAU, with coal consumption decreasing by 0.6%. This decrease is due to the use of substitute renewable technologies in power generation (APS3) and the implementation of EEC measures on the demand side (APS1), and the more aggressive adoption of energy efficiency in thermal power plants (APS2). The TPES by fuel in the BAU scenario and APS5 are presented in Figure 17.9.

Figure 17.9 Total Primary Energy Supply by Fuel in Business-as-Usual and Alternative Policy Scenarios
(Mtoe)

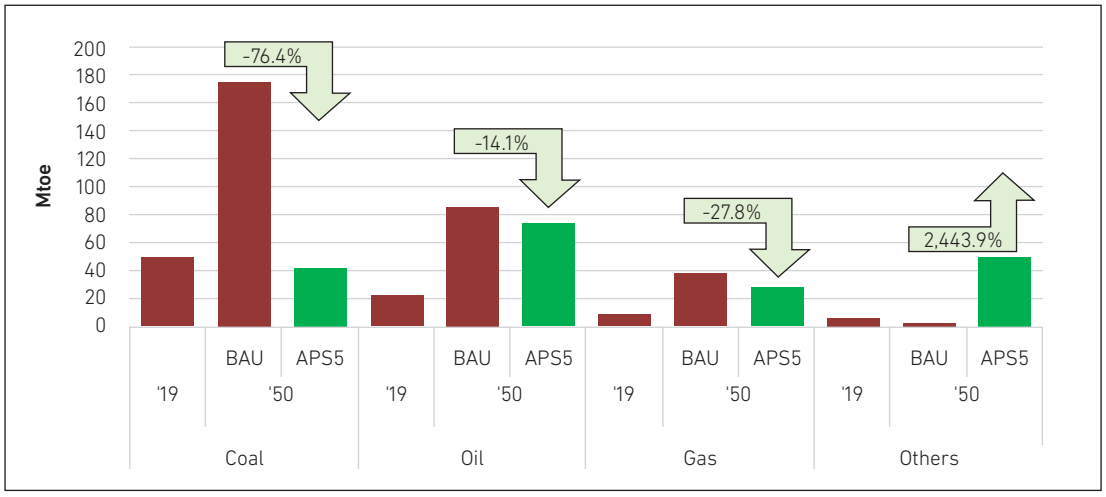


APS = alternative policy scenario, BAU = business-as-usual, Mtoe = million tonnes of oil equivalent.

Source: Author's calculations.

Coal has the highest energy savings potential with 76.4%, followed by natural gas (27.8%) and oil (14.1%). Figure 17.10 shows the primary energy savings potential by fuel in the BAU scenario and APS.

Figure 17.10 Primary Energy Saving Potential by Fuel, Business-As-Usual and Alternative Policy Scenario 5, 2017 and 2050
(Mtoe)

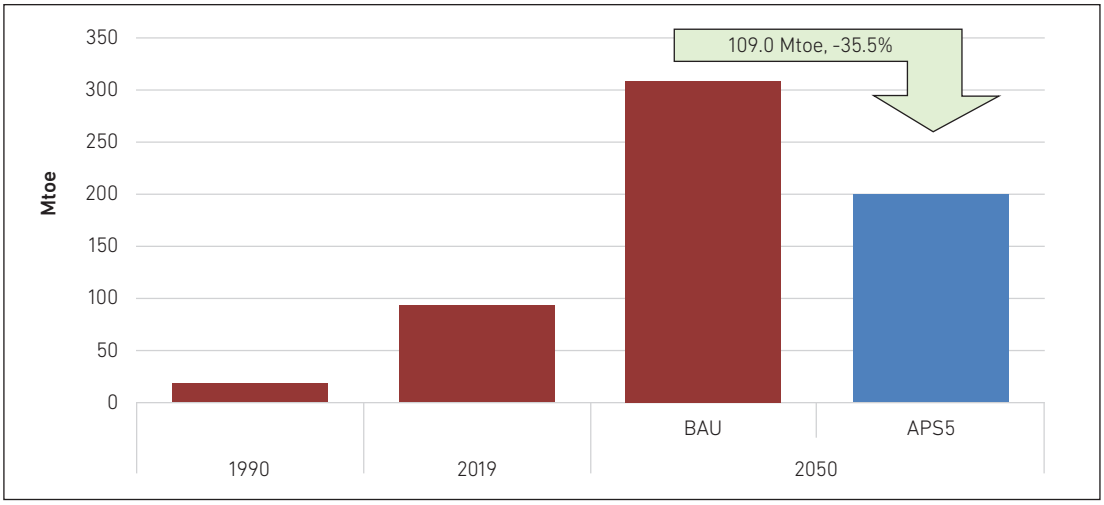


APS = alternative policy scenario, BAU = business-as-usual, Mtoe = million tonnes of oil equivalent.

Source: Author's calculations.

The total energy savings achieved in the APS5 compared to the BAU scenario is 109.0 Mtoe, which is equivalent to 35.5% of Viet Nam's TPES in 2050 (Figure 17.11). These energy savings can be attained through the demand-side EEC measures, greater enhancements on the efficiency of thermal power plants, and increased use of renewable energy resources.

Figure 17.11 Evolution of Primary Energy Supply, Business-As-Usual and Alternative Policy Scenario 5, 1990, 2019, and 2050
(Mtoe)



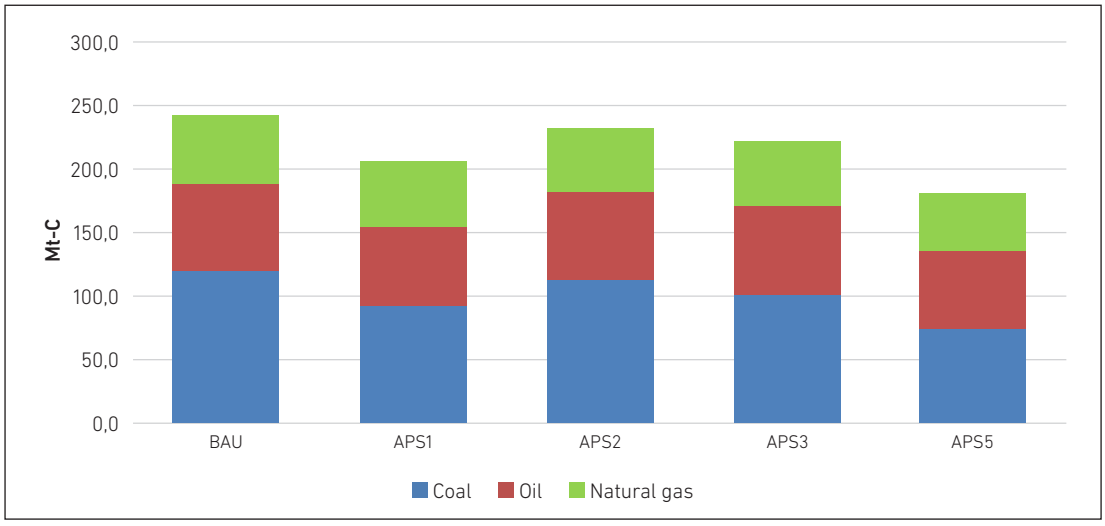
APS = alternative policy scenario, BAU = business-as-usual, Mtoe = million tonnes of oil equivalent.
Source: Author's calculations.

3.2.3. Carbon Dioxide Reduction Potential

The CO_2 emissions from energy consumption under the BAU scenario are projected to increase by 4.3% per year from 78.5 million tonnes of carbon (Mt-C) in 2019 to 290.5 Mt-C in 2050. Meanwhile, under the APSs, the annual increase in CO_2 emissions between 2019 and 2050 is projected to be 1.6% yearly, which is 2.7% points lower than BAU.

Reduced CO_2 emissions are mostly derived from EEC measures on the demand side (APS1). Improvement of energy efficiency in thermal power plants (APS2) and development of renewable technologies (APS3) also contributed significantly to CO_2 reduction (Figure 17.12).

Figure 17.12 Carbon Dioxide Emissions by Fuel, Business-As-Usual and Alternative Policy Scenarios
(Mt-C)

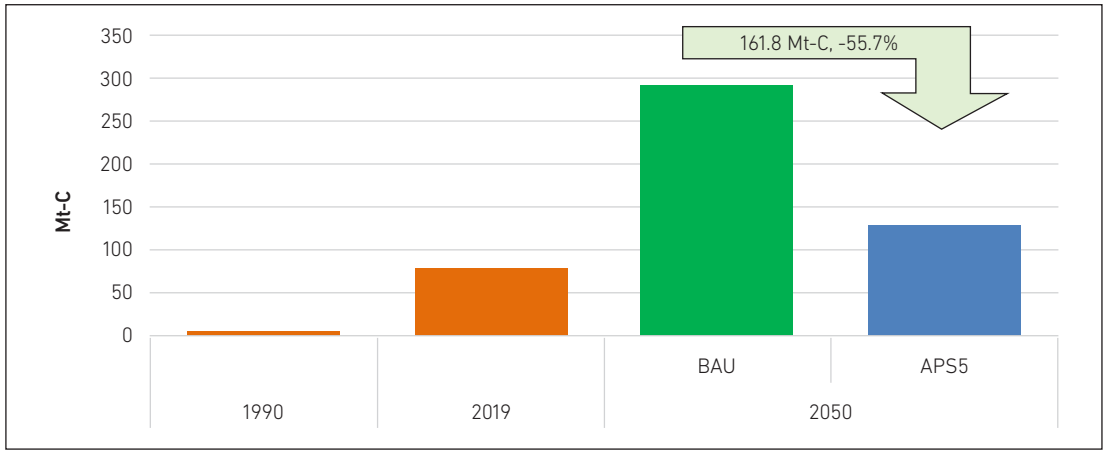


APS = alternative policy scenario, BAU = business-as-usual, Mt-C = million tonnes of carbon dioxide.

Source: Author's calculations.

Improvement in CO_2 emissions under the APSs will be lower than under BAU by 161.8 Mt-C, equal to 55.7% reduction in 2050. This shows that the energy saving goals and action plans of Viet Nam are very effective in reducing CO_2 emissions (see Figure 17.13).

Figure 17.13 Evolution of Carbon Dioxide Emissions, Business-as-Usual and Alternative Policy Scenario 5, 1990, 2019, and 2050
(Mt-C)



APS = alternative policy scenario, BAU = business-as-usual; Mt-C = million tonnes of carbon.

Source: Author's calculations.

3.3. Energy Savings and Carbon Dioxide Reduction Potential in Low Carbon Energy Transition Scenario

This section introduces a new LCET scenario, which builds upon APS5, to assess the effects of LCET on energy supply, consumption, and carbon emissions. The scenario incorporates additional mitigation measures, such as CCUS technology and new hydrogen fuel. The concept of carbon neutralityis a state of net-zero emissions, where the amount of CO_2 emitted is balanced by its removal, often through carbon offsetting by forests.

The calculation of projected land use, land use change, and forestry (LULUCF) Removals under the GHG mitigation scenario was based on available data. Special emphasis was placed on enhancing the capacity of GHG absorption to facilitate progress towards achieving net zero emissions by 2050. Table 17.2 shows the GHG emission reductions in the carbon neutral scenario compared with the BAU.

Table 17.2 Potential Removals of Land Us, Land Use Change, And Forestry in Low Carbon Energy Transition Scenario, 2014–2050

	2014	2020	2025	2030	2035	2040	2045	2050
BAU	-37.5	-35.4	-37.9	-49.2	-52.2	-55.5	-58.1	-60.2
Carbon Neutral	-37.5	-45.9	-65.6	-95.3	-112.4	-134.0	-149.6	-185.2

BAU = business-as-usual; LCET = low carbon energy transition.

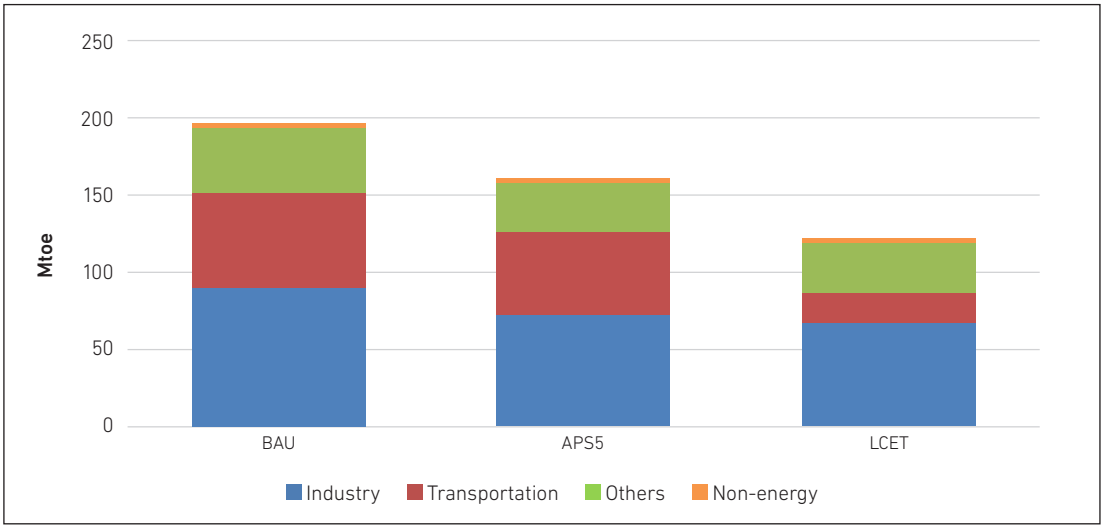
Source: The National Climate Change Strategy, 2022.

According to the National Climate Change Strategy of 2022, achievingnet zero emissions by 2050 requires a restriction on the emissions of the energy sector, which must not exceed 101 $MTCO_2e$ (or 27.5 Mt-C). The remaining 84.2 MT-CO_2e provides the allowance for offsetting CO_2 in other sectors such as agriculture (56.4 $MTCO_2e$), waste (7.8 $MTCO_2e$), and industry processes (20 $MTCO_2e$).

3.3.1. Total Final Energy Consumption

In the LCET scenario, the TFEC is projected to increase at a slower rate of 2.2% per year from 61.3 Mtoe in 2019 to 121.9 Mtoe in 2050. The main reason for the lower final energy consumption in 2050, compared to the BAU scenario (196.6 Mtoe) and APS5 (160.9 Mtoe), was the greater expected energy savings in the industry, residential, and commercial sectors. In addition, the transport sector is expected to switch from oil products to electricity and hydrogen, further contributing to the reduction in final energy consumption. The TFEC by sector in the BAU, APS5, and LCET scenarios by 2050 is presented in Figure 17.14.

Figure 17.14 Total Final Energy Consumption by Sector, Business-as-Usual, Alternative Policy Scenario5, and Low Carbon Energy Transition
(Mtoe)



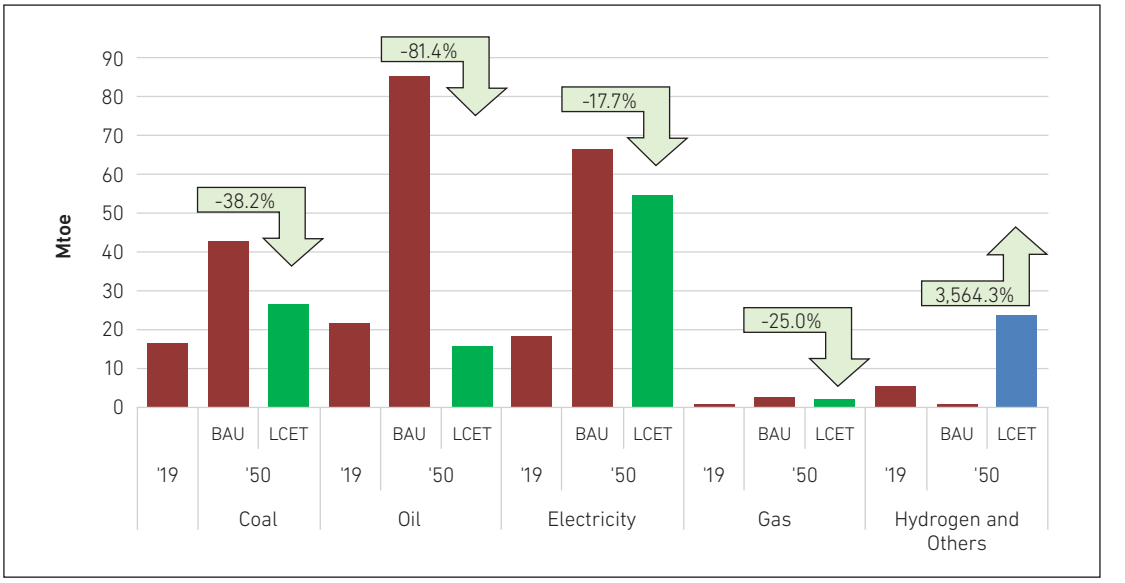
APS5 = alternative policy scenario 5, BAU = business-as-usual, LCET = low carbon energy transition, Mtoe = million tonnes of oil equivalent.
Source: Author's calculations.

Under the LCET, introducing electricity and hydrogen fuel for transport from 2035 onwards impacts the consumption of oil products. The average annual growth rate of oil reduces to 1.0% per year from the 2019 level until 2050. This is in contrast to the higher annual growth rate of 4.6% under BAU and 4.0% under the APS5 scenario.

As a result, fuel switching in transport leads to significant energy savings potential, mainly from oil products. In 2050, these savings would amount to 69.0 Mtoe, which is an 81.4% decrease from the BAU scenario. Additionally, when compared to the BAU scenario in 2050, there are savings in coal with 16.3 Mtoe (38.2%), electricity with 11.7 Mtoe (17.7%), and natural gas 0.6 Mtoe (25.0%).

The final energy consumption by fuel under the LCET scenario is shown in Figure 17.15.

Figure 17.15 Total Final Energy Consumption by Fuel, Business-as-Usual and Low Carbon Energy Transition, 2019–2050
(Mtoe)



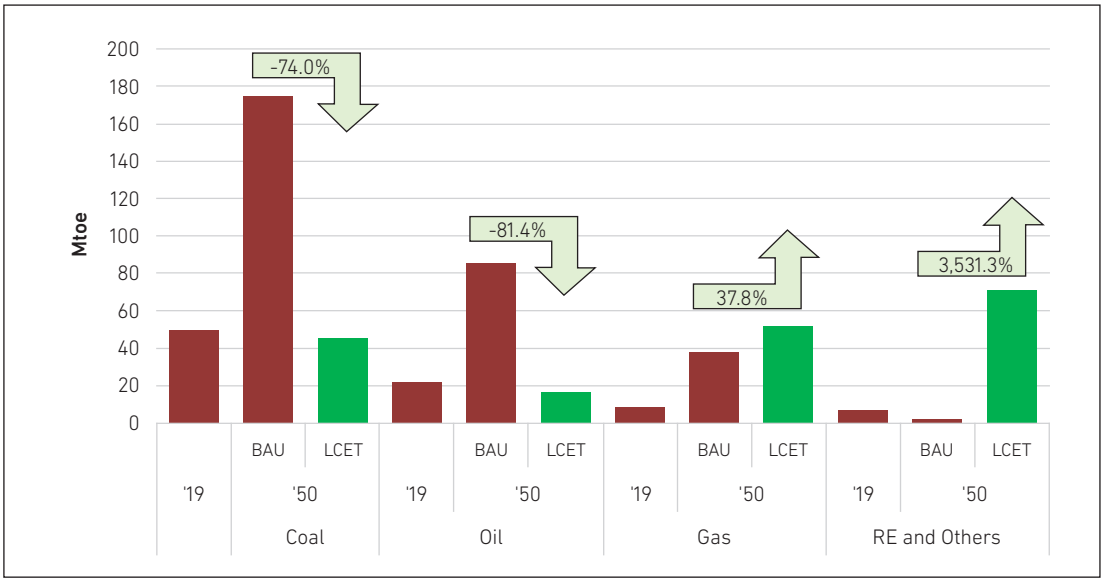
BAU = business-as-usual, LCET = low carbon energy transition, Mtoe = million tonnes of oil equivalent.

Source: Author's calculations.

3.3.2. Primary Energy Supply

In 2050, the total primary energy supply under the LCET scenario is194.7 Mtoe, which is lower from the BAU scenario's 307.4 Mtoe. The largest energy savings potential is observed in oil, with a reduction of 81.4%, followed by coal with 74.0%. This decrease in primary energy supply is due to the shift towards cleaner energy sources such as natural gas and renewable energy. The primary energy savings potential by fuel in the BAU and LCET scenarios are presented in Figure 17.16.

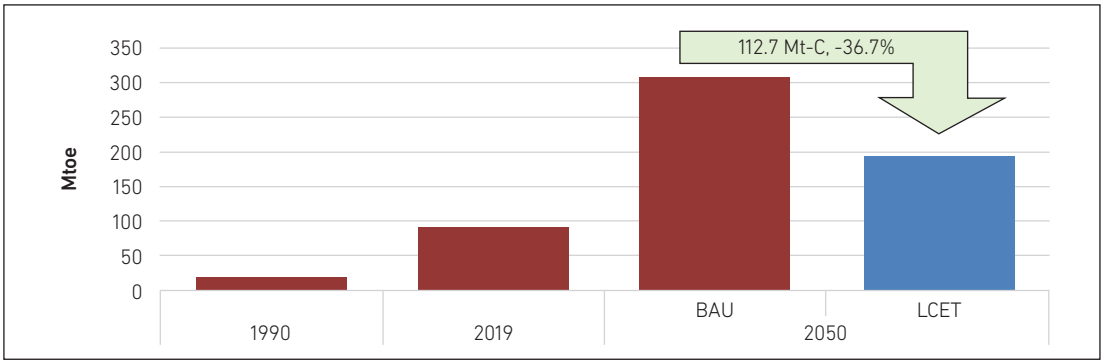
Figure 17.16 Primary Energy Supply by Fuel, Low Carbon Energy Transition Scenario, 2019–2050
(Mtoe)



BAU = business-as-usual, LCET = low carbon energy transition, Mtoe = million tonnes of oil equivalent, RE = renewable energy.
Note: 'Others' includes biomass, wind, solar and imported electricity.
Source: Author's calculations.

The difference between the TPES in the LCET and BAU scenarios is total energy savings, amounting to 112.7 Mtoe, which is equivalent to 36.7% of Viet Nam's TPES in 2050 (Figure 17.17). This energy savings could be achieved from demand-side EEC efforts, improved thermal power plant efficiency, fuel switching, and increased reliance on renewable resources.

Figure 17.17 Evolution of Primary Energy Supply, Business-as-Usual and Low Carbon Energy Transition, 1990, 2019, and 2050
(Mtoe)



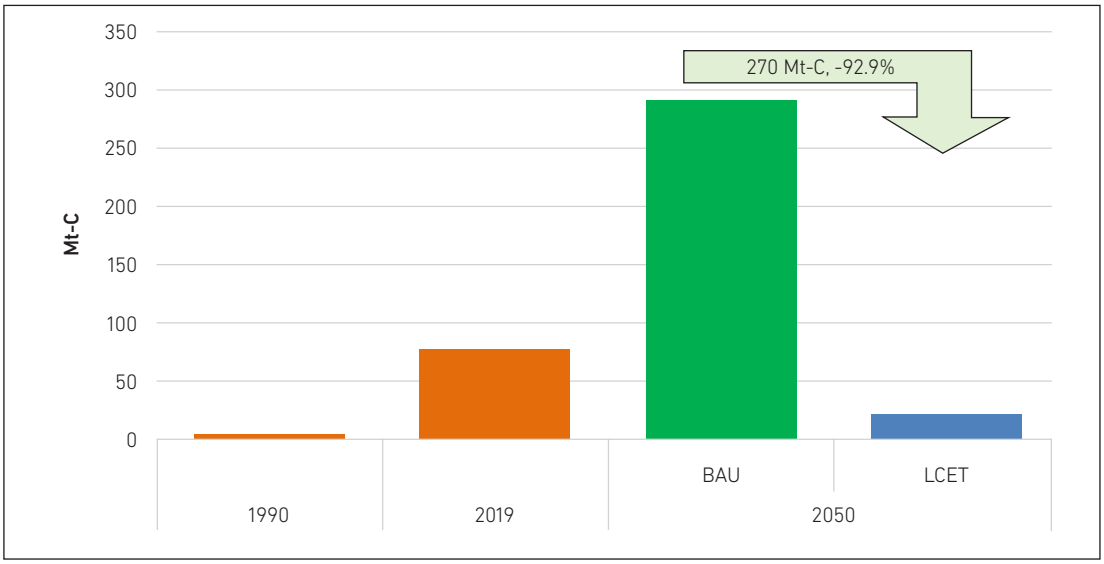
BAU = business-as-usual, LCET = low carbon energy transition, Mtoe = million tonnes of oil equivalent.
Source: Author's calculations.

3.3.3. Carbon Dioxide Reduction Potential

The total CO_2 emission under the LCET scenario is projected to decrease by 4.2% per year from 78.5 million tonnes of carbon (Mt-C) in 2019 to 20.5 Mt-C in 2050, which is lower than CO_2 emissions in 2019 at 58.0 Mt-C. In 2050, CO_2 emission in the BAU scenarios was projected at 290.5 Mt-C, thus the reduction in LCET scenario, compared to BAU, is about 270.0 Mt-C or 92.9%(see Figure 17.18). Based on the calculation results, it is evident that Viet Nam has the potential to achieve carbon neutrality by 2050. The LCET (Low Carbon Energy Transition) scenario has been shown to achieve a carbon emission reduction of 20.5 Mt-C, which is lower than the estimated potential carbon sink capacity of forests, amounting to 27.5 Mt-C until 2050. These findings indicate that Viet Nam can effectively offset its carbon emissions through forest preservation and other measures, paving the way for carbon neutrality by 2050.

The LCET scenario includes significant use of variable renewable energy, such as solar PV and wind. It also integrates new energy technologies, such as hydrogen from wind power generation and CCS applied to coal and gas power plants. Implementing ambitious EEC measures will be crucial for reducing CO_2 emissions across various sectors. There are lots of challenge ahead of Viet Nam, but if the country could tackle these challenges, the LCET scenario suggests it can achieve carbon neutrality by 2050.

Figure 17.18 Evolution of Carbon Dioxide Emissions, Business-As-Usual and Low Carbon Energy Transition, 1990, 2019, and 2050
(Mt-C)



BAU = business-as-usual, LCET = low carbon energy transition, Mt-C = million tonnes of carbon dioxide.

Source: Author's calculations.

4. Implications and Policy Recommendations

To achieve the goal of net zero emissions by 2050, Viet Nam must reduce its reliance on fossil fuel quickly – especially coal-fired power – and switch to renewable energy sources and low greenhouse gas emissions technologies such as CCUS and hydrogen. However, while the cost of solar and wind energy has been decreasing rapidly, their reliability depends on the weather and time of day. Further, CCUS and hydrogen technologies are still in their early stages and require substantial financial investments. Therefore, promoting EEC measures is essential for Viet Nam in the coming years to reduce overall energy consumption, especially in using fossil fuel. The Government of Viet Nam should support the implementation of practical EEC action plans by setting up policies, such as mandatory regulations and incentivising measures.

Coal thermal power plants play a significant role in meeting Viet Nam's growing electricity demand. However, because of the goal of achieving net-zero emissions, the country is transitioning from coal to natural gas for power generation and exploring options for natural gas or LNG imports. The development of transparent markets in Asia will surely enhance Viet Nam's LNG supply security.

The demand for petroleum products in Viet Nam will increase in the coming years. While Viet Nam is a net exporter of crude oil, it relies on petroleum product imports due to limited oil refinery capacity for domestic needs. Efforts will be made to expand its refinery capacity, but petroleum product imports will still be necessary until 2040. To reduce dependence on energy imports, Vie Nam is implementing policies focused on fuel switching from oil to electricity and hydrogen, especially for road transport.

As renewable energy sources will expand rapidly in the coming years, ensuring a safe and stable electricity supply system is crucial for Viet Nam. Therefore, it is necessary to develop a well-balanced power generation portfolio that maximises the use of hydropower resources, prioritise the development of wind and solar power while ensuring safety at reasonable prices, and develops natural gas power as an important source of power supply.

Viet Nam's priorities in developing the national energy system also include establishing a robust financial mechanism, mobilising investment capital for power sector development, and expediting the implementation of a competitive power generation market.

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