CHAPTER 17

VIET NAM COUNTRY REPORT

Nguyen Minh Bao, *Institute of Energy, Viet Nam*

1. Background

Viet Nam has a total land area of about 331,111 square kilometres and lies in Southeast Asia. In 2015, its population was 91.7 million and its gross domestic product (GDP) was $154.5 billion in 2010 US$ terms. The commercial sector contributes the most to Viet Nam's GDP (38.3%), followed by the industry sector (34.2%), agriculture (16.1%), and 'others' (11.4%). GDP per capita was US$1,685 in 2015.

Viet Nam possesses considerable indigenous energy resources. It has 3,390 million tons of proven recoverable reserves of coal, 460 million cubic metres of crude oil reserves, and 610 billion cubic metres of gas reserves.

Viet Nam's total primary energy supply (TPES) was 70.1 million tons of oil equivalent (Mtoe) in 2015. Coal represented the largest share of the country's TPES at 35.9%; oil was second at 22.2%, followed by natural gas (13.7%), hydro (7.8%), and others (20.3%). Viet Nam is a net exporter of crude oil and coal but is an importer of petroleum products because of limited capacity at the Dung Quat oil refinery (6.5 million tons a year) that could meet around 45% of domestic demand.

Coal is mainly used in the industry sector with consumption of 25.2 Mtoe in 2015, while natural gas is largely used to generate electricity.

Viet Nam had around 38.5 gigawatts (GW) of installed generating capacity and produced 159.8 terawatt-hours (TWh) of electricity in 2015. Most of its electricity generation comes from thermal sources (coal, natural gas, and oil), accounting for 60.2% of total generation; the remaining is hydro (39.5%) and others (around 0.3%).

2. Modelling Assumptions

In this outlook, Viet Nam's GDP is assumed to grow at an average annual rate of 6.0% from 2015 to 2040. Growth is projected to be faster in the first outlook period, increasing at 7% per year between 2015 and 2020. For the remaining periods of 2020–2030 and 2030–2040, the country's economic growth will moderate to an annual rate of 6.2% and 5.2%, respectively. Population growth is projected to increase at a much slower rate, increasing by 0.6% per year between 2015 and 2040.

The share of electricity generated from coal-fired power plants is projected to increase considerably because of the expense of other energy types (natural gas and hydro). 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 3%–5% of total energy consumption, equivalent to 5 Mtoe, between 2006 and 2010, and 5%–8% of total energy consumption, equivalent to 13.1 Mtoe between 2010 and 2015, in line with the national target on energy efficiency and conservation (EEC).

In 2010, the Law on Energy Efficiency and Conservation, approved by the National Assembly, focused on priority policies, such as (i) increasing the use of renewable energy in line with Viet Nam's potential and conditions, (ii) contributing to energy security and environmental protection, and (iii) promoting energy efficiency in production and residential areas through regulations and technological measures on energy efficiency and renewable energy.

In November 2015, the Renewable Energy Development Strategy of Viet Nam was approved by the Prime Minister's Decision[1] to accelerate the expansion and use of renewable energy sources; gradually increase renewable energy share in national energy production and consumption and ensure less dependence on fossil sources; and contribute to better energy security, mitigating climate change, environmental protection, and sustainable socio-economic development.

[1] Decision No. 2068/QD-TTg issued on 25 November 2015 to approve the Vietnam Renewable Energy Development Strategy to 2030 outlook up to 2050 (in Vietnamese).

The strategic targets are:

- Increase the share of renewable energy-based electricity to 4.5% in 2020, 15% in 2030, and 33.1% in 2050.
- Increase the proportion of households using solar water-heating devices to 12% in 2020, 26% in 2030, and 50% in 2050.
- Scale up the application of biogas technologies with a construction volume of from about 4 million cubic metres (m^3) in 2015 to 8 million m^3 in 2020, to approximately 60 million m^3 in 2030, and 100 million m^3 in 2050.
- Increase the production of biofuels to meet the transport sector's fuel demand: 5% in 2020, 13% in 2030, and 25% in 2050.

From the above analysis, in this study, Alternative Policy Scenarios (APSs) are proposed: EEC scenarios (APS1), improvement of energy efficiencies in power generation (APS2), and development of renewable energy (APS3).

- **APS1:** Develop EEC scenarios in potential sectors on the demand side, including:
  - **Industry:** Improve technologies in making cement, bricks, non-baked bricks, iron, and steel. For the remaining other industries, EEC measures are assumed to be implemented to reduce energy consumption by around 15% by 2040.
  - **Transport:** Implement EEC measures such as passenger transport mode shift from private to public, freight transport switch from road, and increased penetration of electric vehicles.
  - **Residential:** Replace inefficient devices with efficient ones, such as high-efficient lamps in lighting, efficient refrigerators, and air conditioners in cooling homes.
  - **Commercial:** Use EEC measures in the commercial sector to reduce 12% of energy consumption by 2040.

- **APS2:** Improve energy efficiency in thermal power plants
  The efficiency of coal-fired thermal power plants is assumed to increase to 40% by 2040 compared with 38% in the Business-As-Usual (BAU) scenario, while natural gas with combined cycle gas turbines technologies will increase to 60% by 2040 compared with 52% in the BAU scenario.

- **APS3:** Develop renewable energy technologies
  Installed electricity generating capacity from renewable energy is assumed to reach 40,200 megawatts (MW) in 2040 with solar photovoltaic contributing 20,000 MW; wind,10,000 MW; small hydro, 5,000 MW; biomass,5,000 MW; and biogas, 200 MW.

  Moreover, the Renewable Energy Development Strategy has set the targets for using biofuels in the transport sector, solar water heaters in the residential sector, and biogas cook stoves in rural areas to reduce dependency on oil and curb CO_2 emissions. Therefore, it is assumed that by 2040, the share of households using solar water-heating devices in urban and rural areas would reach 60% and 25%, respectively, biogas cook stoves in rural areas would reach 15%; and the substitution of ethanol for gasoline in the transport sector would reach around 20%.

- **APS5:** Combining from APS1 to APS3.

3. Outlook Results

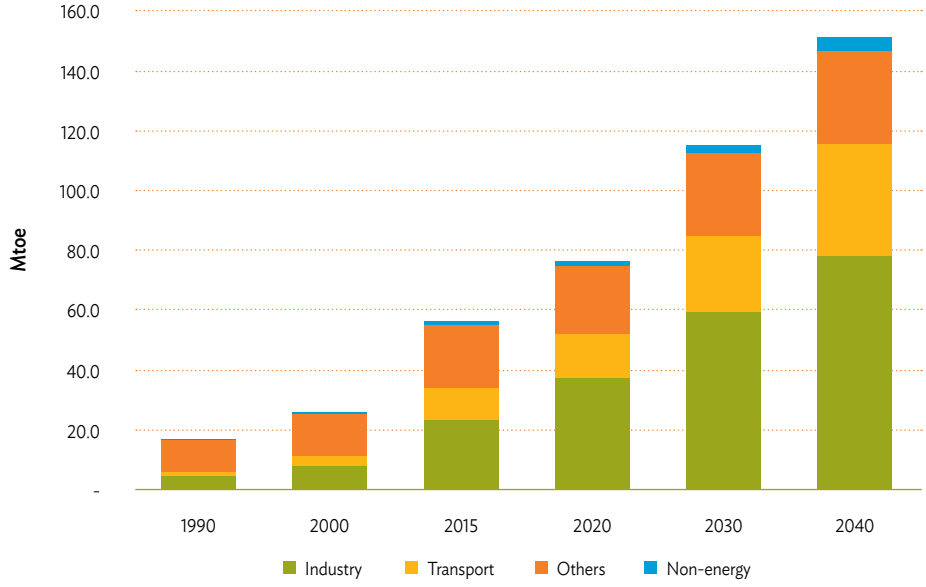
3.1. Business-As-Usual Scenario

3.1.1. Total final energy consumption

Viet Nam's total final energy consumption (TFEC) in 2015 was 56.3 Mtoe, which has increased at 5.1% per year, 3.5 times more than its 1990 level of 16.1 Mtoe. On a per sector basis, the fastest growth occurred in the transport sector (8.4% per year), followed by the industry sector (6.8%), and the residential/commercial ('others') sector (3.0% per year). Non-energy use is expected to grow at 16.3% per year.

For 2015–2040, the TFEC is projected to increase at an average rate of 4% per year under the BAU scenario. Growth is driven by strong economic growth, which is assumed to be at an average annual growth rate of 6.0%, and the rising population at an average annual growth rate of 0.6%. On a per sector basis, the strongest growth in consumption is projected to occur in transport, increasing by 5.2% per year. This is followed by the industry sector (4.9% per year) and the residential/commercial ('others') sector (1.6% per year). Non-energy use is expected to grow at 5.1% per year. Figure 17.1 shows the final energy consumption by sector from 1990 to 2040.

Figure 17.1: Final Energy Consumption by Sector, BAU (1990–2040)



BAU = Business-As-Usual, Mtoe = million tons 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 will decrease from 37.2% in 2015 to 20.7% by 2040 due to the substitution of biomass fuels by commercial fuels with higher efficiency. The decreasing share of the sector is due to the growing economy. Economic growth will translate to improvements in the standard of living, thus, increasing the transition from biomass to modern fuels.

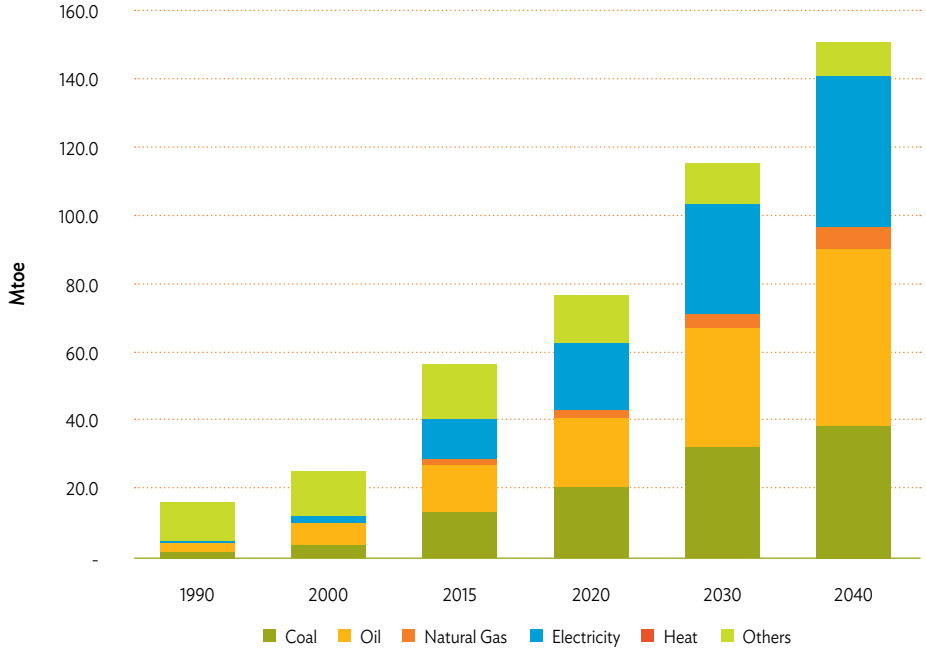
Starting from 2015 up to 2040, the industry sector will be the largest consuming sector in Viet Nam. The share of energy consumption in the industry sector will increase from 42.0% in 2015 to 51.6% in 2040. The smaller consumer is the transport sector although its share will increase slowly from 18.6% in 2015 to 24.9% in 2040.

Meanwhile, other fuels (mostly biomass) are the most-consumed product, accounting for 73.9% of the TFEC in 1990; however, this declined to 28.1% in 2015. Oil was the second most-consumed product, accounting for 14.5% of the TFEC in 1990 and increasing to 25.3% in 2015. The share of coal consumed from 1990 to 2015 increased from 8.3% to 22.5%. Electricity had a small share of 3.3% in 1990 but increased significantly to 21.6% in 2015.

On a per fuel basis under the BAU scenario, natural gas is projected to exhibit the fastest growth in final energy consumption, increasing at 6.1% per year between 2015 and 2040. Electricity and oil are projected to have the second-highest growth rate of 5.3% per year, followed by coal at 4.5%. Other fuels (mostly biomass) are projected to decrease at an annual rate of 1.8% due to the transition from biomass to modern fuels.

Other fuels (dominated by biomass) had the largest share at 28.1% in 2015 but this share will reduce significantly to 6.7% in 2040. Oil products had the second-largest share of 25.3% in 2015; this share is projected to increase to 34.3% in 2040. The third-largest share of demand is coal, which is projected to increase from 22.5% in 2015 to 25.4% in 2040. On the other hand, electricity and natural gas were used primarily in the industry sector with shares of 21.6% and 2.6% in 2015, respectively. In 2040, the shares of electricity and natural gas will increase up to 29.2% and 4.3%, respectively (Figure 17.2).

Figure 17.2: Final Energy Consumption by Fuel Type, BAU (1990–2040)



BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

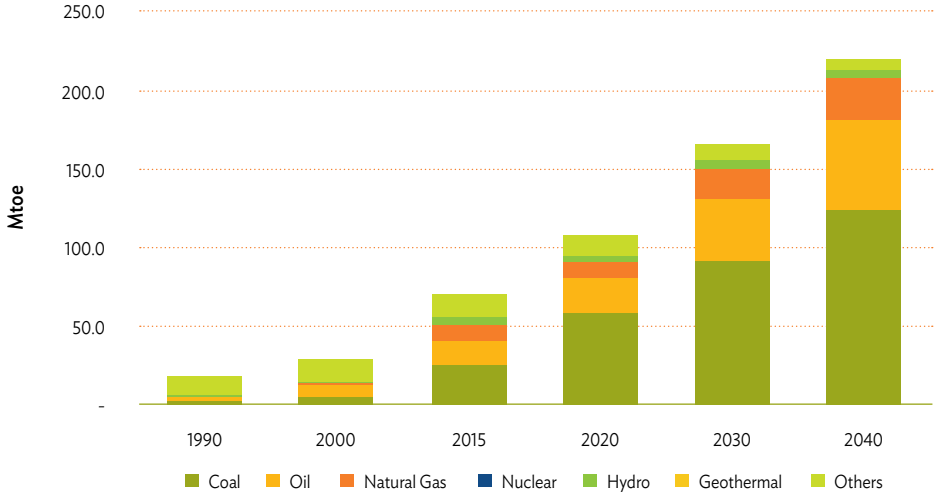
Source: Author's calculations.

3.1.2. Total primary energy supply

Viet Nam's total primary energy supply (TPES) grew at a higher rate than final energy consumption; it increased at 5.6% per year or 3.9 times, from 17.9 Mtoe in 1990 to 70.1 Mtoe in 2015. Amongst the major energy sources, the fastest-growing were natural gas, hydro, coal, and oil. Natural gas consumption grew at an average annual rate of 38.1% between 1990 and 2015 while hydro, coal, and oil grew at 10.4%, 10.2%, and 7.2% per year, respectively.

In the BAU scenario, Viet Nam's TPES is projected to increase at an annual rate of 4.7% or 3.1 times, from 70.1 Mtoe in 2015 to 219.9 Mtoe in 2040. The fastest growth is expected in coal, increasing at an annual average rate of 6.6% between 2015 and 2040, followed by oil (5.4%) and natural gas (4.1%) while hydro and other fuels (mostly biomass) will decrease slightly and strongly at 0.2% and 2.9% per year, respectively. Figure 17.3 shows the primary energy supply by source in 1990–2040.

Figure 17.3: Primary Energy Supply, BAU (1990–2040)



BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

Source: Author's calculations.

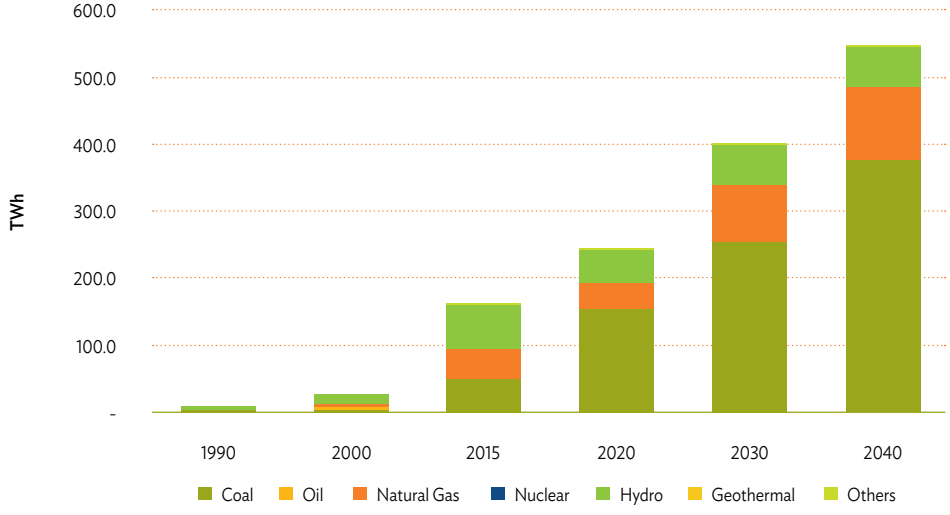
Coal accounted for the largest share of 35.9% of the TPES in 2015 and will increase to 56.2% in 2040. The share of oil was 22.2% in 2015 and will increase to 26.3% in 2040. This growth is due to the projected decline of natural gas (from 13.7% to 12.1%), hydro (from 7.8% to 2.3%), and others (from 20.3% to 3.1%).

3.1.3. Power generation

Power generation output increased at 12.4% per year or 18.4 times, from 8.7 TWh in 1990 to 159.8 TWh in 2015. The fastest growth occurred in natural gas power generation (42.9% per year), followed by coal (13.8%) and hydropower (10.4% per year). This fast growth is due to the 5.8% decrease of oil.

Power generation is projected to increase at an average rate of 5% per year, or 3.4 times between 2015 and 2040, to meet electricity demand under the BAU scenario. The fastest growth will be in coal power generation (8.3% per year), followed by natural gas (3.6% per year). This fast growth is due to the decrease of hydro, oil, and other (mostly small hydropower). Figure 17.4 shows the power generation output by the type of fuel under the BAU scenario from 1990 to 2040.

Figure 17.4: Power Generation by Fuel Type, BAU (1990–2040)



BAU = Business-As-Usual, TWh = terawatt-hour.

Source: Author's calculations.

By the end of 2015, the majority of the country's power came from hydropower, which comprised about 39.5% of the total power generation mix. The share of coal-fired power generation was around 31.9% while the rest were from natural gas (28.1%), oil (0.2%), and other power generation (around 0.3%).

In the BAU scenario, coal will be the major fuel used for power generationbetween 2020 and 2040, with its share increasing from 64.0% in 2020 to 68.9% in 2040. On the other hand, the share of hydro in the total power generation will decline from 20.4% in 2020 to around 11.0% in 2040.

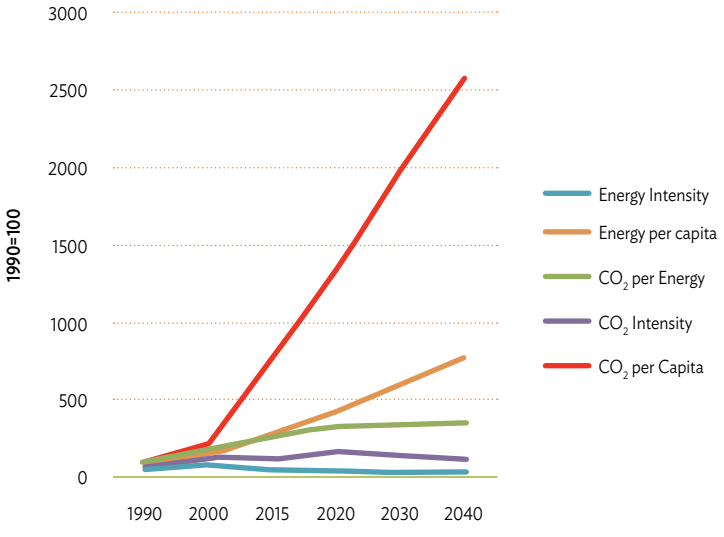
3.1.4. Energy indicators

From 1990 to 2015, Viet Nam's energy intensity showed a decreasing trend. Both primary and final energy intensities of the country decreased from 1,006 toe/million and 905 toe/million 2010 US$ in 1990 to 453 toe/million and 364 toe/million 2010 US$ in 2015. This was due to the high economic growth, which significantly reduced the use of biomass fuels in the residential sector, although the energy requirement in the industry and the transport sectors had been increasing in recent years. The final energy intensity under the BAU scenario is estimated to continue the decreasing trend from 364 toe/million to 228toe/million 2010 US$ by 2040. This decreasing trend indicates that energy will be used efficiently for economic development.

Meanwhile, the primary energy per capita increased from 0.27 toe/person in 1990 to 0.76 toe/person in 2015; it will continue to increase to 2.06 toe/person by 2040. This indicates that, in the future, living standards and people's incomes will increase, resulting in rising total primary energy consumption (TPEC) per capita.

Regarding greenhouse gas (GHG) emissions, CO_2 intensity and CO_2 per energy increased from 265 t-C/million 2010 US$ and 0.26 t-C/toe in 1990 to 317 t-C/million 2010 US$ and 0.7 t-C/toe in 2015, respectively. In the BAU scenario, CO_2 intensity and CO_2 per energy will also slightly increase by 2020 at 417 t-C/million 2010 US$ and 0.84 t-C/toe. Beyond 2020, CO_2 intensity will decline until 2040 at 295 t-C/million 2010 US$, while CO_2 per energy will slightly increase at around 0.89 t-C/toe. CO_2 per capita will continuously increase due to energy demand rising faster than population growth. (Figure 17.5).

Figure 17.5: Energy Indicators (1990–2040)



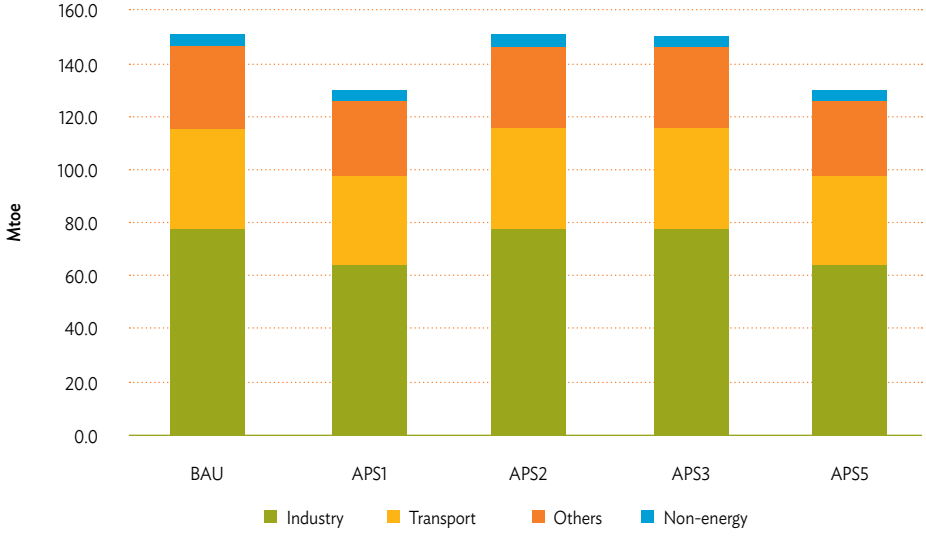
Source: Author's calculations.

3.2. Energy Savings and CO_2 Reduction Potential

3.2.1. Total final energy consumption

In the Alternative Policy Scenario (or APS5, the TFEC is projected to increase at a slower rate of 3.4% per year (compared with 4.0% in the BAU scenario), from 56.3 Mtoe in 2015 to 130.2 Mtoe in 2040 because of EEC measures (APS1) in the industry, transport, and 'others' sectors. The total final consumption by sector in APSs compared to the BAU scenario is presented in Figure 17.6.

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



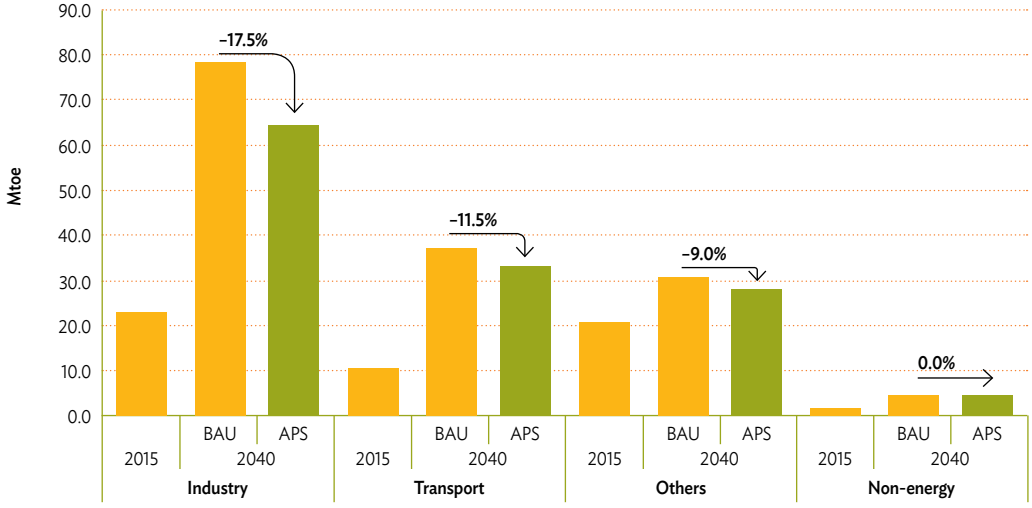
APS = Alternative Policy Scenario, BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

Source: Author's calculations.

The bulk of the savings are expected to occur in the industry sector with 13.7 Mtoe (equivalent to 17.5% reduction), followed by the transport sector with 4.3 Mtoe (equivalent to 11.5% reduction), and the 'others' sector with 2.8 Mtoe (equivalent to 9.0% reduction).

An improvement in end-use technologies and the introduction of energy management systems are expected to contribute to the slower rate of consumption growth, particularly in the industry, transport, and 'others' sectors (Figure 17.7).

Figure 17.7: Final Energy Consumption, BAU vs APS (2015 and 2040)



APS = Alternative Policy Scenario, BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

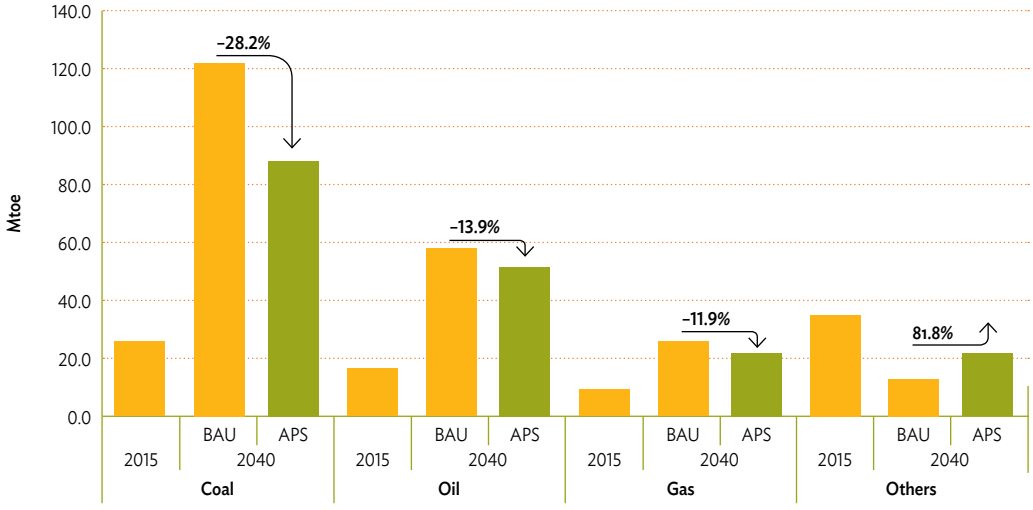
Source: Author's calculations.

3.2.2. Total primary energy supply

In APS5, the TPES is projected to increase at a slower rate of 3.9% per year, from 70.1 Mtoe in 2015 to 183.7 Mtoe in 2040. Coal is projected to grow at the highest average annual rate of 5.2% compared with 6.6% in the BAU scenario. This is followed by oil (4.8%) and natural gas (3.6%), compared with 5.4% and 4.1% in the BAU scenario, respectively, over the same period.

The slower growth in consumption, compared to the BAU scenario, 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. Coal has the highest energy savings potential with 28.2%, followed by oil (13.9%) and natural gas (11.9%). Figure 17.8 shows the primary energy saving potential by fuel under the BAU scenario and APS.

Figure 17.8: Primary Energy Saving Potential by Fuel Type, BAU and APS (2015 and 2040)

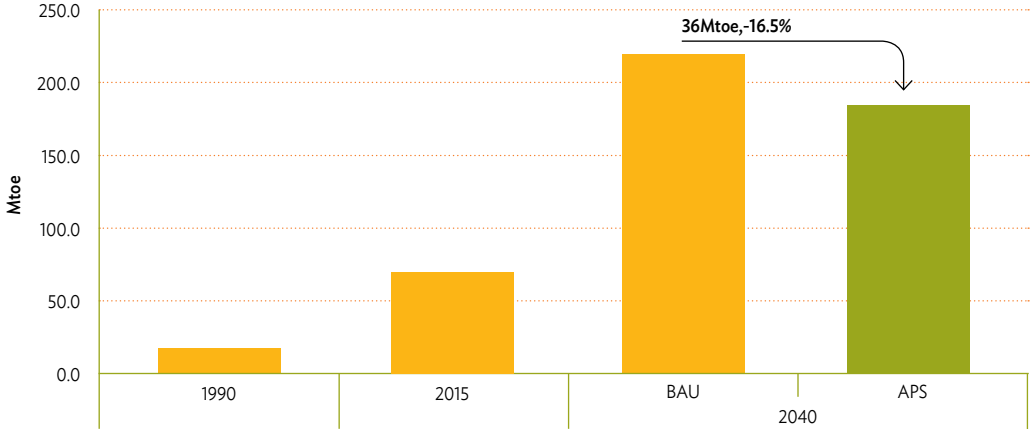


APS = Alternative Policy Scenario, BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

Source: Author's calculations.

The total savings amount to 36.3 Mtoe, equivalent to 16.5% of Viet Nam's TPEC in 2040. (see Figure 17.9).

Figure 17.9: Evolution of Primary Energy Supply, BAU and APS (1990, 2015, and 2040)



APS = Alternative Policy Scenario, BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

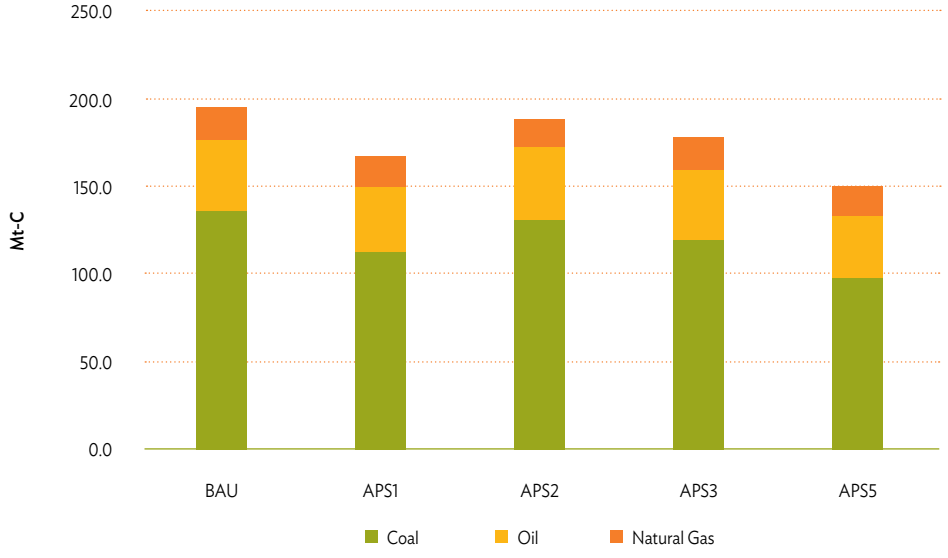
Source: Author's calculations.

3.2.3. CO_2 reduction potential

CO_2 emissions from energy consumption under the BAU scenario are projected to increase by 5.7% per year from 49.0 million metric tons of carbon (Mt-C) in 2015 to 195.2 Mt-C in 2040. Meanwhile, under APS5, the annual increase in CO_2 emissions between 2015 and 2040 is projected to be 4.6% yearly, which is 1.1 percentage points lower than the BAU scenario.

Reduced CO_2 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 renewable energy technologies (APS3) also contributed significantly to CO_2 reduction (Figure 17.10).

Figure 17.10: CO_2 Emissions by Fuel Type, BAU and APSs

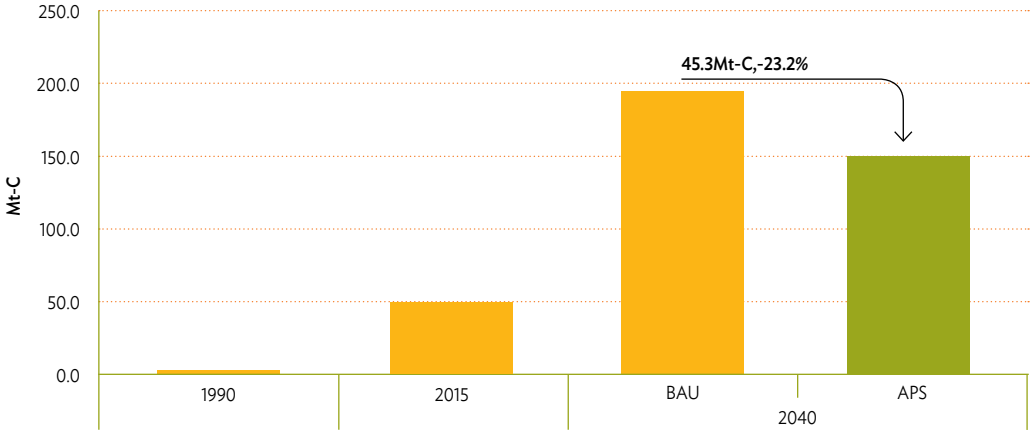


APS = Alternative Policy Scenario, BAU = Business-As-Usual, Mt-c = million tons of carbon.

Source: Author's calculations.

Improvements on CO_2 emissions under the APSs will be around 45.3 Mt-C lower, equal to 23.2% reduction in 2040. This indicates that the energy saving goals and action plans of Viet Nam are effective in reducing CO_2 emissions (see Figure 17.11).

Figure 17.11: Evolution of CO_2 Emissions, BAU and APS (1990, 2015, and 2040)



APS = Alternative Policy Scenario, BAU = Business-As-Usual, Mt-c = million tons of carbon.

Source: Author's calculations.

4. Review of Viet Nam's INDC and APS5 Results

In September 2015, Viet Nam submitted its Intended Nationally Determined Contributions (INDC) to the United Nations Framework Convention on Climate Change. Viet Nam's INDC includes mitigation and adaptation components and covers the entire economy, including the energy; agriculture; land use, land use change, and forestry; and waste sectors. The mitigation component includes both unconditional and conditional contributions. Unconditional contributions are measures implemented using domestic resources, while conditional contributions are those that could be implemented if new and additional international financial support, technology transfer, and capacity building are received.

With domestic resources, by 2030, Viet Nam will reduce GHG emissions by 8% compared to the BAU scenario, equal to around 63 million tons of carbon dioxide equivalent (tCO_2e). The contribution of the energy sector on GHG emissions reduction by 2030 will be 29.5 million tCO_2e, accounting for 46.8% of total GHG emissions reduction under unconditional contribution.

The above-mentioned 8% contribution could be increased to 25%, with international support, equal to around 197 million tCO_2e. The contribution of the energy sector on GHG emissions reduction by 2030 will be 65.9 million tCO_2e, accounting for 33.5% of total GHG emissions reduction under conditional contribution.

GHG mitigation goals in the energy sector are expected to be attained through the potential mitigation options in the industry, transport, and 'others' sectors on the demand side and the development of renewable energy technologies, particularly solar, wind, and biomass for power generation, on the supply side.

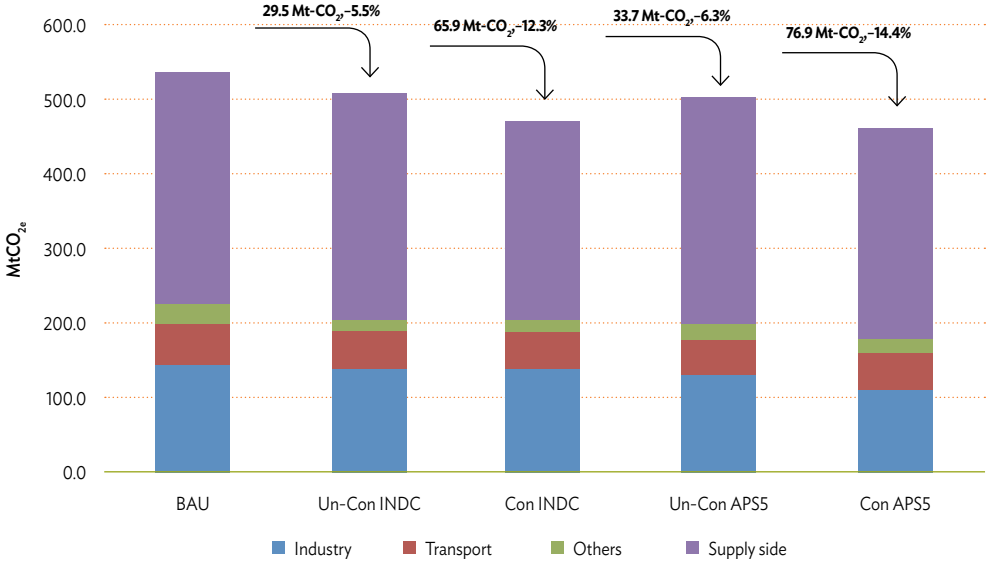
These options were proposed and selected based on the following criteria: government prioritisation, GHG reduction potential, cost-effectiveness, and the maturity of technology development, which can be classified by unconditional and conditional contributions as follows:

- Prioritised mitigation options: GHG reduction potential, alignment with government policies, cost-effectiveness, and maturity of technologies
- Unconditional: low abatement costs, already implemented in Viet Nam, aligned with sectoral plans for 2021–2030
- Conditional: higher abatement costs and new technologies currently implemented in developed countries.

To evaluate and compare GHG emissions reduction potential and targets with Viet Nam's INDC, the author classified the mitigation technologies in APS5 and based on the above criteria to compare APS5 of this study with INDC on GHG emissions reduction.

Under APS5, with domestic resources, Viet Nam will reduce by 2030 33.7 million tCO_2e (or 6.3% reduction) compared to 29.5 million tCO_2e (or 5.5% reduction) in the INDC. These GHG emissions will further decrease to 76.9 million tCO_2e (or 14.4% reduction) compared to 65.9 million tCO_2e (or 12.3% reduction) in the INDC under conditional contribution with international support.

Figure 17.12: GHG Reduction Targets, APS5 vs INDC



APS = Alternative Policy Scenario, BAU = Business-As-Usual Scenario, GHG = greenhouse gases,
INDC = Intended Nationally Determined Contributions, Mt-CO_2 = million tons of carbon dioxide equivalent.

Source: Author's calculations.

In both the INDC and APS5, the power generation and industry sectors have high potential in reducing GHG. Compared to Viet Nam's INDC on GHG emissions reduction targets, those in APS5 look similar but seem to be more ambitious due to new policies and technologies being updated. These also prove that if APS5 were implemented, Viet Nam's INDC would be achieved.

5. Key Findings and Policy Implications

The following are some key findings from the above analysis on energy savings potential:

- Energy demand in Viet Nam is expected to continue to grow significantly, driven by robust economic growth, industrialisation, urbanisation, and population growth. EEC measures can potentially contribute to meeting higher demand in a sustainable manner.
- Viet Nam's energy intensity, which is amongst the highest in the world, indicates high savings potential.
- Electricity demand is increasing with highest annual growth rate of 5.3% in the BAU scenario and is projected to decline to 4.7% in the APS. This decline proves that the EEC measures are effective in electricity demand.

- EEC scenarios on the demand side are most effective compared with other proposed scenarios, which are APS2 and APS3.
- Coal-fired thermal power plants will be the major power source in Viet Nam in the coming years. Their share in the total power generation output is increasing continuously from 31.9% in 2015 to 68.9% in 2040 in the BAU scenario. This is the area with the largest energy savings and GHG mitigation potential in both Viet Nam's INDC and APS5.
- GHG mitigation technologies in APS5 will be developed to conform with Viet Nam's INDC and government policies.

The following policies are recommended to effectively implement EEC activities in Viet Nam:

- **Establishment of new targets and a roadmap for EEC implementation:** Energy demand in Viet Nam in the BAU scenario is expected to continue to grow significantly in the coming years. EEC scenarios on the demand side are most effective compared to other proposed scenarios (APS2 and APS3). Therefore, Viet Nam needs to strengthen EEC activities by updating and setting new targets globally and specifically in each sector for the next periods and by preparing specific road maps or action plans to achieve these targets.
- **Compulsory energy standards and labelling for electrical appliances:** The annual growth of electricity demand, especially in the 'others' sector, is projected to be the second highest (5.3%) in the BAU scenario. Therefore, compulsory energy standards and labelling for electrical appliances is an effective management measure in energy savings.
- **Priority for development of advanced coal-fired thermal power technology:** Coal-fired thermal power plants will be the major source of power generation in Viet Nam up to 2040. Therefore, Viet Nam needs to retrofit the existing thermal power plants to improve the efficiency of power generation and to prioritise energy-effective technologies (clean coal technologies) for the development of new coal-fired thermal power plants.
- **Priority for renewable energy development:** Coal-fired power generation is projected to have a dominant share in the future, which will result in the country's reliance on coal imports for power generation. The development of renewable energy technologies to replace coal for power generation is an important factor for energy independence, energy security, and GHG abatement. This is necessary in setting up policy support and mechanisms to promote renewable energy development.

References

Government of Viet Nam (2006), Decision 79/2006/QD-TTg dated 14 April 2006 of the Prime Minister Approving the National Target Program on Energy Savings and Conservation. Ha Noi.

Government of Viet Nam (2007), Decision 177/2007/QD-TTg dated 20 November 2007 of the Prime Minister Approving the Master Plan on Biofuel Development Until 2015 with Perspective of 2025. Ha Noi.

Government of Viet Nam (2015), Decision No. 2068/QD-TTg dated 2 November 2015 of the Prime Minister Approving 'The Vietnam Renewable Energy Development Strategy to 2030, Outlook Up to 2050. Ha Noi.

General Statistics Office, Government of Viet Nam (2011), Viet Nam Population Forecasts 2009–2049. Ha Noi.

General Statistics Office, Government of Viet Nam (2015), *Statistical Yearbook of Viet Nam*. Ha Noi.

Institute of Energy, Ministry of Industry and Trade, Government of Viet Nam (2015), Revised Power Development Plan for the Period of 2011–2020 with Perspective to 2030. Ha Noi.

Ministry of Natural Resource and Environment (2015), Technical Report. Viet Nam's Intended Nationally Determined Contribution, Ha Noi: Ministry of Natural Resource and Environment.

The National Assembly of Viet Nam (2010), Law on Energy Savings and Conservation (2010). Ha Noi: The National Assembly of Viet Nam.