Chapter 17

Viet Nam Country Report

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CHAPTER 17

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1. Background

Viet Nam has a total land area of about 331,111 square kilometres and is located in the centre of Southeast Asia. In 2012, Viet Nam had a population of 88.8 million and a gross domestic product (GDP) of US$87.5 billion in 2005 US$ terms. The commercial sector contributed most to Viet Nam's GDP (41.7 percent), followed by the industry sector (38.6 percent), and agriculture (18.0 percent). GDP per capita was 986 US$ per person in 2012.

Viet Nam possesses considerable indigenous energy resources. It has 3.4 billion tonnes 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 60.4 Mtoe in 2012. Coal represented the largest share of Viet Nam's TPES at 29.0 percent; oil was second at 28.1 percent, followed by natural gas (12.8 percent), hydro (6.9 percent), and 'others' (23.2 percent). Viet Nam is a net exporter of crude oil and coal, but an importer of petroleum products because of capacity limitations at the Dung Quat oil refinery (6.5 million tonnes a year) that meets around 40 percent of domestic demand.

Coal is mainly used in the industry sector, with consumption of 17.5 million tonnes of oil equivalent (Mtoe) in 2012, and natural gas is largely used for electricity generation.

Viet Nam had around 26.5 GW of installed generating capacity and generated 117.6 TWh of electricity in 2012. Most of Viet Nam's electricity generation comes from thermal sources (coal, natural gas, and oil), accounting for 58.4 percent of total generation; the remainder is hydro (38.6 percent) and other (3.0 percent).

2. Modelling Assumptions

In this outlook, Viet Nam's GDP is assumed to grow at an average annual rate of 6.2 percent from 2012 to 2035. Growth is projected to be faster in the first half of the outlook period, increasing at an annual average 6.6 percent between 2012 and 2020. Economic growth is projected to be slightly lower from 2020 to 2035, at an annual rate of 6.0 percent. The population is projected to grow at 0.8 percent per year between 2012 and 2035.

The share of electricity generated from coal-fired power plants is projected to increase considerably, at the expense of other energy types (thermal and hydro). Viet Nam is expected to increase its imports of electricity, particularly from Lao PDR and China.

The use of nuclear energy is assumed to start in 2020 in line with Viet Nam's nuclear power development plan. In the Business-as-Usual (BAU) scenario, it is assumed that the first unit of nuclear power with a capacity of 1,000 MW will be installed in 2020 and followed by six units and ten of nuclear power with total capacity of 6,000 MW and 10,700 MW will be installed in 2030 and 2035 respectively.

Viet Nam's energy saving goals are assumed to be between 3 percent to 5 percent of total energy consumption, equivalent to 5 Mtoe, between 2006 and 2010, and 5 percent to 8 percent 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). Beyond 2015, Viet Nam's energy saving goals are assumed to follow the trend of earlier periods.

The energy savings goals are expected to be attained through the implementation of energy efficiency programmes in the industry, transport, residential, and commercial sectors on the demand side.

On the supply side, energy efficiency improvement in power generation, development of nuclear power and renewable energy technologies, particularly small hydro, wind, and biomass, are expected to come online intensively from 2013 in line with the master plan on renewable energy development.

From the above analysis, Alternative Policy Scenarios (APS) are proposed – EEC scenarios (APS1), improvement of energy efficiencies in power generation (APS2), development of renewable energy (APS3), and further development of nuclear power plants (APS4).

- **APS1:** EEC Scenarios on the demand side, including:
    * EEC1: Using EEC measures in the industrial sector to achieve 5 percent to 8 percent energy reduction from 2012 to 2015, and 10 percent from 2016 onwards.
    * EEC2: Switching from Diesel Oil (DO) to Compressed Natural Gas (CNG) in transportation and using efficient motorbikes in road transport.
    * EEC3: Replacing inefficient devices with efficient devices in the residential sector, such as coal improved cooking stoves, Compact Fluorescent Lamp (CFL) in lighting, efficient refrigerators, and air conditioners for residential cooling.
    * EEC4: Using EEC measures in the commercial sector to reduce electricity consumption by 10 percent by 2035.
- **APS2:** Improvement of energy efficiency in thermal power plants:

  It assumes that efficiencies of coal, natural gas, and residue fuel oil thermal power plants will increase to 42 percent, 45 percent, and 37 percent, respectively, by 2035 compared with 37 percent, 42 percent, and 31 percent, respectively, in the BAU scenario; natural gas with Combined Cycle Gas Turbine (CCGT) technologies will increase to 55 percent by 2035 compared with 52 percent in BAU.
- **APS3:** Development of renewable energy technologies:

Installed electricity generating capacity from renewable energy is assumed to reach 13,400 MW in 2035, with wind contributing 6,200 MW, small hydro 5,200 MW,

and biomass 2,000 MW.

Moreover, Viet Nam has considered the use of biofuels to reduce dependency on oil and curb CO_2 emissions. According to the Prime Minister's decision 177/2007/QD-TTg approving the master plan on biofuel development, Viet Nam is assumed to produce 250,000 tonnes of biofuels in 2015 (both ethanol and biodiesel, in which ethanol fuel accounts for around two-thirds of the total) and 1.8 million tonnes in 2025.

- **APS4:** Maximum nuclear power development:

  The installed capacity of nuclear power plants under the APS scenario is expected to reach 11,000 MW by 2030 and 15,000 MW by 2035 compared with 6,000 MW and 10,700 MW by 2030 and 2035, respectively, in the BAU scenario.

- **APS5:** Combines APS1, APS2, APS3, and APS4.

3. Outlook Results

3.1. Business-as-Usual (BAU) Scenario

3.1.1. Total Final Energy Consumption

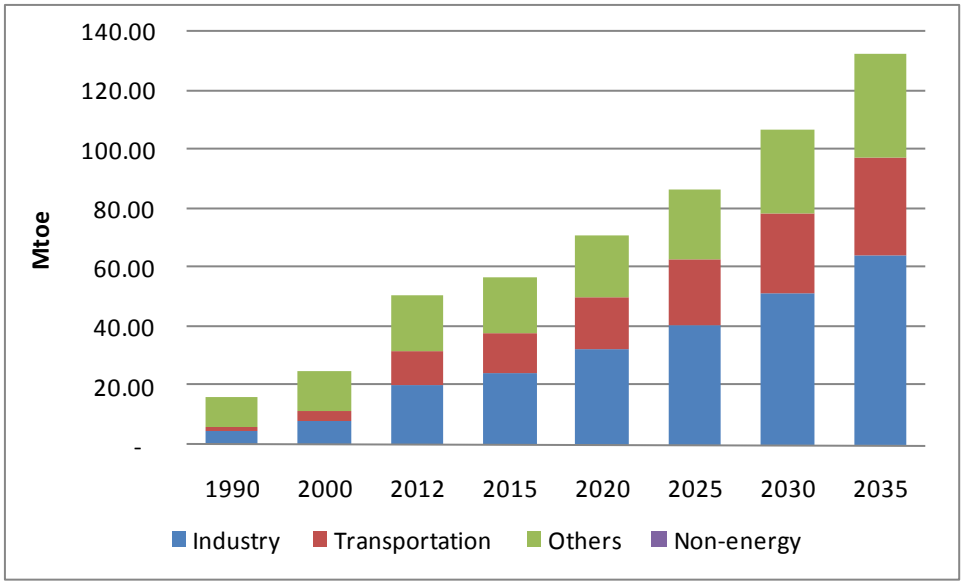
Viet Nam's Total Final Energy Consumption (TFEC) in 2012 was 50.8 Mtoe, 3.2 higher than its 1990 level of 16.0 Mtoe, an annual average increase of 5.4 percent. The fastest growth occurred in the transport sector (10.0 percent per year) followed by the industrial sector (7.1 percent), and the residential/commercial (others) sector (2.9 percent per year).

From 2012 to 2035, TFEC is projected to increase at an average rate of 4.3 percent per year under the BAU scenario, driven by strong economic growth, projected at an annual average rate of 6.2 percent, and average annual population growth of 0.7 percent. The strongest growth in consumption is projected to occur in the industry sector (5.1 percent per year), followed by the transportation sector (4.8 percent), and the residential/commercial (others) sector (2.7 percent per year).

The bulk of the country's energy consumption, or more than 63.1 percent, in 1990 was in the residential/commercial (others) sector, where biomass fuel used for residential cooking accounted for the major share. This share is projected to decline strongly, to 26.6 percent, by 2035 due to the substitution of biomass fuels by commercial fuels with higher efficiency. The decreasing share of the sector is due to an impact of the growing economy. The impact of economic growth will translate to improvement of standard of living, thus increasing the transition from biomass fuels to the model fuels.

The industrial sector is assumed to be the largest consuming sector in Viet Nam from 2012 to 2035. Its share of energy consumption is projected to increase from 40.1 percent in 2012 to 48.5 percent in 2035. The smallest consumer is the transport sector. Its share is expected to increase slightly, from 22.3 percent in 2012 to 24.9 percent in 2035.

Figure 17-1. Final Energy Demand by Sector, BAU



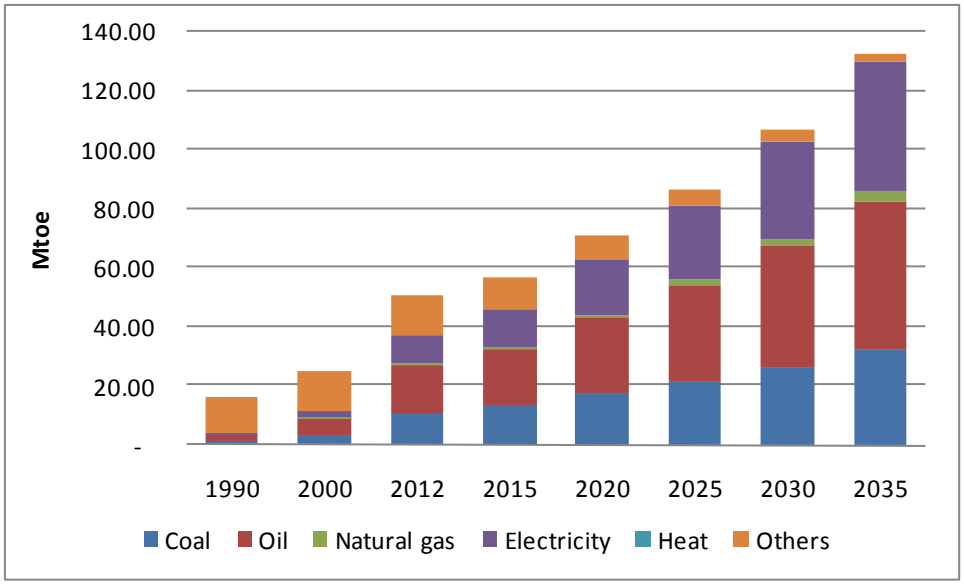
BAU = Business-as-Usual.
Source: Author's calculation.

Other fuels (mostly biomass) were the most consumed products in 1990, accounting for 73.9 percent of total final energy consumption, but this declined to 26.9 percent in 2012. Oil was the second most consumed product in 1990, accounting for 14.5 percent of total final energy consumption, and this increased to 31.7 percent in 2012. Over the same period, the share of coal consumed increased from 8.3 percent to 21.9 percent and that of electricity from 3.3 percent to 18.6 percent.

Under the BAU scenario, natural gas is projected to grow strongest in final energy consumption – it is projected to increase at an annual average rate of 8.1 percent from 2012 to 2035. Electricity is projected to have the second highest growth rate at 7.0 percent per year, followed by oil (5.1 percent), and coal (4.7 percent). Other fuels (mostly biomass) are projected to decrease strongly, at an average annual rate of 6.8 percent, due to the transition from biomass fuels to modern fuels.

Oil products had the largest share in final energy consumption in 2012, at 31.7 percent, and this share is projected to increase to 38.1 percent in 2035. Other fuels (biomass) accounted for the second largest share in 2012, at 26.9 percent, but this is projected to decrease to 2.0 percent in 2035. Coal, which is used primarily in the industry sector, was the country's third consumed fuel in 2012, with a share of 21.9 percent, and its share will increase to 24.2 percent in 2035. The largest increase will be in the share of demand for electricity; it is expected to rise from 18.6 percent in 2012 to 33.4 percent in 2035.

Figure 17-2. Final Energy Demand by Fuel, BAU



BAU = Business-as-Usual.
Source: Author's calculation.

3.1.2. Total Primary Energy Consumption

Total Primary Energy Consumption (TPEC) in Viet Nam grew at a higher rate than final energy consumption, increasing at 5.8 percent per year, or 3.4 times, from 17.8 Mtoe in 1990 to 61.2 Mtoe in 2012. 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 42.9 percent between 1990 and 2012, and hydro, coal, and oil grew at 10.5 percent, 9.8 percent, and 8.9 percent per year, respectively.

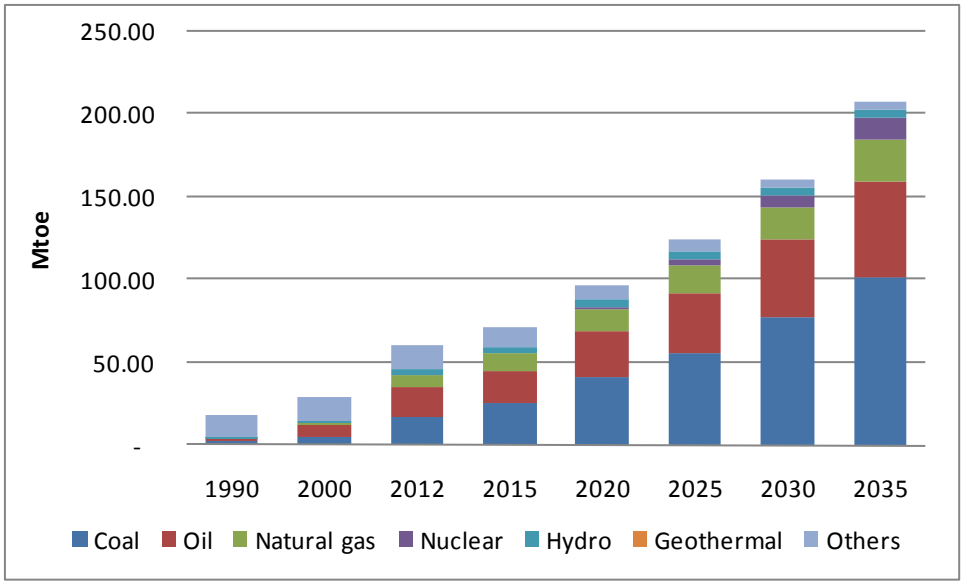
In the BAU scenario, Viet Nam's TPEC is projected to increase at an annual rate of 5.5 percent per year, or 3.4 times, from 61.2 Mtoe in 2012 to 208.2 Mtoe in 2035. The fastest growth is expected in coal, increasing at an annual average rate of 7.9 percent between 2012 and 2035, followed by oil, natural gas, and hydro at 5.4 percent, 5.3 percent, and 1.0 percent, respectively, whereas other fuels (mostly biomass) will decrease strongly, by 5.0 percent per year.

Coal accounted for a 28.6 percent share of TPEC in 2012 and is projected to increase strongly, to 48.6 percent in 2035. The share of oil was 29.1 percent in 2012 and will increase slightly, to 28.5 percent in 2035. The increases in the shares of coal and oil are a result of projected declines in the shares of natural gas, hydro, and others, which are expected to decrease from 12.6 percent to 12 percent, from 6.8 percent to 2.5 percent, and from 22.9 percent to 2.1 percent, respectively.

3.1.3. Power Generation

Power generation output increased at an average 12.6 percent per year from 8.7 TWh in 1990 to 117.6 TWh in 2012. The fastest growth occurred in natural gas power generation (49.3 percent), followed by coal (12.4 per cent), hydropower (10.2 percent), and oil (1.9 percent).

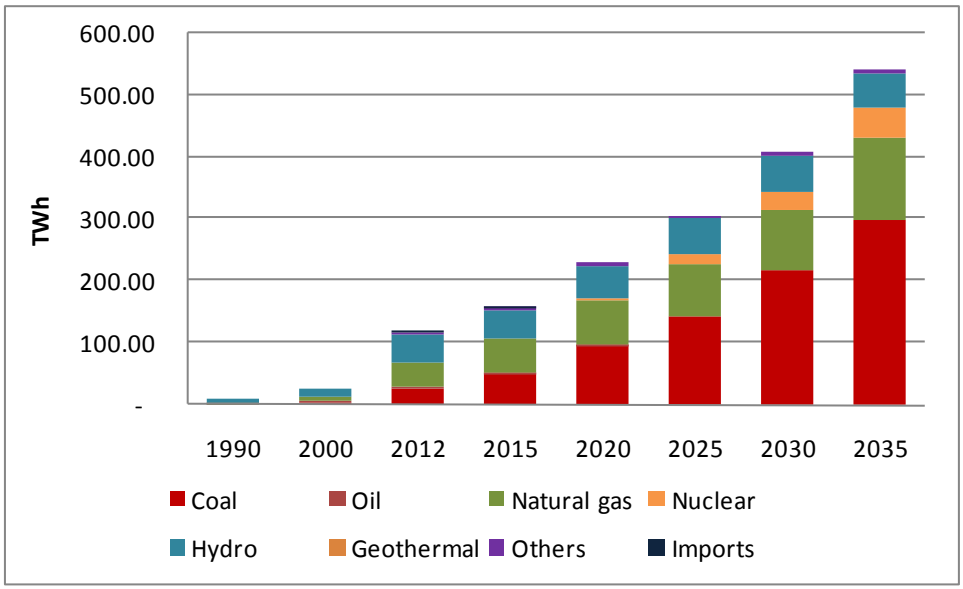
Figure 17-3. Primary Energy Demand, BAU



BAU = Business-as-Usual.
Source: Author's calculation.

To meet electricity demand under the BAU scenario, power generation is projected to increase at an average rate of 6.9 percent per year, between 2012 and 2035. The fastest growth will be in coal power generation (11.2 percent), followed by natural gas (5.3 percent), 'others' (almost only small hydro power) generation (2.2 percent), and hydro power generation (0.9 percent).

Figure 17-4. Power Generation by Type of Fuel, BAU



BAU = Business-as-Usual.
Source: Author's calculation.

At the end of 2012, most of Viet Nam's power requirement was met by hydropower, which accounted for 38.6 percent of the total power generation mix. The share of natural gas power generation was 34.6 percent, and coal and oil power generation accounted for the remainder.

In the BAU scenario, coal will be the major fuel for power generation from 2020 to 2035, with its share projected to increase from 42.5 percent to 54.8 percent. The share of natural gas in total power generation will decline from 34.6 percent in 2012 to 24.5 percent in 2035.

3.1.4. Energy Indicators

From 1990 to 2012, Viet Nam's energy intensity showed a decreasing trend. Both primary and final energy intensities of the country decreased, from 1,004 and 903 toe/million 2005 US$, respectively, in 1990 to 699 and 580 toe/million 2005 US$, respectively, in 2012. This was mainly due to strong economic growth, which resulted in a significant reduction in the use of biomass fuels for cooking in the residential sector, although the energy requirement in the industrial sector and transport sector increased strongly from 1990 to 2012. Final energy intensity under the BAU scenario is estimated to decrease from 597 to 380 toe/million 2005 US Dollars by 2035. This decreasing trend is a good indication that energy will be used efficiently for economic development.

Primary energy per capita increased from 0.27 toe/person in 1990 to 0.69 toe/person in 2012 and is projected to increase to 1.98 toe/person in 2035. This indicates that people's living standards and incomes will increase, resulting in an increase in total primary energy consumption per capita.

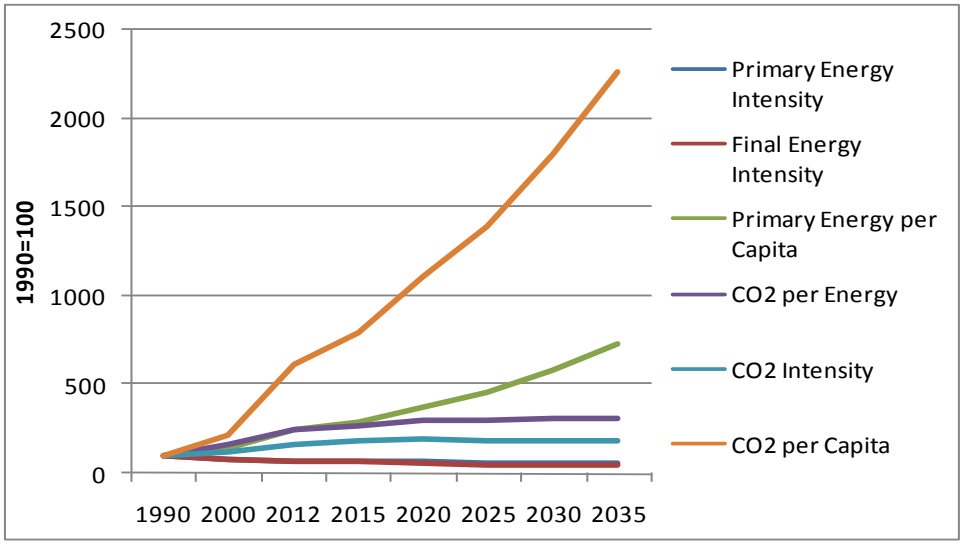
Regarding greenhouse gas (GHG) emissions, CO_2 intensity and CO_2 per energy increased from 265 t-C/million 2005 US$ and 0.26 t-C/toe, respectively, in 1990 to 442 t-C/million 2005 US$ and 0.63 t-C/toe, respectively, in 2012. In the BAU scenario, CO_2 intensity and CO_2 per energy are projected to increase slightly up to 2020, to 519 t-C/million 2005 US$ and 0.78 t-C/toe. From 2020 to 2035, CO_2 intensity will decline to 487 t-C/million 2005 US$, and CO_2 per energy will stay at around 0.82 t-C/toe. However, CO_2 per capita is projected to increase steadily, due to energy demand increasing faster than population growth rate (Figure 17-5).

3.2. Energy Savings and CO_2 Emissions Reduction Potential

3.2.1. Total Final Energy Consumption

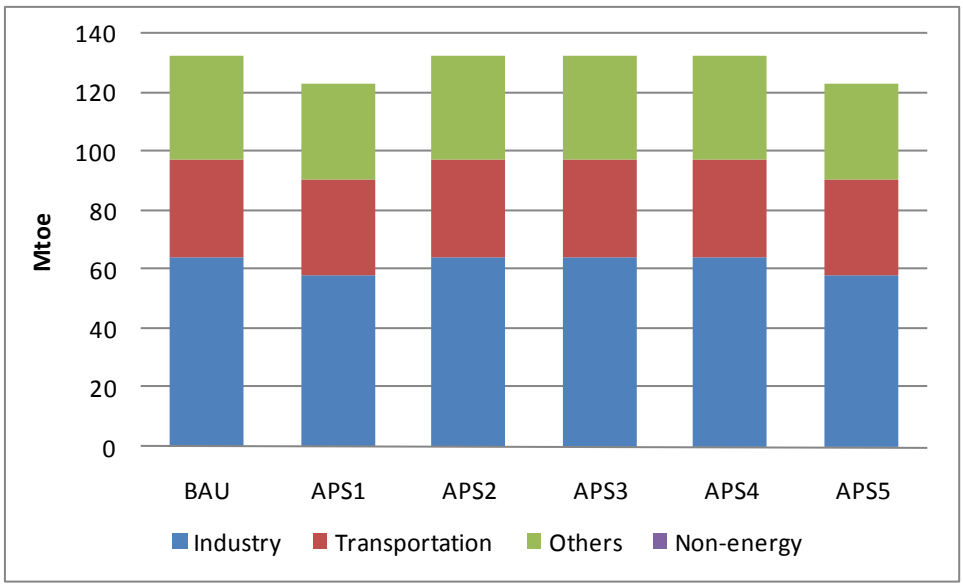
In APS5, Total Final Energy Consumption (TFEC) is projected to increase at a slower rate, of 3.9 percent per year (compared with 4.3 percent in the BAU scenario), from 50.8 Mtoe in 2012 to 123.1 Mtoe in 2035 because of EEC measures (APS1) in the industrial, transport, residential, and commercial (other) sectors.

Figure 17-5. Energy Indicators



Source: Author's calculation.

Figure 17-6. Total Final Energy Consumption by Sector in BAU and APS

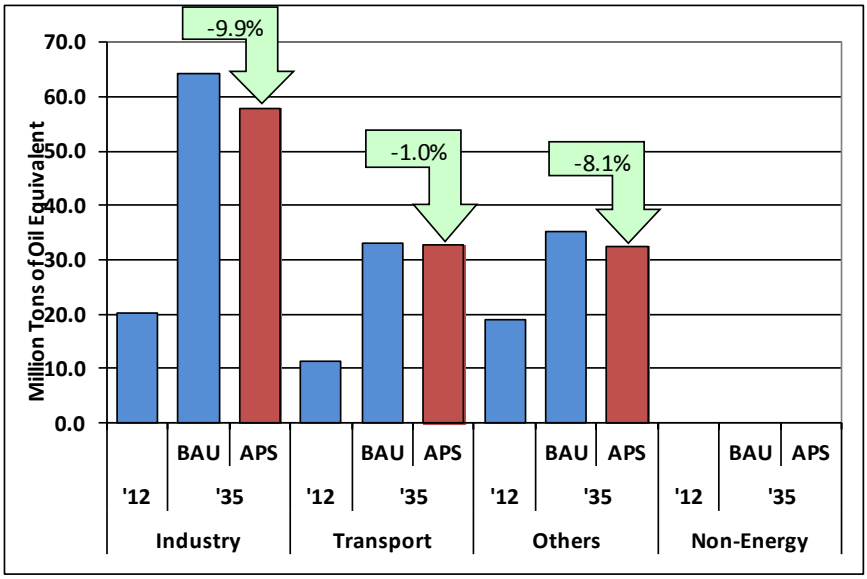


BAU = Business-as-Usual; APS = Alternative Policy Scenario.
Source: Author's calculation.

The bulk of savings are expected to occur in the industry sector, with 6.4 Mtoe, equivalent to a 9.9 percent reduction, followed by the residential/commercial (others) sector, with 2.9 Mtoe, equivalent to a 8.1 percent reduction, and the transportation sector, with 0.3 Mtoe, equivalent to a 1.0 percent reduction.

An improvement in end-use technologies and the introduction of energy management systems is expected to contribute to the slower rate of consumption growth, particularly in the industry sector, the others (residential and commercial) sectors, and the transport sector.

Figure 17-7. Total Final Energy Consumption, BAU vs. APS



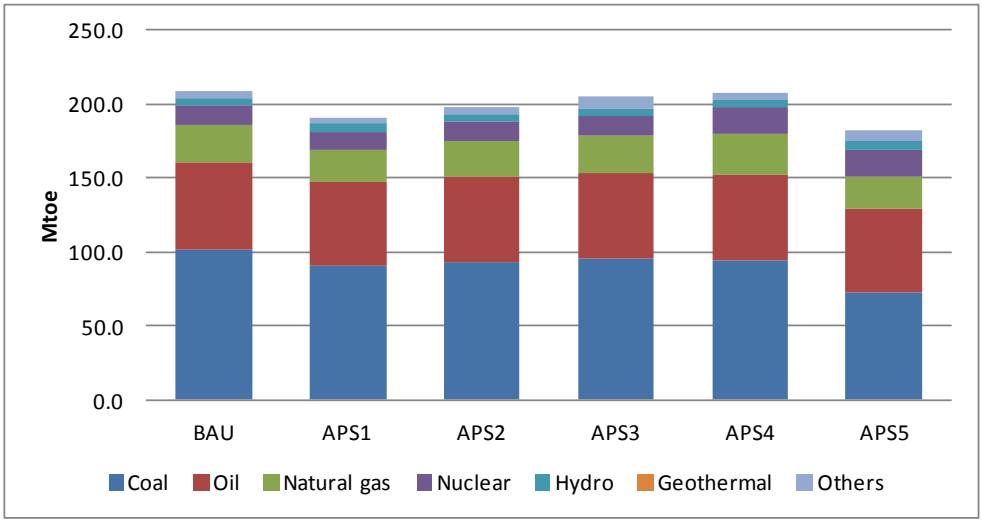
BAU = Business-as-Usual; APS = Alternative Policy Scenario.
Source: Author's calculation.

3.2.2. Total Primary Energy Consumption

In the APS5, Total Primary Energy Consumption (TPEC) is projected to increase at a slower rate, of 4.9 percent per year, from 61.2 Mtoe in 2012 to 182.9 Mtoe in 2035. Coal is projected to grow at the highest average annual rate, of 6.4 percent, compared with 7.9 percent in BAU, followed by oil and natural gas with 5.2 percent and 4.6 percent (compared with 5.4 percent and 5.3 percent in BAU), respectively, over the same period.

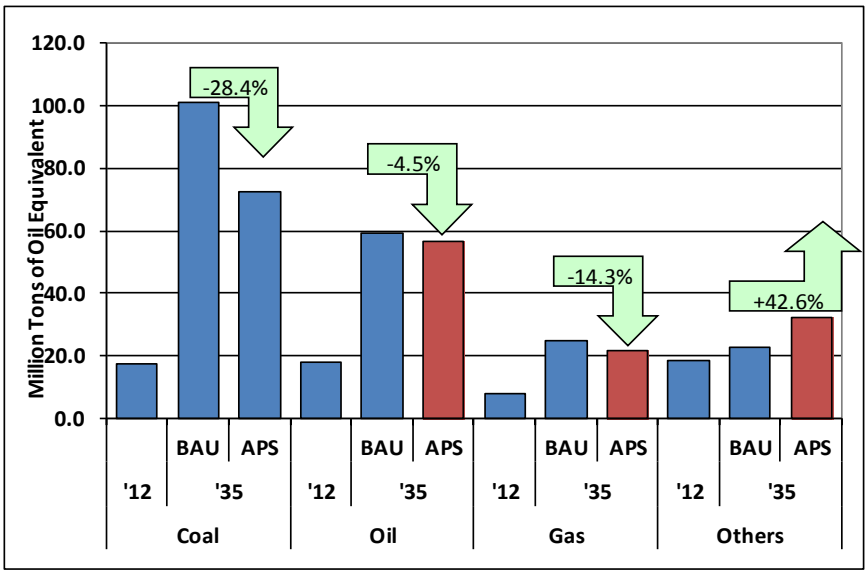
The slower growth in consumption, relative to the BAU scenario, stems from EEC measures on the demand side (APS1), and the more aggressive uptake of energy efficiency in thermal power plants (APS2), renewable (APS3) and nuclear energy (APS4) on the supply side. Coal has the highest energy saving potential, with 28.4 percent, followed by natural gas (14.3 percent), and oil (4.6 percent).

Figure 17-8. Primary Energy Demand by Fuel in BAU and APS



Source: Author's calculation.

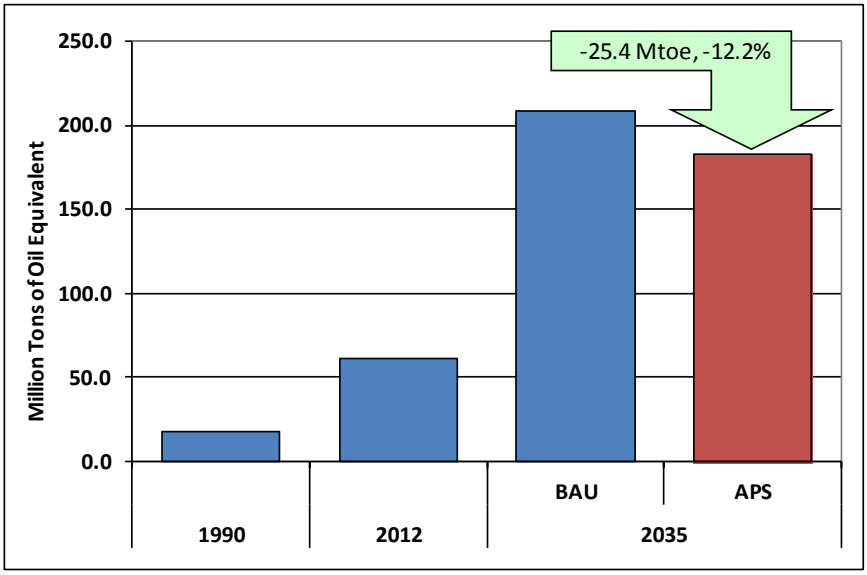
Figure 17-9. Primary Energy Saving Potential by Fuel, BAU vs. APS



BAU = Business-as-Usual; APS = Alternative Policy Scenario.
Source: Author's calculation.

The total savings amount to 25.4 Mtoe, or the equivalent to 12.2 percent of Viet Nam's projected total primary energy consumption in 2035 (Figure 17-10).

Figure 17-10. Evolution of Primary Energy Demand, BAU and APS



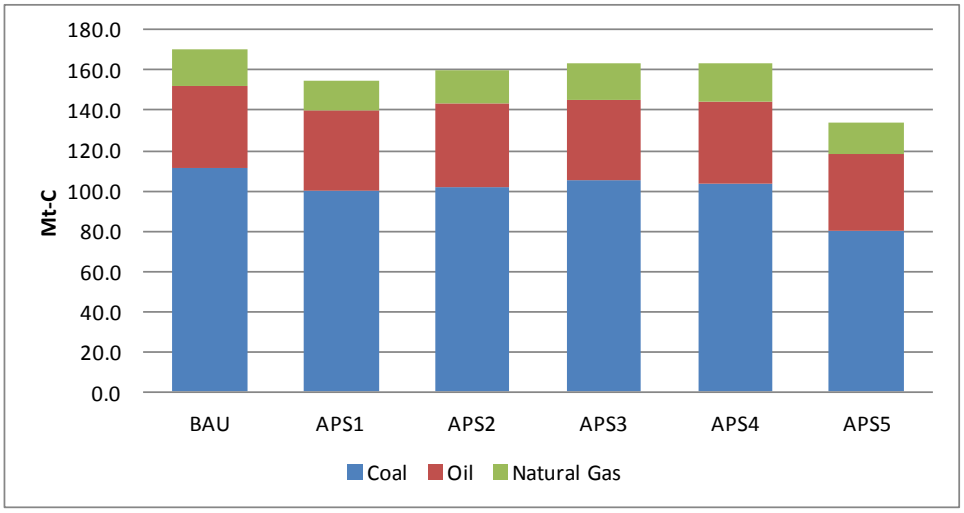
BAU = Business-as-Usual; APS = Alternative Policy Scenario.
Source: Author's calculation.

3.2.3. CO_2 Reduction Potential

CO_2 emissions from energy consumption under the BAU scenario are projected to increase by 6.6 percent per year, from 38.7 million metric tonne of carbon (Mt-C) in 2012 to 170.0 Mt-C in 2035. Under APS5, the annual increase in CO_2 emissions between 2012 and 2035 is projected to be 5.5 percent, which is 1.1 percentage points lower than in the BAU scenario.

The CO_2 emission reduction is mostly expected to result from EEC measures on the demand side (APS1). Moreover, improvement of energy efficiency in thermal power plants (APS2), development of renewable energy technologies (APS3), and maximum nuclear power development (APS4), also contributed significantly to CO_2 reduction (Figure 17-11).

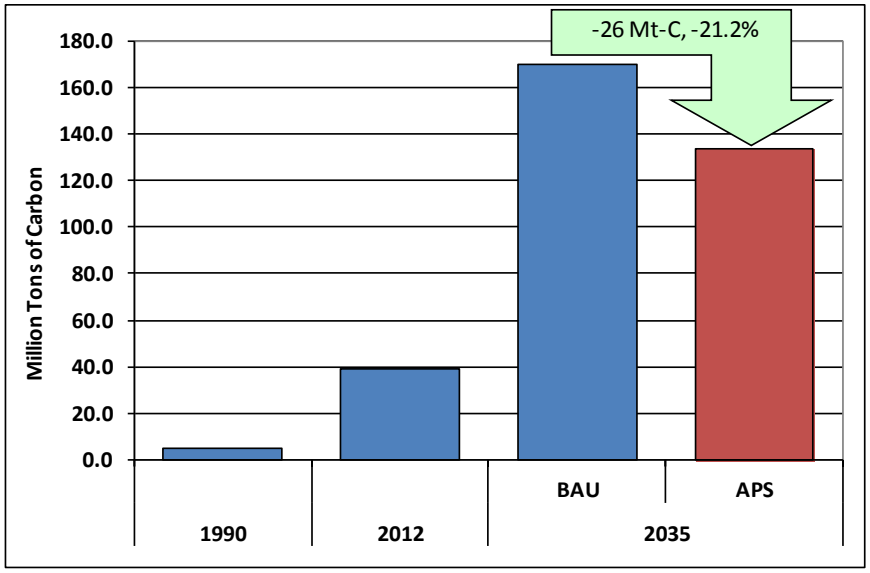
Figure 17-11. CO_2 Emissions by Fuel, BAU and APS



BAU = Business-as-Usual; APS = Alternative Policy Scenario.
Source: Author's calculation.

Reduction of CO_2 emissions under the APS will be around 36.1 Mt-C lower, equal to a 21.2 percent reduction in 2035, indicating that the energy saving goals and action plans of Viet Nam are very effective in reducing CO_2 emissions.

Figure 17-12. Evolution of CO_2 Emissions, BAU and APS



BAU = Business-as-Usual; APS = Alternative Policy Scenario.
Source: Author's calculation.

4. Key Findings and Policy Implications

From the above analysis on energy saving potential, some keys findings are as follows:

- Energy demand in Viet Nam is expected to continue to grow at a significant rate, driven by robust economic growth, industrialisation, urbanisation, and population growth. Energy efficiency and conservation measures have the potential to contribute to meeting higher demand in a sustainable manner.
- Viet Nam's energy intensity, which is amongst the highest in the world, indicates high saving potential. However, the energy saving potential derived from the EEC goals of Viet Nam (25.4 Mtoe) seem to be modest (because energy efficiency goals focus heavily on the industry sector and buildings) compared with its potential.
- Annual growth of energy demand in the transportation sector is projected at the second highest rate, of 4.8 percent, in the BAU scenario, and its share is expected to increase from 22.3 percent in 2012 to 24.9 percent in 2035. This shows that the transportation sector has large energy saving potential.
- Electricity demand is increasing at the highest annual growth rate, of 7.0 percent, in the BAU scenario and is projected to decline by 6.5 percent in the APS. This decline proved that the EEC measures are effective in electricity demand. However, the electricity saving potential is still large, particularly in the residential and commercial sectors.
- Coal thermal power plants will be the major power generators in Viet Nam in the coming years. Its share in total power generation output is projected to increase steadily, from 22.2 percent in 2012 to a dominant share of 54.8 percent in 2035. This is the area with the largest energy saving and GHG mitigation potential in Viet Nam.
- EEC scenarios on the demand side are most effective compared with other proposed scenarios on energy saving as well as GHG emissions reduction.

Based on the above findings, we recommend the following actions to effectively implement EEC activities in Viet Nam:

- **Establishment of new targets and a roadmap for EEC implementation**: Targets for EEC in Viet Nam were set for a short-term period (2006–2015) and focused on the industry sector and buildings. New long-term targets should be set based on an assessment of the energy saving potential for all energy sectors, including transport and residential and commercial (other) sectors, which have a large potential for energy saving up to 2035.
- **Compulsory energy labelling for electrical appliances:** Annual growth of electricity demand is projected at second highest rate of 7.0 percent in BAU, especially demand on electricity use in residential and commercial (other) sectors. Therefore, compulsory energy labelling for electrical appliances is an effective management measure for energy saving.
- **Priority for development of advanced coal thermal power technology:** Coal thermal power plants will account for most of the power generation in Viet Nam up to 2035. Therefore, advanced coal thermal power or energy effective

technologies should be prioritised for coal thermal power plant development at the stage of project design.

- **Priority for renewable energy development:** Coal power generation is projected to have a dominant share in 2035, which will result in the country being reliant on coal imports for power generation. Renewable energy technology-based power generation is an important factor for energy independent, energy security and GHG abatement. Therefore, this is necessary to build up the strategy and mechanisms to support renewable energy development.

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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.