Chapter 13

Philippines Country Report

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1. Background

The energy sector of the Philippines is mandated to ensure sustainable, stable, sufficient, accessible, and reasonably priced energy by formulating and implementing policies and programmes that aim to improve quality of life. Currently, the country's total primary energy supply (TPES) is supported by coal, which is largely used for power generation. In the draft Philippine energy plan for 2023–2050, a clean energy scenario is being considered, which includes decarbonisation targets such as higher renewable energy targets in power generation and inclusion of new and other emerging technologies. It also targets higher electric vehicle (EV) penetration and higher biofuel blends in oil for transport. These plans are in accordance with the country's energy transition strategies towards a low-carbon future and contribute to the achievement of the Sustainable Development Goal 7.

Energy sustainability is the primary factor to reduce the impact of emissions on the environment; as such, a transition towards a clean energy future is being pushed by the global community. The transition is expected to make a significant structural change in the energy sector of the Philippines, which currently dominated by fossil fuels such as coal and oil. Accordingly, a low-carbon energy transition–carbon neutral (LCET-CN) scenario is being studied. An LCET-CN scenario is based on investment in low-carbon technologies such as renewable energy; energy efficiency and conservation; and other new technologies, such as hydrogen and carbon capture, utilisation, and storage (CCUS).

This study develops an LCET-CN scenario, calculates associated energy costs, and records the emissions reduction benefits compared to a business-as-usual (BAU) scenario in the Philippines.

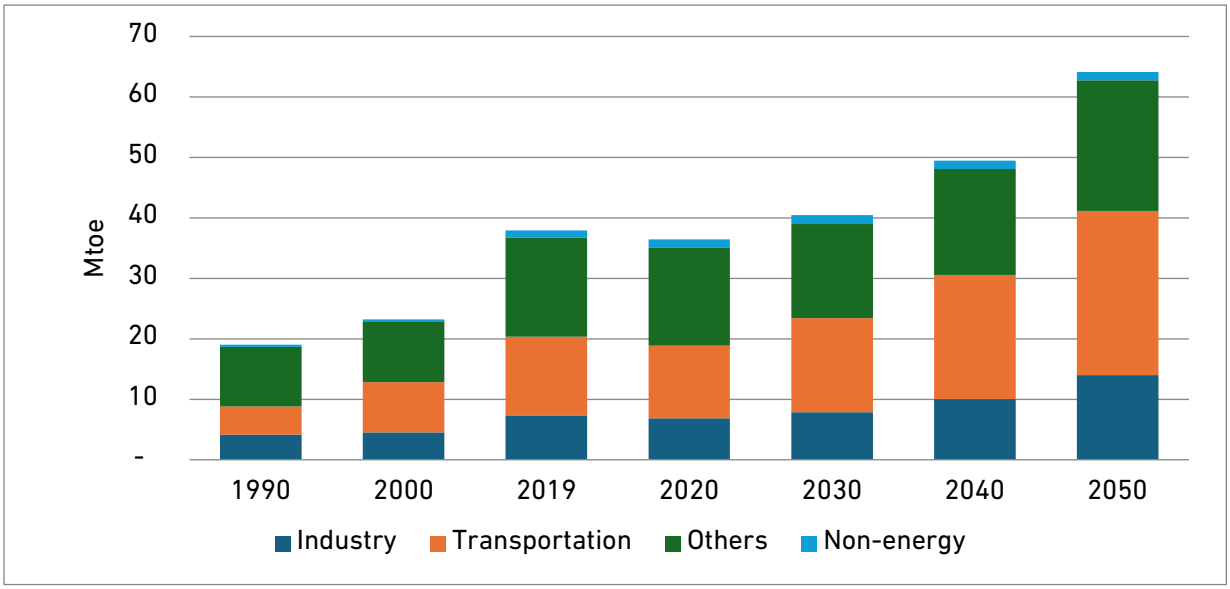
2. Final Energy Consumption (historical trend: 2019, 2030, 2040, 2050)

Under the LCET-CN scenario, the country's total final energy consumption (TFEC) is expected to increase 1.3% per year to 2050 from the 2019 level, much lower than the BAU scenario, which increases 2.9% per year. The lower growth rate under the LCET-CN

scenario is due to higher energy efficiency and improved conservation measures in end-use sectors such as industrial, residential, and commercial. The potential savings of energy efficiency under the LCET-CN scenario is assumed at 10% to 2040. The TFEC projection is based on gross domestic product and population growth assumptions.

Figure 13.1. Final Energy Consumption by Sector under the LCET-CN Scenario, 1990–2050

(Mtoe)

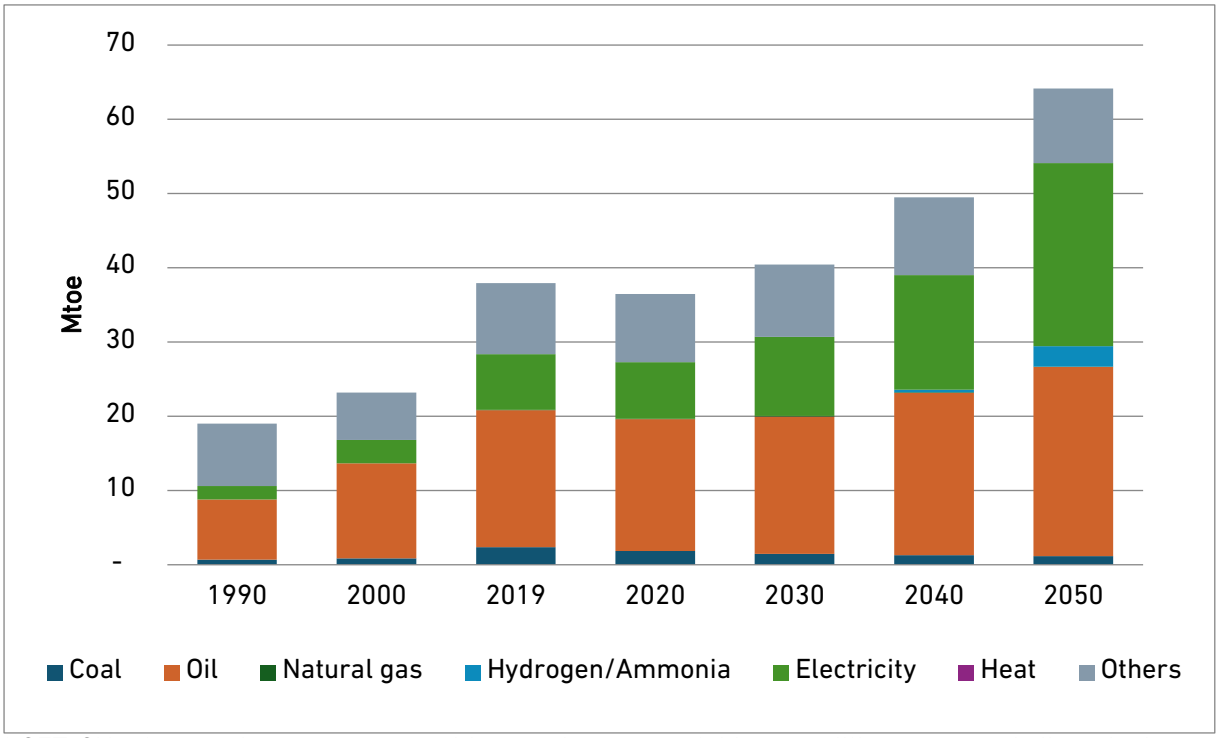


LCET-CN = low-carbon energy transition–carbon neutral, Mtoe = million tonnes of oil equivalent.
Source: Author's calculations.

Figure 13.1 shows the final energy consumption by sector under the LCET-CN scenario. In 2050, the TFEC is expected to reach 64.14 million tonnes of oil equivalent (Mtoe). The transport sector is expected dominate with a share of 42.3% by 2050. The 'others' sector (i.e. combined residential, commercial, and agriculture) would remain second, with a share of 33.7% in 2050, lower than its 43.4% share in 2019. Meanwhile, the industrial sector is expected to increase at an average rate of 2.1%, growing to around 21.0% in 2050 from 19.3% in 2019.

Figure 13.2. Final Energy Consumption by Fuel under the LCET-CN Scenario, 1990–2050

(Mtoe)



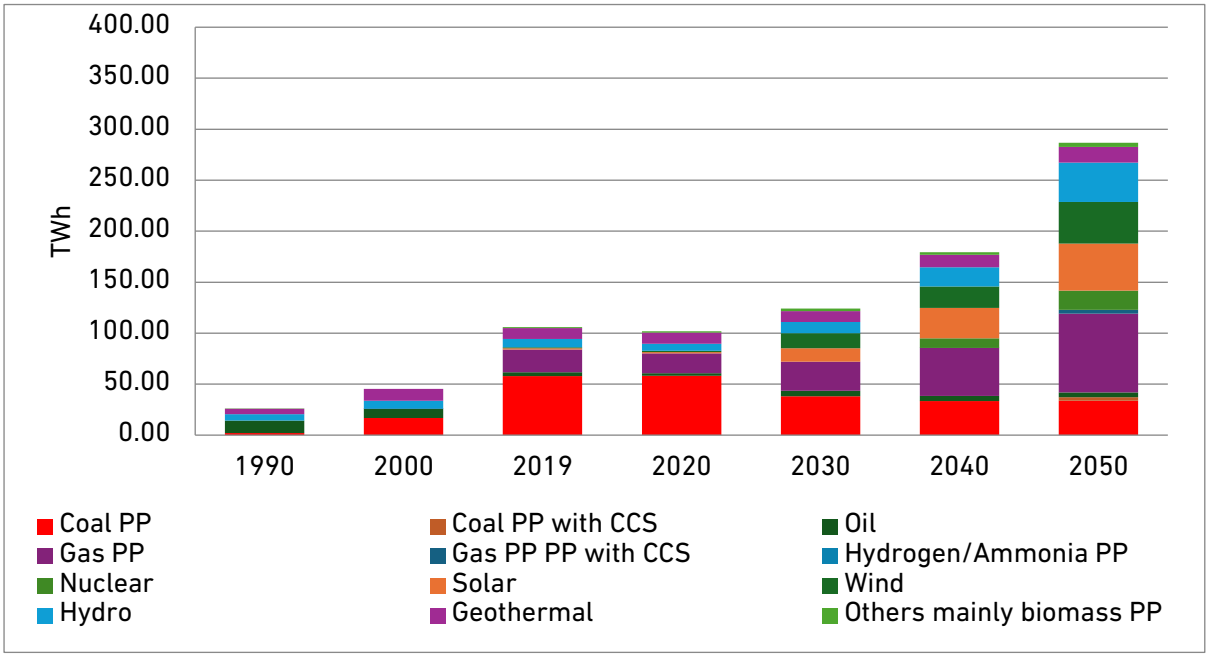
LCET-CN = low-carbon energy transition–carbon neutral, Mtoe = million tonnes of oil equivalent.
Source: Author's calculations.

The LCET-CN scenario highlights the importance of clean energy to help lower emissions. According to Figure 13.2, on a per fuel basis, the share of oil would fall from a 45.0% share under the BAU scenario to a 39.7% share under the LCET-CN scenario due to the introduction of energy efficiency and conservation measures, shift to EVs, higher biofuel blends, and introduction of hydrogen in the transport sector. By end of the study period, hydrogen would contribute around 4.3% in the TFEC. Meanwhile, the share of electricity will be 38.3% by 2050 compared to 19.8% in 2019.

3. Power Generation (historical trend: 2019, 2030, 2040, 2050)

In 2050, the total power generation of the Philippines is expected to register at 286.7 terawatt-hours (TWh) under the LCET-CN scenario, 36.5% lower than the BAU scenario of 451.7 TWh. The implementation of energy efficiency and conservation measures in the end-use sectors – specifically oil and electricity – would contribute to the decrease. Moreover, higher power plant efficiency was adopted in the model; more efficient power plants require smaller input compared with less-efficient power plants.

Figure 13.3. Electricity Generation by Fuel under the LCET-CN Scenario, 1990–2050
(TWh)



CCS = carbon capture and storage, LCET-CN = low-carbon energy transition–carbon neutral, PP = power plant, TWh = terawatt-hour.
Source: Author's calculations.

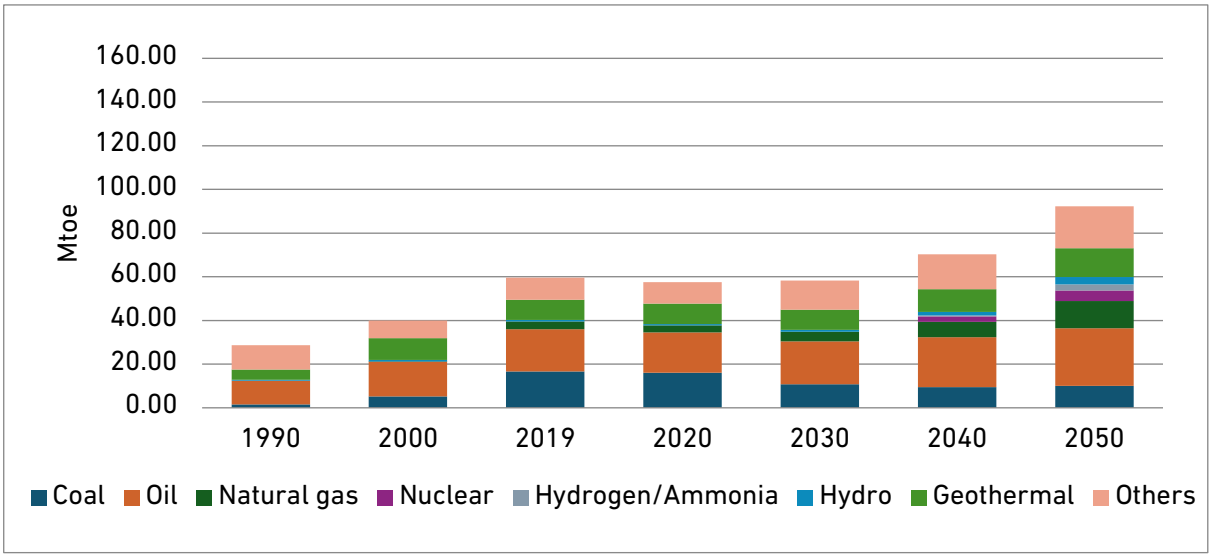
On a per fuel basis, the combined share of natural gas, including natural gas with carbon capture and storage (CCS), would dominate with a share of 28.2%, reaching 80.8 TWh in 2050 under the LCET-CN scenario. Coal (including coal with CCS) would reach a 13.0% share in 2050 under the LCET-CN scenario compared to a 30.4% share under the BAU scenario.

4. Primary Energy Supply (historical trend: 2019, 2030, 2040, 2050)

The total primary energy supply under the LCET-CN scenario is expected to increase 1.4% per year from 2019 to reach 92.3 million tonnes of oil equivalent (Mtoe) in 2050 under the LCET-CN scenario. The incremental rate is lower when compared to the BAU scenario's 2.8% rate, due to a higher energy savings target of 10% in 2050 (Figure 13.4).

Figure 13.4. Total Primary Energy Supply by Fuel Type under the LCET-CN Scenario, 1990–2050

(Mtoe)



LCET-CN = low-carbon energy transition–carbon neutral, Mtoe = million tonnes of oil equivalent.
Source: Author's calculations.

Natural gas fuel would record the highest increase amongst fossil fuels at 4.0% per year from 2019 until 2050 under the LCET-CN scenario. This increase is due to power generation becoming a substitute for coal, whose use would decrease at an annual rate of 1.6%. Meanwhile, the combined contribution of solar, wind, and ocean power would grow quickly at an annual rate of 12.4%. Biofuel would also contribute 10.0% per year during a similar time horizon. By increasing the share of renewable energy to 50.0% by 2040, the share of other renewables such as hydro, geothermal, and biomass would also increase at annual rates of 5.2%, 1.2%, and 0.4%, respectively. Hydrogen would also form part of the mix, contributing 2.7 Mtoe to the TPES by 2050.

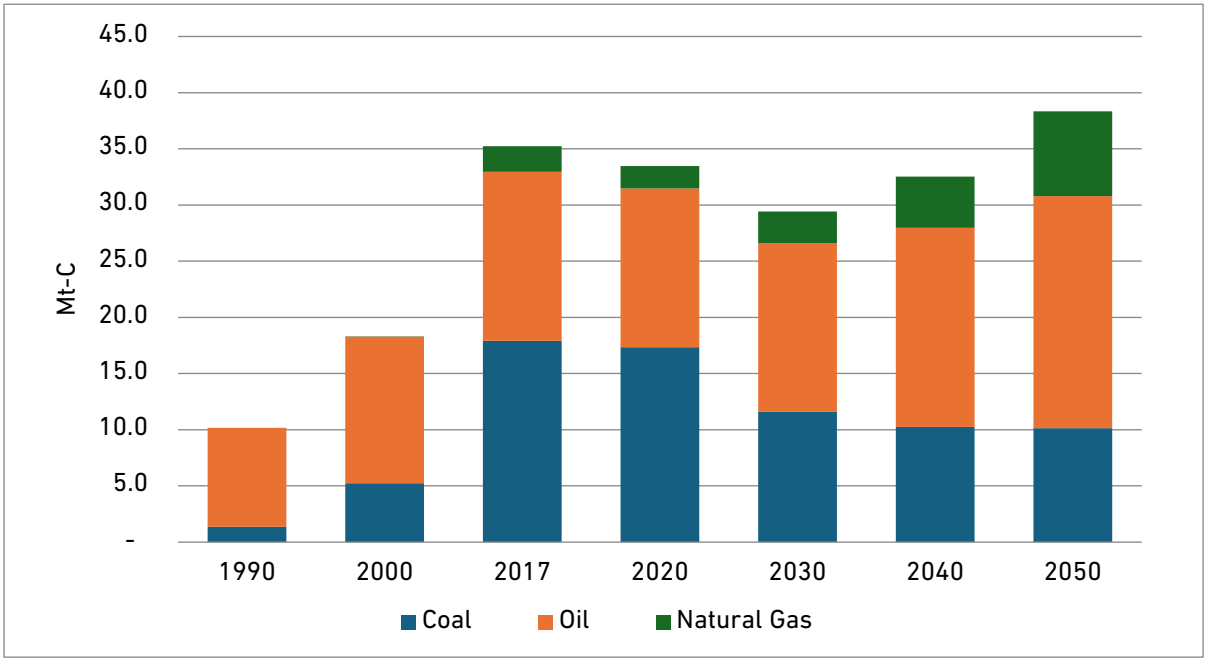
As a strategy to reduce emissions, the draft 2023-2050 Philippines energy plan targets 19 gigawatts (GW) and 50 GW onshore and offshore wind power, respectively, to form part of its energy mix.

5. Emissions

Total emissions under the LCET-CN scenario would reach 38.3 million tonnes of carbon (MtC), an increase of 0.3% per year from the 2019 level (Figure 13.5). Emissions from coal are expected to decrease at annual rate of 1.8% from 2019 until 2050 due to repurposing the use of coal for power generation. In December 2022, the Department of Energy (DOE) issued a moratorium on endorsing greenfield coal-fired power projects to improve energy sustainability, reliability, and flexibility by increasing the share of renewable energy in the energy mix; promoting new technologies; increasing system flexibility; and adhering to

higher environmental standards. Under the LCET-CN scenario, emissions from natural gas are expected to increase by 3.9% per year from 2019 until 2050 due to this coal moratorium. Similarly, total emissions from oil would increase at an annual rate of 1.0%, reaching 20.7 MtC in 2050.

Figure 13.5. Total Emissions by Fuel Type under the LCET-CN Scenario, 1990–2050



LCET-CN = low-carbon energy transition–carbon neutral, MtC = million tonnes of carbon.
Source: Author's calculations.

By the end of the forecasted period, the share of oil would still dominate total emissions with a 53.9% share of the total, followed by coal at 26.4%, and natural gas at 19.7%.

6. Cost Comparison Analysis

6.1. Assumptions

An analysis of energy costs was carried out to compare the BAU and LCET-CN scenarios (Table 13.1). The objective of this analysis to understand the total energy costs that are needed to implement all assumptions both scenarios.

Table 13.1. Assumed Fuel Costs

Fuel	2019/2020	2050 (2019 Constant Prices)	Unit
Coal	80.03	98.00	US$/tonne
Oil	41.00	100.00	US$/bbl
Gas	7.77	7.50	US$/mmbtu
Hydrogen	0.80	0.30	US$/$Nm^3$
CCS	0	30.00	US$/$tCO^2$

bbl = barrel, CCS = carbon capture and storage, mmbtu = million British thermal unit, Nm^3 = normal cubic metre, tCO_2 = tonne of carbon dioxide.
Source: Author's calculations.

The fuel cost assumptions above were adopted to be consistent with other Association of Southeast Asian Nations (ASEAN) Member States involved in this study.

The assumptions of construction cost per each power source are in Table 13.2.

Table 13.2. Assumed Construction Costs per Each Power Source
(US$/kilowatt)

Power Source	2019	By 2050
Coal	1,500	1,525
Oil		
Gas	700	700
Hydrogen		700
Nuclear	4,500	3,575
Hydro	2,000	2,223
Geothermal	4,000	4,256
Solar	1,600	307
Wind	1,600	1,235
Biomass	2,000	3,019

Source: Author.

6.2. Fuel Costs

Based on fuel cost assumptions in Table 13.1, the overall total fuel costs in 2050 are in Table 13.3.

Table 13.3. Total Fuel Costs
(US$ million)

Power Source	BAU	LCET-CN
Coal	2,876	1,027
Oil	15,751	4,808
Gas	6,237	2,527
Hydrogen	0	3,913
Total	**24,864**	**9,500**

BAU = business as usual, LCET-CN = low-carbon energy transition–carbon neutral.
Source: Author.

From the results above, the total fuel costs in 2050 for the BAU scenario are much higher than those for the LCET-CN scenario due to the high dependency on fossil fuels in 2050 under the BAU scenario. The LCET-CN scenario would incur hydrogen costs at about US$4 billion, but if the Philippines achieves carbon neutrality by 2050, this hydrogen cost would be even higher due to more hydrogen use in the energy sector, especially regarding transport.

6.3. Power Generation Investment

Based on assumptions in Table 13.2, the total investment cost for power plants in 2019–2050 under the BAU and LCET-CN scenarios are shown in Table 13.4.

Table 13.4. Power Plant Costs
(US$ million)

Plant	BAU	LCET-CN
Coal PP	17,278	–4,485
Oil PP	0	0
Gas PP	14,483	5,841
Hydrogen PP	0	0
Nuclear PP	0	9,626
Hydro PP	13,069	19,470
Geothermal PP	6,705	4,538
Solar PV	6,391	9,261
Wind PP	10,926	13,957
Biomass PP	15,410	1,472
Total	**84,262**	**59,682**

BAU = business as usual, LCET-CN = low-carbon energy transition–carbon neutral, PP = power plant, PV = photovoltaic.
Source: Author.

The total additional capacity needed for the BAU scenario is 74,243 megawatts (MW). The additional capacity needed under the LCET-CN scenario in 2050 is much lower at 59,881 MW, as increasing the energy efficiency target as well as using high thermal-efficiency power plants would reduce the need for additional capacity for power generation. The BAU scenario would increase the capacity of thermal power plants and renewable energy plants because of a significant increase in electricity demand. The LCET-CN scenario would increase nuclear and renewable energy power plants, which would reduce emissions as well. As a result, the total investment for power plants during 2019–2050 under the BAU scenario is forecasted to be US$84,262 million, while it would be US$59,682 million under the LCET-CN.

6.4. Carbon Capture and Storage Costs

Under the LCET-CN scenario, the study assumes CCS for coal and natural gas power plants starting in 2040. In 2050, coal power plants with CCS will generate 3.69 TWh and gas power plants 3.69 TWh. Thus, coal consumption by coal power plants with CCS in 2050 would be 10 Mtoe, and gas consumption by gas power plants with CCS would be 8.4 Mtoe. Emissions reduced by CCS would total 39 million tonnes of carbon dioxide ($MtCO_2$) by coal power plants and 18 $MtCO_2$ by gas power plants. Consequently, CCS costs for coal power plants and gas power plants in 2050 are forecasted to be US$1,537 million. If the Philippines achieves carbon neutrality by 2050, it could increase the number of coal power plants with CCS and gas power plants with CCS, and the CCS costs in 2050 would increase rapidly.

6.5. Overall Cost

A breakdown of the total investment costs is shown in Table 13.5.

Table 13.5. Overall Investment Costs
(US$ million)

Cost	BAU	LCET-CN
Fuel Cost, 2050	24,864	9,500
Power Investment, 2019–2050	84,262	59,682
CCS Cost, 2050	0	1,537
Total	**109,126**	**70,719**

BAU = business as usual, CCS = carbon capture and storage, LCET-CN = low-carbon energy transition–carbon neutral.
Source: Author.

The overall investment costs for the BAU scenario are projected to be US$109,126 million, and for the LCET-CN scenario, US$70,719 million. If the Philippines achieves carbon

neutrality by 2050, power investment and costs of hydrogen and CCS would increase. In addition, the Philippines will need to own the energy efficiency and conservation costs for achievement of energy savings, especially electricity demand, which are estimated at US$10,000 million. However, it can be claimed that the LCET-CN scenario will contribute to reducing fossil fuel consumption, lessening fossil fuel costs significantly.

7. Conclusions and Recommendations

This study shows that significant energy savings potential of around 33.8% from 2019 levels can be achieved by 2050 with implementation of energy efficiency and conservation standards and measures, higher fuel economy of vehicles, and use of clean and energy-efficient fuel for power generation. Under the LCET-CN scenario, the share of oil in the final energy demand would fall from 45.0% under the BAU scenario to 39.7%. Moreover, the Electric Vehicle Industry Development Act (EVIDA) would complement the reduction of the share of oil in the transport sector. Note that to increase the penetration rate of EVs in the market, necessary infrastructure must be in place; the government should help encourage investment in this regard. It should also focus on intensifying the targets and promotion of alternative fuels in the transport sector to substitute the use of oil.

The TPES is expected to double from the 2019 level of 59.6 Mtoe to 139.5 Mtoe by 2050 under the BAU scenario, which will require more investment until 2050. Under the LCET-CN scenario, the TPES would decrease to around 92.3 Mtoe, and the share of coal in the TPES would fall to 10.9% from 25.0% under the BAU scenario as a result of fuel switching in end-use sectors; entry of more renewables, natural gas, and nuclear for power generation; and improved efficiency of fossil fuel-based power plants. The reduction of coal in the TPES would contribute to decreased emissions levels of 73.3%.

The LCET-CN scenario would also entail lower energy costs. If the Philippines achieves carbon neutrality by 2050, it would save US$43,042 million in energy sector costs compared to the BAU scenario.

To achieve the goal of transitioning to a clean energy future, the government must encourage investment, establish needed frameworks, develop an expert workforce, and raise public awareness. Regional cooperation and understanding between economies should be strengthened through dialogues, seminars, and workshops.

The Philippines has already established strategies for a low-carbon future in the *Philippine Energy Plan (PEP) 2020–2040* and draft 2023–2050 plan. Meanwhile, a net-zero emissions target for the Philippines has yet to be established compared with other ASEAN Member States like Malaysia (2050) and Indonesia (2060 or sooner). The Philippines should evaluate the advantages and disadvantages of technologies to help the country adopt and not sacrifice supply, security, affordability, and sustainability of energy. After identifying the most suitable technologies, a roadmap should be developed for each strategy.

References

Congress of the Philippines (2007), Republic Act No. 9367, Biofuels Act of 2006, Manila.

––––– (2008), Republic Act No. 9513, Renewable Energy Act of 2008, Manila.

––––– (2019), Republic Act No. 11285, Energy Efficiency and Conservation Act, Manila.

––––– (2022), Republic Act No. 11697, Electric Vehicles Industry Development Act, Manila.

Government of the Philippines, Department of Energy, Philippine Energy Supply and Demand Outlook, https://doe.gov.ph/energy-supply-and-demand-outlook

––––– (2020), *2019–2020 Energy Sector Accomplishment Report 2020,* Manila.

––––– (2021), *Philippine Energy Plan (PEP) 2020–2040*, Manila.

Government of the Philippines, Department of Energy, Energy Policy and Planning Bureau (2019), *Philippine Energy Situationer 2019,* Manila.

International Monetary Fund (IMF), World Economic Outlook Databases, https://www.imf.org/en/Publications/SPROLLs/world-economic-outlook-databases#sort=%40imfdate%20descending [accessed 3 February 2023]

Philippine Statistics Authority, (2019), *Philippine Statistical Yearbook 2019*, Manila.

World Bank, International Comparison Program, https://www.worldbank.org/en/programs/icp

–––––, World Development Indicators, https://databank.worldbank.org/source/world-development-indicators [accessed 3 February 2023]

World Energy Council, https://www.worldenergy.org/