Chapter 15
Thailand Country Report

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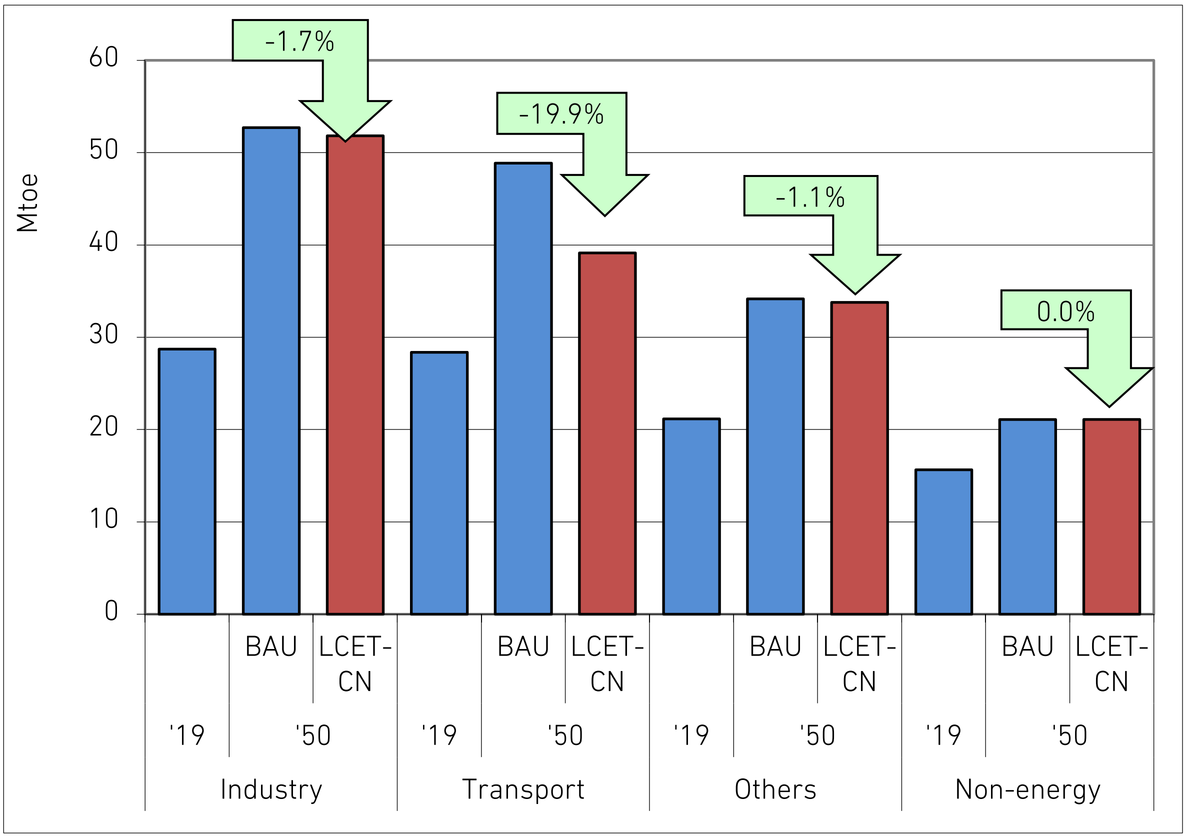
1. Basic Concept of Low-carbon Energy Transition–Carbon Neutrality

Thailand targets to achieve carbon neutrality in 2050. For the energy sector, the Office of Natural Resources and Environmental Policy and Planning set the carbon dioxide (CO_2) offset to be within 100 million tonnes of CO_2 (Mt-CO_2) in 2050. The low-carbon energy transition–carbon neutral (LCET–CN) scenario focuses on how to achieve this target in 2050. The low-carbon technology of carbon capture and storage (CCS) and low-carbon energy (blue and green hydrogen) will be assumed to replace the conventional fossil fuels in use today. In the case of Thailand, the LCET–CN scenario assumes hydrogen will be used in the industry sector but not in the transport and 'others' sectors.

2. Final Energy Consumption

In the LCET–CN scenario, final energy consumption is projected to grow by 1.4% per year, from 93.9 million tonnes of oil equivalent (Mtoe) in 2019 to 145.8 Mtoe in 2050. This is around 7.0% lower than in the business as usual (BAU) scenario. The increasing stock of electric vehicles will lower the use of oil. Consumption is different from BAU in the transport and 'others' sectors, but much greater in transport at –19.9%, in industry –1.7%, and in the 'others' only –1.1%, as shown in Figure 15.1.

Figure 15.1. Final Energy Consumption by Sector, BAU and LCET–CN Scenarios

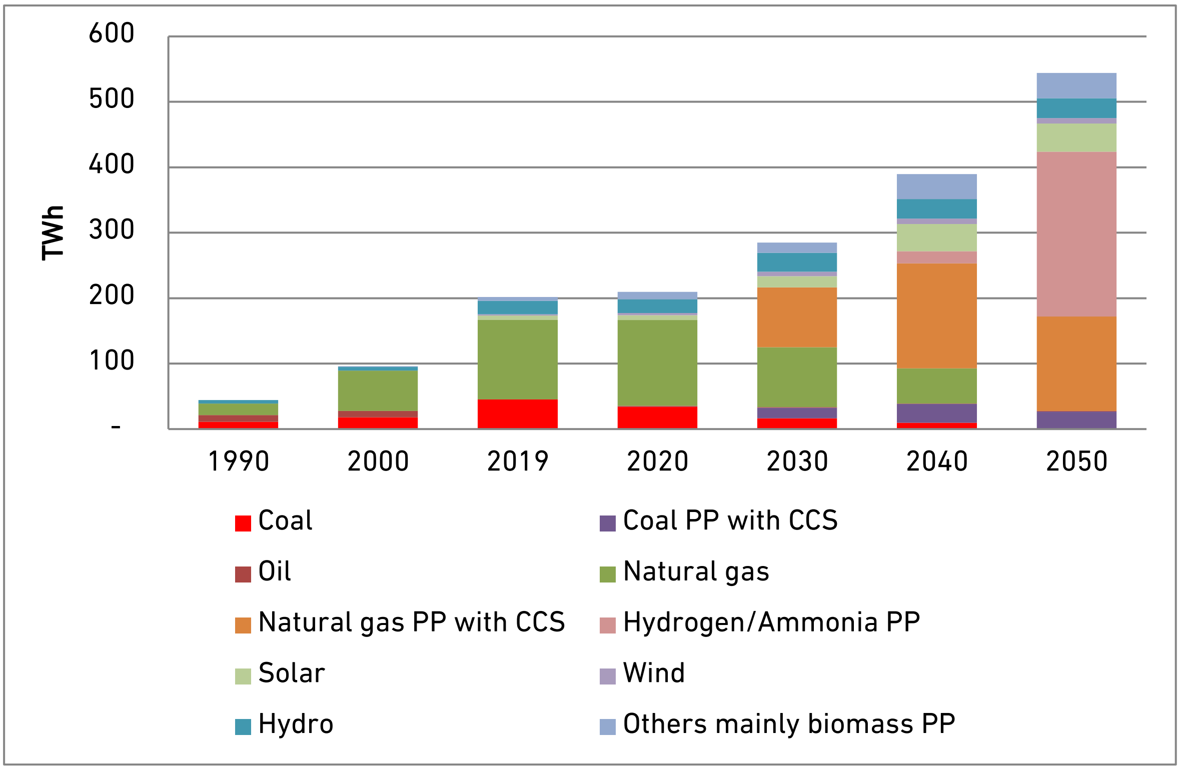


BAU = business as usual, LCET–CN = low-carbon energy transition scenario–carbon neutral, Mtoe = million tonnes of oil equivalent.
Source: Authors' calculations.

3. Power Generation

In the LCET–CN scenario, power generation is expected to grow at around 3.3% per year from 2019 to 2050 and will reach 544.2 terawatt-hours (TWh) in 2050. In 2050, hydrogen will be the dominant fuel used in power generation with the highest share of 46.4% or 252.3 TWh. The second largest source of power generation will be natural gas with CCS, a share of 26.5% (144.2 TWh) in 2050. The rest will be solar photovoltaic (PV), biomass, hydro, coal with CCS, wind, and oil, with shares of 7.8%, 7.1%, 5.5%, 4.9%, 1.6%, and 0.2%, respectively (Figure 15.2).

Figure 15.2. Power Generation by Fuel Type, LCET–CN Scenario



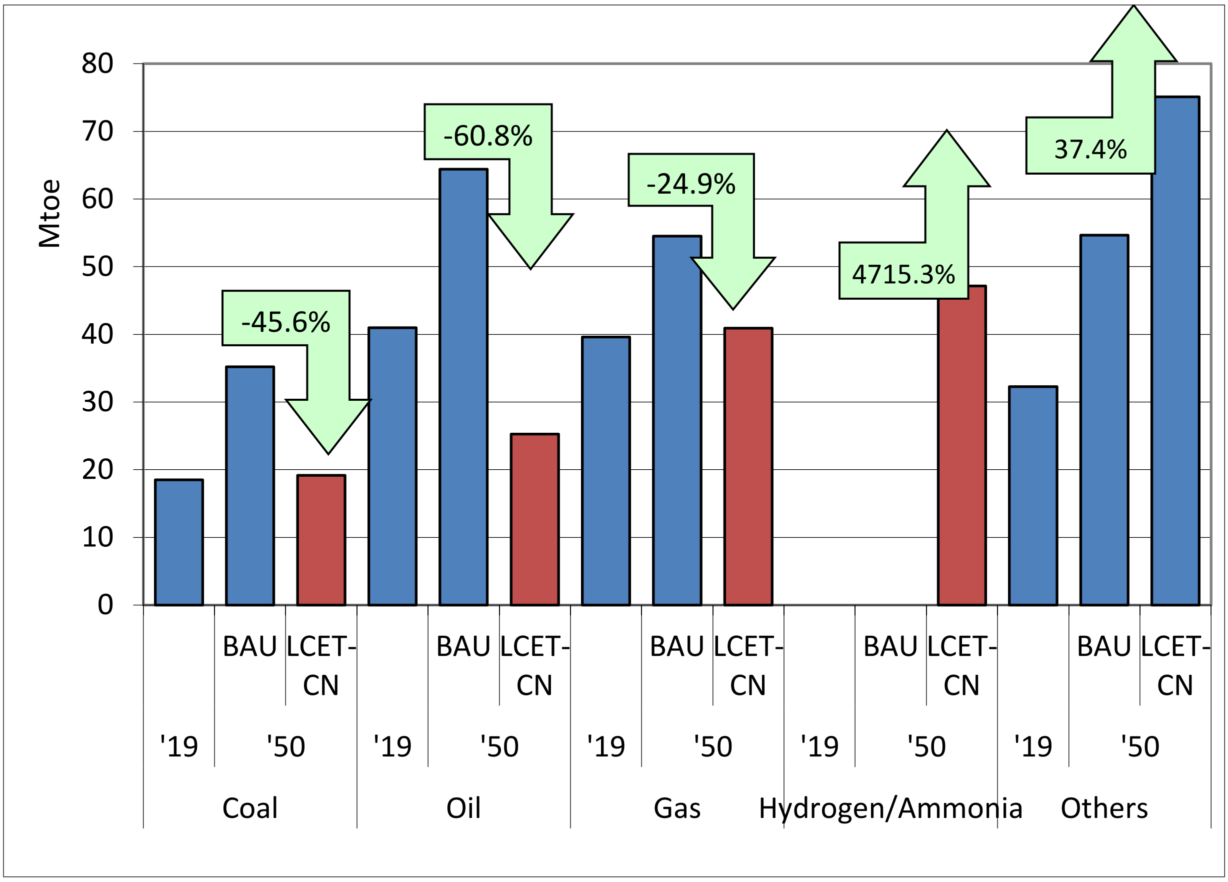
CCS = carbon capture and storage, LCET–CN = low-carbon energy transition scenario–carbon neutral, PP = power plant, TWh = terawatt-hour.
Source: Authors' calculations.

4. Primary Energy

The growth rate of the primary energy supply in the LCET–CN scenario is projected to be the same as that in the BAU scenario, increasing at 1.5% annually and reaching 210.2 Mtoe in 2050. However, the primary energy supply in the LCET–CN scenario has a different fuel mix from the BAU scenario.

To achieve carbon neutrality in 2050, fossil fuels (coal, oil, and natural gas) must be replaced by alternative fuels, new energy sources such as hydrogen and ammonia, and renewable energy. In the LCET–CN scenario, the consumption of coal, oil, and natural gas is projected to be lower compared to the BAU scenario by 45.6%, 60.8%, and 24.9%, respectively. However, they are expected to increase in the 'others' category by 37.4% and hydrogen/ammonia (from 0 Mtoe in 2019 to 47.2 Mtoe). The differences in the projections between the two scenarios are shown in Figure 15.3.

Figure 15.3. Primary Energy Supply by Source, BAU and LCET–CN Scenarios

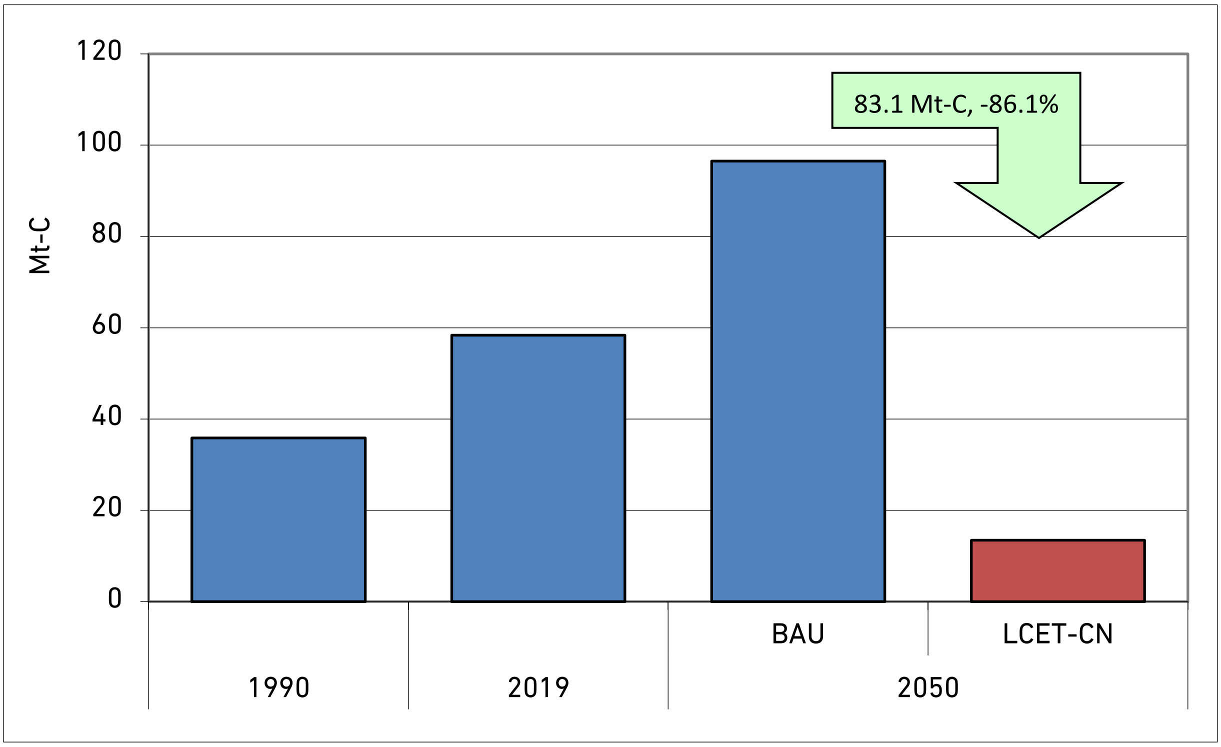


BAU = business as usual, LCET = low-carbon energy transition–carbon neutral, Mtoe = million tonnes of oil equivalent. Source: Authors' calculations.

5. Carbon Dioxide Emissions Reduction

Under the LCET–CN scenario, the average annual growth in CO_2 emissions from 2019 to 2050 is projected to be –4.6%, with an emissions level of 13.5 million tonnes of carbon (Mt-C) in 2050. The difference in CO_2 emissions between the BAU and the LCET–CN scenarios is 83.1 Mt-C, or 86.1%. This can achieve carbon neutrality, which is less than the offset capability in Thailand in 2050 of 27 Mt-C. The reduction in CO_2 emissions highlights the range of benefits that can be achieved through energy efficiency improvements and savings via action plans, environmentally-friendly fuels, and CCS in industry and in power generation for coal and natural gas (Figure 15.4).

Figure 15.4. Carbon Dioxide Emissions from Energy Consumption, BAU and LCET–CN Scenarios

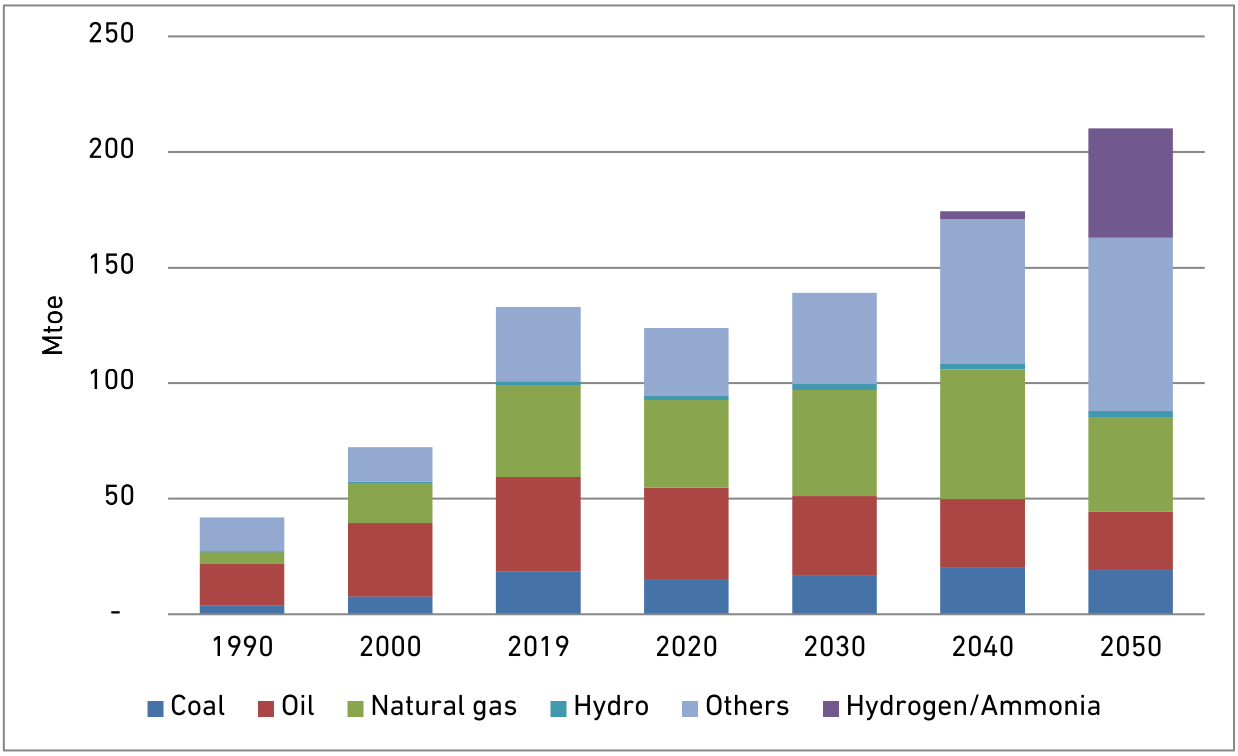


BAU = business as usual, LCET–CN = low-carbon energy transition–carbon neutral, Mt-C = million tonnes of carbon.
Source: Authors' calculations.

6. Hydrogen Demand across Sectors

In the 2050 LCET–CN scenario, the total hydrogen supply of 47.15 Mtoe is expected to come from imports. Natural gas from indigenous sources may no longer exist in 2050, thus, domestic blue hydrogen will not be produced. Hydrogen will be consumed in the power generation sector (45,265.3 ktoe) and the industry sector (1,887.9 ktoe). Hydrogen's share in the primary energy supply will be 22.4% (Figure 15.5).

Figure 15.5. Hydrogen Demand



Mtoe = million tonnes of oil equivalent.
Source: Authors' calculations.

7. Energy Cost Comparison between BAU and LCET–CN Scenarios

The energy cost is the estimation that covers the cost of fuel, power generation investment, and CCS. A comparison will be made to see the difference of primary energy and power generation of 2019 to 2050, and it will compare the BAU and LCET–CN scenarios. This cost comparison will be a helpful tool for making a final decision. Tables 15.1, 15.2, and 15.3 show the assumptions for fuel cost, construction cost and capacity factor of power plants.

Table 15.1. Fuel Cost Assumptions

	2019/2020	2050 (2019 constant price)	Unit
Coal	80.03	98.00	US$/ton
Oil	41	100	US$/bbl
Gas	7.77	7.50	US$/MMBtu
Hydrogen	0.8	0.3	US$/$Nm^3$
CCS	0	30	US$/$CO_2$ ton

bbl = barrel, CCS = carbon-capture and storage, CO_2 = carbon dioxide, MMBtu = metric million British thermal units, Nm^3 = normal cubic metre.
Source: Authors' calculations.

Table 15.2. Construction Cost of Power Plants Assumptions

(US$/KW)

	2019	by 2050
Coal	1,500	1,525
Oil	0	0
Gas	700	700
Hydrogen	0	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

KW = kilowatt.
Source: Authors' calculations.

Table 15.3. Capacity Factor of Power Plants Assumptions

(%)

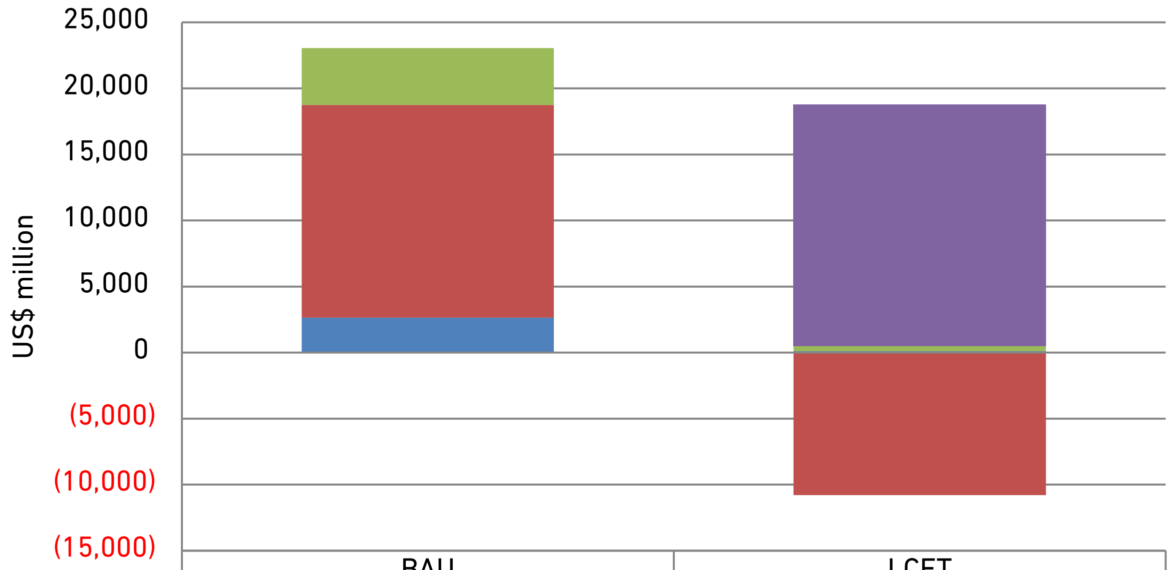
	2019	by 2050
Coal	75	80
Oil	75	80
Gas	75	80
Hydrogen	0	80
Nuclear	100	80
Hydro	50	40
Geothermal	50	50
Solar	17	17
Wind	40	40
Biomass	50	70

Source: Authors' calculations.

7.1. Fuel Cost

Thailand's fossil fuel cost (coal, oil, and natural gas) and hydrogen cost from primary energy in 2019 and 2050 in the BAU scenario is around US$23,052 million, and in the LECT–CN scenario it is around US$8,000 million. In comparison between 2019 to 2050, the increases in the cost in the BAU scenario is much greater than the LCET–CN scenario (Figure 15.6). The LCET–CN scenario can save in the use of fossil fuels, especially oil, although the cost of hydrogen will be high. In terms of fuel cost, Thailand might be in a better situation.

Figure 15.6. Change of Fuel Cost 2019 to 2050, Comparison between BAU and LCET–CN Scenarios



	BAU	LCET
Hydrogen	0	18,314
Gas	4,302	382
Oil	16,109	(10,803)
Coal	2,641	106

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

7.2. Power Generation Investment

According to the BAU and LCET–CN scenarios from 2019 until 2050, the difference of the installed capacity of power generation, Thailand might increase capacity to 81,265 MW in the BAU scenario and 122,251 MW in the LCET–CN scenario. The investment in new additional power generation of both cases expects to be US$113,821 million in the BAU scenario and US$131,545 million in the LCET–CN scenario. In the case of the LCET–CN scenario, the cost soars by new investment in hydrogen power plants (Table 15.4).

Table 15.4. Total Investment Power Plants Cost Comparison, BAU and LCET–CN Scenarios in 2050

	Electricity Generation in BAU for 2019 (TWh)	Electricity Generation in BAU for 2050 (TWh)	Electricity Generation in LCET–CN for 2050 (TWh)	Additional Capacity for BAU (MW)	Additional Capacity for LCET–CN (MW)	Total Investment Cost, BAU in 2050 (US$ million)	Total Investment Cost, LCET–CN in 2050 (US$ million)
Coal	133	216	71	11,843	–8,834	18,060	–13,471
Oil	1	2	3	89	0	0	0
Gas	253	381	269	18,070	2,205	12,649	1,544
Hydrogen	0	0	526	0	75,119	0	52,583
Hydro	200	30	30	2,709	2,746	6,021	6,104
Solar	6	43	43	24,319	24,319	7,466	7,466
Wind	2	9	9	1,835	1,835	2,267	2,267
Biomass+ Municipal Solid Waste	32	169	184	22,311	24,860	67,358	75,052
Total	**448**	**847**	**1,135**	**81,265**	**122,251**	**113,821**	**131,545**

BAU = business as usual, LCET–CN = low-carbon energy transition–carbon neutral, MW = megawatt, TWh = terawatt-hour.
Source: Authors' calculations.

CCS Cost

In the case of the LCET–CN scenario, Thailand can be expected to use CCS in coal-fired plants at 26.5 TWh and natural gas-fired plants at 144.2 TWh. It is assumed to capture and store CO_2 at approximately 19.7 Mt-C. If the cost of CCS is US$70/$CO_2$ tonne, the total cost for CCS of 19.7 Mt-C or 72.3 Mt-CO_2 in 2050 will be approximately US$4,553 million (Table 15.5).

Table 15.5. Total Investment Cost of CCS for LCET–CN Scenario in 2050

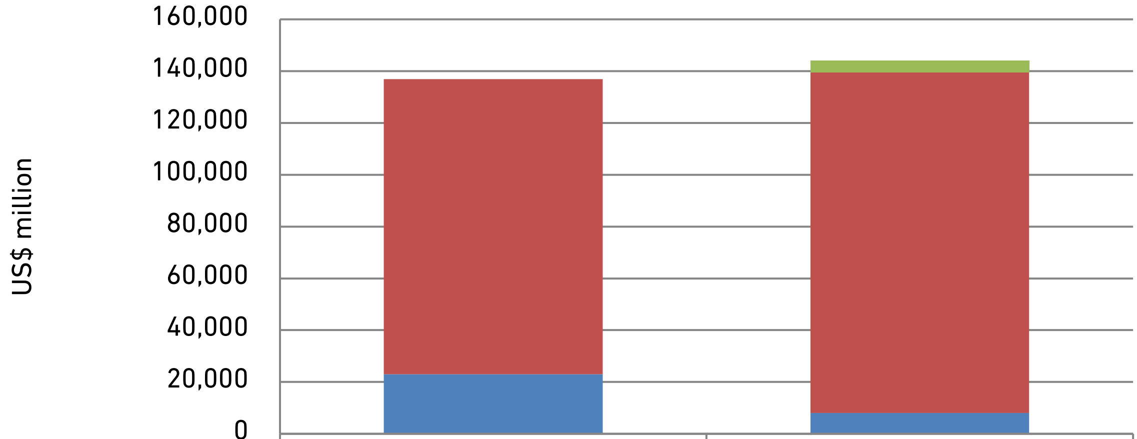
	Consumption for LCET–CN in 2050 (Mtoe)	CO_2 Emissions for LCET–CN (Mt-CO_2)	CO_2 Emissions for LCET–CN (Mt-C)	Total Investment Cost of CCS for LCET–CN (US$ million)
Coal Power Plant with CCS	6.1	22.8	6.2	1,438
Natural Gas Plant with CCS	23.2	49.4	13.5	3,115
Total	**29.3**	**72.3**	**19.7**	**4,553**

CCS = carbon capture and storage, LCET–CN = low-carbon energy transition–carbon neutral, Mt-C = million tonnes of carbon, Mt-CO_2 = million tonnes of carbon dioxide, Mtoe = million tonnes of oil equivalent.
Source: Authors' calculations.

Overall Cost

When fuel cost, power generation investment, and CCS cost are combined together, in 2050 the approximate overall cost will be US$136,873 million in the BAU scenario and US$144,097 million in the LCET–CN scenario. The different amount between these two cases is around US$7,224 million, but higher in the LCET–CN scenario (Figure 15.7).

Figure 15.7. Overall Cost Comparison between BAU and LCET–CN Scenarios



	BAU	LCET-CN
CCS	0	4,553
Power capital cost	113,821	131,545
Fuel Cost	23,052	8,000

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

8. Conclusions and Recommendation

Hydrogen/ammonia and CCS might help Thailand to transition to low-carbon energy. The use of hydrogen and CCS will cut CO_2 emissions from 96.5 Mt-C in the BAU scenario to 13.5 Mt-C in the LCET-CN scenario, which is lower than the carbon neutrality target of 27 Mt-C or 100 Mt-CO_2 (carbon offset) in the energy sector in 2050. However, when cost is considered, power generation investment cost and CCS cost drive the cost of low carbon higher than in the BAU scenario at around US$7,224 million. The extra cost for environmentally-friendly energy would be around 0.7% of GDP (US$1,092.5 billion) in 2050. Policymakers will need to make hard decisions to choose whether to pay more money for the environment. Moreover, carbon neutrality will impact the way of using energy. It will change the use of conventional energy, coal, natural gas, and oil to new energy types, and hydrogen in particular.