Chapter 9

Lao People's Democratic Republic Country Report

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1. Background

At the United Nations Framework Convention on Climate Change Conference in November 2021, discussions were held on significantly increasing countries' nationally determined contribution (NDC) targets and establishing a carbon credit trading system to accelerate climate-change mitigation measures. All parties to the Paris Agreement are expected to help limit the increase in the global average temperature to well below 2.0° Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5° Celsius. Even developing countries like the Lao People's Democratic Republic (Lao PDR) are expected to declare carbon neutrality targets for 2050.

In the *9th Five-Year National Socio-Economic Development Plan (2021–2025)*, the Government of the Lao PDR has made the use of renewable energy and promotion of electric vehicles (EVs) priorities in its efforts to promote green growth and to address climate-change mitigation. In addition, its NDC, which was updated last year, calls for net-zero emissions by 2050. Yet emissions from coal-fired power plants for export and from the transport sector, which consumes crude oil, are challenges.

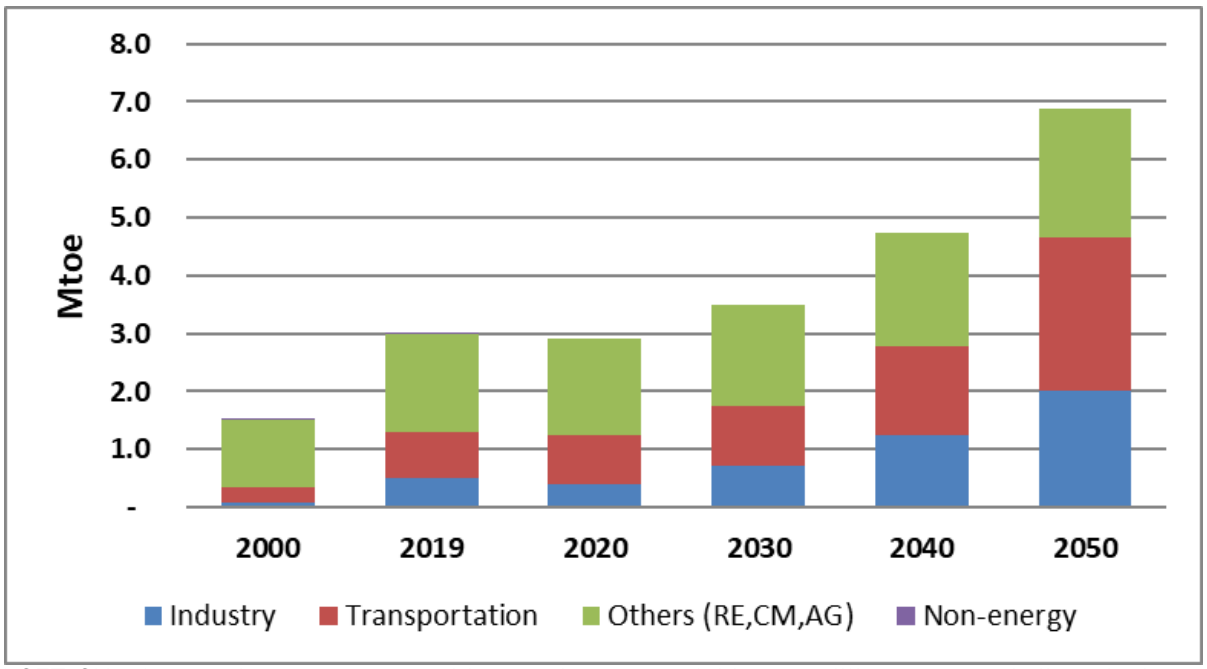
The Lao PDR is rich in clean and renewable hydropower resources, with 80% or 8,924 megawatts (MW) of its 10,971 MW installed capacity in 2021 coming from hydropower. Therefore, since its emissions are lower than those of other countries in Asia, it has the potential to contribute to their decarbonisation targets through the utilisation of existing hydropower and other renewable energy resources of the Lao PDR, taking into account environmental and social impacts.

The power system of the Lao PDR also has a large capacity compared to what is needed domestically; thus, a surplus of electricity during the rainy season has become apparent. This surplus could be used by increasing domestic demand during the rainy season, increasing exports from the domestic power system, and reducing the supply during the rainy season and increasing the supply during the dry season. In addition to exploring potential domestic electricity demand, it is necessary to set up a policy framework with clear goals. Moreover, note that future electricity demand trends will be influenced by the creation of untapped industries in addition to existing industries.

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

Under a low-carbon energy transition–carbon neutral (LCET-CN) scenario for the Lao PDR, total final energy consumption (TFEC) is expected to increase 2.7% per year during 2019–2050. This rate is much lower than that under the business-as-usual (BAU) scenario at 3.5% per year. The lower growth rate per year under the LCET-CN scenario would be due to EV use in the transport, 'others', and industrial sectors. The potential energy savings from EVs under the LCET-CN scenario is assumed to be 3.8% from 2040 until 2050. The projection of the TFEC for the BAU scenario until 2050 is based on gross domestic product and population growth assumptions.

Figure 9.1. Final Energy Consumption by Sector, LCET-CN Scenario, 2000–2050
(Mtoe)

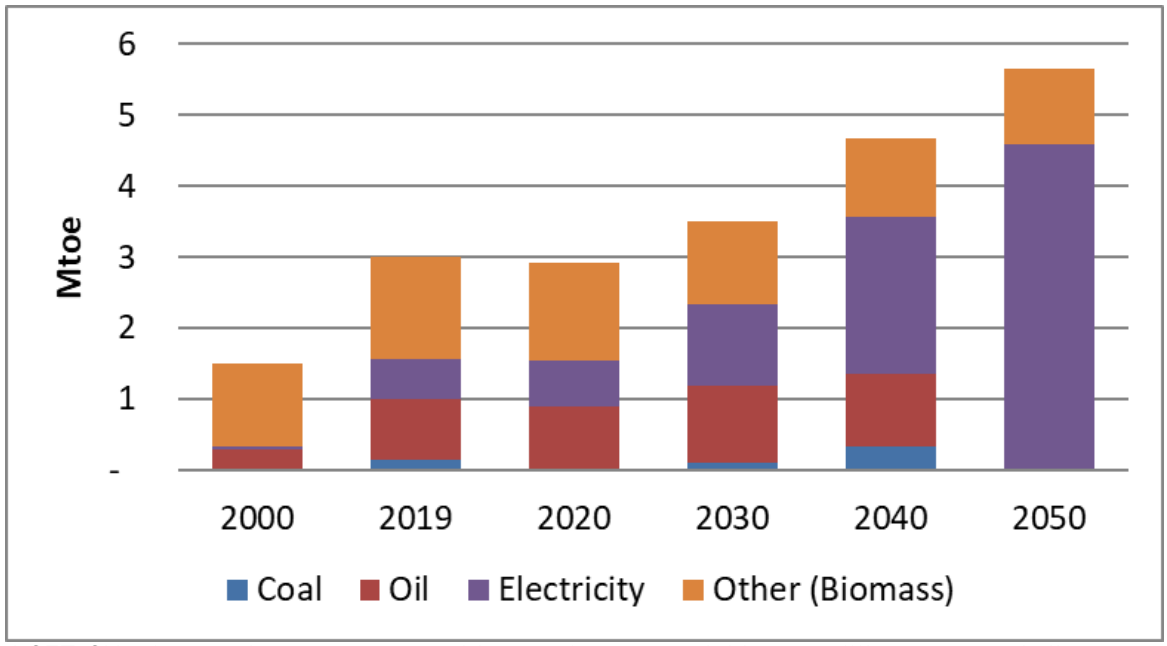


LCET-CN = low-carbon energy transition–carbon neutral, Mtoe = million tonnes of oil equivalent.
Source: ERIA calculations.

Figure 9.1 shows the final energy consumption by sector under the LCET-CN scenario. In 2050, the TFEC is expected to be 6.86 million tonnes of oil equivalent (Mtoe). The transport sector is expected to remain the dominant sector in 2050, with 38.3% of the total share. The industrial sector would increase at the highest rate per year at 4.6%. 'Others', which is the second-largest final energy consumer, would settle at 2.22 Mtoe or 32.3% of the total share. The increment per year for this sector would only be 4.6% from 2019 until 2050. The transport sector would increase at 3.9% per year from 2019 until 2050, and the non-energy sector would increase 0.9% per year. Although in 2050, the transport sector would have a higher average growth rate than those of the other sectors, during 2019–2050, it would have a higher average rate because the industrial sector would grow

rapidly from 2020 to 2040 and then decrease to 2050. The transport sector would grow slowly during 2020–2040 and speed up until 2050.

Figure 9.2. Final Energy Consumption by Fuel, LCET-CN Scenario, 2000–2050
(Mtoe)



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

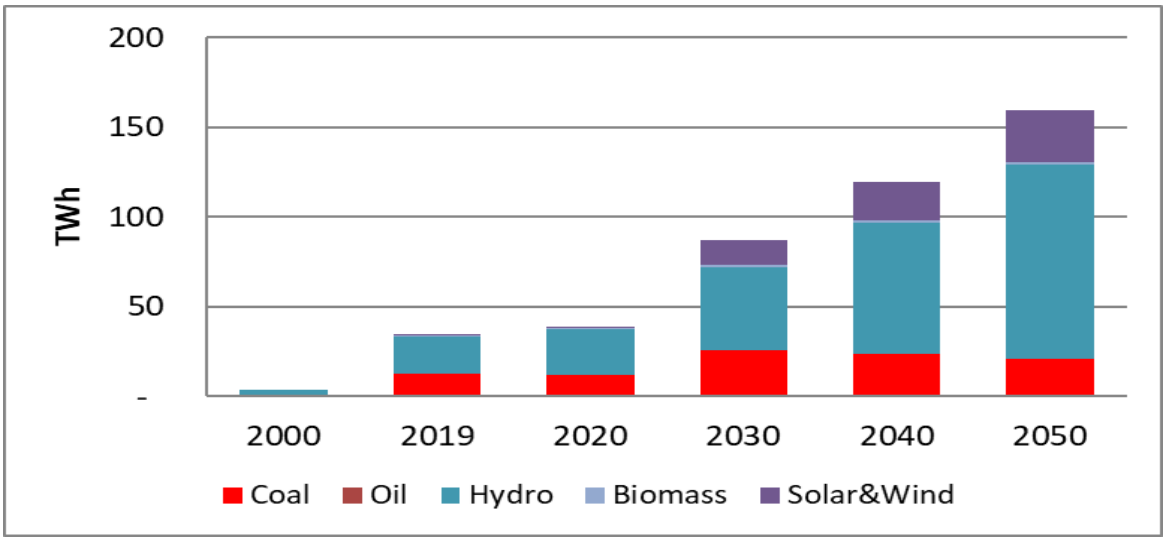
As shown in Figure 9.2, the introduction of EVs would result in a change to the mix of final energy consumption in 2050. The rate of oil consumption would decrease to 10.2% in 2023 and to 0.2% in 2050. This would also be due to the government's policy to increase the consumption of electricity and to reduce the importation of oil.

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

In 2050, the total power generation is expected to register at 160 terawatt-hours (TWh) under the LCET-CN scenario (Figure 9.4). This figure is higher than those in the BAU scenario and APS 1, at 127.70 TWh and 120.77 TWh, respectively. The LCET-CN scenario would reduce power generation capacity from coal and increase power generation capacity from hydro, solar, and wind.

Figure 9.3. Electricity Generation by Fuel, LCET-CN Scenario, 2000–2050

(TWh)



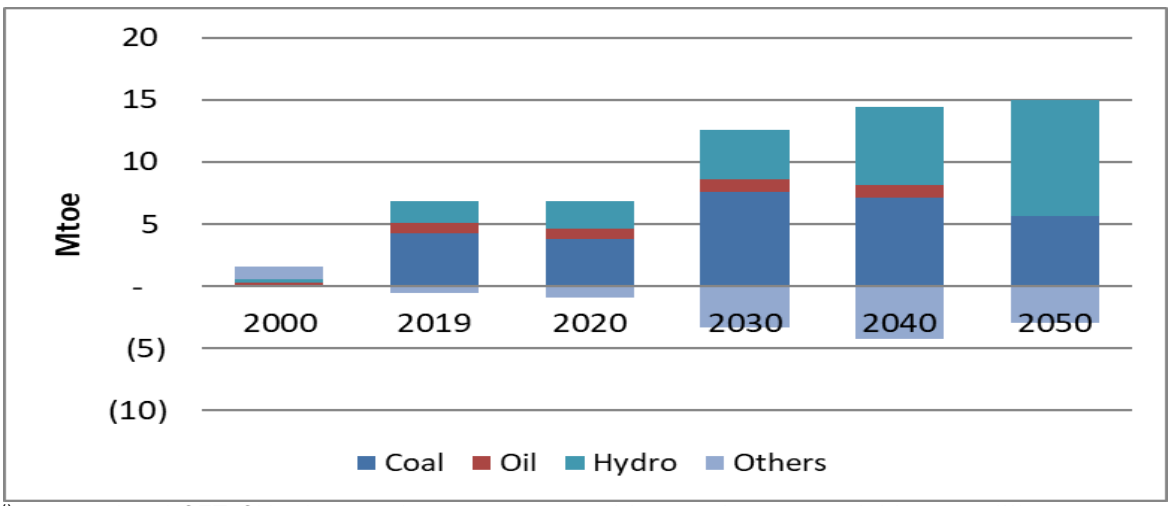
LCET-CN = low-carbon energy transition–carbon neutral, TWh = terawatt-hour.
Source: ERIA calculations.

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

The total primary energy supply (TPES) under the LCET-CN scenario is expected to increase 2.1% per year from 2019 until 2050, a lower rate than those in the BAU scenario at 3.6%.. According to the *National Power Development Strategy of the Lao PDR, 2021–2023,* the country is committed to reducing emissions by 2050. The consumption of coal and oil is expected to fall, and the use of energy from hydro, solar, and wind promoted.

Figure 9.4. Primary Energy Supply by Fuel, LCET-CN Scenario, 2000–2050

(Mtoe)



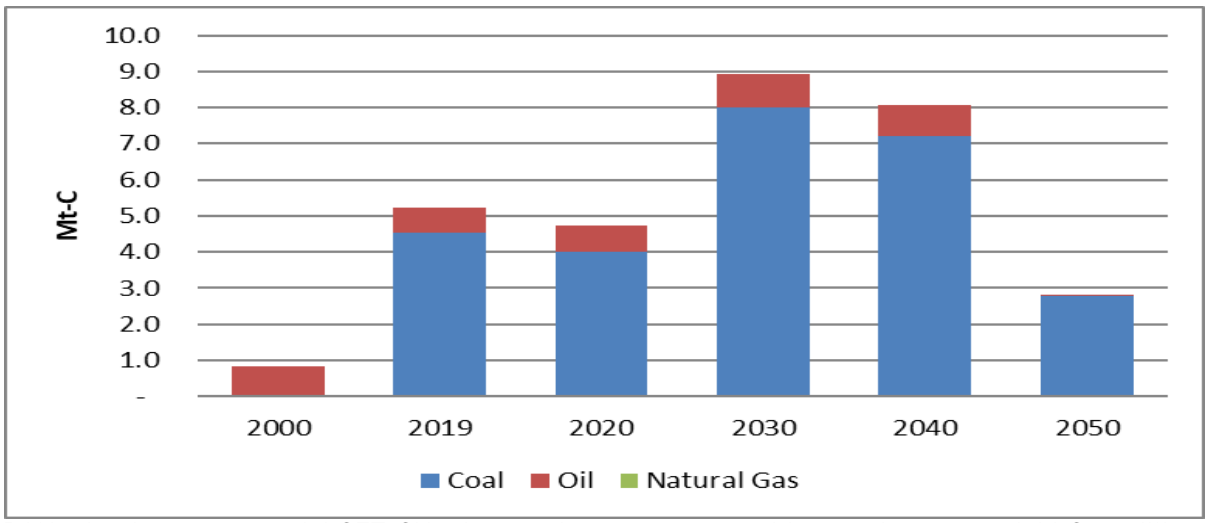
() = negative, LCET-CN = low-carbon energy transition–carbon neutral, Mtoe = million tonnes of oil equivalent.
Source: ERIA calculations.

According to Figure 9.4, under the LCET-CN scenario, 'others' would have a 5.5% share; solar and wind, a 21.7% share; and electricity, a 3.8% share of the TPES. Hydro would increase 5.6% per year from 2019 until 2050, while oil would fall 14.0%. Overall, the TPES would be expected to register at 12.01 Mtoe in 2050.

5. Emissions

Overall, for 2050, total emissions under the LCET-CN scenario would be 2.8 million tonnes of carbon (MtC), falling 2.0% per year from the 2019 level. Emissions from coal would decrease from 2019 until 2050 at 1.6% per year; likewise, oil emissions would fall 13.9% per year during the same time period. According to the *National Power Development Strategy of the Lao PDR, 2021–2023,* the consumption of coal and oil is set to decrease.

Figure 9.5. Primary Energy Supply, LCET-CN Scenario, 2019–2050
(MtC)



BAU = business as usual, LCET-CN = low-carbon energy transition–carbon neutral, MtC = million tonnes of carbon.
Source: ERIA calculations.

From Figure 9.5, under the LCET-CN scenario, the amount of oil used in 2050 would decrease significantly due to the promotion of clean energy in the transport sector, while the amount of coal would decrease as well. However, this would be a smaller amount due to various concession contracts with coal power plants and the use of coal in cement factories.

6. Power Demand

Currently, electricity generation sources (including exports) are from hydro, accounting for more than 80.41% of the total share. Coal thermal electricity accounts for 18.61%, and solar and biomass electricity account for 0.98% of total installed power. Domestic electricity generation comprises 91.49% hydroelectricity, 3.17% coal-fired power, and 5.34% renewable energy.

Under the LCET-CN scenario, in 2050, hydro would still produce the most energy, with higher demand growth than solar and wind energy. In the transport sector, fuel consumption would be replaced with electric power; the goal is to promote the use of EVs by 2025 to 14% of the total compared to 2017. The percentage of clean energy use in the transport sector should rise to 50% by 2050; there will be 2.63 Mtoe of electricity consumption from road transport. Hydrogen energy will be used in the Lao PDR starting in 2040, with a total consumption of 0.04 Mtoe, growing to 1.20 Mtoe in 2050.

7. Cost Comparison

7.1. Assumptions

An analysis of energy costs was carried between the BAU and LCET-CN scenarios to understand the total investment costs needed to implement all assumptions under the LCET-CN scenario. The basic assumptions for this analysis are in Tables 9.1–9.3.

Table 9.1. Assumed Fuel Costs

Fuel	2019/2020	2050 (2019 constant price)	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		30.00	US$/$tCO_2$

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

Table 9.2. Assumed Construction Costs of Power Plants
(US$/kilowatt)

Fuel	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: ERIA calculations.

Table 9.3. Assumed Capacity Factors of Power Plants
(%)

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

Source: ERIA calculations.

7.2. Fuel Costs

Based on fuel cost assumptions in Table 9.1, fuel costs for both scenarios are shown in Table 9.4.

Table 9.4. Fuel Cost Comparison, BAU and LCET-CN Scenarios, 2050

	Final Energy Consumption, BAU, 2019 (Mtoe)	Final Energy Consumption, BAU, 2050 (Mtoe)	Final Energy Consumption, LCET-CN, 2050 (Mtoe)	Total Investment Cost, BAU, 2050 (US$ million)	Total Investment Cost, LCET-CN, 2050 (Mtoe)
Coal	4.27	13.29	5.69	1,426	226
Oil	0.86	3.56	0.01	1,857	(587)
Gas	0	0	0	0	0
Hydrogen	0	0	1.20	0	1,398
Total	**5.127**	**16.85**	**6.90**	**3,282**	**1,037**

() = negative, BAU = business as usual, LCET-CN = low-carbon energy transition–carbon neutral, Mtoe = million tonnes of oil equivalent.
Source: ERIA calculations.

From the results above, the fuel costs in 2050 for the BAU scenario would be US$3,282 million, higher than that of the LCET-CN scenario at US$1,037 million.

7.3. Power Generation Investment

Based on the assumptions in Tables 9.2 and Table 9.3, the total investment cost for power plants in 2050 under the BAU and LCET-CN scenarios are in Table 9.5.

Table 9.5. Power Plants Cost Comparison, BAU and LCET-CN Scenarios, 2050

	Electricity Generation, BAU, 2019 (TWh)	Electricity Generation, BAU, 2050 (TWh)	Electricity Generation, LCET-CN, 2050 (TWh)	Additional Capacity, BAU (MW)	Additional Capacity, LCET-CN (MW)	Total Investment Cost, BAU, 2050 (US$ million)	Total Investment Cost, LCET-CN, 2050 (US$ million)
Coal	13	39	21	3,778	1,174	5,762	1,790
Oil	0	0	0	0			
Gas	0	0	0	0	0	0	0
Hydrogen	0	0	0	0	0		0
Nuclear	0	0	0	0	0		0
Hydro	20	79	108	16,893	25,045	37,554	55,674
Geothermal	0	0	0	0	0	0	0
Solar	0	8	19	5,045	12,450	1,549	3,822
Wind	0	0	11	0	3,011	0	3,718
Biomass	1	1	1	124	139	373	418
Total	**34**	**128**	**160**	**25,840**	**41,817**	**45,237**	**65,423**

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

From Table 9.5, the total additional capacity needed under the BAU scenario is 25,840 MW more than the 2019 level. The additional capacity under the LCET-CN scenario in 2050 is much greater at 41,817 MW more. This is due to more aggressive assumptions for renewable energy for power plants to reduce emissions. As a result, the total investment for power plants in 2050 under the BAU scenario would be US$45,237 million, while under LCET-CN scenario, it would be US$65,423 million.

7.4. Carbon Capture and Storage Costs

The introduction of carbon capture and storage (CCS) for coal and natural gas power plants would be implemented under the LCET-CN scenario starting in 2041. Based Table 9.1, the CCS cost is around US$30 per tonne of carbon dioxide equivalent. The total investment cost of CCS is shown in Table 9.6.

Table 9.6. Total Investment Cost of Carbon Capture and Storage for the LCET-CN Scenario, 2050

	Consumption in 2050 (Mtoe)	Emissions ($MtCO_2$)	Emissions (MtC)	Total Investment Cost (US$ million)
Coal Power Plant with CCS	5.69	21.2457	5.78901	574
Natural Gas Plant with CCS	0.00	0	0	0
Total	**5.69**	**21.2457**	**5.78901**	**574**

CCS = carbon capture and storage, LCET-CN = low-carbon energy transition–carbon neutral, Mtoe = million tonnes of oil equivalent, MtC = million tonnes of carbon, $MtCO_2$ = million tonnes of carbon dioxide equivalent.
Source: ERIA calculations.

Table 9.6 indicates that the total investment cost of CCS will be US$547 million for coal power plants under the LCET-CN scenario.

7.5. Overall Costs

The breakdown of the total investment costs are shown below.

Table 9.7. Overall Total Investment Cost for BAU and LCET-CN Scenarios, 2050
(US$ million)

Cost	BAU	LCET-CN
Total Fuel Cost Investment	3,282	1,037
Total Power Capital Cost Investment	45,237	65,423
Total CCS Cost Investment	0	0
Total	**48,520**	**66,460**

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

The overall investment cost under the BAU scenario in 2050 is projected to be US$48,520 million, while in LCET-CN scenario, it would be US$66,460 million.

8. Conclusions and Recommendations

From the overall calculation of the total investment costs, the LCET-CN scenario would require higher investment costs than the BAU scenario.

To reach net-zero emissions in 2050, the Lao PDR has increased investment in hydropower, solar power, wind power, and biomass power plants while reducing investment in coal. Regarding its conditional NDC, developed countries will help the Lao PDR achieve it though technology transfer, particularly in the areas of forestry and expanding renewable energy sources such as solar power, hydropower, wind power, and biomass power.

The Lao PDR currently does not have its own methodology for determining emissions, and national emissions reduction targets have been established with assistance from international organisations. Therefore, it is crucial to prioritise the establishment of a national greenhouse gas inventory.

References

Government of the Lao People's Democratic Republic (Lao PDR) (2018), *National Green Growth Strategy of the Lao PDR till 2030*, Vientiane.

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