CHAPTER 4

Cambodia Country Report

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1. Background

The Kingdom of Cambodia is in the Lower Mekong region of Southeast Asia. The country has an area of 181,035 square kilometres and an 800-kilometre border with Thailand in the west. Lao People's Democratic Republic (Lao PDR) lies to the north and Viet Nam to the east. The landscape is dominated by lowland plains around the Mekong River and the Tonle Sap Lake. The country has about 2.5 million hectares of arable land and more than 0.5 million hectares of pastureland.

For 2 decades, until March 2020, before the coronavirus disease (COVID-19) pandemic, Cambodia's gross domestic product (GDP) growth was strong, at about 7.7% average yearly. The government's policy reforms have attracted foreign direct investment. Energy has been critical in supporting economic activities and growth. The impact of the pandemic on energy demand has prompted a rethinking of the future energy mix, including types of fuel to meet electricity demand and demand in other sectors. Cambodia has revised its Power Development Plan 2020–2030, which foresees a larger share of gas consumption in the power generation mix. Post–COVID-19 economic recovery is expected from 2022 onwards. Thus, energy demand is expected to rebound strongly, with liquefied natural gas (LNG) and other clean fuels playing a crucial role in the energy mix, especially in power generation, industrial use, transport, and commercial and residential use.

The longer historical energy data set reflects the following energy demand–supply analysis. Total final energy consumption (TFEC) grew by 6.6% per year in 2000–2010 and by 7.9% in 2010–2019. Energy demand increased rapidly after 2010. If biomass is excluded, the rate in 2000–2010 was 9.9% and 11.2% in 2020–2019. Demand for conventional energy such as oil and especially electricity increased remarkably by 17.9% per year in 2000–2019. Total primary energy supply (TPES) increased by 5.8% per year in 2000–2010 and by 8.0% per year in 2010–2019, showing the same trend as that of TFEC. Due to the significant increase in electricity demand, Cambodia rapidly increased its hydropower and coal power generation in 2010–2019. Liquefied petroleum gas (LPG), used for cooking and as transport fuel, marked a higher increase ratio in 2000–2019. However, traditional biomass has been phasing out and, as a result, TPES without biomass increased by 11.1% in 2000–2019. Cambodia is promoting energy efficiency and conservation (EEC) in accordance with the Energy Efficiency and Conservation Master Plan for Cambodia prepared by the Economic Research Institute for ASEAN and East Asia. Using the longer historical energy data set, the energy outlook business-as-usual (BAU) model has been updated based on the latest future macroeconomic assumptions, although the results are more moderate than previous ones. The growth rate of TPES in 2019–2050 is 4.4% per year compared with 5.6% in 2018–2050 due to different GDP assumptions, which are 5.8% in the revised case and 6.4% in the previous one. Data coverage is extended from 9 years to 19 years, so that the elasticity between GDP and energy consumption has improved, from 0.875 of the previous results to 0.8 of the current ones. Longer data coverage seems to provide better energy outlook results than shorter data coverage when the econometrics approach is applied.

2. Modelling Assumptions

2.1. Gross Domestic Product and Population

Based on energy demand forecast to 2050, GDP is assumed to increase at an average annual growth rate (AAGR) of 6.18% and population is projected to increase steadily at an AAGR of 1.5%, resulting in an AAGR of GDP per capita of 4.61%.

Table 4.1 Cambodia – Updated Energy Information

Year	2019	2020	2030	2040	2050	AAGR, 2019–2050
GDP (billions 2010 US$)	20.92	22.28	41.36	74.90	134.14	6.18
Population (millions)	16.49	16.73	19.42	22.54	26.16	1.5

AAGR = average annual growth rate, GDP = gross domestic product.

Source: Author.

2.2. Electricity Generation

In BAU, LNG is expected to dominate the fuel mix in 2050, followed by hydro and solar energy. Cambodia is predicted to have total installed electricity generation capacity of 22,604.07 megawatts (MW) in 2050, mainly from LNG, with 8,700 MW; hydro energy, 6,156.7 MW; and solar energy, 4,526.8 MW.

Table 4.2 Cambodia – Installed Capacity, Business as Usual

Installed Capacity (megawatt)	2019	2020	2030	2040	2050
Coal	675.00	675.00	2,210.00	2,210.00	2,210.00
Heavy fuel oil	624.80	617.55	545.03	472.52	400.00
Hydro	1,331.70	1,331.70	1,561.70	3,156.70	6,156.70
Biomass	30.57	30.57	30.57	30.57	30.57
Solar	105.32	215.81	1,976.80	3,226.80	4,526.80
Natural gas	-	-	-	2,700.00	8,700.00
Wind	-	-	180.00	380.00	580.00
Total	2,767.39	2,893.71	6,757.95	12,176.59	22,604.07

Source: Author.

Table 4.3 Cambodia – Installed Capacity, Alternative Policy Scenario 5

Installed Capacity (megawatt)	2019	2020	2030	2040	2050
Coal	675.00	1,000.00	1,640.00	1,640.00	1,640.00
Oil	624.80	617.55	545.03	472.52	400.00
Hydro	1,331.70	2,103.00	4,727.00	6,127.00	7,127.00
Biomass	30.57	30.57	30.57	30.57	30.57
Solar	105.32	215.81	1,976.80	3,596.80	5,596.80
Natural gas	-	-	-	2,700.00	8,700.00
Wind	-	-	230.00	430.00	860.00
New biomass	-	-	450.00	650.00	1,750.00
Total	**2,767.39**	**3,966.93**	**9,599.40**	**15,646.89**	**26,104.37**

Source: Author.

Table 4.4 Cambodia – Installed Capacity, Low-carbon Energy Transition

Installed Capacity (megawatt)	2019	2020	2030	2040	2050
Coal	675.00	1,000.00	1,640.00	-	-
Oil	624.80	617.55	545.03	472.52	400.00
Hydro	1,331.70	2,103.00	4,727.00	6,127.00	9,000.00
Biomass	30.57	30.57	30.57	30.57	30.57
Solar	105.32	215.81	1,976.80	3,600.00	7,500.00
Natural gas	-	-	-	2,700.00	-
Wind	-	-	230.00	430.00	1,500.00
New biomass	-	-	450.00	650.00	2,000.00
Coal PP with CCS	-	-	-	1,640.00	3,000.00
Natural gas PP with CCS	-	-	-	5,000.00	12,000.00
Total	**2,767.39**	**3,966.93**	**9,599.40**	**20,650.09**	**35,430.57**

CCS = carbon capture and storage, LCET = low carbon energy transition, MW = megawatt, PP = power plant.

Source: Author.

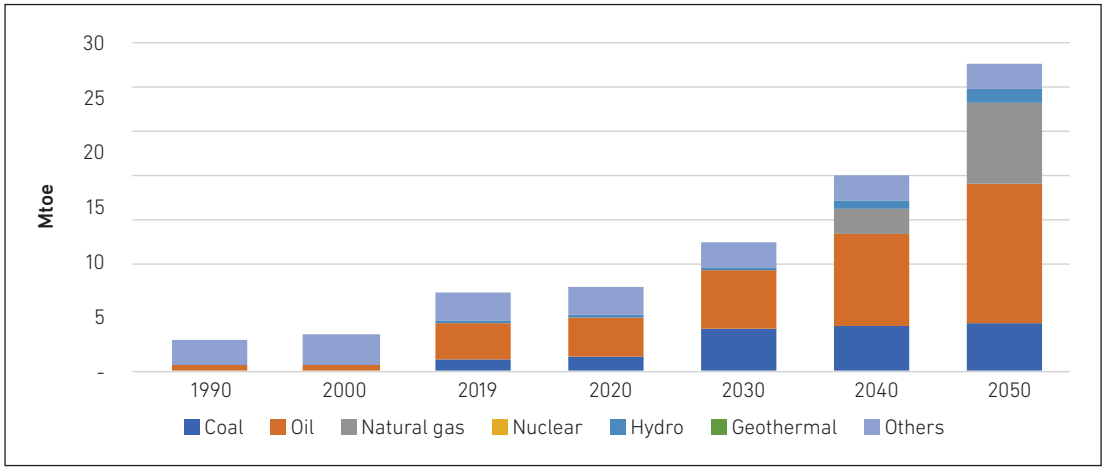
3. Outlook Results

3.1. Business-as-Usual Scenario

3.1.1. Primary Energy Supply

Total primary energy supply (TPES) will grow at an AAGR of 4.44% in 2019–2050. Primary energy supply will increase from 7.17 million tonnes of oil equivalent (Mtoe) in 2019 to 27.56 Mtoe in 2050, slightly faster than final energy demand, from 4.97 Mtoe in 2019 to 19.46 Mtoe in 2050. Amongst the major energy sources, the fastest growing is solar and wind energy, with an AAGR of 14.2% in 2019–2050, followed by oil at 4.6% and coal at 4.1%. The share of solar and wind energy is projected to increase by 14.2% in 2050 to comply with the policy on renewable energy, which promotes utilising clean energy to the maximum extent possible to help mitigate climate change. The share of LNG is projected to increase from 2.09% in 2032 to 25.8% in 2050 due to global limitations on the use of coal.

Figure 4.1 Cambodia – Total Primary Energy Supply, Business as Usual



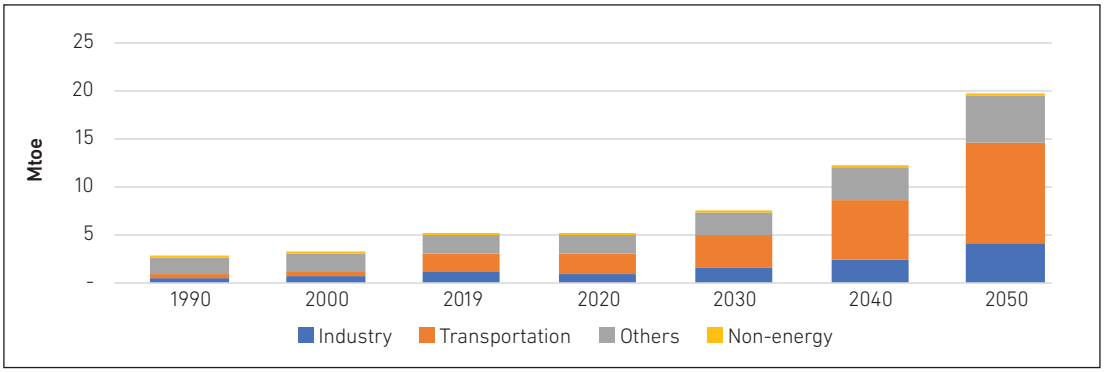
Mtoe = million tonnes of oil equivalent.

Source: Author.

3.1.2. Final Energy Consumption by Sector

Total final energy consumption (TFEC) will grow at an average annual rate of 4.51% in 2019–2050. Final energy demand by sector will increase from 4.97 Mtoe in 2019 to 19.46 Mtoe in 2050 (Figure 4.2).

Figure 4.2 Cambodia – Total Final Energy Consumption by Sector, Business as Usual



Mtoe = million tonnes of oil equivalent.

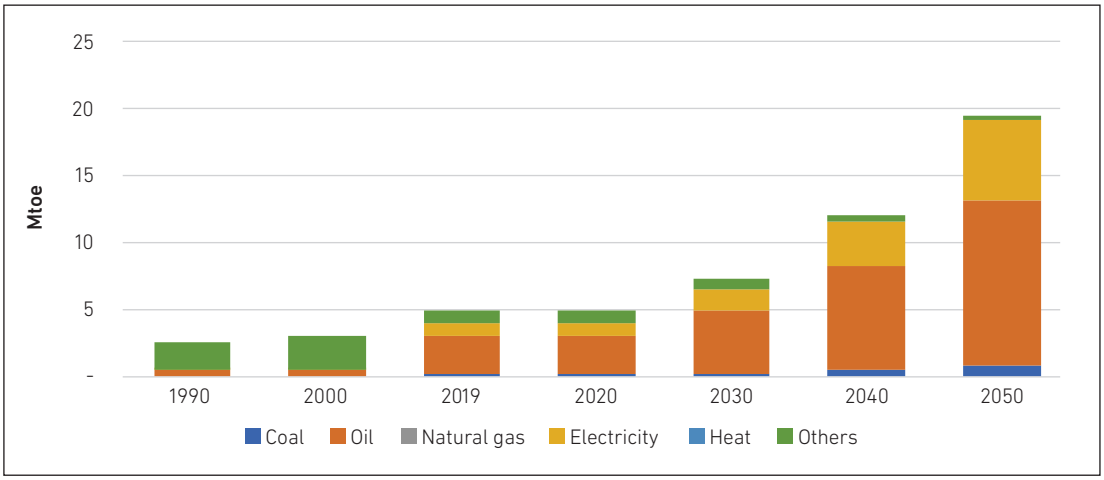
Source: Author.

Strongest growth in demand is projected in transport, which will increase fivefold at an annual average rate of 5.33% in 2019–2050, from 2.09 Mtoe to 10.46 Mtoe. Demand in industry is projected to grow 4.32 times at an annual rate of 4.85%, from 0.95 Mtoe in 2019 to 4.11 Mtoe in 2050, followed by 'others' at 3.07%, from 1.91 Mtoe in 2019 to 4.88 Mtoe in 2050.

3.1.3. Final Energy Consumption by Fuel

Electricity is projected to exhibit the fastest growth in final energy consumption, 14.7 times at 6.37% per year, from 0.88 Mtoe in 2019 to 5.96 Mtoe in 2050. Coal is projected to have the second-highest growth, 5.79% per year or 5.6 times, from 0.14 Mtoe in 2019 to 0.78 Mtoe in 2050. Oil is projected to have the third-highest growth rate, 4.79 % per year or 4.26 times, from 2.90 Mtoe in 2019 to 12.37 Mtoe in 2050 (Figure 4.3).

Figure 4.3 Cambodia – Total Final Energy Consumption by Fuel, Business as Usual



Mtoe = million tonnes of oil equivalent.

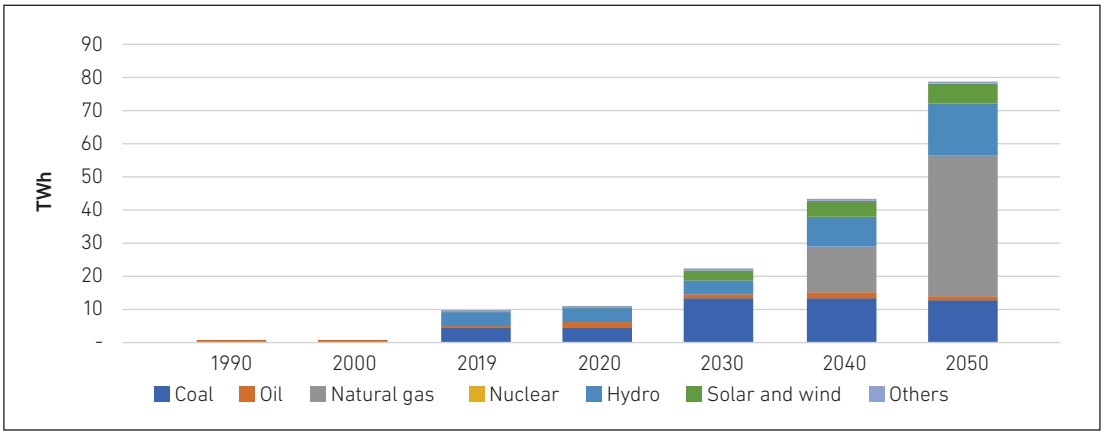
Source: Author.

3.1.4. Electricity Generation

Electricity generation is projected to increase by 7.23% per year from 9.01 terawatt-hours (TWh) in 2019 to 78.36 TWh in 2050. From 2032 to 2050, three main fuels will contribute to electricity generation: LNG, from 6.37% to 54.9%; coal, from 53.6% to 15.9%; and hydropower, from 20.52% to 19.9%.

To meet demand for electricity, power generation is projected to increase at an average rate of 7.23% in 2019–2050. The fastest growth in electricity generation will be in solar energy, by 14.34% per year; followed by coal, 3.8%; and hydropower, 4.38% (Figure 4.4). Generation from heavy fuel oil power plants will decrease by 1.44% from 2020 to 2050 due to high fuel cost.

Figure 4.4 Cambodia – Power Generation by Fuel, Business as Usual



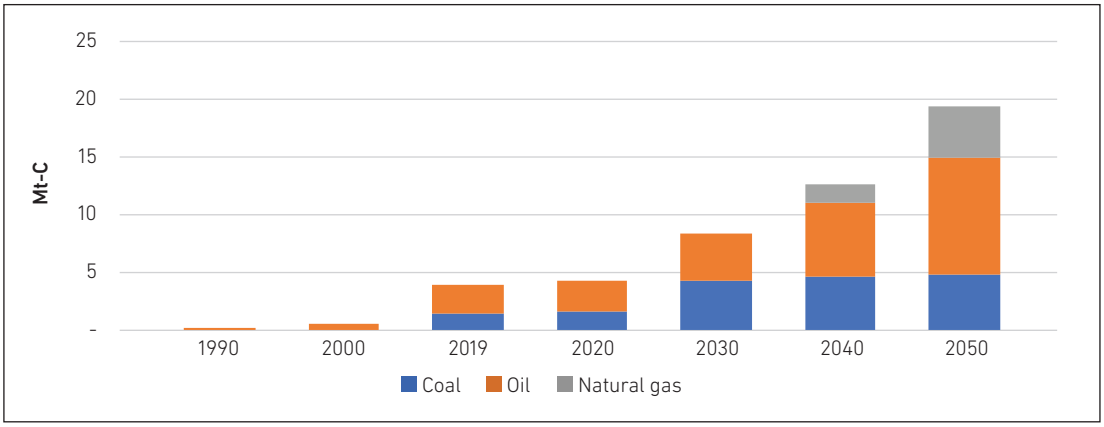
TWh = terawatt-hour.

Source: Author.

3.1.5. CO_2 Emissions

Carbon dioxide (CO_2) emissions from energy consumption are projected to increase by 5.17% per year, from 3.84 million tonnes of carbon (Mt-C) in 2019 to 19.35 Mt-C in 2050. Oil is the largest source of carbon emissions, which will increase fastest, with an AAGR of 4.63%, from 2.49 Mt-C in 2019 to 10.13 Mt-C in 2050. The second-largest source of carbon emissions is coal, with an AAGR at 4.09%, from 1.35 Mt-C in 2019 to 4.09 Mt-C in 2050 (Figure 4.5).

Figure 4.5 Cambodia – CO_2 Emissions from Energy Consumption, Business as Usual



Mt-C = million tonnes of carbon.

Source: Author.

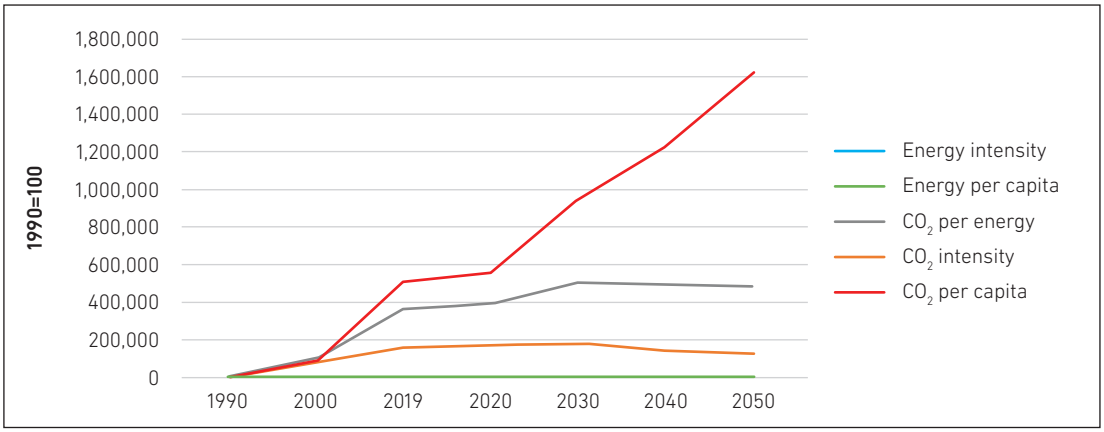
3.1.6. Energy Indicators

Primary energy intensity decreased from 775 toe/US$ million in 1990 to 343 toe/US$ million in 2019. Energy intensity will further decrease to 205 toe/US$ million in 2050, indicating that energy will be used more efficiently as a result of the implementation of an EEC programme.

Per capita primary energy increased from 0.32 toe/person in 1990 to 0.43 toe/person in 2019. Per capita energy will further increase to 1.05 toe/person in 2050, indicating that living standards will improve, which will result in increasing energy demand per capita.

Figure 4.6 shows various indicators of energy consumption.

Figure 4.6 Cambodia – Energy and CO_2 Indicators, Business as Usual



Source: Author.

CO_2 per primary energy in BAU is projected to increase from 0.54 metric tonne of carbon per tonne of oil equivalent (t-C/toe) in 2019 to 0.70 t-C/toe in 2050, implying faster growth of fossil fuels in the total energy consumption. However, CO_2 intensity increased from 108 t-C/US$ million in 1990 to 184 t-C/US$ million in 2019 and will decrease to 144 t-C/US$ million in 2050.

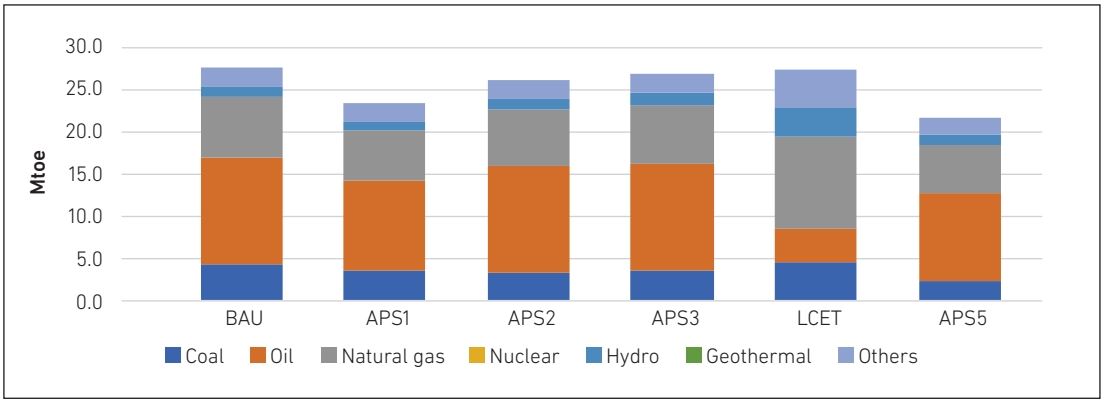
3.2. Alternative Policy Scenario

Alternative policy scenario (APS) 5 consists of three scenarios: EEC (APS1), improvement of energy efficiency in power generation (APS2), and development of renewable energy (APS3). The scenarios are individually modelled to determine the impact of each on reduction of energy consumption and CO_2 emissions. Below are the assumptions in each scenario:

- **APS1**. Focus on EEC on the demand side:
  - Energy demand is projected to increase by an AAGR of 3.9% in 2019–2050, from 4.97 Mtoe to 16.29 Mtoe, which is slower than the AAGR in BAU of 4.5%, from 4.97 Mtoe to 19.46 Mtoe.
  - Use efficient motorbikes, LPG cars, and hybrid cars for road transport.
  - Replace inefficient devices – such as those used in cooking, lighting, refrigeration, air conditioning, etc. – with efficient ones in the commercial and residential sectors.
- **APS2**. Improvement of energy efficiency in thermal power plants. Energy efficiency of LNG, coal, and fuel oil thermal power plants is assumed to stay constant at 44.6% until 2050 in BAU. In APS, it is assumed that new LNG, coal, and fuel oil thermal power plants will have thermal efficiencies of 51.7%. APS2 is projected to improve efficiency of thermal power generation to about 21% in 2019–2050.
- **APS3**. The share of renewable energy in the power generation mix is 27.66% in BAU but 31.07% in APS3 in 2050. However, in the power generation mix in 2050, the share of hydropower is 27.61%; LNG, 55.55%; coal, 11.9%; solar and wind energy, 9.45%; and biomass, 0.12%.
- **APS5 or APS**. Combine APS1, APS2, and APS3.

The assumptions in APS were analysed separately to determine the individual impacts of each in APS1, APS2, APS3, and APS5. Figure 4.7 shows the changes in primary energy supply in all scenarios. APS1 and APS5 have the largest reduction in primary energy supply in 2050 due to improvement of energy efficiency in thermal power generation and energy efficiency assumptions in APS1. In APS1, primary energy supply could be lower than in BAU by 4.2 Mtoe or 18.2%. In APS2, the reduction will be slower, amounting to 1.49 Mtoe or 5.7%.

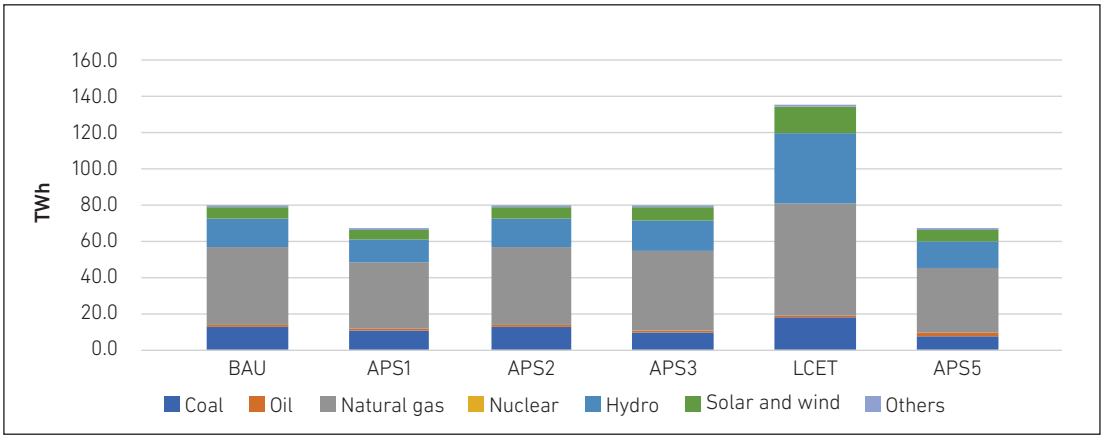
Figure 4.7 Cambodia – Total Primary Energy Supply, Business as Usual, Alternative Policy Scenario, and Low-carbon Energy Transition (2050)



APS = alternative policy scenario, BAU = business as usual, LCET = low-carbon energy transition, Mtoe = million tonnes of oil equivalent.
Source: Author.

Figure 4.8 shows total electricity generation in 2050 in all scenarios. In APS1, due to lower electricity demand, the share of fossil fuel–fired electricity generation will be 17% lower than BAU in 2050. In APS3, the share of fossil fuel generation will be 25% lower than in BAU and APS2, the share is the same as in BAU in 2050. In APS5, the reduction in the share of fossil fuel energy–based generation will be significant, at almost 38% lower than in BAU in 2050.

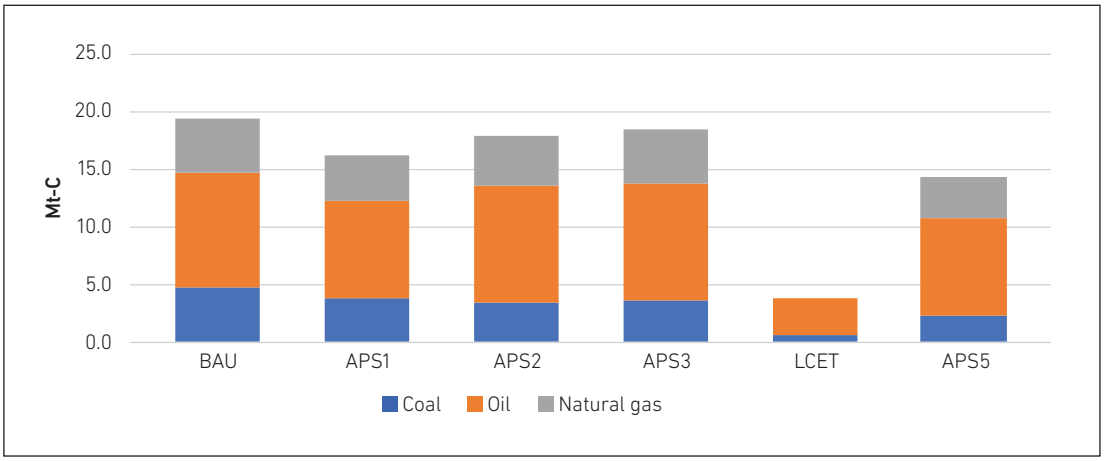
Figure 4.8 Cambodia – Electricity Generation, Business as Usual, Alternative Policy Scenario, and Low-carbon Energy Transition (2050)



APS = alternative policy scenario, BAU = business as usual, LCET = low-carbon energy transition, TWh = terawatt-hour.
Source: Author.

Figure 4.9 compares CO_2 emission scenarios in 2050. In APS1, emissions could be lower by 19.85% than in BAU. In APS2, the installation of more efficient new power plants is projected to reduce emissions by 8.13%. In APS 3, as the result of small contributions from solar, wind, and biomass energy to power generation mix, emissions could reduce by 4.99%. All the assumptions combined (APS5) could reduce CO_2 emissions by 35.02% in 2050.

Figure 4.9 Cambodia – CO_2 Emissions, Business as Usual, Alternative Policy Scenario, and Low-carbon Energy Transition (2050)



APS = alternative policy scenario, BAU = business as usual, LCET = low-carbon energy transition, Mt-C = million tonnes of carbon.
Source: Author.

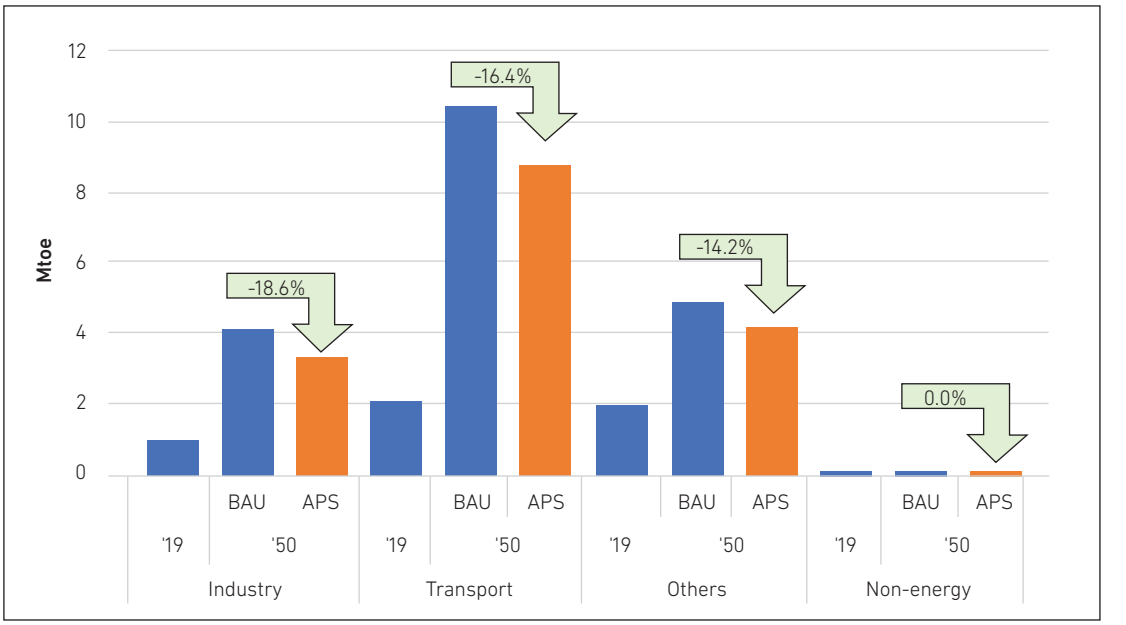
3.2.1. Final Energy Consumption in Alternative Policy Scenario 5

TFEC is 16.29 Mtoe, smaller than TFEC in BAU, which is 19.46 Mtoe by 2050. Final energy demand in APS5 is projected to decrease by 16.3% compared with BAU in 2050 as a result of EEC measures in APS1 in the industrial, transport, and residential and commercial ('others') sectors.

Final energy demand savings in APS5 amount to 3.17 Mtoe, mostly in transport (1.71 Mtoe), followed by industry (0.76 Mtoe) and 'others' (0.69 Mtoe) in 2050.

An improvement in end-user technologies and the introduction of energy management systems is expected to contribute to the slower rate of consumption growth, particularly in 'others' (residential and commercial sectors), industry, and transport (Figure 4.10).

Figure 4.10 Cambodia – Final Energy Demand by Sector, Business as Usual and Alternative Policy Scenario



APS = alternative policy scenario, BAU = business as usual, Mtoe = million tonnes of oil equivalent.

Source: Author.

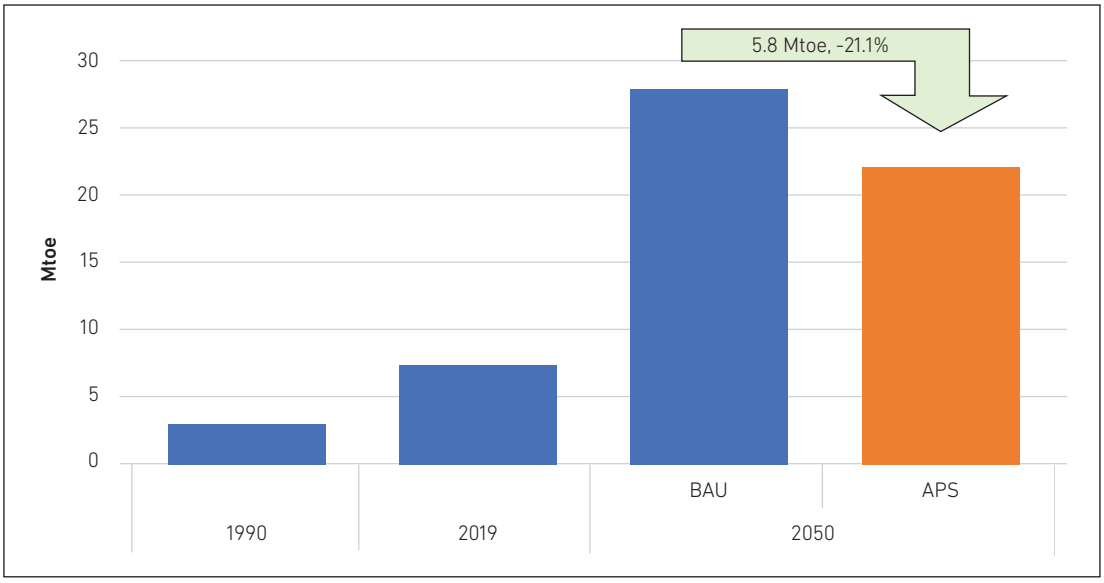
3.2.2. Primary Energy Supply in Alternative Policy Scenario 5

Primary energy supply is projected to increase by 3.6% per year, from 7.17 Mtoe in 2019 to 21.76 Mtoe in 2050. The savings could mostly be derived from EEC on the demand side and development of renewable energy technology (APS3).

Solar and wind energies are projected to grow fastest, by an annual average rate of 14.4% compared with 14.3% in BAU, followed by hydropower at 4.2% compared with 4.4% in BAU, and oil at 4% compared with 4.6% in BAU.

Total savings are equal to 5.8 Mtoe, equivalent to 2.5% of primary energy supply in 2050 (Figure 4.11).

Figure 4.11 Cambodia – Primary Energy Supply by Fuel, Business as Usual and Alternative Policy Scenario

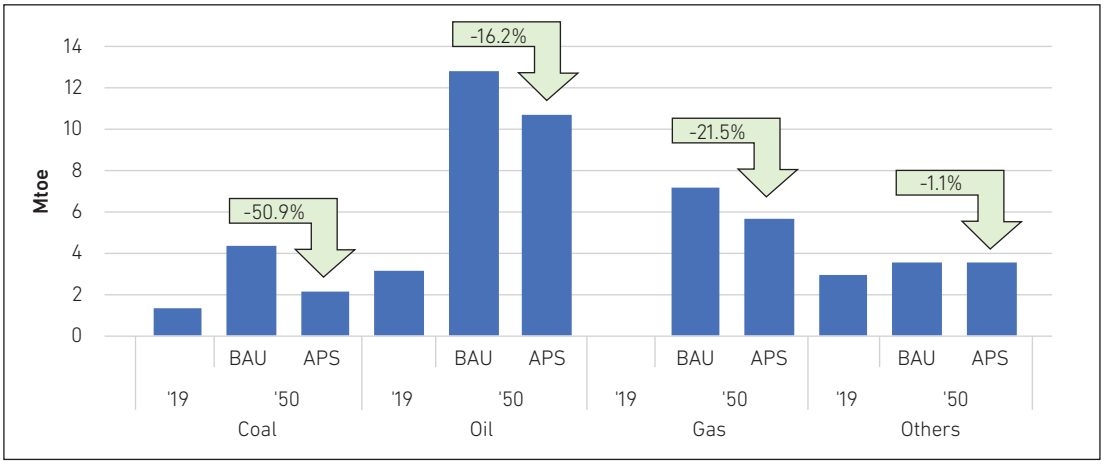


APS = alternative policy scenario, BAU = business as usual, Mtoe = million tonnes of oil equivalent.

Source: Author.

Consumption is reduced because of demand-side EEC measures (APS1), more aggressive uptake of energy efficiency in thermal power plants (APS2), and supply-side adoption of renewable energy (APS3). The energy-saving potential from coal sources will be 50.9%, followed by LNG at 21.5% and oil at 16.2% (Figure 4.12).

Figure 4.12 Cambodia – Total Primary Energy Saving Potential by Fuel, Business as Usual vs. Alternative Policy Scenario



APS = alternative policy scenario, BAU = business as usual, Mtoe = million tonnes of oil equivalent.

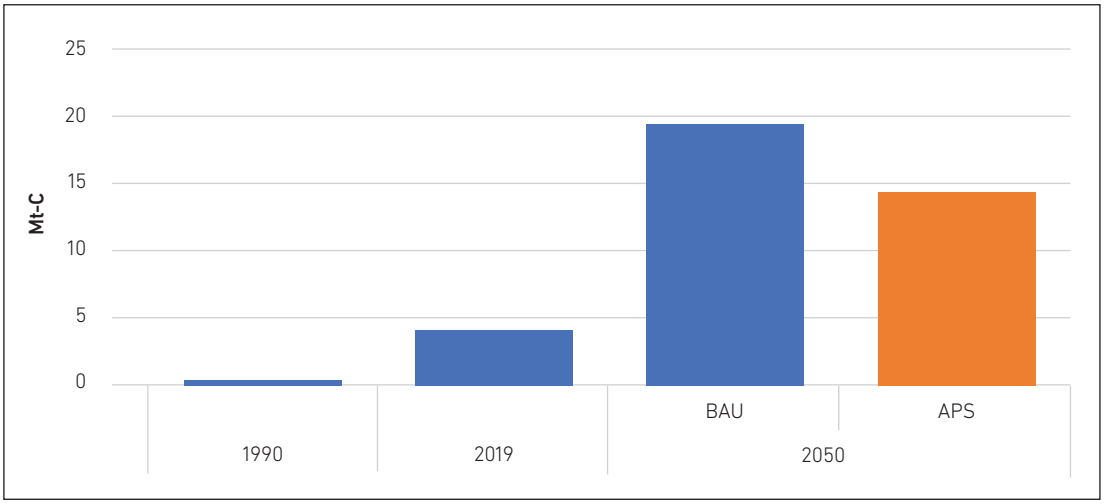
Source: Author.

3.2.3. CO_2 Emissions, Business as Usual and Alternative Policy Scenario 5

CO_2 emissions from energy consumption in BAU are projected to increase by 5.4% per year, from 3.84 Mt-C in 2019 to 19.35 Mt-C in 2050. In APS5, the annual increase in CO_2 emissions is projected to be 4.3 % per year in 2019–2050, 25.9% lower than in BAU.

CO_2 emission reduction will be mostly derived from demand-side EEC measures (APS1). Improvement of energy efficiency in thermal power plants (APS2) and development of renewable energy technologies (APS3) can contribute significantly to CO_2 reduction (Figure 4.13).

Figure 4.13 Cambodia – CO_2 Emission by Fuel, Business as Usual and Alternative Policy Scenario



APS = alternative policy scenario, BAU = business as usual, Mt-C = million tonnes of carbon.

Source: Author.

3.3. Low-carbon Energy Transition Scenario

The low-carbon energy transition (LCET) scenario was used to assess the impact of new energy technologies – use of hydrogen and ammonia for heat and electricity generation, and carbon capture, utilisation, and storage (CCUS) – on TPES, TFEC, power generation, and CO_2 emissions. Carbon neutrality means the balance of energy-related CO_2 emissions and carbon sink by forest. Cambodia's nationally determined contribution (NDC) in 2020 for the United Nations Climate Change Conference in Glasgow (COP26) states that greenhouse gas (GHG) emissions are expected to rise by up to 90 million tonnes of carbon dioxide equivalent (tCO_2e) per year by 2030, whilst GHG emissions are expected to increase to 155 million tCO_2e per year in BAU.

Table 4.5 Cambodia – Sectoral Share and Absolute Number of Greenhouse Gas Emissions, Business as Usual (2030)

Sector	Sectoral Share (%)	GHG Emissions ($MtCO_2e$)
FOLU	49.2	76.3
Energy	22.2	34.4
Agriculture	17.5	27.1
IPPU	9.0	13.9
Waste	2.1	3.3

BAU = business as usual, FOLU = forestry and other land use, IPPU = industrial processes and product use, $MtCO_2e$ = metric tonne of carbon dioxide equivalent.

Source: Cambodia's Updated Nationally Determined Contribution 2020.

Forestry and other land use (FOLU) will mark the highest CO_2 emissions in BAU in 2030, at 49.2%, followed by energy, 22.2%; agriculture, 17.5%; and industrial processes and product use, 9.0%. The estimated emission reduction in the NDC in 2030 will be about 64.5 million tCO_2e per year, or a 41.7% reduction, of which 59.1% is from FOLU (Table 4.5 and Table 4.6). We assume about 38 $MtCO_2e$ as carbon sink by forest until 2050 (Table 4.6).

Table 4.6 Cambodia – Summary of Business-as-Usual Emissions and Nationally Determined Contribution Emission Reduction

Sector	BAU 2016 Emissions ($MtCO_2e$)	BAU 2030 Emissions ($MtCO_2e$)	NDC 2030 Scenario ($MtCO_2e$)	NDC 2030 Reduction ($MtCO_2e$)	NDC 2030 Emission Reduction
FOLU	76.3	76.3	38.2	–38.1	–50%
Energy	15.1	34.4	20.7	–13.7	–40%
Agriculture	21.2	27.1	20.9	–6.2	–23%
IPPU	9.9	13.9	8.0	–5.9	–42%
Waste	2.7	3.3	2.7	–0.6	–18%
Total	**125.2**	**155.0**	**90.5**	**–64.5**	**–42%**

BAU = business as usual, FOLU = forestry and other land use, IPPU = industrial processes and product use, $MtCO_2e$ = metric tonne of carbon dioxide equivalent, NDC = nationally determined contribution.

Source: Cambodia's Updated Nationally Determined Contribution, 2020.

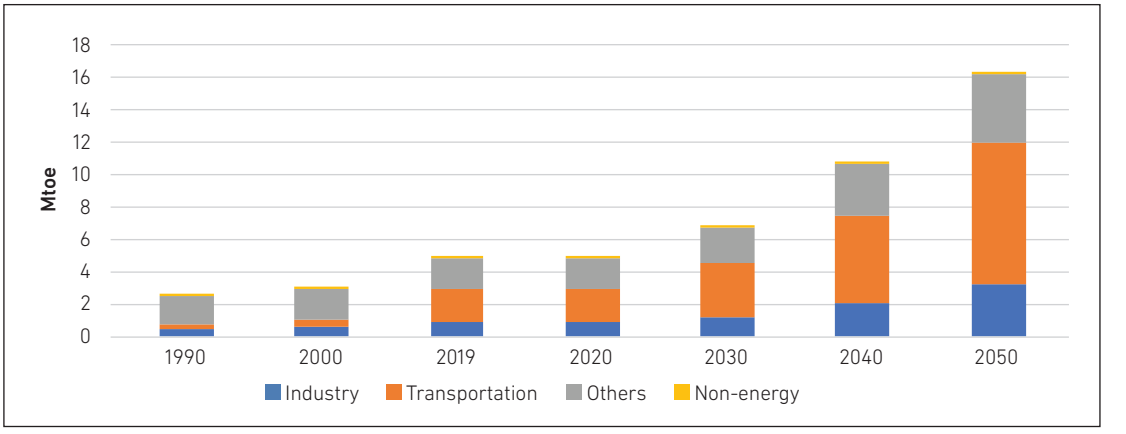
To create the LCET scenario in line with the NDC emission-reduction target, in addition to assuming carbon sink by forest until 2050, decreased oil demand is projected at 9.4% per year in industry and at 18.6% per year in transport in 2040–2050 due to electrification. New technologies are applied, such as coal power plants using clean coal technologies with CCS and natural gas power plants with CCS in 2040–2050.

3.3.1. Final Energy Consumption by Sector

Figure 4.14 illustrates final energy consumption by sector in 1990–2050. The AAGR is 3.9% per year in 1990–2050, which is the same as the AAGR of final energy consumption in APS5.

Demand growth is projected to be strongest in transport, by an annual average rate of 4.73% in 2019–2050, from 2.09 Mtoe to 8.74 Mtoe. Industry is projected to grow by an annual rate of 4.2%, from 0.95 Mtoe in 2019 to 3.35 Mtoe in 2050, followed by 'others' at 2.06%, from 1.91 Mtoe in 2019 to 4.19 Mtoe in 2050.

Figure 4.14 Cambodia – Total Final Energy Consumption by Sector, Low-carbon Energy Transition



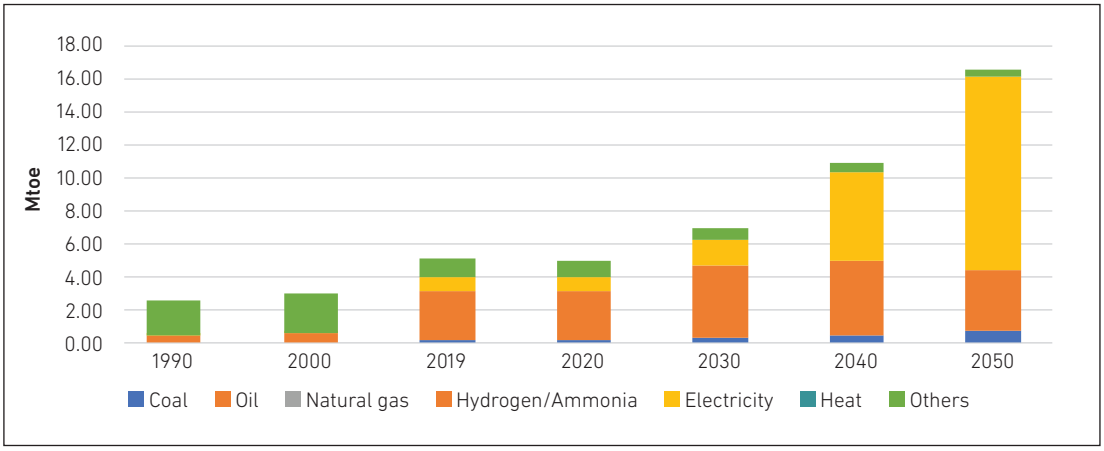
Mtoe = million tonnes of oil equivalent.

Source: Author.

3.3.2. Final Energy Consumption by Fuel

Figure 4.15 shows the highest shares of electricity demand in 2040–2050, the result of reducing oil demand in transport. The AAGR of TFEC in LECT is projected to increase by 3.9% in 2019–2050. Electricity has the main share, at 50.4% in 2040 and 71.2% in 2050, followed by oil, at 41.5% in 2040, before it drops to 22.8% in 2050.

Figure 4.15 Cambodia – Total Final Energy Consumption by Fuel, Low-carbon Energy Transition



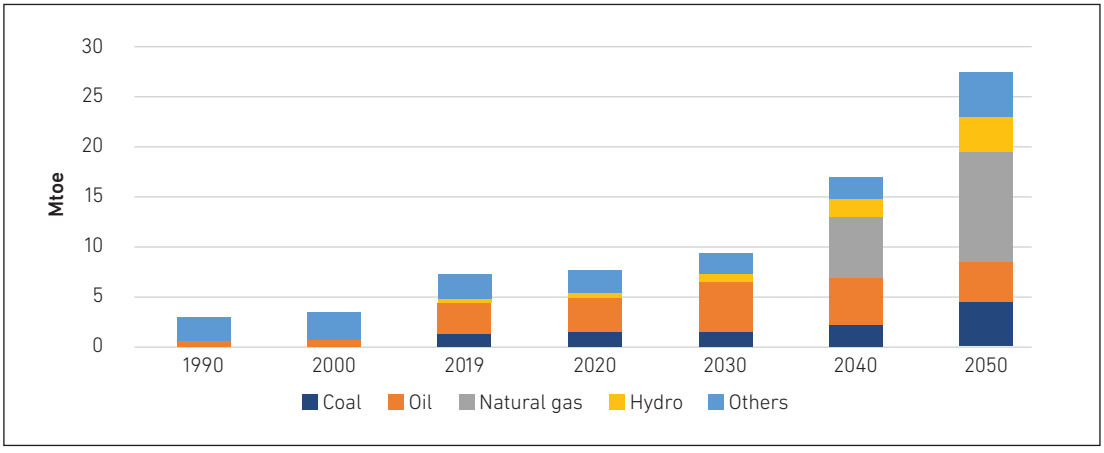
Mtoe = million tonnes of oil equivalent.

Source: Author.

3.3.3. Primary Energy Supply

In 2050, total primary energy supply will register at 27.35 Mtoe, much higher than in APS5 at 21.76 Mtoe. TPES recorded AAGR at 4.4% per year in 2019–2050 in LCET and 3.6% per year in APS5. Biomass is the only fuel that registered negative average annual growth, –1.05%, because people replaced firewood with LPG as cooking fuel in urban and rural areas.

Figure 4.16 Cambodia – Total Primary Energy Supply by Fuel, Low-carbon Energy Transition



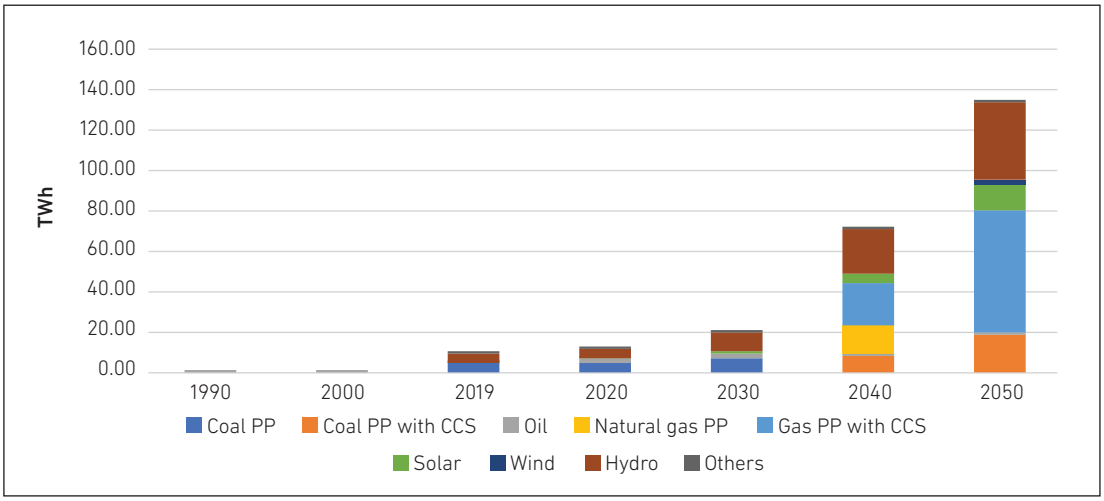
Mtoe = million tonnes of oil equivalent.

Source: Author.

3.3.4. Electricity Generation

Figure 4.17 shows total electricity generation in 2050 at 134.02 TWh, much higher than in APS5 at 65.82 TWh due to projected huge decrease in oil demand in 2040–2050. CO_2 emissions will be reduced as natural gas power plants will be the main contributor to electricity generation in 2032–2040; natural gas with CCS and coal with CCS will be the highest contributors in 2040–2050. Electricity generation is projected to have an AAGR of 9.1%, with solar energy having the highest at 16.9% in 2019–2050.

Figure 4.17 Cambodia – Total Primary Energy Supply by Fuel, Low-carbon Energy Transition



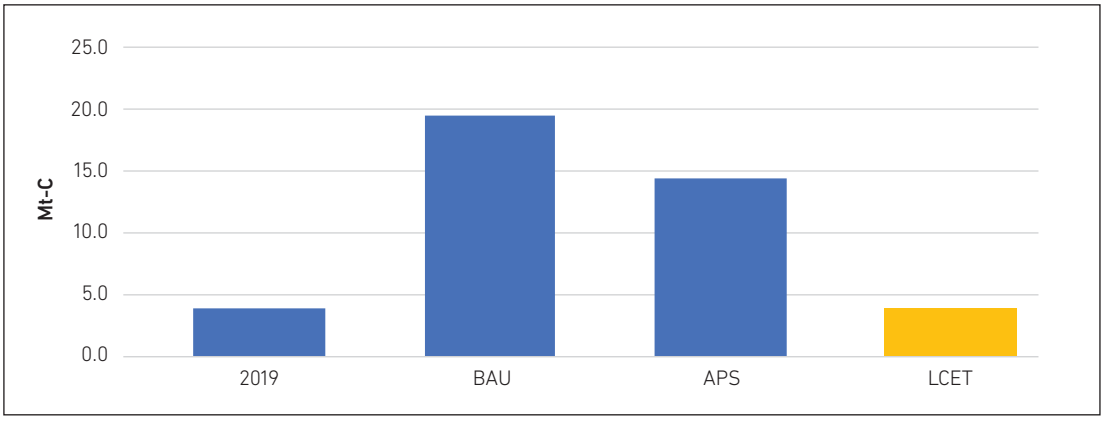
CCS = carbon capture and storage, PP = power plant, TWh = terawatt-hour.

Source: Author.

3.3.5. CO_2 Emissions

CO_2 emissions from energy consumption are projected to decrease by 3.7% per year, from 5.64 Mt-C in 2040 to 3.85 Mt-C in 2050. In APS5, the AAGR of CO_2 emissions is projected to increase by 4.3% per year in 2019–2050. CO_2 emissions in LCET will decrease by 10.5 Mt-C or about 73.2% compared with APS5 in 2050 (Figure 4.18). Carbon sink by forest is assumed to be about 38 $MtCO_2e$ or about 10 Mt-C. Applying CCS technologies, Cambodia could achieve carbon neutrality by 2050.

Figure 4.18 Cambodia – CO_2 Emission Reduction, Business as Usual, Alternative Policy Scenario 5, and Low-carbon Energy Transition



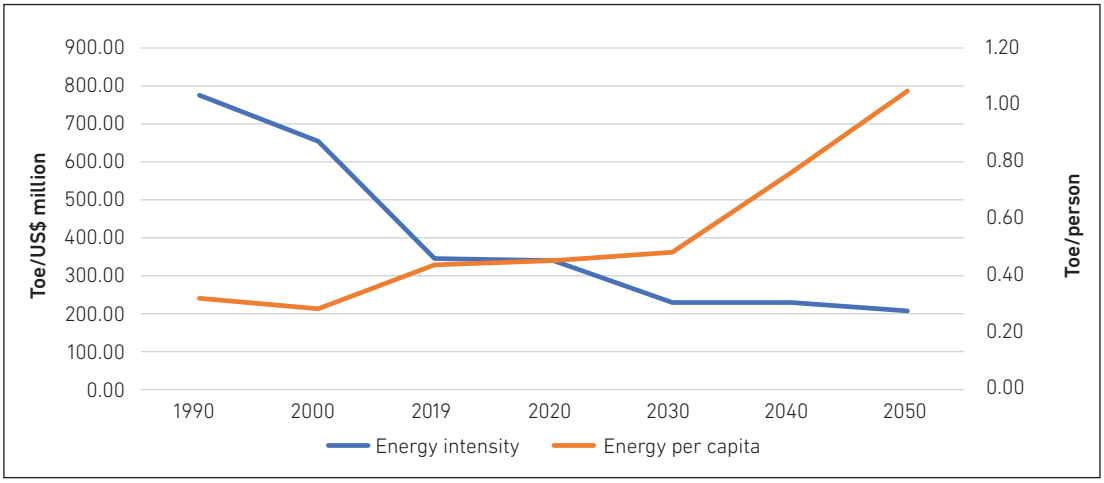
APS = alternative policy scenario, BAU = business as usual, LCET = low carbon energy transition, Mt-C = million tonnes of carbon.
Source: Author.

3.3.6. Energy Indicators

Figure 4.19 shows that primary energy intensity decreased from 775 toe/US$ million in 1990 to 343 toe/US$ million in 2019 and will further decrease to 204 toe/US$ million in 2050. The trend indicates that energy will be used more efficiently as a result of implementation of the EEC programme and use of new technologies.

Primary energy per capita increased from 0.32 toe/person in 1990 to 0.43 toe/person in 2019 and will further increase to 1.05 toe/person in 2050, indicating that living standards are improving, resulting in increasing energy demand per capita.

Figure 4.19 Cambodia – Energy Indicator, Low-carbon Energy Transition



Source: Author.

4. Key Findings and Recommendations

The key findings are as follows:

- Energy demand is expected to continue to grow significantly, driven by robust economic growth, industrialisation, urbanisation, and population growth. EEC is reflected in APS and LCET.
- Energy intensity will further decrease until 2050 due to efficient use of energy.
- Annual growth of energy demand in transport is projected to be the highest at 5.3%, from 2.09 Mtoe in 2019 to 10.46 Mtoe in 2050 in BAU, but in LCET, the AAGR of transport sector energy demand is projected lower at 4.7% reaching only 8.74 Mtoe in 2050.
- Coal demand is increasing, with the highest annual growth rate of 5.8 % in BAU, and projected at slightly lower at 5.0% in APS5 and LCET.
- LNG power plants will be the major power generation source. LNG's share in total power generation output is increasing continually, from 6.4% in 2032 to 55% in 2050 in BAU. But in LCET, natural gas power plants will be the main power-generating source in 2032–2040. Then natural gas with CCS and coal with CCS will contribute the highest generation in 2040–2050, thereby reducing CO_2 emissions. Projected AAGR in power generation in LCET is 9.1%. Solar energy will have the highest AAGR at 16.9% in 2019–2050.
- Hydropower plants will be the second major source of power generation. Their share in total power generation output will increase continually to 46% by 2019 but drop to 20% in 2050 due to LNG's huge contribution.

To implement EEC, the following actions are recommended:

- Establish appropriate policies, including targets and road maps, to promote EEC measures. EEC targets should be for the short, medium, and long term, and focused on the building and industrial sectors. The long-term plan should be based on an assessment of energy-saving potential of all energy sectors, including the residential and commercial sectors, which have large energy-saving potential up to 2050. Some activities can promote EEC, such as (i) support for the development of professionals in the energy conservation field, who can be responsible for energy management and operation; verification and monitoring; consultancy and engineering services provision; and the planning, supervision, and promotion of the implementation of energy conservation measures; (ii) support for the development of institutional capability of agencies and organisations in the public and private sectors to be responsible for planning, supervision, and promotion of the implementation of energy conservation measures; (iii) support for the operation of energy service companies to alleviate technical and financial risks of entrepreneurs who wish to implement energy conservation measures; and (iv) energy conservation public relations and knowledge provision through educational institutions and fostering of awareness amongst the youth.
- Establish a compulsory energy standard and labelling system for electrical appliances. Annual growth of electricity demand in the residential and commercial sectors is projected to be substantial. The measure could generate energy savings.

- Prioritise the development of advanced hydro and thermal power technologies, including coal and natural gas. Hydropower and thermal power plants will be the major source of power generation up to 2050. Therefore, advanced technologies for both types of resources should be prioritised for development from project design onwards.
- Prioritise renewable energy development policies. Renewable energy is an important resource for energy independence, energy security, and GHG emission abatement. The strategy and mechanisms to support renewable energy development must be built up.
- Keep in touch with international and regional CCUS frameworks, such as the Asia CCUS Network. Monitor the development and deployment of CCUS under appropriate carbon-pricing mechanisms in Asia as conducted by Organisation for Economic Co-operation and Development countries and the network. CCS and CCUS will be important innovations in decarbonisation technologies.

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