



ASEAN GREEN
FUTURE PROJECT
PHASE 1 REPORT

Decarbonization in Lao PDR: the options and challenges

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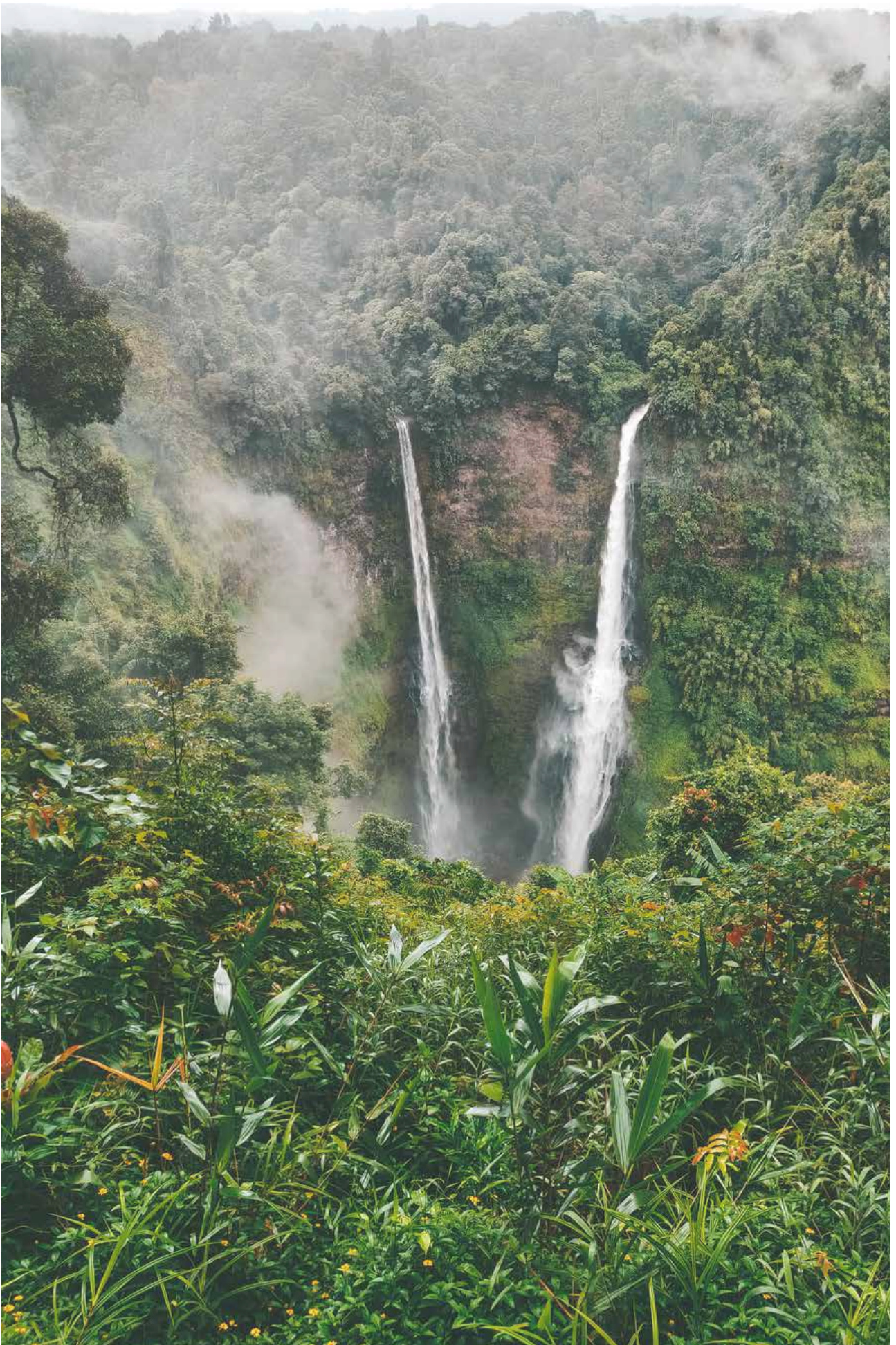
About ASEAN Green Future

The ASEAN Green Future project is a collaboration between the Sustainable Development Solutions Network, ClimateWorks Australia, the Jeffrey Sachs Center on Sustainable Development at Sunway University, and research groups from across Southeast Asia (Cambodia, Indonesia, Laos, Malaysia, and Thailand, with potential participation by Brunei, Myanmar, the Philippines, Singapore, and Viet Nam in the future).

The Phase 1 report of each country team presents priorities and actions to date, and key technology and policy opportunities to further advance domestic climate action. The Phase 1 regional report situates the region's path to low-carbon transition within a global context using the country reports and other studies. This series of reports, produced through a synthesis of existing research and knowledge, builds the case for advancing the region's climate agenda. Phase 2 of the ASEAN Green Future project will undertake quantitative assessments of the different options for decarbonizing the ASEAN countries.

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1. Introduction

The Lao People's Democratic Republic (Lao PDR) is facing various challenges as it pursues sustainable economic growth, poverty reduction and environmental protection. The protection of the environment is the main priority of the Government of Lao PDR.

Lao PDR aims to emerge from Least Developed Country (LDC) status and become a middle-income country by 2030 (GoL, 2020) through sustainable economic growth, eradication of poverty, and environmental protection. The government recognizes the vital link between sustainable economic development and the need to bring environmental considerations into the mainstream and include action on climate change within economic development efforts.

The National Strategy on Climate Change of the Lao PDR (NSCC) was approved in early 2010 (GoL, 2010), and was followed by the Climate Change Action Plan 2013–2020 in April 2013 (MoNRE, 2013). In addition, Laos also submitted its intended Nationally Determined Contribution (INDC) to the United Nations Framework Convention on Climate Change (UNFCCC) on 30 September 2015 (GoL, 2015) and a Nationally Determined Contribution (NDC) in March 2021. In support of these efforts, in 2018 the Government of Lao PDR adopted the Green Growth Strategy to 2030 and issued a number of laws and regulations related to climate change and the environment (including a new forestry law in 2019 and a decree on climate change in September 2019).

Despite these progressive strategies and commitments, Laos is facing a number of challenges in implementing activities to address its climate action targets and goals to minimize climate change. However, there is a large opportunity for Laos to refine its goals, modify the institutional frameworks within which it operates, and facilitate the financing needed to meet both its climate and economic development goals together.



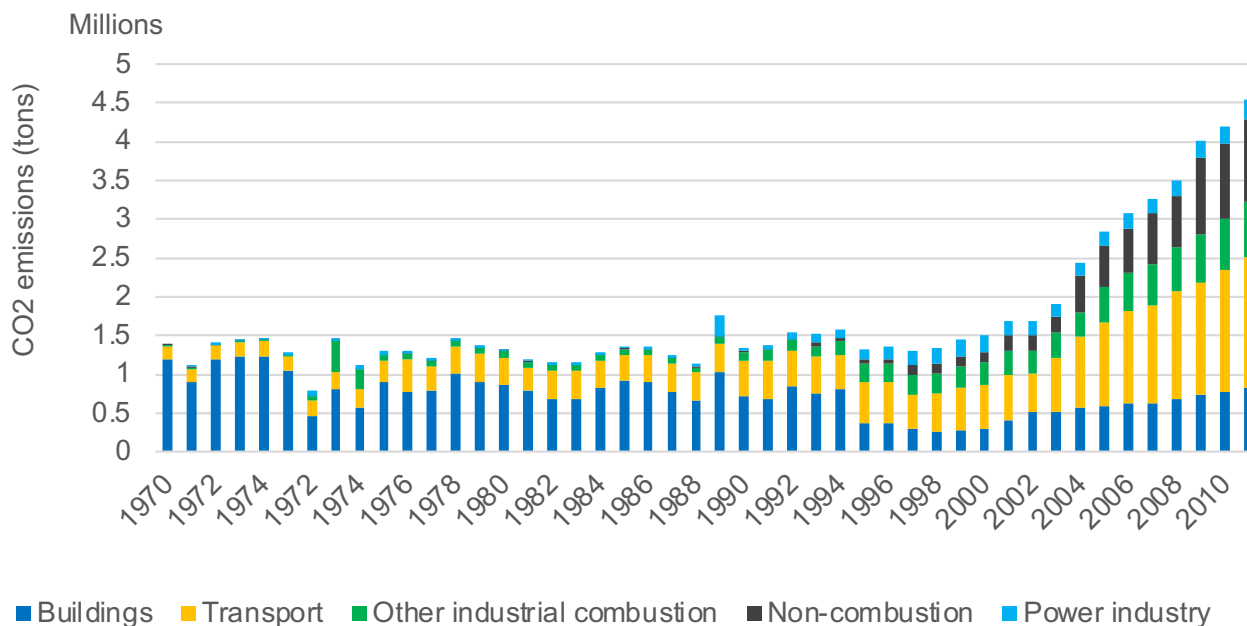
2. Carbon dioxide emissions (CO₂) in Laos

CO₂ emissions in Laos are very low compared to many other countries.¹ CO₂ emissions from Laos totalled 4,531,276 tons in 2016, an increase of 7.92 percent, or 332,393 tons, from the previous year (Figure 2-1). In 2016, the CO₂ emissions per capita in Laos were equivalent to 0.66 tons per person (based on a population of 6,845,846) which represents a change of 6.3 percent in CO₂ emissions per capita from 2015 to 2016.

Laos uses hydropower generation to produce electricity, and exports it to neighboring countries. Almost 100 percent of electricity consumed comes from hydropower generation, but electricity remains a small portion of final energy consumption as shown below. It is primarily due to industrial development that CO₂ emissions have increased.

CO₂ emissions by sector can be divided into transportation (36.9 percent), non-combustion (23.6 percent), buildings (18.4 percent), other industrial combustion (15.7 percent), and the power industry (5.4 percent) (Figure 2-2).

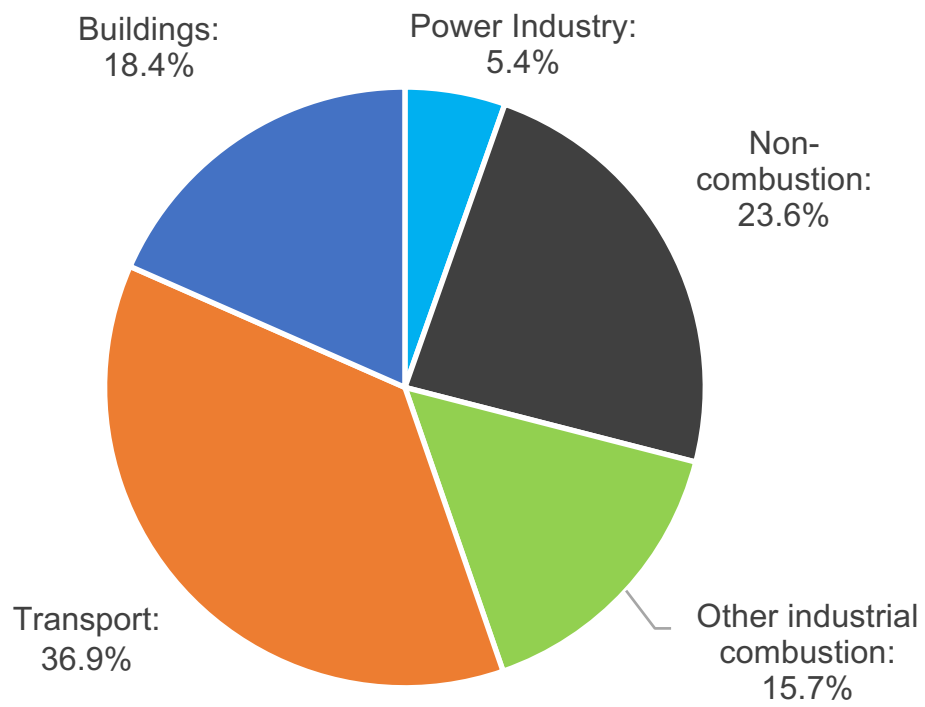
FIGURE 2-1. CO₂ EMISSIONS IN LAO PDR



Source: <https://www.worldometers.info/co2-emissions/laos-co2-emissions/>

¹ CO₂ emissions are 2.660 tonnes per capita in Laos, 3.714 tonnes per capita in Thailand, and 2.698 tonnes per capita in Vietnam (World Bank, 2021).

FIGURE 2-2. CO₂ EMISSIONS BY SECTOR



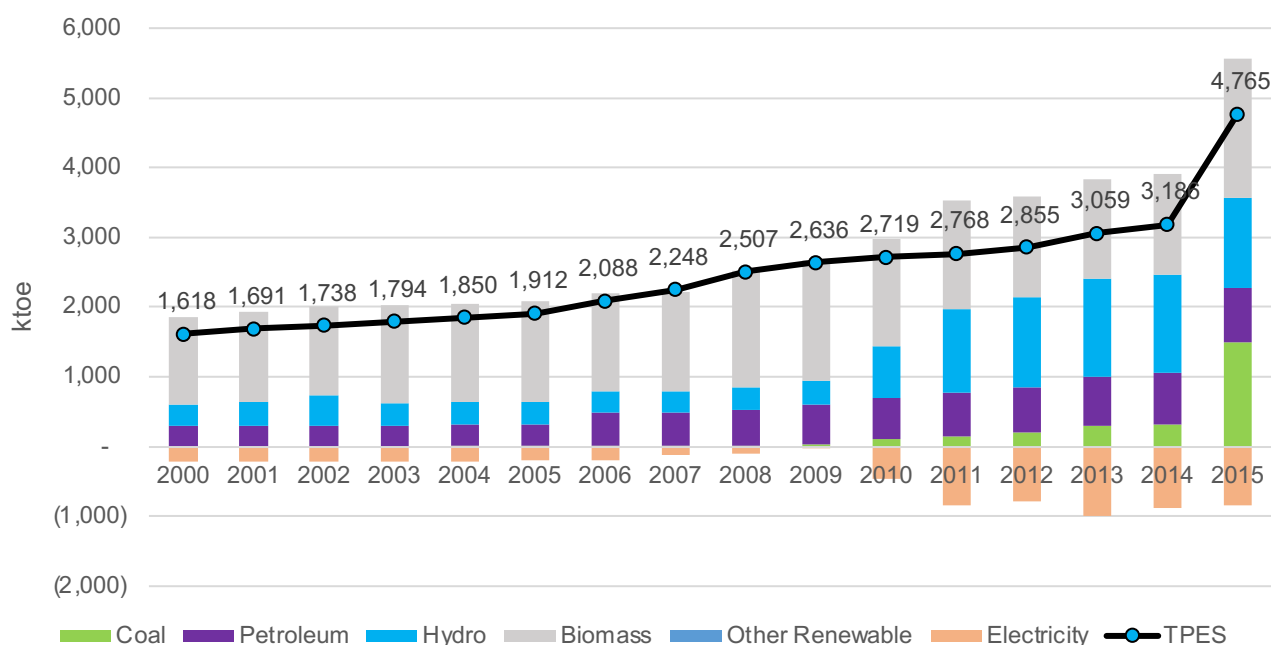
Source: <https://www.worldometers.info/co2-emissions/laos-co2-emissions/>

3. Energy supply and demand in Lao PDR

The total primary energy supply (TPES) increased from 1,618 thousand tons oil equivalent (ktoe) in 2000 to 4,765 ktoe in 2015, at an average annual growth rate of 7.5 percent. Coal saw the highest increase over the 2000–2015 period, at an average growth rate of 42.2 percent per year. The second highest growth during the period was hydropower at 9.8 percent per year. Hydropower is the primary energy source for electricity production in Lao PDR² (Figure 3-1). Petroleum supply also increased rapidly at an average of 8.5 percent a year.

In 2000, the largest share in the TPES was biomass at 78 percent, followed by petroleum (15 percent), hydropower (5 percent), and coal (0.5 percent). By 2015, coal supply was growing rapidly, so coal's share in the TPES had increased significantly to 33 percent (MoEM, 2018). The share of biomass, on the other hand, had declined to 34 percent by 2015, indicating a growing switch from biomass to electricity for cooking in the residential sector. Shares of the other supply sources increased, but not as significantly as coal. Hydropower's share had increased to around 9 percent by 2015 while those of petroleum products had reached 20 percent (Figure 3-1).

FIGURE 3-1. TOTAL PRIMARY ENERGY SUPPLY



Source: MoEM (2018).

² Electricity supply sources are shown in Appendix 3-1.

According to estimates by MoEM (2018), Lao PDR has high potential for the production of electricity from hydropower for domestic consumption and exports.³ MoEM (2018) also notes that transmission and distribution losses are significant, and efficiencies need to be improved across the system (Table 3-1).

TABLE 3-1. ELECTRICITY BALANCE (GWH)

Year	Production	Export	Import	Consumption	Losses
2000	3,438	2,793	180	640	186
2001	3,654	2,871	184	710	256
2002	3,604	2,798	201	767	240
2003	3,178	2,285	229	884	239
2004	3,348	2,425	278	903	298
2005	3,509	2,506	330	1,011	323
2006	3,595	2,487	631	1,406	333
2007	3,374	1,741	793	1,616	810
2008	3,717	2,315	845	1,916	330
2009	3,366	1,921	1,175	2,258	362
2010	8,449	6,646	1,210	2,441	571
2011	12,969	10,669	904	2,556	649
2012	13,057	10,363	1,329	3,075	948
2013	15,510	12,494	1,272	3,381	907
2014	15,275	11,936	1,559	3,792	1,106
2015	16,302	11,549	2,050	4,239	2,565

GWh = gigawatt-hour.

Source: MoEM (2018).

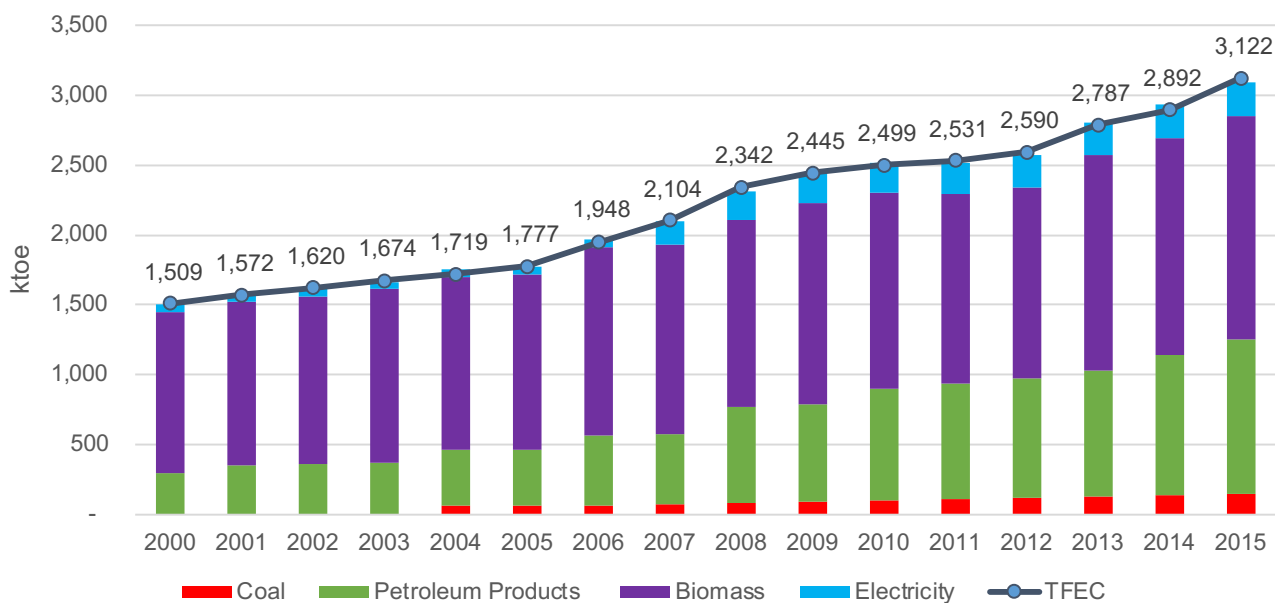
3. 2. Total final energy consumption (TFEC)

The total final energy consumption (TFEC) of Lao PDR increased at an average annual growth rate of 5 percent from 1,509 ktoe in 2000 to 3,122 ktoe in 2015 (Figure 3-2). By type of fuel, coal grew the fastest at 28.4 percent per year, followed by electricity at 13.4 percent per year.⁴ The average annual growth rate of petroleum products consumption was 8.5 percent, while biomass consumption grew by only 1.4 percent per year over 2000–2015 (MoEM, 2018). Despite the high average annual growth rate of consumption during this period, the share of coal in the TFEC was only 13 percent in 2015. The share of electricity in the TFEC was the lowest at 12 percent. Petroleum products and biomass had a total share of more than 76 percent during the 2000–2015 period. The share of biomass in the TFEC decreased from 78 percent in 2000 to 46 percent in 2015 due to the growth of coal and electricity (Figure 3-3).

³ The hydropower potential of Laos was estimated at around 26,000 MW (excluding mainstream Mekong) while the exploitable hydropower potential, including mainstream Mekong, was around 23,000 MW (Pholsena and Phonekeo, 2004).

⁴ The increase in coal sources is mainly from electricity supply using coal. The Hongsa Power Company Limited (HPC) is the first coal fired power plant, established in 2009, with the Government of Lao PDR and private foreign investment as shareholders. The power plant was completed in 2016 and has a capacity of 1,878 MW, the highest capacity in Laos. Most of the electricity is exported to Thailand.

FIGURE 3-2. TOTAL FINAL ENERGY CONSUMPTION BY SOURCE



Source: MoEM (2018).

The residential sector is the highest contributor to the TFEC because it is the major consumer of fuel wood (biomass). Lao PDR's energy consumption in the residential sector increased from 959 ktoe in 2000 to 1,254 ktoe in 2015 at an average rate of 1.8 percent per year. Its share in the TFEC declined, however, from 64 percent in 2000 to 40 percent in 2015.



4. The Reduction of Carbon Dioxide (CO₂) Emissions Plan (2015-2030)

Even though Lao PDR, a Least Developed Country (LDC), has very low CO₂ emissions compared with other countries in the ASEAN, the government intends to implement policies that support the long-term goal of limiting global GHG emissions in line with the objectives of the UNFCCC and the findings of the Intergovernmental Panel on Climate Change's Fifth Assessment Report (Phosalath and Phongpachith, 2019).

The CO₂ emissions reduction plan (2015–2030) is shown in Table 4-1. There are six plans being implemented in Lao PDR: (1) Implementation of the Forestry Strategy to the Year 2020; (2) Renewable Energy Development Strategy; (3) Rural Electrification Programme; (4) Transport-focused National Appropriate Mitigation Action (NAMA); (5) expansion of the use of large-scale hydropower; and (6) climate change action plans (GoL, 2015). The CO₂ emission reduction plans tie with the 9th National Socio-Economic Development Plan (NSEDPP), which brings balance between sustainable economic growth, poverty reduction, and GHG reduction.

Implementation of the Forestry Strategy to the Year 2020 seeks to not only increase forestry cover, leading to reduced GHG concentrations, but also contribute to improvement of the livelihoods of people in Lao PDR. It has the potential to help avoid flooding, soil erosion, and landslides, as well as increase biodiversity and ecosystem services.

Implementation of the Renewable Energy Development Strategy could generate income by selling electricity to neighboring countries. It could also contribute to reducing GHG emissions in neighboring countries, and therefore benefit not only Lao PDR but also the region.

Even though electrification in Lao PDR is quite high compared to some ASEAN countries, implementation of the Rural Electrification Programme would benefit the poor in rural areas and contribute to GHG emissions reductions because most people in rural areas currently use biomass for cooking and other activities. GHG emissions will be reduced, rural development will be promoted, and poverty will be reduced as a result of the rural electrification initiative (Phosalath, and Phongpachith, 2019)

Improved public transportation would decrease GHG emissions from travel and contribute to more sustainable economic growth.

TABLE 4-1. REDUCTION OF CO₂ EMISSIONS PLAN (2015–2030).

No.	Name of activity	Objectives of the activity	Estimated CO ₂ equivalent reductions
M 1	Implementation of the Forestry Strategy to the Year 2020	To increase forest cover to 70% of land area (i.e. 16.58 million hectares) by 2020. Once the target is achieved, emissions reductions will carry on beyond 2020.	60,000 ktCO ₂ e to 69,000 ktCO ₂ e (once the target has been met, from 2020 onwards)
M 2	Implementation of the Renewable Energy Development Strategy	To increase the share of renewable energy to 30% of energy consumption by 2025 large-scale technologies with installed capacity equal to or greater than 15 MW are not included in this target). For transport fuels, the objective is to increase the share of biofuels to meet 10% of the demand for transport fuels by 2025.	1,468,000 ktCO ₂ e per year (once the target has been met in 2020)
M 3	Implementation of the Rural Electrification Programme	To make electricity available to 90% of households in rural areas by 2020. This will offset the combustion of fossil fuels to produce power where there is no access to the electricity grid.	63 ktCO ₂ e per year (once the target has been met in 2020)
M 4	Implementation of transport-focused National Appropriate Mitigation Action (NAMA)	In one NAMA feasibility study, road network development is identified as the primary objective, which will reduce the number of kilometers travelled by all vehicles. The second objective is to increase the use of public transport compared to business as usual. In addition to reducing greenhouse gas emissions, this activity will lead to a reduction in nitrous oxide and sulfur oxide emissions.	Road network development: 33 ktCO ₂ e per year Public transport development: 158 ktCO ₂ e per year
M 5	Expansion of the use of large-scale hydroelectricity	The objective of this activity is to build large-scale (>15 MW) hydropower plants to provide clean electricity to neighboring countries. The total installed capacity of the hydropower plants will be approximately 5,500 MW by 2020. In addition, 20,000 MW of additional hydroelectric capacity is planned for construction after 2020.	16,284 ktCO ₂ e per year (2020–2030)
M 6	Implementation of climate change action plans	To build capacity to monitor and evaluate policy implementation success, with the aim of producing new policy, guidance, and data. The objective is to develop and implement effective, efficient, and economically viable climate change mitigation and adaptation measures.	To be estimated as part of the implementation plan
		\$180 million	
	Estimated cost	This is assuming that the cost for forest management is approximately \$10.84/hectare (this does not include costs related to plantations and therefore provides a lower bound of the total cost related to this measure).	Ends in 2030

Note: CO₂ = carbon dioxide, EU = European Union, kt = kilotonnes, Lao PDR = Lao People's Democratic Republic.

Source: GoL (2015): Lao PDR's Intended Nationally Determined Contribution (INDC).

5. Existing decarbonization analyses and simulations

5.1. Existing decarbonization analyses

Table 5-1 below summarizes mitigation targets (1 to 6) set out in the 2015 NDC and the progress towards their achievement as documented in the 2021 NDC. The Government of Lao PDR had set a target to achieve 70 percent forest coverage of the land area by 2020 (1). However, this target has not been completed. According to Lao PDR's Forest Reference Emission Level (FREL) submitted to UNFCCC in 2018, forest coverage in 2015 accounts for about 58 percent of the country's total surface area. Moreover, Lao PDR increased its hydropower resources to reach over 4,500 MW installed capacity in 2018 (5). About 13,000 kt CO₂e/year emissions were abated in this sector. The amount is equivalent to 26 percent of total national emissions in the year 2000 (50,742 kt CO₂e). In addition, the implementation of the rural electrification program (3) achieved the electrification of 93.79 percent of the total population. However, there are a number of challenges in other targets. Financial constraints were identified as the main challenges for 1, 2, and 4. Data uncertainty, data inconsistency, lack of transparency and access to data, lack of data, and limited cross-sectoral coordination are other key hurdles in the implementation of 1 (GoL, 2020).

TABLE 5-1. STATUS OF 2015 NDC MEASURES

No.	Sectors	2015 NDC measure	Horizon	Progress
M 1	Implementation of the Forestry Strategy to the Year 2020	• Increase forest cover to 70% of land area	2020	Not achieved
M2	Implementation of the Renewable Energy Development strategy	• 30% renewable energy excluding large-scale hydropower	2025	Not on track
		• Share of biofuels to meet 10% of transport fuel needs	2025	Not on track
M3	Implementation of the Rural Electrification Programme	• 90% of households electrified	2020	Achieved
M4	Transport and urban development	• Transport NAMA	2025	Not achieved
M5	Expansion of the use of large-scale hydropower	• Expansion of large-scale hydropower to 5,500 MW (2020)	2020	Achieved
		• 20,000 MW (2030)	2030	On track
M6	Implementation of climate change action plans	• Climate change action plan		On track

Source: GoL (2021).

5.2. The simulation scenarios and methods

According to the Second National Communication to the UNFCCC in June 2013, total emissions of greenhouse gases in Lao PDR were projected to be 50,742.91 kt CO₂e in the year 2000, with land use change and forestry (LUCF) and agriculture responsible for over 95 percent of the total (GoL, 2021).

However, the economic structure of Lao PDR has changed in many ways. For instance, the number of vehicles registered in the country grew dramatically from 367,900 in 2004 to 2,133,500 in 2017 (+480 percent), while transport fuel consumption increased from 855 million liters in 2013 to 1,442 million liters in 2016 (GoL, 2021).

The simulation from the NDC (GoL, 2021) considered three scenarios:

(1) Baseline scenario

The baseline scenario assumed the absence of GHG mitigation activities. This scenario is used for comparison with the other two scenarios: the unconditional and conditional mitigation scenarios. Under the baseline scenario, total GHG emissions in Lao PDR would be expected to reach around 82,000 kt CO₂e in 2020 and 104,000 kt CO₂e in 2030. The main sectors expected to contribute to baseline emissions are land use change and forestry (LUCF), agriculture, and energy, including the transport and power sub-sectors, the latter through the potential addition of coal-fired power generation (GoL, 2021). However, the expansion of coal-fired power generation for domestic uses and exports puts achieving net zero emissions in 2050 at high risk, and also violates international commitments. In addition, coal-fired power generation adds to pollution and health risks (Mokhtar et al. 2014).

(2) An unconditional mitigation scenario

This scenario reflects GHG emission reductions efforts that Lao PDR can commit to, considering its own resources and existing levels of support from developed countries. Lao PDR aims to accelerate the implementation of the national strategy to reduce emissions from deforestation and forest degradation, and foster conservation, sustainable management of forests, buffer zones of protected areas and other preserves, and enhancement of forest carbon stocks. The target is to reduce land use change and forestry (LUCF) emissions by 1,100 kt CO₂e per year on average between 2020 and 2030.⁵

In the energy sector, three sub-sectors – hydropower, energy efficiency, and transport – are the main contributors to mitigation efforts. The total target for installed hydropower capacity in the country by 2030 is set at 13 GW. The introduction of 50,000 energy-efficient cookstoves will reduce the use of biomass for combustion. A new target in the transport sector replaces the M4 target in the 2015 NDC.⁶ The unconditional targets for energy efficiency and the transport sector have been defined, with financing for the projects already secured (Table 5-2).

TABLE 5-2. SECTORAL LEVEL 2030 UNCONDITIONAL MITIGATION TARGETS

Sector	The activities (2020–2030)	Average abatement between 2020 and 2030 (kt CO ₂ e/year)	Share (%)
Land use change and forestry	Reduced emissions from deforestation and forest degradation, fostering of conservation, sustainable management of forests, buffer zones of national parks and other preserves, and enhancement of forest carbon stocks.	1,100	27.7%
Hydropower	13 GW total hydropower capacity (domestic and export use) in the country	2,500	62.9%
Energy efficiency	Introduction of 50,000 energy-efficient cookstoves	50	1.3%
Transport	New rapid transit bus system in the capital, Vientiane, and an associated non-motorized transport component	25	0.6%
	Lao-China railway	300	7.5%
Total		3,975	100%

Source: GoL (2021)

5 The target can be achieved by ongoing projects including Green Climate Fund's FP117: "Implementation of the Lao PDR Emission Reductions Programme through improved governance and sustainable forest landscape management", World Bank's "Lao Landscapes and Livelihoods Project (P170559)" (GoL, 2021).

6 These have not been implemented, namely the construction and operation of a new rapid transit bus system in the capital, Vientiane, the associated non-motorized transport component, and the construction and operation of a Lao-China railway to displace the use of private internal combustion engine vehicles.

(3) A conditional mitigation scenario

This scenario includes additional GHG emissions reductions that Lao PDR could achieve, contingent upon increased levels of financial support from developed countries.

In the land use change and forestry (LUCF) sector, Lao PDR would increase forest cover to 70 percent of the total land area, in line with the National Forestry Strategy (GoL, 2021).

In the energy sector, three sub-sectors would contribute to reaching the conditional target. Renewable energy capacity would be increased to 1 GW solar and wind power and 300 MW biomass power capacity. This new renewable energy target updates the M2 target in the 2015 NDC. Two conditional targets are added in the transport sector, namely 30 percent electric vehicle penetration for two-wheelers and passenger cars in the national vehicles mix, and an increase in the share of biofuels to meet 10 percent of transport fuel needs by 2030, in line with M2 from the 2015 NDC. Finally, a new target of 10 percent reduction of final energy consumption compared to the baseline scenario is introduced in the energy efficiency sub-sector to support the implementation of the 2016 National Policy on Energy Efficiency and Conservation, which estimated total energy demand in Lao PDR as reaching 4,320 ktoe in 2030 (GoL, 2021). The finance needs to implement the conditional measures are shown in Appendix 5-1.

A new conditional target in the agriculture sector is the development of adjusted water management practices in 50,000 hectares of lowland rice cultivation. The agriculture sector is the second most carbon-intensive sector in the country and was not covered in the previous NDC submission (GoL, 2021).

In addition, a new conditional target is introduced in the waste sector through the implementation of 500 tons/day sustainable municipal solid waste management capacity in the capital, Vientiane. The transition towards a circular economy is one of the priority areas in the upcoming 9th National Socio-Economic Development Plan (GoL, 2021).

TABLE 5-3. 2030 CONDITIONAL MITIGATION TARGETS

Sector	Mitigation measure (2020–2030)	Average abatement between 2020 and 2030 (kt CO ₂ e/year)	Share (%)
Land use change and forestry	Increase forest cover to 70% of land area (i.e., to 16.58 million hectares) through reduced emissions from deforestation and forest degradation, fostering conservation, sustainable management of forests, buffer zones of national parks and other preserves, and enhancement of forest carbon stocks.	45,000	98.5%
Renewable energy	Solar and wind: 1 GW total installed capacity in the country	100	0.2%
	Biomass: 300 MW total installed capacity in the country	84	0.2%
Transport	30% electric vehicle penetration for two-wheelers and passenger cars in the national vehicles mix	30	0.1%
	Biofuels to meet 10% of transport fuel needs	29	0.1%
Energy efficiency	10% reduction of final energy consumption compared to baseline scenario	280	0.6%
Agriculture	Adjusted water management practices in 50,000 hectares of lowland rice cultivation	128	0.3%
Waste	Implementation of 500 tons/day sustainable municipal solid waste management project	40	0.1%
Total		45.691	100%

Source: GoL (2021).

This simulation used the UNEP DTU Partnership's⁷ Greenhouse Abatement Cost Model (GACMO). The data came from various sources,⁸ including Lao PDR Second National Communication to the UNFCCC, Lao PDR Technology Needs Assessments Report - Climate Change Mitigation, Lao PDR Forest Reference Emission Level, and Forest Reference Level (FREL/FRL) for REDD+ Results Payment under the UNFCCC (GoL, 2021).

⁷ See detailed information at: <https://unepdtu.org/>

⁸ Greenhouse gases comprise carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). Emissions hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆) are considered negligible in Lao PDR and excluded from the analysis.

5.3. The results of the simulation

In the 2021 Nationally Determined Contribution (NDC) from the Government of Lao PDR (GoL, 2021), three scenarios were simulated: (1) baseline scenario; (2) unconditional mitigation scenario; (3) conditional mitigation scenario. The simulation used the UNEP DTU Partnership's Greenhouse Abatement Cost Model (GACMO). The results of the simulation are shown in Figure 5-1.

Without mitigation activities, in the baseline scenario, GHG emissions soar and could reach 120,000 kt CO₂e/year by 2050. However, if the unconditional mitigation scenario is implemented, GHG emissions could reduce to 40,000 kt CO₂e/year in 2030, and 20,000 kt CO₂e/year in 2050. The conditional mitigation scenario could further reduce GHG emissions to around 20,000 kt CO₂e/year in 2040, and to net zero in 2050 (Figure 5-1).

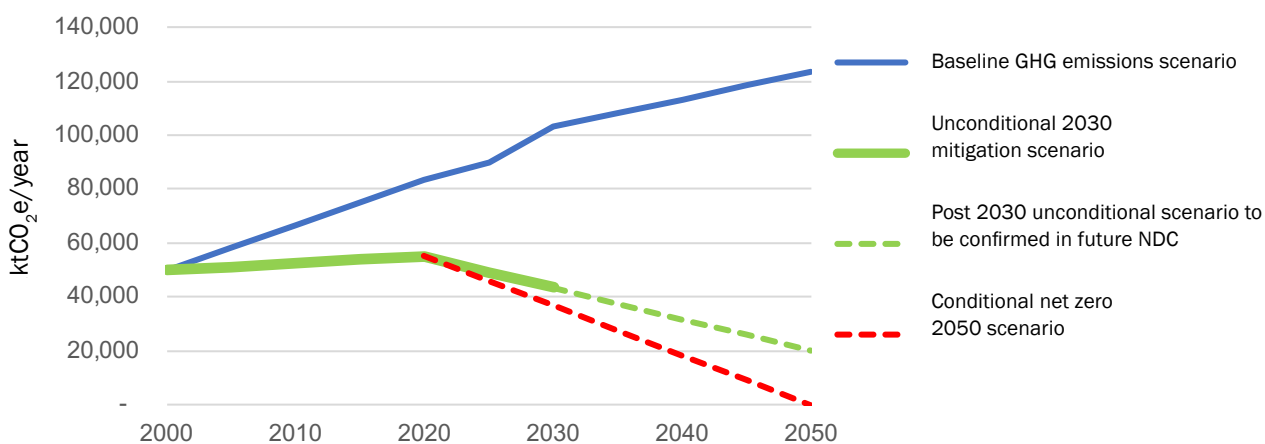
The existing decarbonization plans focused on five areas, including agriculture (M1), forestry and land use change (M2), water resources (M3), transport and urban development (M4), public health (M5), and other sectors in the climate change action plans. Those five sectors are the main priorities of emission reduction and have potential for development in Lao PDR.

Higher ambition via the conditional mitigation scenario is possible if the Government of Lao PDR receives support from international donors. However, there are many challenges to achieving this, as discussed in Section 6.

The Covid-19 pandemic has had a severe impact on GHG emissions in Lao PDR. The main sectors with potential to reduce GHG emissions in Lao PDR are agriculture, and land use change and forestry (LUCF). Due to the Covid-19 pandemic, activity in the industry and services sector has declined, while in the agriculture sector it has increased with higher levels of conversion of forestry land to agricultural land, with significant impacts on natural forestry resources. The loss of forest cover also leads to a decline in biodiversity and ecosystem health, and poverty.

Therefore, the Government of Lao PDR should pay attention to agriculture, and land use change and forestry (LUCF) in the post Covid-19 pandemic recovery.

FIGURE 5-1. SIMULATION RESULTS OF THE GHG EMISSIONS SCENARIOS



Source: GoL (2021).

6. Opportunities and challenges in the implementation of the NDC

One of the essential factors in the execution of the NDC is the Government of Lao PDR's commitment to achieving NDC targets through new government policies and a legislative framework (Vongvisouk et al., 2020). Moreover, as Lao PDR is a least developed country with constraints in human resources and funding availability, international and regional donors are keen to support implementation of the NDC in Lao PDR.

The forestry industry receives greater donor support than other NDC target sectors, supporting the implementation of the Lao PDR's Forestry Strategy to the Year 2020. The Government of Lao PDR's stated national forestry policy, which aimed to grow forest cover to 70 percent of the country's total land area by 2020, is one of the key reasons that various funders are helping to carry out the actions outlined in the plan (Vongvisouk et al., 2020; GoL, 2021).

However, there are some challenges and factors hindering NDC implementation. According to studies by Vongvisouk et al., (2020) and GoL (2021), the most significant challenges for NDC implementation include coordination between systems, insufficient financial support, and the capacity of technical staff and institutions. In addition, Vongvisouk et al (2021) highlight the following challenges related to modalities for transformational change and the need for enhanced capacity and transparency.

The Ministry of Natural Resources and Environment's (MoNRE) Department of Climate Change (DCC) is in charge of NDC coordination. DCC's challenges include a lack of coordination and capacity, and significant personnel turnover in the target sectors. Another barrier to NDC implementation in Lao PDR is funding,⁹ as the government is heavily reliant on donors (Vongvisouk et al., 2020; GoL 2021). This first challenge can be addressed in part by improving institutional setup and creating a more specific mechanism for tracking and reporting on NDC implementation. It is also necessary to improve coordination between key ministries and invest more heavily in data collection and administration capability.

The challenge in NDC implementation is that the NDC is currently under the control of the DCC under the Ministry of Natural Resources and the Environment, but other national institutions, particularly those in target sectors, do not effectively implement or participate in NDC plans. In order for the NDC to be achieved, there will need to be adjustments to governance structure and institutional environment.

The second relates to capacity limits at the national and subnational level. Capabilities to conduct feasibility studies, mitigation analyses, policy development simulations, data analysis, and modeling are still lacking among government employees.

Third is data accuracy and availability. According to Vongvisouk et al (2020) and GoL (2021), there are a lack of comprehensive, up-to-date data collection systems and analysis available to government officials. Transparency is another problem for collected data, methodologies, and analysis results (Vongvisouk et al., 2020; GoL, 2021).

A fourth challenge is the lack of funding and finances for NDC implementation. The government does not have the budget necessary to support all NDC activities, despite Lao PDR receiving significant donor funding for the forestry sector (Vongvisouk et al., 2020). An integrated budgeting and review process that aligns economic and environmental objectives with government financing instruments is needed.

⁹ Investment in hydropower plants is via Foreign Direct Investment (FDI); see the FDI by sector and country in Appendix 6-1, 6-2, and 6-3.

Fifth is the coordination between international donors. Each donor has their own vision and mission,¹⁰ and the donors do not coordinate with each other effectively. As a result, funded projects or activities by multiple donors tend to overlap, resulting in ineffective implementation.



10 According to Vongvisouk et al. (2020), the forestry sector has received larger funding than other sectors.

7. Key opportunities and key risks

7.1. Key opportunities for economic growth

The key opportunity for economic growth in the country, particularly in low-carbon or climate-affected sectors, is hydropower electricity.¹¹ This allows the generation of electricity from water resources without producing GHG emissions. The Government of Lao PDR also allows foreign investors to invest in hydropower electricity for domestic uses and export to neighboring countries (Pholsena and Phonekeo, 2004).

In addition, Lao PDR has abundant water and land resources, which are not yet polluted. The Government of Lao PDR has supported organic agriculture products and trades. This sector has high potential for reducing GHG emissions and increasing sustainable development in Lao PDR.

7.2. Key risks and opportunities for finance and investment flows

The Government of Lao PDR promotes private sector and direct foreign investment in hydropower electricity generation. The private sector investment mostly follows the model of build-operate-transfer in the hydropower electricity sector (Kyophilavong, 2016; Kyophilavong and Toyoda, 2012). As a result, this industries have been booming in the past two decades, primarily due to exports.

However, this sector is facing risks. First is the risk of climate change. The generation of hydroelectricity is highly dependent on rainfall and water resources. However, due to climate change, rainfall has decreased, causing lower levels of electricity generation (Spalding-Fecher et al, 2017; Chilkoti et al, 2017). According to the annual report of the EDL-Generation Public Company (EDL-Gen) (2019), the largest electricity hydropower generation company, electricity production did not meet targets due to declining rainfall. In addition, there are risks of pollution of natural resources, including of forestry cover, water, and soil.

7.3. Increasing global momentum creates risks for delay

Despite having many opportunities to reduce GHG emissions, the Government of Lao PDR is facing several risks. First, finance and human capital availability are risks to achieving the targets. Lao PDR is facing both large budget deficits and a lack of human resources at the central and provincial level to implement the climate change strategy (World Bank, 2021). Second, market incentives and tools to involve private sectors and consumers in reducing GHG emissions are not in place. Until now, the Government of Lao PDR has not had taxes, subsidies, and financial incentives to reduce GHG emissions. Third, as Lao PDR is facing government budget deficits and a high rate of poverty, the use of coal to generate electricity for export might increase in the future.

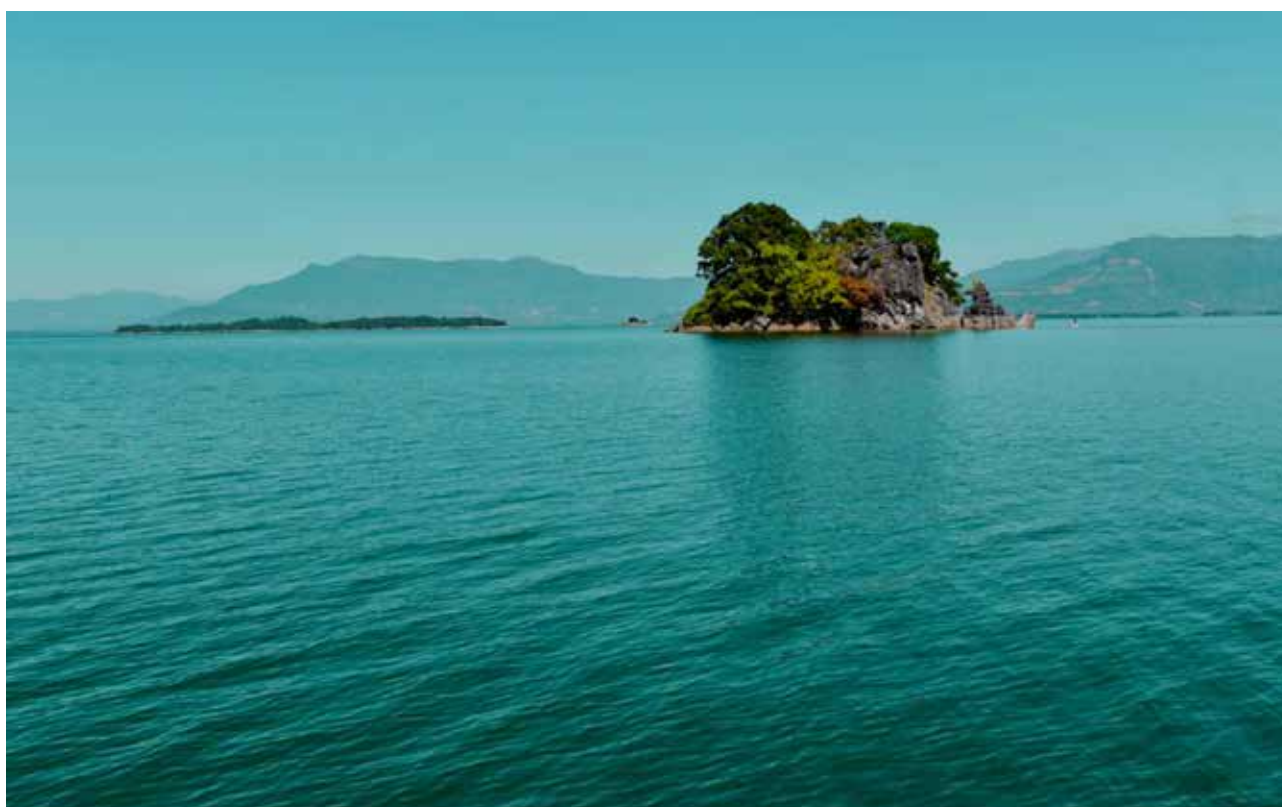
¹¹ Laos has extensive water resources with high potential to produce electricity from hydropower. The theoretical hydropower potential of Lao PDR is about 26,000 MW (excluding mainstream Mekong) while the exploitable hydropower potential, including mainstream Mekong, is around 23,000 MW (Pholsena and Phonekeo, 2004).

8. The key recommendation

Lao PDR has committed to the agenda of the UNFCCC and reduction of CO₂ emissions is a priority of the Government of Lao PDR. Lao PDR developed the National Strategy on Climate Change (2010), the Climate Change Action Plan 2013–2020 (2013), a submission of Lao PDR's Intended Nationally Determined Contribution (INDC) to the UNFCCC (2015), the Green Growth Strategy till 2030 (2018), and the 9th Five-Year National Socio-Economic Development Plan (2020–2025) (MoPI, 2021). The development strategy is to achieve the Least Developed Countries (LDC)'s criteria through high quality, inclusive, green growth, and attain the UN's Sustainable Development Goals (SDGs) by 2030.

Despite having many opportunities to support decarbonization, a number of challenges remain to Lao PDR's efforts to reduce its emissions. The key recommendations for tackling these challenges and removing barriers to climate action are: first, to improve institutional setup and create a more specific mechanism for tracking and reporting NDC implementation; second, to strengthen governance structure and the institutional environment; third, to improve the capacity of government staff at the national and subnational level; fourth, to improve data accuracy, availability, and transparency; fifth, to support funding and finances for NDC implementation; and sixth, to improve coordination between donors. The development of coal-fired power plants could bring high risk to achieving the commitments, and damage both health and the environment.

Finally, there are number of potential benefits of the clean energy transition such as a reduction in health costs, creation of emissions sinks, development of a sustainable forestry industry and production of minerals to serve the green value chain of the region.



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Appendix

3-1. ELECTRICITY PRODUCTION BY SOURCE (GWH)

Year	Hydro	Coal	Solar	Biomass	Total production
2000	3,438				3,438
2001	3,654				3,654
2002	3,604				3,604
2003	3,178				3,178
2004	3,348				3,348
2005	3,509				3,509
2006	3,595				3,595
2007	3,374				3,374
2008	3,717				3,717
2009	3,366				3,366
2010	8,449				8,449
2011	12,969				12,969
2012	13,057				13,057
2013	15,505			5	15,510
2014	15,270		0	5	15,275
2015	14,039	2,259	0	4	16,302

Source: MoEM (2018).

APPENDIX 5-1: ESTIMATED FINANCING NEEDS - CONDITIONAL MEASURES

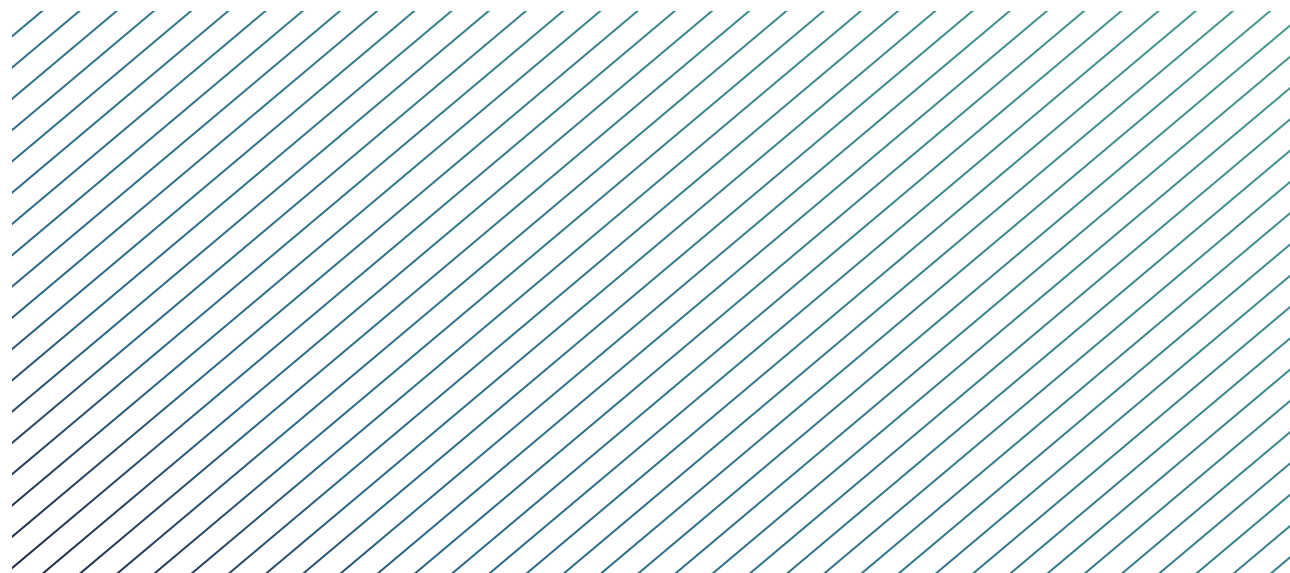
2030 Conditional mitigation measure	Financing needs (million USD)
Increased forest cover to 70% of land area	1,700
Solar and wind: 1 GW installed capacity	1,500
Biomass: 300 MW installed capacity	720
30% electric vehicle penetration for two-wheelers and passenger cars	500
Biofuels to meet 10% of transport fuel needs	230
10% reduction of final stationary energy consumption	30
Adjusted water management practices in 50,000 ha of rice cultivation	65
Implementation of 500 tons/day sustainable municipal solid waste treatment	17
Total financing needs - conditional measures	4,762

Source: GoL (2021): Nationally Determined Contribution (NDC)

APPENDIX 6-1. FOREIGN DIRECT INVESTMENT (FDI) INFLOW TO LAOS (1989-2015)

Year	Value of investment (million USD)	Number of projects
1989	29	9
1990	3.9	25
1991	28	35
1992	69	54
1993	778	80
1994	1313	120
1995	53	82
1996	114	33
1997	659	45
1998	1385	56
1999	186	58
2000	513	61
2001	72	45
2002	434	66
2003	65	121
2004	217	132
2005	119	175
2006	789	260
2007	3128	347
2008	5000	531
2009	1100	616
2010	2850	442
2011	3550	417
2012	1850	442
2013	2640	96
2014	500	56
2015	100	56

Source: Kyophilavong et al (2017).



APPENDIX 6-2: TOP 10 FOREIGN DIRECT INVESTMENT (FDI) BY COUNTRY (1989-2015)

Country	Value of investment (million USD)
China	5484
Thailand	4491
Vietnam	3574
Malaysia	813
South Korea	751
France	491
Japan	438
Netherland	435
Norway	436
Britain	202

Source: Kyophilavong et al (2017).

APPENDIX 6-3. FOREIGN DIRECT INVESTMENT (FDI) BY SECTOR (1989-2015).

No.	Sector	Value of investment (million USD)	Investment share (%)
1	Electricity generation	7,303	30
2	Mining	5,698	23
3	Agriculture	2,946	12
4	Service	2,544	10
5	Industry and handicraft	2,111	9
6	Hotel and restaurant	1,023	4
7	Construction	827	3
8	Telecom industry	663	3
9	Wood	410	2
10	Banking	372	2
11	Trading	325	1
12	Garment	95	0
13	Consulting	67	0
14	Public health	64	0
15	Education	31	0
	Total	24,479	100

Source: Source: Kyophilavong et al (2017).





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