LAO PEOPLE'S DEMOCRATIC REPUBLIC

PEACE INDEPENDENCE DEMOCRACY UNITY AND PROSPERITY

DRAFT

THE FIRST BIENNIAL UPDATE REPORT

24 July 2020

FORWORD

Climate is changing, and it has become global concerns. Mitigation and adaptation in sustainable development context are among the key options for world. Lao PDR supports the actions by becoming a part to the United Nations Framework Convention on Climate Change (UNFCCC), and implement Conference of the Parties' decisions. Lately, Lao PDR adopted the Paris Agreement, and Sustainable Development Goals (SDG) in 2019. In addition, Lao PDR updated the Intended Nationally Determined Contributions to Climate Change (NDC), formulated Decree on Climate Change, Reducing Emissions from Deforestation and Forest Degradation (REDD+), the National Green Growth Strategy and mainstreaming mitigation actions in the 9th national socioeconomic development plan.

Despite strong commitments, Lao PDR has faced number of barriers, need financial and technical support from development partners and international and region organisations, and fund to effectively implement the mitigation policies and strategies and contribute to international communities. Like this BUR, without the support from the Global Environment Facility and United Nations Environment Programmes, Lao PDR would face difficulties to complete this report and address the requirements and the commitments.

This report represents an essential contribution of the Lao PDR to cope with climate change and sustainable development of the country.

EXECUTIVE SUMMARY

In accordance with the COP16 agreed in Cancun December 2010, Lao PDR as a non-Annex I parties to UNFCCC prepared its first Biennial Update Report (BUR) in cooperation with United Nations Environment Programme (UNEP) and support by the Global environment Facility (GEF). This BUR provides information on national circumstances, greenhouse gas (GHG) inventory, mitigation actions, monitoring, reporting and verification (MRV), constraints, gaps, and support needs for especially implementation of mitigation actions. Importantly, its annex includes information about activities and plans on Reducing Emissions from Deforestation and Forest Degradation (REDD+) for result-based payment.

Geographically, Lao PDR is a landlock country, and around 80% of the land area (236,800 km²) is mountainous. Lao PDR is in the humid zone, influenced by monsoon wind from the south west, which causes a lot of rain and moist. The average rainfall of about 1,900 millimetres per year, and the average temperature is around 25-27°C. Socioeconomically, Lao PDR is a small population and economic country. Natural resources, however, remains abundant for the country to protect environment including climate change mitigation and adaption, and pursue sustainable development. As of 2018, total population of Lao PDR was 7.016 million people, and the Gross Domestic Product (GDP) per capital was USD 2,585. Gross National Product (GNP) was around US$ 17.32 billion, and service accounted for 41.61%, which was the highest contribution in the economy. Industry, Agriculture and Taxes shared 31.53%, 15.71% and 11.15%, respectively. As for natural resources, approximately 90% of land area is in Mekong River Basin and its tributaries. These provides potential of large-scale hydropower of about 23,000 megawatts (MW). So far, only 5% of the potential is exploited. Apart from this, Lao PDR could produce electricity from renewable energy including small scale hydropower, solar, biomass, etc of around 725 MW by 2025. Forest cover remains high (58% of the country) despite of decrease from years to years. Mineral resources such as gold, diamond, coal, oil, metal, copper, salt, lead, zinc, gypsum, and others, are partly intact.

Total emissions are also small in comparison with other country in the regions. The net emissions were 24,099.98 GgCO2eq in 2014. AFOLU was the highest carbon sources and sink. AFOLU sector had net emissions of 18,793.41 GgCO2eq, which was the largest sources of emissions, accounting for about 78% of the total emissions. Second largest source of emissions was Energy Sector, which emitted 3,729.42 GgCO2eq (15%). The rest, IPPU and Waste shared 5% and 2% of the national emissions, respectively.

To address the emissions, and contribute to climate change mitigation, Lao PDR, especially in partner with development partners, has made much effort and progress to identify and implement measures for mitigating climate change. In past 10 years. Lao PDR developed and implemented the National Strategy on Climate Change (NCCS) (2010), Climate Change Action Plan (2013), the First Intended Nationally Determined Contributions to Climate Change (INDC) (2015), Climate Change Technology Action Plan (2017). Currently, Lao has Decree on Climate Change in place since September 2019. In addition, climate change mitigation actions were integrated in the national and sectoral policies and plans, such as the 8th National Socioeconomic Development Plan (NSEDP) 2016-2020, Strategy on Renewable Energy, Forestry, and Green Growth Strategy, among others. At the programme and project level,

NAMAs on renewable energy, transport development, and REDD+ have been studied and piloted. However, the majority of implementation and progress were in the forest sectors or REDD+, and some in energy and transport sector and largely dependent on external support and investment. It is matter of fact that, despite strong commitments, Lao PDR has faced number of constraints and barriers, especially financial and technical including environmentally friendly and climate change mitigation technology issues. In future, Lao PDR still need financial and technical support to implement the following mitigation programmes.

1. Renewables development strategy and NAMAs
2. Polices on energy conservation and efficiency
3. Forestry and REDD strategy including upscaling REDD+ programmes and result base payment
4. Sustainable and low carbon transportation strategy and NAMAs
5. Policy on clean and green industry strategy including environment management system
6. The national strategy on climate change
7. the national green growth strategy
8. National communication on climate change and BUR
9. Technology transfer including technology needs assessment and action plan
10. Natural resources and environment strategy and
11. Mitigation action indented in the 9th national socioeconomic development plan.

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LIST OF ACRONYMS, ABBREVIATIONS

ADB	Asian Development Bank
BUR	Biennial Update Report
CliPAD	Climate Protection through Avoided Deforestation
COP	Conference of the Parties
DCC	Department of Climate Change
EIA	Environmental Impact Assessment
EPF	Environmental Protection Fund
FAO	Food and Agriculture Organization (of the United Nations)
FCPF	Forest Carbon Partnership Facility
FIM	Forest Information Management
FIP	Forest Investment Programme
FIPD	Forest inventory and Planning Division
GCF	Green Climate Fund
GEF	Global Environment Facility
GDP	Gross Domestic Product
GHG	Greenhouse gas
GIZ	Deutsche Gesellschaftffs Internationale Zusammenarbeit (German Agency for International Cooperation)
GOL	Government of Lao PDR
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
JICA	Japan International Cooperation Agency
kfW	Kreditanstalt fur Wiederaufbau (German Development Bank)
MAF	Ministry of Agriculture and Forestry
MEM	Ministry of Energy and Mines
MOF	Ministry of Finance
MONRE	Ministry of Natural Resource and Environment
MPI	Ministry of Planning and Investment
MRV	Measuring/Monitoring, Reporting and Verification
NC	National Communication on Climate Change
NFI	National Forest Inventory
NFMS	National Forest Monitoring System
NGOs	Non-Government Organizations
ODA	Official Development Assistance
OECD	The Organization for Economic Co-operation and Development
PAREED	Participatory Land and Forest Management Project
PLUP	Participatory Land-use Planning
REDD	Reducing Emissions from Deforestation and Forest Degradation
REDD+	Reducing Emissions from Deforestation and forest Degradation plus the conservation of forest carbon stocks, sustainable management of forests and enhancement of forest carbon stocks
REL	Reference Emissions Level
R-PP	Readiness Preparation Proposal
SESA	Strategic Environmental and Social Assessment
SFM	Sustainable Forest Management

SIDA	Swedish International Development Agency
SNC	The Second National Communication on Climate Change
SNV	Netherland Development Organisation
SUFORD	Sustainable Forestry and Rural Development
TNC	The Third National Communication on Climate Change
TWGs	Technical Working Groups
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
WCS	World Conservation Society
WREA	Water Resources and Environmental Administration
WRI	World Resource Institute
WWF	Worldwide Fund for Nature

CHAPTER 1: NATIONAL CIRCUMSTANCES AND INSITUTIONAL ARRANGEMENTS

1.1 GEOGRAPHICAL AND PHYSICAL CONTEXT

Lao PDR situated in the Annamite Mount Range in the South East Asia, sharing the border with China to the north; Vietnam to the East; Cambodia and Thailand to the South and Southwest; and Myanmar to the north west (Figure 1). Lao PDR has total land area of 236,800 squares kilometres. Around 80% of total land area is mountainous and 1/3 of it has the slop above 30% and 20% is flat land along the Mekong River. The elevation ranges from 200 to 2,880 meters above sea level.

Lao PDR is in the humid zone, influenced by monsoon wind from the south west, which causes a lot of rain and moist. There mainly 2 seasons: raining season is from May to September with the average rainfall of about 1,900 millimetres per year (80% of a rainfall during a year). Dry season starts from October to April, influenced by cold wind from the north east, which causes the temperature to drop between November and January. Average temperature is about 20° C in the north, and 25-27° C in the rest of the area[1].

Figure 1 Map of the Lao PDR

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[1] National Statistical Bureau (2015). Statistical Yearbook 2015.

1.2 NATURAL RESOURCES

Overall, Lao PDR is a natural resources rich and good environment country in the region, among others, and social economic development largely depends on the natural resource.

Soils

Land use is classified into 6 main categories: forest, cropland, grassland, settlement, other land, and wetland including water. Settlement especially included industrial, transportation, cultural, national defence and security and infrastructure land. On one hand, based on the national land use strategic plan, land is divided into 2 categories: natural resources conservation area (70%); land for economy development and settlement (30%) (Table 1).

Table 1 Strategic Land Use in Lao PDR

No	Land Catgeories	Total areas	
		Hectares(ha)	Percent(%)
I	**Conservation land for forest cover 70%**	**16.576.500**	**70**
1	Conservation forest	4.718.000	**20**
2	Protection forest	8.247.000	23
3	Production forest	3.110.000	13
4	Industrial tree plantation	501.500	2
II	**Land utilization and Economic development(30%)**	**7.102.500**	30
1	Agriculture	4.502.500	19
1.1	Paddy field	2.000.000	8,4
1.2	Biennial plants and Short live plants	1.000.000	4,2
1.3	Fruit tree cultivation	802.500	3,4
1.4	Pasture	700.000	3
2	Building up and other usage	2.600.000	11
2.1	Transportation	180.000	0,8
2.2	Construction	370.000	1,6
2.3	Others	2.050.000	8,6
	Total areas	**23.680.000**	**100**

Source: National Land-use Master plan, 2018

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Water Resources

Lao PDR has abundant water resources including river network. Average rainfalls are approximately 1,900 millimetres per year, and 80% occurs in the raining season and 20% in dry season. Surface water is about 332,5 kilo cubic meters, and on average, 55,000 cubic meter per head per year. About 90% of land of the country is in Mekong River Basin and its 13 river tributaries, and 35% of Mekong water flow is from Lao territory. The ratio of water consumption in the country is 4,260 million cubic meters, accounting for 1.3% of the total freshwater resources. Water use ratio in industrial sector is 4%; household use 3.1% and agriculture 93%. Hydropower potential development is around 23,000 megawatts, and only 5% is exploited.

Forest Resources

Lao PDR used to have very high cover in the region compared to total land area. However, it decreased from time to time over past five decades. Forest cover assessment have been conducted using the combination of sample plot and satellite base estimation from the year 1982-2010, and it showed that the forest cover went down from 70% in 1940 to 41.5% in 2020. In 2015 wall to wall mapping and ground truth was conducted. The result show that from 2005 – 2015: 2005 forest cover is 60.2% or equivalent to 14.3 million hectares, 2010 forest cover is 59.3% or equivalent to 14 million hectares and 2015 forest cover is 58% or equivalent to 13.7 million hectares. (Figure 2). The main driver of deforestation is commercial logging, household use, shifting cultivation, agriculture extension, mining, hydropower, infrastructure development and expansion of settlement area.
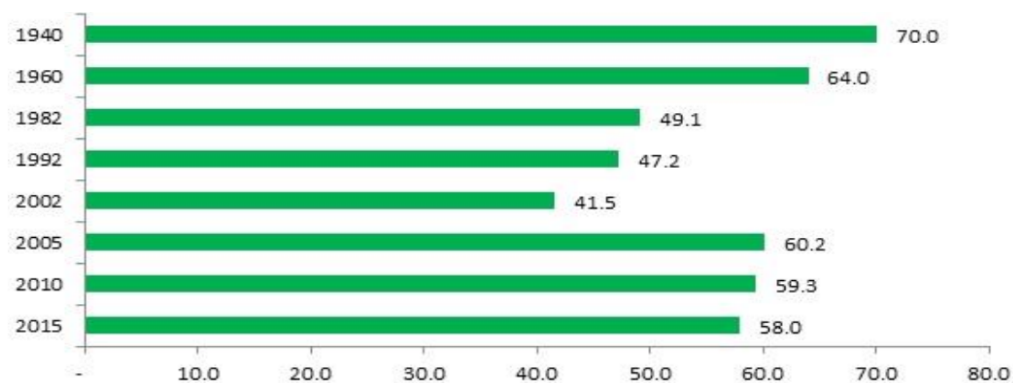
Figure 2 Forest cover (%) in Lao PDR 1940-2015

For the year 2015, 3.1 million hectares of the production forest area, the forest cover is 2.2 million hectares cover 70.8%; 7.9 million hectares of protection forest area the forest cover is 4.8 million hectares cover 59.8%; and 4.8 million hectares of conservation forest area forest cover is 4.8 million hectares cover 73.4%; and forest area that are outside the 3 forest categories is 7.8 million hectares has forest cover of 3.2 million hectares cover 42.5%.

Table 2 Forest areas in 2015

Forest categories	Areas (Mha)	Forest cover (Mha)	Percent of forest cover
Production forests	3,1	2,2	70,8
Protection forests	7,9	4,8	59,8
Conservation forests	4,8	3,5	73,4
Forests have not categorized yet	7,8	3,2	42,5

Mineral Resources

Apart from the existing operations (Table 3), more than 500 locations were intact. Those minerals include gold, diamond, coal, oil, metal, copper, salt, lead, zinc, gypsum, and others, which is the main important income source of the country.

Table 3 Minerals explored in Lao PDR from 2009 to 2013[2]

Minerals	Unit	2009	2010	2011	2012	2013
Gold	Kg	5,033	5,061	3,984	6,415	6,838
Silver	Kg	14,726	15,788	16,738	19,181	29,715
Copper	Ton	67,561	64,241	78,859	86,295	90,03
Copper(concentrate)	Ton	54,019	67,806	59,897	63,285	64,885
Baritina	Ton	12,46	17,5	2,5	21,9	22
Cement	Ton	1,000,000	1,200,000	1,300,000	1,500,000	1,500,000
Lignite Coal	Ton	466,082	501,622	511,7	578,068	580
Gypsum	Ton	761,331	553,396	686,15	578,534	580
Instrasite Coal	Ton	167,447	211,721	166,609	133,583	135
Limestone	Ton	1,488,070	3,106,724	997,591	1,014,000	1,000,000
Tin	Ton	598	925	674	762	800

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[2] MEM (2013). Mineral statistic magazine 2013

Minerals	Unit	2009	2010	2011	2012	2013
Lead	Ton	2	2,27	2,921	4,51	4,5
Zinc	Ton	4	5	5,32	5,25	5,5
Iron	Ton	42	50,9	42,7	48,4	50

In the year 2011 – 2015 mining industrial have a total revenue of 66,746.83 billion-kip average of 6.97% per year, compare to the revenue in the year 2006 – 2010 increase 184.18% (Ministry of Energy and Mining, 2015). However, the contribution to GPD from mining sector is 6.6%, for the year 2010 and 2012 is 8% and 7% respectively (National Bank of Laos, 2013). The volume of mineral produced in Lao PDR during 2009 – 2013 overall is increasing especially the production of silver in 2013 which increase about 55% from 19,181 kilograms in 2013 to 29,715 kilograms in 2013. Exception for cement which decreasing in 2011 – 2013 compare to the volume produced in 2010 show 3 times decrease (Table 3)

1.3 STATE OF THE ENVIRONMENT

Overall Lao PDR still have good environment, peaceful, and secure. However, the ratio of the fast development may have impact on environment: more and more people move from rural area are increasing which lead to the lack of infrastructure, air pollution, water, land, disturbance (haze, smell, noise and colour), chemical, heat, dust, garbage, water pollution, society, green area, city parks and others. At the present the number of garbage in the city is increasing about 0.65 kilo/people/day in 2000 to 0.79% per year and in the rural area is 0.31% per year. Development and management of the city, building and settlement is not promoted fully and not perfectly design to suit with the sustainable of environment: save energy of light under building, house, public transportation system energy use not suitable, green area, park, lake and waste management system, inadequate environmental management plan and others.

In 2017 the government approved and introduced national environment regulation, which set the indicator the quantity of chemical and air pollution is the air, soil and water including the disturbance to overall environment and management of pollution is a technical tools for

every related sectors to use the same standard in the work of pollution protection and control.

In the past the environmental protection work have been fix from central to grassroot level which implemented base on the environmental protection law 2012 and national environmental strategy, Vientiane 2020, national strategy on education and awareness rising 2020, together with the implementation of 5 years plant every 5 year, the most important was the change in basic infrastructure of environmental protection work which cover all aspect and suitable with the current situation of social economy in the country.

Nevertheless, the environmental protection will only move forward still have some issue that will need to address and coordinate with many related sector, technical and funding for environmental data collection still limited, funding for the implementation of environmental protection, society and nature still limited, inadequate plan on environmental protection and some regulation still missing from environmental protection law.

1.4 CURRENT STATE OF THE NATIONAL SOCIOECONOMY

Population of Lao PDR is increasing at a high rate, the total population increased from 5.6 million in 2005 to 6.49 million in 2015 with the increment ratio of 1.45% per year and population density in Lao PDR is 27 people per square kilometre is very low compare to the other countries in South East Asia (Figure 4 and Table 4). The ratio of the increment ratio can be divided into the age group which show a huge difference especially the population in the age of 5 – 14 will decrease about 3.7%, however, the population with employment will increase 10.6% and the elderly will increase 10.1%. The structure change of the age group especially the increase in teenager population will positively contribute to the growth of the country population (national population and household report, 2015)

Figure 3 Population growth 1985-2015

According to the past population age structure indicated that the ratio of new-born had a big increase which lead to the increase of other age group as well; for that reason, the overall population also increase. Population age structure that are changing will get more "Population benefits", in which the ratio of the employed population will increase, at the same time the ratio of the unemployed will decreases. In the year 2015 the ratio of the unemployed population reduces from 0.62% to 0.51% in the year 2023 and will continue to decline to 0.43 in 2045, the said ratio will increase again after 2050. Nevertheless, the population with high age group will not be a problem for Lao PDR because the ratio of the high age group is 3.8% it still lows compare to the other countries in the region, however, the ratio will rapidly increase after 2020. At the year 2050 the ratio of the high age group in Lao PDR still lower than Laos at the present.

Economy Development

From the year 2010 to 2018 the economy of Lao PDR has been continuously and steadily growing at average of 7.5% per year, a large proportion of the growth mostly come from Service and Industrial sectors (Table 5). Total GDP per capital has continuously increasing due to the result of the implementation of social economic development plant from the year 2011 to from the total of 1,217 USD in the year 2010 - 2011 to 1,970 USD in the year 2014 - 2015 and 2,558 USD in the year 2017 – 2018 (Figure 5). In the year 2011, Lao PDR has GNI of 1,010 USD per capital and increased to 1,232 USD in the year 2015 and 2,209 USD. The continuously

growing of the economy due the government mechanism and the suitable macroeconomic management measures; the nation is peaceful, and the society is courteous; political and economic stability; increasing the international and regional integration. From the growth of the economic has reduced the poverty rate from 27.6% in 2008 to 23.2% in 2012-2013 (LECS V).

Table 4 GDP growth rate from 2011 to 2018

	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
GDP growth	8,1	8,3	8,0	7,8	7,5	6,9	6,8	6,5
Agriculture and Forest	2,9	2,8	3,1	3,0	3,0	3,0	2,8	2,5
Industry	15,8	14,4	7,4	8,5	8,9	9,0	9,5	7,7
Service	7,8	8,1	9,7	9,3	9,1	8,5	6,2	7,6
Product and import taxes	-	-	-	-	-	3,8	6,9	3,7

Source: Socio-economic development summary annual report 2010-2011 and 2018-2019
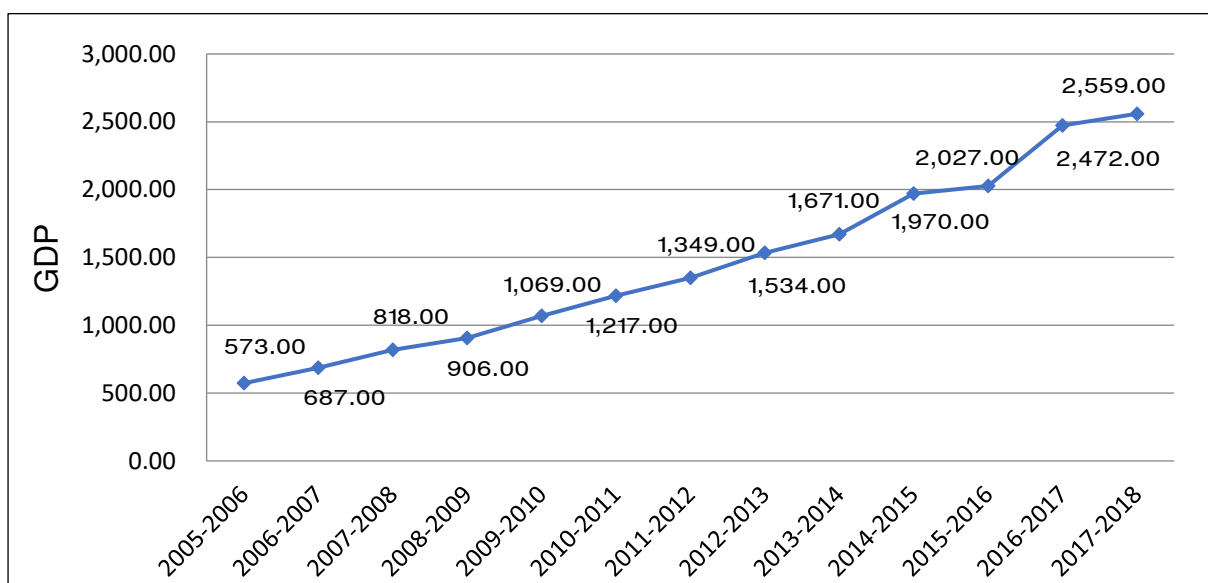
Source: Socio-economic development plan summary annual report 2005-2016 and 2018-2019

Figure 4 Average GDP growth rate/person/year, 2005-2016 and 2018-2019
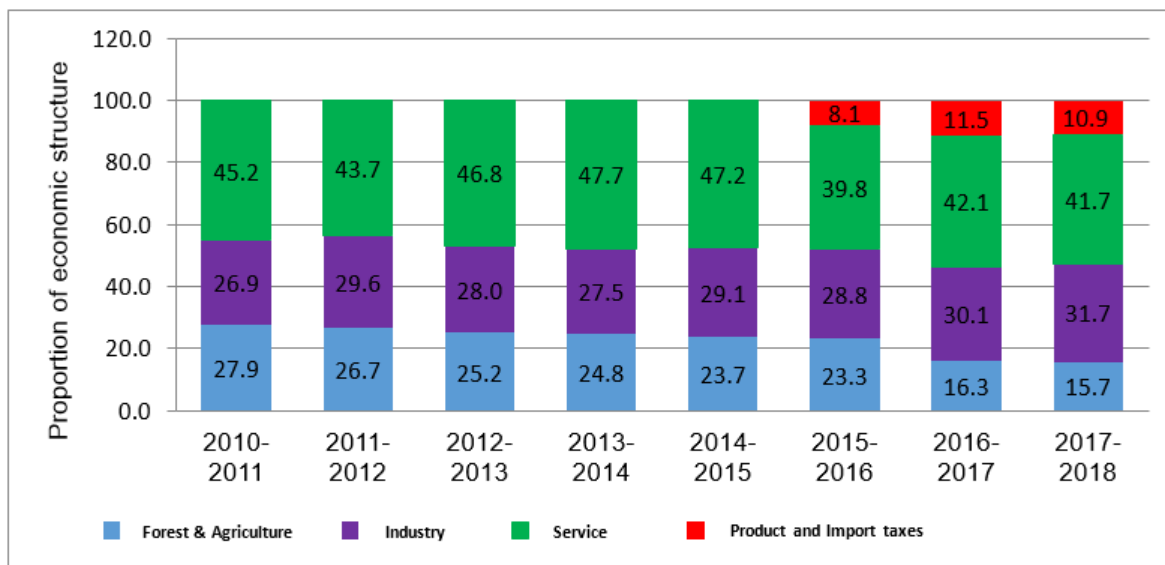
Proportion of economic structure

	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Product and Import taxes						8.1	11.5	10.9
Service	45.2	43.7	46.8	47.7	47.2	39.8	42.1	41.7
Industry	26.9	29.6	28.0	27.5	29.1	28.8	30.1	31.7
Forest & Agriculture	27.9	26.7	25.2	24.8	23.7	23.3	16.3	15.7

Source: Socio-economic development plan summary annual report 2005-2016 and 2018-2019

Figure 5 Proportion of economic structure

The economic structure has changed according to the changed of the industrial and modern: the ratio of agriculture and forestry sectors in the economic structure has reduced from 27.9% in 2010 – 2011 to 23.7% in 2014 – 2015 and in the year 2017 – 2018 reduced to 15.7%; in the industrial sector has increase from 26.9% in 2010 – 2011 to 29.1% and 31.7% in 2014 – 2015 and 2017 – 2018 respectively; in the service sector has the bigger ratio than any other sectors in the economy structure has increased 2% in 2013 – 2015 and 2014 – 2015 compared to 2010 – 2011: increased from 45.2% in 2010 – 2011 to 47.7% in 2013 – 2014 and 47.2% in 2014 – 2015 of GDP. However, the trend seems to be reduced starting from 2016 – 2017 onward after the product and import tax has been separated from each other inside the economy structure (Figure 5).

Agriculture sector is an important sector for the implementation of the government policy and social economic development plan, after the introduction of the new policy which agriculture sector is the main target and identify the suitable path from the normal economy to commercial economy. From the said policy, stepwise improvement of agriculture infrastructure, for instance: litigation system, reservoir and water pumping stations has been implemented in many areas which improved the number of rice planting seasons; Technical infrastructure, for instance research, demonstration and technical service provider centres or

stations has been established and developed, which lead to Lao PDR self-sufficiency on food productions, especially from 2000 onward and part of the food productions also has been exported (Agriculture Strategic Development Plan 2025 and The Vision 2030, Ministry of Agriculture and Forestry, 2015). Furthermore, agriculture and wood industrial sectors, especially the commercial plants: corn, job's tears, sugarcane, beans, coffee, rubber, cottons, vegetables, and fruits are continuously expanding and capable of export to both local and international markets. Animal husbandry and fishery sectors area growing well due to the push for a change in new animal husbandry techniques, new equipment and production factors, technical training on animal husbandry techniques, storage of fodder, grass cultivation, animal vaccination which improve the growth rate of the animal at the ratio of 5% per year.

Forestry sector is another important sector that contribute to social economic development of Lao PDR, especially to the livelihood improvement of rural people that depend on the NTFPs for household consumption and generate revenue. Estimated revenue generate from NTFP is about 320 USD per household especially in the rural area and total revenue for the whole country is about 183.7 million USD per year (Forestry Strategy 2020, Ministry of Agriculture and Forestry, 2015).

Energy sector is the basic infrastructure of the social economic development, the transition from agriculture society to industrial society, which focused more on the unitization of the technology in the day to day leaving. Energy sector is one of the many sectors that drive the social economic to grow. Nowadays, Lao PDR have total of 45 electricity related projects with the total capacity of 6.437 MW, able to produce electricity up to 34.357 million GWh per year. Among those there are power stations which produce electricity more than or equal to 15 MW in total of 29 projects, has the capacity of 6.365 MW can produce the electricity up to 33.957 GWh per year; power stations which can produce electricity more than 15 MW in total 14 projects, has the capacity of 72 MW, can produce electricity up to 400 GWh per year. (National Social Economic Report for the year 2011 – 2015). The mining sector is another important factor that contribute to the social economic development, in the year 2011 mining sector contribute to the total GDP up to 10.3%. In the year 2011 – 2015 the production from the sector had an average growth of 9.97% per year (total revenue produced is 66,746.83

billion kip) compared to the year 2006 – 2010 increase 184.14% (Ministry of Energy and Natural Resources, 2018).

Estimating future energy demand of Lao PDR (Unit: Ktoe)
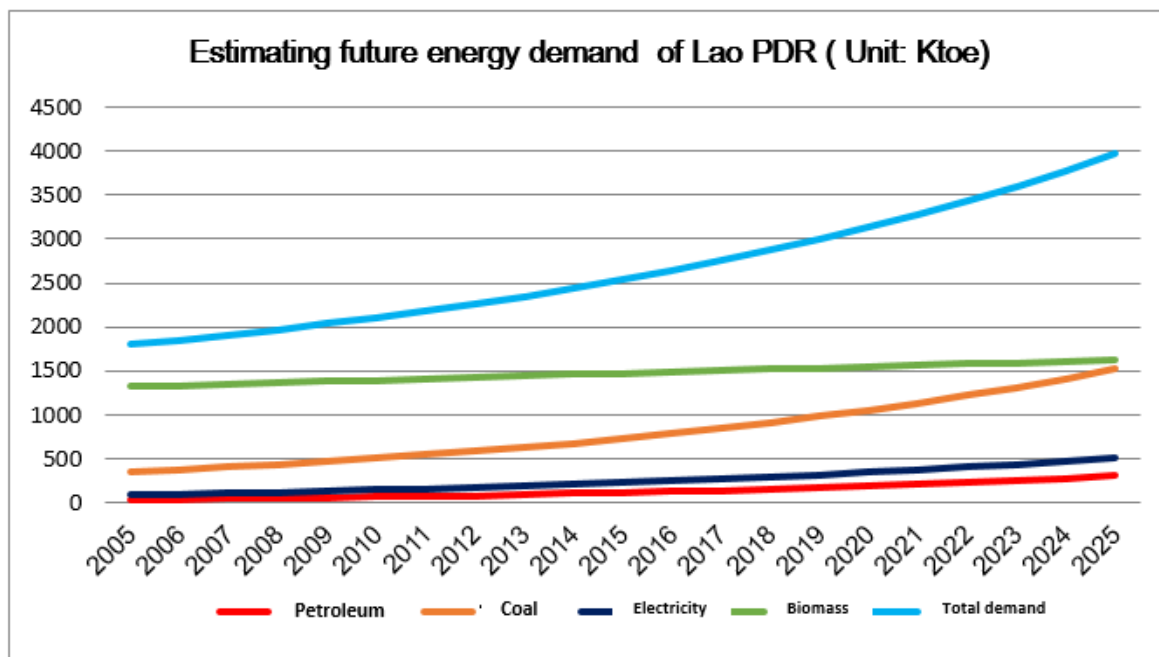
Figure 6 Estimated future energy demand in Lao PDR

The total need of energy for the whole country increase about 3.6% per year, which increase from 1.8 million tons compare to petrol (MTOE) in the 2005 to 3.9 million tons in the year 2025, but there is an indication that the demand from the household decreasing from 77.8% in the year 2005 to 48.5% in the year 2025. At the same time the demand from industrial sector is increasing from 6.1% in the year 2005 to 16.9% in the year 2025. The energy production from hydroelectricity will increase about 11% in the year 2005 – 2025, but about 10% is for the country consumption and 90% will be exported, for the need of electricity inside the country will increase about 8.3% per year until 2025 (Figure 7)

Social Development

In the 5 years period (2011 – 2015) the government have shifted their attention to create village and development group according to the strategic plan call 4 Contents and 4 Objectives, implementation of the 3 Builds (Build province to become strategic unit, strong

and unity district and village to become development unit). Mainly focus on the development of basic economy infrastructure: road to the district, village to village, today the road to the village has covered up to 84.51% of the total number of villages. At the same time the government has also improve and expand the educational system, healthcare and water to rural area.

Educational sector, the government has placed an important role in the development of human resources for the reason the government have allocated the budget for the educational sector up to 17% of the total of the expenditure of the government in order to develop the educational infrastructure and improve the educational system at every level. Which lead to the improvement of Lao PDR educational system both quantity and quality: The village that have finished the secondary level increase from 80% in 2011 to 99.63% of the total number of village in 2014 (Result of the poverty and development analysis, 2015); the ration of the children at the age between 3 – 5 years old increase from 22.1% in the year 2009 – 2010 to 43.20% in the year 2014 – 2015; the ratio of the children at the age of 5 prepare to enter the primary school increase from 52.9% in 2012 – 2013 to 66% in the year 2014 – 2015; the ratio of the student whose enter the primary school increase from 92.7% in 2009 – 2010 to 98.6% in 2014 – 2015; the ratio of the educated people at the age above 15 increase from 81.7% in 2009 – 2010 to 93.6% in the year 2014 – 2015; the ratio of the student enter the secondary and high school reached 78% and 45.7% in the year 2014 and 2015 respectively. Healthcare sector, the healthcare system has expanded wildly throughout the country including the rural area, the village that have achieved the healthcare milestone increase from 24.5% in the year 2011 to 64.84% of the total number of villages in 2014. Today the country has the total of 985 healthcare office all over the country; among that the office that are capable of delivering the baby are 859 location; district hospital 17 capable of providing basic healthcare needs, there are 5 central hospital and specialize hospital 3. The ratio of the use of clean water reached 84.71% in 2014 (target 80%), the ratio the use of toilet reached 67.92% in 2014 (target 60%).

As a summary over 5-year periods. The government have achieved many rural development and poverty eradication works. According to the poverty analysis in 2014 shows that 76,604 households remaining poor, 1,736 villages remaining poor or equal to 23.09% of the total

number of village; Nevertheless, the result of the survey on consumption and expenditure of the household number 5 (LECS V) show that the ratio of poverty has decreased from 27.6% in 2007 – 2008 (LECS IV) to 23.2% in 2012 – 2013 and 20% in 2015.

Climate Change

The impact of climate change to livelihood, food security, water supply and healthcare for the people of Lao PDR. The impact form climate change big part of it came from flood and arid, these events will continue to occur in the future with more frequent and stronger in the future. In the past few year Lao PDR have faced big flood total of 27 times with the average 1 time every one and a half year. Base on the statistic in the year 1966 – 1999 flood and arid have strong negative impact on Lao PDR which cost about 104,897,400 USD from flood and 597,700,000 USD from arid. Some year (1972, 1979, 1986 and 1997 – 1999) the cost from flood and arid cover 77,654,927 USD. Furthermore, there are also wide area flood in the central and southern part of Laos, flesh flood in the northern and east in the year 1995, 1996, 2000, 2002, 2005, 2008 and Ketsana Hurricane in the south of Laos in the year 2009 all together is an important warning regarding the impact of climate change. I the year 2010 the flesh flood occurred in northern of Laos which destroyed both life and properties the damage cost total of 40 billion kip. From the said event 80% of the people who depend on agriculture, animal husbandry and NTFPs are the most impacted.

In order to contribute to the world in solving the problem from climate change and on behalf of member state of the Climate Change Protocol and reducing risk from natural disaster the government of Lao created policy, strategy and implement many activity to counter the climate change and improve the ability to counter the impact from climate change.

Lao PDR introduced natural disaster law, which set the method in natural disaster management, risk assessment, early warning system, disaster control, impact assessment and the emergency need together with the right to access the natural disaster emergency fund and the right of impacted people. Furthermore, the government also introduced the Climate Change Policy. Which set the way, rule and method related to risk management and adjustment with the climate change, reducing emissions from forest degradation and deforestation to counter, stop, contain and reduce the impact from climate change. This is to

ensure the protection of rights, benefits, security, health, environmental, biodiversity, property and infrastructure, together with the contribution to social economy development of the country, reduce climate change and collaboration with regional and international.

In the year 2013 the government introduced Policy No. 220/PM on the implementation of national management and protection of natural disaster committee, with the representative from related ministries and chaired by deputy prime minister. The role of said committee is to manage, protect, counter and solve the negative impact from natural disaster, human made disaster that have impact on social economy, life and property of the people.

Ministry of Natural Resources and Environment approved and introduced the Lao PDR Climate change implementation plan in 2013. Which created base on the climate change strategy of Lao PDR amended by the government of Lao in 2010 and National Communication on climate change No. 2 of Lao PDR amended in 2013. National climate implementation plan set the method to reduce emissions and mitigation method on climate change in agriculture, land use and forestry, water resources, energy, industrial, transportation, rural development and healthcare to be implemented during 2013 – 2020 period. Furthermore, the policy also acts as footprint to ensure the participatory of the government sectors at central, provincial, private and others to engage in the implementation of reducing emission and improve the capability of climate change mitigation.

In order to complete with the given responsibility in the climate change meeting no. 20 in the city of Lima, Peru which ask the member state must take strong responsibility to implement the activity related to climate change and Lao PDR have completed the plan on the objective that will contribute to solve the problem of climate change and amended by the government of Lao at the end of 2015. This plan will help advertise the sustainable development plan of the government, especially the participation in fight against global warming; its also act as a base to request assistant and priority aid from green climate fund; act as a base for may economy and other sectors to implement. In the document also include a plan to flight again emissions together with the ability to fence of the impact from climate change: increase forest cover to 70% in the year 2020; promote the production electricity from renewable energy 100%; The renewable energy implementation plan with focus on the ratio of small scale

renewable energy (including small scale electricity production) cover 30% of the total energy consumptions in the year 2030; promote the use of eco-friendly technology inside industrial sector and infrastructure development which contribute to the overall development and ensure the sustainable development of green economy. As for the climate change mitigation include: a strong of the important economy sectors and natural resources to the impact of the climate change; increase the awareness of the people on natural disaster protection and climate change to increase the participatory of the people in the implementation phase.

Furthermore, some important activities are finished: approved and introduce the clean development plan in Lao PDR; guideline on climate change mitigation base on the ecosystem in Lao PDR; conduct needs assessment on technology needed for reducing emissions and climate change mitigation; produce report on difficulty on the use of technology in the implementation of reducing emissions and climate change mitigation inside agriculture, forestry and water resources sectors.

1.5 INSTITUTIONAL ARRANGEMENTS

BUR was prepared based on the overall institutional arrangement structure shown in the Figure 7 below.
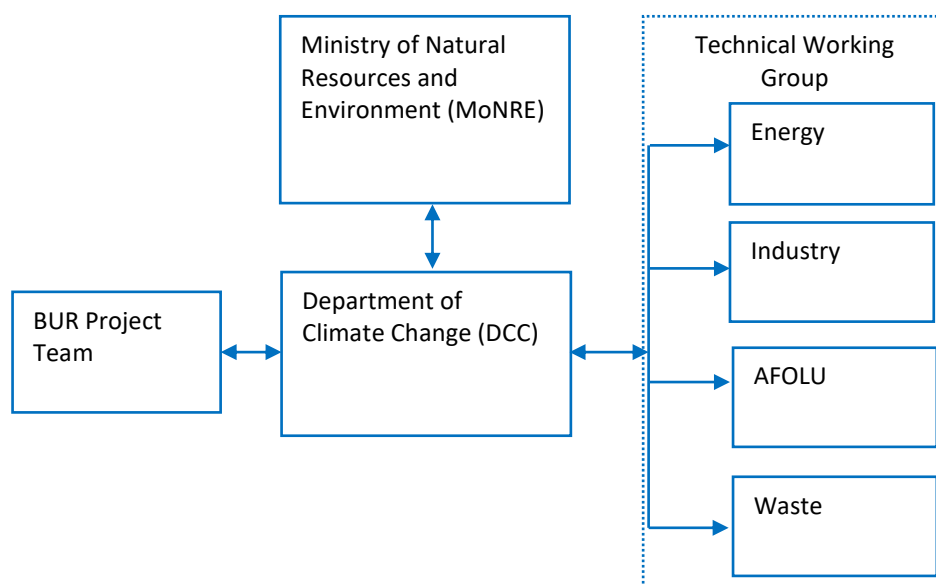
Figure 7 Institutional Arrangement for BUR

The process overseen by Minister and has Ministry of Natural Resources and Environment (MoNRE) leadership. Under MoNRE, Department of Climate Change (DCC) to manage not only quality, relevance, and compliance of BUR, but also ensuring delivery of the BUR and communication with MONRE leadership. DCC was implementing the BUR project including consultants and coordinating with the technical working group (TWG) on the reporting including data collection, assessment and reporting, validation as well as QA/QC. In addition, DCC also laisses with UNEP to ensure compliance of the BUR to the UNFCCC and IPCC's guidelines.

The TWG were promoted by MONRE and the members from relevant sectors and stakeholders were nominated by their respectively authorities to coordinate the BUR activities, especially GHG inventory, mitigation and assessment of constraints and support needs. Their tasks, apart from data provision, assisted review of the report including results.

CHAPTER 2: NATIONAL GREENHOUSE GAS INVENTORIES

2.1 GENERAL OVERVIEW AND RESULTS

The GHG inventory was conducted in accordance with Article 4.1(a) and Article 12 of the of the United Nations Framework Convention on Climate Change, which requires inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol. 2006 IPCC Guidelines and software for National Greenhouse Gas Inventories was used for the inventory. The base year is 2014, which in line the COP's decision. This inventory covered emissions and removals for four sectors, namely Energy, Industrial Process and Product Use (IPPU), Agriculture, Forestry and Other Land Use (AFOLU) and Waste. The GHG emissions estimated were only CO_2, CH_4, and N_2O since data on halocarbon products and use were inadequate, while the emissions of hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6) were possibly small. GHG emissions and removal expressed in CO_2 equivalents (CO_{2e}), and Global Warming Potential (GWP) in the IPCC Second Assessment Report (2RA) were used for the conversion of the unit, which are in line with the previous GHG inventories.

GHG inventory process included data collection and assessment, selection of tools and methods, calculation and reporting, review and validation, and endorsement (Figure 8). It was managed by Department of Climate Change, the Ministry of Natural Resources and Environment, and facilitated and supported national consultant and GHG Technical Working Groups (TWG). The tool employed for the inventory was 2006 IPCC guidelines and software, and Good Practice Guidance (GPG). Tier 1 method and default emission factors (EFs) were used for estimation of GHGs since the country-specific data, especially EFs were not available. However, Transparency, Accuracy, Consistency, Completeness, and Comparability (TACCC) were taken into account in the inventory. Notation Key including Not estimated (NE), Included elsewhere (IE), Confidential information (C), Not applicable (NA) and Not occurring (NO), where appropriated, were used in the reporting. In addition, key category and uncertainty analysis were also conducted following the calculation of the GHGs.

Organisational arrangement
• The GHG inventory teeam including TWG and sub-TWGs were establihsed and trained

Data collection and literature review
• Tools, activity data from national and sectoral stastical reports and other sources were collected and reviewed. GHG TWGs and stakeholder interview and focus group meetings were also held to suppport the process

Selection of tools and methods
• Following data collection and literature review, a tool, 2006 IPCC guidelines and software, which was considered as a best tool, were selected and use for the inventory

GHG calculation, analysis and reporting
• By using 2006 IPCC guidelines, software and GPGs • Reporting followed the IPCC General Guidance and Reporting, incluindg taking into account TACCC and key notations.

GHG inventory review and validation
• As a QA-QC, the review and validation performed by the invenotory team including TWGs, relevant organisaitons and stakeholders by sharing the inventory report, validation workshop and consultation meetings. • GHG inventory was then included in the BUR

International Consultation and Analysis (ICA)
• Once the BUR is technically endorsed by TWGs and MONRE, it shall be ICA

Finalization and approval
• Finalization of the BUR following the ICA • Revisit, approval, publication and submit to the UNFCCC by DCC, MoNRE

Figure 8 GHG inventory and reporting process

The result showed that the net emissions was 24,099.98 $GgCO_{2eq}$ in the inventory year, 2014. AFOLU, especially forest remaining forest, crop land remaining cropland and lands converted to forest had a capacity to remove equivalent to about 13,000 $GgCO_2$. AFOLU sector had net emissions of 18,793.41 $GgCO_{2eq}$, which was the largest sources of emissions, accounting for about 78% of the total emissions. Second largest source of emissions was Energy Sector, which emitted 3,729.42 $GgCO_{2eq}$ (15%). The rest, IPPU and Waste shared 5% and 2% of the national emissions, respectively (Figure 9 and Table 5).

425.26 ; 2%

3,729.42 ; 15%

1,151.89 ; 5%

24,099.98
GgCO2eq

18,793.41 ; 78%

- 1 - Energy
- 2 - Industrial Processes and Product Use
- 3 - Agriculture, Forestry, and Other Land Use
- 4 - Waste

Figure 9 Total Emissions in 2014 in Lao PDR

Table 5 Total GHG emissions in 2014 in Lao PDR

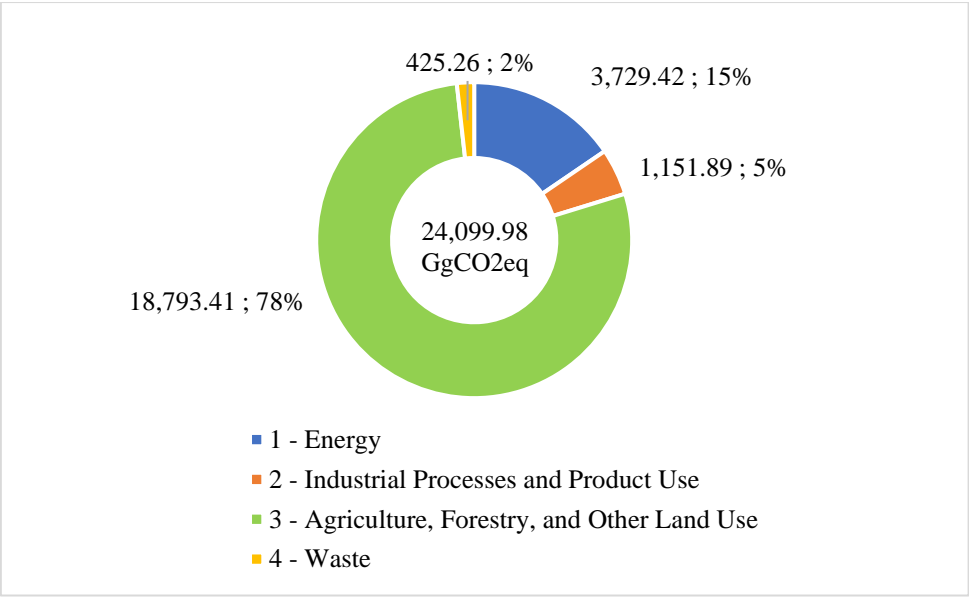| Categories	Emissions (Gg)			Emissions CO2 Equivalents (Gg)				Emissions (Gg)					Emissions (Gg)
	Net CO2 (1)(2)	CH4	N2O	HFCs	PFCs	SF6	Other halogenated gases with CO2 equivalent conversion factors (3)	Other halogenated gases without CO2 equivalent conversion factors (4)	NOx	CO	NMVOCs	SO2	CO2e
Total National Emissions and Removals	**15,441.035**	**300.562**	**7.571**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**24,099.98**
1 - Energy	**3,343.418**	**5.958**	**0.842**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3,729.42**
1.A - Fuel Combustion Activities	3,343.418	5.843	0.842	0	0	0	0	0	0	0	0	0	3,727.00
1.A.1 - Energy Industries	0	5.381	0.718						0	0	0	0	335.44
1.A.2 - Manufacturing Industries and Construction	27.042	0.001	0.000						0	0	0	0	27.16
1.A.3 - Transport	2,281.649	0.270	0.113						0	0	0	0	2,322.40
1.A.4 - Other Sectors	1,034.726	0.190	0.011						0	0	0	0	1,042.01
1.B - Fugitive emissions from fuels	0	0.115	0	0	0	0	0	0	0	0	0	0	2.41
1.B.1 - Solid Fuels	0	0.115	0						0	0	0	0	2.41
2 - Industrial Processes and Product Use	**1,151.890**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1,151.89**
2.A - Mineral Industry	1,090.245	0	0	0	0	0	0	0	0	0	0	0	1,090.24
2.A.1 - Cement production	1,087.294								0	0	0	0	1,087.29
2.A.2 - Lime production	2.951								0	0	0	0	2.95
2.B - Chemical Industry	0	0	0	0	0	0	0	0	0	0	0	0	-
2.C - Metal Industry	61.646	0	0	0	0	0	0	0	0	0	0	0	61.65
2.C.1 - Iron and Steel Production	61.646	0							0	0	0	0	61.65
2.D - Non-Energy Products from Fuels and Solvent Use	0	0	0	0	0	0	0	0	0	0	0	0	-
2.E - Electronics Industry	0	0	0	0	0	0	0	0	0	0	0	0	-
2.F - Product Uses as Substitutes for Ozone Depleting Substances	0	0	0	0	0	0	0	0	0	0	0	0	-
2.G - Other Product Manufacture and Use	0	0	0	0	0	0	0	0	0	0	0	0	-
3 - Agriculture, Forestry, and Other Land Use	**10,943.431**	**280.544**	**6.318**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**18,793.41**
3.A - Livestock	0	179.826	0.615	0	0	0	0	0	0	0	0	0	3,966.89
3.A.1 - Enteric Fermentation		152.914							0	0	0	0	3,211.19
3.A.2 - Manure Management		26.912	0.615						0	0	0	0	755.69
3.B - Land	9,093.245	0	0	0	0	0	0	0	0	0	0	0	9,093.25
3.B.1 - Forest land	(12,661.984)								0	0	0	0	-12,661.98
3.B.2 - Cropland	19,314.621								0	0	0	0	19,314.62
3.B.3 - Grassland	8.148								0	0	0	0	8.15
3.B.4 - Wetlands	0	0							0	0	0	0	-
3.B.5 - Settlements	91.672								0	0	0	0	91.67
3.B.6 - Other Land	2,340.789								0	0	0	0	2,340.79
3.C - Aggregate sources and non-CO2 emissions sources on land	25.883	100.718	5.703	0	0	0	0	0	0	0	0	0	3,908.98
3.C.1 - Emissions from biomass burning		46.057	0						0	0	0	0	967.19
3.C.2 - Liming	1.731								0	0	0	0	1.73
3.C.3 - Urea application	24.152								0	0	0	0	24.15
3.C.4 - Direct N2O Emissions from managed soils			4.215						0	0	0	0	1,306.59
3.C.5 - Indirect N2O Emissions from managed soils			1.355						0	0	0	0	420.05
3.C.6 - Indirect N2O Emissions from manure management			0.133						0	0	0	0	41.37
3.C.7 - Rice cultivations		54.662							0	0	0	0	1,147.90
3.C.8 - Other (please specify)		0	0						0	0	0	0	-
3.D - Other	1,824.303	0	0	0	0	0	0	0	0	0	0	0	1,824.30
3.D.1 - Harvested Wood Products	1,824.303								0	0	0	0	1,824.30
3.D.2 - Other (please specify)	0	0	0						0	0	0	0	-
4 - Waste	**2.296**	**14.060**	**0.412**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**425.26**
4.A - Solid Waste Disposal	0	2.624	0	0	0	0	0	0	0	0	0	0	55.10
4.B - Biological Treatment of Solid Waste	0	0.005	0	0	0	0	0	0	0	0	0	0	0.10
4.C - Incineration and Open Burning of Waste	2.296	0	0	0	0	0	0	0	0	0	0	0	2.30
4.D - Wastewater Treatment and Discharge	0	11.431	0.412	0	0	0	0	0	0	0	0	0	367.76
4.E - Other (please specify)	0	0	0	0	0	0	0	0	0	0	0	0	-
5 - Other	0	0	0	0	0	0	0	0	0	0	0	0	-
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3	0	0	0	0	0	0	0	0	0	0	0	0	-
5.B - Other (please specify)	0	0	0	0	0	0	0	0	0	0	0	0	-
Memo Items (5)													-
International Bunkers	53.068	0.000	0.001	0	0	0	0	0	0	0	0	0	53.54
1.A.3.a.i - International Aviation (International Bunkers)	53.068	0.000	0.001						0	0	0	0	53.54
1.A.5.c - Multilateral Operations	0	0	0	0	0	0	0	0	0	0	0	0	-

There were totally 45 emissions sources and removals in 2014. Of which, there 12 key sources which accounted for about 95% of the total emissions and removals, and the majority were in AFOLU sector (Table 6 and 7). Based on trend analysis, the majority of emissions were on the rising trend, while removals from forest land remaining forest land, emissions from land converted to other lands, and animal manure management decreased in comparison with the previous inventories (Table 7).

Table 6 Key Sources Analysis Approach 1 Level Assessment

IPCC Category	Greenhouse gas	2014 Ex,t (Gg CO2 Eq)	|Ex,t| (Gg CO2 Eq)	Lx,t	Cumulative Total of Column F
Land Converted to Cropland	CARBON DIOXIDE (CO2)	20,057.515	20,057.515	0.394	0.394
Forest land Remaining Forest land	CARBON DIOXIDE (CO2)	(12,472.765)	12,472.765	0.245	0.639
Enteric Fermentation	METHANE (CH4)	3,211.194	3,211.194	0.063	0.702
Land Converted to Other land	CARBON DIOXIDE (CO2)	2,340.789	2,340.789	0.046	0.748
Road Transportation	CARBON DIOXIDE (CO2)	2,228.582	2,228.582	0.044	0.792
Harvested Wood Products	CARBON DIOXIDE (CO2)	1,824.303	1,824.303	0.036	0.828
Direct N2O Emissions from managed soils	NITROUS OXIDE (N2O)	1,306.586	1,306.586	0.026	0.853
Rice cultivations	METHANE (CH4)	1,147.895	1,147.895	0.023	0.876
Cement production	CARBON DIOXIDE (CO2)	1,087.294	1,087.294	0.021	0.897
Other Sectors - Liquid Fuels	CARBON DIOXIDE (CO2)	1,034.726	1,034.726	0.020	0.918
Emissions from biomass burning	METHANE (CH4)	967.191	967.191	0.019	0.937
Cropland Remaining Cropland	CARBON DIOXIDE (CO2)	(742.894)	742.894	0.015	0.951

Table 7 Key Sources Analysis Approach 1 Level Trend Assessment

IPCC Category code	IPCC Category	Greenhouse gas	2010 Year Estimate Ex0 (Gg CO2 Eq)	2014 Year Estimate Ext (Gg CO2 Eq)	Trend Assessment (Txt)	% Contribution to Trend	Cumulative Total of Column G
3.B.1.a	Forest land Remaining Forest land	CARBON DIOXIDE (CO2)	(45,833.410)	(12,472.765)	0.845	0.630	0.630
3.B.6.b	Land Converted to Other land	CARBON DIOXIDE (CO2)	2,809.763	2,340.789	0.089	0.067	0.697
3.A.1	Enteric Fermentation	METHANE (CH4)	3,003.258	3,211.194	0.085	0.063	0.760
3.C.7	Rice cultivations	METHANE (CH4)	1,850.946	1,147.895	0.065	0.048	0.809
3.D.1	Harvested Wood Products	CARBON DIOXIDE (CO2)	1,674.175	1,824.303	0.047	0.035	0.844
1.A.3.b	Road Transportation	CARBON DIOXIDE (CO2)	1,518.850	2,228.582	0.034	0.025	0.869
3.C.4	Direct N2O Emissions from managed soils	NITROUS OXIDE (N2O)	1,002.116	1,306.586	0.025	0.019	0.887
2.A.1	Cement production	CARBON DIOXIDE (CO2)	839.800	1,087.294	0.021	0.016	0.903
3.A.2	Manure Management	METHANE (CH4)	638.416	565.144	0.020	0.015	0.918
3.B.2.b	Land Converted to Cropland	CARBON DIOXIDE (CO2)	6,364.476	20,057.515	0.018	0.013	0.931
1.A.4	Other Sectors - Liquid Fuels	CO2	7.897	1,034.726	0.015	0.011	0.942
3.B.2.a	Cropland Remaining Cropland	CARBON DIOXIDE (CO2)	(162.154)	(742.894)	0.013	0.010	0.952

Uncertainty analysis conducted following the estimation, however, illustrated that there could be versions in total and sectoral emissions or by gases. The combined inventory uncertainty was about 37.93%. Improvement of inventory quality requires improvement of activity data and development of country specific EFs.

2.2 GREENHOUSE GAS EMISSIONS BY SECTOR

2.2.1 ENERGY SECTOR

GHG inventory of the Energy Sector covered estimation of emissions from 1) Fuel Combustion (1A) and 2) Fugitive Emissions from Fuels (1B). The emissions from the Carbon Dioxide in Transportation and Storage (1C) was include elsewhere nor not estimated since data was inadequate, and it was not a key source of emissions.

In 2014, total emissions from energy sector was 3,729.42 Gg, accounting for about 17.08 % of the national total emissions. Of which, 99.94 % (3,727 Gg CO_{2eq}) were emissions from fuel combustion. Particularly, emissions from fuel combustion in transportation, manufacturing and construction, energy industry and other sectors, which shared 62.31% (2,332.40 Gg CO_{2eq}), 27.96 % (1,042.01 Gg CO_{2eq}), 9% (335.44 Gg CO_{2eq}) and 0.73% (27.16 Gg CO_{2eq}), respectively. Fugitive emissions was only from coal mining, which released 2.41 Gg CO_{2eq} (0.06%) of the total emissions from the energy sector (Figure 10).
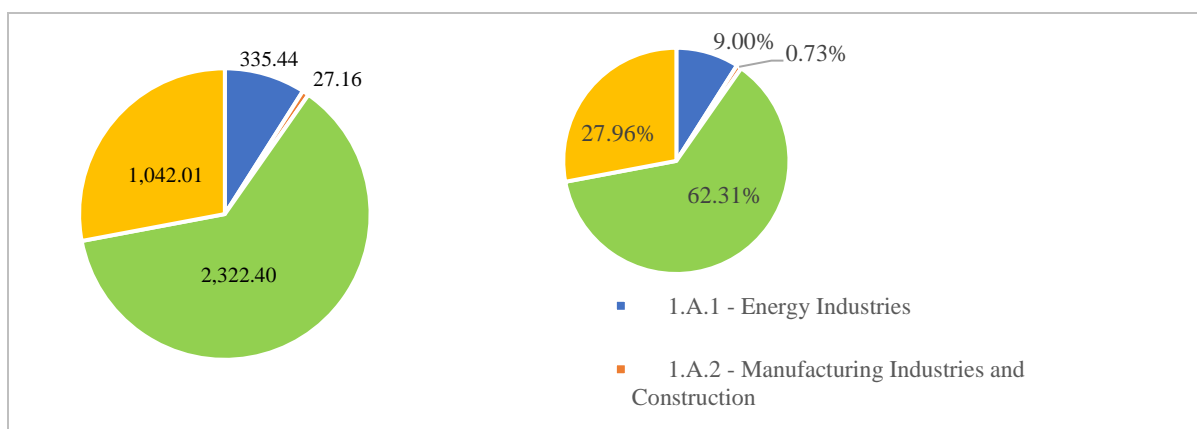

Figure 10 Emissions from Energy Sector

2.2.2 INDUSTRIAL PROCESS AND PRODUCT USE

2006 IPCC guideline and software includes eight industries (2A to 2H) for GHG inventory in the industrial process and product use sector. In Laos, particularly in 2014, there were only two industries that were relevant to the GHG emissions. The mineral industry including cement and lime, and metal industry, particularly iron rod production processes only. Industrial products that potentially emit HFCs, PFCs and SF6 such as freezers, fridge, and electronic appliance, etc. were imported and used in Laos, but its quantity was possibly small. Importantly, it lacked data about the products and uses. So, this report covered only emissions from cement, lime, iron production processes.

Cement, lime, iron rod production in 2014 were 2,220,100 tones, 3,934 tonnes and 42,223 tonnes, respectively, and their production resulted emissions of 1,151.89 Gg CO_2 in total in the inventory year. Cement industry emitted 1087.29 Gg CO2e, which accounted for 94.93% of the total emissions. The rest were emissions from lime and iron production, which were 2.95 Gg CO2 (0.26%) and 61.65 Gg CO2 (5.25%), respectively (Table 8).

Table 8 Emissions from IPPU sector

Categories	(Gg)			CO2 Equivalents(Gg)					(Gg)			
	CO2	CH4	N2O	HFCs	PFCs	SF6	Other halogenated gases with CO2 equivalent conversion factors (1)	Other halogenated gases without CO2 equivalent conversion factors (2)	NOx	CO	NMVOCs	SO2
2 - Industrial Processes and Product Use	**1,151.890**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
2.A - Mineral Industry	1,090.245	0	0	0	0	0	0	0	0	0	0	0
2.A.1 - Cement production	1,087.294								NE	NE	NE	NE
2.A.2 - Lime production	2.951								NE	NE	NE	NE
2.A.3 - Glass Production	NO								NO	NO	NO	NO
2.B - Chemical Industry	NE/NO	0	NE/NO	0	0	0	0	0	NE/NO	NE/NO	NE/NO	NE/NO
2.C - Metal Industry	61.646	0	0	0	0	0	0	0	0	0	0	0
2.C.1 - Iron and Steel Production	61.646	NO							NE	NE	NE	NE
2.D - Non-Energy Products from Fuels and Solvent Use	IE/NO	0	0	0	0	0	0	0	IE/NO	IE/NO	IE/NO	IE/NO
2.E - Electronics Industry	-	0	0	NO	NO	NO	0	NO	NO	NO	NO	NO
2.F - Product Uses as Substitutes for Ozone Depleting Substances	-	0	0	NE/NO	NE/NO	0	0	NE/NO	NE/NO	NE/NO	NE/NO	NE/NO
2.G - Other Product Manufacture and Use	-	0	0	0	NE/NO	NE/NO	0	0	NE/NO	NE/NO	NE/NO	NE/NO
2.H - Other	-	0	0	NE	0	0	0	0	NE/NO	NE/NO	NE/NO	NE/NO

The emissions from IPPU increased sharply compared to the previous inventories. The emissions increased about 24 times in comparison with the total emission in the year 2000, which was only 48 Gg CO2e. However, it was understood that there were some variations

associated with the methods and emission factors. The previous inventory employed the revised 1990 IPCC guidelines and UNFCCC software, while 2014 inventory used 2006 IPCC guidelines for national GHG inventory, which their emission factors and assumptions were slightly different.

2.3.4 AGRICULTURE, FORESTRY AND OTHER LAND USE

This GHG inventory of the Agriculture, Forestry and Other Land Use (AFOLU) sector covered 4 main categories or sources of emissions: 1) emissions from livestock (3A), 2) emissions and removals associated with land use and land use change (3B), 3) aggregate sources and non-CO_2 emission from land (3C) , and 4) other (3D).

The net emissions of the AFOLU sector was 18,793.41 $GgCO_{2eq}$ in the inventory year, 2014. Of which, the largest source of emissions was land and land use change. Its net emissions were 9,093.48 $GgCO_{2eq}$ or about 48% of the total emissions in the sector. Emissions from livestock and Aggregate sources and non-CO_2 emissions sources on land were about the same, sharing about 21% the sector's emissions. Lastly, emissions from other, especially harvested wood product shared about 10% of the emissions. (Figure 11).
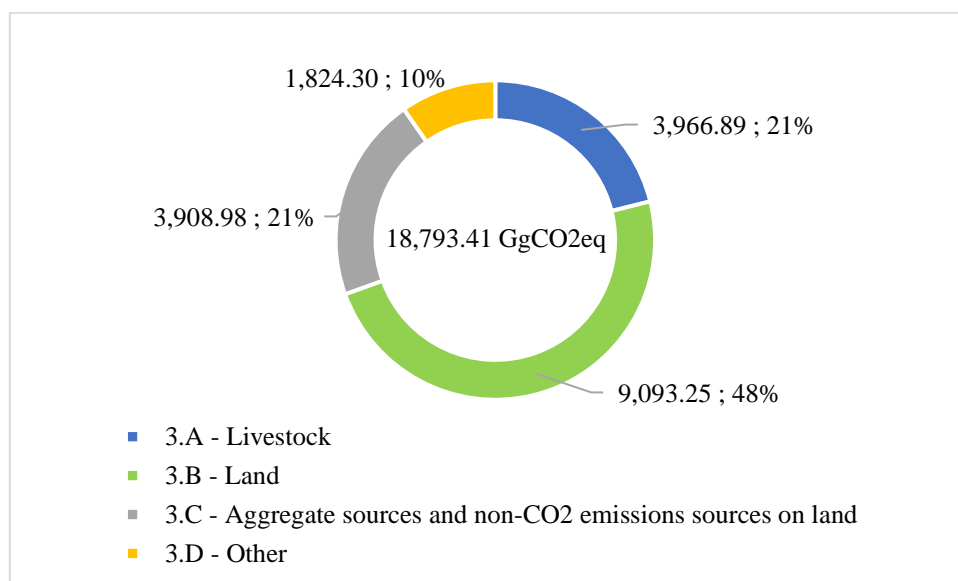

Figure 11 Net emissions from AFOLU sector in 2014

2.3.5 WASTE SECTOR

GHG inventory in waste sector covered four main sources of emissions from waste sector: solid waste disposal (4A), biological treatment of solid waste (4B), incineration and open burring of solid waste (4C), wastewater treatment and discharge (4D). Other source (4E) was estimated since there was no other source of emissions. Solid waste production in Laos has been overtime. In 2003, solid waste about 1.268 million tonnes, and then it went up to about 1.647 million tonnes in 2014. Solid waste disposal at site, however, was relatively low. It ranged from about 16% to 31% only, between 2003 and 2014. The rest were dumped, burned, and disposed elsewhere. The recycling was possibly less than 10%. Biological treatment of solid waste, especially compost was small scale and unorganised. Incineration of solid waste was also small scale since there was only a clinical incinerator in the country. Open burring of solid waste still occurred elsewhere. However, it was estimated that only about 0.1% of the unmanaged solid waste was burned in the inventory year, 2014.

Waste sector released about 423.68 GgCO2e in total. Most of the emissions were from wastewater treatment and discharge, which contributed to almost 87% of the total emissions. Solid waste disposal, based on First Order Decay method, could generate 55.10 GgCO2e in the inventory year. The rest were from solid waste incineration and open burning, and biological treatment, which generated 0.72 GgCO2e (0.19%) and 0.10 GgCO2e (0.03%), respectively (Figure 12).
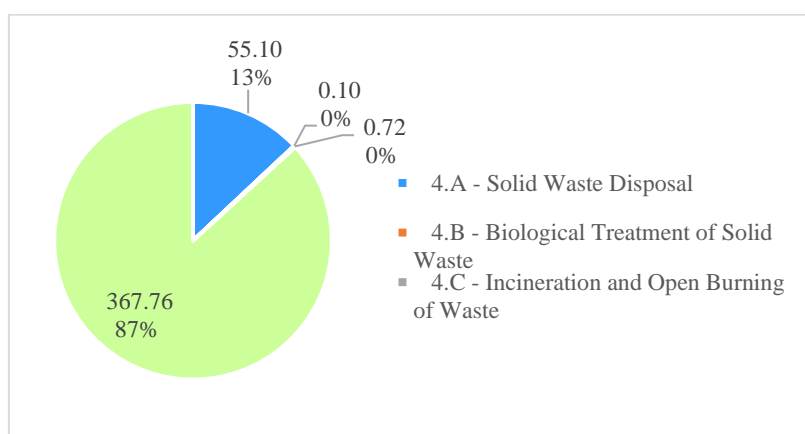

Figure 12 Emissions from Waste Sector

CHAPTER 3: MITIGATION ACTIONS AND EFFECTS

3.1 GHG EMISSION MITIGATION ACTIONS

Lao PDR, in partner with development partners, has made a lot effort and progress to identify and implement measures for mitigating climate change, especially in past 10 years. Key mitigation actions were identified and implemented under the National Strategy on Climate Change (NCCS) (2010), Climate Change Action Plan (2013), the First Intended Nationally Determined Contributions to Climate Change (INDC) (2015), Climate Change Technology Action Plan (2017). Currently, mitigation planning and mitigation is supported and guided by Decree on Climate Change which has been in place since September 2019. In addition, climate change mitigation actions were integrated in the national and sectoral policies and plans, such as the 8th National Socioeconomic Development Plan (NSEDP) 2016-2020, Strategy on Renewable Energy, Forestry, and Green Growth Strategy, among others. At the programme and project level, NAMAs on renewable energy, transport development, and REDD+ have been studied and piloted. However, Lao PDR has not completely set the national or sector's mitigation target. The Table 9 below summarised the existing key mitigation actions and goals set those policies and strategies, and by sector. Its implementation progress and achievements were presented and discussed in section 3.2.

Table 9 Key climate mitigation measures and goals

Mitigation Measures by Sectors	Main Targets/ Objective	CO2 Reduction Potential
Forestry Sector		
1. Maintains the existing forest and carbon including preventing deforestation and forest degradation as well as avoid conversion of forest to other land use and illegal logging	• Forest cover increased to 70% of land area or 16.58 million hectares by 2020[3] • 50% of the protection and conservation forest are well-prevented and managed by 2030 • Slash and burnt agricultural reduced by 15% by 2030 [4]	60,000- 69,000 ktCO2[5]

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[3] Based on Forestry Strategy to the year 2020 (2005), CCS (2009), the 8th NSEDP 2016-2020 (2015), INDC (2016).
[4] MONRE's vision to 2030 and 10-year strategy, 2016-2025 (2015)
[5] Based on estimation in technical report on mitigation for SNC and INDC.

Mitigation Measures by Sectors	Main Targets/ Objective	CO2 Reduction Potential
2. Expands forest and carbon sink by afforestation, reforestation, enhanced regeneration, agroforestry urban and green landscape	• 500,000 ha of plantation established by 2020[6] • Establish a park per community (population>100,000) by 2030[7].	
3. Promotes and maintains sustainable forest and non-timber forest product (NTFP) management including harvesting and efficiency		
4. Increased efficiency of forest resources including wood and non-timber forest products processing and utilization		
Agriculture Sector		
1. Promote conservation and integrated agriculture	Electricity is available to 90% of household in rural area by 2020[8]	63 ktCO2e/pa by 2020
2. Promote precise farming		
3. Promote restoration of degrade farmlands and soils, and enhance soil conservation		
4. Improve livestock feed and feeding		
5. Enhance animal manure manamgen and biogas development		
Energy Sector		
1. Increase access to electricity	Electricity is available to 90% of household in rural area by 2020[9]	63 ktCO2e/pa by 2020
2. Promote renewable energy	Build large (>15 MW) hydropower plants to provide clean electricity to neighbouring countries.[10], [11]	16,284 ktCO2e per annum (2020-30)
	• Renewable energy shares 30% of energy consumption by 2025. • 10% of the fuel use in transport sector replaced by biofuel by 2025 • 58 MW from biomass • 51 MW from biogas • 48 MW from solar power • 73 MW from wind power • 36 MW from municipal solid waste • 400 MW from small-scale hydropower	1,468,000 ktCO2e by 2025

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[6] Based on Forestry Strategy to the year 2020 (2005), the 8th NSEDP 2016-2020 (2015)

[7] MONRE's vision to 2030 and 10-year strategy, 2016-2025 (2015)

[8] Implementation of Rural Electrification Program and INDC (2015)

[9] Implementation of Rural Electrification Program and INDC (2015)

[10] Note: By 2020, 5,500 MW of hydropower planned. After 2020, additional 20,000 MW planned.

[11] INDC (2015)

Mitigation Measures by Sectors	Main Targets/ Objective	CO2 Reduction Potential
3. Promote energy conservation and efficiency in all sector	• Energy saving by 10% by 2030 • Increased energy use efficiency by 10% by 2025[12]	
4. Promote environmentally friendly and low carbon technologies		
Transport Sector		
1. Promote low-emission transportation	• 15% of the emissions in transport sector reduced by 2030[13]	
2. Reduce number of KM travelled by all vehicles		33 ktCO2e/pa
3. Increase use of public transport		158 ktCO2e/pa
Industry Sector		
1. Promote deployment of ISO14001		
2. Promote clean and green industries		
Waste Management Sector		
1. Promote 3Rs practices	•	
2. Promote waste-to-energy	•	
Natural resources and environment sector		
1. Enhanced solid waste management including promoting 3Rs practices	• 15% of chemical and hazardous solid waste reduced by 2030, and 15% of solid waste reduced in 18 towns of the provinces • 18 landfills through the country are improved and standardized. • Ozone depletion substance reduced by 97.5% by 2030[14]	
2. Promote deployment of environmental management system (EMS) in all sectors	• Promote deployment of ISO1400	
3. Promote sustainable and low emission transportation	• 15% of the emissions in transport sector reduced by 2030	
4. Enhance climate change mitigation	• Emissions reduce from 0.15 (2015) to less than 0.6 by 2025 and <1.2 t/cap/yr. by 2030[15].	
5. Enhance conservation of wetland		

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[12] MEM (2015). Policy on energy efficiency of Lao PDR
[13] MONRE (2015). Vision to 2030 and 10-year strategy (2016-2025)
[14] MONRE (2015). Vision to 2030 and 10-year strategy (2016-2025)
[15] Green Growth Secretariat (2019). National Green Growth Strategy to the year 2030 of Lao PDR.

3.2 PROGRESS, EFFECTS AND THE ROADMAP OF NAMAs

Main progress and achievements of the key mitigation action implementation were summarised in Table 10. The majority of implementation progress and achievements are in readiness or pilot phase, and effects of several actions have not been evaluated or not assessable. Variations and gaps are also included in the Table 7, and the roadmap on mitigation, especially NAMAs are presented in Table 8.

Table 10 Main progress on the implementation of climate mitigation measures

Activity	Main Progress and or Achievements
Forestry Sector	- As of 2018, forest cover was only 58% of the total land areas, (82.85% compared to the target by 2020). - Illegal forest logging and encroachment observably decreased resulting law enforcement enhancement, particularly implementation of the Decree No 15/PM on forest inspection. In addition, progress has been made on the Forest Law Enforcement, Governance and Trade (FLEGT), especially Voluntary Partnership Agreements (VPAs) on verified legal timber and Timber Legality Assurance System (TLAS) 7 REDD+ projects and 16 Readiness Initiatives[16] have been implemented through the country since 2010. 446,000 ha of plantation established by 2015[17]. 463,618.06 ha of degraded forest restored[18].
Energy Sector	9 solar powerplants (32 MW) from 2015-17 (66.67% compared to the target). 39.7 MW from biomass (68.44% compared to the target). 2 biomass power plants (25 MW) developed from 2013-2017, and 60 MW plant is under construction[19]. 74.77 MW small scale of hydropower plants developed from 2011-2017 (22.5 MW from 2015-2017) 92% of households nationwide have access to electricity in 2017. - As of 2020, total 46 large scale hydropower plants attained 6,129 MW (161,170 million kwh).

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[16] https://theredddesk.org/countries/laos accessed on April 9th, 2019
[17] Smith et. al (2017). Tree Plantations in Lao PDR: Policy Framework and Review.
[18] MPI (2019). Draft the 9th national socioeconomic development plan 2020-2025. http://www.laofab.org/document/download/3866
[19] ASEAN Centre for Energy (2017). Renewable Energy Development in Lao PDR. http://usaidcleanpowerasia. aseanenergy.org/resource/renewable-energy-development-in-lao-pdr/.

Activity	Main Progress and or Achievements
	• Renewable energy including large hydropower shared 86.14 % of electricity consumption by 2015. • 2,500-hectare jatropha plantation and for biodiesel established, and a biodiesel factory (2,000 litters per/day) operated in Xayabuli Province • Pre-feasibility studies of 2 wind power projects conducted. One (64 MW) is in Savannakhet and another one (50 MW) in Champasak Province.
Transport sector	• 42 public buses are operated under NAMAs, but its effects regarding GHG reduction have not been assessed. The Planned Road network and BRT under NAMAs have not been implemented. • Low Emission EV project initiated in Luangprabang since 2012.

CHAPTER 4: INFORMATION ON DOMESTIC MRV

Lao PDR has not had a harmonised or inclusive MRV system and a standard procedure. However, Lao PDR has planned to carry out MRV of GHGs, mitigation actions and effects, and supports received. For now, and near future, MRV of the three areas shall focus on national level, sectoral, programmes or project and facility level, and base on the existing domestic processes, arrangements, and systems, and sectoral approaches. At national and sectoral level, MRV of GHGs emissions and removals shall be performed under the national GHG inventory for National Communication (NC) on Climate Change and BUR, which shall be conducted on a regular basis, by MONRE, in accordance with the UNFCCC convention, COP's decision and IPCC guidelines. At sectoral level, MRV shall also performed in accordance with its specific sectoral approach or mechanism and requirements. For example, MRV of REDD-plus shall be in line with its mechanism, and the main responsible body shall be the Ministry of Agriculture and Forestry (MAF). MRV of aviation sector shall be carried out in accordance with ICAO's resolution A39-3 and Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), and responsible mainly by the Ministry of Public Work and Transport (MPWT). At programme or project and facility level, sectoral or project and market specific MRV such as REDD+, CDM or JCM, etc. shall be employed.

MRV of mitigation actions and effects focussed on MRV of the implementation and GHGs and sustainable development effects of the national strategy and action plan on climate change, NDC, NAMAs, REDD and Renewable Energy Development and Green Growth Strategy. At sectoral level, relevant ministries or sectors shall carry out MRV of mitigation actions and effects in their sectors and share with MONRE. At national level, it shall be MONRE to coordinate with relevant sectors and compile all mitigation actions and effects in line with, for instance, NC, BUR or NDC reporting timeframe.

MRV of domestic or international supports, the Ministry of Planning and Investment (MPI) and the Ministry of Finance (MOF), who have a centralized support received or ODA database system, shall be the key organisations, among others. However, at national level, MONRE shall be responsible for coordination and reporting support received in the BUR.

Organisationally, in general, MONRE oversees MRV of GHGs, mitigation actions and effects, and supports received at national level. In addition, national assembly and state inspection also pay a role on external or third-party review of especially mitigation actions and support received. External consultants could be hired for verification when needed.

CHAPTER 5: CONSTRAINTS, GAPS, NEEDS AND SUPPORT RECEIVED

In accordance with Decision2/cp.17, this chapter elaborated information on constraints and gaps, and financial and technical support received and needs. The constraints, gaps and needs were summarised in the section 5.1, and supported received is in Section 5.2.

5.1 CLIMATE CHANGE MITIGATION CONSTRINTS

The constraints, gaps, and needs are summarized in the Table 11 below. They were identified by literature review, stakeholder interview and consultations, especially validation workshop and stakeholder consultation meetings.

Table 11 Key constraints, gaps and needs on climate change mitigation

Categories	Key constraints and gaps
Economic and financial	High cost and inadequate financial resources to invest in mitigation technologies or actions, especially clean, renewable energy, and low emission technologies
	Lack of financial incentives for mitigation
Market	Variable carbon credit and market including low price.
	Several CDM and NAMAs have been studied and planned, but very few implemented and achieved.
Policy, legal and regulatory	Unclear and or incomplete legal and regulatory framework, especially policies to promote development, deployment, and diffusion or transfer of renewable energy, environmentally friendly and low carbon technologies and practices. Financially, policies on incentives, feed-in tariff, subsidies, etc. are unclear.
	Ineffective law enforcement
Network	Inexistent specific expert group/network and ineffective network expansion
Institutional and organisational capacity and human skills	Ineffective organisational arrangement including organizational planning and reporting system and procedure
	Lack of coordination amongst stakeholders
	Limited technical capacity and skills
Information and awareness	Insufficient information on technical, financial and economic, social-culture, environmental aspects and effects of mitigation technologies
Other	Insufficient models and best practices
	Lack of M&E and feedback system, data and information system

5.2 FINANCIAL AND TECHNICAL SUPPORT RECEIVED AND NEEDS

About US$ 1.5 billion is needed to implement mitigation actions, especially under the national strategy on climate change in Lao PDR[20]. Just over USD 223 million in ODA flows supported climate change projects in Lao PDR in 2013-14, with a third (33%) on climate change

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[20] ODI, Age of Choice Study (2016) p. 21. https://www.odi.org/publications/10392-age-choice-development-finance-lao-pdr

mitigation directly and about 20% on both mitigation and adaptation[21]. The majority of the support are in the forestry sector, and some of the key projects were summarised in Table 7.

In general, there are gaps financial and technical support in comparison with the needs. In future, Lao PDR still need more financial and technical support to implement priority mitigation programmes outlined in Table 12.

Table 12 Financial and Technical Support Received in Forestry Sector

No	Mitigation projects	Status
1	Sustainable Forestry and Rural Development Project (SUFORD) (2009-2012)	Completed
2	Climate Protection through Avoided Deforestation (CliPAD) (2009-2018)	Completed
3	Sub-national REDD projects in Lao PDR by the Wildlife Conservation Society - Nam Et Phou Loey National Protected Area (NEPL NPA) - the Nam Kading National Protected Area (NK NPA).	Completed
4	Participatory Land and Forest Management Project (PA REDD) 2009-2014	Completed
5	Forest Programme for Forest Information Management 2010-2013	Completed
6	Winrock International Asia Regional Biodiversity Conservation Program's REDD+ Activities in Lao PDR 2010	Completed
7	Grassroots Capacity Building for REDD in Asia Pacific with RECOFTC 2009-2013	Completed
8	SNV-Lao PDR Assessment of Implementing a REDD project in Nam Xam National Protected Area, Huaphanh 2010-2011	Completed
9	Pre-planning for REDD+ Pilots in Xe Pian NPA and Xe Sap NPA by the World Wild Fund for Nature (WWF) 2010	Completed
10	Sustainable Forest and Land Management in the Dry Dipterocarp Forest Ecosystems of Southern Lao PDR (2016-2022)[22]	On going
11	Implementation of the Lao PDR Emission Reductions Programme through improved governance and sustainable forest landscape management (2020-2024, 2020-2029)[23]	On going

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[21] OEDC (2017). Investment framework for green growth in Lao PDR.
[22] https://www.la.undp.org/content/lao_pdr/en/home/projects/Sustainable-Forest-and-Land-Management-in-the-Dry-Dipterocarp-Forest-Ecosystems-of-Southern-Lao-PDR1.html
[23] https://www.greenclimate.fund/document/implementation-lao-pdr-emission-reductions-programme-through-improved-governance-and

Table 13 Financial and Technical Support Needs for Mitigation

No	Mitigation actions or programmes	Budget (million USD)	Status
1	Implement renewables development strategy and NAMAs	To be added	
2	Implement polices on energy conservation and efficiency		
3	Implement Forestry and REDD strategy including upscaling REDD+ programmes and result base payment (see also Annex)		
4	Implement sustainable and low carbon transportation strategy and NAMAs		
5	Implement sustainable and low carbon and or smart city strategy and plan		
6	Implement clean and green industry strategy including environmental management system (ISO 14000)		
7	Implement national strategy on climate change		
8	Implement the national green growth strategy		
9	Prepare and implement NC and BUR		
10	Prepare and implement technology transfer including technology needs assessment and action plan		
11	Natural resources and environment strategy and		
12	Mitigation action indented in the 9th national socioeconomic development plan.		

Lao People's Democratic Republic

Results achieved from Reducing Emissions from Deforestation and Forest Degradation, and Increasing Removals through Enhancement of Forest Carbon Stocks for REDD+ Results-Based Payments

July 2020

Department of Forestry
Ministry of Agriculture and Forestry, Lao PDR

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Acronyms

AD — Activity Data
AGB — Above Ground Biomass
BGB — Below Ground Biomass
CF — Coniferous Forest
DBH — Diameter at Breast Height
DD — Dry Dipterocarp Forest
DOF — Department of Forestry
EG — Evergreen Forest
E/R factors — Emission and Removal Factor
FIPD — Forestry Inventory and Planning Division
FREL/FRL — Forest Reference Emission Level/Forest Reference Level
GHG — Greenhouse Gas
GIS — Geographic Information System
IPCC — Intergovernmental Panel on Climate Change
Lao PDR — Lao People's Democratic Republic
MAF — Ministry of Agriculture and Forestry
MCB — Mixed Coniferous Broadleaved Forest
MD — Mixed Deciduous Forest
NFI — National forest Inventory
NRTF — National REDD+ Taskforce
MRV — Measurement, Reporting and Verification
NFMS — National Forest Monitoring System
REDD+ — Reducing Emissions from Deforestation and forest Degradation plus the conservation of forest carbon stocks, sustainable management of forests and enhancement of forest carbon stocks
RV — Regenerating Vegetation
TWG — Technical Working Group
UNFCCC — United Nations Framework Convention on Climate Change

1   INTRODUCTION

Lao PDR presents this Technical Annex to obtain and receive results-based payments for reducing emissions from deforestation and forest degradation and increasing removals through enhancement of forest carbon stocks through REDD+ actions under the UNFCCC.

This Technical Annex was developed following the guidelines for elements to be included in the technical annex referred to in decision 14/COP19, paragraph 7 and other relevant decisions under the UNFCCC. It presents the **results of 12,805,253 tCO2e for reduced emissions and 1,873,301 tCO2e for increased removals for the period of 1st January 2015 to 31 December 2018 (4 years) estimated consistently against the FREL/FRL**.

The presentation of this Technical Annex does not modify, revise or adjust in any way the Nationally Determined Contribution of Lao PDR, or any national legal instruments or binding agreements under the UNFCCC.

2 SUMMARY OF INFORMATION ON THE ASSESSED FOREST REFERENCE EMISSION LEVEL AND FOREST REFERENCE LEVEL

Lao PDR submitted its initial Forest Reference Emission Level/Forest Reference Level (FREL/FRL) on 8 January 2018, and the modified version was submitted in October 2018. The technical assessment was completed in January 2019 and published in the UNFCCC REDD+ web platform[24].

Elements for FREL/FRL

Table 14 below summarizes the main scope for the FREL/FRL.

Table 14: Main scope for the FREL/FRL

Scope	Contents
Activities included	Deforestation Forest degradation including from selective logging Forest enhancement (restoration) Forest enhancement (reforestation)
Carbon Pools	Included: AGB, BGB Not included: Deadwood, Litter, Soil – lack of data, insignificant
Gases	Only CO2 included
Scale	National
Reference period and validity	2005-2014 (10 years) The validity of FREL/FRL is for the period 2015–2025 (11 years)
Emission/Removal Factors	Data source: 2nd NFI; country-specific allometric equation; IPCC default values; data of Vietnam. Then, stratified into five strata. Calculation: amount of changes in carbon stock of among the five strata.
Activity Data	Data source: national-scale forest type maps for year 2005, 2010 and 2015. Then, stratified in to five strata. Calculation: amount of changes in areas among the five strata. Estimated through reference sampling ('Design-Based Area Estimation')
Model applied	Historical average
Adjustment	No.

Forest definition

According to the Land Law (2003) and Forestry Law (2019), forest and forest resources in Lao PDR occur in lands that are designated by the Government as forest lands, and in areas outside forest lands, and includes stocked and temporarily un-stocked forests.

Lao PDR has applied definitions for Current and Potential forests respectively, as national definitions of the forests, for which a summary is shown below.

- "Current Forest" consists of forest with trees with minimum DBH of 10cm forming minimum crown density of 20% and constituting a minimum area of 0.5ha. For forest plantations, tree plots satisfying a minimum area of 0.5ha are considered as Current Forest (DBH and crown density are not considered).
- "Potential Forest" is defined as Lands previously forested, but presently not meeting the definition of "Current Forest" due to various disturbances, and expected to be restored to "Current Forest" status if

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[24] https://redd.unfccc.int/submissions.html?country=lao

continuously left undisturbed, and not permanently being used for other purposes (i.e. residential, agriculture etc.).

This definition was used for the past two National Communications to the UNFCCC, and has been agreed to be used for the future national Greenhouse Gas (GHG) inventory starting with the Third National Communication and the 1st Biennial Update Report which the Lao government plans to submit both to the UNFCCC in 2020.

Land and forest classification

The land and forest classification system of the country applies two levels of classification, namely, Level 1 consisting of seven classes including "Current Forest" and "Potential Forest" among others, and Level 2 which further classifies "Current forest" class under Level 1 into six natural and plantation forest classes. The land classification system is provided in Table 15 below, and a full description of the definition of each Level 2 class is available at the Department of Forestry (DOF)'s website[25].

Table 15: National level land and forest classification system of Lao PDR with IPCC definition on land use categories

IPCC Definition	National level classification system		
	Level 1	Level 2	
Forest Land	Current Forest	Evergreen Forest	EG
		Mixed Deciduous Forest	MD
		Dry Dipterocarp Forest	DD
		Coniferous Forest	CF
		Mixed Coniferous and Broadleaved Forest	MCB
		Forest Plantation	P
	Potential Forest	Bamboo	B
		Regenerating Vegetation	RV
Grassland	Other Vegetated Areas	Savannah	SA
		Scrub	SR
		Grassland	G
Cropland	Cropland	Upland Crop	UC
		Rice Paddy	RP
		Other Agriculture	OA
		Agriculture Plantation	AP
Settlement	Settlement	Urban Areas	U
Other land	Other Land	Barren Land and Rock	BR
		Other Land	O
Wetland	Above-ground Water Source	River (Water)	W
		Wetland (Swamp)	SW

Stratification

For the purpose of the estimation of forest-related emissions and removals, the national land and forest classification explained above are condensed into five strata. Such simplified stratification will help reduce uncertainty of emissions and removals while balancing the accuracy of sampling and the cost/efforts required.

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[25] http://dof.maf.gov.la/en/home/

Table 16: Stratified land/forest classification system and the five land/forest strata

Land/forest classes			Strata
Level 1	Level 2		
Current Forest	Evergreen Forest	EG	1
	Mixed Deciduous Forest	MD	2
	Coniferous Forest	CF	
	Mixed Coniferous and Broadleaved Forest	MCB	
	Dry Dipterocarp Forest	DD	3
Potential Forest	Forest Plantation	P	4
	Bamboo	B	
	Regenerating Vegetation	RV	
Other Vegetated Areas	Savannah	SA	5
	Scrub	SR	
	Grassland	G	
Cropland	Upland Crop	UC	
	Rice Paddy	RP	
	Other Agriculture	OA	
	Agriculture Plantation	AP	
Settlement	Urban Areas	U	
Other Land	Barren Land and Rock	BR	
	Other Land	O	
Above-ground Water Source	Wetland (Swamp)	SW	
	River (Water)	W	

General methodologies used for the construction of FREL/FRL

Reflecting the dynamic nature of land-use change in the country, and also to adequately monitor the future impacts of REDD+ implementation, Lao PDR considers it more appropriate to present historical emissions and removals separately per each source and sink activity. Accordingly, the four sources and sinks (i.e., emissions from deforestation and degradation, and removals from restoration and reforestation) are estimated by calculating the changes in biomass caused by the shift from one stratum to another. Due to the limitation in available data, emissions and removals occurring in forests remaining in the same category (i.e. strata 1, 2, 3 and 4) are not accounted for, except in the case of emissions estimated through measurement of tree stumps as proxy data for selective logging.

Historical data used

Regarding the Activity Data (AD) and Emission/Removal factors (E/R factors):

- The AD is generated spatially using satellite-based analysis of land/forest cover for the two periods: 2005-2010 and 2010-2015. National-scale Forest Type Maps are used as the basis for estimating the AD. Changed areas are detected by change detection method, and then applied reference sampling ('Design-Based Area Estimation') with respect to generating statistically reliable estimates.
- E/R factors are basically generated using national-scale biomass data from the 2nd National Forest Inventory (NFI) combined with country-specific allometric equations, and an independent biomass measurement

data for Regenerating Vegetation (RV) class[26]. IPCC default and data from neighbouring Vietnam are used for some land/forest classes where no country-specific data are available.

Apart from the above, Lao PDR estimates emissions from forest degradation by selective logging through proxy approach. The approach uses the tree stump records measured through the 2nd NFI to complement the impact of selective logging which was considered as under-represented in the estimation of emissions from forest degradation. The approach also complements quantifying forest degradation in stable forest classes where forest biomass change data is limited.

Emission and removals calculated based on changes among land/forest strata
Based on the process and data explained above, average annual historical emissions and removals based on the changes among land/forest strata over the reference period of 2005-2014 are calculated.
Further, two adjustments were made with an aim to make the estimation as accurate as possible:
(i)   Adjustment of removals (regrowth rate and reversals)

For land cover changes which result in emissions (i.e. 'Deforestation' and 'Forest Degradation'), the entire expected emission is assumed to occur (i.e. evenly distributed) over the time period in question. Meanwhile, for land/forest cover changes which result in removals (i.e. 'Restoration' and 'Reforestation') adjustments were applied as follows;
   a. Adjustments were made to 'Restoration' and 'Reforestation' by considering the types of changes and rate of tree growth. This recognizes that in forest ecosystems, forest biomass increase slowly over time to reach their full biomass (IPCC 2006).
   b. Reversals during the reference period (2005-2014) were identified through time-series analysis of polygons, in order to avoid double-counting. This is because due to the estimation method of generating AD for two independent periods (i.e. 2005-2010 and 2010-2015), there is a chance that the emissions from reversal events which have occurred during the reference period are unreported (in other words, removals are over-estimated).

(ii)   Adjustment of emissions from deforestation and forest degradation

The resulting estimation based on above (i) presents the risk of overestimation of emissions from deforestation and degradation. This is because, the E/R factors are strata-specific and do not reflect the actual accumulated biomass which may be lower. Such change patterns were tracked through the time series-analysis of forest maps. The resulting over-estimation of emissions from deforestation and over-estimation of emissions from forest degradation were estimated and deducted, respectively.

Emissions from selective logging (forest degradation)
As explained already, the 2nd NFI recorded the tree stumps of the trees felled by human activities. The biomass of the felled trees were estimated from the measured size of each tree stump, aggregated for each of the five forest class (i.e. EG, MD, DD, CF, MCB) in order to estimate the average loss of carbon stock, and converted to tCO2e. Then, the results were multiplied with the area of each forest class calculated from the Forest Type Map 2015, to estimate the assumed emissions from such logging events. Possible double-counting between the calculation of emissions from selective logging and the calculation of degradation based on changes in forestland strata (i.e. strata 1, 2, 3 and 4) is avoided by deducting latter from the entire forest degradation emissions.

Results of calculation and the proposed FREL/FRL
From the above, the average value for each period was estimated in order to derive the annual historical emissions and removals. The results are shown in Table 17 below.
Table 17: Annual historical emissions and removals by sources and sinks

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[26] The reason for not using the 1st NFI data is explained in the Annex 10: Emission and Removal Factors Report.

| Year | Annual historical emissions and removals by sources and sinks | | | | Reference level | |
	Emissions: Deforestation	Emissions: Forest Degradation	Removals: Reforestation	Removals: Restoration	Emissions	Removals
2005	9,602,777	25,572,121	-2,922,006	-3,039,488	35,174,898	-5,961,494
2006	9,602,777	25,572,121	-2,922,006	-3,039,488	35,174,898	-5,961,494
2007	9,602,777	25,572,121	-2,922,006	-3,039,488	35,174,898	-5,961,494
2008	9,602,777	25,572,121	-2,922,006	-3,039,488	35,174,898	-5,961,494
2009	9,602,777	25,572,121	-2,922,006	-3,039,488	35,174,898	-5,961,494
2010	9,602,777	25,572,121	-2,922,006	-3,039,488	35,174,898	-5,961,494
2011	15,587,931	34,183,013	-3,739,205	-6,152,448	49,770,943	-9,891,653
2012	15,587,931	34,183,013	-3,739,205	-6,152,448	49,770,943	-9,891,653
2013	15,587,931	34,183,013	-3,739,205	-6,152,448	49,770,943	-9,891,653
2014	15,587,931	34,183,013	-3,739,205	-6,152,448	49,770,943	-9,891,653
				Average	41,013,316	-7,533,558

In conclusion, the FREL/FRL for Lao PDR is 41,013,316 tCO2e/year for emissions and 7,533,558 tCO2e/year for removals.

Assessment of uncertainty

Uncertainty associated with (a) emission and removals calculated based on changes among land/forest strata, and (b) emissions from selective logging, is quantified by applying 'propagation of error approach' and by using the generic equations given in the IPCC Guidelines 2006 (Equation 3.1 and 3.2).

As the final result, the overall uncertainty of the proposed FREL/FRL is considered as 16.0% for emissions and 19.3% for removals.

Table 18: Overall uncertainty of the proposed FREL/FRL

| Source/Sink | 2005-2014 | | |
	Amount (tCO2e/year)	Uncertainty range (tCO2e/year)	Uncertainty (%)
Emission (5 strata and selective logging combined)	41,013,316	6,562,648	16.0%
Removal	-7,533,558	-1,457,714	19.3%

3 RESULTS IN TONNES OF CO2 EQ PER YEAR, CONSISTENT WITH THE ASSESSED FOREST REFERENCE EMISSION LEVEL AND FOREST REFERENCE LEVEL

The full description of the calculation is available in the "Lao People's Democratic Republic: 1st National REDD+ Results Report for REDD+ Results-Based-Payment under the UNFCCC" and associated technical documents available from < http://dof.maf.gov.la/en/publications/>.

Lao PDR has measured the REDD+ results in full consistency with the FREL/FRL in methodology and scope, by using updated data. The results for the period 2015 - 2018 were calculated as the difference between the average annual emissions and removals of 2015-2018 and the FREL/FRL of 2005-2014.

First, the emissions and removals of 2015 -2018 period are summarized in Table 19. Note that the results are separated out into two time periods reflecting the difference in approaches applied for the emissions from selective logging per each time period (see footnote 4 for more explanation).

Table 19: Average Annual Emissions and Removals over the 1st National REDD+ Results period

Source/Sink	Emissions(+)/ Removals(-)		
	Total 2015-2018 (tCO2e)	Average annual 2015-2016 (tCO2e/year)	Average annual 2017-2018 (tCO2e/year)
Deforestation	44,974,274	11,243,569	11,243,569
Forest Degradation	106,273,739	27,088,804	26,048,065
Changes among land/forest strata	71,608,030	17,902,008	17,902,008
Selective logging[27]	34,665,708	9,186,797	8,146,058
Reforestation	-4,337,947	-1,084,487	-1,084,487
Restoration	-27,669,584	-6,917,396	-6,917,396
Total Emission	151,248,013	38,332,373	37,291,634
Total Removals	**-32,007,531**	-8,001,883	-8,001,883

Next, from the above, average value for each period was estimated in order to derive the annual historical emissions and removals. The results are shown in

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[27] As the 2nd NFI in fact includes tree stumps of 2015 and 2016, emissions from selective logging accounted in the FREL/FRL (i.e. 9,186,797 tCO2e/year) is also accounted as the emissions from selective logging for the 2015-2016 period. For the 2017-2018 period, tree stump data from the 3rd NFI is used to estimate the emissions from selective logging (i.e. 8,146, 058 tCO2e/year).

Table 20.

Table 20: 1st National REDD+ results – annualized*

Unit: tCO2e/year

Year	Annual historical emissions and removals 2005-2014		Annual emissions and removals 2015-2018		1st National REDD+ Results 2015-2018	
	Emissions: Deforestation and Forest Degradation	Removals: Reforestation and Restoration	Emissions: Deforestation and Forest Degradation	Removals: Reforestation and Restoration	Emissions reduction	Removals increase
2005	41,013,316	-7,533,558				
2006	41,013,316	-7,533,558				
2007	41,013,316	-7,533,558				
2008	41,013,316	-7,533,558				
2009	41,013,316	-7,533,558				
2010	41,013,316	-7,533,558				
2011	41,013,316	-7,533,558				
2012	41,013,316	-7,533,558				
2013	41,013,316	-7,533,558				
2014	41,013,316	-7,533,558				
	Reference period					
2015	41,013,316	-7,533,558	38,332,373	-8,001,883	2,680,944	468,325
2016	41,013,316	-7,533,558	38,332,373	-8,001,883	2,680,944	468,325
2017	41,013,316	-7,533,558	37,291,634	-8,001,883	3,721,683	468,325
2018	41,013,316	-7,533,558	37,291,634	-8,001,883	3,721,683	468,325
Total					12,805,253	1,873,301

*Figures have been rounded to the nearest whole number

In conclusion, the 1st National REDD+ Results for Lao PDR for the period of 2015-2016 and 2017-2018 is 2,680,944 tCO2e/year and 3,721,683 tCO2e/year respectively (12,805,253 tCO2e over 4 years) for emissions and 468,325 tCO2e/year (1,873,301 tCO2e over 4 years) for removals as shown in
Table **21**.

Table 21: Proposed 1st National REDD+ Results for Lao PDR (2015-2018)

Emissions/Removals	tCO2e/year	4 years total
Emissions reduction 2015-2016	2,680,944	12,805,253
2017-2018	3,721,683	
Removals increase 2015-2016	468,325	1,873,301
2017-2018	468,325	

The overall uncertainty of the proposed 1st National REDD+ Results is considered as 16.5% for emissions and 15.7% for removals for the 2015-2016 period, and 12.7% for emissions and 15.7% for removals for the 2017-2018 period.

Table 22: Overall uncertainty of the proposed 1st National REDD+ Results (2015-2016)

Source/Sink	2015-2016		
	Amount (tCO2e/year)	Uncertainty range (tCO2e/year)	Uncertainty (%)
Emission	2,680,944	442,697	16.5%
Removal	468,325	73,592	15.7%

Table 23: Overall uncertainty of the proposed 1st National REDD+ Results (2017-2018)

Source/Sink	2017-2018		
	Amount (tCO2e/year)	Uncertainty range (tCO2e/year)	Uncertainty (%)
Emission	3,721,683	470,809	12.7%
Removal	468,325	73,592	15.7%

4   DEMONSTRATION THAT THE METHODOLOGIES USED TO PRODUCE THE RESULTS ARE CONSISTENT WITH THOSE USED TO ESTABLISH THE ASSESSED FOREST REFERENCE EMISSION LEVEL AND FOREST REFERENCE LEVEL

As summarized in Table 24 below, the REDD+ results contained in this technical annex is produced in full consistency with the FREL/FRL by using updated data for some elements.

Table 24: Comparison of the FREL/FRL and REDD+ results

Scope	FREL/FRL	REDD+ results
Forest definition	"Current Forest" with - Stand DBH: minimum of 10cm - Crown density: minimum of 20% - Minimum area of 0.5ha. and "Potential Forest" defined as lands previously forested, but presently not meeting the definition of "Current Forest" due to various disturbances, and expected to be restored to "Current Forest" status if continuously left undisturbed.	Same.
Land and forest classification system	National land and forest classification system with two levels of classification: - Level 1 consisting of seven classes including "Current Forest" and "Potential Forest"; and - Level 2 which further classifies "Current forest" class under Level 1 into six natural and plantation forest classes.	Same.
Stratification	For the purpose of the REDD+, the national land and forest classification explained above are condensed into five land/forest strata.	Same.
Activities included	Deforestation Forest degradation including selective logging Forest enhancement (restoration) Forest enhancement (reforestation)	Same.
Carbon Pools	Included: AGB, BGB Not included: Deadwood, Litter, Soil – lack of data, insignificant	Same.
Gases	Only CO_2 included.	Same.
Scale	National	Same.
Reference period and validity	2005-2014 (10 years) The validity of FREL/FRL is for the period 2015–2025 (11 years)	The proposed results period is 2015-2018 (4 years) and within the validity period of the FREL/FRL.

Emission Factor	Data source: 2nd NFI; country-specific allometric equation; IPCC default values; data of Vietnam. Then, stratified into five strata. Calculation: amount of changes in carbon stock of among the five strata.	Data source: 3rd NFI. Otherwise same.
Activity Data	Data source: national-scale forest type maps for year 2005, 2010 and 2015. Then, stratified in to five strata. Calculation: amount of changes in areas among the five strata. Estimated through reference sampling ('Design-Based Area Estimation')	Data source: national-scale forest type maps for year 2019. Otherwise same.
Model applied	Historical average	Same.
Adjustment	No.	Same.

5 DESCRIPTION OF THE NATIONAL FOREST MONITORING SYSTEM AND THE INSTITUTIONAL ROLES AND RESPONSIBILITIES FOR MEASURING, REPORTING AND VERIFYING THE RESULTS

5.1 Description of the National Forest Monitoring System

As evidenced by the submission of this REDD+ Technical Annex, Lao PDR is already implementing core parts of its National Forest Monitoring System (NFMS) which supports the country's REDD+ MRV. It should be noted that Lao PDR currently implements REDD+ MRV on two different scales; one for the national level (as reported herewith) and another for a sub-national level which is for the Emission Reduction Program (ER Program) for the Forest Carbon Partnership Facility's Carbon Fund[28]. The FREL/FRLs for the national and sub-national levels were constructed using same methodologies and datasets, therefore, considered as highly consistent.

The NFMS is being developed in step-wise fashion to support monitoring of the drivers and interventions (a conceptual picture show in Figure 13 below). There are several related initiatives progressing in parallel, and they will be coordinated under the National REDD+ Task Force (NRTF) and the REL/MRV Technical Working Group (TWG) so that the NFMS will contribute to the overall performance monitoring of the forestry sector.

Recognizing the importance of a robust and transparent NFMS, Lao PDR is currently developing its national approach to the NFMS through the development of Lao NFMS Roadmap with support from JICA. The Lao NFMS Roadmap, once complete, would provide a comprehensive overview and work plan for improvements, identified actions, institutional arrangements, and capacity building needs. Based on an assessment of its national circumstances, existing and emerging REDD+ investments, and broader climate finance opportunities the national approach to NFMS will ensure REDD+ MRV requirements are fully considered. The Lao NFMS Roadmap is expected to be complete by the 3rd Quarter of 2020.
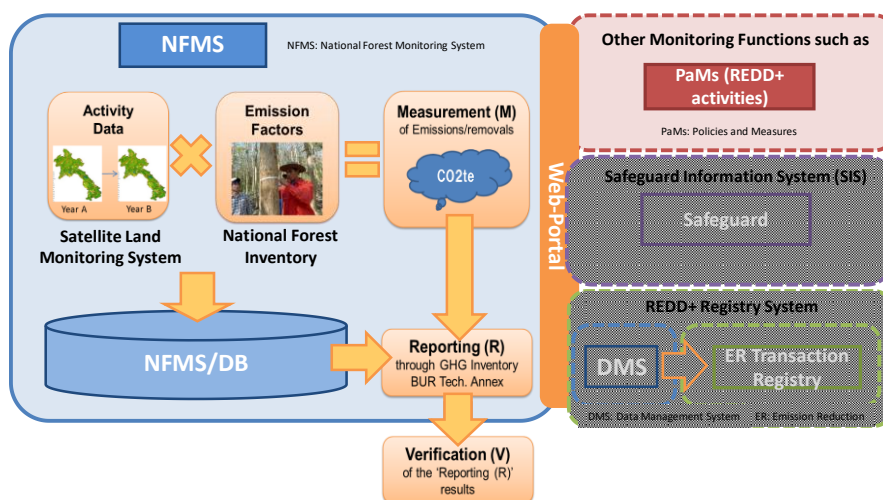

Figure 13: Conceptual diagram of Lao PDR's NFMS and its interactions with other REDD+ system

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[28] https://www.forestcarbonpartnership.org/country/lao-pdr

5.2 Institutional roles and responsibilities for measuring, reporting and verifying the reported results

Role and capacity of entities for conducting MRV

■ Department of Forestry (DOF)

DOF, as the national entity responsible for forest management, will play the main role in the MRV. Forest Planning and Inventory Division (FIPD) of DOF will continue to be responsible for generating the AD and E/R factors, and applying other proxy-based methods as appropriate.

■ REL/MRV Technical Working Group (TWG)

The REL/MRV TWG will technically review the results of the MRV (and other technical areas related to NFMS, such as forest monitoring for law enforcement). The TWG consists of members from the four key government agencies (FIPD of DOF, REDD+ Division of DOF, Department of Agriculture Land Management of MAF, Department of Climate Change of MONRE) and one from academia (Faculty of Forestry, under the National University of Laos (NoUL)). The TWG is technically supported by international projects and advisors and is an open process. Although the MRV itself is under the responsibility of the REL/MRV TWG, members of other five TWGs[29] will be invited as appropriate, where there are links between the thematic areas. Having DDC of MONRE, who is the national focal point to the UNFCCC, and responsible for climate change related issues including GHG Inventory, as a member of the TWG will allow the coordination of the MRV process and results with other GHG mitigation initiatives in the country.

■ National REDD+ Task Force (NRTF)

The NRTF will be responsible for reviewing and politically endorsing the results of MRV. The NRTF consists of concerned government agencies, academia (NoUL) and business associations (Chamber of Commerce) who have stake in forestry, land-use, climate change, poverty reduction and other issues related to REDD+ in Lao PDR.

■ Ministry of Agriculture and Forestry (MAF)

MAF will be responsible for the overall governance and supervision of the REDD+ including the MRV, and will undertake the final responsibility to submit the MRV report (through MONRE who is the UNFCCC focal point).

■ Private sector and local community

The private sector and local community will be informed of the results to ensure transparency and accountability in MRV. Some of them, particularly the local communities, will continue to be involved in supporting the technical work, such as being local guides for the NFIs. Moreover, the information from their own activities are expected to be used as ancillary information to support and improve the MRV, particularly in forest mapping. This includes, for example, plantation management information of the forest companies to improve classification of plantations, and village-level forest monitoring activities based on the land-use plans to further understand the stages of shifting-cultivation and forest regeneration stages. Other potential means of engagement will be explored through the course of designing the future NFMS.

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[29] Benefit Sharing TWG, Land TWG, Legal TWG, Monitoring and Promoting REDD+ Strategy Implementation TWG and Social and Environmental Safeguards TWG.

6   NECESSARY INFORMATION THAT ALLOWS FOR THE RECONSTRUCTION OF THE RESULTS

Lao PDR is in the process of developing its NFMS including the database system and web-based portal.
For the development of a database system which enables automated estimation of forest carbon stocks and its changes over time, this will be done through developing functions to:
1.   Archive, calculate and output the AD
2.   Archive, calculate and output the E/R factors
3.   Calculate, evaluate and output the forest carbon stocks and its changes, and convert to tCO2e.

The advantage of such system is that it will unify all the existing official data used for the emissions and removals into one single database, reduce costs by means of automating, and facilitate transparency of the estimation methods and results. Moreover, overlaying such information with the administrative boundary data, forest category data, and other forestry-related data will allow the data users to analyse forests according to their interest.

Table 25: Data to be presented in the NFMS web-portal

Data related to AD	Data type
Forest Type Map 2000, 2005, 2010, 2015, 2019	Raster data
Forest cover change map 2000-2005, 2005-2010, 2010-2015, 2015-2019	Raster data (partly vector data)
Satellite imagery used for the development of Forest Type Maps Landsat (2000), SPOT4, 5 MS(2005), RapidEye (2010, 2015) (both false colour and true colour), Sentinel 2(2019)	Raster data
Data related to E/R factors	**Data type**
1st NFI data	Tabular data
2nd NFI data	Tabular data including GIS points
3rd NFI data	Tabular data including GIS points
Other data	**Data type**
Administrative area: national, province, district	Vector data
Forest category: Production Forest, Protection Forest, Conservation Forest	Vector data
Reports	**Data storage**
FREL/FRL Report to the UNFCCC including annexes	Available in UNFCCC website
1st National REDD+ Results to the UNFCCC including annexes	To be made available in UNFCCC website
1st National Communication to the UNFCCC	Available in UNFCCC website
2nd National Communication to the UNFCCC	
3rd National Communication to the UNFCCC	To be made available in UNFCCC website
1st Biennial Update Report to the UNFCCC	

The NFMS web-portal will enable access through internet[30]. The information to be presented in the NFMS web-portal will be further enhanced, although step-wise, to ensure transparency.

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[30] <http://nfms.maf.gov.la:4242/nfms/>. As the web-portal is currently inaccessible due to its system upgrading in progress (as of June 2020), the temporary back-up website can be accessed through <http:/nfms-lao.net/nfms/>.

7 DESCRIPTION OF HOW THE ELEMENTS CONTAINED IN DECISION 4/ CP.15, PARAGRAPH 1(C) AND (D), HAVE BEEN TAKEN INTO ACCOUNT

7.1 To use of the most recent IPCC guidance and guidelines

The Lao PDR used the methodologies and equations provided in the 2006 IPCC Guideline for the construction of the FREL/FRL. The REDD+ results presented herewith maintains overall consistency with the 2006 IPCC Guideline by applying methodologies consistent with the FREL/FRL as explained in Section 4.

Equations 2.15 and 2.16 from vol. 4, chapter 2) of the 2006 IPCC Guidelines are used for the estimation of carbon stock changes in land converted to other land-use categories. For lands remaining in the same land-use category, gain and loss method is partially used by considering only the losses in carbon stocks from selective logging.

A simplified approach for land representation is applied in which all non-forest land classes (cropland, grassland, wetlands, settlements and other land) are grouped into one non-forest class. Such approach was adopted in order to reduce the uncertainty associated with the land representation. Lao PDR acknowledges this approach is not consistent with the approaches for land representation provided in the IPCC 2016 Guidelines (vol. 4, chapter 3), however, the national data allows the application of approach 3 for land representation provided in the IPCC 2006 Guidelines.

The forest carbon stocks for the REDD+ results were derived using the data from the 3rd NFI conducted in 2019 together with the default parameters provided in the 2006 IPCC Guidelines and also some data from Vietnam. To calculate the above-ground biomass stocks of the five strata of land and forest classes, country-specific allometric equations are used. To calculate the below-ground biomass stocks, the root-to-shoot ratios provided in the 2006 IPCC Guidelines (vol. 4, chapter 4, Table 4.4) are used. Biomass stocks were converted into carbon stocks using the carbon fraction values (0.46 or 0.47 depending on the land class) provided in the 2006 IPCC Guidelines (vol. 4, chapter 4, Table 4.3).

Apart from the above, there are several areas for future technical improvement which will be addressed step-wise in the future in order to further improve conformity with the 2006 IPCC Guidelines.

7.2 To establish, according to national circumstances and capabilities, robust and transparent national forest monitoring systems that:

As already described in Section 5 and Section 6, Lao PDR already has the initial phase of NFMS which supports the REDD+ MRVs, including the database system and web-based portal. The NFMS is also being developed step-wise to improve the quality of REDD+ MRVs as well as to support monitoring of the drivers and interventions. Lao PDR is currently developing its Lao NFMS Roadmap with target for completion by the 3rd Quarter of 2020.

Standard Operating Procedure (SOP) is developed for each of the components below, with aim to achieve efficiency and quality output in standardized manner, thereby make the NFMS robust and transparent:
- SOP for Forest Type Map development
- SOP for National Forest Inventory
- SOP for NFMS database and web-portal (user manual, data installation manual)
- SOP for estimation of emissions/removals, REDD+ results and uncertainty

(i) Use a combination of remote sensing and ground-based forest carbon inventory approaches

As explained in the FREL/FRL submission and also in the 1st National REDD+ results, the NFMS of Lao PDR uses a combination of remote sensing and ground-based forest carbon inventory approaches for consistently

estimating the REDD+ results as summarized below (in fact the two approaches support each other in many ways). Uncertainty of each of the input data as well as the overall uncertainty are assesed.

    a.   Measurement based on land/forest area changes
- Use of AD estimated based on the stratified wall-to-wall mapping (remote sensing-based) and through reference sampling ('Design-Based Area Estimation'); and
- Use of E/R factors based on the biomass data from the NFIs (ground-based survery) ;

    b.   Proxy data (tree stumps observed and measured through the NFIs) to estimate emission from forest degradation by selective logging

    c.   Uncertainty assessment by using propagation of error approach.

(ii) Provide estimates that are transparent, consistent, as far as possible accurate, and that reduce uncertainties

The NFMS database stores national datasets used for generating AD and E/R factors and made accessible to everyone. Thus, the dataset used for the construction of FREL/FRL are made transparent through the NFMS database and other documentation (e.g. FREL/FRL report and other background documents being published). In a same way, the dataset used for the estimation of REDD+ results will be made transparent and allow reconstruction of the estimation.

The raw datasets are stored in a server system of DOF primarily to serve for the use of technical staff authorized by DOF staff, however, they can be shared to other users if the purposes are reasonably acceptable. DOF is planning to replace the server system managed by FIPD in order to strengthen its data management capacity and system security. The calculation spreadsheets and other data sources can be provided upon request. This Technical Annex will be made publicly accessible once the technical anaylsis is completed.

Institutioanlly, the NRTF established under the leadershipf of MAF vice minister serve as a venue to review and endorse the issues related to REDD+ including the REDD+ results. Under the NRTF, REL/MRV TWG operates as a venue to technically review and agree on the issues related to REL/MRV. The meetings of the REL/MRV TWG are generally open, to enhance partnership and transparency.

The estimation of REDD+ results are conducted in a consistent manner with the methods used for constructing the FREL/FRL as repeatedly explained elsewhere.

Lao PDR is commited to continuously improve the accuracy and reduce the uncertainty of the estimates as described in the related reports and technical documents associated to this Technical Annex. Through the excercise of developing the FREL/FRL and the REDD+ results, and also through various interactions with external expertise such as the technical assessment process of FREL/FRL and FCPF Carbon Fund, Lao PDR already has acknowledged some areas that need improvement. As explained in Section 5, the Lao NFMS Roadmap being prepared will help to clarify how DOF seeks to improve the MRVs and other forest monitoring components. JICA has been leading in technical support to the NFMS in collaboration with other development partners, with prospect to continue its support for the coming years.

For asseing unceraiy, Lao PDR conducted uncertainty assessment of the FREL/FRL by using propagation of error approach. Same approach is applied in the estimation of the REDD+ results and the results are already presented in Section 3.

(iii) Are transparent and their results are available and suitable for review

Lao PDR recognizes the importance of building a truly functional institutional set-up, robust technical elements, data transparency, and a data management system to support a sustainable operation of the NFMS.

As explained in Section 6, the NFMS web-portal and other documentations are/will be made accessible for enhanced transparency. The Lao NFMS Roadmap will also enhance transparency and allow interested stakeholders to understand how Lao PDR aims to manage and develop its NFMS.