



# REQUEST FOR CEO APPROVAL

**PROJECT TYPE: Medium-sized Project**

**TYPE OF TRUST FUND: GEF Trust Fund**

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## PART I: PROJECT INFORMATION

Project Title: Reducing of Green House Gas (GHG) emission in the Industrial Sector through Pelletization Technology			
Country(ies):	Lao People's Democratic Republic (PDR)	GEF Project ID: <sup>1</sup>	5743
GEF Agency(ies):	UNIDO	GEF Agency Project ID:	140057
Other Executing Partner(s):	Renewable Energy and New Materials Institute (REMI); Department of Industry and Handicrafts (DoIH); Ministry of Industry and Commerce(MoIC) Cleaner Production Center Lao (CPC-L)	Submission Date: Resubmission Date: Resubmission Date: Resubmission Date:	04/20/2015 05/18/2015 08/20/2015 09/16/2015
GEF Focal Area (s):	Climate Change	Project Duration(Months)	36
Name of Parent Program (if applicable): ➤ For SFM/REDD+ <input type="checkbox"/> ➤ For SGP <input type="checkbox"/> ➤ For PPP <input type="checkbox"/>	NA	Project Agency Fee (\$):	120,511

### A. FOCAL AREA STRATEGY FRAMEWORK<sup>2</sup>

Focal Objectives	Area	Expected FA Outcomes	Expected FA Outputs	Trust Fund	Grant Amount (\$)	Co-financing (\$)
CCM-3 (select)		Investments in RE technologies increased	RE capacity installed	GEF TF	1,268,539	6,640,000
<b>Total project costs</b>					1,268,539	6,640,000

### B. PROJECT FRAMEWORK

**Project Objective:** To reduce GHG emission in Lao PDR's industries by promoting the production and usage of industrial grade solid biofuel for thermal energy generation

Project Component	Grant Type	Expected Outcomes	Expected Outputs	Trust Fund	Grant Amount (\$)	Confirmed Co-financing (\$)
1. Capacity development and knowledge management	TA	1.1. Improved awareness, knowledge and capacity on solid biofuel production and usage in the country	1.1.1. An information and learning centre for solid biofuel production and usage established  1.1.2. Capacity of at least 20 policy makers developed and capacities of potential solid biofuel producers and users, RE / technical	GEF TF	190,000	840,000

<sup>1</sup> Project ID number will be assigned by GEFSEC.

<sup>2</sup> Refer to the [Focal Area Results Framework and LDCF/SCCF Framework](#) when completing Table A.

			institutions and bank / financial institutions developed (target 50 persons)			
2. Strengthening policy and regulatory framework for promoting investments in solid biofuel use in industries	TA	2.1. Improved confidence among investors in solid biofuel production and utilization	2.1.1. Database developed on agro & wood wastes availability and on final energy consumption in industrial sector 2.1.2. National strategy to promote investment in solid biofuel production and utilization in place 2.1.3. Technical adjustments for solid biofuel usage in participating industries	GEF TF	70,000	305,000
3. Demonstration of solid biofuel production and utilization	Inv	3.1 Increased use of solid biofuel for industrial applications	3.1.1. Systematic and comprehensive biomass resource assessment in target areas 3.1.2. Detailed plant designs prepared for the demonstration projects 3.1.3. Solid biofuel pelletizing systems established for a cumulative capacity of 3.6 tph	GEF TF	831,685	5,047,000
4. Monitoring and Evaluation (M&E)	TA	4.1. Effectiveness of the outputs assessed, corrective actions taken and experience documented	4.1.1. End of project M&E report prepared 4.1.1. Experience and information dissemination workshop 4.1.2. Publication and websites	GEF TF	70,000	167,500
Subtotal					1,161,685	6,359,500
Project management Cost (PMC) <sup>3</sup>				GEF TF	106,854	280,500
<b>Total project costs</b>					<b>1,268,539</b>	<b>6,640,000</b>

<sup>3</sup> PMC should be charged proportionately to focal areas based on focal area project grant amount in Table D below.

**C. SOURCES OF CONFIRMED CO-FINANCING FOR THE PROJECT BY SOURCE AND BY NAME (\$)**

Please include letters confirming co-financing for the project with this form

Sources of Co-financing	Name of Co-financier (source)	Type of Co-financing	Co-financing Amount (\$)
National Government	REMI	In-kind	950,000
National Government	DoIH	In-kind	780,000
Private Sector	Boten salt factory	Cash	984,000
Private Sector	Boten salt factory	In-kind	186,000
Private Sector	Veunkham salt factory	Cash	2,219,000
Private Sector	Veunkham salt factory	In-kind	201,000
Private Sector	Lao furniture industry	Cash	989,000
Private Sector	Lao furniture industry	In-kind	181,000
GEF Agency	UNIDO	Grant	60,000
GEF Agency	UNIDO	In-kind	90,000
<b>Total Co-financing</b>			<b>6,640,000</b>

**D. TRUST FUND RESOURCES REQUESTED BY AGENCY, FOCAL AREA AND COUNTRY<sup>1</sup>**

GEF Agency	Type of Trust Fund	Focal Area	Country Name/ Global	(in \$)		
				Grant Amount (a)	Agency Fee (b) <sup>2</sup>	Total c=a+b
(select)	(select)	(select)				0
<b>Total Grant Resources</b>				0	0	0

<sup>1</sup> In case of a single focal area, single country, single GEF Agency project, and single trust fund project, no need to provide information for this table. PMC amount from Table B should be included proportionately to the focal area amount in this table.

<sup>2</sup> Indicate fees related to this project.

**F. CONSULTANTS WORKING FOR TECHNICAL ASSISTANCE COMPONENTS:**

Component	Grant Amount (\$)	Co-financing (\$)	Project Total (\$)
International Consultants	168,000	56,000	224,000
National/Local Consultants	160,000	480,000	640,000

**G. DOES THE PROJECT INCLUDE A “NON-GRANT” INSTRUMENT? No**

(If non-grant instruments are used, provide in Annex D an indicative calendar of expected reflows to your Agency and to the GEF/LDCF/SCCF/NPIF Trust Fund).

## **PART II: PROJECT JUSTIFICATION**

### **FINDINGS DURING THE PPG STAGE**

The following activities carried out, and findings discovered during the PPG stage are highlighted below:

- Analysis of fossil fuel as well as biomass fuel currently used in the salt industry;
- Pre-feasibility study for the development of solid biofuel project;
- Potential of wood waste from different industries has been assessed as supply for solid biofuel production mills;
- Energy consumption of salt industries in Lao PDR has been assessed;
- Stakeholder's discussions show that there is inadequate awareness, technology and technical capacity to support the switch from the use of fossil fuel to solid biofuel;
- Although there is a general policy to promote the development of renewable energy through the Ministry of Energy and Department of Industry and Handicrafts (DoIH), there is still inadequate policy and regulatory frameworks to support the production and use of solid biofuel.

Every year the agriculture and forestry sectors produce large amounts of waste, such as rice straw and husks, sawdust, and corncobs. The annual potential of this waste is estimated at 500 million tons of oil equivalent (mtoe), which can be used as feedstock for power generation. So far, biomass is mostly used at the household level; the focus of this proposed project is to promote the efficient use of biomass in the industrial sector.

Coal along with traditional biomass is the fuel used by industries generating thermal energy for heat application in Lao. The major consumers of coal in Lao's industrial sector are the salt, cement and brick industries. There is an increase in demand for coal and traditional biomass over the years due to growth in the identified industries. The proposed project intends to replace the coal consumption in the industrial sector with solid bio-fuel, in this case with biomass pellets. Major opportunities exist in the industrial sector, where capital investment is yet to take place, through adoption of more efficient technologies and energy conservation measures. The project has perceived multiple benefits of pelletization technology, including social, environmental and economic, to promote waste to energy production and usage. It is socially desired, technically feasible and economically viable. It is expected that the project will result to the following socio-economic impacts:

- Investments in this area will lead to creation of jobs during the construction, commissioning, and operation phases hence contributing to poverty alleviation;
- Combustion of biomass with the appropriate technology is cleaner and cheaper compared to coal;
- Thermal energy generation from biomass pellets will reduce the dependency on coal;
- Densification of biomass will reduce transportation cost as well as fuel used for transportation.

In the approved PIF document, UNIDO identified three salt factories willing to participating in the proposed project. However, one of the factories opted out from the proposed project due to financial constraints; this reduced the co-financing amount from 6.69 to 6.64 million USD.

## A. DESCRIBE ANY CHANGES IN ALIGNMENT WITH THE PROJECT DESIGN OF THE ORIGINAL PIF<sup>4</sup>

The following changes were made in the project framework due to findings during the PPG stage. The changes are shown in the table below.

Project Component		Expected Outcome		Expected Output	
PIF	CEO Document	PIF	CEO Document	PIF	CEO Document
1. Capacity development and knowledge management	Not changed	Improved Capacity on solid biofuel production and usage	1.1.Improved awareness, knowledge and capacity on solid biofuel production and usage in the country	1.1. An information and learning unit established for solid biofuel production and usage 1.2.Trained key policy makers (50) and other target groups (50 in each group) available to continuously support the solid biofuel production and usage	1.1.1. Not changed  1.1.2. Capacity of at least 20 policy makers developed and capacities of potential solid biofuel producers & users, RE / technical institutions and bank / financial institutions developed (target 50 persons)
2. Promoting investments in solid biofuel production and utilization	2. Strengthening policy and regulatory framework for promoting investments of solid biofuel use in industries	Improved investment environment	2.1. Improved confidence among investors in solid bio fuel production and utilization	2.1. Database developed on biomass availability and final energy consumption in the industrial sector 2.2. Biomass resource assessed and logistics planned for transporting wastes 2.3. Solid biofuel end use incentive scheme facilitated	2.1.1. Database developed on agro & wood wastes availability and on final energy consumption in industrial sector 2.1.2. National strategy to promote investment in solid biofuel production and utilization in place 2.2.3. Technical adjustments for solid biofuel usage in participating industries

<sup>4</sup> For questions A.1 –A.7 in Part II, if there are no changes since PIF and if not specifically requested in the review sheet at PIF stage, then no need to respond, please enter “NA” after the respective question.

Project Component		Expected Outcome		Expected Output	
PIF	CEO Document	PIF	CEO Document	PIF	CEO Document
3. Demonstration of solid biofuel production and utilization	Not changed	Increased use of solid biofuel in industries	3.1. Increased use of solid biofuel for industrial applications	3.1. Solid biofuel pelletizing systems installed for cumulative 3.6 tph capacity	3.1.1. Systematic and comprehensive biomass resource assessment in target areas 3.1.2. Detailed plant designs prepared for the demonstration projects 3.1.3. Solid biofuel pelletizing systems established for a cumulative capacity of 3.6 tph
4. Monitoring and evaluation (M&E)	Not changed	Not changed		4.1. Mid-term M&E report prepared 4.2. End of project M&E report prepared	4.1.1. End of project M&E report prepared 4.1.2. Experience and information dissemination workshop 4.1.3. Publication and websites

### A.1 National strategies and plans

The following national strategies and plans are available in Lao PDR:

*Initial National Communication to UNFCCC, October 2000:* The major mitigation possibilities in Lao's energy sector include: a) introduction of advanced technologies that are more efficient or based on Renewable Energy (RE) sources; b) promotion of the use of RE such as small-scale hydropower development and electricity generation by wind, solar, biomass thermal energy and biogas; c) Energy conservation and improvements in energy efficiency through up gradation of currently employed technologies; and d) expansion of public transportation service.

*Technology needs assessments report, Climate Change Mitigation, April 2013:* Technology needs assessment identified the following mitigating measures:

- Extend the utilization of the advanced technologies;
- Enhancing energy conservation and the utilization of efficient technologies;
- Utilization of existing RE potentials;
- Developing small-scale electric power stations;
- Creating awareness on energy saving measures.

*Strategy on Climate Change (SCC) of the Lao PDR, 2010:* The objectives of SCC are to mainstream climate change mitigation measures into national socio-economic development plan and promote successful implementation of the National Growth and Poverty Eradication Strategy. Among the mitigation options for the energy sector is accelerating the development of RE sources such as solar, wind and hydropower including mini-hydro especially for remote communities. For the industrial sector, mitigation options such as reduction in energy consumption and waste generation as well as promoting the utilization of waste to energy.

*Renewable Energy Development Strategy, October 2011:* Through this strategy, the Government of Lao PDR aims to increase the share of RE to 30% of the total energy consumption by 2025. The Government recognizes the use of agro-residues and municipal solid waste as potential resources in achieving this aim. The development strategy focuses on promoting RE sources for electricity production. Among the initiatives that the Government plans to undertake, is the assessment of biomass resources in the country.

*Second National Communication to UNFCCC, June 2013:* The document identifies major mitigation possibilities in different sectors. In the industrial sector, greenhouse gas (GHG) reduction potentials can be achieved by reducing energy consumption and promoting the conversion of waste being generated in the sector to energy.

*Proposed Green Industry Plan:* Lao PDR is among the 21 Asian countries that agreed to the Manila Declaration on Green Industry in Asia on 9th September 2009. Currently, the Ministry of Industry and Commerce (MoIC) is developing a new manufacturing law in regards to the Manila Declaration, the concept of green industry will be a component of the law. The five sectors that the law is targeting are agro-processing, textile, wood and furniture, construction and food processing industries. The Green Industry Plan focal areas consists of the following:

- Efficient use of raw materials, energy and water;
- Prevention of emissions and wastes;
- Safe and responsible management of chemicals;
- Reduce, reuse and recycle (3R) industries;
- Industrial pollution control;
- Renewable energy industries;
- Cooperate social responsibility (CSR).

The proposed project will support the above Government policies and strategies targeted to increase the usage of RE in the industrial sector.

## **A.2 GEF focal area and/or fund(s) strategies, eligibility criteria and priorities**

The proposed UNIDO/GEF project focuses on promoting the use of solid biofuel for energy generation replacing coal usage. This area was selected due to its rapid scaling up and GHG emission reduction potential. These are in line with *GEF-5 climate change focal area strategic programme CCM-3: Promoting the investment in RE technologies*.

## **A.3 The GEF Agency's comparative advantage**

The project is a technical assistance/capacity development intervention that fits within the climate change focal area objective CCM-3. The GEF Council paper "Comparative Advantages of the GEF Agencies" (GEF/C.31/5rev.1)<sup>5</sup> recognises the comparative advantage of UNIDO in these objectives.

The mandate of UNIDO is to promote Inclusive Sustainable Industrial Development (ISID) in developing countries and economies in transition. UNIDO's vision is a world where economic development is inclusive and sustainable and economic progress is equitable. UNIDO has been providing technical assistance to Lao PDR for more than two decades. UNIDO's interventions in Lao PDR focus on four components: (i) enabling environment for industrial development, (ii) small and medium enterprise development, (iii) poverty reduction through productive activities and (iv) investment promotion and trade capacity building. UNIDO in collaboration with MoIC and UNEP established the Cleaner Production Center-Lao PDR (CPC-L) in 2010. The main goal of the centre is to contribute to poverty reduction and promote the country's environmental sustainability in the service and industrial sectors through increasing productivity, more efficient and utilization of resources and reducing impacts on environment and workers health and safety.

During the last decade, the UNIDO Regional Office in Thailand has implemented more than 30 projects in Lao PDR with a budget of around USD 4.5 Million. The proposed project will benefit from some of the administrative structures established for UNIDO's ongoing projects in the country. UNIDO will use the expertise and resources of CPC-L funded

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<sup>5</sup> <http://www.thegef.org/gef/sites/thegef.org/files/documents/C.31.5%20Comparative%20advantages.pdf>  
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by Switzerland through UNIDO as executing partners of the proposed project. Also, UNIDO has a large portfolio with GEF with over 90 projects in climate change mitigation focal area.

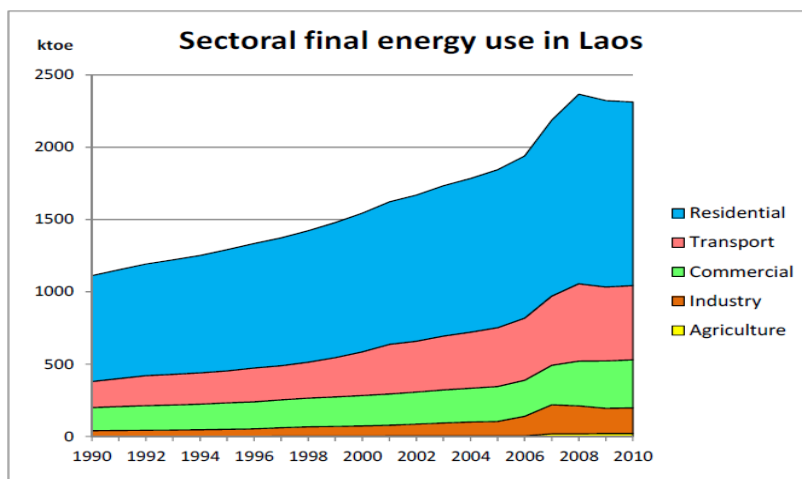
#### A.4 The baseline project and the problem that it seeks to address

##### Energy Scenario

Lao PDR is a landlocked country in southeast Asia, bordered by Myanmar and People's Republic of China to the northwest, Vietnam to the east, Cambodia to the south and Thailand to the west. Its population is around 6.8 million, and it has an average per capita GDP of 960 USD/year. The GDP growth rate is around 8.1 %<sup>6</sup>, which has resulted in increasing energy consumption<sup>7</sup>. The economy of Lao PDR is accelerating rapidly with the increasing international demands for its mineral resources; it has helped the country to achieve consistently high economic growth rates throughout the last decade.

In year 2000, Lao recorded a total emission of 43.811 million tons of CO<sub>2</sub>. About 2.047 million tons of CO<sub>2</sub> were removed, due to land-use change and forestry. Thus, the net CO<sub>2</sub> emission of about 41.764 million tons of CO<sub>2</sub> was recorded. This emission figure represents a substantial increase compared to a net sink of 104.570 million tons of CO<sub>2</sub> in the year 1990. This increase is attributed to a) improved technical capacity and data availability and b) rapid socio-economic development. Land-use change and forestry sector contributed almost 97% of the emissions with 2.3% emission from the energy sector, around 0.6% from non-renewable biomass usage and 0.1% from the industrial sector<sup>8</sup>.

Energy consumption in Laos has been growing considerably in recent years as shown in figure 1. In 2012, the final energy consumption was 2,336 kilotons of oil equivalent (ktoe). The residential sector accounted for 54%, the transport sector for 22%, the commercial sector for 14%, and the industrial and agricultural sectors for 10%. The high share accounted for by households reflects their reliance on traditional biomass. It also reflects the relatively low level of industrial and commercial activity. Also by sources of emissions, CO<sub>2</sub> emissions in the energy sector were primarily related to the use of biomass fuels derived from forest conversion. As electricity in Lao PDR is generated primarily by Hydropower, hence, emissions from this sector are negligible<sup>8</sup>.



**Figure1: Energy uses in different sectors in Lao**

The energy sources consumed in the country are fuelwood, oil, electricity and coal. Fuelwood, electricity and coal are domestically produced, while fuel oil and LPG are imported. Fuel oil is consumed in the transport and industrial sector; individuals that are not connected to the grid network also use it to generate electricity<sup>9</sup>. The primary energy source in Lao, as in many developing countries in the region, is traditional biomass. However, in terms of final energy use,

<sup>6</sup> <http://www.worldbank.org/en/country/laos/overview>

<sup>7</sup> Renewable Energy Development Strategy, in Lao PDR, October 2011

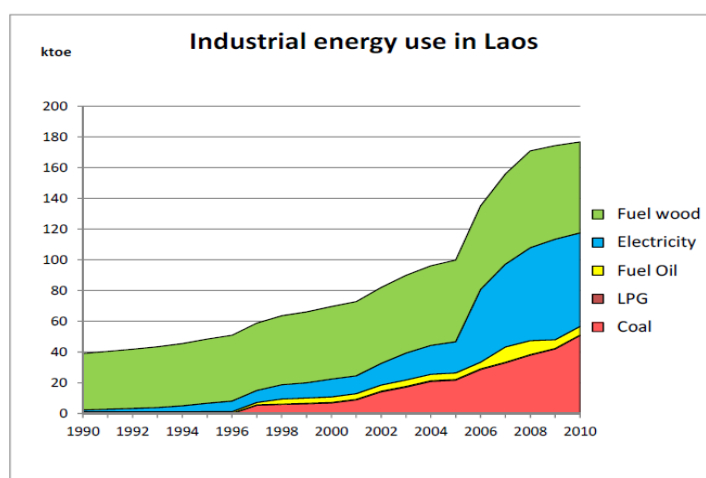
<sup>8</sup> Second National Communication to UNFCCC

<sup>9</sup> ADB Lao People's Democratic Republic: Energy Sector Assessment, Strategy, and Road Map, 2013 Update



biomass accounts for less than 60%, petroleum products account for about 17%, electricity for 12% and charcoal and coal for 11%<sup>10</sup>.

In the industrial sector, the use of coal has increased considerably, in the year 2010, about 0.1Mtoe of coal was consumed. Currently, coal is consumed in cement, salt and brick industries. Besides coal, other Laotian industries consume LPG, fuel oil, fuel wood and electricity to meet their energy demand. Figure 2 shows the sources of industrial energy use in Lao<sup>11</sup>. Fuel wood accounts for about 30% of the energy consumption in the industrial sector. A significant number of rural and urban small, medium and micro enterprises (SMMEs), including some large-scale industries are dependent on fuel wood for heat application. In 2007, the total consumption of wood for energy generation in small industries accounted for about 330,716 m<sup>3</sup>/year<sup>12</sup>. Hence, the primary concern is to reduce the usage of coal and fuel wood as much as possible in the industrial sector; according to the mitigation measures identified in the Second National Communication to UNFCCC for the industrial sector, energy efficiency, waste minimization and energy from waste. In addition, forest resources have been identified as important RE resources in Lao PDR. Based on the identified mitigation measures the salt and wood industries were selected for the proposed project. The salt industry has the potential for improving the inefficient method of producing salt, and the wood industry has the potential for supplying sustainable wood waste as feedstock for conversion to energy.



**Figure 2: Industrial energy use in Laos**

### Impacts of Climate Change on the energy sector

As a least developed country with few relevant adaptive capacities, Lao PDR is highly vulnerable to the impacts of climate change. Despite Lao PDR's small share of total GHG emissions, primarily from traditional biomass and fuel oil, mitigations of such emissions are worth pursuing. Moreover, without the capacity to manage the potential risk, the country will be exposed to even higher climate risks in the future.

The energy sector contributes to GHG emission based on production and consumption of energy. There are three major sources of energy for domestic and economic activities in Lao PDR: biomass, hydropower and fossil fuel. Hydropower is Lao's main source of electricity, which in turn, accounts for 12% of total energy consumption. Climate change is significantly affecting the energy sector and it is driven by internal rainfall variability that can be linked with extreme climate events such as frequent floods, mostly in the south, and droughts in the north. Nevertheless, climate change mitigation measures and adaptation are directly relevant to the planning and design of electricity generating stations and associated infrastructure.

<sup>10</sup> ADB Lao People's Democratic Republic: Energy Sector Assessment, Strategy, and Road Map, 2013 Update

<sup>11</sup> Future Energy Demand In Laos: Scenario Alternatives for Development, Finland Futures Research Centre, 2012 accessible at [http://www.utu.fi/fi/yksikot/ffrc/julkaisut/e-tutu/Documents/eBook\\_2012-8.pdf](http://www.utu.fi/fi/yksikot/ffrc/julkaisut/e-tutu/Documents/eBook_2012-8.pdf)

<sup>12</sup> Potential of Biomass Utilization in ACMES; A presentation by Kasetsart University, Thailand; GEF5 CEO Endorsement Template-February 2013.doc

Energy consumption in Lao PDR is projected to increase from 2,654 Ktoe in 2010 to 3,036 Ktoe in 2015 and 3,667 Ktoe in 2020. This will increase CO<sub>2</sub> emissions steadily from about 1,000 Gg in 2010 to more than 1,800 Gg in 2015 and nearly 3,000 Gg in 2020<sup>8</sup>. GHG reduction can be achieved in the industrial sector through the following mitigation measures:

- Energy efficiency: improving energy inputs in production processes;
- Waste minimization: reducing wood waste through the enhancement of furniture manufacturing efficiency;
- Energy from wastes: promoting the use of agricultural wastes or residues to produce energy or heat for post-harvest activities.

### Baseline Scenario

Lao PDR have recognized the importance of harnessing its RE potentials and have set up a strategy for the development and effective use of RE resources. The Renewable Energy Development Strategy (REDS) aims to develop new renewable energy resources, which are not yet widely explored in Lao PDR to replace energy sources that are contributing to GHG emission. Lao is endowed with abundant RE resource, Table 1 shows the available RE potential in Lao and future targets under REDS<sup>13</sup>.

**Table 1: RE potential and REDS target**

Item	Energy source	Target					
		2015		2020		2025	
		MW	MUSD	MW	MUSD	MW	MUSD
A	<b>Electricity</b>	140	477	242	1105	725	1799
1	Small Hydropower	80	288	134	629	400	1010
2	Solar	22	41	36	90	48	144
3	Biomass	13	24	24	52	58	72
4	Biogas	10	21	19	45	51	192
5	Municipal solid waste	9	48	17	105	36	168
6	Wind	6	55	12	120	73	168
B	<b>Biofuels production</b>	ML	MUSD	ML	MUSD	ML	MUSD
1	Ethanol	2	5	41	33	79	63
2	Biodiesel	2	9	50	33	79	63
C	<b>Thermal Energy</b>	Ktoe		ktoe		ktoe	
1	Solar	17		22		109	
2	Biomass	23		29		113	
3	Biogas	22		44		178	
D	<b>Research &amp; Development</b>		56		10		17
<b>Total</b>			<b>491</b>		<b>1105</b>		<b>1799</b>

ktoe = kilo ton of oil equivalent; MW = Mega Watts; MUSD = Million US dollars

Source: Lao People's Democratic Republic. 2011. Renewable Energy Development Strategy in Lao PDR, Vientiane

Lao PDR is an agriculture-based economy, and generates a substantial amount of wastes from agriculture and forest production. In promoting biomass for energy generation, the Government has carried out biomass resource assessment and formulated framework to stimulate private sector investments in biomass based power plants. Table 2 illustrates the potential of major biomass resources in Laos<sup>14</sup>.

<sup>13</sup> ADB Lao People's Democratic Republic: Energy Sector Assessment, Strategy, and Road Map, 2013 Update

<sup>14</sup> Biomass Utilization In Lao PDR, Bounchanh Douangvilay, Deputy Director General, RENMI

**Table 2: Available biomass residues in Lao PDR**

<b>Biomass</b>	<b>Metric tons</b>	<b>Energy</b>	
		<b>GJ</b>	<b>ktoe</b>
Sawdust	24,067	433,206	10.25
Rice Husk	545,000	7,777,142	184.19
Corn cob	19,500	243,540	5.77
<b>Total</b>		<b>8,453,888</b>	<b>200.21</b>

Still, the utilization of solid biofuel to replace fossil fuels receives little attention due to several barriers as listed below:

- Inadequate awareness and confidence to replace fossil fuels with solid biofuel;
- Insufficient human and institutional capacity to provide technical assistance for users and producers;
- Inadequate technology, knowledge and skill available on industrial grade solid biofuel production technology;
- Lack of industrial grade locally produced solid biofuel comparable with that of fossil fuels;
- Lack of reliable and affordable technology available domestically for solid biofuel production;
- Low investment in solid biofuel production technology;
- Low solid biofuel demand and supply information;
- Inadequate policy and regulatory frameworks/incentives for production and usage of solid biofuels;
- Inadequate access to finance and financial incentives;
- Lack of supply chain management for solid biofuel starting from downstream to upstream including supporting industries such as technical and service providers.

Laos Government is implementing “*Cleaner Production (CP)*” in Luang Prabang Province by cooperating with the Souphanouvong University and the Department of Industry & Commerce of Luang Prabang Province in agro-processing industries, handicrafts and hotel sector. The project started in the year 2012 and is supported by agencies such as Swedish International Development Agency (SIDA), United Nations Development Programme (UNDP), United Nations Industrial Development Organization (UNIDO), International Labour Organization (ILO) and German Society for International Cooperation (GIZ). The project was successful in reducing energy, raw material and wastes, which resulted in increased income. Nineteen demonstration projects have been established under this project.

#### *Other Waste-to-Energy (WTE) initiatives in Lao*

Very few waste-to-energy (WTE) projects have been implemented in Laos. However, in the recent years, few feasibility studies have been done in this area, including *Joint Crediting Mechanism/Bilateral offset crediting mechanism (JCM/BOCM)*<sup>15</sup> *Feasibility Study 2012, conducted by EX Research Institute Ltd.* The study identified the following projects:

- Landfill gas (LFG) capture, flaring and/or energy utilization from final disposal landfills of municipal solid waste (MSW)
- Aerobic treatment of organic matters in MSW with mechanical biological treatment (MBT) technology.

*Biogas programme run by Renewable Energy and New Material Institute (RENMI):* This project involved the installation of a 5 m<sup>3</sup> biogas plant in a pig farm/liquor processing plant for process heat applications at Phonesavath village, Phonhong district, and Vientiane province. In the absence of the project, the wastes from pig stable were

<sup>15</sup> A new carbon credit mechanism developed by Japan  
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drained to a nearby pond and firewood was used to generate the heat for liquor processing. Science and Technology Research Institute (STRI), Chiang Mai University, Thailand constructed the biogas system. The biogas system was able to reduce the firewood consumption by approximately 30%. Five local masons were trained during the installation of five biogas digesters in Oudomxy province as part of the capacity building and sustainability of the project. Although this project focuses on waste to energy generation, it is limited to small scale.

*Thai Biogas Energy Company (TBEC) Biogas Project in Lao PDR:* Once completed, this project will generate biogas from wastewater in a starch plant. The biogas would be supplied to the starch factories at a discounted price. The starch factory will burn biogas as substitute fuel to coal to dry the starch. The project will help stimulate Lao PDR's economy, provide another domestic fuel source and ultimately contribute to a better living environment for local factory staff, farmers and residents.

Lao Institute of Renewable Energy (LIRE) is actively investigating opportunities for second-generation biofuels (solid biofuel) which are produced from non-food crops and waste biomass in Laos. In addition, LIRE is establishing WTE programs to develop and pilot WTE technologies relevant to Lao PDR.

#### *Other major donor initiatives*

Recently, Laos has been a recipient of several donor projects in the energy sector from the World Bank, Japan International Cooperation Agency (JICA), Government of Finland and Asian Development Bank (ADB). Other development partners include the Australian Agency for International Development, KfW of Germany, and the People's Republic of China, the Republic of Korea and the Swedish International Development Cooperation Agency<sup>16</sup>. Some of the key areas of focus of a few of these donors are given in the following table:

<b>Agency</b>	<b>Focus area</b>
The World Bank	<ul style="list-style-type: none"> <li>- Tariff reform</li> <li>- Energy efficiency</li> <li>- Rural electrification</li> </ul>
JICA	<ul style="list-style-type: none"> <li>- Hydropower development</li> <li>- Power transmission and distribution</li> </ul>
ADB	<ul style="list-style-type: none"> <li>- Rural electrification</li> <li>- Hydropower development</li> <li>- RE, energy efficiency and conservation</li> </ul>

It is quite clear that very little activities have been going on in the field of RE applications in industries. The proposed project will aim at creating a progressive environment and encouraging industries to utilize biomass in the form of solid bio-fuels (pellets).

#### Baseline project

The Government of Lao PDR is in the process of promoting high value added policies for various industrial sectors including agro-processing, wood manufacturing, construction materials, food processing, and textile industries. The law is to enforce efficient utilization of resources, improving product quality, competitiveness and improving workplace environment.

<sup>16</sup> ADB Lao People's Democratic Republic: Energy Sector Assessment, Strategy, and Road Map, 2013 Update  
GEF5 CEO Endorsement Template-February 2013.doc

An initiative under the project title “Enhancing sustainable tourism, clean production and export capacity in Lao PDR”, has been embedded within the National Integrated Framework Governance Structure. The project started in year 2012 and is supported by agencies such as SIDA, UNDP, UNIDO, ILO and GIZ. The project has been successful in reducing energy consumption; raw material and waste generated in Lao PDR.

The proposed project aims to build on the above initiatives with focus on the utilization of solid biofuel as an alternative to coal and traditional biomass consumption in industries using thermal application. Industries such as salt making industries that rely on both coal and traditional biomass for their thermal application use very inefficient and primitive technologies. During the PPG phase, it was discovered that these industries use very low-quality coal, and as the coal prices are increasing at a significant rate in the market, they were unable to increase their production. Among the small and medium industries, the salt industries have a demand for coal and biomass, which is comparatively higher than the other industries apart from the cement industry.

*Salt Industries in Lao PDR (Solid biofuel User & Producer)*

Laotian salt has become a niche product due to its authenticity and pure taste; the traditional way of production is by evaporating brine water into salt. Based on information from Laotian’s salt producer association, there are seven salt factories in the country excluding small producers with one or two boiling pots. The annual production in these factories is around 3,500 ton of industrial salt and 32,200 ton of table salt. In 2010, due to the increased cost of sawdust, salt industries decided to switch to anthracite cakes as an alternative fuel source. These cakes are made from low heating value grade anthracite mixed with clay and are purchased from cement factories. The production capacity and fuel used in each of these factories are shown below in Table 3.

**Table 3: Existing salt factory and their production capacity and fuel used in Lao, 2012**

S.No	Factory name	Location	Distance from Vientiane (km)	Production capacity (ton/ year)		Fuel Type	Consumption (ton/year)
				Industry salt	Table salt		
1.	Boten Salt Factory	Luang Namtha	650	NA	1,600	Anthracite	1,600
						Corn cob	Not accounted
2.	Oudomxay Salt Factory	Oudomxay	500	NA	10,000	Anthracite	3,000
3.	Veunkham Salt Factory	Vientiane Capital	33	1,000	4,000	Anthracite	3,000
						Sawdust	750 to 1000
4.	Khok Saat Salt Factory	Vientiane Capital	21	4,000	1,500	Fuel wood and rice husk	Not accounted
5.	Ban Bo Salt Factory	Vientiane Province	65	900	1,600	Sawdust	Not accounted
6.	Nateuy Salt Factory	Savannakhet	500	2,500	4,000	Fuel Wood	Not accounted
7.	Kengkok Salt Factory	Savannakhet	550	1,000	8,000	Fuel Wood	Not accounted
	<b>Total</b>			<b>9,400</b>	<b>30,700</b>	Anthracite	<b>7,600</b>

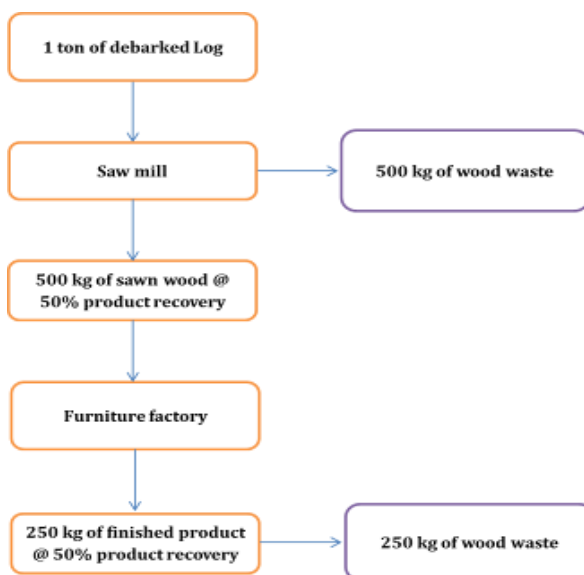
The table above shows that there is a potential of replacing about 7,600 tons of anthracite coal annually through the introduction of densified solid fuel just in the salt production industry. Apart from the replacement of coal, there is a potential of converting the current method of fuel usage in the Laotian industries to the proposed method as they also rely extensively on biomass fuel.

In the year 2011, there were approximately 1,175 wood industries in Laos including sawmills and furniture factories<sup>17</sup>. The overall sawn wood and furniture production in Lao was estimated to be around 754,926 m<sup>3</sup> per year or 641,687 tons per year<sup>18</sup>. Table 4 shows the selected list of provinces with wood processing factories, these provinces were selected based on the high number of wood processing factories and their production capacity. The waste generated in the wood industries will be used by the salt industries as fuel heat application after it has been converted through pellitization. To prevent illegal logging, the proposed project will ensure that wood waste will only come from certified forestry sources. In addition, the participating furniture industry will comply with the Forest Law Enforcement Governance and Trade (FLEGT) and have Forest Stewardship Council - Chain of Custody (FSC-CoC) certification.

**Table 4: Number of wood processing factories (sawmills and furniture) in selected provinces**

No.	Name of province	Number of sawmill and furniture factories	Annual Production (m <sup>3</sup> per year)
1.	Bolikhamxay	77	104,143
2.	Vientiane Province	86	105,630
3.	Khammouane	86	105,400
4.	Xayabouly	90	11,760
5.	Luang Prabang	105	17,472
6.	Vientiane Capital	157	104,350
7.	Savannakhet	239	114,560
	<b>Total</b>	<b>763</b>	<b>563,315</b>

Average wood waste generation in a typical sawmill is around 50% (of which sawdust waste is around 18 to 20% sawdust)<sup>19</sup>. The sawn wood is then taken to the furniture factory for processing. Typical furniture processing industries generate 50% wood waste (of which shaving dust waste is 30%)<sup>20</sup>. Wood waste generation in a typical sawmill and furniture factory is shown in figure 3.



**Figure 3: Wood waste generation in sawmills and furniture factory**

<sup>17</sup> Department of Industry and Handicraft, internal report on reconstruction of wood industry No.617/DOIH/DOMPI, 07 September 2012

<sup>18</sup> Assuming an average density of 850 kg/m<sup>3</sup>

<sup>19</sup> <http://www.fao.org/docrep/003/x6966e/x6966e02.htm>

<sup>20</sup> Experience from Cleaner Production (CP) in Luang Prabang Province by cooperating with the Souphanouvong University and the Department of Industry & Commerce of Luang Prabang Province in agro-processing industries, handicrafts and hotel sector

The proposed project aims at promoting the utilization of solid bio-fuel among industries, by removing barriers from both the producer and the user side of industrial-grade solid bio-fuels. There has been an increasing awareness and demand for usage of biomass for thermal and electricity generation at power plants and industries. However, higher fuel cost compared to the conventional fossil fuels and some practical difficulties in using biomass hamper the switch from traditional fossil fuel and fuel wood. Some of the difficulties in biomass usage are its high moisture content (25-50%), low heating value, low density, high volume, presence of impurities, etc. Also low bulk density of biomass results in higher transportation costs, which eventually adds up to the manufacturing cost. In this context, solid bio-fuels offer cost effective alternatives because of their higher heating value, improved bulk density and ready-to-use form. Pelletizing yields standard biomass pellets or wood pellets and contain four times more energy density than loose biomass residues. The proposed project will build on the baseline projects/initiatives and will focus on overcoming the identified barriers in Lao PDR.

Without GEF intervention, these barriers may continue to exist, where the present scenario of poor waste management in industries, without appropriate usage, will continue, with little or no significant improvement. Traditional biomass based energy consumption and GHG emission will continue to increase. By mitigating some of the identified barriers, the proposed solid biofuel project will provide more opportunities for the private sector investment.

## **A. 5 Incremental /Additional cost reasoning**

### Pelletization potential

The usage of biomass fuel has been limited to traditional method of firing cook stoves or in some cases where they have established biomass gasifiers to produce electricity at either pilot scale or community scale level. This means that there is a high potential of promoting solid biofuel in the form of densified fuel in the early stage so that it can capture the market. An estimate of sawdust and other furniture waste show that there is a potential of about 389,100 ton available annually which is equivalent to about 166.2 ktOE of energy. The potential of biomass resources obtainable in Lao is; about 545,000 tons of rice husk and 13,500 tons of corncob are generated annually. These figures are estimates, thus, there is a higher potential of biomass resources in Lao. Rounding the figures up would give a total estimate of biomass resource of about 356 ktOE of alternative energy annually. Rice husk, straw bale, corncob, sawdust and wood shavings are agricultural and wood residues that can be converted to densified wood fuel. Considering the displacement of the usage of coal, the potential or the estimated quantity of biomass resource is capable of reducing about 1,465 tCO<sub>2</sub>e annually<sup>21</sup>. However, considering the use of coal and traditional bio mass in the salt industry, the entire salt industry would potentially require about 65,700 tons of wood pellets annually. The industry would have to invest on higher and more efficient technology that combust wood pellet and this switch will be the incremental cost for factories. The proposed project will not only achieve GEF goals but also contribute to energy security, ISID, as well as the growing economy of Lao PDR.

### Proposed alternative scenario

ADB's assessment of Lao's energy sector identified that one-off and stand-alone capacity building interventions are ineffective in addressing environmental and social concerns linked to the energy sector. Continuous streams of interventions are necessary to improve environmental and social impact analysis and management capabilities.

In this context, this project will employ a two-pronged strategy removing technological barriers for both producers and end users on one hand, and improving policies to expedite investments in the production and use of solid biofuels.

The project will focus on the following goals:

- i. Promote investment and use of wood pellets in industries as an alternative to fossil fuels;
- ii. Support the transfer of wood pellet production technologies;
- iii. Incorporate standardization (following ISO 170225) for co-firing techniques through pilot project demonstration;

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<sup>21</sup> GHG emission factor of anthracite coal is about 98,300 kg/TJ. Source: <http://www.ipcc.ch/meetings/session25/doc4a4b/vol2.pdf>  
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- iv. Develop strategies to promote sustainable wood pellet production and use as a part of green industry policy including greenhouse gases emission reduction in Laotian industries;
- v. Establish a cumulative capacity of 3.6 tph of biomass pellets production for usage in salt industries through private sector investments.

In year one, the project will focus on the demonstration of the pelletization system. During the second year, technical assistance will be provided to salt producers to use wood/agro pellets at the demonstration factories. During the third year, the use of wood pellets/agro pellets in the industrial sector will be at least 5% for co-firing. Two salt factories have been selected as demonstration sites for the proposed project.

#### GEF context

Under the business-as-usual scenario, most of the investments in the energy sector will come from the government. The role of the private investor, which is very crucial in achieving the substantial investments needed in the energy sector in Lao PDR, would be minimal.

Without the GEF's intervention, the utilization rate of pelletization potential would be less and the initiatives taken in the energy sector would be inadequate. No holistic, countrywide efforts to improve the sector would take place. In addition, funding for this project could be difficult considering the barriers present in the country in developing WTE. GEF funding will place the Government in a better position to mobilize co-financing for the project. Therefore, GEF support will be instrumental for the deployment of WTE based energy systems in Lao PDR, supporting government initiatives for improving the energy situation in the country.

In conclusion, the baseline projects and baseline scenario would not be able to bring about significant mitigation of most of the barriers that hamper the implementation of WTE projects in Lao within a short-term. The underlying critical problems of the lack of adequate institutional capacity, supporting financial environment and excellent technical expertise and skills on the market would remain unsolved. The GEF/UNIDO project will result in the removal of key barriers that currently limits the use of abundant agro residue to generate energy for productive uses in agro industries. Thereby, resulting in a substantial reduction in GHG emissions.

#### Project Component 1: Capacity development and knowledge management

Awareness will be created on production and usage of solid biofuel in industries through trainings and information dissemination mechanisms. Information dissemination will be a major activity in this component. For effective penetration of solid biofuel usage, human and institutional capacity training will be organized. Relevant Government ministries/departments, officials, institutions, public and private enterprises, will be trained to understand the various stages of the solid biofuel production and usage.

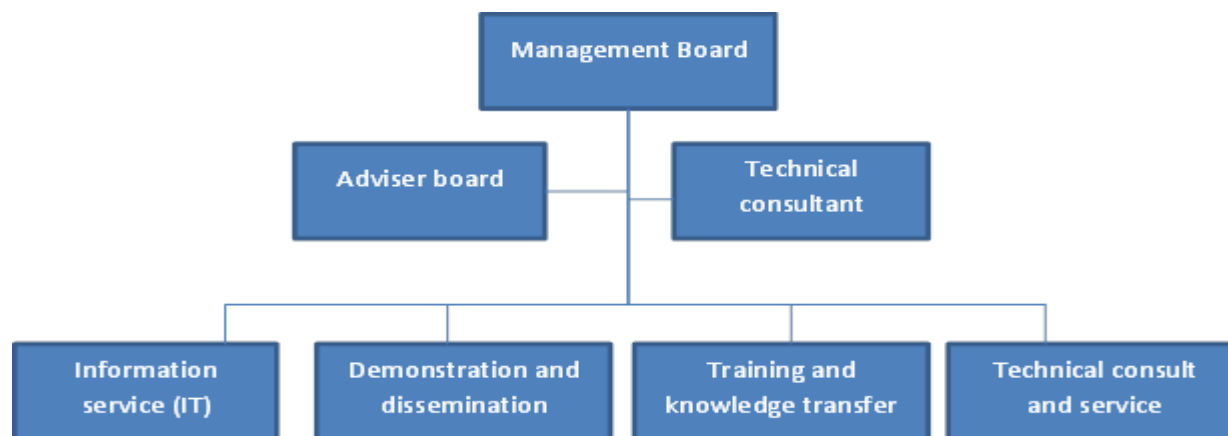
Under this component, the project aims at delivering the following outputs:

##### *Output 1.1.1: Information and learning centre (I&LC) for solid biofuel production and usage established*

I&LC for solid biofuel production and usage will be established at the Renewable Energy and New Material Institute (RENMI). The main purpose of setting up the I&LC is to demonstrate and build capacity of relevant stakeholders in renewable energy technologies (RETs). This centre will create a database, which includes all information required for developing solid biofuel projects. It will also provide necessary trainings for various stakeholders, i.e. the agro-industries, project developers, financial institutions, technology developers, suppliers, end users, etc., accordingly, as per their requirements. RENMI falls under the umbrella of Ministry of Science and Technology (MoST); RENMI has collaborated with MoIC, MoEM, and other NGOs working on solid biofuel. RENMI also works in close collaboration with MoE, MOST and MoNRE. One of its objectives is to support the use of sustainable fuel and efficient, clean cook stove. The institute has the capacity for value chain development and technical inputs.



The proposed centre will be integrated with the existing structure of RENMI making use of the already available human capacity in the institute. The structure of the I & LC is shown in figure 4:



**Figure 4: Structure of information and learning centre at RENMI**

The operational sector's roles and functions of the I&LC are explained below:

- *Information service (IT)*: Through IT the centre will create a website to provide and share information on the centre's activities and service. A database on agro & wood wastes availability and final energy consumption in the industrial sector will be developed as well.
- *Demonstration and dissemination*: This department will oversee the installation of a pelletization unit at the demonstration sites. These sites will be used to carry out research & development on pelletization technology as well as to demonstrate and disseminate the technology to student and public society.
- *Training and knowledge transfer*: This department will organize training courses on renewable energy and technology to local authority/ local communities/ society associations and individual or group of local people.
- *Technical consult and service*: This department will provide technical assistance to interested investors in conducting pre-feasibility study, feasibility study, detailed engineering design and installation of a pelletization system.

The capacity development activities at the proposed I&LC will be sustained through the following:

- A nominal fee will be charged for the training activities at I & LC. The fee will be used to manage and sustain the activities of the centre.
- The existing staff members of RENMI will manage the I&LC. Hence, there will be no additional work force cost.

The following guidelines will be used to ensure long-term training strategy for the I & LC:

- Analyze the needs of the various identified groups when designing the training plan. It will assist in choosing the right type of training for their requirement.
- Identify skill gaps within each group and focus the training on the identified gap.
- Prioritize the training for the identified groups into categories.
- Once the needs have been analyzed, the gaps identified and the training prioritized training manuals will be developed.

Prior to their responsibility under this centre, the staff will be trained in operation and management of the I&LC. Necessary and appropriate training material for relevant stakeholders will be prepared. Available guidebooks and strategies on solid biofuel production and usage will be customized to adapt to the local conditions. Any information regarding solid biofuel including technology and regulatory issues can be obtained from this centre. RENMI's role and function is to conduct research and development of appropriate RETs, technology transfer, provide diverse academic services and consultancy to the local community, human resource development and provide training to upgrade technical skills. In future RENMI plans to create a RE centre and the proposed I&LC to be established at RENMI will

complement its plans. Prior to the project RENMI has conducted similar activities, and it has established a wide network in renewable energy development by working with other organizations such as SNV. RENMI's office is located in the capital city of Lao; the I&LC will be accessible to the populace. The above arrangement will ensure the sustainability of the proposed activities in capacity development.

*Output 1.1.2: Capacity of at least 20 policy makers developed and capacities of potential solid biofuel producers & users, RE/technical institutions and bank/financial institutions developed (target 50 persons)*

Capacity will be developed among policy makers for public and private sector development. Even when the industrialists take best initiatives, the projects fail due to non-existence of supportive policies. Hence, policy makers are expected to promote the solid biofuel through implementation of supportive policies and regulatory environment, it is essential to engage the policy makers by providing tailored training to at least 20 personnel. Without appropriate supporting policy and regulatory environment, no technology promotion can be achieved at any point in time. Only when the industries are educated about the potential of solid biofuel production and usage, they will be able to take initiatives. Specific trainings aimed at industries will also be conducted, and it is envisaged to train at least 50 people.

Various campaigns and workshops will be held exclusively for industries to raise awareness among them to invest in the production of solid biofuel. Awareness raising materials such as flyers, jingles, etc., will be developed and subsequently used for awareness raising purposes. Key decision makers from different RE/technical institutions (at least 50) will be trained to support, develop and implement solid biofuel projects.

Around 50 personnel from banks and financial institutions will be trained in assessing/conducting due diligence on the solid biofuel projects. Trainings aimed at banks/financial institutions will be conducted at the earliest as a priority, to enhance their knowledge and increase their confidence in financing projects.

In addition, trainings for various target groups such as local engineering and operation & maintenance (O&M) institutions will be developed (at least 50 personnel) to facilitate sustainable operation of the demonstration and replication projects. It has to be noted that all capacity building activities will be carried out at I & LC to be established at RENMI.

#### Impact of the intervention

From the outcome of this project component, it is expected that an enabling environment for the implementation and replication of similar projects will be created, and the following barriers removed:

<b>Barriers / Challenges</b>	<b>How it is addressed</b>
Inadequate general awareness and confidence to replace fossil fuels with solid biofuel	Creation of I&LC centre and awareness created through the centre
Inadequate technical capacity in data collection	Organize training for: <ul style="list-style-type: none"> <li>• RE/technical institutions</li> <li>• Interested project developers</li> </ul>
Inadequate human and institutional capacity to provide technical assistance to users and producers	<ul style="list-style-type: none"> <li>• Creation of I&amp;LC centre and awareness created through the centre</li> <li>• Training of: <ul style="list-style-type: none"> <li>- RE/technical institutions</li> <li>- Interested project developers</li> <li>- Interest users</li> </ul> </li> </ul>
Inadequate technology, knowledge and skill available on industrial grade solid biofuel production technology	<ul style="list-style-type: none"> <li>• Creation of I&amp;LC centre and awareness created by the centre</li> <li>• Training of: <ul style="list-style-type: none"> <li>- Key policy makers</li> <li>- Government officials</li> </ul> </li> </ul>

Barriers / Challenges	How it is addressed
	<ul style="list-style-type: none"> <li>- Banks/financial institutions</li> <li>- RE/technical institutions</li> <li>- Interested project developers on the production of industrial grade solid biofuel</li> <li>- O&amp;M companies on the successful operation of the production units to produce high quality solid biofuel</li> </ul>
Inadequate local technical capacity for sustainable operation and maintenance	Training of: <ul style="list-style-type: none"> <li>• Local engineering companies</li> <li>• Local O&amp;M companies</li> </ul>

### Project Component 2: Strengthening policy and regulatory framework for promoting investments of solid biofuel

Analysis of the existing policies and initiatives shows the willingness of the Government to develop the RE sector in Lao. Though biomass is an important energy source in the country, there is no clear-cut initiative or policy framework to develop the solid biofuel market in the country. Thus, it is necessary to support and strengthen the national strategy to promote development of solid biofuel. The outputs mentioned in the approved PIF as part of project component 2. Such as, database development and biomass resource assessment will be part of the work undertaken in project component 1, which will support the strengthening of the national strategy.

#### *Output 2.1.1: Database developed on agro & wood wastes availability and final energy consumption in the industrial sector*

During a meeting with RENMI, it was discussed that Lao PDR did not have any official assessment of biomass availability. In 2004, a study was carried out by Kasetsart University of Thailand in collaboration with Ministry of Energy and Mines to assess the agricultural residues in Laos. However, studies have been performed on assessing the potential of biomass for the production of liquid bio-fuel (bio-diesel from palm and Verenicia Montana and bio ethanol from cassava). The studies omitted the potential for solid bio-fuel in the country both for industrial and power generation application.

A countrywide dynamic database will be developed for agro and wood wastes availability and on final energy consumption in the industrial sector. This database is expected to be used for identification of replication projects in the future. The database will contain details such as: a) sources of biomass waste; b) agro/wood processing details; c) waste generation quantity; d) existing waste usage; e) available waste for potential usage; f) distance from the nearby industry/industrial clusters who are the major coal products consumers; and g) demand and supply of solid biofuel. The database will also reflect the current usage of biomass and the existing potential. With the acquired information, economic viability of the value chain of solid biofuel will be conducted taking into consideration possible demand and supply scenarios. This output will put the policy makers in a better position in developing an appropriate and more realistic policy especially in regards to supporting green industry development.

#### *Output 2.1.2: National strategy developed to promote investment in solid biofuel production and utilization as a part of industrial promotion and green industry policies*

Without appropriate supporting policy and regulatory environment, investment promotion in solid biofuel production cannot be achieved, and the long-term uptake of this technology cannot be guaranteed. To ensure that proper policies are available to support WTE (solid biofuel) on the long term, a gap analysis on existing policies will be carried out. Based on the gap analysis, relevant ministries to implement the policy will be identified, and required policies necessary for long-term uptake of the technology shall be taken. Linkages would be created between policy advocacy groups and the Government. The linkage will identify potential problems that may make their way to the proposed policies. Recommendations would be given regarding the policies to be brought in to bridge the gap for investment in solid biofuel production.

During the project implementation stage, a National strategy will be developed to promote investment in solid biofuel production, and thermal energy utilization as part of the industrial promotion and green industry policies. The strategy will be linked to the Green industry policy. Special soft loan conditions will be designed to attract the private sector and promote investment in solid biofuel production and utilization in the industrial sector. Since fossil fuels are comparatively cheaper than high-grade solid biofuel, the end users are reluctant to replace coal and other fossils with biomass-based solid biofuel. Hence, under the proposed project, an incentive scheme will be developed and facilitated to encourage users to replace fossil fuels with solid biofuel after discussions with relevant Government agencies. The scheme intends to make the cost of solid biofuel more competitive in comparison with fossil fuel.

All these would create an enabling environment for implementation and replication of solid biofuel projects and would increase its usage.

*Output 2.1.3: Technical adjustment for solid biofuel usage in participating industries*

UNIDO conducted a benchmarking study of specific energy consumption and GHG emission in August 2012 through the CPC-L. This study among other industrial sectors identified cement, brick and salt producers to be major coal users. In order to reduce the consumption of coal by the identified industries, an alternative source of energy for heating will need to be in place. Under this output, detailed technical plant design will be developed for the salt industries for adapting to solid bio fuel in their production process. Among other details, the plant design report would include the following:

- Detailed baseline assessment;
- Global environmental benefits;
- Potential for replication.

The salt industries were selected based on the following criteria, (i) expressed interest in participating in the proposed GEF project and confirmed co-financing, and (ii) pre-feasibility study conducted during the PPG stage. The project would target the following salt industries as part of the demonstration project:

- a) Boten Salt Factory
- b) Veunkham Salt factory

Boten uses three types of fuel for salt production, such as lignite, corncob and fuel wood; while Veunkham salt factory, uses anthracite coal in the form of cake and sawdust. The two factories are identified as both producers and users of pellets. The current fuel consumption in these factories is estimated in Table 5.

**Table 5: Fuel consumption of salt factories**

S.No	Factory name	Location	Salt Produced ton/year	Fuel	
				Type	Amount (ton/year)
1	Boten Salt Factory	Luang Namtha	1,700	Lignite	2,100
				Firewood	150
				Corn cob	196
2	Veunkham Salt Factory	Vientiane Capital	5,000	Anthracite	1,680
				Sawdust	6,552
	<b>Total</b>		<b>6,700</b>	<b>Sawdust</b>	<b>10,678</b>

The project will provide technical assistance to adjust brine water boiler pot so that it will be fired by wood and agro-pellets effectively and efficiently. In order to replace the consumption of coal with wood pellet, the current stoves that are used for the traditional method of brine cooking need to be modified as it is not designed to burn wood pellets. An efficient design stove will be used to combust the wood pellet and at the same time reduce the fuel demand through increased efficiency of the stove.

As of now, there are no stove technologies available in Lao that can enable the combustion of wood pellet. The technology will be transferred during the implementing stage. During the PPG stage, it was seen that India has quite a

number of pellet cook stoves that have been introduced in their market. A desktop research has been conducted to see some of the available pellet cook stove. This information is provided in the pre-feasibility analysis of pellet plant attached as Annex I.

The demonstration project will also serve as a training centre to increase awareness about wood/agro pellets production and use as one of the RE technologies for industrial heating.

### Impact of the intervention

From the outcome of this project component, it is expected that an enabling policy and regulatory environment for the implementation and replication of similar projects will be created, and the following barriers are removed:

<b>Barriers / Challenges</b>	<b>How it is addressed</b>
Inadequate policy and regulatory frameworks / incentives for production and usage of solid biofuel	Biomass resource assessment and solid bio-fuel value chain analysis Establishment of a national strategy to promote solid biofuel production and usage
Inadequate access to finance and financial incentives	Establishment of end-user incentive scheme of solid biofuel

### Project Component 3: Promotion of solid biofuel production and use

Site visits were made to salt producing factories to understand the fuel usage and salt production process. Fuel sample was collected from Veunkham salt factory to measure the calorific value of the fuel being used. Due to the findings, a slight modification has been proposed in the project output. In the PIF, it was envisaged that the proposed project will develop a demonstration project through the installation of biomass pellet mill for a cumulative capacity of 28.8 ton per day. It is equivalent to setting up 3.6 ton per hour of production capacity with a daily operational time of 8 hours. The fuel demand of the pellet plant will not be met operating with the initial hours. Thus, the plants need to operate for a longer period during the day to meet its annual energy demand. Therefore, the value was changed from 28.8 tons per day to 3.6 tons per hour.

For all the proposed demonstration plants, GEF support is required in the form of technical and financial assistance. This initiative is essential to building confidence among the project stakeholders including developers and financing institutions on the technology and success of the project.

This component will focus mainly on i) building confidence level of investors for pelletization system investments in the industries and ii) technology transfer on wood pellet production, standardization following ISO 170225 and firing technique through pilot project demonstration.

Under this component, the project aims at delivering the following outputs:

#### *Output 3.1.1: Systematic and comprehensive biomass resource assessment in target areas*

One important factor in the success of solid biofuel production and its usage would be the successful establishment of a supply chain that connects both the producers and the end users. Hence, under the project, market linkage will be developed in the form of special solid biofuel depots, which will be a one-stop centre for sale and purchase of solid biofuel. One centre in each province can be created by identifying the interested individuals or industries. These centres may encourage the establishment of few more future centres by similarly interested parties as well as strengthening the market linkage between the suppliers and end-users of the biofuel. These centres will be identified during the value chain analysis as proposed in output 2.1.1.

At present, the salt industries are taking anthracite cakes from a far distance from Viengphoukha coal plant in Luang Namtha province. As a result of the proposed project, the transportation cost between the salt factories and coal plant will drastically reduce as shown in Table 6.

**Table 6: Reduction in transportation of fuel for salt factories**

S. No	Factory name	Location	Distance from Viengphoukha coal plant (km)	Distance from solid bio-fuel plant (km) once implemented
1.	Boten Salt Factory	Luang Namtha	125	0
2.	Veunkham Salt Factory	Vientiane Capital	150	0

In order to understand the sustainability of each project, specific resource assessment is required. Sustainability of each biomass resources that are to be considered for pellet production will be assessed. In the proposed project, the pellet production facility will be established by the salt industry itself. Thus, it is crucial that proper resource mapping is undertaken to sustain the fuel demand of the factory. Also, taking into consideration the possibilities of expansion of the pellet mills to support the requirements of nearby industries. Resource assessment in target areas will include the following:

- Comprehensive biomass resource availability;
- Logistic and transport of the wastes;
- Pre-treatment techniques required to prepare biomass residues for pellet production and also reduction of the high moisture content of biomass residues;
- Logistic and transport of solid biofuel.

Biomass residues have different moisture content. The pellet production mills are designed depending on the type of fuel being processed. Moisture content is an extremely important fuel quality parameter when it comes to green wood fuels. For pellets made of dried materials, however, its importance is less significant though a slight difference in moisture can affect fuel quality and performance. Pellet fuels have moisture content lower than 10% enabling the pellet to burn efficiently and produce virtually no smoke during combustion. The biomass residues to be used for pelletization have moisture content higher than 20%. Therefore, the biomass residues require drying during pre-treatment process. Biomass residues are dried before it is passed into the hammer mill, as wet biomass would require more energy to reduce particle size than when it is dry. Drying can be done in a drum-drier or on a flatbed drier, which works at a relatively low temperature. The first option is better suited for fine material while coarse material needs a lower temperature.

#### *Output 3.1.2: Detailed plant designs prepared for the demonstration projects*

Under this component, detailed technical plant design reports will be prepared for the proposed solid biofuel production projects. Among other details, such reports would include the following:

- Practical installed capacity;
- Detailed baseline assessment;
- Global environmental benefits;
- Potential for replication.

#### *Output 3.1.3: Solid biofuel pelletizing systems established for a cumulative capacity of 3.6 tph*

The proposed project plans to establish pelletizing units for a cumulative capacity 3.6 tph at the selected salt factories. These units are established in factories that satisfy the following criteria:

- A factory must have sufficient sustainable supply of agro/wood wastes such as wood chips, sawdust, wood slabs, bark, corncobs;
- Moreover, the factory must be closer to the users of solid biofuel (the salt industries). It must be open for public visits including potential investors, academicians, government officials, service providers, banks/financial institutions, etc.

Technical assistance will be provided for plant design of the demonstration projects, including tender document preparation, tendering, equipment supplier selection, etc. A portion of GEF grant will be used to provide an incentive towards equipment purchase within the limits set by the principles of incremental cost.

#### Boten Salt Factory

Boten Salt Factory is located in Luang Namtha province, a border province with Myanmar and China, Northern part of Lao. The factory produces about 1,600 tons of salt annually by consuming using 1,600 tons of anthracite per year. Due to the low number of wood processing factories within Luang Namtha province an alternative source of feedstock is proposed for Boten Salt factory. From the available information from National Statistic Bureau, Luang Namtha produced 21,605 tons of corns in the year 2010 leaving around 4,320 tons of corncobs without any usage. In addition to Luang Namtha province, its neighbouring province, Oudomxay (second largest corn producer) produced around 137,945 tons of corn in the year 2010 leading to the generation of nearly 27,600 tons of corncob. Boten will setup a pellet production factory in a location where the corncob will be collected for pelletization and then transported to the salt factory for usage.

#### Veunkham Salt Factory

Veunkham Salt Factory is located in Vientiane province. The company's main products are boiled iodized salt for consumption and Solar Evaporated Salt. The company produces annually 5,000 tons of salt through traditional technique. At present, sawdust is collected from various parts of Vientiane and other nearby provinces as fuel for salt production. Adequate sawdust as fuel for the factory is available in nearby handicraft village, which is about 50 km away from the factory, but the quantity is unknown. Additional sawdust and wood shavings are also available in the southern part of the country as mentioned in the earlier section of the document. However, during the value chain analysis, viability of connecting the resources from the southern region with the proposed pellet mill will be assessed.



**Figure 5: Salt production in Veunkham salt factory**

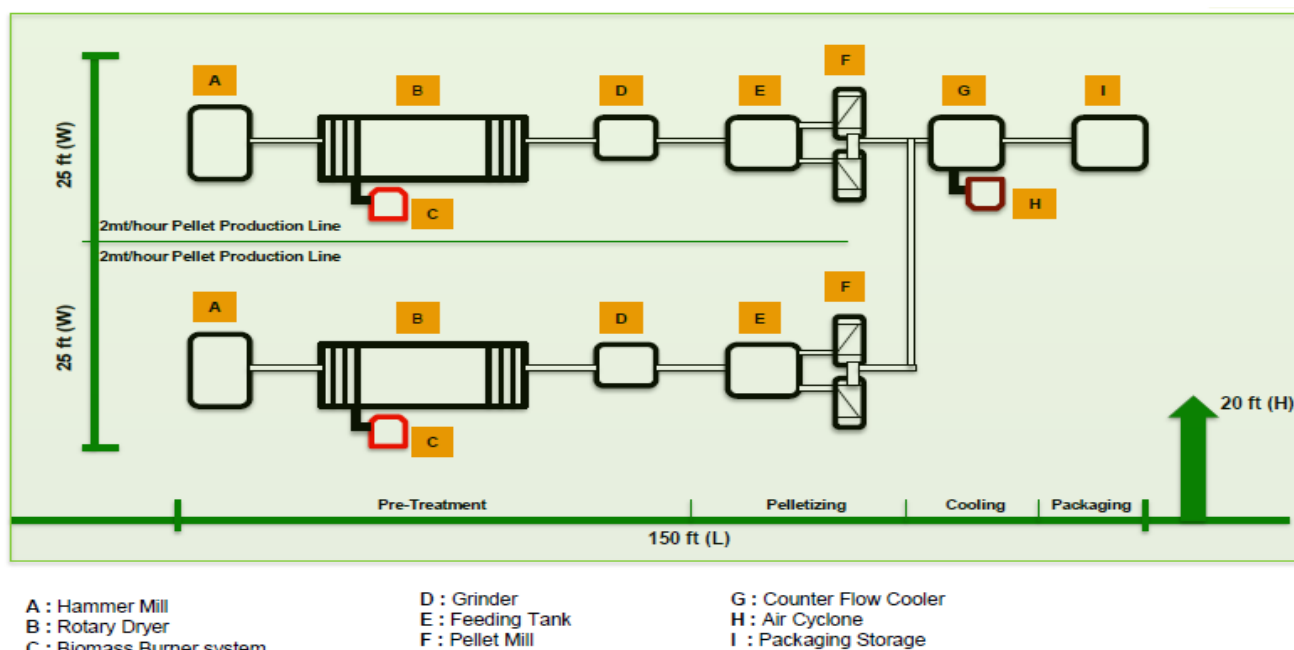
A typical pellet unit and its components are shown in figure 6 below, the various stages of pelletization is as follows:

- Drying is optional which depends on the moisture of raw material. If the raw material consists of shaved dust or dry sawdust, then no drier is needed. A hot gas generator is most often used for drying.
- Milling is the process of graining raw material to make smaller in size. Usually, a hammer mill is



used for grinding, when homogeneous raw material is obtained for compression. Normally, milling and drying can be combined because crushing will make the drying process considerably easier. As the moisture content of all particles is homogeneous, the pellets are more durable.

- Pelletization is the mechanical process to compress raw material in a flat or vertical mounted ring die. No additives are normally used in the compression of wood pellets, but pellets are formed by the cohesion of inner surfaces by adhesion caused by lignin that is softened by the heat of compression. The pellet will not gain its strength until it is cooled.
- Cooling is a process after compression where the temperature is high - usually 90° C. The moisture released in the compression stage is removed with heat from product. Cooling stabilizes the pellets and hardens the lignin melt on the surfaces of pellets, which result in the shape of a pellet that will remain unchanged.
- Screening is the separation of raw material dusts that are mixed with pellets and bring back the dust to pelletization process. Normally the screening is performed by vibrating.
- Packaging and storing is the final process for transportation to consumers.



**Figure 6: A typical pelletization unit**

From preliminary assessment, it has been decided that Boten Salt factory will set up a pellet mill, which will produce pellets from corncob. Whereas for Veunkham Salt factory, wood pellets will be produced from residues from Lao Furniture Industry Co. (LAOFIC). LAOFIC is one of Lao's premier manufacturers and exporters of Lao hardwood indoor and outdoor furniture made from planted wood and wood from well-managed forest. LAOFIC is focused on improving its environmental strategy to deliver high quality product and has a FSC-CoC certification (see Annex J). There is no wood pellet technology available in Lao for local implementation. The technology needs to be imported and transferred for implementation. At the same time, no technology is available to combust the biomass pellet. Biomass pellet stove technology will be transferred from another country. During the implementation stage, UNIDO will contact potential developers of pellet stove, discuss with them the legalities of technology transfer, and market development in Lao PDR. As well as sizing, the technology to adapt the needs of the project this will also suit the needs of other industries in Lao with similar industrial process.

A pre-feasibility study of the two plants to be set-up has been performed. The details of the economic analysis are shown in Annex I. From the pre-feasibility study, it was determined that Boten requires annually 2,340 tons of pellets produced from corncob. Veunkham requires 9,100 tons of biomass pellets produced from sawdust. Based on the annual energy demand, a pellet mill of capacity 0.71 tph will be set up at Boten salt factory. Veunkham salt factory will set up a pellet mill with a production capacity of 2.89 tph). Due to the higher fuel cost envisaged to be paid by Boten, the



payback period of investment made at Boten factory is much shorter (about half of that of Veunkham salt factory). The payback period of Veunkham pellet mill is about eight years.

#### Impact of the intervention

The expected outputs and outcomes of this component will mitigate the following barriers:

<b>Barriers/Challenges</b>	<b>How it is addressed</b>
Low investment in solid biofuel technology	Increased investments from the private sector
Lack of high quality solid biofuel comparable to that of fossil fuels	Production of high-quality solid biofuel based on appropriate technology selection based on available raw material
Lack of reliable and affordable technology available domestically for solid biofuel production	Appropriate, reliable and affordable technology transfer from Thailand, which would make domestic solid biofuel production cost competitive
Lack of supply chain management for solid biofuel	Establishment of market linkage
Inadequate local technical capacity for sustainable operation and maintenance	Training for: Local engineering companies Local O&M companies/institutions
High costs of installing the systems	Successful demonstration will lead to: <ul style="list-style-type: none"> <li>• Replication of the technology that will induce competition in the market.</li> <li>• Transfer of technology which will reduce the project cost</li> </ul>

#### Project Component 4: M & E

The project will be subjected to mid-term and final evaluations. The project will be monitored from the beginning. No mid-term M&E will be conducted as earlier mentioned in the PIF. Thus, only an independent final evaluation will be conducted three months prior to the terminal review meeting. The final evaluation will look at the impact and sustainability of results, including the contribution to capacity development and the achievement of global environmental benefits goals. The final evaluation will also provide recommendations for follow-up activities. After completion of the demonstration project and successful operation, the project performance monitoring will be conducted to study the technical, financial, environmental and socio-economic performances of the projects. Visits to the demonstration project sites and seminars will be organized, and the project experiences will be disseminated to various interested stakeholders to increase the replication potential of the project. Various dissemination tools such as leaflets, website, etc., will be used for effective dissemination.

Methodologies / tools will be developed to use the collated information for better planning and decision-making. Case studies will be prepared and presented to raise more investment in biogas projects for commercial medium to big scale farms, using the trained capacity and various financing schemes that are created.

An annual report and periodical newsletters on best practices, information on country level projects and key indicators of progress made under the project will be prepared and distributed to the key stakeholders and agencies. Annual reports will be submitted to the GEF secretariat in the form of Project Implementation Reviews (PIRs). The project implementation schedule is given in Annex E.

### **Local and national environmental benefits**

In the absence of the proposed project, the salt industries along with other industries identified will continue to rely on the combustion of coal during production. Due to the growth in the industrial sector in Lao, the demand for coal as fuel will increase, thus contributing to emission of greenhouse gasses.

At the national level, the equivalent amount of GHG is mitigated.

### **Global environmental benefits**

Direct global environmental benefit is derived from the implementation of demonstration projects for approximately 3.6 tph of cumulative biomass pellet production. Indirect benefits are obtained from the contribution of the project towards capacity development, policy and regulatory transformation, institutional strengthening and technology adaptation.

As shown in Table 3, about 40,100 tons of salt is produced annually using the traditional method of brine cooking that consumes both coal and other types of biomass as fuel. In addition, the Ministry of Energy and Mines reported that the cement industry being the largest consumer of anthracite consumes 300,000 tons per year. With increasing number of new cement factories, the demand for anthracite could reach 440,000 tons per year soon. Thus, there is a potential of replacing coal with biomass solid fuel.

Considering the human and institutional capacity development, with the establishment of information and learning centre. Successful implementation of the proposed project is envisaged to lead to replication of the technology. It is estimated that at least 18 tph capacity of pellet production plant will be replicated all over the country within a period of 10 years after the closure of the project. The replication will reduce the CO<sub>2</sub> emissions considerably and improve the energy supply situation in Lao PDR.

### **Baseline for all the demonstration projects:**

- Replacement of anthracite coal or lignite is taken as the baseline (emission factor of anthracite coal is 98.3 tCO<sub>2</sub>/TJ and emission factor of lignite is 101.2 tCO<sub>2</sub>/TJ as per IPCC default value).
- As per data collection, the net calorific value of anthracite is 16 MJ/kg and for lignite, it is 14.5 MJ/kg.
- The lifespan of a pellet plant vary for different component of the plant; conservatively it is taken as 15 years.

Overall emission reduction from the demonstration projects is estimated based on the “Manual for Calculating GHG Benefits of GEF Projects: Energy Efficiency and Renewable Energy Projects”<sup>22</sup>. The overall emission reduction potential from the demonstration projects are presented in Table 7.

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<sup>22</sup> [https://www.thegef.org/gef/sites/thegef.org/files/documents/C.33.Inf\\_.18%20Climate%20Manual.pdf](https://www.thegef.org/gef/sites/thegef.org/files/documents/C.33.Inf_.18%20Climate%20Manual.pdf)  
GEF5 CEO Endorsement Template-February 2013.doc

**Table 7: Emission reduction potential in demonstration projects**

S. No.	Name of Factory	Type of Pellet Plant	Fuel replaced	Quantity of fuel replaced (kg/year)	Emission Reduction (tCO <sub>2</sub> /year)
1	Boten Salt Factory	Corn cob pellet plant	Lignite	2,212,173	3,077.41
2	Veunkham Salt Factory	Sawdust pellet plant	Anthracite	3,125,000	4,899.64
	<b>Total</b>			<b>5,218,000</b>	<b>7,977</b>

Note: Apart from fossil fuel, other biomass fuels used in factory in the baseline scenario are replaced as well, but emission factor is considered as Zero.

The demonstration project of capacity 3.6 tph will reduce a cumulative of 119,656 tCO<sub>2</sub> directly throughout the project lifetime of 15 years. Emission reduction due to reduced transportation has not been considered as of now as adequate details on transportation is not available. The indirect emission reductions through an expected replication of 18 tph will reduce a cumulative of 1,118,507<sup>23</sup> tCO<sub>2</sub> throughout the project lifetime of 15 years. The emission reduction benefits from the proposed project are summarized in Table 8.

**Table 8: Emission reduction benefits of proposed project**

S. No	Type of benefit	Emission Reduction (tCO <sub>2</sub> )
1	Direct reduction	119,656
2	Indirect reduction	1,181,507

The following method is used to calculate the GHG emission reduction directly and indirectly as a result of the GEF project. The project replaces the usage of lignite and anthracite coal with biomass pellets. It has been assumed that the emission factor of biomass pellet is zero. The project will replace:

- 2,093 tons of lignite annually or 31,395 tons of lignite during the period of the project
- 3,125 tons of anthracite annually or 46,875 tons of anthracite annually during the period of the project
- The period of the project is equivalent to the life of the pellet mill (15 years)

Using the default GHG emission factor from IPCC, the GHG emissions are:

- 46,161 tCO<sub>2e</sub> during a period of 15 years from the use of lignite
- 73,495 tCO<sub>2e</sub> during a period of 15 years from the use of anthracite
- Thus a total direct emission of 119,656 tCO<sub>2e</sub> during a period of 15 years

The following methodology is used to calculate the indirect emission reduction:

- The project has a replication capacity of 18 ton per hour of biomass pellet production
- Assuming plants would operate 90% of the year, annual production of pellet is about 47,304 ton
- Average calorific value of biomass fuel of 16.7 MJ/kg and 16 MJ/kg as average calorific value of coal

Using the calorific value of the two fuels and the quantity of biomass pellets produced annually. It can be estimated that about 47,400 tons of coal can be replaced annually, resulting in replacing 1,181,507 tCO<sub>2e</sub> in 15 years indirectly.

### **The incremental cost of the project**

Under project component 1, the GEF funding would be used to establish an I&LC to strengthening human and institutional capacity, at the same time funding will be used to develop a database and support capacity building. Under

<sup>23</sup> Average calorific value of 4,000 kCal/kg considered for Coal; 3,539 kCal/kg as average heating value of wood pellet (case for Thailand, Ministry of Energy, 2013)

project component 2, funding will be used to support the development of policy framework and national strategy to promote the use of solid biomass fuel. Under project component 3, part of the incremental cost funded by the GEF resources will demonstrate the benefits of the use of biomass densification technology to replace carbon intensive fuel. As such, this will build confidence among investors and attract more investments. Under project component 4, the GEF resources will be used for funding the incremental cost of monitoring and independently evaluating the demonstration projects. As well as other project components to ensure that the global environmental benefits objectives of the project are achieved. Table 9 shows the incremental cost for each of the demonstration project plant.

**Table 9: Incremental cost of the demonstration project**

S.No	Company	Capacity (tph)	Baseline	Baseline Investment (USD) <sup>24</sup>	Project Investment (USD)	Incremental cost (USD)
1	Boten Salt Factory	0.77	Lignite/Corncob/Fuel wood	140,692	322,237	181,545
2	Veunkham Salt Factory	2.83	Anthracite/Sawdust	315,395	1,614,636	1,299,241
	<b>Total</b>	<b>3.6</b>		<b>456,087</b>	<b>1,947,025</b>	<b>1,480,786</b>

Out of the above incremental cost, GEF will bear the cost of USD 831,685, which is 56.1% of the total estimated incremental cost. The total GEF resource of around USD 1,268,539 is used to mitigate CO<sub>2</sub> emission at a rate of USD 14.8 /tCO<sub>2</sub> directly and around USD 1.07/tCO<sub>2</sub> indirectly<sup>25</sup>. Table 10 shows the scenario before and after the project.

**Table 10: Pre and post project scenarios**

Scenario before the project	Scenario after the project
Low human and institutional capacity on densification technology and usage	Improved human and institutional capacity
No data on biomass availability	Database of biomass resource prepared
No I&LC	I&LC on densification technology created at RENMI
No strategies or policy on the use of solid biofuel	National strategy developed
Usage of coal for thermal energy	Replacement of coal and other biomass fuel with densified fuel. Also through replication projects for a cumulative 18 tph capacity, approximately 47,300 tons of coal will be avoided

The above table clearly shows the increment of the project. This increment can be practically realized to the fullest extent only with the GEF/UNIDO intervention. In the absence of the GEF project, the existing scenario would remain the same or get worse with increased consumption in coal. The proposed demonstration projects are designed not only to demonstrate the viability of the usage of wood pellets, but also to provide a framework for replication in other parts of Lao PDR.

<sup>24</sup> Baseline cost is taken as the annual cost of fuel

<sup>25</sup> Cost efficiency for replications projects is less because of the fact the assumption that proposed project will help in replication of at least 18tph of pellet production projects and replace more of coal fuel (as compared to 3.6 tph of demonstration projects).

## Innovation

The project offers an innovative approach to reduce GHG emission from Lao industries by establishing the complete value chain of solid biofuel industry. The project will boost both producer and user sides, and will enable the investment in the sector and strengthen the capacity. This way, both supply and demand of the solid biofuel will be established, linked up and progressed along market mechanism. The proposed project will also boost industries using thermal energy and will also enable investment environment and strengthen human and institutional capacities.

## Sustainability

The capacity development activities at the proposed I&LC would be sustained through the following:

- A nominal fee would be charged for the training activities. This amount would be used to manage and maintain the activities of the centre sustainably.
- Well-trained institution staff members of RENMI would be managing the I&LC and hence, there would be no additional work force cost.
- MoST that oversees the activities of RENMI will ensure sustainability of the training.

The above arrangement will ensure the sustainability of capacity development even after the GEF project ends. Capacities of RENMI and DOIH will be built throughout the duration of the project implementation. Thereafter, they will embrace the technical knowledge on solid biofuel, in both production and usage. They will continue to provide technical guidance to wider group manufacturers and enterprises in particular, those manufacturers who are clients of the Green Industry Initiative. By this way, the sustainability of the methodologies, introduced by the project, will be realized, and the dissemination of the project's results to a wider range of users fulfilled.

Each demonstration project will be operated and maintained by the investor through their operation and maintenance (O&M) staff. Local engineering and O&M companies will be trained in O&M of pellet mill through I&LC. In addition, the O&M staff of the demonstration projects will be trained by the respective suppliers. Through such arrangements, the demonstration projects will continue to operate sustainably after the project implementation is over.

## Scaling up

Production of wood pellet will be scaled up, as a result of the following:

- *Successful implementation and operation of the demonstration projects: This will boost the confidence among similar industries and private investors.*
- *Facilitation of solid bio fuel end-user incentive scheme: This would promote the use of solid bio-fuel usage substituting coal products.*
- *Establishment of solid bio-fuel depots: This will result in one stop centre for sale and purchase of solid bio-fuels. This convenient option will give thrust to the private investors for adopting solid bio-fuel (both production and usage).*

The proposed demonstration projects are designed not only to demonstrate the viability of wood pellet production and usages, but also to provide a framework for replication in other industrial sectors of Lao PDR.

## **A.6 Risks**

<b>Component</b>	<b>Risk</b>	<b>Proposed Mitigation Measure</b>	<b>Risk Level</b>
Political risk	Low government commitment and support for transfer of solid biofuel production and utilization technology to the country	The project objectives and activities are perfectly in line with national policies and objectives for climate change mitigation through GHG reduction	Low

Component	Risk	Proposed Mitigation Measure	Risk Level
Technical risks	Solid biofuel technologies are relatively new in the country, and there is a lack of technical expertise for development and implementation of such projects.	Detailed techno-economic feasibility studies will be carried out.  The technical personnel in the industries will be trained on deployment of such technologies.  Capacity of the government officials and relevant institutions will be built.	Low
Market risks	No off-takers for the generated solid biofuel.	The demand for clean and cheap fuel is very high among Lao PDR industries	Low
Sustainability risk	Application of solid biofuel production technologies in agro-industries might be halted by the shortage of inputs.	The installations will be done only after a proper resource assessment study is done in order to ensure the supply of wastes from agro-industries.	Low
	Lack of human capacity to operate the demonstration projects.	All the demonstration projects O&M staffs will be trained by the respective suppliers. Moreover, under the project, there will be several trainings on successful operation and maintenance of biomass and biogas projects.  In addition to this, information and learning centre will be established for continuous capacity building activities. All these would sustain the objectives of the proposed project.	Low
Climate Change risk	Flooding	Demonstration plant and site office will be located on an elevated area to prevent flooding. All buildings and structures will be designed and built appropriately to avoid flooding.	Low

#### **A.7 Coordination with other relevant GEF financed initiatives**

The proposed project will build on the outputs of the National Greenhouse Gas (GHG) Inventory Project funded by GEF that identified four main sectors as sources of greenhouse gas emissions. The sector includes Energy, Agriculture, Forestry and Waste that are all related to the industrial sector.

The proposed project will supplement the efforts of GEF and other national projects to achieve the global GHG emission reduction. The proposed project will facilitate the wide adoption of the clean energy in the industries to help reduce GHG emissions in the country as part of a large country effort in mitigating the anticipated climate change impacts. It will specifically focus on reducing coal consumption of the industry that has been rising sharply over the past 10 years.

#### Other national initiatives

The project will coordinate with the following projects; two are under implementation, and the last one has been completed.

*Off-grid Electrification Pilot Demonstration:* A Component of the Lao PDR Southern Provinces Rural Electrification, SPRE I (IBRD, completed project) whose objective was to increase electricity access in remote and rural areas of Lao PDR through RE technologies (micro-hydro and solar PV).

*Southern Provinces Rural Electrification II Program (IBRD, under implementation):* Expansion of SPRE I project central and southern provinces of Lao PDR through solar, hydro, distributed engine-generator sets and other mini-grid technologies.

*Rural Electrification Phase II (IBRD, under implementation):* This project aimed at: a) substantial adoption of RE energy in Government's rural electrification program; and b) increased efficiency in electricity supply.

*SNV-funded Biogas plant project to promote renewable thermal energy:* The project provides households with technical assistance and subsidies to install and manage bio-digesters that produce biogas for cooking and lighting. The project covers more than 20 districts in a number of provinces including Vientiane, Savannakhet, Xiengkhuang, and Khammouane. Three main types of biogas plants are promoted: 4 m<sup>3</sup>, 6m<sup>3</sup>, and 10m<sup>3</sup>. The average biogas plant cost is 2,379,274 kip (4 m<sup>3</sup>), 2,936,042 kip (6m<sup>3</sup>), and 3,100,000 kip (10m<sup>3</sup>). Households receive an average installation subsidy of 483,858 kip, about 24% of the average total biogas plant cost. In 2011, the project reported a cumulative number of about 2,405 biogas plants been installed.

*World Bank-financed Clean Stove Initiative:* The World Bank's East Asia & Pacific region is implementing a Clean Stove Initiative (CSI) to help scale up access to clean and efficient stoves in the EAP countries. In Lao, the initiative included bio-digester dissemination and was renamed Clean Cook stoves and Bio-digester Initiative (CSBI). It is being implemented in two phases: Stocktaking Review and Development of Intervention Strategy; Technical assistance and capacity building; From the outputs of the stocktaking review and preliminary intervention strategy prepared, in 2012 Lao's key stakeholders and the World Bank team agreed to intervene in the following areas:

#### Clean cook stoves

- Formulation of national technical standards for clean cook stoves;
- Establishment of facilities for testing, development, and labelling of cook stoves;
- Technical assistance to the private sector for participation in production and distribution of the cook stoves;
- Public awareness and education to promote the use of clean cook stoves; and piloting of a new finance mechanism for clean cook stoves.

#### Bio digesters

- Pilot of new financing mechanism to promote the installation of household bio-digesters;
- Livestock management and slurry utilization for fertilizer;
- Updating bio-digesters' standards;
- Providing services after bio digesters installation.

UNIDO is implementing another institutional project "Cleaner Production Center-Lao PDR" with funding from SWISS SECO and in co-operation with DoIH. Cleaner Production Centre-Lao PDR (CPC-L) has been initiating a large range of cleaner production and energy efficiency activities addressing sustainable development. CPC-L has been focusing on: a) increased production efficiency through optimization of the productive use of natural resources; b) environmental management through minimization of the impact on environment and nature; and c) minimization of risks to people and communities because of industries. The proposed project will be in synergy with "Cleaner Production Center-Lao PDR" project.

## **B. ADDITIONAL INFORMATION NOT ADDRESSED AT PIF STAGE:**

### **B.1 Describe how the stakeholders will be engaged in project implementation.**

The proposed GEF project implementation arrangement is given below:

## **Implementing Agency**

UNIDO is the only GEF Implementing Agency involved in this project and no specific arrangement with other GEF Agencies is sought.

## **Executing Agencies**

REMNI, DoIH, CPC-L and Ministry of Industry and Commerce will be the main executing agencies coordinating with UNIDO.

## **Project Implementation Arrangement**

The project will be implemented by UNIDO in collaboration with the concerned Ministries, Governments and the private sector stakeholders. UNIDO will take the responsibility of implementing the project, the delivery of the planned outputs and the achievement of the expected outcomes.

## **DoIH**

DoIH, is a government agency responsible for providing coordination and linking the industries together. It is one of the primary executing agencies where it will provide support for project execution and oversee the industrial application of wood pellet in Lao PDR. During the project cycle, DoIH will be responsible for trade promotion and trade fair, developing and conducting awareness-raising seminars, provide technical assistance to industries and carry out dissemination and replication workshops.

## **RENMI**

RENMI is a government agency under the Ministry of Science and Technology (MoST). It is one of the main counterparts as well as the main executing partner of the project, thereby putting in line the project deliverables within the government plans. RENMI will act as a technical hub for solid biofuel technology that is to be demonstrated under the project. As being the host for the Information and Learning Centre, it will carry out technical advisory roles to factories during and after the project. In collaboration with UNIDO, it will be responsible for the establishment of the pellet manufacturing units.

## **CPC-L**

CPC -Lao PDR is an initiative of UNIDO under its global Cleaner Production promotion movement. It is one of the executing agencies and will raise awareness on cleaner production benefits in the industrial sector.

## **Other stakeholders**

### **Demonstration plant owners**

The demonstration project will result in the setup of a cumulative 3.6 tph pellet manufacturing units. These project promoters are responsible for mobilizing financing for investment in their plants and for utilization. They will also be responsible for O&M of the plants and will operate the projects throughout their projects' lifetime. They will also be in charge of keeping records of the plant operations necessary for monitoring the pellets manufactured and utilized and ultimately the GHG emission reduction.

Private investors such as Boten Salt Factory and Veunkham Salt Factory will also be responsible, cooperate in undertaking technical studies, and participate in capacity building exercises.

### **Others**

Other RE/technical institutions, financial institutions, will be recipients on training activities on biomass solid fuel



usage. It would encourage them to support the development of similar projects. Local people and village communities will be part of the labour force in the project.

## **UNIDO**

UNIDO will be specifically responsible for:

- Monitoring;
- Reporting on the project performance to the GEF;
- Procuring international and local expertise needed for delivering the planned outputs ;
- Approving selected industries for the demonstration projects;
- Approving selected equipment suppliers for the demonstration projects;
- Managing, supervising and monitoring the work of the international teams and ensuring that the deliverables are technically sound and consistent with the project requirements.

Any amendments to the project will be done in accordance with the GEF policy C.39.09 and UNIDO rules and regulations.

## **Project Management Unit**

A Project Management Unit (PMU) will be established within CPC-L. PMU will also be the project steering committee secretariat. The PMU will consist of a Project Manager (PM), the Project Administrative Assistant (PAA) and technical advisors. The responsibilities of PMU will be as follows:

- Daily management of project execution;
- Coordination of all project activities carried out by the national experts and other partners;
- Day-to-day management, monitoring and evaluation of project activities as per planned project work;
- Organization of the various seminars and trainings to be carried out.

Throughout the period of the project execution, the PMU will receive the necessary management and monitoring support from UNIDO and the monetary support from GEF and its counterparts.

## **Project Steering Committee**

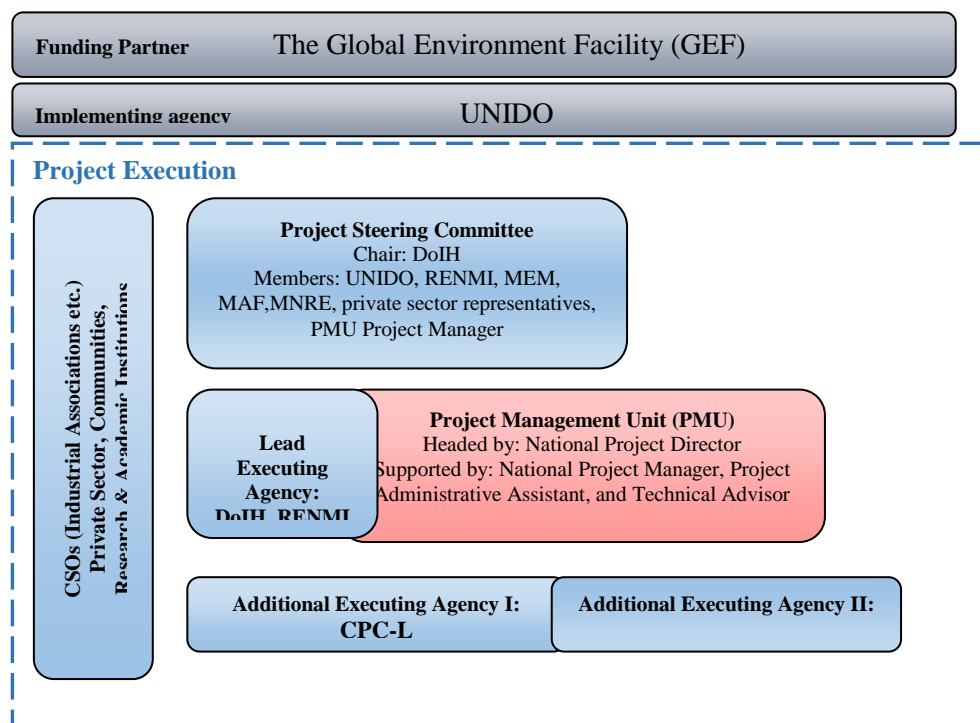
A Project Steering Committee (PSC) will be established with key stakeholders including MEM, MoNRE, RENMI, DoIH, private sector representatives and UNIDO, for providing strategic guidance and review of progress in project execution. It will also facilitate coordination among project shareholders, maintain transparency in the ownership, and support the sustainability of the project.

PSC will be responsible for:

- Guiding the overall strategic project development;
- Promoting partnership among stakeholders;
- Reviewing project progress reports, including inception report;
- Initiating remedial action to remove impediments in the progress of project activities that were not earlier envisaged.

DoIH will chair the committee; the final composition of the PSC will be defined during the project inception phase. The PSC is expected to meet twice a year.

At the beginning of the project implementation, a detailed work plan for the entire duration of the project will be developed by UNIDO in collaboration with the PMU, Lao PDR government and the international teams of experts. The working plan will be used as management and monitoring tool by PMU and UNIDO and will be reviewed and updated appropriately on a biannual basis. Figure 7 shows a diagram of the project implementation arrangement.



**Figure 7: Diagram of project management structure.**

UNIDO will closely coordinate with the ongoing and planned relevant initiatives to ensure maximum synergies and the overall impact of Climate Change related technical assistance to Laos.

**CSOs and NGOs:** Potential CSOs and NGOs will be consulted, including those focusing on gender equality issues and advocating women's empowerment, such as women's associations (also see Annex F), will be consulted and/or involved whenever appropriate during project implementation.

## **B.2 Describe the socioeconomic benefits to be delivered by the Project at the national and local levels**

### Socio-economic benefits at the national level

At the national level, through this project a direct emission reduction of about 119,656 tCO<sub>2</sub> by replacing about 5,218 tons of coal annually. In addition to which the project expects to reduce additional coal consumption of about 47,300 tons annually indirectly. This will ensure the reduction of the importation of coal and savings in foreign exchange for the country.

The project will also help prepare the country for a transition towards low-carbon and environmentally friendly economy and society through green manufacturing as intended in many country policies including the proposed Green Industry Plan and Renewable Energy Development Strategy.

The project will lead to the development of a national strategy to promote investment in solid biofuel production and utilization as part of industrial promotion and green industry policies. It will also build institutional capacity for the applications of solid biofuel technology in industries and reduction of GHG emissions in the industry sector. Through the replication, project indirectly about 70-100 jobs could be created at pellet production facilities and additionally about 70-100 more for biomass collection.

### Socio-economic benefits at the local level

At the local level, the local benefits of the project include access to clean thermal energy for the industries such as the salt industries, cement industries, brick industries, etc. Efficient use of available local energy resource and reduction of production cost because of savings from reduced use of coal with increasing price. The project will also create about 15 jobs within the pellet production mills and about 15-20 jobs in the wood collection process directly. As the plant would switch from coal and other sources to biomass fuel to biomass pellet, farmers and wood processing industry will have additional income by supplying biomass for pellet production. By selling additional biomass resource to the factory apart from what is already being purchased by the two salt factories, about 652 million Kip will be a source of income for the community.

On the other hand, this project would improve the relationship between the waste producers and the pellet manufacturers. Without the project, industries will continue to use and burn coal to generate heat for their production process. This would result in the generation of local pollutants such as volatile organic carbons, nitrogen oxides, sulphur dioxide, and particulates as well as waste that impair the health of local people. The project will thus contribute to the reduction of local environmental problems in the surrounding communities. In addition, the project will boost the development of local industries and expertise and local manufacturers/suppliers related to solid biofuel technology.

The use of solid biofuel will reduce the transport requirements for bringing coal products as the solid biofuel produced from agricultural residue nearby.

Capacity building and technology transfer of solid biofuel utilization, safety operation and maintenance training to the related stakeholders will also be another benefit from the project.

### Gender mainstreaming

#### **a) Gender Mainstreaming at UNIDO**

UNIDO recognizes that gender equality and the empowerment of women have a significant positive impact on sustained economic growth and inclusive industrial development, which are key drivers of poverty alleviation and social progress. Commitment of UNIDO towards gender equality and women's empowerment is demonstrated in its policy on Gender Equality and the Empowerment of Women (2009), which provides overall guidelines for establishing a gender mainstreaming strategy that:

- Ensures that a gender perspective is reflected in its programmes, policies and organizational practices;

- Advances the overall goal of gender equality and the empowerment of women, particularly the economic empowerment of women;
- Benefits from the diversity of experiences and expertise within the United Nations system to advance the internationally agreed development goals related to gender equality and the empowerment of women;
- Accelerates the Organization's efforts to achieve the goal of gender balance, in particular at decision-making levels.

At the operational level, UNIDO has developed an energy-gender guide to support gender mainstreaming of its sustainable energy programmes and initiatives at all stages of the project cycle. In addition to introduction of basic concepts and strategic approaches, it also includes tools that can be used at relevant points of the project cycle to guide the thought processes and activities. These tools include:

- gender categorization tool, which assesses how much direct impact the project will have on gender dimensions;
- gender mainstreaming check list, which summarizes key considerations which must be considered during project development;
- gender analysis tool which provides specific questions that can guide the project developer in considering gender dimensions of a project, before full gender analysis is conducted by an expert;
- gender mainstreaming the project cycle tool, which lists key activities to be considered at each step of the project cycle;
- gender indicator framework that encourages results based management by indicating potential gender dimensions and quantitative indicators for specific energy interventions.

To ensure that all projects consider gender dimensions from inception, UNIDO has also integrated a robust gender review as part of the project appraisal process both at technical and organizational level.

#### **b) Gender dimensions of the project**

This intervention in Lao is expected to have limited direct influence over gender equality and/or women's empowerment in the country and therefore could be classified as a project with "limited gender dimensions"<sup>26</sup> according to the UNIDO Project Gender Categorization Tool.

Nevertheless, UNIDO recognizes that all energy interventions are expected to have an impact on people and are, therefore, not gender-neutral<sup>27</sup>. In fact, due to diverging needs and rights regarding energy consumption and production, women and men are expected to be affected differently by the project (in terms of their rights, needs, roles, opportunities, etc.). Therefore, regardless of the project's gender category, the project aims to demonstrate good practices in mainstreaming gender aspects into pelletization technology projects, wherever possible, and avoid negative impacts on women or men due to their gender, ethnicity, social status or age.

During the PPG phase, a preliminary gender analysis of the country context has been conducted (please see Annex F), based on which potential gender dimensions of project outcomes and outputs, as well as potential entry points for gender equality and women's empowerment (GEEW) were developed. The identified gender outputs and activities will be considered in detail during project inception while also building upon the existing gender analysis.

For instance, an analysis of the current female staff in the factories related to the proposed demonstration projects has been conducted. Results are given in Table 11.

**Table 11: Analysis of female workers at the demonstration factories**

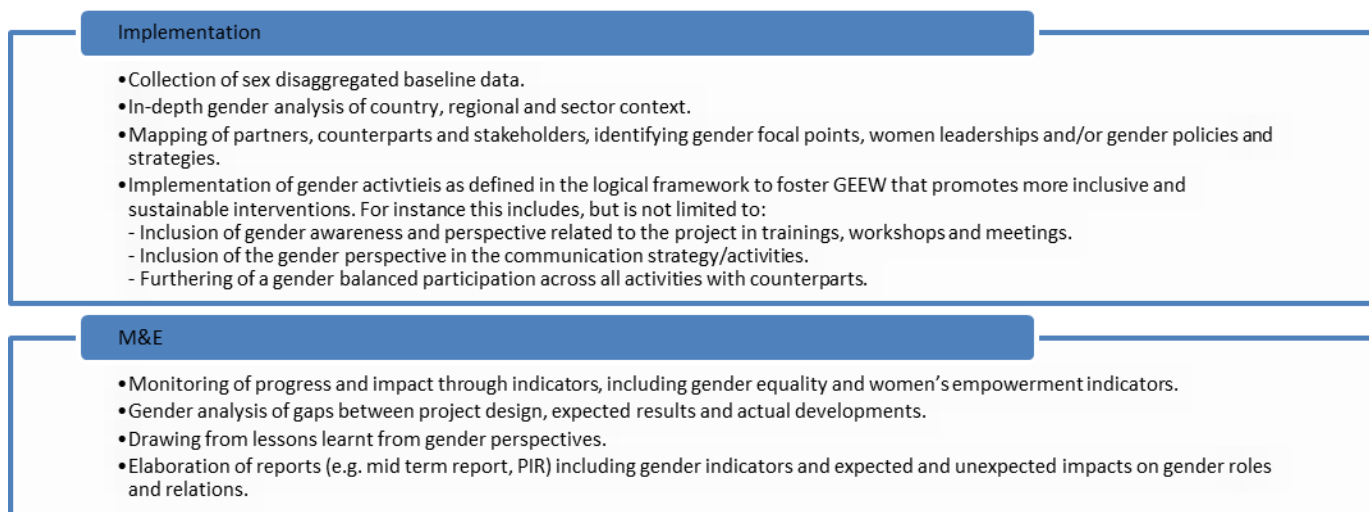
Company Name	Number of workers			
	Male	Female	Total	% Female
Boten Salt Factory	64	9	73	12%
Veunkham Salt Factory	61	33	94	35%

<sup>26</sup> This would require the project to ensure at least 20% of the project outputs have clearly identified activities promoting gender equality and/ or the empowerment of women, including gender-responsive indicators and a corresponding budget OR at least one indicator in each project output refers to gender in some way. Furthermore, a gender-analysis is conducted of gender issues are included in ESIs. Please see also "Gender Categorization Tool"

<sup>27</sup> ENERGIA "Turning Information into Empowerment: Strengthening Gender and Energy Networking in Africa. Leusden, 2008; Joy Clancy "Later Developers: Gender Mainstreaming in the Energy Sector", 2009

It can be seen that the number of female staff in the factories is lower than the number of male staff employed. Nevertheless, it can also be seen that the number of females working at Veunkham Salt Factory is 35% while at the Boten Salt Factory it is only 12%. Hence, it would be of great interest to analyse why the proportion of female staff differs substantially. If concrete aspects can be identified at the Veunkham Salt Factory responsible for the relatively higher female participation, it could be beneficial to develop and implement some actions at Boten Salt Factory to raise female staff.

Complete details on all the potential gender dimensions of the project components are provided in Annex F. The proposed gender dimensions will be considered throughout project implementation as well as during M&E. Figure 8: Gender mainstreaming the project cycle below provides an overview of key issues that might be further considered during the gender mainstreaming of the next steps in the project cycle.



**Figure 8: Key issues of gender mainstreaming the project cycle**

### c) **Project gender mainstreaming strategy**

Guiding principle of the project will be to ensure that both women and men are provided equal opportunities to access, participate in, and benefit from the project, without compromising the technical quality of the project results.

In practical terms,

- Gender-sensitive recruitment will be practiced at all levels where possible, especially in selection of project staff. Gender responsive TORs will be used to mainstream gender in the activities of consultants and experts. In cases where the project does not have direct influence, gender-sensitive recruitment will be encouraged. Furthermore, whenever possible existing staff will be trained and their awareness raised regarding gender issues.
- All decision-making processes will consider gender dimensions. At project management level, Project Steering Committee meetings will invite observers to ensure that gender dimensions are represented. Also at the level of project activity implementation, effort will be made to consult with stakeholders focusing on gender equality and women's empowerment issues. This is especially relevant in policy review and formulation.
- To the extent possible, efforts will be made to promote participation of women in training activities, both at managerial and technical levels. This can include advertising of the events to women's technical associations, encouraging companies to send women employees, etc.
- When data-collection or assessments are conducted as part of project implementation, gender dimensions will be considered. This can include sex-disaggregated data collection, performing gender analysis as part of ESIA's, etc.

### **B.3. Explain how cost-effectiveness is reflected in the project design:**

The project addresses the barrier through policy and regulatory framework development to promote the usage of biomass solid fuel and thus replacing coal. Due to the availability of biomass resources in the country, replacing coal with wood pellet for cleaner production of thermal energy in industries would be justifiable.

The project is considered a cost-effective intervention for GEF due to the CO<sub>2</sub> emission reduction potential through the displacement of coal and promotion of the use of biomass solid fuel. For a GEF contribution of USD 1.27 million, this project will directly result in the displacement of 5,218 tons of coal annually and setting up of cumulative wood pellet mill of 3.6 tph. More importantly, the project is expected to result in the replication of several similar projects for a cumulative 18 tph capacity thus making it a high impact GEF intervention. The pilot plants established by the project will increase the local capacity in such a way that the future interventions will be increasingly cost effective.

The project is expected to save a cumulative direct GHG emission of 119,656 tCO<sub>2</sub>e and an indirect GHG emission of 1,181,507 tCO<sub>2</sub>e.

### **C. DESCRIBE THE BUDGETED M & E PLAN:**

Project monitoring and evaluation will be conducted in accordance with the established GEF and UNIDO procedures. The M&E activities are defined by Project component 4 and the concrete activities for M&E are specified and budgeted in the M&E plan. Monitoring of the project will be based on indicators (for project component 1, 2 and 3) defined in the strategic results framework given in Annex A (which details the means of verification) and the annual work plans. Monitoring and Evaluation will make use of the GEF Tracking Tool, which will be submitted to the GEF Secretariat twice during the duration of the project: at CEO Endorsement, and at closure.

UNIDO as the Implementing Agency will involve the GEF Operational Focal Point and project stakeholders at all stages of project monitoring and evaluation activities in order to ensure the use of the evaluation results for further planning and implementation.

According to the Monitoring and Evaluation policy of the GEF and UNIDO, follow-up studies like Country Portfolio Evaluations and Thematic Evaluations can be initiated and conducted. All project partners and contractors are obliged to (i) make available studies, reports and other documentation related to the project; and (ii) facilitate interviews with staff involved in the project activities.

The overall objective of the M&E process is to ensure successful and quality implementation of the project by: i) tracking and reviewing the execution of project activities; ii) taking early corrective action if performance deviates significantly from the original plans and iii) adjusting and updating project strategy and implementation plan to reflect possible changes on the ground results achieved and the corrective actions taken.

#### **a. Monitoring**

A detailed monitoring plan for tracking and reporting on project time-bound milestones and accomplishments will be prepared by UNIDO in collaboration with the established PMU and project partners at the beginning of project implementation and then will be updated periodically. Monitoring activities will be carried out on the basis of the periodic reports developed by the PMU with the frequency aligning with the quarterly reports.

By referring to the impact and performance indicators defined in the Project Results Framework, the monitoring plan will track, report and review the project activities and accomplishments in relation to the following activities:

- Implementation of solid biofuel production and usage plants;
- Operation and effectiveness of the information and learning centre;
- Conduct various capacity building trainings and their usefulness;
- Level of awareness and technical capacity within relevant institutions in the market and within industries
- Replication potential of similar projects elsewhere in Lao;

- CO<sub>2</sub> emission reductions resulting from the implemented projects;
- CO<sub>2</sub> emission reduction potential from other replication projects;
- Effectiveness and usefulness of the dissemination activities such as trainings, seminars, site visits, performance reports, project website, leaflets, etc. (This includes considerations regarding the gender dimensions of dissemination activities).

## b. Reporting

PMU will present a report to UNIDO every six months with detailed information on the progress of the project as per the annual implementation plan and activities that have been carried out during the period of each report. An annual report shall be submitted by PMU at the end of each project cycle year with a summary of activities carried out over the year and will be the basis of Project Implementation Review (PIRs). The annual report will also cover the benefits and impacts achieved from the implementation of the project. In addition, the report will include the evidence to demonstrate the progress made in the achievement of the indicators highlighted in the Logical Framework.

## c. Evaluation

The project will be subjected to a final evaluation. The project will be monitored from the beginning an internal evaluation will be conducted at the end of the 2nd year of the GEF project. This evaluation will focus on various activities of the project such as the construction of the demonstration plant, assessment of the effectiveness of the trainings, establishment of learning centre, establishment of revolving fund, etc. carried out until the 2nd year of the project.

An independent final evaluation will be conducted three months prior to the terminal review meeting. The final evaluation will look at the impact and sustainability of results, including the contribution to capacity development and the achievement of global environmental benefits goals. The final evaluation will also provide recommendations for follow-up activities. Table 12 provides the tentative budget summary for the total evaluation, which has been included in Project Component 4.

**Table 12: Indicative Monitoring and Evaluation Plan.**

Activity	GEF (USD)	Co-financing (USD)	Responsible party
Monitoring of project impact indicators (as per log frame)	70,000	60,785	Proposed (to be adopted to project specific scenario):
Measurement of GEF tracking tool specific indicators		31,070	• Project technical experts provide feedback to project executing partner/PMU;
Periodic Progress Reports			• Project execution partner/PMU submit inputs for consolidation and approval by project steering committee (PSC);
Independent terminal evaluation		75,645	PSC submits final inputs/reports to UNIDO PM
<b>Total</b>	<b>70,000</b>	<b>167,500</b>	

## Legal Context

*“The Government of the Lao People’s Democratic Republic agrees to apply to the present project, mutatis mutandis, the provisions of the Standard Basic Assistance Agreement between the United Nations Development Programme and the Government, signed and entered into force on 10 October 1988.*


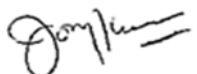
**PART III: APPROVAL/ENDORSEMENT BY GEF OPERATIONAL FOCAL POINT(S) AND GEF AGENCY(IES)**

- A. RECORD OF ENDORSEMENT OF GEF OPERATIONAL FOCAL POINT(S) ON BEHALF OF THE GOVERNMENT(S):** ):  
(Please attach the [Operational Focal Point endorsement letter\(s\)](#) with this form. For SGP, use this [OFP endorsement letter](#)).

NAME	POSITION	MINISTRY	DATE (MM/dd/yyyy)
<b>Mr. Khampadith Khammounheuang</b>	Director General	DEPARTMENT OF ENVIRONMENT QUALITY PROMOTION, MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT, LAO PDR	12/03/2013

**B. GEF AGENCY(IES) CERTIFICATION**

This request has been prepared in accordance with GEF/LDCF/SCCF/NPIF policies and procedures and meets the GEF/LDCF/SCCF/NPIF criteria for CEO endorsement/approval of project.

Agency Coordinator, Agency Name	Signature	Date (Month, day, year)	Project Contact Person	Telephone	Email Address
Mr. Philippe R. Scholtès, Managing Director, Programme Development and Technical Cooperation Division - PTC, UNIDO-GEF Focal Point		09/16/2015	Mr. Jossy Thomas, Project Manager, PTC/ENE/RRE	+43-1-26026-3727	j.thomas@unido.org 



**ANNEX A: PROJECT RESULTS FRAMEWORK** (either copy and paste here the framework from the Agency document, or provide reference to the page in the project document where the framework could be found).

Project Strategy		Objectively verifiable indicators				
		Indicator	Baseline	Target (quantified and time-bound)	Source of verification	Risks and Assumptions
<b>Goal</b>	Increased usage of solid bio-fuels in Laotian industries.	Tons of annual usage of solid bio-fuels in Laotian industries.	Industries depend upon fossil fuel for their thermal energy requirements.	<ol style="list-style-type: none"> <li>1. Achieve emission reduction of at least 182,445 t CO<sub>2</sub>e through demonstration projects.</li> <li>2. Achieve emission reduction of at least 912,225 t CO<sub>2</sub>e through replication projects.</li> </ol>	Terminal evaluation report.	Support from Laos Government and private investors.
<b>Objective</b>	To reduce GHG emission in Laotian industries by promoting the production and usage of industrial grade solid bio-fuel for energy generation	<ol style="list-style-type: none"> <li>1. USD investment in solid biofuel production technologies.</li> <li>2. USD investment in solid biofuel utilization technologies.</li> </ol>	<ol style="list-style-type: none"> <li>1. Inadequate knowledge and awareness on production and utilization of solid biofuel.</li> <li>2. Inadequate policy to promote investment of the solid biofuel.</li> </ol>	<ol style="list-style-type: none"> <li>1. To invest around USD 5 million (producers + users).</li> <li>2. To undertake capacity building activities for 20 beneficiaries in each target groups.</li> <li>3. Solid biofuel plants for a cumulative 3.6 tph capacity demonstrated.</li> <li>4. Expected replication of 18 tph solid biofuel replication capacity.</li> <li>5. To develop national strategy for promoting investments in solid</li> </ol>	<ol style="list-style-type: none"> <li>1. Physical verification of the plants with solid biofuel production technologies and utilization technologies.</li> <li>2. Terminal evaluation report.</li> </ol>	Support from RENMI, DoIH, training participants, organization hosting information and learning centre and private investors.

Project Strategy		Objectively verifiable indicators				
		Indicator	Baseline	Target (quantified and time-bound)	Source of verification	Risks and Assumptions
				biofuel production and utilization.		
<b>Project Component 1: Capacity development and knowledge management</b>						
<b>Outcome 1.1</b>	Improved awareness, knowledge and capacity on solid biofuel production and usage in the country.	<ol style="list-style-type: none"> <li>1. I&amp;LC for solid biofuel usage and production created and functioning.</li> <li>2. Number of trainings organized for different target groups (such as policy makers, solid biofuel producers &amp; users, RE / technical institutions and bank / financial institutions).</li> </ol>	Insufficient knowledge in developing, implementing and managing solid biofuel production and utilization.	<ol style="list-style-type: none"> <li>1. To establish a sustainable centre for technical capacity building.</li> <li>2. To undertake training activities to improve the awareness on solid biofuel of 20 beneficiaries in each target groups.</li> <li>3. To target at least 20% women participation in each group.</li> </ol>	<ol style="list-style-type: none"> <li>1. Physical verification of the centre.</li> <li>2. Training reports.</li> <li>3. Number of trained persons.</li> </ol>	Continuous support from RENMI, training participants and training institute.
<b>Output 1.1.1</b>	An information and learning centre for solid biofuel production and usage established.	<ol style="list-style-type: none"> <li>1. Centre established and operating.</li> <li>2. Business plan and annual work plans of the centre are implemented successfully.</li> </ol>	Lack of one-stop technical centre on solid biofuel usage and production.	To establish the centre, strengthen it with trained personnel and equip with necessary tools and systems for solid biofuel usage and production.	<ol style="list-style-type: none"> <li>1. Physical verification of the centre</li> <li>2. Business plan and work plans - status reports</li> <li>3. Terminal evaluation report</li> </ol>	Continuous support of the RENMI and Government of Lao PDR.
<b>Output 1.1.2</b>	Capacity of at least 20 policy makers developed and capacities of	<ol style="list-style-type: none"> <li>1. No. of key policy makers available with sufficient knowledge on solid biofuel.</li> </ol>	<ol style="list-style-type: none"> <li>1. Key policy makers are not aware of the benefits of solid biofuel production and</li> </ol>	<ol style="list-style-type: none"> <li>1. To build capacity of at least 20 policy makers</li> <li>2. To train at least 20 industries and the</li> </ol>	Training reports	<ol style="list-style-type: none"> <li>1. Continuous support of the key policy makers.</li> <li>2. Support of the participating</li> </ol>

Project Strategy		Objectively verifiable indicators				
		Indicator	Baseline	Target (quantified and time-bound)	Source of verification	Risks and Assumptions
	potential solid biofuel producers & users, RE / technical institutions and bank / financial institutions developed (target 20 persons).	2. No. of persons trained.	utilization. 2. Insufficient local capacity to develop, finance and operate solid biofuel production and usage systems.	identified institutions on solid biofuel production, system implementation and maintenance. 3. To target at least 20% women participation in each group.		ministries, agro industries, solid biofuel users, RE institutions, bank and financial institutions.
<b>Project Component 2: Strengthening policy and regulatory framework for promoting investments in solid biofuel use in industries</b>						
<b>Outcome 2.1</b>	Improved confidence among investors in solid biofuel production and utilization	1. No. of solid biofuel production units. 2. No. of solid biofuel co-firing plants.	Low interest among investors to engage in solid biofuel production and utilization.	1. To demonstrate solid biofuel production plants for at least 3.6 tph cumulative capacity. 2. Industries co-firing at least 3.6 tph solid bio-fuel with anthracite. 3. Replicate at least 18 tph solid bio-fuel production plants.	1. Physical verification of the operating solid biofuel production units. 2. Physical verification of the operating solid biofuel co-firing plants.	Support of DoIH, other government departments, investors, solid biofuel producers and users.
<b>Output 2.1.1</b>	Database developed on agro & wood wastes availability and on final energy consumption in industrial sector.	1. Database availability. 2. Viability of supply chain.	Lack of comprehensive data.	1. At least one comprehensive database for agro & wood wastes and on final energy consumption. 2. Mapping of viable biomass supply chain.	Strengthening policy and regulatory framework for promoting investments of solid biofuel use in industries	Continued support of the DoIH and RENMI.

Project Strategy		Objectively verifiable indicators				
		Indicator	Baseline	Target (quantified and time-bound)	Source of verification	Risks and Assumptions
<b>Output 2.1.2</b>	National strategy to promote investment in solid biofuel production and utilization in place.	1. No. of strategies facilitated to promote investment in production and utilization of solid biofuel. 2. No. of standards ensuring quality of the produced solid biofuel.	Inadequate policies and regulations to create confidence among various stakeholders.	1. At least one relevant strategy for promoting investment in production and utilization of solid biofuel. 2. At least one quality standard for solid biofuel established.	1. Publication on introduced strategy. 2. Publication on introduced standards. 3. Terminal evaluation report.	Continuous support from DoIH and private sector
<b>Output 2.1.3</b>	Technical adjustments for solid biofuel usage in participating industries	No systems developed to co-fire or combust pellet fuel	1. Lack of demonstrable wood pellet combustion systems. 2. Industries currently use coal or anthracite.	Industries installed with adequate combustion systems to burn wood pellet	1. Physical verification of the sites. 2. Terminal evaluation report.	Industries ready to invest in technical adjustments to co-fire or combust solid biofuel.
<b>Project Component 3: Demonstration of solid biofuel production and utilization</b>						
<b>Outcome 3.1</b>	Increased use of solid biofuel for industrial applications.	USD investments in solid biofuel production and utilization.	Investors not ready to produce / use solid biofuel in Lao due to perceived risks and lack of knowledge.	1. To invest at least USD 4.5 Million in demonstration projects. 2. To invest in replication projects within the end of project duration.	1. Physical verification of the solid biofuel production units and utilizing/co-firing plants. 2. Terminal evaluation report.	Continuous support of DoIH, investors and industries

Project Strategy		Objectively verifiable indicators				
		Indicator	Baseline	Target (quantified and time-bound)	Source of verification	Risks and Assumptions
<b>Output 3.1.1</b>	Systematic and comprehensive biomass resource assessment in target areas.	No. of biomass resource assessment reports.	Lack of reports on available biomass resource and logistics.	At least one biomass assessment report for each target area.	Biomass resource assessment reports.	Continuous support of the DoIH and industries generating waste.
<b>Output 3.1.2</b>	Detailed plant designs prepared for the demonstration projects.	No. of detailed plant designs.	Lack of detailed plant design reports.	To develop detailed plant design reports for each demonstration plant.	Detailed plant design reports.	Continuous support from RENMI and solid biofuel producers.
<b>Output 3.1.3</b>	Solid biofuel pelletizing systems established for a cumulative capacity of 3.6 tph.	TPH of the installed solid biofuel pelletizing systems.	<ol style="list-style-type: none"> <li>1. Lack of demonstrable solid biofuel pelletizing systems.</li> <li>2. Available agro-wastes being unutilized.</li> </ol>	Solid biofuel plants for a cumulative 3.6 tph capacity demonstrated.	<ol style="list-style-type: none"> <li>1. Physical verification of the sites.</li> <li>2. Terminal evaluation report.</li> </ol>	Industries ready to invest in solid biofuel pelletizing systems.

**ANNEX B: RESPONSES TO PROJECT REVIEWS** (from GEF Secretariat and GEF Agencies, and Responses to Comments from Council at work program inclusion and the Convention Secretariat and STAP at PIF).

S. No.	GEF Secretariat Comment at PIF Work Program Inclusion	
1.	Please present market research results on the use of solid biofuels. If the GEF does not finance the project, how will the solid biofuels be used by other sectors or wasted?	Details on the use of solid biofuel in Lao and the salt industries have been presented under baseline scenario and baseline project respectively in section A.4. From the current usage of fuel in the industrial sector, if GEF does not fund the project there is no technology in the market that will allow the switch from using coal to densified biomass fuel. Although many industries use biomass as fuel for their heat process, the fuel is not used in an efficient manner, thus a major part of the energy is lost or not converted. In the absence of the project, the industrial sector will continue to use coal though the price of coal is increasing.

**ANNEX C: STATUS OF IMPLEMENTATION OF PROJECT PREPARATION ACTIVITIES AND THE USE OF FUNDS<sup>28</sup>**

A. PROVIDE DETAILED FUNDING AMOUNT OF THE PPG ACTIVITIES FINANCING STATUS IN THE TABLE BELOW:

PPG Grant Approved at PIF: <b>\$ 10,000</b>			
<b><i>Project Preparation Activities Implemented</i></b>	<b><i>GEF/LDCF/SCCF/NPIF Amount (\$)</i></b>		
	<b><i>Budgeted Amount</i></b>	<b><i>Amount Spent To date</i></b>	<b><i>Amount Committed</i></b>
Stakeholders consultation	1,500	1,500	0
Finalization of sustainable operating procedure for the information/learning centre	2,000	1,500	500
Selection of potential sites and carrying out of detailed feasibility studies	1,500	1,500	0
Preparation and finalization of medium-sized project document	5,000	2,493	2,507
<b>Total</b>	<b>10,000</b>	<b>6,993</b>	<b>3,007</b>

<sup>28</sup> If at CEO Endorsement, the PPG activities have not been completed and there is a balance of unspent fund, Agencies can continue undertake the activities up to one year of project start. No later than one year from start of project implementation, Agencies should report this table to the GEF Secretariat on the completion of PPG activities and the amount spent for the activities.

**ANNEX D: CALENDAR OF EXPECTED REFLOWS** (if non-grant instrument is used)

Provide a calendar of expected reflows to the GEF/LDCF/SCCF/NPIF Trust Fund or to your Agency (and/or revolving fund that will be set up)

Not applicable



# ANNEX E: PROJECT IMPLEMENTATION SCHEDULE

Activity	Year 1								Year 2								Year 3							
	I		II		III		IV		I		II		III		IV		I		II		III		IV	
<b>PC 1 - Capacity development and knowledge management</b>																								
1.1.1 An information and learning centre for solid biofuel production and usage established																								
a. Capacity development and knowledge management																								
b. Business plan and annual work plans of the centre are implemented successfully																								
c. Training to centre staff on operation and management of the centre																								
d. Preparation of training materials for different trainees to be trained at the centre																								
e. Public announcement and media campaign to publicize the services of I&LC																								
f. Preparation of leaflets and website for information dissemination through the I&LC																								
1.1.2 Capacity of at least 20 policy makers in both public and private sector developed and capacities of potential solid biofuel producers & users, RE / technical institutions and bank / financial institutions developed (target 50 persons)																								
a. Assessment of capacity of policy makers																								
b. Training to at least 20 policy makers on WTE project development																								
c. Training at least 50 industries on solid biofuel production system implementation and solid biofuel co-firing with coal																								
d. Train of at least 50 personnel from local engineering and O & M companies																								
e. Training of at least 50 personnel from different RE / technical institutions																								
f. Training of at least 50 personnel from banks, financial institutions and funding agencies in assessing the solid biofuel projects.																								

Activity	Year 1								Year 2								Year 3							
	I		II		III		IV		I		II		III		IV		I		II		III		IV	
PC 2 - Strengthening policy and regulatory framework for promoting investments of solid biofuel use in industries																								
1.1.3 Database developed on agro & wood wastes availability and on final energy consumption in industrial sector																								
a. Platform created for data collection																								
b. Value chain analysis																								
2.1.2 National strategy to promote investment in solid biofuel production and utilization in place																								
a. Analysis of the barriers to the use of solid biofuel																								
b. Identify the specific type of policy support targets through the gap analysis																								
c. Relevant strategy for promoting investment in production and utilization of solid biofuels																								
d. Quality standard for solid biofuels established																								
2.1.3. Technical adjustments for solid biofuel usage in participating industries																								
a. Design analysis of furnaces of potential industries																								
b. Recommendation on design changes to adapt to the combustion of biomass pellet																								
c. Design of stoves to combust wood pellet																								
d. Preparing bidding document for wood pellet stove construction																								
e. Launching the bid document, bidding, evaluating and selecting contractor for stove construction																								
f. Construction and commissioning of the pellet stove																								
g. Monitoring. Testing and reporting of performance of pellet stoves																								
h. Conducting demonstration site visit and seminar																								

Activity	Year 1								Year 2								Year 3							
	I		II		III		IV		I		II		III		IV		I		II		III		IV	
<b>PC 3 - Demonstration of solid biofuel production and utilization</b>																								
3.1.1 Systematic and comprehensive biomass resource assessment in target areas																								
a. Analysis of biomass resources in target areas completed																								
3.1.2. Detailed plant designs prepared for the demonstration projects																								
a. Detailed designs of the pellet mills for the demonstration site																								
b. Location identified to minimize transportation of raw material																								
3.1.3. Solid biofuel pelletizing systems established for a cumulative capacity of 3.6 tph																								
a. Study on insurance required for wood pellet mills during construction and operation																								
b. Preparing bidding document for wood pellet mills																								
c. Launching the bid document, bidding, evaluating and selecting contractor for wood pellet mill																								
f. Finalization of plants O&M plan																								
g. Financial closures																								
h. Construction and commissioning of the mill																								
i. Conducting expert inspection during construction and commissioning by Owner's Engineers																								
j. Monitoring, testing and reporting on pellet production performance																								
k. Conducting demonstration site visit and seminar																								
<b>PC 4 - Monitoring and Evaluation (M&amp;E)</b>																								
4.1.1 End of project M & E report prepared																								
a. Preparation of TORs & recruitment of evaluation consultant																								
b. Conduct of final evaluation and preparation of M&E report																								

Activity	Year 1								Year 2								Year 3							
	I		II		III		IV		I		II		III		IV		I		II		III		IV	
c. Design and preparation of publication website																								
d. Workshop on lesson learned and experiences gathered																								
<b>Project Management</b>																								
a. Establishment of Project Management Unit																								
b. Development of a detailed activity plan and schedule																								
c. Establishment of Project Steering Committee																								
d. Periodic convening of PSC meeting																								
e. Implementation of wood pellet projects																								
f. Reporting																								
g. Day-to-day coordination, management and monitoring of all project activities																								

**LIST OF ATTACHMENTS:**

1. ANNEX F- Gender Analysis Report
2. ANNEX G- Itemized Budget
3. ANNEX H- Co-financing Letters
4. ANNEX I- Pre-feasibility Analysis Report
5. ANNEX J – LAOFIC Profile and Certification