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**Project Title: Reducing of Green House Gas (GHG) emission in the Industrial Sector
through Pelletization Technology**

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Final Progress Report



Prepared for the project extension

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*This document has not been edited



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1 Introduction

1.1 Project Description

The GEF5 project “Reducing of greenhouse gas (GHG) emissions in the industrial sector through pelletization technology in Lao PDR” responds to aims at promoting the production and usage of industrial grade solid bio-fuel for thermal energy generation. In this way the project intends to reduce coal consumption and promote waste-to-energy methods. Thus, the project aims to contribute to the sustainable energy usage practices in Lao, aims to enhance national energy security, promote job creation and reduce carbon dioxide emissions as well as hinder deforestation. The 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. This will be done through building necessary human and institutional capacities at all levels. In particular, this project will involve salt production companies, furniture manufacturing plant and saw mills.

Fuel wood accounts for about 30% of the energy consumption in the industrial sector, a significant number of SMEs including some large-scale industries are dependent on fuel wood for heat application. 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. This project will focus on synergies between the salt and wood industry, hence the efficient use of wood waste can be used to cover not only the own power needs but also cover energy needs of the salt industry.

The project started in January 2016 and planned to finish in November 2019. Since starting the project activities, some of the activities had been implemented but some not as planned and it has been delayed. The steering committee agreed in 2018 to extend to project till 2nd November 2020. However, in the extended period many activities could not be finished, thus, the steering agreed to further extend the project till the end of 2020. The request letter has been being submitted to the GEF secretariat.

The partnering factories are located in the districts in Vientiane and Luang Namtha.





1.2 Stakeholder

The project **partners** are

- a) Ministry of Science and Technology: Renewable Energy and New Materials Institute (REMI);
- b) Ministry of Industry and Commerce (MoIC): Department of Industry and Handicrafts (DoIH) (Cleaner Production Center Lao PDR);
- c) Ministry of Planning and Investment;
- d) Ministry of Natural Resources and Environment;
- e) Ministry of Energy and Mines;
- f) UNIDO.

The following clusters of **beneficiaries** can be identified:

1. Factories as demonstration

- Salt Factories:
 - Bolten Salt Factory, in Luang Namtha
 - Veunkham Salt Factory, in Vientiane Capital
- Wood Processing Factory (Saw Mill And Furniture)

2. Government Departments:

- Ministry of Science and Technology: Renewable Energy and New Materials Institute (REMI);
- Ministry of Industry and Commerce (MoIC): Department of Industry and Handicrafts (DoIH);
- Ministry of Planning and Investment;
- Ministry of Natural Resources and Environment;
- Ministry of Energy and Mines.

3. In a wider perspective the **community** and the **population** at large is a beneficiary both through protection of the environment (reduced CO2 emissions, reduced negative impact due to climate change, reduced emissions, reduced resource extraction) and new/ better jobs (due to enhanced competitiveness of the salt and wood processing factories, reduced energy costs, more efficient production process).

Project Management	
UNIDO	<ul style="list-style-type: none"> Tasked by the Government of Lao with the overall project management, as international implementing agency.
Cleaner Production Centre Lao PDR (CPC-L)	<ul style="list-style-type: none"> National implementing and hosting institution. The Project is physically based at the CPC-L, providing the CPC-L with the opportunity to enhance the visibility and reputation of the center, build the capacity of their staff, and to liaise closer with industries.
Project Steering Committee (PSC)	<ul style="list-style-type: none"> Provides the overall guidance and oversight on the project implementation. Consists of the following representatives: <ul style="list-style-type: none"> Director General of Department of Industry and Handicraft, Mr. Buavanh Vilavong, chairman DDG of Renewable Energy and New Material Institute, Mr. Bounchanh Douangvilay, vice chairman Representative from department of foreign division, ministry of investment and planning, member



	<ul style="list-style-type: none"> • Representative from institute for renewable energy, ministry of energy and mines, as member • Representative from department of environmental quality promotion, ministry of Natural Resource and Environment, National GEF focal point, as member • Director of Veunkham salt factory, as member • Director of Lao Furniture industry, president of wood product export association as member • Mr. Patrick Nussbaumer, Project Manager, UNIDO, Vienna HQ, as member • Mr. Thongphet Phonsavath, National Project Coordinator CPC-L, Lao, as Secretary
Project Management Team/Unit (PMU)	<ul style="list-style-type: none"> • In charge of the project implementation on a daily basis. • The role of PMU is to coordinate the execution and monitor the progress of the project. PMU will also liaise with all stakeholders and keep communication with counterparts.

1.3 Progress of project activities

The project started in early after the launching of the project in November 2015. Since that there were several activities had been implemented such as:

- Missions of the technical advisor visited the salt factories and wood processing sites 2-8 May 2016;
- International expert for Capacity development and knowledge management visited the sites and met stakeholders from 18-21 July 2016.
- Energy audit by Enerteam Company 2016
- Project steering 2016 on 30th May 2016, at Subnakhone hotel, Vientiane Capital
- COMFAR training on 13th -17th March 2017 at Ministry of Industry and Commerce
- Training on Biomass resource assessment on 3rd -5th May 2017 at Ministry of Industry and Commerce
- Project steering 2017 30th August 2017, at Vientiane Plaza hotel, Vientiane Capital
- Workshop on Pilot testing on using biomass pellet as fuel and Jacketed steam boiler for salt evaporation at Veunkham salt factory, Vientiane Capital
- Pilot on using Greenhouse Solar dryer for salt drying and slat evaporation in February 2018
- Project steering 2018 on 10th December at Crowne Plaza hotel, Vientiane Capital.
- Stakeholder workshop on palletization Technology and investment on pellet production on 5 April 2018
- Biomass Resource Assessment end of 2018
- Launching of the BTILC in December on 10th December 2018
- Project steering 2019 on 18th October 2019, in Vangvieng
- Stakeholder workshop on palletization and technology in Bolikhamxay, 6th December 2019
- Announcement on interesting on pellet production January- February 2020
- Online assessment of the factories showing interest on investment on pellet which submitted proposal to UNIDO.
- Online training on Biomass Technology in May 2020
- Procurement of laboratory equipment for BTILC 2022
- Formulation of biomass energy strategy conducted in 2021-2023



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- UNIDO provide incentive to three companies for investment in pellet plant 2021-2022
- Ministry visit to neighboring countries in March 2023
- Procurement of measuring equipment for CPC-L March 2023

More information in detail of project activities and progress is shown in the table below.



Table 1: Project activities and progress

Outputs by Project Component		Responsible	Status of implementation	Comments
Component 1 – Capacity development and knowledge management				
Outcome 1: Improved awareness, knowledge and capacity on solid biofuel production and usage in the country				
Output 1.1: An information and learning centre for solid biofuel production and usage established			Done	
1.1.1	Preparation of ToR for institute to support REMI to set up the centre in Lao (on-going)	UNIDO	complete	
1.1.2	Identify institute to support REMI to set up the centre in Lao (on-going)	UNIDO	complete	
1.1.3	Establish Agreement with institute to support REMI to set up the centre in Lao (planned)	UNIDO	complete	
1.1.4	Trainings for BTILC staff (incl. training materials, database of stakeholders, services to pellet producers, etc.) from partner (e.g. BIOMA)	UNIDO	complete	
1.1.5	Training from int. expert for pellet lab	UNIDO	complete	
1.1.6	Procurement of Pellet Testing Equipment, small pellet machine and basic Energy Audit Equipment incl. training (to be finalized based on business plan submitted from REMI) (in-progress)	UNIDO	complete	
1.1.7	COMFAR training	UNIDO	complete	
Output 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 20 persons).				
1.2.1	Conduct training needs assessment (assessment of capacity of policy makers) (on-going)	REMI (for BTILC staff), UNIDO for other policy makers (and for REMI through Martin Englisch)	Complete	
1.2.2	Training for policy makers	REMI to provide logistics (obligated); UNIDO to provide expertise	Not implemented	
1.2.3	Training for solid biofuel producers & users, RE / technical institutions and bank / financial institutions: on FS and proposals	REMI to provide logistics (obligated); UNIDO to provide expertise	Not implemented	
1.2.4	Training for solid biofuel producers & users and RE / technical institutions: on O&M of the system	UNIDO (done by supplier with support from REMI)	Not implemented	
Component 2 – Strengthening policy and regulatory framework for promoting investments in solid biofuel use in industries				
Outcome 2: Improved confidence among investors in solid biofuel production and utilization				
Output 2.1: Database developed on agro & wood wastes availability and on final energy consumption in industrial sector				
2.1.1	Develop database structure (incl. data collection methodology) and provide initial input for collecting final energy consumption data of Lao's agro and wood processing industry as well as other data relevant for establishing a bio-energy industry	CPC-L	complete	
2.1.2	Conduct biomass resource assessment incl. training and involvement of DOIH staff	CPC-L	complete	



2.1.3	Conduct knowledge dissemination workshop on biomass resources	CPC-L	complete	
2.1.4	Translate biomass resource assessment survey and disseminate it	CPC-L	complete	
2.1.5	Editing of biomass resource assessment (english version) and dissemination	CPC-L	complete	
Output 2.2: National strategy to promote investment in solid biofuel production and utilization in place (international & national experts to be contracted)				
2.2.1	Preparation of ToR for Development of the national biomass strategy and quality standards for solid biofuel	UNIDO	complete	
2.2.2	Recruit international expert to provide advice and support CPC-L developing the national biomass energy strategy	UNIDO	complete	
2.2.3	Develop the national biomass energy strategy to promote investment in production and utilization of solid biofuel	UNIDO/ CPC-L	On-gping	
2.2.4	Develop standards ensuring quality of the produced solid biofuel	UNIDO/ BTILC	Not implemented	
2.2.5	Conduct knowledge dissemination workshop on recommendations for the national strategy to promote investment in solid biofuel production and utilization	UNIDO/ CPC-L	Planned	
Output 2.3: Technical adjustments for solid biofuel usage in participating industries				
2.3.1	Pilot System at Veunkham Salt		complete	
2.3.1	Solar Dryer for Salt Production (incl. knowledge dissemination)	CPC-L	complete	
2.3.2	Market creation: Technical adjustments for salt factories to use pellets or identification of alternative industries that can possibly use solid biomass (for thermal energy)	UNIDO (vendor/ salt factory)	On-going	
Component 3 – Demonstration of solid biofuel production and utilization				
Outcome 3: Increased use of solid biofuel for industrial applications				
Output 3.1: Systematic and comprehensive biomass resource assessment in target areas				
Combined with 2.1 (general data collection) and 3.1 (specific data collection for FSs)				
Output 3.2: Detailed plant designs prepared for the demonstration projects				
3.2.1	Conduct technical and economic feasibility analysis for solid biofuel utilization at Veunkham Salt		complete	
3.2.2	Conduct energy audits in Veunkham Salt to identify energy demand		complete	
3.2.3	Conduct Energy Audits in participating industries to identify energy demand in the participating industries		complete	
3.2.4	Develop Guide for investors for solid biofuel pellet investments	UNIDO/ Enerteam	complete	
3.2.5	Support project specific plant designs and feasibility studies for solid biofuel production and utilization	UNIDO	complete	
Output 3.3: Solid biofuel pelletizing systems established for a cumulative capacity of 3.6 tph				
3.3.1	Establish financial incentive system	UNIDO	On-going	
3.3.3	Install/ Support demo pellet production system through call for proposals through CfEol (CfEol to be finalized). Next steps a. Develop CfEol b. Publish CfEol c. Evaluate CfEol Eol d. Request for proposals	UNIDO/ vendor	complete	



	e. Review proposals f. Sign contracts g. Implementation and monitoring (Construction, Commissioning, Operation)			
	2nd. call for proposals (if required)	UNIDO/ vendor	complete	
	Monitor execution	UNIDO	complete	
4.	M&E			
	PSC Meetings	UNIDO	complete	Done 2016, 2017, 2018, 2019, 2021.2022
	Terminal Evaluation	UNIDO	complete	

2 Detailed Progress activities

2.1 Project Launching

The launching of the project was on 11th November 2015. The launching workshop was a mark of starting the project later on early 2016. The workshop was chair by Mr. Manohack Rasachack, Director General of Department of Industry and Handicraft, Ministry of Industry and Commerce, Mr. Bounchanh Duangvilay, Deputy Director general of Renewable Energy and new Material Institute, Ministry of Science and Technology, and Mr. Jossy Thomas, Project Manager, UNIDO. Attended the workshop were participants from Government agencies, private company and institutions as well as international organization all together about 40 participants. The launching workshop was the mark starting project since 2016.



Figure 1: Launching workshop in Vientiane Capital

2.2 Energy audit

After the two visits of CTA and international expert conducted in May and July 2016, as per the first evaluation of possible promotion of production and utilization of pellet, it was seen that many of the salt factory included one furniture factory which involved in as demonstration units of the project are inefficient in terms of energy usage. It was thus, recommended to conduct an energy audit in 6 salt factories and ne furniture factory. The purpose was to find their energy consumption and propose possible option for improvement of the energy performance of different options. The energy audit was





conducted by Enerteam Company from Ho Chi Minh City, Vietnam in August 2016 for Veunkham salt factory and later on in May 2017 for all the other six factories. The brief report and summary of the energy audit is attached in this report in Annex1.



Figure 2: Enerteam and staff of BTILC conduct energy audit at salt factories

2.3 COMFAR training

Department of Industry and Handicraft (Cleaner Production Centre Lao PDR), Ministry of Industry and Commerce in collaboration with the United Nations Industrial Development Organization had organized a training on COMFARIII (Computer Model for Feasibility Analysis and Reporting, beginner), under the project “Reduction of Greenhouse Gas Emission in Industrial Sector through Pelletization Technology” funded by the Global Environmental Facility or GEF5, on 13th to 17th March 2017, under the chairmanship of the Director General of department of Industry and Handicraft Mr. Manohack Rasachack. The lesson was delivered by the UNIDO COMFAR expert.

Attending the training were staff from different financial institutions both Government and enterprises like banks, micro-finance institution and business associations, all together 15 participants. The objective of the training was to build capacity on financial analysis of a project and project development through a computer modeling, which make the process of analysis effectively, easier, faster and more precise.



Figure 3: Participants at COMFARIII training at Ministry Industry and Commerce.

2.4 Training on Biomass Resource assessment

The training on Biomass Resource Assessment was held on 3rd to 5th May 2017. The objective of the training was to build capacity for government staff on how to collect data and assess the biomass resources for conducting Biomass Resource Assessment. The lesson was presented by the project CTA on the procedure of the data collection, the methodology of mapping of the source and sink and how to assess the data collected to ensure the quality and reliability of the data collected. The workshop was chaired by Mr. Savath Koundavong, DDG of Department of Industry and Handicraft and the lesson was delivered by Dr. Jutamanee Martchamadol, Project CTA. Attended the training were the staff of Cleaner Production Center Lao PDR, the Department of Industry and Handicraft, the Renewable Energy and new Material Institute, the staffs of Provincial Department of 12 provinces, and the project staff. The result of the training was the understanding of participants in collecting and assessing the data and mapping the location of sources of biomass user and sink.



Figure 4: Mr. Savath Khounlavong, Ms Jutamanee and participants at training on biomass resource assessment

2.5 Project Steering Committee Meeting

As per work plan the Project Steering Committee Meeting was held yearly to review the project progress and approve the activities of the next year. The members of project committee members are from the Department of Industry and Handicraft, MOIC; Renewable Energy and New Material Institute, MOST; Department of International Cooperation, MPI; Institute of Renewable Energy Promotion, MEM; Department of Environmental Quality Promotion, MONRE; UNIDO; PMU and 2 private companies.

The first steering committee meeting was held on 30th May 2016,
The second steering committee meeting was held on 30 August 2017,
The third steering committee meeting was held on 10th December 2018, and
The fourth steering committee meeting was held on 18th October 2019.

The MOM's of each steering committee meetings are attached in this report in Annex2.



Figure 5: Mr. Manohack Rasachack, Mr. Jossy Thomas at Project steering committee meeting 2018, at Crowne Plaza hotel, Vientiane Capital



Figure 6: Mr. Somphong Soulivang, Mr. Jossy Thomass at Project steering committee meeting 2019, at Chanthavisouk Vangvieng hotel, Vangvieng

2.6 Workshop of Pilot testing on using biomass pellet as fuel and Jacketed steam boiler for salt evaporation at Veunkham salt factory

The workshop took place at Veunkham salt factory, Ban Samsaath, Xaythany district, Vientiane Capital on 30th August 2017

The objective of the workshop was the demonstration of new salt evaporation technology use steam through a double jacketed steam boiler in order to showcase the success of the new steam evaporation technology in salt industry.

The workshop were chair by Mr. Manohack Rasachack, Director General of department of industry and handicraft, Ministry of Industry and Commerce; Mr. Bounchanh Duangvilay, Deputy Director of Renewable Energy and new Materials Institute, Ministry of Science and Technology, Mr. Jossy Thomas, Project manager PTC/ENE/RRE, UNIDO and Mrs.



Bounthavy Chounlamany, Director of Veunkham salt factory, attended by the invited participants from salt factories, mechanical companies, women enterprises association, young entrepreneur association, steering committee members, academy, newspapers and the staff of Veunkham salt factory, all together approx. 30 participants. The result of the pilot of the Jacketed Steam boiler is attached in this report in Annex 3.



Figure 7: Participants at the workshop on pilot testing of Jacketed steam boiler at Veunkham salt factory



Figure 8: Mr. Manohack Rasachack, center left, Mr. Bounchanh Duangvilay center right, Mr. Jossy Thomas Project Manager left and Mrs. Bounthavy Chounlaman, right remarked the workshop.

2.7 Pilot on using Greenhouse Solar dryer for salt drying and slat evaporation in February 2018

Purpose of pilot

Following the request received from the salt factories, it was decided during the Project Steering Committee Meeting held on 30th August 2017 to assist the salt industries in finding a suitable solution that will allow them to carry out salt production using solar energy throughout the year and produce improved quality salt following Good Manufacturing Practice (GMP).

A detailed review found that solar dryers have been widely used in South-East Asia for drying of agricultural and agro-industrial products. However, no attempts have been made so far to use similar technology for solar evaporation of brine for salt production. The system has been designed by the ATR solar company from India. The installation and testing took place in February and March 2018. A description of installation and summary of testing result is attached in this report Annex 4



Figure 9: Mr. Mohanty Brahmanand CTA and Mr. Teri Rajan, Expert of ATR on preparation of civil work for installation of greenhouse solar dryer.

2.8 First stakeholder workshop on palletization technology and investment

Stakeholder workshop on palletization Technology and investment on pellet production was held on 5th April 2018. The objective of the workshop was to seek potential investor on pellet production under the assistant of the UNIDO project of Reducing Greenhouse Gas Emission in Industrial Sector through Pelletization Technology. The workshop was chaired was Mr. Khamnoy Chanphenxay, Director of Handicraft Division, Department of Industry and Handicraft. The half-day workshop was held specifically for decision makers (14 persons, 4 women) of industries producing wood and biomass waste to share information regarding pellet technology and investment opportunities. The workshop was also attended by the World Bank staff, REMI staff and the Indian Biomass Energy Company.

There was a consulting meeting with expert in the afternoon. The brief report of the workshop is attached in this report Annex 5.



Figure 10: Participants at the stakeholder workshop and consulting meeting at Lao Plaza

2.9 Establish and launching the Biomass Technology Information and Learning Center (BTILC)

UNIDO has signed an agreement with Renewable Energy and new Materials Institute (REMI) on establishment and operation of Biomass Technology Information and Learning Center (BTILC) on 31 January 2018 and the contract on launching and operation of BTILC on 10 December 2018. The BTILC has been launched on 10 December 2018 at the Renewable Energy and New Materials Institute, Ministry of Science and Technology under presided by of Vice Minister of MOST Dr. Chanseng Phimmavong, Director General of REMI Mrs. Mayty Vongkhamsao, DG of Department of Handicraft and Industry Mr. Manohack Rasachack, UNIDO project director Mr. Josy Thomas and UNIDO Lao Representative Mr. Sommai Faming, and other invited guest from relevant agencies.



Figure 11: Dr. Chanseng Phimmavong (center right), Mr Manohack Rasachack (center left), Mrs. Mayty Vongkhamsao (second left), Mr. Jossy Thomas (second left), Mr. Sommai Faming (third left)

2.10 Biomass Resource assessment

To promote the production and utilization of pellet, which is not well known in Laos to be used as information for both private sector for possible investment and for government agencies for promoting through variant policy, strategy and measurement, a data base on potential resource and sink shall be available. And this is current and specifically did not exist. So the project had conducted a biomass resources and sink assessment implemented by the Cleaner Production Centre Lao PDR under a contract with UNIDO. PO. no 3000062552. The survey had been conducted in late 2018 to early 2019.

As refer to contract signed, the focused sector shall be rice mill, wood processing and other agro-product processing factory like corn mill etc. The selection of provinces was based on the size of factories gained from the pre-screening of factories collected from the database of the Statistic Division of department of Industry and Handicraft. There are totally 12 provinces included Vientiane Capital and Vientiane province which initially is not listed in the contract. After re-screening of the number of factories the survey team found that there are other factories which have biomass potentials of sources and sinks then the number of 92 factories listed in the contract and it reached 362 factories in total 12 provinces. For preparing the site visit, the

Department of Industry and Handicraft had sent the request to provincial department of Industry and Commerce for collaboration.

The survey started with the site visit and the on-site training started in Middle to end of October 2018 first in southern provinces: Salavan, Sekong, Attapeu and Champasack, in Northern provinces: Luangprabang, Luangnamtha and Xayabouly, and in November in middle part of Laos in Savannakhet, Khammouane and Bolikhamxay, and in Vientiane Province and Vientiane Capital end of November 2018. The purpose of on-site training was for teaching provincial staffs on data collection, data pre-analyse and reporting. After the training, the provincial staff had practiced their job with questionnaire prepared by the project.

The questionnaire has designed into two forms specific for Biomass resources residue and Biomass sinks. Department of Industry and Handicraft assigned 12 enumerators from provinces (Local officer) in order to conduct survey plan in each province, go to the survey areas, interview and record information to questionnaires, check and correct information in questionnaire and sent questionnaire to CPC-L.



Figure 12: Project team conduct onsite training on biomass survey practice the survey in factory.

2.11 Final dissemination workshops on Biomass resource assessment

As included in the proposed work plan and budget, the last activity of the biomass resource assessment is the final dissemination workshop. The aim of final dissemination workshop is to disseminate the result of biomass resource assessment, the feedback and understanding of participants on the report.

The workshop was held on 15th August 2019 under the chairmanship of the Director General of Department of Industry and Handicraft, attended by participants from provincial Department of Industry and Commerce, staff from REMI, IREP, Ministry of



Natural Resources and Environment and staff from Ministry of Industry and Commerce all together about 30 participants.



Figure 13: Director General of DIH, Dr. Buavanh Vilavong, Deputy Director General, Mr. Somphong Soulivanh are on board at the final validation workshop

2.12 Second Stakeholder workshop on palletization technology and investment

Follow the agreement on the PSC in October 2019, there was a need to announce the financial assistance of UNDO to private companies in Laos on investment on pellet in addition to the expression of interest announced by UNIDO in July and September 2019. On December 06, 2019, the Department of Industry and Handicraft in coloration with the United Nations Industrial Development Organization, under the GEF-funded project “Reducing Greenhouse Gas Emission in the Industrial Sector through Pelletization Technology in Lao PDR” held a meeting on the promotion of biomass fuels (Pellet) at Vilaysack Hotel, Pakxan District, Bolikhamxay Province, under co-chairmanship of Mr. Somphong Soulivanh, Deputy Director General of DIH, Ministry of Industry and Commerce and Mr. Khonesavanh, Soukaserm Deputy Director General of Department of Industry and Commerce, Bolikhamxay province.

The objective of the workshop was to seek Lao enterprises who are interested in investment on pellet production in Lao PDR with a small grant from project. The overall purpose is to demonstrate the production and utilization of pellet in processing industry and encourage domestic and international pellet market of Laos. Attended by total of 35

participants, 6 from Government agencies, 27 from private companies and 2 UNIDO representatives. The minute of the workshop is attached in this report in Annex 6.



Figure 14: Mr. Somphong Soulivanh Deputy Director General of DIH and Mr. Khonesavanh Soukasderm, Deputy Director General of Borlikhamxay province at the stakeholder workshop in Borlikhamxay

2.13 Call for expression of investment

Follow the agreement on the PSC 2019 and the following stakeholder workshop on pelletization technology and investment held in December 2019, UNIDO announced a call for expression of investment RFX no. 700004103 in January 2020. This announcement was also on local newspaper. Seven companies had submitted their proposals. Project team and expert planned to have a mission in early March 2020 to do the site evaluation of the companies which submitted their proposal for selection of units that passed the criteria of the project, but due to the COVID-19 pandemic in early 2020, UNIDO announced travel ban of UNIDO staff. Thus, the mission was cancelled and the evaluation of the companies needed to do online instead. In March 2020, UNIDO expert and project team send questionnaires to factories to collect information as much as possible. The expert and project team had evaluated the data collected from the factories and found that data collected was not sufficient for making decision on selection. Many data given, seems not be reliable and need to be recollected and inspected by project team especially the raw material and sources.



Call for Expression of Investment (EOI)

To develop waste-to-energy (WTE) pelleting plant under the framework of the GEF-5 project "Reducing Greenhouse Gas Emission in Industrial Sector through Pelletization Technology in Lao PDR"

The United Nations Industrial Development Organization (UNIDO) is implementing a Global Environment Facility (GEF) funded project entitled "Reducing Greenhouse Gas Emission in Industrial Sector through Pelletization Technology in Lao PDR" in collaboration with the Ministry of Industry and Commerce (MoIC) and the Ministry of Science and Technology (MoST) Lao PDR. The goal of the project is to promote the production and usage of industrial grade solid bio-fuel for thermal energy generation. In this way the project intends to reduce coal consumption and promote waste-to-energy methods. Thus, the project also aims to contribute to the sustainable energy practices in Lao, to enhance national energy security, to promote job creation and to reduce carbon dioxide emissions as well as avoid deforestation. The project will employ a two-pronged strategy of 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. This will be done through building necessary human and institutional capacities at all levels.

Project Objective: The proposed intervention will enable agro-processing facilities and industries convert the generated biomass wastes to solid biofuel by supporting project developers and promoting private sector investment in utilization of biomass pellet and briquette technologies in Lao PDR. As part of the project activities, a number of pellet production plant developers/investors will be supported to demonstrate the technical and financial viability of the technology utilizing agricultural residue and industrial biomass wastes generated from agro-processing facilities and industries. Support will be provided to the project developer/investor as capital grant subsidy. This call for EOI is to identify interested parties utilizing biomass wastes generated from agro-processing facilities and industries to generate solid biofuel through available funding by GEF.

If you want to participate in this call of EOI, all related information and documents can be found out at the UNIDO e-procurement portal (<https://procurement.unido.org/>). (RFX 7000004013, Supply and installation of biomass pellet (or briquette) production plant, Lao PDR). Submission deadline for the EOI is 6 March 2020.

Project Title:	Deadline Date	Type	Event Number
Reducing Greenhouse Gas Emission in Industrial Sector through Pelletization Technology in Lao PDR	06.03. 2019 23:59:00 CET	CEOI	7000004013
Questions and your response should be send to UNIDO by email to: A.Orlov@unido.org and to A.Eruwa@unido.org			

Figure 15: Advertisement of Expression of interest on local newspaper

2.14 Online training on Biomass Technology

As per the ToR and work plan, BTILC staff shall receive capacity building and knowledge about biomass technology. The training was planned to be organized in early March 2020 in parallel to the mission of UNIDO expert, but due to COVID-19, it had been postponed and replaced with online training in May 2020 instead. The training was presented by the UNIDO expert Mr. Martin Englisch from the Bio-energy institute from Austria. The topic of the training was online training on pelletization technology which was divided 4 sessions with the contents as below

12May 2020: General information on pellet, market and use of pellet in household and industry

15May 2020: Pellet market and subsidy

22May 2020 Pellet production and

27May 2020 Pellet quality and standard

Attended the workshop were also participants from companies which interested in investment on pellet and staff from DIH, all together 25 persons.



Figure 16: Participants of the online training at BTILC

2.15 Develop and update BTILC's homepage

The homepage of the BTILC had been developed on January 2019 by the technical staff of Information and Technology Institute, Ministry of Science and Technology. The purpose of the homepage is to provide information on project activities, on project materials, publication and provide information on technology on palletization. The homepage was designed in to English and Lao language where interested persons can visit with the following link: btilec.most.gov.la

BTILC has also created their social media link on Facebook page: Biomass Technology Information and Learning Center.

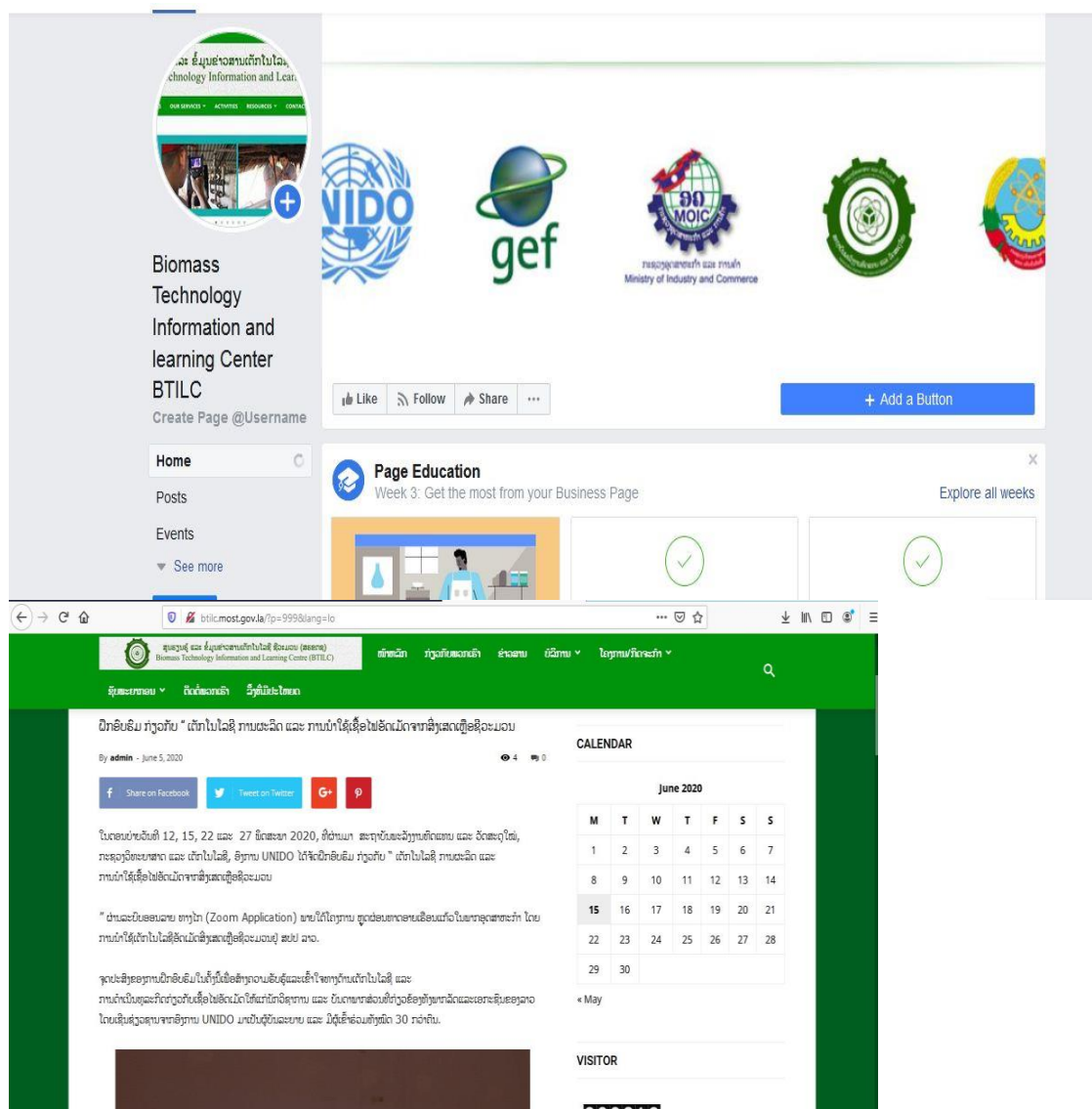


Figure 17: BTILC homepage

2.16 Develop BTILC's brochure

BTILC has developed their own brochure by hiring designer to design a good brochure for the enter in English and Lao language. The purpose of creating brochure is to promote and advertise the BTILC. The brochure contents the vision and mission of the BTILC and the main service to be provided by BTILC generally.



Figure 18: BTILC brochure



2.17 Develop Manual Guide for Project Developer on Pellet for Laos

As pellet is new for Laos, both for producer and user, pellet is known in industrial use and even household, so there is also a need to have a guide for new investor and project developer accordingly. Thus, project has developed a guide by hiring EnerTEAM company from Ho Chi Minh City, Vietnam. The guide over 150 pages shall be useful for new investor and project developer on pellet, especially for Laos.

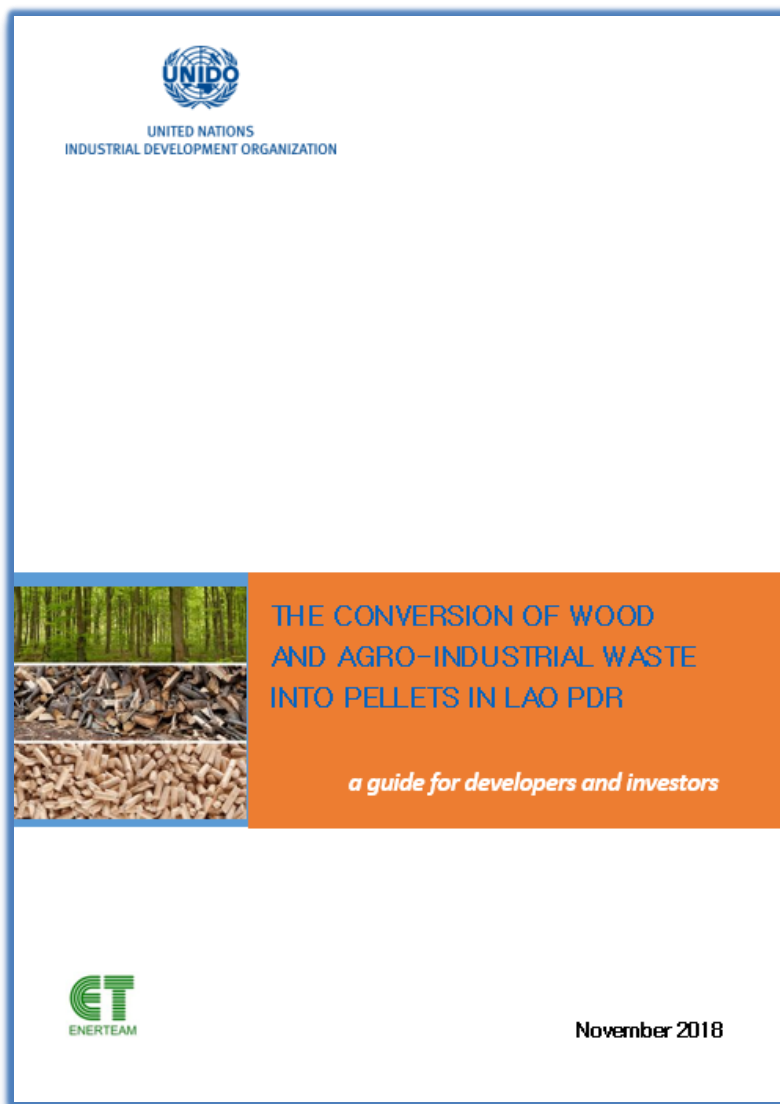


Figure 19: Pellet guide for Lao PDR

2.18 Prepare of the booklet “Biomass Resource and Sink Assessment”

In parallel to the biomass assessment, as the result, a small report of biomass resources and sink assessment has been prepared. This is small booklet which summarize the way of conducting of biomass resource assessment. The



methodology of conducting, the data collected and analysis with the mapping of potential of where the resources (factories) and where the user are. The booklet is ready to be printed or downloaded in the related website.

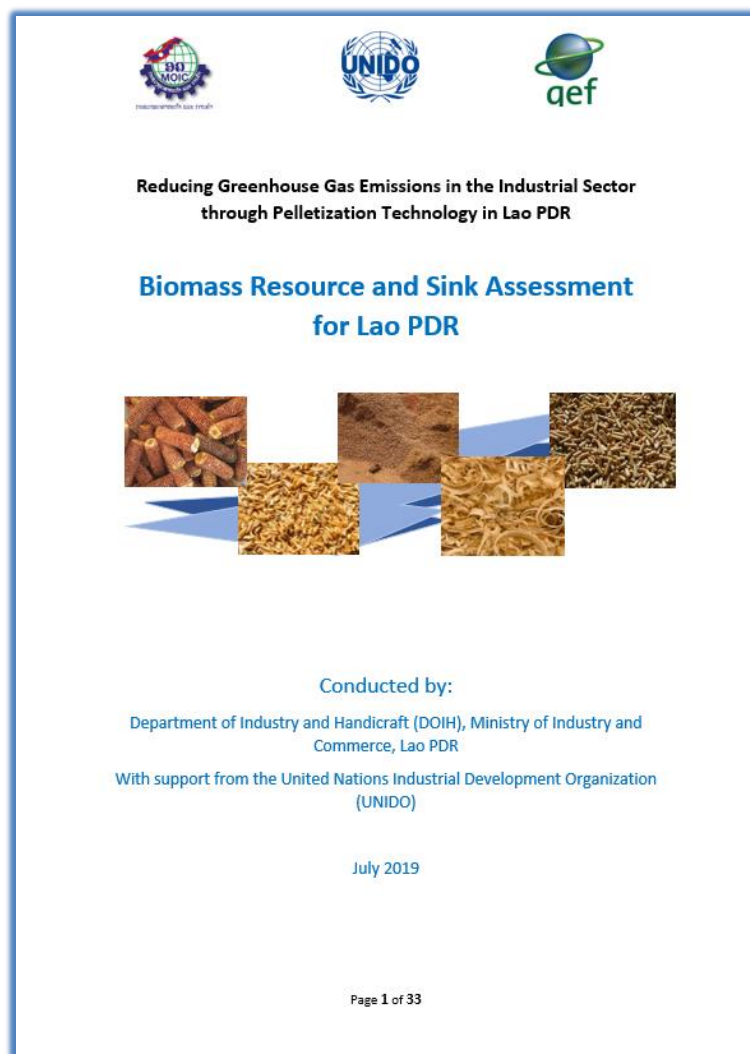


Figure 20: Booklet of biomass resource and sink assessment

2.19 Support BTILC on operation and setting up laboratory

As per work plan and contract between UNIDO and REMI on establishment and operation of the BTILC, a further capacity building in incubation phase and sustainable need to be given. Till now after the launching of BTILC there was an only training conducted in May 2020. . The set-up laboratory for BTILC which had been assessed by UNIDO expert on the requirement of some equipment. UNIDO had announced a call for proposals RFX 7000004698 in February 2021. There were companies submitted their proposals. UNIDO had evaluated and selected a supplier to deliver the said equipment. The equipment has reached the BTILC in February 2022 There was a training on using the equipment for the BTILC staff. The installation of the laboratory is completed in April 2022. A letter of acceptance of the equipment attached in annex 9.



Through UNIDO procurement rule and regulation a supplier company GRAIDCO was selected for delivery of the said equipment. A contract between the supplier and UNIDO was signed in July 2021 under the PO NO 3000091088.

The delivery of the equipment of the first lot started end of September 2021. The delivery was expected to be finished within two months. However, due to the COVID, situation and the preparation of the import paper and the tax exemption paper was delayed, resulted the delay of the delivery of the equipment. The second (final lot) of the equipment was delivered completely in February 2022.



Figure 21: Unloading the lab equipment at BTILC

2.19.1 Training and operation testing of the laboratory equipment.

The purpose of the training was to transfer knowledge of operation of the equipment. The training took place online on 8th April 2022 by the supplier. The topic of the training was the operation of the calorimeter such as the calibration, sample taken and measuring. Following picture show the training done online at BTILC laboratory room.



Figure 22: Online training on Laboratory equipment setting

2.19.2 The testing of measuring the calorimeter

After the training BTILC staff tested the measuring the calorific meter. The measuring was successful. The result of the testing shows in the annexes.

2.19.3 Testing of the pellet machine

The testing of the pellet machine by using saw sawdust and job's tear and raw material is still no success. It could not be pelleted. BTILC staff is trying to find the reasons. It might be too high or too less moisture contents of the raw materials. BTILC does not have the moisture meter to check the moisture contents. Figures below show the testing with no success. A recommendation from supplier is required at this stage.



Figure 23: Testing of pellet machine



The main activities next is still the need assessment of the BTILC, preparing training material and conduct the training and awareness workshop on biomass pellet and technology and the possible training on cook stove in selected provinces in harmony to the supper clean cook stove of the World Bank project.

There shall be handover ceremony of the equipment at the end of this proejct. Further information on progress and next activities for BTILC is attached in this report in Annex 8.

2.20 Salt production technology using solid biofuel pellets and briquettes

Cleaner Production Center as contractor had hired a consultant company: JSK Sole Co., LTD its address at Xaysavarng, Xaythany district, Vientiane Capital, tel: 020 54255454, to do the design job include the supervision of the installation and testing the furnace system.

The contract and the drawing of the furnace system is attached separately.

For the installation of the system, CPC-L has hired local labour for construction the furnace with chimney. Materials for the construction of the system was purchased. The list of the materials is in the annex attached.

The furnace is completely constructed with cooking and covered with roof. The photo below shows the completion of the construction of the furnace. The furnace is connected with the pellet feeding systems. The system consists of a silo covered with roof and walls. Originally, the pellet feeding was designed with screw conveyer, but the cost of screw conveyer and its accessory was too high. So, it was modified to used only silo with vibrator. For fill up the silo a stair case will be built and the feeding will be done manually.

Up to date, the construction of the system is about 60% completed. Next step is to build to silo and testing the feeding system which planned to be completed in coming month.



Figure 24: Construction of pellet furnace at Veunkham salt factory

2.21 Demonstration and promote investment on pellet

As part of the project output component 3, the demonstration of the pellet production and unitization of 3.6 ton per hours accumulated, the project shall promote the investment on production and utilization of pellets. This has been attempting since starting the project by trying to find best options for implementation such as a pilot on Jacketed steam boiler and the pilot on installation of greenhouse dryer for salt drying and salt evaporation which is also reported in this report. After the PSC meeting in October 2019 and the stakeholder meeting in December 2019 and lastly the PSC 2020, there was an announcement of UNIDO on call for expression of investment in February 2020 under the RFX 700004013 and previously under the RFX 7000004855 in May 2021. Three companies had submitted their proposals: Dokchampakham pellet mill, Simmalakham briquette factory and Alxson Job's tear mill. UNIDO had evaluated and selected the successful companies to get further technical and financial support by the means of incentive. October 2021, UNIDO granted contract to three companies mentioned above, Contract_ 30000903432 for Simmalakham, 30000903431 for Dokchampakham, and 30000903430 for Alexson respectively. After signing the contract, the three companies prepared to procured and installed the pellet plant.

Early 2022, Simmalkham Saw Dust Charcoal Briquette Personal had started to purchased and install a pellet plant. May 2022, the company had completed the installation of 3.0 tons per hours and run the production test in from May 2022. The equipment is from china Rotaxmaster company. The factory installed 2 production line of 1.5 ton each to run separately or parallel in case of need of higher production volume. The testing show that in 1 hour the one-line machine can produce 1.5 ton of pellet. The size of pellet is dia of 8mm and the length from 10 mm to 70 mm. The suitable moisture content for pelting is

12-14%. There is dryer to bring down the moisture to the desired content. It was recommended to keep the optimum moisture contents, so that a minimum length of the pellet 12mm-15mm can be achieved. The factory will run the production test and supply local market. The factory sent the sample to Vietnam for testing the property parameter. In addition, sample was taken to be tested at BTILC for the said parameter such as moisture content, ash content and calorific value and this had been reported to project and factory. The result of the testing is attached in this report.

Furthermore, it was recommended to install silo to keep the pellet and allow the packaging of the pellet properly. It was also recommended to install a grate together with a big fan to separate the short pieces of pellet to improve the specification of the pellet. The fan will allow cooling of the pellet and also reduce breaking of the pellet. The factory has the plan to install such equipment when they are in the full production.



Figure 25: Deputy Director of DIH and its staff and project staff visit Simmalakham pellet factory



The production test was done several times after installation, It was fully testing on 15 March 2022 for showing to the delegates from Department of Industry and Handicraft and the Department of Industry and Commerce of Bolikhamxay province. The photo below showed the site visit led by the Deputy General of the Department of Industry and Handicraft and technical staff of Cleaner Production center Lao PDR and UNIDO staff.

To mark to starting of the first pellet production in Bolikhamxay provinces which was supported by the United Nations Industrial Development Organization, the factory released a press news by local newspaper: Vientiane Time and the Social-economic newspaper of the Ministry of Industry and Commerce. The news on the two newspaper are shown below.

Vientiane Times



State officials visit the Simmalakham Briquette Factory.

New biomass pellet plant to produce 25 tonnes a day for market supply

Times Reporters

A recently constructed biomass pellet plant in Borikhamxay province will be able to produce between 25-30 tonnes of biomass pellets a day for supply to local markets and export, according to a report.

The new plant will use waste from wood processing plants and agro-processing factories such as sawdust, waste wood, rice husks and corn cobs, as well as waste wood from plantations.

The factory is currently running production tests and is expected to go into full production very soon, to meet the needs of the general public.

The report was presented during a working trip to the Simmalakham Briquette Factory, which built the plant, by state officials led by the Deputy Director General of the Department of Industry and Handicraft, Mr Savath Khoundavong.

During their visit, officials also assessed the operations of the Simmalakham briquette

factory located in Sisavath village, Borikhamxay province.

Completed in February 2022, the pellet plant was built using a partial grant contribution from the United Nations Industrial Development Organisation (UNIDO) and the Global Environment Facility (GEF). Director of the Simmalakham Briquette Factory, Mr Khamfanh Simmala, said his factory is making use of the province's potential to produce the pellets given the availability of sufficient quantities of raw materials.

He pointed out that making pellets was cheaper than making briquettes.

Given the support offered under the UNIDO project "Reducing Greenhouse Gas Emissions in Industrial Sector through Pelletisation Technology in the Lao PDR", the factory decided to go for pellet production.

"Currently, we are doing a trial run of the production process and expect to run at full capacity very soon," Mr

Khamfanh said.

The quality of the pellets will be checked by the Biomass Technology, Information and Learning Centre of the Ministry of Energy and Mines.

Mr Savath praised the Simmalakham Briquette Factory for their determination to invest in the pellet plant – the first of its kind in the province.

He suggested that the factory concentrate on producing pellets for supply to local markets and export in order to lessen dependence on fossil fuels, whose price is rising rapidly. Pellet production and use will also help to reduce greenhouse gas emissions.

Officials from the Cleaner Production Centre, Ministry of Industry and Commerce; Biomass Technology, Information and Learning Centre, Ministry of Energy and Mines; and the Department of Industry and Commerce in Borikhamxay province also joined the working trip.

Figure 26: News on local newspaper: Vientiane Time

2.23 Ministerial visit to neighboring countries

2.22.1 Visit Thailand

The ministerial visit to Viet Nam was on 27 February to 3rd March 2023. The objective of this visit and capacity building was the sharing experience on green industry, lesson and practical green industry implementation, industrial zone management. The visit also looked at national and global policies, standards, incentives and regulations that drive implementation of green industry zone and industry parks.

The outcome of visit are as follow:

- Presentation from the Department of Factories, Ministry of Industry on policies, legislation and conditions for the development of green industries and eco-industrial districts in Thailand
- Presentation of experts from the Environmental Engineering Association of Thailand on procedures, principles, methods and preparations as well as indicators to create a factory as a green industry, an eco-industrial zone, and create an eco-industrial city
- Presentation on lessons of practical implementation visit SCGP cardboard factory
- Visit Thamak Sugar Co., Ltd., a company that produces and distributes sugar that lies in the KSL vines with more than 70 years of experience in sugar production
- Visit recovery house power plant
- Visiting Capital Industrial Estate

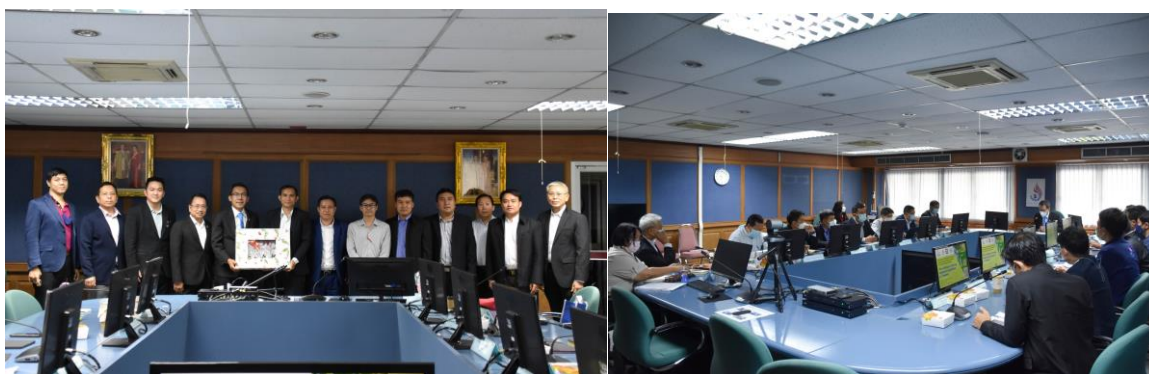




Figure 27: Staff of DIH and project staff took lessons in classroom and visit factories in Thailand

The result of the visit and capacity buildings

1) Green industry

Thailand's green industry consists of 5 levels: Level 1 Green commitment, Level 2 Green activity, Level 3 Green system, Level 4 Green culture and Level 5 Green network. The green industry certificate of Thailand level 1 is ageless while level 2-5 is 3 years old. The Ministry of Industry has a plan to promote the development of green industry to 100% by 2025, which currently has more than 84,000 industrial plants nationwide with 80% green industry certification. The policies obtained from being a green industrial factory include getting the



right to stick the green industrial logo on the product, getting advertising on the website of the factory department, getting merit and so on.

- 2) **Ec0-industry park:** Eco-industry park standards consist of 5 dimensions: physical, economic, environmental, social and management. These 5 dimensions consist of 22 sub-areas. The ultimate goal of Eco-industry park is to make the industry stay together with the community with happiness and stability.
- 3) **Eco-Industrial District:** The Thai government has a plan to develop an Eco-Industrial District by initially setting 39 provinces and 54 areas as the target area for developing into an Eco-Industrial City with a development strategy, principles and indicators to become an Eco-Industrial City clearly covering 5 dimensions, 20 aspects and 41 indicators to determine the characteristics of an Eco-Industrial City. The King of Thailand is the one who determines the eco-city area and the eco-industrial area, the industry in the area must follow the ecological industry principles that the Department of Industry sets the standards.
- 4) **Waste-to-Energy:** The Thai government promotes the disposal of industrial waste with a circular economy mechanism, including the promotion of reuse and use as a source of energy. The government has a special policy for the energy produced from industrial waste, which allows Thailand's electricity (municipal electricity or provincial electricity) to be purchased at 7 baht/kWh compared to other alternative energy at 3 baht/kWh.

2.22.2 Visit Vietnam

The ministerial visit to Viet Nam was on 12-16 March 2023. The objective of this meeting program is to share Vietnam experience on eco-industry park and clean energy technologies. This is also an opportunity to share Vietnam experience on green industry, lesson and practical green industry implementation, industrial zone management. The delegates team led by the Vice Minister of Industry and Commerce Mr, Bountheung Douangsavanh, accompanied by Deputy Director of Department of Industry and Handicraft and it staffs, and UNIDO staff.

The outcomes of the visit are as follows

Courtesy visit to vice minister

The vice minister of MOIT Viet Nam Mr. Tru Truong Tran Quoc Khanh had received the delegates from MOIC and said Thank You for the visit of Mr. Bountheung Douangsavanh, vice minister of MOIC and the delegates.

There was a warm discussion of the two ministers as follows:

- The minister recommended to learn about management of eco-industry park from Viet Nam.
- Lao PDR is currently formulating the decree on management of the eco-industry park and special economic zone
- Currently, Lao PDR import petrol from Thailand 90% and only 10% from Viet Nam. In future, MOIC would like import more petrol from Viet Nam.
- The MOIT of Viet Nam has the mandates to manage the currency directly and could control the prices of goods in the markets.
- A special issue that promote the industry park is the price of land in Viet Nam is very high

- In Laos the land price is not so high, there is not big issue for Lao investor and some investor can build their factory in their own land. The important thing is how to attract the investor to invest in the industry park.
- Viet Nam has success in management of special economic zone, expressing that there are many investors invested in Viet Nam.

For the management, there is decree no. 35 issued in the year 2022, replacing decree no.82. The decree described in detail the management of industry park and the special economic zone. Because MOIT only manage the industry cluster, thus, only parts of the decree relate to the responsibility of MOIT, especially the paragraph 57 of the decree as follow: 1) the main management in the industry park, 2) import and export in the industry park, 3) issue operation license to the factories, 4) the recommendation of procurement outside the industry park.



Figure 28: Courtesy visit of vice minister of industry and commerce of Laos to the vice minister of commerce and trade of Viet Nam

As the schedule, there were visiting of those below.

- Meeting with departments of ministry
- Meeting with VNCPC
- Visiting company Kinh Bac
- Visit Viglacera company
- Visit power plant, and



- Visit HIEP HOA factory








Figure 29: Vice minister of MOIC and staff of DIH and project staff visit companies and factory in Viet Nam 13-16 March 2023

2.23 Purchasing of measuring equipment for PMU

As agreed on the 7th PSC meeting in October 2022, measuring equipment was purchased for Project Management Unit (Cleaner Production Centre Lao PDR) in March 2023 and completely delivered to CPC-L in July 2023. The purpose is to equip the CPC-L with qualified measuring to provide service on energy audit and environment quality control of industry, aimed at reduction of specific energy consumption and overall impact on environment. The equipment purchased is listed below:

Table 2: List of measuring equipment ESSI delivered to CPC-L Laos

No.	Items	Qty	Picture
1	Multiparameter pH/ ORP/ EC/ TDS/ Salinity/ DO/ Pressure/ Tenperature Waterproof Meter - HI98194 Warranty probe 6 months Instrument 1 year	1	
2	Sound Level Meter + Tripod It can measure the sound level for office space/ factory/ the hotel/ hospital / school	2	

3	Gas analyzer O2 + CO + NO + SO2 Bluetooth for high concentration flue gas environments	1	
4	Air PM2.5 PM10 Dust	2	
5	Lux Meter	2	

6	Power Meter NK300 Optical / OPM + VFL Integrated Machine	1	
7	Temperature and Humidity Meter Model HT-96	2	

3 On-going activities

The project “Reducing Greenhouse Gas Emission in Industrial Sector through palletization Technology Lao PDR” had been extended till 31 March 2023. The remaining activities had been implemented. However, due many technical reasons, the activity of formulation of Biomass Energy strategy and the clearance of measuring equipment to CPC-L have been delayed. The said activities are being implemented and expected to be complete in the next two months.

3.1 Develop Biomass Energy Strategy

As part of the project component 2, the project shall develop policy and strategy to promote the production and utilization of solid biofuel, especially biomass pellet. As agreed in PSC, the job was given to CPC-L. UNIDO gave the offer to CPC-L. CPC-L had submitted their technical and financial proposal in April 2021. The proposal has been evaluated by UNIDO procurement. A contract with CPC_L had been signed in July 2021. CPC-L as contractor has drafted the first draft of the biomass energy strategy and organized a consultation workshop at Inthira hotel on 1, 5th July 2022 chaired by the Deputy Director General Mr. Savath Koundavong, attended by participants from division under the department of industry and handicraft and the line ministry related all



together 20 participants. The purpose of the workshop was the brainstorming for improving the contents of the first draft of the strategy.

The drafted biomass energy strategy consists of:

1. Introduction
2. Supply and demand analysis
3. Barriers, Challenges and potentials
4. Forecast of investment and utilization of biomass in future, and
5. Mechanism of implementation



Figure 30: First consultation workshop on biomass energy strategy in Vangvieng

CPC-L had improving the contents of the drafted biomass strategy with the comments from participants received at the consultation workshop and preparing for the validation workshop and had organized the second work shop in August 2022 for getting specific technical comments from participants from mainly department of industry and commerce and every province throughout the country.



Figure 31: First validation workshop on biomass energy strategy in Thakhaek, Khammouane province.



This workshop was co-chaired by Mr. Bountherng Douangsavanh, Vice Minister of Industry and Commerce and Mr. Bounhome Moukdasack, Head of the Department of Industry and Commerce of Khammouan Province, which was attended by the Deputy Director of the Department of Industry and Handicrafts, Heads, Deputy Heads of Departments and representatives from the Department of Industry and Commerce of 17 province and Vientiane Capital and businessmen in Khammouan Province total 47 people.

After the workshop, CPC-L had further improved the contents of the strategy to the third draft. CPC-L had organized the second validation workshop in Vangvieng on 6th July 2023 to finalized the final draft.

The workshop was chaired by the Acting Director and the Deputy Director of the Department of Industry and Handicraft Mr. Samly Boutsady and Mr. Savath Khoundavong, attended by participants from related ministries, such as ministries of Energy and Mines, ministries of Natural Resource and Environment, ministries of Agriculture and Forestry, and staff of Department of Industry and Handicraft, all together 24 persons. At the workshop, there was a presentation from CPC-L on the final draft of the strategy and valued comments from participants, which will be used to improve the contents of the strategy.



Figure 32: Second validation workshop on biomass energy strategy in Vangvieng in July 2023

From now, it will take about 2 month's time to get final draft of the biomass strategy. The final draft will be then submitted to Minister of Industry and Commerce for Approval.



Annex1. Brief energy audit report and summary

Specific energy consumption for salt production

Specific energy consumption of sawdust; coal briquette and wood logs fired furnace

Factory	Fuel consumption / batch (kg)	Fuel heating value (MJ/kg)	Salt production / batch (kg)	Specific energy consumption (GJ/ton of salt)	GHG emissions (kg of CO ₂ /ton of salt)
Khok Sa Ath	252	12	246	12.3	1,377
Songkhone	622	9	391	14.3	1,604
Kengkok	976	9	687	12.8	1,432
Saithip	755	12	757	12.0	1,340
Nateuy	470	12	463	12.2	1,364
Boten	150	12	125	14.4	1,613
Veunkham (Sawdust fired furnace)	171	15.27	182	14.3	1,602 ¹

¹ Wood emission factor: 112,000 kg of CO₂/ TJ, source: IPCC 2006



Annex 2: Summary options of 7 factories

Summary of the potential improvements in the audited salt factories

Summarized list of energy savings and substitution measures	BOTEN Salt Factory	Kengkok Salt Factory	Khok Sa Ath Salt Factory	NATEUY Salt Factory	SAITHIP Salt Factory	Song Khone Salt Factory	Veunkham Salt Factory ²
Measure #1: Use sawdust briquette as furnace fuel	Applicable ³	Applicable	Applicable	Applicable	Applicable	Applicable	Tried with biomass pellets
Measure #2: Use steam boiler briquette fired for evaporation	Applicable	Applicable	Applicable	Applicable	Applicable	Applicable	Applicable – Tried with pilot project
Measure #3: Modify the furnaces to reduce heat loss and improve product quality	Applicable	N.A ⁴	Applicable	Applicable	N.A	Applicable	Applicable
Measure #4: Utilize rubber woods	Applicable	N.A	N.A	N.A	N.A	N.A	
Measure #5: Use electrical resistance bag sealing machine and replace coal oven (for packing process of salt products)	Applicable	N.A	N.A	N.A	N.A	N.A	
Measure #6: Build wood log storage	Applicable	Applicable	N.A	N.A	N.A	Applicable	
Measure #7: Reduce compressed air leakage	N.A	N.A	Applicable	N.A	Applicable	N.A	Applicable

² The audit results of Veunkham factory are not elaborated the detail in this report.

³ Applicable: Energy measure can be applied in this case.

⁴ N.A: Not applicable: Energy measure cannot apply in this case.



Measure #8: Change salt harvesting method	N.A	N.A	Applicable	N.A	N.A	N.A	
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Annex3: MOM of the project steering committee meeting of 2021

Minutes of Meeting

6th Project Steering Committee Meeting 2021 of project
11 November 2021, Amari Hotel, Vangvieng

The Department of Industry and Handicraft in collaboration with UNIDO held the 6th PSC meeting through in-persons and VIDEO CONFERENCE on 11th November 2021 at Amari Hotel, Vangvieng under the “Project on Reducing Greenhouse Gas Emission in Industrial Sector through Pelletization Technology Lao PDR” under the chairmanship of Dr. Buavanh Vilavong, Director General of the Department of Industry and Handicraft, attended by UNIDO project manager Mr. Jossy Thomas, UNIDO country Representative to Lao PDR Mr. Sommai Faming and the member of Project Steering Committee from Renewable Energy and new Materials Institute (REMI) Ministry of Energy and Mines, Institute of Renewable Energy Promotion (IREP), Ministry of Energy and Mines, Director of Veunkham salt factory and the staff of Cleaner Production Centre, all together about 16 persons from virtual and in persons as follows.

1. Dr. Buavanh Vilavong, Director General of DIH, the chairman
2. Mr. Sommai Faming, UCR Lao PDR
3. Mr. Jossy Thomas, Project Director in Vienna
4. Mr. Khamphone Keodavalong, Director of CPC-L
5. Mr. Bounlird Singsombuth, Deputy Director of CPC-L
6. Mr. Bualy Vongvisith, Head of Division, REMI
7. Mrs. Bounthavy Chounlamany, Director of Veunkham Salt Factory
8. Ms. Siamphone Sisomphou, factory manager of Veunkham Salt factory
9. Mr. Latsayakone Pholsena, Technical staff of IREP
10. Mr. Chanpheng Khamphoukeo, Technical staff of CPC-L
11. Mr. Thongphet Phonsavath, National Project Coordinator
12. Mr. Pantavanh Dalavong, Project Assistant
13. Mr. Kolade Esan, Project Assistant in Vienna
14. Mr. Houmpheng Theuambounmy, Deputy Director General of REMI
15. Mr. Xayalack Vilayda, National TE expert
16. And PwC team (3 persons)

The contents and the agenda of the meeting are as follow

1. Objectives

- To report on project implementation from 2020 to October 2021.
- To discuss and provide comments on extension of the project and planned activities of the year 2022.
- To approve the work plan 2022

2. Meeting procedures

Dr. Buavanh Vilavong, Director of Department of Industry and Handicraft, gave opening remarks and summarized the works implemented in last one year



of the outcome 1, 2 and 3 and the issues to be discussed on project implementation in the year 2022.

Mr. Sommai Faming addressed the meeting: mentioned the goals and objective of the project as 1) reduction of the greenhouse gas and 2) technical initiatives on biomass which is a clean energy and 3) the policy to promote the production and the utilization of biomass that the project carried out in the last 6 years. This year is the final year and it was the result of the cooperation of all stakeholders. Thanks to stakeholder that made this happened, even though there was a changing of management in past year and the outbreak of COVID-19. Mr. Sommai Faming also requested stakeholders to continue cooperation in order to implement the remaining project activities successfully.

The meeting was proceeded as per agenda and detailed as follows:

1) Presentation:

Mr. Thongphet Phonsavath, National Project Coordinator presented the implementation of one year up to October 2021, the budget and the work plan of 2022, which could be summarized as follows:

Component 1: procurement of laboratory equipment for Biomass Technology Information and Learning Center (BTILC) BTILC: the project selected company GRAIDCO as foreign supplier of the equipment. Currently, it is in the process of delivered the equipment from China and other items will be delivery from the Netherlands. The project management unit (PMU) is preparing the import and tax exemption documentation.

Translation of manual guide for pellet project developer finished in October 2021.

Component 2: UNIDO signed the contract with Cleaner Production Centre on formulation of national biomass energy strategy in July 2021 and it is currently in preparation formulating the strategy.

Component 3: Held a consultation meeting with seven factories for supporting the factory on production of pellet on 4th February 2021 at the Department of Industry and Handicraft. From the interested six factories, three were ready to invest in pellet plant. UNIDO signed the contract with the three companies: Dokchampakham, Simmalakham and Alexson import-export for receiving incentive from UNIDO. Currently, the three companies are procuring the equipment and preparing installation.

Component 4: The monitoring and evaluation of the project. The project is conducting Terminal Evaluation by hiring a national consultant and expert for carrying out the task. The expert is conducting the TE and interview stakeholder. The TE is expected to be finished by December 2021.

Work plan: presented the project work plan and the budget for remaining activities in 2022.

Request for project extension and approve the work plan 2022: The chair of the PSC requested the extension for another six months. On behalf of National Project Coordinator, there was a concern that the time frame for implementation of planned activities would be not enough to complete remaining activities especially component 2, the formulation of the biomass energy strategy which need time about at least eight months.



The presentation by PricewaterhouseCooper: Presented the feasibility study of the ethanol industry in Lao PDR.

3. Discussions

Mr. Khamphone Keodalavong

Thanks to UNIDO for supporting Department Industry and Handicraft for some project office equipment and implementation of project activities, especially the formulation of the biomass energy strategy in manufacturing and the modification of pellet technology for salt industry at Veunkham salt factory. It is seen that the implementation of some project activities since 2016 has success significantly, but some activities have been delayed due to outbreak of COVID-19 as a reason. Therefore, it is requested to UNIDO to extend the project to another 6 months until June 2022 in order to expedite and complete the remaining project activities. In addition, the Cleaner Production Center as PMU lacks of office equipment for supporting project, some of the equipment are old and out of order. Thus, it is requested to UNIDO to consider some budget for purchasing of some office equipment such as computer set, laptop, printer etc.

Mr. Bualy Vongvisith: the activities implemented successfully such as 1) procurement of laboratory equipment for BTILC, 2) the need assessment of biomass energy technology, the need of operating of the BTILC such as develop training material, 3) the dissemination of biomass energy technology, improve BTILC website for advertise itself and additionally is the use of the purchased equipment for measuring, evaluating pellet quality, biomass and provide such kind of service to the private sector.

Mr. Sommai Faming: It is a question whether the extension for six months would be enough, REMI requested for extension of one year.

Mr. Houmpheng Theuabounmy: Suggested an extension of project for one year because there are many activities to be implemented for example: the use of the laboratory equipment purchased, the testing of pellet quality, training by online-training would not receive a good result. Additionally, there is some pending activities such as seeking for institutional support to BTILC, until now it still could be found.

Mr. Bounlird Singsombuth: Raised three issues: 1) the collaboration with UNIDO, 2) the achievement, 3) failures and lesson learned. For 1), the collaboration with UNIDO was beneficial to Laos and needs to be continued in a successful level, especially the success of using solar greenhouse dryer for salt drying at Veunkham and Khoksaath salt factory and the survey on biomass resources. It showed that there are potential of producing biomass pellet in Lao PDR. Currently, there is BTILC for testing of pellet standard. But in other aspect the implementation of project activities has not achieve as expected and not as the budget spent. The reason could be the method of working of both the Lao and UNIDO sides. It is to accept that it is slow. In 2022, even though there is an extension for six or one year, if we do not expedite the activities, it will not be successfully implemented.

Mr. Jossy Thomas



It is seen that there were some activities implemented in 2021 and they are in progress such as the procurement of laboratory equipment for BTILC, signed contract with CPC-L for formulation of biomass energy strategy and signed contract with the companies to support them on investment in pellet production. In 2022 we should implement the remaining activities successfully. The delay of some activities was beyond our control such as the use of Jacketed steam boiler for salt cooking. From the experiment, it showed a good result of good quality of salt, but the fuel used (pellet) is needed to import and the price is still high. This is one of the reasons why the project is promoting the local production and utilization of pellet. It is to promote business and demonstrate the pellet production at the same time. Thus, the project provides incentive to the companies to produce pellet to supply the local market, for example the development of clean cooking using pellet which could integrated to the World Bank project. Thus, it is proposed a new activity which will collaborate with REMI/BTILC in developing market and clean cook stove that use biomass pellet. The collaboration with Ministry of Industry and Commerce in the value chain will be a benefit to enterprises. At the beginning there were 7 factories interested in investing on pellet production and finally, only three factories are ready for investment and were selected. To implement the remaining, proper time is needed. Thus, there shall be a project extension for one year.

Mr. Kolade Esan: Presented and explained the project budget, the remaining budget available up to this month is totally USD 285,000, in which USD 40,000 is for the component 1 and USD 195,000 is for component 2 and 3 and USD 50,000 is for the component 4 monitoring and evaluation of the project.

Mrs. Bounthavy Chounlamany: Veunkham salt factory is waiting for the pilot of re-design of furnace. If it is successful, Veunkham factory is ready to cooperate and if the price of pellet is not high, Veunkham is ready to invest. Veunkham welcome the pilot and ready to provide facilities.

Mr. Thongphet Phonsavath: Seeing that there were many activities such as component 1 as mentioned by Mr. Houmpheng that there will be experiment of producing pellet and measuring property/parameter of pellet for showing the possibility of applying biomass technology, which requires time. Secondly, regarding the formulation of biomass energy strategy, the proposed time of six months would not be enough. As per work plan, the activity will need at least eight to nine months and the remaining time shall be for reporting. Thus, it shall request to extend the project for one year. For the activity to promote using pellet for clean cooking is also important and relate to the work of BTILC. Thus, there shall be later discussed with BTILC how to implement.

Mr. Jossy Thomas: The activities promoting the production of pellet for clean cooking, the design of cook stove does not overlap the project of World Bank, because the World Bank project does not develop cook stove but import. Our project will also promote producers and users at the household



level. There will be cooperation with REMI to provide after sale service, design and improve cook stove in order to promote as new business in country. The use of clean cook stove will contribute to the reduction of environmental impact, reduce deforestation and health impact. Thus, this new proposed activity is important.

Mr. Khamphone Keodalavong: Currently, Cleaner Production Center as PMU lacks office equipment such computer set, laptop, printer. Is it possible to mobilize a fund allocated for the new activity of USD 30,000 to purchase the said equipment? For project extension, as requested from stakeholders there are many activities to completed and would take time, it is agreed to extend the project for another one year according to the work plan.

Mr. Sommai Faming: Considering the purchasing of office equipment and the development of clean cooking technology, which one will be more sustainable. The office equipment will used only in the office, but the promotion of production and utilization of pellet in that way will help people learn about the technology and see the potentials of the pellet market and also access to the technology, research which will be beneficiary to enterprises or not.

4. Conclusion

Mr.Joss Thomas: The extension of the Project is very important to implement the remaining activities successfully and build capacity for an institution that work with project for the six years. The institution will ensure the sustainability of the activities, because it is only the single institution which already work with project for six years and will be continued in future. The centre will create opportunity to develop technology and market and strengthens of the center. UNIDO is ready to collaborate with Ministry of Industry and Commerce and Ministry of Energy and Mines. Currently, UNIDO is initiating the regional project which involved Laos, Cambodia and Thailand with the Adaptation Fund to develop a project on the bio-energy. And there will be access to the GCF fund on the ethanol industry in Lao PDR as presented by PriceWaterCoper which could be a cooperation in future. Thanks to all stakeholders, which worked together for a long time, especially Venkham salt factory. Thanks to the chairman and do hope to receive collaboration in future.

Chairman: Summarized and agreed that request for project extension for one year and approve the suggested work in 2022. The methodology of implementation in detail shall be discussed, especially the activity developing technology for clean cooking.

The chairman closed the meeting on the same day at 18:00 PM.

Vientiane Capital, date

**Acknowledged by
Chairman
by**

Minutes taken

Annex:4 Brief report using Jacketed Steam for salt production

The table salt production in Laos is mostly traditional using firewood, sawdust, sometimes also rice husk and coal cake (mixed lignite with clay) as fuel for evaporation. The obsolete technology led to higher energy losses and poor quality of salt and poor working condition as smoke affects worker health and salt quality directly. The product is mostly contaminated by smoke and dust. To avoid dust and smoke, a proper working environment and proper process control and even new technology is required. Based on the UNIDO project “Reducing Greenhouse Gas Emission in Industrial Sector through Pelletization Technology in Lao PDR” SAP ID. 140057 for using pellet for salt production in Laos to substitute the coal and firewood from natural forest, the project had developed a Clean Technology using Jacketed steam vessel in combination with pellet boiler to produce steam and use the steam to evaporate salt in a Double Jacketed Steam vessel. The purpose of using pellet boiler to generate steam is the objective of project to promote utilization of pellet as fuel for thermal energy use.

The installation and testing of Jacketed steam boiler system.

The Jacketed steam vessel and their component was designed by the Daicuong Boiler company from Ho Chi Minh City, Vietnam. The installation took place 12-15 August 2017 by the engineer of the Daicuong company.

With technical and financial assistance provided by UNIDO, a boiler and steam jacketed evaporator were manufacture in Vietnam, transported to Lao PDR, and commissioned at the site of the Veunkham salt factory between 28th August 2017, as shown in Figure below.



Boiler and steam jacketed evaporator



The system was delivered with 2tons of pellet from Vietnam.

The testing of the system took place immediately after completion of installation on 15th August 2017 with the result of

No	Fuel	Date	Boiler run time		Boiling time		Salt water used	Take out salt each time (kg)	Energy (Kg)	Total Energy cost (Kip)
			Start	Finish	Boiling	Become				
-	Pellet	15/08/	10:20:0	11:00:0	0	0			25	
I	Pellet	15/08/			11:00A	14:00 PM		75	66	
II	Pellet	15/08/			14:28	18:15 PM		85	51	
-	Pellet	18/08/	9:08A	10:02A					36	
II	Pellet	18/08/			10:02A	12:35AM	17	56	27	
IV	Pellet	18/08/			12:46P	15:30PM	17	57	44	
V	Pellet	18/08/			15:45P	19:06PM	19	60	51	
	Average							33	30	

The second testing took place on 28th August 2017 with witness from stakeholder and beneficiaries with following result.

3 Result of testing

- The performance of the biomass pellet-fired boiler and steam jacketed evaporator is found to be satisfactory.
- The texture and quality of salt produced with the pellet-fired boiler and steam jacketed evaporator is very satisfied
 - Practically almost no fumes and smoke around the boiler.
 - Production of salt in a very clean and hygienic environment.
 - Less drudgery for the workers (men and women).



Current status of the using of the system

After the installation and testing, the system has not been in operation. The reason for not using the system is lack of pellet. The pellet had been delivered from Vietnam for 2 tons and it had been used about half. However, the remain pellet cannot be used to operate the boiler for production test. The system is still kept at Veunkham salt factory without use. For two year, the system has not been in operation, some of machine part start to be covered by dust and corrode, especially the part of join and connection. The electronic control device is also not in use for two year, which could be damaged because of no use.

Following photos show the part of the system.



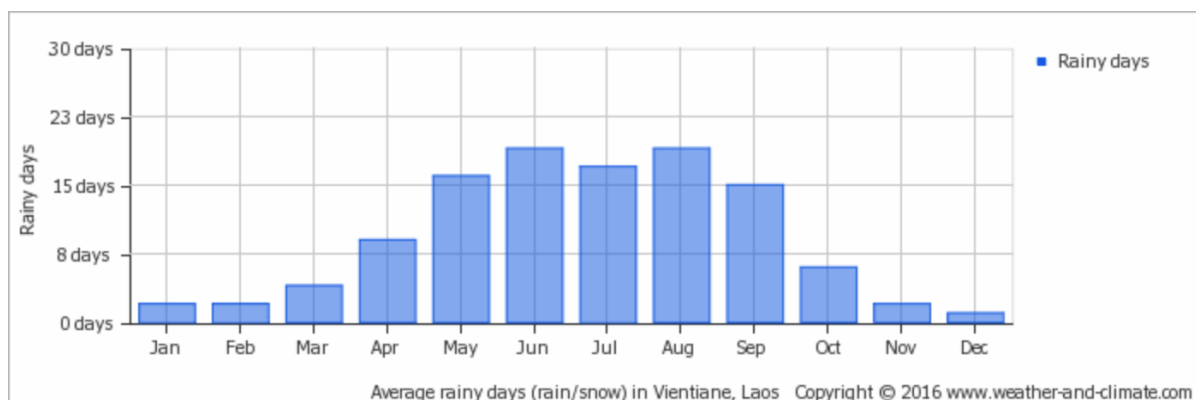


Recommendation

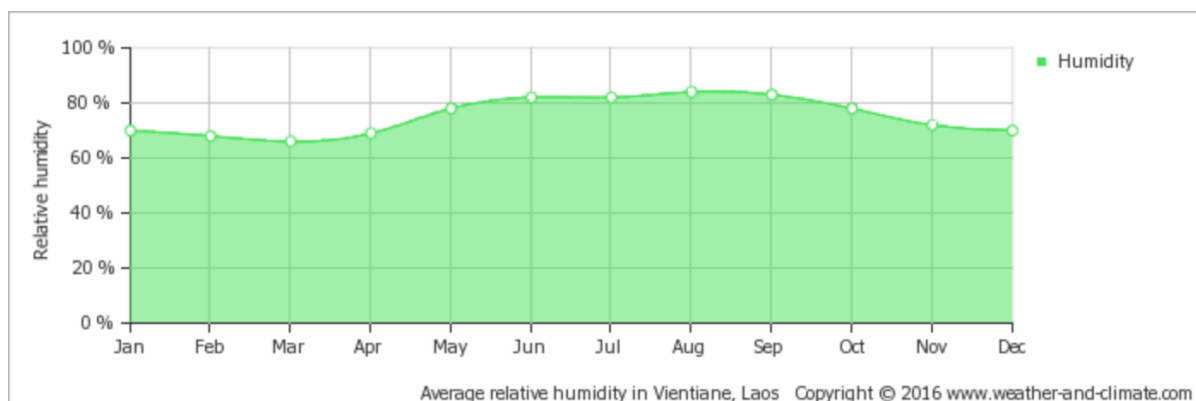
As the system is not in operation and Veunkham does not use it or make any benefit from it and just keep it for project, it is recommended that the system shall be transfer to other party probably other salt factory. As disused with other salt factories, one salt factory in Savannakhet province is interested to receive and operate the system.

Annex 5: Installation and commissioning of the solar dryers

During the base line study of energy performances of salt factories, it was observed that apart from using traditional and fossil fuels, salt factories also produce considerable amount of salt using open-air solar drying. The salt produced using this method is of inferior quality and fetches a lower price in the market. Moreover, this mode of salt production cannot be carried out during rainy months, spanning from May to September.



Apart from the risk of the brine being diluted by rain, the evaporation process is drastically reduced due to high ambient humidity during the same months.



Also, it has been noted that the salt produced using evaporation based on biomass-driven stoves is too wet and needs to be dried further before it can be packaged. The solar greenhouse will help in removing the remaining moisture from the salt.

The two solar greenhouses have been designed and installed on the premises of two salt factories, namely Veunkham Salt Factory and Khok Saath Salt Factory, located in Vientiane province. These two factories have volunteered to take part in this pilot initiative on cost- and risk-sharing basis. The installation took place from 7th to 15th February 2018 under assistance of expert Mr. Theri Rajan. Experimental performances and monitoring will be undertaken from now till end of March 2018 for suggestion of any improvements needed and recommend appropriate operational strategies (in terms of loading, air temperature and humidity, air velocity, etc.) for their widespread usage in other salt factories of Lao PDR. International and national experts in the field of solar greenhouse drying have been mobilized to ensure satisfactory results and transfer of know-how to local counterparts.



Each pilot solar greenhouse was installed over an area of roughly 60 m² and is equipped with solar photovoltaic panels and ventilating fans to ensure adequate air movement and avoid high air humidity inside the solar greenhouse.

Specification of the solar greenhouse for salt production from brine:

	Item	Description
1	Size of the solar salt making unit	5.2 m width x 10.5 m length x 3.2m height
2	Orientation of the solar greenhouse	North-South direction
3	Shape and material of the roof structure	Parabolic shape to reduce the wind load and 6 mm thick polycarbonate sheets
4	Brine loading capacity	2 – 4 m ³ /day
5	Raw material	Brine pumped from the well
6	Estimated salt production	Around 400-500 kg salt per day
7	Base of the dryer	Concrete floor
8	Trays in which brine is to be evaporated	Raised platforms for ease of operation (loading, stirring, unloading)
9	Base of the tray to evaporate brine	Black plastic sheet
10	System for air circulation in the unit	DC fans powered by solar photovoltaic cells
11	Front side of the dryer	Two air inlets at appropriate height for air circulation at the level of the brine
12	Position of the DC fans	Opposite to the air inlets to suck out moist air from the unit

The solar greenhouses consist of a parabolic roof structure made of polycarbonate sheets on a concrete floor. The dimension of each unit is 5.2m wide, 10.5 m long and 3.2 m high. All sides of the solar salt making unit is covered with polycarbonate sheets with the thickness of 6 mm in order to create the greenhouse effect inside the unit. The unit is made in a parabolic shape in order to reduce the wind load, in case of stormy weather. The front side wall of the unit has two air inlets. The brine to be evaporated is placed in trays on a raised platform to facilitate loading brine, stirring and unloading salt. The maximum loading capacity of the dryer for handling brine is approximately 2 – 4 m³/day. Six DC fans operated by solar photovoltaic modules are installed in the wall opposite to the air inlets to suck out moist air from the inside of the unit to the surrounding environment. The unit is oriented in the north-south direction. There are two 230 V ventilators installed in addition, using electricity from grid in the night time.

2.1 Detailed work done

The following tasks have been completed by the end of February 2018:

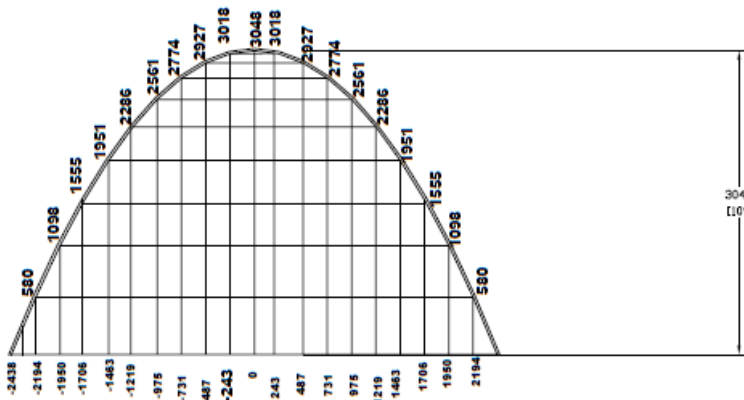
1. Preparation: Engineering design and system layout of the solar greenhouse was done in January 2018 by international expert Mr. Theri Rajan
2. Civil work was completed from early to middle of February 2018 by the two salt factories (Veunkham and Khok Saath)
3. A list of materials required for the construction of the solar greenhouse was prepared and revisions were made during the purchase according to the availability of materials in the local market, (see annex 5).

4. Installation of the two solar greenhouses along with the factory management started from 7th to 21st February 2018.
5. Temperature and humidity sensors have been installed for monitoring indoor and outdoor ambient air temperature and humidity values as well as control the fan operation according to the requirement
6. Pilot tests have been conducted with both the solar greenhouses in March 2018;
7. Training CPC-L, REMI team and factory staff took place on 15th February 2018 at Khoksaath salt factory. The project team had trained the staff of Veunkham factory on 18th February on operation of and maintenance the system.

Preparation

CPC-L had contracted international and national experts for designing and monitoring of the system. The engineering design of the solar greenhouse dryer was done by the international expert Mr. Theri Rajan, who was also contracted by CPC-L to supervise the installation of the system in Laos. In addition, Mr. Vathsana Khamvongsa has been contracted by CPC-L as national expert for assisting in the monitoring of the system after completion of the installation.

The materials for construction were purchased locally. CPC-L has contracted a local workshop namely the Saengkarnsang at Ban Natha-ngon Xaythany district, Vientiane Capital, for the construction of the two solar dryers.



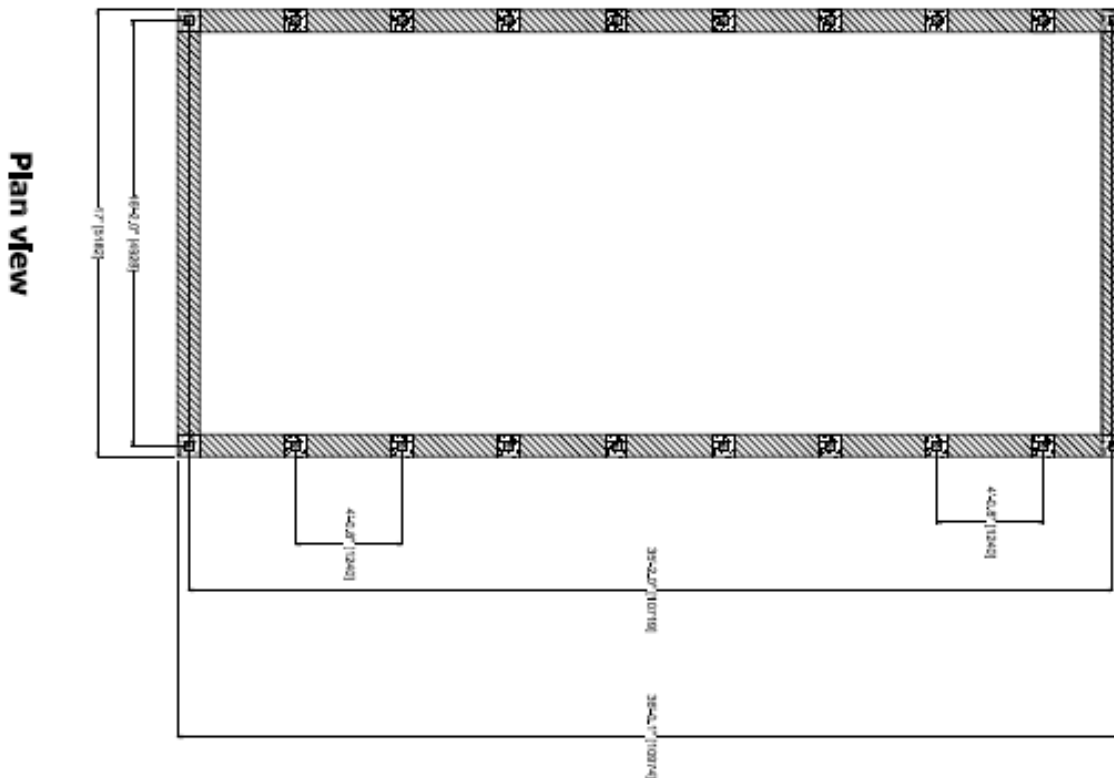
Bending diagram



Bending job at Saengkarnsang workshop

Civil work at the salt factory

The two factories were instructed to prepare the foundation for the solar dryer by making the concrete floor as per the detailed drawing shared by the international expert Mr. Theri Rajan.



Drawing of the foundation



Preparation of foundation at Khok Saath salt factory



This solar dryer is suitable for drying pre-boiled brine and investment makes economic sense due to the very low pay-back period. The dryer is covered by polycarbonate sheets and stainless structure with 10 years warranty.

Payback for Khoksaath salt factory

Brine can be evaporated in the solar dryer throughout the year (all 12 months). After the improvement, the drying process requires instead of 6 days now only 4 days or 96h to produce high quality salt without exposing to contamination from the environment. The test also showed that the produced salt is whiter than salt from drying outside in the sun or from boiling process. So, 1 month, it can be produced 6 batch, it means 1 year is able to dry about 72 times. In the installed solar dryer 258 kg/5days of one circle can be harvested or about 18,576kg per year.

The price of 1kg of conventionally dried salt with sunlight at the open air is 805LAK, while the one produced by solar dryer could be sold in the price of 1400 Lak for iodine salt (appr. 0.16 USD). The price increased is 595LAK. Therefore, the estimated annual revenue was 26,006,400 LAK (18,576x1,400), minus the max production cost of conventionally dried salt with sunlight at the open air 14,953,680 LAK (18,576x595) is 11,052,720 Lak saving.

The dryer can be used for 10 years.

$$\text{Payback period} = \frac{77.895.000}{11.052.720} = 7.05 \text{ year}$$

$$\text{Payback period} = 7.05 \text{ year or } 85 \text{ Months}$$

So, the profits will be able to a payback the investment within 7 years. This dryer can be used for 10 years. Therefore, the payback period of 7 years is good.

For the salt factory in Lao a payback period of 7 years seems too long since investment is too high compared to open air sun drying and payback is too long for the factory. However, if the company can increase the price of the salt, due to the higher quality the payback period will come down, which would increase the interest of the factory owners to invest.

5.2 Payback for Veunkham salt factory

The estimated production capacity of the solar dryer with 4 cycles per months was 25,000kg per months or 300,000kg per year with the consideration of



weather in the rainy season. The total cost saving will be 300,000kg * 322LAK/kg gives saving of 96,600,000LAK equivalent to 12,000USD.

From above table, research team analysed the economic performance to assess if the investment on the solar dryer makes economic sense. The incremental investment on the solar dryer is compared with the economic savings achieved due to change from the traditional drying practice to the solar drying to calculate the simple payback period, as following:

Simple Payback period is the division of total incremental investment by annual net saving without consideration of inflation rate or bank interest:

$$\text{Simple Payback period} = \frac{\text{Total incremental investment}}{\text{annually net saving}}$$

From above data can be calculated as

$$\text{Payback period} = \frac{77,895,00}{96,600,000} = 0.81 \text{ year}$$

Payback period= 0.81year or < 10months

So, the savings made by adopting the solar dryer will be able to pay back the investment within <1 year or 10 months. Since the payback period is very short, there is no need to consider the time value of money (inflation rate).

However, if the production of salt is lower than 25,000kg per month, the payback period will be longer.

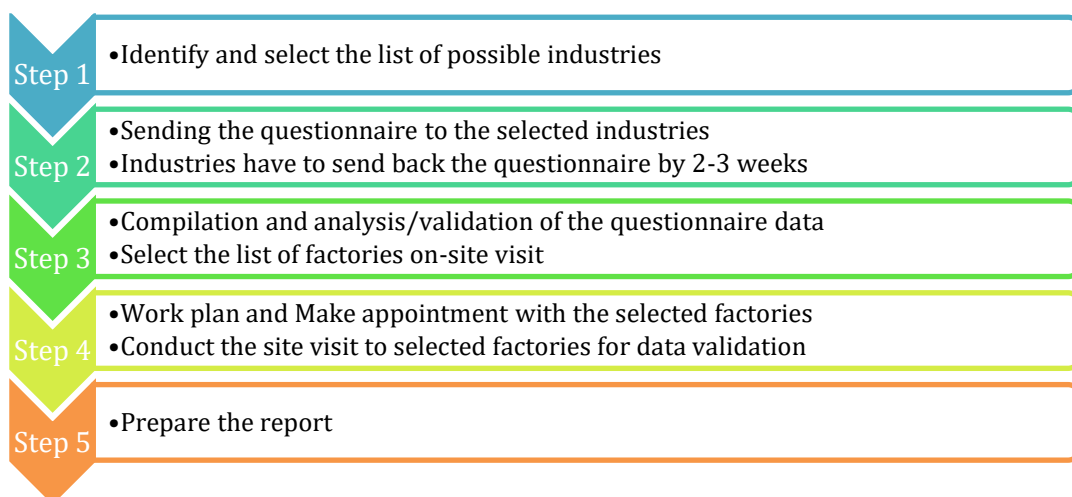
This solar dryer is suitable for drying pre-boiled brine and investment makes economic sense due to the very low pay-back period. The dryer is covered by polycarbonate sheets and stainless structure with 10 years warranty.



Annex5: Biomass Resource and Sink assessment

Survey procedure

There are 5 steps of gathering the required information as shown below



Detailed work done

Pre-selection of provinces and factories

As refer to contract signed, the focussed sector shall be rice mill, wood processing and other agro-product processing factory like corn mill etc. The selection of provinces was based on the size of factories gained from the pre-screening of factories collected from the database of the Statistic Division of department of Industry and Handicraft. There are totally 12 provinces included Vientiane Capital and Vientiane province which initially is not listed in the contract. After re-screening of the number of factories the survey team found that there are other factories which have biomass potentials of sources and sinks then the number of 92 factories listed in the contract and it reached 362 factories in total 12 provinces. For preparing the site visit, the Department of Industry and Handicraft had sent the request to provincial department of Industry and Commerce for collaboration.

Conduct on-site training and site visit

The survey started with the site visit and the on-site training started in Middle to end of October 2018 first in southern provinces: Salavan, Sekong, Attapeu and Champsack, in Nothern provinces: Luangprabang, Luangnamtha and Xayabouly, and in November in middle part of Laos in Savannakhet, Khammouane and Bolikhamxay, and in Vientiane Province and Vientiane Capital end of November 2018. The purpose of on-site training was for teaching provincial staffs on data collection, data pre-analyse and reporting. After the training, the provincial staff had practiced their job with questionnaire prepared by the project.

The questionnaire has designed into two forms specific for Biomass resources residue and Biomass sinks. Department of Industry and Handicraft assigned 12 enumerators form provinces (Local officer) in order to conduct survey plan in each provinces, go to the



survey areas, interview and record information to questionnaires, check and correct information in questionnaire and sent questionnaire to CPC-L.

The contact persons responsible for the data collection are presented in the table belows:

Contact and responsible person for data collection in provinces.

No	Province	Enumerator's Name	Contact number
1	Luangnamtha	Mr. Bounpone	020 5525 4178
2	Luangprabang	Mr. Khamheck Daohongsouly	020 5699 5499
3	Xaygnabuly	Mr. Phaithoun	020 2236 6083
4	Vientiane Capital	Mr. Thavyxay	020 2222 5508
5	Borlikhamxay	Mr. Phaimee	020 2282 1818
6	Khammuan	Mr. Duangchai	020 23465558
7	Salavan	Mr. Phonesak	020 9611 5888
8	Sekong	Mr. Stsomephone Banthaver	020 2895 0302
9	Savannakhet	Mrs. Veosy	020 9833 6999
10	Champasak	Mr. Molasone Thongkeo	020 9830 3999
11	Attapeu	Mr. Vylaisouk	020 2229 2244
12	Vientiane	Mr. Sangthong	020 22253343

Data collection and analysis

The On-site survey and data collection:

The biomass residues types of selected factories, which located in the provinces are bagasse, coffee residues, corncob, job's tear residues, rice husk and sawdust were found in the assessment survey. And during conducting survey and data collection the enumerators found that the possible industries to conduct the biomass resources and sinks survey in their provinces are more than initial selected from DoIH, thus the team decided increase the number of industries from 92 in initiative to be 262 as follow:

The total number of selected factories by provinces

Province	Agricultural manufacturing	Rice mill	Wood processing	Grand Total
Borlikhamxay		12	21	33
Champasak	1	22	8	31
Khammuan		14	6	20
Luangnumtha		2	4	6
Luangprabang	5	8	15	28
Salavan	1	4	3	8
Savannakhet		21	2	23
Sekong		18		18
Attapeu	1	2	27	30



Vientiane Capital		6	25	31
Vientiane Province	1	3	8	12
Xaygnabuly	5	9	8	22
Grand Total	14	121	127	262

The data collection is done by provincial staff with closely assistance from the staff of statistic division of the department of industry and handicraft. It took about three months to get all the data and analysis of the data of about 362 factories of the 12 provinces. The name and number of factories are shown in the annexure of this report.

Assessment result and reporting

The data collected was analysed by the staff of statistic division. During the analysing process, it was found that some data collected was not reliable and the data collection had to be repeated which delayed the whole assessment process. However, with the effort of the staffs, data of target factories of 12 provinces had been completely collected and final report had been prepared (see also final report attached).

The table 3 below illustrates the availability of biomass resource as waste generated in agro-processing factory. This shown amounts of biomass residues available in factories by provinces of selected factories.

Table 3. Remained biomass residues availability (Tons)

Province	bagasse	Corn cob	Rice husk	Sawdust	Coffee residues	Job's tears residues & Corn cob	Job's tears residues	Grand Total
Borlikhamxay			1,168.80	4,900.43				6,069.23
Champasak			9,894.36	619.20	180.00			10,693.56
Khammuan			2,184.58	2,994.86				5,179.44
Luangnumtha			560.40	1,290.70				1,851.10
Luangprabang			1,810.86	4,375.56		1,472.00	1,886.95	9,545.37
Salavan		40.32	2,093.02	793.80				2,927.14
Savannakhet			20,649.16	70.00				20,719.16
Sekong			1,177.22					1,177.22
Attapeu	8,970.00		88.55	3,180.95				12,239.50
Vientiane Capital			10,542.00	11,676.84				22,218.84
Vientiane Province			434.88	9,736.10			4,320.00	14,490.98
Xaygnabuly		1,520.00	643.80	1,361.00		2,990.00		6,514.80
Grand Total	8,970.00	1,560.32	51,247.63	40,999.44	180.00	4,462.00	6,206.95	113,626.34



The table 4 below illustrates their current state of utilization in country. This shown amounts of biomass residues utilization by provinces which selected factories located.

Table 4. The total number of biomass residues utilization by provinces (Tons)

Province	bagasse	Corn cob	Rice husk	Sawdust	Coffee residues	Job's tears residues & Corn cob	Job's tears residues	Grand Total
Borlikhamxay			885.54	2,653.33				3,538.87
Champasak			902.05	367.96	122.40			1,392.41
Khammuan			866.36	728.71				1,595.07
Luangnumtha			668.68	902.34				1,571.02
Luangprabang			2,126.50	3,445.55		1,030.42	1,422.57	8,025.04
Salavan		9.68	1,377.18	355.50				1,742.36
Savannakhet			9,924.00	0.00				9,924.00
Sekong			988.88					988.88
Attapeu	4,500.00		67.32	2,147.03				6,714.35
Vientiane Capital			2,073.11	4,837.92				6,911.03
Vientiane Province			146.44	1,999.77			2,607.47	4,753.68
Xaygnabuly		783.04	462.05	321.62		1,617.32		3,184.03
Grand Total	4,500.00	792.72	20,488.11	17,759.73	122.40	2,647.74	4,030.04	50,340.74

More information on number of biomass residue you can find in the final assessment report prepared by the statistic division, department of industry and handicraft. The report shows also the location of each kind of biomass resources in corresponding provinces, which can be used as primary data for considering of biomass business in the country.



Annex 5: Note of the 1st stakeholder workshop in April 2018

- Following the inaugural speech by a representative from the DoIH, the project coordinator shared some information about the UNIDO project, key outputs and achievements
- This was followed by a technical presentation of the pellet manufacturing process by the expert mobilized by UNIDO
- A representative from the World Bank invited by the project spoke about World Bank's plan to disseminate a large number of pellet fired cookstoves in Vientiane
- The last presentation was on biomass business model, showing that the pellet manufacturing in Laos can be financially attractive with payback period less than 3 years; this was followed by a Q&A session where several questions were raised by the participants regarding the technology, economics and the type of support that could be expected from UNIDO
- The program of the workshop as well as the list of participants are attached as Annexes.
- Since the workshop had invited decision makers from the factories, the participants were attentive to the presentations made during the workshop; thanks to the simultaneous translation arrangement with personal headphones, much could be covered in the morning session, including an interesting Q&A session.
- The participants wanted to know what the level of investment would be for setting up the plant and the type of facilities needed on site; they were interested to know the operation and maintenance cost of the pellet production facility; some sample figures were shared by the pellet expert on the range of capital investment and the breakdown of the O&M costs per ton of pellet production. Based on the sample figures, it appears that if the pellets are sold at around US\$100-110, the capital investment could be recovered in less than 3 years
- Based on the calculations presented by the World Bank, the retailed selling price of pellet would be around 170 USD/ton. World Bank plans to initially introduce the pellet fired efficient cookstoves in targeted urban areas where people are purchasing charcoal at a high price (charcoal purchased by a single family is estimated as 4.5 USD/week whereas pellet cost was estimated to be only 1.2 USD/week)
- Information was shared with UNIDO that the salt factory having a market for improved quality of salt may be able to pay up to 120 USD/ton for the pellets delivered at their factory. Though this price is lower than that estimated by the World Bank, the main difference is that the dissemination of pellets for cookstove would require packing and shipping smaller quantities of pellets over longer distances whereas the pellets can be sold in truck loads to the salt factory
- Four companies had further discussion with UNIDO to gather detailed information; these included specific technical and financial questions, as well as the support they can receive from UNIDO

In response to their question regarding UNIDO support, it was stated that UNIDO is not a financing agency, hence the companies should not expect financing from UNIDO for setting up pellet plants; however, UNIDO could assist them in conducting techno-economic feasibility as well as explore ways to minimize their risks; UNIDO can provide financial support/incentive only if the time to recover the capital investment was found to be longer than what is generally acceptable for the companies.



- The four companies that participated in the afternoon discussion included representatives from IDP rice mills,, Chanpheng rice mill, Somephone rice mill, and VLS wood processing factory
- During the discussion, the first two listed companies appeared to be convinced about investing in pellet production whereas the other two companies were interested to gather more information before making final decision
- IDP has 4 rice mills in the South of Laos and they wanted to start with the development of pellet plant in one of the factories to test the financial viability before taking decision to replicate in their other rice mills. IDP wanted to be sure that there will be a local market for biomass pellet and the technology employed in the pellet plant should not be very advanced and expensive because they want to avoid taking loan from the bank and do not have skilled staff in their rice mills
- Chanpheng rice mill also confirmed its interest to go ahead with the pellet plant on condition of getting assistance from UNIDO in technology selection and techno-economic feasibility study



Annex 6 : MoM of the second stakeholder meeting in December 2019

Stakeholder Workshop on Biomass Pellet and Technology

6th December 2019

Minute of Meeting

On December 06, 2019, the Department of Industry and Handicraft in collaboration with the United Nations Industrial Development Organization, under the GEF-funded project “Reducing Greenhouse Gas Emission in the Industrial Sector through Pelletization Technology in Lao PDR” held a meeting on the promotion of biomass fuels (Pellet) at Vilaysack Hotel, Pakxan District, Bolikhamxay Province, under co-chairmanship of Mr. Somphong Soulivanh, Deputy Director General of DoIH, Ministry of Industry and Commerce and Mr. Khonesavanh, Soukaserm Deputy Director General of Department of Industry and Commerce, Bolikhamxay province. Attended by total of 35 participants, 6 from Government agencies, 27 from private companies and 2 UNIDO representatives. The details of the agenda of the meeting are as follows:

1. The purpose of the meeting

The objective of the workshop was to seek Lao enterprises who are interested in investment on pellet production in Lao PDR with a small grant from project. The overall purpose is to demonstrate the production and utilization of pellet in processing industry and encourage domestic and international pellet market of Laos.

2. The Meeting Procedure

Mr. Khonesavanh Soukaserm, Deputy Director General of Department of Industry and Commerce Bolikhamxay Province gave welcome remark to participants. He also gave overview of the economic and social development and the potential production of fuel pellets from biomass (Pellet) in Bolikhamxay province. The province has many processing factories and rice mills which generate sawdust and rice husk suitable for producing pellet.



Then, Deputy Director General of the Department of Industry and Handicraft, Mr. Somphong Soulivanh, gave opening remark of the meeting and mentioned that it was a consultation meeting to find companies who are interested in investment on pellet production to supply the industry with pellets. Moreover, he also raised the importance of biomass energy, especially biomass pellet production and utilization to reduce greenhouse gas Emissions. Then, the chairman officially opened the workshop.

2.1 Presentation

Mr. Bounlird Singsombuth, Deputy Director of Cleaner Production Center, Department of Industry and Handicraft presented a number of papers:

- Sources and quantities of raw materials for producing biomass fuels in the PDR.
- Benefits of biomass for fuel producers, suppliers, consumers and the environment.
- Overall policies and investment incentives, focusing on the tax-exemption policy, value-added tax and tax exemption on material - equipment and machinery for doing business specified in the Investment Promotion Law, which will be crucial to attract Pellet investors.

Mr. Thongphet Phonsavath, National Project Expert presented the background of the project and application of pelletization technology for biomass pellet production and possible application of biomass pellet in the processing industry and household, the recent and upcoming activities, pellet fuel market and eligibility of participation in the UNIDO project.

2.2 Discussion

After the two presentations a number of company representatives commented on the following:

1. It is found that the production of biofuel from Pellet in Lao PDR is the only the factory in Attapeu. Previously, Japan would need to buy biomass fuel from Pellet Laos, but they want to buy in big amount about 300,000 tons per year, in which the factory was not able to meet their demand of the



Japanese market due to limited production. In addition, factory manager had also introduced the Pellet production technique of their pellet factory Dokchampakham in Attapeu Province.

2. The pellet production should be done in groups, associations or federations to produce more biomass pellet for export. On the one hand, the market should be wide open for the survival of the business, the production must be available, and therefore the project team or the Department of Industry and Handicraft need to assist them on the market search and make them be eligible to apply for a loan with a Bank for their financial support.
3. Promotion policy is important, so the public sector must have a policy of marketing, technical and machine promotion to the business sector and the business sector must make good decisions.
4. In the past, the Renewable Energy Research Institute has been produced pellet cook stove for using with pellets and generally. But the problem was, if the prices are high, people are not interested in buying, and on the other hand, the use of pellet as fuel in Lao PDR was not well known. The production was little and make distribution of the cook stove difficult.
5. Representatives from Industrial Solution Company had offered number of Pellet machine, price and capacity for those attending the event and those interested in ordering the machine. In the event that the customer is acquired when the machine is broken or not work well, the company is responsible for repairing, advising, and provide training on how to operate and maintain the engine fully.

3. Summary of meeting results.

Through the meeting, the chairperson of the meeting summarized the results of the meeting on the basis of consensus as follows

1. Pellet's production and market conditions in Lao PDR are relatively fragile, with limitation of production and consumption. In contrast, international organizations and the Government of Lao PDR emphasize the production and consumption of biomass energy for environmental reasons.
2. The workshop is the first workshop on finding businesses who are interested in setting up biomass pellet plant to produce pellet for



industry use, restaurants, household and other sectors for self-consumption and export.

3.A total of 27 participating factories, through this consultation meeting, there were 14 factories that shown initially interest in participating into the Pellet biomass project under the conditions set by UNIDO.

4.The meeting unanimously agreed that the company who is interested in investment on pellet plant shall submit a written proposal to the Department of Industry and Handicraft for further consideration by the project

5.The Department of Industry and Handicraft will set criteria and conditions for the selection of factories participating in the Pellet production project.

The meeting was closed on the same day and it was so successful, so that the minutes of this meeting were to be taken as reference for further implementation.

Conference Chair
taken by

Minute

Copy:

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- ✓ Participants
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Annex 7: Work plan of BTILC

Output	Result	Activities	Output/Deliverables	Timeline	Status	Next steps
	BTILC is established	1.1 Identify training requirement of BTILC personnel based on the expertise needed at the BTILC	Official organization chart with names of the experts is shared with UNIDO	1 month after contract signature	Done The organization chart and CV of BTILC team see in annex 1	
		1.2 Develop/update business plan and annual work plan of the centre including an internal capacity building plan.	Business plan (incl. sustainability and exist strategy for the time when the GEF funded project ends), annual work plan This includes a strategy for self-sufficiency of the BTILC, reflected in pricing for the trainings and services provided by BTILC. The following issues are to be considered: cost-sharing and fundraising (e.g. national, regional, or international funds).	1 month after contract signature	Last version after comment from PMU, see in Annex2	What are the next steps?
		1.3 Set-up the BTILC and pellet testing infrastructure	Invoices of investments and photos of the BTILC	4 months after contract signature	On going BTILC Sent the list of some require equipment for pellet testing and some testing equipment available in REMI Lab. to PMU, the list and photo of equipment see in Annex 3	Overview of equipment prepared by Martin to be discussed with BTILC ToR for equipment is be developed (Thongphet to take the lead and make first draft); then call for proposals from supplier
		1.4 Organize launching event for the BTILC	Press release, Photos, Videos and presentation material of the Launching Event for at least 80 participants incl. facility, moderator, presentations, (at least 30% female participants)	2 months after contract signature	Done the launching ceremony was held on 10 December 2018, the report of launching event for the BTILC see in Annex 4	
		1.5 Familiarize BTILC team with the business plan and work plan (discussion and fine tuning of plans between PMU and BTILC team)	BTILC business plan and work plan	2 months after contract signature	Done	
2	Internal Capacity building of BTILC	2.1 BTILC provides logistical support (expertise and training material provided by	Training Reports incl. training certificates for at least 20 participants (at	6 months after contract signature	on-going Organized 4 online trainings (2 hours each) via	... Recommendations from Martin on training?



(personnel are trained and their capacity improved; BTILC experts get familiar with the role they are expected to play)	UNIDO) for targeted training courses for stakeholders and BTILC team to enable them to test the biomass pellet quality and sustainability: a) appr. 5-day introductory training about solid biofuel (pellet) production and utilization b) appr. 5-days of advanced training about solid biofuel (pellet) testing or demonstration on production and utilization.	least 30% female participants) per training		Zoom application, the presentation was provided by UNIDO Expert and translated into Lao language by BTILC and project coordinator and interpreter during training by project coordinator (Mr. Thongphet), training report and sample of certificate to trainee are attached in Annex 5	Training by EnerTEAM? Training on equipment (to be included in ToR)?
	2.2 BTILC members attend on the job and in field training by accompanying international expert during project missions	Mission reports	6 months after contract signature	- in 2018 Four BTILC member participated in energy audit mission, installation of boiler and jacket steam pot and solar drying in salt factory, - Planning to accompany UNIDO expert mission for pellet production and usage potential assessment in 2020.	- Training on feasibility studies? Data collection? Maybe through Martin (then to include in the JD); maybe done by CPC-L, PMU
	2.3 BTILC members participate in a gender mainstreaming training courses	Certificates of participation of all BTIC members on at least 1 gender mainstreaming training (e.g. an online training such as by UN Women: I know gender);	4 months after contract signature	https://trainingcentre.unwomen.org/portal/unw-checkout/#selfpaced Sessions mandatory sessions: • 1-2-3 • 15	https://trainingcentre.unwomen.org/portal/product/i-know-gender-1-2-3-gender-concepts-to-get-started-international-frameworks-for-gender-equality-and-promoting-gender-equality-throughout-the-un-system/ https://trainingcentre.unwomen.org/portal/unw-checkout/#selfpaced



3	Networkin g (Network with solid biofuel/bio mass centers, researchers, project developers, technology suppliers of solid biofuel in the region created)	3.1 BTILC members join online discussions, trainings, and networks for modern solid biofuel development and certification for thermal applications	Press releases published on BTILC website	Continuou s (every 2 months)	REMI has some contact with university and research institute related to biofuel energy such as Yunnan Normal University of China, Agriculture University in Beijing China,Thailand Institute of Scientific and Technological Research (TISTR),	What is planned?
4	Informatio n Sharing (In formation gathered and database for promoting solid biofuel production and usage)	4.1 Develop materials and content to be shared on the BTILC website (incl. Gather information through review of literature by BTILC team); Review existing websites related to solid biofuel to develop and update own website that is specific to the project activities in Laos	BTILC website is regularly updated (presenting the objective, role and action plan; articles on biomass technologies, etc.)	Continuou s (every 2 months)	Regularly update website,	Add website in facbeook Upload website to google
		4.2 Update and expand a database of all key stakeholders along with some basic information on them and update as and when new information is available (Undertake a survey to expand the database of solid biofuel stakeholders, if required)	Database of the key stakeholders of the solid biofuel network in and outside Laos expanded and available on BTILC website	4 months after contract signature	On going in make up database to share in BTILC website based on data and information provided by project coordinator, such as a list of key solid biofuel stakeholder and biomass resource and ...?	What are the next steps?
		4.3 Develop database of pellet machinery providers that fulfill minimum quality requirements	Database of the key stakeholders (e.g. pellet machinery providers) of solid biofuel in and outside Laos established and available on BTILC website	4 months after contract signature	On going in make up available data of key stakeholder to share in BTILC website	What are the next steps?
5	Capacity building of stakeholde rs (Training and workshop materials are developed based on	5.1 Assess training needs of various target groups of the UNIDO project including project developers, policy makers and financial institutions and provide them information about the project and biomass technology.	Training needs assessment including questionnaire, pictures, notes from meetings with the target group (3 meetings with at least 10 participants, at least 30% female participants)	4 months after contract signature	On going Some got from participants of online training evaluation in May 2020. Annex ...	What are the next steps?




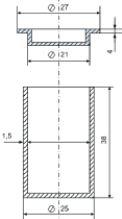



	the available resources)	5.2 Develop customized training programme and materials to suit the context of Laos (e.g. based on review of biomass training programs and training material e.g. from neighboring solid biofuel/biomass centers)	Customized training programme and materials for (1) policy makers, (2) project developers, (3) banks, (4) solid biofuel producers, and (5) solid biofuel users (incl. solid biomass handbook).	4 months after contract signature	Starting prepare training material base on presentation in online training course during May 2020 by UNIDO expert (Mr. Martin Englisch)	Will be based on outcomes of 5.1 results What are the next steps?
		5.3 Organize at least 3 national/regional awareness raising workshops (half-day) on biomass pellet technologies and available support for factories tentatively in provinces representing the north, center and south of Laos for at least 50 project developers (each group with a target of at least 30% female participants).	Workshop reports for each workshop including presentations, attendance list and contacts, pictures, , press release, article on the website, etc.	6 months after contract signature	Not started	Will be based on 5.1 results What are the next steps? <ul style="list-style-type: none"> • Prepare concept • Draft list of invitees • Prepare outreach • Find partners, • ...
6	Outreach	6.1 Develop promotional leaflets/ brochures on BTILC	At least 2 Brochures/leaflets and other promotional materials are finalized for circulation in English and Lao	2 months after contract signature	One brochure to introduce BTILC in Lao language and in English was developed by UNIDO, printed and released during BTILC Launching ceremony and onward. In June 2020 BTILC developed one brochure in Lao language see in Annex 5	What are the next steps?
		6.2 Make public announcement and media campaigns to publicize services	Promotional materials and media campaigns are publicized in English and Lao Public announcement made in English and Lao	4 months after contract signature	Update website regularly, and announcement the online training program on BTILC website and Facebook See Annex	What are the next steps?
		6.3 Develop promotional videos for BTILC	2 videos (1 long version of around 5-10 minutes, short version of 2-3 minutes) in English and Lao	6 months after contract signature	Not started	What are the next steps? <ul style="list-style-type: none"> • Draft storyline



						<ul style="list-style-type: none">• Material collection for videos
--	--	--	--	--	--	--

Annex 8: list of laboratory equipment purchased

bulk density cylinder		according ISO 17828; 2 sizes with 5l (for saw dust, pellets) and 50 l (wood chips and other bigger biofuels)	specific equipment for biomass, some producers but compatible simple equipment	for small container: € 100 - 400.-
trays for drying		Dishes and trays of non-corrodible and heat-resistant material; dimension that they will hold the total test portion not exceeding 1 g of material per cm ² . The surface shall be such that adsorption/ absorption is minimized (very clean and even surface).	different products suitable e.g. aluminium trays	per tray: € 1 - 10.-
laboratory mill	 cutting mill	1. Shredder or coarse cutting mills are used for cutting materials into lengths of about 10 mm to 30 mm (depending on the biofuel and the analyses to be performed). 2. Cutting mills are used for reducing the nominal top size of materials used as biofuels from about 10 mm to 30 mm down to about 1 mm or less (depending on the biofuel and the analyses to be performed). The mill shall be provided with screens of various aperture sizes covering this range, including an appropriate sieve to control the nominal top size of the material produced.	standard lab equipment used for other purposes as well, produced by many companies worldwide -very big differences in quality;	each: € 2.000 - 10.000.-
quartz crucibles (for volatile)			crucibles only used for solid fuel analysis	per crucible with cover: € 20 - 40.-
calorimeter		calorimeter according ISO 18125	few producers worldwide e.g. IKA, CKIC, Parr	automated system, state of the art: € 15.000 - 40.000.-
pellet press for calorimeter	may be bought as accessory with calorimeter			

sieve shaker		sieving machine according ISO 17827-2	some producers worldwide e.g. IKA, CKIC, Parr	€ 1.000- 3.000.-
standard sieve series 3,15 mm and below		wire mesh sieves according ISO 3310-1; Ø 200 mm, — 3,15 mm round holes; — 2,8 mm metal wire cloth; — 2,0 mm metal wire cloth; — 1,4 mm metal wire cloth; — 1,0 mm metal wire cloth; — 0,5 mm metal wire cloth; — 0,25 mm metal wire cloth.	standard lab equipment used for other purposes as well, produced by some companies worldwide, many traders e.g. Retsch, Laarmann, Tokyo screen, ...	per sieve € 50 - 100.-
pellet production machine		Capacity 120-200 kg/h Power 11 kw, 380 v 50 hz Net weight 290kg Size 1140*470* 970 mm Die size 230 MM	Production model ZLSP-230	FOB (Qingdao/Tianjin/Shanghai) € 1.000-1.5000



**VOSA CORPORATION
VOSA DANANG**



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PROOF OF DELIVERY

No.: 01/22-002/SI-FH

I, The under signed, hereby certify the receipt all cargo from **VOSA DANANG** of the shipment with the details as follow:

- HBL No: CLV/675.1027.01
- Commodity: PELLETING MACHINE, AUTOMATIC CALORIMETER
- Quantity: 3 CASES

No	QUANTITY	MEASUREMENT	Gross Weight (Kg)	Note
1	3 CASES	1.945 CBM	543.000	
TOTAL: 3 CASES			543.000	

In good order and conditions.
Place of delivery:

**DEPARTMENT OF INDUSTRY AND HANDICRAFT
MINISTRY OF INDUSTRY AND COMMERCE
PHONXAY ROAD, PHONXAY VILLAGE, XAYSETTHA DISTRICT,
VIENTIANE CAPITAL, LAO PDR**

RECEIVER

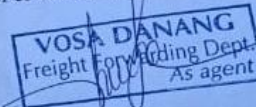
For & O/B of Consignee

Signature:

Houmpheng THEUAMBOUNMY

DELIVERER

For & O/B of VOSA DANANG



85



Ministry of Energy and Mines
Research Institute for Energy and Mines

CERTIFICATE OF ANALYSIS

Customer's Name:

Address:

Sample: Wood pellet

Description and Identification:

Manual Number of testing : 20220418A04

Date Received: 15 March 2022

Date/s tested: 18 April 2022

Test	Result	Test Method
		GB
Heating Value (MJ/Kg)	19.253	(Ckic 5E-C5500 Calorime

TESTER

SACHAI SAYKHAMM



UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

GRAIDCO

GLOBAL RELIEF, AID & DEVELOPMENT COMPANY

COUNTRY OF ORIGIN CERTIFICATE

Item.	Description.	HS-code	Qty.	
10	AUTOMATIC CALORIMETER	9027809990	1	
12	S.T.C. PELLETING MACHINE	8474802000	1	

DELIVERED AT PLACE VIENTIANE – LAO PDR (INCOTERMS 2010) including Insurance at 110% (End User)

COUNTRY OF ORIGIN: CHINA

GRAIDCO

GLOBAL RELIEF, AID & DEVELOPMENT COMPANY

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WWW.GRAIDCO.NL INFO@GRAIDCO.NL



GRAIDCO REFERENCE NR.: G-210062					
UNOPS Purchase Order number: 3000091088					
2-12-2021		WEIGHT: 74 KGS DIMENSIONS: 80 X 60 X 102 CM			
Item.	Description.	HS-code	Qty.	Cat No.	Brand.
2	3,15 mm sieve	73141490	3	1034003150	Laarmann
3	Reception pan for sieve	73141490	3	1034000001	Laarmann
4	Caliper ruler	90178090	1	1220 417-D	Helios Preisser
6	Bulk density cylinder	90278090	2	01-0012 01-0013	Bioenergy
7	Trays for drying	84193900	5	YX76.1	Carl Roth
8	Laboratory cutting mill	84742090	1	CM500	Laarmann
9	Quartz crucibles	70171000	12	NT46.1	Carl Roth
11	Standard sieve series 3,15 mm and b	73141490	1	1001003150 1001002800 1001002000 1001001400 1001001000 1001000500 1001000250	Laarmann
COUNTRY OF ORIGIN:					
THE NETHERLANDS					

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Annex8: Work plan 2021-2022

Project		Reducing of greenhouse gas (GHG) emissions in the industrial sector through pelletization technology in Lao PDR
SAP ID		140057
Country		Lao PDR

Outputs by Project Component		Responsible	Year 2021		Year 2022			
			Q3	Q4	Q1	Q2	Q3	Q4
status								
on-going		Component 1 – Capacity development and knowledge management						
on-going		Outcome 1: Improved awareness, knowledge and capacity on solid biofuel production and usage in the country						
on-going		Output 1.1: An information and learning centre for solid biofuel production and usage established						
1.1.1	completed	Preparation of ToR for institute to support REMI to set up the centre in Lao (on-going)	UNIDO					
1.1.2	on-going	Identify institute to support REMI to set up the centre in Lao (on-going)	UNIDO					
1.1.3	on-going	Establish Agreement with institute to support REMI to set up the centre in Lao (planned)	UNIDO					
1.1.4	on-going	Training for BTILC staff (incl. training materials, database of stakeholders, services to pellet producers, etc.) from partner (e.g. BIOMA)	UNIDO					
1.1.5	on-going	Training from int. expert for pellet lab (Martin Englisch)	UNIDO					
1.1.6	on-going	Procurement of Pellet Testing Equipment, small pellet machine and basic Energy Audit Equipment incl. training (to be finalized based on business plan submitted from REMI) (in-progress)	UNIDO					
on-going		Output 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 20 persons).						



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1.2.1	on-going	Conduct training needs assessment (assessment of capacity of policy makers) (on-going)	REMI (for BTILC staff), UNIDO for other policy makers (and for REMI through Martin Englisch)						
1.2.2	not yet started	Training for policy makers	REMI to provide logistics (obligated); UNIDO to provide expertise						
1.2.3	not yet started	Training for solid biofuel producers & users, RE / technical institutions and bank / financial institutions: on FS and proposals	REMI to provide logistics (obligated); UNIDO to provide expertise						
1.2.4	not yet started	Training for solid biofuel producers & users and RE / technical institutions: on O&M of the system	UNIDO (done by supplier with support from REMI)						
	on-going	Component 2 – Strengthening policy and regulatory framework for promoting investments in solid biofuel use in industries							
	on-going	Outcome 2: Improved confidence among investors in solid biofuel production and utilization							
	on-going	Output 2.1: Database developed on agro & wood wastes availability and on final energy consumption in industrial sector							
2.1.1	completed	Develop database structure (incl. data collection methodology) and provide initial input for collecting final energy consumption data of Lao's agro and wood processing industry as well as other data relevant for establishing a bio-energy industry	CPC-L						
2.1.2	completed	Conduct biomass resource assessment incl. training and involvement of DOIH staff	CPC-L						
2.1.3	completed	Conduct knowledge dissemination workshop on biomass resources	CPC-L						
2.1.4	completed	Translate biomass resource assessment survey and disseminate it	CPC-L						
2.1.5	on-going	Editing of biomass resource assessment (english version) and dissemination	CPC-L						
	on-going	Output 2.2: National strategy to promote investment in solid biofuel production and utilization in place (international & national experts to be contracted)							
2.2.1	on-going	Preparation of ToR for Development of the national biomass strategy and quality standards for solid biofuel	UNIDO						
2.2.2	not yet started	Recruit international expert to provide advice and support CPC-L developing the national biomass energy strategy	UNIDO						



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2.2.3	not yet started	Develop the national biomass energy strategy to promote investment in production and utilization of solid biofuel	UNIDO/ CPC-L						
2.2.4	not yet started	Develop standards ensuring quality of the produced solid biofuel	UNIDO/ BTILC						
2.2.5	not yet started	Conduct knowledge dissemination workshop on recommendations for the national strategy to promote investment in solid biofuel production and utilization	UNIDO/ CPC-L						
	on-going	Output 2.3: Technical adjustments for solid biofuel usage in participating industries							
2.3.1	completed	Solar Dryer for Salt Production (incl. knowledge dissemination)	CPC-L						
2.3.2	on-going	Market creation: Technical adjustments for salt factories to use pellets or identification of alternative industries that can possibly use solid biomass (for thermal energy)	UNIDO (vendor/ salt factory)						
	on-going	Component 3 – Demonstration of solid biofuel production and utilization							
	on-going	Outcome 3: Increased use of solid biofuel for industrial applications							
	on-going	Output 3.1: Systematic and comprehensive biomass resource assessment in target areas							
	on-going	Output 3.2: Detailed plant designs prepared for the demonstration projects							
3.2.1	on-going	Develop Guide for investors for solid biofuel pellet investments	UNIDO/ Enerteam						
3.2.2	on-going	Support project specific plant designs and feasibility studies for solid biofuel production and utilization	UNIDO						
	on-going	Output 3.3: Solid biofuel pelletizing systems established for a cumulative capacity of 3.6 tph							
3.3.1	completed	Establish financial incentive system	UNIDO						
3.3.2	on-going	Output 3.3.3: Install/ Support demo pellet production system through call for proposals through CfEoI (CfEoI to be finalized). Next steps	UNIDO/ vendor						
3.3.3	completed	a. Develop CfEoI							
3.3.4	completed	b. Publish CfEoI							
3.3.5	completed	c. Evaluate CfEoI EoI							
3.3.6	completed	d. Request for proposals							



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3.3.7	on-going	e. Review proposals							
3.3.8	not yet started	f. Sign contracts							
3.3.9	not yet started	g. Implementation and monitoring (Construction, Commissioning, Operation)							
3.3.10	not yet started	2nd. call for proposals (if required)	UNIDO/ vendor						
3.3.11	not yet started	Monitor execution	UNIDO						
	on-going	M&E							
4.1.1	on-going	PSC Meetings	UNIDO						
4.1.2	on-going	PMU and other miscellaneous costs	UNIDO						
4.1.3	not yet started	Terminal Evaluation	UNIDO						
4.1.4	on-going	NPC, assistant, driver, national expert until December 2021	UNIDO						
4.1.5	on-going	Contingency (e.g. for FS, PMU, HQ support), Knowledge sharing/ dissemination, outreach/ advocacy (e.g. video production, printing, translations), lessons learnt, etc.	UNIDO						
		Total sum							

Budget available

	Planned
	On-going
	Completed



Annex 9 : Certificate of acceptance

CERTIFICATE OF ACCEPTANCE

Issued by the Supplier's Representative, UNIDO Representative, and End-User

Name of Supplier's Representative: GRAIDCO Global Relief, Aid & Development Company B.V, its office at Vesterbrogade 12,1 Energieweg 4, 4691 SG Tholen, The Netherlands

Name of End-User: Biomass Technology and Learning Center (BTILC)
Hosted by the Research Institute for Energy and Mines (RIEM)
Dane Xang Village, Xaythany District, Tha-gnone Road
Vientiane Capital LAO, PDR Tel: +856 21739011

Name of MoIC Representative: Department of Industry and Handicraft
Ministry of Industry and Commerce
Phonxay Road, Phonxay Village, Xaysettha Disticy
Vientiane Capital, Lao PDR, Tel +856 21 455095

Name of UNIDO Representative: Country Office in Lao PDR
P.O.Box 345, Lan Xang Avenue, Vientiane, Lao PDR.
United Nations Industrial Development Organization
Tel: (+856 - 21) 267 777; 267 708 |Fax: (+856 - 21) 267 799; 264 939
Email: s.fanning@unido.org | Mobile: (+856-20) 9980 2320

The following items /equipment, including assembling services have been examined and accepted for the purposes of this Contract:

No	Items	Code	Amount/un it
1	Sample divider	84796999	1
2	3,15 mm sieve	73141490	3
3	Reception pan for sieve	73141490	3
4	Caliper ruler	90178090	1
5	Tumbler	39249090	1
6	Bulk density cylinder	90278090	2
7	Trays for drying	84193900	5
8	Laboratory cutting mill	84742090	1
9	Quartz crucibles	70171000	12
10	(S.T.C.PELLETTING MACHINE),	HS-Code: 8474802000, Qty: 1, Cat No: ZLSP230B, Brand: Gemco	1



11	Standard sieve series 3,15 mm	73141490	1
12	AUTOMATIC CALORIMETER),	HS-Code: 9027809990, Qty: 1, Cat No: 5E-C5500, Brand: OGC	1

The following items/services/terms did not conform with the requirements of the Contract:

none

Remedial Action Proposed, including expected date of completion: N/A

All the parties concerned herewith certify the completion of delivery and receiving the above items.

Signed and stamped by:

Signature and date

Name of the Supplier's Representative:

Max Simon
GRAIDCO Global Relief
Managing Director

Research Institute for Energy and Mines

Mr. Phouvieng KEBOUPHA
Director General



Name of MoIC Representative:

Dr. Buayanh VILAVONG
Director General



05 JUL 2022

05 JUL 2022

Name of UNIDO Representative:

Mr. Sommai Faming
Country Representative



Annex 10: MoM PSC 2022

Minutes of Meeting

7th Project Steering Committee Meeting 2022 of project
27 October 2022, Dokchampa hotel, Pakson (Bolikhamxay)

The Department of Industry and Handicraft in collaboration with UNIDO held the 7th PSC meeting through in-persons in the morning of 27th October 2022 at Dokchampa hotel, Pakson, Bolikhamxay province under the “Project on Reducing Greenhouse Gas Emission in Industrial Sector through Pelletization Technology Lao PDR” under the chairmanship of Mr. Savath Khoundavong, Deputy Director General of the Department of Industry and Handicraft with co-chair of Mr. Phouvieng Keoboupha Director General of Research Institute of Energy and Mines, attended by UNIDO project manager Mr. Jossy Thomas and the member of Project Steering Committee from Ministry of National Resources and Environment, Ministry of Planning and Investment, Director of Veunkham salt factory and the staff of Cleaner Production Centre, all together about 15 persons as follows.

17. Mr. Savath Khoundavong, Deputy Director General of DIH, the chairman
18. Mr. Phouvieng Keoboupha Director General of RIEM
19. Mr. Jossy Thomas, Project Director in Vienna
20. Mr. Khamphone Keodavalong, Director of CPC-L
21. Mr. Vilakone Nou Khaiyang Kongchee, Staff of CPC-L
22. Mr. Sachai Saykhammoun, Staff of RIEM
23. Mrs. Bounthavy Chounlamany, Director of Veunkham Salt Factory
24. Ms. Siamphone Sisomphou, factory manager of Veunkham Salt factory
25. Mr. Vonephasao Oraseng, Head of Division, MONRE
26. Mr. Chanpheng Khamphoukeo, Technical staff of CPC-L
27. Mr. Thongphet Phonsavath, National Project Coordinator
28. Mr. Khankham Samakhy, Project Assistant
29. Mr. Bounthan Chandara, Ministry of Planning and Investment
30. Mr. Sounadet Soukchaleun, MONRE, GEF OFP
31. Ms. Grazia Chidi, Project assistant, HQ

The contents and the agenda of the meeting are as follow

5. Objectives

- To report on project implementation from 2016 to 2022.
- To discuss and provide inputs/comments on remaining activities of the year 2022 and agreement on turning the remaining budget to other possible activities.

6. Meeting procedures

Mr. Savath Khoundavong, Deputy Director General of Department of Industry and Handicraft, gave opening remarks and summarized the works implemented in last 7 years of the component 1, 2 and 3 and the issues to be discussed on project implementation in the year of project 2022.



Mr. Phouvieng Keoboupha: remarked the meeting with saying thank you for the assistance of UNIDO to RIEM on establishing the BTILC and the support of establishment of laboratory at RIEM, which has been taken from the tasks and responsibility of the REMI.

Mr. Jossy Thomas remarked the meeting with saying thank to all the project partners on collaboration and implementation of the project activities successful from the beginning till the end of this project in December 2022.

The meeting was proceeded as per agenda and detailed as follows:

2) Presentation:

Mr. Thongphet Phonsavath, National Project Coordinator presented the implementation of seven years project implementation till October 2022, the remaining activities till December 2022 and turning the budget to other possible activities. The main activities could be summarized as follows:

Component 1: Establishment of BTILC in 2018, training for BTILC staff on pelletization technology and procurement of laboratory equipment with complete delivery and setting-up the laboratory in May 2022.

Component 2: Training and assess on biomass resources of selected 262 selected factories of 12 province completed in 2019. Drafting of national biomass energy strategy (second draft on 20th October 2022). The strategy shall finalise end of this year.

Component 3: UNIDO signed the contract with the three companies: Dokchampakham, Simmalakham and Alexson import-export for receiving incentive from UNIDO. One company, Simmalakham briquette factory invested for the pellet machine of 3.0 ton per hour, while the two company hesitate to invest due to not sure of market.

Component 4: The monitoring and evaluation of the project. The project is conducting Terminal Evaluation by hiring a national consultant and expert for carrying out the task and completed in December 2021.

7. Discussions

Mr. Phouvineg Keoboupha

RIEM will continue the remaining activities focusing of organise training for repair and maintain cook stove in three provinces: Vientiane Capital, Savannakhet and Champasack in November to December 2022.

Mr. Khamphone Keodalavong

Thanks to UNIDO for supporting Department Industry and Handicraft for some project office equipment and implementation of project activities, especially the formulation of the biomass energy strategy in manufacturing sector and the modification of pellet technology for salt industry at Veunkham salt factory and purchasing of some measuring equipment. The next activities until the end of the project will be the improvement of the pellet furnace installing at Veunkham factory, finalise the biomass energy strategy planned to be finished in December 2022 and the turning the remaining budget for capacity building/sharing experience of industry management in neighbouring countries, for organizing a workshop and printing of green industry decision planned to be held in December 2022. Mr. Khamphone also raised the question for the activities that need more time



than two months, is it possible to implement the activities few months after the closing date of the project. Mr. Khamphone had also propose to further collaborate with UNIDO and find some project in future.

Mrs. Bounthavy Chounlamany: Veunkham salt factory addressed that the reason for joining project was to find solution on fuel. Veunkham factory use coal and sawdust as fuel. Nowadays, Veunkham factory is facing the scarcity of fuel, if there is no other fuel that can replace coal and sawdust the factory would not continue production as it is.

The pilot project done in Veunkham factory showed that good quality of salt can be produced. Till now, the salt cooking by using sawdust, there is dust contaminated the salt.

Veunkham factory expected to use new fuel, if the fuel (pellet) is cost effective, Veunkham factory will stop using sawdust and coal. Veunkham wants to know the energy efficiency of fuel, the moisture content of salt. For this purpose, equipment is required. If the project can support this would be grateful. For telling information on using pellet in salt industry, there is annual meeting of salt association, where all the member from country will join. It can take this opportunity to organize a meeting at ministry to introduce pellet technology and pellet use in salt factory with the success case of pellet furnace in Veunkham salt factory.

Mr. Thanongxay Keoyothy (GEF OFP): agreed on the implemented activities presented. Concern is about the remaining activities especially the formulation of the biomass energy strategy. The strategy will very useful for the private sector who want to invest on pellet. The remain budget will be useful to purchase the measuring, equipment, exchanging and sharing experience on industry management in neighbouring countries.

Mr. Vonephasao Oraseng (MONRE): agreed with the presentation and compliment the success of the project such as the establishment of the biomass Technology Information and Learning Center, the establishment of laboratory at BTILC (RIEM) and other successful activities. The project was one of the successful projects and it was a good project in Lao PDR.

Mr. Jossy Thomas

Good to hear that this project is important to Veunkham factory, and the alternative fuel is so important to Veunkham. For the measuring equipment, project is seeking supplier. The measuring equipment required by Veunkham can be considered to purchase at the same time. Thanks to MONRE that see the importance of the project. UNIDO is ready to assist the remaining activities in supporting the production and utilization of biomass. A consultation meeting between association of salt manufacturers and pellet manufacturing companies may be organized to highlight the potential pellet market and the possible use of pellet for salt cooking. DDG of DIH may chair such a meeting. For the activities that agreed and with the contract with UNIDO, it can be completed a few months after the date closing but not for many months.



8. Conclusion

Chairman: Summarized and agreed to continue remaining activities as discussed till the end of the project as follows:

1. Continue and prepare for the procurement of measuring equipment to PMU,
2. Finalize of the biomass energy strategy planned to be finish within this year lead by DIH
3. Improvement of the pellet furnace at Veunkham salt factory to be completed by CPC-L
4. Prepare for the capacity building or sharing experience of industrial management in neighbouring countries Thailand and Vietnam
5. If there is opportunity to have a meeting with salt company with involvement of government to disseminate pellet technology will be good.
6. Inform and cancel the contract with company that failed to meet their *contractual* obligations with UNIDO.

The chairman closed the meeting on the same day at 12:00.

Vientiane Capital, date

Acknowledged by
Chairman
by

Minutes taken