Report on the National Assessment Framework of Enabling Environment and Technology Innovation Ecosystem for Making Sustainable Energy Options Affordable and Accessible

LAO PEOPLE'S DEMOCRATIC REPUBLIC

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TABLE OF CONTENTS

Figures

Tables

ABBREVIATIONS

ADB	Asian Development Bank
APB	Agricultural Promotion Bank
BCEL	Banque pour le Commerce Exterieur Lao
BoL	Bank of Laos
BPP	Lao Biogas Pilot Project
BRE	Bio-Renewable Energy
CMPI	Committee for Promotion and Management of Investment
DEPP	Department of Energy Policy and Planning
DEB	Department of Energy Business
DEPD	Department of Energy Promotion and Development
DEPP	Department of Energy Policy and Planning
DEM	Department of Energy Management
DEMO	District of Energy and Mines Office
DG	Diesel Generator
DLF	Department of Livestock and Fishery
DOPI	District Office of Planning and Investment
EdL	Electricite' du Lao
EDL Gen	EdL-Generation Public Company
EEC	Energy Efficiency and Conservation
EMCO	Energy Management and Conservation Office
EMI	Ekphatthana Microfinance Institute
EPD	Department of Energy Promotion and Development
ESCO	Energy Service Company
ESF	Electriciens sans Frontieres
FE	Faculty of Engineering
FISD	Financial Institution Supervision Department
FIT	Feed in Tariff
FS	Faculty of Sciences
GDP	Gross Domestic Product
GEF	Global Environment Facility
GMS	Greater Mekong sub-region
GoL	Government of Lao People's Democratic Republic
HH	Household
IEC	International Electro-technical Commission
IFC	International Finance Corporation
IPP	Independence Power Producer
IREP	Institute of Renewable Energy Promotion
JICA	Japan International Cooperation Agency
LPRP	Lao People's Revolutionary Party
LSX	Lao Securities Exchange
MAF	Ministry of Agriculture and Forestry
MEM	Ministry of Energy and Mines
MFC	Microfinance Centre
MIC	Ministry of Industry and Commerce
MIH	Ministry of Industry and Handicraft
MIS	Management Information System
MOST	Ministry of Science and Technology
MOU	Memorandum of Understanding
MPI	Ministry Planning and Investment
NCA	Norwegian Church Aid
NGPES	The National Growth and Poverty Eradication Strategy
NSO	Network Support Organization

NUOL	National University of Laos
ODA	Official Development Assistance
OPS	Off Grid Promotion and Support
OSU	One-Stop-Service Unit
PDEM	Provincial Department of Energy and Mines
PDP	Power Development Plan
PESCOs	Provincial Energy Service Company
PMG	PMG
PPA	Power Purchase Agreement
PPP	Public-Private Partnership
PSC	Production Sharing Contracts
PSHD	Policy on Sustainable Hydro Power Development
PVEP	PetroVietnam Exploration Production Corporation
RDMA	Rural Development in Mountainous Areas
RDPE	Rural Development and Poverty Eradication Plan
RE	Renewable Energy
REDSL	Renewable Energy Development Strategy of Laos
RETs	Renewable Energy Technologies
RFSDP	Rural Finance Sector Development Programme
SCU	Savings and Credit Union
SE	Sustainable Energy
SHP	Small Hydro Power
SHS	Solar Home System
SNV	Netherlands Development Organization
SPP	Small Power Producer
SW	Shield Wire
SWER	Shield Wire Earth Return
TA	Technical Assistance
TBEC	Thai Biogas Energy Company
VEAC	Village Electricity Advisory Committee
VEC	Village Energy Committee
VEM	Village Electricity Management
VFSC	Village Fund Supervision Committees
VOPS	Village Off-grid Promotion and Support
VT	Village Technician
WB	World Bank

A. National Scenario for Sustainable Energy

1. General Information

1.1 Topology

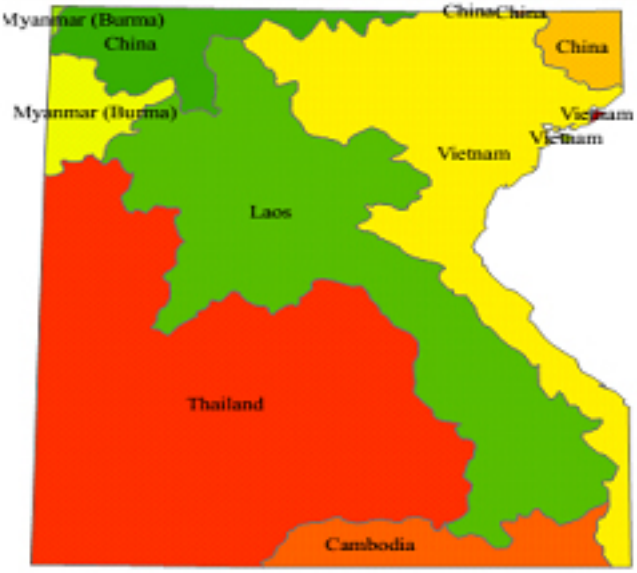

Figure 1: Map of Lao People's Democratic Republic

Lao People's Democratic Republic is a landlocked country located in the center of the Mekong region. The country stretches from north to south, bordering Viet Nam to the east, Thailand to the west, Cambodia to the south, and China and Myanmar to the north. Mountains and plateaus occupy almost 70% of its land, and the Mekong River flows over 1,900 km through the country from north to south. Lao People's Democratic Republic has harnessed these geographical characteristics through hydraulic power potential for its economic growth. Lao People's Democratic Republic has a tropical climate with two distinct seasons, the rainy season and the dry season. The country is on average muggy throughout the year.

For political context, Lao People's Democratic Republic has maintained a single-party system led by the Lao People Revolutionary Party (LPRP). The structure of political power remains unchanged since Lao People's Democratic Republic was established in 1975. Although the country had pursued its central economic planning system in its early years, Lao People's Democratic Republic has undertaken significant economic reforms to move towards a market economy under New Economic Mechanisms which was introduced in 1986. Thanks to the high economic growth of neighboring ASEAN countries, Lao People's Democratic Republic has been successful in sustaining its robust economic growth, with real Gross Domestic Product (GDP) growth rate of 7.5[1]% and more for recent 5 years. However, Lao People's Democratic Republic remains a Least Developed Country (LDC).Gross National Income per capita was around US$ 1,088in 2012[2]. The Government of Lao People's Democratic Republic (GoL) has set a goal of, "freeing the country from the status of LDC by 2020." A summary country profile is provided in Table 1.

[1] The Seventh Five-Year National Socio-Economic Development Plan 2011-2015
[2]Mr. KhamsoKouphokham, DDG, DEPP, ACD Seminar on Sustainable Hydropower Development and Regional Power Exchange of Lao People's Democratic Republic, 2-3 April, Lao Plaza Hotel

Table 1: Country summary[3]

Land	Area	236,800 km^2
	Capital	Vientiane
	Climate	Tropical monsoon having rainy and dry seasons. High temperature and humid through the year
Population	Total	6,514,432 (2012)
	Growth rate	1.4 % per annum
	Population density	28 persons per square kilometres
Health	Average Life Expectancy	67.5 years old
	Birth Rate	28.1 persons per 1,000 population
	Infant Mortality	51.5 person per 1,000 population
Labour	Labour force	2.8 million. In 2006 Around 80 % of the labour force was engaged in agriculture.
	Growth rate	1.5% per annum (comparison between 2011 and 2012)
Ethnic groups		Lao: 55%; Khmou: 11%; Hmong: 8%; other about 49 groups.
Religion		Buddhism (66.8% as of 2005)
Language (official)		Lao
School enrolment		Primary enrolment: 84%; Junior high school enrolment: 38%
Literacy rate		73% (age over 15 years old)
GDP/capita		US$1,088 [2012]
Growth Average		7.5% (2007)
Access to safe water		35% (household base)
Physicians		1.3 per 1,000 people
Hospital beds		1.18 per 1,000 people

1.2 No of provinces/states in the country

Lao People's Democratic Republic has 17 provinces and one capital as illustrated in Table 2 below. Xaysomboun is a new province and was found in 2014. Xaysomboun was created from parts of Vientiane and Xiengkhuang provinces.

[3] Statistical Year Book 2012, Ministry of Planning and Investment, Lao People's Democratic Republic

Table 2: Population and Households across country[4]

No	Provinces	Population		HHs No	No	Provinces	Population		HHs No
		Total	Female				Total	Female	
Whole country		6,514,432	3,259,980	1,144,526					
01	Vientiane Cap	797,130	398,654	201,410	10	Vientiane	506,881	249,362	84,420
02	Phongsaly	179,822	89,390	30,446	11	Borikhamxay	281,207	139,013	44,565
03	Luangnamtha	171,967	86,548	30,378	12	Khammoun	390,701	197,995	72,764
04	Oudomxay	314,269	156,943	49,071	13	Savannakhe	937,907	473,686	147,175
05	Bokeo	173,962	87,229	29,461	14	Saravane	384,438	195,003	62,929
06	LuangPrabang	463,485	231,232	75,275	15	Sekong	103,326	52,046	16,878
07	Huaphanh	333,762	165,336	46,138	16	Champasack	670,122	337,110	115,045
08	Xayabury	389,139	192,653	70,280	17	Attapeu	133,545	67,802	25,100
09	Xiengkhuang	282,769	139,978	43,191	18	Xaysomboun	New province		

1.3 Administrative set-up[5]

The political regime of Lao People's Democratic Republic is a people's democratic republic with the president as head of state. The president is elected by the national assembly and the term of office is five years. The prime minister and cabinet ministers are appointed by the president with the approval of the national assembly.

The Ministry of Energy and Mines (MEM) was found in 2006 and was transformed from the Ministry of Industry and Handicrafts (MIH). An administrative organization chart of the various components of MEM is illustrated in Figure 2. The organization of the technical and policy departments of MEM is illustrated in Figure 3. From this diagram, we can see that there are a number of different bodies under MEM, including the Cabinet Office, Personnel Department, Inspection Department and three electricity-related departments: Department of Energy Business, Department of Energy Policy and Planning, and Department of Energy Management.

In addition, the Mine Department and Institute of Renewable Energy Promotion was set up in April 2012.

The Electricity Law prescribes that MEM is responsible for making policy and strategy for the nation's electricity sector. MEM also has the responsibility to develop and implement laws and regulations, and to supervise the businesses of electricity companies.

The Department of Energy Policy and Planning (DEPP) is under the jurisdiction of MEM. DEPP is in charge of policy-making and planning, and is responsible for energy policy-making, energy /electricity supply planning.

The Department of Energy Promotion and Development (DEPD) changed its name to Department of Energy Business (DEB) under an organizational reform in April 2012. DEB has taken over the responsibilities of DEPD, which include promoting and negotiating IPP

[4] Statistical Year Book 2012, Lao Statistics Bureau, Ministry of Planning and Investment
[5] Ministry of Energy and Mines (MEM)

development and in some cases arranging various agreements and monitoring construction and operation.

The Institute of Renewable Energy Promotion (IREP) is responsible for promoting renewable energy development, promoting and developing rural electrification and energy efficiency and conservation. The following activities are implemented by IREP with the cooperation of donors and other investors.

Table 3: Activities Implemented by IREP

No	Description	Partners/Sponsor	Remarks
01	Solar Home System (SHS)	JICA, WB	Conducting since 1998 up to now
02	Small Hydro Power (SHP)/Mini Hydro	JICA, WB, EEP	
03	Biomass	EEP	
04	Hybrid	NEDO	Solar Pump, Solar Capacitor, Hydro power, SHP,
05	Biodiesel	Lao-AgrotechCo.Ltd.,Makao-Lao Biodiesel Co Export-Import Ltd.,	Demonstration
06	Biogas	EEP, WB	Domestic, Pig farms
07	Cooking Stove	WB, LIRE	
08	Biofuel Assessment	EEP, consultants	
09	Provide RE training	JICA, EEP, WB, FE	Training for PDEM, PESCO, other relevant stakeholders
10	Drafting regulation for supporting RE development and management	GoL, EEP., etc. and consultants	Concerned line ministries are involved in drafting regulations.

Due to a lack of capacity to conduct research themselves, IREP's research programme has received staff from the New Energy Foundation of Japan since 2010. The research topics mostly cover bio and wind energy namely: *Jatropha curcas* Linnaeus as a Feedstock for Biodiesel, Quality standardization of biodiesel and application appropriate technology to improve charcoal production and wind energy.

The GoL has also set up the Provincial Department of Energy and Mines (PDEM) and a District Energy and Mines Office (DEMO), both of whom work under MEM.

The PDEM is responsible for the operation of electricity business of less than 15 megawatts installed capacity, implementing strategies and plans of MEM, energy planning, development and management of energy development. As well as this, PDEM is also responsible for the dissemination of regulations and the electricity law to the public and private utilities at the provincial level and the reporting of all activities related to energy such as electrification expansion (grid and off-grid) and renewable energy potential in provincial areas.

DEMOs have responsibilities similar to PDEM. However, they have limited responsibility for authorization. For example, DEMOs have the right to instruct on the operation of electricity

business of installed capacity of less than one hundred kilowatts relating to the electrical facilities as well as the reporting of all energy activities to PDEM.[6]

Electricity tariffs in Lao People's Democratic Republic are defined by the ElectricityLaw. Electricity tariffs for domestic supplies and exports are set in Articles 47 and 48. Tariffs for rural electrification are defined in Article 49. As can be seen in article 47 of the Electricity Law, electricity tariffs should be established by the GoL; therefore, Electricité du Laos(EdL) submits a draft electricity tariff to the Ministry of Energy and Mines (MEM) and the GoL approves modification of the tariff in principle.

Article 47 Electricity Tariff

The determination of electricity tariffs shall ensure the socio-economic conditions of thecountry and shall be suitable to the targets of use and types of user.

Electricity prices shall be stable and ensure electricity investment return and development.
MEM shall cooperate with other sectors concerned with the study of electricity price structure of each type to be submitted to the Government for consideration within each period.

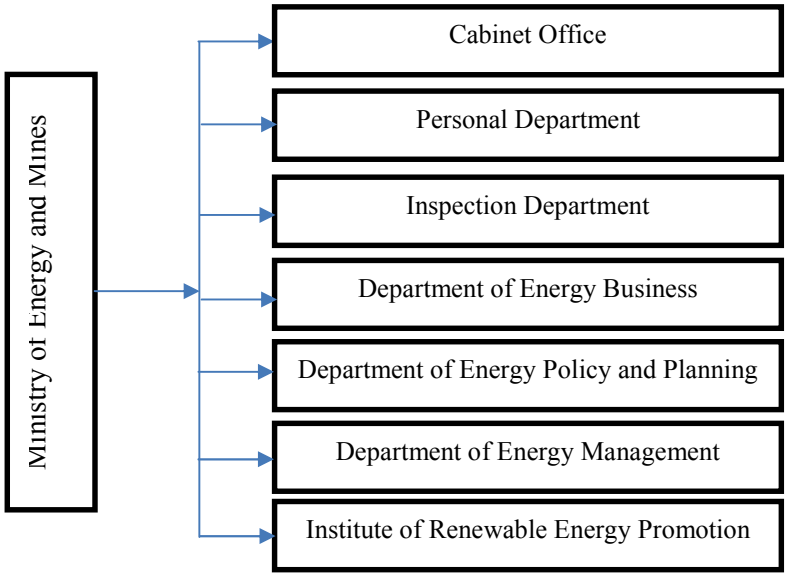

Figure 2: Administrative Organization Chart of MEM

Electricity prices for use targets and user types shall be determined by the GoL. The GoL has a scheme to cross subsidize by collecting high rates for big consumers, commercial, NGOs and industrial consumers as illustrated in Table 4 and 6.

[6] Electricity Law 2012

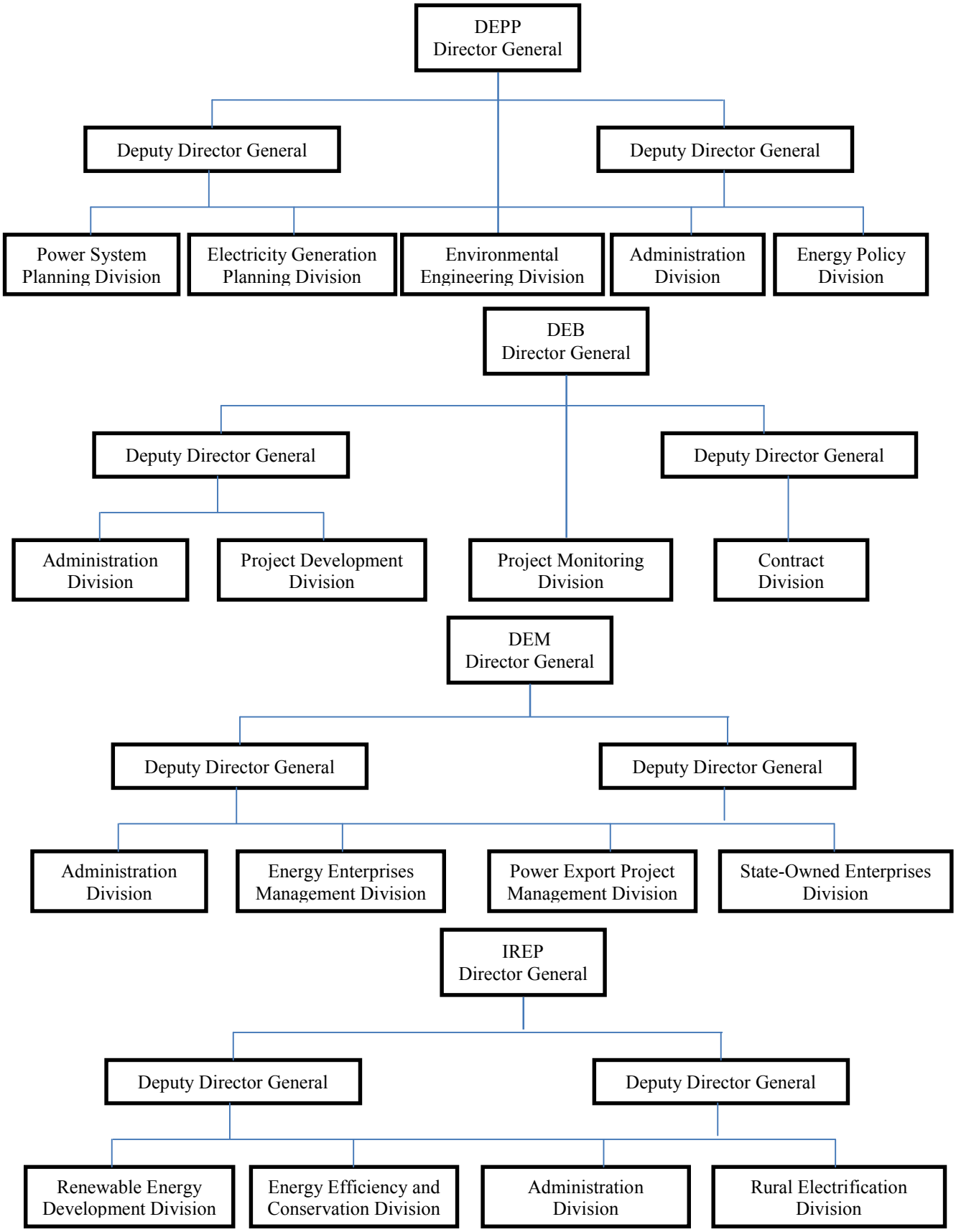

Figure 3: Organization Technical and Policy Department of MEM

The electricity tariff determination is illustrated in Figure 4 below.

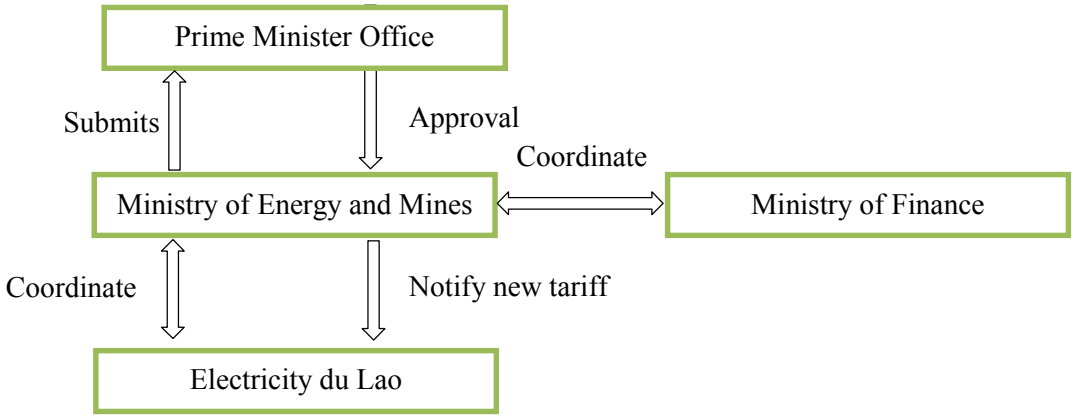

Figure 4: Procedure for Determining Electricity Tariff

1.4 Population

As mentioned in Table 2, there are 6,514,432 people in Lao People's Democratic Republic, of which 3,259,980 (50.04%) are female. About 28.8% of populations in Lao People's Democratic Republic live in urban areas and 71.2% live in rural areas[7]. Most of the rural population work in agriculture as farmers. Data on electrification rates in urban and rural areas is not available.

The poverty headcount in Lao People's Democratic Republic is defined as having a net income lower than US$2 a day and 16 kg of milled rice a month. In 1992/93, the poverty headcount in Lao People's Democratic Republic was 46% in 1992/3. In 1997/98, this dropped to 39.1%. This trend continued over the coming years. The most recent figures suggest that the poverty headcount in 2007/08 was 26%.

1.5 Households

As mentioned previously, the electrification rates of urban and rural areas are not available. However, in December 2013 there were 943,599 electrified households in Lao People's Democratic Republic. This is approximately 87.34% of the 1,080,342 households across the country[8].

1.6 Current power sector set-up

The structure of organization in the electric power sector was established by MEM. Under this structure, there are three departments and one institute in charge of the promotion, and regulation of electric power sector such as the establishment of a strategy plan for an energy supervision environment, as well as the promotion and development of an energy project in relation to independent power producers (IPP) and structures of the power sector, which is illustrated in Figure 5.

[7] Poverty in Lao People's Democratic Republic 2008, Ministry of Planning and Investment, Department of Statistic

[8] EdL/Planning Office, December 2013

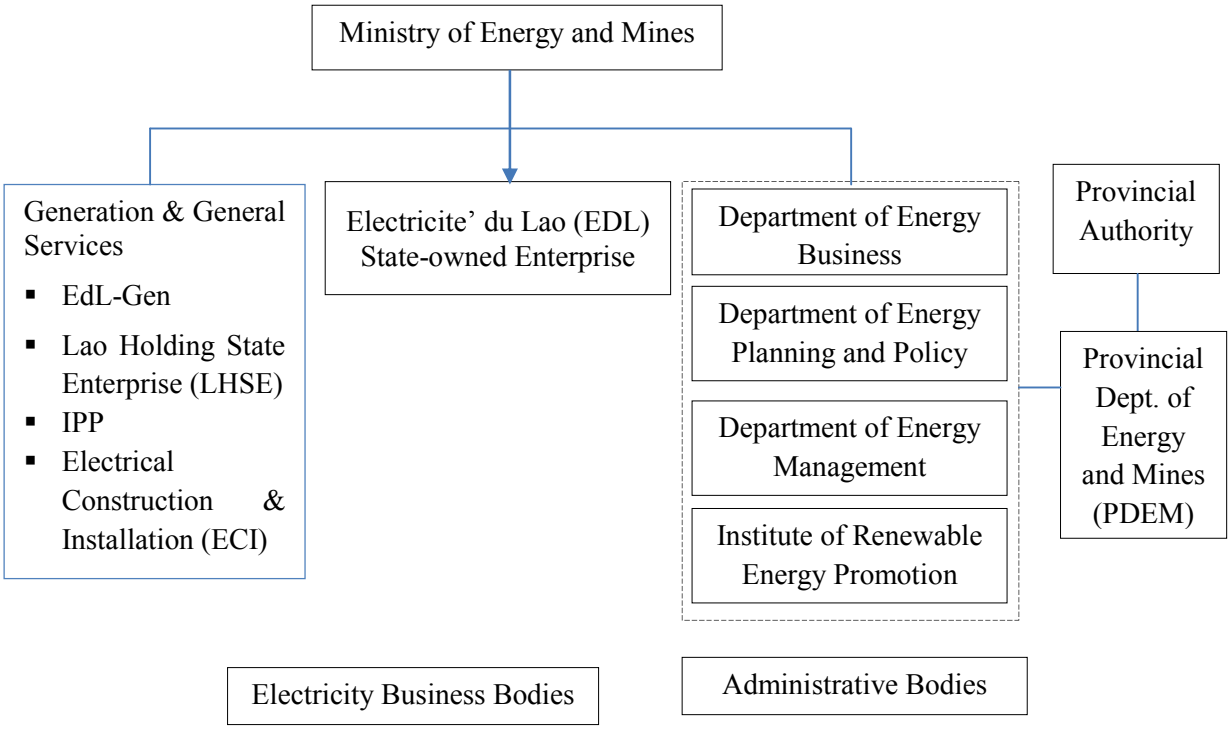

Figure 5: Organization of Power Sector

EdL

EdL is a state-owned electric power utility, supplying electricity to domestic consumers through its transmission and distribution lines. EdL also manages imports and exports of electricity. EdL owns transmission lines and distribution lines for domestic supplies countrywide, obtaining electricity from EdL-owned power stations, EdL-Gen, IPP for domestic (IPP(d)), off-take from IPP for export (IPP(e)), power stations, and imports from neighbouring countries.

EdL was a vertically integrated utility, which owned generation, transmission, and distribution facilities, and had functions to product, transmit, and sell electricity energy. In 2010, following directives from the GoL on restructuring the electricity industry in Lao People's Democratic Republic, the function of electricity generation of EdL was taken from EdL and given to EdL-Gen Company.

EdL-Gen

EdL-Generation Public Company (EdL-Gen) was established on December 15, 2010 as the first publicly-held enterprise in Lao People's Democratic Republic listed on the Lao Securities Exchange (LSX).

The main objectives of EdL-Gen are as follows:

- To generate energy for EdL for wholesale and future export. This includes development of transmission lines and substations, as necessary.
- To invest in or set up joint ventures with other electricity generation projects.
- To provide management and maintenance services for other generation electricity projects.

Lao Holding State Enterprise (LHSE)

Lao Holding State Enterprise (LHSE) is a state-owned stock-holding enterprise established in 2005. The mission of LHSE is to hold and manage shares of IPP projects.

Electric Tariff

The average electricity tariff in 2010 is 664 kip/kWh or 0.08 US$/kWh[9].

Electricity Tariff for Domestic Customers

The historical record of EdL's electricity tariff for domestic customers over the last 10 years back can be seen below in Table 4. From this, we can see that the electricity tariff is set in nine categories for low voltage supply and four categories for medium voltage supply. The tariff for residential use and irrigation are set at a lower level than others for customers, as illustrated in the table4.

Table 4: Retail Electricity Tariff for Domestic Consumers (EdL)

Category			2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Low voltage 0.4 kV	Residential	0-25 kWh	75	99	113	115	133	154	177	203	203	269
		26-50 kWh					276	284	293	301	301	320
		51-150 kWh	176	231	265	265						
		150 kWh-	508	667	765	765	773	773	773	773	773	773
	Irrigation		196	257	295	295	313	247	345	362	362	399
	Government Office		469	616	706	706	703	694	684	674	674	656
	Industrial		422	555	636	636	634	625	616	607	607	591
	General Business		549	721	826	826	835	835	835	835	835	835
	International		1,007	1,052	1,054	1,066	1,077	1,077	1,077	1,077	1,077	1,077
	Entertainment		727	955	1,095	1,066	1,066	1,066	1,066	1,066	1,066	1,066
Medium voltage 22-35 kV	Irrigation		196			251	266	210	293	308	308	340
	Industrial		422			541	539	531	524	516	516	502
	Government Office		469			600	598	590	581	573	573	557
	General Business		549			702	709	709	709	709	709	647

Source: EdL Annual Report 2001-2010

The average historical record of EdL's electricity tariff for domestic customers since 1997 to 2012 is illustrated in the Table 5.

Table 5: Statistics of Electricity for Domestic Tariff of EdL

Year	Average in kips/kWh	Equivalent US cents/kWh	Exchange rate Kip/UDS		
			Beginning of year	End of Year	Average
1997	52	4.3	945	1,891	1,220
1998	52	1.61	2,139	4,235	3,235
1999	113	1.61	4,300	7,805	7,044
2000	169	2.41	7,620	8,245	7,911
2001	240	2.68	8,255	9,550	8,948
2002	370	3.52	9,550	10,740	10,171
2003	402	3.78	10,670	10,499	10,625
2004	492	4.62	10,451	10,386	10,646
2005	510	4.76	10,356	10,832	10,706
2006	517	5.09	10,536	9,755	10,147

[9] Electricity Statistics Year Book 2010 of Lao People's Democratic Republic

Year	Average in kips/kWh	Equivalent US cents/kWh	Exchange rate Kip/UDS		
			Beginning of year	End of Year	Average
2007	523	5.44	9,740	9,353	9,607
2008	542	6.21	9,230	8,491	8,720
2009	547	6.41	8,521	8,802	8,533
2010	559	6.76	8,496	8,073	8,262
2011	559	6.95	8,080	8,043	8,047
2012	662	7.75	8,018	8,005	8,023

In March 2012, the GoL approved and announced a new electricity tariff system as illustrated in Table 6. The tariff increases gradually from March 2012 to December 2017 at an annual rate of about 2%. The category of consumer was revised as follows:

- The category for Education and Sports is newly defined for low voltage and medium voltage. The tariff for Education and Sports is set to be the same as that for a Government Office.
- The category for Industry for medium voltage is divided into two categories depending on power demand.
- The tariff for entertainment for medium voltage is newly defined.

Table 6: New Electric Tariff of EdL[10]

Category			2011	2012	2013	2014	2015	2016	2017
Low voltage 0.4 kV	Residential	0-25 kWh	269	321	328	334	341	348	355
		26-150 kWh	320	382	390	398	405	414	422
		150 kWh-	773	923	941	960	979	999	1,019
	Irrigation		399	476	486	496	506	516	526
	Government Office		656	783	799	815	831	848	865
	Industrial		591	706	720	734	749	764	779
	General Business		835	997	1,017	1,037	1,058	1,079	1,101
	International		1,077	1,286	1,312	1,338	1,365	1,392	1,420
	Entertainment		1,106	1,321	1,347	1,374	1,401	1,429	1,458
	Education and Sport		-	783	799	815	831	848	865
Medium voltage 22-35 kV	Irrigation		350	406	414	422	431	439	448
	Industrial (<5 MW)		502	599	611	624	636	649	662
	Industrial (>5 MW)		-	647	660	673	687	700	714
	Government Office		557	665	678	692	706	720	734
	General Business		647	647	660	673	687	700	714
	Education and Sport		-	665	678	692	706	720	734
	Entertainment		-	1,255	1,280	1,305	1,331	1,358	1,385

Source: Ministry of Energy and Mines, Ref. No. 325, 9.3.2012

1.7 Suitability of established technology with respect to grid-connected and off-grid applications

Grid-connected

- A 115 kV transmission line was installed across the country between station and substation.
- All 35 kV transmission lines were either installed or imported electricity from neighbouring country such as from Viet Nam. This came through the villages before step down to 0.4 kV.

[10]Ministry of Energy and Mines, Ref. No. 325, 9.3.2012

- All 34.5 kV transmission lines or SW (Shield Wire and SWER-Shield wire earth return) systems were installed or connected from 115 kV before step down to 0.22 kV.
- All 25 kV transmission lines or SW systems were installed or connected from 115 kV before step down to 0.22 kV.
- A 22 kV transmission line was installed from substation and connected though the villages and community before step down to 0.4 kV.
- All SWER 12.7 kV transmission lines or SW.
- A 0.4 kV distribution line was installed after step down from 35 kV 34.5 kV, 22 kV and 12.7 kV and expanded through the villages and community before connecting to households or customers.

After installation, all systems mentioned above have received regular maintenance from the state power utility EdL.

Based on the fact that the number of consumers has increased each year, one could argue that consumers of the grid connected system have accepted the current cost of electricity.

Off-Grid

The GoL has the target of increasing the national electrification rate to 90% of all households (HH) by 2020, in which 85% will be connected to the grid and 5% will use off-grid connections. Renewable energy (RE) such as solar home systems (SHS) and micro/mini hydropower have been used for rural electrification in Lao People's Democratic Republic.

Photovoltaic (PV) solar power plays a major role in rural electrification. In 2009, SHS has a total capacity of 474 kW, supplying electricity to 25,000 HHs. Most of the SHS implementation have been carried out by the public sector with support from WB and private sector. In addition solar mini-grid has also been built in Luang Prabang province through a public private partnership model with shared ownership between villagers and private entity. Details of solar mini-grid are illustrated in Table below.

Table 7: Solar Mini-grid[11]

No	Type of System	Install Cap [kW]	Donor	Village	Province
01	Stand alone	6.5	EEP, FONDEM	Houaypha	Luang Prabang
02	Hybrid (Solar/Diesel)	4.8/5	EEP, FONDEM	Phakeo	Luang Prabang

Most of the off-grid systems in Lao People's Democratic Republic were installed where the grid could not be connected e.g. mountainous areas and where the potential for alternatives were available such as solar and village hydro.

Ownership of SHS is transferred to the household after completion of instalments. However, SHS is installed with a battery and controller to charge energy in battery to use electricity at night, which requires operation and maintenance works. Rural Electrification Project (REP) I introduced Local Electricity Service Companies (ESCOs) for operation and maintenance of

[11] 9th Steering committee meeting, 13 February 2014, Lao Plaza Hotel, Vientiane, Lao People's Democratic Republic

SHS. Services from ESCOs to repair and replace batteries and controllers are paid by users as fee-for-services.

Most of the off-grid connected consumers accepted the fees associated with electrification. However, not all have accepted the use of off-grid system, due to the fact that off-grid systems have limited power for their utilization, which will decrease with more users. However, small hydro power is typically deemed acceptable for both cost and power utilization.

1.8 Capital Cost Range for Renewable Energy

On-grid

There is few capital cost range for renewable energy in Lao People's Democratic Republic, but there is only preliminary study on model projects for renewable energy, the capital cost range for each technology can be seen in Table 8 below.

Table 8: Capital cost range for grid-connected RE Technologies[12]

Technology	Cost (US$/MW)
Small Hydro Power	2,500,000
Solar PV	2,500,000-3,000,000
Wind	1,500,000
Biogas	3,200,000
Biomass (Sugar mill)	650,000[13]

Off-grid

There is no capital cost range for off-grid renewable energy in Lao People's Democratic Republic. The following Table shows the capital cost range for each technology used in a number of different projects.

Table 9: capital cost range for off-grid renewable

Technology	Application for	Cap (kW)	Cost (US$/kW)
Stand-alone solar PV	Water pumping	100	-
	Lighting [14]	6.5	78,615 Euro
	Roof-top solar PV	-	-
	Solar water heating (sqm)	-	-
	Solar thermal for space heating (sqm)	-	-
	Solar thermal for drying (sqm)	-	-
Biomass gassifier[15]		40	7,150 Euro
Biogas (million cum)		20	3,200☼
Small wind turbine		4	5,000☼

Note: ☼Data Collection Study (Preliminary Assessment) on Energy Sector in Lao People's Democratic Republic, July 2012 (JICA)

[12] Data Collection Study (Preliminary Assessment) on Energy Sector in Lao People's Democratic Republic, July 2012 (JICA)
[13] Feasibility study report on sugar mill and biomass, June 2011
[14] Scaling-Up Electrification and Local Capacity Building for Rural Areas of LuangPrabang Province (EEP-Mekong)
[15] www.eepmekong.org

1.9 Financing norms (for grid-connected and off-grid RE projects)

Grid-connected RE projects

Financial support for renewable energy development in Lao People's Democratic Republic has followed the rule of available commercial banks and free duty fee for the import of equipment and materials which could not be produce in the country (Investment Law 2009, Tax Law 2005, VAT 2006 and Custom Law 2005).

Off-grid RE projects

Financial mechanisms for off-grid renewable energy projects in Lao People's Democratic Republic were supported by a number of international organizations such as the World Bank (WB) and the Japan International Cooperation Agency (JICA).

To achieve a higher electrification rate in rural communities, a capacity of 20~40Wp SHS is sold through a sales scheme to rural households with monthly instalments. Because size and capacity are relatively small, the unit price is not too high. However, the average price of US$500 is not cheap for rural households in remote areas in Lao People's Democratic Republic. In an attempt to address this, the WB has designed and introduced a longer-term payment scheme of 10 years.

SHS are installed under a grant from the WB and other donors. These grants for REP I & II can be considered as a capital investment from international donors to promote rural electrification. Manpower costs and expenses including incentives for village managers and ESCOs are similar to the running costs for maintaining SHS. Initial investment cost, therefore, is recovered from the balance of instalments after deducting operation and maintenance costs, together with incentives for village managers and ESCOs. However the initial cost will not be repaid in full because of the insufficient components of the monthly charge as described above. For example, only 50% of the initial cost is included because the investment cost of SHS is quite high compared to the income of rural households in Lao People's Democratic Republic, making it difficult for the rural household to pay in one time, as identified within Rural Electrification Fund (REF). REF is a revolving fund to promote further rural electrification, which may enable REP I & II to be considered reasonable investments for rural electrification.

1.10 Tariff setting methodology for grid-connected RE technologies

Electricity tariffs in Lao People's Democratic Republic are established by the GoL. EdL submits a draft electricity tariff to MEM and the GoL approves modification of the tariff in principle.

There is still no feed in tariff (FIT) methodology to define or set electricity tariff from renewable energy for grid connected sources in Lao People's Democratic Republic. Methodology of electricity tariff from renewable energy is based on the negotiations between producers and power utility, EdL. The purchase price from small power producers is mostly lower than import price due as there is no firm power to contest with. The import price of electricity ranges from US$ 4 cent/kWh, US$ 6 cent/kWh, US$ 13 cent/kWh and US$ 74 cent/kWh. However, currently DEPP is preparing an electricity tariff policy to account for different scenarios, as illustrated in Table 10 below:

Table 10: Electricity tariff structure from RE[16]

	Season	Electricity tariff	2014	2015	2016	2017	2018	2019	2020
Off-peak	Wet	US$ cent/kWh	**3.54**	3.58	3.61	3.65	3.68	3.72	3.76
Off-peak	Dry		**4.40**	4.44	4.49	4.53	4.58	4.62	4.67
Peak	Wet		**5.82**	5.88	5.94	6.00	6.06	6.12	6.18
Peak	Dry		**7.88**	7.96	8.04	8.12	8.20	8.28	8.36

Remark:

- Off-peak: 22:00-09:00 and Saturday and Sunday
- Peak: 09:00-22:00 Monday to Friday
- Sources for power generation were clarified in four categories as follow
  - Category 1: hydro power with install capacity higher than 5 MW
  - Category 2: power generation from coal, gas, fuel and other
  - Category 3: hydro power with install capacity more less 5 MW
  - Category 4: power generation from renewable energy as define in renewable energy development strategy in October 2011, except hydro power
- Wet season: As define from 1st June until 31st October
- Dry season: As define from 1st November until 31st May

Power purchase from category 1 and 2 as follow by Table 9, category 3 follow by dry season peak, while category 4 is also follow dry season peak

1.11 In case cost plus feed-in tariff methodology is being practiced provide information on the financial parameters adopted

Up to now, Lao People's Democratic Republic has not set a feed in tariff. However, the GoL provides financial incentives due to the fact that development costs of RE are generally much higher than thermal power and hydropower projects. In general, most countries provide financial measures to make RE economically viable for example the Feed in Tariff, Adder adopted in Thailand, etc.

The GoL also has a plan to provide various financial incentives to RE projects and investors as described below. The GoL has already provided (a) and (b) to sugar companies and biodiesel developers.

(a) Free import duty for production machinery, equipment, and raw materials;

(b) Free import duty for chemical materials necessary for biofuels production within seven years;

(c) Profits are taxed at three levels: 20%, 15%, and 10%.Exemption from taxes on profits is possible for a certain period depending on activities, investment areas, and scale;

(d) Subsidies for unit product price depending on energy type and period.

Investors can also obtain non-fiscal incentives, such as:

(e) Leasing period up to 75 years (for enterprise construction land);

(f) Permission to expatriate earnings to home or third countries;

(g) Right to employ foreign workforce (not more that 10% of enterprise's total labour).

[16]Department of Energy Policy and Planning, Ministry of Energy and Mines (MEM)

Concerning Carbon Financing, the GoL ratified the Kyoto Protocol in 2004, appointed the Ministry of Natural Resources and Environment to be the Designated National Authority, developed sustainable development criteria and established approval processes for CDM projects. With the recent progress of CDM, the Government ensures small-scale projects such as SHS, biogas, improved cook stoves, and solar water heaters will be developed.

1.12 Cost for generation of grid-connected technologies (US cents/KWh)

According to the results of JICA'sData Collection Study (Preliminary Assessment)on Energy Sector in Lao People's Democratic Republic, the average cost for generation in mega solar (PV) projects is about US$0.20/kWh. The details of the costs of generation of grid-connected technologies are illustrated in Table below.

Table 11: Cost of generation of grid-connected technologies

No	Description	US$/kWh
1	Solar PV	0.20
2	Small Hydro Power	0.07
3	Biomass	0.11
4	Biogas	0.11
5	Solid waste	0.12
6	Wind	0.15

1.13 Investment made in RE/SET projects

- *Grid connected technologies*

Most of the renewable energy investment projects are made by both public and private sectors. For instance, the private sector had invested on power generation from biomass (sugar factory) in Savannkhet province, which generates 9.7 MW. Similarly, in Attapeu province, private sector investment has led to the generation of 30 MW.

As well as this, the government has invested on several small hydropower plants (< 15 MW) through EDL. Currently, the GoL now has a policy for IPPs to promote private investors to develop small hydropower (< 15 MW).

Small hydropower (less than 15 MW) is generally less economical than medium and large-scale projects because small hydropower cannot benefit from economies of scale. Credits for developers/producers and engineering ability of construction companies might be low, compared to players involved in medium to large scale hydropower projects. Because banks are unwilling to supply loans at low interest rates due to above situation and if foreign contractors/consultants are involved, construction costs might increase significantly.

- *Off-grid technologies*

Off grid technologies are also made by both public and private sector, but the project made by public was supported by financial institution such as the World Bank, ADB, EEP, JICA and other international non-government organizations.

Sunlabob Renewable Energy Co. Ltd is a private sector company involved in a number of activities, including RE development. The company provides a range of energy services, including the sale of energy products and rental services.

Sunlabob is a pioneer of the franchise approach to rural electrification. The company is now involved in a solar mini-grid of 10 kW to supply 150 households for rural electrification. The role of Sunlabob for the solar mini-grid is to design and install solar systems, train operators and supply spare parts.

Besides these SHS for off-grid rural electrification, there are other off-grid technologies. For example, the power generation from agriculture by-products (corncob) by Energy Management and Conservation Office (EMCO) of Khon Kean University has a total capacity of 40 kW in Xayabury province. However the system appears not to be working properly due to some difficulties in controlling the gas supply to the engine.

There are a large number of other private sector companies involved in RE development. However, these companies are focused on RE services and rarely invest in RE assets or equipment.

To deliver off-grid power to poor villages, Sunlabob has designed an innovative model through the provision of community-owned lanterns, which are charged every few days by a village-based solar station rented from Sunlabob. The villagers pay for uses of these lanterns at reasonable and affordable rates. The lanterns are operated by a village technician (VT) who provides technical services and collects fees. The VT is under supervision of Village Energy Committee (VEC) who oversees the whole process and act as problem solving units in case of conflict between users and the VT.

2. Resource Availability and Access

2.1 Percentage share of different primary sources of energy in country's energy portfolio

Primary energy in Lao People's Democratic Republic covers biomass, hydro, solar, coal and wind as illustrated in Table 12. However, these figures were collected from a number of different sources. Therefore, it is difficult to have complete confidence in their accuracy.

Table 12: Share of primary energy sources

No	Energy type		Ktoe/year
01	Biomass[17]	Saw dust	4.30
		Rice husk	256.28
		Municipal solid waste	30.86
		Corncob	96.99
		Bagasse	85.30
		Animal manure	147.71
		Biofuel crop	52.76
		Biogas (industry wastewater)	3.97
	Sub total		678.17
02	Coal[18]		539.44

[17] Laos's Biomass Potential Status 2013, by Phonepasong S
[18] Department of Energy Policy and Planning, MEM 2013

03	Solar		511 MW
04	Wind		1,800MW
05	Hydro		18,000-30,000MW

2.2 Share of different sources of electricity in country's energy portfolio in terms of % as well as installed capacity in MW

Based on presentation during 11-12 February 2014 from Ed DEPP, MEM and IREP, the total existing installed capacity of each source is shown in Table 13. Of the total installed capacity in Lao People's Democratic Republic, 98.61% is generated by hydro power. The remainder of installed capacity is made up of biomass, diesel and solar.

Table 13: Share of sources electricity supply

No	Power sources	Percentage	Install Capacity (MW)
01	Hydro[19]	98.61	2,978.17
02	Biomass[20]	1.32	39.74
03	Diesel	0.04	1.491
04	Solar	0.03	0.87387
05	Coal		-
06	Nuclear		-
	Total	100	3,020.27

2.3 Number and percentage of households using energy by sources

There is no information on the breakdown of energy source use per household. However, there is information of the number and percentage of households using electricity as of December 2013. According to these figures, 943,599 households in Lao People's Democratic Republic were using electricity in December 2013, which equates to 87.34% of households in Lao People's Democratic Republic. Only 2% of total households in Lao People's Democratic Republic were electrified by off grid sources.

2.4 Whether resource assessment for fossil fuel has been carried out

There has been no resource assessment for fossil fuels to date. However, a number of surveys have been conducted.

2.5 Whether renewable energy (RE) resource assessment has been carried out

There has been very little resource assessment on renewable energies to date in Lao People's Democratic Republic. In January 2014, a biofuel assessment and development plan was completed. However, there has been no other form of assessment on renewable energies in Lao People's Democratic Republic.

In order to analyze the biofuel feedstock potential in the country, apart from the identified palm, Jatropha and *Vernicia montana* crops, such as soybean, maize, sorghum, cassava and sugarcane are also analyzed for their suitability for the biofuel programme in the country.

[19] Lao People's Democratic Republic National Stakeholders Workshop on Accessible and Affordable Sustainable Energy, 11-12 Feb 2014, EdL

[20] Institute of Renewable Energy Promotion (IREP), MEM 2014

Lao People's Democratic Republic is developing a national programme for biofuel development with a vision to introduce 10% biofuel in the transport sector by year 2025.

Based on projections, it is estimated that in 2025, 1811.05 ML of diesel and 663.80 ML of gasoline will be required to meet the transport sector petroleum fuel demand.

Based on the calorific value for pure biodiesel (B-100) and pure bio-ethanol (E-100), the amount of biofuel that will be required to achieve the 10% blending target by 2025 is shown in the Table below.

Table 14: Biofuel Estimation for Lao People's Democratic Republic

Blending % of Bioethanol/Biodiesel	Year	Estimated Value	Estimated Value
		B100 requirement (ML)	E100 requirement (ML)
3%	2015	22.25	15.42
5%	2020	63.93	34.62
10%	2025	194.44	97.64

If the country wants to achieve 10% biofuel blending targets by 2025, it would have to secure supplies of approximately 194.4 ML of B100 (100% pure biodiesel) and 97.6 ML of E100 (100% pure bioethanol).

In Lao People's Democratic Republic, if the crop with least bioethanol yield per hectare (maize) is selected for bioethanol production then a total of 47,548.5 ha of land will be required to meet the 10% blended gasoline demand for year 2025.However, the same demand can be met by just 6457 ha of land if 100% bioethanol demand is met through sweet sorghum (crop with highest bioethanol yield per ha).

Similarly, 320,425 ha of land will be required if crop with least biodiesel yield per hectare (soybean) is selected for meeting 100% of country's biodiesel demand. The same demand can be met by *V. montana* grown in just 196,404 ha of land.

2.6 Gross potential (in MW) of grid- connected RE technologies identified in the country

Based on Lao Renewable Energy Development Strategy November 2011, the potential of renewable energy sources for grid connecting are as illustrated in Table 15 below.

Table 15: Potential RE for grid connecting

No	RE type	Potential (MW)
01	SHP	2,000
02	Solar	511
03	Wind	>40
04	Biomass	938
05	Biogas	313
06	Solid waste	216

2.7 Technically and economically feasible potential (in MW)

There are no details of technical or economic studies for grid connecting. However, there have been studies which predict the installed capacity of various RETs over the coming years. The information from these studies can be found in Table 16.

Table 16: Technical and Economic Potential RE for grid connecting

No	Phase Description	2015		2020		2025		Total	
		MW	M US$	MW	M US$	MW	M US$	MW	M US$
01	SHP	80	288	134	629	400	1,010	614	1,927
02	Solar	22	41	36	90	48	144	106	275
03	Wind	6	55	12	120	73	168	91	242
04	Biomass	13	24	24	52	58	72	95	148
05	Biogas	10	21	19	45	51	192	80	258
06	MSW	9	48	17	105	36	168	62	321

2.8 Potential of off-grid RE technologies/applications identified in the country

There is no information identified yet for the potential of off grid RETs.

2.9 Installed Capacity (in MW) of grid connected RE technologies in the country

Based on the information from IREP, up to the end of 2013, Lao People's Democratic Republic has a total installed capacity of about 67.86 MW. Of this, 27.924 MW is small hydro power, 39.7 MW is biomass and 0.236 is solar power, as can be seen in Table 17 below.

Table 17: Total capacity of the grid connected RE technology

No	RE type	Capacity (MW)
01	SHP	27.924
02	Solar	0.236
03	Wind	-
04	Biomass	39.7
05	Biogas	-
06	Solid waste	-

2.10 Installed capacity of off-grid RE technologies/applications in the country along with number of operational projects

In the end of 2013 there was a total installed capacity of 1,576.37 kW from off grid RE technologies and applications. Of this, 898.5 kW is micro hydro power, 637.87 kW is solar and 40 kW is biomass.

2.11 Un-electrified areas away from the conventional grid

By the end of 2013, there are 1,696 villages, 136,743 households. Of these households, 12.66% are un-electrified. Most of these are scattered in remote rural areas. Regardless of the remoteness of un-electrified villages, the GoL is determined to increase electricity access. This will most likely be done by off grid renewable energy systems as the cost of grid extension for many of these areas is too high, making off grid renewable energy systems more economical.

2.12 The sustainable energy programmes sponsored/implemented by national government

Currently, the GoL is reviewing the Policy on Sustainable Hydropower Development in Lao People's Democratic Republic (PSHD). The PSHD is updated based on the National

Policy on Environmentally and Socially Sustainable Hydropower 2005(NPSH), current legal and institutional arrangements, implementation experience and MEM policies for the hydropower development sector. The policy applies to all hydropower projects larger than 15 MW throughout the project development process (planning, construction, operation, and transfer/closure stages) and incorporates technical, engineering, economic and finance, and environment and social impacts aspects.

Lao People's Democratic Republic presents a remarkable success story in rapid national electrification that is integrated within a broader strategy of national and rural development. In fifteen years, electricity access more than quadrupled from 15% in 1995 to 69% in 2009 and 87.34% in 2013; the number of households with electricity access grew more than five times from 120,100 in 1995 to over 700,000 in 2009 and 943,599 households in 2013. The country is on track to achieve the government's target of 90% national coverage by 2020.

This achievement in the power sector in Lao People's Democratic Republic, especially the grid rollout programme spearheaded by the national utility, EdL, is exemplary compared to other successful national electrification programmes worldwide in terms of the speed of progress. The remainder of this chapter highlights the GoL's role and highly visible hand in enabling the extraordinary progress to date in national electrification.

The key to the success of increased electrification in Lao People's Democratic Republic is the government's clear target and implementation under the donors' policy. For example, the "Power to the Poor" (P2P) programme is a subsidized, affordable connection and indoor wiring financing mechanism implemented by EdL, with the support of MEM. Designed with a gender focus, it offers the poorest rural households, who cannot afford the entire upfront costs of connection and internal wiring necessary to access to the main electricity grid for basic service. The objective is to raise household connection rates up to 85-90% in village communities connected to the grid.

The programme design utilizes participatory methods and gender-sensitive eligibility criteria, targeting poor female-headed households in particular. Eligible households receive the same no-cost "basic" 3/9 ampere-metre (low voltage), as provided by EdL to all households. This is sufficient for an average household to run two light bulbs and a small electrical appliance, such as a radio.

Another programme is the off-grid rural electrification programme, which was supported by the World Bank. The SHS pilot programme was implemented by small private companies based in the respective provincial capitals. Under the model adopted by village off-grid promotion service (VOPS), these private companies – PESCOs – work in cooperation with the Provincial Department of Energy and Mines (PDEM) offices responsible for rural electrification.

PESCOs have a participatory planning process, designed by VOPS, that identifies villages that meet the off-grid criteria, procures equipment and employs village energy managers (VEMs) who are responsible for installing and maintaining the systems and collecting bill payments. Payments to the PESCOs and VEMs themselves are linked to

their actual achievement (rebate based) in planning, installation and payment collection and reporting.
In addition, PECOs also receive performance-based incentives if their cumulative annual collections from users are over 80%.

2.13 The Best practices of implementing sustainable energy programme at provincial government

Based on section 2.12 above, there is no information on the best practices of implementation sustainable energy programme at provincial level.

2.14 Success/failure factors of above programme

There are a number of factors contributing to the success of these programmes.

Firstly, visionary and effective leadership, with strong commitment to rural electrification has instilled a corporate culture dedicated to accountability for results and a work ethic characterized by open-minded professionalism. As well as this the GoL has targeted electrification rates of 70% of households by 2010, 85% by 2015 and 90% by the year 2020 respectively. These targets have contributed to the success of the programmes;

Secondly, sound programme planning and prioritization to enhance broad-based development impact with special emphasis on the poor has been very beneficial. This coupled with the fact that Lao People's Democratic Republic has a huge hydro power source has led to the success of many programmes;

Thirdly, steadfast enhancement of organizational capacity and operational productivity, including decentralization, increased customer focus, steady gains in labour productivity and technical operational efficiency as well as strengthening of technical capacity of staff and of management systems. As well as this, the fact that EdL has full power to extend electrification through the country has been beneficial;

Fourthly, generous contributions from donors have been a major contributor to the success of these programmes. Similarly, public and private participation has also played a major role in programme success.

Lao People's Democratic Republic has had success in electrification extension for rural areas. For example, the number of electrified households rapidly increased from700,547 households in 2009, 756,604 in 2010, 821,295 in 2011, 876,762 in 2012 and 943,599 households in 2013 respectively.

But, some projects are not sustainable. For example, small biomass for power generation has been unsustainable in some cases due to poor performance of technology, lack of human resources to operate technology and the fact that most of projects are installed in poor villages who find it difficult to meet the payments required for the electricity tariff.

As well as this, many off grid projects are doomed to failure due to personal preferences of some rural households. For example, many households are not preferable to off grid programmes due to small limits of power generation and relatively high cost.

3. Need and Demand for Energy

Analysing needs and demand for energy may provide information on present scenario in the country with respect to energy access and standard of living.

3.1 Energy usage in various sectors (tons of oil equivalent) (Please mention all energy sources separately for every sector)

It is not surprising that traditional fuels (mostly fuel wood) comprise the bulk of primary energy consumption in Lao People's Democratic Republic. In 2008fuel wood consumption comprised about 70 % of the total final energy consumption, petroleum products20%, charcoal about 5 %, electricity 4% and coal about 1 %. The energy consumption rates have continued to increase since 1990 up to 2008. This is summarized in Table 18 below.

Table 18: Energy Consumption by Fuel Type[21]

Year	Energy type (ktoe)				
	Coal	Petroleum products	Electricity	Fuel wood	Charcoal
1990	-	182.4	14.15	858.76	56.31
1991	-	195.7	18.98	880.02	57.61
1992	-	209.9	21.74	901.61	58.93
1993	-	213.8	22.77	924.11	60.29
1994	-	218.7	24.08	947.02	61.67
1995	-	223.0	29.02	976.29	63.09
1996	-	236.1	32.64	1,000.70	64.54
1997	7.4	238.8	37.31	1,025.72	66.03
1998	8.0	253.5	64.91	1,051.35	67.55
1999	8.6	277.2	48.64	1,077.62	69.10
2000	9.4	307.7	55.03	1,103.48	70.69
2001	12.2	349.7	61.09	1,129.96	72.32
2002	19.3	357.8	65.94	1,157.08	73.98
2003	23.5	379.5	76.00	1,184.85	75.68
2004	28.5	394.4	77.64	1,213.29	77.42
2005	29.6	413.7	86.95	1,242.41	79.20
2006	39.0	437.2	120.17	1,272.22	81.02
2007	106.2	505.2	111.65	1,374.50	89.96
2008	82.3	561.5	135.69	1,474.68	106.18
Total	374.1	5,955.7	1,104.394	20,795.66	1,351.58

3.2 Grid electricity availability

Based on an interview with a representative of EdL on 14 February 2014, availability of electricity in both urban and rural areas is continuous, 24 hours a day. Power is only shut off in rare instances of maintenance and repair.

EdL has record distribution losses in the whole country since 1991 until 2011. The losses fluctuated since 1991 to 2005. Since then, the losses have slowly decreased from 17.86% in 2006 to 10.14% in 2011. Table 19 presents detailed information of the annual losses from 1991 to 2011.

[21] Department of Electricity, Ministry of Energy and Mines, Lao

Table 19: Distribution Losses in the whole Country[22]

Year	Percentage	Year	Percentage	Year	Percentage
1991	19.38	1998	19.02	2005	19.32
1992	15.25	1999	20.03	2006	17.86
1993	17.05	2000	18.81	2007	15.30
1994	27.18	2001	17.66	2008	13.70
1995	24.22	2002	18.66	2009	11.98
1996	23.03	2003	16.41	2010	11.78
1997	22.89	2004	19.01	2011	10.14

3.3 Quality of power supply (with regard to operation) in urban/rural areas

Most of the power supply in industrial and commercial areas is paid for by industrial and commercial bodies. On the other hand, agriculture and residential areas are provided by the power utility, EdL. However, these areas have to pay for their own wiring and household equipment.

3.4 Previous year electricity consumption patterns (MU)

EdL has also recorded electricity consumption by consumer's category as illustrated in Table 20 below. Table 20 illustrates that electricity consumption is continuing to increase in residential, government offices, commercial and industry. Meanwhile, consumption by other sectors such as entertainment, irrigation and international organizations have been fluctuating. However, the electricity consumption in Lao People's Democratic Republic as a whole is continuing to increase.

Table 20: Electricity consumption by consumer categories

Year	Residential [kWh]	Commercial [kWh]	Entertainment [kWh]	Gov. office [kWh]	Irrigation [kWh]	Int. org [kWh]	Industrial [kWh]	Education and sport, Business [kWh]	Total [kWh]
1995	170,190,786	38,833,339	-	42,919,778	13,589,860	7,458,563	64,479,985	-	337,472,311
1996	192,638,819	40,703,798	-	44,716,515	13,441,015	8,079,996	79,961,280		379,541,423
1997	218,286,703	40,094,203	9,701,282	49,623,547	16,969,721	8,098,174	91,086,827		433,860,457
1998	252,218,101	50,110,610	10,685,471	54,444,110	29,631,919	8,583,191	107,598,300		513,272,507
1999	285,053,266	58,553,120	11,068,706	54,464,514	33,905,540	7,712,277	114,789,455		565,546,838
2000	324,693,846	67,804,500	11,838,193	59,802,343	33,413,405	7,480,376	134,825,919		639,858,582
2001	371,410,713	72,441,414	12,707,319	67,210,227	40,750,934	10,928,830	134,880,705		710,330,142
2002	394,557,813	78,142,296	10,223,482	77,484,072	34,799,916	7,560,312	163,970,932		766,738,823
2003	454,478,322	94,976,309	7,503,590	83,410,978	31,751,549	8,201,237	203,416,998		883,738,983
2004	455,257,272	93,606,656	5,151,205	82,284,106	39,424,757	8,397,137	218,641,651		902,762,784
2005	510,600,135	115,528,297	5,808,152	98,632,880	35,326,748	8,630,259	236,538,840		1,011,065,311
2006	565,241,431	138,179,395	6,767,067	96,590,934	39,678,724	8,220,478	257,729,273		1,112,407,302
2007	642,490,509	180,769,521	7,135,300	103,751,834	46,862,476	8,579,073	308,753,930		1,298,411,674
2008	706,736,340	332,136,362	8,340,000	112,787,734	44,371,211	9,324,020	365,369,311		1,577,860,278
2009	813,510,000	499,730,000	7,965,121	126,980,000	39,040,000	9,910,000	403,710,000		1,901,290,000
2010	942,640,723	584,360,453	7,775,644	145,756,520	42,515,134	10,322,141	494,590,904		2,228,150,996
2011	1,004,074,384	598,738,092	7,775,644	149,066,348	46,185,606	9,434,332	584,087,955		2,399,362,401
2012	1,160,983,870	796,716,638	8,828,124	173,918,474	39,451,631	10,427,767	680,870,098	3,010,072	2,874,206,674

3.5 Next 5 year load forecast for electricity consumption to understand and predict potential demand as aspired by the community

- Outline of Power Development Policy

[22] Electricity statistic 2011, EdL

MEM sets the strategy for power development based on the "National Socio Economic Development Plan." The responsibility of MEM for power development is established by Article 10 of the Electricity Law.

MEM is charged with working with all concerned organizations to draw up the "Power Development Plan" and submit it to the GoL for approval. Requisites of power development plan are also suggested in Article 10 as follows:

1. Ensure principles of using natural resources in appropriate, economical, and highly effective manner;
2. Set targets, directions, mechanisms, and methods for developing power projects technically and economically; ensure the safe and stable supply of electricity, and mitigate social and environmental impacts of power development;
3. Ensure domestic electricity demand, which is a fundamental for economic and social growth in each period and policy for national socio-economic development; and,
4. Set targets for electricity exports based on the exclusive right of domestic supply and demand in neighbouring countries.
   MEM established the strategy for the energy and mines sector titled "Strategy Plan for 2006 to 2020." Based on the power development strategy established by MEM, EdL formulated the "Power Development Plan" for domestic power development. The current PDP formulated by EdL (PDP 2010 revision-1) corresponds mainly to items 2 and 3 of Article 10 of the Electricity Law.

- Power Development Plan 2010-2020
  The latest "Power Development Plan" formulated by EdL is "Power Development Plan 2010-2020 Revision-1" (PDP2010-2020 Revision-1). Article 9 of the Electricity Law states that the electricity enterprise shall prepare the electricity development plan. EdL has been preparing the "Power Development Plan" every three to five years. EdL formulated the "Power Development Plan" (PDP2010-2020) in August 2010, revising the former PDP2007-2017. In August 2011, EdL updated PDP2010-2020 by reflecting the latest electricity demand forecast and prospective project developments.

  PDP2010-2020 was submitted to the government and obtained the approval of the Prime Minister's Office according to Article 10 of the Electricity Law. The content of the PDP2010-2020 Revision-1 updated data. Therefore, there was no need to get approval for PDP2010-2020 Revision-1

- Demand Forecast
  The demand forecast calculated by EdL in PDP2007-2017, PDP2010-2020, and PDP2010-2020 Revision-1 (PDP2010-2020R1). Electricity demand in PDP2010-2020 and PDP2010-2020R1 includes significant demand from Sino-Lao Aluminium Corporation (SLACO), an aluminium refining project in the southern region. Comparing the demand forecast between PDP2007-2017 and PDP2010-2020 Revision-1, demand after 2014 is estimated to be much larger in the latest forecast than previous records. EdL gathers data for the calculation as follows:

① Demand in Residential Sector

EdL gathers current data on population, households, and villages in rural and urban areas from the Department of Statistics, Ministry of Planning and Investment (MPI). EdL makes the forecast based on certain assumptions such as growth rate of population and number of persons per household. EdL estimates future electricity consumption per household by multiplying the growth rate for data on current electricity consumption. The future value for electrification rate is based on the Government's target. System losses are assumed to improve 0.2% annually from the present level. Based on these assumptions, electricity consumption for residential demand is forecasted.

② Demand in Non-residential Sector

Demand in the non-residential sector is forecasted by aggregating demand from two classes of consumer. Large industrial demand such as from mines, cement factories, special economic zone (SEZ), and construction of power plants and railways are forecasted and calculated on a project-by-project basis, then total large industrial demand is calculated. Future demand data of large projects are supplied by the relevant organization. Electricity consumption by mines and cement mills is estimated by MEM. Demand for railway construction is provided by the Ministry of Public Works and Transport. EdL learns from developers of the SEZ about demand in SEZ. Table 21 illustrates the peak demand forecast in PDP2010-2020 Revision-1.

The demand for the residential sector grows gradually from 2010 to 2020 with an average rate of increase of about 7%. Non-residential demand is expected to increase substantially due to the rapid growth of demand from factories and mines. The average growth rate of non-residential demand, except SLACO, is 33% a year from 2010 to 2020.

Table 21: Demand forecast (MW)[23]

Year/consumers	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Residential	492	522	557	592	631	673	718	769	838	916	1,004
Factory	17	45	133	214	260	475	578	778	785	793	794
Mining	75	77	168	176	192	320	536	539	521	524	527
SEZ	-	-	10	35	58	70	116	120	180	180	210
HP Construction	-	24	33	27	159	395	311	143	147	70	41
Railway	-	92	120	120	120	49	21	21	21	21	21
Subtotal	584	758	1,021	1,165	1,420	1,982	2,281	2,371	2,492	2,504	2,597
SLACO	-	-	-	-	100	900	900	900	900	900	900
Total	584	758	1,021	1,165	1,520	2,882	3,181	3,271	3,392	3,404	3,497

Furthermore, MEM and EdL have forecast a power development plan for domestic supply and export. Domestic supply is expected to account for 5,726 MW, while exports will account for 17,303 MW by 2020.

[23]EdL PDP2010-2020 Revision-1

4. Energy Demand-Supply Gap

Assessment of the demand and supply gap will indicate the scale and type of project that needs to be undertaken in the present scenario and measures needed to enhance demand and strengthen supply.

4.1 Statistical numbers, if available (mtoe)

- Energy Demand

  Energy demand has been projected by JICA, who concluded that total energy demand will increase at an annual average of 6.7% for real GDP growing at an annual average of 7.1% for the period 2010-2025. Therefore, GDP elasticity to energy is 0.94. Looking at details by energy source, coal (annual average 18.0%) and electricity (annual average 10.4%) will increase significantly in the period 2010-2025, and coal (4.4% in 2010 to19.9% in 2025) and electricity (8.7% in 2010 to 14.6% in 2025) will expand their shares in 2025. Importantly, these shares will still only be half that of fuel wood and charcoal (35.1%) and petroleum products (28.0%).

  By sector, the industrial sector, which is assumed to have high real GDP growth, will rapidly increase demand (annual average 15.3%), expanding its share from 9.6% (2010) to 31.1% (2025), which will be higher than the transportation sector (29.2% in 2025) and household (residential) sector (29.3% in 2025). On the other hand, the increase rate of residential use will remain at 2.6% as an annual average during 2010-2025 as its growth in 2000-2010 is small compared to other sectors. The details of energy demand by sources and sectors are illustrated below in Table 22 and Table 23respectively.

Table 22: Energy demand by sources

Unit: ktoe	2000	2010	2015	2020	2025
Coal	0	106	355	746	1,268
Petroleum product	272	592	981	1,355	1,781
Biodiesel	0	0	0	46	127
Bioethanol	0	0	0	11	27
Electricity	55	210	393	633	927
Fuel wood	1,103	1,386	1,561	1,752	1,954
Charcoal	71	128	174	226	279
Total	1,502	2,442	3,464	4,769	6,364

Table 23: Energy demand by sectors

Unit: ktoe	2000	2010	2015	2020	2025
Industry	63	232	615	1,193	1,977
Transportation	266	564	939	1,354	1,859
Commercial	210	332	431	528	611
Residential	959	1,269	1,466	1,651	1,865
Agriculture	3	21	26	30	35
Other	0	3	7	12	17
Total	1,502	2,442	3,464	4,769	6364

4.2 Electricity demand supply

EdL had also projected electricity demand from 2010 to 2025. Table 24 illustrates electricity demand in the whole country. In general the electricity demand will continue to increase from 2000 to 2025. The highest electricity demand is in the industry sector. The next highest is in the residential sector. The lowest demand is in the agriculture sector.

Table 24: Electricity demand by sectors (BAU)

Unit: GWh	2000	2010	2015	2020	2025
Industry	135	707	1,899	3,576	5,912
Commercial	147	749	1,225	1,747	2,185
Residential	325	943	1,402	1,995	2,631
Agriculture	33	43	47	52	56
Total	640	2,441	4,574	7,360	10,785

4.3 Domestic availability of fossil fuel

- Coal: The Lao People's Democratic Republic's coal reserves are estimated to be about 600 million to700[24] million tons, occurring mostly as lignite with smaller amounts of anthracite. The largest reserve of lignite has been found in Hongsa in Xayabouly province; it is estimated to contain about 400 million tons, or more than half the estimated total reserves for the country. The mid-grade lignite is suitable for electricity generation and meeting other industrial thermal energy requirements. Coal consumption is currently limited to a cement factory, using about 35,000 tons per year, and a few smaller users. However, this is about to change as an IPP commenced construction in 2011 of a 1,800 MW coal-fuelled thermal plant in Hongsa. Most of the electricity will be exported to Thailand, with 100 MW reserved for sale to EdL.

- Oil and Gas

  There are no official figures for the proven resources of oil and natural gas in Lao People's Democratic Republic. In the 1930s, oil seeps were reported and investigated by French colonial geologists, but it was not until 1986 that hydrocarbon exploration commenced when the GoL opened the country's economy to foreign investment and private investment. Three Production Sharing Contracts (PSCs) were signed between 1989 and 1991.

  a) UK-based Enterprise Oil held the Savannakhet PSC between September 1989 and January 1996. Two 2D seismic surveys were undertaken, but no wells were drilled under this PSC. The Pakse PSC was held by US-based Hunt Oil Company between February 1990 and November 1997. Following acquisition of 967 km of 2D seismic data, the wildcat well Pakse1 was spudded in December 1996. The well was drilled to Total Depth (TD) at 2,540m, but was dry. The well was plugged and abandoned in March 1997.

  b) Shlapak Development Company operated by UK-based Monument Oil was awarded an SDC PSC from January 1991 until October 1998. Monument

[24] Energy Sector Development in Lao People's Democratic Republic, 24 June-12 July 2013, Energy Policy Training Course , TOKYO, Japan

acquired 494 km of 2D seismic data and spudded the wildcat well Naxay on 1st April 1996. But, it was found to be dry at a depth of 2,091m and the well was plugged and abandoned in July 1998.

Following 1998, no further exploration was undertaken until 2008 when UK-based Salamander Energy Co Ltd acquired 350 km of 2D seismic survey in its Savannakhet PSC. Stakeholders in the project are a Lao private company NCD/LIBC (5%), state-run PetroViet Nam (25%), International Finance Corporation (IFC), a member of the World Bank Group (10%), Australian Origin Energy (30%), and Salamander (30%).

In February 2010, Salamander Energy spudded its first well Bang Nouan 1 adjacent to the gas discovery Mukdahan-1 well in Thailand. The MB Century 26 rig was contracted for drilling. The Bang Nouan prospect was thought to be an extension of the proven Khorat Plateau play beyond the Mekong River, and was estimated to contain between 700 bcf and 1.2 tcf of potential gas reserves. The well was drilled to a total depth of 3,400 m and logging has been completed. Gas shows have reportedly been observed in Triassic –age Kuchinarai sandstones between 2,020 and 2,120 m and preliminary analysis indicates 25 m of potential gas pay. But, in August 2010, the company announced that the well had been plugged and abandoned because no significant flow of hydrocarbons to achieve a commercial flow rate was observed. In December 2010, Salamander and its partners elected to relinquish the Savannakhet PSC.

However, the well confirmed several elements of the hydrocarbon play. Gas shows in the Kuchinarai formation demonstrated long-distance gas migration from the source kitchen. The well also found a high permeability reservoir within the PhaNokKhao formation, which constitutes a target for future wells in the area.

The company also holds a 20% stake in the Champasak & Saravan PSC. The Champasak & Saravan PSC covers 41,140 km^2 and is located south of and adjacent to Salamander's Savannakhet PSC. Salamander's interest was acquired in March 2008 through a cross-assignment agreement with PetroVietnam Exploration Production Corporation (PVEP). Salamander is now conducting a 2D seismic survey in the block to define the prospects for drilling in 2012.

4.4 Fossil fuel import (last 5 years)

Due to the fact that Lao People's Democratic Republic lacks petroleum and natural gas resources, indigenous demand for petroleum products liquefied gas phase products (LPG) is met by importing from neighbouring countries, especially Thailand and Viet Nam. In 2010, the country imported 736,530 KL of products including gasoline, diesel fuel, boiler fuel, jet fuel, and lubricants. In addition, 1,510 metric tons of LPG was imported. About 45% to 50% of petroleum products imported are consumed in the capital Vientiane and in Vientiane province.

Table 25: Oil import in last five year[25]

Year	Diesel (L)	Gasoline (L)	Jet fuel (L)	Boiler fuel (L)	LPG (L)
2008	723,474,175	152,513,812	16,022,000	5,274,885	2,150
2009	457,322,690	159,459,824	14,078,244	5,919,000	2,160
2010	538,768,614	178,296,403	13,358,500	6,104,750	2,510
2011	546,000,000	198,260,000	19,000,000	8,741,000	770
2012	691,522,000	216,862,000	130,592,000	7,916,000	2,300

5. Current and Potential Market for Energy Services

The market potential for energy services and their applicability needs to be analyzed for assessing the national scenario for sustainable energy.

5.1 Identification of potential category of customers for decentralized RE technology/ application

TheGoL has a clear target of increasing the national electrification rate to 90% on a household basis by 2020.According to EdL, by the end of December 2013, 87.34% of households had been electrified and the remaining 12.66% had not been electrified. In other words, 136,743 households or 1,696 villages were not electrified by the end of December 2013.

The number of villages and households not yet electrified in each province is illustrated in Table 26. Base on this information, there is clearly a great number of potential customers for decentralized renewable energy technology. It is also worth noting that Lao People's Democratic Republic has many small and medium scale pig farms and other animal waste, municipal solid waste or household waste and agriculture as well as other natural resources such as small rivers, wind and so on that may be suitable for applying to renewable energy technology.

Table 26: District, village and number of non-electrified households

No	Province	District			Village			Households		
		Total	Non-electrified	%	Total	Non-electrified	%	Total	Non-electrified	%
01	Phongsaly	7	0	0.00	541	327	60.44	29,719	16,328	54.94
02	LuangNamtha	5	0	0.00	364	25	6.87	28,831	1,543	5.35
03	Huaphanh	9	1	11.11	716	310	43.30	46,618	18,782	40.29
04	Bokeo	5	0	0.00	265	40	15.09	30,190	398	1.32
05	Oudomxay	7	0	0.00	470	77	16.38	48,135	13,014	27.04
06	Xayabuly	11	0	0.00	433	61	14.09	70.184	3,915	5.58
07	LuangPrabang	12	0	0.00	772	32	4.15	75,275	12,368	16.43
08	Xiengkhuang	8	0	0.00	520	107	20.58	43,270	8,797	20.33
09	Vientiane	13	0	0.00	503	9	1.79	93,375	2,777	2.97
10	Vientiane Capital	9	0	0.00	500	0	0.00	139,925	8	0.01
11	Borikhamxay	7	1	14.29	315	38	12.06	46,158	4,638	10.05
12	Khammuan	10	0	0	581	94	16.18	71,407	9,774	13.69
13	Savannakhet	15	0	0	1015	285	28.08	144,754	23,341	16.12
14	Champasack	10	0	0	644	41	6.37	110,324	2,220	2.01
15	Saravan	8	0	0	605	101	16.69	60,281	8,932	14.82
16	Attapeu	5	0	0	147	32	21.77	25,100	5,420	21.59
17	Sekong	4	0	0	229	117	16,796	51.09	4,488	26.72
Total		145	2	1.38	8620	1,696	19.68	1,080,342	136,743	12.66

Source: EDL, Planning Office, December 2013

[25] Ministry of Industry and Commerce, Lao state Fuel Company, and Fuel and Gas Association

5.2 Decentralized RE technology/applications and services suitable to cater to the needs of urban and rural areas, Provide qualitative information

Most of RE technologies used in urban areas are solar, biomass. These are used for a number of applications, such as water heating, street lighting, solar roof, cooking stove and biogas digester.

Meanwhile, the main technologies in rural areas are solar, biomass, small hydro power (SHP), cooking stove, metal tripod, stone fire, biogas digester and gassifier (40 kW only in Xayabuly province, north of Lao).

6. Energy Efficiency

Resources need to be used efficiently to reduce costs and increase the energy reach of available resources.

6.1 Energy efficiency programmes implemented by national/provincial government

Energy efficiency and conservation (EEC) in the Lao People's Democratic Republic is at an early stage. The government has yet to develop a comprehensive national strategy for EEC. There has been some assistance provided by multilateral and bilateral donors, most notably the World Bank Rural Electrification Project concerning demand-side management.

With the creation of the IREP and DEM under MEM, EEC initiatives are now more coordinated. The IREP is preparing a national EEC strategy and draft regulations. The DEM is preparing requirements concerning monitoring of energy use and labelling for electricity appliances.

While EdL had been promote efficient use of electricity in government office, residential and industrial sectors by providing more efficient lamps, cleaning air conditioning and increasing awareness on how to use electricity efficiently through TV, leaflets and posters.

Lao has cooperated with many organizations to carry out EEC. Details of these activities can be seen below.

① World Bank
- Change 400,000 bulb lamps to CFL
- Change FL T8 to T5 in 50 buildings
- Change 100 units of Window Air-cons to Ceiling Air-cons
- Propagation of Energy Saving in the mass media

② MEM continue to work with the ASEAN programme as: PROMEEC, AEMAS, Standard and Labelling

③ Tokyo University study on the Road map for the Energy Efficiency

④ Government announced a plan to stop the import of used cars from February 2012

⑤ Government of Japan gave 40 new public bus to Government of Lao People's Democratic Republic in June 2012 for public transport

6.2 Policy / law / mandate with regard to energy efficiency programme implemented

Under the supporting of Asia Development Bank (ADB), IREP is preparing a national EEC strategy and draft regulations

6.3 Has any time bound national target been specified for energy efficiency

Under the draft national energy efficiency and conservation strategy, Lao has set a target to reduce energy consumption up to 10% by 2030.

6.4 National energy efficiency plan

Under the draft national energy efficiency and conservation strategy, the development plan has been divided in three periods as short-term, medium-term and long-term as follows:
Short-term: 2013-2018 focus on development of policy and regulation framework, develop law, and develop the guideline and regulation for the energy efficiency and conservation in the residential, building, industries sector;
Medium-term: 2019-2024
Long-term: 2025-2030

6.5 Energy efficiency standards and labelling programmes at national level/best practices at provincial level

In terms of cook stoves, Lao People's Democratic Republic's lack of a national agreement on standards has made it challenging for stove manufacturers, distributors, investors, and users to rate the quality and efficiency of cook stoves in different markets. As improved stoves are not necessarily significantly cleaner, safer, or more efficient, having a set of standards in place that clearly define how technology impacts fuel use, emissions, durability and safety will allow consumers to make more informed choices, encourage manufacturers to build higher quality stoves and increase the level of overall investment in the sector.

The introductions of the energy efficient cook stoves (Tao Prayat) and improved cook stoves reflects the consequences of the lack of national standards. Indeed precise specifications have been implemented in collaboration with stoves producers in order to improve the regular bucket stoves.

But when it appeared that profit margins were low, producers started to cut down the cost of production by reducing insulation, the thickness of grates and the number of grate holes. The absence of standards could not guarantee the quality of the stoves produced, and so user confidence in the stove decreased.

Creation of national standards will give stove makers affirmation of product quality, let users know they are making a worthwhile investment and drive industry innovation.

However, when we consider electricity appliances, Lao People's Democratic Republic has been member of the International Electro-technical Commission (IEC) affiliate country programmes sine 01 June 2006 and adopted IEC standards of 50 Electrical and Electronics products as Lao National Standards. These include safety and performance specifications for lighting products, for double-capped fluorescent lamps and performance

requirement for ballasts for tubular fluorescent lamps and lamp holders for tubular fluorescent lamps and starter holders.

In 2013, there are additional IEC standards of 67 Electrical and Electronics products waiting for adopting as Lao National Standards[26]

Lao People's Democratic Republic has not yet developed National Labelling Programmes. As well as this, Lao People's Democratic Republic has no manufacturing capability for Electrical and Electronics products such as lighting products. These products are typically imported from neighbouring countries such as Thailand, China and Viet Nam. Lao People's Democratic Republic also has no test laboratories for energy efficiency. Many appliances are imported without the quality control, some appliances are high quality but some appliances are low quality (high energy consumption, not safe, easily broken and sometimes very expensive)

6.6 Awareness level of community to use energy efficient products /services

As mention in section 6.1 Lao People's Democratic Republic has cooperated with many organizations to conduct activities to promote EEC under the programmes such as

- The ASEAN-Japan: Promotion on Energy Efficiency and Conservation (PROMEEC)
- The Ayerawadee-Chao Phraya-Mekong Economic Cooperation Strategy (ACMECS):

The activities include raising awareness on energy saving, organizing training, seminar, workshop and energy audit.

- The Demand Side Management/Energy Efficiency (DSM/EE) project in EdL, which support by WB: the activities of DSM/EE Expansion of the Public Sector Energy Database (PSED), Household Appliance Saturation Survey, Implemented of the energy audit for 50 government buildings, Selected in 4 government buildings as pilot project. The main activities of this project is:
  - ✓ Cleaning air conditioning units and installing timers
  - ✓ Installing a switch for each lamp
  - ✓ Propagating information on energy saving through the mass media and distributed the posters and brochures

[26] Department of Energy Management, MEM, Mr. Viengxay CHANTHA

B. Technology Enabling Environment and Ecosystem

1. Government Initiatives to Promote Sustainable Energy Technologies (SETs)

Role of government is to be examined in creating enabling conditions for the development of sustainable energy options and energy services and provisions for access to energy for the poor.

1.1 Details of existing national policies/law/regulations for development of SETs, grid-connected and off-grid, Provide documents in support of this

Beside the Policy on Sustainable Hydropower Development in Lao People's Democratic Republic (PSHD), which is currently being updated, and Lao Electric Power Technical Standards (LEPTS), Lao doesn't have any policy/law/regulation to promote sustainable energy technologies (SETs) for grid and off-grid.

The Government of Lao People's Democratic Republic launched the Renewable Energy Development Strategy in October 2011 which became the main policy framework for the development of renewable energy in the country. The strategy targets to increase the share of renewable energy in total energy consumption to 30% by 2025.The government also aims to replace 10% of transport fuels by biofuels during the same period[27], the target detail of each renewable energy resource are illustrated in Table 27 below.

Table 27: Target of renewable energy development until 2025

Item	Phase Description	2015	2020	2025
		MW	MW	MW
1	**Electricity**	140	243	725
1.1	Small Hydropower	80	134	400
1.2	Solar	22	36	48
1.3	Biomass	13	24	58
1.4	Biogas	10	19	51
1.5	Municipal solid waste	9	17	36
1.6	Wind	6	12	73
2	**Biofuels production**	**ML**	**ML**	**ML**
2.1	Ethanol	15.42	34.62	97.6
2.2	Biodiesel	22.25	63.93	194.5
3	**Heat**	**Ktoe**	**Ktoe**	**Ktoe**
3.1	Biomass	23	29	113
3.2	Biogas	22	44	178
3.3	Solar	17	22	109

Currently, electricity purchase from renewable energy in Lao People's Democratic Republic is based on negotiations on a case-to-case basis. The power utility, EdL, accepts an electricity tariff less than US$7 cent. There are no specific policies for providing energy access.

[27] Renewable Energy Strategy Development in Lao People's Democratic Republic, October 2011

1.2 Measures undertaken by government for private sector participation in SETs

The development cost of RE is generally much higher than thermal power and medium and large hydropower projects. Most countries around the world provide financial measures to make RE economically viable such as Feed in Tariff, Adder adopted in Thailand, etc.

The GoL has provided various financial incentives by addressing laws relevant to RE projects and investors as described in part A, sub-section 1.11 of section 1. These laws include, but are not limited to, investment promotion law, tax laws, value added tax laws and duty laws.

1.3 Regulations framed to promote grid connected / off-grid renewable energy technologies by electricity regulatory authority

Beside LEPTS and Lao/EdL grid code, Lao People's Democratic Republic doesn't have any regulation or laws to promote grid connected renewable energy technologies. As well as this, Lao People's Democratic Republic doesn't have electricity regulatory authority. MEM is typically responsible for managing power development.

1.4 Subsidies rolled out for fossil fuels

Based on a discussion with Ministry of Finance and Ministry of Industry and Commerce, Lao People's Democratic Republic doesn't have any subsidies for fossil fuels

1.5 Subsidies rolled out for renewables

As mentioned in part B, section 1.2, Lao doesn't have any law/regulation to allow subsidies for renewable technologies

2. Institutional and Human Resource Development Framework

Institutional and HR capacity building is critical for successful implementation of SET programmes in a country.

2.1 Provide information on Institutions engaged in implementing RE and SET programmes at federal and provincial level

The lead organization engaged in implementing renewable energy is IREP/MEM, followed by MOST, MIC which are responsible for liquid fuel, LPG and the provision of licensing for manufacturing. MAF, MONRE, Lao Women Union, National University of Laos (NUOL), EdL and the private sector are all involved in implementing RE and SET.

In general, renewable energy resources will most likely be developed under the direction of MEM. Coordination with renewable energy sector organizations is recommended so that their data, experience and expertise can be accessed for future projects. As well, these organizations are able to contribute practical experiences on appropriate technologies, implementation approaches and pilot projects

Table 28: List of Institutions and function implement renewable energy

No	Name of Institution	Function
01	Institute of Renewable Energy Promotion/MEM	①Implementation the RES of Lao People's Democratic Republic in practicable issued by government - Promote and develop renewable energy

No	Name of Institution	Function
		- Formulate and improve laws and regulations, standards, procedure and guidelines to facilitate renewable energy development - Encouraging renewable energy development especially biodiesel and bioethanol and small power generation for self-consumption and connected to the grid of EDL - Research, reviews and provide technical comment for investment, beneficial on financial and economic analysis, energy purchase, energy marketing in the country and in the area - Study, data collection and database formulation, disclose and advise on data and information of renewable energy such as small hydro power with install capacity more less than 15 MW, solar, wind, biomass, waste from city and industry and other of renewable energy related with regulations ②Promote and develop rural electrification - Study and formulate plan, project action plan to development and extend rural electrification and update rural electrification master plan - Review and provide technical comment for investment, beneficial on financial and economic analysis, energy purchase, energy marketing in the country and in the area of supporting and developing off-grid project related with regulation - Monitoring and extend rural electrification relate to planed and in the scope of supporting by international organization ③promote energy efficiency and conservation - Study, formulate and draft policy and strategy of energy efficiency and conservation - Define procedure, regulations and guidelines for energy efficiency and conservation related with heat energy - Study and formulate plan, project action plan to development and support energy efficiency and conservation - Encourage and production cooking stove in effectively and safely - Cooperation and Coordination with line ministries, agencies for both national and international to support the implementation of Clean Development Mechanism and Climate Change Adaptation The activities has been done by IREP are described in section 1.3
02	Renewable Energy and New Materials Institute (REMI)/ MOST	REMI plays role as secretary to MOST in research, development, transfer, promotion, application and service on Science and Technology. The REMI plays a vital role and function in conducting research and development in

No	Name of Institution	Function
		an applied and adaptive research platform on renewable energy technology in conjunction with traditional technology for demonstrative and dissemination applications of renewable energy technology to support government guideline, policies and development programmes. Study, research, select or adjust international progressive sciences and technologies to actual condition of country for the national socio-economic development. Transfer the successful result of research, adjustment or development on the science and technology within the country. MOST had created a REMI which will be a training centre, demonstration and research centre promoting the development and use of RET. Demonstration of RET applications for public awareness. This Institute will also offer training in the utilization of the various technologies to the national technicians and also to the region
03	Provincial Department of Energy and Mines	The provincial level also supports the implementation of RE and EEC. The PDEMs support is described in section 1.3, part A.
04	Faculty of Engineering, National University of Laos	Is mainly involved with research and educational issues on renewable energy. Over 200 students have graduated in this field since 2000s.
05	Faculty of Science, National University of Laos	Mainly involved with research and education issues on renewable energy
06	Lao Institute for Renewable Energy (LIRE)	Consultancy conducting research and providing renewable energy technological (pico-hydro, biodiesel, biogas, improved cooked stoves "ICS", rural energy) socio-economic and energy efficiency services Providing public resources for information and advice on the use of renewable energy technology Capacity building and training related to renewable energy
07	Ministry of Natural Resources and Environment (MONRE)	Main coordinating agency for environmental planning and management across all sectors
08	Renewable Energy for Sustainable Development Renewable Energy for Sustainable Development Association (RESDALAO), Sunlabob	Are private sector organizations, heavily involved with the introduction of Renewable energy equipment using innovative mechanisms like hire-purchase systems of PV system, solar powered water pumping, etc.

2.2 Provide information on Institutions engaged in implementing energy efficiency programmes at federal and provincial level

The main actors involved in implementing EEC at the national level are MEM and EdL. PDEM and EdL branch offices are responsible for implementing EEC at the provincial level.

The draft national energy efficiency and conservation strategy describes the activities undertaken by the relevant ministries involved in EEC. This can be seen below in Table 29.

Table 29: List of Institutions and function implement EE & C

No	Name of party concerns	Function
1	MEM	The main agency responsible for EEC coordination and its main functions are the following ▪ Develop overall EEC policy and support the achievement of sustainable development goals ▪ Formulate transparent market mechanisms to promote investments; ▪ Promote human capacities for the development of renewable energies, and strengthen capacities of other government agencies; ▪ Propose investment incentives.
02	MOST	MOST has the role of conducting research and pilot tests on science and technologies developed from different countries for EE & C applications.
03	MOIC	Facilitates the importation of equipment and machinery.
04	MoF	Determines appropriate tax and duties policies for equipment, machinery.
05	MPWT	Responsible for the introduction of policies that promote the use of alternative fuels in individual vehicles, public transportation systems, freight and air transports.
06	Commercial Bank	Consider credits and low interest loans as source of financing for EEC.
07	MPI	Responsible for the formulation of investment policies and incentives to attract and facilitate domestic and foreign investors concerning EE & C investments.
08	MCT	Raise people's awareness to understand government policies on energy efficiency and conservation; as well as mobilize and promote the use of EE & C through different communications media.
09	MoES	Encourage development and integration of EE & C in the tertiary education levels.
10	Other sectors and provincial governments	Will ensure that the roles and responsibilities of these agencies are respected and enforced.

2.3 Financial institutions and the service offered by them in grid-connected and off-grid RE and SET development at federal and provincial level

Most of financial institution services for grid connected and off-grid renewable energy and sustainable energy technologies in Lao People's Democratic Republic are from international

organizations. For example JICA, New Energy and Industrial Technology Development Organization (NEDO), New Energy Foundation of Japan (NEF), WB, ADB, Energy and Environment Partnership (EEP-Mekong), Nordic Development Fund and AusAid all offer financial services to GoL for a variety of RET and SET projects.

2.4 Micro-financing institutions involved in RE and SET financing

There is no information to suggest that micro financing institutions are involved in financing RE and SETs.

2.5 Role of institutes: Instances of capacity development of local and national institutes for project implementation and possibility of taking over project functions once financial and technical support is withdrawn

These institutions will continue to monitor project implementation once financing is withdraw. It is likely that these institutes will face difficulty and will keep looking for additional donors. The IREP had been carried out on capacity building for provincial level such as biomass and alternative energy, Small Power Producer (SPP) and improved cooking stoves.

2.6 Status of academic / trade curricula in respect of coverage of sustainable energy

Based on discussion with Prof. Dr. Khamphone NANTHAVONG at the Faculty of Engineering (FE), National University of Laos (NUOL), there are currently two faculties at NUOL conducting modules relating to renewable energy courses at the bachelor degree level; the faculty of engineering and the faculty of science.

The faculty of engineering (FE) has had a RE course conducted by the Mechanical Engineering Department since 1994, focusing mainly on solar, biomass technology and small hydro power. The electrical engineering department conducts modules on solar only. The FE receives cooperation with many international organizations to develop solar technical textbooks and assessments on solar radiation. Furthermore, FE also receives cooperation from the Government of Finland on capacity building, focusing mainly on staff. The FE also cooperates with universities from neighbouring countries.

In 2011, the Faculty of Science (FS) created a Master of Sciences Degree in Renewable Energy. This programme mainly involves research and education on issues relating to renewable energy

The institutions or parties that have been involved in trade curricula in respect to coverage of sustainable energy include the following:

Institute of Renewable Energy Promotion/ Ministry of Energy and Mines

IREP/ MEM conducted rural electrification by SHS under support from JICA during 1997-2000. Since2001, the World Bank has supported implementation of the Rural Electrification Programme (REP). REP Phase I (REP I) was completed in April 2012 followed by REP Phase II (REP II), which will be completed in 2014. REP is being implemented both through solar photovoltaic systems, i.e., solar home systems (SHS) and grid extension to develop rural energy access. To achieve a higher electrification rate in rural communities, a capacity of 20~50 Wp SHS is sold through a sales scheme to rural households with monthly instalments. Because size and capacity are relatively small, the unit price is not too high. However, the

average price of installation (US$500)is often prohibitive for rural households in remote areas. To address this, MEM and World Bank have designed and introduced a longer-term payment scheme of 10 years.

Ownership of SHS is transferred to the household after completion of instalments. However, SHS is installed with a battery and controller to charge energy in battery to use electricity at night, which requires operation and maintenance works. REP I introduced ESCO for operation and maintenance of SHS. Services from ESCO to repair and replace batteries and controllers are paid by users as fee-for-services.

Ten years is the maximum time limit of instalments under the hire-and-purchase scheme. The monthly charge per unit ranges from US$2 to US$3, which consists of the following costs:

(a) 50% of initial cost

(b) Salary, expenses, and incentive required for ESCO business

(c) Salary, expenses, and incentive for operators selected in communities

Monthly fees are collected and transferred from communities to MEM in Vientiane. Balances of the collected cash deducted by each village manager and ESCO for costs and incentives are pooled in the Rural Electrification Fund (REF), which is a revolving fund under the management of MEM for promoting further rural electrification. Figure 6in Part C, Section 1.6 shows the structure of REF together with cash flow and work flow for both REP I & II. The main organization handling REF is VOPS, which is appointed by PMU through an open tender organized by MEM. A French consultant, Innovative Energy Development, was selected in REP I. For REP II, Envir-Tech Consultant Co. Ltd. /Green Energy Company Limited, a joint venture between Thailand and Lao People's Democratic Republic was appointed in February 2012.

SHSs are installed under a grant from the World Bank and other donors. We may consider grant money for REP I & II as a capital investment from international donors to promote rural electrification. Manpower costs and expenses including incentives for village managers and ESCOs are similar to running costs for maintaining solar home systems. Initial investment cost, therefore, is recovered from the balance of instalments after deducting operation and maintenance costs, together with incentives for village managers and ESCOs. Although the initial cost will not be repaid in full because of the insufficient components of the monthly charge as described above, e.g., only 50% of the initial cost is included, as we identified, the fund is reserved within REF as a revolving fund to promote further rural electrification, which may enable REP I & II to be considered reasonable investments for rural electrification.

Provincial Energy Services Companies (PESCO) conducting under the supervision of IREP to conduct rural electrification

Sunlabob Renewable Energy Co., Ltd. is a Lao People's Democratic Republic private energy services company offering a range of energy products and services. As well as this, the company is considered a pioneer of the franchise approach to rural electrification. To deliver off-grid power to poor villages, Sunlabob has designed an innovative model through which villagers buy light as a service through community-owned lanterns, which are charged every few days by a village-based solar station rented from Sunlabob and operated by a village

franchisee. Because staff are required for the activity in villages, a village energy committee and village technician are established, then engineering is transferred to the staff following 6-9 months training.

2.7 Existence of specialized course in sustainable energy at different level of education

Currently, there are no special courses at any level of education except those provided by the Faculty of Engineering and at the Faculty of Sciences at the NUOL, which were described previously in part B, section 2.6.

2.8 Institutes having expertise in various technologies and policy making

The FE at NUOL have expertise in various renewable energies such as solar, small hydro power and biomass technology. FS specializes on chemical components of RE and faculty of hydrology has expertise on hydro power.

MEM (IREP, DEPP) has experience on policy and governance on energy development, especially power development. In particular, Lao People's Democratic Republic has experience in governance mechanisms for sustainable power development, policy development on sustainable hydropower development in Lao People's Democratic Republic, power planning, Lao renewable strategy development, rural electrification funds and EEC strategy.

MOST (REMI) has experience conducting research on biofuel (biodiesel and bio ethanol) production from various feedstock, solar, improving cooking stove (ICS).

2.9 Institutions responsible for undertaking R&D in SET and services

The official institution responsible for undertaking research and development currently is REMI under the MOST. Meanwhile, IREP is also working on a mechanism to enable international and local investors to develop renewable energy and supply the grid (or mini grids), using a yet-to-be-developed standardized agreement, pricing policy and off-grid projects.

2.10 Ministries/agencies involved in collaboration for projects and promoting the best technologies

The official Ministries involved in cooperation for projects and promoting renewable energy development are MEM and MOST.

3. RE and SET Manufacturing Capacity

RE and SET manufacturing capacity indicates the capability of a country to produce components domestically. A good RE and SET manufacturing capacity reduces cost of projects because of low cost components used in the project.

3.1 Industries involved in manufacture of SET products and services

Lao People's Democratic Republic doesn't have any manufacturing capacity to produce the equipment needed for renewable energy.

3.2 RE and SET manufacturing base in the country (location and production capacity MW/annum)

Most of renewable energy equipment is imported, except cooking stoves which are locally produced. Currently, the improved cooking stove design chosen for the project was more efficient than before and suitable for the local conditions. It has a wide opening so that it is possible to use large pieces of wood.

3.3 Provide information on support offer by government to RE and SET manufacturing sector

- Policies/law on domestic content requirement: Lao People's Democratic Republic doesn't have any standard yet for RE and SET except LEPTS and Lao grid code or EdL grid code.
- Reduction in duty for RET/SET equipment/component import: To reduce investment cost, the GoL provides free duty fee for the import of equipment and materials that could not be produced in Lao People's Democratic Republic (e.g. Investment Promotion Law 2009, tax law 2005, VAT 2006 and custom law 2005).
- Infrastructure support e.g. creation of special economic zone (SEZ): there has been no investment by the government in terms of infrastructural support. However, the government has full support under the special economic zone law.

3.4 Examples of effectiveness of national and local environment in attracting private entrepreneurs, investors, foreign direct investment, etc.

The Investment Promotion Law, tax law, VAT law and custom law provide free duty fee for importing equipment and material which could not be produced in Lao People's Democratic Republic. Under the Electricity law, the government provides concession agreements for operation up to 30[28] years after completion construction, so that in terms of energy development in Lao People's Democratic Republic, large hydro power development is effective. For example, Nam Theun 2 Hydro Power Project, Theun-HinBoun Hydro Power, Nam Ngum 2 and many other existing and other hydro power project which are under construction.

Moreover, the government established a positive and open environment for dialogue and cooperation with the development partner community. This led to strong donor engagement and support that continues today. For over two decades, the energy sector has received an ongoing stream of well-sequenced credits and grants blending policy support with programme financing. In this process, the sector has been very open to, and has benefitted from, knowledge and advice conveyed over the course of regular and frequent interactions with donors. This complemented international experience and lessons learned on the policy front with significant day-to-day implementation support experience gained in the Lao People's Democratic Republic programme.

[28] Electricity Law 2011

C. Business Enabling Environment and Ecosystem

Businesses play different roles, depending on size and type of product and service they provide and their value proposition.

1. Financing of SETs and Delivery Services and Risk Management

1.1 Public fund available for loan guarantee, risk mitigation and insurance support to help address policy risk for SE investments

For a decade, foreign investors in Lao People's Democratic Republic have mainly been represented by consortia of foreign companies and foreign private investors interested in large hydropower generation for export. The main financing mechanisms for large and medium IPP projects are risk and guarantee by international banks (e.g. the World Bank and The Asian Development Bank) and credit export companies, capital investment and investors. Currently, there is no public fund available for loan guarantee, risk mitigation or insurance support to help address policy risk for SE. However, the Asian Development Bank (ADB)[29] support will be provided primarily through the GMS Programme of Economic Development, which will work with ADB's Private Sector Operations Department to promote opportunities for PPP for investing in the energy sector. ADB will also draw on its new financial instruments, including partial risk and other forms of guarantees, to help improve the availability and terms of financing for private-sector-led power generation projects.

1.2. Information on risk mitigation instrument practiced

There is no risk mitigation instrument practiced in the country. However, the proposed ADB strategy in support of the Lao People's Democratic Republic energy sector integrates risk mitigation. The importance of capacity building for MEM and EdL staff is emphasized. With appropriate training, staff of the MEM and EdL will be better able to appraise and approve the most technically sound and economically efficient project proposals. In the same manner, well-trained and experienced staff of key government agencies (e.g. MEM and MONRE) will be able to properly prioritize power projects and ensure that project developers apply the best practices in meeting social and environmental safeguards. The proposed ADB strategy includes a non-lending programme support for capacity building to mitigate the first and second risks. The third risk [30]will be mitigated through synchronization of project implementation. The ADB strategy includes support in partnership with both the public sector (for transmission network projects) and the private sector (for hydropower projects)

[29]Lao People's democratic Republic , Energy Sector Assessment , Strategy, and Road Map, 2013 update, Asian Development Bank

[30] ADB's proposed strategy of support for the Lao People's Democratic Republic energy sector is subject to three main risks. First, the Lao People's Democratic Republic has a limited capability to manage energy projects. Skilled human resources are required to actively participate in project identification and development in assessing social and environmental impacts, project appraisal, and project implementation and management. Second, there is the risk that the influx of private developers looking for business in the Lao People's Democratic Republic will increase the risk that government agencies will make the wrong choices—choosing "easy" projects at the expense of environmental protection and social impact mitigation. Third, and related to the first two risks, delays in securing IPPs would impact negatively on the government's export target.

1.3. Provide information on import regulations in case of SETs with supporting documents

All types of exported, imported or circulated goods within the country shall be controlled by customs officers. In order for a company to import commercial goods into Lao People's Democratic Republic, it is necessary that the company be registered with the Ministry of Industry and Commerce, Enterprise Registration Division.[31]

Before importing goods into Lao People's Democratic Republic, it is necessary to ensure that the goods do not fall into the category of prohibited goods. Prohibited goods cannot be imported, exported, transited, sold or circulated in Lao People's Democratic Republic (*Customs Law 2011, Article 31*). Among prohibited goods are weapons, narcotics, psychotropic substances and hazardous chemical substances. It is necessary to refer to the specific laws and regulations that cover these prohibitions. The goods can be imported into Lao People's Democratic Republic with warehouse regime and temporary imports regime.

The goods imported under the *Temporary Imports* regime are described by the following characteristics:

- Goods necessary for the manufacture, processing, assembly, transformation or repair of items which will subsequently be re-exported ("inward processing")
- Vehicles imported for the purpose of project supervision or for tourism or business visits as long as they are re-exported by the allotted time
- Materials required for project supervision purposes, Exhibition, educational or scientific materials

For these types of import, one must submit a declaration under *Temporary Imports* regime. No duties are payable on these imports.

In all the above cases relevant documents or permits must be obtained from the relevant authority and presented to customs. Before importing goods under this regime, it is necessary to contact customs to obtain advice as to what documentation will be required for the case specific circumstances.

Exemption from customs duties and other obligations are available for diplomatic missions, for goods imported under a government investment promotion scheme or for certain economic zones and for other goods to be imported under certain circumstance.

In case of RETs, the equipment and system accessories can be imported by either the project owner or concerned company. Presently, there is no standard to regulate quality of import of RET equipment and accessories into Lao People's Democratic Republic. In order to promote utilization of RET, The Renewable Development Strategy of Lao People's Democratic Republic[32] has mentioned that all investments in renewable energy projects in Lao People's Democratic Republic, whether on biofuels production, grid connected or isolated systems, off-grid projects or individual systems are entitled to investment incentives under the Investment Law of Lao People's Democratic Republic, updated in 2009. The financial incentives include the following:

- Import duty free on production machinery, equipment and raw materials;
- Import duty free on chemical materials necessary for biofuels production within seven years;

[31] Guide to import and export, Lao People's Democratic Republic trade portal, version1.0, June 2012, http://laotradeportal.gov.la

[32] The Renewable Development Strategy of Lao People's Democratic Republic, MEM 2011

1.4. Existence of clean energy fund by levying access on electricity generated from fossil fuel / fossil fuel consumption

Right now, there is no existence of clean energy fund by levying access on electricity generated from fossil fuel/fossil fuel consumption due to the fact that most of the electricity produced in Lao People's Democratic Republic comes from hydro power. As well as this, the government does not want to make the consumer responsible by placing a high price on imported fuel. However, it was found in the draft version of the decree for regulation and utilization of Bio-fuel in Lao People's Democratic Republic[33], an amount of 10 kip per litre (US$0.125 cent) will be charged from consumers of all kind of oil product and bio-fuel producer to contribute to Renewable Energy Fund.

1.5. Whether the financial institutions / banks are considering RE / SE finance under priority sector lending

The Bank of the Lao People's Democratic Republic (BoL)[34] is the central bank that supervises and oversees the Lao banking sector. In the hierarchy of the GoL, the BoL holds a position that is equivalent to a ministerial level.

Currently, BoL does not have any policy on the financing of RE projects. However, they are willing, and would like to play a key role in this sector in the future. There are two possible approaches that BoL can adopt in financing RE. One option would be to attract grants from international donors, where MPI would play a lead role in this. The funds could then be put into the Agricultural Promotion Bank and Nayobai Bank, and divided into two components. For example 500,000 US$ is put aside for grants, while 300,000 US$ for TA.

Another possible way for financing RE is through micro financing, where at the moment the BoL wants to raise the limit of loans to 10 million kip (US$ 1,200) for end users who must be under grant coverage/grant project. Borrowers would need to pay back the loan on a regular basis, within a maximum timeframe of five years[35]. Borrowers would not need any physical or individual collateral, but it can be a 'group collateral'. Furthermore, BoL can play a leading role in attracting grants as a means to facilitate financial issues at a macro level for MPI. Moreover, BoL can also promote RE projects through wider advertisement in the city and rural areas, as well as increasing awareness on RE technologies.

The banking sector in Lao People's Democratic Republic is compiled of five major categories of actors, whose financial records are summarized in the following Table:

[33] The draft version of decree for regulation and utilization on biofuel in Lao People's Democratic Republic, Prepared by MEM dated of 11 September 2013, circulate to concerned organization for comment,

[34] Bio-Renewable Energy Financing Study (Lao People's Democratic Republic), Final Report, LIRE, November 2010.

[35] As mentioned in report of Microfinance in Lao 2009, There were 26 Microfinance Institutes under regulation of Bank of Laos, in those 5 Institutes are Deposit-Taking, 8 institutes are Non-Deposit Taking and 13 are Saving and Credit Union (SCU), the interest rate of loan the money for Microfinance institute (MFI) in Laos is higher compare to international standard, usually the interest rate charge in monthly, it is difficult to charge in yearly due to decreasing of loan balance. The steady interest rate for loan with one year loan is 2% per month. the loan over once year the interest rate is not uniform, 46% of MFI charge around 4% per month, 19 % of MFI charge over 4% and 35% of MFI charge less than 4%, in these, major of SCU charge higher interest rate.

Table 30: Financial records of major banking categories in Lao People's Democratic Republic

	Number	Assets Millions USD	Deposits Millions USD	Loans Millions USD	Loan-to-Deposit Ratio
State Owned Banks	4	1,486.98	1,035.95	654.29	63.16%
Joint Venture Banks	2	138.65	77.20	80.73	104.58%
Private Banks	4	152.58	134.78	97.77	72.54%
Affiliated Banks	3	142.41	55.72	53.29	95.64%
International Banks	8	284.96	117.32	152.86	130.29%
TOTAL	**21**	**2,205.59**	**1,420.97**	**1,038.94**	**73.11%**

SOURCE: Bank of the Lao PDR, 4th Quarter Review 2009

State-Owned Commercial Banks

The state-owned banks dominate the banking sector, accounting for 67.41% of all banking sector assets, and 62.98% of all bank loans[36] (as of the fourth quarter 2009). There are four state-owned commercial banks in the Lao People's Democratic Republic: Banque pour le Commerce Exterieur Lao (BCEL), Nayoby Bank, Agricultural Promotion Bank (APB) and Lao Development Bank (LDB)

The Agricultural Promotion Bank (APB) does not have any formal RE policy. However it has supported several biogas and biofuel projects. APB is willing to expand its activities beyond biogas and biofuels to also support both solar and pico-hydro projects in the future. There is no limit when it comes to scale of investment and the assessment of funding is centrally based on the reality and feasibility of a project. The APB invests in both small and large-scale projects (maximum loan up to 1,300 billion Kip)[37]. The maximum loan per company cannot exceed 25% of the capital registered by the business license. In terms of micro credit, the maximum loan per borrower is 1,220 US$, short terms loans (up to one year) have an interest rate of 10-14% and medium and long-term loans (up to 3 years) are at 12-15%. One practice that has worked effectively up till now is the practice of group collateral. The legal procedure to request financial support is through the certification of the village chief, which is to be signed by both spouses and a project feasibility study, needs to be certified by the relevant ministry.

The Lao Development Bank (LDB) is a public enterprise, which provides credit/banking services to SME customers who want to borrow or save money. LDB does not have a specific policy on financing RE projects, but it does provide funds to small and medium scale projects in Lao People's Democratic Republic. For example, LDB is financing the 'Namlong Hydropower Project' with a capital investment requirement of US$ 9 million. LDB is providing US$ 1 million, with the rest of the financing being derived from a loan from BCEL Bank and the project owner's fund. The legal procedure to request financial support are based on customer interviews, certified applications by the village chief and spouses, feasibility

[36] As indicated in Lao Development Bank, the interest rate of loan divided into three terms: 12-14% Short terms loans (up to one year), 13-15% for medium and long-term loans (one up to 5 years) and 14-16% for long term over 5 years

[37] 1$US is about 8,000 kip

study that are certified by the line government departments, collateral (land title) and contribution fund of the borrower.

Joint Venture Banks

There are two joint venture commercial banks in the Lao People's Democratic Republic: Joint Development Bank and Lao-Viet Bank. The joint venture banks account for 6.29% of all banking sector assets and 7.77% of all bank loans (as of the fourth quarter 2009).

Private Commercial Banks

There are four private commercial banks in the Lao People's Democratic Republic: Phongsavanh Bank, Indochina Bank, ST Bank and Booyong Lao Bank. The private commercial banks account for 6.92% of all banking sector assets and 9.41% of all bank loans (as of the fourth quarter 2009).

Affiliated Banks

There are three affiliated banks in the Lao People's Democratic Republic: ANZV Bank, ACLEDA Bank, and International Commercial Bank. The affiliated banks account for 6.46% of all banking sector assets and 5.13% of all bank loans (as of the fourth quarter 2009).

ANZ VCB does not have any formal policy to support the RE sector*;* however the ANZ group in Singapore has financed two large-scale hydropower projects in Lao People's Democratic Republic. There is no limit to the size of a loan. The bank is more interested in investing in large-scale projects rather than micro or small-scale entrepreneurs. The reason for this is that larger well-established companies are better prepared and constitute a less risky investment.

The ACLEDA bank was established in 2008, and now has branches across four provinces. The ACLEDA bank does not have any formal RE policy to support the RE sector. It is however open to all types of businesses (as BCEL, APB, and LDB are) to borrow money from the bank, particularly SMEs. On average the total loan size is 300,000 US$ and interest rates vary from 19% (small loans) to 13% (large loans). The legal procedure for requesting financing is based on an assessment of home/business.

International Banks

There are eight international bank branches or representative offices in the Lao People's Democratic Republic: Siam Commercial Bank (Thailand), Thai Military Bank (Thailand), Bangkok Bank (Thailand), Krungthai Bank (Thailand), Ayudhya Bank (Thailand), Public Bank (Malaysia), Sacom Bank (Viet Nam), and Standard Chartered (UK – representative office only). The international banks account for 12.92% of all banking sector assets and 14.71% of all bank loans (as of the fourth quarter 2009).

A number of the above mentioned international banks have been involved in the financing of medium and large hydropower projects. They facilitated project bonding and Thai Bath currency for debt financing.

1.6. Existing mechanism for SET finance (both for grid- connected and off-grid technology)

The GoL will provide support by seeking assistance from international organizations, commercial banks and low interest loan sources [38]for funding renewable energy projects; to encourage private commercial banks to understand and develop an interest in renewable energy projects.

As well as this, the GoL issues investment guidelines and development roadmaps to attract internal and foreign investments in renewable energies. The GoL will establish a one-stop service centre for disseminating information and facilitating investments on renewable energies.

To harmonize the support to renewable energies in Lao People's Democratic Republic, the Government will establish a Renewable Energy (REN) Fund as sub-account to the existing Rural Electrification Fund (REF). The Fund will be used for the following:

- Financial assistance for the development of renewable energy and biofuel industry and market across the country.
- Finance barrier removal activities such as resource assessment; research, development, and demonstration activities; project preparatory studies, etc.;
- Fund capacity building activities, promotional activities, dissemination of knowledge on effective renewable energy use, etc.

The Fund will be sourced from the following:

- Government budget;
- International organizations and donor countries, international financial organizations and NGOs;
- Financial contribution or investment from social organizations and from domestic and foreign investors.

Though the REN Fund is a sub-account of the Rural Electrification Fund (REF), the GoL ensures that there is a clear separation between the two accounts. The existing management of the REF will also manage the REN Fund whose functions are the following:

- Account, control and disburse funds;
- Monitor loans and grants.

The GoL will establish a Steering Committee who will be responsible for making decisions on the use of funds with MEM acting as its Secretariat. Each Province will be represented in the Steering Committee to ensure development of renewable energy markets in the provinces.

All related sectors should increase cooperation in the implementation of this strategy on the development of renewable energy. Policies and instruments presented in this strategy are improved to fit with goals of the policy in order to attract investors. This strategy consists of

[38] There is no exact mentioned about the rate of low interest loans , it depends on negotiation, the source of low interest rate it can be international organization, commercial bank, between government to government. For instance the government got soft loan from World Bank for rural electricity programme.

three components; the increase in financial support, strengthened legal framework and enhanced coordination between public organizations and institutes.

The Rural Electrification Fund was established in2005 with the specific objective of being the centre for saving and mobilizing funds from consumers, trading sector, loan providers with conditions or without conditions and other sources. The Fund was also established to ensure an adequate fund to support and develop local and rural electricity system within the boundaries. This is to improve quality of lives of villagers in the remote areas and to improve cooperation with the private sector to distribute electricity for people who live in the remote rural areas in line with Lao People's Democratic Republic's policy. Money from the fund should be used for implementation of work in following areas: socio-economic survey before installation of local and rural electricity; planning, designing, equipment and installation of the electricity system at the village level; study and design programme for technology development for rural electricity; and office administration, monitoring and evaluation.

Although the use of funds is dependent upon project compliance with cluster plans and provincial development plans, funds disbursement is not directly related to technological choices. However, two main limiting factors should be mentioned:

- The available funds are still limited.
- The fund is not yet set-up as an independent institution, but is still functioning as a World Bank Project Implementation Unit.

As a result, the fund has until now principally been used for World Bank off-grid projects. Furthermore, small IPPs may be reluctant to subscribe to the conceptual model presented below in Figure 6 and the associated fixed energy tariff.

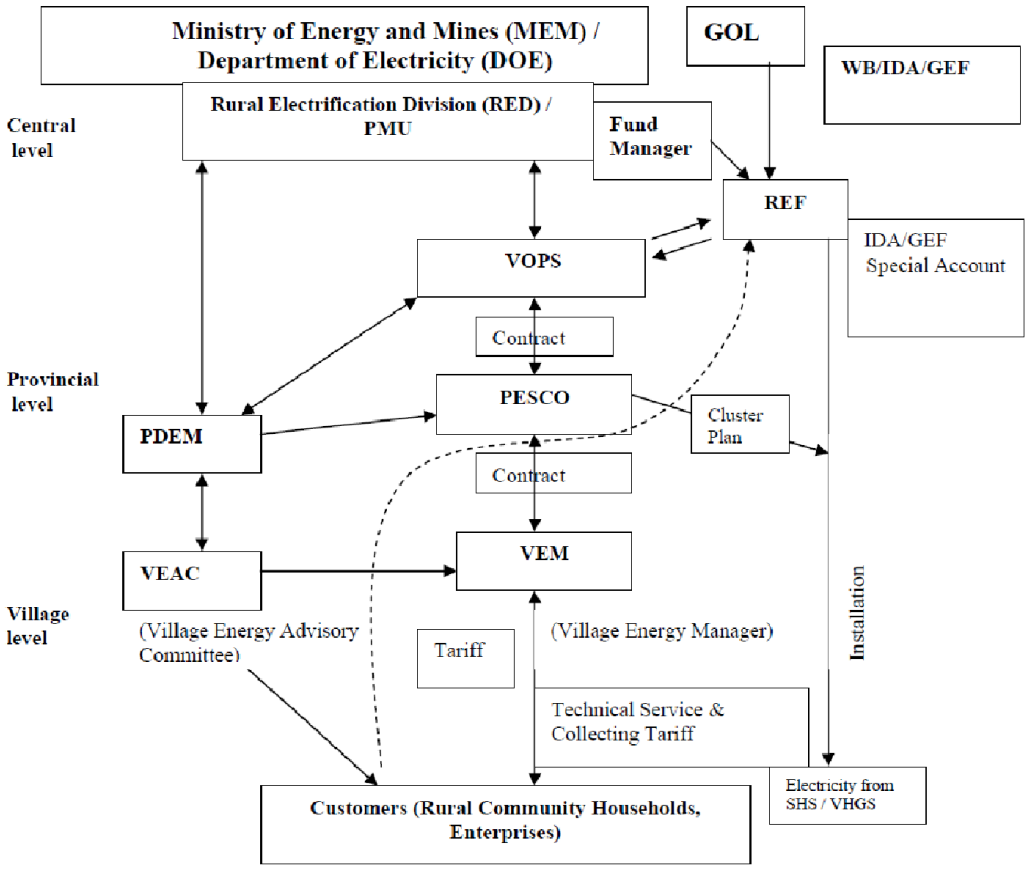

Figure 6: "Conceptual Design of Rural Electrification Fund"
(World Bank and MEM, Rural Electrification Fund Operations Manual, Draft Report, 2009)

IFC- MEM Micro Hydro Public Private Partnership: Lease and Purchase Agreement

Recently, MEM consulted with potential investors/project developers on the best mechanisms to implement four micro-hydropower plants in the province of Huaphan. These will act as pilot projects to test the financing mechanisms and the possibility to scale it up. The project is based on a lease purchase agreement (see Figure 7) where:

- The investor/project developer makes the upfront investment for the overall system (generation, distribution and supply).
- The investor/project developer operates the system for a period between five to ten years.
- The GoL pays a fixed lease term to the investor/project developer.

This financing mechanism is principally based on the availability of funds in the REF and GoL subsidies on electricity tariffs. It is meant to overcome institutional and financial risks. The initiative will make use of a bidding system, where the selected investor/project developer is selected on the basis of cost-efficient proposal. Although the price will be a key factor of the proposal investors/project developers have no interest in under evaluating the project cost. In other words, the fixed leasing payment agreed at the proposal stage acts as a guarantee of project return on investment.

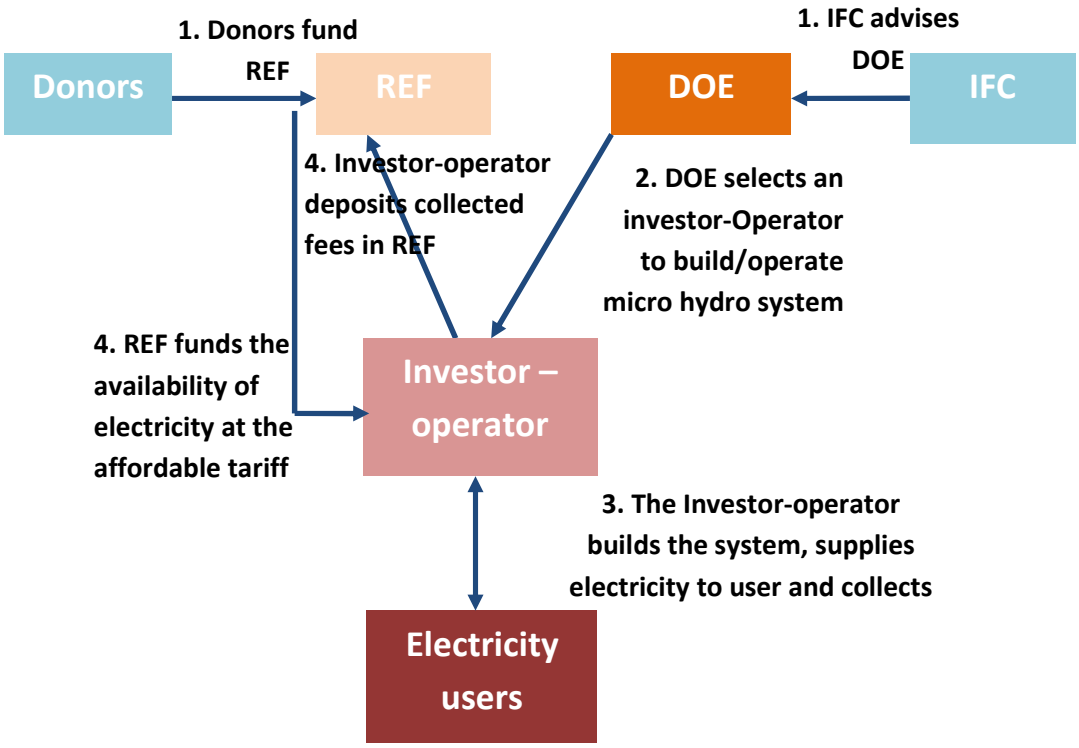

Figure 7: "Model for Micro Hydropower Public Private Partnership,"
(Presented by the DOE at a consultation with potential investors-operator, 24 September 2010)

As a consequence the only risks left to the investor/project developer are:

- The system design,
- The technological risk or the risk of equipment failure. However, this risk may be offset by the equipment supplier guarantee.

Although it has not been envisaged that the REF act as a guarantee for lending, the safety of the project design in itself may be enough to facilitate access to credit. But, to attract future investors/project developers the MEM may consider a 50% advance on the lease payment for the equipment and installation costs.

Public-private partnerships model

Figure 8 presents the proposed business model from Sunlabob Renewable Energy Ltd,a Private Energy Service Provider. This model was utilized in one hybrid village grid project at Nam Kha in Xiengkhouang province, in northern Lao People's Democratic Republic. As the private partner, Sunlabob invested in generating equipment and operated the system as a locally operated decentralized energy service. The NGO Helvetas was the primary public partner, and financed electricity network infrastructure and community capacity building activities.

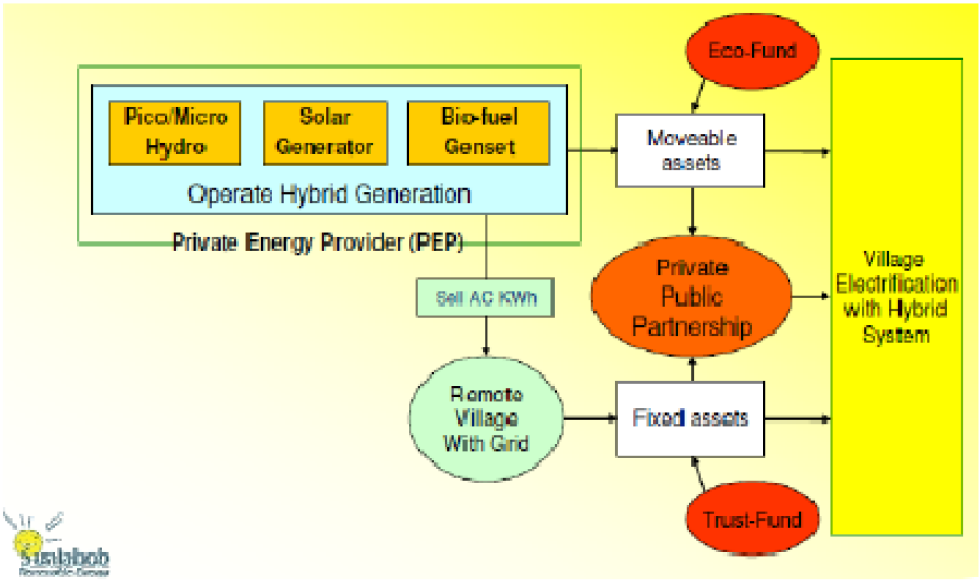

Figure 8: Sunlabob, Business Models for Mini-Grids in Developing Countries: Village Hybrid Grids, Paying for the Service not the Hardware

Rental Schemes for Energy Systems

The financial risk of high capital investment for many RE technologies remains a primary barrier to its uptake in rural areas, especially for new products. Rental schemes offer a means to transfer this risk from the end user to a service provider, which must therefore absorb the cost into a long term business plan. Given the difficulty for low-income households to make large investments, and a generally poor awareness of comparative operational costs amongst potential users, a rental scheme has the potential to greatly improved uptake of RE. Further advantages of rental schemes include the inherent incentive for service providers to invest in high quality, long lifetime products instead of less expensive options, and the opportunity to provide technical support services as part of rental subscriptions.

The critical requirement is a rental fee that is both commercially viable for the service provider and affordable for the user. Although other criteria are needed to determine overall viability, this single measure can be used to indicate the economic feasibility of any technology for a given socio-economic context.

In Lao People's Democratic Republic, rental services for rural energy supplies were pioneered by Sunlabob Renewable Energy Ltd, initially for SHS from 2000 and later for a range of other services including solar water pumps and recharging stations. Sunlabob's rental services were propagated through Lao People's Democratic Republic by developing an extensive network of franchisees, trained by the company in installation and maintenance services. The Sunlabob SHS product was discontinued in 2008 due to competition with the Rural Electrification Programme financed by the World Bank, which provided a subsidized SHS package on a lease basis with limited after sales service.

According to Sunlabob, there were also other limitations to SHS rental systems. The company found that, even on a rental basis, only the top third of village households could afford the SHS package it offered. Secondly, systems and services needed to be carefully adapted to existing consumer behaviour. For the SHS, money was collected by the franchisee from the end-users on a monthly basis. This was difficult for most rural households, which neither have regular monthly incomes nor are used to putting money aside on a monthly basis for their expenses. Additionally, the training of village energy committees and technicians to manage services was found to be too expensive without donor support, even though the company found that such community engagement activities are essential for service delivery.

Hire-purchase payments (rent to buy) implemented under the Rural Electrification Programme[39] by MEM to provide electricity to rural villagers via ESCOs and VEMs. The financial support is managed by an Off-Grid Promotion and Support (OPS) office located within Ministry of Industry and Handicraft (MIH) [40] in Vientiane. This programme was introduced in 1998 with funding coming in the form of a soft loan from the World Bank combined with Global Environment Facility (GEF) grant.

ESCOs offer each village a choice of three technologies: SHS, village-scale hydro (VH), and engine generator sets or gen-sets (GS). One function of the ESCO is to identify electricity entrepreneurs in villages. There are already over 80 such VEMs. Most of these are acting as franchisees of the ESCOs, handling consumer contracts, financial management, maintenance and spare parts supply for villagers using solar home systems. Other VEMs are operating engine-based or hydro businesses supplying villagers with conventional 220V AC by cable to each house. All the VEMs sign contracts with the ESCOSs, agreeing to pay or transfer monthly hire-purchase payments for equipment provided by the ESCOs.

Five ESCOs have licenses from the programme and these companies are all registered as electricity installation companies permitted to work in all parts of Lao People's Democratic Republic. The concession agreement signed with OPS, gives the companies an additional license to implement REP in particular areas, be it a group of districts or a whole province.

This system was designed to create reliability. The main mechanism is financial incentive. This works in three ways:

First, the SHS user is buying the equipment, and is motivated to take care of it so as to not lose their investment. In the case of village-scale hydro and engine-generator sets or gen-sets (VHGS), the VEM makes a significant private investment and looks forward to increased income at the end of the hire-purchase period. As a result, the VEM is motivated to keep the equipment in good condition. The VEM depends on tariff payments for their livelihood and is therefore interested in providing reliable supply every night.

Second, one can see from Figure 9 that the VEM, Village Electricity Advisory Committee (VEAC)[41], and ESCO receive a portion of each user's payment (which is further described

[39] Village Energy and Electricity, Best Practice in Lao People's Democratic Republic, February 2004
[40] MIH now charged to MEM
[41] VEAC formed with head villager, Village women union, youth, etc. established to consumers by overseeing their contracts with the VEM, providing short term loans and by promoting productive uses of electricity.

below in table31). These portions are called “operational rebates”, which means they are received only if the user payment is actually made. An unreliable system means the customer does not pay, so the VEM, VEAC, and ESCO lose their rebate. They are therefore motivated to think ahead, keep spare parts in stock, check for early warning signs of faults, and make sure the customer knows how to use their equipment well and avoid problems. This gives them an incentive to become experts in preventive maintenance as they essentially require their customers to be satisfied.

Table 31: List of Incentives for ESCOs and Other Actors

Description	Amount (KIP)	Comments
Planning fee	45,000	Paid after approval by PDEM and VOPs
Hardware and local transport	110,000	
Installation, including customer and VEM training	80,000	After receipt of PDEM inspection report, fee to be shared between PESCO (50,000 KIP) and VEM (30,000 KIP)
Yearly post installation and service fee	Up to 30,000	Bonus paid every year based on technical and financial assessment PESCO performance during the period.
Monthly service fee	9,000	Fee to be shared between PESCO (4,500 Kip), and VEM (4,500 KIP)
System removal fee	55,000	Paid when the system is back at PESCO warehouse and ready for re-utilization.
PESCO Business loan [42]	Up to 50,000,000	Maximum one year, 0% interest.
Start up support fee	3,000,000	1,000,000 KIP per month over the first 3 months of activity
VEAC inspection fee	1,000	Per system and per month
PDEM system inspection	15,000	For every inspection to cover their transport cost and expenses.

Source: Village Off-Grid Promotion and support, Newsletter 7. November 2009

[42] VOPs offer offers an interest-free one year loan to the PESCOs to facilitate the purchase by the end-users of equipment to keep operational their solar home systems. Mainly, the loan consists of procurement of batteries, lamps and a few charge controllers. The business plan to be prepared and submitted to VOPS by the PESCOs include the items which will be procured by the PESCO, the income generated from the sale to the customers under regulated economic conditions and the additional equipment the PESCOs intend to procure from the income generated by the repayment schedules differentiation, as customers pay back over 3 to 6 months, while the loan is over 12 months. Thus, the cash generated is used as a revolving fund.

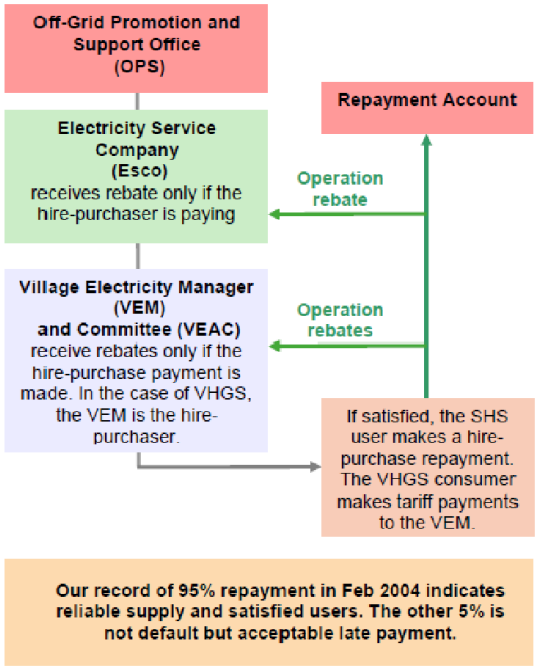

Figure 9: Operational Rebates

Third, OPS does not approve plans for installations in new villages, if the ESCO is not maintaining an average repayment rate above 95% from all his villages. If the ESCO allows reliability to slip, repayments will slip and the business will fail. The ESCO is in competition with other ESCOs, who would then expand their business in his area. An OPS has designed the ESCO license agreement to open each area up to competition two years from date of signing.

Another method of ensuring reliability is the progressive increase in private investment by VEMs and ESCOs. This is recouped through reliable payments by customers over many years.

In general, the ESCOs need to market themselves effectively and build good customer relations in order to grow and survive. At present they distribute a standard price and tariff leaflet which carries the motto “Every Night, Light”. As competition grows, they will develop their own distinctive styles of marketing strategy and support systems. This programme provides business training on marketing, planning, and organization aimed ultimately at securing reliable supply for villagers.

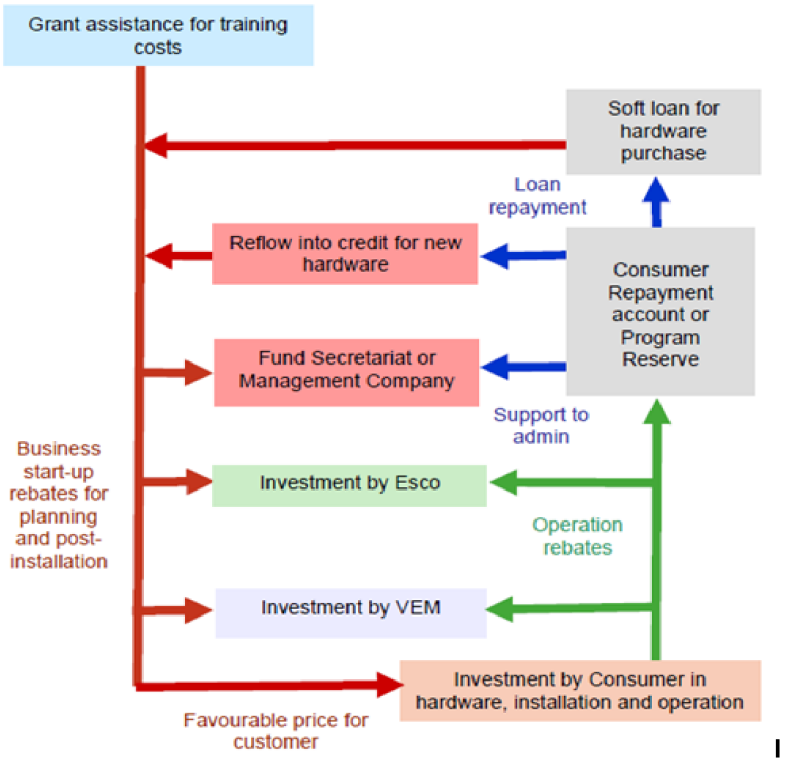

Figure 10: Flow of Finances

2. Project and End User Financing Options

2.1. Subsidies rolled out by the national governments to encourage use of the off-grid renewable energy technologies /applications and services

Currently, there are no subsidies rolled out by the national governments to encourage use of off-grid renewable energy technologies/applications and services. However there is one financial incentive under REP to assist un-electrified villagers to access electricity. The function of this programme had been mentioned in part C, section 1.6 (hire-purchase payment). The programme provides a subsidy to reduce system cost at 4%, 14%, 18%, and 29% for 20Wp, 30Wp, 40Wp and 50Wp SHS respectively. The rest of the system cost is used to account for the amount of monthly payments of customers. The subsidy also provides for GS and village hydro at 21% and 31% respectively. The payment for a solar kit is spread over 5 to 10 years with different amounts in monthly installations depending on the size of system. The users of VHGS pay for monthly tariff of their electricity consumption, not for buying hardware as in the case of SHS. The figures below show the price and monthly payment of each system.

Village Hydro and Gen-Sets		Installation fee	Monthly Tariff payments	
Night Units	Examples of appliances switched on at same time Other examples also available	Includes House kit Kip	Minimum Kip/mth	Maximum Kip/mth
1	Two 7W CFL lamps	150,000	12,000	16,000
2	Ditto plus cassette-radio	150,000	18,000	22,000
3	Ditto plus 30W audio CD	150,000	24,000	28,000
4	Four 7W CFLs and 30W CD or B+W TV	150,000	30,000	34,000
5	Six 7W CFL, one 30W CD or 48W colour TV	150,000	36,000	40,000
6	One 7W CFL, one 48W colour TV and 30W satellite receiver	150,000	42,000	46,000
7	One 7W CFL, one 48W colour TV, one 50W VCD	150,000	48,000	52,000
	One 7W CFL, one 65W colour TV, one 30W satellite receiver	150,000	54,000	58,000
Night units	Village Hydro: usually 12 hours from dusk to dawn, by agreement Gen-sets: usually 3 hours evenings, by agreement during planning			
Day units	For hours specified by VEM, power is available to a small number of day customers for small industries, rice mills, refrigeration, ice, battery-charging, carpentry, etc			Price set by VEM

Figure 11: SHS Pricing

Solar Home Systems		Installation fee	Monthly Payments for solar kit	
Solar panel size	Examples of Service The time for which these appliances can be switched on varies according to sunshine hours and the size of your system. For example, the more lamps switched on all evening, the less time for TV. If some lamps switched off, more time for TV.	Includes House kit price Kip	Pay for 5 years Kip/month	Pay for 10 years Kip/month
20 W	1 or 2 lamps for 2-3 hours on evenings following sunny days. Radio-cassette. B+W TV, 1 hour.	160,000	20,000	10,000
30 W	1 or 2 lamps for 3-4 hours on evenings following sunny days. Radio-cassette. B+W TV, 3 hours	190,000	30,000	15,000
40 W	2 or 3 lamps for 3-4 hours most evenings except when no sun for two days. Radio-cassette, TV, other 12 V appliances	220,000	40,000	20,000
50 W	3 or 4 lamps for 3-4 hours most evenings. Radio-cassette, TV, other 12V appliances	250,000	50,000	25,000

Additional costs: The purchaser is responsible to pay for new batteries when they stop working. If the battery is kept in the box, kept clean, and connected only to controller at all times, it will last a long time. Locally available car batteries can be used as replacements. Manufacturing defects are covered by warranty for one year for controllers; after this year, the consumer is responsible to pay for replacements.
Note: Prices can change. Only the most recent issue of this sheet is valid. This version was issued on 1 November 2003.

Figure 12: VHGS Pricing

Note: 1$US is about 10,000 kip

The Lao Biogas Pilot Project (BPP) was established in November 2006; it was funded by the Netherlands Development Organization (SNV) and was operated under the Lao Department of Livestock and Fishery (DLF). The bio-digester model called the "Lao-Net" was made available in 4 different sizes: 4-m^3, 6-m^3, 8-m^3 and 10-m^3 digester volume. BPP has been implemented in the five pilot provinces of Xiangkhuang, Vientiane, Khammouane, Savanakhet and Vientiane Municipality with the target to install 6,600 biogas digesters within 5 years of project period (2006-2010). This programme had provided financial incentive to biogas user with flat rate subsidy of EUR 100 for biogas digester construction cost. By the end of 2011, 2680 household biogas plants had been installed around Lao People's Democratic Republic (Biogas Pilot Programme Annual Report, 2011).

2.2. Whether the financial incentives offered by government is proved useful for development of market for off-grid RE / SE technologies and applications

As detailed in Articles 40 to 55 of the 2009 Investment Promotion Law of Lao People's Democratic Republic, the GoL offer income tax holidays for time frames between 1 to 10 years as per investment type and location**.** In the case of the former, the law identifies 3 levels of 'promoted sectors' which cut across agriculture, industry, handicraft and services[43]. As well as this, there are special conditions that apply to concession investments – hydropower, mining, agriculture, forestry and tourism which are the biggest sectors of foreign direct investment (FDI) to date.

In the case of hydropower, Department of Energy Promotion and Development (EPD) within MEM offers investors baseline incentives in the form of free access to land (including areas to

[43] Investment incentives for sustainable development: the case of Lao People's Democratic Republic, OshaniPerera, International Institute for Sustainable Development, February 2011

be flooded), a waiver on land conversion fees (US$15,000 per hectare), a 'reasonable' tax holiday, a waiver on withholding taxes on net profit repatriated, waivers or reduced rates on import duty for materials, equipment and supplies, the unlimited use of foreign labour in both skilled and unskilled functions, extended concession periods of 25-30 years, waivers from other taxes as well as duties and offshore banking facilities.

In the case of renewable energy, the government has policies to support renewable energy, especially financial measures which include[44]:

- Policies on subsidizing tariffs bought from energy until 2015, especially the revision of the tariff rate, in reference to appropriate technological and economic conditions;
- Policies on funding for investment promotion and risk warranty, especially small industry;
- Policies on the supply of investment capital to assist in initial investment on renewable energy, including low interest loans for the investment in the production of renewable energy;
- The government is responsible for basic infrastructure to accommodate the expansion of renewable energy such as: transmission line systems and warehouses for storing bio-fuel
- Improve law and regulations related to renewable energy;
- Budget for related sector to be used for studies, research and development, promotion, mobilization, dissemination of renewable energy technology;
- Access to information on renewable energy such as potentials of solar power, wind energy, hydropower and sources of raw materials;
- Establish renewable energy technology standards.

According to the Power Development Plan (PDP)[45] for 2010 to 2020, to provide enough power supply for the future demand and to support the social-economic development between 2010 and 2020, EDL has been set up the policy on the power supply sources as follows:

- EDL will put an investment on some new power plants,
- Purchase from Small Power Producers (SPP) and Domestic Independent Power Producer, IPP(d) projects, Purchase from take-off from IPP (e) projects,
- Continue to import power from neighbouring countries to the area where there is no network access and
- Continue to exchange (imports/export) power from neighbouring countries to increase reliability and security of power supply.

Currently, there are a number of private sector companies interested in investing in power production, especially small hydropower. There are 21 hydropower plants currently in commercial operation with a total capacity 2,973.15 MW[46]. Of this, 10.86 MW is from ten small hydropower plants with a capacity ranging from 0.08 MW to 7 MW. There are six plants with a capacity of 3.78 MW which are owned by EdL, three plants with capacity of 8.3 MW which are owned by SPPs. There are a final two plants with capacity of 12 MW, which are owned by EDL-Gen. Three of these the small hydropower plants started commercial operations in 2011, with a further three commencing commercial operations in 2012. The majority of these small hydropower plants are found in northern part of the country.

[44] This policy is a part of REDSL
[45] Power Development Plan 2010-2020 (revision-1), EDL, August 2011
[46] Generation resource in Lao People's Democratic Republic, Presented in Statistic Yearbook 2012 , prepared by planning office, EDL

Moreover, projects with total capacity of22.5 MW are currently under construction, and a number of other projects totalling 100.0 MW are at the feasibility study stage[47].

The Rural Electrification Programme has received financial support from the World Bank, GEF, IDA and IFC. This programme has aimed to deliver electricity to villages in remote areas by using renewable energy technology with financial incentive schemes for stand-alone installation by means of a hire-purchase arrangement. This allowed villagers who generally could not pay more than US$ 2 a month or an installation fee of US$ 300 to avail of SHSs. In this arrangement, users could choose to lease systems for 5 or 10 years with an up-front payment of about US$ 20, becoming owners at the end of the period on condition that all payments have been made. The programme provides face-value subsidy to reduce system cost of SHS and hardware of GS and VH. The detail of this subsidy amount and portion to be allocated for PESCO, VEM and VEMC have been described previously in part C, section 1.6.

This programme ran from 1998 to 2010. As a result of the programme, there are 35,000 households currently using off-grid systems such as SHS or SHP.

2.3. Instances of income generation activity due to sustainable energy projects that increase affordability

The benefits of using RET were found in REP. For example, in one village using SHS, most of the houses immediately moved their weaving looms upstairs and it was found that teenagers were happy to contribute extra income weaving in the evenings. This income paid back the cost of the solar panel and weaving materials and also left some additional money for the family. In the same village, solar lights had helped improve incomes by allowing net mending to take place at night, and also by allowing charging of batteries used for fishing and for hunting frogs at night.

In one village with hydro supply, the villagers have told us the electric light has increased their incomes significantly. Many of the families make small baskets for sale to tourists. With extra hours of lighting, they are able to earn significantly more than they would have prior to the introduction of RETs (one estimate was higher than 300,000 kip per month).As a result of this increased earning, users tend to be more than happy to pay the monthly hydro tariff.

One lady uses the light to sew in the evenings for her customers, another uses a fridge to make cold sweets for sale. A carpenter is using power tools in the day time and the VEM is charging batteries for fee-payment. There is talk of upgrading to run a rice mill, and at one stage ice production started as it proved to be a profitable application. One man is hoping to rear poultry with the help of electric bulbs.

In 2012, Phonephachank Keovilay produced a report entitled Household Biogas Technology to Improve Rural Livelihoods in Lao People's Democratic Republic[48]. The report describes a study conducted by Phonephachank Keovilay, in which a survey was used to interview 100 biogas users under BPP in five provinces: 32 users in Vientiane capital, 28 users in

[47] This Figure mentioned in a part of the report of Lao People's Democratic Republic: Energy Sector Assessment, Strategy and Road Map-2012 Update

[48] *Journal of Developments in Sustainable Agriculture 7: 158-163 (2012)*, Household Biogas Technology to Improve Rural Livelihoods in Laos, Phonephachank keovilay

Savannakhet, 17 users in Xiengkhuang, 17 users in Vientiane province and 6 users in Khammouane. The results of the survey show that installation of bio-digesters substantially reduced expenditures of farmers for cooking and lighting. Farmers saved an average of 318 thousand kip/month[49] for cooking fuel (firewood, charcoal and LPG). Cost savings for lighting (candles, kerosene and electricity) were an average of 68 thousand kip/month. In addition, the use of bio-slurry for fertilizer reduced average monthly cost for chemical fertilizer from 85.8 thousand to 65.2 thousand kip, a monthly reduction of 20.6 thousand kip.

2.4. Examples of use of micro-credit to expand RE / SE services and for providing start up and working capital loans

There are four deposit-taking microfinance institutions registered in the Lao People's Democratic Republic: Ekphatthana Microfinance Institute (EMI), Lao Postal Saving Institute, Saynhai Samphanh Microfinance Institute and Microfinance Centre (MFC).

EMI and MFC do not have any policy on financing the RE sector. However, there is a positive trend towards the green energy market, as more people are aware of climate change and the funding available in this field. In general, MFIs still need more information on RE technologies before they can finance this sector. MFIs would most likely not be able to finance hydropower, as these types of projects require a huge amount of funds. The main reason why MFIs do not finance the RE sector is because there is a low profit margin. However, the driving force for MFIs to finance RE projects in the future is to raise awareness among people on the MFIs concerns for the environment, as well as part of the companies' social marketing strategy to build up market and recognition.

The target customers of MFIs are small-scale entrepreneurs such as market vendors, business people, and farmers in urban and peri-urban areas. MFIs such as EMI give loans out to their customers, which do not exceed 10 million Kip, as EMI has a revolving fund of 2.4 billion Kip. The interest rates for the loans are set at 4% per month. MFIs criteria for screening and approving loans are based on the 5 Cs[50]. The legal procedure to request financial support is a certification from the village chief, which is signed by both heads of the household; this is done to avoid future conflicts.

Statistics of microfinance year 2009 reported that there were 4, 113 village funds with 365,608 members which provided 34.57 billion kip in loans to members. Of this 34.57 billion kip, 64% was used for agriculture and livestock, 24% for commercial and service, 6% for handicraft, 4% for emergent cases and 2% for other activities.

As mentioned above there are no microfinance institutions with policies for providing loans to expand renewable energy or sustainable energy services.

2.5. Examples of financial assistance given to national micro financing institutions and development banks which are often considered as effective vehicles for providing loans

The National Growth and Poverty Eradication Strategy (NGPES) was approved in 2003 by the 4th Ordinary Session of the National Assembly, identifying 47 priority districts for poverty

[49] 1$US is about 8,000 kip

[50] The 5 Cs: Character of the borrower, Capability (ability to pay back), Cash flow (physical assets), Client history (development of customer), and Collateral.

eradication. Regarding the lack of capital for income-generating activities as one of the main obstacles to poverty eradication, the GoL has allocated an amount of 25 billion kip for the 47 poorest districts in the 2003-2004 budgets to establish village funds as a source of funds for production and services. This should enable the poor to gradually change from traditional to modern technologies and respond to market demand. This in turn was expected to strengthen communities and their development potential in the framework of the NGPES.

To monitor and supervise the utilization of the budgetary resources, the GoL established Village Fund Supervision Committees (VFSCs) at central, provincial and district levels. This was followed by an instruction of the Prime Minister's Office and President of the Leading Committee for Rural Development and Poverty Eradication (LCRDPE) on the financial management of the village funds, issued on 14 January 2009.

From 2003-2007 the GoL allocated some 41.7 billion Kip to the development of village funds across the country. 10% of the budget was used for technical support at central, provincial and district levels. 90% was dedicated as seed funds for VFs. By September 30, 2009 the GoL's support for VFs in the 47 poorest districts covered 528 villages and 34,865 families. The number of active members comprised 21,759 families, and total revolving funds stood at 42.5 billion kip.

As well as financial support from government to microfinance institutions, support has also been provided by International programmes and projects, with the source of funding coming from multilateral agencies and non-government agencies. Some examples of this support are described below[51]:

ADB has played a prominent role in the development of the financial sector in Lao People's Democratic Republic, with an emphasis initially on the banking sector (starting in the early 1990s) and subsequently on the promotion of a regulated microfinance sector. From 2007 to 2012 ADB's *Rural Finance SectorDevelopment Programme (RFSDP)* has included a policy-based loan (USD7.8 million), a project loan (USD2.3 million), a technical assistance grant (USD0.7 million) and grant projects (USD1.98 million and USD0.472 million). ADB contributed substantially to the transformation of the APB from a loss-making policy bank to a commercial bank. In microfinance, ADB has focused on the policy framework for MFIs: supporting the establishment of a Microfinance Division in BoL in2003, pilot regulations for SCUs in 2004 and for MFIs in 2005, and three regulations together with the related charts of accounts enacted in June 2008.

GIZ has supported village funds in Lao People's Democratic Republic since 1998, initially covering three provinces in the northern region (Bokeo until 2008, Luang Namtha and Sayaboury) under the project *Rural Development in Mountainous Areas (RDMA)*. By April 2011, a total of 346 village funds had been promoted, with some 24,000 members, 4 billion Kip in savings and 10.6 billion Kip in loans outstanding. Total assets amounted to 13.1 billion Kip, which included grants of some 6.7 billion Kip. In addition to technical assistance GIZ initially provided seed capital in cooperation with IFAD, Lao Government and Norwegian Church Aid (NCA), amounting between 1998 to 2011 to 7.2 billion Kip (56% of which was provided to Bokeo). Since May 2009 GIZ's support of village funds has been integrated into a

[51] Information is taken from GIZ microfinance report 2012.

broader financial sector development project with BoL, *Microfinance in Rural Areas - Access to Finance for the Poor (AFP)*, adding provinces of Attapeu and Savannakhet; AFP now covers 64 village funds in four provinces, with some 20,000 members and a loan portfolio of 8.8 billion Kip as of August 2012. GIZ has contributed EUR 3.75 million from the German government; as of December 2011 Lane Xang Minerals Limited (LXML) has added EUR 805,000 for the second phase. A pivotal part of GIZ's approach has been the establishment of Network Support Organizations (NSOs) of village funds, three of which are registered with BoL and licensed as limited companies with the Department of Industry and Commerce at provincial level, the remaining two have submitted their applications to BoL.

As an exit strategy, the NSOs are designed to become sustainable by providing cost covering financial intermediation services and technical support (bookkeeping, auditing, financial literacy training, management training) against membership and service fees. In addition to its support to village funds at the micro level and to NSOs at the meso level, AFP provides technical assistance to BoL at the macro level, with a focus on microfinance policy, regulation and capacity building of the Financial Institution Supervision Department (FISD). Results include the Prime Minister Decree on Microfinance Institutions on 3rd October 2012 and the implementing of an improved Management Information System (MIS) by FISD.

UNDP/UNCDF: In the mid-1990s UNDP/CDF initiated a microfinance roundtable, acting as a coordinator of communication among international donors. In 1996 UNDP/UNCDF carried out the first microfinance survey among rural households, reporting on 1,640 village funds (most of them rice banks) and 28 projects. Concluding that the dominant revolving fund approach posed serious problems of sustainability, a *Microfinance and Sustainable Livelihood Project* was prepared with BoL in 1997 to build capacity and disseminate good practices. Field interventions in three provinces led to the establishment of three MFIs: Sayaboury Microfinance Office, Sihom Project Savings and Credit Scheme and Oudomxay Development NDTMFI. One of the lasting results has been the establishment of the Microfinance Centre (MFC), a leading training and consultancy provider. In June 2010 UNCDF and UNDP entered into a joint programme with BoL, *Making Access to Financemore Inclusive for Poor People*, with a budget of US$ 7 million, focusing on interventions at the macro, meso and micro levels. This is to include strategic capital and technical assistance to increase access to financial services by low-income households and micro-entrepreneurs on a sustainable basis, with a goal of increasing client numbers in the microfinance sector to over140,000 by 2014.

The World Bank provides financial and implementation support to the development of village funds through its Community Driven Development (CDD) projects. The Khammouane Development Project (KDP), 2008-2013, aims at provincial capacity building and local development through grants to 27 villages in 3 districts to support their agricultural livelihood activities. Its local implementing partner is the provincial government through the Planning and Investment Office. The Sustainable Forestry and Rural Development Project (SUFORD), 2004-2008 and 2009-2011, provide revolving funds to 723 rural villages in nine provinces to support their livelihood development for sustainable forest management. The project is co-financed with the government of Finland and implemented by the Department of Forestry, MAF. The Lao Social and Environmental Project (LSAE) Additional financing, 2010-2013, provides grants for livelihood development for sustainable watershed management to 12 villages in two districts of Borikhamxay. The Livelihood Pilot Project, as

part of the Poverty Reduction Fund-II (PRFII) under the National Committee for Rural Development and Poverty Eradication, 2011-2014, focuses on the four poorest districts of Houaphan and Savannakhet. The pilot project will provide grants to self-help groups of10-20 families in some 200 villages, with the objective of improved nutrition in the community.

In Khammouane and Savannakhet Village Income Restoration Funds are established as part of a downstream livelihood strategy, compensating villages for the loss of livelihood caused by NamTheun 2, a large hydropower project. The World Bank provides implementation support through its technical and management teams in cooperation with LWU; financial support is provided by the Nam Theun 2 Power Company (NTPC) and the government. IFC, which is a member of the World Bank Group, has supported jointly with ADB and the EU the establishment of a Credit Information Bureau, which may also cover MFIs in the future. IFC also works with BoL on the development of a payment system and, possibly, branchless banking.

As mentioned in the microfinance report 2012, there were 42 MFIs in 2011 (up from 26 in 2009), comprising 9 deposit-taking MFIs (DTMFIs), 15 Non-deposit-taking MFIs (NDTMFIs) and 18 Saving and Credit Unions (SCUs) (up from 5 DTMFIs, 8 NDTMFIs and 13 SCUs, respectively, in 2009).Of these 42 MFIs, 25 operate in the central region, 13 in the north and 4 in the south.

2.6. Examples of involvement of local co-operative society in financing SE/RE products/ services

There are deposit taking institutions throughout Lao People's Democratic Republic in the form of Savings and Credit Unions (SCU) and credit cooperatives. These include Naxaythong Rural Development Cooperative, Credit Cooperative for Promotion of Small Producers / Fonds Cooperative and Lao Farmer Production Cooperative.

Besides the SCUs, there are also several types of microfinance structures in Lao People's Democratic Republic. These include Village Savings and Credit Groups and Village Revolving Funds[52]

The Lao Farmer Production Cooperative is a company that deals with agricultural products such as jams, tea, coffee etc., from the rural areas of Lao People's Democratic Republic. Presently, they have twelve Fund Cooperatives in eleven provinces in Lao People's Democratic Republic. The cooperative does not have a specific RE policy. Microfinance is the key business and funds come partially from the ACLEDA bank. The portfolio is about 5 billion Kip, with an extremely high interest rate of 36% per year. This network aims to build up the capacity through trainings on agricultural production and processing, and marketing of products of rural people to be self-sufficient and self-sustained. The criteria of approving loans are based on the assessment of need of investment and the borrower must have a savings account. The borrower can lend up to 80% of their savings and must have at least 1 share (10,000 Kip ~ US$1.2).

[52] Access to Finance Study, Lao People's Democratic Republic, February 2008, Commissioned by SNV, Heinz Williams & Bouasavanh Khanthaphat

The Naxaythong Rural Development Cooperative was established in 2001, with the participation of four villages and a total fund of just 50 million Kip (~ US$5,587). However by 2009 the fund accumulated 4.8 billion Kip with the participation of fifty-two villages within Naxaythong district. Loans are provided to three main sectors: agriculture, industry and service. The criteria for giving out loans are that the borrower must be a member of the cooperative, hold at least 1 share (10,000 Kip ~ US$1.2), and have a savings account. The interest rate for borrowing is 28%-30% per year.

As mentioned above, there is no involvement of local co-operative society in financing SE/RE products/services.

3. Promotion of Participation of Private Sector in RE

3.1 Provide information on existing policies/laws/regulations for providing market access to private sector for introducing required technologies

Entrepreneurs in RE projects in Lao People's Democratic Republic are:

• Foreign Companies and Funds investing in large scale projects, such as hydropower generation for export or buying equity in a local medium and/or small scale project such as biofuel and hydropower supplying local consumption.

• Although they are few in the market, small local enterprises also invest in the provision of energy services by RE technologies. A non-exhaustive list of these entrepreneurs includes: Sunlabob, Provincial Energy Services Company (PESCOs), Kolao, etc. It is worth noting that almost all these companies started under a Public-Private partnership agreement. In other words, they have been financially supported by public institutions and/or financing mechanisms (i.e. subsidies for technology, tax exemption, equity capital, etc.). The main characteristic of these entrepreneurs is that they are very different by nature and as such face different institutional and financing barriers, whilst not benefiting the same opportunities in terms of capacity to invest and access sources of funds.

As well as this, the GoL issues laws assuring foreign investors in repatriating capital and dividends. In addition, the GoL issues laws governing tax exemptions or waivers relating to project construction, infrastructure and certain activities regarding process and industrial activities that use modern technologies. There are also laws concerning tax exemptions on imported machinery. Tools, spare parts and relevant vehicles including raw materials that are unavailable in Lao People's Democratic Republic or of an insufficient quality.

The Renewable Energy Development of Lao People's Democratic Republic is another incentive developed by the GoL. Under this incentive the GoL supports domestic and foreign entrepreneurs and investors to invest in energy projects at the village level. The development of renewable energy resources while responding to the needs of the local people contributes to the process of becoming self-sufficient in energy supply and for the development of energy exports. Renewable energy development involves participation of public and private sectors.

Policies on the promotion and development of renewable energies in Lao People's Democratic Republic focuses on small power development for self-sufficiency and grid

connection, biofuels production and marketing, and development of other clean energies in the country. The government defines priorities for development as follows:

- Provide financial incentives to investors who aim to produce clean energies to meet domestic demand and, who take socially and environmental corporate responsibility in order to increase investments in renewable energy projects;
- Formulate and improve laws and regulations to facilitate renewable energy development.

For electricity and energy development in rural areas, important aspects being considered are as follows:

- Prioritization of policies which facilitate private sector investments in rural electrification such as provision of incentives and financing;
- Development of small power systems, biofuels, solar and biomass energy at the village level to provide electricity and energy to rural and remote communities.

People in rural areas will be encouraged to use renewable energy to enhance self-sufficiency and the GoL will seek cooperation with private sector, NGOs and development partners to encourage investment support for processing equipment and necessary machinery adjustments.

3.2. Examples of prevailing institutional framework for sanctions of private sector in the country

There are three types of investment in Lao People's Democratic Republic which can gain a business license, such as: general business[53] (Ministry of Industry and Commerce will issue the business), concession business [54](Ministry of Planning and Investment will issue the concession license) and activities for development of special economic zones and specific economic zones (Secretariat to National Committee for Special Economic Zones at Government Office will issue the license). In order to manage the investment in concession business the government established the Committee for Promotion and Management of Investment (CPMI) at the central[55] and provincial levels[56]. Each level has a One-Stop-Service Unit (OSU) consisting of an Investment Promotion Division, an Investment Screening Division, Legal Affairs Division and Strategy Plan & Service Division.

An individual or legal entity that wishes to invest in any socio-economic sector that relates to the rights of concession or operations in any investment sector must submit an application to the CPMI, attaching supporting documents: copies of their family registration book and resume, the feasibility study or business plan and, information relating to the business if the

[53]General business is an investment in the general business sector including businesses defined in the list of controlled businesses and it is not a concession business.

[54]Concession business refers to investment activities authorized by the government to utilize ownership and other rights of the Government in conformity with regulations, for the purpose of developing and conducting business operations; these include rights on land concession, minerals, electric power, airlines, telecommunication, insurance and financial institutions.

[55]CPMI at central level is established by Prime Minister and located at the Committee for Planning and Investment, the function of CPMI is study strategies and policies to promote and attract domestic investments and to propose them to the government for approval. Planning and promote domestic investment, …

[56]CPMI at provincial level is established by the chairman of the CPMI at the central level, and located in Provincial Planning and Investment Division, it acts as a secretariat to the provincial governor, the mayor of the capital city, the chief of special zone and the CPMI at the central level in promoting and managing domestic investment.

applicant is an enterprise or the joint venture agreement if the investment is in the form of a joint venture.

Except for the operations mentioned above, other applications for operations (general business) shall be submitted to the commercial sector (Department of Domestic Trade, Enterprises Registration Office and Ministry of Industry and Commerce).

Upon receipt of a correctly completed application with all relevant documents, the commercial sector shall consider the application and respond in writing to the domestic investor pursuant to the following timeframes:

• For common operations, the commercial sector shall respond within twenty official working days.

• For operations relating to the rights of concession, the CPMI shall respond within thirty official working days. For other operations, the response shall be given within twenty official working days.

The applicant for an investment license, who submits their application to the CPMI and meets all qualifications, shall receive an investment license together with an enterprise license and tax registration from the CPMI.

The applicant for an investment license, who submits theirapplication to the commercial sector and meets all qualifications, shall receive an enterprise license together with tax registration from the commercial sector.

After that the enterprise will be regarded as a legally established enterprise, and within 90 days, the domestic investment enterprise shall commence business operations in accordance with the feasibility study or business plan that was attached to the application for an investment license. In the event that the enterprise does not commence operations without sufficient reasons, its investment license and enterprise license will be withdrawn.

3.3. Financial and fiscal incentives

Investments in renewable energy projects in Lao People's Democratic Republic, whether on biofuels production, grid-connected or isolated systems, off-grid projects, and individual systems, are entitled to investment incentives under the Investment Law of Lao People's Democratic Republic, updated in 2009. The financial incentives include the following:

- Import duty free on production machinery, equipment and raw materials;
- Import duty free on chemical materials necessary for biofuels production within 7 years;
- Profit tax is divided in to 3 categories: 20%, 15% and 10%. Profit tax exemption is possible for a certain period depending on activities, investment areas and size investment;
- Subsidies on unit product price depending on energy type and times period.

Additionally, the investors can obtain also non-fiscal incentives, such as:

- Up to 75 years leasing term (for enterprise construction land);
- Permission to expatriate earnings to home or third countries;
- Right to employ foreign workforce (not more that 10% of the enterprise's total labour).

3.4. Barriers (policy /legal/regulatory /institutional /economical)

As mentioned in part A section 1, Lao People's Democratic Republic is a heavily mountainous country with a large number of scattered settlements and communities. This acts as a serious challenge in relation to increase electrification in Lao People's Democratic Republic. Renewable energy has potential to be sourced locally, which can be explored to meet demand and support socio-economic development, particularly in rural areas. However, there are several constraints and barriers to a more widespread use of renewable energy in Lao People's Democratic Republic. Some of the barriers are noted below:

Policy/legal/regulatory barriers

Electricity prices in Lao People's Democratic Republic are very low, although IPPs for large and medium hydropower power producers have been able to negotiate highly competitive feed-in tariffs. There is not yet clear regulation or system to estimate feed-in tariffs, which is a constraint concerning prospective entrepreneurs and project developers. For small and medium entrepreneurs this represents a strong barrier because it adds on risks and transaction costs.

Without clear regulation, small and medium enterprises encounter more difficulties to negotiate the prices, particularly because of the GoL policy of maintaining low electricity prices. These prices do not reveal production and distribution costs. Even though they are not directly subsidized, the subsidies on transmission lines and tax exemptions for imported equipment that benefit foreign investors partly explain how the low tariffs are first made possible. As well as this, they represent a market distortion constraining other power generation type.

Complexity of institutional responsibilities, despite the guidelines set in the electricity law also acts as a barrier. Depending on the size of the project, the authority is at national, provincial or district level. However, in practice the responsibilities depend more on the ability of the entrepreneur to navigate with the administrative procedures.

The complexity of institutions leads to high transaction cost both for entrepreneurs and households. For entrepreneurs, this requires the development of complex institutional settings to ensure the fees collection and the maintenance of the system etc. The result is high administration cost of the system, whilst the energy services tariff remains very low.

For foreign investors it is important to find a skilled and reliable Lao People's Democratic Republic counterpart. This means that the institutional context must provide a trustful environment for investors to ensure that this step is not perceived as a risk.

Decentralized generation is still a general idea. There is no acceptance yet on the cost-benefit of a decentralized system as opposed to economy of scale generated by national cover of energy services. Without recognition of cost-benefit of DG, it is difficult for entrepreneurs to establish the benefit of their system. Because of the long history of large energy systems, cost-benefit analysis does not always take into consideration the full implementation and operation cost of a traditional system (e.g. recycling costs, cost of grid extension often offset by ODA, cost of the raw material without subsidies, environmental costs, etc.).

Economic barriers

At village level, the entrepreneur may face difficulties related to weak/strong social organization. In other words, it may be difficult to collect the fees for energy services if there is no clear engagement of local leaders and formal institutions to support the entrepreneurs.

D. Business Models for SET Delivery

1. Character with Associated Factors

1.1. Robustness of RE/SET and energy services with user convenient design, economic viability with regard to the technology used in the selected business models

Renewable energy systems operated in Lao People's Democratic Republic include solar PV systems, small hydropower, pico-hydro power, biogas and gasification. The system of mini and small hydro power always has a control unit to manage power production and supply, allowing users to conveniently operate the system. Similarly, the Solar PV system usually comprises an automatic control unit to control power storage and supply, which needs relatively little skill to operate.

Pico hydro systems have no control unit and are easy to buy in common shops in the town. The users buy and install the system by themselves. Installation of these pico-hydro systems is quite easy as it simply requires water from a stem to flow to a turbine with a low water head. In general, this technology has been accepted by rural people, particularly those living close to rivers and streams. However, safety concerns may exist in areas where these systems have been inappropriately installed.

Biogas systems have many designs available in Lao People's Democratic Republic, including fixed dome with cement brick base construction material, fibreglass tank and plastic bag. The fix dome type of biogas digester with cement brick and concrete designed and used in Pilot Biogas Programme are considered cheaper and easier to build compared to the full cement brick counterpart. Fibreglass tank and plastic bag are also easy to construct. However it is necessary to import these biogas systems, which results in additional expense for transportation.

Finally, thanks to financial support from international agencies, there are currently a number of gasification power plants installed in Lao People's Democratic Republic. However, the materials needed for these plants are not manufactured in Lao People's Democratic Republic and must be imported from elsewhere. Unfortunately, some of these plants are of an insufficient quality, leading to failure. Due to a lack of skilled technicians, this can result in long periods of power outage.

1.2. Experience of the project proponent in setting up RE/SET project: The type of approvals required from concerned authorities and ease of getting such approvals

Promotion of rural electricity had been described in Article 43 of the Electricity Law (amended in December 2011) that: individuals, legal entities or organizations investing in electricity generation, distribution, electricity purchase and sale, investment in construction of electrical transmission lines and distribution line, electrical services or in electrical generation source by new energy, renewable energy in order supply the electricity to the remote areas and upland areas, shall receive special promoted policies relating to investment, the same as of other investment promotion activities in accordance with other law on investment and other relevant laws and regulations.

In Lao People's Democratic Republic, electricity business is divided into two types; general electricity business and electricity business in the form of concession[57]. Any individual, legal entities or organizations wishing to operate the general electricity business shall ask for the authorization with industry and commerce sector and with the approval of the energy and mines sector, and shall comply with the enterprise law. Any individual, legal entities or organizations wishing to operate the general electricity business shall ask for authorization with the planning and investment sector and with the approval of the energy and mines sector, and shall comply with the Law on Investment Promotion. The level of authority and approval of business license for electricity projects in the Lao People's Democratic Republic are divided into four sizes of installation capacity as follows:

1. Electricity project with an installed capacity from one hundred kilowatts shall be approved by the district or municipal governor on the proposal of the district, municipality Office of Planning and Investment with technical consent of the provincial, District Division of Energy and Mines;
2. Electricity project with an installed capacity more than one hundred kilowatts to fifteen megawatts shall be approved by provincial, district governor on the proposal of the district, municipality Office of Planning and Investment with technical consent of MEM;
3. Electricity projects with an installed capacity more than fifteen megawatts to one hundred megawatts shall be approved by the government on the proposal of the MPI with technical consent of MEM;
4. Electricity projects with an installed capacity more than one hundred megawatts or with a reservoir area with more than ten thousand hectares or with a severe socio-economic and natural impacts shall be approved by standing Committee of the National Assembly the proposal of the Government.

The electricity projects with no requirement for concession agreement are: projects implemented by government; hydropower with installed capacity less than 15 MW and with no serious harmful effect to environment, society and nature; thermal power plant with capacity less than 500 KW; and electricity produced from any kind of renewable energy sources.

When applying for license approval for hydropower and other renewable energy projects with install capacity less than100 KW, the following procedure must be followed. First, the project developer must submit a project proposal consisting of preliminary assessment, investment proposals, cost estimates, economic technical analysis, and environmental impact evaluation to District Office of Planning and Investment (DOPI).Upon receiving project proposal, DOPI will check the benefits of the project to the district's socio-economic development plan. The proposal will be circulated to the relevant organizations for review and comment related to responsibility of each organization. For example, District Office of Energy and Mine will provides comments in technical terms of power production and distribution, while the environment sector will provide comments on environment and social impact issue. If the comments received are supportive of the project, the DOPI will grant a license to the parties engaged in project implementation. If the DOPI needs more information before approval of

[57] General electricity business includes: planning, data collection survey, design, construction, installation, distribution and general services. Electricity business in the form of concession includes: generation and electricity transmission by the public and private sectors.

the project, the DOPI will ask to the project developer to update the application in the relevant areas.

The implementation of standalone system can start after getting approval from DOPI. If the system is a grid-connected system, the project developer has to agree a price with EdL at which electricity can be sold to the grid. The complete application process is typically completed within thirty working days. For systems with installed capacity over 100 kW but less than 15 MW, the aforementioned process must be completed with the relevant organizations at the provincial level.

The application process for large-scale hydropower and other RE source with installed capacity over 15 MW is slightly different and is summarized below:

- The signing of a Memorandum of Understanding (MoU) between private investor and the MPI to conduct feasibility study.
- Proceed with feasibility study with private investor as the lead actor.
- Presentation of feasibility study results to DEPD at MEM.
- Negotiation of Concession Agreement (CA) between private investor and the GoL led by MEM.
- Parallel to this, private investor submits an Environmental Impact Assessment (EIA) report for approval to WREA.
- Negotiation of Power Purchase Agreement (PPA) between private investor and power purchaser (following the signing of the CA and EIA approval).
- After the signing of PPA, private investor will start with necessary preparation for dam construction both technically and socially (regarding resettlement, compensation).

The draft decree for regulation and utilization of Biofuel in Lao People's Democratic Republic, date 11 September 2013 classified the size of Biofuel production and level of approval into three levels: family business size, small to medium business size and large business size.

Family business size (production capacity less than 200 litre per day) shall require licensing approval by the Energy and Mine District Office in accordance with agreed of organizations concerned. Small- to medium-size business (production capacity between 201-9,999 litres per day) shall require licensing approval by Energy and Mine Provincial Division. Large-scale business (production capacity over 10,000 litre per day) shall require licensing approval by MEM.

In order to get licensing approval, applicants should have economic and technical analysis of project including: plan for land survey and use for energy crop plantation, data collection, system design, construction/installation, productivity, processing, transportation, distribution, export and service. For small to large scale of business, applicants are required to submit detail of environment-social impact assessment. However, these documents are not needed for family business scale.

1.3. Improvement in standard of living in the community and benefits to disadvantaged segments by setting up the RE/SET project/energy service the energy product/service

As already mentioned in part B section 2.3, there are a growing number of new businesses in newly-electrified villages, especially retail stores, weaving and knitting shops and rice mills. As indicated in the comprehensive socio economic survey conducted in 2005, there are approximately 30 new businesses per village since the arrival of electricity. The use of electric tools and appliances has improved living standards and allowed for other productive activities. As well as this, electrical lighting has extended the evening hours for the family to work at home or to study.

1.4. Availability and price of RE/SET service/product, their availability and price as compared to other products available in the market and acceptability of RE/SET energy service/product in the community

Currently, there are no local RE/SET products in Lao People's Democratic Republic. These accessories are imported from many sources with varying quality and price. These accessories are typically imported by ESCOs, project staff and dealers.

RETs have a high initial investment and are typically not affordable for low income rural people. Without promotion campaigns or incentive mechanisms to support RE/SET products, it will be difficult to expand utilization of RET in rural areas.

The cost of generation of RE technologies for grid-connected systems has already been presented in part A, section 2.6.As mentioned here, rural people typically prefer being connected to the grid as the connection is more reliable. However, this cost for grid extension can often be prohibitive for many households. The average cost of grid extension is US$1,640 per household in the Northern part of the country and US$1,390 per household in the South, while the connection fee in electrified villages (the up-front connection and house-wiring cost) is US$100-US$120. The average cost of micro-hydropower is US$8,000 per household.

Pico hydropower is typically very popular in the northern part of the country. There are two main types of pico hydropower; one is low-head-propeller with the rate capacity vary from 200 W to several Kilowatts (Mattijs, el la 2008), the other is 'Turgo' Pico-hydro unit, which requires more head and has to be connected to a penstock, a long pipe to channel the water, to function. These units can generate power ranging from 500 W upwards.This type of Pico-hydropower is suitable for hilly and mountainous areas. The Table below shows the comparison of different off-grid electricity production systems in Lao People's Democratic Republic.

Table 32: Comparison of Various Off-Grid Electricity Production Systems

Technology	Capacity (no. hh)	Lifetime	Equipment cost over lifetime (US$)	Installation cost (US$)	Operation and maintenance cost per year (est.)(US$)	Life-cycle cost (US$/year per hh)
Pico-hydro	(Rated) 300 W (1 hh)	3 years	29-138	0	25	35-71
Family Pico-hydro	200 W (1 hh)	5 years	80-200	40-300	50	74-150

Community Pico-hydro	220/119 VAC , 3,000 W (15 hhs)	-	Varies:	1,000-3,000	200	~31-40
PV-solar home system	100 Wp (1 hh)	20 years	600-800	200-600	100	140-170
Small wind (China)	300 W (1 hh)	15 years	800	300	80	153
Small diesel/petrol gen-sets	1-3 KW (1-3 hhs)	10 year	1,000-5,000	100-350	40-400 (depends on hours of use)	150-311

Source: Technography of Pico-Hydropower in Lao People's Democratic Republic-Report3, LIR, 2008

1.5. Experience of project proponent in extending the reach of RE/SET service/product, i.e. rural or remote locations which present challenges in terms of logistics and distribution models

In Lao People's Democratic Republic, most un-electrified villages are located in rural and remote areas. Extension of energy services to such areas are faced by a number of challenges such as:

i) Poor road condition access to these areas (some have no roads, some can only be accessed during the dry season) resulting in high cost of transportation, installation and after sale service.

ii) Low density of village (30-100 hhs/village) and low energy consumption. Usually electricity used in rural area is mainly for lighting, not for productivity.

iii) People have low income as they cannot afford energy system and services, for instance in electrified village only 80% of households are able to pay grid connection fee.

iv) People have low technical skill/ education making it difficult to adopt new technology.

v) Alack of information of RET applications in rural areas results in a lack of awareness of RETs and new technologies and

vi) Practice mechanisms of public financial incentives for RE promotion do not exist.

There have been a number of efforts to address some of the challenges associated with extension of rural energy services. For example, the Rural Electrification Programme has shown the model of RE/RET services in remote areas via the ESCOs and VEM. As well as this, private companies like Sunlabob Renewable Energy Ltd have addressed these challenges by training local villagers to offer services as network franchisees. These schemes are aimed at addressing insufficient initial cost of RET installation with rental system, PPP for VHGS, making service available, spare part and after sale service for operation and maintenance in remote areas. The ESCOs or VEM is very useful to help remote villagers to provide technology option, planning and making decision for selecting technology and payment term that are suitable to their ability and demand.

1.6. Information on capacity building training provided to the community for operation and maintenance of energy service/product

Previously, it was found that all RETs installed in the country were either done by government or private companies. After installation of the system had completed, the local management committee was created by project developer to manage operation of the system and coordination between users and project owner. As well as this, local technicians (some of whom are villagers) have been trained in technical aspects to operate and maintain the system. Similarly, many users received training and education relating to appropriate uses of electrical appliances in their house.

1.7. Existing quality control mechanism for building up consumer confidence

There is no existing quality control mechanism of build-up consumer confidence. However, there are some offers of warrantee/guarantee duration of one to three year of RET components provided by some private companies.

1.8. Provide information on the support made available from government/private sector for strengthening capacity of entrepreneur

In Lao People's Democratic Republic, each ministry has representatives in district and provincial level to act and provide services as mandated by the relevant ministry. Strengthening the capacity of local staff plays a very important role in providing continuous supply in the relevant communities.

REMI, under MOST, has provided technical training to staff of local office branches and common people in system design, installation, operation and maintenance of solar PV and solar drying systems. Organized training for improved cook stove production for stove producers and also fix dome biogas digester construction for local masons allows recipients of the training to apply their knowledge acquired from these training courses for energy services in their local areas.

Similarly, REP supports and improves the capability of entrepreneurs. This in turn creates models of decentralized service in rural areas by establishing ESCOs and VEM. However, the practical management of the processes involved in enabling the private sector is still a major challenge. An example is the need to manage healthy competition between ESCOs, such that proficient ESCOs serve more customers and inefficient ESCOs are forced to improve their service. Although clear and simple procedures are already in place, their application remains a challenge for forthcoming years. To facilitate enablement, the programme has developed a full set of regulations, guidelines, administrative standards, cash flows (for ESCOs) and business plan formats (for VHGS VEMs), standardized contracts, and technical specifications.

1.9. Provide information on monitoring mechanism set for evaluation of efficiency of the RE/SET project/energy service delivery with regard to the set standards

Right now there is no national standard or official monitoring mechanism set for the evaluation of efficiency of the RE/RET project/energy service delivery in Lao People's Democratic Republic, However, the RET projects implemented in Lao People's Democratic

Republic have their own methodology to monitor and evaluate the implementation of the project.

2. Service Provision and Distribution Mechanism

2.1. Subsidies, grants or tax benefits available in remote areas

There is no subsidy scheme from government to promote utilization of RE. However, there are a number of policies and programmes, such as REP and REDSL, which provides incentives for private sector companies and entrepreneurs who wish to provide energy services in remote areas.

2.2. Examples of local orientation on programme objective and methodology

The government is planning to expand electricity and energy services to rural and remote areas through decentralized power generation. For example, power generation with capacity installation less than 100 KW has been approved by the district governor. Energy services in rural and remote areas can be accessed via ESCOs and VEM. The franchise form has been found to be an effective method to expand service and provide reliable and sustainable service in local areas.

2.3. Available financial packages well suited to needs of community and other income generating activities

The local community can gain access to credit with APB, Nayoby Bank and the Village Fund. The detail of these loans and interest rates are mentioned in part C section 2.5.

2.4. Possibility of a build up for local energy and services distribution chain

Currently, REP and Sunlabob Renewable Energy Ltd train local entrepreneurs to do business as franchise. On the other hand, the financial incentive mentioned in REDSL, investment incentives and efforts of government for rural development and poverty eradication programme may persuade local people to become interested in entering the energy service business.

2.5. Reaching rural areas for goods and services

As indicated in Five Year Rural Development and Poverty Eradication Plan (RDPE) 2011-2015, most poor families currently live in remote rural areas without easy road access. The GoL attempts to develop basic infrastructure in rural and remote areas to facilitate social-economic development. As indicated in the rural development and poverty eradication five-year plan (2011-2015), there were 6,537 villages (75.54%) with all-weather road access year round in 2011. As well as this, 588 rural markets were established to facilitate goods distribution throughout surrounding areas.

3. Country-specific Risks that Could Impede Project Implementation

As mentioned in the energy sector assessment in Lao People's Democratic Republic conducted by ADB, there are three main country specific risks that could impede project implementation. First, Lao People's Democratic Republic has a limited capability to manage

energy projects. Skilled human resources are required to actively participate in project identification and development in assessing social and environmental impacts, project appraisal and project implementation and management. Second, there is the risk that the influx of private developers looking for business in Lao People's Democratic Republic will increase the risk that government agencies will make the wrong choices-choosing "easy" projects at the expense of environmental protection and social impact mitigation. Third and related to the first two risks, delays in securing IPPs would impact negatively on the government's export target.

3.1 Instances of lack of community involvement during the implementation stage

Participation of the local community plays a very important role in rural energy project implementation as project sites usually concern the property of local people. As a result, it may be necessary to move some people from their homes, be it temporarily or permanently. However, problems may occur when these people are not willing to be moved from their land. In these cases, it may be necessary to offer some form of compensation to these people. However, this can be time consuming, which adds further costs onto the project.

3.2. Example of lack of commitment shown by the government

The GoL play a very important role in expanding energy services, particular in planning for energy production and supply. The private sector also plays an important role as an investor for energy production to meet demand and provide services in energy supply systems. Good regulation and incentive mechanisms are needed to urge and encourage private sectors to invest in this field.

3.3. Example of non-participation by financial institutions (FI's) including micro finance organizations

The GoL encourages the private sector to invest in energy services, particularly for off-grid systems aiming to rapidly increase the levels of accessible energy services in remote areas where electric grid will not be able to reach in the near future. RET is one solution to produce and use energy locally.

However, the problem with RETs is the high level of investment required for implementation coupled with the fact that people in these remote areas typically have very low incomes and cannot afford to pay for the installation or use of these RETs. Microfinance plays a very important role in helping these people gain access to RETs. Without this support, it will be very difficult to expand energy services in rural areas.

3.4. Example of advancement in technology

RETs are typically the most sustainable energy source as they use mainly renewable sources to produce energy. This energy can be used for a range of activities, including increased productivity, income generation and general contribution to livelihood. Clearly, it is essential that these benefits are experienced by poor rural communities.

3.5. Availability of alternative solutions, other than the one considered by the project proponent

While the aforementioned incentive schemes are useful for increasing the accessibility of RETs in rural areas of Lao People's Democratic Republic, it is also important to consider alternative solutions. This could come in the form of the provision of support for RET applications or increased capacity building in relation to the technical skills required to operate RETs.

E. Social-Economic Factors

Various socio-economic factors impact the environment for development of sustainable energy options in a country. It is thus important to assess the sustainable energy options with respect to parameters that indicate suitable social and economic environment for selecting suitable energy options for a country.

1. Social factors

Various social factors influence the adoption of renewable energy technologies among the communities in a country.

1.1 Awareness efforts made by the government in promotion of RE and SETs

- Through electronic media: So far, Lao People's Democratic Republic doesn't have a specific website for promoting renewable energy and sustainable energy. However, Lao People's Democratic Republic does have a website on power development.
- Through print media: it is very difficult to find text books on renewable energy in book stores. Having said that, IREP, REMI, NUOL (FE, FS), LIRE and Sunlabob Company Ltd produce general information on the topic.
- Training programme: Previously, a number of training programmes have been provided by IREP/MEM, REMI/MOST, FE/NOUL, LIRE, and Sunlabob. However, these training courses have been quite general and have not provided specialized teachings.
- Direct campaigning: Previously, there has been evidence of direct campaigning. These campaigns have involved solar power, pico-hydro power and biogas systems.

1.2 National and society openness to technological innovations

As mentioned earlier, Lao People's Democratic Republic isn't involved in the manufacture of RET equipment.

1.3 Examples of community involvement in developing RE and SET product and service

- SHS conducted by IREP, support by WB. The project is managed by the Village Off-grid Promotion and Support (VOPS) office established by MEM. The installation, operation and maintenance of SHSs are performed by trained VEM. Newly-formed or existing Local ESCOs are responsible for supporting the VEMs during installation and O&M. A VEAC is formed in each target village and plays an advisory role for the village electrification strategy and implementation. VOPS owns SHS during the renting period of 5 or 10 years, and the household will own the SHS at the end of renting term. There are no representatives from local people involved in VOPS.
- Green electricity for village-based pico-hydro electrification, the project was to provide the villagers with skills for installing and maintaining pico-hydro generators. The project consisted of the following main elements
    - ✓ 2-3 rice farmers per village were given basic hydro generator training (installation, operation and maintenance);
    - ✓ Provision by the project of all the necessary equipment for the 24 villages to implement two pilot installations per village;

- ✓ Implementation of 2 pilot installations per village by the trained "technicians", with contribution from the villagers without ESF's presence;
- ✓ Establishment of "Village Electricity Management Committees" to manage the pico-hydro electrification system in each village;
- ✓ Improved availability of pico-hydro equipment and materials through a search and review of available equipment and material and setting up a workshop in Phongsaly;
- ✓ Training of 12 best "technicians" in repairing and improving the reliability of pico-hydro generators;

1.4 Consumer preferences and product development due to cultural diversity, rural and urban population

The use of electricity or LPG is very limited in urban and rural areas, especially as a primary cooking fuel. The low penetration of electricity and LPG is a function of their higher costs and the cultural attachment households have to cook with wood or charcoal. Concerns over the safety of LPG are also a factor but to a lesser extent. Among solid fuel users, charcoal tends to be the preferred fuel source however it is more expensive than wood. Most households use a mix of charcoal and wood.

1.5 Example of involvement of women and disadvantaged groups that impact project success

The energy situation in Lao People's Democratic Republic is characterized by low conventional energy consumption. Biomass accounted for 68%of the total energy consumption in 2009, followed by petroleum products (17%), and electricity (12%). The high proportion of fuel wood consumption reflects its widespread use, particularly in the rural areas. Imported oil and LPG are mainly used in the transport and residential sector respectively. Wood fuels consumption in 2009 was3.9 million tons and accounted for 68% of total energy consumption in Lao People's Democratic Republic. It is estimated that about 88% of households use wood fuels for cooking. Charcoal is one of the most important traditional sources of energy for both urban and semi-urban populations, and is used mainly for cooking

In Lao People's Democratic Republic, each authority from centre to local and also in each village has an association of women. However, women are underrepresented in the National Assembly as well as local decision-making bodies, yet have higher representation then in most countries in the region.

More women are part of the labour force than before. This is especially true in urban areas where women follow a trade. Women's wages, however, are still lower than those of men.

Cooking stove programmes conducted by SNV successfully managed to leverage women as a powerful vector of diffusion by involving women at all stages of the life cycle of a project.

A Biogas pilot programme (BPP) has also been conducted by SNV which involved women at all stages of the project. Due to the fact women are typically responsible for decision making in relation to domestic tasks, it was important that many women were able to have an input on the programme.

1.6 Instances of involvement of local and national-level NGOs

SHS are currently implemented by IREP atthe national level, Provincial Department of Energy and Mines at the provincial level, Energy and Mines Office at the district level and VEM at the village level. In addition PESCOs are involved at every level of implementation. Projects implemented by NGOs receive government cooperation at all levels.

1.7 Assistance from local community groups in promoting SETs / RETs

After biogas digesters and efficiency cook stove were introduce in Lao People's Democratic Republic and sufficient community training was provided, local people from each province were able to produce biogas digesters and efficiency cook stoves for commercial and self-application.

2. Affordability and accessibility

Affordability of energy options is an important factor that influences the decision making ability of end users, whether to use the conventional technologies or renewable energy technologies and services. Accessibility in terms of reach of the people to access finance for buying the RE technologies and sustainable energy services as well as availability of centralized grid power also influence the decision making process. This in turn affects the dissemination of renewable energy products/services in the society.

2.1 Information on type of conventional energy source being used for various applications along with average unit price of source of energy being used

The fuel wood consumption of an average family in Lao People's Democratic Republic was 6-18m^3per year depending on the family size. The villagers were either buying fuel wood or collecting fuel wood themselves. For the families who had to purchase fuel wood, the cost amounted to between US$25 and US$150 per year[58]. For the brick factories and other industries, the average cost of purchasing fuel wood was about US$10/$m^3$.

2.2 Average monthly spending on use of conventional technologies for requested applications (US$/month)

Fuel Purchase

- In urban areas, mobile sellers make solid fuels (especially charcoal) easily accessible. They supply about 58% of households.
- In rural areas, more than 65% of the fuel used for cooking is wood collected in nearby surroundings. Wood collection requires less time than in other countries where wood is more scarce.
- Women and children were said to be mainly responsible for wood fuel collection in 35% and 15% of rural households surveyed. These households typically spend 0.3 hours per day for wood collection

58

http://www.wisions.net/files/uploads/SEPS%20Summary%20%20Laos%20Reduced%20Stoves%20SC057.pdf

Available Fuel Cost

The use of solid fuels for cooking is not limited to low income populations and can be found across various income categories. There are no piped gas networks in Lao People's Democratic Republic. Most of the gas is imported from Thailand. The average monthly spending on use of conventional fuel is illustrated in Table below.

Table 33: Average Monthly Spending on use of Conventional Fuel in Lao People's Democratic Republic

Fuel	Quantity/month	Price/unit	Yearly expend
Wood	25-35 kg	Free	Free-US$6
Charcoal	25-40 kg	US$0.02-0.04	US$6-19.2

2.3 Information on subsidies available for conventional fuel

Based on a discussion with a representative of Ministry of Finance (MoF), Lao People's Democratic Republic doesn't have any subsidies on fuel. However, the GoL has limited the fuel price. For example, the price of diesel should never exceed 10,000 kip per litre while gasoline fuel price should not exceed 11,000 kip per litre. In addition, other conventional fuels like solid biomass (e.g. fuel wood and charcoal) are not subsidized.

Note: US$1=8,000 kip)

2.4 Information on end-user financing schemes for purchasing RE technologies and services

International financial institutions and other donors provide financial support for purchasing renewable energy technologies and soft-loans to implement renewable energy project/programmes. There are no banks or financial institutions in Lao People's Democratic Republic who provide the fund with low interest rate. The WB has been provided funds to the GoL for power grid expansion with a 1% interest rate per year. The GoL then provides funds to EdL with interest rate 7% a year.

2.5 Cultural preference that influences affordability for a particular product/service

In Lao People's Democratic Republic, cooking is usually the responsibility of women. Owing to the Lao culture on cooking habits, most households cook with solid fuel cook stoves(wood or charcoal) with several stoves typically used when cooking a meal. Households rely mainly on wood as a fuel source. However, charcoal is preferred when cooking grilled meat and special occasions in general. There is also evidence to suggest that the people of Lao People's Democratic Republic believe that food prepared by biomass actually tastes nicer than when it is cooked with other fuels.

The use of rice cookers is widespread. However, sticky rice cannot be cooked with a rice cooker.

Solid fuels are the prevailing cooking fuel in rural and urban areas. They are used by more than 90% Lao households. For most users, charcoal represents an alternative cooking fuel to wood.

Fuel Usage & Availability

The use of electricity or LPG is very limited in urban and rural areas, especially as a primary cooking fuel.

The low penetration of electricity and LPG is a result of their higher costs and the cultural attachment households have to cooking with wood or charcoal. There are also a number of people who have concerns over the safety of LPG.

Among solid fuel users, charcoal tends to be the preferred fuel source. However, it is more expensive than wood. Most households use a mix of charcoal and wood

In urban areas, wood users are mostly located in peri-urban areas

Lao People's Democratic Republic's large forest cover makes wood an abundant and cheap fuel available in rural areas, as well as in some peri-urban areas.

F. South-South and Intra-country Co-operation

South-South and intra-country co-operation acts as an impetus to the process of expansion of sustainable energy technology deployment and use in a country.

1. **Energy co-ordination (Co-ordination with different organizations, private sectors and NGOs for country-level energy plans and programmes)**

   There has been a lack of coordination between energy stakeholders and organizations, which is one of the biggest challenges facing renewable energy development in Lao People's Democratic Republic.

2. **Policy and planning**

   The Electricity Law prescribes that MEM is responsible for making policy and strategy for the nation's electricity sector. MEM also has the responsibility to develop and implement laws and regulations and to supervise the businesses of electricity companies. Therefore, energy policy and planning is typically prepared by the various departments under MEM. In case of electricity tariff setting and modification, EdL prepares and submits new electricity tariff to MEM and GoL approves modification of the tariff.

3. **Power sector (New and alternate energy sources)**

   MEM and line ministries are involved in Renewable Energy Development strategy of Lao People's Democratic Republic.

4. **Renewable energy (RE systems and deployment, Public-private partnership)**

   There is R&D of RETs carried out in research institutes and universities. However, there have been no joint research projects among research institutes, universities and private sector companies found in previous years. Also there is no private company providing financial support to research institutes or universities to do research for the company.

5. **Environment (Project life-cycle, Waste disposal)**

   It is essential to carry out an EIA when applying for a license for construction of hydropower plants and other types of business concerning environmental impacts. Private companies typically work with environmental agencies when undertaking this task.

   Small-scale RETs on the other hand do not require an EIA. However, they must describe how they are addressing an environmental problem and show evidence of this after project completion.

6. **Efficiency and conservation (Demand-supply management)**

   EEC in Lao People's Democratic Republic is at an early stage. Currently there is no national strategy for EEC. Having said that, IREP is presently creating the strategy and regulation for EEC with assistance from the department of energy management of MEM. Assistance was also provided by multilateral and bilateral donors. For example, the World Bank provided support to rural electrification projects concerning demand-side management.

MEM also has initiated activities of EEC under ASEAN programmes for capacity building, standard setting and labelling.

Since 1998, the promotion of improved cook stove programmes has been implemented by a number of different bodies, including international agencies, NGOs and ING.

7. Skill building and institutional capacity (Training: Vocational training, R &D, Standardization and harmonization, Innovation stroke and technology development)

Several activities for skill building and institutional capacity have been conducted in relevant organizations both public and private such as:

- MEM implements REP by providing training to local people on technical and business aspects required to be an entrepreneur such as ESCOs and VEM. Capacity building and sharing information on RET via ASEAN Energy Centre (AEC) and international cooperation is also undertaken by MEM
- REMI carry out R&D on RET and its applications, organize vocational training courses on bio gas digester construction, improve cook stove production, PV system design, installation and maintenance, installation of laboratories for study, standardization and harmonization of biofuel, capacity building, sharing experience and knowledge via ASEAN-COST Subcommittee of Sustainable Energy Research and international cooperation.
- Private organizations such as Sunlabob and LIRE conduct research and provide training to local communities to enable them the set up franchises providing RE services in rural areas.
- National University of Lao carries out R&D and teaching on RET

8. Trade (Concessional duties, Trade Zones, Integrated infrastructure development)

Incentives and regulations from the government to promote RE services have been described in greater detail in part B section 1.

9. Private sector participation

The participation of the private sector in RE services can be seen in two forms. One is in direct correspondence with the customer, the other is via PPPs. In the latter case, the public can be government, international agencies or donors.

Previously, funding was supported by government and then passed on to a PPPs scheme. Other business models practiced in Lao People's Democratic Republic involve private companies training local people to be entrepreneurs so that they can provide energy services in their local as a franchise of companies.

10. Pro-poor policies (Involvement of poor and addressing the gender issues)

There is one programme carried out by EdL known as "Power to the Poor", which received initial financial support from World Bank. This programme provides interest-free credit for electricity connection charges. This is especially valuable to families who live in villages

already in the power grid but who cannot afford connection costs. A household is eligible for support if it meets at least one of the poverty criteria or is female / single parent headed and safe to electrify.

There are a wide variety of benefits which can be enjoyed by those who have recently gained access to electricity, particularly in the case of women. For example, electrification can result in a significant reduction in time spent performing tedious tasks such as water collection, flexibility in organizing household activities, income-generating potential and greater security.

Case Study 1: Biogas production and utilization from cassava flour factory

CS 1-1: Project Background

The project aims to capture and destroy methane to significantly reduce greenhouse gas emissions. It also aims to replace fossil fuel usage and to efficiently clean wastewater to reduce the smell. The project converts wastewater of a starch factory into clean biogas in an anaerobic reactor. The produced biogas is sold back to the starch factory to replace coal for heating to dry the starch as substitute fuel to coal to dry the starch. The project helps stimulate Lao People's Democratic Republic's economy, provide another domestic fuel source and ultimately contribute to a better living environment for local factory staff, farmers and residents.

CS 1-2: Project Description

Biogas plants capture and destroy methane, significantly reduce greenhouse gas emissions, efficiently clean wastewater, reduce smell and replaces fossil fuel usage. Carbon dioxide (CO_2) reduction of greenhouse gas emissions equivalent of carbon dioxide equivalent compared with no project (baseline). Project is capable to reduce greenhouse gas emissions equivalent up to 37,000 tons carbon dioxide per year equal to gas emissions from 15,000 cars when compared with no project. Further, as the wastewater is cleaned in a controlled reactor, the rotten egg smell (from the open lagoons where the wastewater currently goes) is eliminated. In addition, the project directly creates employment for nearby residents.

The biogas plant designed by a leading designer of biogas plants using covering in ground anaerobic reactor technology and implemented by TBEC in Thailand that received the Crown Standard award for quality of construction of a small biogas plant. The technology is new to Lao People's Democratic Republic and thus the project facilitates technology transfer.

CS 1-3: Project Cost and Partner

The total project cost was € 2,300,000. This was supported by Thai Biogas Energy Company (TBEC), Liqum, National University of Laos (NUOL), TBEC (Lao) Co., Ltd. Who collectively provided € 2,100,000 and Energy and Environment Partnership (EEP) who provided € 200,000.

So far, EEP only provides grants for demonstration projects, feasibility studies, capacity building, policy development, co-finance and so on. For example Interlinkages between Energy and Livelihoods-Data, Training and Scenarios for Sustainable Energy Planning in Laos, Rehabilitation of hydroelectric power plants and distribution network using new clean technology Permanent Management Generator (PMG) solution in Lao People's Democratic Republic, Scenarios for Sustainable Energy Planning in Laos, Green electricity for 24 villages of the Phongsaly District Phongsaly, co-finance for construction biogas plant to treat wastewater from a cassava-fed starch factory by anaerobic digestion of TBEC (Lao) Co., LTD. Scaling-up electrification and local capacity building for rural areas of LuangPrabang province, Detailed Viability Study of Decentralized Small Scale Biodiesel Production in Lao People's Democratic Republic and First Pilot Implementation at District Level, Pre-feasibility

study of the wind potential in Laos, Developed Renewable Energy Development Strategy in Lao People's Democratic Republic.

The total project cost of €2,300,000 is covered by support from TBEC (€ 2,100,000) and EEP (€ 200,000).

CS 1-4: Relevance to Country's Energy and Environment Policies

The project is in line with the policy of Lao People's Democratic Republic government to increase the share of renewable energy and with the National Growth and Poverty Eradication Strategy as it promotes energy security and contributes to environmental protection. It is also relevant for the starch industry and local populations affected by such factories. Below is a list of benefits of the project:

- Promotes economic development
- Increases starch industry competitiveness
- Aligns well with the Millennium Development Goals (MDGs), especially the goal to ensure environmental sustainability
- Reduction of greenhouse gas emissions through removal of methane and substitution of coal
- Develops a centralized source of energy
- Provides a domestic fuel source
- Supports Lao People's Democratic Republic renewable energy aspirants and is in line with the Lao priorities in reducing GHG emissions
- Increases availability of biogas and replaces coal in its vicinity
- Provides dependable energy supply and thus alleviates a bottleneck for continuous production and growth
- Creates a sustainable environment
- Facilitates technical and scientific know-how transfer from donors to the EEP countries
- Improves socio-economic and living conditions
- Training and capacity building to fully localize the operation, maintenance and management of the plant

C-S 1-5: Innovation and Knowledge Transfer

The project is used as a model to educate locals and government authorities on CDM mechanisms through organized site visits, workshops and seminars.

Staff training increases the capacity of local employees to handle different kinds of situations. TBEC Laos staff in the plant were trained locally and at TBEC's sites in Thailand. TBEC's experts conducted the training together with NUOL and laboratory persons.

Students also were trained to take and test water samples in the university and at on-site laboratories. Site visits for several international organizations were conducted. Furthermore a public hearing was held for local people to introduce the project.

Environmental and technical workshops helped to make the project successful. International and local experts discussed renewable energy related issues during workshops. In addition, local experts had an opportunity to visit the TBEC Thai biogas plant.

Case study 2: Green electricity for 24 villages of the Phongsaly District, Phongsaly Province by pico-hydro

CS 2-1: Project Background

Lao People's Democratic Republic is a landlocked country, where traditional energy sources, especially fuel wood and charcoal are widely used. Currently there are many villages in north Lao People's Democratic Republic that don't have access to electricity. One of the key energy sector objectives of the government is to provide access to electricity to its entire population by expanding and improving the main grid and through new off-grid electrification projects. The low population density and the hilly terrain of the region make the extension of the national grid to this region economically unfeasible. In this situation, the solution is only to provide the region's population with access to electricity. This requires decentralized and autonomous electricity producing installations.

CS 2-2: Project Description

The goal of this project was to help improve standards of underprivileged families in 24 remote villages located in the Phongsaly district through the provision of a sustainable and safe source of pico-hydropower. The main objective of the project was to develop the capacity of villagers to have long-term collective access to electricity. The implementation of this project also helps contribute to the Lao People's Democratic Republic government goal of extending access to electricity in the region to 50% of the population. The project had five main objectives:

- Provide theoretical and practical training in basic hydro generator techniques to 3 people from each of 24 selected villages
- Provision of all the necessary equipment for the 24 villages to implement two pilot installations per village
- Implementation of 2 pilot installation per village by technician, with contribution from the villagers
- Provide extensive maintenance training, to 12 of the best trained technicians
- Setting up village electricity management committees in each of the selected villages

CS 2-3: Project Cost and Partner

The total project cost € 210,000. This was supported by Electriciens sans Frontieres (ESF), CominKhmere Co., Ltd. Who provided € 110,000 and EEP who provided € 100,000. ESF also provided a grant for implementing this project.

CS 2-4: Project Outcomes

The outcome of this project resulted in 41 Pico-hydro generators being installed in 20 out of the 24 selected villages, through which 500 households gained access to electricity. The total capacity of the installed Pico-hydro generators was 21 kW. The electricity generated is mainly used for lighting, with a total of 100 LED light bulbs being distributed amongst the 20 villages.

CS 2-5: Innovation and Knowledge Transfer

Although the technology is not new, this is an innovative project due to its focus on village-based self-reliance organization of electrification. This is based on the transfer of the technological and organizational know-how to villagers. All the pilot installations were made by the villagers using low-cost, locally available materials

A total of 69 villagers were trained in the technology and installation of pico-hydro generators, constructing electrical supply lines and installing equipment in buildings. 15 of the 69 villagers received further training as technicians in order to be able maintain and improve the reliability of installed pico-hydro turbine-generators. To help the long-term sustainability of the project, a central workshop for repairing a Pico-hydro turbine-generator was established in Phongsaly. As well as this, VEM committees were set up in all 20 villages.

The project has helped to improve the standard of living in the selected villages by replacing kerosene and diesel lamps and candles with electric lighting thus reducing health risks caused by indoor pollution. The average monthly cost of using kerosene, diesel lamps and candles is about US$ 4-5[59]. This switching of lighting sources has produced positive environmental impacts, namely reduction in GHG emissions.

Overall, the project has been very successful and has high potential for replication due to its focus on village based approach to technological transfer and organizational know-how. As a result 3 of the 20 villages have already added additional pico-hydro installations after completion of the project, bearing all the equipment costs themselves.

The necessary material for implementation such as operation and maintenance (O&M) and installations is available in Lao language. 100% of teaching and installation aid is given to the trainees in Lao. Two or three technicians in each village are capable of building the hydroelectric and electric installations. Two or three rice farmers are trained in each village

VEM committees were created in partnership with local authorities. The committees' tasks, their organization and how they should operate were defined. Monthly payments for electricity supply were established in agreement with local authorities

C-S 2-6: Sustainability and Replicability

Sustainability: The village-based pico-hydro electrification system established by the project should continue to operate on a self-sustaining basis in each village. This should include the Pico-hydro installations, the trained technicians and the VEM committees in each village. The legal ownership of the installed Pico-hydro is with DDEM, who is also responsible for continued monitoring of the installations. By project completion, all villages had established Management Committees responsible for the operation and maintenance of the Pico-hydro installations including collecting and managing fees and monitoring compliance with rules for use. The trained technicians (2-3 per village) carry out maintenance and necessary repair works enforced by the Management Committee and get back-up from DDEM when needed. Some repairs have already been done using the material and tools in the workshop established in Phongsaly. The electricity fee, 2,000 LAK/month/household, was set in cooperation with

[59] Rural Electrification Division, Institute of Renewable Energy Promotion, Ministry of Energy and Mines (April 2014)

authorities. Collected fees are operated as a revolving fund to cover O&M of the installations and the electricity fee including manpower cost.

Replicability: Replicability for this project is concerned with two levels: (1) the scaling up of benefits with the 20 villages through installation of further Pico-hydro units, and (2) the replication of the project in other locations. The ability of the villagers to create new pico-hydro installations was an integral part of the training conducted by the project, which supports installation of further Pico-hydro units. According to information from DDEM in November 2013, no new hydro installations have been done by the villagers after the completion of the project.