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NAMA FOR THE RENEWABLE ENERGY SECTOR OF LAO PDR

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FOREWORD

Energy is one of the most important inputs for economic growth and human development in Lao PDR. Energy access as a means for productive use is of key importance for rural communities to earn a decent living.

This document presents a NAMA on Rural Development through Electrification with Renewable Energies. It is designed to support Lao PDR in achieving its strategies relevant to rural development and rural electrification as outlined in the Rural Electrification Master Plan. The overall target of the NAMA is to provide access to electricity to 90 per cent of households by 2020.

During recent years, NAMAs have become a focus of climate change mitigation negotiations in the UNFCCC process. The NAMA modality can provide the essential holistic framework to overhaul a complete sector when framed within the context of sustainable development and beyond pure mitigation aspects. The focus on the sustainability of the entire sector is essential for achieving lasting results.

Moreover, the understanding of the NAMA concept is still evolving, and there is relatively little on-the-ground experience with respect to turning the concept into concrete actions. In this regard, UNDP in Lao PDR and the UNDP MDG-Carbon Programme have supported the development of this NAMA in order to help Lao PDR to achieve a transformative change and bring about rural development and enhancement of the private sector as long-term goal.

The outcomes of this NAMA with regards to Sustainable Development, GHG Emission Reductions and inclusive Green Growth are strongly interrelated building blocks as a pathway of a change framework that shall ensure that the NAMA is fully embedded in national development goals.

The NAMA design will provide the country with an accurate and credible information framework by applying a robust MRV system for sustainable development impacts and GHG emission reductions. The calculation of GHG emission reductions are based on an approved CDM methodology while the MDG Carbon NAMA Sustainable Development Evaluation Tool will allow to quantify and monitor the sustainable development impacts.

This NAMA on Rural Development through Rural Electrification with Renewable Energies in Lao PDR is designed as an encouraging holistic framework that will help Lao PDR to move towards a low-carbon pathway while advancing long-term sustainable development benefits and strengthening the private sector.

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Executive Summary

Access to modern energy services is a prerequisite for sustainable development. Even though the electrification rate in Lao PDR was 72.5 per cent of households in 2010, approximately 30 per cent of the population still remain without proper access to electricity. According to the updated the Rural Electrification Master Plan (REMP), the Government has set the national electrification target at a household level to 94 per cent by 2020 (MEM, 2010).

The Nationally Appropriate Mitigation Action (NAMA) represents an opportunity for sustainable and low carbon development for Lao PDR. The government can build on the existing policy framework, which incorporates policies, plans and actions aimed at mitigating GHG emissions while achieving sustainable development, so as to define a comprehensive and coherent NAMA development framework for Lao PDR.

NAMAs differ from traditional funding mechanisms which promote rural electrification and renewable energy projects. Interventions under the NAMA framework are prioritized in line with the socioeconomic development objectives of the host country. NAMA are designed with sustainable development benefits in mind and the design includes interventions which focus on income-generating activities which can create business opportunities for individuals, households and communities. NAMAs spur the development of an environment which facilitates transformative change in the energy sector through an attractive regulatory and policy environment that incentivizes the private sector.

The overall target of this NAMA is to support Lao PDR in achieving the goal defined in the Rural Electrification Master Plan, namely to provide access to electricity to more than 90 per cent of households in Lao PDR by 2020. The NAMA will reduce GHG emissions through the replacement of fossil fuels with renewable forms of energy. It will also contribute sustainable development (SD) benefits, including as improvement of the situation of groups with specific vulnerabilities, women and the poor.

This NAMA covers one type of technical intervention – the establishment of mini grids. Rural communities, tourism, agricultural facilities, health centres, and schools and literacy centres are the focus of these mini grids due to their demand for electricity for lighting, cooling and appliances. The mini grids will predominantly use renewable energy sources (hydro, solar) and will provide electricity for lighting, radios and phone charging for households, and for service and production activities.

In this first phase the NAMA aims to establish eight mini grids. This will provide electricity to around 1,000 households and around 6,000 people. Over the 15-year lifetime of the NAMA, emission reductions will reach around 13,000-14,000 tonnes of CO_2eq.

Capacity-building will be a key component in the implementation of the NAMA. Special emphasis will be given to identifying and supporting the development of income-generating activities in the Rural Productivity Zones (RPZs), as the key to positive rural development. Another important component will be technical support during the identification and implementation of the different mini grids, as the aim is to implement technically sound projects with low operating costs.

The baseline scenario for this NAMA consists of two components, a GHG baseline and a sustainable development (SD) baseline. Setting the baseline scenario in this way allows all effects to be properly assessed and quantified

through the monitoring activities described in the Measurement, Reporting and Verification (MRV) system. In the MRV, the UN Framework Convention on Climate Change (UNFCCC) "Small-scale Methodology AMS-III.BL: Integrated methodology for electrification of communities Version 01.0" will be used to monitor GHG emission reductions.

The total cost of the NAMA is estimated at around US$3.4 million. This includes support to cover the investment costs of the technical intervention as well as extensive capacity-building efforts. In total, the Government of Lao PDR is committed to providing around 14 per cent of the required funding. The remaining 86 per cent is expected to come from NAMA donors.

Implementation of the NAMA will be led by the Ministry of Energy and Mines as the NAMA Coordinating Authority (NCA). The Ministry of Natural Resources and Environment will be appointed as NAMA Approver/Focal Point to the UNFCCC. The role of NAMA Implementing Entity (NIE) will be taken by the Rural Electrification Fund.

The NAMA will receive capacity development support over a period of three years. Initial efforts will focus on securing national and international funding as well as establishing the institutional structure. The first eight projects will be prepared and implemented in the years 2016-2017. Depending on the availability of additional funding, further mini grids can be implemented. After the implementation of the projects, the NAMA will operate over a period of 15 years.

Abbreviations

5ps	Pro-Poor Private-Public Partnership
AC	Alternate Current
ASEAN	Association of Southeast Asian Nations
CDM	Clean Development Mechanism
COP	Conference of Parties
DDEM	District Department of Energy and Mines
DEB	Department of Energy Business
DEM	Department of Energy Management
DEPP	Department of Energy Policy and Planning
EDL	Electricité du Lao PDR
EE	Executing Entity
ESCO	Energy Service Company
FONDEM	Fondation Energies pour le Monde
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environmental Facility
Gg	Gigagrams
GHG	Greenhouse Gas
GoL	Government of Lao PDR
GWh	Gigawatt hour
ICT	Information and Communications Technology
IDA	International Development Association
INDC	Intended Nationally Determined Contributions
IPP	Independent Power Producer
IREP	Institute of Renewable Energy Promotion
KN	Kip (Lao PDR currency)
kTOE	kiloton Oil Equivalent
KW	Kilowatt
kWh/m²	Kilowatt hours per square meter
kWp	Kilowatt peak
LHSE	Lao Holding State Enterprise

NEDO	New Energy and Industrial Technology Development Organization
MCTPC	Ministry of Communication, Transportation, Post and Construction
MDG	Millennium Development Goals
MEM	Ministry of Energy and Mines
MoENR	Ministry of Environment and Natural Resources
MoF	Ministry of Finance
MoIC	Ministry of Industry and Commerce
MoNRE	Ministry of Natural Resources and Environment
MoST	Ministry of Science and Technology
MPI	Ministry of Planning and Investment
MRV	Measurement, Reporting and Verification
MW	Megawatt
NA	NAMA National Focal Point/ National NAMA Approver
NAMA	Nationally Appropriate Mitigation Action
NCA	NAMA Coordinating Authority
NDA	National Designated Authority
NEC	National Environmental Committee
NEDO	New Energy and Industrial Technology Development Organization
NEE	NAMA Executing Entity
NIE	NAMA Implementing Entity
NGPES	National Growth and Poverty Eradication Strategy
NORAD	Norwegian Agency for Development Cooperation
NSCC	National Strategy on Climate Change
ODS	Ozone-depleting Substances
PDEM	Provincial Department of Energy and Mines
PESCO	Provincial Electricity Service Company
PV	Photovoltaic
RE	Renewable Energy
RED	Rural Electrification Division
REDS	Renewable Energy Development Strategy
REF	Rural Electricity Fund
REMI	Renewable Energy and New Materials Institute
REMP	Rural Electrification Master Plan
RPZ	Rural Productivity Zone

SD	Sustainable Development
SHS	Solar Home Systems
SHP	Small Hydro Power
SLRS	Solar Lantern Rental System
SME	Small and Medium Enterprise
tCO_2eq	Tonne Carbon Dioxide Equivalent
TEPCO	Tokyo Electric Power Company
UNDP	United Nations Development Programme
USD	United States Dollar
UXO	Unexploded Ordnance
V	Volt
VAT	Value Added Tax
W	Watt
WB	World Bank
WTO	World Trade Association

1. Introduction

1.1 Rural Electrification and Development

Access to modern energy services is a prerequisite for sustainable development. Yet, as many as 1.3 billion people worldwide lack access to electricity. Between 2011 and 2013, the total number of people globally without access to electricity remained essentially unchanged (REN21, 2014). In many rural areas in developing countries, the cost of providing access to electricity are prohibitive and cannot be recovered within the economic lifetime of the electrification project.

The global initiative Sustainable Energy for All, launched by the UN Secretary-General, Ban Ki-moon, in 2011, is encouraging the international development community in its efforts to improve energy access and thereby reduce energy poverty.[1]

By increasing access to affordable lighting, communications and refrigeration, improved public health, and energy for productive activities, renewable energy systems offer an unprecedented opportunity to accelerate the expansion of energy access in remote and rural areas while at the same time contributing to the transition to modern energy services. Renewable energy can expand access to modern energy services in developing countries, both rapidly and cost effectively. (REN21, 2014).

The impacts of access to adequate lighting, the means for food preservation (cooling) and information and communications technologies (ICTs) are significant. A study in Rwanda found that once grid electricity was available, four out of five households switched completely from traditional lighting sources (GTZ and SenterNovem, 2009). Money saved by switching from conventional (kerosene fuelled) to solar lamps has been found to be commonly spent on better food, education and farming. Children were spending an average of an extra hour per night studying.

Food preservation is essential in hot climates, with cooling being the preferred conservation method. A study using data from five South American countries showed that refrigeration is a high priority for people in all income groups and a priority appliance for the poorest 20 per cent.

Information and communications technologies (ICTs), such as radios, televisions and computers, require electricity for their operation and can give people access to information (such as political activities, human rights, the market value of goods and produce, education, livelihood options and so on) (Practical Action, 2014).

At least as important as the impact of energy access on the quality of people's lives are the opportunities it creates for the world's poorest people to earn a living. There is a direct connection between energy access and poverty reduction based on the ability to earn a decent livelihood by using energy as a means of production. There are a variety of opportunities, ranging from having light to keeping a shop open longer to providing cooling space in a freezer to running a pump to irrigate land.

1 See http://www.se4all.org

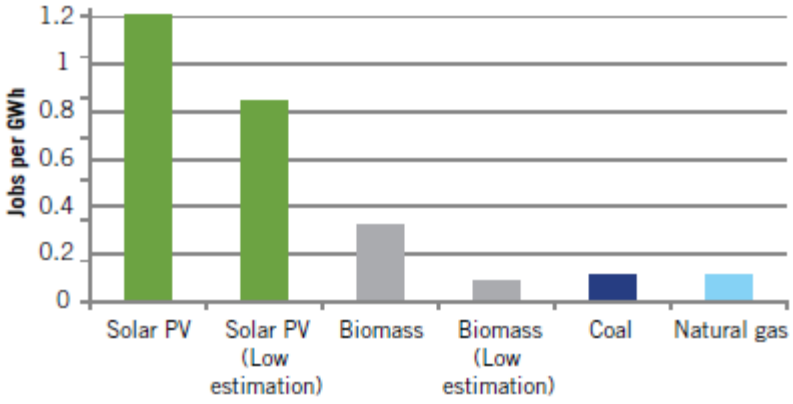
The Poor People's Energy Outlook (Practical Action, 2014) identifies four principal ways in which poor people earn a living, and all of those are affected by energy access:

- earning a living off the land;
- running small and medium-sized enterprises (SMEs);
- being employed; and
- earning by supplying energy to others.

Agriculture is one of the most significant contributors to the ability of poor people to earn a living and is one of the areas where energy can have the greatest impact by improving existing earnings. Energy plays a key role along the entire agricultural production chain, improving productivity, producing better-quality products, and earning more from adding value to produce. Improved agricultural processing and storage/cooling are energy services that expand incomes for farmers while creating employment in the SME sector. SMEs can lower costs, improve efficiency, broaden the services offered, and improve returns via more affordable, more reliable and higher quality energy supplies.

Energy supply also represents an important employment sector with growth potential in and of itself. Increasing the number and quality of suppliers is an obvious prerequisite for successfully increasing access to energy supplies and services. The figure below shows the potential for job creation through investment in renewable energy technologies.

Figure 1. Estimated jobs created per GWh



Source: Practical Action, 2014.

Renewable energy technologies often feature very low running costs, but high capital costs. Additionally, there are challenges of local-level maintenance, availability, and awareness of the technologies, which remain barriers to increased uptake. In order to increase rural renewable electrification it is essential to establish and strengthen institutional, financial, legal and regulatory support mechanisms for renewable energy deployment. In turn, these mechanisms can help by improving access to financing, developing the necessary infrastructure, and building awareness about renewable energy and the challenges posed by the lack of access to sustainable sources of energy. As sector-transforming instruments, Nationally Appropriate Mitigation Actions (NAMAs) have the potential to increase access to energy for rural populations in developing countries.

1.2 Nationally Appropriate Mitigation Actions

Nationally Appropriate Mitigation Actions (NAMAs) are voluntary, non-binding policy instruments that provide a framework for pursuing a country's socioeconomic and development goals, while contributing towards global greenhouse gas mitigation efforts. NAMAs were first introduced at the 13th Conference of Parties to the Kyoto Protocol (COP13) in Bali in 2007. Many developing countries are taking steps to develop and implement NAMAs, which can help countries achieve their growth objectives and participate in the global climate change mitigation agenda. NAMAs help governments leverage national and international support to achieve appropriate, effective and transformational GHG mitigation and sustainable development targets for the country and within communities. COP 19 in 2013 saw the introduction of Intended Nationally Determined Contributions (INDCs), which were to be submitted by all parties, developed and developing, to the United Nations Framework Convention on Climate Change (UNFCCC). The INDCs are for the period following 2020 and detail the actions the parties will take to address climate change. The types of actions (e.g. mitigation, adaptation) and the means of implementation to be included are yet to be determined. The exact relationship of INDCs and NAMAs is thus also yet to be determined, but both incorporate short- and medium-term goals, with NAMAs also acting as an implementation tool to translate short-and medium-term goals into action by outlining the means and vehicle/ action plan to implement them (GIZ/UNEP, 2014).

1.2.1 NAMA as an Opportunity for Lao PDR

Renewable energy offers a unique opportunity to accelerate access to electricity through small-scale, off-grid and stand-alone projects, often with simple and cost-effective solutions. Additionally, renewable energy systems in rural communities provide income-generating opportunities to the local population.

Financing, whether in terms of high upfront costs or lack of access to credit, remains one of the most significant challenges for renewable energy, particularly off-grid renewable energy. A NAMA provides an opportunity to facilitate the flow of financing for renewable energy. In Lao PDR, a renewable energy NAMA that is designed within the appropriate policy environment and required regulatory framework, and which has a sufficient level of technical and financial support, could be a catalyst for transformational change in the energy sector.

The proposed renewable energy NAMA for Lao PDR focuses on rural electrification, thus addressing multiple SD objectives—poverty alleviation, local job creation, alternative income generation, provision of income equality opportunities, improved energy access and better health, educational and environmental conditions.

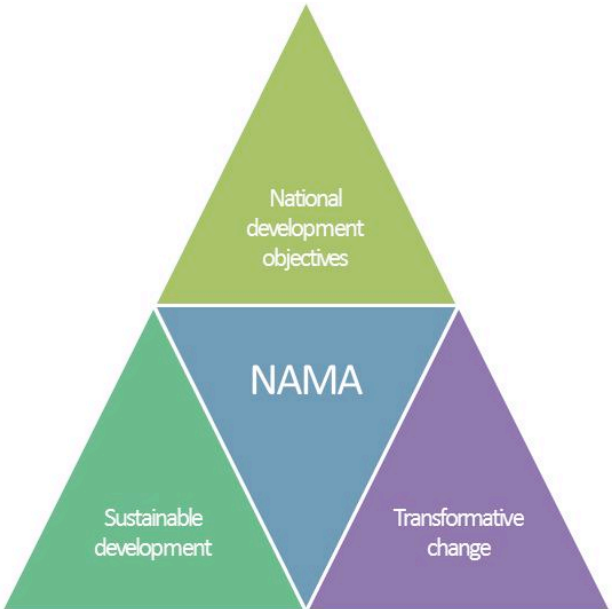
The guiding principle for the design of the NAMA for the Renewable Energy Sector of Lao PDR is to increase or provide access to electricity across the country's rural communities. The objective is to increase the total installed electricity generation capacity through a set of renewable energy projects which will be facilitated by specific policy and financial instruments.

By promoting these projects, the NAMA will help strengthen public–private partnerships, increase and improve access to electricity for the majority of the population and fuel sustainable growth in the most remote rural areas of the country.

NAMAs differ from traditional funding mechanisms which promote rural electrification and renewable energy projects mainly because of three key components, summarized in Figure 2.

- **Alignment with national development objectives:** The interventions under a NAMA framework must be compatible with the host country's policy and development objectives.
- **Focus on sustainable development:** The NAMA is designed with sustainable development benefits in mind. The design includes a focus on interventions which allow for income-generating activities that can create business opportunities for individuals, households and communities.
- **Facilitates transformative change:** The NAMA will spur the development of an environment which facilitates a transformative change in the energy sector. Since Lao PDR is already advanced in its technical electrification its NAMA focuses above all on the creation of an attractive regulatory and policy environment which incentivizes the private sector. Initial interventions will catalyse private sector development and the creation of local jobs. The business models associated with the NAMA interventions will be easily replicable in other communities across the country. The development aspect of the NAMA is of key relevance for the sustainable success of the interventions and the enhancement of livelihoods.

Figure 2. NAMA components



2. Background to Lao PDR

2.1 Geography and Administration

Lao PDR is a landlocked country with an area of 236,800 km^2. The country shares borders with Thailand, China, Myanmar, Vietnam and Cambodia. For administrative purposes the country is divided into 17 provinces (Vientiane being the capital and the biggest city) (Nanthavong, 2006).

The country has huge potential for hydroelectric power generation due to its altitude variations, high annual rainfall and abundance of water resources. The Mekong (locally known as Nam Khong) is the biggest river in the country, running for 1,900 km (within Lao borders), and the most important source of its water and energy. The country's terrain is mostly mountainous, with rugged terrain in the central-north part and near the southern border with Vietnam, and some plains and plateaus in other areas. Woodland and forests constitute almost 47 per cent of the land area and average rainfall ranges between 1,300 and 3,000 mm[2] (UNDP, 2012). The Combination of forests, abundant rainfall and variations in altitude variations result in favourable conditions for harnessing hydropower.

2.2 Economy

Lao PDR is categorized as a least developed country, but in the last six years, Lao PDR's GDP has risen by nearly 8 per cent a year on average. The GDP growth rate was a relatively modest 7.3 per cent in 2014, after being measured at 7.9 per cent in 2013 (ADB, 2014). Per capita GDP was estimated to be US$1,707.3 in 2014 (World Bank, 2015).

Rapid economic growth has been helping improve household income. The incidence of poverty in the country was reported to be 32 per cent in 2002/03 compared with 39 per cent in 1997/98. But at the same time, lack of infrastructure and poor connectivity limit the capacity of the rural population in the country to raise their economic performance (Oraboune, 2008). The country is predominantly rural with 66.8 per cent of the population residing in rural areas in 2010 (WHO and MoH, 2012). Rural areas in the country are characterized by underdeveloped infrastructure. According to 2005 National Census results, about 34 per cent of rural areas were still not connected by road, only about 66 per cent of these areas were electrified and only 6.4 per cent had access to piped water (Nanthavong, 2006). The infrastructure-poverty nexus is further highlighted by the fact that the incidence of poverty is the highest in the northern mountainous region, which is the least developed region in terms of connectivity and other infrastructure.

2.3 Demography

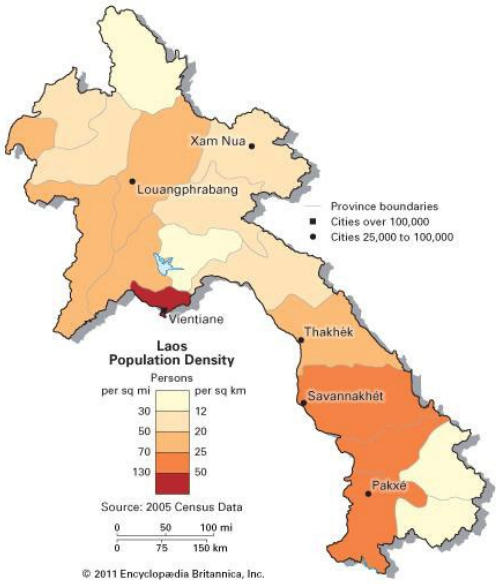
The country's population in 2014 was estimated to be 6.8 million (UNDP, 2013). The population has been growing since 2007 at annual average rate of 1.1 per cent, meaning that the country is adding about one million people to its population every decade. It is expected that by 2015 the working age population (the population between 15

2 Lao PDR has a tropical climate, which is influenced by the southeast monsoon which causes significant rainfall and high humidity (UNDP, 2013)

and 64 years) will represent about 67 per cent of the country's population (UNDP, 2012).

Despite the population growth, the country is one of the most sparsely inhabited countries in South-east Asia, with an average density of 24 persons per km2 (Nanthavong, 2006).[3] This low population density also affects the viability of energy projects because of the higher investment costs incurred in reaching distant settlements. The distribution of the population according to its density is represented in the Figure 3.

Figure 3. Population density in Lao PDR



Source: Silverstein, 2013.

Urbanization is increasing approximately 5 per cent per year. In 1995 only 17 per cent of the population was living in cities; by 2011 the urban residents constituted 34.3 per cent of the population. This trend is expected to continue, as the country's urban areas develop faster than the rural regions. Further, migration is not restricted to urban locations alone, the country's workforce is also leaving for other countries where prosperity is higher. In 2004-05, Thailand was home to an estimated 250,000 registered and un-registered Lao workers (UNDP, 2012).

The main reason for this large scale migration to urban areas is the widening disparities in livelihoods and access to health and education between urban and rural areas. Further, within the rural areas the socioeconomic divide is increasing between the uplands and the lowlands (UNDP, 2012).

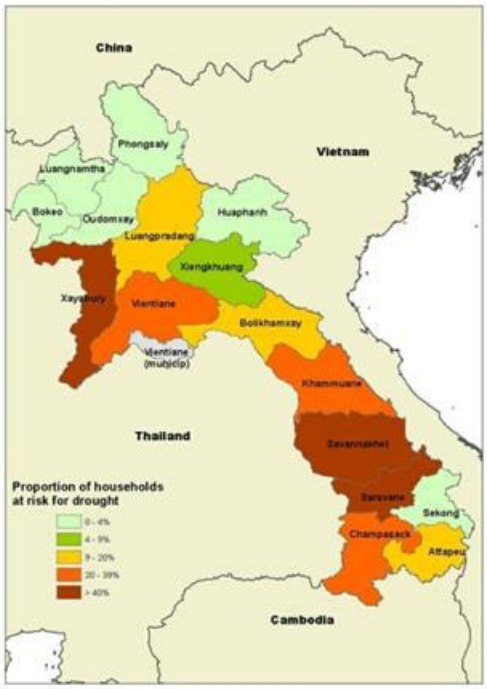
2.4 The Socio-Economic Situation

Poverty in the country is high and concentrated in rural areas, making these areas less attractive for investors. Half of country's poor live in seven of the country's 17 provinces. The rise in population, land diversion for mining, plantations, and hydroelectric and other projects are putting the natural resource stock and flows under unprecedented pressure. Further, these activities are alienating the communities from land which has traditionally

3 Population density in neighbouring Vietnam was 293 per km2 during 2010-14, and in Myanmar it was 82 per km2.

been central to their economies (UNDP, 2012), adding to income disparities and poverty in the country.

Figure 4. Proportion of households at risk of drought



Source: WFP, 2015.

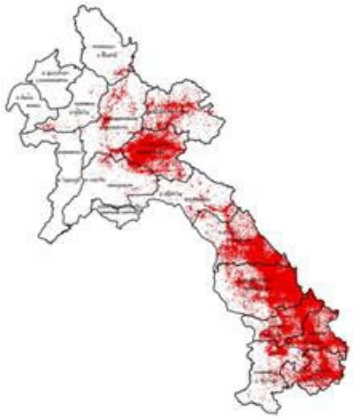
Population growth and its concentration in particular areas are increasing the pressure on available land and forest resources. At the same time land concessions for mines, hydropower works, and plantations are reducing the community's access to and control of land resources. These land- and capital-intensive developments are not generating sufficient employment opportunities, especially in rural areas, or demand for local services (UNDP, 2012).

Factors that have implications for the economic development of the country include the following (UNDP, 2012).

- **Low farm productivity:** The farmers in the country are poor and support mechanisms to promote farm modernization are non-existent (UNDP, 2012). Further, most farmers practise subsistence farmers, and markets have not yet reached remote areas where they could help farmers reap the benefits of economic development.
- **Rising inequality in land, security of land tenure, and landlessness:** About 15 per cent of the rural households are landless. Half of the landless depend on agriculture activities for their livelihoods. The rapid privatization of lands and forests, including community-managed commons, has reduced the opportunities for the poor to make a livelihood. The granting of land concessions to both foreign and domestic companies for hydroelectric plants, mines, and plantations has accelerated the land alienation process, dragging more people into poverty (UNDP, 2012).

- **Unexploded ordinance (UXO):** During the Second Indochina war (1964-1973) over 270 million cluster bombs were dropped in Lao PDR, of which only 70 per cent exploded. The malfunctioned bombs remain buried in the country's landscape. Today about 25 per cent of the country's villages are UXO contaminated (see Figure 5) (NRAUXO/MAC, 2014).

Figure 5. UXO contaminated regions of the country



Source: NRAUXO/MAC, 2014.

The presence of UXO hampers development in the affected areas, affecting all developmental activities (including agriculture and infrastructure development). The threat of the UXO leaves land unproductive, and causalities due to UXO are a major impediment to the economic well-being of the families affected. The result is that UXO contaminated provinces are also the country's chronically poor provinces (UNDP, 2012).

2.5 National Development Strategies

The strategic socioeconomic and environmental development priorities of the country are reflected in the National Socio-Economic Development Plan (NSEDP), 2011-2015, and are also demonstrated by Lao PDR´s actions to achieve the country's Millennium Development Goals (MDGs).

2.5.1 The Seventh Five-year National Socio-Economic Development Plan, 2011-2015

Overall targets of the Seventh Five-Year NSEDP

The targets set for the NSEDP can be categorized under four broad aspects:

i. The first target set the goals of maintaining annual economic growth at above 8 per cent and achieving a per capita GDP of US$1,700.

ii. The second target covered the socio-economic and environmental aspects and committed the country to achieving the MDGs (including poverty reduction) by 2015. Further, the NSEDP set the target of bringing the country out of poverty by 2020 and allowing Lao PDR to graduate from LDC status.

iii. The third target focuses on sustainable development by achieving a balance between rapid economic growth and the social and environmental well-being of the nation.

iv. The last target is more political in nature, and strives to make the country more stable, secure and open for regional and international integration (Ministry of Planning and Investment, 2011).

Targets for rural electrification in the Seventh Five-Year NSEDP

During the five year period 2011-2015, the country planned to construct eight more hydropower plants with a combined installed capacity of about 2,862 MW. This was to be followed by expansion of medium voltage power transmission lines to expand grid electricity in rural and remote areas (Ministry of Planning and Investment, 2011). Electrification is also considered as part of the strategy to achieve MDG targets for the country.

The government also planned to promote the use of electricity in rural areas, focusing on developing irrigation for agricultural development using machinery and electricity. The target was to promote agricultural production and relate to industrial processing and services in rural areas (including crops, livestock and associated services). The plan also envisaged reorienting irrigation to serve agricultural systems by using electricity based options and improving access to irrigation facilities. The target was to irrigate 60-70 per cent of cultivated land in the country (both plains and mountain areas) (Ministry of Planning and Investment, 2011)

Strategies to achieve economic development

The government introduced market-based mechanisms in the country to give momentum to economic development. Lao PDR´s association with the Greater Mekong Subregion and the Association of Southeast Asian Nations (ASEAN), and more recently its membership of the World Trade Organization (WTO), was an effort to spur economic development through regional integration (Oraboune, 2008).

Infrastructure is considered one key to boosting the economy by facilitating greater participation and promoting cross-sector development. One example is the focus on improving road connectivity, which is coordinated through the Ministry of Communication, Transportation, Post and Construction (MCTPC). The success of this commitment is evidenced by the fact that the road network expanded from 33.86 thousand km in 2005 (Oraboune, 2008) to 51.60 thousand km in 2014 (AJTP Information Centre, 2014) (AJTP, 2014).

The three pronged approach followed by the country to stimulate economic growth comprises the following objectives (OECD, 2013).

i. Reduce poverty through inclusive growth: The poverty headcount in the country has gone down considerably during since the early 1990s. It fell down from 55.7 per cent in 1992 to approximately 40 per cent in 2008. But as the Integrated Household Living Conditions Survey (IHLCS) conducted by UNDP showed, the poverty incidence in the country is almost double that of neighbouring Vietnam and almost the same as Myanmar's.

   Despite the efforts of the Government, income disparities have widened. This is due to the fact that 83 per cent of the population in the country depend for their livelihood on agriculture, which is largely isolated from the economically developing sectors in the country (OECD, 2013).

   Improve natural resource management, in particular mining, to ensure environmental sustainability: Lao PDR is predominantly rural. With an abundance of forests and other natural resources available, the economy can benefit by putting its natural resource stock and flow to proper use. The mining, forestry and hydropower sectors have witnessed tremendous growth during recent past decade. Mining, a crucial economic sector, accounted for 9 per cent of GDP during the 2006-11 period when it grew at an average annual growth rate of 19.9 per cent.

ii. Develop infrastructure to speed up development: The Government has introduced regional and subregional infrastructure development projects. The focus of infrastructure development is on aligning the country's infrastructure with regional economic development strategies, including the Mekong Subregion and Triangle Development Area and ASEAN development framework. The ASEAN countries have agreed to cooperate on cross-boundary regional projects focusing on improving regional transportation, energy and communication, which have been incorporated into the Master Plan on ASEAN Connectivity (OECD, 2013).

At the country level, infrastructure accounted for 4.8 per cent of GDP during 2006-2010. During this period the infrastructure sector witnessed average annual growth of 11.3 per cent. By 2013, the Government had implemented 25 projects as part of 11 priority programmes followed by 111 projects (under the Eighth Master Plan on Communication and Transport) with the objective of developing sub-regional, urban and rural road links (OECD, 2013).

2.5.2 The Millennium Development Goals

Lao PDR adopted the Millennium Declaration (MD) in 2000. The first and second reports on progress towards achieving the MDGs in the country were published in 2004 and 2008 respectively. A Millennium Development Goals Interim Report was released in 2013 (Lao PDR/UN, 2013). The interim report presented country's performance to date and charted future strategies to meet the MDG goals. In September 2015 a UNDP supported summary review of the MDG goals and lessons was published. The review document summarizes the country's achievements and lessons learnt during the MDG implementation process, and identifies areas for improvement (UNDP, 2015).

With regard to the close relationship between energy access and development, the implementation of the following MDGs is relevant to rural electrification in Lao PDR:

- Goal 1: Eradicate extreme poverty and hunger;
- Goal 7: Ensure environmental sustainability;
- Goal 8: Develop a global partnership for development; and
- Goal 9: Reduce the impact of unexploded ordnance (UXO)

Goal 1: Eradicate extreme poverty and hunger

Lao PDR has made great strides and achieved key milestones towards eradicating poverty and hunger. The national poverty rate in Lao PDR has declined steadily, having dropped by 40 per cent over the period 1992/93-2007/08. In terms of the international poverty line, Lao PDR showed a one-third decrease in the poverty rate over the same period. The country has also seen a steady reduction in the poverty gap and poverty severity over time (Lao PDR/UN, 2013) (Lao PDR/UN, 2013). The overall assessment is that Lao PDR is well on track to achieving the poverty target, or has already reached it.

On the employment front, the share of vulnerable employment (fisheries, agriculture) in Lao PDR is very high. The country has one of the highest employment-to-population ratios (ETPR) in the region, which means that the quality of work/efficiency may be an issue of concern (Lao PDR/UN, 2013)(Lao PDR/UN, 2013).

Table 1. MD Goal 1- Eradicate extreme poverty and hunger (status as of 2013)

Goals and indicators	Baseline	Status	Target (2015)	Target/Goal Achievable?
Target 1.A: Halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day				
Proportion of population below national poverty line	46 per cent (1992)	27.6 per cent (2007/08)	24 per cent	on target
Poverty gap ratio (per cent of poverty line)	11.2 per cent (1992)	6.5 per cent (2007/08)	6 per cent	on target
Share of poorest quintile in national consumption	8.8 per cent (1992/93)	7.9 per cent (2007/08)		No target set
Target 1.B: Achieve full and productive employment and decent work for all, including women and young people				
Average annual growth rate of GDP per person employed	3.8 per cent (1995- 2005)	5.9 per cent (2005- 2010)	—	No target set
Employment-to-population ratio	84.9 per cent (1995)	77.7 per cent (2010)	—	No target set
Proportion of employed people in two poorest quintiles	—	37 per cent (2010)		No target set
Proportion of own-account and contributing family workers in total employment	91 per cent (2005)	84 per cent (2010)	—	No target set
Target 1 C: Halve, between 1990 and 2015, the proportion of people who suffer from hunger				
Prevalence of underweight children under five years of age	44 per cent (1993)	32.0 per cent (2011/12)	22 per cent	Not on target
Prevalence of stunting in children under five years of age	48 per cent (1993)	38 per cent (2011/12)	34 per cent	Not on target
Proportion of population below food poverty line	32.5 per cent (1997/98)	24.6 per cent (2007/08)	19 per cent	Not on target

Source: Lao PDR/UN, 2013.

The following have been identified as the key interventions needed to achieve the goals.

- Special efforts to tackle disparities and reduce the remoteness of villages.
- To better target the poorest, the Government has refined its poverty and development criteria in accordance with Prime Ministerial Decree 201/PM of 2012.
- The Government is also taking special measures to address concerns about the threat facing rural livelihoods as agricultural lands are converted into land used for foreign direct investment projects.

- To sustain high growth and benefit from the demographic dividend, the country needs to address the issue of low human capital.
- More equitable and inclusive growth needs to be promoted by reallocating revenues from the resource sector to broader economic and social development.
- Lack of access to infrastructure, markets and services needs to be addressed through tailored interventions.
- The country launched its 2008 National Nutrition Policy for engaging government agencies and development partners on nutrition issues.
- The country joined the global Scaling-up-Nutrition (SUN) movement in April 2011.
- The country has developed an Agriculture Development Strategy (2011-2020) to ensure a successful transition from subsistence to commercial smallholder production.

Goal 7: Ensure environmental sustainability

Goal 7 of the MDGs aims to incorporate sustainable development into the country's policies and programmes. MDG 7 also targeted bringing two-thirds of the country under forest cover by 2015. This would be a complete reversal of the current state of country's forests which are losing 1.4 per cent of their area every year (Lao PDR/UN, 2013). MDG 7 also prescribes targets for biodiversity and sets the tone for the country's commitments under the Montreal Protocol on restricting use of ozone-depleting substances (ODS).

Table 2. MD Goal 7, Ensuring environmental sustainability (status as of 2013)

Goals and indicators	Baseline	Status	Target (2015)	Target/Goal Achievable?
Target 7A: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources				
Proportion of land area covered by forest	49.1 per cent (1990)	40.3 per cent (2010)	65 per cent	Not on target
Net CO2 emissions (Gg)	-104,570 (1990)	+41,764 (2000)		No target set
CO2 emissions (Gg)	+10,291 (1990)	43,811 (2000)		No target set
CO2 emissions removal /sink (Gg)	-121,614 (1990)	-2,047 (2000)		No target set
Consumption of ozone-depleting substances (in ozone-depleting potential-weighted tons)	43,3 (1995)	2.5 (2010)	— (2015)	No target set
Target 7B: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss				
Number of fish conservation zones		197 (2011)		No target set

Goals and indicators	Baseline	Status	Target (2015)	Target/Goal Achievable?
Proportion of renewable internal freshwater resources used		1.3 per cent (2011)		No target set
Proportion of land area under protection (conservation forests)		20.18 per cent (2011)		No target set
Proportion of land area under protection (protected areas)		14.2 per cent (2011)		No target set
Target 7C: Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation				
Proportion of population using an improved drinking water source	39 per cent (1995)	70 per cent (2011)	80 per cent	Not on target
Proportion of population using an improved sanitation facility	17 per cent (1995	57 per cent (2011)	60 per cent	On target

Source: Lao PDR/UN, 2013.

Key interventions needed to achieve the goals are identified as:

- ensuring the participation of forest-dependent communities for successful forest management;
- setting up institutional mechanisms and policy frameworks to address climate change;
- development and implantation of mitigation strategies to reduce carbon emissions; and
- giving due emphasis to biodiversity and the environment when designing/executing development projects that might have a negative impact on the surrounding area.

Goal 8: Develop a global partnership for development

Lao PDR has made significant progress in integrating its economy with the global trading system. The Government continues to engage in regional and international economic cooperation to achieve sustainable economic growth and meet development targets. Since Lao PDR is at the centre of many economic and transport corridors, opportunities exist for market access under unilateral and reciprocal preferences. The role of Lao PDR in regional economic development is evident by the fact that flows through the country to neighbouring countries from the electricity grid and the roads have been on the rise, involving in the case of roads connections between multiple countries forming regional transportation corridors.

There has also been an increase in the flow of international development funds to the country. Net official development assistance (ODA) to Lao PDR have increased both in amount and in per capita terms over the past two decades.

Table 3. MD Goal 8 - Developing global partnership for development (status as of 2013)

Goals and indicators	*Baseline*	*Status*	*Target (2015)*	*Target/Goal Achievable?*
Official development assistance to Lao PDR (US$ per capita)	63 (1990)	66 (2010/11)	—	No target set
Internet users (% of population	0.11 (2000)	9.0 (2013)	—	No target set
Cell phone subscribers (% of population	0.23 (2000)	87.1 (2013)	—	No target set
Telephone lines (% of households)	0.76 (2000)	1.7 (2011)	—	No target set

Source: Lao PDR/UN, 2013.

Key interventions needed to achieve the goals are identified as:

- development of market access opportunities under unilateral and reciprocal preferences from 47 industrialized and developing countries;
- Facilitation of movement of goods into and out of the country, to make the country "land-linked" rather than landlocked;
- Improvement of the overall business-enabling environment in the country; and
- The country's launch of an Aid Management Programme (AMP) public portal to enhance transparency and accountability in managing aid.

Goal 9: Reduce the impact of unexploded ordnance (UXO)

Lao PDR is the most heavily bombed country in the world in per capita terms. The unexploded ordnance (or UXO) dropped in the country during the Indochina war continues to pose major problems for the country. It is also a significant obstacle to the development of the country as a large part of its land area remains inaccessible. The Government has plans and programmes for locating and removing the UXO. But because of limited resources, during the past 40 years, less than 2 per cent of the contaminated area has been cleared. The Government of Lao PDR has set a clearance target of 20,000 hectares a year.

Table 4. MD Goal 9 Ensuring complete clearance of UXO from priority land (status as of 2013)

Goals and indicators	**Baseline**	**Status**	**Target (2015)**	**Target/Goal Achievable?**
Target 9A: Ensure the complete clearance of UXO from priority / high value agricultural land by 2020				
Number of hectares released from UXO contamination (hectares/ year)	580.77 (1999)	6,034 (2011)	20,000	Not achieved

Goals and indicators	Baseline	Status	Target (2015)	Target/Goal Achievable?
Target 9B: Reduce substantially the number of casualties as a result of UXO incidents				
Number of casualties reported as result of UXO incidents (casualties/year)	257 (1999)	99 (2011)	<75	Not achieved
Target 9C: Ensure that the medical and rehabilitation needs of all UXO survivors are met in line with treaty obligations under the Convention on Cluster Munitions				
Provision of proper assistance to UXO survivors (%)	—	—	100	

Source: Lao PDR/UN, 2013.

A key intervention needed to achieve the goals is identified as:

- Focusing on high priority regions, the National Regulatory Authority for UXO/Mine Action in Lao PDR (NRA) has identified 46 priority districts in nine provinces which are the ones most highly affected by UXO).

The outstanding targets for the MDGs and the barriers to meeting them are summarized in Table 5.

Table 5. Outstanding targets of the MDGs and associated barriers

Goals and indicators	Barriers and challenges
Goal 1: Eradicate extreme poverty and hunger	• Lack of infrastructure and connectivity • Limited skilled and qualified human resources • Unequal distribution of resources • Limited research and development • Prevalence of malnutrition • Backwardness of the agriculture sector • Weak governance and mismanagement of funds • High prevalence of subsistence farming
Goal 7: Ensure environmental sustainability	• Weak policy environment to tackle environmental concerns • Limited role of communities in natural resource management • High dependency of communities on natural resources • Natural resources under pressure from economic growth

Goals and indicators	Barriers and challenges
Goal 8: Develop a global partnership for development	• Lack of infrastructure and connectivity • Lack of direct access to ports • Lack of transparency in government functioning
Goal 9: Reduce the impact of unexploded ordnance (UXO)	• Lack of financial resources • Lack of skilled resources • High degree of poverty • Community's high dependence on natural resources

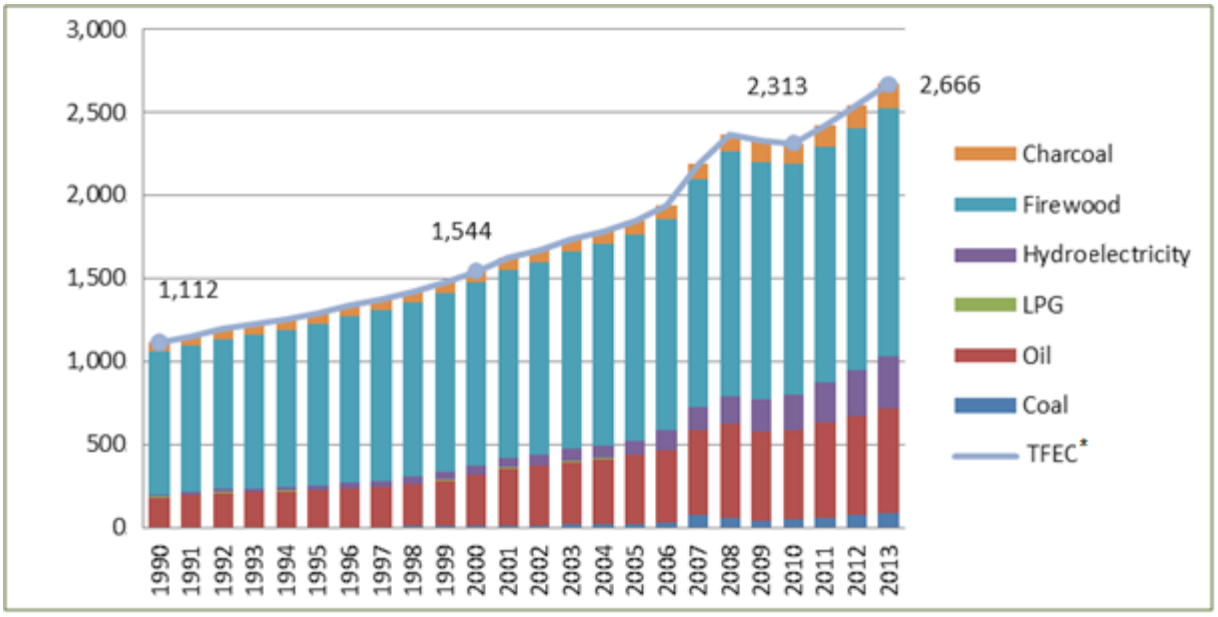
3. Background to Rural Electrification in Lao PDR

4.1 Primary Energy Demand and Supply

Absolute energy consumption in the Lao PDR has been rising for the past two decades. The growth can be attributed to the rising population and economic development. Total energy demand in the country was estimated to be 1,112 kTOE in 1990. It had increased by 140 per cent to 2,666 kTOE by 2013, implying expansion of net energy demand by approximately 10 percent per annum between 1990 and 2013.

Firewood has been the mainstay of energy supply over these years. However, hydroelectricity has emerged as the fastest expanding energy source with its share increasing from approximately 1 per cent in 1990 to 12 per cent in 2013 in overall energy contribution (see Figure 6).[4]

Figure 6. Energy demand in Lao PDR by fuel source, 1990-2013 (kTOE)



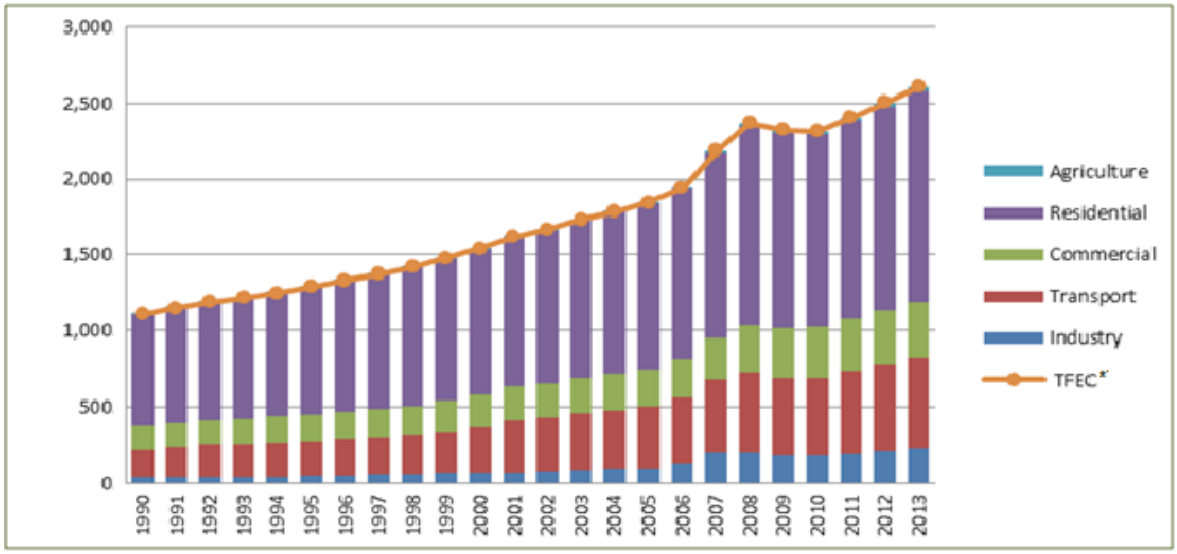
***Total Final Energy Consumption**

Source: DEPP/MEM.

4 Data in text and Figures 6 and 7 provided by courtesy of the Department of Energy Policy and Planning in the Ministry of Energy and Mines, Lao PDR (DEPP/MEM).

If energy demand is compared across segments, the residential sector has remained the largest consumer segment, accounting for 53 per cent of total energy consumption in 2013. The transport sector has witnessed the fastest expansion and accounted for 23 per cent of the energy demand in 2013. It was followed by the commercial sector, which was the third largest consumer in 2013, accounting for 14.2 per cent of energy demand (see Figure 7).

Figure 7. Energy demand in Lao PDR by sector, 1990-2013

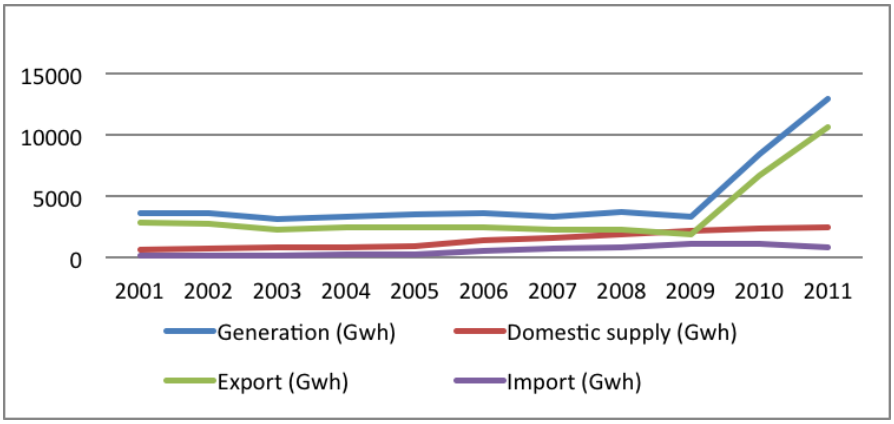


Source: DEPP/MEM.

3.2 Electricity Demand and Supply

Electricity demand is on the rise. Economic development in the country is behind the push for greater access to and demand for electricity. In 2010, about 73 per cent of the households had access to electricity compared with only 15 per cent in 1995 (Liu, Masera, & Esser, 2013).

Figure 8. Electricity demand-supply in Lao PDR, 2001-2011



Source: Vongsay, 2013.

Power demand is not uniform across provinces The disparity between power consumption across the nation can be established by comparing peakload power demand between the provinces. Among the provinces, the maximum peak demand for electricity in December 2012 was in the capital, Vientiane (224.3 MW) followed by Savannakhet (50.88 MW) and Champasak (48.80 MW). The three provinces with lowest peak demand in December 2012 were Phongsali (0.62 MW), Houaphan (16.17 MW), Xekong (3.2 MW) and Oudomsay (4.48 MW). To put these numbers in context, the top three power consuming provinces accounted for 62.8 per cent of nationwide power demanded, whereas the bottom three power consuming provinces were responsible for a mere 3.9 per cent of the power consumed nationally (the remaining 33.3 per cent was consumed by other 11 provinces) (EDL, 2013). Most of the power demand is then generated from regions in central Lao PDR, wheras least demand is generated by the remote northern and southern provinces

Electricity demand on the national grid is met by the domestic electric power plants and imports from neighbouring countries. Almost all the electricity generated in the Lao PDR comes from hydropower plants. In 2008, 99.96 per cent of the electricity consumed in the country was generated by the hydropower plants. Diesel and solar based power plants produced 0.02 percent of electricity each (Liu, Masera, & Esser, 2013).

The power generation facilities in the country are managed by Electricité du Lao PDR (EDL), private sector companies and the Provincial Departments of Energy and Mines (Liu, Masera, & Esser, 2013). In 2015, a total of 22 hydropower plants with a capacity of 3,276.5 MW are operational in the country (DoEB, 2014a), with EDL having stakes of varying size in 17 of these projects (of which nine are 100 per cent owned by EDL (DoEB, 2015).

Electricity exports are one of the country's key revenue sources. Electricity exports grew from 2,871.4 GWh in 2001 to 10,668.4 GWh in 2011 (an approximately 270% increase) (Vongsay, 2013). Of the 22 hydroelectric projects operational in the country, only 12 supply 100 per cent of their power to domestic consumers, whereas six power plants are dedicated to supplying power to Thailand (DoEB, 2014b).[5]

Since almost all national power production is hydro based, the domestic facilities are not able to cover domestic demand for power all year round. To match the seasonal fluctuations in electricity production, power has to be imported from neighbouring countries during the lean seasons. Imports of power are continuously rising: from 183.8 GWh in 2001, imports of power increased to 904.3 GWh in 2011 (Vongsay, 2013).

Power plants in preparation

Hydropower potential in the country is estimated to be approximately 26,500 MW. Of this exploitation of only about 18,000 MW is technically feasible (DoEB, 2014a). As of 2015, the country has 20 projects under construction with a combined capacity of 3,083 MW. Of this, six projects are scheduled to be completed by 2015 and the remaining ones by or before year 2020 (DoEB, 2014a).

The country is focusing on big hydro power projects as revenue generation from export of power is a priority.

The inaccessible terrain, predominantly rural population and presence of UXO slow the expansion of the grid in many provinces of the country, while low economic growth in the inaccessible provinces is a constraint on electricity demand.

5 All IPP projects that are established to export energy are required to supply at least 10 per cent of their installed capacity for local consumption

3.3 Renewable Energy Potential and Status

In addition to large hydro projects Lao PDR is also developing other renewable energy sources such as small hydropower (SHP), solar, wind, biomass, biogas and municipal solid waste.

Estimates of the growth of grid connected renewable energy systems from these sources is presented in Table 6.

Table 6. Potential grid connected renewable energy in Lao PDR, 2015-2025 (capacity in MW)

Sl#	RE Type	Year			Total
		2015	2020	2025	
1	SHP	80	134	400	614
2	Solar	22	36	48	106
3	Wind	6	12	73	91
4	Biomass	13	24	58	95
5	Biogas	10	19	51	80
6	Municipal solid waste	9	17	36	62

Source: Theuambounmy & Xayyavong, 2014.

Despite the huge potential of these alternative renewable energy sources in the country, their current utilization is rather low. In 2011 the grid connected installed capacity using renewable sources was approximately 68 MW (Theuambounmy & Xayyavong, 2014).

Table 7. Grid connected renewable energy in Lao PDR, 2011 (MW)

Sl#	RE Type	Installed capacity
1	SHP	27.924
2	Solar	0.236
3	Wind	—
4	Biomass	39.7
5	Biogas	—
6	Municipal solid waste	—

Source: Theuambounmy & Xayyavong, 2014.

Similarly, the installed capacity of off-grid technologies and applications is also quite low. By the end of 2013, the installed capacity of off-grid renewable energy projects in the country was 1,576.3 kW (Theuambounmy &

Xayyavong, 2014). SHP contributed more than 50 per cent of the installed capacity, followed by solar systems which are promoted under the Government supported solar home system programme.

Table 8. Off-grid connected renewable energy in Lao PDR, end-2013 (kW)

Sl#	RE Type	Installed capacity
1	SHP	898.5
2	Solar	637.8
3	Wind	0
4	Biomass	40
5	Biogas	0
6	Municipal solid waste	0

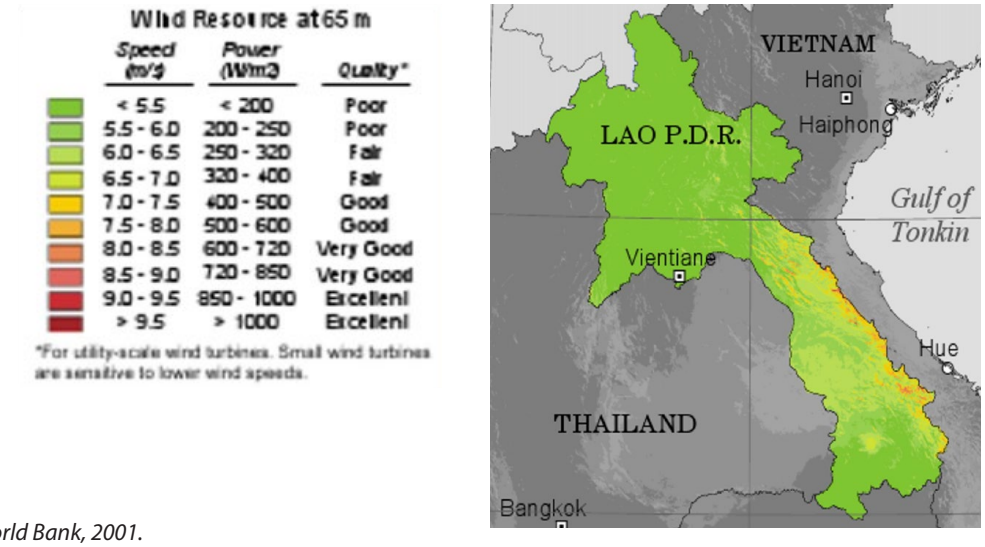
Source: Theuambounmy & Xayyavong, 2014.

The various renewable energy options and their respective potential in the country are explained in the following section.

3.3.1 Wind

In Lao PDR, detailed wind resource mapping has been carried out (Figure 9 is a wind resource map of the country at height of 65 m). The wind energy potential exists in the central provinces of the country, especially on the high mountain ranges along the Lao-Vietnam border (Savannakhet and Khammuane provinces) where wind speeds greater than seven metres per second are recorded. The theoretical potential for wind energy in Lao PDR (in regions where wind potential is categorized as very good and excellent) is estimated to be approximately 2,800 MW (World Bank, 2001) .

Figure 9. Wind resource map of Lao PDR



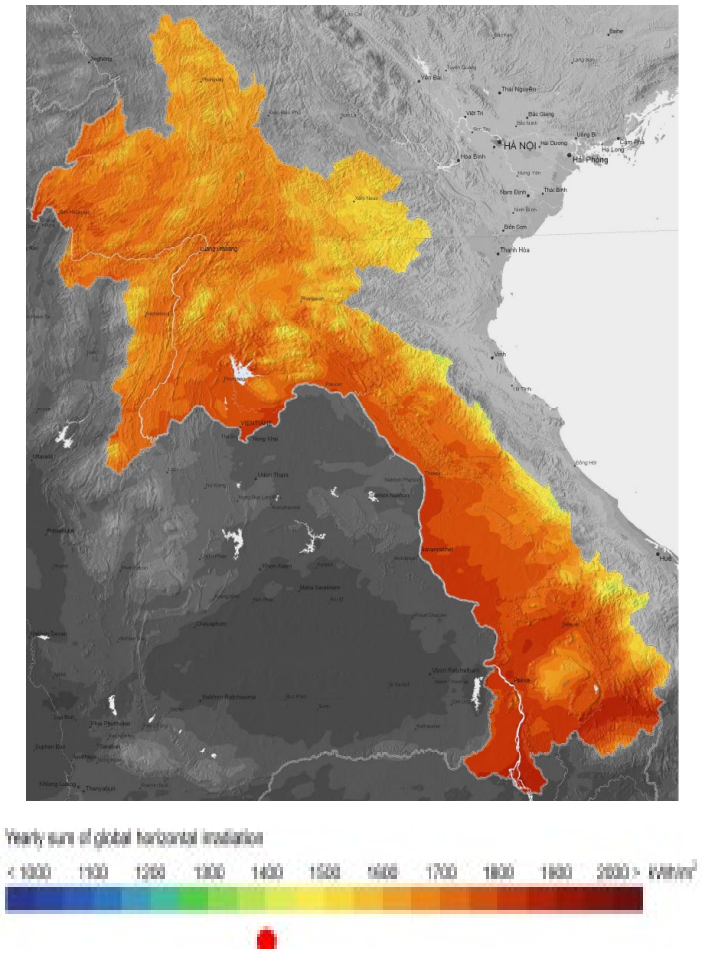
Source: World Bank, 2001.

In order to tap into wind energy, prefeasibility studies in the Nong and Xonbuly districts of Savannakhet province were carried out to estimate the wind energy potential in the region. The basic feasibility study indicated wind power potential of 64 MW at these two sites (Pillai, 2014). The Government is seeking financial support to study the development of grid connected wind projects, as well as hybrid or independent systems (Vientiane Times, 2014).

3.3.2 Solar

Various studies indicate that the solar energy potential in the country is high (200-300 sunlight days/year available), especially in the southern parts of the country (Pillai, 2014). Solar irradiance in Lao PDR varies between 3.6 kWh/m^2 and 5.5 kWh/m^2, with sunshine of up to 1,800-2,000 hrs/year (see Figure 10).

Figure 10: Solar resource map of Lao PDR

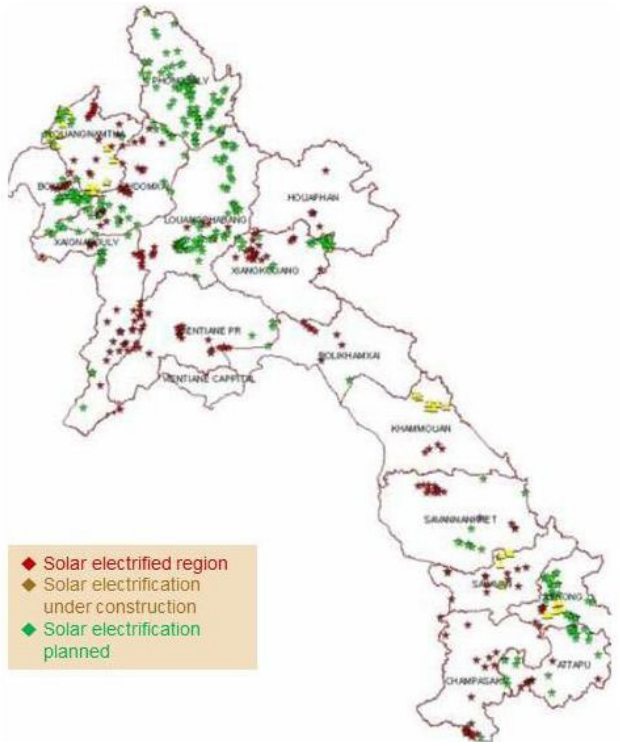


Source: ADB, 2015.

The country has slowly started harnessing it solar energy potential. The largest solar farm in the country (of 230kW capacity) is operational at Wattey International Airport. It is also the only grid connected rooftop Photovoltaic (PV) system in the country. The second major solar experiment in the country, the solar-hydro hybrid system (of 200kW capacity) established in Xieng Khuang province is designed on the public-private partnership model GIFT, 2014b.

At the mini-level (household level) about 13,000 solar home systems (off-grid solar PV systems) are installed in remote regions (Pillai, 2014), and there are plans to install another 19,000 household level (mini-solar) systems by 2020 (see Figure 11) (Green Light, 2014).

Figure 11. Solar projects and plans for Lao PDR



Source: Green Light, 2014.

3.3.3 Small Hydropower

In Lao PDR, hydropower plants with power generation capacity of 15 MW or less are designated small hydro (and renewable) plants. As of 2013, the potential for small hydro in the country was estimated to be 2,000 MW, of which 30 MW has been developed (Pillai, 2014) . Of this 27 MW is grid-connected (Theuambounmy & Xayyavong, 2014). Further, in 2013, an additional 80 MW of small hydropower capacity was under construction (Pillai, 2014).

Small hydro is a potential solution for rural and off-grid electrification in view of the country's abundant streams and small rivulets that could be potentially used for power generation.

Pico-hydro is a small potable water-driven turbine that is used at the village level for power generation. It is commonly used in remote rural areas of the northern provinces. Pico-hydro machines are available in the market with capacities ranging from 150 watts to 1.5 kW. The pico-hydro systems of one kilowatt or less are most popular in the country. It is estimated that approximately 60,000 low head pico-hydropower units provide electricity to 90,000 households (Liu, Masera, & Esser, 2013).

3.4 Electricity Tariffs

In Lao PDR the cost of electricity within the national grid is lower than the cost of off-grid options due the grid's economies of scale and its ability to import electricity from neighbouring countries.

In Lao PDR, the Government decides the tariff of the grid electricity (GIFT, 2014).

The tariff plan for grid connected consumers varies depending on the type of consumers and usage. The various consumers in the country are first divided into four broad categories:

- Low voltage residential consumers;
- Low voltage non-residential consumers;
- Medium voltage consumers; and
- High voltage consumers.

In 2012-2013, the average electricity tariff for these categories was KN666 /kWh.

The tariff for grid connected residential consumers varies according to the amount consumed in a month. Households consuming less than 25 kWh per month, pay the minimum unit price, followed by consumers whose consumption is between 25 and 150 kWh. Consumers with consumption exceeding 150 kWh per month fall under the highest unit price bracket.[6]

Strategies have been developed in Lao PDR to reduce electrification costs for the poor through well targeted subsidies. To make power affordable to the poor and small consumers, the power bills of residential and agricultural consumers are cross-subsidized by other customer segments. The improved affordability has helped rural and poor households to switch to grid electricity (from lighting provided by candles, diesel lamps, batteries, and so on) (World Bank, 2012).

3.5 Electrification

In 2008 63.4 per cent of households had access to grid electricity and by 2010 the figure had risen to 72.5 per cent (Vongsay & Bounsou, 2014) Under the updated Rural Electrification Master Plan (REMP) of 2010, the Government set the national electrification target at a household level to 94 percent by 2020.

Grid based rural electrification in Lao PDR is promoted mainly by the state owned utility Electricité du Laos (EDL). Apart from domestic energy sources, EDL also imports power to support electrification in strategically important settlements in border areas. Examples of EDL's main rural electrification projects are the Northern Area Rural Power Distribution Project for the northern provinces and two programmes, Rural Electrification Programmes I and II, for the southern provinces.

The Rural Electrification Project Phase II has been under implementation since 2010. The project is financed by the Government of Lao PDR and development agencies such as the World Bank (US$20 million), the International

6 From the EDL website (http://www.edl.com.la).

Finance Corporation (US$15 million), the Norwegian Agency for Development Cooperation (NORAD) (US$4 million), and GEF (US$1.818 million) (ESMAP, 2012). The project has been highly successful: using both on-grid and off-grid systems, as of May 2015 the project had electrified about 42,300 households, 112 per cent of the 37,700 households originally targeted as of May 2015 (World Bank, 2015b).

Off-grid rural electrification (mini grids, solar home systems) is the preferred option in cases where grid extension is not cost effective.

3.5.1 Experience with Rural Electrification using Mini grid Approaches

Lao PDR has already gained experience with installation and operation of mini grids, focusing on areas beyond the reach of the national grid. In some cases these systems are owned and/or operated by EDL (Pillai, 2014). Not much information is available on the status or performance of such interventions.

Houayxe hybrid system[7]

The mini grid project was established in 2003 in the Nga district of Oudomxay province in northern Lao PDR. The project was funded by the New Energy and Industrial Technology Development Organization (NEDO) of Japan and executed by the Tokyo Electric Power Company (TEPCO). The objective of the project was to demonstrate and research the performance of a small-scale pumping system using photovoltaic technology. Operating on a hybrid system based on hydropower (80 kW) and photovoltaic (100 kWp), the system provided electric power to households and helped run the water pumping machines.

Meung Mai hybrid system[8]

Implemented during 2007-2010, this mini grid project is located in Phongsaly province (Northern Lao PDR). The project was also funded by NEDO of Japan. It too was a hybrid small-scale power generation system that was implemented for demonstration and research purposes. Operating on a hybrid system based on hydropower (110 kW) and photovoltaic (40 kWp). The system is currently running and supplies power to a nearby village through a mini grid.

Ban Houaypha solar powered mini grid

Implemented during 2013, a 6.5 kWp solar plant has been established in Ban Houaypha village in Luang Prabang province to provide electricity to households through a decentralized village grid. The mini grid provides electricity to 83 households, a community centre and a street lighting system. The project is implemented by Sunlabob Renewable Energy with funding support from Fondation Énergies pour le Monde (Fondem). Sunlabob has not only established the system but has also helped the community develop the capacity to operate, maintain and manage the mini grid system on its own (Sunlabob, 2013).

Ban Phakeo

This mini grid hybrid system was established by Sunlabob with funding from Fondation Énergies pour le Monde

7 Source: NEDO project brochure
8 Source: NEDO-MEM project brochure

(Fondem) in 2008 (Smits, 2015); it supplies power to about 100 rural households. The mini grid installed in Ban Phakeo in Luang Prabang province is a hybrid solar-diesel system with battery backup. The system has a total peak power of 4.8kW and feeds into a 220V AC single-phase mini grid system. There is power backup provided using a diesel generator (of 5.6 kW) which also serves as a battery charger during periods of low solar irradiance. The management of the system has been handed over to the local authorities and the villagers. Sunlabob has trained a "village energy committee" and technicians who manage the system (Sunlabob, 2009).

The following table gives a brief summary of the most important parameters of the mini grids.

Table 9. Snapshot of mini grid power systems in Lao PDR[9] [10] [11] [12]

	Houayxe hybrid system[9]	*Meung Mai hybrid system*[10]	*Ban Houaypha*[11]	*Ban Phakeo*[12]
Installation year	**2003**	**2007-2010**	**2013**	**2008**
Installed Capacity	80 kW mini hydropower 100 kWp solar PV	110 kW mini hydropower 40 kWp solar PV	6.5 kWp solar	4.8kWp solar 5.6 kW diesel
Technology	**Solar PV, mini hydro**	**Solar PV, mini hydro**	**Solar PV**	**Hybrid solar-diesel system**
Number of consumers connected	Not available	Not available	83 households, a community centre and a street lighting system.	100 households
Investment costs	**Not available**	**Not available**	**Not available**	**Not available**
Financing	Funding by NEDO (Japan)	Funding by NEDO (Japan)	Fondation Énergies pour le Monde (Fondem)	Fondation Énergies pour le Monde (Fondem)
Operator	**Executed by Tokyo Electric Power Company (TEPCO)**	**Execution by NEDO (Japan)**	**Executed by Sunlabob, managed by villagers**	**Executed by Sunlabob, managed by "village energy committee"**

The lessons learnt from implementing and operating mini grids in Lao PDR are derived from the hybrid mini grids operated by Sunlabob in Nam Kha I (in 2007) and Nam Kha II (in 2010) in Xieng Khaung province designed for 650 households.

9 Source: NEDO-MEM project brochure
10 Source: NEDO-MEM project brochure
11 Source: Sunlabob, 2009.
12 Sources: Sunlabob, 2009; Smits, 2015.

Table 10. Lessons from mini grid projects[a]

	Risks identified	Suggested solutions
Risk 1	The rise in demand for electricity did not happen as expected by the project developer. This resulted in the non-optimal performance of the system, and hence the commercial viability of the project suffered.	Project emphasis should also be on increasing consumption of electricity over time. This is critical for the project's commercial viability. Strategies should be developed to increase energy consumption over time. Supporting the promotion of enterprises is one of the options available to the project developers.
Risk 2	The power generated from the minigrid system was costlier than grid power. This resulted in dissatisfaction among consumers. Mini grid power is often costlier than grid power, and since power demand was low (refer to risk identified in previous row of the table), the unit cost of power generation escalated.	The unit price of electricity from on-grid and off-grid sources should not be very different. A gap-filling subsidy is required from the Government to make the prices of off and on grid power comparable.
Risk 3	The project proponent was the sole owner of the hardware installed at the project site. Sunlabob identified this as a drawback as the financial risks in such an ownership model were too high.	In a country like Lao PDR where the rural population is thinly spread and income levels are low, the business risk of operating a mini grid is very high. Capital risk can then be shared by the Government to make mini grid/off-grid electricity projects attractive.

[a]Based on the experience of Sunlabob.
Source: Schroeter, 2013.

3.6 Financing and Support Instruments for Rural Electrification

The country has tested multiple national and regional arrangements to help manage the costs of rural electrification services and projects.

The Rural Electricity Fund

The Government of Lao PDR has established the Rural Electricity Fund (REF) to enable larger uptake of renewable energies for off-grid electrification. It is a revolving fund to support renewable projects. Established in 2005, the fund was developed with funding support from the International Development Association (IDA), the World Bank and NORAD. Managed by the Ministry of Energy and Mines (MEM), the fund was designed on a revolving capital principle to implement rural off-grid electrification using renewable energy sources (World Bank, 2015b). Although the fund is designed to promote off-grid solutions it is currently mainly limited to supporting solar home based solutions.

Under the REF, a hire-purchase scheme is offered to rural households to make solar home systems (SHSs) affordable for the rural households (Pillai, 2014). The households pay an upfront installation fee and then make monthly payments to repay the balance. The households can opt to choose between payment terms varying between five and 10 years.

The REF is implemented through Provincial Electricity Service Companies (PESCOs) in each of the provinces. The REF signs a management contract with a PESCO for installation, bill collection and maintenance of the SHS. The PESCO collects the installments from the households and shares it with the REF. Under this arrangement, the REF recovers about 35 per cent of the investment (by default it is therefore a diminishing fund, in which full cost recovery does not occur).

Tax exemption programme

The renewable energy programmes are supported by the Government through import concessions (duty-free imports) on equipment and materials that cannot be produced in the country (Theuambounmy & Xayyavong, 2014).

Solar Lantern Rental System (SLRS)

The SLRS is a public-private partnership (PPP). The Sunlabob company has partnered with local entrepreneurs and village committees to implement SLRS to deliver affordable solar lighting systems to villages. Sunlabob manages the charging stations with the help of entrepreneurs. The entrepreneurs enter into a franchise agreement with Sunlabob and establish a solar lighting recharging station in the village/locality. The recharging station rents out the lamps to villagers on a fixed fee basis (Pillai, 2014).

MEM's mini-hydro PPPs

The MEM has implemented four mini-hydro projects (under a pilot project scheme) in the province of Huaphan using the public-private partnership (PPP) model. The pilots were designed to test the practicality and scalability of lease-agreement models for off-grid power projects. In this scheme, the most cost-efficient project developer was selected to manage the mini-hydro facility through a bidding system. The successful bidder (who made the lowest quote) developed the project and was allowed to run the facility for a fixed period and in turn got a fixed lease term payment from the Government (Pillai, 2014).

Subsidy support to improve access to electricity:

As mentioned above the power bills of poor consumers are cross-subsidized by other customer segments.

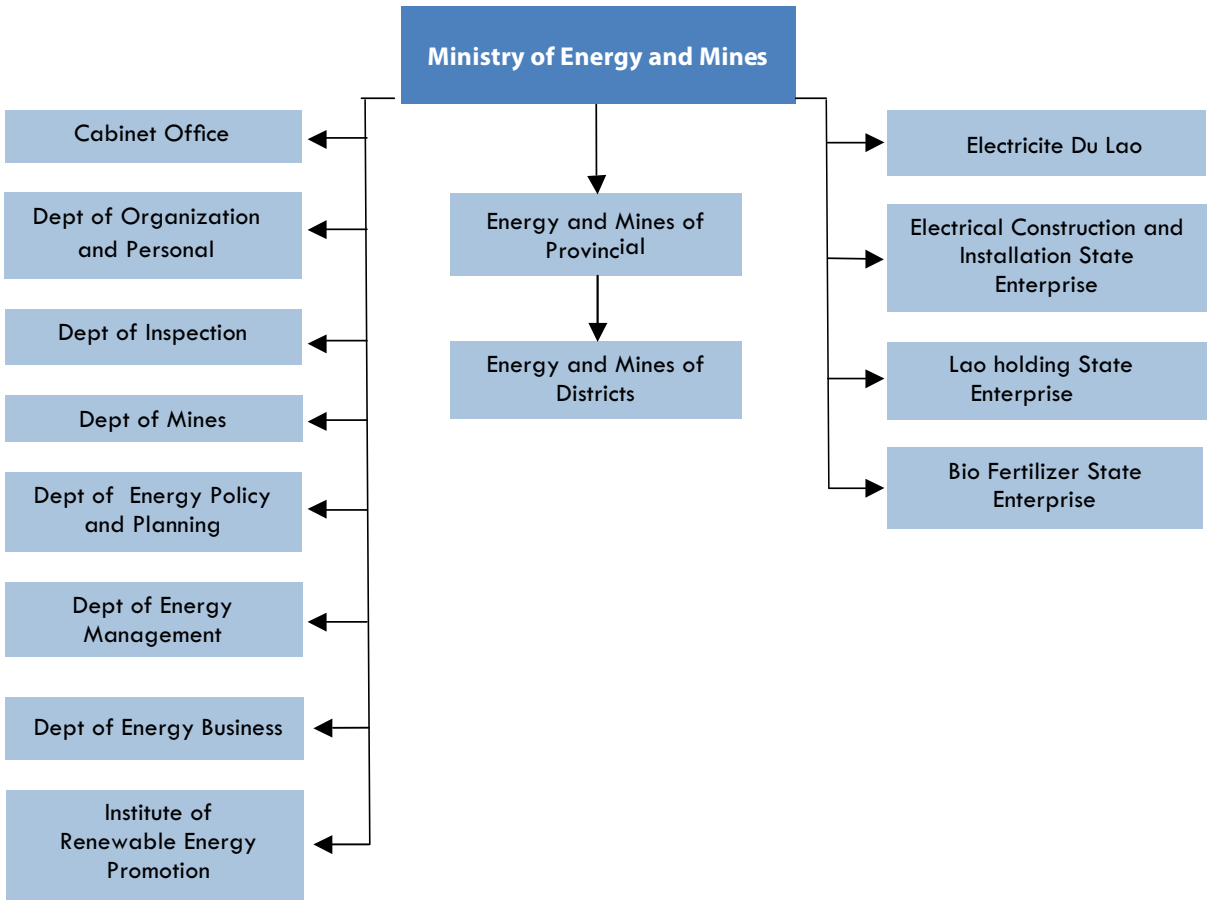
4. The Policy Environment

4.1 The Institutional Framework for Rural Electrification

4.1.1 The Ministry of Energy and Mines

In Lao PDR, the Ministry of Energy and Mines (MEM) is the principal authority managing rural electrification programmes. MEM has the power to develop and implement laws and regulations governing the electricity sector (Liu, Masera, & Esser, 2013). The associated entities and the departments under MEM are in displayed in the following figure

Figure 12. The departments of MEM



Source: Pillai, 2014.

These departments (and the business entity) play specific roles in delivering electricity services in urban and rural Lao PDR. The Institute of Renewable Energy Promotion (IREP) and Rural Electrification Division (RED) specifically focus on rural energy (including electrification). The roles of the departments are described in the table below.

Table 11. Overview of institutions linked to rural electrification

Sl. No.	Departments/entities	Energy Specific Roles and Responsibilities
1	Department of Energy Business (DEB)	DEB is in charge of private investment in the power sector. Its main role is to negotiate project development agreements and power purchase agreements (Pillai, 2014).. The DEB deals with logistics and administration, project development, legal affairs, and project monitoring of electricity projects (MEM, 2014c).
2	Lao Holding State Enterprise (LHSE)	The Lao Holding State Enterprise (LHSE) is a state-owned enterprise that holds, owns and manages on behalf of the Government the shares of power projects companies that have either been acquired by LHSE or have been transferred to it by the government (LHSE, 2014).
3	Department of Energy Policy and Planning (DEPP)	DEPP is responsible for policymaking and planning the Ministry's involvement in the energy sector (Theuambounmy & Xayyavong, 2014).
4	Electricité du Lao PDR (EDL)	EDL is a state-owned electric power utility, supplying electricity to domestic consumers through its transmission and distribution lines. EDL also manages the import and export of electricity. Since EDL's own generation is insufficient to meet demand in the domestic market, it buys power from a number of domestic IPPs and from abroad (Pillai, 2014) .
	EDL-Generation Public Company (EDL-Gen)	EDL-Gen is the electricity generation entity of MEM. The main objectives of EDL-Gen are (1) to generate energy for EDL, and (in near future) to export surplus power; (2) to invest in or set up joint ventures with other electricity generation projects; and (3) to provide management and maintenance services for other electricity projects (EDL, 2015).
5	Department of Energy Management (DEM)	DEM is the regulatory, monitoring and compliance entity within MEM. This department is in charge of drafting energy-related laws, regulations, guidelines and technical-safety standards. It also monitors both state-owned and private sector parties to ensure compliance (Pillai, 2014).
6	Institute of Renewable Energy Promotion (IREP)	IREP is equivalent to a department and is responsible for renewable energy development, energy efficiency and conservation and rural electrification effort of the country (Pillai, 2014).
7	Provincial authorities	Provincial Departments of Energy and Mines (PDEMs) and District Energy and Mines Offices (DEMOs) work under the MEM, at the provincial and district levels (Pillai, 2014).

Through its Rural Electrification Fund (REF) Secretariat, MEM also collaborates with the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) to promote rural entrepreneurship using an innovative pro-poor public-private site-specific partnership (5Ps) model- (Liu, Masera, & Esser, 2013).

4.1.2 Other Public Sector Entities

There are other ministries and institutions that help shape the rural energy sector in Lao PDR. These entities influence the energy choices, rural electrification planning, and implementation.

The Ministry of Environment and Natural Resources (MoNRE)

MoNRE is an important entity for hydropower projects as it is the main coordinating agency for environmental planning and management across all sectors (Pillai, 2014).

Since most rural electrification interventions will take place in the least developed provinces, which also are ecologically rich, the role of MoNRE will become critical in ensuring compliance with environmental externalities associated with the project.

The Renewable Energy and New Materials Institute (REMI), the Ministry of Science and Technology (MoST)

REMI can play an important role in the renewable energy sector because of three key functions of the institute that are critical for the sustainable development of renewable energy projects in the country: (i) it conducts R&D on renewable energy technologies; (ii) it is involved in identifying suitable renewable energy technologies that could be adopted locally; (iii) it is involved in communicating R&D findings and science and technology relating to the energy sector within the country (Pillai, 2014).

REMI is the body to check the appropriateness for rural Lao PDR of any technological research on renewables and small-scale electrification.

Ministry of Planning and Investment (MPI)

The main function of the MPI is to coordinate with the Government's line ministries in the preparation of their respective socio-economic development strategies. MPI is also responsible for implementing investment strategies, promoting regulation, and overall investment approvals. It prevents investment which may (potentially) have a negative impact on the environment (Voladet, 2009)

The Ministry of Industry and Commerce (MoIC)

MoIC is responsible for overseeing and developing industrial and commercial activity in Lao PDR. All imports of equipment and machinery are overseen by this ministry.

With reference to rural energy programme proposals, the role of MoIC will come into play when technology is to be imported into the country.

The Ministry of Finance (MoF)

MoF defines the financial environment in the country. It determines policies that set the appropriate tax and duties for land use, vehicles and equipment for renewable energy projects. It also assists in raising funds for renewable energy development in the country[13].

13 Source: www.mof.gov.la.

The tax environment in the country is already very supportive for rural energy/renewable energy projects. The role of this Ministry therefore becomes critical only when additional concessions are proposed.

4.1.3 Private Sector Entities

Independent Power Producers (IPPs)

There are several private sector companies managing power projects in the country. Termed Independent Power Producers (IPPs), these entities produce electricity which is exported through EDL (while a small percentage is retained for domestic consumption). IPPs have witnessed dramatic growth in recent years, made possible by the surge of public funding to support large-scale energy projects in the region.

Energy Service Companies (ESCOs)

ESCOs were promoted to support the off-grid rural electrification programme, especially for the execution of off-grid rural electrification projects. According to the World Bank (2014), there were a total of 16 ESCOs operating in the country (one in each province, except for Vientiane and Xaysomboun provinces). The ESCOs were responsible for off-grid services in identified regions (including solar home systems (SHSs), village pico-hydro units and small diesel generator sets). The current number of active ESCOs is not known, as some them have stopped functioning or have diversified into grid based operations. ESCOs may play an important role in the rural energy programme as they have presence and experience of the region and the technology. The experience of Sunlabob (described in Section 4.5.1 and other companies working on off-grid programmes will be useful in designing strategies for the country.

4.2 The Strategic and Regulatory Framework for Rural Electrification

There are several strategies, policies, laws and decrees that govern the rural electrification Lao PDR which are summarized below.

The Electricity Law (1997, amended 2012)

The electricity law governs electricity generation and distribution in Lao PDR. It lays out guidelines for the management of small-scale power projects and also prescribes electricity pricing principles.

The Power Sector Policy Statement (2001)

The overall aims of power sector policy are to (i) maintain and expand an affordable, reliable sustainable electricity supply within the country to promote economic and social development; (ii) promote power generation for export (to provide revenues to meet government's development objectives); (iii) and ensure sustainability (ESMAP, 2012).

Further to the Power Sector Policy Statement, the Government announced the policy framework that highlights the rural electrification (ESMAP, 2012).

Specifically with regard rural electrification, the objectives of the policy are as follows (ESMAP, 2012).

i. Mobilize financial resources for off-grid activity, in particular in the form of foreign assistance, both loans and grants.

ii. Seek grants and concessionary loans to provide capital cost subsidies for off-grid developments to establish them on an independent, affordable and commercial basis.

iii. Use of mini-finance facilities in the development of rural electrification.

iv. Introduce systematic and sufficient capital subsidies and tax incentives to establish off-grid developments on a sound commercial and affordable basis. In order to reduce costs, respond to socio-economic conditions and adhere to regulations regarding off-grid pricing, discretionary capital subsidies will be applied effectively to reduce the price paid for equipment and assist business start-ups.

The National Growth and Poverty Eradication Strategy (2004)

The National Growth and Poverty Eradication Strategy (NGPES) was approved by the National Assembly in 2004. Apart from identifying the key elements for national development and poverty alleviation, the national strategy also provides a policy framework for the energy sector (ESMAP, 2012).

The strategy identifies rural electrification and electricity export business as key areas for national development. NGPES set the 90 per cent electrification target for 2020. To reach out to rural areas, the strategy envisages a grid extension programme, supplemented by off-grid options (ESMAP, 2012).

The Prime Minister's Decree on the Local and Rural Electrification Development Fund (REF) (2005)

The REF was promulgated by the Prime Minister on 11 August 2005 (through decree number PMO 238 REF. The decree serves as the foundation for promoting rural electrification and includes institutional arrangements for sustainable financing of local and rural electricity systems. It also opens up scope for private sector participation in the development of electrification in rural and remote areas in conformity to the Lao Government's policy.

The REF decree defines the specific objectives, governance aspects and financing sources of REF for expanding rural electrification networks. The use of the fund is overseen by a REF Management Unit established within the Department of Energy in (DoE) the Ministry of Energy and Mines (MEM). REF is managed using an operational manual that was developed in 2009 (with support from the DoE and the World Bank), and was approved and adopted by MEM in May, 2010. The adaptation of the manual is a key step to opening up the REF to alternative off-grid technologies.

The REF has largely focused on solar energy to expand the rural energy programme. The hire purchase scheme offered to rural households is designed around solar home systems (Pillai, 2014).

Renewable Energy Development Strategy (REDS) (2011)

In recognition of the importance of renewable energy technology options in meeting Lao PDR's goal of providing energy services to rural households, the Renewable Energy Development Strategy (REDS) was announced in 2011. The Government aims to increase the share of renewable energies to 30 per cent of the total energy consumption by 2025. REDS aims to develop new renewable energy resources, which are not yet widely used, to replace resources that will be depleted in the future, "non-renewable energy" such as fossil fuels, coal, natural gas etc. These renewable resources include biofuels (such as biomass and biogas), solar power, wind, small scale hydro and geothermal.

MEM Decree Establishing the Institute for Renewable Energy Promotion (IREP) (2012)

IREP is charged with formulating transparent market mechanisms to promote investment; strengthening the capacities of other government agencies; proposing investment incentives; identifying key technological issues for the public sector; evaluating the costs and benefits of renewable energy; expanding cooperation at sub-regional level in the field of renewable energy development and use; and ensuring fair access to the grid network for renewable energy projects.

In addition the following laws have an indirect effect on rural electrification and the use of renewable energy.

The Customs Law (2005)

The renewable energy programs in the country are supported by providing import concessions (duty free imports) on equipment and material that cannot be produced in the country (MFA, 2012).

The Value Added Tax (2006)

The value-added tax is an indirect tax that is collected on the proportion of value added to goods and services. It is levied at all stages of the supply process, from production, distribution, service and supply to consumption (MFA, 2012).

National Policy on the Environmental and Social Sustainability of the Hydropower Sector in Lao PDR (2005)

The policy provides for the sustainable management of natural resources and introduces social safeguards to contain the losses to project-affected communities in accordance with prescribed offsetting mechanisms. The policy also makes it mandatory for Environment Impact Assessments (EIA) to be conducted on all hydroelectric projects.

The Law on Investment Promotion (2009)

The law provides incentives to attract and facilitate domestic and foreign investors making renewable energy investments (MFA, 2012). All investments in renewable energy projects in Lao PDR (whether grid-connected or isolated systems) are entitled to investment incentives (duty-free imports) under the Investment Promotion Law (GIFT, 2014).

4.3 Lao PDR Intended Nationally Determined Contributions

Lao PDR has a long-term goal for national development which is set out in the upcoming Eighth Five Year National Socio-Economic Plan (2016-2020), with a Vision to 2030. According to this vision, the goal is for Lao PDR to make the transition from a Least Developed Country (LDC) to a middle income country by 2030 supported by inclusive, stable and sustainable economic growth while alleviating poverty. Lao PDR recognizes the strong link between economic development, sustainability and the need to mainstream environmental considerations, including action on climate change, into its development plans.

The Climate Change and Disaster Law is being developed, providing an overarching legal framework for climate change and disaster management. The law is expected to be approved in 2017.

The National Strategy on Climate Change (NSCC) of Lao PDR was approved in early 2010, and sets out a vision on how to address climate change: "To secure a future where Lao PDR is capable of mitigating and adapting to changing climatic conditions in a way that promotes sustainable economic development, reduces poverty, protects public health and safety, enhances the quality of Lao PDR's natural environment, and advances the quality of life for all Lao People."

In addition to the overarching strategy set out in the NCCS, climate change action plans for the period 2013-2020 define mitigation and adaptation actions for agriculture, forestry, land use change, water resources, energy, transportation, industry and public health.

Lao PDR is highly climate-vulnerable, and the country's greenhouse (GHG) emissions were only 51,000 CO_2 equivalent in the year 2000, which is negligible compared with total global emissions. Despite this, Lao PDR has ambitious plans to reduce its GHG emissions while at the same time increasing its resilience to the negative impacts of climate change. Examples of such plans include the following.

An ambitious target is set out in the National Forestry Strategy to the Year 2020 for increasing forest cover to a total of 70 per cent of land area by 2020, and maintaining it at that level going forward. This will reduce the risk of floods and prevent land degradation, yet at the same time the greenhouse gas mitigation potential of such a target is substantial and long-lasting.

In terms of Lao PDR's large scale electricity generation, the electricity grid draws on renewable resources for almost 100 per cent of its output. Lao PDR also aims at utilizing unexploited hydropower resources to export clean electricity to its neighbours. By supplying neighbouring countries such as Cambodia, Viet Nam, Thailand and Singapore with hydroelectricity, Lao PDR will enable other countries in South-East Asia to develop and industrialize in a sustainable manner.

The Government of Lao PDR has also laid the foundations for the implementation of a renewable energy strategy that aims to increase the share of small scale renewable energy to 30 per cent of total energy consumption by 2030.

Climate change is already causing economic loss and affecting the livelihoods, food security, water

supply and health of much of the country's population. The frequency and intensity of climate related hazards, such as droughts and floods, are expected to increase in future, so Lao PDR must also urgently take steps to build its resilience by enhancing its adaptation efforts across all sectors.

Lao PDR is committed to the implementation of its NCCS and its sectoral climate change action plans, for the national, regional and global benefit. However, it will require technical and financial support to deliver the mitigation and adaptation actions identified in these programmes. With such support, the NCCS will be implemented efficiently, the potential GHG reductions identified will be optimized, and Lao PDR can most effectively adapt to the negative and immediate effects of climate change.

4.4 Policy Gap Analysis in the Context of Rural Electrification

As demonstrated in the previous section, the country has well defined policies that can facilitate rural off-grid and grid electrification by creating an enabling environment for the public and private sectors. There are also provisions that protect consumer welfare through a controlled power pricing regime. The rural electrification programme also

focuses on livelihood promotion (UNESCAP's "5P Model" based on pro-poor private-public partnerships) to ensure that demand for electricity is generated and consumers' paying capacity is improved.

In order to further improve the supportive framework for sustainable rural electrification, existing national policies, regulations and programmes are assessed to identify gaps and to make recommendations for filling them.

4.4.1 The Electricity Law (1997, Amended 2012)

As mentioned above, the Electricity Law governs the country's grid and off-grid electricity programmes. It also provides the required framework for the promotion and development of rural electrification in Lao PDR. The major features of the Electricity Law as it affects rural electrification include the following (MFA, 2012).

Electricity pricing

Electricity pricing is regulated in accordance with consumers' socioeconomic conditions. The Government approves pricing levels for each type of electricity supply (based on the electricity source) and allows for periodic revisions of prices.

Management of small-scale power projects

The majority of rural electrification projects are under 5 MW (or less than 500 kW in the case of diesel generators). The provincial and district authorities and the village administrative authorities have coordinating and supervisory duties and rights with regard to such projects. Electrification projects between 100 kW and 5 MW capacity are handled by the relevant Provincial Department of Energy and Mines (PDEM) after approval by MEM, and projects of less than 100 kW capacity are handled at the district authority level (DDEM) with approval from the PDEM and MEM.

Financial support for small/rural energy projects

The law also provides for the establishment of "a fund for assistance and for loans for carrying out works in building, installing and developing electricity in the localities and in rural areas".

Gaps

As already described (see Section 3.5.1), off-grid programmes have faced setbacks due to demand and pricing issues. Projects have not been able to operate at optimum levels and have ended up charging consumers more than initially expected. Further, the capital risks for the projects' promoters have been high.

The Electricity Law mentions small hydro systems but it does not place any emphasis on electricity generated from renewable sources. . The Law has not been amended to cover financial options like net-metering and feed-in-tariffs that are used as policy tools to improve the financial viability of small-scale energy projects.

Further, the current retail electricity tariff in the country is very low, as residential consumers are subsidized by high volume consumers. The off-grid/mini grid systems in rural areas cannot produce electricity at such low prices. In addition, in some provinces (such as Huaphanh) the provincial government regulates electricity pricing for off-grid systems, which may affect the financial sustainability of such projects (REPIC, 2010).

Recommendations

The Electricity Law in its current form does not address rural off-grid electrification projects. Although the amended law of 2012 does mention renewable energy in the context of rural electrification, it does not elaborate on the subject. It needs to be revised to include provisions for electricity generated from renewable sources.

To promote renewable electricity in rural areas the Electricity Law should offer terms favourable to the operation small-scale renewable energy systems (though Article 39 of the law does provide concessions for selected systems) The law needs to be amended to include regulations on the generation and distribution of electricity from off-grid systems.

The Electricity Law should also be amended to include provisions that could help create a more favourable business environment for small-scale power projects and improve the financial viability of off-grid projects, for example by ensuring the minimal involvement of the state in tariff setting for such projects, by introducing feed-in tariffs for the grid-evacuation of power, and minimum support prices.

4.4.2 The Power Sector Policy Statement (2001)

The Policy Statement is an elaborate document on power sector approaches and strategies. Specifically on rural electrification, the Policy Statement places great emphasis on exploring off-grid energy options. Realizing the country's resource limitations, the statement also suggests exploring avenues for tapping international financial support, especially for mini-grid projects.

The Policy Statement was developed almost 15 years ago. The strategies mentioned in the statement focused on both supply side off-grid power management (through seeking donor and concessional funds for the promotion of off-grid systems) and consumer demand management (using mini-finance facilities to develop rural electrification activities). To enhance capital flows into off-grid power projects, discretionary incentive mechanisms were proposed.

The policy environment has evolved since the Power Sector Policy Statement was announced, including through the introduction of regulations favourable to off-grid rural electrification.

Recommendations

The policy environment has evolved during last 15 years, with the result that no recommendations to supplement the Policy Statement are made.

4.4.3 The National Growth and Poverty Eradication Strategy (2004)

As explained in Section 4.2.1, this strategy was based on the premises that development and access to energy are closely linked and that rural electrification can be the key to rural economic development.

Gaps

Since details on the implementation of this strategy are not available, no gaps have been identified.

Recommendations

No recommendations are suggested.

4.4.4 The Prime Minister's Decree on the Local and Rural Electrification Development Fund (REF) (2005)

The REF is designed to support rural electrification by making equipment affordable. The fund is important for rural electrification programmes, such as the proposed NAMA, as it can provide financial support for part of the projects' capital expenditure.

Gap

The REF was designed for rural electrification in general, but currently, the fund is mainly limited to supporting solar home based solutions.

Recommendation

There are multiple off-grid rural electrification technologies available, and some of these technologies and related interventions have been tested in Lao PDR by different entities. REF has successfully supported solar technologies in the country. It should also explore the possibilities for diversifying to non-solar renewable technology options (product testing is advised before full-scale launch).

4.4.5 The Renewable Energy Development Strategy (2011)

The National Strategy on Renewable Energy Development, prepared by the Ministry of Energy and Mines, analyses the potential for renewable energy, sets targets, and defines implementation measures. The intention is to raise the share of renewables in the energy mix to 30 per cent by 2025. The strategy focuses on promoting public and private domestic and foreign investment in biofuels production, small-scale electric power plants, other forms of renewable energy such as solar, biomass, biogas and wind, and alternative energy for transport. Special tariffs for renewable energy are to be introduced and low-interest loans offered for investment in renewable energy production (MEM, 2011).

Specifically on rural electrification, the strategy identifies small hydropower plants as a possible solution to the problem of supplying power to remote areas. The strategy also identifies the factors that have resulted in the non- or underperformance of small hydro projects in the past (MEM, 2011).

The specific actions prescribed in the action plan of the strategy document include development of renewable energy development plans for the country and establishing a legal framework and promoting a conducive business environment for the promotion of renewable energy projects (MEM, 2011).

Gaps

The strategy document is very comprehensive but the sector specific regulations are yet to be introduced.

Recommendation

No recommendations on the substance of the document are suggested, but it is hoped that MEM will expedite the actions proposed in the strategy document.

4.4.6 The Customs Law (2005)

Customs duties are levied on individuals, organizations and other entities that are engaged in carrying out operations across border customs posts. Apart from raising revenues, government policy on customs is also used as a tool to promote, protect and encourage production and services in preferred sectors. There are several categories of exemptions listed in the law. The law lists general exemptions (in Article 43), the exemption and reduction of customs duties to promote investment (in Article 44) and special cases (in Article 45). Articles 46 and 47 describe the exemptions that are offered to promote economic development by extending custom duty free zones (MFA, 2012). Renewable energy equipment is import duty-free on the basis of the Law of Investment Promotion outlined below.

Gaps

No specific gaps were identified

Recommendations

No specific recommendations are suggested.

4.4.7 Value Added Tax (2006)

Article 10 of the VAT law exempts certain items/services from the tax. These items/services are classified under 15 broad categories, including goods and services supplied to grant aid projects, certain categories of vehicles, medical equipment, articles related to education programmes and articles supporting health services (MFA, 2012).

Gaps

In the context of the rural electrification NAMA, VAT is an important ingredient that can make or break the rural electrification strategy because of its implications for electricity pricing.

Although the VAT law of the country exempts certain fuel supplies (if, for example, they are for international air transport, or are "used in business, manufacturing and services that are liable to and exempted from value-added tax"), the VAT exclusions do not include items that are or can be used in energy generation and transmission.

Recommendations:

It is recommended that the VAT currently applicable to renewable energy items be reduced or abolished. The components of renewable energy systems (turbines, batteries, wires, lights, meters and so on) should be exempted from VAT to improve the financial viability of rural energy projects and to make services more affordable to rural consumers.

4.4.8 National Policy on the Environmental and Social Sustainability of the Hydropower Sector in Lao PDR (2005)

The country's hydroelectric potential is significant. It already invests heavily in expanding hydroelectric capacity to meet domestic demand and earn revenue by exporting electricity. The government acknowledges that the use of hydropower should be sustainable to achieve lasting benefits. Hence the National Policy on the Environmental and Social Sustainability of the Hydropower Sector focuses on economic, social and environmental sustainability issues associated with the projects.

Gaps

The policy is targets hydroelectric projects with capacities exceeding 50 MW, and therefore does not address the environmental and social externalities associated with the small hydro plants that are considered to be one of the keys to expanding rural electrification.

Recommendations

Considering the fact that such small hydro projects may be built in pristine locations which may be ecologically sensitive, it is recommended that regulations be devised to address the social and environmental implications associated with small hydro projects, while at the same time being aware that too much regulation may dilute the rural electrification drive. Hence a minimalist yet effective regulatory regime is recommended.

Specifically policy should be revised to promote low cost, rapid environmental and social impact assessments of small hydro projects. Further, clear guidelines on offsetting the externalities associated with the small hydro projects should be developed.

The Government can help develop an initial assessment of potential mini/micro hydro project sites with a view to identifying "go", "go-slow" and "no-go" regions and sharing this information with investors.

In order to contain the cost of small hydro projects, the Government can extend partial support to the project developers for offsetting the impacts of their projects.

4.4.9 The Law on Investment Promotion (2009)

The Law on Investment Promotion defines the principles, regulations and measures governing the promotion and regulation of domestic and foreign investments (MFA, 2012).

Investment in economically backward regions is encouraged through tax exemptions. To this end, the country is divided into three zones with Zone 1 denoting the least developed provinces. Zones to be promoted are classified by the condition of the local infrastructure. The exemptions available are listed in the table below.

Table 12. Tax exemptions and reductions by investment zone

Zone	Profit tax exemption period	Profit tax rate during reduction period (%)	Regular tax rate (%)
Zone 1 Mountainous, plain and plateau zones where there is no economic infrastructure to facilitate investments	7 years	—	10
Zone 2 Mountainous, plain and plateau zones with limited economic infrastructure that can support investments to some extent	5 years	7.5 for three years	15
Zone 3 Mountainous, plain and plateau zones where there is sufficient infrastructure to support economic activities	2 years	10 for two years	20

Source: Investment Promotion Department, 2015.

All investments in renewable energy projects in Lao PDR (grid-connected or isolated systems) are also entitled to investment incentives (duty-free imports) under the Investment Promotion Law (GIFT, 2014).

Gaps

The investment laws in the country are highly favorable for renewable energy projects. No gaps could be identified.

Recommendation

No recommendations are suggested.

4.4.10 Summary of Policy Recommendations

The following table summarizes the most important policy recommendations.

Table 13. Summary of recommendations on developing a favourable policy environment for a rural mini grid programme

Policy	Key recommendations
Electricity Law (1997, amended in 2012)	• The Electricity Law needs to be revised to include provisions for electricity generated from renewable sources. • The law needs to include regulations for the generation and distribution of electricity from off-grid systems. • Provisions need to be introduced to help create a favorable business environment for small scale power projects.

Policy	Key recommendations
Power Sector Policy Statement (2001)	• No specific recommendations are suggested.
National Growth and Poverty Eradication Strategy (2004)	• No specific recommendations are suggested.
The Prime Minister's Decree of Local and Rural Electrification Development Fund (REF) (2005)	• REF schemes should be devised for non-solar renewable technologies (product testing is advised before full-scale launch).
The Renewable Energy Development Strategy in Lao PDR (2011)	• No specific recommendations are suggested.
The Customs Law (2005)	• No specific recommendations are suggested
Value Added Tax (2006)	• It is recommended that the VAT currently applicable on renewable energy items be reduced or abolished.
National Policy on the Environmental and Social Sustainability of the Hydropower Sector in Lao PDR (2006)	• Regulations to address the social and environmental impacts of small hydro projects • Low cost, rapid environmental and social impact assessments of the small hydro projects need to be introduced. • Partial support should be given to project developers to offset the impacts of such projects
Law on Investment Promotion (2009)	• No specific recommendations are suggested.

5. NAMA Baseline and Targets

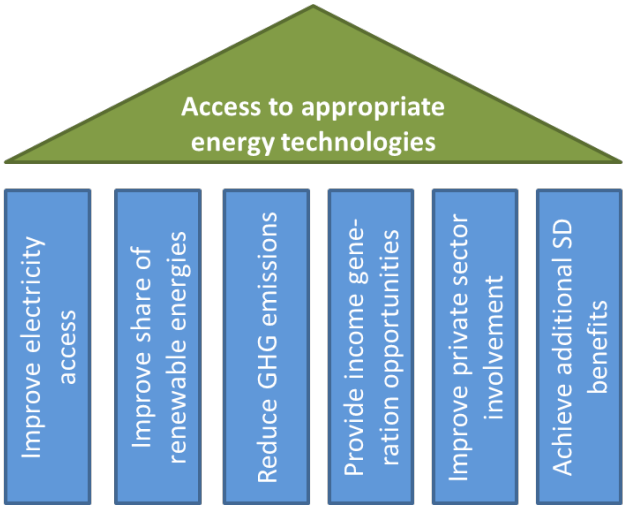
5.1 NAMA Objectives

The NAMA objectives are designed to support Lao PDR in achieving its strategies for rural electrification and to complement ongoing activities in this field by supporting the implementation of mini grid solutions. More specifically, the NAMA aims at achieving the following objectives.

- Improve electricity access: the NAMA envisages the provision of electricity to regions, households and companies which are currently without access to electricity.
- Maintaining the share of renewable energies: Electricity for mini grids will mainly be generated from hydro and solar energy but potentially also from other renewable energy sources.
- Reduce GHG emissions: GHG emissions will be reduced through the replacement of fossil fuels with renewable energies.
- Provide conditions for income generation and new business opportunities: a key element of the NAMA interventions will be to provide one of the basic preconditions for the creation of income-generating opportunities in rural areas¾access to electricity¾ and will thus contribute to reducing poverty in these areas.
- Increase private sector involvement: the private sector is seen as an essential partner in the implementation of the NAMA¾either through public-private partnership enterprises or in sub-contracting relationships with the public sector as technical consultants, technology suppliers, constructors, operators, etc. Without the private sector and its commitment to providing co-funding and taking risk, implementation of the interventions would be limited.
- Achieve additional SD benefits: the NAMA aims at contributing to SD benefits such as improvements to air quality and the livelihood of the poor (the SD indicators are discussed in more detail in Section 6.3.2).

The following figure summarizes the NAMA objectives.

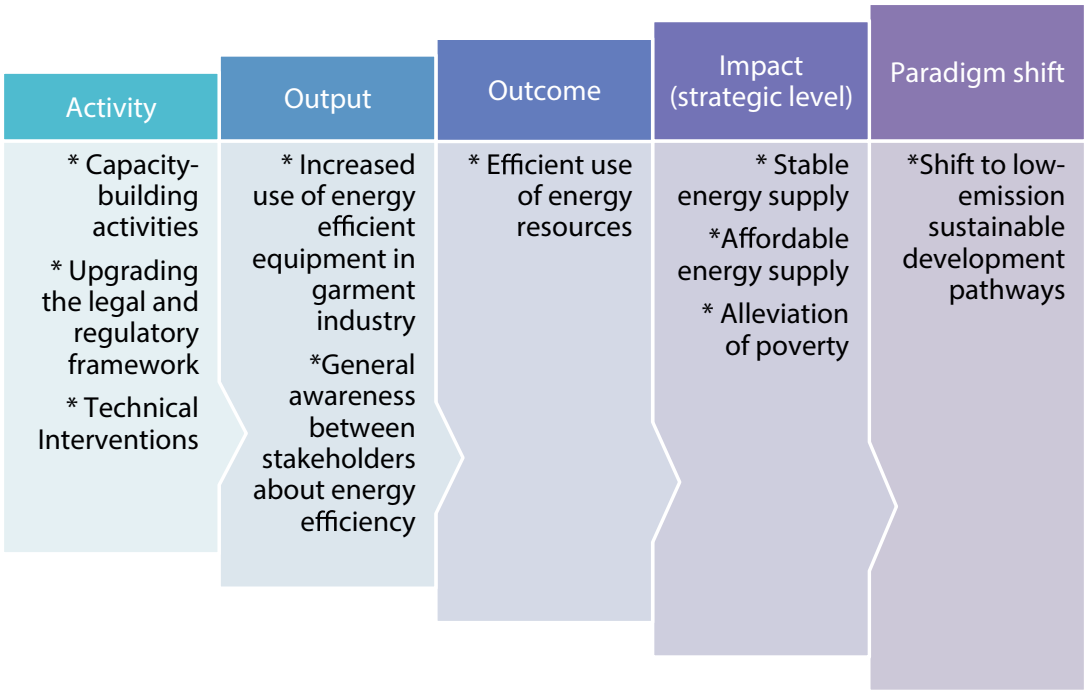
Figure 13. NAMA objectives



5.2 Alignment of NAMA Design with National Strategies and Transformative Change

The transformative change of the NAMA can best be seen through the application of a theory of change approach. The theory of change approach "defines all building blocks required to bring about a given long-term goal. This set of connected building blocks—interchangeably referred to as outcomes, results, accomplishments, or preconditions—is depicted on a map known as a pathway of change/change framework, which is a graphic representation of the change process" (Center for Theory of Change, 2013). Using this approach will help to ensure that the NAMA focuses not just on emissions reductions but also on achieving sustainable development, national development goals and transformative change. This approach is also aligned with the Green Climate Fund (GCF) results framework and is illustrated in the following figure:

Figure 14. Theory of change approach to NAMA targets



The transformative change must also occur in a fashion which is aligned with national development goals. The following table summarizes how this NAMA will contribute to achieving the goals and objectives defined in relevant policy documents of Lao PDR.

Figure 15. Relationship of NAMA objectives to national strategies and goals for rural electrification

NAMA objectives	National strategies, policies and goals
Improve access to electricity	The National Socio-Economic Development Plans (the latest being the one for 2011-2015) consider access to electricity as a strategy to achieve the Millennium Development Goals for the country. The National Growth and Poverty Eradication Strategy has set a 90 per cent electrification target for 2020. To reach out to rural areas, the strategy advocates a grid extension programme, supplemented by off-grid options.
Improve share of renewable energies	The Renewable Energy Development Strategy aims to increase the share of renewable energies to 30 per cent of total energy consumption.
Reduce GHG emissions	The Climate Change Action Plan 2013-2020 promotes the use of clean energy to reduce GHG emissions (without giving specific targets given) (MoNRE, 2013).
Provide income generation and new business opportunities	The National Growth and Poverty Eradication Strategy (NGPES) identifies rural electrification and electricity exports as key areas for national development. The NSEDP aims to develop agricultural systems and additional business opportunities by improving access to electricity based irrigation systems.
Improve private sector involvement	The Rural Electrification Development Fund opens up scope for private sector participation in the development of electrification in rural and remote areas.
Achieve additional SD benefits	No direct reference to such benefits in the policy documents.

5.3 NAMA Baseline

The baseline scenario of the NAMA is the hypothetical scenario describing what will happen in the absence of the proposed NAMA interventions.

The baseline scenario consists of two components, a GHG emission reduction baseline and a Sustainable Development (SD) baseline. Setting the baseline scenario in this way allows the effects of the Nationally Appropriate Improvements (NAI) to be properly assessed and quantified through the monitoring activities described in the Measurement, Reporting and Verification (MRV) system.

5.3.1 GHG Emission Reduction Baseline

Significant GHG emissions arise from the use of fossil fuels in the baseline scenario. The determination of the GHG emission baseline is based on the UNFCCC "Small-scale Methodology AMS-III.BL.: Integrated methodology for electrification of communities" (UNFCCC, 2015).

This methodology is applicable in situations where consumers who were not connected to a national/regional grid before project implementation are supplied with electricity generated from the project activity. The NAMA intervention represents such a situation and project activity.

The baseline determined through the UNFCCC's "Integrated methodology for electrification of communities" is based on three steps:

- Step 1. Classify consumers
- Step 2. Determine the consumption of each consumer type
- Step 3. Determine the baseline emissions of each consumer type

Step 1. Classify consumers

For the NAMA intervention on mini grids, only the consumer types 1 and 2 are relevant. Type 1 consumers are consumers who were not connected to a national/regional grid or a mini grid before project implementation and who consume less than 500 kWh per year; Type 2 consumers include inter alia consumers who use more than 500 kWh per year and had no supply before the project or were previously supplied by a stand-alone fossil fuel power system such as diesel generators.

Step 2. Determine the consumption of each consumer type

The methodology uses consumption levels for each type of consumer to define the applicable metering system for electricity consumption.

For the NAMA intervention on mini grids the following options are relevant.

- Option A. Metering for any consumer with annual consumption greater than 1,000 kWh; and
- Option C. Distribution metering and consumer numbers are relevant in cases where annual consumption is less than 1,000 kWh

Step 3. Determine the baseline emissions of each consumer type

Baseline emissions are calculated separately for consumer type 1 and 2, as described in Section 10. The following baseline emission factors are applied:.

Baseline emissions factor for Type 1 consumers

Case 1: ECT1,x,y $\geq$ 500 kWh:

- For $EC_{T1,x,y}$ proportion 0- 55 kWh: $EF_{CO2,T1}$ = 6.8 tCO_2/MWh
- For $EC_{T1,x,y}$ proportion 55 kWh – 250 kWh: $EF_{CO2,T1}$ = 1.3 tCO_2/MWh
- For $EC_{T1,x,y}$ proportion 250 kWh - 500 kWh: $EF_{CO2,T1}$ = 1.0tCO_2/MWh

Case 2: $EC_{T1,x,y} \geq 500$ kWh:

$EF_{CO2,T1} = 1.0\ tCO_2/MWh$

Baseline emissions factor for Type 2 consumers

≥ 1000 kWh

$EF_{CO2,T1} = 1.0\ tCO_2/MWh$

5.3.2 Sustainable Development Baseline

Electrification is one of the preconditions for development, especially in rural areas, and brings many additional benefits besides the electricity itself. Thus, the NAMA will contribute to improvement of several aspects of the sustainable development indicators.

Quantification of the baseline is in most of these cases more appropriately done at the local level, in particular in the locations where the NAMA activities will take place. However, in view of the nature of the focus areas of this NAMA (remote, off-grid areas), the baseline for them is assumed to be zero. Therefore the need for and the impact of the NAMA activities are high

Table 14. Indicators for SD baseline

Domain	Indicator
Environment	Climate change adaptation and mitigation. GHG emissions from combustion of the fossil fuels for electricity generation will be reduced/avoided.
Social	Improvement of health and healthcare conditions due to electrification of clinics and health centres. Improved livelihood of the poor/poverty alleviation through: • enhanced productivity/efficiency arising from provision of electricity; • creation of income-generating activities (jobs) and more business opportunities; • reduction of expenditure on electricity (e.g. charging of phones).
Growth and Development	Access to clean and sustainable energy, reduced use of fossil fuels (diesel and paraffin) and establishment of new sales points for renewable energy and energy efficient (RE & EE) technology. Education¾improved learning conditions due to electrification of the schools.
Economic	Creation of income-generating activities (enterprises); creation of jobs, for men and women.

5.4 NAMA Targets

The values below are used in the following sections for estimation of NAMA impacts on GHG emission reduction and reaching the SD indicators. The values are only for the first eight mini grid projects to be implemented.

Table 15. Expected and targeted impact of first eight mini grids

Installed capacity	144 kW
Proxy RE technology	
Annual electricity demand	Approx. 340,000 kWh
Annual GHG saving/avoidance	850-940 tons CO_2eq
Number of public buildings	8
Number of households electrified	1,054
Number of people with access to RE electricity	6,300
Number of educational institutions electrified	8
Number of new income-generating activities (enterprises)	8
Number of new jobs (total)	32
Number of new jobs for women	16

6. NAMA Interventions

New mini grids based on renewable energy will be installed in rural communities and will provide the following services.

- Households: electricity for daily lighting (two lamps minimum), radio and phone charging will be provided.
- Public buildings: electricity for lighting and internet (schools, government buildings, health centres), computers/printers, mobile charger stations and basic clinic instruments in health centres).
- Rural Productivity Zones (RPZs): electricity for income generation opportunities for entrepreneurs and community projects (food processing units, internet access, charging of phones, etc.).
- Literacy centres: electricity for lighting libraries, operating computer, TVs etc.

Box 1. Development through productivity zones and literacy centers

Rural Productivity Zones

The concept of the Rural Productivity Zone (RPZ) is based on the paradigm of an integrated approach to sustainable rural development. It consists of setting up an energy system and associated infrastructure in a rural area to provide power for a range of activities that leads to income enhancement and social development. The resulting economic activities lead to money being generated, which in part goes into paying for the investment, operation and maintenance of the energy system and infrastructure. In this manner RPZs increase the ability of consumers to make consumer payments, by allowing for more community level income generation. In addition to economic activities RPZs offer the potential to create social infrastructure for healthcare and education, which builds a sense of ownership and supports local capacity development, leading to the community's sustainable development (UNDP, 2014a).

Literacy Centres applying the READ Global approach

READ Global (www.readglobal.org) provides holistic education for villagers of all ages and backgrounds. Literacy and basic education is often the first step, opening doors to training in livelihoods and information communications technology (ICT). Every READ Centre has a fully stocked library, a computer room, children's and women's sections, a training hall and an audiovisual section. READ Centres focus on four areas with the following sub-components:

Education: providing training with partners in literacy, health, children's programmes and youth support

Economic empowerment: livelihood skills training, small business skills training, sustaining enterprises, savings cooperatives

Technology: computers and internet, mobiles and radio, online educational content, sustainable hardware

Women's empowerment: leadership development, women's and family health, gender sensitization, women's group.

READ Global often partners with Ministries of Education. READ also works with ministries to do outreach to local schools, often sharing books, inviting students to use the computers at READ Centres, and hosting children's educational camps.

Phase 1 of the NAMA will focus on implementing mini grids in eight areas for which pre-feasibility studies have already been conducted. Phase 2 will allow for the expansion of the NAMA into other areas.

6.1 Eligibilty Criteria

In order to be able to receive funding under the NAMA, any mini grid needs to meet the following eligibility criteria.

Table 16. Eligibility criteria for the NAMA intervention

Eligibility criterion	Description
Location	Any off-grid area as indicated in the Rural Electrification Master Plan (REMP)
Technology	Energy supply: the mini grid will be operated with hydro power (only run-off-river projects are allowed), solar (PV, CSP), wind or biomass or any combination of these.
	Battery: batteries may be used for a steady electricity supply.
	Backup: fossil-fuel back-up systems are allowed; however, the share of electricity from renewable energies must be at least 50 per cent. Generally hydro-solar hybrids are preferred.
Connections	The mini grid must connect a minimum of 20 households.
Service level	Domestic users: the minimum service level provided to domestic users needs to include at least two sources of lighting, radio and phone charging.
	Income-generating activities: the mini grid must include opportunities for income-generating activities, for example, agriculture (mainly rice, corn, and peanuts), small-scale animal husbandry and fishing, three small shops
	Literacy centres: the mini grid must provide sufficient electricity to operate the equipment of a literacy centre: a computer and printer, a mobile phone charging station, LED TV, a satellite dish and receiver
Implementation	Mini grids must be operational within 18 months of contract award.
Funding	Maximum international grant funding is 90 per cent of total investment costs. Operating costs must be covered from income from electricity sales.

6.2 Approval Process for NAMA Interventions

The selection of the mini grids to be financed under the NAMA will be carried out following the steps shown below.

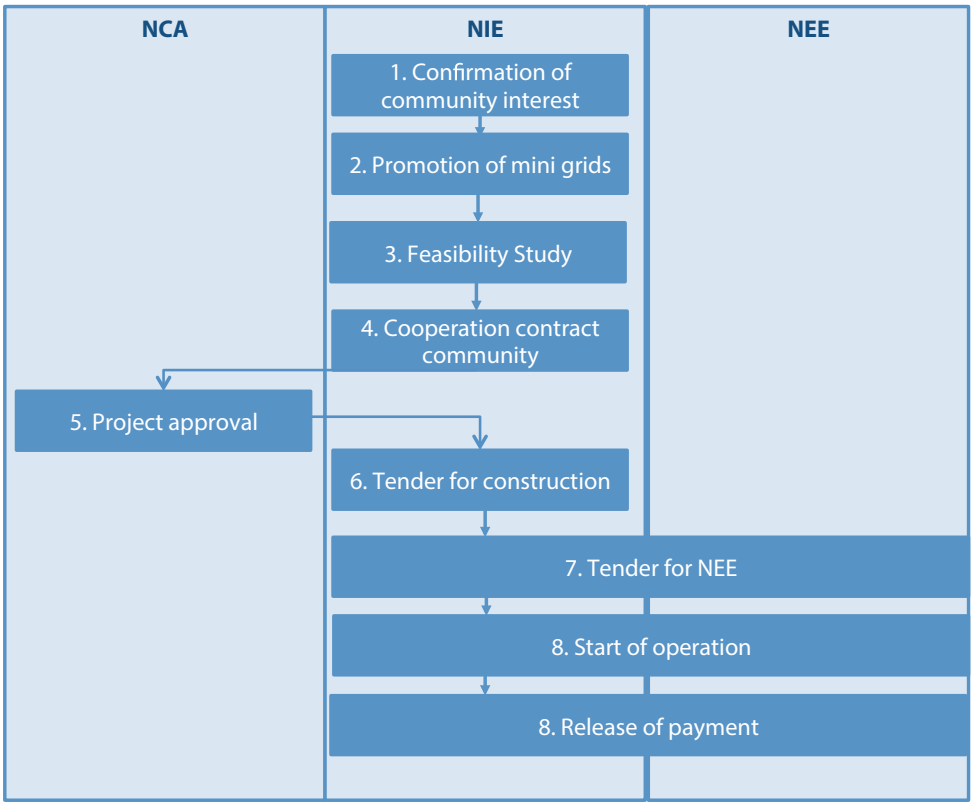
Table 17. Description of approval process for NAMA interventions

No.	Step	Description
1	Confirmation of community interest	The NAMA Implementing Entity (NIE) will contact the communities where the mini grid will be implemented, to confirm their interest in taking part in the implementation and operation of the mini grid
2	Promotion of mini grid	The planned implementation of the mini grid will be promoted by the NIE in the villages to be covered by the grid. Information will be given to households and institutions about the service level they can receive and expected associated costs. Existing companies and potential operators of income-generating activities will be informed about the planned electricity supply and associated costs. This step will generate a list of potential connections in the different categories (households, public and commercial establishments, income-generating facilities).
3	Feasibility study	A feasibility study is carried out defining details of the mini grid, including: • List of consumers to be connected; • Required capacity; • Draft plan of the mini grid; • Investment costs; • Tariff structure.
4	Discussions on cooperation and contracts (including tariff setting)	Discussions will be held between the NIE and community about the roles and responsibilities of each partner in the mini grid's construction and operation, the latter being outsourced to a private sector NAMA Executing Entity—NEE. The electricity tariff which will cover the non-subsidized part of the investment costs as well as the operation and maintenance of the grid need to be at the maximum end of current national tariffs. Once discussions are finalized, a cooperation contract will be elaborated and signed.
5	Project approval	Each mini grid will be presented to the NAMA Coordinating Authority (NCA) for NAMA approval. The submitted documents shall include all the other approvals required for that project type.
6	Tender for construction	After approval by the NCA, a tender will be announced to procure the required equipment and services through a private renewable energy company for each mini grid. It is recommended that tenders for different mini grids are bundled together in order to achieve economies of scale.

No.	Step	Description
7	Tender for NEE (operation and maintenance of mini grid)	During/after the construction of the mini grid a tender for operation and maintenance services by an NEE will be issued. The NEE needs to specify what services it can provide and to offer a price. The NEE can also be the company which is constructing the grid.
8	Start of operation	After implementation of the mini grid and determination of the NEE the mini grid can start operations
9	Release of payment	Payment is released by the NIE to the NEE periodically.

The following flow diagram shows the approval process and the stakeholders involved:

Figure 16. Approval process for interventions



6.3 Ownership and Operation of Interventions

There are different models that can be followed in the preparation and operation of mini grids. UNDP MDG Carbon's Guidance Paper on Finance Structure and its Management for a Rural Electrification NAMA presents these different models and describes the advantages and disadvantages of each of them (UNDP, 2014b).

The intervention will be structured on the Public-Private Partnership (PPP) business model (which in the case of Lao PDR would involve the Government of Lao PDR, community cooperatives and the private sector).

- The Government of Lao PDR will hold the title/ownership of the assets (the generation and distribution system); and
- a private party will operate, maintain and manage the energy services.

A project steering committee will be established to ensure efficient and effective operation of the mini grid and will consist of one representative each from the community where the mini grid is being implemented, the MEM and the private company/ies selected for implementation and operation of the mini grid.

The electricity will be distributed via a low voltage mini grid, which directly distributes single-phase AC power to each household. Each household will be provided with a consumer connection, which will include a basic lighting kit and a ready board with prepaid meter, surge protection and power sockets.

The Rural Productivity Zone (RPZ) will be provided with a three-phase AC power supply and metering/surge protection, to meet the electricity demand of the various pieces of equipment in the zone.

Consumers will pay for residential electricity via prepaid metering and for electricity used at the RPZ facilities and the literacy centre through consumption meters. The private company operating the mini grid will also explore opportunities to tie up with private enterprises in the vicinity (such as telecommunications companies, agriculture produce processing units, tourism facilities and so on), to which they might sell electricity. A stabilization fund to support mini grid consumers in the early phases of NAMA implementation will be set up to provide funding for payment of electricity bills (see Section 9 for further details)

6.4 Pilot Mini Grids

The Government of Lao PDR has proposed the following mini grids as pilot projects under the NAMA.

Table 18. Overview of proposed NAMA pilot projects

Village Name	Ban Kobong and Ban Thaphiban	Ban Vanchang	Ban Xoklek	Ban Makfueng	Ban Thamean	Ban Omkanang	Ban Thameng	Ban Aho
Distric/ Province	Nakay Khummuane	Nakay Khummuane	Nakay Khummuane	Nakay Khummuane	Nakay Khummuane	Mai Phongsali	Nakay Khummuane	Samouay Salavan
No. of households	136	60	48	130	385	40	185	70
Population serviceda	816	360	288	780	2310	240	1110	420

Village Name	Ban Kobong and Ban Thaphiban	Ban Vanchang	Ban Xoklek	Ban Makfueng	Ban Thamean	Ban Omkanang	Ban Thameng	Ban Aho
Potential income-generating activities	Agriculture (mainly rice, corn, and peanuts) but also some small-scale animal husbandry and fishing, ecotourism; three small shops	Agriculture (mainly rice, corn, and peanuts) but also some small-scale animal husbandry and fishing, ecotourism; three small shops	Agriculture (mainly rice, corn, and peanuts) but also some small-scale animal husbandry and fishing, ecotourism; three small shops	Agriculture, forestry products (such as bamboo shoes, mushroom, fish, and animal sales), ecotourism	Agriculture (mainly rice, corn, and peanuts) but also some small-scale animal husbandry and fishing, ecotourism; three small shops	Farming (mainly rice but also pig, cattle and chicken raising). two shops and eight personal (family) rice mills have been identified. agriculture, forestry products ecotourism	Agriculture (mainly rice, corn, and peanuts) but also some small-scale animal husbandry and fishing, ecotourism; three small shops	Agriculture (mainly rice, corn, and peanuts) but also some small-scale animal husbandry and fishing, ecotourism; one shop
Other facilities connected	Clinic, school, literacy centre	Clinic, school, literacy centre	Clinic, school, literacy centre	Clinic, school, literacy centre	Clinic, school, literacy centre	Clinic, school, literacy centre	Clinic, school, literacy centre	Clinic, school, literacy centre
Source of energy	Hydro	Hydro	Hydro	Hydro	Hydro	Hydro	Hydro	Hydro
Backup system	Solar PV, battery and/or diesel	Solar PV, battery and/ or diesel	Solar PV, battery and/ or diesel	Solar PV, battery and/ or diesel	Solar PV, battery and/ or diesel	Solar PV, battery and/ or diesel	Solar PV, battery and/ or diesel	Solar PV, battery and/or diesel
Required capacity	19 kW	10 kW	8 kW	18 kW	46 kW	8 kW	24 kW	11 kW
Estimated annual consumption	63 MWh	32 MWh	28 MWh	61 MWh	155 MWh	25 MWh	81 MWh	47 MWh

[a]*Assuming average household size of six persons.*

The GoL has identified five additional locations for mini grids, either as potential substitutions in case one of the eight original mini grids is not realized or as part of a second phase of the NAMA.

These five (hydro based) mini grids are located nearby to the following villages:

1. Na Nokxeo, Na Ang (20-25 kW)
2. Huay Vane, Huay Khay (15-20 kW)
3. Na Or, Huay Veuy (25-30 kW)
4. Maeng Ko Phong (25-30 kW)
5. Omkanaeng (10-15 kW).

7. NAMA Implementation Structure

7.1 Actions to Institutionalize the NAMA

The coordination and management of the NAMA requires an institutional structure, which shall meet the following requirements:

- It is embedded in national and sectoral policies and strategies.
- It ensures effective communication and reporting as required by international agencies, such as the UNFCCC.
- It provides interface to international bilateral and multilateral NAMA funding entities, such as the Green Climate Fund.
- It ensures proper management of financial flows between the NAMA funding entities and the recipients.
- It ensures the achievement of NAMA targets in terms of energy savings, GHG mitigation, sustainable co-benefits.
- It allows transparent monitoring of GHG emission reductions and the sustainable development indicators.

The recommended institutional structure of the NAMA is based on the following principles:

- It ensures the strong involvement of national stakeholders to create country ownership and political commitment.
- It utilizes existing and experienced entities' organizational systems already in place, thus allowing for prompt and smooth implementation of the NAMA
- It ensures that the institutional structure is appropriate for receipt of international private and/or public donor funding

7.2 NAMA Institutions

The institutional structure for the NAMA in Lao PDR will include the following institutional bodies on the country level:

1. the NAMA National Focal Point or National NAMA Approver (NA)
2. the NAMA Coordinating Authority (NCA)
3. the NAMA Implementing Entity (NIE)
4. NAMA Executing Entities (NEEs)
5. The National Environmental Committee (NEC).[14]

14 In cases where there is GCF co-funding, an additional entity the National Designated Authority (NDA) (in Lao PDR, the Ministry of Natural Resources and Environment) needs to be involved as the country focal point in all relations with the GCF.

National NAMA Approver and Focal Point (NA)

The national NAMA Approver or Focal Point will, among other things:

- approve NAMAs which will be registered at the UNFCCC;
- report to the NEC about international developments and status of the national NAMA portfolio, and follow the guidance of NEC in international negotiations;
- provide guidance to the NAMA Coordinating Authority with regard to access to climate finance;
- implement measures to account for emission reductions, ensuring that double counting of emission reductions from the implemented NAMAs projects does not occur;
- support the preparation of the National Communication, Biennial Update Reports, Summary of GHG reductions and other communications with the UNFCCC.

The Ministry of National Resources and Environment (MoNRE) will be appointed as the NAMA Approver

NAMA Coordinating Authority (NCA)

The NAMA Coordinating Authority (NCA) is the entity which coordinates this NAMA. Its main tasks are:

- acting as primary contact for international donor(s);
- approving:
  - i. NAMA targets (the electrification rate, GHG emission reductions, the sustainable benefits indicators);
  - ii. The implementation process regarding submissions of project applications and the disbursement of funds (in close collaboration with the NEC, the NAMA Focal Point and the NIE);
- approving and updating the eligibility criteria for the interventions;
- approving annual monitoring reports prepared by the NIE (covering, among other things, the number of projects implemented, the calculation of emission reductions, etc.); and
- supervising the financial flows between donors and beneficiaries.

As the relevant sectoral ministry, the Ministry of Mines and Energy will act as the NAMA Coordinating Authority. This is in line with the Climate Change Action Plan of Lao PDR for 2013-2020, which states: "Identified line ministries shall take key responsibilities in reconciliation of projects and focal tasks included in the action plan for integrating into strategies, plans and budgeting of their own sectors with relations to strengthen organizational functions and work methods focusing on effective implementation under its scope of authority" (MoNRE, 2012, p. 18).

NAMA Implementing Entities (NIEs)

The NAMA Implementing Entity (NIEs) will constitute the main operative body of the Renewable Energy Sector NAMA in Lao PDR. It will be responsible for (i) handling of the financial flow from funding entities to the beneficiaries and (ii) project monitoring.

The main tasks of the NIE are:

- ensure the proper transfer and disbursement of funds from the donors to the recipients based on an agreed set of criteria ;
- prepare reports to the NEC/NCA/donor on
  - i. the use of funds,
  - ii. the number of projects implemented,
  - iii. targets achieved etc.;
- promote private sector engagement in the operation of the mini grids (the ownership will stay with the NIE);
- cooperate with internal and external financial auditors;
- check and approve applications for funding under the NAMA;
- develop technical standards for equipment/installations used under the NAMA;
- provide capacity development for institutions and companies involved in the implementation of the NAMA (among others, mini grid operators, engineering companies, equipment suppliers);
- coordinate promotion and awareness raising campaigns about rural electrification based on renewable energy;
- coordinate and compile monitoring data.

Lao PDR has created a variety of special-purpose funds which manage donor money to finance projects in different sectors. The most relevant funds for this NAMA are the Rural Electrification Fund, the Renewable Energy Fund and the Environmental Protection Fund. The Rural Electrification Fund will be the NAMA Implementing Entity (NIE), acting as financial and technical NIE. Supplementing internal technical capacity, external experts will support the technical NIE during its first year(s) to deliver the expected results

NAMA Executing Entities (NEEs)

The NAMA executing entities will be private entities which implement and/or operate projects under the eligible NAMA interventions. Each NEE will:

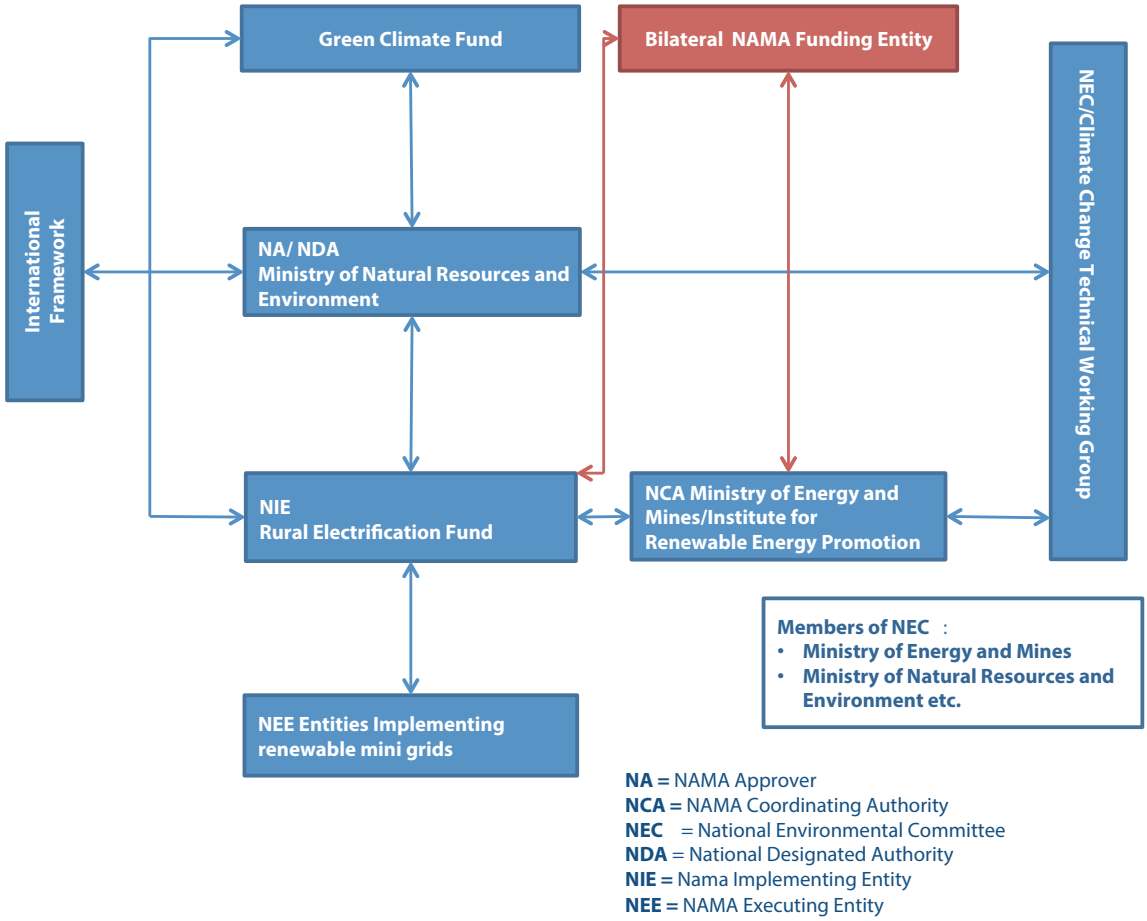
- implement projects in compliance with the rules of each intervention;
- inform the technical NIE about the technical performance of the projects;
- collect data for monitoring purposes to meet the requirements of the MRV (e.g. installed capacity, operating hours etc.).

National Environmental Committee (NEC)

The National Environmental Committee, through its Technical Working Group on Climate Change, chaired by the Deputy Prime Minister, is the top body providing policy guidance on climate change policies in Lao PDR.

The following organizational diagram illustrates the institutional structure of the NAMA. Bilateral funding entities or donors will be in direct contact with the NCA. MoNRE will act as the focal point for the GCF. The NEC will act as the national high level political supervisory body of the NAMA.

Figure 17. NAMA institutional set-up



8. NAMA Capacity-Building

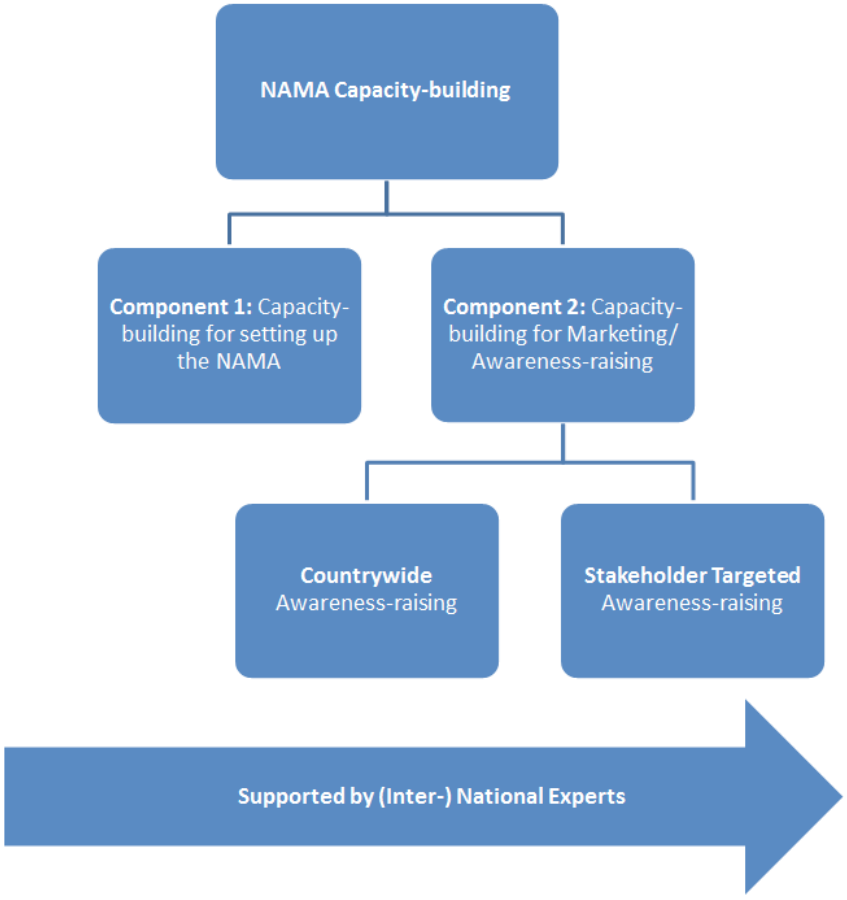
The NAMA capacity development (CapDev) programme will enable the smooth launch of the NAMA and contribute to the successful implementation of its activities. It will consist of two components.

The first component will focus on setting up the NAMA (e.g. definition of processes, preparation of documentation) and will provide capacity-building for the involved governmental and semi-governmental entities (such as the NIE or the NA).

The second component will focus on the awareness raising and marketing side of the NAMA after implementation and will provide (i) general capacity-building to create a common awareness for the NAMA and (ii) specific stakeholder oriented capacity-building.

The capacity-building programme will be led by international experts with the support of national experts. The first component will be carried out by international/national consultants only. In the second component NCA and NIE staff who have been trained in the first component will start to provide seminars/training and workshops.

Figure 18. Structure of NAMA capacity-building



8.1 Component 1: Capacity-Building for NAMA Implementation

The CapDev programme for setting up the NAMA will support:

- establishing a NAMA working network and processes (technical and financial project cycle), including staff training;
- devising NAMA related regulations and designing the contractual conditions;
- preparing NAMA project documentation (application forms, call and tender documents, procurement rules, monitoring, evaluation and reporting forms, etc.).

This first component focuses on activities which will be performed by the NAMA Coordinating Authority and the NAMA Implementing Entities.

8.1.1 Implementing The NAMA Network, Processes and Financial Cycle

This part of the CapDev program will facilitate the establishment of the NAMA entities and yjr specific positions dealing with the NAMAs within the structures of the other stakeholders involved by holding multilateral and bilateral meetings and workshops.

During this phase, the NIE will receive assistance through the following types of technical training:

- train the trainer programmes on the objectives, benefits and procedures of the NAMA (the NIE will then be able to offer training to the general public, NEEs, banks and equipment suppliers);
- case study training for project approval and verification;
- training on MRV for GHG emission reductions and SD co-benefits;
- training in developing an infrastructure protection plan for renewable energy facilities, to increase the climate resilience of the community;
- designing lines of authority and time frames for process steps within the NIE;
- training on reporting to the NCA;
- identifying staff within the organizations involved for NAMA positions, providing individual turn-key know-how and training to entities and individual personnel;
- preparing communication structures and information procedures, and contact lists for the network;
- preparing the financial processes cycle; and
- making contact with to counterparts in neighbouring countries in order to set up a regional south-south cooperation platform on NAMAs.

8.1.2 Regulations and Contractual Conditions

This part of the capacity development programme will help participants to:

- draft, in close cooperation with the Government, amendments to the existing regulations and new regulations, as required;

- assist in the approval of the new regulations by holding consultative meetings with the responsible authorities;
- draft contractual conditions and documents setting out the relationships between the NAMA stakeholders, as required (e.g. to distribute responsibilities between the ministries);
- develop the support contract to be signed by the NIE and the Executing Entities, which will be designed by the NIE (with the support of the capacity-building programme) and will contain at least:
  - the name and address of the legal entity asking for support;
  - a description of the equipment to be purchased by the Executing Entities;
  - the amount of subsidy to be given;
  - a description of the legal framework for this NAMA and the relevant approval procedures;
  - the period for finalizing the purchase of equipment and issuing invoices to the NIE;
  - the NEEs' reporting requirements; and
  - payment conditions.

8.1.3 Preparing NAMA Project Documentation

This part of the CapDev programme will help to

- prepare the documents (application forms, call and tender templates, evaluation and reporting forms, etc.);
- prepare the procedures for practical implementation (procurement rules, the monitoring manual, evaluation, cross-checking, approval and reporting structures, etc.); and
- ensure that the relevant forms and procedures are subject to consultation with potential end users and are sufficiently robust to secure practicability, avoid bureaucracy and eliminate corruption.

8.2 Component 2: Capacity-Building for Marketing and Awareness Raising

This CapDev component will consist of general and specific activities.

8.2.1 General activities

A countrywide generic marketing/ awareness raising strategy for the NAMA will create a common understanding of the benefits of rural electrification, renewable energies and energy efficiency, and explain the NAMA's objectives and procedures.

Organizing the NAMA Launch Event

The launch event will be the countrywide kick-off for the NAMA and will inform the public about its objectives, stakeholders and timelines. The launch event will include a press briefing and will provide some informal networking opportunities.

Designing/Maintaining the NAMA Website

The web page is one of the main communication tools of the NAMA providing information about:

- the qualification criteria for projects;
- case studies;
- best practice;
- success stories;
- templates;
- news and achievements of the NAMA; and
- donors.

Coordinating General NAMA Awareness Raising Events

In addition to the launch event, four general information events will be organized per year (for the first three years of the NAMA) which will present the concepts of renewable energy and energy efficiency; information about this specific NAMA, its objectives and opportunities; and an explanation of the NAMA procedures.

Support in Business Development

Special emphasis will be given to supporting new entrepreneurs in developing income-generating activities. This will include support on technical issues such as production techniques as well as general business development issues such as the financing of production, product selection, client selection and market access.

Preparing/Disseminating NAMA Marketing Material

Typical materials will include leaflets, pens, notepads, a guide to best practice, folders, banners, etc.

Cooperation with the Public and Private Media

There will be a continuous flow of information to the media about the implementation and outcomes of the NAMA.

8.2.2 Stakeholder-Targeted Activities

These marketing/awareness raising strategies will aim to ensure widespread participation in the NAMA.

This section refers to capacity-building activities tailored to the needs of the specified stakeholders (excluding the NCA and the NIEs, whose capacity- building programme is already covered under component 1 and under the generic activities of component 2) and provided by international experts. The main stakeholders of the NAMA are described Section 7.2.

The National Environmental Committee (NEC)

The NEC acts as the high level authority coordinating and monitoring the implementation of the Government's policies, strategies, regulations, plans and programmes in response to climate change issues. In addition to the generic marketing/ awareness activities the NEC will not receive any specific NAMA related capacity-building.

National NAMA Approver (NA)

The NA acts as the interface with international bodies on climate change policies. Its most important task with regard to the NAMA is to avoid double counting of emission reductions. Therefore the NA's specific capacity-building will focus on:

- the exchange of know-how with other countries which are implementing or have implemented rural electrification NAMAs; and
- the Measurement, Reporting and Verification (MRV) system of the NAMA.

NAMA Executing Entities (NEEs)

NAMA Executing Entities are the companies which will operate the mini grids. Workshops and presentations on NAMA objectives, eligibility, procedures, etc. will be provided to these companies.

Rural Communities

The NIE will inform rural communities about the objectives of and opportunities offered by the NAMA and how they can participate. The NIE will explain the business model, time plans and the scope for involvement of the community, especially in relation to the Rural Productivity Zones and the literacy centres.

Suppliers and Installers of Renewable Energy Technologies

General information on the business potential of the NAMA will be provided to interested companies.

9. NAMA Costs and Finance

This chapter provides details about the funding requirements and the financial mechanisms which will be used in the NAMA.

9.1 Costs of the Intervention

Investment costs for the proposed pilot mini grids are based on the prefeasibility studies conducted in the framework of the World Bank sponsored Rural Electrification Program (Phase 2) (World Bank, 2014) and assume the addition of a diesel backup in case the proposed hydro plant does not meet all the energy demand.

The total investment cost for the eight pilot mini grids (excluding the literacy centres) are estimated at approximately US$800,000.

The expected cost of the literacy centres varies between US$30,000 and US$50,000 each depending on the size of the community. The total cost of the literacy centres will therefore be approximately US$320,000.

Annual operational and maintenance costs are estimated at 8 per cent[15] of the investment costs of the mini grids, totalling around US$64,000 per year. Annual costs per kWh generated would then be about US$0.13 (also assuming an equal allocation of costs to all consumers).

Since the mini grids will differ in their design and site specific parameters, and the maintenance service will be tendered to private companies, these figures can only be very rough estimates and need to be further elaborated in detailed feasibility studies for each mini grid (and may also be revised after the tender phase).

9.2 Costs of NAMA Capacity Development and Operations

In order for the NAMA to be successfully implemented and to be extended after the implementation of the first eight mini grids, the capacity development needs must be met through the provision of capacity-building activities and additional personnel must be hired for the management of the NAMA. Most of the capacity-building activities will be provided in the first three years of NAMA set-up, which are seen as the critical phase.

The following additional positions will be created for management of the NAMA:

- a NAMA team leader to oversee the implementation of the NAMA programme;
- a mini grid expert, responsible for the implementation of the intervention;
- a technical expert to support the implementation of the intervention in technical matters.

15 This estimate is confirmed by the Ministry of Energy and Mines.

All these positions will be assigned to the NIE. To create and increase the capacity of the staff to be hired, international experts will be involved in the first phase of the NAMA. The positions that will need to be filled by international experts are those of NAMA expert and rural electrification expert.

Their task will be to increase the capacity of the NAMA implementation team.

The following table gives an overview of the costs associated with capacity development and the operation of the NAMA. The table shows costs for the first three years and also indicates the likely costs for the further operation of the NAMA in years 4-5.

Table 19. Capacity development and NAMA operational costs

				Year 1		Year 2		Year 3		Year 4-5		Total
No	Cost component	Units	Unit rate	No of units	Costs	No of units	Costs	No of units	Costs	No of units	Costs	Year 1-5
1	Human Resources											
1.1	Local Salaries/Consultants											
	NAMA Team Leader	Month	2,200	12	26,400	12	26,400	12	26,400	24	52,800	132,000
	Mini grid expert	Month	1,200	12	14,400	12	14,400	12	14,400	24	28,800	72,000
	Technical expert	Month	1,200	12	14,400	12	14,400	12	14,400	24	28,800	72,000
1.2	International Salaries/Consultants											
	NAMA Expert	Month	12,000	12	144,000	12	144,000	6	72,000	12	144,000	504,000
	Rural electrification expert	Month	10,000	12	120,000	12	120,000	6	60,000			300,000
	Subtotal Human Resources				319,200		319,200		187,200		254,400	1,080,000
2	Travel											
2.1	International travel	Flight	2,000	5	10,000	5	10,000	5	10,000	5	10,000	40,000
2.2	National travel	Travel	200	15	3,000	15	3,000	15	3,000	20	4,000	13,000
2.3	Per diems											
2.3.1	Abroad	Per diem	150	15	2,250	15	2,250	10	1,500	20	3,000	9,000
2.3.2	Local	Per diem	100	40	4,000	40	4,000	30	3,000	50	5,000	16,000
	Subtotal travel				19,250		19,250		17,500		22,000	78,000
3	Equipment											
3.1	Furniture, computer equipment	Place	2,500	6	15,000							15,000
	Subtotal equipment				15,000							15,000
4	Local office											
4.1	Office rent	Month	800	12	9,600	12	9,600	12	9,600	12	9,600	38,400
4.2	Consumables	Month	200	12	2,400	12	2,400	12	2,400	12	2,400	9,600
4.3	Other services (tel/fax, electricity,...	Month	200	12	2,400	12	2,400	12	2,400	12	2,400	9,600
	Subtotal local office				14,400		14,400		14,400		14,400	57,600
5	Other costs services											
5.1	Publications				5,000		5,000		5,000			15,000
5.2	Feasibility studies mini grids	Project	30,000	4	120,000	4	120,000					240,000
5.3	Expenditure verification				10,000				10,000		10,000	30,000
5.4	Costs of conferences/seminars											
	NAMA Launch Event				5,000							5,000
	NAMA Awareness Raising Events	Event	1,000	4	4,000	4	4,000	2	2,000			10,000
5.5	Website/marketing material											
	Website/website management				2,000		1,000		1,000		1,000	5,000
	Marketing materials				6,000		3,000		3,000		3,000	15,000
	Subtotal other costs services				152,000		133,000		21,000		14,000	320,000
	Contingency (5%)				25,993		24,293		12,005		15,240	77,530
	Project administration (5%)				25,993		24,293		12,005		15,240	77,530
	Total Costs				571,835		534,435		264,110		335,280	1,705,660

9.3 The Stabilization Fund

As the NAMA interventions are focused on rural areas, there is a risk that consumers (households, companies, institutions) will not have sufficient financial capacity to cover their electricity bills. This risk is especially high in the first phase of NAMA implementation, when households might face difficulties in budgeting for their future electricity bills and new companies will still be struggling to set up their operations and will need funds for buying machinery or procuring raw materials. A lack of capacity on the part of consumers to pay for their electricity could lead to serious financial problems for the operators of the mini grids.

To overcome these problems, a Stabilization Fund will be established. The Stabilization Fund will support consumers in the early phases of NAMA implementation by providing funds to pay electricity bills. It will mainly bridge the gap between the costs/kWh in the specific mini grid and the electricity tariff charged by the national grid operator to the different classes of consumer (electricity tariffs vary between the various types of consumer, e.g. residents consuming less than 25 kWh are currently paying US$0.04/kWh, while business consumers are paying up to US$0.13/kWh.

Money will be pledged to the Stabilization Fund by NAMA donors and the Government of Lao PDR. A fund size of US$100,000 is recommended (assuming a maximum gap of US$0.09/kWh ¾between the regular rural tariff for private consumers US$0.04/kWh and the estimated cost of production from the mini grids of US$ 0.13/kWh) to cover the initial three years' operational costs of the first eight mini grids. The fund will be managed by the NIE.

The fund will operate as follows.

- Consumers will apply to the NIE for money from the Stabilization Fund. The application will be based on a simple template (to be elaborated by the NIE) including the following information:
  - Name of applicant;
  - Contact details;
  - Services requested (lighting, phone charging, radio, etc.);
  - Income situation;
  - Requested support.
- The support given by the Stabilization Fund will be for a maximum of 75 per cent of monthly electricity costs over a maximum of three years.
- The aim of the Stabilization Fund is to support only those consumers who do not have the financial means to pay for basic electricity services.
  - For households, these basic services are lighting, phone charging and radio. No support will be given for additional services, such as televisions or computers.
  - For income-generating activities, only newly founded companies/activities will be eligible for support.
- Decisions on each application will be made by the NIE.

If sufficient funding is still available in the Stabilization Fund, support can be extended beyond the first eight projects to any additional future activities. As already noted, funding for the Stabilization Fund will be from both the NAMA donors and the Government of Lao PDR. Of the initial US$100,000, the contribution of the NAMA donors will

be US$90,000, with the Government of Lao PDR contributing the remaining US$10,000.

The initial funding of US$100,000 will support the operation of the interventions for at least three years. After three years, the fund will be reassessed. If further funding is required, the Government of Lao PDR or donors will provide additional funds.

As shown in the table below, the NAMA costs are distributed over five years.

Table 20. NAMA costs (US$)

		Years						Total
Cost Items		1	2	3	4	5		
Investment in Electricity Systems				396,878	400,000			796,878
Investment in Literacy Centres				160,000	160,000			320,000
Stabilization Fund				33,000	33,000	34,000		100,000
Capacity Development		571,835	534,435	264,110	168,280	167,000		1,705,660
Total		571,835	534,435	853,988	761,280	201,000		**2,922,538**

9.4 National and International Finance

Financial flows and their management are a cornerstone of any NAMA, as they tie together many of the main NAMA components. In the context of this NAMA, the main focus will be on how to build and integrate a reliable and transparent structure of financial governance into the NAMA and how to manage the financial flows and the controls required to ensure a sustainable use of funds. The basis of this NAMA is a co-financed effort between the Government of Lao PDR and international partners/NAMA donors. Therefore, this section considers the two tracks of finance, national finance and international finance.

National Finance

For the purpose of this NAMA, national finance is defined as financial flows or capital directly influencing the ventures and incentives designed under the NAMA, and which are within the operational control of the national Government. In this NAMA, it is proposed that national finance will include the following financial flows.

The Government of Lao PDR will contribute:

- 10 per cent of investment costs as investment support to the interventions,
- local salaries, national travel costs, equipment and office costs for capacity-building (as already described in the previous section), and
- an initial US$10,000 for the Stabilization Fund and additional funds, if required.

In addition the Government will waive the import tax on renewable energy equipment, which is currently approximately 10 per cent of the equipment value.

International Finance

For the purpose of this NAMA, international finance is defined as financial flows or capital directly influencing the interventions designed under the NAMA and which originate from and are controlled by international partners (consisting of multilateral financing institutions and/or multilateral/bilateral programmes). The NAMA donor(s) is/are expected to contribute:

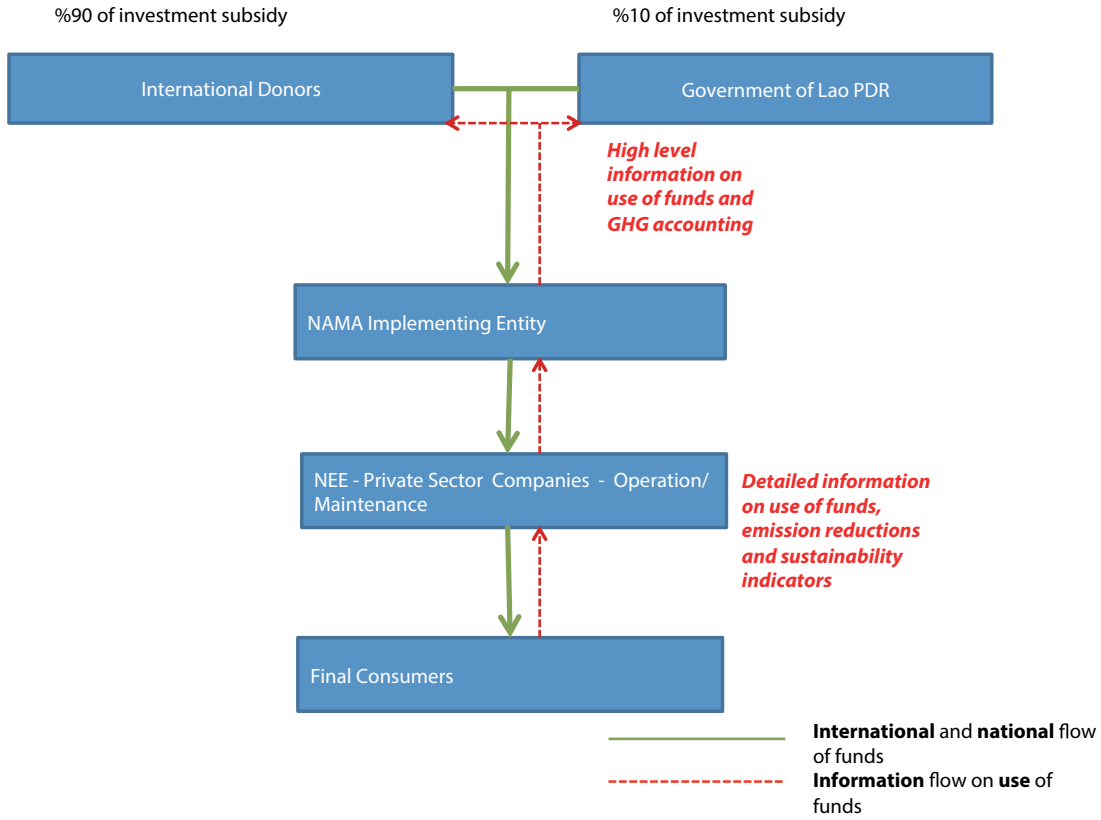
- 90 per cent of the investment costs of interventions as investment support;
- US$90,000 for the Stabilization Fund; and
- the majority of funding for capacity-building (mainly covering the cost of international experts, international travel, feasibility studies and verification).

For each of the tracks of finance, there are two components:

- the management and governance of capital; and
- the disbursement of funds.

The next figure shows the flow of funds from the international donors and the Government of Lao PDR to the NIE, from there to the NEE(s) and the final consumers. The flow information on the use of funds, emission reductions and sustainability indicators is originated by the final consumers, aggregated by the NEEs and the NIE, and finally submitted to the Government of Lao PDR and the international donors.

Figure 19. Flow chart of national and international finance



Since the NAMA is based on the principle of Output Based Aid (OBA), it is very important that the expectations of the NAMA stakeholders and their outputs are clearly and realistically defined at the start of NAMA implementation. There should be some flexibility in budgeting and in the completion of outputs, taking into account overall performance as well as minimum performance.

International contributions will be directly channeled to the NIE. Part of the money will be given as grants to NEEs, part will be used for capacity-building. National financing will contribute through equity and grants to financing the investments of NEEs and supporting capacity- building efforts.

Based on the cost estimates for the technical intervention sand capacity- building, the following table gives an overview of total NAMA implementation costs as well as the contribution of national and international sources.

Table 21. Contributions to NAMA financing of first eight mini grids

	Total Cost	Lao PDR Government	NAMA Donors
Cost Items			
Electricity Systems	796,878	79,688	717,190
Literacy Centres	320,000	32,000	288,000
Stabilization Fund	100,000	10,000	90,000
Capacity Development	1,705,660	305,000	1,400,660
Total	**2,922,538**	**426,688**	**2,495,850**

10. NAMA Measurement, Reporting and Verification (MRV)

As a NAMA is an instrument of output based aid, the results of implemented NAMAs need to be measurable, reportable and verifiable (MRV) to attract donors and to guarantee the sustainable success of the interventions introduced.

The methodology for monitoring the effects of NAMAs needs to follow the general principles of transparency, consistency, comparability, completeness and accuracy. This applies to all the components to be monitored. The NAMA MRV will cover the following components:

- GHG Emissions reductions;
- Sustainable Development Benefits; and
- Financial Support

10.1 The MRV System for GHG Emissions Reductions

The MRV framework for GHG emission reductions includes the following elements.

1. System boundary definition
   The system boundary encompasses significant anthropogenic GHG emissions by sources under the control of the project participant that are reasonably attributable to the NAMA intervention as a project activity.
2. Baseline scenario
   The baseline scenario is the scenario for a NAMA activity that reasonably represents the anthropogenic emissions by sources of GHG that would occur in the absence of the proposed NAMA intervention.
3. Project activity scenario
   The project activity scenario is a NAMA intervention¾in this instance a mini grid¾and the related anthropogenic emissions by sources of GHG that occur due to the project activity.
4. Emission reduction calculation
   The GHG emissions reduction achieved by the project activity will be determined by calculating the difference between the baseline emissions and the project emissions.
5. Monitoring
   Monitoring defines the parameters to be monitored.
6. Reporting and verification
   Reporting and verification define the reporting requirements and verification procedures

The total GHG emissions reductions of the NAMA, in a given year y, (ERy) are the sum of the emissions reductions achieved by the NAMA intervention, i.e. by the mini grids.

The emissions reductions achieved by the NAMA interventions are calculated by comparing the actual (project) emissions (PEy) with the emissions under the baseline scenario (BEy):

Equation 1: *ERy = BEy – PEy*

Where:

Parameter	Description	Unit
ERy	Emission reductions over the time period y	tCO_2
BEy	Baseline emissions over the time period y	tCO_2
PE,y	Project emissions over the time period y	tCO_2

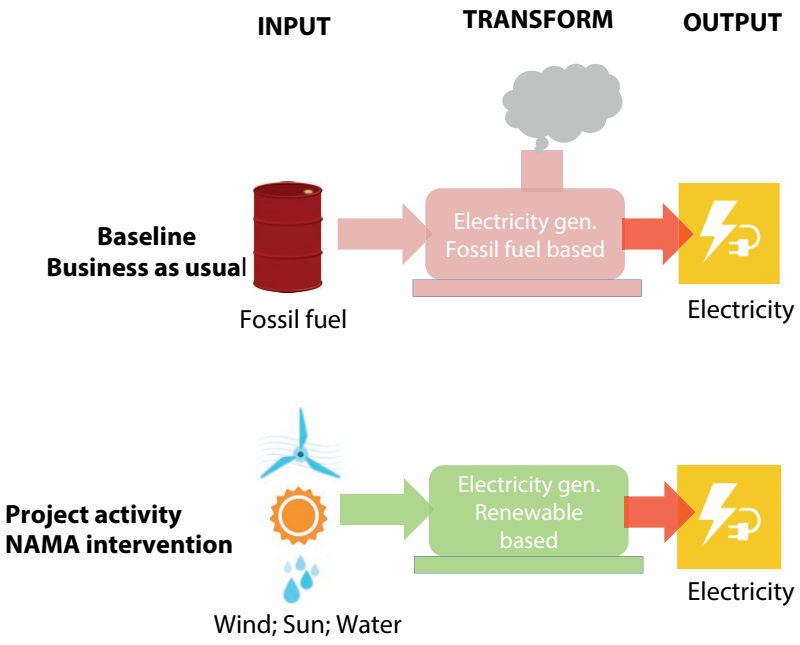
10.1.1 Baseline

The baseline scenario is defined ex ante and derived from the fossil fuel-based electricity generation system (e.g. diesel generators), which burns fossil fuel as the energy input to produce electricity as an output, thereby producing CO_2 emissions.

Under the NAMA intervention, as a project activity renewable based electricity generation systems will be applied, using wind, sun or water as the source of the energy input to produce zero emission electricity as output.

The baseline and project activity scenarios are as depicted in the figure below.

Figure 20. General concept – baseline vs. NAMA intervention



10.1.2 GHG Emissions Reductions

As already noted, the GHG emissions reductions in a given year y (ERy) are calculated by comparing actual (project) emissions (PEy) with the emissions under the baseline scenario (BEy).

Assumptions:

The determination of emission reductions is based on the UNFCCC's "Small-scale Methodology AMS-III.BL: Integrated methodology for electrification of communities " (UNFCCC, 2015). The AMS-III.BL methodology is simplified for the MRV NAMA mini grid intervention as follows.

- **Transmission and distribution losses are neglected**
  The mini grids are characterized by short distances between the source of electricity generation and the consumers of the electricity. Thus the grid losses are minor and will be neglected.
- **Consumers are classified into two types**
  There are only consumers who were not connected to the national/regional grid or a mini-grid before the NAMA intervention. Thus only types 1 and 2 consumer exist (see Section 5.3.1).
- **Measuring consumption by Type 2 consumers**
  The electricity consumption of Type 2 consumers (i.e. 500-1,000 kWh per year) can be measured using electricity meters or can be estimated (e.g. by multiplying installed capacity with average periodic hours of usage).

System boundary

The project activity is defined by the introduction of a mini grid as a NAMA intervention, and thus the project boundary encompasses the mini grid, the source of electricity generation, and the consumer(s) of the electricity.

The baseline is electricity generation by combustion of a fossil fuel (e.g. diesel generator).

Figure 21. Baseline scenario for the NAMA intervention – mini grid

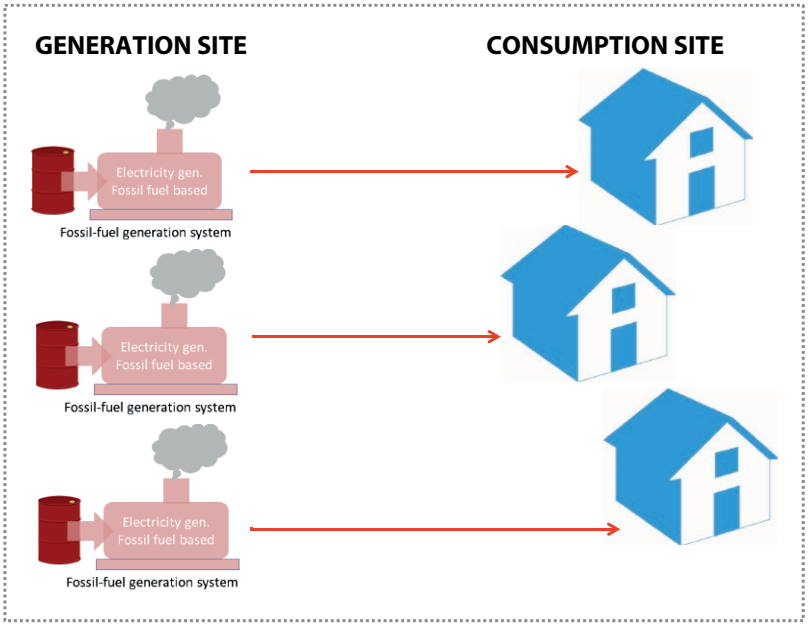
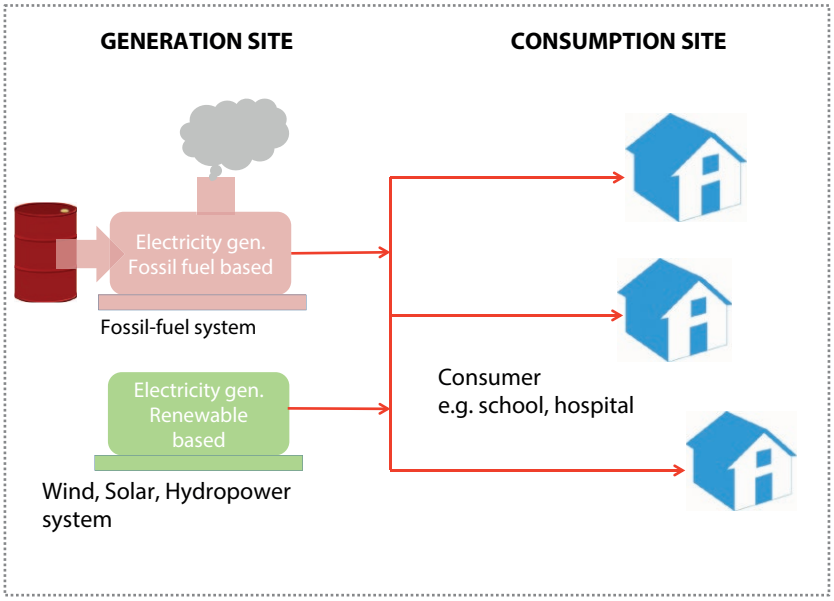


Figure 22. Project activity for NAMA intervention – mini grid



Overview of emission reduction calculation

The GHG emissions that have been avoided due to the NAMA intervention are calculated as follows.

Equation 2: $ER_y = BE_{T1,y} + BE_{T2,y} - PE_y$

Where:

Parameter	Description	Unit
ER_y	Emission reductions over the time period y	tCO_2e
$BE_{T1,y}$	Baseline emission from Type 1 consumers in year y	tCO_2e
$BE_{T2,y}$	Baseline emission from Type 2 consumers in year y	tCO_2e
PE_y	Project emissions over the time period y	tCO_2e
y	Period of time: encompasses 12 continuous calendar months	—

The details of the method of calculation will be given in the following sections.

The Baseline emission scenario

In absence of the NAMA Intervention, generating electricity would rely on fossil fuel-based off-grid electricity generation systems only.

A fossil fuel-based off-grid electricity generation system, such as a diesel generator, emits carbon dioxide into the atmosphere due to the combustion of the fossil fuel within the motor which drives the generator to produce electricity. Therefore the generated electricity is directly linked to carbon dioxide (CO_2) emissions that can be expressed as the emission factor (tCO_2/MWh).

The baseline emissions are calculated as follows:

Step 1: Classification of consumers

The baseline scenario is determined by the type of consumer. Consumers are classified into two types:

- Type 1 – consumers who were not connected to a national/regional grid or a mini-grid before the NAMA intervention and who consume less than 500 kWh per year;
- Type2 – consumers who were not connected to a national/regional grid or a mini-grid before the NAMA intervention and who consume more than 500 kWh per year.

The NAMA implementer will provide an ex-ante estimate of the number of consumers falling into each type, based on business plans or other similar project documents. The estimates of consumers by type will be documented transparently. During NAMA implementation, the exact number of consumers by type will be recorded as part of the monitoring.

Step 2: Determine total generated electricity

Equation 3: $$EG_{Total,y} = (\sum_{R=1}^{n} EG_{R,y} + \sum_{F=1}^{n} EG_{F,y})$$

Each electricity generation system, R and F, in the mini grid needs to be equipped with a calibrated electricity meter to monitor the generated electricity (EGR,y or EGF,y) supplied to consumers connected to the mini grid over the time y.

Where:

Parameter	Description	Unit
$EG_{Total,y}$	Electricity generated and delivered to the mini grid over the time y	MWh
$EG_{R,y}$	Electricity generated and delivered by renewable electricity generation system ***R*** to the consumers connected to the mini grid over the time ***y***.	MWh
$EG_{F,y}$	Electricity generated and delivered by fossil fuel based electricity generation system ***F*** to the consumers connected to the mini grid over the time ***y***.	MWh
R	Renewable energy system, where the electricity generated and delivered to the consumers connected to the mini grid over the time y.	—
F	Fossil fuel based energy system, from which the electricity is generated and delivered to consumers connected to the mini grid over the time y	—
n	Total number – counting variable	—

Step 3: Determine baseline emissions of consumer type 1

Pre-Step: Annual average electricity consumption

The annual average electricity consumption of Type 1 consumers are calculated using the equation below:

Equation 4: $$EC_{T1,x,y} = \frac{\sum_{R=1}^{n} EG_{R,y} + \sum_{F=1}^{n} - \sum_{z=1}^{n} EC_{T2,z,y}}{N_{T1,y}}$$

Where:

Parameter	Description	Unit
$EC_{T1,x,y}$	Annual average electricity consumption of Type 1 consumer in year y	MWh
$EG_{R,y}$	Electricity generated and delivered by renewable electricity generation system R to the consumers connected to the mini grid over the time y.	MWh
$EG_{F,y}$	Electricity generated and delivered by fossil fuel based electricity generation system F to the consumers connected to the mini grid over the time y.	MWh
R	Renewable energy system, where the electricity generated and delivered to the consumers connected to the mini grid over the time y.	—
F	Fossil fuel based energy system, from which the electricity is generated and delivered to consumers connected to the mini grid over the time y	—
$EC_{T2,z,y}$	Annual electricity consumption of Type 2 consumer over the time y, i.e. ECT2,z,y ≥ 500 kWh	MWh
$N_{T1,y}$	Total number of Type 1 consumers over the time y	—

For Type 1 consumers, baseline emissions are calculated as follows:

Equation 5: $$BE_{T1,y} = \sum_{x=1}^{n} \left(EC_{T1,x,y} * EF_{CO2,T1} \right)$$

Where:

Parameter	Description	Unit
$BE_{T1,y}$	Baseline emission from Type 1 consumers over the time y	tCO_2
$EC_{T1,x,y}$	Annual average electricity consumption of Type 1 consumer over the time y	MWh
$EF_{CO2,T1}$	Baseline emissions factor for Type 1 consumers Case 1: $EC_{T1,x,y} \leq$ 500 kWh: • For $EC_{T1,x,y}$ proportion 0- 55 kWh: $EF_{CO2,T1}$ = 6.8 tCO_2/MWh • For $EC_{T1,x,y}$ proportion 55 kWh – 250 kWh: $EF_{CO2,T1}$ = 1.3 tCO_2/MWh • For $EC_{T1,x,y}$ proportion 250 kWh - 500 kWh: $EF_{CO2,T1}$ = 1.0 tCO_2/MWh Case 2: $EC_{T1,x,y}$ >500 kWh: $EF_{CO2,T1}$ = 1.0 tCO_2/MWh Type I consumers are defined as having less than 500 kWh/year consumption at the start of the NAMA activity. In the event that average electricity consumption of Type-I consumers monitored during the monitoring period exceeds 500 kWh/year, they should be reclassified as Type II	(tCO_2/MWh)

Step 4: Determine baseline emissions of consumer type 2

For Type 2 consumers, baseline emissions are calculated as follows:

Equation 6: $$BE_{T2,y} = \sum_{z=1}^{n} \left(EC_{T2,z,y} * EF_{CO2,T2} \right)$$

Where:

Parameter	Description	Unit
$BE_{T2,y}$	Baseline emission from Type 2consumers over the time y	tCO_2
$EC_{T2,z,y}$	Annual electricity consumption of Type 2 consumer z over the time y	MWh
$EF_{CO2,T2}$	Baseline emissions factor for Type 2 consumers, $EF_{CO2,T2}$ = 1.0 tCO_2/MWh	tCO_2/MWh

Step 2: Determine the total baseline emissions:

Equation 7: $BE_y = BE_{T1,y} + BE_{T2,y}$

The project activity emission scenario

The project activity is represented by a mini grid comprising electricity generation system(s) based on renewable sources only or a combination of renewable sources and fossil fuel sources (hybrid mini grid).

Project emissions

The electricity generated by renewable energy systems, which can be based on hydro, solar or wind as sources, causes no greenhouse gas emissions. Thus the project emissions are considered to be zero.

Fossil-fuel systems are allowed; however, the share of electricity from renewable energies must be at least 75 per cent. Therefore for each monitoring period y the following condition needs to hold:

Equation 8: $$\sum_{R=1}^{n} EG_{R,y} * 0.75 > \sum_{F=1}^{n} EG_{F,y}$$

In the case where fossil fuel based electricity generation systems are installed and have generated and delivered electricity to the consumer connected to a mini grid (hybrid mini grids), the project emissions are calculated as follows.

Equation 9: $$PEy = \sum_{F=1}^{n} EG_{F,y} * EF_{CO2}$$

Where:

Parameter	Description	Unit
PE_y	Project emissions over the time period y	tCO_2
$EG_{F,y}$	Electricity generated and delivered by fossil fuel based electricity generation system F to consumers connected to the mini grid over the time y.	MWh
EF_{CO2}	Fossil fuel emission default factor = 1.0 t CO_2/MWh	tCO_2/MWh

Emission reductions

Emission reductions are the difference between the baseline emissions and project emissions after implementing the NAMA intervention mini grid.

Based on the formula given under the baseline and project emission scenario, the emission reduction calculation due to the NAMA mini grid intervention requires the following main steps.

i. Applicability criteria check

The share of electricity from renewable energies must be at least 75 per cent. Therefore for each monitoring period y:

$$\sum_{R=1}^{n} EG_{R,y} * 0.75 > \sum_{F=1}^{n} EG_{F,y}$$

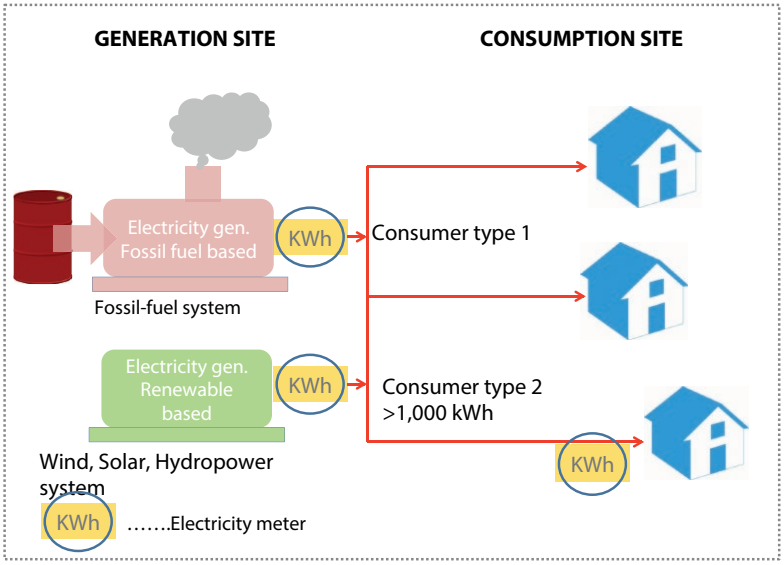
ii. Calculation of GHG emission reductions

ERy=BEy-PEy

Measurement and monitoring

As all the electricity generated by the energy generation systems (R, F) will be consumed by consumers connected to the mini grid, the generation site needs to be monitored via calibrated electricity meters. Each consumer type 2 with annual consumption more than 1,000 kWh needs to be equipped with an electricity meter. It is also recommended but not mandatory to equip consumer type 2 consuming less than 1,000 kWh, i.e. 500-1000 kWh/year with a calibrated electricity meter. The estimates of consumption by types 1 and 2 consumers not equipped with an electricity meter shall be transparently documented. Each consumer of type and 1 (x) and 2 (z), i.e. all consumers connected to the mini grid, needs to be recorded on a centralized register.

Figure 23. Monitoring of electricity generated and consumed



Where:

Parameter	Description	Unit
$EG_{R,y}$	Electricity generated and delivered by renewable electricity generation system ***R*** to the consumers connected to the mini grid over the time ***y***.	MWh
$EG_{F,y}$	Electricity generated and delivered by fossil fuel based electricity generation system ***F*** to the consumers connected to the mini grid over the time ***y***.	MWh
R	Renewable energy system, from which the electricity is generated and delivered to the consumers connected to the mini grid over the time y.	—
F	Fossil fuel based energy system, from which the electricity is generated and delivered to consumers connected to the mini grid over the time y	—
$EC_{T2,z,y}$	Annual electricity consumption of Type 2 consumer z over the time y, i.e. $EC_{T2,z,y} \geq 500$ kWh	MWh
X	Type 1 consumer	—
Z	Type 2 consumer	—
$N_{T1,y}$	Total number of Type 1 consumers in year y	—
Y	Period of time: encompasses 12 continuous calendar months	—

Readings of the electricity meter(s) should be recorded by the duty operator on a data sheet at least bi-weekly. A consolidated data sheet should be compiled monthly and should be stored in a safe place together with a description of the measurement instrument, its identification and calibration certificate.

In case of emergencies, when conditions prevent the responsible entity from monitoring electricity generation and consumption, the beginning and end of the emergency, the resumption of normal operations and the details of the emergency should be reported.

Figure 24. Monitored GHG parameter

Data/parameter	GHG emissions reduced/avoided
Unit	tCO_2
Description	GHG emissions reduced/avoided by the mini grids
Value	930 t CO_2/year for all eight grids
Source of data	Measured electricity generated by the mini grid and consumed by type 1 or 2 consumers, multiplied by the emission factor
Measurement methods	Each electricity generation system and each consumer consuming more than 1,000 kWh/y in the mini grid need to be equipped with a calibrated electricity meter to monitor the electricity generated and consumed.

Reporting

The EEs should produce reports to the NCA regularly on achieved GHG emission reductions due to NAMA interventions. The reports should include:

- a description of the method of calculation used to quantify GHG emissions
- the measurement method applied and the parameters monitored
- the characteristics of the measurement instrument (type, installation date, identification, calibration)
- values of the monitored parameters including supporting evidence (measurement records)
- identification of any uncertainty or variability associated with quantifying GHG emissions.

Hard copies or soft copies of the reports should be kept at a safe centralized point and be archived

10.2 MRV System for Sustainable Development Benefits

In addition to GHG emissions, the Measurement, Reporting and Verification (MRV) system for this NAMA will monitor the impact of the NAMA intervention on selected Sustainable Development (SD) indicators.

The selection of the SD indicators was done using the Sustainable Development Evaluation Tool (SD Tool) developed by UNDP (UNDP MDG Carbon, 2014). The SD Tool divides the SD indicators into four different domains: environment; social; growth and development; and economic.

The tool requires that an indicator (such as air pollution, biodiversity, health, etc.) be selected, the impact identified, and an explanation of the chosen indicator be added, the effect (positive, negative or both) defined and that it be indicated whether monitoring has been done.

The indicators selected for the mini grids intervention in each of the four SD domains are as follows.

Table 22. SD indicators for the mini grid intervention

Domain	Indicator	Selected (Yes/No)	Identified impacts	Monitored (Yes/ No)
Environment	Air pollution/quality	Yes	Reduce indoor pollution	No
	Water pollution/quality	No		No
	Soil pollution/quality	No		No
	Others (Noise/visibility)	No		No
	Biodiversity and Ecosystem balance	No		No
	Climate change adaptation and mitigation	No		No

Domain	Indicator	Selected (Yes/No)	Identified impacts	Monitored (Yes/ No)
Social	Health	Yes	Improvement of health and health care conditions	Yes
	Livelihood of poor, poverty alleviation, peace	Yes	Poverty reduction	Yes
	Affordability of electricity	No		No
	Access to sanitation and clean drinking water	No		No
	Food security (access to land and sustainable agriculture)	No		No
	Quality of employment	No		No
	Time savings/time availability due to project	No		No
	No child labour	No		No
Growth and Development	Access to clean and sustainable energy	Yes	People less dependent on fossil fuels by having access to RE electricity	Yes
	Education	Yes	Better learning conditions	Yes
	Empowerment of women	Yes		No
	Access to sustainable technology	No		No
	Energy security	No		No
	Capacity- building	No		No
	Equality (quality of jobs given, job condition for men/women)	No		No
Economic	Income generation/expenditure reduction/ balance of payments	Yes	Enhance productivity, efficiency, business opportunities	Yes
	Asset accumulation and investments	No		No
	Job creation (number of men and women employed)	Yes	Job creation	Yes
Institutional	Policy and planning	Yes	Professional dialogue, Awareness raising	Yes
	Laws and regulations	Yes	Enhance proper operation management	Yes

For the sake of simplicity, only a few indicators are to be monitored. The indicators selected are represented by the following parameters.

Table 23. Monitored SD parameters

No.	Parameter
1	Number of public buildings electrified
2	Number of households electrified
3	People with access to RE electricity
4	Number of schools or educational institutions electrified
5	New income-generating activity (businesses)
6	Number of new jobs (total)
7	Number of new jobs for women
8	NCA Organisation structure
9	Capacity development program
10	Promotion and awareness raising campaigns
11	Overall operation management system NCA
12	NIE Operation management system
13	NEE Operation management system

Baseline SD scenario

Since the NAMA targets off-grid regions of the country, the baseline values are assumed to be zero in the ex-ante estimation. However, in places where electricity sources, such as diesel generators, already exist before project implementation, this will be incorporated into the monitoring process.

Table 24. Project SD scenario and targeted SD benefits

Nr.	Parameter	Unit	Baseline value	Project value (assumed for one mini grid)
1	Number of public buildings electrified	buildings	0	8
2	Number of households or educational institutions electrified	households	0	1,054
3	People with access to RE electricity	persons	0	6,300
4	Number of schools electrified	schools	0	8
5	New income-generating activity (businesses)	enterprises	0	8
6	Number of new jobs (total)	persons	0	32

Nr.	Parameter	Unit	Baseline value	Project value (assumed for one mini grid)
7	Number of new jobs for women	women	0	16
8	NCA Organisation structure	system	0	1
9	Capacity development program	program	0	1
10	Promotion and awareness raising campaigns	campaign	0	1
11	Overall operation management system NCA	system	0	1
12	NIE Operation management system	system	0	1
13	NEE Operation management system	system	0	1

Measurement, monitoring and reporting

The SD benefits achieved due to the NAMA intervention should be measured continuously, and reported by the responsible entity/intervention implementer regularly. Hard copies or soft copies of the reports should be kept at a safe centralized point, and be archived.

Table 25. Monitored SD parameters

Data/parameter	Number of public buildings electrified
Unit	Buildings
Description	Number of public buildings electrified by the mini grids
Value	8
Source of data	Intervention implementer´s records
Measurement methods	Mini grid connection and electricity provision contract between the intervention implementer and the the authority managing the public buildings

Data/parameter	Number of households electrified
Unit	Households
Description	Number of households electrified by the mini grids
Value	1,054
Source of data	Intervention implementer´s records
Measurement methods	Mini grid connection and electricity provision contract between the intervention implementer and households

Data/parameter	People with access to RE electricity
Unit	Persons
Description	People with access to RE electricity due to the mini grids
Value	6,300
Source of data	Intervention implementer´s records, in cooperation with the local authority (local census, local survey)
Measurement methods	Counting

Data/parameter	Number of schools or educational institutions electrified
Unit	Schools/institutions
Description	Number of schools electrified by the mini grids
Value	8
Source of data	Intervention implementer´s records
Measurement methods	Mini grid connection and electricity provision contract between the intervention implementer and the schools

Data/parameter	New income-generating activity (enterprises)
Unit	Enterprises
Description	New income-generating activity (businesses) due to the mini grids
Value	8
Source of data	Intervention implementer´s records, in cooperation with the local authority
Measurement methods	Mini grid connection and electricity provision contract between the intervention implementer and businesses, and survey undertaken in cooperation with the local authority

Data/parameter	Number of new jobs (total)
Unit	Persons
Description	Number of new jobs (total) due to the mini grids
Value	32
Source of data	NAMA implementer´s records
Measurement methods	Intervention implementer´s records on number of new employees generated internally within institution and reports on number of new employees from intervention implementer and other relevant stakeholders

Data/parameter	Number of new jobs for women
Unit	Women
Description	Number of new jobs for women due to the mini grids
Value	8
Source of data	NAMA implementer´s records
Measurement methods	NAMA implementer´s records on number of new employees generated internally within institution and reports on numbers of new employees from intervention implementer and other relevant stakeholders

Data/parameter	NCA Organisation structure
Unit	-
Description	NCA set up proper organisation structure, inter alia nominate human resource; modalities of communication to donors and NEE, NIE; Finance monitoring scheme
Value	1 (=implemented)
Source of data	NAMA implementer´s records
Measurement methods	Audit

Data/parameter	Capacity development program
Unit	-
Description	Capacity development planning for institutions and companies involved in the implementation of the NAMA established by the NIE
Value	1 (=implemented)
Source of data	NAMA implementer´s records
Measurement methods	Audit

Data/parameter	Promotion and awareness raising campaigns
Unit	-
Description	NIE Promotion and awareness raising campaigns (including private sector engagment) action plan developed by by NIE
Value	1 (=implemented)
Source of data	NAMA implementer´s records
Measurement methods	Audit

Data/parameter	Overall operation management system NCA
Unit	-
Description	Overall operation management system established by the NCA including management procedures, manuals and monitoring, reporting guidelines for NIE and NEE
Value	1 (=implemented)
Source of data	NAMA implementer´s records
Measurement methods	Audit

Data/parameter	NIE Operation management system
Unit	-
Description	Management procedures are implemented in the NIE structure, inter alia: target monitoring, fund management, auditor cooperation, monitoring data compiling; approved by NCA, and fully operational
Value	1 (=implemented)
Source of data	NAMA implementer´s records
Measurement methods	Audit

Data/parameter	NEE Operation management system
Unit	-
Description	Management procedures are implemented in the NEE structure, inter alia: data collection, technical performance reporting and approved by NIE , and fully operational
Value	1 (=implemented)
Source of data	NAMA implementer´s records
Measurement methods	Audit

Further details on monitoring frequency and responsibilities can be found in a separate Emission Reduction Calculation Excel sheet.

Verification

Verification is the periodic independent evaluation and ex post determination by a third party of monitored SD parameters and emission reductions as a result of a NAMA intervention.

Verification rules for NAMAs are usually based on the requirements of the NAMA funding agencies, as well as host country requirements. The selected body for third party verification should apply appropriate assessment methodologies and be familiar with local conditions and greenhouse gas emission protocols and standards.

Since the data sources for the monitored SD indicators are either local authorities or the entities responsible for implementing intervention activities, the most suitable verification method is the on-site visit. Depending on the total number of implemented projects and the budgetary funding available, verification may take the form of a representative sample or cover all the projects. When samples are taken, the guidance on sampling in the SD Tool should be followed.

10.3 MRV System for Financial Support

The support provided as part of the NAMA will also need to be measured. Support will be provided in many forms: capacity-building, technology transfer and financial. As the bulk of support will come in the form of financing, it is the financial support which should be measured.

Data/Parameter:	$FS_{international}$
Data unit:	US$
Description:	International financial support spent per activity
Measurement procedures (if any):	All finances disbursed need to be tracked as per the standard governmental tracking procedures
Monitoring frequency:	Measured continuously and recorded at least monthly

Data/Parameter:	$FS_{national}$
Data unit:	US$
Description:	National financial support (i.e. subsidies) spent per activity
Measurement procedures (if any):	All finances disbursed need to be tracked as per the standard governmental tracking procedures
Monitoring frequency:	Measured continuously and recorded at least monthly

10.4 MRV Management

Responsibilities and process workflow

Responsibility for the MRV system lies mainly with the managing institution, which may delegate some of the tasks to the project implementers (grid operators, equipment suppliers).

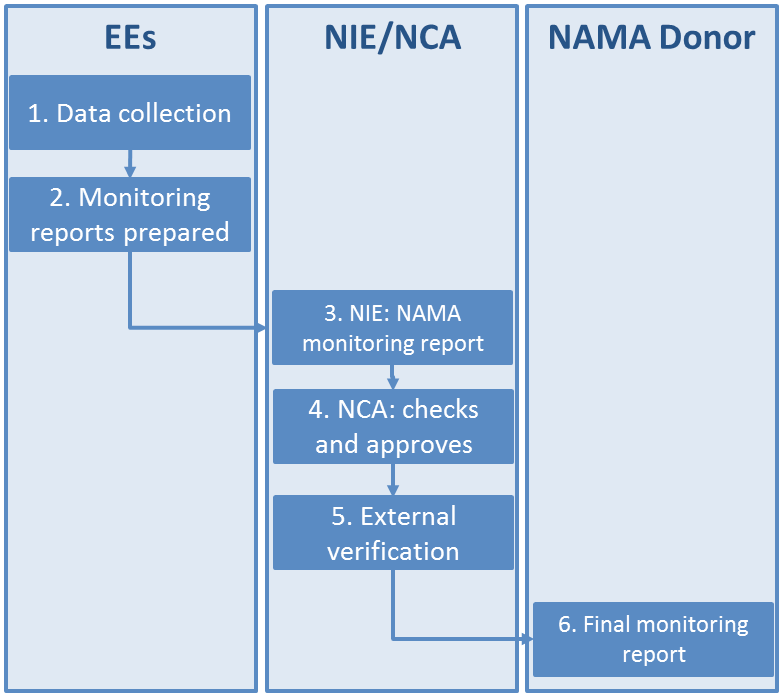
- The process should unfold in the following sequence:
- The Executing Entities collect data according to the monitoring plan (as part of their approved application) and ensure they fulfill all related requirements such as record keeping and quality control.
- The Executing Entities report the monitoring results to the NIE in an annual report.
- The NIE collects all monitoring reports, combines them in a central monitoring database and summarizes the results in a NAMA monitoring report.

This report contains information on GHG emission reductions, progress in the SD indicators, and the financial performance of the NAMA activities.

- The NCA checks and approves the annual monitoring report.
- The NIE arranges for an external verification entity to verify the annual monitoring report.
- The final monitoring report together with the verification report of the external verifier is submitted to the NAMA donor(s) by the NCA.

The following figure summarizes the process in graphic form.

Figure 25: NAMA MRV Process



Reporting Forms

The NCA is charged with creating reporting form templates. These forms will include at a minimum the following information:

- details about the venture;
- ESP contact details;
- a description of the measuring system;
- the data parameters measured;
- the default values applied;
- details of the sampling plan; and
- calculations of emission reductions.

The reporting form template will be provided by the NCA to the EEs. The completed forms will submitted annually to the NCA by the EEs.

10.5 Verification

The goal of verification is to have an independent third party auditor ensure that the NAMA is operating as planned and that the measuring and reporting system is being implemented as planned. The verification process also ensures that emissions reductions and SD benefits are real and measurable.

Auditors should be accredited entities. They can be entities accredited under the CDM[16] or under another accreditation system acceptable to the Government of Lao PDR and the NAMA donor(s).

Verification should occur every one or two years. The verification will consist of:

- desk review of documents;
- site visits/interviews of key stakeholders;
- the drafting of the verification report;
- provision of feedback on the report by the NCA; and
- finalization of verification report.

16 Accredited entities are listed in CDM, 2015.

11. NAMA Implementation Plan

The implementation of the NAMA will be carried out in three main steps. As a first step, the institutional structure for the NAMA implementation proposed in this document needs to be established. In parallel, funding both from international and national sources needs to be secured. Once these first two steps are finalized, implementation of the intervention can start

11.1 Implementation of NAMA Institutional Structure

The institutional structure proposed in Section 8 of this document needs to be established as a basis for the interventions. The benefit of the proposed structure is that all players are already established and no new body needs to be created. What needs to be confirmed are the roles each of the stakeholders are to play.

It is suggested that implementation starts with a first meeting of the NEC, which acts as the supervising body for the NAMA. In this first meeting, the distribution of roles (between the NAMA Coordinating Authority (NCA) and the NAMA Implementing Entity (NIE)) as well as the distribution of tasks should be confirmed. If fine-tuning is necessary, this should be discussed in the NEC.

11.2 Securing Donor Support and Domestic Funding

Potential donors that already actively fund NAMAs are German and UK Governments through the NAMA support facility[17], the Global Environmental Facility (GEF)[18] through its executing agencies, the Green Climate Fund (GCF)[19], EU Governments as well as Japan through the Japan International Cooperation Agency (JICA).[20]

A secured budget for the domestically funded component always provides a strong signal to potential donors of the commitment to NAMA. Therefore, it is essential that the domestic contributions to the intervention are secured within the national budget.

11.3 Implementation of Intervention

Once the institutional structure is in place and funding (both national and international) is secured, implementation of the interventions can start. The process of implementation will be as described in detail in Sections 5 and 6. The following table gives a summary of the implementation timeline.

17 http://www.nama-facility.org/start.html
18 http://www.thegef.org/gef/
19 http://news.gcfund.org/
20 http://www.jica.go.jp/english/index.html

Table 26:. NAMA implementation time line

	2016				2017				2018				2019				2020			
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
Establishment of Institutional Structure																				
National and International Financing																				
Intervention																				
Confirmation of interest of communities																				
Promotion of mini grid																				
Feasibility study																				
Discussions on cooperation and contracts																				
Project approval																				
Tender for construction																				
Announcements of tender results																				
Release of payment																				
Construction and operation																				

Annex – Overview of Mini Grids

Number of Households	136				
Village location	Ban Kobong and Ban Thaphiban				
Item	**No.**	**Unit Cap. (W)**	**Total Cap. (W)**	**Av. Hour Load (24hr)**	**Daily Demand (Wh)**
Hydropower plant energy use					
Lighting (11W CFL)	2	11	22	100%	528
Stores					
Lighting (11W CFL)	4	11	44	50%	528
Fans (50W)	2	50	100	50%	1,200
Refrigerator/ Freezer	3	500	1,500	13%	4,500
Public buildings (e.g. clinic/school)					
Lighting (11W CFL)	5	11	55	75%	990
Refrigerator/ Freezer	1	500	500	100%	12,000
Industries					
Lighting (22W CFL)	9	11	99	46%	1,089
Textile Sewing Machine (100W)	3	100	340	26%	2,142
Mechanical shop (drills, saws… 1hp)	3	750	2,550	19%	11,475
Combined Food processing (mills, rollers..1hp)	3	750	2,550	19%	11,475
Literacy center					
Lighting (11W CFL)	10	11	110	75%	1,980
Computer & Printer	4	150	600	58%	8,400
Mobile phone charging station	4	50	200	44%	2,100
Large LED - TV	2	70	140	38%	1,260
Satellite Dish and Receiver	2	60	120	38%	1,080
Rural Homes					
Lighting Per Home (2x each 11W CFL)	272	11	2,992	69%	49,368
Radio / Music Player (35 W)	136	35	4,760	46%	52,360
Mobile Phone Charger (5 W)	136	5	680	58%	9,520
Total Demand			**17,362**		**171,995**

Hydraulic losses (%)	2%
Transformer losses (%)	1%
Parasitic electricity losses (%)	1%
Annual downtime losses (%)	4%
Total losses (%)	8%
Design demand generation (kWh)	186
Design demand capacity (kW)	19
Site hydro capacity (kW)	10.39
Capacity demand not met (kW)	8
Effiency of diesel generator	33%
Capacity of diesel generator needed (kW)	25

Calculations adapted from work done by Grue + Hornstrup A/S (www.g-h.dk)

Cost of hydropower system ($/kW)	6,000
Cost of hydropower system ($)	62,340
Cost of 25kW diesel generator ($)	12,645
Cost of the literary center ($)	50,000
Total capital investment required for the system ($)	124,985

Number of Households	60				
Village location	Ban Vanchang				
Item	No.	Unit Cap. (W)	Total Cap. (W)	Av. Hour Load (24hr)	Daily Demand (Wh)
Hydropower plant energy use					
Lighting (11W CFL)	2	11	22	100%	528
Store					
Lighting (11W CFL)	4	11	44	50%	528
Fans (50W)	2	50	100	50%	1,200
Refrigerator/ Freezer	3	500	1500	13%	4,500
Public buildings (e.g. clinic/school)					
Lighting (11W CFL)	5	11	55	75%	990
Refrigerator/ Freezer	1	500	500	100%	12,000
Industrial Shed					
Lighting (22W CFL)	6	11	66	46%	726
Textile Sewing Machine (100W)	2	100	150	26%	945
Mechanical shop (drills, saws… 1hp)	2	750	1125	19%	5,063
Combined Food processing (mills, rollers..1hp)	2	750	1125	19%	5,063
Literacy center					
Lighting (11W CFL)	5	11	55	75%	990
Computer & Printer	2	150	300	58%	4,200
Mobile phone charging station (10x5W)	2	50	100	44%	1,050
Large LED - TV	1	70	70	38%	630
Satellite Dish and Receiver	1	60	60	38%	540
Rural Homes					
Lighting Per Home (2x each 11W CFL)	120	11	1320	69%	21,780
Radio / Music Player (35 W)	60	35	2100	46%	23,100
Cell Phone Charger (5 W)	60	5	300	58%	4,200
Total Demand			**8,992**		**88,032**

Hydraulic losses (%)	2%
Transformer losses (%)	1%
Parasitic electricity losses (%)	1%
Annual downtime losses (%)	4%
Total losses (%)	8%
Design demand (kWh)	95
Design capacity (kW)	10
Site hydro capacity (kW)	20
Capacity demand not met (kW)	- 10

Calculations adapted from work done by Grue + Hornstrup A/S (www.g-h.dk)

Cost ($/kW)	6,000
Cost of hydropower system ($)	120,000
Cost of literacy center ($)	30,000
Total investment required for the system	150,000

Number of Households	48				
Village location	Ban Xoklek				
Item	No.	Unit Cap. (W)	Total Cap. (W)	Av. Hour Load (24hr)	Daily Demand (Wh)
Hydropower plant energy use					
Lighting (11W CFL)	2	11	22	100%	528
Store					
Lighting (11W CFL)	4	11	44	50%	528
Fans (50W)	2	50	100	50%	1,200
Refrigerator/ Freezer	3	500	1500	13%	4,500
Public buildings (e.g. clinic/school)					
Lighting (11W CFL)	5	11	55	75%	990
Refrigerator/ Freezer	1	500	500	100%	12,000
Industrial Shed					
Lighting (22W CFL)	3	11	33	46%	363
Textile Sewing Machine (100W)	1	100	120	26%	756
Mechanical shop (drills, saws… 1hp)	1	750	900	19%	4,050
Combined Food processing (mills, rollers..1hp)	1	750	900	19%	4,050
Literacy center					
Lighting (11W CFL)	5	11	55	75%	990
Computer & Printer	2	150	300	58%	4,200
Mobile phone charging station (10x5W)	2	50	100	44%	1,050
Large LED - TV	1	70	70	38%	630
Satellite Dish and Receiver	1	60	60	38%	540
Rural Homes					
Lighting Per Home (2x each 11W CFL)	96	11	1056	69%	17,424
Radio / Music Player (35 W)	48	35	1680	46%	18,480
Cell Phone Charger (5 W)	48	5	240	58%	3,360
Total Demand			**7,735**		**75,639**

Hydraulic losses (%)	2%
Transformer losses (%)	1%
Parasitic electricity losses (%)	1%
Annual downtime losses (%)	4%
Total losses (%)	8%
Design demand (kWh)	82
Design capacity (kW)	8
Site hydro capacity (kW)	7
Capacity demand not met (kW)	1
Effiency of diesel generator	33%
Capacity of diesel generator needed (kW)	3

Calculations adapted from work done by Grue + Hornstrup A/S (www.g-h.dk)

Cost ($/kW)	6,000
Cost of hydropower system ($)	44,640
Cost of 5kW diesel generator ($)	7,189
Cost of literacy center ($)	30,000
Total investment required for the system	81,829

Number of Households	130				
Village location	Ban Makfueng				
Item	No.	Unit Cap. (W)	Total Cap. (W)	Av. Hour Load (24hr)	Daily Demand (Wh)
Hydropower plant energy use					
Lighting (11W CFL)	2	11	22	100%	528
Store					
Lighting (11W CFL)	4	11	44	50%	528
Fans (50W)	2	50	100	50%	1,200
Refrigerator/ Freezer	3	500	1500	13%	4,500
Public buildings (e.g. clinic/school)					
Lighting (11W CFL)	5	11	55	75%	990
Refrigerator/ Freezer	1	500	500	100%	12,000
Industrial Shed					
Lighting (22W CFL)	9	11	99	46%	1,089
Textile Sewing Machine (100W)	3	100	325	26%	2,048
Mechanical shop (drills, saws… 1hp)	3	750	2437.5	19%	10,969
Combined Food processing (mills, rollers..1hp)	3	750	2437.5	19%	10,969
Literacy center					
Lighting (11W CFL)	10	11	110	75%	1,980
Computer & Printer	4	150	600	58%	8,400
Mobile phone charging station	4	50	200	44%	2,100
Large LED - TV	2	70	140	38%	1,260
Satellite Dish and Receiver	2	60	120	38%	1,080
Rural Homes					
Lighting Per Home (2x each 11W CFL)	260	11	2860	69%	47,190
Radio / Music Player (35 W)	130	35	4550	46%	50,050
Cell Phone Charger (5 W)	130	5	650	58%	9,100
Total Demand			**16,750**		**165,980**

Hydraulic losses (%)	2%
Transformer losses (%)	1%
Parasitic electricity losses (%)	1%
Annual downtime losses (%)	4%
Total losses (%)	8%
Design demand (kWh)	179
Design capacity (kW)	18
Site hydro capacity (kW)	28.08
Capacity demand not met (kW)	- 10

Calculations adapted from work done by Grue + Hornstrup A/S (www.g-h.dk)

Cost ($/kW)	6,000
Cost of hydropower system ($)	168,480
Cost of literacy center ($)	50,000
Total investment required for the system	218,480

Number of Households	385				
Village location	Ban Navang				
Item	No.	Unit Cap. (W)	Total Cap. (W)	Av. Hour Load (24hr)	Daily Demand (Wh)
Hydropower plant energy use					
Lighting (11W CFL)	2	11	22	100%	528
Store					
Lighting (11W CFL)	4	11	44	50%	528
Fans (50W)	2	50	100	50%	1,200
Refrigerator/ Freezer	3	500	1500	13%	4,500
Public buildings (e.g. clinic/school)					
Lighting (11W CFL)	5	11	55	75%	990
Refrigerator/ Freezer	1	500	500	100%	12,000
Industrial Shed					
Lighting (22W CFL)	30	11	330	46%	3,630
Textile Sewing Machine (100W)	10	100	962.5	26%	6,064
Mechanical shop (drills, saws… 1hp)	10	750	7218.75	19%	32,484
Combined Food processing (mills, rollers..1hp)	10	750	7218.75	19%	32,484
Literacy center					
Lighting (11W CFL)	10	11	110	75%	1,980
Computer & Printer	4	150	600	58%	8,400
Mobile phone charging station	4	50	200	44%	2,100
Large LED - TV	2	70	140	38%	1,260
Satellite Dish and Receiver	2	60	120	38%	1,080
Rural Homes					
Lighting Per Home (2x each 11W CFL)	770	11	8470	69%	139,755
Radio / Music Player (35 W)	385	35	13475	46%	148,225
Cell Phone Charger (5 W)	385	5	1925	58%	26,950
Total Demand			**42,991**		**424,159**

Hydraulic losses (%)	2%
Transformer losses (%)	1%
Parasitic electricity losses (%)	1%
Annual downtime losses (%)	4%
Total losses (%)	8%
Design demand (kWh)	458
Design capacity (kW)	46
Site hydro capacity (kW)	35.56
Capacity demand not met (kW)	11

Calculations adapted from work done by Grue + Hornstrup A/S (www.g-h.dk)

Cost ($/kW)	6,000
Cost of hydropower system ($)	213,360
Cost of 12 kW diesel generator ($)	6,670
Cost of literacy center ($)	50,000
Total investment required for the system	270,030

Number of Households	40				
Village location	Ban Omkanang				
Item	No.	Unit Cap. (W)	Total Cap. (W)	Av. Hour Load (24hr)	Daily Demand (Wh)
Hydropower plant energy use					
Lighting (11W CFL)	2	11	22	100%	528
Store					
Lighting (11W CFL)	5	11	55	50%	660
Fans (50W)	2	50	100	50%	1,200
Refrigerator/ Freezer	3	500	1500	13%	4,500
Public buildings (e.g. clinic/school)					
Lighting (11W CFL)	5	11	55	75%	990
Refrigerator/ Freezer	1	500	500	100%	12,000
Industrial Shed					
Lighting (22W CFL)	8	11	88	46%	968
Textile Sewing Machine (100W)	1	100	100	26%	630
Mechanical shop (drills, saws… 1hp)	1	750	750	19%	3,375
Combined Food processing (mills, rollers..1hp)	1	750	750	19%	3,375
Literacy center					
Lighting (11W CFL)	5	11	55	75%	990
Computer & Printer	2	150	300	58%	4,200
Mobile phone charging station (10x5W)	2	50	100	44%	1,050
Large LED - TV	1	70	70	38%	630
Satellite Dish and Receiver	1	60	60	38%	540
Rural Homes					
Lighting Per Home (2x each 11W CFL)	80	11	880	69%	14,520
Radio / Music Player (35 W)	40	35	1400	46%	15,400
Cell Phone Charger (5 W)	40	5	200	58%	2,800
Total Demand			**6,985**		**68,356**

Hydraulic losses (%)	2%
Transformer losses (%)	1%
Parasitic electricity losses (%)	1%
Annual downtime losses (%)	4%
Total losses (%)	8%
Design demand (kWh)	74
Design capacity (kW)	8
Site hydro capacity (kW)	15
Capacity demand not met (kW)	- 7

Calculations adapted from work done by Grue + Hornstrup A/S (www.g-h.dk)

Cost ($/kW)	6,000
Cost of hydropower system ($)	90,000
Cost of literacy center ($)	30,000
Total investment required for the system	120,000

Number of Households	185				
Village location	Ban Thameng				
Item	No.	Unit Cap. (W)	Total Cap. (W)	Av. Hour Load (24hr)	Daily Demand (Wh)
Hydropower plant energy use					
Lighting (11W CFL)	2	11	22	100%	528
Store					
Lighting (11W CFL)	4	11	44	50%	528
Fans (50W)	2	50	100	50%	1,200
Refrigerator/ Freezer	3	500	1500	13%	4,500
Public buildings (e.g. clinic/school)					
Lighting (11W CFL)	5	11	55	75%	990
Refrigerator/ Freezer	1	500	500	100%	12,000
Industrial Shed					
Lighting (22W CFL)	6	11	66	46%	726
Textile Sewing Machine (100W)	5	100	462.5	26%	2,914
Mechanical equipment (e.g. drills, saws 1hp)	5	750	3468.75	19%	15,609
Food processing equipment (e.g. mills, rollers 1hp)	5	750	3468.75	19%	15,609
Literacy center					
Lighting (11W CFL)	10	11	110	75%	1,980
Computer & Printer	4	150	600	58%	8,400
Mobile phone charging station	4	50	200	44%	2,100
Large LED - TV	2	70	140	38%	1,260
Satellite Dish and Receiver	2	60	120	38%	1,080
Rural Homes					
Lighting Per Home (2x each 11W CFL)	370	11	4070	69%	67,155
Radio / Music Player (35 W)	185	35	6475	46%	71,225
Cell Phone Charger (5 W)	185	5	925	58%	12,950
Total Demand			**22,327**		**220,755**

Hydraulic losses (%)	2%
Transformer losses (%)	1%
Parasitic electricity losses (%)	1%
Annual downtime losses (%)	4%
Total losses (%)	8%
Design demand (kWh)	238
Design capacity (kW)	24
Site hydro capacity (kW)	35.56
Capacity demand not met (kW)	- 11

Calculations adapted from work done by Grue + Hornstrup A/S (www.g-h.dk)

Cost ($/kW)	6,000
Cost of hydropower system ($)	213,360
Cost of literacy center	50,000
Total investment required for the system	263,360

Number of Households	70				
Village location	Ban Aho				
Item	No.	Unit Cap. (W)	Total Cap. (W)	Av. Hour Load (24hr)	Daily Demand (Wh)
Hydropower plant energy use					
Lighting (11W CFL)	2	11	22	100%	528
Stores					
Lighting (11W CFL)	4	11	44	50%	528
Fans (50W)	2	50	100	50%	1,200
Refrigerator/ Freezer	3	500	1,500	100%	36,000
Public buildings (e.g. clinic/school)					
Lighting (11W CFL)	5	11	55	75%	990
Refrigerator/ Freezer	1	500	500	100%	12,000
Industries					
Lighting (22W CFL)	6	11	66	46%	726
Textile Sewing Machine (100W)	2	100	175	26%	1,103
Mechanical shop (drills, saws… 1hp)	2	750	1,313	19%	5,906
Combined Food processing (mills, rollers..1hp)	2	750	1,313	19%	5,906
Literacy center					
Lighting (11W CFL)	5	11	55	75%	990
Computer & Printer	2	150	300	58%	4,200
Mobile phone charging station (10x5W)	2	50	100	44%	1,050
Large LED - TV	1	70	70	38%	630
Satellite Dish and Receiver	1	60	60	38%	540
Rural Homes					
Lighting Per Home (2x each 11W CFL)	140	11	1,540	69%	25,410
Radio / Music Player (35 W)	70	35	2,450	46%	26,950
Mobile Phone Charger (5 W)	70	5	350	58%	4,900
Total Demand			**10,012**		**129,557**

Hydraulic losses (%)	2%
Transformer losses (%)	1%
Parasitic electricity losses (%)	1%
Annual downtime losses (%)	4%
Total losses (%)	8%
Design demand generation (kWh)	140
Design demand capacity (kW)	11
Site hydro capacity (kW)	15
Capacity demand not met (kW)	- 4

Calculations adapted from work done by Grue + Hornstrup A/S (www.g-h.dk)

Cost ($/kW)	6,000
Cost of hydropower system ($)	90,000
Cost of literacy center ($)	30,000
Total investment required for the system	120,000

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