Lao Institute for Renewable Energy

Pico-hydropower Report Series

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Pico-hydropower Innovation and Capacity Building Program (Phase 2) in Lao PDR

Final Report

Vientiane, Lao PDR

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Lao Institute for Renewable Energy

LIRE

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Pico-hydropower Innovation and Capacity Building Program – Phase 2

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About us

LIRE is a social professional non-profit organisation dedicated to the sustainable development of a self sufficient renewable energy sector in the Lao PDR. The institute offers agronomical, technological and socio-economic research services, and works to provide a free public resource of information and advice on the use of renewable energy technologies in Laos. LIRE strives to support the development of the country by exploring commercially viable means to establish renewable energy technologies in rural parts of the country, in areas without connection to the national grid and with little access to technical expertise.

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1 INTRODUCTION

Pico-hydropower is a term used for small scale hydropower installations, producing up to a 5kW power rating. This is not a new technology in Laos and has existed for more than 20 years in countless villages. One reason for this wide utilisation is the low cost of and the market accessibility to the required equipment and the ease of access the pico-hydropower is popularly used in rural areas where the main grid cannot reach. Estimates give a value of 60,000 low-head pico-hydropower units, providing electricity to around 90,000 households. Current challenges of this technology include the low quality of hardware, risk of electrocution and breaking of electric devices and light bulbs. Many of these problems have been overcome by innovation within the supply chain: users, village technicians, shopkeepers, traders and producers.

In 2008 LIRE initiated research on pico-hydropower and found opportunities for scaling up and improving the quality, safety, efficiency and reliability of pico-hydropower technology through existing and potential new market channels. Between 2008 and 2010 LIRE undertook the *Pico-hydropower Innovation and Capacity Building Program*, funded by the Dutch NGO ETC Energy. The program's objectives are to provide the required knowledge within communities via various training initiatives, and to create useful and relevant technical documents for dissemination. Four main activities were ultimately chosen:

- Information workshops for shop owners
- Technical training for selected technical advisors
- Introduction of Electronic Load Controller (ELC) into local market
- Development of the Pico-hydropower installation and user manual in Lao language

This report is divided into three main parts: introduction, further narrative and the financial report. The report as a whole summarizes all activities conducted in three targeted provinces: Xiengkhuang as the pilot province, Huaphanh and Phongsaly as the extended provinces. The outcomes of the four main activities and results from the last two field trips during September and October 2010 on monitoring and evaluation are integrated in several sections of this report.

2 NARRATIVE REPORT

2.1 Project Objectives

Following the completion of capacity building within LIRE during the first Phase of the project (Phase 1), the second phase aims at provincial level implementation. The objectives of this second phase are similar to the first, and include the following outputs:

1) Informational workshops for shop owners: These workshops are targeted at shop owners, who sell the pico-hydropower turbines and spare parts such as windings, bearings and cables. The workshops will provide not only information and support to shop owners to improve their sales, but also improve the quality and safety of pico-hydropower units available.

2) Technical advisor training: Technical Advisors are trained experts consisting of technical staff from Provincial and District Department of Energy and Mines, literate and experienced pico-hydropower users in target villages or other technicians in the area. They will be able to

provide advice on installing, optimizing and maintaining pico-hydropower systems while focussing on safety.

3) Development of a pico-hydropower Installation and User Manual in Lao language and targeted at Lao PDR uses. The manual is written in Lao language and uses graphics to address the main points, ensuring the widest possible access among villagers. The manuals are distributed to shop owners, Village Technical Advisors and government staff to be provided at product purchase, consultation or inquiries.

4) Introduce Electronic Load Controller (ELC) into the Lao market: This device is not yet in use in Lao PDR and needs to be introduced into the existing market. The electronic load controller is a device that stabilizes the excess voltage in the pico-hydropower grid. It significantly increases the lifetime of household appliances.

In summary, the overall goals of the program are to scale up and improve the quality, safety, efficiency and reliability of pico-hydropower technology through existing and potential new market channels in three target provinces in Laos.

2.2 People Involved in the Project

2.2.1 LIRE Staff Team

Mr. Thongsanti B.Vongsaly, Project Manager (100%, full time):

Main tasks: Project planning, financial administration and management, report writing, liaison with ETC, liaison with governmental counterparts, advocacy for ETC/LIRE towards external organisations.

Mr. Soulineyadeth Sopha, Technical Officer (100%):

Main tasks: Information collection, field measurements, data entry and analysis, supporting report writing, liaison with French speaking organisations.

Mr. Hattaphone Sisouvong, Project Technical Assistant (100%):

Main tasks: Assist in providing training, assist in market surveys and field surveys, assist in monitoring and evaluation, setting up database and Stakeholder profiles, create pico-hydropower ETC materials, document filing, assist in LIRE-ETC administrative tasks.

Mrs. Chansamone Khaovong, Accountant and Office Manager (25%):

Main tasks: Review current accounting system and contribute to set up a new accounting system, daily office management and accounting; finance activities related to office and human resources management, in close collaboration with her direct supervisor (for finance control and HR supervisor; Responsible for coordinating the consultancy contracts, planning and budgeting in close collaboration with Project Managers; Report to the Board of LIRE Director and Managing Director about the financial status of LIRE and other matters.

2.2.2 Other People Involved

Dr. Khamphone Nanthavong, Professor at the Faculty of Engineering, National University of Laos; advisor to the pico-hydropower program:

Main tasks: Participating in setting up the ETC-LIRE pico-hydropower innovation and capacity building project, participating in discussion and brain storming meetings, liaison for LIRE student project on hydropower and PV, strengthening of LIRE contacts with the Faculty of Engineering, liaise

for LIRE and its projects on Faculty level and during government meetings, and providing capacity and resources for LIRE's research activities.

Mr. Vonevilay Vilailuck:

Main tasks: liaison for LIRE student project on hydropower and PV, strengthening of LIRE contacts with the Faculty of Engineering, technical support in terms of electrical field, assist in provide training , assist in market surveys and field surveys, assist in monitoring and evaluation.

Mr. Matthew Jordan, consultant specialised in user interactions (contributions almost entirely pro bono):

Main tasks: developing the concept ranking methodology, advising on project strategy and methodology, supporting report writing, input on development of user manual.

National Interns: Mr. Monivanh Boulom, Ms. Bounthin Somlaka and Ms. Kongmany Chammalay, Bachelor Degree in Environment Studies, Faculty of Environmental Science, National University of Laos:

Main tasks: Assist in filing documents, translation work, field trip and budget planning, contact government offices, data entry for actor profiles and evaluation forms, assist in organizing meeting room and complete other tasks as being assigned.

International Interns: Mr. Samuel Stamp, Ms. Silvia Vicente, Master of Physics and Master of Renewable Energy from UK and Spain, respectively:

Main tasks: undertake field trip, assisting writing report, assisting in project intervention, assisting in poster and leaflet development, and other tasks as being assigned.

2.2.3 Government Civil Servants (Provinces and Districts)

At this stage of Phase 2, LIRE-ETC activities are conducted in three provinces and nine districts. Due to this expansion, support from government staff at both provincial and district levels in terms of technical advisors, coordination and field works are necessary. These stakeholders are listed in the table below:

Table 1: Government civil servants in provincial level and district level

Provinces	Xiengkhuang	Huaphanh	Phongsaly
Provincial level	Saysamone Latthamavong	Bountheuang Phommavongsay	Souksavanh Manotham
	HongkhamPhommavong	Maiphone	Seumxay
		KhetvilayPhommavy	ChinthanormChormseng
District level	SidavanhKhamsivoravong	SouphanHuameuang	Somephone
	XaysombathSoukchaleun	SaysavanhXaysomboun	PhonleuVanhnaphone
			VannaxayKhounsaly

Their maintasks include accompanying and leading LIRE team for field visits in their responsible districts and provinces. They are also Provincial and District Technical Advisors who coordinate logistic arrangement and are the main contact people for district and village technical advisors,

potentially train non-target-district and/non-target-village upon request. When there is no representative from the District Energy and Mines available, one provincial staff is acting as a district Technical Advisor.

2.2.4 ETC/EASE Contact People

Ms. Tamara Flink:

Direct contact person from February to November 2010 (and beyond).

Mr. Frank van der Vleuten:

Official contractual contact person for the Pico-hydropower Innovation and Capacity Building Program.

2.3 List of Activities Conducted

2.3.1 Information Workshops for Shop Owners

Figure 1: Information workshop session

LIRE invited local shop owners to a number of workshops where product samples such as ELC, switchboard, cables, draft tubes/channels, quality units etc were introduced to the sellers.

The information provided during these workshops was oriented to train sellers about the product characteristics, specification and their application to the pico-hydropower systems, including the concept of quality and safety.

The workshops had the aim of providing shop owners a basic technical background that can be used to improve their customer relationships and improve the quality of advice. Initially, Xiengkhuang was selected as the pilot province. An initial workshop was performed with shop owners to determine the general workshop structure to roll out in the three selected provinces. According to the feedback obtained from the pilot workshop, the following structure was created:

1) Starting point: workshop addressed to all shopkeepers in each target district:
    - General information about pico-hydropower turbines and complementary products (load controllers, draft channels, cables, switchboards, light bulbs, etc)
    - How to supply information to customers (e.g. in the form of the user manual)
    - Concepts introduced:
        - Village Technical Advisor acting as a broker for the shop owner
        - Selling locally manufactured, prefabricated draft tube and draft channel
        - Battery charging station
        - Acting as a representative for producers from Vietnam

2) Intensification: Tailor-made follow-up coaching in smaller groups / individual shop owners: working on specific issues listed previously, according to demand.

2.3.2 Results and Feedback from Information Workshops for Shop Owners

Table 2 shows the summary of vendor shops in target provinces where the program was conducted. It shows that the project cannot reach the initial target number, 45 of shops to be trained. In fact, only 32 shops were reached. The target number of shops to be involved with project was targeted at 5 shops per target district at the beginning of the project. However, in reality there are districts that cannot meet the target number due to the low number of existing shops. For example, in Khoun district there were no shops selling pico-hydropower products. End users in this district buy the products in Phonesavanh, the capital district of Xiengkhuang province, due to improved access road and close distance between the capital district and Khoun district.

Table 2: Summary of trained shops in targeted provinces

Province	District Name	Number of shops targeted	Number of actual shops trained
Xiengkhuang	Paek	5	6
	Kham	5	4
	Khoun	5	0
Huaphanh	Samneua	5	4
	Samtai	5	5
	Viengxay	5	1
Phongsaly	Phongsaly	5	5
	Bounneua	5	6
	Bountai	5	6
Total		***45***	***32***

After the training provided by LIRE, impacts were measured and assessed. From the site monitoring and evaluation trips during September and October 2010, it was apparent that improved service was given to customers in terms of explanation on the products description and specification, and distribution of pico-hydropower installation and pico-hydropower manuals to their clients. Shops have become focal points for advice and for the distribution of pico-hydropower installation and user manuals for clients. In certain cases, end users borrow the manual from shop owners. Furthermore, it was reported by many shop keepers that there are more customers buying insulated cables. The shop owners claimed that it is unclear what caused this change, but it may be attributed to the improved awareness of safety concerns raised by the government and LIRE-ETC project intervention.

Despite the project intervention, the general sales performance of shops visited did not improve due to the reasons summarized in table two. First, it was claimed that sales keep falling due to continuous expansion of the electric grid, with the government target at 90% of the population by 2020. In addition, there is poor sales performance due to pico-hydropower market saturation. In the past years, people bought a large number of pico-hydropower turbines. The number of new turbine purchases has slowed but pico-hydropower spare parts continue to sell well. Furthermore, it will take time for people to uptake new recommended products that are seen as expensive and still not affordable by local people who have low incomes and are acquainted to the existing products. During the interviews, end users and shop owners explained that in order to convince people to buy new recommended products, it requires demonstration to show and prove to end users that the

new product is really efficient and productive. Few shop owners claimed that the lack of ideal site locations is also a reason why people do not use pico-hydropower, especially for the vertical (standing) installation type recommended by LIRE.

Table 3: Summary of positive and negative feedbacks from the shops

Positive	Negative
Product advice	Sales drop due to grid expansion & pico-hydropower market saturation
Be points of distribution of installation and user manuals for clients and end users	Low uptake of new recommended products – expensive & familiarity of existing products
Sales of more insulated cable	Quality goods – expensive Vs low income end users
	Need more demonstrations
	Lack of locations

2.3.3 Technical Advisor Training in Three Provinces

The activity was developed in two steps. First, provincial and district Technical Advisors were selected in consultation with the relevant authorities during the provincial assessment trips. At village level, village technical advisors are chosen by village chiefs in consultation with district authorities and LIRE staff. Clear criteria are set for the selection processes, including literacy in Lao language, being a pico-hydropower end user, basic knowledge on pico-hydropower operation and maintenance and willing to pass on knowledge to others.

Figure 3: VTA theory training

In the second step, LIRE Technical Officer conducted the workshops to train the selected participants, at provincial, district and village levels. After the workshops, participants acquired enough knowledge to develop the following activities:

Technical Advisor level:

- establish relations with the villagers: introduce concepts including sharing pico-hydropower energy and safety issues
- to provide advice on installing and improving new/existing pico-hydropower unit in order to generate extra income
- to reinforce safe interactions and maintenance with the pico-hydropower unit

2.3.4 Results and Feedback on Technical Advisor Training

Table 4 shows the summary of the technical advisors trained by the LIRE-ETC project team over one year and a half. Originally, the project targeted twelve technical advisors at provincial and district levels. For the project to reach a wider coverage, it was decided to go further, training at the village level as well. The number of trained technical advisors is the same across provincial and district levels. Nonetheless, the number of end users who were trained varies at the village level. 22 villagers in 2 districts in Xiengkhuang were selected.

In short, the project was able to train 69 technical advisors from provincial (PTA), district (DTA), and village levels (VTA) in three provinces, which is higher than initially planned.

Table 4: Number of technical advisors trained in each province and district

Province	District	PTA	DTA	VTA	Target
Xiengkhuang	Paek	*2*			*4*
	Kham		*1*	*12*	
	Khoun		*1*	*10*	
Huaphanh	Samneua	*2*	*1*	*5*	*4*
	Samtai		*1*	*5*	
	Viengxay		*1*	*9*	
Phongsaly	Phongsaly	*2*	*1*	*6*	*4*
	Bounneua		*1*	*3*	
	Bountai		*1*	*5*	
	Total	**6**	**8**	**55**	**12**
	Total	**69 (trained)**			**12**

Various feedbacks were obtained on the impacts of the technical advisors training during the monitoring and evaluation trips in September and October 2010. These impacts are both positive and negative.

Figure 4: Channel improved by VTA

On the positive side, the technical advisors have shared their pico-hydropower installation and user manuals and knowledge with their neighbour.

Many explained that after training they attended village meetings to inform others of their qualification and their ability to provide services. Some of them have explained the importance for using insulated cable for safety and efficiency reasons. The field monitoring showed that more houses in the target village in Khoun district are now using insulated cables. This was cross checked with shop owners who explained that the sales for insulated cable have increased.

However, the shop keepers did not know how much they sold despite the fact that they have been coached on how to monitor the sales performance. The experience from the last field trip also showed that there are some technical advisors who are hired by their villagers to install new systems and also to improve the efficiency of existing systems. These occurred in three provinces. In return,

technical advisors received compensation between 100,000 to 300,000 kip (15 to 25 US dollars) per installation or system improved. On certain occasion, they were rewarded with foods and drinks.

Table 5: Summary of positive and negative feedbacks from VTA training

Positive	Negative
Sharing installation & users manuals	Slow up-take of knowledge
Sharing of best practice between neighboring villages	Not really active
Promote themselves for service provision	End users knows and trust in themselves
TA provided installation service – installation & system improvement	Lack of locations for installation
	Need of demonstration unit to show village

On the negative side, it was observed that there is a slow uptake of knowledge by technical advisors. After the evaluation trips, it was found that there are some technical advisors who did not absorb the lesson learnt during the training session. Some of them suggested that the lessons given were sometimes too complicated to understand due to the new terminology used and their lack of a good educational background. In addition, many trainees are not currently active. They claimed that they are busy with their harvesting and had no time to go to villages to provide services. Some commented that there was no one interested in their work as people already know how to install basic systems themselves. There was also a comment that in order to convince people to pay for their service, it would be necessary to have a demonstration site or unit in their village to show that the installation service is cost effective. The lack of proper locations for vertical installations was also claimed as a reason for lacking work. Technical advisors explained that lessons learnt from the training focussed on the standing installation of the pico-hydropower system, but in their villages, there is no location that provides the necessary head of 1.5 meter.

2.3.5 Development of a Pico-hydropower Installation and User Manual in Lao Language and Other Educational Materials

LIRE created a pico-hydropower manual based on the technical knowledge of LIRE engineering staff, consultants and on the lessons learned from projects carried out by LIRE.

The original user manual was written in English and had a high technical orientation. During the project, this manual was translated to Lao language and technical concepts were adapted to aid the end user. In order to assure that illiterate users can understand the manual, each subject was illustrated with easily understandable images.

The guide targets end users, shop owners, Village Technical Advisors and relevant local government authorities. It is perceived as a tool for:

- Helping end users understand the system and give them the instructions to run it in a safe way
- Providing shop owners with technical specifications of products and the list of needed system devices. This will let them act as a first customer advisor and improve local market with the introduction of new and more reliable products (such as an ELC) and gaining the trust of customers as the devices will be more efficient.

- Giving instructions to Technical advisors about how to manufacture some elements of the system including draft channels and draft tubes.
- Providing orientation to Government departments about rural electrification.

The manual was improved and tested in the field a few times before the final edit into several formats to assure wide dissemination and distribution. The final characteristics of the manual include black and white books for shop owners to photocopy as well as books for the end users with an orange cover. In total, there are 3003 copies of pico-hydropower installation and user manuals (see Table 6 hereafter) distributed mostly to target and non target project areas.

Currently, most of the manuals are in districts and village development group offices, which are accessible to the end users. The manuals were distributed by various methods. One of them was to transport by bus from LIRE office to each province where the PDEM staff pick them up for further distribution by district offices. In an interview with the Xiengkhuang PDEM staff, it was found that the manuals provided had run out and thus a large number of manuals were additionally provided to the province. This shows that there is high demand for the manuals as this was also witnessed by the TA and shop owner in Kham district.

Furthermore, during the evaluation trip the team brought a large number of manuals with them to give to PDEM, district and village development group offices. Where possible, the books were handed to end users directly. Besides giving them the materials, end users were told where to obtain the manuals at their nearest station. Provincial and district staffs were requested to deliver more manuals to villagers whenever they are on mission to the field. For sustainability, advice on lending and sales of manuals was given to shop keepers, government officials and end users who are interested in selling and borrowing the manuals.

Figure 5: Pico-hydropower manual

Figure 6: Pico-hydropower VDO training

In addition, a pico-hydropower training Video CD was created after the completion of the shared pico-hydropower construction in Angsang village, Viengxay District, Huaphanh Province in order to transfer the practical lessons learnt to other viewers both literate and illiterate. The Video CD also aims to enhance the understanding of low or non-educated people on how the system is installed and to promote the idea of shared pico-hydropower systems in villages. Unfortunately, due to the limited budget, only 158 copies (Table6) were produced and distributed to each target district and province, particularly to village technical advisors in order to allow them to display the training Video CD during village events and gatherings. Some copies were given to provincial and district offices as a master copy so that they can make further copies at a later date.

Apart from the training Video CD on pico-hydropower installations and operation, posters were produced in order to disseminate the project intervention activity, especially to inform people of the new services available from shop keepers and technical advisors. It also advertises and introduces the new technology of Electronic Load Controllers and where to get pico-hydropower installation and user manuals in target provinces, districts and village development group. Posters were posted

in prominent places including markets, bus stations, village development group offices, government offices and other public places.

Figure 7: Poster posted on the shop

In addition to posters, public announcements through village and market horn speakers were used to promote the service of technical advisors and availability of the manuals.

The impact of these two methods was not seen to be very effective. Not many people who have experienced announcement and village horn speakers were interested in obtaining the manuals from shops and village development groups. Also the district or provincial energy and mines offices are perceived by villagers as a government function, not normally visited by ordinary people.

There was no measured direct effect of posters or announcements on the VTA services undertaken. End users who received the TA service informed that they know about the service because they have heard from neighbors saying that a man from his village was selected to be trained by the project. Others heard about the availability of the service and manuals from the village meeting when promotion of VTA was announced after the training.

Table 6: Summary of manual, VDO, posters distributed in target and non targeted areas

Province	District	Manual Distributed	Training VCD distributed	Poster Posted
Xiengkhuang	Paek	137	14	15
	Khoun	241	11	17
	Kham	344	19	21
	Non target dist.	160	-	6
Huaphanh	Xamneua	317	19	22
	Viengxay	214	12	19
	Xamtay	491	19	23
	Non target dist.	210	-	6
Phongsaly	Phongsaly	181	18	18
	Bounneua	178	20	20
	Bountai	190	19	33
	Non target dist.	210	-	-
Non-target provinces	Udomxay	70	2	-
	Khammuane	60	1	-
Total (3000 target)		**3003***	**154**	**200**

Table 7: Feedback summary of technical document

Positive	Negative
Distributed to provinces, districts, village development groups, village, end users - More accessible by end users	Most manuals are at village development groups
End users borrow manual to improve their systems – demand for manuals	Illiterate can refer to pictures in manual only
Reference for system improvement	Black and white manual – color needed
VCD help literate and literate villagers to understand easily	Limited number of VCDs produced

2.3.6 Introduction of Electronic Load Controller (ELC) in Lao Market

One of the objectives of this project is to introduce an electronic load controller (ELC) to the local market in Lao PDR. As this is a new element in most pico-hydropower installations, LIRE installed some of these devices in selected households in the village with the aim to demonstrate to villagers the benefit of this device. To ensure that the new element can protect end users, the ELC test was done two times, both in the lab and in the field. With the positive lab and field testing results, the ELC was introduced to shop keepers and end users through several workshops in order to foster the supply and demand of this device. However, this device was introduced quite late in the project because of the failure of the first pilot test due to a faulty device.

Figure 8: ELC tested in the field

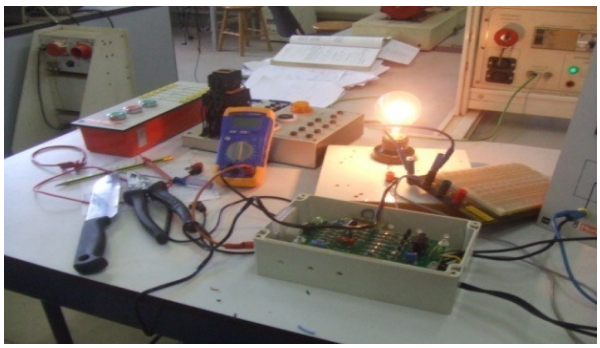


Figure 9: ELC tested at FoE lab before installed at the field

The previous field trip on monitoring and evaluation proved that there was no ELC displayed or sold in shops that were trained nor has it been used by end users in Xiengkhuang and Huahphanh provinces. Very few numbers of this device were introduced and installed in villages in Phongsaly province. The devices were taken to end users by District Technical Advisor in Bountai district to demonstrate its qualities and technical performance.

First, the district technical advisor bought the device from the local shop nearby at the price of 110,000 Kip (USD 12) and brought it to village. The village chief used village funds to buy the ELC to demonstrate the product. Any villager wishing to try the ELC with their existing pico-hydropower system was allowed to borrow the device. Orders can be made through the VTA or DTA at the price of 150,000 Kip (USD 18). Profits arising from selling these products are shared on a 50/50 basis between district and village technical advisors.

So far, there were four units of the ELC installed and demonstrated in the village and recently four units are ordered from a Vietnamese shop in Bountai District. Nonetheless, these devices were not imported through the recommended suppliers, but other channels that LIRE was unable to identify.

Not all the feedback gained from the field trip was positive. It was witnessed that there is no shop selling the ELC device in nearly all of the target districts. Shop owners and end users criticized that the recommended ELC is too expensive, which the poor end users will not be able to afford. It is further perceived that the device is a new technology which they have never seen before and would not take the risk of selling or buying it until they have actually seen how it works. This shows again that a demonstration unit would be required.

Table 8: Feedback summary of ELC

Positive	Negative
ELCs sold only in Phongsaly	Specific ELC recommended by LIRE too expensive
• 4 units installed	
• 4 units ordered from Vietnamese shop in Bountai District	
ELC distributed and sold by TA – good initiative	No trained shops selling ELC, except single location in Bountay district
Demand just started – interested by end users e.g some order made through DTA	No ELC supplier in local market
	Perceived as expensive - Poor cannot afford it
	Still new technology

2.4 National Workshop

As we were near the end of the program, LIRE organized a Project Completion Workshop in Settha Palace Hotel on the 4th of November 2010, in Vientiane Capital.

The workshop aimed to present and disseminate the implementation result of pico-hydropower project on Innovation and Capacity Building. Different organisations were invited to attend this half-day workshop, including government and international organisations, private companies such as: PDEMs, Poverty Reduction Fund (World Bank initiative), United-Nations Food and Agriculture Organization (FAO) Laos, World Vision, Sunlabob Renewable Energy Company, technical colleges and University of Laos.

The presentations were made in both Lao and English. **See presentation in Appendices III and IV**.

At the end of the workshop participants gave few comments and recommendations about the project. Narrative parts are reported here:

> *'Congratulations!'*
>
> '*LIRE – ETC program was greatly helpful for all involved PDEMs/ PTA and DDEM DDA persons. All wish to see LIRE continuing such similar activities at larger scale in the three project provinces but also in other provinces to able training more persons with the same approach and tools developed.*
>
> *'It is a unique project of this kind in the country, targeting to improve the sustainability of the pico-hydropower sector nationwide through capacity building with genuine useful manuals and information tools.*

'What are the next steps?' What are LIRE and ETC's plans to move forward from now? '

'Do you have already secured funding for a next project phase?'

Although no-one gave any negative remarks about the project, no-one either suggested or proposed any improvement that could be integrated into a next stage of activities.

Remark: It seems that the whole audience was very pleased about the achievements of the project team and ways of doing the work, and enthusiastic to wished to see a next step to bring all these achievements up to another level that is a larger scale and/or institutional. However, up-scaling requires a solid funding plan that was not in place at the time of the workshop.

Figure 10: National Workshop in Vientiane Capital

3 RESULTS

The results of the project is based on the assessment of the project monitoring throughout the project timeframe and through final evaluation trips made during September and October 2010 to three target provinces where one targeted village per district is visited. The main conclusions cover three main aspects such as access, control and sharing.

3.1 Information Workshops for Shop Keepers

Output

In total 32 local hardware shops in the target districts received the training course developed by the LIRE-ETC project team. The formal component of this training comprised district level workshops, in which shopkeepers received information and materials to enable them to provide a higher quality of service to their customers. As a result, all of the participating shops are now better equipped to inform pico-hydro users on appropriate product selection, and they are becoming recognised as

local resource centres where users can obtain information on the installation and use of pico-hydropower technology.

In a more informal capacity, local shopkeepers were approached and involved during most field trips, and they were found to be a particularly valuable group of participants to engage with whilst discussing the project with provincial and district authorities. The shopkeepers provided valuable first hand observations of the market in their area, and offered their views on the likely effectiveness and limitations to the project interventions.

Outcome

The project directly confronted the limited size of the pico-hydropower market chain when attempting to achieve the target number of participating shops. The involvement of only 32 shops instead of the desired 45 is a simple indication of the lack of points of sale in the market. Indeed it is interesting to observe the importance of the few shops (and hence the individuals that run them) for relatively large populations when considering that the average population of districts in the Lao PDR is around 50,000 people.

The capacity and willingness of individual shopkeepers to advise their customers on pico-hydropower technology was found to be highly variable. The inclusion of follow-up coaching sessions to reinforce the standard course provided during initial workshops was therefore an essential component to this activity, and one that should be replicated for similar initiatives in the future.

More generally, as well as enabling the project team to pursue specific interests and needs of individual shopkeepers during these sessions, it was found this format of repeated engagement with participants in small groups was a highly suitable approach for the local context and a valuable method to reinforce the significance of the key information.

Impact

In terms of improving access to safe and reliable energy resources, a number of positive behaviour changes were observed on the part of shop keepers. It was highly encouraging to see participating shopkeepers easily adopting the promotion of better quality insulated cable, and hence that customers will correspondingly benefit from a better understanding of the greater safety associated to using appropriately gauged transmission lines, and also the economic benefits over the longer term (durability and reduced power losses). As described below, the educational materials were also generally welcomed and served to reinforce the shopkeepers' responsibility in advising their customers on best practise.

Regarding other more expensive products (better turbines and ELC), it was clear that shopkeepers alone are unable to significantly change the behaviour of their customers. The value of better quality products relative to their cost remains unproven for most users, and shopkeepers were on the whole unwilling to take on the burden of investing in a high cost and high risk line of products. This challenge is also compounded by the fact that good and poor quality products are not always so easy to differentiate, with the absence of any form of labelling or quality assurance standards.

Another essentially external factor to limit shop keepers' effectiveness in improving the use of pico-hydropower technology was the perceived onset of market saturation. Under such conditions shops are even less likely to make new investments. In reality, the apparent saturation of the pico-hydropower market is in part linked to the endemic use of poor quality hardware and inefficient installation. Many villagers reported to the project team that they were running out of sites to use for their pico-hydropower turbines. However, the local hydro resources of communities could be sufficient if better technology and better installation techniques were employed. A good example of potential is the LIRE shared pico-hydropower demonstration project, implemented during 2009-

2010 in Angsang village. In this instance, 17 individual pico-hydropower turbines with (approximated) power ratings ranging from 300-1000W were replaced by two 1000W turbines and a shared distribution network that increased access to electricity from around 70 to 100% in the village. Members of this same community had also reported that some households were previously not using pico-hydropower technology due to a lack of water in the local stream.

In summary, the involvement of shopkeepers had a positive impact on local behaviour and awareness of quality and alternative products. However, the effectiveness of this group of stakeholders would be strengthened by greater involvement of local and national authorities. The market will remain largely driven by up-front costs until perceptions of product value are reinforced by public endorsement, both by regulation and by technology demonstrations.

3.2 Technical Advisor Training in Three Provinces

Output

With the aid of local authorities, the project team successfully identified a good number of suitable candidates for the Technical Advisor training programme, including 6, 8, and 55 trainees at province, district and village levels respectively across the three selected provinces. Training was in phases and adopted the existing hierarchical structure of regional governance, as it was more readily accepted by participating local authorities. Thus provincial technical advisors were trained to become the trainers of TAs operating on a more local scale. This was advantageous in the regard that it fostered a sense of ownership in local authorities, but it also had draw backs as detailed below.

Outcome

The project has achieved a first concrete improvement in access to essential knowledge and skills in the target provinces, through relying on members of the community and local authorities as resource points. However the level of improvement was far from uniform. The final capacity of TAs varied widely, largely as a function of pre-existing technical skills and perception of pico-hydropower technology. Although some district and province TAs were highly receptive to the training and their participation in the programme, generally speaking village level TA training was the most successful in terms of how the TAs made use of their new skills and new visibility. The monitoring activities of the programme revealed good evidence of TAs working to improve the standards of existing pico-hydropower installations following the training, particularly in their own villages.

The technical advisor approach was found to fit well within the local context, and made good use of the typical structure of rural communities in the Lao PDR wherein one often finds a particular individual who is general relied upon for technical needs of the community. Thus, although the training focused on individuals, the dissemination of information to the wider community occurred spontaneously. The monitoring survey showed this to be the case throughout the target areas. Even so, the capacity of TAs to transform their communities was ultimately limited by habitual knowledge of communities concerning pico-hydropower technology, which has been widely used in some of the target districts for over 15 years.

Impact

Several TAs installed pico-hydropower systems shortly following their training and provided advice to other users. However there was little evidence of such activities extending beyond the villages where the TAs lived. These two observations give a good indication to the scale of impact achieved by this intervention: in general, the impact was positive but quite localised. The TAs themselves reported either a lack of locations or difficulty to overcome the preconceptions of existing users as the main limitations to their following activities. The impact considering province and district TAs was less significant, which in part is a reflection that pico-hydropower power is still not seen with the

necessary level of importance at government level. Clearly the importance of pico-hydropower is most clearly understood by those who rely on the technology.

It is now apparent that the impact of the TA training programme could have been greater had certain opportunities been more fully recognised and exploited. One of the main weaknesses associated to this component was a lack of continuity from training through to practice. The transition from trainee to expert was not clearly defined, so ultimately it was left to the initiative of individuals to make use of their training. In some cases this presented no difficulty and certain individuals demonstrated good entrepreneurial spirit, but more generally this aspect of the intervention had not been given sufficient attention in the project planning.

As for the shopkeepers, it was difficult for TAs work in isolation to improve the supply chain and confront the cost-driven nature of the market. In future it could be interesting to develop greater interaction and interdependence between TAs, by forming a network. This could serve to reinforce the credibility of individual TAs whilst also introducing a support structure. In such a scenario the impact of having province and district TAs could be more significant, as their roles could be to visibly demonstrate the support of the government, and to maintain a line of communication from urban and peri-urban areas to rural areas.

Most of the participants demonstrated good entrepreneurial initiative and were keen to transform their training into new business activities. This opportunity could have received greater attention by the programme. Although the training equipped the TAs with good technical skills, there was no specific attempt to improve basic business skills such as marketing and bookkeeping, and thus success in terms of follow-up activities was largely dependent upon the existing capacities and experience of the individual. Such aspects could have been better integrated into the training programme had the primary purpose of the TA training been to introduce technical services rather than develop capacity in rural areas.

3.2.1 Installation and User Manual and other Educational Materials

Output

The target areas each received significant numbers of manuals and the other materials, which should remain as valuable references over the medium term. Interest for the manual and VCD was such that distribution was extended to other districts in the target provinces and a few copy were also sent to neighbouring northern provinces in the Lao PDR.

The development of educational materials in participation with the target beneficiaries was in itself a great success. Beyond their direct utility for pico-hydropower installation in the Lao PDR, these resources have long term value both in terms of promoting the visibility of LIRE, and in serving as a guide for LIRE to produce educational and informational tools in the future. Distribution on a significant scale was an excellent learning experience for LIRE, and it should be noted that the figures achieved by the project team are comparable to the larger INGO and state programmes in the Lao PDR that dedicated to this activity alone.

Outcome

Access to the resources was limited by the number of available copies, but also by the location where they were stored. Most of the manuals were retained by village development groups. These limitations could have been mitigated by introducing additional means to copy the manuals (for example, if shopkeepers and TAs were to print off-copies and sell these for a nominal fee).

Although efforts were made to ensure the clarity and simplicity of explanations in the manual, those users unable to read Lao language would be limited to interpreting the pictures. The utility of

educational materials were thus higher because they were introduced in parallel with the training and demonstration activities.

Impact

Awareness rising through the distribution of the materials was good, as confirmed by the monitoring activities. It is more difficult to evaluate the specific impact of the materials in terms of improving access, safety and reliability of pico-hydropower technology as they were often used in conjunction with other activities. In terms of the manual standing as a resource for people in rural communities to use directly to improve the quality of their experience, awareness of its existance was observed to be good in the target communities. Since the programme relied primarily on local authorities and village chiefs to reach communities, it can be observed that conventional communication in rural areas is quite effective. Less encouraging was the level of access to manuals for individuals. In most cases the manuals were highly value by their custodians, and hence there was some hesitancy to distribute irreplaceable documents. This could be overcome by encouraging district authorities and shopkeepers to make copies and hence sustain and extend distribution of the manuals.

Activities undertaken by LIRE concurrently with those included in the ETC-partnership programme indicate that other approaches to awareness raising may be more success. In particular, LIRE's engagement with demonstration projects has drawn considerable spontaneous interest by the public and also state media. Many workshop participants also made reference to the demonstration projects of the organisation. For future initiatives in the pico-hydropower sector, it may therefore be interesting to include small scale (but permanent) technology demonstrations as an integral part of training programmes. Similarly for efforts to establish supply chains, these could offer a useful device with which to engage local enterprises.

3.2.2 Introduction of Electronic Load Controller in the Lao Market

Output

Following the programme, the local potential for ELC technology is now well understood by LIRE. As well as confirming electrical instability as a major cause of failure for light bulbs, the durability of ELCs produced from neighbouring countries (Vietnam and Thailand) was tested under real conditions. The latter also presented an opportunity to observe the response of end-users to this new technology. Thus the cost and benefit of introducing ELCs has now been determined.

Outcome

The potential sources of ELC technology from neighbouring countries have been identified, but further action would be required to encourage the development of a supply chain. The project team's understanding of ELCs and the opportunities to represent for end users was included in the education materials developed by the programme and disseminated through the training programmes. Thus the awareness of ELCs by TAs and shopkeepers is good, which could be valuable to future efforts focussing on developing supply and encouraging demand.

The ELC trials in the laboratory and in the field were a good internal capacity building activity for LIRE, laying the foundations to undertake similar assessments of new and alternative technologies in future.

Impact

Over the short term, the uptake of ELCs in rural areas as a result of this activity was very low, primarily due to high product cost and no supply chain established. A further challenge is presented by the use of relatively inexpensive voltage regulators by wealthier households. Although they are quite different technologies, there is a clear confusion because they are used (rightly or wrongly) to overcome the same problem. This, combined with substantially higher prices for the ELCs that are

currently available for import, suggest that the introduction of these products would be highly challenging, except for the case of larger systems and wealthier households.

The field and laboratory trials stimulated a great deal of discussion within the project team and also with the local project partners at the National University of Laos. The collaboration built stronger relations LIRE and this major local educational establishment. More specifically, the activity revealed some opportunities to develop simpler, cheap and more appropriate ELCs for the Lao market. This could be very interesting to pursue, if combined within a wider programme to establish domestic supply chains for pico-hydropower technology.

3.3 Access

Output

The main objective of the project is to make pico-hydropower power easily and safely accessible to end users and extend this system generation amongst poor families in the North of Lao PDR.

An important justification of the approach adopted by the programme rests on the fact that pico-hydro technology was already in widespread use in the target areas, but access to it and its potential to improve livelihoods was limited by poor quality products and practices. Rather than undertaking a series of hardware installations in the target communities, the programme thus adopted an information and skills approach to improving access to energy, thereby engaging both existing and potential users. It was also essential to fully involve key stakeholders such as shopkeepers upon which the supply chain relies. Thus, when evaluating the project outputs in terms of access to energy, the 32 **hardware shops** and **73 Technical advisors trained in** the **9 districts** and the **3003 pico-hydropower manuals distributed** (see table 6) equate both to potential new users of pico-hydro and also an improved experience for existing users. Indeed the two are correlated, since one of the limiting factors to uptake of pico-hydro technology on a village level was observed to be the apparent shortage of available sites and water capacity. With improved standards, the potential of local resources have been made more available.

Outcome

As per in the first phase, the outcome of the project has been limited in terms of sheer numbers, since the main objective is to offer information and training to the people involved in the project.

Manuals were distributed to **41 Villages** through 73 Technical advisors in the target districts. This resource can be directly utilised for the **82 pico-hydropower installations** in these areas by 2010**.** Hence, it is estimated that about **861 people** benefit from access to manuals in the same year.

Considering that most village's TAs were found to be focusing on the needs of their own communities rather than any larger area, the number of people benefiting from these enhanced skills can be broadly estimated to be the sum population of the 41 villages involved. Over the longer term it is expected that these skills would spread to other neighbouring communities, but since the programme did not make specific attempt to ensure such an expansion, including neighbouring populations in the total is viewed as an overestimate.

Sustainability and gender balance

Impact over the longer term depends primarily on the sustained relevance of the pico-hydro for communities, and the sustained awareness of the information and skills that are available in the target areas thanks to the activities undertaken in the programme. Considering the second condition first, the programme has created several centres of knowledge. These include LIRE, district and province authorities, and the shops in the target areas. LIRE continues to be active in the pico-hydro sector in the Lao PDR and thus shall continue to make the resources available to rural communities.

By maintaining activities in the pico-hydro sector, LIRE shall maintain its technical capacity. The Faculty of Engineering, National University of Laos also assists in sustaining the technical expertise, through the professors who participated in the programme and continue to collaborate with LIRE.

Local authorities can play a significant role in making the resources accessible to future development interventions by other organisations, since all such projects would work with the cooperation of province and district offices. However, although good communication is maintained on a one to one basis with several of the rural stakeholders, neither of these bodies have a specific engagement with the shopkeepers and TAs involved in the programme, who are ultimately responsible for maintaining the results of the programme in the target areas. Whilst still visible, the promotional materials introduced will serve to reinforce communication to LIRE and local authorities.

Regarding gender balance, the project has engaged with improving knowledge and access to information resources in communities as a whole. Hence, both male and female members are now more able to evaluate their circumstances, and thus contribute to the decision-making process. Importantly, as an external and neutral source of information, the materials made available through the project activities also serve to give a louder voice to those who have previously had to submit to conventional wisdom.

The gender balance is implicit in the project without extra interaction required. In general, most shops are run by a husband and wife, sharing equally in the work load. When it comes to electricity use, these are mostly the women who benefit from electricity from light during cooking hours. Entertainment, watching television or listening to music, is often a shared benefit, not just within the household but also outside. As such, it is an important social function as well.

3.4 Control

Output

As happened in first phase, ACCESS and CONTROL are interrelated. Workshops carried out with shop dealers and Technical advisors will increase the ACCESS of population to the pico-hydropower energy. The CONTROL will come through the deeper knowledge of technical characteristics pico-hydropower installation. That includes the introduction of the ELC device and the maintenance and proper use instructions included in the Maintenance & user's Manual in Lao Language. As a result, pico-hydropower installations will be safer, and will include also the use of switchboards and electricity plugs

Figures of CONTROL told us that about **2,849 installations** will be improved as a result of the Lao Manual distribution that will implies about **25,641 people** belonging to poor households will be benefited.

Outcome

The main outcome in terms of control is improving the quality, reliability and safety of pico-hydropower, obtained by means the selection of the proper pico-hydropower components and a correct installation and maintenance of the generation and distribution system.

By introducing more control over the technology, through manuals, load controllers and advice, the End-users satisfaction increase as a result of the higher efficiency of the system and a drastic reduction of the broken parts or lights and devices. This was observed during the field trips through the interest shown towards purchasing ELCs by households that participated in the field trials, and the positive response to information concerning the primary sources of inefficiency and loss in a typical pico-hydro system.

Sustainability and gender balance

Sustainability is largely covered under the ACCESS part. On the other hand, although Lao user and maintenance Manual is addressed to all population, males and females, it will be mostly the men who would benefit from increased control over pico-hydropower, because they are the ones usually maintaining and repairing the system.

Risk and mitigation

The project has not given any subsidies. Besides the already mentioned risk of grid extension, it might also be hard to change the existing the pico-hydropower market because it is a mature one. After 20 years of existence without a real technical development, end-users and shopkeepers could be unwilling to use new and complementary products as the ELC.

As mitigation measure, the shop owners were engaged in the project from the beginning to win their trust on the new elements.

An additional risk is the communication difficulties due to many shops are owned by Chinese people. It was mitigated with the participation of a translator.

3.5 Sharing

Output

Main sharing of this second phase is the creation and distribution of the Pico-hydropower-hydro Installation and User Manual in Lao language as well as development of posters, training VCD, brochures, and workshop for shop owners aimed at supporting market developers, and technical advisors training aimed at developing technical advisors. The manuals were distributed in different places such as PDEM, DEMO, village development group, shops, village office and directly to end users.

Additional sharing is done through the EASE toolkit and within the EASE network and LIRE website. During the project, fourteen reports were edited, included this final one.

Outcome

SHARING will be done through the EASE toolkit and the other deliverables which will be shared within the EASE network, the LIRE network and through the LIRE website. There are also the invention methodology for sharing, for instance when LIRE participate to other workshop or organize other workshop, LIRE will take the opportunity to disseminate the information.

Sustainability and gender balance

The sustainability of the SHARING aspect is guaranteed by focusing on the capacities of the shop keepers and Technical advisors and improving those during the workshops carried out. As mentioned before, the shopkeepers are well balanced when it comes to gender. As a result of all the project activities, end users being a 50% female will be benefited with more reliable and safer pico-hydropower installations.

Risk and mitigation

The main risk about sharing is that the knowledge and benefits does not to reach targeted population. The mitigation action had two actions plans. First one was to spread technical knowledge by inviting all local shop owners to the workshops and selecting the appropriate Technical advisors in each district. The second one was that **3,003 copies** of the Pico-hydropower Manuals that were distributed to various stations that are closer to end users these places can be at shop owners, technical advisors, local authorities, villages targeted and also to general public

accessible locations as bus stations, PDEM, DEMO, shops, development group office, village office. The latest figure on 28 December indicates there were only 476 manuals left at PDEM and DEMO.

See "Appendix V: Monitoring Protocol" for further details.

4 LESSONS LEARNED

From the implementation of this program, lessons learned can be summarized into various aspects.

Strengths

- The EASE team within LIRE is established and functioning well. Administrative tools have been put in place.
- Training needs for shops owners and technical advisors were identified and intervention strategy were clearly defined and formulated.
- Capacity within the project team has been built through the formal training in Vietnam, working with consultant and practical experience at field.
- Master trainer, LIRE-ETC project staff, has passed on knowledge to provincial, district and village technical advisors which made service available to other end users.
- Informal networks of technical advisors were established. These actors are well filed.
- Pico-hydropower installation and users' manuals in Lao are developed and distributed to end users, which made available in different places such as PDEM, DEMO, District Administration Office, Village Development Group Office, village office and shops.
- Government support in terms of project coordination.

Weaknesses

- The quality and type of installations vary greatly from village to village and even within villages. To address all this diversity is difficult.
- High incidences in individual systems, resulting in high cost bearing by an individual, one person paying for hardware. Unwilling to go for shared pico-hydropower system.
- Delay in organizing informational workshop for shop owners and training for technical advisors due to the first failure of pilot testing of the ELC which the project team requires the test results to convince shop keepers and end users about the benefits of ELC.
- No subsidy provided despite the actual requirement from shop owners and end users.
- Recommended products were viewed as expensive where people get used to existing products - slow uptake new technology and new products.

Threats

- Grid expansion in some of the potential target areas makes pico-hydropower obsolete. Similarly, the relevance of the project results is assured so long as communities do not have access to larger grid or decentralised energy services.
- Un-informed planned of grid extension in certain districts due to lack of coordination between local authorities. This relates to the impact of the project: in some communities people are concerned about investing in pico-hydro systems because they believe the grid will soon arrive in their neighbourhood. Poor coordination and information of grid extension

results in false hopes in certain communities, and missed opportunities to improve energy access through pico-hydro power.

- Lack of suitable locations for installation exists in many villages; this is true for standing installation type. However, end user still keep on installing free standing type of pico-hydropower. The project focussed primarily on the use of pico-hydro for individual households. Although easier to implement and maintain, household pico-hydro is considerably less efficient than shared systems and village grids. The risk associated to prioritising household pico-hydro is that in some cases negative experiences could result in poor perceptions of the technology in general.
- Difficulties in changing behaviours/beliefs when end users believe they already know how to install a system and when they feel "royal" to the existing products.
- Pico-hydropower is still considered as an informal renewable energy in Laos despite the fact that it is one of the cheapest sources of the renewable energy.

Opportunities

- Cross checking for plan with more authorities: PDEM, DEMO, District Administration Office, and EDL provincial branches.
- More awareness raising and promotion of pico-hydropower technology recognition and its importance as formal renewable energy source of the country through lobby and advocacy among national stakeholders.
- Capacity building:
    - Formal - Vocational and technical school (development of curriculum);
    - Informal - local technicians/end users, specifically training on installation, operation and maintenance.
- More research:
    - Technology e.g. free standing installation;
    - Supply chain: cheaper and better quality products thanks to locally produced accessories such as draft tube & draft channels.
- Promotion of shared pico-hydropower model through demonstration site in order to increase access to electricity in off-grid areas, raise awareness of the technology and to change people attitudes.
- Strong government support/international organization of this technology - recognize this type of energy as important source of power.

4.1 Evaluation Summary

This programme set out to make pico-hydropower power easily and safely accessible to end users and extend this system generation amongst poor families in the North of Lao PDR.

The monitoring activities towards the end of the programme showed encouraging signs of improvements in the target areas. Above all, there was a raise awareness of safety issues and inefficiencies introduced due to poor installation techniques. Each of the activities made positive contributions to achieving this goal, and were perhaps most successful because they were conducted in parallel and with a high degree of interaction. For instance, testing of ELC technology directly fed into the training and development of education materials. Another advantage of carrying

out multiple activities in parallel has been a significant improvement in the visibility of LIRE at national level, which is now widely regarded as a major local platform for the energy, environment, and development sectors. LIRE now regularly receives invitations to the national workshops and consultations hosted by government and international development organisations, indeed too many for LIRE to participate in all of them.

In engaging with this goal LIRE has made a logical progression: building upon a comprehensive, but essentially academic, survey of pico-hydropower use in the Lao PDR in 2008, Phase 1 of the LIRE-ETC hydropower programme successfully identify promising bottom-up interventions to develop with the participation of the target groups. In phase 2 these interventions were rolled out in several districts across 3 provinces, at a sufficient scale to evaluate their effectiveness. A general outcome of this direct attempt to raise standards in the target areas is a clear insight into the endemic challenges to improving the use of pico-hydropower technology in the Lao PDR.

Two main issues continue to limit the effectiveness of interventions such as those undertaken in this programme:

1) A lack of recognition of pico-hydropower power at government level, and
2) An inadequate domestic supply chain that keeps the price of the technology relatively high for the end user.

The first was frequently observed during the course of the project, most notably by the different results of TA training at province, district and village level. Provincial government still fails to see the full potential of pico-hydropower technology in terms of national development objectives. As described in the results section above, national and provincial government institutions could play a significant role in reinforcing local support networks and the supply chain through a general endorsement of best practice, but also through regulation and certification. If pico-hydropower technology were to be viewed in the same light as other rural electrification efforts, including grid extension, then the later would follow by necessity.

The second limitation must also be engaged with at a scale that is not limited to the areas where the target beneficiaries live. LIRE's own experience has shown that access to materials and skilled labour, for example for the construction of draft channels and tubes, can be very challenging in rural areas. Were this situation to be improved, the overall efficiency and cost effectiveness of pico-hydropower, and hence access to energy, could be significantly improved. In parallel efforts to engage with the domestic supply chain would work complementarily to the capacity already developed by the LIRE pico-hydropower programme.

4.2 Future Vision of LIRE's Role in the Pico-Hydropower Sector

Following three years of activity in the Lao pico-hydropower sector, today LIRE is equipped with both a solid experience and knowledge of the situation in the field, and perhaps more importantly, a level of recognition that was only a distant aspiration in 2008. LIRE is in a unique position and has a real opportunity to make a major impact at national level. As detailed in the preceding sections, the institute learned valuable lessons in terms of effective intervention approaches, and in parallel has developed a refined understanding of the key bottlenecks that limit the wider uptake of improved practices and products. The natural progression for LIRE is thus now to tackle these bottlenecks in a more targeted fashion, and taking full advantage of its elevated status.

LIRE is neither structured to lead large scale implementation, nor it is able to act as an authority on appropriate technology in isolation. Thus, rather than launching an expanded set of activities of the kind considered in phase 2, LIRE's future vision is to encourage and facilitate those organisations, public and private, that do possess the mandate and the resources to engage with the key issues.

Acting therefore as a lobby, LIRE's future objective should be to advocate pico-hydropower technology as an opportunity for all stakeholders, and the development of the Lao pico-hydropower sector as a mechanism to achieve national development objectives pertaining to rural livelihoods, energy access, and environmental sustainability.

The core future activities of LIRE must therefore first address the perception of pico-hydropower technology at national government level, and then furnish decision makers with the necessary information and tools to enable regulatory, educational, and commercial interventions into the market. Examples of such interventions could include the introduction of standards and economic incentives to certifying pico-hydropower installations; vocational education focusing on the domestic supply chain; and trade agreements with neighbouring countries. A key challenge for LIRE shall be to convey the significant value of the existing market chain to organisations that are more familiar with top-down development actions. In this regard, the participants of the phase 2 programme can be a considerable asset in promoting a more inclusive approach. The embryonic TA network should be developed further and incorporated into the delivery of the next wave of interventions resulting from lobbying national government. Similarly, the materials already developed by LIRE can be integrated into government led activities, thereby achieving greater dissemination and perceived value for the end-user.

5 FINANCIAL REPORT

5.1 Budget and Actual Expenditures

This financial report covers the period from 1 May 2009 to 31 November2010. The approved budget for the Pico-hydropower power Innovation and Capacity Building Program Phase 2 is 75,600 Euro where 74,916.73 EURO has been spent for carrying out project. In addition to agreed budget items, various requests and amendment were made by LIRE and approved by ETC. These include:

- Approval on increase of overhead cost of LIRE from 350 EURO to 600 EURO per month starting from 1 January 2010 in order to cover LIRE administrative costs derived from office relocation and expansion
- Using unspent budget items which then exceeds 10% of some budget items for:
    - Additional field trips for monitoring and evaluation in equivalent of 6,000 EURO.
    - Increasing budget item on national workshop from 2,000 EURO to 6,500 EURO
    - Additional cost of dissemination of Pico Installation and User Manuals/VCD in equivalent to 2,700 EURO
    - Technical Assistance: 1,250 EURO

Table 9: Financial report

Financial Report (1 May 2009 to 31 November 2010)								
Financial Reporting				**Unit: euro**				
Budget Line	**Activity Items**	**Budget**	**Total Advance**	**Expenses**				**Balance**
				May-Nov 09	**Dec09-Jun 2010**	**Jul-Nov 2010**	**Total Exp**	
1	Staffing	31,080.00		11,138.47	10,837.41	9,455.74	31,431.62	
2	Workshops for shop owners	8,700.00		377.10	2,971.53	6,886.94	10,235.57	
3	Technical Advisor programme	6,576.00		567.14	4,939.62	0	5,506.76	
4	Developing pico-hydropower user manual	2,197.00		585.10	1,393.74	278.67	2,257.51	
5	Electronic Load Controller	1,383.00		898.25	0	0	898.25	
6	Other Project Activity	7,017.00		1,110.39	1,132.47	4,112.81	6,355.67	
7	Technical Assistance	8,750.00		4,900.75	1,189.54	1,922.32	8,012.61	
8	LIRE overhead	6,300.00		2,438.91	3,324.38	3,834.59	9,597.88	
9	Contingencies (5%)	3,598.00		759,43	212.95	214.48	1,186.86	
Total Budget according to the Agreement		***75,600.00***						
Payment to Photographer *		566.00						
	Total with Photographer Payment	**76,166.00**	**Partial Inv.**	**22,775.54**	**26,001.64**	**26,705.55**	**75,482.73**	**683.27**
			Amount Received	**25,000.00**	**25,566.00**	**18,885.00**	**69,451.00**	**(6,715.00)**
							Balance in LIRE-ETC Account	***(6,031.73)***
	* Photographer's fee for Taku Mori was paid by ETC money which then ETC was reimbursed this during the second install payment							

5.2 Overview Advances and Invoices

5.2.1 Advances

Table 10: Advances and invoices summary

Item	Description	Amount Requested in EURO	Date	Amount received in EURO	Date received	Remarks
1	First install payment	23,889.60	21/04/2009	23,889.60	24/04/2009	+1,110.40 (left from Project phase II)
2	Second install payment	25,566.00	27/11/2009	25,566.00	30/12/2009	
3	Third install payment	25,600.00	29/06/2010	18,885.00	13/09/2010	
4	Final Install Payment	*6,031.73*	29/12/2010			Sending to ETC for approval

5.2.2 Partial Invoices (Actual Expenditures)

Table 11: Partial invoice summary

Item	Description	Amount reported in EURO	Date issuing invoice	Remarks
1	Partial invoice May -Nov 2009	22,775.59	27/11/2009	
2	Second invoice Dec 09-June 2010	26,001.64	29/06/2010	Revised Invoice
3	Final invoice July –Nov 2010	26,705.55	28/12/2010	

6 APPENDICES

6.1 Appendix I: Testing Questions

1) ***What are the needs of shop owners and how can they best be addressed through informational workshops and individual coaching? What improvement in the functioning of the market is feasible?***

The capacity of shopkeepers to inform and advise their customers on pico-hydro technology is clearly limited by their own knowledge of the products and their use, and also by their access and control of products (a shopkeeper is less likely to advise a customer to buy something not available at his/her shop). In this context control relates to the fact that if a shopkeeper cannot provide sufficient assurances of value for money, the customer is likely to resort to the cheapest option.

Access to information about pico-hydro was regularly reported by shopkeepers during the various interviews undertaken during the first phase of the program, and so this was identified as the main need of these stakeholders. Informational workshops and individual coaching directly tackled the lack of technical capacity amongst shopkeepers, whilst raising awareness about the key issues

related to safety and reliability. Above all, shopkeepers participated in the programme because they recognised a business opportunity. The core need of shopkeepers is to have a compelling business case for offering higher quality products and services to customers. The workshops and coaching satisfied this need to some degree by providing expertise on call to the shopkeepers so that they could fully understand the opportunities, and decide themselves whether it was worth changing their behaviour. In this respect the activities were successful in partly meeting the needs of shopkeepers. However, the content of these activities was perhaps overly focused on the technical aspects of the products, at the expense of enabling shopkeepers to develop a business plan and take the next steps towards providing new products and services. An important need associated to those is to offset risk on the part of the shopkeeper. This was not tackled by the programme.

Despite the shortcomings mentioned in the preceding paragraph, the informational workshops and individual coaching did have a positive impact upon the way in which the market functions. Most importantly, the project activities served to foster a greater sense of responsibility on the part of shopkeepers, as essential actors in the sector. By equipping each with a better understanding of the products they sell, the project has enabled shopkeepers to actively contribute to the customer's decision process. This is a significant improvement in the role of shopkeepers, and one that is beneficial to both sets of stakeholders.

In terms of improving the functioning of the market, the project was limited by the difficulties in introducing new products, largely the cost and risk to the shop. Any follow up activities to engage directly with the market would need to tackle these challenges as a major component of the activity plan.

With difficulties in communicating with Chinese and Vietnamese shop owners, translators were hired to translation the presentation slides for training as well as giving instant interpretation during the training and site visits. Apart from introducing new quality products, contact details of new and reliable suppliers from Vietnam are introduced to these people as they claimed of interesting of selling the recommended products. It is further suggested by the shops that the project should assists shops in terms of providing sample products to be sold in shops first in order to test the sale performance. It is also advised by them that the project coverage areas should reach the real remote which there will not electricity from the main grid for at least the next ten years.

2) What is the best model and target group for technical advisors on pico-hydropower?

The project has chosen three main groups of people to become technical advisors. One of them is the staff of provincial department of energy and mines. Their main functions are to coordinate project works with project team members and also to give training to district or villages whenever requested. Similarly to districts level, a staff from district energy and mines office or district administrative office (where there is no district energy and mine office exists) is chosen to become a district technical advisor. The roles of this person are almost the same as those provincial technical advisor, in exception to that they are more closed to village technical advisors and somewhere between PTA and VTA. The last group is at village level (a grass-root level). Five to ten literate villagers in each target village who have experience in installing the pico-hydropower system and would like to transfer knowledge and experience to others are chosen by village chief in consultation with project team and district staff.

Village Technical Advisor acts as a consultant who provides technical services on site survey, system installation and maintenance for end users in order to obtain financial compensation in return. Beside this, the technical advisor also plays important role in disseminating and passing on knowledge and experience to other end users/villagers through a word of mouth and manual loan. They are people who are more in touch with local villagers than those district and provincial staff. This makes them become key people to bring new innovation to villages. Moreover, technical

advisor acts as a broker on certain occasions. For example, ELC was brought to target villages as demonstration unit. As a result, orders were placed and profit was shared between DTA and VTA. This benefits all market players: shop owner, technical advisors and villagers.

It is believed the VTA model was most successful due to the proximity to end users and first hand understanding of both the challenges and the potential for picohydro. This meant that VTAs were generally more enthusiastic about applying the skills they gained, and so even though the training was to the same level for all groups, the impact of VTAs was greater.

3) What is the best design for the pico-hydropower manual? How can the manual be made accessible for end-users and shopkeepers in the Lao PDR? What are the best ways to spread the installation and introduce the manuals?

The best design of the pico-hydropower installation and user manual is to have it written in Lao language, using as simple technical wording as much as possible in order to allow low educated readers to understand it quickly. Apart from that, more illustrations of local context character are also contained which helps to attract attention of readers and also assist those who are illiterate to capture contents by just seeing the pictures. After several tests and feedbacks gains from end users, the manual was finally divided into two main sections. With the first section, it contains shortened version which try to capture Lao end users who traditionally do not read long text with more illustration and short description only. The second part describes all steps in details. It contains full description that helps to enhance further understanding whenever the first part was not fully understood or the readers acquire detailed explanation.

Numbers of manuals were distributed to shop keepers and end users in target and non-target provinces in the northern and central parts of Laos and delivered through public and private transportation. Hard copies of pico-hydropower manuals were given to these provinces, including Xiengkhuang, Huaphanh, Oudomxay, Phongsaly and Khamouane as they have high incidence of the pico-hydropower use. However, soft copies are only given to the target provinces and districts. Whenever the manual was run out at shops, shop owners can ask for more copies or ask for a soft copy from the provincial and district designated offices in order to reproduce the manual.

There is no single best way to distribute the manuals, but rather mixed strategy. Manuals were sent to Provincial Department of Energy and Mine which then are delivered to either district administration offices or District Energy and Mine Offices. PTA and DTA were asked to give them shop owners selling pico-hydropower products and directly to end users or pass on to heads of village development groups who go to attend meeting in district office at least once a month. During their way back, they can bring the manuals with them to give to end users. Officials concerned were requested to bring with them when going for field trips to remote village some manual to hand it to village offices and/or end users. This is a way to save money spending on transportation and delivery costs. Another method was used to increase demand for manuals. Posters are posted in public prominent places such as public offices, bus station, village notice boards and others in order to increase awareness on the availability of manuals at their nearest stations. This helps audience to collect manuals at shops and village offices. Direct distribution was also applied during project team field visits. Manuals were given to villagers, village chiefs and shop owners visited. Public announcement could help on this also but could be more effective in other regions in which audiences are interested in listening to horn speaker radio.

4) How can electronic load controllers be introduced to the market?

Pilot testing and demonstration in villages and laboratory are one of the best ways to introduce the technology to people. It allows them to compare the system efficiency with and without the use of ELC. The results of lab and field tests as well as the concepts and technology of ELC were

disseminated and presented in various workshops with shop keepers and technical advisors. Moreover, support was given to shop keepers to put them in contact with suppliers. Furthermore, posters are used to introduce and explain more on this technology to end users while also permit them to contact trained shop owners to obtain the products. Finally, ELC can be introduced to the market through technical advisors. The experience of the project show that district technical advisors and village technical advisors acted as brokers to bring in the ELC into target villages. The products was bought from a local market and brought to village chief to demonstrate the product within a village. End users who wish to use them are allowed, but compensation must be made if the device broken. ELCs were bought and ordered by end users. Profits from selling the products were shared between the district and village technical advisors.

5) ***What is the optimal role for LIRE in this market toward market players and other stakeholders? (capacity of LIRE and innovations)***

LIRE performs various roles in this market toward market players and other stake holders. One of the optimal roles is to be a capacity builder. LIRE exploited bottom up approach to interview and identify training needs of shop keepers and technical advisors for training and formulate strategy for intervention. Finally, it could select the project participants in consultation with local authorities according the project characteristics and the expected results.

While providing training to these people, LIRE has tried to influence shop owners for supply side. It has introduced new technology such as ELC and better quality pico-hydropower products to shop owners as well as pico-hydropower installation and user manuals in order to make available at their shops. In parallel, it has tried to stir up the demand side by giving training and manuals to technical advisors who most of them are end users in order to let them know the availability of the products and technology. As consequence, there is a starting demand of ELC in Phongsaly where purchase orders were made through district and village technical advisors to shop owner.

Over te longer term LIRE will increasingly act as a platform for stakeholders in the energy subsectors of the Lao PDR, rather than making the kinds of direct interventions included in this project. This is a necessary move in order to maximise the impact of LIRE's cumulated expertise and information, especially given the small size of LIRE. Another reason for prusuing this opportunity is that ther are very few such linking organisations in the Lao PDR that are equally adept at serving the public and private sectors.

6) ***Does improvement of the safety and quality of turbine and installation lead to increase in number of end-users?***

Pico-hydropower systems are one of the cheapest electricity sources in the isolated rural areas. However end users are usually discouraged to install them due to they see that the current “hand made” installations of their neighbours are not as reliable as expected. The program aims to improve the efficiency, quality, security and reliability of the installations by means the understanding of the pico-hydropower systems and the introduction of good quality products. Workshops and practical demonstrations during the field trips showed the benefits of pico-hydropower to the end users. However, it showed that improvement of safety and quality of turbine and installation provided by village technical advisors create demand for improvement of existing systems and for new system, but does not indicate at what speed.

Through working to dispel misconceptions of pico-hydro technology limitations, raising the profile of the technology for rural communities by demonstrating government interest, and lore directly by improving installation practices in the target areas, this project has increased the uptake of pico-hydro technology. Safety and quality issues are often related for this technology. For instance, inappropriate choice of transmission line is both unsafe and wasteful. Improving the quality and

safety increases the power output of individual turbines and the period of time that they can operate. This increases the number of people that can utilise electricity, and may encourage informal sharing between neighbouring households. Similarly by making better use of available water resources, more turbines can be installed.

6.2 Appendix II: List of Deliverables

#	Description deliverable	Status	Remarks
1	Final Report	done	First draft sent on 28.12.2010, Revised for Final sent on 18.03.2011
2	Updated Pico-hydropower-hydro Toolkit	done	
3	New Provinces Assessment reports	done	
4	Workshop materials	done	
5	Actor Profiles shopkeepers involved in coaching trajectory	done	
6	Training material Technical Advisors	done	
7	Actor Profiles Technical Advisors	done	
8	Installation and Use Manual	done	
9	Report ELC tests (including end-user profiles)	done	
10	Policy brief	done	
12	Quarterly reports	done	
13	Trip to Vietnam Report[1]	done	
14	Training in Vietnam Report	done	
15	All final documents	done	All documents in one CD sent on the 28.12.2010

1 See Appendix 3: Term of Reference for Technical Officer to Vietnam for market survey and site exploration

6.3 Appendix III: Minute of Project Completion Workshop

Date:	**28/10/2010**	**Location:**	**Settha Palace**
Recorded by:	Hattaphone S. and Tom K.		
Attendees:	Link1: \\lire\5. Short_cut_Hydro_programme\0. Administration\National Workshop\Participant_new_list		
Presentation file:	Link2: \\lire\5. Short_cut_Hydro_programme\0. Administration\National Workshop		
Pictures and voice recorded:	Link3: \\lire\5. Short_cut_Hydro_programme\0. Administration\National Workshop\Pictures & voice recorded		
Subject of Meeting:	Project Completion Workshop Pico-hydropower Innovation and Capacity Building Program		

Minutes of Meeting

Item 1:	LIRE-ETC project
Project completion workshop Pico-hydropower Innovation and Capacity Building Program	➢ **Sign Up & Registration** ○ The registration started at 8:00 am to 8:30 am by Hatthaphone Sisouvong and Soulideth Luanglath. ➢ **Opening speech for the workshop.** ○ The workshop was opened by Mr. Saleumphon Vongsakhamphoui, LIRE director. ➢ **Workshop introductory presentation.** ○ The workshop content was presented by Mr. Thongsanti, LIRE Managing director or Pico-hydropower project manager, and Mr. Sopha Soulinyadeth, Project technical officer. Both are also act as the translator. ➢ **Comments and Questions** Mr. Ilari Sohlo, FAO: Has LIRE thought of working across agencies & industries, for example forestry, to fund these best practice projects? Mr Thongsanti responded by mentioning that LIRE is continually engaging other agencies, NGOs, and the government on collaboration to spread the lessons learnt and best practice techniques across Laos. To date there has been no collaboration with forestry but this could be looked into in the future. Mr. Keo Chanthalangsy, World Vision: Voiced his opinion on the need of electricity for people in remote areas, and Pico-hydropower can be fulfilled this gap. He had two questions; 1) if LIRE does not have the base funding, how LIRE will have an efficiency distributing the information from their research or project? 2) Why does LIRE not get financial supporting from the government to do the monitoring and evaluation? Responded to the two questions by Thongsanti was that despite the fact that LIRE does not base funding, LIRE will keep on seeking for fund from other local and international organization to support the research. At the moment,

what LIRE can do is to integrate activities for a field trip. For example, if LIRE has other project other activities in the same province, LIRE could take an opportunity to take a visit for monitoring and evaluation. At the moment, LIRE is monitoring the demonstrated project through phone call. Despite the fact, government does not provide financial support to the shared pico, however, the provincial government, especially the Provincial Department of Energy and Mines does provide technical and managerial support to the project team, including coordination and site accompany.

Mr. Ketvilay Phomaly, Huaphanh's PDEM: expressed his appreciate on behalf of the PDER that the project has conducted in Huaphanh province and help to building capacity of local people and for the help in the construction of the shared pico in Angsang village, Viengxay district, Huaphanh province. He would like LIRE to continue supporting and have more projects in Huaphanh provinces in order to enable villagers in rural areas can access to the electricity, and also to help PDEM reach their goal that villager should access to the electricity by 70% in 2015, and by 90% in 2020. In fact, suggested by Thongsanti, LIRE needs to see its roles. LIRE mission and roles are more like a research institute which aims at provide information for the public. It does not provide or supply hardware or financial support to people, but rather a capacity building and sharing knowledge and experience and document giving. Nonetheless, LIRE would provide, whenever possible, to technical support to the government.

Mr. Bae PHEAXAY, Faculty of Environment and Social Science: congratulate for the completion of the project implementation. He wondered on the presentation that there were 4 main programmes in the slide, but just only Hydropower was presented. He was interested and would like know more on other programs in LIRE. Explained by facilitator, Thongsanti explained that the reason for not giving details of the rest three programs such as bioenergy, waste water treatment and solar water purification was that main aim of the workshop today was to disseminate the result of the implementation of the pico-hydropower innovation and capacity building program phase 2.

Mr. Saleumphone LIRE Director: explained more on the LIRE's vision and what is LIRE doing. LIRE is just a platform of expertise and technology, we are not yet unable to provide financial support to local. Financial support of course is important for conducting research activities. We did not mean that we are at best in implementing activities in the three provinces, we still need your comments for improving activities and transfer knowledge to others.

Mr. Sengthavy Sihaphone, Poverty Reduction Fund: mentioned that there is high demand for pico-hydropower in rural areas. He further commented that LIRE should have the implementation service because LIRE has the capacity and very experienced staffs. In his sight, the donor is interested to work with LIRE, but as LIRE has only consulting and research service which cannot convince or gain donor's confidence to provide funding, which is not large for pico-hydropower. The donor would like to save money from hiring consultant as much as they can in order to directly use that money to help poor villagers and build the project. He insisted that LIRE is specialized in pico, as he sees no other, therefore should be pico-hydropower implementation agent as well.

Mr. Xayyaphet Sonephet, Lecturer from Lao-German Technical School: agreed and would like to cooperate with LIRE on the ideas to create the curriculum on

renewable energy, focussed on Pico-hydropower and solar panel. All technical schools in 17 provinces in Laos are supported the curriculum from Lao-German technical school, so if LIRE and Lao-German school have a cooperation it would be wide benefit for other technical school.

Mr. Xaysavanh, Xiengkhaung's PDEM: would like to comment on pico-hydropower innovation and capacity building project that if there is a project continue in the future, it is recommended to change the target district from Khoun district to other district like Nonghet district or villages in remote area in order to train more village technical advisors to be aware of pico-hydropower safety and technical part. The reason of changing target district is because of the present target district and most villages will reach the main grid soon. Thongsanti responded that before launching activity in Xiengkhuang Province, the project team had approached the PDEM to seek for advice and suggestion for selecting target districts. One of criteria for selecting a target district shall have no access to main grid at least the five years was explained to both provincial and district authority. Khoun district was recommended for a target district. At the end of the project, during the monitoring and evaluation trip to Xiengkhuang in October 2010, it was astonishingly found out that the grid was installed along the main road within Khoun district. Local people are just waiting for house connection. The project team leader accepted, if a project is continued, it would probably change the target villages or district as recommended by Xiengkhuang PDEM staff.

Mr. Tom Koskella, LIRE: How will LIRE manage to share this valuable project with other interested partners in the mid-term (2-15 years)? The knowledge contained in the manuals and Angsang best practice needs to be available for future initiatives. In many cases, capturing this knowledge and sharing in the future is incredibly difficult in practice, once people move on to other areas of interest. Mr. Thongsanti: Acknowledged that this is a challenge for LIRE and in the short term always spreads information on partner websites etc. There is no easy solution for maintaining this advertising after the first year or two hence LIRE does need to work on finding a solution of sharing in the long term.

Boualaphanh, a monitoring and evaluation staff from Helvetas: commented that there are various rural development projects. But most of projects are not energy-related projects. In order to transfer the lesson learnt, LIRE can propose this lesson to integrate into those projects to achieve the goal of reaching 90% to be electrified throughout the country.

- **Closing speech for the workshop by Mr. Thongsanti B.V.**

6.4 Power Point Presentation of Project Completion Workshop

(please, see next pages)

Project Completion Workshop Pico Hydropower Innovation and Capacity Building Program

28th October 2010, Somha Palace Hotel

By: Thongsavanh B. VONGSALY
S.Sopha

Presentation Outline

1. Introduction of LIRE
2. LIRE programs in brief
3. Hydropower background in Laos
4. Pico program
   1. Shared pico-hydropower in Angsang, Viengxay, Houaphan
   2. Pico hydropower innovation and capacity building program
5. Conclusion

1. Introduction of LIRE

- A platform for research and development
- An institute for applied research
  - Lao social professional non-profit association of 5 members, set up in 2006
  - Operation under LUSEA (under Prime Minister's office)
  - No base funding
  - Independent programs and on-demand research for NGOs, private sector & government)
  - Fully authorized to work in the Lao PDR

LIRE's Mission

Objectives: to explore, develop and sustain effort for making Laos develop its renewable energy sector

Through:

- Training and local capacity building to local people
- Research and implementation on RE:
  - Research and development at the pre-commercial stage
  - Identifying market opportunities
  - Mobilization of all different technologies and the coordination of all stakeholders from public and private side
  - Sustainable implementation models and service packages
- Providing a local platform for all stakeholders involved
  - Knowledge exchange network
  - Technical advice
  - Feasibility studies
  - Monitoring and evaluation
- Policy support and development

Personnel composition

- Lao and foreign experts
  - 20 staffs: foreign and local

LIRE Members

Sunlabob

Lao Promotion Organic Product Association

TRI

LIRE Partners

AIR

ETC

ourworld

GEXSI

FACT

RE impact

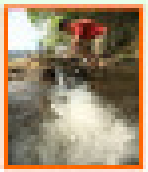
2. LIRE Programs

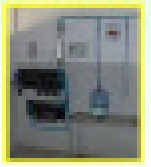
Bio-Energy

Hydropower

Wastewater treatment

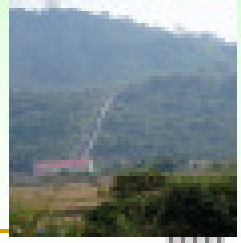
Solar and water supply





3. Hydropower in the Lao PDR

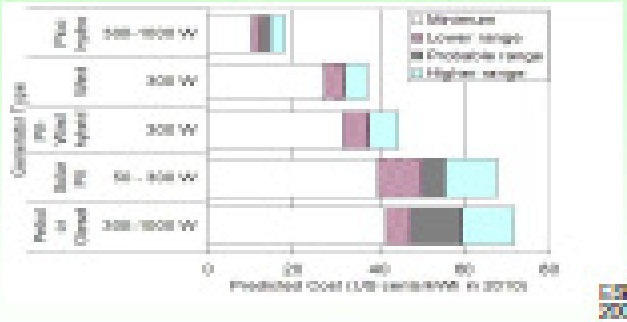
- Hydropower
  - Large
    - Installed: 1730 MW, under construction 1210 MW, potential 30,000 MW
    - Interest from foreign investors – IPP driven
    - Export oriented (30% for domestic market)
    - Environmental and social disruptions
  - Micro + Pico
    - Great location potential
    - Limited number of sustainable implementations, especially small scale (<100 kW, 21 out of 30 failed)



3. Hydropower in the Lao PDR (Cont.)

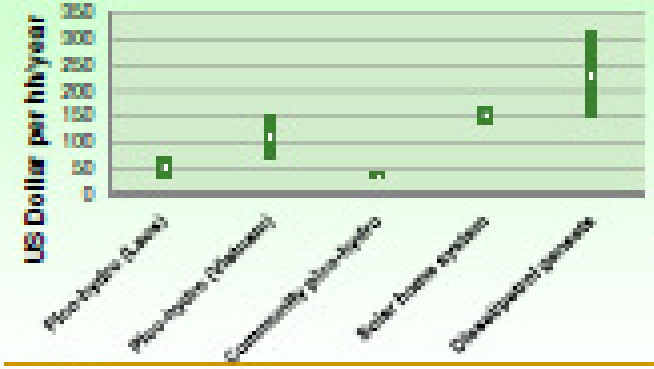
* Turbine <5Kw , Pico hydro, widely-used in rural areas
* 40.000 – 60.000 units believed installed
* Limited support from local authorities or development organizations
* Poor safety, reliability, and quality
* Opportunity to enable access to energy through market oriented approach

Pico Cost compared to other types of energy



ESMAP, 2003

Financial analysis pico-hydropower



ESMAP 2003

4. Pico program

4.1 Shared pico hydropower system in Angsang village – demonstration project

4.2 Pico hydropower innovation and capacity building phase 1 & 2 (2008-2010)

4.1 Shared pico hydropower system in Angsang village

- Construction funded by German Embassy & BORDA
- Implementing Partner: Sunlabob Renewable Co., ltd.
- Location: Angsang Village, Viengxay Dist., HP
- Two one-kilowatt turbines
- 24 households connected (123 population)
- 4 communal buildings serviced

4.1 Shared pico hydropower system in Angsang village (Cont.)

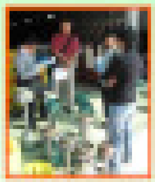
- Managed by villagers
- Model system for research and replication
- But, no funding for further monitoring and evaluation

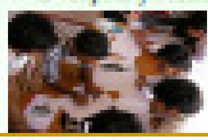
Lesson Learnt

- Supply chain problems of spare parts
  - Phillips light bulbs, current limiters, ELCBs
- Communication and monitoring
- *Attach Promo movie (here)*

4.2 Pico Hydropower Innovation and Capacity building

- Funded by ETC Energy, Dutch NGO
- Phase I (Nov 2008 to Apr 2009)
  - Field work in target provinces
    - Users
    - Shopkeepers
  - Determine most effective intervention strategy
  - Capacity building of LIRE (involving students)



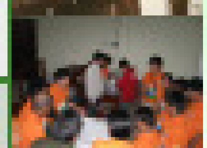


Pico hydropower activities

- Phase II (May 2009 to Nov 2010)
  - Roll out program in four target areas in Laos
    - Xiengkhuang province: *Phonesavanh, Kham, Khoun*
    - Huaphanh province: *Samneua, Samtay, Viengxay*
    - Phongsaly Province: *Phongsaly, Bounneua, Bountay*
  - Four main activities:
    - Training for shop owners
    - Training for technical advisors: provincial, district & village
    - Development of pico installation and user manuals
    - Introduction of electronic load controller

Technical Advisors Training

Province	District	PTA	DTA	VTA	Target
Xiengkhuang	Nak	2			4
	Kham		1	12	
	Khoun		1	10	
Houaphanh	Samneua	2	1	5	4
	Samtai		1	5	
	Viengxay		1	9	
Phongsaly	Phongsaly	2	1	6	4
	Bounneua		1	3	
	Bountai		1	5	
Total		*6*	*8*	[illegible]	*12*
Total		[illegible] (trained)			12



P= Provincial
D = District
V = Village
TA= Technical Advisor

TA Training - Impacts

Positive	Negative
Sharing installation & users manuals	Slow up-take of knowledge
Sharing of best practice between neighboring villages	Not really active
Promote themselves for service provision	End users knows and trust in themselves
TA provided installation service – installation & system improvement (how many)	Need of demonstration unit to show village
	Lack of locations for installation

TA Training – Impacts (Cont.)

According to 42 TA monitored in 69 TA:

- Pico system installed by TA after training:
  - 11 units in 3 provinces

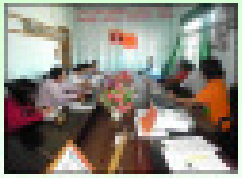
TA Training – Impacts (Cont.)

- Pico system improved by TA after training:
  - 16 improved systems in 3 provinces
- Advice given to other end users:
  - 55 end users advised in 3 provinces

Note: not all target villages surveyed

Shop Owner Training

Province	District	Target	Shop (enlisted)
Xaysomboun	Paek	5	4
	Khem	5	4
	Khoun	5	0
Houaphanh	Xamneua	5	4
	Xamtai	5	5
	Viengxay	5	1
Phongsaly	Phongsaly	5	5
	Boontaeu	5	6
	Khoua	5	6
Total		40	32

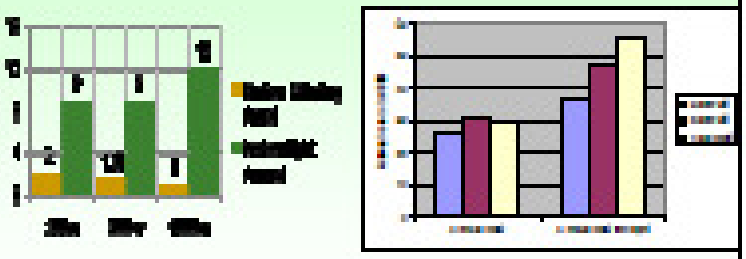


Shop owners training - Impact

Positive	Negative
Product advice	Sales drop due to grid expansion & pico market saturation
Re points of distribution of installation and user manuals for clients and end users	Low uptake of new recommended products – expensive & familiarity of existing products
Sales of more insulated cable	Quality goods – expensive VS low income end users
	Need more demonstrations
	Lack of locations

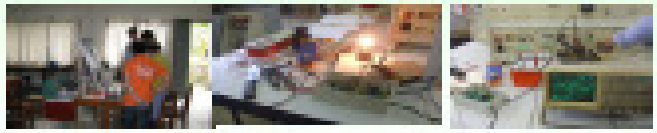
Introduction of ELC

- Why introduce ELC?



Introduction of ELC (cont.)

- Field test
  - First test: Namsuang Village, Kham district, Xieng Khouang province (4 weeks: from 22 May–28 June 2009)
- Laboratory test: Faculty of Engineering, National university of Laos



Introduction of ELC (Cont.)

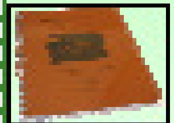
- Second field test:
  - IHR and Leonic ELC tested
  - Two villages – two districts: Kham and Khoun
- Period: 29/09-29/10/2009
- Results:
  - 8 broken light bulbs one month before ELC installed
  - No broken light during a month of testing

Introduction of ELC - Impacts

Positive	Negative
ELCs sold only in Phongsaly - 4 units installed - 4 units ordered from Vietnam	Specific ELC recommended by LIRS: too expensive
ELC distributed and sold by TA– good initiative	No trained shops selling ELC, except single location in Boumboy district
Demand just started – interested by end users e.g some order made through DTA	No ELC supplier in local market
	Perceived as expensive- Poor cannot afford it
	Still new technology

Installation and user manuals/VCD

Province	District	Manual Distributed	Training VCD distributed	Poster Posted
Xiengkhouang	Pek	137	14	15
	Khoun	281	11	17
	Kham	346	19	22
	Non target dist.	180	-	6
Houaphanh	Xamneua	317	19	22
	Viengxay	214	12	19
	Xamtay	491	19	23
	Non target dist.	250	-	6
Phongsaly	Phongsaly	181	18	18
	Bounneua	178	20	20
	Bountai	190	19	33
	Non target dist.	250	-	-
Non target prov.	Udomxay	70	2	-
	Champasack	60	1	-
Total (3000 target)		3003*	154	200



Installation and user manuals/VCD

Positive	Negative
Distributed to provinces, districts, village development groups, village, end users - More accessible by end users	Most of manuals are at village development groups
End users borrow manual to improve their systems – demand for manuals	Illiterate can refer to pictures in manual only
Reference for system improvement	Black and white manual – color needed
VCD help literate and illiterate villagers to understand easily	Limited number of VCDs produced

5. Conclusion

- Challenges
  - Can we reach 90% of electrification by 2020
  - Lack of locations for installations exist
  - High cost for individual system, one person paying for hardware
  - Difficult to change behavior/beliefs when they already "know" how to install a system

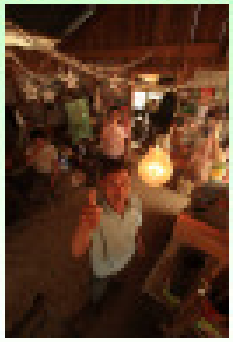
Possible solutions

- More awareness raising & promotion of pico technology and quality products
- Capacity building:
  - Formal - Vocational and technical school (development of curriculum)
  - Informal - local technicians/end users, specifically training on installation, operation and maintenance

Possible solutions

- More research:
  - Technology e.g. free standing installation,
  - Supply chain: cheaper and better quality products thanks to locally produced accessories such as draft tube & draft channels
- Promotion of shared pico model in order to increase access to electricity in off-grid areas
- Strong government support/international organisation of this technology
- Public Private Partnership

Thank you for your attention!



Questions ? and Discussions

Contact us: contact@lao-ire.org

6.5 Appendix V: Monitoring Protocol

Strategy 1:	**EASE ACCESS - Building local markets for energy access**		
	Indicators	**Targets 2010**	**Source of Verification**
Output:	1. Number of supported technicians: 2. Number of additional target installations: 3. Number of additional people in poor households benefiting for household use : 4. Number of supported Energy Access Providers: *5.* Number of additional people in poor households benefiting for productive uses : *same as above*	*1. 32 hardware shops selling pico turbines and other related product* *2. 73Technical Advisors at provincial, district and village levels + 4 technician at Angsang* *3. 82 (40 villages x 2 installations/ village and 2 shared system in Agsang)* *4. 861 (82 installation x 6 people per household x sharing factor 1.5) + 123 (Angsang Share Pico systems)* *5.* Same as above	Project reporting, reporting from field visits Final Report Shared Pico-hydropower System Report
Outcome:	Increase in number of people in poor households acquiring modern energy products. Number of interviewed households, affected by shop owners	Per country: - 50,000 people for household, social and productive uses *(baseline to be established before the start of each project)* People reached: 600 (114 hh * 6 people/hh) + (32 shops * 10 hh * 6 people/hh) + 1008 baseline = 3.612	Sales information and/or client lists from supported suppliers, specified in household, productive and social use. Deliverables: idem
Sustainability:	Dependence of energy access suppliers on short term subsidies for survival *(target 2010: 0)*		

	Capacity building and provision of pico installation and user manual Technical advisors are based in target villages, service are provided and knowledge is transferred		
Gender balance:	Percentage of women among energy access suppliers and technicians *(target 2010 40% for suppliers resp 30% for technicians)* • Most shopkeepers ran by man and woman, so 50% • Although technicians are all men (so far no woman has been identified as technical advisors), but roles of women are as safety reminders of their spouse and to be accountant of the family and that most women are financial controller at home • Involvement of women as ELC tester (33% is women)		
Risk:	Number of market developers and players losing interest and abandoning the market • Loss of interest because of grid expansion in some areas • No continuation of provision of technical advice, provision of hardcopy of pico-hydropower power installation and user manual		
Strategy 2:	**EASE CONTROL - Beneficiaries have control over their energy access to ensure 10year sustainability**		
	Indicators	**Targets 2010**	**Source of Verification**
Output:	1. Number of improved installations 2. Number of existing people in poor households benefiting for improved productive uses: 3. Number of people in poor households benefiting from improved social uses (schools, health centers) 4. % subsidy energy entrepreneurs receive (of their 100% total investment) 5. Number of male entrepreneurs supported: 6. Number of female entrepreneurs supported:	1. 2849 = *2527 (target number of manuals) + 154 training VCD + 168 baseline* 2. 25,641 (2849* 6 people per household * sharing factor 1.5) 3. teachers (teacher accommodation) 4. *No subsidy given so far* 5. 32 males 50% 6. 32 females 50%	Project reporting, reporting from field visits **Deliverable:** 1. 1, 2 & 3 quarterly reports 2. Shared Pico-hydropower System Report 3. Final report

Outcome:	End-user satisfaction • Improve satisfaction due to maintenance and electricity output • Interests of end users in obtaining installation and user manual • Positive feedback from training • Number of people reached:	80 percent (*baseline to be established during inception of projects*) • 738 (derived from 82 additional installations x 6 people per household x sharing factor 1.5) • 2849 manuals • 105 = 73 technical advisors + 32 shop owners gave feedback during training • 5,988 (1008 from the first phase + 180 (30 hh*6people/hh) + 4,800 (8 shops*10 hh*10hh*6 people/hh)	Sample surveys, focus group feedback, complaint handling on market level • Actor profile (End-Users) • Training material Technical Advisors • ELC field trip report No.10 • 1, 2 & 3 quarterly reports • Final report
Sustainability:	Number of rural suppliers who include targets and measurement of customer satisfaction in their normal business practice *(target 2010: 50%)* Distribution of Pico-hydropower Installation and User manuals and of training Video CD		
Gender balance:	Percentage of end-user satisfaction measurements taking into account both male and female end-users *(target 2010: 100%)* Idem		
Risk:	1. Other energy projects with conflicting approaches reduce opportunities for end-user control (e.g. using heavy subsidies in promotion of similar products obscure buying decision making process of end-users) No other projects on pico-hydropower yet. Threat of grid extension as the result of Rural Electricity Project only. 2. Rural suppliers do not take up role in managing customer satisfaction End-users and shopkeepers could be unwilling to use new and complementary products as the ELC. Communication difficulties due to many shops are owned by Chinese people		
Risk Mitigation:	1. Promotion to these projects of end-user control as core value (target 2010: 100%) 2. Mobilise local facilitators in role of managing customer satisfaction (e.g. CBOs, local government, ..) (target 2010: 100% of markets		

	where suppliers do not take up this role) Local government already involved in the project and willing to take more responsibility		
Strategy 3:	**EASE SHARING - Practical and applicable knowledge base developed and shared**		
	Indicators	**Targets 2010**	**Source of Verification**
Output:	Number of market development toolkits developed and shared • Number of viewers seeing Training movies (Youtube) on pico-hydropower power supply chain shows on LIRE website • Number of Training VCD on installation given to • Electronic Load Controller Report • Final report of phase 1 • Annual report 2009, including pico-hydropower section • Number of brochures dissemination • Number of Poster posted	1 per market developer (including end-user profile, product description, micro-franchise packages, lessons learned) • 463 viewers • 154 Training VCD on installation distributed • Soft copy sent to ETC • Post on website and more than 20 copies given to visitors and in workshopss • Posted on website and more than 100 copies given to international and national organizations and in workshops • 330 copies distributed • 200 copies	EASE toolkits available at ETC • Final report • Youtube website • Final report • LIRE website • LIRE website • Actual counting • Final Report
Outcome:	Number of market developers that acquire the EASE toolkits	500 market developers worldwide	Sharing statistics on EASE toolkits; download-webstatistics;

	Number of market developers		
Sustainability:	Number of (elements of) EASE toolkits embedded in external energy projects or promoted commercially in an expanding franchising operation *(target 2010: 50% of market development projects and businesses in countries of operation)*		
Gender balance:	Toolkits make specific reference to gender issues *(target 2010: 100%)* Tools developed in this phase will take gender balance into account - *50% males and 50% females as of shop keepers and beneficiaries*		
Risk:	Target actors cannot access and apply toolkits • knowledge and benefits does not to reach targeted population • Relevant parts of the toolkit will be spread through informational workshops, technical advisers and a manual • Pico-hydropower Installation and User Manual may not be sustainable		
Risk Mitigation:	Developed appropriate presentation forms (target 2010: 100% has been tested and improved to have appropriate form) Toolkits promoted through National Advisory Boards (target 2010: 100%) • Developed a manual and business development support tools fitted for the local context • Provide soft copy to Provincial and/or district concerned authority for further distribution upon request • Encourage shop owners to provide further copies of manual and VCD to their clients while imposing certain costs • Manual can be lent out • Publication on website		