ESMAP
Energy Sector Management Assistance Program

Workshop Proceedings 009/10

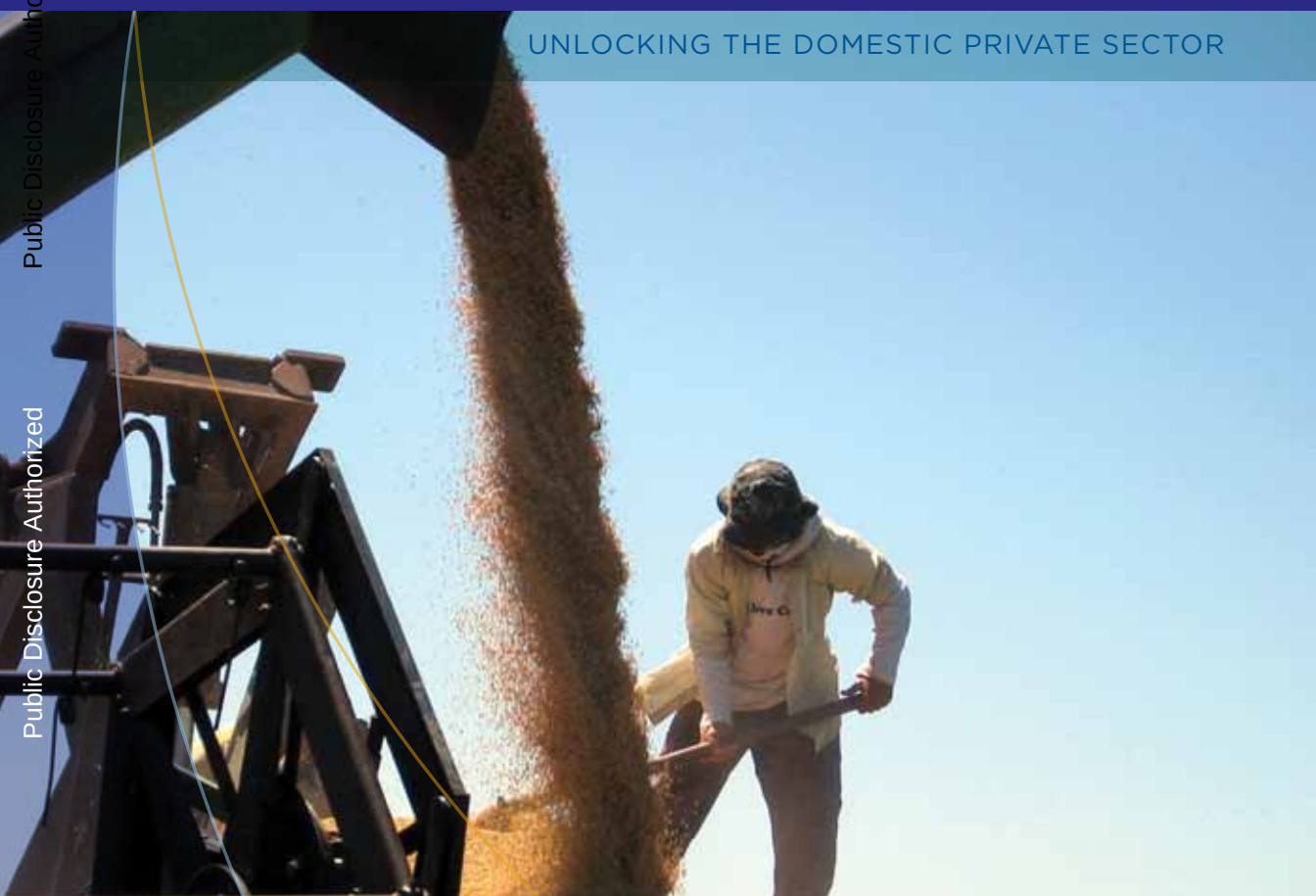
77432

Fighting Poverty through Decentralized Renewable Energy

Energy SME Conference | Phonm Penh, Cambodia

ENERGY SMALL AND MEDIUM ENTERPRISES PROGRAM

UNLOCKING THE DOMESTIC PRIVATE SECTOR



ENERGY SMALL AND MEDIUM ENTERPRISES PROGRAM

Fighting Poverty through Decentralized, Renewable Energy

Decentralized energy services remain at the forefront in the fight against poverty. Small and medium size enterprises (SME) are driving this effort to provide an alternative to state-owned utilities and other large energy providers in poor and developing countries. SMEs allow entrepreneurs to provide alternative energy supply in remote and rural areas while also providing jobs, lowering energy costs, and reducing carbon and other greenhouse gas emissions.

SMEs' role in this effort and related issues were detailed on April 6-7, 2009, at the Energy SME Conference, in Phnom Penh, Cambodia, sponsored by the Energy Sector Management Assistance Program (ESMAP)—a global trust fund program administered by The World Bank. The conference provided a forum to discuss the specific role of SMEs in the energy sectors of Cambodia and Lao People's Democratic Republic and establish a blueprint for SME involvement in alternative energy products and services in other countries.

ENERGY ACCESS: A GLOBAL ISSUE

Lack of access to adequate energy supply affects as much as 90 per cent of the population of many developing countries. Some 1.6 billion people globally are without electricity while a similar number remain dependent on biomass fuels—such as wood, charcoal, animal dung, and crop residue—to cook daily meals. Inefficient use of traditional energy sources—such as wood and agricultural residue—pose economic, environmental, and health threats to the world. Rising urban and industrial demand for energy is outpacing the rate of investment in new energy technology, creating an energy supply shortage. Despite large government investments over many years, access to energy services remains limited. Even where reforms have been made, there is little evidence they have improved or expanded services to poor communities.

Electricity services monopolized by large, state-owned or privately owned utilities fail to meet the needs of most rural and periurban populations. This has created opportunities for the private sector to work in the energy field as independent power producers and service providers. SMEs managed by local entrepreneurs are often more flexible in the use of technology, use locally available resources, and understand better the needs of end users. For

instance, where there is no utility company to service a rural area, an SME energy provider may offer rural clients off-grid power, such as solar or small hydropower stations to recharge batteries for small household appliances.

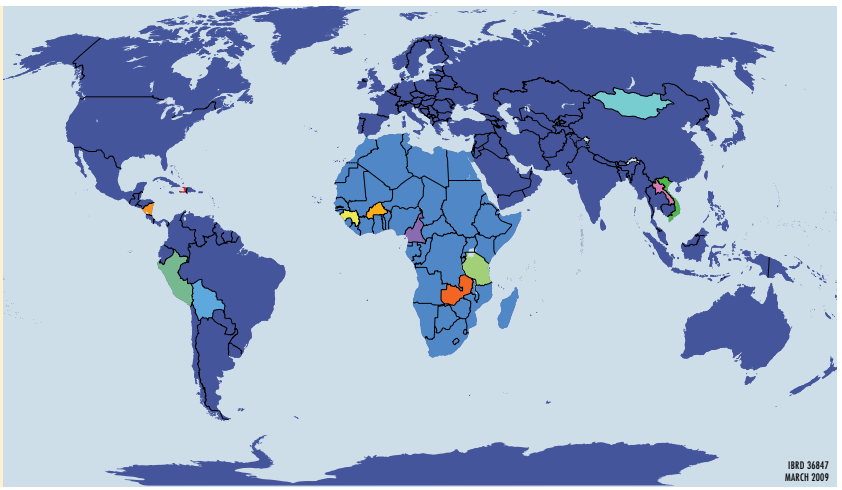
ESMAP ENERGY SME PROGRAM: Unlocking the Domestic Private Sector

ESMAP's Energy Small and Medium Enterprise Program[1] (ESME), implemented with a grant from the Department of International Development (DFID), supported governments' engagement with SMEs to provide access to sustainable and affordable energy services in small towns, periurban, and rural areas. ESME was designed to help countries unblock the factors that prevent their local SMEs from supplying electricity to households, public facilities, or businesses with limited or no access to electricity. The program focused on reducing biomass use and improving off-grid electrification to relatively isolated communities and households yet to be electrified and for whom off-grid electrification may be the only economically rational choice. The program aimed to leverage ESMAP's international experience and knowledge base to address local circumstances and challenges. ESME provided institutional and project-level support, building capacity among local private sectors and governments through partnerships with international companies and experienced rural energy development agencies. During the design and implementation stages of these pilot projects, ESME identified obstacles that prevented the economic scaling-up of local SMEs and the investments needed to supply these energy services.

SMEs delivering energy in lower income economies is a relatively new phenomenon. As in many new enterprises, SMEs face several constraints, and a

Figure 1: ESMAP's Completed ESME Activities

- Bolivia
- Burkina Faso
- Cambodia
- Cameroon
- Guinea
- Haiti
- Lao PDR
- Mongolia
- Nicaragua
- Peru
- Tanzania
- Zambia
- Lighting Africa Regional Program



[1] For more information on the program, see presentation 1 by Marlon Lezama, Global SME Program Coordinator: *Unlocking the Domestic Private Sector: Overview of ESMAP Energy SME Program* on enclosed CD.

number of country-specific studies were made to identify barriers to entry. The studies' results showed, first, that SMEs were operating within outmoded or nonexistent legal and regulatory frameworks, often without adherence to quality standards or guidelines. Second, market rules favoring large utility companies excluded SMEs in many countries. Third, a lack of funds and access to financing made it difficult for SMEs to make capital investments and overcome high transaction costs in the energy industry.

ESME's approach to removing barriers facing energy SMEs embraced a holistic view of the industry. The framework for this program was based on experiences over a two-year period during which ESMAP supported 13 energy projects in 12 countries and 1 regional initiative in Africa to address economic, institutional, and technical challenges facing SMEs (Figure 1). Although results of the initiatives varied widely from country to country, they demonstrated opportunities for scaling up activities in some countries. Figure 2 illustrates ESME's six-step process for providing technical assistance to local stakeholders.

ENERGY SME CONFERNCE | Phonm Penh, Cambodia

ESMAP's Energy SME conference drew more than 80 participants, including energy SME entrepreneurs, nongovernmental organizations (NGOs), policy decisionmakers, and donors. Discussions focused on details and achievements of pilot initiatives; implementation challenges and various issues facing SMEs; lessons learned; best practices; and recommendations on how SMEs can scale up their energy services programs and efforts to the national level.

Conference Presentations

In his opening remarks, His Excellency Ith Praing, Secretary of State for the Cambodia Ministry of Industry, Mines and Energy, spoke of developing energy alternatives in rural communities as a means of eradicating poverty. At the same time, he stressed the need to address the problems of increased pressure on forest resources from new technologies, such as biomass gasification, and the lack of effective regulation in the energy sector.

Figure 2. ESME's Framework for Empowering SMEs

Conference presentations[2] were structured around six main themes of energy supply:

1. Energy Efficient Cook Stoves
2. Biomass Energy
3. Solar Lanterns
4. Hydropower
5. Technical Assistance to Rural Electricity Enterprises
6. Public-Private Partnerships

1. ENERGY EFFICIENT COOK STOVES

The burning of wood accounts for 90 per cent of total energy consumption in Cambodia, with 2.1 million people in rural areas using inefficient wood-burning stoves. Wood for cooking is obtained from nonrenewable sources, contributing to deforestation. Moreover, gathering wood for fuel is time consuming and physically draining work, frequently carried out by women and children, diverting them from more productive activities like farming and education. Traditionally in Cambodia, wood for fuel has been gathered freely, but this is changing as supply dwindles. More and more people living in rural areas must buy wood. This underscores the importance of improved biomass stoves in Cambodia, which require less wood than traditional wood-burning stoves. The use of more energy efficient stoves has been an important step in the country's transition to a more environmentally friendly and sustainable energy structure.

"When I used the Neang Kongrey Stove and traditional Lao Stove [which she used previously] at the same time, I recognized that NKS uses less firewood than NLS and it cooks quickly. So, I decided to promote the NKS."

—A female rice wine maker in village E, Kampong

ESME supported two pilot trials of biomass stoves in rural Cambodia. The first project introduced the Neang Kongrey Stove for domestic use in rural homes; the second introduced the Vattanack Stove for commercial production of granulated palm sugar.

Energy Efficient Cook Stove Pilot | Neang Kongrey Stove

See presentations by: Ayako Hiwasa: ***Gender Analysis of Households Energy Projects: Improved Cook Stove Dissemination & Production, LED Lantern, and Biodigesters***

S.Y. Iwan Baskoro: ***Rural Improved Cook Stove Dissemination and Production Facility***

ESME contracted the NGO, GERES Cambodia, to conduct a survey of the supply chain of cook stoves with the goal of commercializing improved cook stoves in rural areas. Four cook stoves were selected for comparison—the New Lao Stove (NLS), Baby Samaki Stove (BSS), Neang Kongrey Stove (NKS), and Ba Phnom Stove (BPS). A score was calculated for each stove based on price, fuel-saving characteristics, biomass source, and durability, among other qualities, deemed important for energy efficient stoves.

Ultimately, the NKS was selected for distribution to rural villagers. All four prototype stoves had similar efficiency qualities, but the NKS was relatively inexpensive, with a retail price of US$1.25 compared to the NLS

[2] Power Point presentations can be found on the enclosed CD in PDF format.

at US$3.50. Further, its manufacture depended on clay-stove making skills already possessed by many women who make the traditional stoves. Village officials arranged for delivery of 7,000 stoves to villagers, NGO farm extension workers, community market representatives, community savings groups, and grocery stores.

The trials were not without challenges and many problems surfaced. During the project's early stages, supply-chain limitations caused a shortage of stoves. Quality issues surfaced as stoves were produced without quality control standards. Stoves had folds, cracks, and ill-fitting grates. As a result, about 20 per cent of the stoves were rejected by households. Additionally, production facilities were concentrated in Lao Kampong Chhnang Province, raising manufacturing and distribution problems for retailers in other parts of Cambodia. Many stoves were damaged during transport, resulting in higher prices to the end user. Also, NKS proved too small for the needs of an average Cambodian family of five. Customer feedback communicated the need for a larger stove for cooking enough rice for the family's main meal. Retailers of the stoves also faced problems, mainly due to little working capital. Many retailers lacked the funds to invest in warehousing or other storage options to maintain inventories and to advertize and adequately market and promote the stoves.

To address these problems, GERES Cambodia, with support from The World Bank's Asia Sustainable and Alternative Energy Program (ASTAE), set up a model production facility that used mechanized clay mixing, improved molding techniques, and kiln firing. The aim was to produce a better quality stove, pay fair wages, and reduce costs to ensure affordability by all households, including the poorest. The facility also provided training to women potters to allow them to work at home, established a potters' cooperative, and introduced a daily deliverable/payment schedule.

Energy Efficient Cook Stove Group Discussion

To scale up the NKS Cook Stove program to the national level, quality and distribution problems were addressed. GERES Cambodia proposed a national "efficient cook stove" program to establish 26 regional manufacturing facilities. All manufacturers would require licensing. Stoves brands would be developed and brand recognition would be promoted through advertizing and on TV, radio, and at village cooking demonstrations. A credit fund would be proposed to support distribution and sales costs. The program would be monitored and evaluated using specific indicators, including the number of sales, distribution costs, efficiency, and durability.

It was determined that a national program could bring energy efficient cook stoves to Cambodia's 2.1 million rural households and greatly reduce the impact of smoke inhalation on the health of women and children.

Commercial Cook Stove Pilot | Vattanak Stove

See presentation by Ruben Mahendran: ***Marketing Granulated Palm Sugar with Highly Efficient Post-Combustion Cook Stoves***

"In this village, the villagers do not have stoves. They just use three stones for cooking. Now I use two NKSs here [in front of her shop], so when the villagers come to buy something at my shop, they can see that it will save them firewood; then they buy it."

—A female grocery seller in village D, Kampong Siem

Sweet sap from the Borassus Flabellifer palm tree has been used traditionally to produce a semi-liquid sugar paste, sold in Cambodia's markets as a food sweetener. This paste has a short shelf life and requires further processing into granules to add value. In the past, producers have been unable to effectively convert the paste to granules because of the intensity of traditional stove fires, often causing the paste to burn.

GERES Cambodia, with ESME support, developed a technique to distill the palm sugar paste to produce granules. It also developed an improved palm-sugar production stove—the Vattanak Stove, a gasifier burner. With an output of 30kW of power, pilot users of the Vattanak Stove saved 30 per cent of fuelwood compared to traditional stoves. The Vattanak Stove consumed less biomass, produced less smoke, and eliminated the wasting of precious sugar paste that often occurred with traditional stoves. The introduction of the Vattanak Stove and the new palm sugar distilling process fostered a partnership between GERES Cambodia and EcoBiz, a company that specializes in locating markets for granulated palm sugar. They helped SMEs design attractive packaging for the granules and expanded marketing of the product to restaurants and supermarkets. Additionally, a payment schedule was created to help producers acquire the stoves.

Commercial Cook Stove Group Discussion

The Vattanak Stove was found to have potential use in other small-scale production operations, such as distilleries, noodle makers, rice wineries, and soya bean processers. Several recommendations were made for commercializing cook stoves:

- Decentralize production to keep distribution costs low.
- Build production facilities close to markets to prevent loss of product during transport.
- Negotiate with micro-finance institutions to provide lower interest loans.
- Target women retailers, since traditionally women have been more responsible borrowers than men, paying loans back on time.
- Keep production costs low to assure, at the bare minimum, the same benefits and profits seen in the production of traditional stoves.
- Evaluate mechanized stove production, including hydraulic stove pressing, as a possible way to reduce high labor costs and make facilities economically viable.
- Provide quality control training.
- Support stove producers with training in basic skills and best practices in accounting, raw materials procurement, inventory control, and marketing and promotion.

2. BIOMASS ENERGY

Biomass energy has great potential as a fuel substitute in Cambodia's rice mills, ice plants, brick factories, garment factories, and hotels with the potential to reduce diesel fuel consumption by up to 75 per cent. It is particularly suitable for use in the many medium-size rice mills, with production capacity of at least two tons per day. It has the potential to reduce diesel consumption at these mills by 60,000 liters per year, with a savings of approximately US$6,000 per year. Given rice is a staple food in Cambodia, the country has more than 500 rice mills with capacity of more than one ton per hour. If half of these mills converted to biogas, nearly 15 million liters of diesel fuel would be saved each year.

Biogasification Pilot | SME Cambodia

See presentation by Tony Knowles: ***Integrated Biomass Gasification Services, and Increasing Biomass Gasification Investment: 2009–2013***

From May 2007 to June 2008, ESME supported a biomass gasification pilot project, involving a process of extracting energy from organic material, implemented by the NGO, SME Cambodia. SME Cambodia surveyed and assessed 23 rice mills, 2 rural electricity enterprises (REEs), 3 ice plants, and 1 stone crushing plant to determine potential fuel cost savings by installing gasifiers fueled by rice husk. The survey determined, with the change, the rice mills alone could reduce diesel fuel consumption by 50 to 80 per cent. The project also provided operations training and post-sales service support.

SME Cambodia's economic analysis showed biogasification would benefit rice mills more than any other production enterprise in Cambodia, as fuel costs represent about 70 per cent of the mills' operations costs. High borrowing costs, however, made it difficult for rice mills to invest in gasifiers. To overcome this hurdle, SME Renewable Energy, a subsidiary of SME Cambodia, designed a financial package for these mills that included a flexible down payment, a loan term of up to 5 years, and a competitive annual interest rate of 13 per cent compared to the prevailing commercial rate of 18 per cent. It also promoted large-scale investment in biomass gasification in medium-size enterprises by providing funds for a loan program and training to technical and financial managers. SME Renewable Energy also called for establishing and regulating equipment standards and assuring biomass supply was environmentally sustainable. Gasification technology was reviewed to identify gasifiers most suitable for use in Cambodia. Given the poor design and construction of locally manufactured gasifiers, units produced in India generated considerable interest at the local manufacturing level and were targeted for import into the country.

During the pilot, SME Renewable Energy imported, installed, and commissioned 11 gasifier systems; another 18 orders were placed after the pilot program ended. Also, two REEs replaced diesel systems with biomass gasification technology, providing cleaner electricity to more than 2,000 households.

Biodigester Pilots | NBP & BPP

See presentations by Nicolette Matthijsen: ***Building Viable Domestic Biogas Programmes—Success Factors in Sector Development***

Phil Psilos and Yin Sombo: ***Biodigester PSD Through MSE Development—National Biodigester Program***

Pongtip Puvacharoen: ***How the CDM Can Be Used to Assist Small-Scale Energy Projects: An Example from Thailand***

Poon Thiengburanathum: ***Programmatic CDM for Swine Farms Industry in Thailand***

Biodigesters convert organic waste into biogas and liquid fertilizer. The National Biodigester Program (NBP) developed a pilot sustainable business model for Biodigester Construction Companies (BCC). Under NBP, BCC staff were trained to sell and market products and provide post-sales services. Companies were required to legally register before entering into customer contracts. Masons recruited to build the biodigesters were required to show they had experience in their area(s) of expertise, a track record of quality work, and business growth potential.

The Lao Biogas Pilot Program (BPP) was supported by Netherlands Development Organization (SNV), a Dutch development agency. SNV promoted a sustainable biogas sector using a market-oriented approach. The objective was to find the best fit for the use of this technology by analyzing the country's environmental, technical, economic, social, and political frame of reference. Under BPP, Cambodia's Ministry of Agriculture and Forestry targeted biodigesters for 6,600 households by 2010. Each household selected for the program was required to have animals to produce dung for use in biodigesters. To date, about 150 biodigesters had been built.

SNV also considered development of a cook stove for those unable to buy biodigesters.

Biogas Group Discussions

The potential of small biodigesters to improve villagers' health was discussed. For instance, wood and charcoal used for cooking often generate black smoke, which can fill houses. The biodigester program included demonstrations to villagers on the proper use of lighting and cooking equipment to avoid this health hazard. Recommendations made in conference discussions included:

- Use animal farms as "power plants."
- Use community centers, such as temples or schools, as sites to provide information about biodigesters.
- Launch a school slogan, "No toilet, no lunch."[3]
- Local banks and micro-finance organizations should provide financing for poorer households to build diodigesters.

[3] Schools with 20–30 students can generate enough waste to operate a biodigester.

3. SOLAR LANTERNS

Less than 20 per cent of rural households in Cambodia have access to grid-quality electricity. Energy use in these rural areas is inefficient, costly, and environmentally unsustainable. For households without access to electricity, batteries and kerosene are the best available energy sources. Nearly all the people in rural areas use kerosene for lighting and lead-acid rechargeable batteries for household appliances. The relatively high cost of kerosene is a burden on most families, but better, less expensive alternatives are not always available.

Given this situation, ESME supported several solar energy pilots to provide alternative lighting for families using kerosene.

Solar Lantern Pilots

See presentations by Andy Schroeter: ***Solar Lanterns and Hybrid Grids—Paying for the Service, Not the Hardware***

Brahmanand Mohanty: ***Scaling Up the Pro-Seed Lighting Service Report***

Chheang Penghorn: ***Delivery of Energy Service to the Poor***

Jeroen Verschelling: ***Developing Products and Services for Rural Electrification in Cambodia***

The Pro-Seed pilot project was implemented by Centre Krom Ngoy (CKN) and Kamworks, which tested several lanterns already available on the market. CKN found them to be of poor quality and designed a prototype LED lantern that would last for five nights before requiring a recharge. CKN then trained local lighting service providers to rent the LED lanterns in villages. A total of 283 lanterns were rented for 250 riel per day (US$1.83 per month) by 5 local entrepreneurs in 5 villages in Kandal Province. The service providers on average visited 10 families a day to collect the rental fees and replace batteries. Total monthly revenue of US$91 was split between the entrepreneurs and Pro-Seed. Loans for this investment were to be repaid within four years.

Unfortunately, quality issues arose with the LED lanterns. The lanterns were not bright enough and required frequent charging after providing just a few hours of light. Battery charging stations depended on kerosene, an unsustainable option for most villagers. As a result, plans were made to switch to solar power lanterns.

The Research Development International (RDI) Lantern project, in collaboration with a Chinese manufacturer, was based on the redesign of a flashlight using LED lights, resulting in a powerful flashlight for room lighting. Two thousand lanterns were distributed to market retailers while solar panel charging stations were offered for sale, with the option to rent. The lanterns were sold for US$15 each and the solar panels for US$19 each. Dissemination was slow and erratic, with less than 25 per cent of the lanterns sold. Payment for the units was also slow due to the high price.[4]

[4] Higher income households bought these lanterns for supplemental lighting.

The RDI Lantern also suffered from quality problems. Buttons were fragile, LED lights often failed, and the unit was not waterproof. Design was also an issue as the lantern produced light for just a few hours and could not replace kerosene lamps as a night light. The charging outlet was difficult to connect and the lantern itself did not have a "low" mode.

Sunlabob Renewable Energy Ltd., based in Lao PDR, developed a portable battery lantern that had outlets for charging mobile phones and radios. The system was rented out to a village committee, which consisted of Sunlabob-trained villagers. Sunlabob installed the systems and also provided maintenance while the village committee ensured the credible collection of rent. At a cost of US$50 per lantern, households in rural Lao PDR found it too costly to buy or rent. The ESME pilot enabled Sunlabob to incorporate a rental scheme to make the lanterns more affordable.

Research and feedback showed that a strong, water-resistant, affordable LED must be produced before broad dissemination to local markets could occur. Each lantern tested needed design and other improvements while market strategies to sell them were not fully commercialized. Other issues were the high cost of the solar charging station, increasing investor costs, and prices paid by consumers.

Solar Lantern Group Discussions

Observations and recommendations on solar lanterns at the conference included:

- LED lanterns and solar panels should be available on a rental basis. These lanterns have great potential to benefit poor households in rural areas, but many retailers said they could not afford the initial capital to purchase lanterns and solar panels.
- Retailers selling lanterns are dominated by women already running micro enterprises and small businesses at the village level. Many have a low literacy level and lack the capacity to ensure the profitability of their business; these women would benefit greatly from training and capacity-building efforts.
- Rural Electrification Fund (REF) subsidies should be made available to retailers and those in households who want to to purchase (v. rent) their own lanterns.

4. HYDROPOWER

Hydropower plants provide inexpensive electricity while producing no pollution. Unlike other energy sources, such as the burning of fossil fuels, water is not destroyed during hydroelectricity production—it can be reused for other purposes. Traditional hydropower technology has often been used in remote communities for small-scale processing of agricultural produce. Through recent developments, hydropower has become even more cost effective for rural electrification. Additionally, lightening produced from hydropower is safer than kerosene lamps.

Pico Hydropower

See presentation by Jakob Rietzler and Thongsanti Vongsaly: ***SMEs and Renewable Energy in Laos: Perspectives from the Lao Institute for Renewable Energy***

In many areas of Cambodia and Lao PDR, people have a source of falling water but no electricity. For these rural communities, pico hydropower—production capacity of up to five kW—is the lowest cost technology for generating electricity. In some cases, a single pico hydropower unit supplies just one household, while in other instances one unit serves an entire community. Moreover, pico hydropower meets modern requirements for electricity and mechanical power.

There is a high demand for pico hydropower technology, especially in Lao PDR, due to its extensive mountainous areas. An estimated 60,000 pico hydropower units provide electricity for about 90,000 households in these areas. The units are affordable (at less than US$500 each), no tariffs are imposed when acquired, and they produce a high-load factor—high output with a low cost per unit.

At the same time, poor quality, faulty installation, and limited maintenance cause problems, only to be exacerbated by electricity load fluctuations. Frequent maintenance is needed, for instance, with units often being contaminated with river debris. Broken electronic devices and light bulbs pose the risk of injury with several people and animals reportedly electrocuted at the site of these units. Although safety records do not not exist for the pico hydropower units, they often do not conform to Lao PDR electricity standards. Installation is often done by trial-and-error because the units are rarely delivered with instructions or installation documents. When manuals or instructions are available, they are usually written in a foreign language, such as Chinese or Vietnamese.

The pilot program in the Lao PDR attempted to address these problems by supporting the Lao Institute for Renewable Energy (LIRE), a local center for applied research. LIRE's objective is to improve the safety, quality, and efficiency of pico hydropower turbines by educating and training hydropower end-users, like shopkeepers, in pico hydropower technology.

Pico Hydropower Group Discussions

Observations and recommendations on pico hydropower at the conference included:

- Conduct safety awareness campaigns to alert people about hazards from poor quality equipment and faulty home connections.
- Set up demonstration sites and training. Successful and safe installation of pico hydropower technology depends on significant technical knowledge and experience. Villagers should be provided with hands-on training and advice based on environmental issues and electricity/power demands specific to their village.
- Translate installation guides and manuals into local languages.

- Install electronic load controller devices to mitigate load fluctuation. Moderated load fluctuations would decrease damage to appliances, light bulbs, and injury to end-users and service providers.

Micro Hydropower

See presentation by Grayson Heffner: ***Micro-Hydro Business Models in Lao PDR***

Micro hydropower plants with production capacity of less than 100 kW (0.1 mW) are seen as a renewable, environmentally sustainable energy source. In Lao PDR, they are also seen as economically feasible and ideal for use in rural electrification. But household demand alone is insufficient to finance these plants. Also, site selection is limited as plants require a year round water source.

The Lao PDR Department of Energy identified 10 potential micro hydropower plant sites following surveys and feasibility studies. Donors proposed a business model for funding that included the following parameters:

- Hydropower systems and village grids would be subsidized by donor grants, providing up to 50 per cent of costs.
- Ownership of the asset would be turned over to a community corporation after 10 years.
- Households and businesses would pay a variable connection fee, according to service levels.
- Those bidding on construction tenders would be offered extra incentives to take an equity stake in the plant and to operate it.
- Alternatively, an operator franchise would be made available to bidders, with an extra incentive for taking an equity stake in the plant.
- A flat monthly tariff, according to service level, would be imposed, with recovery of nominal investment costs and operating costs spread over 10 years.
- Tariff prices would be comparable to those imposed on solar power home systems.
- Any profit remaining after plant owners met repayment obligations and contributed to maintenance and repairs/contingency funds, would be transferred to the REF.

Investments in micro hydropower systems were seen as costly and risky, with uncertain returns. But the electricity produced by them was superior in quality and quantity to solar power home systems or pico hydropower. It was agreed that village electrification would depend on the productive use of micro hydropower plants, but private sector investment was unlikely to materialize unless risk was mitigated.

Micro Hydropower Group Discussions

For the further development of micro hydropower generation it was agreed:

- Industry policies and the regulatory framework for this sector should be reviewed.
- Public-private partnerships should be established, accompanied by government-funded feasibility studies, for micro hydropower generation and distribution projects. Banks should have access to financing with guarantees and risk sharing from the government.
- The micro hydropower generation cost structure should be reviewed. All public investment funds and subsidies should be open and transparent. Ownership should be diversified, with the private sector highly involved.

5. TECHNICAL ASSISTANCE TO RURAL ELECTRICITY ENTERPRISES

See presentations by Im Saroeun: ***CKN and Their Contribution to Rural Electricity***

Sommai Phon-Amnuaisuk: ***Renewable Energy for Rural Electrification Promotion and Awareness in Cambodia***

Cambodia has one of the lowest electrification rates in Asia and its electricity costs are among the highest in the world.[5] Privately operated REEs have been supplying electricity to rural customers for years, but many are now challenged by weak demand and rising operating costs. An REE is unlikely to expand supply in remote areas showing weak or falling demand, or where population density is static or falling.

To improve the efficiency of REE operations and encourage the formation of new REEs, ESME sponsored pilot training programs through the Centre Krom Ngoy (CKN), a NGO specializing in training for those in the electricity sector. One hundred twenty-two of the 150 licensed REEs that provide most of the electricity in rural Cambodia, with local grids powered by diesel generators, attended ESME-sponsored training. A CKN team traveled to northern Cambodia to provide technical, safety, and business management training to those working for REEs in remote areas. CKN's training occurred in a lecture room laboratory during which experiments were conducted on voltage, current, resistance, and other electricity dynamics.

[5] At the time of the study, about 10 per cent of a typical household's monthly expenditures went to energy services.

6. PUBLIC-PRIVATE PARTNERSHIPS

See presentations by Ganesh Shrestha: ***The Rural Electrification Fund (REF)—Lao PDR***

Ian Crosby: ***Access to Finance for REEs—Risk Sharing Fund***

Phayvanh Vongsaly: ***Delivery Structure and Financial Mechanism for Rural Electrification Fund in Lao***

San Viryan: ***The Rural Electrification Fund—Cambodia***

REEs face several obstacles to secure debt financing, which is directly linked to their perceived commercial viability, insufficient technology and infrastructure, inadequate collateral, high interest rates, and the short duration of loan terms. Banks and micro-finance institutions will not provide them with loans because they are unfamiliar with the sector and have little experience with the risks involved. To address some of these problems, The World Bank proposed partial credit guarantees for local banks to allow them to provide financing to REEs. This risk-sharing instrument would also provide technical assistance to project developers and simplify transaction costs. It would also standardize terms of conditions and streamline finance processes for REEs. The initiative's success was linked to banks' ability to conduct flexible investigations on REEs and governments' willingness to set up transparent subsidy structures. Parties were also expected to be mindful of a project's impact on women and the environment.

The Philippines | A Case Study

See presentation by James Morley: ***Public-Private Partnerships—PPPs***

Public and private partnerships are important in providing public or quasi-public services. Off-grid projects are often small in scale, resulting in high unit costs and overhead. Since the private sector is likely to bear significant financial, technical, and operational risks, it is essential for concession agreements to be structured properly. The International Finance Corporation's (IFC) case study presentation highlighted problems and solutions faced by the government of the Philippines in its supply of off-grid electricity. The Philippines government had difficulty recovering full production costs from the local population. The inefficient use of government subsidies and technical difficulties led to unreliable electricity supply. With technical assistance from the IFC, the Philippine government launched competitive bidding with public tenders for new independent power providers. Talks with bidders to finalize terms and conditions, including contracts, were held, and the winning bidder was selected based on the best and lowest proposed subsidy. The case study demonstrated how the private sector could help governments achieve their objectives of delivering energy services in remote, off-grid areas.

Lao PDR | A Case Study

See presentation by Hatsady Sisalouth: ***Lao PDR—Power to the Poor Program***

The Power to the Poor Program (P2P) in Lao PDR provided interest-free credit facilities to families unable to afford the grid connection fee, with repayment stretched over three years. The project was implemented by the Lao PDR Department of Electricity through a donor fund. A total of 537 households in 20 villages received grid connection through P2P credit facilities. P2P was seen as an important empowerment event for rural Lao PDR, given 43 per cent are women-headed households.

"Before, I used to share electricity with my neighbors, but now I have my own. I am very happy and it will let me work at night. My children will be able do their homework in the evening. I also plan to buy a water pump so that I can bring water from the river, which will reduce time and energy from having to carry buckets of water home...."

—Lao Villager

Moderator's Overview

Throughout the conference Moderator Ian Crosby noted:

Private-sector enterprises play a critical role in delivering energy services. SMEs lack of access to financing requires banks to be flexible in their investigations and to become familiar with specific issues facing this sector. There is a need for the public sector to invest in infrastructure that supports scale-up activities. The impact of programs on gender-specific issues and the environment is also important to consider in rural area alternative/renewable energy programs. Further, many issues facing the private sector are not energy specific, but applicable to all entrepreneurs in all industries.

The conference presentations and discussions stress the need for public and private sectors to take a nontraditional approach to public-private partnerships to support alternative energy technology employed in rural areas of poor and developing countries. Deployment of this technology faces many challenges, including poor quality equipment, weak or unpredictable demand, the absence of quality control standards, and the lack of a viable manufacturing industry for alternative/renewable energy products and services. Nevertheless, SMEs are demonstrating that such an industry could be fully commercialized. It is possible for public-private partnerships to stimulate growth, improve efficiency, and make better use of subsidy funds.

Rural energy is not just about providing electricity; affordable maintenance systems are needed. Also, standards are needed to ensure technology is employed properly and equipment is installed properly.

In his final address to the conference participants, Crosby made the following recommendations:

- Match the technology/equipment with local needs and ensure adequate infrastructure to support investment and operations.
- Characterize the alternative/renewable energy sector as entrepreneurial at its core. People in this sector are not just focused on technology; they are developing innovative business models.
- Access to energy should drive economic development and consumers should be encouraged to be entrepreneurial.
- Consider alternative ways of performing investigations on companies with little or no history of financial statements, especially in Cambodia and Lao PDR.

ACRONYMS AND ABBREVIATIONS

ASTAE	Asia Sustainable and Alternative Energy Program
BSS	Baby Samaki Stove
BCC	Biodigester Construction Companies
BPP	Lao Biogas Pilot Program
BPS	Ba Phnom Stove
CKN	Centre Krom Ngoy
DFID	Department for International Development
IFC	International Finance Corporation
LED	Light-emitting diode
LIRE	Lao Institute of Renewable Energy
NBP	National Biodigester Program
NGO	Nongovernmental organization
NKS	Neang Kongrey Stove
NLS	New Lao Stove
P2P	Power to the Poor Program
RDI	Research Development International
REE	Rural electricity enterprises
REF	Rural Electrification Fund
SME	Small and medium size enterprises
SNV	SNV Netherlands Development Organization

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