



Laos Rural Electrification Program Planning

Case Study for the LEADS GP Sustainable Energy
and Development World Atlas

AUTHORITIES

P2P: Ministry of Energy and Mines (MEM), Electricité du Laos (EDL)

SHS: Department of Energy under the MEM, Provincial Energy Service Companies (PESCOs)

SUPPORTING ENTITIES

Asian Development Bank (ADB), AusAID, Energy Sector and Management Assistance Program (ESMAP), Global Environment Facility (GEF), International Development Association (IDA), Norwegian Agency for Development Cooperation (Norad), World Bank

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Program Name:

Solar Home Systems (SHS); Power to the Poor (P2P)

Country and Region:

Lao People's Democratic Republic (PDR), Asia

Years of Implementation:

2004–2009 (SHS); 2008–2012 (P2P)

KEY OUTCOMES

Between 2004 and 2012, the **Lao Rural Electrification Program** provided more than 39,000 formerly unconnected households with access to electricity. This access has facilitated many social, economic, and environmental co-benefits, including higher household incomes, reduced time spent on chores, reduced local air pollution, and reduced expenditure on energy assets. The program prioritized households from marginalized groups, including female-headed, poor, and disabled communities.

The Solar Home Systems (SHS) and Power to the Poor (P2P) initiatives have dramatically increased rural socioeconomic activity without notably increasing electricity use-related carbon emissions levels. They present remarkable case studies on how low-emission rural electrification initiatives can contribute significantly to rural social and economic development.



INTRODUCTION: THE NEED FOR RURAL ELECTRIFICATION IN LAOS

Located in Southeast Asia, Lao PDR is a landlocked country that is rich in natural resources. About 80 percent of the population relies on agriculture as the primary source of income.¹ Providing rural communities with modern electricity services has historically been a challenge for the government. The lack of financial resources for generation and grid investments meant that Lao PDR was largely unable to exploit its enormous indigenous energy resources such as hydropower, wind, solar, and biomass.

Responding to these challenges and integrated within Lao PDR’s broader strategy for national electrification, Solar Home Systems (SHS) and Power to the Poor (P2P) present remarkable case studies on how low-emission rural electrification initiatives can contribute significantly to rural social and economic development. Carried out by various energy sector actors and under guidance from the Ministry of Energy and Mines (MEM) and Electricité du Laos (EDL), these initiatives have more than doubled rural electricity access rates, dramatically increasing rural socioeconomic activity without notably increasing electricity use-related carbon emissions levels.

SHS and P2P combine highly effective business models with a targeted focus on providing electricity through on-grid and, where necessary, off-grid systems for low-income and underserved communities.² Both programs include a combination of interest-free credit lines and subsidized installation costs to incentivize connectivity to the grid (for P2P) and off-grid electricity supply through solar (for SHS). Thanks to these programs, the government of Lao PDR is well on its way to achieving its goal of 90 percent electricity access by 2020.³

SOLAR HOME SYSTEMS

SHS was launched in pilot phase in 2004 by EDL, the main utility company in Lao PDR. However, because EDL was simultaneously handling other grid projects, primary responsibility for SHS was transferred to the Lao PDR Department of Energy (DOE), run under the MEM. Under the DOE, the regulatory structure of SHS is made up of Provincial Energy Service Companies (PESCOs), which function as transitional entities to support planning, installing, and providing ongoing technical assistance for the duration of the initiative. The PESCOs also identify eligible villages for off-grid system setup and employ Village Energy Managers (VEMs) who are responsible for installation and maintenance.

Like P2P, SHS was initiated as a pilot project, which ended in 2004 after installing more than 5,700 solar rooftop units in 50 villages across 6 provinces of Lao PDR. Following the pilot project, SHS was immediately scaled up to supply solar rooftop units for more than 10,000 homes. Households were provided with a wide range of options for solar PV panel sizes, lease terms, and installation fees. The breakdown of these finances is described in Table 1.⁴

Table 1. Breakdown of SHS Options and Payments in US Dollars

Panel Size	Installation Fee	5-Year Repayment Period	10-Year Repayment Period
20 W	\$19.94	\$2.49	\$1.25
30 W	\$23.68	\$3.74	\$1.87
40 W	\$27.41	\$4.98	\$2.49
50 W	\$31.15	\$6.23	\$3.12

Source: World Bank

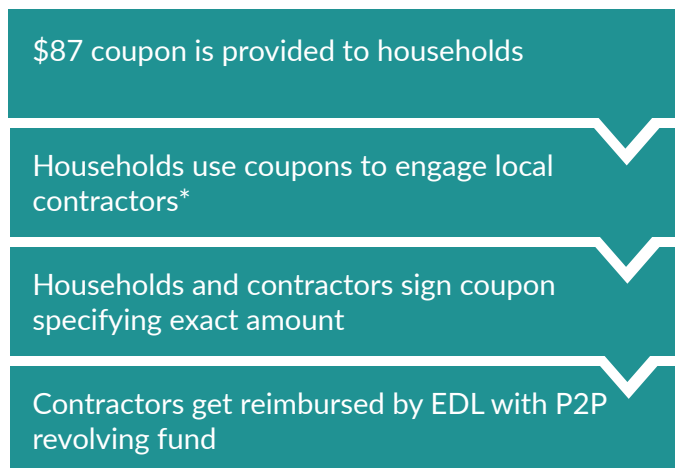


Based on their income and ability to repay loans, consumers can choose the sizes of solar PV systems as well as their respective repayment periods. At the end of the 5- or 10-year term, they become sole owners of the unit. The solar PV panel is routed through a charge controller, protecting the associated batteries from overcharging. The charge controller is attached to a deep-cycle battery for recharging, which can then power lightbulbs, radios, and televisions for up to four hours per day. Solar PV in these areas is cost-competitive with conventional electricity fuels. However, to achieve the government's overall target of 90 percent electrification, off-grid installation needs to be increased three- to fourfold.⁵

POWER TO THE POOR (P2P)

P2P's main objective was to ensure electricity connection for those who are part of the power grid but cannot afford upfront connection costs. Its aim was to increase household connection by 85 to 90 percent.⁶ A secondary, broader objective was to determine whether a subsidized financing scheme for electrification is the most effective way to improve rural grid infrastructure.⁷ (See Figure 1.) The P2P program includes the supply of a 22 kilovolt transmission and low-voltage distribution system.⁸

Figure 1. Basic Business Model for P2P



*If cost exceeds US \$87, households are expected to pay the difference. Source: World Bank.

The transmission and distribution system has enough voltage to power two lightbulbs and an appliance per household. Households are given an interest-free loan of US \$87 which is repaid over a preset period of three years. The beneficiary is expected to pay in monthly installments of US \$2.50 in addition to electricity consumption charges that range from US \$1 to \$3 per month.

Figure 2. Champasak Province, Lao PDR



From fall 2008 to spring 2009, the P2P pilot program was implemented in 20 villages in Champasak province. (See Figure 2.) During Phase I, the households that were most likely to receive interest-free loans were female-headed because the program directly targeted addressing social issues, in particular gender inequality and poverty. Prior to Phase I, project planners held a series of consultations and meetings in the targeted villages. Planners emphasized holding these events during times when women were available to attend.

Following on the remarkable success of Phase I at the regional level (see "Program Impacts" section), a second component of the initiative was launched on a national scale. Approved in 2012, Phase II of P2P targets nationwide implementation and an additional 8,000 homes within three years. This target was aimed specifically at households with disabled family members in addition to other households deemed safe for electrification.

Phase II included setup of the P2P revolving fund supported by grants given by AusAid and IDA and sent to households



as coupons that could be exchanged for installation services by local contractors and then redeemed for cash. The business model is shown in Figure 1. Phase II implementation also was a success and far exceeded expectations. EDL reported that 20,394 households were connected, far above the target of 8,000 households. Of those connected, 1,101 households were female-headed and 606 housed disabled people. The payback rate throughout Phase II has been consistent, and the monthly reflow is increasing.⁹ Criticism of P2P has pointed out that the program was often unable to connect villages in the most remote and poorest areas of the country, noting that a majority of Lao PDR citizens reside in mountainous areas and lack access to modern public infrastructure.¹⁰

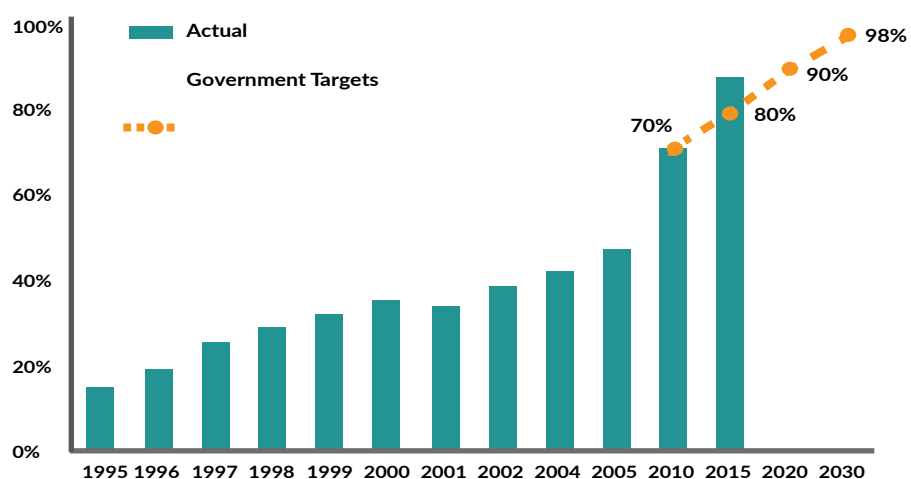
DEVELOPMENT IMPACTS OF RURAL ELECTRIFICATION PROGRAMS IN LAOS

Following the deployment of Lao PDR's rural electrification programs (SHS and P2P), rural areas in the country have experienced significant cross-sectoral benefits.

Economic Impacts

- Per capita electricity consumption in Lao PDR has increased more than 10 percent on average in the last 15 years, from 188 kilowatt-hours (kWh) in 2000 to 470 kWh in 2015 (enabling the country to move out of the United Nations classification of "least developed countries" (LDC) for that data indicator, although Lao PDR overall retains LDC status).¹¹
- National household electrification rates strongly exceed government intermediary targets for 98 percent electrification by 2030.¹² (See Figure 3.) Rural electrification rates rose from 40 percent in 2000 to 55 percent by 2012.¹³ (See Figure 4.)
- For SHS, the number of households with operating rooftop solar PV panels increased more than 300 percent from the initiation of the program in 2004 to 2013.¹⁴ (See Figure 5.)
- For P2P, average grid connection rates for households in the targeted Pilot Phase villages increased from 65 percent to 95 percent. Connection rates among female-headed households increased from 63 percent to 90 percent. Including Phase II, it is estimated that more than 8,000 households have benefited from the P2P electrification projects, including 1,101 female-headed households and 606 households with disabled family members.¹⁵
- For P2P, out of all households in the 20 villages targeted in Phase I, 32 percent were considered "not poor enough," meaning that they could afford upfront costs and had steady income; 29 percent of households had insufficient income to pay back the loan provided by P2P over the three-year period; and 39 percent were too far from existing grid infrastructure to accommodate interconnection under P2P. As a result, a total of 145 households in the villages were not connected under P2P.¹⁶

Figure 3. Household Electrification Rates Relative to Government Targets, 1995–2030



Source: Laspho

Social Impacts

- For P2P, evaluation in 2013 found strong social benefits from grid connections, including income-generation opportunities, reduced time spent by women on chores (from more than 60 minutes down to 23 minutes per night on average), and reduced air pollution exposure, which benefits women and children who spend the most time indoors. Compared to a baseline study in 2004, household incomes were three times higher on average, and households owned more assets and spent less share of their income on energy.
- The 2013 evaluation found a positive association between grid connections and business activities. P2P participants (16,010 households by completion) benefited in particular from these changes as they tended to be newly formed families with less means (land, education, capital, and assets) to earn income. About 93 percent of P2P recipients agreed that work undertaken by women was easier with electricity. About 90 percent of retail businesses undertaken by P2P recipient households were operated by women.

- Children in households serviced with grid connections by P2P did not appear to have greatly increased their study time in the evening as a result of better lighting conditions, and, like elsewhere, they preferred to spend more time watching television. Television usage was the most increased household appliance use after lighting for households benefiting from P2P.¹⁷
- For SHS, evaluation in 2013 found fewer social benefits from solar home systems due to their small size and the unaffordability/unavailability of goods and services to maintain or upgrade systems and for suitable electric appliances. There was no evidence that SHS contributed to income-generating activities. However, 95 percent of users were satisfied with their SHS, and all agreed that electricity from SHS is a better alternative than using kerosene wick lamps, as users can work more easily at night and the lease purchase payment agreement is affordable.¹⁸

Environmental Impacts

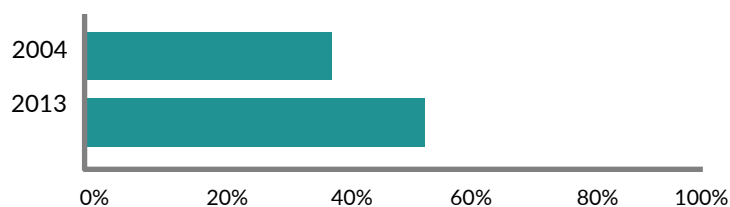
- Carbon emissions per capita decreased by 0.062 metric tons per year from 2004 to 2011.¹⁹ (See Table 2.)

Table 2. Carbon Emissions per Capita

Year	Metric Tons per Capita
2004	0.251
2011	0.189

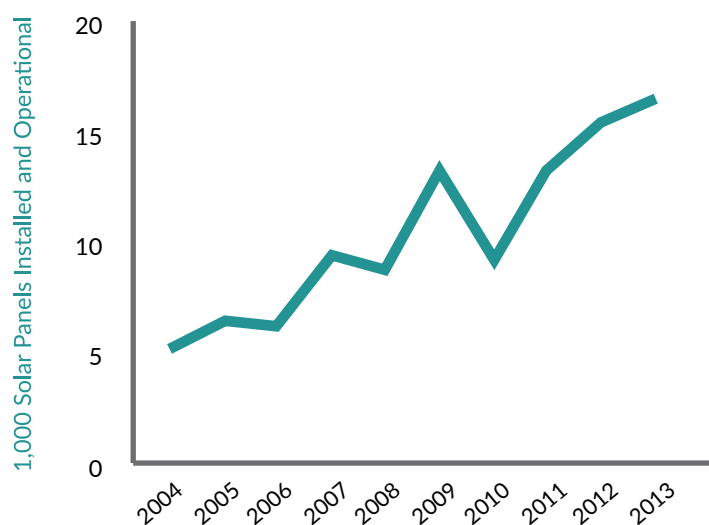
Source: CDIAC

Figure 4. Rural Electrification Rate in Laos (Electricity Access as Percentage of Total Rural Population)



Source: World Bank

Figure 5. Rural Households with Operating Rooftop Solar PV Panels, 2004–2013



Source: Laspho



SUCCESS FACTORS AND REPLICABILITY

Community Engagement in Project Design

Prior to implementation of P2P, socioeconomic surveys were conducted in 2007 on the rural communities eventually targeted under the initiative. These studies revealed that poor and non-grid connected rural households tended to be disproportionately headed by women (often widows or divorcees). While female-headed households comprised only 8 percent of the total households surveyed, they accounted for 43 percent of all households classified as poor, reflecting a lack of sufficient household earning power. As a result of this community engagement, P2P explicitly targeted female-headed households and households with work-disabled family members.

Similarly, in the design of SHS, project managers used a highly participatory approach requiring close collaboration with village committees and relying on in-village representatives. Trained as VEMs (Village Energy Managers), these representatives were responsible for daily maintenance, trouble-shooting, and fee collection for SHS units. This participatory approach was a key factor in achieving high household penetration rates, and repayment rates consistently reported in the high 90th percentile.

Synergies in P2P and SHS Design

While not designed specifically to address shortcomings of P2P's utility-driven grid-based electrification program, SHS's focus on off-grid and remote communities has functionally provided an alternative option for electrification in communities that are too poor to afford grid connection costs associated with P2P. The synergy created between P2P and SHS not only minimized duplication of effort but also helped ensure that opportunities for rural electrification were distributed more equitably among different economic strata of the targeted communities. An area that could be improved in future iterations of these initiatives is explicit coordination between them on eligibility criteria. Criteria to qualify for subsidized alternative electrification programs

(such as in SHS) should be designed explicitly to capture households in targeted communities that are otherwise unable to qualify for market-based loan programs to pay for grid connectivity (such as in P2P).

Support from International Institutions

Both P2P and SHS have benefited tremendously from close coordination with and financial support of international development institutions. When P2P was scaled up to the national level under the Rural Electrification Phase II Project in 2009, a key component to its viability was the P2P Revolving Fund, operated by EDL to provide interest-free credit to targeted households. Both IDA and AusAID contributed US \$600,000 each to the fund. Norad provided funds for training provincial implementation teams from EDL and MEM prior to the rollout of Phase II. These organizations also provided significant grant support for the purchase of solar PV units and training of VEMs for the SHS program.

Government and Private Sector Integration

Incentivizing the robust participation of private sector entities in P2P and SHS has been a key factor in the sustained economic viability of these initiatives. From their outset, both SHS and P2P were designed with an emphasis on cost recovery and commercial viability. In the case of SHS, these ambitions proved over-optimistic and required oversight from a dedicated government entity (MEM); however, both programs incorporated robust local private sector participation, amplifying social and economic benefits incurred through rural electrification.

During the SHS pilot and scaled-up programs, MEM worked closely with small private companies (PESCOs), based in the capitals of targeted provinces, to identify villages meeting SHS criteria, procure equipment, and manage VEMs. Similarly, the Revolving Fund established for P2P provided households with subsidized loans to employ local contractors to install equipment for grid-connection, helping to increase the demand for and incomes of local and technically trained laborers.



ENDNOTES

¹ “Laos Country Profile,” *BBC News*, October 14, 2015.

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⁴ World Bank, “Lao PDR – Power to the People: Twenty Years of National Electrification,” January 2012.

⁵ *Ibid.*

⁶ *Ibid.*

⁷ *Ibid.*

⁸ S. Martin and J. Susanto, “Supplying Power to Remote Villages in Lao PDR: The Role of Off-grid Decentralized Energy Options,” *Energy for Sustainable Development* 19 (April 2014): 111–21.

⁹ World Bank, *op. cit.* note 4.

¹⁰ Martin and Susanto, *op. cit.* note 8.

¹¹ Trading Economics, “Electric Power Consumption (kWh per Capita) in Least Developed Countries UN Classification,” 2011, www.tradingeconomics.com; United Nations Committee for Development Policy, “List of Least Developed Countries (as of May 2016),” www.un.org/en/development/desa/policy/cdp/ldc/ldc_list.pdf.

¹² Litthanoulok Laspho, Lao PDR Ministry of Energy and Mines, “Lao Rural Electrification,” presented at SE4ALL Consultation Workshop: Monitoring the Status of Asia-Pacific, June 14, 2015, www.slideshare.net/energyforall/laos-rural-electrification.

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¹⁴ Laspho, *op. cit.* note 12.

¹⁵ World Bank, *Implementation Completion and Result Report: Rural Electrification Phase II Project* (Washington, DC: December 17, 2015).

¹⁶ *Ibid.*

¹⁷ *Ibid.*

¹⁸ Laspho, *op. cit.* note 12.

¹⁹ Carbon Dioxide Information Analysis Center, “CO2 Emissions from Lao People’s Democratic Republic,” <http://cdiac.ornl.gov/trends/emis/lao.html>, viewed September 14, 2016.