

The World Bank

Asia Sustainable and
Alternative Energy Program



Lao PDR

Power to the People:

Twenty Years of National Electrification





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branch offices in Pakse, Champsak province; for their arranging a field visit to see and better understand how the national electrification program is organized, and to see implementation at work on the “front lines”—grid and off-grid—and witness firsthand the clear evidence of results and the developmental impact on the ground in a number of diverse communities across the southern region of Lao PDR.

Abbreviations and Acronyms

BAS	Billing and Accounting System	PDEM	Provincial Department of Energy and Mines
BO	Branch Office	PDP	Power Development Plan
DOE	Department of Electricity	PESCO	Provincial Electricity Supply Company
EDL	Electricité du Laos	PHRD	Policy and Human Resources Development Fund (Japan)
EGAT	Electricity Generating Authority of Thailand	PMU	Project Management Unit
ESCOs	Electrification Service Companies	PSDP	Power Sector Development Plan
GEF	Global Environmental Facility	RE	Rural Electrification
GoL	Government of Lao PDR	REF	Rural Electrification Fund
GS	Generating Sets	REP	Rural Electrification (APL) Program
GWh	Gigawatt hour	REP I	Rural Electrification Phase I Project
kV	Kilovolt	SHS	Solar Home Systems
HHPC	Houay Ho Power Company	SPC	State Planning Committee
ICB	International Competitive Bidding	SPRE	Southern Provinces Rural Electrification Project
IPP	Independent Power Producer	THPC	Theun-Hinboun Power Company
JICA	Japan International Cooperation Agency	UNDP	United Nations Development Programme
Lao PDR	Lao People's Democratic Republic	VEM	Village Electricity Manager
LNCE	Lao National Committee for Energy	VH	Village Hydro
LV	Low Voltage	VOPS	Village Off-Grid Promotion Office
MEM	Ministry of Energy and Mines		
MoF	Ministry of Finance		
NDF	Nordic Development Fund		
NGPES	National Growth and Poverty Eradication Strategy		
NORAD	Norwegian Agency for Development Cooperation		
NT2	Nam Theun 2		

Currency

Kip

EXECUTIVE SUMMARY

The Lao PDR National Electrification Program Success Story

Outstanding Results

The Lao People's Democratic Republic presents a remarkable success story in rapid national electrification integrated within a broader strategy of national and rural development. In fifteen years (1995–2009), electricity access more than quadrupled, from about 15 percent in 1995 to 69 percent in 2009—and the program is on track to achieve the government's target of 70 percent national coverage by 2010 year-end. This expanded electricity access resulted in over 700,000 household connections by 2009 year-end, from about 120,000 households connected in 1995.

Two outstanding features of the Lao PDR electrification program are highlighted in figure E.1. First, the program to date has maintained a faster pace of implementation compared to most other countries considered to have staged successful national electrification programs. This is evident from the steep path charted and the duration shown (by length of line). Second, and even more remarkable, the country has managed to achieve this result at a relatively low level of GDP (PPP) per capita, comparable to Vietnam and China.

How Did this Extraordinary Progress Come About? Key Factors and Lessons

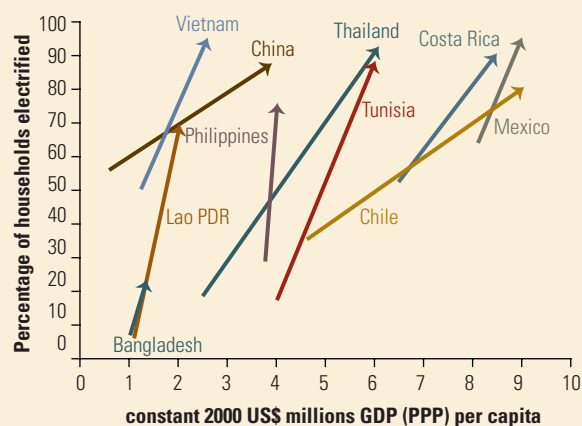
1. Government's visible hand—unwavering commitment, getting the policies right, and staying the course

Lao PDR's impressive national electrification program results are the consequence of old virtues combined with a flexibility to adapt new ones. The government of Lao PDR (GoL) has pursued a pragmatic and purposeful approach, rather than an ideological one. By and large, the government focused on doing the right things at more or less the right time. Further, a series of government policy initiatives helped steer the rapid liberalization and modernization of the national economy, as a consequence of which the economy has grown at an average annual rate of 6.5 percent since 2001. The conducive overarching economy has provided a supportive backdrop, and in turn has benefited from the government's parallel efforts to develop and expand the power sector as a strategic asset in enabling the country's economic growth and the socioeconomic progress of all its citizens.

The government set clear targets for electricity access—70 percent by 2010 and 90 percent by 2020—to be achieved by means of an aggressive grid extension program complemented by off-grid electrification where cost effective. The national electricity utility, Electricité du Laos (EDL), was held accountable to meet the annual targets for grid-based access expansion. By the same token, the government followed up with the policy and financial commitment necessary to manage a pivotal balance between (i) ensuring affordability of electricity connections to the vast majority of the population, and (ii) meeting the need to strengthen EDL's financial health and sustainability to deliver the grid extension program according to schedule.

Hydropower export revenues have played a defining role in financing the startup and early-stage growth of the national electrification program. Visionary and opportunistic development of hydro projects were pursued during the late 1970s and early 1980s, driven by export sales to proximate Thailand markets and smartly coupled with negotiated arrangements for power buy-back or exchange arrangements, where feasible, for electrification of border areas. The revenues from these projects enabled not only financing of those early hydro projects, but also that of the national power grid expansion and connections

FIGURE E.1 SUCCESSFUL NATIONAL ELECTRIFICATION PROGRAMS WORLDWIDE



Source: Data for countries other than Lao PDR is estimated from figure 1–2, Douglas F. Barnes, *The Challenge of Rural Electrification*, RFF Press, 2007; data for Lao PDR is from Ministry of Energy and Mines, and Electricité du Laos.

Note: Time period covered: Lao PDR (1995 and 2009); Philippines (1985 and 2002); other countries (1980 and 2002).

program over the years. Subsequently, government reforms, starting in the late 1980s, were instrumental in engaging the participation of independent private power producers (export hydro IPPs) and led to the significant private investments underlying installed power capacity today (and with several more in the pipeline).

Last and not least, the government established a positive and open environment for dialogue and cooperation with the development partner community. This “sector-wide approach” and mindset led to the longstanding and strong donor engagement and support—finance for the national electrification program investment as well as knowledge to help the government carry out sector reforms, strengthen institutions, and improve sector performance and efficiency—that continues today.¹ Appendix G provides more information about the World Bank’s engagement, dating back to 1966, in the Lao PDR energy sector.

2. Electricité du Laos—key to successful implementation

The key to the successful implementation of the national electrification program in Lao PDR—fast paced, efficiently executed, and effective in terms of results and impact—has been its institutional model of grid extension and rollout driven by the national electricity utility EDL. By virtue of its consistent and high-performance track record, EDL has been a key enabler and front line partner in Lao PDR’s national and rural development. Several factors have contributed to EDL’s excellent implementation record.

- **Effective leadership with strong commitment to rural electrification** has instilled a corporate culture dedicated to accountability for results and an engineering tradition. As the grid rollout progressed well beyond Vientiane, accountability for meeting implementation and connection targets was shifted squarely on to each EDL provincial branch concerned within their respective provincial service areas. The branch offices today are well supported and empowered to plan, design, procure, and manage delivery of their connection targets; they are complemented by highly professional and motivated staff who take pride in their mission and mandate.
- **Sound program planning and prioritization** to enhance broad-based development impact. The rural electrification planning process in Lao PDR is based on

a multiyear expansion plan that takes into account the financial and economic viability of the investments made and incorporates a village screening process to maximize social impact—clinics, schools, temples, irrigation and production activities get priority—within the constraints of available budgeted resources.

- **Cost-cutting technical innovations mainstreamed—operating efficiency improvements.** EDL engineers have been open to learning from relevant practices across the region and beyond, and to adapting innovations that help lower the electrification program’s investment costs. As a result, EDL’s network design and equipment specifications for the grid rollout conform to best engineering and commercial practices, the result of a deliberate effort to balance cost considerations and performance. EDL has also made steady progress in reducing distribution losses from 19 percent in 2005 down to 12 percent by year-end 2009, which has had a direct impact on its bottom line.

3. Financing, subsidy and tariff policy—striking a workable balance

The government recognized from the start that rural electrification implemented nationwide in a programmatic manner is a capital-intensive effort and cannot be accomplished on a purely commercial basis. State subsidies would be required to ensure retail tariffs and the connection fee for grid access would be affordable by poorer segments of the population, especially as the grid’s reach extended deeper into the rural areas of the country, where the vast majority of the population resides and incomes typically decline.

At the same time, implementation could not be achieved at the pace desired without maintaining EDL’s commercial viability along the way—indeed, without steadily strengthening it over time, as EDL in the late 1980s and early 1990s was in a weak financial position that challenged its ability to undertake the daunting task of electrifying the country. Capital and operating subsidy were channeled to EDL primarily by way of two financing mechanisms: (i) dividends from hydropower export revenue earnings; and (ii) mobilizing the bulk of the financing requirements (about 75%), over the program period from international development organizations and on-lending them to EDL on highly concessionary terms.²

1. The major grid extension projects sponsored by multilateral institutions, over the period 1987–2009, together provided an estimated US\$450 million; of which about US\$400 million was for grid investment, US\$5 million for off-grid investment, and about US\$25 million for institutional capacity-building. See appendix E.

2. The total investment cost of the EDL grid rollout program over the period 1987–2009 is estimated at about US\$600 million; of which two-thirds (about US\$400 million) was financed by concessionary loans or grants from multilateral and bilateral agencies, and the remaining one-third of investment (about US\$200 million) from domestic sources (GoL, EDL, and consumers). See appendix E.

In 2005, the GoL launched a Power Sector Financial Sustainability Action Plan covering the period 2005–2011. After a two-year suspension of the previous tariff adjustment initiated in 1998, a new tariff adjustment program was initiated at the end of 2005 as part of the Financial Sustainability Action Plan. It allowed for a gradual annual increase in EDLs average retail tariff with the aim of (i) achieving cost recovery and phasing out EDLs reliance on government subsidies with hydropower dividends; (ii) achieving a positive return on EDLs assets; and (iii) reducing cross-subsidies among consumer categories. To ensure affordability to the poor, a life-line tariff was also provided to the residential consumers under the new tariff regime, and tariff levels for the industries and irrigation categories were gradually reduced over the adjustment period to enhance the competitiveness of the industries and to support the agriculture production in the country. In parallel, since 2005, EDL has vigorously invested in distribution loss reduction. This, in addition to the fast expansion of the power distribution network to remote rural villages, EDL achieved an 8% cut of distribution losses over the period of 2005–2009. As a result, EDLs domestic business was turned from running losses to making net profits since 2007, while the weighted average retail tariff was maintained at US¢5.40/kWh (in 2009), among the lowest in the region (figure 4.3). The inexpensive cost of hydropower generation is also a factor in keeping retail tariffs low and in improving EDLs financial performance.

Striking and maintaining the right balance along the way has been a key enabler of the electrification program financing story, with the GoL and EDL having to come together to make it happen. Since 2007, EDL has achieved cost recovery and made profits from its domestic business; it is on course to achieve a commercially viable standalone mode of operation by year-end 2011.

4. Power to the Poor (P2P) Program—targeting the gender dimension of rural electrification

The “Power to the Poor” (P2P) Program implemented by EDL is a targeted, subsidized, affordable, and sustainable financing mechanism for connection and indoor wiring. It is designed with a gender focus to provide an interest-free credit that allows the poorest rural households, who cannot afford to pay the entire costs of connection and internal wiring up front (about US\$60–80), to access the main electricity grid for basic service. This service is sufficient for an average household to run two light bulbs and a small appliance such as a radio. The monthly payments for both the credit and electricity consumption are designed to be about the same as the cost for lighting by candles, diesel lamps, or car batteries prior to

electrification. The objective is to raise household connection rates from 60–70 percent to 85–90 percent in villages connected to the grid. The program has been successful in most villages where it has been offered: connection rates have gone from under 80 percent to well above 90 percent, even reaching 98 percent in several instances.

5. Off-Grid Electrification—reaching out to those beyond the grid

Off-grid electrification, based on solar photovoltaic (PV), micro-hydro, and biomass and implemented by both the public and private sectors, has to date provided access to about 2.5 percent of households in remote rural areas where the grid cannot reach in the short term. Notably, solar home systems (SHS) are available to these households through an innovative hire-purchase scheme. Households have a choice of a range of solar PV panel sizes and pay an installation fee (the lowest of which is 136,000 kip (about US\$16), then lease the system and make monthly payments of 8,500 to 25,500 kip (about US\$1 to US\$3) over five or ten years. They become the owners of the system at the end of the lease period. Most significantly, in off-grid communities that have benefited from the SHS program, it is clear that there can be a transformational impact on off-grid community residents: small amounts of electricity provided by solar PV systems are changing their lives, including enabling significant levels of increased income generation.

Keeping a Good Thing Going— The Challenges Ahead

Lao PDR is on the threshold of graduating from Least Developed Country status. The power sector has been a key partner in the nation’s development so far. However, looking ahead, new demands and expectations of the sector pose new and different challenges. Keeping the success going will require not merely doing more of the same. A far greater role than before for off-grid delivery systems in this decade is called for.

At this stage of national electrification in Lao PDR, more of the unconnected population lives in “deep rural” villages and scattered communities in hard-to-reach places, including many in mountainous areas. A telling statistic of the rapidly evolving cost structure of grid extension is the near doubling of the average cost per grid connection over the course of the last seven years—about 7.7 million kip (about US\$900) today compared to 3.8 million to 4.7 million kip (about US\$450–550) in 2005.

Achieving the government's 90 percent national coverage target by 2020 likely will require at least between a three-to four-time increase in coverage by off-grid solutions over the course of this decade, from around 2.5 percent share of national households today to 8–10 percent by 2020. This roughly translates into an annual off-grid connection rate of about 10,000 connections per year, several orders of magnitude higher than rates achieved in recent years.

Other key challenges the sector is looking to address include ensuring supply adequacy and improving service reliability; effectively satisfying the fast growing load demands from mining projects; developing hydropower (export IPP) further—and doing it better; and mainstreaming energy efficiency, now that nearly 70 percent of the population has electricity access.

Feature stories about the rural electrification process in Lao PDR are posted on YouTube:

Lighting Homes, Empowering Lives: 20-years of Electrification in Lao PDR

<http://www.youtube.com/watch?v=5ssLx1r9IBE>

Lao PDR: Rural Electrification for All – A Gender Lens

http://www.youtube.com/watch?v=h-DY3T_1RPI

Country and Power Sector Overview

Country Overview

Lao People's PDR is a landlocked country located in the center of Southeast Asia, sharing borders with Cambodia, China, Myanmar, Thailand, and Vietnam. The land area is approximately 236,800 km², slightly less than the United Kingdom, and is mostly mountainous, with 68 percent forest coverage. The Mekong River forms a large part of the Lao PDR border with Thailand.

With an estimated population of 6.2 million, the country is the least populated among its neighbors, with the lowest population density—26 people per km² (table 1.1). Seventy-three percent of the population lives in

rural areas. The country is home to 49 recognized ethnic groups that comprise 160 sub-categories.³ The largest group, the ethnic Lao, make up approximately 55 percent of the population and is located predominately in the lowland areas along the Mekong. Ethnic minorities make up the balance and are mostly disbursed throughout the highland areas.

Lao PDR is among the poorest countries in the region, and along with its neighbors Cambodia and Myanmar, is among the countries on the UN's list of Least Developed

3. Socioeconomic Atlas of the Lao PDR, 2008: An Analysis Based on the 2005 Population and Housing Census, Lao Department of Statistics.

TABLE 1.1 REGIONAL SNAPSHOT 2008

Country	Land Area ^a (km ²) (thousands)	Population ^a (million)	Pop. Density ^a (people/km ²)	GNI* per capita (US\$)	HDI Ranking ^b (out of 182 countries)
Lao PDR	236.8	6.21	26	740	133
Cambodia	181.0	14.7	81	600	137
Thailand	513.1	67.39	131	2,840	87
Myanmar	676.6	49.19	73	-	138
Vietnam	329.3	86.21	262	890	116

Sources:

a. World Development Indicators Database, September 2009 unless otherwise indicated.

b. Human Development Index, UNDP 2007, <http://hdr.undp.org/en/statistics>.

Note: * GNI stands for Gross National Income.

Countries (LDCs).⁴ The country is ranked 133 of 182 countries on the Human Development Index.⁵

The majority of the population derives its livelihood from agriculture, which accounts for more than half of the country's gross domestic product, estimated at US\$5.6 billion in 2008.⁶ The country's major exports historically include electricity, garments, timber products, and coffee.

While several development challenges lie ahead, the nation has come a long way following its founding as Lao PDR in 1975. Since then, the Lao PDR government has systematically advanced the process of industrialization and modernization, with substantial external support for public expenditures from donor governments, the World Bank, and the Asian Development Bank. Major government reforms in the late 1980s to steer from a centrally planned to a market-based economy managed by the state led to a gradual return to private enterprise and the liberalization of foreign investment laws. In recent years, new sources of funds, from both the private sectors and the economic regional powerhouses, such as China and Korea, have started playing an increasingly important role in the nation's public sector development.

The government has implemented ambitious socioeconomic development programs, as laid out in the National Growth and Poverty Eradication Strategy (NGPES) and Periodic National Socioeconomic Development Plan. The National Socioeconomic Development Plan (2006–10) has as its development objectives: (a) sustaining economic growth; (b) accelerating efforts to reduce poverty; (c) protecting the country's environmental resources; and (d) promoting industrialization and modernization. The government's goal is for Lao PDR to graduate from Least Developed Country status by 2020. As a result of government-led development efforts, the economy has been growing at an average annual rate of 6.5 percent since 2001, driven mostly by increased foreign direct investment in the hydropower and mining sectors.

4. UN-OHRLLS Least Developed Countries <http://www.unohrrls.org/en/lidc/related/62/>

5. Human Development Index (HDI), UNDP 2007 <http://hdr.undp.org/en/statistics>. The HDI provides a composite measure of three dimensions of human development: living a long and healthy life (measured by life expectancy), being educated (measured by adult literacy and gross enrollment in education), and having a decent standard of living (measured by purchasing power parity (PPP) and income). Between 1995 and 2007 Lao People's Democratic Republic's HDI rose by 1.26% annually from 0.518 to 0.619 today.

6. World Development Indicators Database, September 2009.

The sustained economic growth has enabled significant and steady decline in poverty rates (percentage of population living under US\$1.25 a day); the number of poor households fell from 46 percent (1992–93) to 27 percent (2007–08) and is projected at 24 percent by 2015. government statistics indicate that over the same period, the primary-school completion rate increased from 45 percent in 1993 to 75 percent in 2007; life expectancy was extended from 56 to 65 years of age. The country's basic infrastructure has also improved substantially. North–south arterial highway networks now greatly ease cross-country transportation; more bridges and rails run through the country's borders with its neighbors; public health networks are gradually becoming ubiquitous in villages; and information and communications technology (ICT) networks have reached all districts.

Power Sector—A Strategic Asset Effectively Developed and Expanded for the Nation's Benefit

The power sector, as one of the country's strategic growth sectors, has grown at a remarkable rate over the last several decades and the pace is unabated. Its pivotal role in enabling the country's economic growth and socioeconomic advancement over the decades is abundantly evident. Opportunistic and visionary development of hydro projects pursued early on (1970s and early 1980s), driven by export sales to proximate Thailand markets and smartly coupled with negotiated arrangements for power buy-back or exchange arrangements, where feasible, for electrification of border areas, enabled not only financing of the early hydro projects; as well, the surplus revenues generated contributed to financing of the national power grid expansion and connections program over the years, with 69 percent national coverage achieved by 2009 and targets of 70 percent by 2010 and 90 percent by 2020. Government reforms starting in the late 1980s enabled participation of private enterprise in the power sector and have been instrumental in advancing the public-private partnerships and private investment in the power generation, underlying the rapid expansion of installed power capacity to date.

Hydropower Development

In 1975 there was only 40 MW installed capacity in the country,⁷ mostly from one hydropower plant (Nam Ngum 1, 1 unit x 30MW) located near the capital city, Vientiane.

7. Source: *30 Years of EDL (1975–2005)*, Electricité du Laos 2008.

TABLE 1.2 GENERATION CAPACITY IN LAO PDR

Name	Location	Year	Capacity (MW)	Generation* (GWh)	Market	Ownership
Selabam	Champasak	1970	5.04	23.74	Domestic	EDL
Nam Dong	Luangprabang	1970	1	5.59	Domestic	EDL
Nam Ngum 1	Vientiane	1971	155	1,145.78	Domestic	EDL
Xeset 1	Saravan	1991	45	115.48	40% Export (Thailand)	EDL
Nam Ko	Oudomxay	1996	1.5	9.03	Domestic	EDL
Theun-Hinboun	Bolikhamxay	1998	210	1,546.85	95% Export (Thailand)	EDL 60% Nordic Group (Norway) 20% MDX (Thailand) 20%
Houay Ho	Attapeu	1999	150	392.55	99% Export (Thailand)	EDL 20% Suez Energy (Belgium) 60% HHTC (Thailand) 20%
Nam Ngay	Phongsali	2002	1.2	1.84	Domestic	EDL
Nam Leuk	Vientiane	2003	60	252.29	Domestic	EDL
Nam Mang 3	Vientiane	2005	40	223.82	Domestic	EDL
Nam Tha**	-	2006	1.25	-	Domestic	EDL
Mini/ micro-hydro**	37 locations	-	11.5	-	Domestic	PDEM
Diesel Generators**		-	175	-	Domestic	PDEM
Total			698.99	3,716.97		

Source: Electricity Statistics Yearbook 2007 of Lao PDR, Department of Electricity, Ministry of Energy and Mines, unless otherwise indicated.

*Generation in 2008. Source: EDL Annual Report 2008.

**World Bank Project Appraisal Document (PAD), Rural Electrification Project Phase II December 2009.

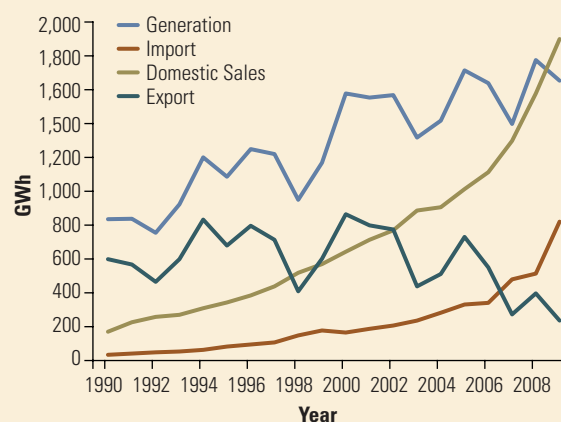
Note: PDEM stands for Provincial Department of Energy and Mines; IPP stands for Independent Power Producer.

Today approximately 700 MW of installed capacity, 97 percent of it hydropower, is in operation. It is owned by a mixture of public and public-private players (table 1.2) and generated an estimated total of 3,700 GWh⁸ in 2008, of which 1,578 GWh⁹ (around 42 percent) was consumed domestically, and the rest supplied export markets (figure 1.1).

Looking ahead, only a tiny fraction of the potentially exploitable 23,000 MW hydropower—15,000 MW excluding mainstream Mekong—has been developed so far. The revised Electricity Law by the National Assembly in 2008 further strengthened the government commitment to promoting private-sector led hydropower development for cross-border trade, with expectations

8. 3,700 GWh is total power generation in Lao PDR for 2008, which includes 1,777.57 GWh from EDL-owned plants and 1,939.85 GWh from IPPs.

9. EDL Annual Report 2008.

FIGURE 1.1 EDL GENERATION, IMPORT, EXPORT, AND DOMESTIC SALES CURVE

Source: EDL Statistics 2009.

Note: Generation includes only EDL solely-owned plants and not EDL joint venture IPPs.

of increasing the nation's installed capacity from approximately 700 MW to approximately 3,000 MW by 2013, including Nam Theun 2. The hydropower projects under construction today are mostly IPPs for export to Thailand, financed by foreign investments (table 1.3). With the commissioning of Nam Theun 2 in 2010, net government revenues from hydropower exports are expected to grow from US\$17 million currently to approximately US\$100 million by 2011 and US\$350 million by 2020.

Electricité du Laos (EDL)

Central to the impressive growth and performance of the power sector in Lao PDR—the rapid expansion of national electricity access and pioneering work in developing hydropower for the export market—is the state-owned power utility, EDL. It is not an overstatement that EDL is one of the country's priorities and star performers. Established in 1959 to supply the French military

TABLE 1.3 POWER PROJECTS UNDER CONSTRUCTION IN LAO PDR

Name	Location	Year*	Capacity (MW)	Generation* (GWh)	Market	Ownership
Nam Theun 2	Khammouane/ Bolikhamxay	2009	1,088	5,936	95% Export (Thailand)	LHSE (Lao PDR) 25% EDF (France) 35% EGCO (Thailand) 15% ITD (Thailand) 15%
Xeset 2	Saravane	2009	76	309	20% Export (Thailand)	EdL
Nam Nhone	Bokeo	2009	3.5	-	Domestic	EdL
Nam Lik 1–2	Vientiane	2010	100	435	Domestic	EdL 10% China International Water and Electric Corp 90%
Tatsalen	Savannakhet	2010	3.2	-	Domestic	SIC Manufacturer (Thailand) 100%
Xekaman 3	Sekong	2011	250	977	90% Export (Vietnam)	EdL 15% Viet-Lao Power Investment and Development Joint Stock 85%
Nam Ngum 5	Vientiane/ Xiangkouang	2011	120	507	Domestic	EdL 15% Sinohydro 85%
Nam Ngum 2	Vientiane	2013	615	2,300	100% Export (Thailand)	EdL 25% Ch. Kanchang PLC 25% Bangkok Expressway PLC 12.50% Shlapak Development Company (USA) 4% PT Construction & Irrigation Co.Ltd (Lao PDR) 4% Team Consulting Engineering and Management Co., Ltd (Thailand) 1%
Theun-Hinboun Expansion	Bolikhamxay	2012	220+60	-	88% Export (Thailand)	EdL 60% Nordic Group (Norway) 20% MDX (Thailand) 20%
TOTAL			2,536	10,464		

Source: EDL Annual Report 2008.

*Expected completion year and expected generation.

bases in Vientiane, EDL today owns and operates the country's main generation, transmission, and distribution assets. It was EDL's visionary thinking and commercially-minded instincts, coupled with its tenacious entrepreneurial drive, that got the ball rolling in the 1970s, with the opportunistic development of the nation's first major hydro resources. Over the past decades, EDL has aggressively and effectively led the country's national grid rollout program, resulting in national electrification rates that quadrupled from 16 percent in 1995 to 69 percent in 2009. Electrification coverage in rural areas stands at around 35 percent. As noted, the government target is to electrify 70 percent of the population by 2010, 80 percent by 2015 and 90 percent by 2020, by deploying the least-cost strategy of further grid rollout, complemented by an expanded off-grid program.

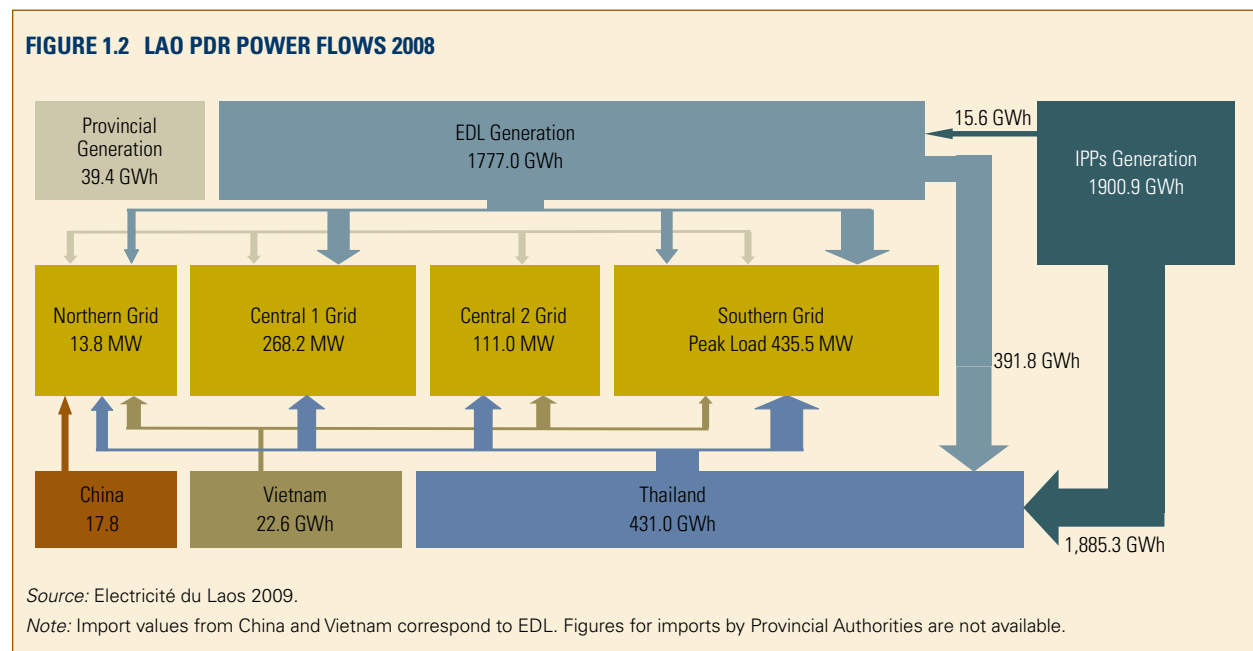
Regional Power Market

Consistent with the early drivers of power system development, today there are four regional subgrids in Lao PDR (Northern Grid, Central Grid 1, Central Grid 2, and Southern Grid). These are not interconnected, but each is individually linked to the Thai power grid (figure 1.2) over high-voltage links. Because hydropower is dominant

in the country's power generation mix, and because a unifying national backbone grid is not yet in place, when there is a transmission bottleneck and in dry seasons, EDL continues to import electricity from Thailand to meet domestic demand in each subgrid in dry seasons.

National Grid Development Program Underway

Several ongoing grid strengthening projects are underway, with the objective of integrating these four regional grids into a single integrated national grid over the medium term. These developments will facilitate enhanced power-flow stability, adequacy, and security in the national grid. This ongoing development is crucial, as well, in underpinning further expansion of the regional cross-border power market to meet growing demand in the Greater Mekong Subregion (GMS)—Thailand, Vietnam, China, Cambodia, and Myanmar. Specifically, the following are well underway: construction of a modern a national power dispatch center; 500kV substations; and critical transmission lines and cross-border links in southern Lao PDR for export of hydropower to Cambodia and Vietnam.



Sustained National Commitment— Enabling Rapid Transformation of the Power Sector with Strong Donor Engagement

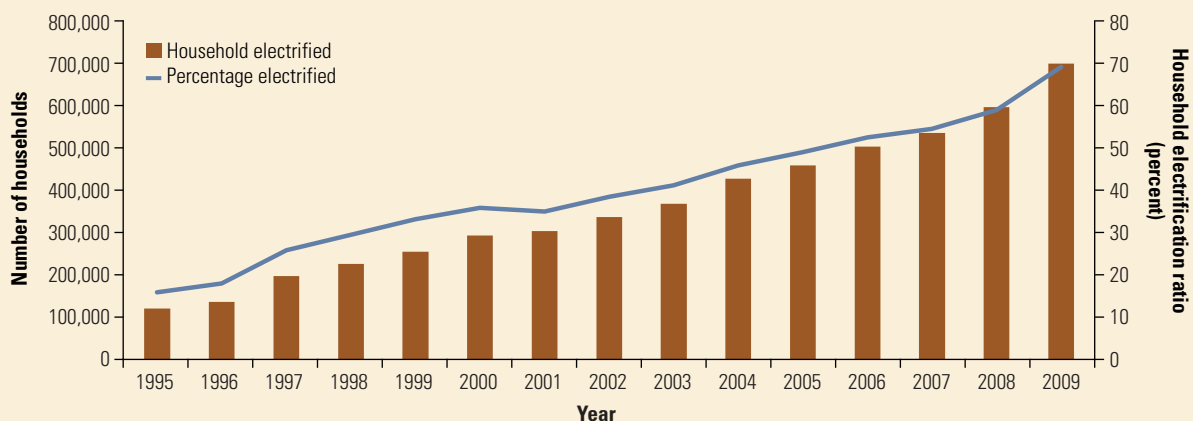
National Electrification Program Results Stand Out

Lao PDR presents a remarkable success story in rapid national electrification that is integrated within a broader strategy of national and rural development. In fifteen years, electricity access more than quadrupled from 15 percent in 1995 to 69 percent in 2009; the number of households with electricity coverage grew more than five times from 120,100 in 1995 to over 700,000 in 2009 (figure 2.1). The country is on track to achieve the government's target of 70 percent national coverage by 2010 and looking ahead to the next challenge—reaching 90 percent access by 2020.

This achievement in the power sector in Lao PDR—especially the grid rollout program spearheaded by the national utility, EDL, is singularly exemplary compared to other successful national electrification programs worldwide in terms of the speed of progress (figure E.1). Even more remarkable, the country has managed to achieve 69 percent overall coverage at a relatively low level of GDP per capita, compared to Vietnam and China.

The remainder of this chapter highlights the GoL's role and highly visible hand in enabling the extraordinary progress to date in national electrification.

FIGURE 2.1 HOUSEHOLDS ELECTRIFIED IN LAO PDR 1993–2009



Source: Department of Electricity, Ministry of Energy and Mines, and Electricité du Lao PDR.

Government Role— Unwavering Commitment, Getting the Policies Right, and Staying the Course All the Way

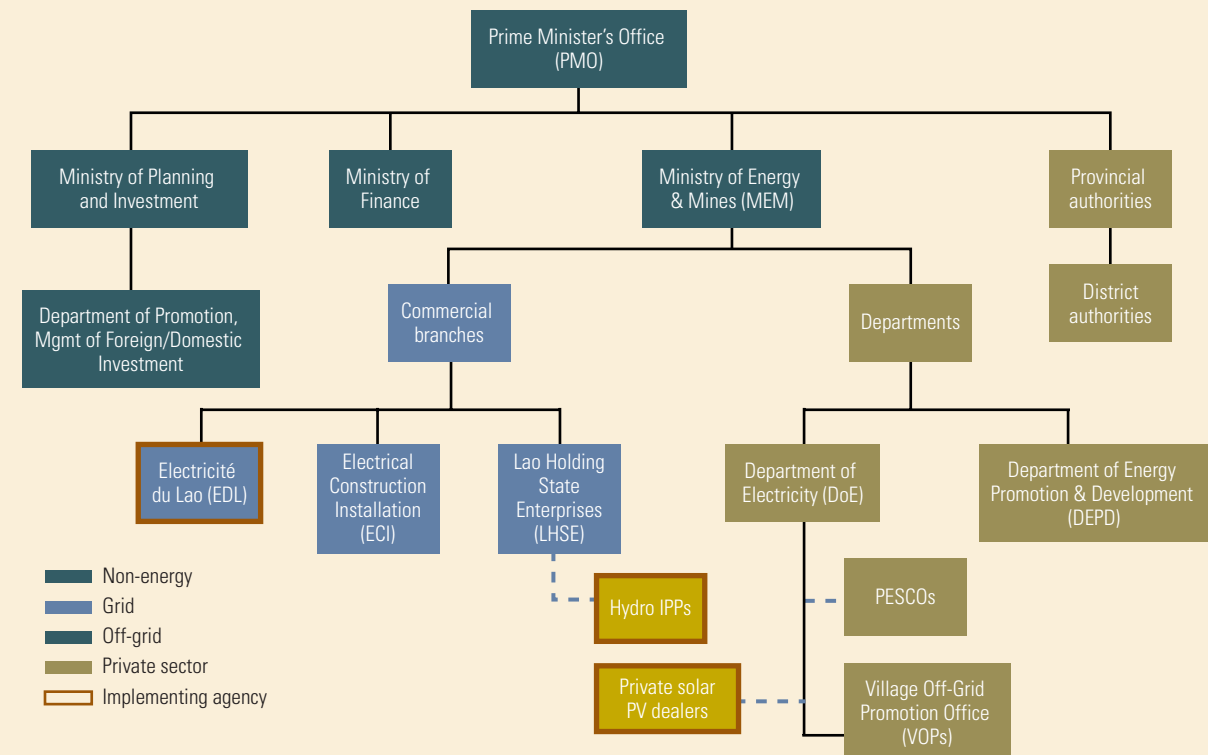
By and large, the government focused on doing the right things and at more or less the right time. Further, a series of government policy initiatives helped steer the rapid modernization and expansion of the power sector and its ability to step up and perform its role in achieving Lao PDR's broader developmental goals.

Clear national goals and targets, coupled with highly supportive political environment. From the outset, following independence, the government's vision at the highest levels has been of national electrification as a public good, essential for economic development and modernization of the country for the benefit of all its citizens. Rural electrification has been an integral component of the government's growth and poverty-reduction programs. It has been and is rooted in an unwavering commitment to redressing regional development imbalances, improving quality of life, and increasing access for all to

social services and economic opportunities. The political resolve did not stop with the rhetoric; the government set clear targets for electricity access. This was followed up by policy and financial commitment, against the backdrop of a conducive overarching national economy that has grown at an average annual rate of 6.5 percent since 2001. The government also fostered friendly and productive relationships with not only its historic political partners, but with its regional neighbors, as well—especially Thailand, with which Lao PDR has strong and shared cultural and economic ties, and which had its own successful and very visible national electrification program just across the Mekong river. Critically, as well, the GoL successfully established a highly positive and longstanding partnership with international donors and financial institutions.

Enabling policy and an appropriate institutional framework for the power sector. The GoL has pursued a pragmatic and purposeful approach rather than ideological approach in establishing an institutional framework, comprising specialized and effective implementing agencies/institutions best suited to deliver the desired results (figure 2.2). Specifically, the GoL has put in place enabling policies that

FIGURE 2.2 LAO PDR POWER SECTOR INSTITUTIONAL FRAMEWORK (2006–PRESENT)



Source: Authors.

support three distinct delivery agents/mechanisms in the power sector.

- **Generation: promote entry of private sector IPPs.** IPPs effectively help finance the development of the nation's sizeable low-cost hydropower resources for export, thereby becoming a major revenue earner for the country.
- **Electricity grid system.** EDL, the national utility, is vested with responsibility for running and expanding the domestic electricity business, and also accountable for meeting the grid rollout-based electricity access targets.
- **Off-grid program—private delivery complementing grid rollout.** A special-purpose delivery mechanism and implementation channel was established, with oversight by the Department of Energy (DOE), in the Ministry of Energy and Minerals (MEM), to advance public-private partnerships for setting up and extending energy services delivery chains to get solar home systems to rural households, especially in areas not likely to be grid-connected soon.

Provide stable financing platform for the program. The government recognized from the start that rural electrification implemented nationwide in a programmatic manner is a capital-intensive effort that cannot be accomplished on a purely commercial basis—state subsidies would be required, and not simply on a one-off or intermittent basis. It has an ongoing capital subsidy to EDL delivered primarily through two financing mechanisms: (1) dividends from hydropower export revenue earnings; and (2) mobilizing the bulk of the financing requirements over the program period from international development organizations and on-lending them to EDL on highly concessionary terms.

The government also effectively balanced, by means of a retail electricity tariff-setting and adjustment mechanism, the somewhat conflicting priorities of (i) ensuring that retail tariffs and connections to the grid were affordable to the poorer segments of the population, and (ii) maintaining the commercial viability of EDL along the way (further details are discussed in chapter 4).

Commercialization of EDL. Starting with the corporatization of EDL in 1997, the GoL has been committed to the objective of EDL becoming an autonomous, profitable, and self-financing commercial institution. In this effort and throughout the process, the government collaborated with EDL and donor organizations in implementing policies and tariff reforms and improving its governance and operational efficiency—combined with significant equity injections—that steered the transformation of EDL to what is today: a commercial public utility.

Sector-wide approach leading to longstanding and substantial donor engagement. The government established a positive and open environment for dialogue and cooperation with the development partner community. This led to strong donor engagement and support that continues today. For over two decades, the energy sector has received an ongoing stream of well-sequenced credits and grants blending policy support with program financing. In this process, the sector has been very open to, and has benefited from, knowledge and advice conveyed over the course of regular and frequent interactions with donors. These complemented international experience and lessons learned on the policy front with significant day-to-day implementation support experience gained in the Lao PDR program.

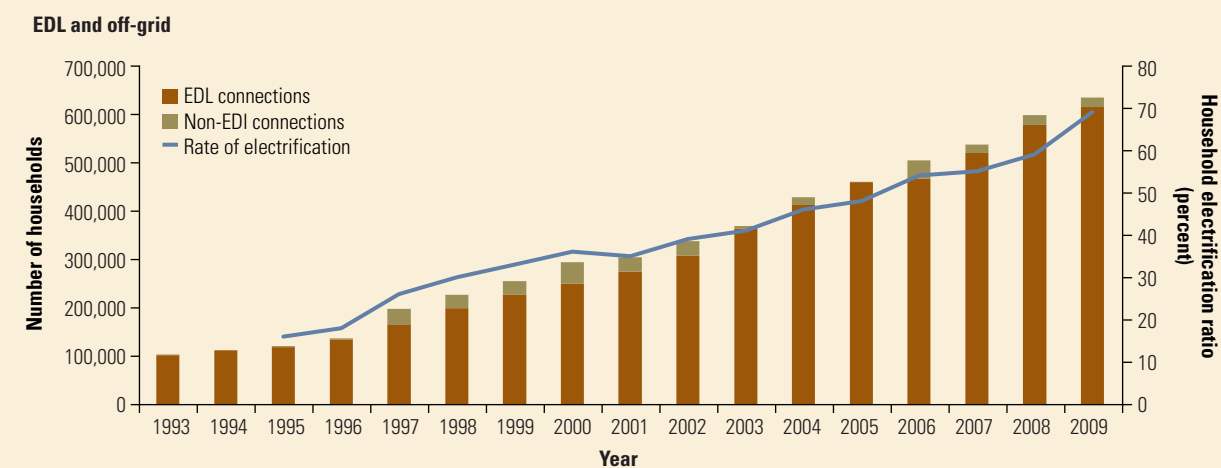
Electricité du Laos— Highly Effective National Utility

Key to successful implementation of the national electrification program in Lao PDR—fast paced, efficiently executed, and effective in terms of results and impact—has been its institutional model of grid extension and roll-out driven by the national electricity utility EDL. Despite the geographic and demographic challenges posed by mountainous terrain and low population density, EDL has more than quadrupled national electricity access from 15 percent in 1995 to 69 percent in 2009 through its grid extension effort (figure 3.1). The country is on track to achieve the government’s target of 70 percent overall coverage—grid and off-grid—by 2010. By virtue of its consistent and high-performance track record, EDL has been a key enabler and frontline partner in Lao PDR’s national and rural development.

Several factors have contributed to EDL’s excellent implementation record, which has earned it a place in the select club of countries worldwide acknowledged as best-practice national electrification programs.

- **Visionary and effective leadership, with strong commitment to rural electrification**, has instilled a corporate culture dedicated to accountability for results and a work ethic characterized by open-minded professionalism;
- **Sound program planning and prioritization** to enhance broad-based development impact with special emphasis on the poor;
- **Cost-cutting technical innovations mainstreamed** to lower grid rollout program costs; and

FIGURE 3.1 HOUSEHOLDS ELECTRIFIED 1993–2009



Source: EDL Statistics 2009.

- **Steadfast enhancement of organizational capacity and operational productivity**, including decentralization, increased customer focus, steady gains in labor productivity and technical operational efficiency, and last, but not least, strengthening technical capacity of staff and of management systems.

Visionary and Effective Leadership, Steering Professional Implementation and a Results-Driven Culture

Vision followed up by action: hydropower exports in early years set the stage for access program financing. Since 1975, EDL leadership has been central to driving the impressive growth and performance of the power sector. It was the visionary drive and business acumen of the early senior leadership of EDL that recognized and successfully pioneered hydropower development for the export market—seeing that benefits in the medium term, in the form of surplus revenues from exports, over time could help finance investment to grow the domestic power sector. This powerful example¹⁰ set the stage for the government’s subsequent push for a more ambitious hydropower exports-based market development program in Lao PDR, anchored by IPPs. The dividends from the government’s share of these projects comprised a significant share of overall access program financing until recently (see chapter 4).

Rural electrification: motivated staff and results-driven culture. From the outset, the senior leadership of EDL also set a tone and values ethic that signaled an unwavering and strong commitment to rural electrification, and to meeting the GoL’s targets as a top priority for the national utility. As the grid rollout progressed beyond Vientiane, accountability for meeting the rollout implementation and connection targets was shifted squarely on to each EDL provincial branch within their respective service areas. The branch offices today are well supported and empowered to plan, design, procure, and manage delivery on their connection targets and their targets for customer service improvements or technical loss reduction. Branch offices have a highly professional and motivated staff, who take pride in their mission and mandate. For example, detailed spatial planning capacity resides in the branch offices and easy-to-use tools are available

10. Indeed, there was an earlier time when revenues from electricity sales from Nam Ngum to neighboring Thailand represented Lao’s biggest export earner. Subsequently the tourism sector became the biggest export earner. More recently the mining sector and the fast-growing IPP-based big hydropower exports will change this picture again.

to facilitate dialogue with visitors such as village leaders, provincial and other officials, and donors. The tools include, for example, topographic maps of the provincial service area, showing a diagram of the existing EDL network and the planned network expansion by year. Transparency and accountability are integral to branch office *modus operandi*.

Open-minded professionalism. Last, but not least, EDL leadership has been successful in fostering a corporate culture at ease in engaging productively with international donors—bilateral and multilateral—and thereby building a two-way, trusting, and productive partnership that has lasted from the very outset of the access program to the present time.

Sound Program Planning and Project Prioritization—Transparently Driving Implementation

The rural electrification planning process in Lao PDR is based on a multiyear electrification expansion plan. It takes into account the financial and economic viability of every investment and incorporates a project selection methodology that prioritizes areas and villages to be electrified to maximize social impact, within the constraints of available resources.

Simple but rigorous village screening and prioritization process. Areas to be electrified (“subprojects”) typically consist of several villages in a cluster. Those that are to be electrified through grid extension as part of the subproject are prioritized based on (i) proximity to existing major roads; (ii) larger number of households; and (iii) more economic and social activity, measured by the number of clinics, hospitals, saw mills, rice mills, schools, temples, irrigation, and other small industries. Different weights are assigned to different types of connections: higher weighting to connections likely to generate economic use of electricity, such as saw mills, as well as those with social importance, such as schools and clinics. For example, one saw mill could be weighted as 20 connections, as its revenue is around 20 times that of a household (table 3.1).

A total weighted connection score for each subproject is then calculated, and each subproject are ranked on the basis of the cost of electrification, including its share of the medium-voltage (MV) network, divided by the total weighted score. Finally, the scope of the subproject is adjusted to include priority villages selected by provincial governments to promote economic growth or achieve

TABLE 3.1 AN EXAMPLE OF ECONOMIC WEIGHTING OF A SUBPROJECT

Economic Activities	Total No.	Weight	Weighted Connections	Remarks
Household	419	1	419	Household revenue considered as the base revenue
Temple	0	15	0	10 points for estimated revenue, 5 points for religion importance
School	4	25	100	20 points for estimated revenue, 5 points for social importance
Irrigation	2	35	70	30 points for estimated revenue, 5 points for social importance
Rice Mill	16	25	400	Weighted according to estimated revenue
Clinic	0	7	0	4 points for estimated revenue, 3 points for social importance
Saw Mill	0	20	0	20 points for estimated revenue
Total			989	

Source: EDL, Authors.

other social objectives, such as development of ethnic minorities. Specifically, under the consultative process used, EDL branch offices make proposals to the headquarters office, based on expected funds available and taking into consideration the upstream consultations with provincial energy officials and other authorities as to their priorities and regional development plans. Following a cross-cutting review of all provincial and branch-level proposals, a revised implementation plan is prepared, and any adjustments conveyed to branch offices to proceed accordingly.

Cost-Cutting Technical Innovations and Practices Mainstreamed

EDL engineers have been very open to learning from relevant practices across the region and beyond, and adapting innovations that lower the investment costs of the national electrification program. As a result of this deliberate effort to balance cost considerations and performance, EDL's network design and rollout conform to best engineering and commercial practices. This practice has been mainstreamed, and is evident in many aspects of the network in place today, among them construction, network design, and equipment specifications.

Low-cost concrete poles

EDL adopted low-cost prestressed concrete pole technology similar to that used in Thailand, significantly lowering both fabrication and transport costs. The far simpler technology and production process makes it feasible to produce the poles in "mobile factories" that are easily

dismantled and moved to follow construction progress as the network expands. The shorter transport distance has also meant that fewer poles are broken en route. This is a significant achievement: pole costs typically represent around one-third of the total investment costs of rural electrification programs.

SWER reticulation

Single Wire Earth Return (SWER) network reticulation, pioneered and widely utilized in Australia and New Zealand, and more recently in South Africa's rural electrification program, has been deployed effectively by EDL in several subproject areas. The technology is used to connect small and dispersed loads that are too far from each other to be economically or technically served by even a conventional single-phase spur line from the MV network. SWER reticulation typically involves a simpler steel wire conductor, wider pole spacing, because a far lighter conductor is used, and hence, fewer poles per km circuit.

EDL has implemented six SWER projects in as many provinces. Together, they involve approximately 135 km of SWER reticulations to serve around 4,500 households and a remote army camp. Several more SWER projects are planned for implementation in the near term. Further, EDL planners recognize that grid network extensions are beginning to reach the stage where an increasing portion of the remaining loads is smaller, more dispersed, and scattered in increasingly deeper rural areas. Looking to the next decade, it is anticipated that the technical and economic case for deploying conventional single-phase and SWER reticulation is growing.

Shield wire technology on high voltage transmission lines

In the mountainous northern region of Lao PDR, in addition to occupying a more difficult terrain, load clusters tend to be dispersed and small, making it expensive to use normal reticulation design and standards to connect. EDL has deployed shield wire technology on some high-voltage (HV) transmission lines, which enables low-cost tap-offs from the shield wire that runs separately with the HV line without compromising network security or stability. The spur lines that form the tap-off point are situated at several places along the length of the HV line, to connect small clusters of loads within reach; this obviates the need for costly substations at each location to serve small clusters of households and others close to the HV line.

Steadfast Enhancement of EDL's Implementation and Organizational Capacity and Productivity

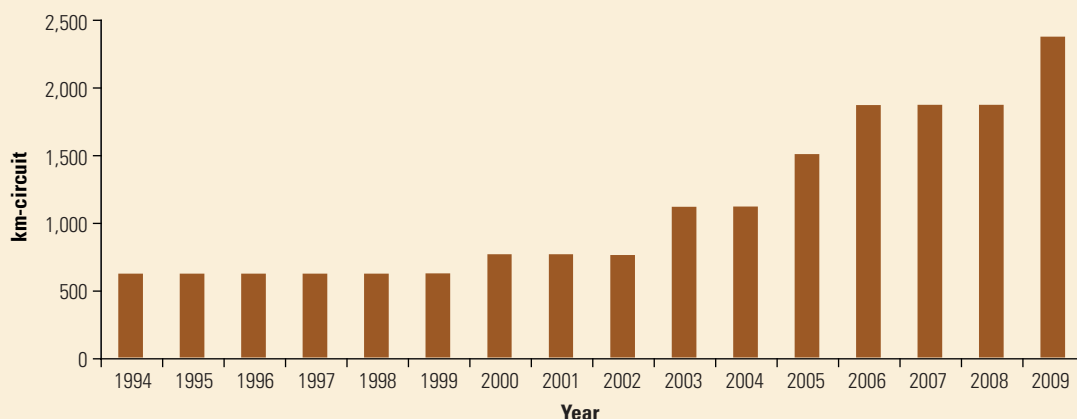
Fast-paced construction program for network infrastructure rollout. Underpinning the national electrification program targets achieved each year is an equally impressive institutional capacity for staging and orchestrating a fast- and sustainably-paced transmission and distribution network construction program, anchored by extensive engineering design capabilities. Just two decades ago, the country's transmission and distribution networks consisted of 90 km of 115 kilovolt (KV) single-circuit and 90 km of 115 kV double-circuit transmission lines running through the Vientiane Prefecture; 9 substations; 606 km of 22 KV lines; and 553 km of low-voltage (LV) lines. Outside

Vientiane, only 5 of the 16 provinces had public electricity supply. EDL was able to serve fewer than 50,000 households, around 6 percent of the total in the country.

Since 1994, EDL's 115KV transmission system has expanded at an average annual rate of 8.2 percent, to comprise about 2,364 km in 2009. By the end of 2006, EDL had 23 115/22KV substations with total capacity of 813MVA. Its distribution system network reticulation (MV) has grown at an average annual rate of 14.5 percent from 1,861 km in 1994 to 14,203 km in 2009, with LV network reticulation growing annually at around 12.9 percent from 2010 km in 1994 to about 12,500 km in 2009 (figures 3.2 and 3.3).

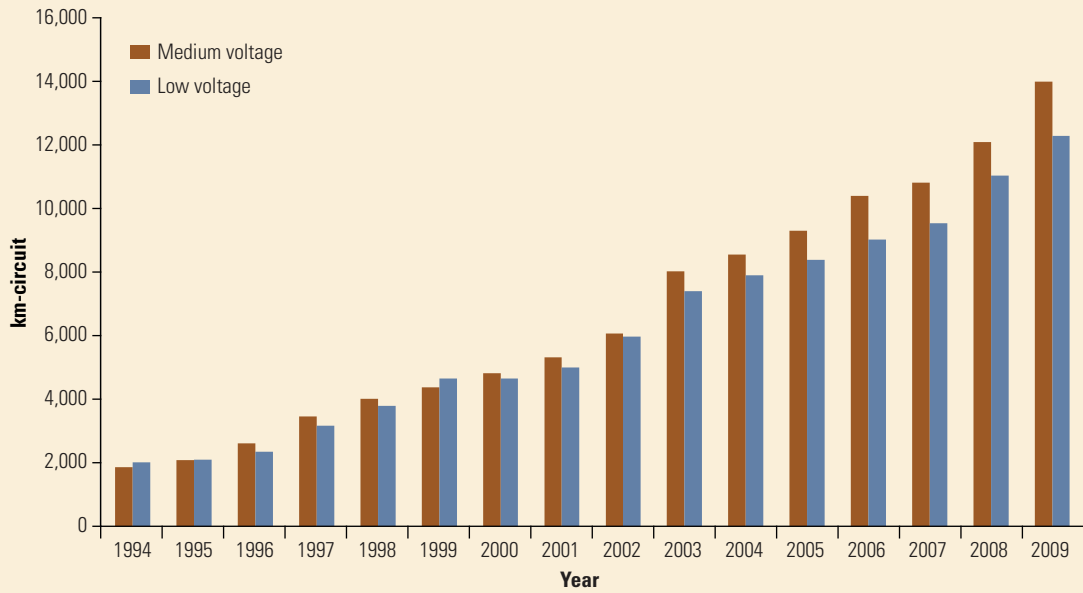
Technical capacity—an engineering tradition. From the outset, EDL has maintained a solid tradition of according status to the engineering profession and its professionals. It has benefitted from the historic and continuing ties and links originating in the association of Lao PDR with the eastern bloc nations, and most notably, its neighbor Thailand—with whom Lao PDR shares a common culture and friendly relations and whose electrification program is highly visible across the Mekong River. Many senior EDL engineers were trained in Russia and the former USSR. These early ties grew into a culture of solidly grounded engineering professionals as the utility expanded. The tradition has continued with an active program for sending promising young engineers overseas from provincial EDL branches to strengthen their engineering skills and improve their career development prospects as well. The practice has also helped create a highly professional and committed work force and workplace.

FIGURE 3.2 115KV TRANSMISSION LINES (KM-CIRCUIT)



Source: EDL 30-Year Growth Report for 1994–2004 and EDL Annual Reports 2006–09.

FIGURE 3.3 DISTRIBUTION LINES (KM-CIRCUIT)



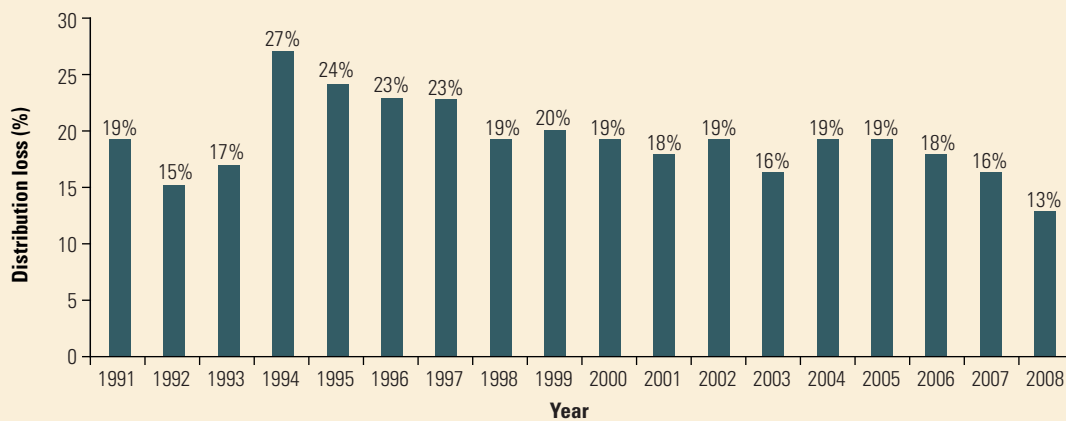
Source: EDL 30-Year Growth Report for 1994–2004, and EDL Annual Reports 2006–2009.

Decentralization geared for improving operational efficiency and customer service. EDL has grown over the years to keep pace with the scale and geographical spread of the grid rollout program, and indeed to drive it more effectively and efficiently. Starting as a Vientiane-based company, the utility today has over 3,000 employees among its headquarters office in Vientiane and 22 branch offices in the 7 provinces of Lao PDR: 9 branches in the northern region, 13 in the southern region, and 6 subdivisions in

greater Vientiane. Starting in 2003, several branch offices were rebuilt and equipped with new computers, vehicles, and modern other equipment. Performance incentives are in place to improve the utility’s key efficiency and productivity indicators.

Figure 3.4 depicts the steady and significant progress made over time under the distribution system loss reduction program—technical and otherwise. This targeted

FIGURE 3.4 EDL DISTRIBUTION LOSSES 1995–2008

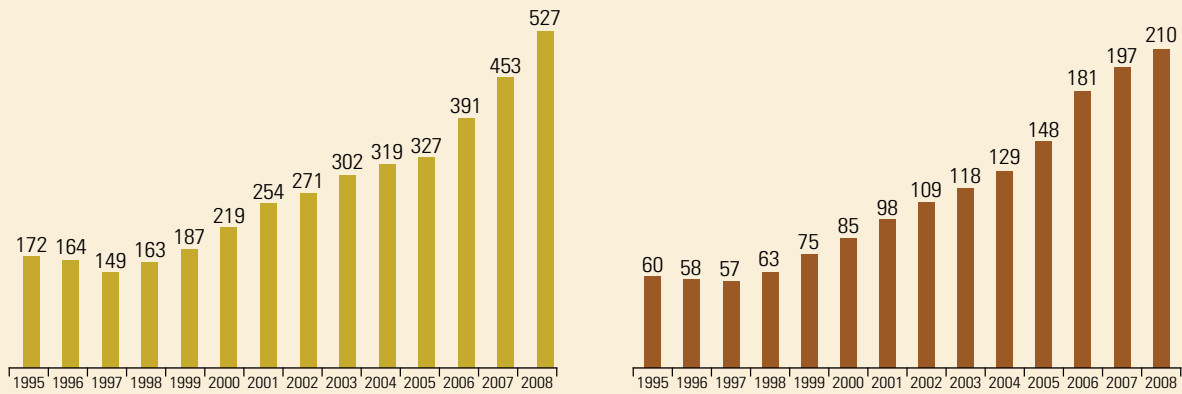


Source: EDL Statistics 2009.

program has been given high priority because it directly affects EDL's financial bottom line. Since 2005, intensive training on system analysis for loss reduction has been provided by international consultants to EDL's system planning engineers at both corporate and branch levels. Investments have been made systematically over time in the entire range of measures, including substations and transformer upgrading, optimizing feeder line length,

replacement of old meters, increasing meter reading frequency, mainstreaming state-of-the-art software and hardware for computerized billing and accounting. Not least, a performance bonus is provided to field staff pegged to actual reduction in system losses achieved. Figures 3.4 and 3.5 depict the progress along two labor productivity indicators.

FIGURE 3.5 LABOR PRODUCTIVITY 1995–2008



Source: EDL Statistics 2009.

Financing, Subsidy, and Tariff Policies

Electrification is a capital-intensive effort. Steady and rapid expansion of EDL's medium-voltage and low-voltage distribution networks, outside of the more densely populated urban and peri-urban areas, has required an ever-increasing amount of financing over the two decades starting around 1987. This is not an easy feat for a poor country. How the required financing was mobilized—in adequate amounts, and on a sustained basis—to maintain the rapid pace of implementation and increase in national electricity coverage—is highlighted in this chapter.

The success in addressing the financing challenge of the national electrification program in Lao PDR is the result of steering a workable, ongoing, and lasting balance between two divergent fiscal and policy tensions. On the one hand, it was recognized that the program could not achieve the government's target of 90 percent access by 2020 without maintaining EDL's commercial viability along the way. Indeed, the utility would have to be strengthened over time: its weak financial position in the late 1980s and early 1990s challenged its ability to undertake the daunting challenge of electrifying the country. On the other hand, it was necessary to devise an effective and efficient subsidy and cross-subsidy policy, so retail tariffs and connection fees for grid access would be affordable by the poorer segments of the population. This would be especially important as the grid's reach extended deeper into the rural areas where the vast majority of the country's population resides and incomes typically decline. Striking the right balance and maintaining it along the way has been a key enabler of the national electrification program financing story in Lao PDR. It is an essential feature that the Lao PDR program shares with other successful national electrification programs worldwide.

Program Financing

Overall financing mix. The total investment cost of the grid rollout program over the period 1987–2009 is estimated at about US\$600 million (annex E). It has been financed predominantly (about 75 percent) by concessionary loans or grants from multilateral and bilateral agencies, with the remainder from domestic sources, including EDL, the GoL and electricity customers. Domestic contributions were sourced primarily from EDL's surplus revenues from hydropower exports and proceeds from new connection charges as elaborated below. As EDL's financial position improved over time, the share of domestic contribution to financing gradually increased from under 25 percent of the total in the early days to around one-third of the total today.

Subsidies

Capital subsidy—long-term concessionary financing with grant components. As noted, the government recognized from the start that rural electrification implemented nationwide is a capital intensive activity, and cannot be accomplished on a purely commercial basis. From the outset, the GoL channeled concessionary funds¹¹ from international developmental organizations to EDL in the form of subsidiary loans through the Ministry of Finance (MOF). Together, these account for about 90 percent of EDL's loan portfolio. These long-term, highly concessional

11. The World Bank has provided the government of Laos with 30-year IDA loans at 0.75% per annum, with a 10-year grace period. The ADB has offers loans with the same tenure at 1.00% per annum.

funds, along with favorable on-lending terms,¹² have allowed EDL to carry out its capital investment programs with low-cost and long-term financing. In recent years, a certain portion of the foreign funds has been conveyed to the GoL in the form of grants.¹³ In these instances, the government's practice has been to transfer 80 percent of the grant proceeds to EDL and on-lend the remaining 20 percent on concessional terms.

Operating subsidy for rural electrification—hydropower export revenues and dividends. In addition to mobilizing concessionary funds and grants from foreign sources, the government also directly provides EDL with an operating subsidy in the form of retained dividends from export-oriented private-sector hydropower projects. Specifically, EDL is the designated nominee shareholder¹⁴ of several GoL-IPP investment projects, currently holding 60 percent and 20 percent of shares, respectively, in Theun Hinboun Hydropower Corporation (THPC) and Houay Ho

Power Company (HHPC) (table 1.3). The dividend income stream that EDL has received from these shareholdings since 1998 has been sufficient not only to offset the shortfall between EDL's cost of supply and electricity sales revenue collected under allowable retail tariffs, but also to provide the necessary liquidity for EDL to fulfill its debt service obligations, while carrying out its grid extension and rollout at an uninterrupted pace, and maintaining positive net profit margins since 1998 (figure 4.1).

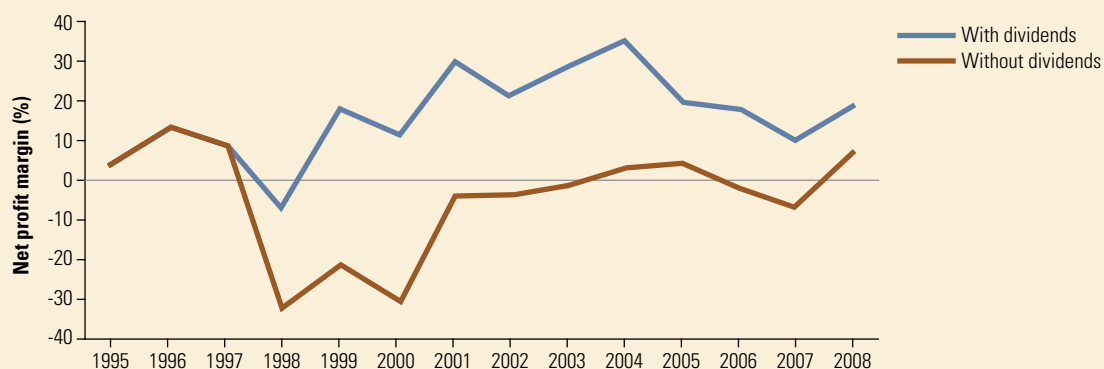
Catalytic role of hydropower exports and dividends—setting in motion a virtuous dynamic for sustained expansion of domestic power sector. Hydropower export revenues have played a defining role in financing the “startup” and early-stage growth of the domestic electricity business in Lao PDR's power sector. They helped early on to catalyze a virtuous cycle that enabled future expansion of the domestic business, leading to the scale of the business today. More specifically, for a large part of the 1990s, hydropower exports revenues and dividends constituted over 70 percent of EDL's revenue, as its domestic customer base was small (figure 4.2). These revenues from exports had enabled early investments in grid extensions into the domestic urban and peri-urban areas, which had, in turn, enabled a transformation in EDL's revenue mix as the domestic business and revenue base grew with more customers connected through further grid extensions. Today, EDL's domestic business has transformed into the backbone of the utility's business, accounting for more than 80 percent of its revenue (figure 4.2b). Finally, rapid expansion of the domestic customer base over time, coupled with the government's tariff reform process described in following, enabled the gradual strengthening of EDL's commercial viability.

12. In the aftermath of the Asian financial crisis, the GoL restructured EDL's entire subsidiary loan portfolio. As a result, seven loans, classified as socially oriented, were repriced from 6.0–11.6% annual rate to 2.0% in FY01–04 and to 6.0% in FY2005–07; another seven loans, classified as non-socially oriented were re-priced with 50% of their original rates in FY2001–04. Along with the price cut, maturity of all subsidiary loans was extended by 5 years.

13. The IDA funding on the Rural Electrification Project (REP) I and II starting 2006 is in the form of grants. In recent years, nontraditional lenders, such as China and India, have played an increasing role in providing export credits with a significant grant element for projects where goods and construction services are sourced through their respective countries.

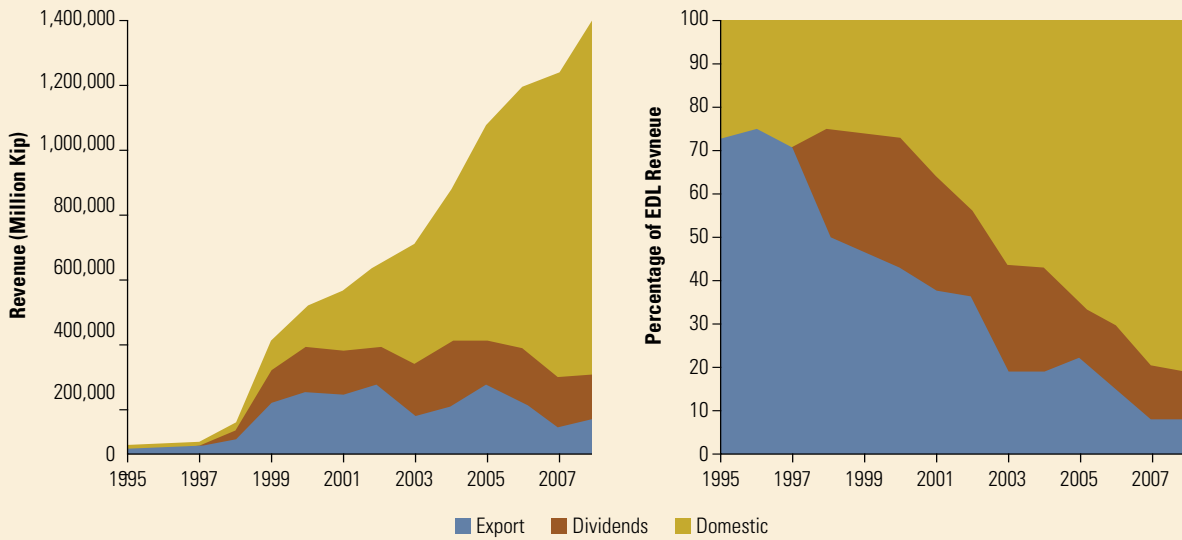
14. In 2000, the GoL converted two subsidiary loans, with a combined balance of US\$64.67 million, to government equity in EDL. These loans were used to finance EDL's share in THPC and HHPC.

FIGURE 4.1 EDL NET PROFIT MARGIN 1995–2008



Source: EDL audited income statements 1995–2008.

FIGURE 4.2 COMPOSITIONS OF EDL'S REVENUE



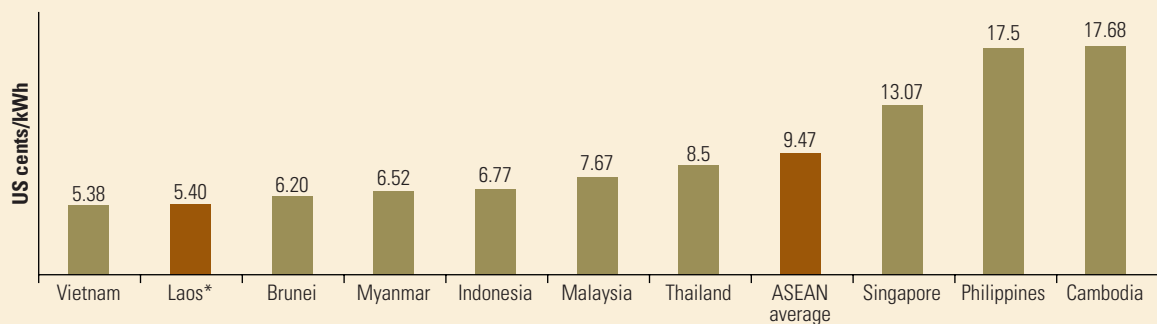
Source: EDL audited income statements (1995–2008).

Tariffs

Charting a course towards full cost recovery. In the early years of the national electrification program, a combination of factors—low domestic tariffs, high distribution losses, and high accounts receivable from domestic sales, especially from government arrears—adversely affected EDL’s financial viability. Starting around 1998, the government set in motion a deliberate tariff reform process with the objective of gradually strengthening EDL’s commercial viability, while ensuring affordability for selected low-consumption customer segments. The tariff reform was suspended in 2004 for an assessment of financial impacts on EDL and affordability to consumers.

At the end of 2005, GoL launched a Power Sector Financial Sustainability Action Plan for 2005–2011. In 2005, a new tariff adjustment program was initiated as part of the Financial Sustainability Action Plan. It allowed for an annual increase on the average tariff with the aim of (i) achieving cost recovery and phasing out EDL’s reliance on government subsidies with hydropower dividends; (ii) achieving a positive return on EDL’s assets; and (iii) reducing cross-subsidies among consumer categories. A life-line tariff was also provided to residential consumers under the new tariff regime to ensure affordability for the poor. Tariff levels for industry and irrigation categories were gradually reduced over the adjustment period to enhance the competitiveness of the industries

FIGURE 4.3 WEIGHTED AVERAGE TARIFF IN ASEAN COUNTRIES 2007



Source: The Heads of Asean Power Utilities/Authorities (HAPUA), Lavalin, June 2009.

Note: *Current average tariff US¢ 6.50/kWh.

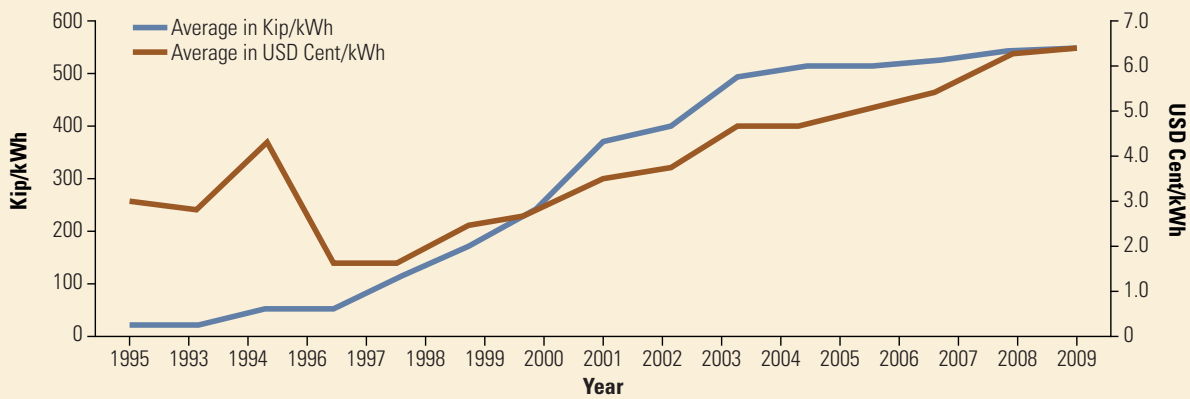
and to support the agriculture production in the country. Concurrently, EDL has invested vigorously in distribution loss reduction since 2005. While quickly expanding the power distribution network to remote rural villages, EDL also achieved an eight percent cut in its distribution losses from 2005–2009. As a result, EDL's domestic business went from running losses to making net profits since 2007, and the weighted average retail tariff was maintained at US¢5.40/kWh, among the lowest in the region, (figure 4.3). The government and EDL have been aided in this endeavor by the low cost of a power supply based on domestic hydro. Further, despite the nation's low income level, consumer willingness to pay

(WTP) continues to exceed the cost of supply.¹⁵ Consequently, the government has been able to implement tariff increases with little adverse social impact or notable reduction in demand.

Tariff adjustments—the path travelled. From 1990 until 1996, domestic tariffs remained nearly constant, and well below long-term marginal costs. Even following the June 1996 increase of tariffs for large customers, the average tariff yield recovered less than 50 percent of the long-term marginal cost. In October 1997, responding

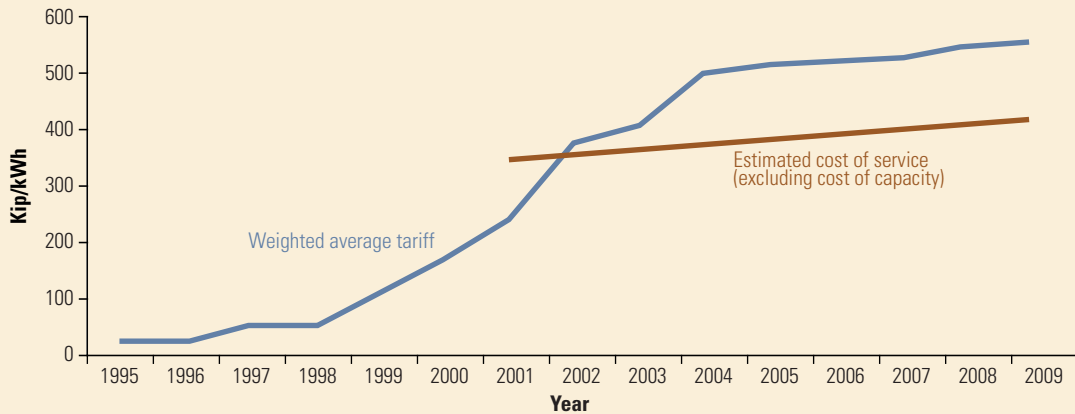
15. A survey, carried out in seven provinces among 1,043 electrified households and 2,161 non-electrified households in 2004, suggested consumer willingness to pay (WTP) for electricity exceeded supply costs.

FIGURE 4.4 AVERAGE ELECTRICITY TARIFFS 1992–2009



Source: EDL Statistics 2009 for tariffs from 1997–2009 and SPRE Project Appraisal Document for tariffs from 1995–96.

FIGURE 4.5 AVERAGE ELECTRICITY TARIFFS VS. ESTIMATED COST OF SERVICE 1995–2009



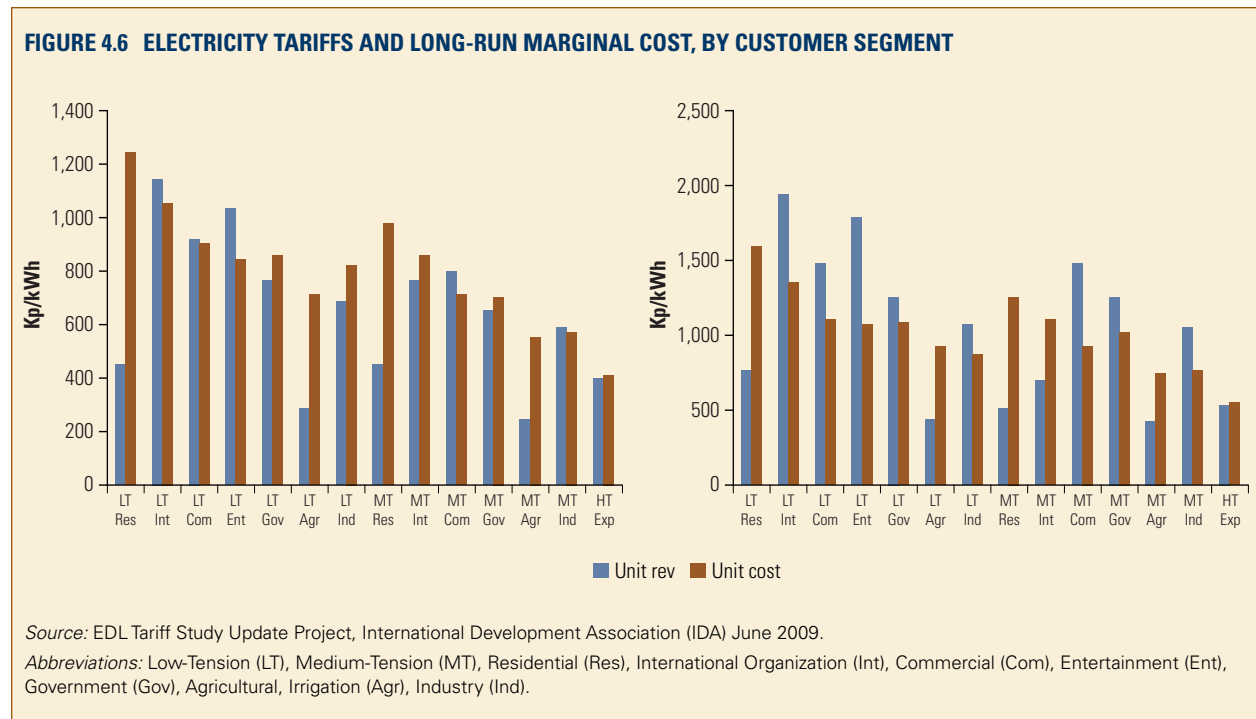
Source: EDL Statistics 2009 and SPRE Project Appraisal Document. EDL Tariff Study Update Project, International Development Association (IDA) June 2009.

to the Asian financial crisis, the government raised the weighted average domestic tariff by more than 100 percent, from 25.52 kip (US¢1.2) per kWh to about 55.12 kip (US¢2.6) per kWh.¹⁶ The government subsequently committed to additional tariff increases, including a further 50 percent increase and quarterly indexation thereafter, both of which took effect in 1999 (figure 4.4), bringing the average tariff to within 83 percent of the long-term marginal cost. In 2007, the tariff increase was suspended for an impact assessment. Thereafter, the government endorsed (June 2005) and approved (November 2005) a schedule of systematic tariff adjustments to reflect domestic inflation and exchange rate fluctuations from 2005 to 2011. EDL's current average tariff is about 560 kip (US¢ 6.50) per kWh, compared to the average cost of service (excluding cost of capacity) of 720 kip (US¢ 5.0) per kWh (figure 4.5). Looking ahead, EDL is now on track to achieve commercially viable modes of operation by the end of the tariff adjustment period, while maintaining a reasonable level of cross-subsidies to allow a life-line tariff for the poor households. In this process, how EDI performs as a profit-oriented company versus the costs of social goods achieved will be easier to delineate. The tariff adjustment is also driven by other underlying

performance expectations: achieving a rate return on revalued assets of 4 percent at the end of the six-year implementation period 2005–11; and EDL gradually phasing out its reliance on dividends by 2011.

Cross-subsidies across business lines permit uniform national tariff policy. The financing and tariffs policies cited in the preceding together have been instrumental in helping maintain the government's policy of nationally uniform retail tariffs. Additionally, tariffs for selected low-consumption customer segments are set to be "affordable," albeit with the judicious use of cross-subsidies. As in many other countries, residential and agricultural consumers in Lao PDR have been cross-subsidized by other customer segments. This is one of the most critical factors contributing to the willingness—by even the poorest rural households—to shift from lighting provided by candles, diesel lamps, or car batteries to grid-supplied electricity. However, the extent of cross-subsidization across customer segments is projected to decline. Under the government-approved implementation of the gradual tariff adjustment process, most customer segments will start generating revenue that exceeds the cost of supply to its tariff class (figure 4.6).

16. When long-run marginal costs of supply were 116 kip (US¢ 5.4) per kWh and 66 kip (US¢ 3.1) per kWh for residential and agricultural consumers, respectively.



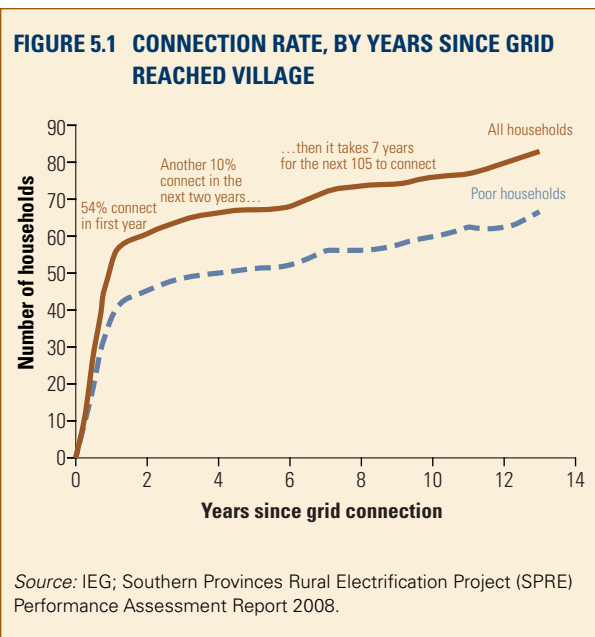
Making the Poor Count— Targeting the Gender Dimension of Rural Electrification

Despite the rapid and remarkable achievement of the Lao electrification program in reaching a national connection rate of about 69 percent of all households, around 20 to 40 percent of households in connected villages—mainly poor—have remained without a connection for a long time. Most cannot afford the upfront connection charge; some simply choose not to connect.

Especially revealing is an analysis over time of connection uptake rates (penetration) in village communities following their connection to the grid. These historical data indicate that about 60 percent of families are able to mobilize sufficient cash to pay the upfront connection charge within the first two years after connection to the grid and an additional 20 percent connect in the following six years (figure 5.1). However, some 20 percent of households remain unconnected, even 10 years after grid access, primarily because they cannot afford the average upfront connection charge of kip 700,000 to kip 850,000 (around US\$87 to US\$110).

Results from a socioeconomic survey in June 2007 further revealed that poor households that remain unconnected tend to be disproportionately headed by women (often widows and divorcees). While female-headed households comprise 8 percent of all households, they account for 43 percent of poor households, mainly because they lack of the earning power of a male in their predominantly rural areas.

In light of the preceding, it was recognized that for the benefits of the national electrification program to reach all—including the very poor—and in order to realize the government’s ambitious goal of 90 percent national coverage of all households by 2020, the connection cost barrier for the poor needed to be effectively addressed



by a well targeted subsidy mechanism. This provided the rationale and case for the Power to the Poor (P2P) program.

Power to the Poor (P2P) Program

The “Power to the Poor” (P2P) Program is a subsidized affordable connection and indoor wiring financing mechanism implemented by EDL, with the support of MEM. Designed with a gender focus, it offers the poorest rural households, who cannot afford the entire upfront costs of connection and internal wiring, access to the main electricity grid for basic service. The objective is to raise



Households below the poverty line and female-headed households—much in common

household connection rates up to 85–90 percent in village communities connected to the grid.

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

Eligible households pay at least 200,000 kip (about US\$24) upfront on average. They can receive an interest-free credit of up to 700,000 kip (US\$87) to cover the costs of installation and indoor wiring. The credit is paid back in equal installments of 20,000 kip (US\$2.50) to EDL over three years, as a part of the household’s monthly electricity bill (that is, in addition to the electricity consumption charge for the month).

One of the key ideas of P2P is to keep the monthly expenditures of the targeted households for both the repayment of the interest-free credit and electricity consumption bills at the same level as their expenditures for lighting before the connection to the grid. Once connected, the typical beneficiary household’s repayment is about kip 20,000 (US\$2.5), in addition to electricity consumption charges between kip 10,000 to kip 25,000 (about US\$1–3), per month. By contrast, these households typically would be spending approximately kip 25,000 to 40,000 (about US\$3 to USD\$5) per month for vastly inferior traditional energy substitutes such as batteries, diesel lamps, or candles. The monthly savings in household energy expenditure are projected to be

sufficient to allow households to repay the connection cost fully in three years.

Pilot Phase

Funded by EDC, GEF, GAP, and IDA, under the Rural Electrification Phase I Project, the P2P scheme was pilot-tested across 20 selected villages in Champasak province, starting in the fall of 2008 and finishing by March 2009. EDL subcontracted with Electricity Construction and Installation (ECI), to provide the house wiring service. For eligible households, ECI provides a quote for the cost of wiring the household. EDL then provides a voucher to the household for a loan of up to 700,000 kip (about US\$87), and signs a contract with the household, agreeing that the household will pay back the loan and cover the difference between the 700,000 kip loan and the ECI quote, if any.

In order to ensure efficient targeting of the truly poor and needy, several eligibility criteria were incorporated in P2P. These included a gender-sensitive poverty criterion, to determine eligible households (table 5.1), and input from the village chief and village committee on who is poor and not poor. In addition, gender-appropriate information and dissemination materials highlighted the benefits of electricity, and gender-inclusive consultation and participation was promoted, for example, by scheduling meetings at times women were likely to be available.

The P2P pilot was available only to those villages that had been electrified for more than two years, giving sufficient time for those who were willing and able to pay the full connection charge up-front to connect on their own.

BOX 5.1 EXAMPLE: PHOSSAAD VILLAGE UNDER THE P2P PILOT

In 2002, EdL expanded its power grid to the Phossaad Village, located in Champasak Province in southern Laos, through the World Bank-supported Southern Provinces Rural Electrification Project (1998–2004). At the end of 2008, before the P2P pilot began, 63 of the 270 households in the village were not connected to the grid because they could not afford the cost of connection. In approximately one month between February and March of 2009, all 63 households were connected to the grid through the P2P pilot, with the connection rate in the village jumping from 77 to 100 percent.



Phossaad Village



EDL staff visiting a female-headed household in Phossaad

Pilot phase results. Implementation of the pilot phase resulted in 537 newly electrified households, of which 68 were female-headed, and in an increase in overall connection rate from 78 percent to 95 percent (table 5.2). When considering only female-headed households, the increase in connection rate attributable to the P2P

Program design was far greater, from 63 percent to 90 percent (table 5.3).

Of the remaining 145 non-eligible households in the 20 pilot villages, 46 (32 percent) were considered not poor enough. Many of these families had just built a new

TABLE 5.1 EVALUATING ELIGIBILITY TO PARTICIPATE IN P2P**Step 1: Determine if the household has permanent housing that is safe to electrify:**

Is the house safe to be electrified?

An eligible participant must live in a structure that is safe to electrify.

Step 2: Determine if the household is poor:

- Household has a rice shortage at least 6 months per year
- Or
- Household does not have any livestock
- Or
- Household has access to less than 1 ha of land for rice cultivation
- Or
- Household cannot finance medical costs
- Or
- Household is female-headed

An eligible participant must meet at least one criteria.

A household is eligible for support if it has housing that is safe to electrify AND meets at least ONE of the poverty criteria.

Source: P2P Training and Implementation Manual.

BOX 5.2 POWER TO THE POOR (P2P) PROGRAM: THE VOICES AND FACES OF SOME OF THE BENEFICIARIES

Ban Nongbung, a village in Champasak, Lao PDR's most southern province. It was electrified in 2003, but not all village households were able to connect; they were simply too poor and could not afford the upfront connection costs. With the assistance of the P2P program managed by EDL, several poor households and female-headed households, such as Ms. Phanh's, were able to connect in 2009.



Ms. Phanh is a 57 year-old divorcee in normal health. She has been living on her own for 20 years, as her adult children have moved away. Her home is made of wood and thatch and consists of one very small room, where she sleeps, and an equally small covered porch area. She works for 6 to 7 hours per day finding fish, frogs, and bamboo shoots for her own subsistence and to sell, as her only income generating activity. She earns around 50,000 kip (about US\$6.25) per month. Other than this work, she is unemployed, as local opportunities are for manual labor in the fields, for which men are favored. Her income is often insufficient to meet her needs, and she depends on her son for additional food and money.

Since her home was connected in April 2009, Ms. Phanh has been using the electricity mostly for lighting and operating some small appliances. She consumes a very small amount of electricity per month, approximately 14 kWh. For this she pays approximately 2,842 kip (about US\$0.35) and in addition the 20,000 kip (about US\$2.50) for repaying the P2P credit provided by EDL to cover the upfront connection costs.

Now that Mrs. Phanh has electricity, she hopes to purchase an electric water pump for irrigating a small vegetable garden she would like to plant near her home to earn additional income.

Deuaytia village, Mounlapamok District—A man tending his four children while his wife works in the rice paddy. *"Before, I used to share electricity with my neighbors, but now I have my own. I am very happy and it will support me to do work at night. At the same time, 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 bucket of water home."*



This father is thankful that his children can do their homework in the evening.

Khaidiow village—A grandmother who looks after her six grandchildren while their parents are away working in the city shares her heartfelt feelings: *"This is my long-awaited moment to have electricity in my house. In all my 78 years*



For Grandmother Chanh, this is a long-awaited opportunity.

of life without electricity, now I am speechless and delighted to see my house bright and I can see all my grandchildren's faces clearly at night...hopefully, my grandchildren will be able to benefit from having electricity, not only in agriculture work, but also for their education as well as finding some part-time activity that they can do at night to earn income for the family."

TABLE 5.2 GRID-CONNECTED HOUSEHOLDS (HH) IN THE 20 PILOT VILLAGES

	No. of HH	% of all HH
All HH	3,057	100
HH connected before P2P	2,375	78
HH connected through P2P	537	18
Total HH connected after P2P	2,912	95
Total HH un-connect after P2P	145	5

Source: Rapid Assessment of Power to the Poor Pilot Project. Sunlabob May 2009.

TABLE 5.4 NON-ELIGIBLE HOUSEHOLDS (HH)

Reason for Non-eligibility	No. of Non-eligible HH	% of Non-eligible HH
All non-eligible HH	145	100
Not poor HH	46	32
Too far away HH	57	39
Too Poor HH	42	29

Source: Rapid Assessment of Power to the Poor Pilot Project. Sunlabob May 2009.

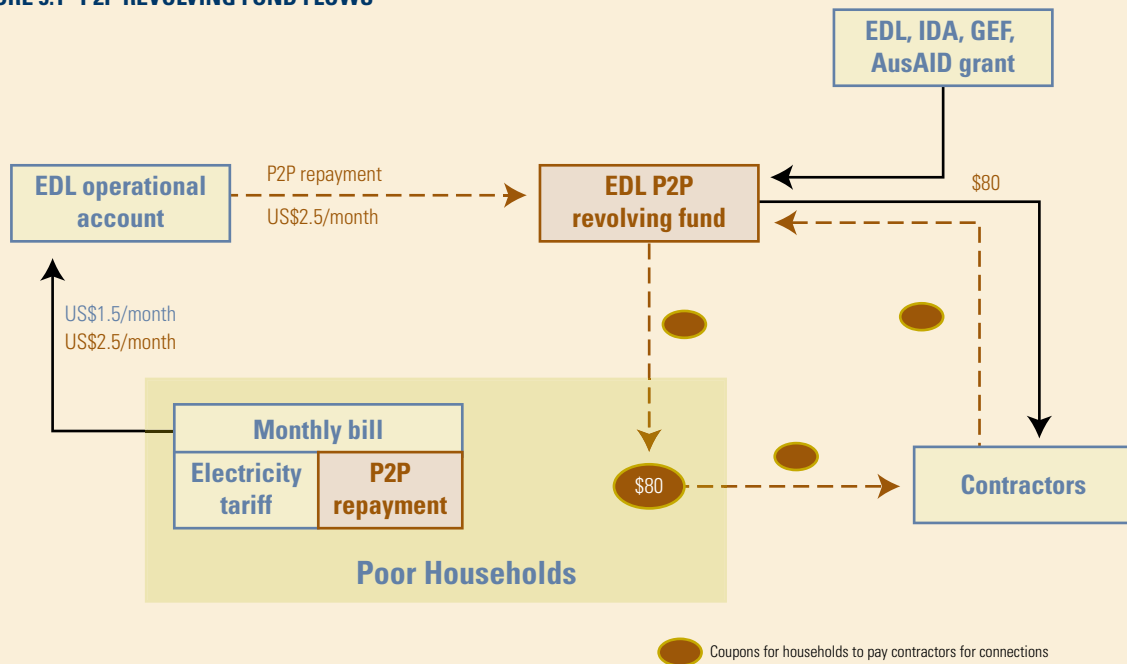
TABLE 5.3 GRID-CONNECTED FEMALE-HEADED HOUSEHOLDS (HH) IN THE 20 PILOT VILLAGES

Period	No. of all female-headed HH	No. of connected female-headed HH	Percentage of connected female-headed HH
Pre P2P	247	155	63
Post P2P	247	223	90

Source: Rapid Assessment of Power to the Poor Pilot Project. Sunlabob May 2009.

house, some even with concrete, and were considered by the village chief or the survey team able to mobilize the money to cover the connection costs in the near future. The remaining 57 households (39 percent) were located too far away from the electricity source. Finally, 42 households (29 percent) were considered, or considered themselves, too poor to even join the program, as they would not be able to pay the extra monthly cost of 20,000 kip (about US\$2.5) (table 5.4). Together these poorest of the poor families represent about 3–4 percent of all households in the 20 pilot villages.

FIGURE 5.1 P2P REVOLVING FUND FLOWS



Source: Authors.

The broader development objective of the P2P pilot was to assess the effectiveness of the targeted connection-charge subsidy and financing scheme as an efficient and effective means for subsequent scale-up to help increase the connection rate in already electrified villages, in support of the aim of achieving the GoL's 2020 target of 90 percent household access. The pilot phase overwhelmingly achieved this objective: the household connection rate at the end of the pilot program varied slightly across the 20 villages, but the range of from 84 percent to 100 percent signaled success. In 16 villages, the pilot program raised household connection rates between 90 and 99 percent. In two others, it achieved a 100 percent household connection rate. Only in 2 of the 20 villages was there a connection rate lower than 90 percent at the end of the pilot phase. Looking at another metric, among all households in the 20 villages, only 5 percent remained without a formal grid connection at the end of the pilot phase.¹⁷

Bottom line—P2P mainstreaming is underway countrywide.

In 2009, buoyed by the promising results of the pilot, EDL decided to scale up the P2P Program under the Rural Electrification Phase II Project to all electrified villages in the country. The P2P program will target an additional 8,000 households in the next three years. To support the scale-up, EDL has employed teams to work with all of the provincial offices of DOE and MEM to implement the P2P. A P2P Revolving Fund was established within EDL to provide interest-free credit to targeted disadvantaged rural households. IDA and AusAID contributed US\$600,000, respectively, to the fund. Norad provided funds for training provincial teams of EDL and MEM prior to implementation of the P2P scale-up program. Coupons with a face value of up to 700,000 kip (US\$87) have been widely distributed to eligible households. The eligibility criteria have been modified to include more beneficiary households. The key features of the P2P scale-up program are summarized below:

- A P2P Revolving Fund was established by EDL to provide financial support to the targeted beneficiaries. It was capitalized with IDA and AusAID grants.
- The Fund provides an interest-free credit to eligible households. The monthly repayment to the credit is designed to keep the monthly expenditures of the households for both the credit repayment and electricity consumption bill at the same level as their

monthly expenditures for lighting before the connection by the traditional means (e.g., candles, diesel lamps, and car batteries). The process is explained below.

- A coupon with a face value up to 700,000 kip is provided upfront to eligible households for the households to pay contractors for connection charges.
- Households can use the coupons to pay local contractors that they can choose for the cost of connection (up to 700,000 kip). If costs exceed 700,000 kip, the household pays the additional amount. The households and the contractors sign the coupon, indicating the specific amount paid off with the coupon. This is done after the connection is completed. The actual amount of the interest-free credit must equal the amount shown on the signed coupon.
- The contractors get reimbursed by EDL with the P2P Revolving Fund by submitting the signed coupons.
- EDL enters the information into its computerized billing system, which will generate monthly bills with two items listed: the P2P credit repayment and the electricity consumption bill.
- Villages electrified for at least one year can become eligible.
- All female-headed households are eligible.
- All families with disabled members are eligible;
- The household must reside in a house that would be safe for electrification.
- EDL's monitoring system keeps track of the number of female-headed households as well as households that include any people with disabilities who have benefited from the P2P Program.

EDL has mainstreamed the P2P Program into its rural electrification program. It has set up the fund and the institutional arrangements for implementation at both its headquarters and at provincial branch offices. Its computerized billing and accounting system was modified to enable the inclusion of the P2P program and it was then rolled out to all the provincial branch offices. The monitoring system for the P2P program, including gender indicators, has been mainstreamed into the monitoring system for rural electrification and has been deployed in each of the provincial branch offices for regular data collection and monitoring.

Significant results have been achieved to date, far exceeding the target of 8,000 households. EDL reported that, to date, 20,394 disadvantaged households were connected to the grid through the P2P program, and among these beneficiaries were 1,101 female-headed households and

17. Detailed analysis of the pilot phase (table 5.4) also revealed that while the program was designed for and aimed at poor households, it did not reach the very poorest of the poor at the bottom, who cannot afford to take the loan; nor those few families who live on the outskirts of the village, some even in the middle of the rice fields, well beyond the reach of a cost effective service connection.

606 households with disabled family member(s). This contributed to an increased access rate in Lao PDR of 69 percent in 2009 to 73 percent in 2010. Since each of the beneficiary households are paying US\$2.5/month, about US\$50,000 are flowing back to the P2P Revolving Fund monthly and this reflow is increasing, which will enable even more disadvantage households to benefit from the P2P program.

Gender sensitive approach: Key lessons and experiences.

The key lessons and experiences that can help ensure that the P2P program is gender sensitive are summarized below:

- There should be several entry points for addressing gender issues in rural electrification projects.
- Addressing gender issues requires a slightly different focus and approach but is not “rocket science.”
- A commitment to “go the extra mile” is essential.
- Additional resources are needed but a small amount of money can go a long way.
- In the end, addressing gender issues is a smart way to make rural electrification effective and its impact more inclusive.

A video, *Lao PDR: Rural Electrification for All—A Gender Lens*, is posted on YouTube at: http://www.youtube.com/watch?v=h-DY3T_1RPI&feature=player_embedded

Off-Grid Electrification— Reaching Out Beyond the Economic Limits of Grid Rollout

Context: Grid Rollout—So Far So Good

Of the 69 percent national coverage by year-end 2009, off-grid electrification—based on solar, micro hydro, and biomass, and implemented by both the public and private sectors—provided access to about 2.5 percent of households in remote rural areas where the grid cannot reach in the short term. Covering the remaining distance to achieve the government’s target of 90 percent access by 2020 will call for a far greater role for off-grid delivery systems in this decade than in the last, as the costs of grid-based connections at the margins continue to rise rapidly.

Recognizing that off-grid electrification would have to become an integral component over the long run, and a sizeable complement to grid rollout, in 1999 the GoL—with support from the donor community and working with the private sector—initiated an off-grid pilot program to establish the capacity for sustainable implementation of off-grid systems. The emphasis was on cost recovery from operations and the use of low-cost technologies. The program focused primarily on the delivery of SHS to villages not expected to be connected to the grid in the next 10 years.

Institutional Framework for the SHS Program

The SHS program was initiated under the Southern Provinces Rural Electrification Project (1998–2004). It was originally housed in and implemented by EDL. EDL already had its hands full orchestrating the ambitious grid rollout program, and the *ex ante* expectation that the pilot program would be commercially viable proved

over-optimistic. In February 2001, the GoL transferred responsibility for the pilot program to a dedicated entity in the Ministry of Infrastructure and Handicrafts (MIH), now known as the Ministry of Energy and Mines (MEM). The Off-Grid Promotion Support Office (OGS) in the Department of Electricity of MEM was established to manage the program (figure 2.2). In March 2001, MEM’s Power Sector Policy Statement established the policy and regulatory mandate for Provincial Energy Service Companies (PESCOs) as intermediary entities to plan, help organize and install, and then provide ongoing support to off-grid schemes in rural areas of Lao PDR.

Supply and Service Delivery Chain

The SHS pilot program was implemented by small private companies based in the respective provincial capitals. Under the model adopted by OGS, these private companies—PESCOs—work in cooperation with the Provincial Department for Energy and Mines (PDEM) offices responsible for rural electrification. PESCOs have a participatory planning process, designed by OGS, that identifies villages that meet the off-grid criteria, procures equipment, and employs village energy managers (VEMs) who are responsible for installing and maintaining the systems and collecting bill payments. Payments to the PESCOs and VEMs themselves are linked to their performance in planning, installation, and payment collection and reporting.

Scale-up beyond initial pilot phase. At the end of the pilot project in 2004, more than 5,700 SHS were installed in more than 50 villages in 6 provinces, especially in recovering full operational cost and partial capital cost.

TABLE 6.1 SOLAR HOME SYSTEM OPTIONS AND PAYMENTS

	Installation fee		Monthly Payments for Solar Kit (kip/month)			
			5-year repayment period		10-repayment period	
	Kip	US\$	Kip	US\$	Kip	US\$
20W	160,000	19.94	20,000	2.49	10,000	1.25
30W	190,000	23.68	30,000	3.74	15,000	1.87
40W	220,000	27.41	40,000	4.98	20,000	2.49
50W	250,000	31.15	50,000	6.23	25,000	3.12

Source: Department of Electricity.

The dissemination model proved to be successful overall, warranting further donor support to scale up the program to another 10,000 households and in all provinces—and to test alternative energy technologies other than SHS, such as village hydro and village hydro and generating sets (VHGS). This program has been underway since 2006.

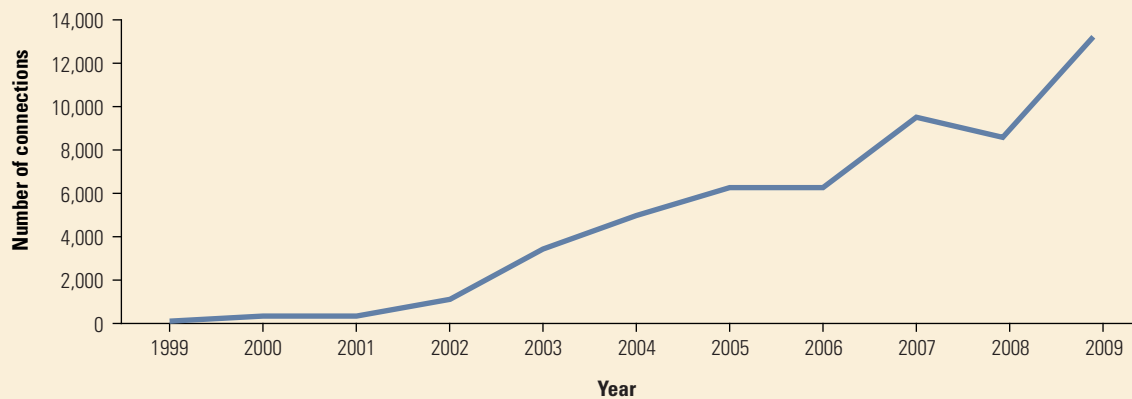
Financing and Pricing— Hire-Purchase Scheme

Solar home systems are available to remote households through hire-purchase agreements. Households have a choice of a range of solar PV panel sizes and pay an installation fee, the lowest of which is about kip 130,000

(about US\$16), then lease the system and make monthly payments of between kip 10,000 to kip 25,000 (about US\$1 to US\$3) over 5 or 10 years. The household can choose the 5- or 10-year lease term depending on the affordability of the monthly payment. They become the owners of the system at the end of the lease period. The least expensive panel costs 10,000 kip (about US\$1) per month for 10 years (table 6.1).

The solar power is routed through a charge controller to a deep-cycle battery for recharging, which can then power light bulbs, radio, and TV for up to four hours per day. This allows villagers, who generally cannot afford more than kip 15,000 (US\$1–2) per month for electricity and a cost per connection of approximately kip 2.4 million (US\$300), to receive solar home systems.

FIGURE 6.1 PROGRESS OF SHS CONNECTION FROM GOVERNMENT SHS PROGRAM 1999–2009



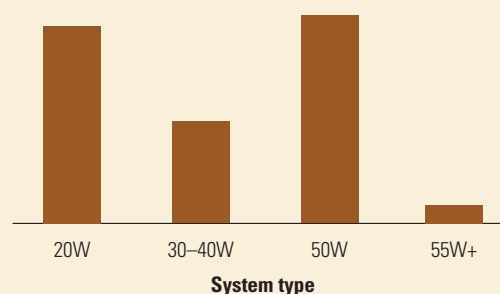
Source: Department of Electricity.

SHS Program Experience to Date

By the end of 2009, PESCOs were active in every province, covering more than 200 villages and having delivered more than 13,000¹⁸ solar home systems to rural households with the grant funding from IDA and AusAID (figures 6.1 and 6.2). An additional 10,000 solar home systems are to be delivered under the proposed Rural Electrification Phase II Project supported by IDA, AusAID, GEF, and Norad. The delivery model involving PESCOs and VEMs as implementing agents has proved to be moderately sustainable, as customer payments flow into a revolving fund that finances the costs of installation, management, maintenance, and payment collection. Beyond operational expenses, the off-grid program arrangement generates reflows that can finance additional systems for distribution to new customers. Customer repayment rates are reported to be in the high 90th percentile on a continuous basis. A key factor in achieving high household penetration rates and high repayments rates is the participatory approach of the village identification process. The design of the program requires close collaboration with village committees and relies on at least one representative of each

18. Over 15,000 SHS have been installed under the off-grid program, however, approximately 13,000 are in operation. The gap is mostly the result of the withdrawal of SHS from households that gained access to the grid. As mentioned in annex B, over 19,000 off-grid households had been electrified by the end of 2009. Of this 19,000 the majority of households are beneficiaries of the government SHS program, and to a lesser extent, other technologies such as village hydro. Beyond the 19,000, the private sector, such as Sunlabob, contributes an additional 10% of electrified households, mostly solar home systems.

FIGURE 6.2 NUMBER OF SHS INSTALLED BY SIZE 1999–2009



Source: Department of Electricity.

village who is willing to be trained to become the VEM and be responsible for daily maintenance, basic troubleshooting, and collection of fees.

Program Impact. Most significantly, in off-grid communities that have benefited from the SHS program, *it is evident that there can be a transformational impact on off-grid community dwellers, even from the small amounts of electricity provided by solar PV systems* (box 6.1).

Charting the course ahead—reaching the population well beyond the economic limits to grid rollout. The vast majority of connections to date (67 percent of the 69 percent coverage) have been made by extending the grid in a cost-effective way, involving a least-cost rollout plan together with a simple but rigorous prioritization and the village screening process. The signs now are clearly that this

BOX 6.1 PRODUCTIVE USES OF SOLAR HOME SYSTEMS

Small amounts of electricity making a big differences in the lives of rural communities

Nongsala Village, Champasak Province. Pakse is a city in southern Lao PDR, situated at the confluence of the Xedone and Mekong Rivers, with a population of 70,000. It is the largest city in Champasak province and its capital. Several kilometers outside Pakse lies a small village, just a few kilometers from the main road, named Nongsala. Although Nongsala is relatively close to the main road, the ancillary roads leading to the village are extremely rugged and inaccessible by most motor vehicles. Coupled with the village being beyond the reach of the medium-voltage lines from the nearest substation, its inaccessibility has left it unconnected to the power grid, and it is not expected to be connected for years to come. Nongsala is one of 33 villages in Champasak province participating in the off-grid electrification program managed by the Ministry of Energy and Mines (MEM) and implemented by Provincial Energy Service Companies (PESCOs) and their village-level staff—the Village Energy Managers (VEMs). In 2003, Mr. Chan Samone, who had some technical experience as an electrician and small entrepreneur, applied to be and was selected as the PESCO for Champasak and



Mr. Chan Samone, PESCO, Champasak and Attapeu provinces

(continued)

BOX 6.1 CONTINUED



Mr. Seng and Mr. Khampon, VEMs of Nongsala village

Attepeu provinces. In 2007, the program reached Nongsala village, where Mr. Samone now employs Mr. Seng and Mr. Khampon, who were formerly farmers, to install SHS, provide maintenance, and collect payments on a full-time basis.

Nongsala village has approximately 81 households that depend mostly on rice farming and some handicrafts for their subsistence and income. Only a few households live below the poverty line; the majority earn approximately 1 million kip (about US\$125) per month. Approximately 10 percent of their income

before connection was spent on energy-related expenses, mostly kerosene and wax candles for lighting, and most households retired for sleep at about 7 or 8 PM. Now, 74 households use solar home systems of 20–50 watts. Almost overnight, these households switched from reliance on traditional unsafe fuels to clean, safe, and far superior SHS for lighting and to charge their cell phones. Nearly all households immediately purchased black and white televisions, and on average now stay up until 10–11 PM. Villagers are able to work more at night, increasing their productivity and their incomes, thanks to better lighting. *Several villagers, such as Mrs. Tim, have reported a 50 percent increase in earned income from the additional time spent on making handicrafts in the evening since the SHS was installed.*



Mrs. Tim's 50w solar panel.

Mrs. Tim lives in a household of eight people, including herself, her husband, and six children. They, like most other rural villagers, used to depend on kerosene and candles that supplied very poor household lighting. Now, Mrs. Tim and her family are enjoying better lighting, watching their black and white television, and working later into the night to make brooms that are exported to Thailand. *Their SHS system allows her to earn an additional kip 120,000 (about US\$15) per week.*



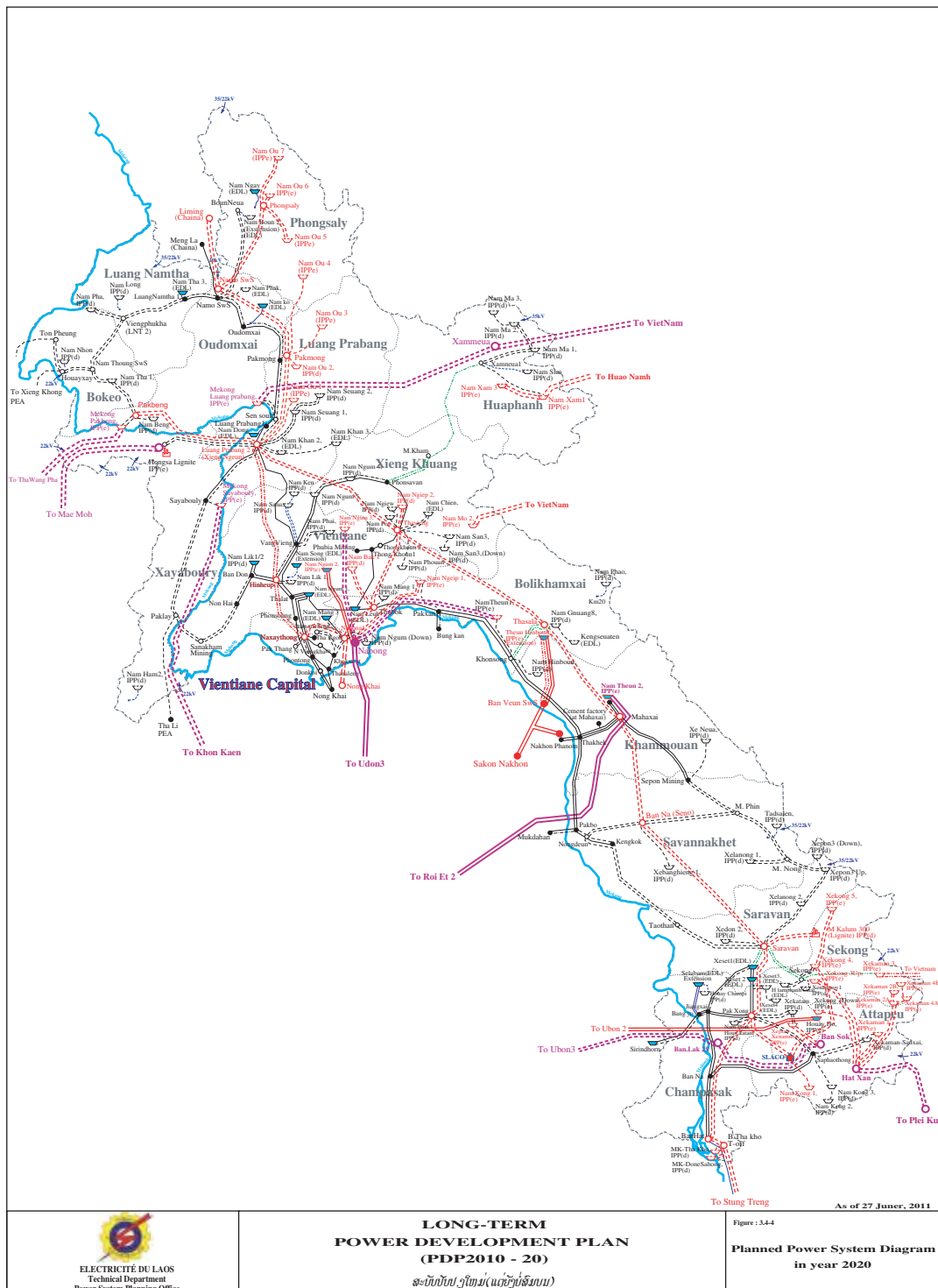
Mrs. Tim and children, Nongsala Village, Champasak province.

modus operandi is increasingly becoming prohibitively expensive. More of the unconnected population lives in “deep rural” villages and scattered communities that are in very hard and costly to reach places, including many in mountainous areas. A telling statistic on this rapidly evolving cost structure is the near doubling of distribution cost per grid connection over the course of the last seven years, from around 7.2 million kip (about US\$900) today compared to 3.6 million kip to 4.4 million kip (about US\$450–US\$550).¹⁹

Pending results of the Rural Electrification Master Plan implementation, achieving the government’s 90 percent national coverage target by 2020 likely will require at least a three-to four-fold increase in coverage by off-grid solutions over this decade, from around 2.5 percent today to 7–10 percent of households by 2020. This is the central implementation challenge to be tackled in the next stage of Lao PDR’s highly successful national electrification program.

19. World Bank due diligence in preparation of the Southern Provincial Electrification Program (SPRE) in 2003 and the Rural Electrification Program Phase II (REP II) in 2009. Both figures include the MV, LV, service drop, house meter, and in-house wiring costs.

Long-Term Power Development Plan (2010–2020)



National Electrification Results in Lao PDR (1993–2009)

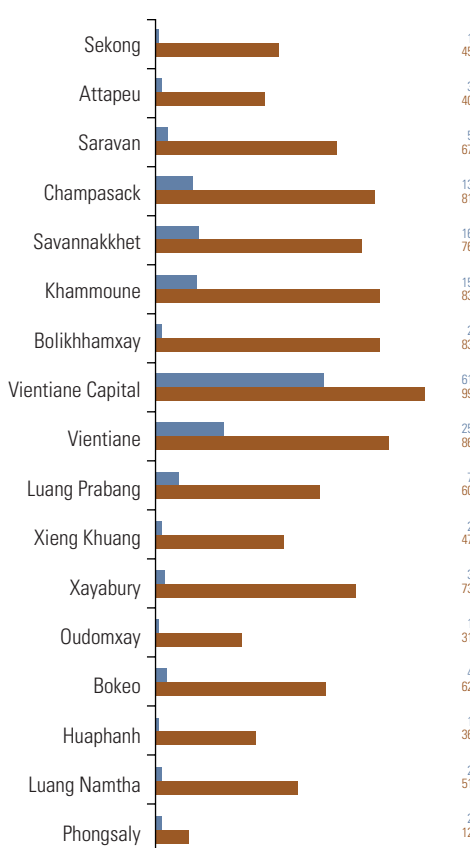
Year	Households	Households electrified	Percentage	EDL connections	Percentage	Non-EDL
1993		102,900		101,138		1,762
1994		111,200		111,226		-26
1995	754,265	120,100	16	117,922	16	2,178
1996	758,036	136,280	18	134,084	18	2,196
1997	761,808	196,998	26	165,308	22	31,690
1998	765,579	226,004	30	198,330	26	27,674
1999	768,142	254,610	33	226,317	29	28,293
2000	818,668	293,495	36	249,648	30	43,847
2001	866,277	303,690	35	273,825	32	29,865
2002	875,744	337,363	39	307,521	35	29,842
2003	892,872	368,259	41	363,141	41	5,118
2004	931,000	428,086	46	411,762	44	16,324
2005	935,019	459,077	49	458,985	49	92
2006	958,955	504,000	53	465,988	49	38,012
2007	982,485	536,727	55	518,841	53	17,886
2008	1,011,778	597,428	59	577,355	57	20,073
2009	1,011,800	700,547	69	681,113	67	19,434

Source: EDL Statistics 2009.

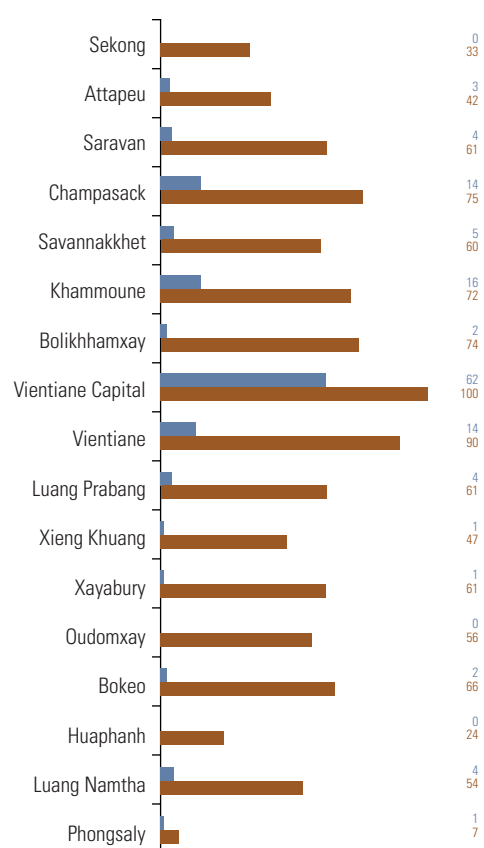
Note: *To expedite the process of electrification and reduce distribution loss, EDL has tapped into power supplies from neighboring countries. Currently, four provinces in the north—Luang Namtha, Huaphanh, Bokeo and Xayabury—are electrified with power supply from China and provincial electric authorities, and eight border villages in the south are supplied by power Sources from Vietnam. 98,016 households that account for 14 percent of households electrified are supplied with power from foreign sources.

Percentage of Households/Villages Electrified, by Province (1995 vs. 2009)

PERCENTAGE OF HOUSEHOLDS ELECTRIFIED



PERCENTAGE OF VILLAGES ELECTRIFIED



■ 1995 ■ 2009

Source:

- 1) Ministry of Industry and Handicrafts September 1995.
- 2) Department of Electricity.

APPENDIX D

Lengths of High-, Medium-, and Low-Voltage Lines

Province	High-voltage		Medium-voltage				Low-voltage			
	Transmission		Distribution	Shield wire		Th. Phase	SWER	Th. Phase	SWER	Shield wire
	230kV	115kV	35kV	34.5kV	25kV	22kV	12.7kV	0.4kV	0.22kV	0.22kV
Vientiane Capital		357				1,433		2,006		
Phongsaly						73		46		
Luang Namtha			1			199		156		
Oudomxay						135		105		
Bokeo						351		214		
Luang Prabang		146		14	144	397		287		
Houaphan			164			78		153		
Sayboury		75		80		467		488		
Xiengkhuang		181		94		94		173		
Vientiane		220		68	20	1,126		1,023	114	22
Bolikhamxay		85				793	20	698		5
Khammouane						1,343	68,991	765		29
Savannakhet		52				1,796		1,446		
Saravane			2520			734	25	600		
Sekong						198	22	147		
Champasak		235				1,372		1,948		
Attapeau		113				169		117		
Total	247	1,463	2,685	256	164	10,757	69,057	10,372	114	56

Source: Tables 10 and 11, Electricity Statistics Yearbook 2007 of Lao PDR, Department of Electricity, Ministry of Energy and Mines; original data. From Provincial Department of Energy and Mines, Lao PDR.

Major Grid Extension Projects Sponsored by ADB and the World Bank

Projects	Period	Agency	Total US\$ million	Grid US\$ million	Off-Grid US\$ million	Institution capacity building US\$ million	Others US\$ million	Villages electrified	Households electrified	
									Grid	Off-grid
Vientiane Plain Rural Electrification Project—I	1987 (end)	ADB	7.20	7.20	-	7.20	-	n.a.	n.a.	-
Vientiane Plain Rural Electrification Project—II	1990 (end)	ADB	10.30	10.30	-	-	-	n.a.	n.a.	-
Nam Ngum-Luang Pra- bang Power Transmission	1989–98	ADB	20.30	20.30	-	-	-	n.a.	5,200	-
Power Transmission and Distribution	1997–2002	ADB	58.31	51.25	-	-	7.06	350	30,700	-
Northern Area Rural Power Distribution (NARPD)	2004–09	ADB	51.51	51.51	-	-	-	421	27,000	-
ADB subtotal			147.62	140.56	-	7.20	7.06	771	62,900	-
Southern Province Elec- trification (SPE)	1988–94	WB	30.44	26.64	-	1.34	2.46	147	8,354	-
Provincial Grid Integra- tion Project (PGI)	1993–2000	WB	47.52	32.89	-	1.63	13.00	439	33,478	-
Southern Province Rural Electrification (SPRE)	1998–2004	WB	41.41	31.72	2.31	7.39	-	721	51,805	6,097
Rural Electrification Project I (ongoing)	2006–10	WB	36.27	26.40	2.37	2.00	7.50	540	42,000	10,000
World Bank subtotal			155.64	117.65	4.68	12.35	22.97	1,847	135,637	16,097
ADB and World Bank subtotal			450.88	398.76	4.68	26.75	37.09	3,389	261,437	16,097
LAO PDR PDR (GoL, EDL, and Consumer)	1975–2009	Lao PDR	215.26	213.93	1.33	0.00	0.00	1,890	419,676	3,337
Domestic subtotal			215.26	213.93	1.33	0.00	0.00	1,890	419,676	3,337
Total			666.14	612.69	6.01	26.75	37.09	5,279	681,113	19,434

Source: The World Bank, ADB and EDL.

Development Projects of Transmission and Distribution in Lao PDR

Development Projects	Status	Agencies
Southern Province Electrification (SPE)	Completed	World Bank
Provincial Grid Integration Project (PGI)	Completed	World Bank
Southern Province Rural Electrification (SPRE)	Completed	World Bank
Power Transmission and Distribution Project (PTD)	Completed	ADB
Rural Electrification Project I (REP I)	Ongoing	World Bank
Rural Electrification Project II (REP II)	Preparation	World Bank
Northern Area Rural Power Distribution Project II (NARPD II)	Ongoing	ADB
Northern Area Rural Power Distribution Project I (NARPD I)	Completed	ADB
Vientiane Distribution System Improvements (VDSI)	Completed	ADB
Off-Grid Renewable Energy Electrification Project	Ongoing	UNDP/GEF
Southern Provinces Transmission Development I	Ongoing	China Export-Import Bank
Southern Provinces Transmission Development II	Ongoing	India Export-Import Bank
Transmission Development Project	Ongoing	Lane Xang Minerals, Ltd.
Transmission Line and Substation System Master Plan	Completed	JICA
Institutional Development for Off-Grid Electrification	Completed	ESMAP
Power Sector Policy Reform	Completed	Public-Private Infrastructure Advisory Facility
Xeset 2 Hydropower Project	Ongoing	China Export-Import Bank
115 KV transmission Line	Ongoing	Namo-Lao-China Border
115 KV Transmission Line	Ongoing	Thakhek-Cement Factory-Mahaxai
GMS Northern Power Transmission Line Project	Preparation	Multilateral
230 kV Transmission Line	Ongoing	Hinheup-Naxaythong
115 KV Transmission Line	Ongoing	Hongsa-Luangprabang
115 KV transmission Line	Ongoing	Phosavanh-Xamneua

World Bank Engagement

Bank support for the energy sector in Lao PDR can be traced back to 1966–1971, when the Nam Ngum Dam project was completed (installed capacity of 30MW and a total cost of US\$28 million under an agreement with the World Bank on the 1966 Nam Ngum Development Fund. This set the stage for the growth of EDL, which was created by decree on December 18, 1961. More recently, over the course of the last two decades, the following Bank projects have provided financing and technical assistance aimed broadly at electricity access scale-up through EDL network extensions and customer connections, as well as support for off-grid program development:

- Southern Province Electrification (1987–93);
- Provincial Grid Integration (1993–98);
- Southern Province Rural Electrification (1998–2004);
- Rural Electrification Phase I (2005–12);
- Rural Electrification Phase II (2010–14)

Investments

Of 570,000 new connections 1983–2009, Bank-financed rural electrification projects have financed over 20 percent (135,000 households). It is further estimated that the MV network extensions financed under these Bank projects directly facilitated an additional 20–30 percent of connections in the years immediately following Bank project closings, representing low-cost intensification undertaken by EDL using its own funds.

Capacity Building

Bank projects have

- provided continued technical capacity building in formulating sector strategies, policies, and regulations, and in project implementation (planning, design, implementation, operations, procurement, safeguards),

- initiated an Action Plan for Financial Sustainability of the Power Sector (2005–13), aimed at EDL's system loss reduction, tariff reform, and settlement of EDL's accounts receivable, and demand-side management and energy efficiency,
- provided capacity building toward commercial operation of EDL, including corporate restructuring, financial management, billing and accounting, inventory and materials management, and integration of business at branches, and
- supported an enabling environment for private sector participation in off-grid renewable energy development for rural electrification.

Mobilization of Resources

Given limited IDA allocations, the Bank played a pivotal role in mobilizing resources from other donors for rural electrification. Cofinancing mobilized to the RE Program includes

- GEF—US\$5.57 million,
- NORAD—US\$14 million,
- AusAID—\$15.0 million for investment,
- ESMAP—US\$0.25 million,
- PHRD—US\$1.3 million, and
- ASTAE—US\$0.25 million for project preparation and implementation TA.

Cooperation of IDA and IFC

Under the RE Program, IDA developed business for IFC including (i) a US\$15 million loan to cofinance the RE Phase II.





The World Bank

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