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ESMAP

Energy Sector Management Assistance Programme

" Lao P.D.R.

Urban Electricity Demand Assessment Study "

Report No. 154/93

A joint report with the

Power Development, Efficiency and Household Fuels Division
Industry and Energy Department

&

Asia Alternative Energy Unit
Asia Technical Department

JOINT UNDP / WORLD BANK
ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME (ESMAP)

PURPOSE

The Joint UNDP/World Bank Energy Sector Management Assistance Programme (ESMAP) was launched in 1983 to complement the Energy Assessment Programme, established three years earlier. ESMAP's original purpose was to implement key recommendations of the Energy Assessment reports and ensure that proposed investments in the energy sector represented the most efficient use of scarce domestic and external resources. In 1990, an international Commission addressed ESMAP's role for the 1990s and, noting the vital role of adequate and affordable energy in economic growth, concluded that the Programme should intensify its efforts to assist developing countries to manage their energy sectors more effectively. The Commission also recommended that ESMAP concentrate on making long-term efforts in a smaller number of countries. The Commission's report was endorsed at ESMAP's November 1990 Annual Meeting and prompted an extensive reorganization and reorientation of the Programme. Today, ESMAP is conducting Energy Assessments, performing preinvestment and prefeasibility work, and providing institutional and policy advice in selected developing countries. Through these efforts, ESMAP aims to assist governments, donors, and potential investors in identifying, funding, and implementing economically and environmentally sound energy strategies.

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FUNDING

ESMAP is a cooperative effort supported by the World Bank, UNDP and other United Nations agencies, the European Community, Organization of American States (OAS), Latin American Energy Organization (OLADE), and countries including Australia, Belgium, Canada, Denmark, Germany, Finland, France, Iceland, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Sweden, Switzerland, the United Kingdom, and the United States.

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For further information or copies of completed ESMAP reports, contact:

ESMAP
c/o Industry and Energy Department
The World Bank
1818 H Street N.W.
Washington, D.C. 20433
U.S.A.

LAO P.D.R.

URBAN ELECTRICITY DEMAND ASSESSMENT STUDY

MARCH 1993

A JOINT REPORT

Power Development, Efficiency
and Household Fuels Division
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ABBREVIATIONS AND ACRONYMS

EdL	Electricite du Laos
ESMAP	Energy Sector Management Assistance Programme
KGOE	Kilograms of Oil Equivalent
MOI	Ministry of Industry and Handicrafts

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This report was prepared by Ms. Carolyn Tager (Task Manager) with Mr. Voravate Tuntivate (Consultant). Mr. Tuntivate coordinated the survey work in the Lao PDR and was assisted by Mr. Albrecht Kaupp (Consultant) on appliance efficiency issues. Report production was managed by Mmes. Jeannette Frink and Valerie Peters.

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PREFACE

This report presents the findings of the first study in the Lao PDR to assess the residential demand for electricity in Vientiane, the capital. Electricity exports are critical to the country's foreign exchange earnings and play a dominant role in the Government's sector investment strategy. Expansion of the domestic grid is also a fundamental development goal. However, recent economic reforms have seen an unprecedented rise in the domestic demand for electricity in Vientiane and the widespread use of appliances for cooking, refrigeration, lighting and entertainment. These trends, and their corresponding downward pressure on export revenues, were key determinants in the design of the study and in the recommendations of this report.

Financed with a grant (US$ 130,000) from the Government of Sweden and assistance from the World Bank East Asia I Industry and Energy Division (EA1IE), the study was conducted by the Joint World Bank/UNDP/Bilateral Aid Energy Sector Management Assistance Programme (ESMAP), in close cooperation with the Ministry of Industry and Handicrafts (MOI), Electricite du Laos (EdL), EA1IE and the Asia Alternative Energy Unit (ASTAE). Field work was coordinated by an ESMAP Survey Expert, Mr. Voravate Tuntivate (Consultant) from July 25-October 5, 1991. The survey was designed and implemented with the assistance of EdL staff and private sector Lao consultants. The study team enjoyed the support of EdL's General Manager, Mr. Houmphone Bulyaphol and Deputy Manager, Mr. Khamphone Saignasane. Mr. Albrecht Kaupp, Appliance Efficiency Expert (Consultant), also assisted the team in its work.

In July 1992, the Government introduced a national tariff for grid-supplied electricity, raising average revenues in all Lao grids from US 2¢/kWh to US 3.7¢/kWh. Average revenues for residential consumption in the Vientiane area would rise from US 1.6¢/kWh to an estimated US 2.1¢/kWh. While the new tariff will substantially improve EdL's financial condition and increase the amounts charged, residential consumption trends in Vientiane will not materially change. This is because electricity will remain inexpensive for much of the residential population.

Thus, the tariff increase does not change the conclusions of the analyses nor the soundness of the recommendations in this report. Moreover, the steady tariff increases throughout the 1990's, which will be implemented in connection with the IDA-assisted Provincial Grid Integration Project, should be supplemented by the early introduction of measures to manage demand in Vientiane. In this way, consumers will develop energy-efficient behavior, well before the tariff increases are in place. EdL will improve its understanding of the energy consumption behavior and motivations of its customers, both of which are central to effective demand-side management programs. As a result, the Government will be better able to strike a balance between the benefits of electricity exports and the desire to increase the access of the population to energy services.

I. BACKGROUND

A. Country and Sector Summary

The Economic Situation[1/]

1.1 The Lao PDR, with a population of 3.6 million and a per capita GDP of US$ 180 per annum (1988), is one of the world's poorest countries. The largest city is Vientiane, the political, administrative and commercial capital, with a population of about 442,000. Some 40% of the population lives in and much of the economic activity is centered around two narrow ribbons of development: (i) along the Mekong River and in close proximity to the Thai border in the south, and (ii) in the Vientiane-Luang Prabang corridor in the north. Elsewhere, the country is characterized by difficult terrain, including rugged mountains and dense tropical jungle, sparse population, and meager infrastructure.

The Energy and Power Sectors: An Overview

1.2 The Lao PDR has deposits of coal, lignite, iron, copper lead, tin and other metals, many of which are unexploited. There are also vast forest reserves, with about 130,000 square km (about 58% of the land area) under effective forest cover. About 90% of the energy consumed in the country is produced from woodfuels. With the exception of Vientiane, woodfuels are used extensively in the residential, commercial and industrial sectors throughout the country.

1.3 The extent and level of wood and charcoal consumption outside Vientiane, their end-use patterns and environmental impacts are not known. Because wood is the principal source of energy for most of the population, and because deforestation is a national concern, this information should be collected and a strategy developed by the designated ministry(ies) to ensure a reliable and affordable energy supply to meet the population's basic needs over the long term. Nonetheless, it is important to note that rural populations across the developing world typically meet their fuelwood requirements from dead wood, the impact on the environment of which is marginal--if at all. This situation would appear to prevail in the Lao PDR, where the main contributors to deforestation are thought to be slash-and-burn agriculture and logging for export.

1.4 The Lao PDR has rich hydroelectric resources with a potential of over 18,000 MW, of which only about 200 MW has been developed. Hydroelectric development is designed to export

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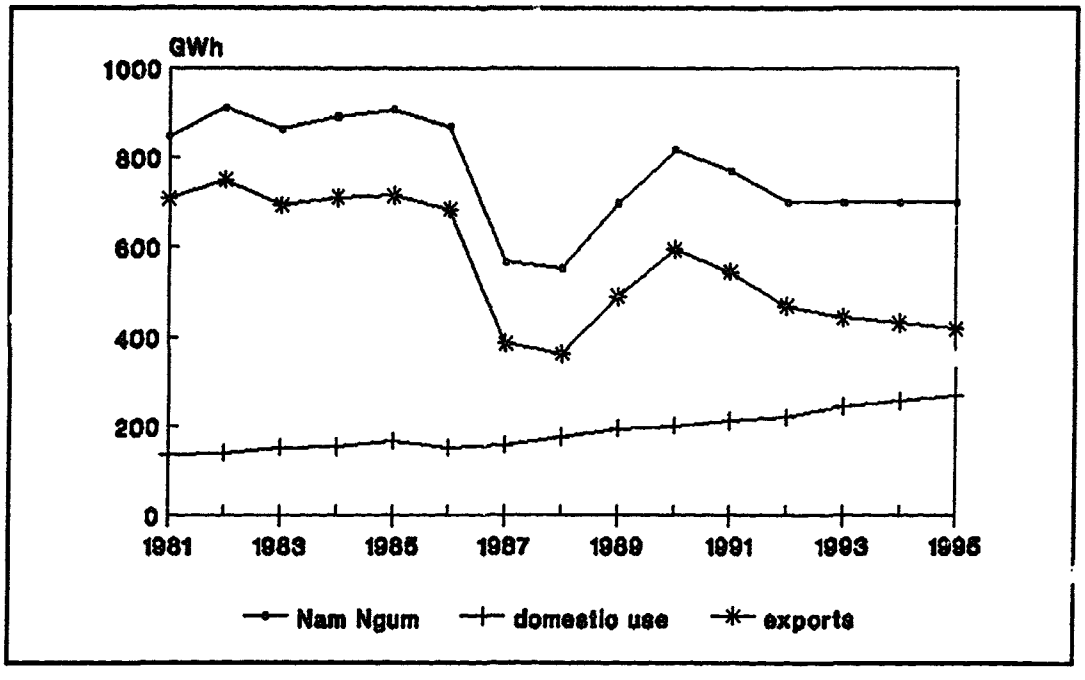
[1/] The background sections are drawn from the Green Cover Staff Appraisal Report for the Provincial Grid Integration Project.

electricity over and above the supply of domestic demand. Because of steady growing local demand, exports decreased from a high of 790 GWh in 1979 to about 600 GWh in 1990. Figure 1 below illustrates the decline in electricity exports, due to rapidly growing domestic consumption. Despite this trend, electricity has remained the Lao PDR's leading export over the last decade. In 1990, about 70% of Electricite du Laos' (EdL) annual production, representing about US$ 18.2 million in revenues, was exported to Thailand; this accounted for 28% of all the country's export revenues.

Figure 1. Electricity Generation & Export Trends in Vientiane



Source: Data from Appendix 4, Green Cover SAR Provincial Grid Integration Project

Electricity Generation and Consumption

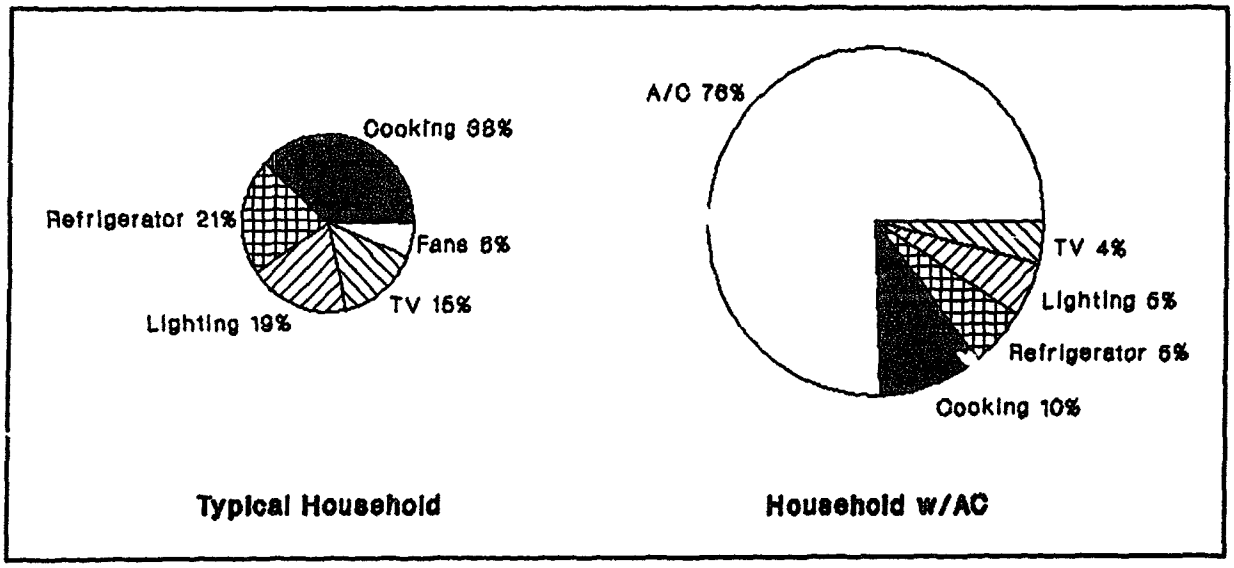
1.5 The installed generating capacity is about 211 MW, consisting of about 200 MW of hydro-generation and the remainder of small diesel plants. The country's major system is the 150 MW Nam Ngum hydropower station, located in the Vientiane Plain about 70 km north of the capital. Approximately two-thirds of Nam Ngum's total generating capacity is exported. The rest is consumed largely in Vientiane. Outside Vientiane, the distribution network is limited, and only about 17% of the total population currently has access to electricity supplied from three small, separate grids. It is not surprising, therefore, that the Lao PDR's national average power consumption is among the lowest in Asia, at about 50 kWh per person per annum (1989).

B. Vientiane: The Importance of the Residential Sector

1.6 Vientiane accounts for 80% of the Lao PDR's total domestic electricity consumption, of which 54% is consumed by the residential sector. The opening of the country to market forces has dramatically changed and will continue to alter the structure of residential energy consumption across income groups in the capital: In 1970, Vientiane, like the rest of the country, was entirely dependent on woodfuels for its energy supply. By 1990, electricity accounted for 50% of total household energy use, which is only slightly lower than Bangkok (59%) and Manila (55%), much larger and more affluent cities. Estimated average monthly electricity consumption per household in Vientiane is 271 kWh, compared to 275 kWh in Bangkok and 230 kWh in Manila. Average consumption in Chiang Mai, comparable to Vientiane in size and consumer mix, but more affluent in per capita income, is about 176 kWh per month, or 35% less than Vientiane.

1.7 Energy Sector Issues. Figure 2 below illustrates a typical household electricity consumption pattern in Vientiane's urban core and an emerging pattern that reflects higher income households with increased air conditioner use. The implications of these consumption patterns on power sector planning in the Lao PDR are discussed below.

Figure 2. Household Electricity Consumption



Source: ESMAP/EdL Survey, 1991

1.8 The Lao PDR faces five major energy issues that are closely tied to the demand for energy in Vientiane's residential sector:

(a) the rapid transition from woodfuels to electricity for cooking;

(b) the steady rise in electric appliance ownership;

(c) the relatively low efficiency of available electric appliances;

(d) the cross subsidization of domestic electricity prices with export revenues; and

(e) weak institutional capacity to implement and monitor initiatives to manage the domestic demand for energy services.

1.9 Understanding the determinants of the transition to electricity for cooking is critical for EdL, because cooking accounts for about 58%, or 42% kilograms of oil equivalent (kgoe), of total household energy consumption in Vientiane. Moreover, about 62% of households use some electricity in meal preparation. Meal preparation is coincident with the evening peak demand and the unabated rise in electricity use during this period cuts into export revenues. The July 1992 tariff increase is expected to yield average revenues for residential consumption in Vientiane of about US 2.1¢/kWh, whereas the Lao PDR exports electricity during the evening peak at US 5.8 ¢/kWh. Therefore, any measures to shift residential consumption or increase its efficiency have significant economic value to the Lao PDR. In the absence of such measures, especially during the evening peak, export revenues will continue to decline, as more and more households switch to electricity for cooking. Chapter II examines this dominant trend of electricity consumption.

1.10 The Lao PDR faces several obstacles to promoting substitute fuels for cooking: (a) low residential electricity tariffs; (b) dependence on petroleum imports (LPG and kerosene); (c) the high cost of imported LPG and kerosene cooking appliances; (d) negative environmental consequences, especially around Vientiane, of a wholesale shift back to woodfuels; and (e) the political difficulty if not impossibility, of promoting a shift back to woodfuels, after years of easy access to electricity. A discussion of these issues and possible solutions is presented in Chapter III.

1.11 Electric appliance ownership is accelerating rapidly in Vientiane, even among the poorest income groups. This trend is an important factor in the Lao PDR's peak load growth that dampens export sales to Thailand. With the exception of a locally made hot plate (with an imported filament), the Lao PDR relies totally

on imported electric appliances, whose brand names and characteristics are typical of those found across the region. And, while they are no worse than models found across Asian cities, their low prices make them more attractive than more efficient models. Because purchase decisions are primarily driven by first cost, inefficient appliances could remain on the Vientiane market for years, with negative consequences for the consumer, EdL and the Lao PDR.

1.12 There are some measures that can help to mitigate the impact of these appliances including (a) the promotion of more efficient, affordable appliances than are presently being used; (b) the dissemination of information on their efficient use; and (c) the implementation of measures to prevent the entry of inefficient appliances into the Lao PDR from other countries that have introduced minimum efficiency appliance standards. These measures, together with efforts to shift peak consumption, are applicable to the commercial sector, whose share of the peak has yet to be determined, but could be as high, if not higher than that of the residential sector. The commercial sector, therefore, is likely to be a significant area of opportunity for efficiency measures. Chapter IV provides a discussion of appliance ownership patterns, their characteristics and uses, and low and no cost measures to begin to improve efficiency.

1.13 **The Government's past policy has been to cross-subsidize domestic consumption with export revenues.** However, export revenues have declined and domestic electricity consumption has dramatically increased in recent years. As the available margin for cross-subsidization shrinks, domestic revenues will have to cover an increasing share of EdL's financial requirements. During the next few years, tariffs will have to rise to satisfy both EdL's financial performance targets and its objective of approaching the recovery of economic costs. The impact of increased tariffs can be cushioned by efficiency measures that shift and/or lower electricity consumption, while maintaining or improving households' living standard.

1.14 Electricity in the Lao context is a primary source of export earnings as a traded commodity with an agreed border price. Any incremental consumption within the Lao PDR at the time of Thailand's peak (the same as the Lao PDR's peak) is lost revenue at the highest export price. The recently revised export/import agreement between the two countries, which became official on October 1, 1991, calls for a time-of-day bulk export tariff to Thailand of US 5.8 ¢/kWh during peak periods, US 3.3 ¢/kWh during shoulder daytime periods, and US 2.6 ¢/kWh for nighttime off-peak periods. A residential consumer with a relatively high share of peak period consumption and a load factor of 30% incurs a total

cost of close to US 6 ¢/kWh. By comparison, the average tariff for residential consumers in Vientiane in 1991 was US 1.6 ¢/kWh.[2/]

1.15 Because the export tariff for the Nam Ngum grid is fixed for four years and adjustments thereafter are expected to be modest, revenues from local sales will need to shoulder the major burden of increases in EdL's cash requirements (especially debt service) projected for the next ten years. With the cost of exports and the proportion of local sales projected to increase progressively, the capacity for cross-subsidization is eroding rapidly. Table 1 below illustrates the margin of cross subsidization by time period and the corresponding value to EdL of increased domestic energy efficiency. The details are provided in Annex 1.

Table 1. Export Earnings
Exports vs.
Domestic Consumption
(in US $/kWh)

Time of Consumption	Sold to Thailand	Wtd Average Production Cost[1]	Net Earnings	Consumed in Lao PDR	Wtd Average Production Cost[1]	Net Earnings
Peak	.058	.012	.046	.022	.057	-.035
Shoulder	.033	.012	.021	.022	.057	-.035
Off-Peak	.027	.012	.015	.022	.057	-.035
			(in Kn/kWh)			
Peak	40.6	8.4	32.2	15.4	39.9	-24.5
Shoulder	23.1	8.4	14.7	15.4	39.9	-24.5
Off-Peak	18.9	8.4	10.5	15.4	39.9	-24.5

1) Weighted production cost values are derived in Annex 1 and are based on allocations of Nam Ngum costs in proportion to exports from Nam Ngum.

1.16 The rapid shift to electricity for cooking is, in part, a consequence of the tariff level. The 1991 tariff increase reflects the Government's commitment to bringing domestic rates more in line with the costs of service delivery. With the July 1992 tariff increase, the Government introduced local tariffs that are expected to yield average revenues in all Lao grids of about US 3.7 ¢/kWh. Nonetheless, **over the medium term, electricity prices will not reflect real costs in Vientiane's residential sector, and**

[2/] The July 1992 tariff increase is expected to yield average revenues from residential consumption of about US 2.1¢/kWh.

this situation will have important consequences for the pattern of increasing electricity consumption in Vientiane:

(a) the low electricity price faced by the Vientiane consumer will remain a strong disincentive to purchasing more efficient appliances and/or to using them more efficiently;

(b) the structure of tariffs will continue to stimulate a high domestic peak demand and the accelerated shift to electricity for cooking for those who have not yet made this transition;

(c) the low incomes of the Lao population will inevitably direct purchasers to lower first cost appliances, which tend to be the least energy efficient ones on the market; and

(d) as economic activity grows in Vientiane and households have more money to spend, electricity consumption will continue to rise and new uses for electricity will be adopted.

1.17 Finally, **EdL's institutional capability** has been primarily developed to operate and maintain its existing assets and expand its investment program, a situation that reflects the development of utilities across the developing world. Managing the demand for electricity is a new initiative and one that would require, at a minimum, the recycling/training of existing staff, but, most probably, the recruitment of new staff and the development of programs to address this aspect of its operations. Initially, the absence of this institutional capacity would be a constraint to designing and implementing management measures. Chapter V addresses the need to develop this framework and some measures to start the process.

C. Objectives of the Urban Electricity Demand Assessment Study

1.18 The development of approaches to manage the domestic demand for electricity requires an understanding of household energy consumption behavior. Even without sufficient data, the Ministry of Industry and Handicrafts (MOI) and EdL have been concerned that Vientiane's higher incomes, access to electricity and an array of electric appliances have accelerated the transition from charcoal and wood to electricity for cooking, increasing pressure on the evening peak demand. This concern prompted the MOI and EdL to request ESMAP assistance to assess electricity consumption patterns and trends in Vientiane, to determine if this transition is, indeed, well advanced and to advise on the next steps. The Government of Sweden agreed to provide the funding.

1.19 The objectives and study design were fully agreed upon with the MOI, EdL and the East Asia I Industry and Energy Division (EA1IE) of the World Bank, which has an on-going investment program in the Lao PDR's power sector. ESMAP has consulted regularly with EA1IE throughout implementation and several of the preliminary findings and conclusions have already been incorporated into the Provincial Grid Integration Project, which was appraised in November, 1991. These recommendations include (i) developing a technical cooperation arrangement between EdL and an Asian power utility to increase management efficiency and strengthen institutional capacity and (ii) strengthening EdL's customer service function to incorporate an understanding of domestic consumption behavior into EdL's power sector planning framework.

1.20 Study Objectives. The objectives of the Lao PDR Urban Electricity Demand Assessment Study are to:

(a) develop a profile of urban residential electricity consumption growth, patterns and trends;

(b) assess the nature and extent of electric appliance usage in the residential/commercial sector (i.e. cooking lighting refrigeration, cooling, water heating, and leisure and entertainment activities)

(c) identify the potential for energy savings through energy efficiency improvements in appliances, together with other measures to promote energy conservation behavior among consumers, while maintaining existing service levels; and

(d) recommend follow-up actions as required to Government to initiate development of an urban energy demand management program within EdL.

II. URBAN RESIDENTIAL ENERGY USE PATTERNS

A. ESMAP/EdL Study Parameters

2.1 This chapter first defines the geographical area that was the subject of the ESMAP/EdL survey. It then profiles urban residential energy use patterns and addresses the dominant trend of electricity consumption in the residential/commercial sector. The analysis is drawn from the ESMAP/EdL Residential Energy Consumption Survey conducted in Vientiane in 1991 (Annex 2).

The Urban Energy Consumption Survey Area

2.2 The Vientiane Prefecture, consisting of 7 Districts, with an estimated population of 442,000, covers a large area of both rural and urban agglomerations. The energy use patterns of this population vary widely. On the other hand, the "urban" core of Vientiane, which covers the major part of four Districts, has a population of approximately 180,000 and reflects the energy consumption patterns of a typical urbanizing area. For example, EdL data show that approximately 50% (25,000 households) of its residential customer base in the Vientiane Prefecture and a small part of the Vientiane Plain (total of 10 Districts) consume less than 70 kWh/month. In contrast, only 8% of households in the surveyed area consume less than 70 kWh of electricity each month, while more than 40% of these households consume over 200 kWh/month. Since the survey was carried out only in the urban area of Vientiane, it is important to bear in mind that the study findings do not reflect the entire Vientiane Prefecture nor, indeed, other urban areas in the country.

2.3 According to EdL, residential customers in the urban core account for 56% (26,706 households) of all EdL's residential customers. ESMAP/EdL estimated that they consume 94% of total monthly kWh (7,319,256 kWh) sold to the entire residential sector. Table 2 illustrates this consumption pattern.

Table 2. Comparison of Residential Customers in the Urban Area and All EDL's Residential Customers

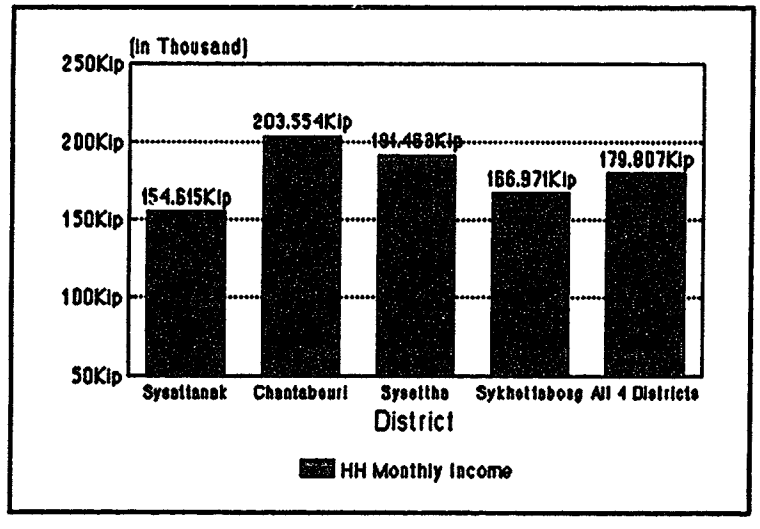
	Monthly Consumption	Number of Customers
All EDL Residential Customers	7,772,124*	47,710
	Estimated Monthly Consumption (kWh)	
Urban Customers	7,319,256**	26,706

Note: * Source: EdL
** Source: ESMAP Survey, 1991

Income Distribution in Urban Vientiane

2.4 Prior to the ESMAP/EdL survey, there was no reliable data on income and expenditures in Lao households.[3/] Figure 3 and Table 3 below set out the income categories in "urban" Vientiane that served as the basis for the subsequent analysis. The average monthly income for urban Vientiane is Kn 179,807/household/month (US$ 256) and family size averages about 6.7 persons.

Figure 3. Total Household Monthly Income



Source: ESMAP/EdL Survey, 1991.

Table 3. Distribution of Total Family Income per Month

Income Class	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000.....	81	32	20	15	14
(percent).....	20%	30%	16%	18%	15%
Income 75,000-102,000...	82	23	24	18	17
(percent).....	20%	22%	19%	22%	18%
Income 103,000-150,000..	83	19	26	19	19
(percent).....	20%	18%	21%	23%	20%
Income 151,000-200,000..	81	13	28	15	25
(percent).....	20%	12%	23%	18%	27%
Income 201,000-270,000..	38	9	13	5	11
(percent).....	10%	9%	11%	6%	12%
Income > 270,000.....	40	10	12	10	8
(percent).....	10%	9%	10%	12%	8%
Total Cases.....	405	106	123	82	94
(percent).....	100%	100%	100%	100%	100%

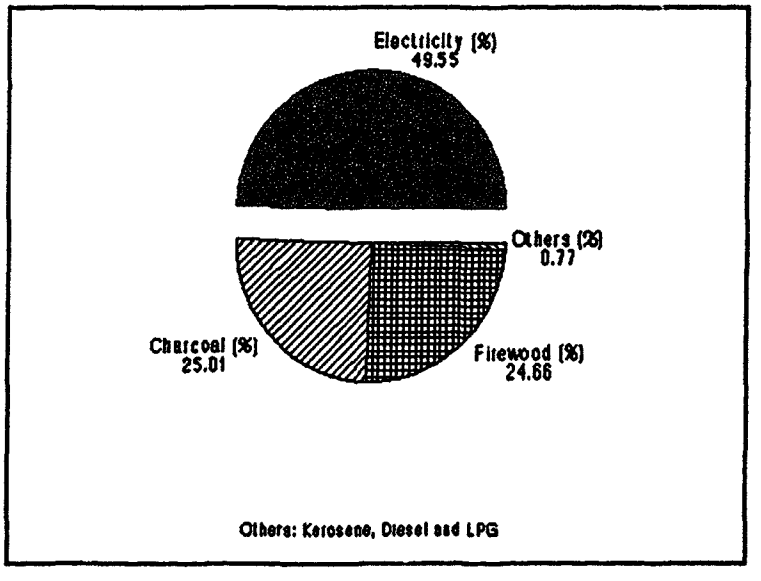
3/ The National Statistics Office, in cooperation with the Swedish Government, is currently undertaking a national income and expenditure survey.

B. Urban Energy Consumption Patterns: An Overview

2.5 The choice of household fuels is influenced by several factors: household size and income; relative fuel prices; fuel availability and access; the cost and appropriateness of equipment, convenience; adequate information and cultural factors. In the case of the Lao PDR, the low cost of electricity relative to other fuels, its ease of access, and household income figure prominently in fuel choice, although all of the above play a role in the Vientiane household energy profile.

2.6 The ESMAP/EdL survey shows that the average monthly household energy consumption of all fuels is about 72 kgoe. Figure 4 highlights the preeminence of electricity in household energy consumption, which represents 50% of total fuel use. The traditional fuels, charcoal and firewood, account for the remaining 50% and are split almost equally. Kerosene, diesel and LPG play an insignificant role. Nonetheless, because LPG is fast and clean, it is becoming popular among a few high-income households and restaurants in the central core of the city.

Figure 4. Household Energy Consumption
Percentage of Energy Share



Source: ESMAP/EdL Survey, 1991

Electricity

2.7 The generalized access to electricity contributes to its penetration across income groups. All households, with the exception of two in the surveyed area,[4/] have access to electricity

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[4/] One household refused to pay the connection charge, while the other reported that it was too expensive.

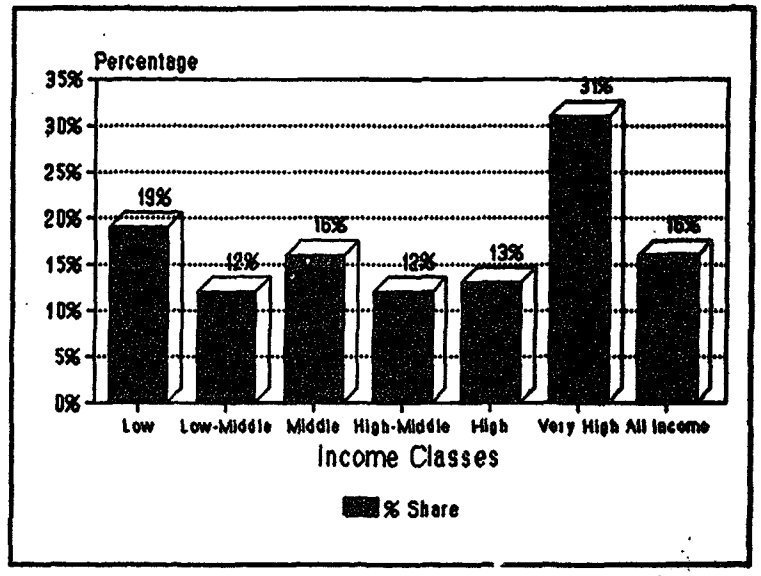
and, at a minimum, use it for lighting. Not surprisingly, the amount of electricity consumption is positively related to income, with the exception of the lowest income group. The average monthly electricity consumption of the lowest income group is higher than that of low-middle and middle income households. In addition, the percentage share of electricity in overall fuel use of this income bracket is higher than that of other income classes, except in the highest income households. Its share is highest among the bottom 20% and the top 10% of the income categories. As Table 4 indicates, electricity accounts for 54% of total monthly energy consumption in the lowest income households and rises to 65% in the highest income households.

Table 4. Percentage of Energy Share in the Household

Percent of Energy Share	All Income	Income					
		Low Less Than 75,000	Low-Mid 75,000 to 102,000	Middle 103,000 to 150,000	High-Mid 151,000 to 200,000	High 201,000 to 270,000	Very Hi More Than 270,000
Electricity Percent Share (%).....	49.55	53.93	47.73	44.35	47.43	45.35	64.88
Charcoal Percent Share (%).....	25.01	17.56	22.01	25.70	28.48	35.93	23.81
Firewood Percent Share (%).....	24.66	27.92	29.63	29.40	22.79	18.14	10.42
Kerosene Percent Share (%).....	.20	.09	.00	.04	.69	.19	.00
Diesel Percent Share (%).....	.31	.50	.20	.51	.18	.11	.29
LPG Percent Share (%).....	.26	.00	.43	.00	.43	.28	.59
Total Energy Consumed kgoe/month	71.55	40.93	51.29	57.17	85.58	118.28	115.91

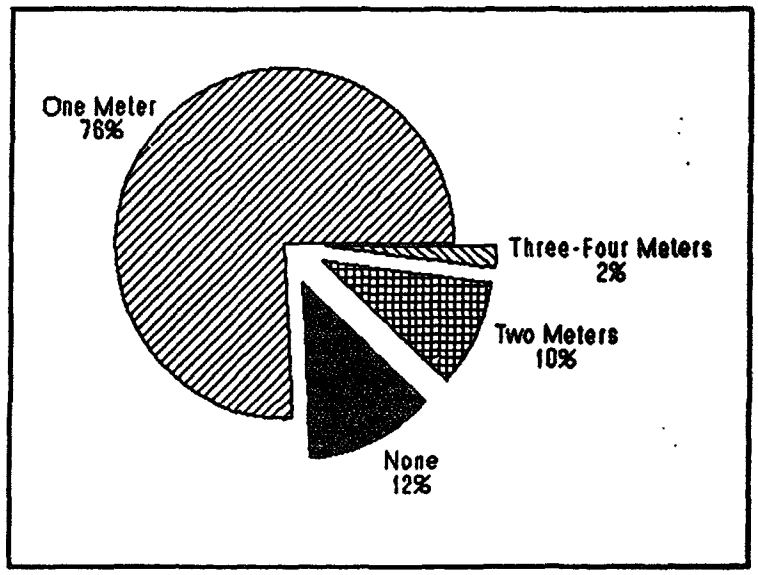
2.8 One explanation for this phenomenon could be the significant number of households in both income groups who share electricity with others. Figure 5 shows that approximately 19% of the lowest income group with meters and 31% of the highest income group with meters share electricity with others. The ESMAP/EdL data revealed that about 12% of households across income groups have no meter, either sharing with a neighbor/relative or living in Government housing with master meters. The percentage is surprising, since EdL has implemented a program to eliminate the sharing of meters. About 12% of urban residents have more than one meter as shown in Figure 6.

Figure 5. Percentage of Metered Households Sharing Electricity with Others



Source: ESMAP/EdL Survey, 1991

Figure 6. Percentage of Electric Meters Installed



Source: ESMAP/EdL Survey, 1991

2.9 Residential Peak Demand Growth. Overall electricity consumption has been increasing at about 8-10% per year. Peak demand has grown from 13 MW in 1977 to 40 MW in 1991, or an annual growth rate of about 14%. This increase in the daily peak, which occurs between 6:30-9:30 p.m., is consistent with the use of electric appliances in the early evening for cooking, lighting, cooling, and entertainment activities. Moreover, the rapid transition to electricity is directly related to the increase in appliance ownership. All electric appliances in Vientiane show generally high levels of ownership: lighting (99.5%) fans (96%),

televisions (84%), irons (73%), refrigerators (61%), and hot plates (60%). The most important appliances in terms of their average share of overall electricity consumption are hot plates (30%), lighting (25%) and refrigerators (ranging from 12-22%).

2.10 Peak demand in the Lao PDR is not strictly a function of residential use. While the ESMAP/EdL survey did not examine non-residential consumption, it is important to note that some of the growth in the peak demand could be attributed to the rapid expansion of commercial activity (e.g. hotels, restaurants; cafes, etc.) that has resulted from the program of economic reform. EdL data show that the category "private enterprises" accounts for about 13% of local sales. However, based on casual observation, the number of new businesses that opened in Vientiane during the fieldwork would appear to suggest that the share of this sector is underestimated.

2.11 **Recommendation: Because EdL must meet the domestic demand for electricity before it can export, and in light of the accelerating economic activity in the urban core, EdL should investigate the consumption patterns of this segment of its customers. Rapid growth in commercial sector energy consumption can be a serious constraint to increasing export earnings. Energy consumption in the commercial sector can be as significant an opportunity as the residential sector to manage load during the peak period. Moreover, technology options in the commercial sector may be easier to implement, due to the higher energy savings and easier access to more energy efficient equipment.**

Woodfuels

2.12 Despite the rapid shift to electricity, woodfuels play an important role in household energy consumption, due to their wide availability and the fact that fuelwood can still be self-collected in Vientiane. Charcoal and firewood are used for cooking and boiling water. As shown in Table 5, charcoal is the fuel of choice among the middle and higher income groups, where 55% and more than 65% of these households respectively are charcoal users. For lower income households, this figure drops to 36%. Estimated average household charcoal consumption is 64 kg/month, and ranges from 43 kg in low-income households to over 122 kg among high income households.

Table 5. Percentage of Household Using Each Fuel and Average Monthly Consumption

Average Monthly % of HH Using Each Fuel	All Income Classes	Low Less than <75000	Low-Mid 75,000 to 102,000	Middle 103,000 to 150,000	High-Mid 151,000 to 200,000	High 201,000 to 270,000	Very Hi More than 270,000
Electricity Consumption (kWh/Household)	271	199	178	197	273	385	606
% of HH Electrified	100 %	99 %	99 %	100 %	100 %	100 %	100 %
Charcoal Consumption... (Kilogram/Household)	64	43	53	47	63	122	70
% of HH Using Charcoal	54 %	36 %	42 %	55 %	67 %	74 %	65 %
Firewood Consumption... (Kilogram/Household)	100	50	87	91	139	93	202
% of HH Using Firewood	64 %	67 %	68 %	66 %	63 %	58 %	48 %
Kerosene Consumption... (Liter/Household)	5	2	2	1	6	10	0
% of HH Using Kerosene	2 %	3 %	1 %	1 %	5 %	3 %	0 %
Diesel Consumption..... (Liter/Household)	2	3	2	2	2	1	2
% of HH Using Diesel	9 %	4 %	8 %	12 %	10 %	11 %	10 %
LPG Consumption..... (Kilogram/Household)	15	0	15	0	22	15	5
% of HH Using LPG	2 %	0 %	1 %	0 %	4 %	3 %	5 %

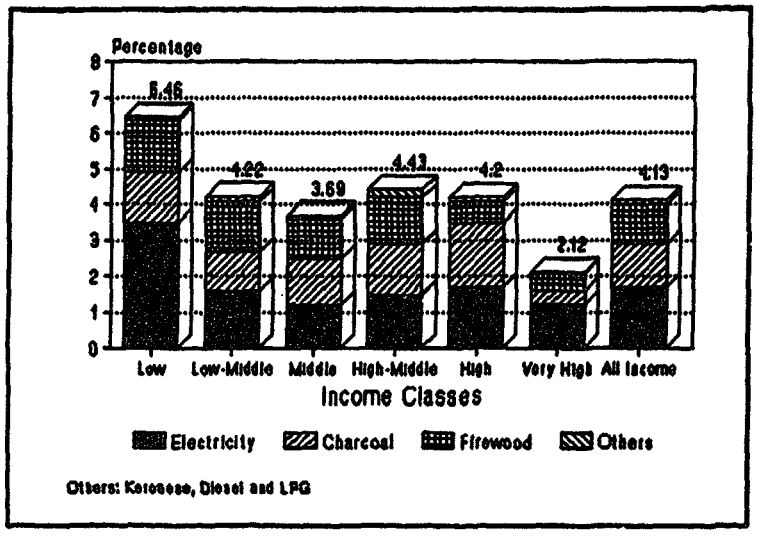
Source: ESMAP/EdL Survey, 1991

2.13 Not surprisingly, firewood is more popular among lower income households, where more than 67% are firewood users. As Table 5 shows, higher income households rely less on firewood, with 58% of the high and 48% of the top 10% of the income bracket using firewood. Estimated average household firewood consumption is 100 kg/month, and ranges from 50 kg in low-income households to over 130 kg among higher income households.

Household Energy Expenditure Patterns

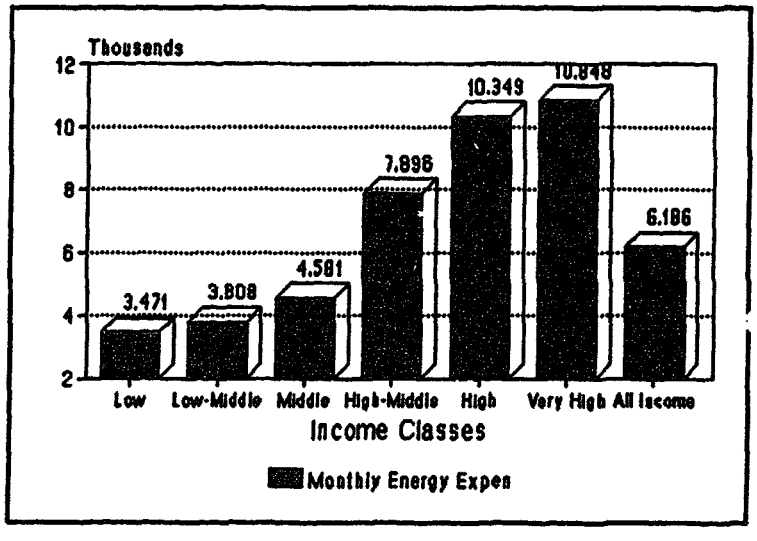
2.14 Figure 7 below highlights the share of energy in total household expenditures. It ranges from about 6% for the lowest income category to 2% for the highest income group. These percentages are slightly lower than those in other Asian cities and reflect, in part, the low energy prices faced by the Vientiane consumer. For example, in Indonesia, the figures are 11% for the lowest income group and 5% for the highest income category. In the rural Philippines, where 80% of the population earns less than Kn 50,000/month, the level is in the range of 6-8%.

Figure 7. Percentage of Household Energy Expenditure to Total Income



Source: ESMAP/EdL Survey, 1991

Figure 8. Household Energy Expenditure by Income Classes



Source: ESMAP/EdL Survey, 1991

2.15 Figure 8 illustrates a typical pattern of household expenditure on energy in Vientiane's urban core. It shows that the average monthly energy expenditure among higher income households is much higher than the lower income households, ranging from Kn 7,896 to Kn 10,848/month among higher income households and Kn 3,471 to Kn 4,581/month among lower income households. This pattern of energy expenditures is typical of that found across the developing world.

III. STRUCTURE OF HOUSEHOLD ENERGY USE

3.1 Across the developing world, cooking is the most important household fuel use. In urban Vientiane, it accounts for about 58% of total monthly household energy consumption. Because of easy access and abundance, Vientiane households traditionally have used firewood and charcoal as their primary cooking fuels. However, as stated in the previous chapter, households have made an unusually rapid transition to electricity, especially for cooking. This chapter examines the mix of fuels used for cooking and compares the costs of switching from electricity to other fuels.

A. Fuel Mix for Cooking

3.2 Figure 9 below illustrates a typical pattern of primary fuel use (defined as the first cooking fuel and exclusive cooking fuel). Table 6 below provides a detailed overview of the mix of fuels used for cooking in urban Vientiane. It shows that:

(a) about 61% of all households use a mix of fuels for cooking;

(b) about 39% of all households cook with one fuel;

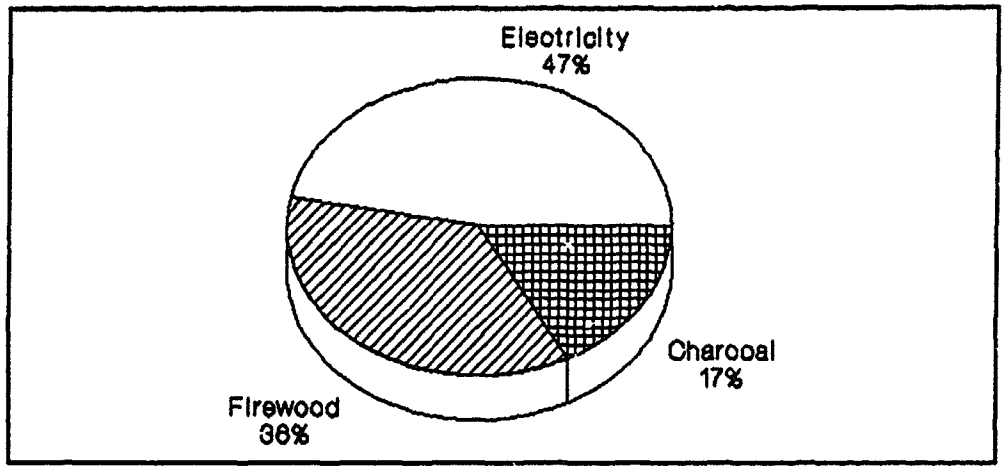
(c) about 14% of households use electricity as their exclusive fuel; 24% use electricity as their primary fuel, with charcoal and firewood as their secondary fuels;

(d) only 5% of households use charcoal as their exclusive cooking fuel, while 9% use it as their primary fuel and use electricity and firewood as secondary fuels;

(e) about 20% of households use firewood as their exclusive cooking fuel, while 9% use firewood as their primary fuel, and electricity and charcoal as their second fuels; and

(f) about 19% use a combination of all fuels, (the survey was unable to identify for this category the split between the first and second fuel).

Figure 9. Household Cooking: Primary Fuel Use



Source: ESMAP/EdL Survey, 1991

Table 6. Mix of Fuels for Cooking

Fuels	Percent	Estimated No. of HH
SINGLE FUEL		
Electricity	14 %	3,738
Charcoal	5 %	1,335
Firewood	20 %	5,341
Total Single Fuels	39 %	10,414
MIX OF FUELS		
Electricity 1st		
+ Charcoal & Firewood 2nd	6 %	1,602
+ Charcoal 2nd	10 %	2,670
+ Firewood 2nd	8 %	2,136
Sub Total	24 %	6,308
Charcoal 1st	1 %	267
+ Elec. & Firewood 2nd	3 %	801
+ Electric 2nd	5 %	1,335
+ Firewood 2nd	9 %	2,403
Sub Total		
Firewood 1st		
+ Elec. & Charcoal 2nd	3 %	801
+ Electric 2nd	3 %	801
+ Charcoal 2nd	3 %	801
Sub Total	9 %	2,403
Other Mixes	14 %	3,738
Electricity + Charcoal + Firewood	5 %	1,335
Charcoal + Firewood	19 %	5,073
Sub Total		
Total Mix of Fuels	61 %	16,187

Note: 1) Kerosene, diesel and LPG use for cooking is insignificant. Kerosene, diesel and LPG are used as fire starter.
2) The ESMAP/EdL survey found only one household using kerosene as their first cooking fuel and charcoal as the second fuel.
3) The ESMAP/EdL survey found only 4 households using LPG in their fuel mix.

Source: ESMAP/EdL Survey, 1991

Table 7. Mix of Electricity with Other Fuels for Cooking

Fuels	Percent	Estimated No. of HH
SINGLE FUEL		
Electricity	14 %	3,738
MIX OF FUELS		
Electricity 1st		
+ Charcoal & Firewood 2nd	6 %	1,602
+ Charcoal 2nd	10 %	2,670
+ Firewood 2nd	8 %	2,136
Sub Total	24 %	6,308
Electricity 2nd		
+ Other Fuel 1st	10 %	2,671
Electricity + Charcoal + Firewood	14 %	3,738
Total Electricity	62 %	16,558

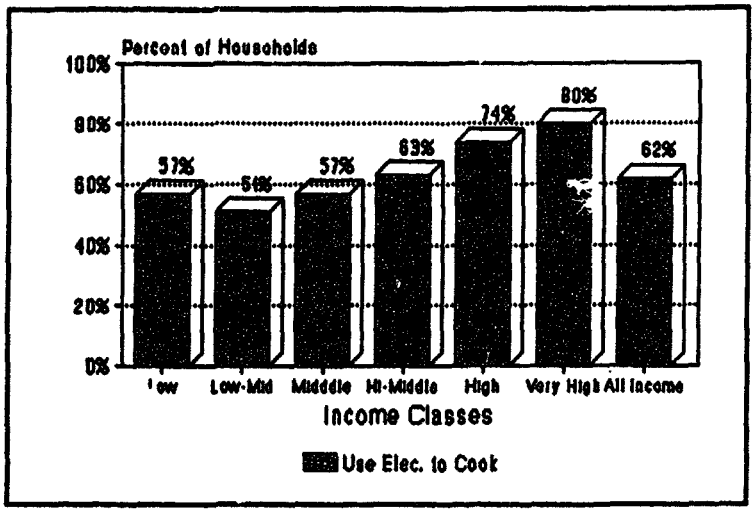
Source: ESMAP/EdL Survey, 1991.

3.3 Table 6 highlighted the broad mix of fuels used for cooking in Lao households. Table 7 above underscores electricity's important place as a cooking fuel. It shows that about 62% of the households use some electricity for cooking. Table 6 and Table 7 show the across-the-board reliance on several fuels. This reliance on a mix of fuels suggests that any major change in the price or supply of any one fuel can be expected to have a far reaching impact on the population. The recently appraised Provincial Grid Integration Project makes the case for a steady rise in domestic tariffs in the 1990's to offset EdL's increasing costs. The ESMAP/EdL Study emphasizes the role of low electricity tariffs in rising domestic electricity consumption. Given the share of cooking in total household energy use and the mix of cooking fuels, a significant rise in electricity prices can be expected to affect the price and supply of other fuels. As a consequence, when changing the domestic tariff structure, the Government of the Lao PDR must also address the broader issue of a national urban household energy strategy to meet the basic needs of the population.

Cooking with Electricity

3.4 The previous section has illustrated the large number of households in urban Vientiane who have switched from traditional woodfuels to electricity for cooking. Figure 10 shows that **all income groups rely heavily on electricity for cooking.** This reliance ranges from 57% in the lowest income group to 80% in the highest income bracket.

Figure 10. Percent of Households Using Electricity for Cooking by Income Classes



Source: ESMAP/EdL Survey, 1991

3.5 The principal reasons for this widespread use of electricity for cooking have been: (a) the low domestic tariff (0-200 kWh @ Kn 7/kWh; >200 kWh @ Kn 14/kWh) compared to the cost of other cooking fuels; (b) the relatively low cost of electric cooking equipment and spare parts; (c) the high level of household connections and (d) the convenience of cooking with electricity. In July 1992, the lifeline block was eliminated for all but residential consumers. A three block structure now applies for these customers: (i) their first 100 kWh per month will be charged at the lifeline rate of Kn 8/kWh; (ii) their second 100 kWh per month will be charged at the subsidized rate of Kn 15/kWh; and (iii) all their remaining consumption will be charged at Kn 25/kWh. Under this scenario, electricity will still be inexpensive for residential consumers; based on current patterns, 86% of residential consumers would have their full electricity requirement fall within the subsidized blocks. It is not expected, therefore, that household consumption patterns will be significantly altered by the new tariff structure.

B. Electricity Pricing: Customer Attitudes

3.6 Pricing is the most powerful tool of energy policy and key to a successful demand management program. A correct price signal to the Vientiane consumer should discourage wasteful electricity consumption and encourage fuel switching, especially for cooking. **This does not mean that the Vientiane consumer should be obliged to move back down the fuel ladder to fuelwood and charcoal for cooking.** Rather, the tariff structure should allow for the promotion of a broader, more rational mix of fuels than is presently the case. This mix would include rely more on fuelwood and charcoal as well as kerosene and LPG, ensure the availability of affordable and acceptable cooking devices, and take into account the environmental consequences of any increased reliance on woodfuels.

3.7 The low price of electricity in Vientiane is reflected in the attitude of the population towards this resource. The population generally agrees that electricity is abundant and cheap, as shown in Figures 11, 12, and 13 below. About 53% of households surveyed disagree that electricity is expensive, while only 43% agree that the tariff is high. Attitudes towards cooking with electricity should be of concern to EdL: about half the population found cooking with electricity to be expensive, while the other half did not. About 71% of households surveyed agree that, if the price remains the same, they will continue cooking with electricity. This suggests that EdL will be unable to materially alter consumer behavior vis-a-vis electricity consumption, especially for cooking, in the absence of an adequate price mechanism.

Figure 11. Attitude Toward Electricity Price: "Electricity is Expensive"

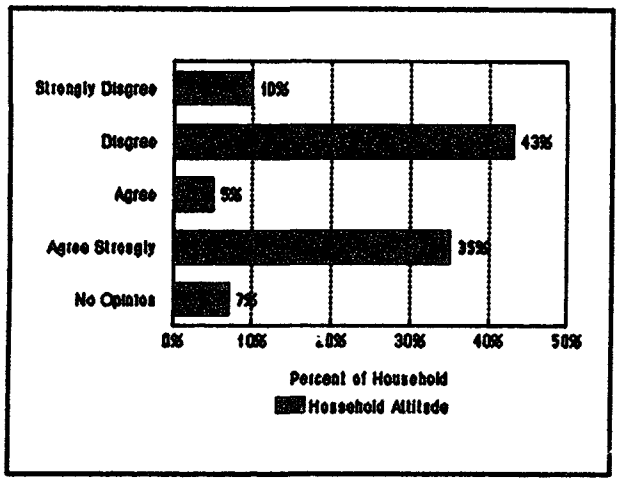


Figure 12. Electricity for Cooking: "If Price not Prohibitive, Will Continue to Cook With Electricity

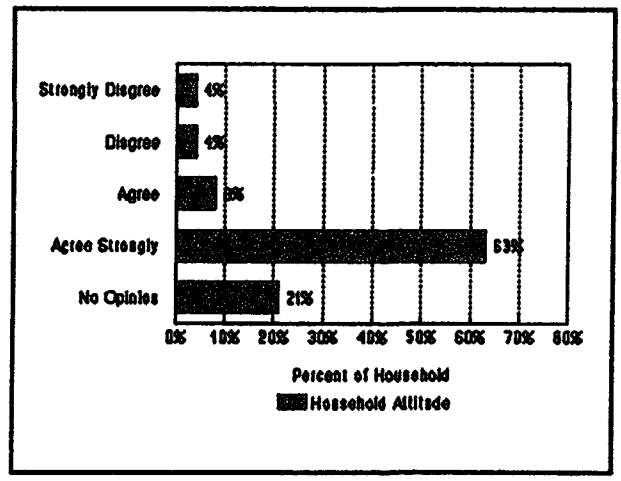
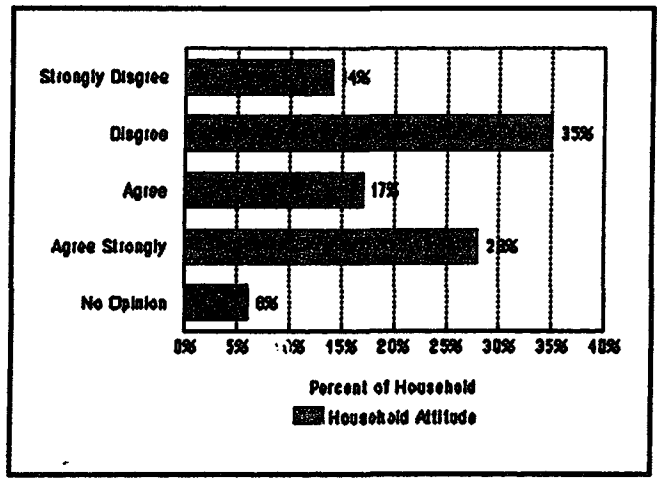


Figure 13. Attitude Toward Electricity for Cooking: "Cooking With Electricity is Expensive"



C. Characteristics of Cooking Equipment.

3.8 The typical Lao electric cooking device is a one-burner hot plate. There are two types of hot plate on the Vientiane market: a single burner, Lao-made model, which costs Kn 2,000 (US$ 3.00), and a Russian-made single burner version costing Kn 4,500 (US$ 6.50). While the Lao-made model is cheaper, it accounts for only 41% of all hot plates used in urban households, the Russian model accounting for the remaining 59%.

3.9 The reason for the popularity of the imported equipment, notwithstanding its higher cost, would appear to be its higher reliability, lower operating costs and greater versatility: The Lao hot plate uses an imported filament that requires replacement, at a minimum, on an annual basis at a cost of Kn 700 (US$ 1.00). Replacement of the Russian filament is done on an infrequent basis. The imported model also offers three settings, making it a more flexible cooking device. Both hot plates have a high electrical demand: 2,200 watts for the locally made hot plate and 950 watts for the imported model.

D. The Potential for End-Use Efficiency

EdL: The Benefits of Promoting the Imported Hot Plate

3.10 Elsewhere in the region, electricity is generally not used for cooking, or is used in very small quantities. Given the Lao PDR's comparatively low level of economic development and the role of electricity exports in economic growth and the importance of cooking in peak demand growth, it is important to examine the impacts of using less electricity for cooking and/or switching to other fuels. The paragraphs below discuss the potential impact on EdL, on electricity exports and on consumers of a switch to a more efficient hot plate. The potential for switching to alternative fuels is also presented.

3.11 The financial analysis examines the potential for energy peak demand reduction using the Russian hot plate for illustrative purposes. At the time of the survey, the Russian equipment was the only alternative to the locally produced hot plate available on the Vientiane market. Given rapidly changing market conditions in the Lao PDR and its trading partners, the sources of supply of appliances can be expected to shift. Likely sources include Thailand and the People's Republic of China. In these markets, suitable cooking equipment equal to or greater to the efficiency of

the Russian hot plate will likely become available.[5/] As a result, the savings illustrated in the analysis below may be somewhat conservative.

3.12 The ESMAP/EdL survey estimated that 6,500 households cook with the Lao-made hot plate, while another 10,000 households use the Russian-made model. If it is assumed that 90% (accounting for diversity and peak coincidence) of these households cook during the evening peak, cooking with electricity accounts for a total of 21.5 MW.[6/] Based on these estimates, cooking with electricity accounts for more than half of the daily peak load in urban Vientiane (40 MW). If households currently using the Lao hot plate switched to the imported model, the peak demand for cooking could be reduced to 14.2 MW,[7/] or a reduction in the peak load of 7.3 MW for cooking. If it is assumed that 38% of urban households, or approximately 10,600 households who do not now cook with electricity, purchase a Lao-made hot plate, another 21 MW of peak demand would be required.[8/] Clearly if those same households were to purchase the imported model, the increase in peak demand would be less.

3.13 The ESMAP/EdL study did not examine other imported alternatives to the Lao stove. Moreover, it did not examine the potential for increasing the efficiency of the locally made hot plate. If a decision is taken to promote the reduction of the peak demand for cooking, the cost effectiveness of these scenarios would need to be determined. Any scenario to discourage or eliminate the use of the locally-made stove would require an assessment of the economic and social impacts of such a recommendation. Detailed information would be required on, inter alia, the number of local stove producers and the number of their employees; equipment preferences of stove users; costs and availability of alternatives; and an assessment of the contribution of this local production to the Vientiane economy.

5/ On the other hand, movements to implement appliance efficiency standards in the Lao PDR's supplier markets could have the opposite effect, with obsolete equipment entering the Vientiane market.

6/ A total daily demand for cooking of 21.5 MW; (2200 watts x 5,850 households=12.9 MW for the Lao-made hot plate) plus (950 watts x 9,000 households= 8.6 MW for the Russian-made hot plate.)

7/ The daily peak demand for cooking would be 14.2 MW (8.6 + 5.6); the demand of 12.9 MW by the Lao hot plate would be reduced to 5.6 MW (950 watts x 5,850 households = 5.6 MW, a savings of 7.3 MW)

8/ 21 MW accounts for diversity and peak coincidence. One additional Lao-made hot plate adds 2.2 kW, whereas the Russian model adds slightly less than 1.0 kW.

The Lao PDR: The Incremental Cost of Promoting the Imported Hot Plate

3.14 Replacing the 6,500 Lao-made appliances with the imported model could save 7.3 MW in peak demand/day. In addition, the switch would have the following foreign exchange implications:[9/]

Import Costs of the Lao-made Hot Plate: The Lao-made hot plate has imported components (filament and cement).[10/] The present value of the cost of the 6,500 hot plates is US$ 24,635.

Import Costs of the Russian-made Hot Plate: The present value of the cost of 6,500 imported hot plates is US$ 41,786.[11/]

Net Import Cost: The present value of the net incremental import cost of a switch to the imported hot plate is US$ 17,151.

The Consumer: Benefits of the Lao vs the Imported Hot Plate

3.15 Preparation of the typical Lao food staple (glutinous rice) is an energy intensive activity, due to the appliance used as well as the traditional cooking method. Urban Vientiane households consume at least 2-3kg of rice per day.[12/] Experiments conducted in the field show that about 0.7 kWh is needed to cook 1 kg of glutinous rice. Based on this consumption, each household would use at least 45 kWh per month just to cook 2 kg of rice/day. The ESMAP/EdL survey estimated that Vientiane households consume an average 80 kWh/month for cooking.

3.16 Estimating cooking costs requires an examination of both stove and fuel costs, as well as the relative efficiencies of the stove models. ESMAP/EdL field tests yielded an efficiency of 70% for the Lao model, as compared to 80% for the Russian-made hot

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9/ Life cycle cost analysis of the hot plates is based on 5 years at a discount rate of 10%.

10/ Cement constitutes a small fraction of the imported costs. Therefore, only the cost of the filament US$1.00 is used in the comparative cost analysis. The cost of the imported filament over a five-year life of one Lao stove is estimated at US$ 3.79.

11/ US$ 6.42/hot plate

12/ All households surveyed reported eating their meals at home.

plate. A comparison of the cooking costs[13] of the two devices shows that, at the current domestic tariff of Kn 14/kWh, households switching to the Russian model would save about Kn 8,922 (US$ 12.75) (PV) over 5 years; the present value of the annual savings for a household would be about Kn 1,784 (US$ 2.55).[14] Households could recoup the higher cost of the imported model in two years, as shown in Figure 15.

3.17 If the domestic tariff is raised to Kn 21/kWh,[15] the present value of the financial savings is Kn 2,746/household/year ($3.92) over 5 years for households switching to the Russian model. More importantly, as Figure 17 shows, at Kn 21/kWh, the savings/household increases and the payback time is shortened significantly: the consumer can recover the costs of the more efficient, more expensive imported model is less than 1 year.

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[13] Based on a current price of the Lao-made and Russian-made hot plate of Kn 2,000 and 4,500, respectively, for a single burner hot plate, and a filament replacement for the Lao-made hot plate of Kn 700. The analysis is based on a conservative assumption of an annual filament replacement.

[14] Based on the 5 year lifetime for both hot plates and a 10% discount rate.

[15] Rate increases taken from the Green Cover SAR for the Provincial Grid Integration Project.

Figure 14. Annual Cooking Costs Comparison: Lao vs Russian-Made Hot Plate

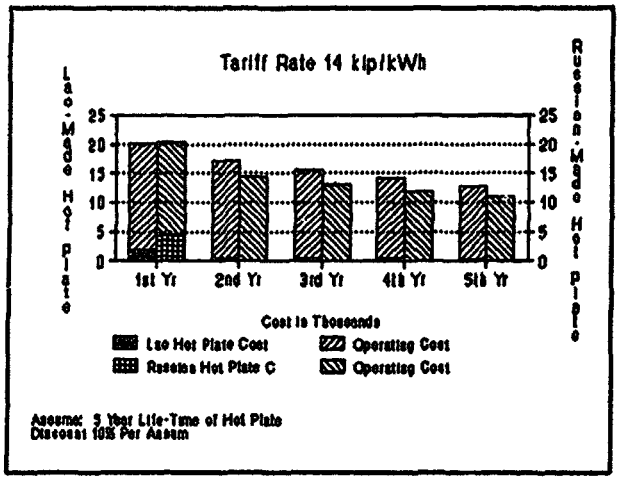
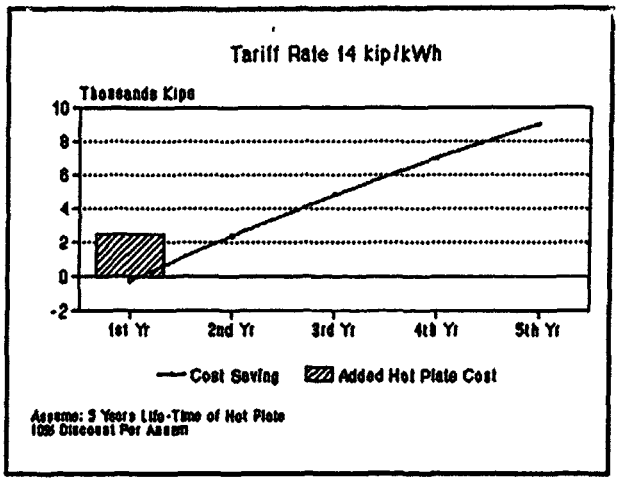


Figure 15. Household Cost Savings of Switching from Lao-Made to Russian-Made Hot Plate



Source: ESMAP/EdL Survey, 1991

3.18 It must be recognized that these savings are probably too small to convince the consumer to switch to the imported model, in the absence of some kind of incentive program or regulatory measure. Incentives are typically used as a vehicle to overcome barriers such as low tariffs, limited energy efficient equipment in the marketplace and cultural factors, which discourage customer investment in energy efficiency. These programs require an institutional capacity that would need to be developed within EdL. Nevertheless, in light of the potential reduction in peak demand that could be achieved from the use of more efficient cooking appliances, it is recommended that EdL investigate the kind of incentive program that could attract customer participation at the lowest possible cost to EdL.

Figure 16. Annual Cooking Costs Comparison: Lao vs Russian-Made Hot Plate

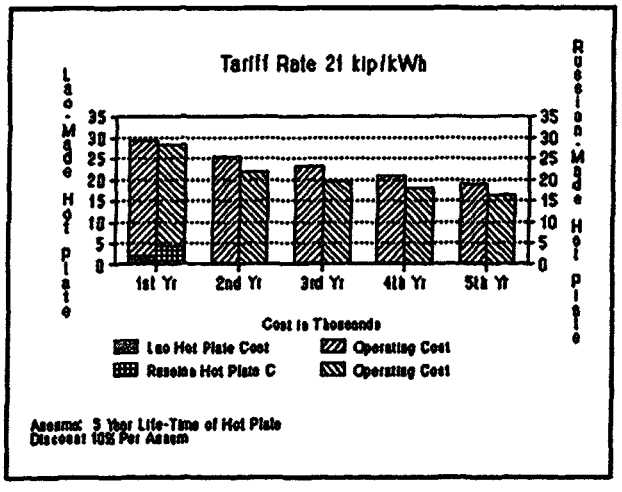
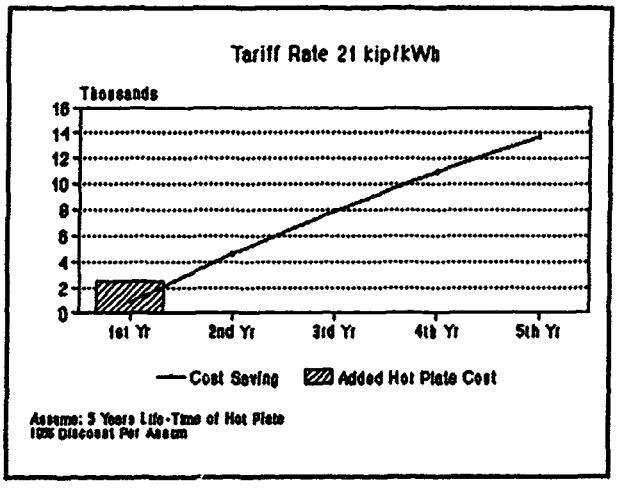


Figure 17. Household Cost Savings of Switching from Lao-Made to Russian-Made Hot Plate



Source: ESMAP/EdL Survey, 1991

E. Prospects for Fuel Switching

EdL: The Benefits of Switching to Alternative Fuels for Cooking

3.19 From EdL's perspective, any incremental electricity consumption within the country, especially during the peak, directly implies a marginal loss of export earnings. The ESMAP/EdL study estimated that an average annual 1,000 kWh/household is consumed for cooking, or a total of 16.5 MWh/year[16]. At the 1991 average domestic tariff of US 2¢/kWh and a cost of supplying electricity to the residential consumer estimated at US 6 ¢/kWh, EdL has borne an annual subsidy of US$ 660,000 for urban households cooking with electricity. Clearly, this situation cannot provide a satisfactory financial result for EdL over the long run. At the same time, the scenarios for fuel switching are financially unattractive, as shown in the paragraphs below. Under these circumstances, EdL's options to constrain electricity consumption for cooking are limited. It is recommended that EdL look carefully at the kinds of demand-side energy efficiency programs described in this report and under implementation in Asia and elsewhere that could reduce peak energy consumption and that would be viable in the Lao PDR context.

Comparison of Cooking Costs

3.20 The comparative costs of various cooking fuels, cooking devices, and relative efficiencies are shown in Table 8. Details are provided in Annex III. As shown in Table 8 and highlighted in Figure 18, at the 1991 tariff of Kn 14/kWh, the electricity cost per useful kWh is Kn 18, which is much lower than the cost of woodfuels and other petroleum-based fuels. From a financial point of view, cooking with electricity is the cheapest, at Kn 18,000/household/year. At current market prices, charcoal costs Kn 35,000/household/year, while firewood costs Kn 45,000/household/year. Table 8 confirms that, at the prevailing tariff before the July 1992 increase, and given the availability of inexpensive cooking appliances, the shift to electricity for cooking is likely to continue. It is not expected that the recent increase will slow this trend. However, if the tariff were raised to an economic cost of Kn 56/kWh, the electricity cost per useful kWh would be comparable to LPG at Kn 70/useful kWh. At an economic cost of Kn 56/kWh, cooking with electricity would cost Kn 70,000/household/year. At this tariff, electricity is competitive with kerosene and LPG (Kn 56,000 and Kn 70,000/hcusehold/year respectively), but it is more expensive than woodfuels at their current market prices.

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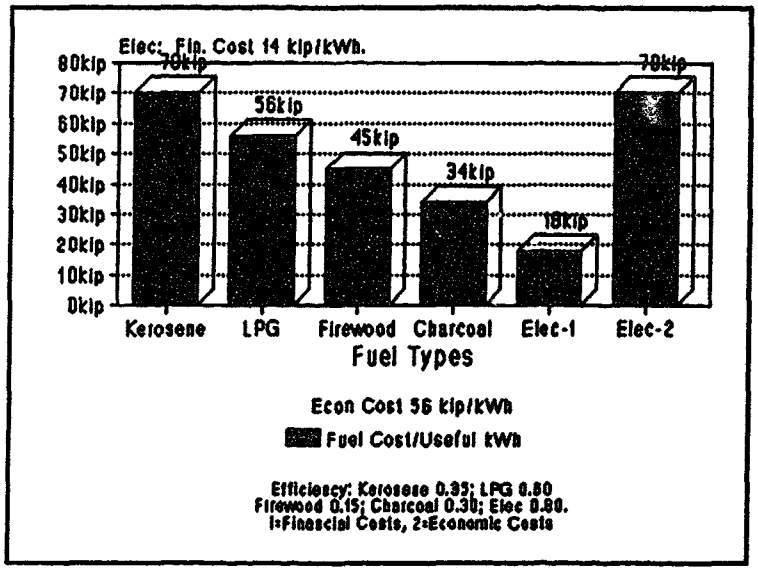
[16] 16,500 households presently cooking with electricity.

Table 8. Comparison of Fuel Prices and Stove Costs in Vientiane

Fuel Type	Energy Value (MJ/Kg)	Price Per Kg. (Kn)	kWh/Kg	Effi-ciency Rating	Useful/ kWh	Kips/ Useful kWh	Fuel Cost Kips/Yr (1000 kWh)	Stove Cost 1 Burner
LPG	45.2	420	12.6	0.60	7.53	56	56,000	87,000
Kerosene	43.2	294	12.0	0.35	4.20	70	70,000	35,000
Firewood	16.0	30	4.4	0.15	0.67	45	45,000	2,000
Charcoal	30.0	85	8.3	0.30	2.50	34	34,000	4,700
Electric (Economic)	3.6/kWh	14	na	0.80	na	18	18,000	4,500
Electric (Financial)	3.6/kWh	56	na	0.80	na	70	70,000	4,500

Note: 1) Based on annual consumption/household of 1000 kWh.
2) All calculations are adjusted to reflect: (a) market price of fuels and cooking equipment, with the exception of electricity, which shows both financial and economic costs; (b) the average stove efficiency; (c) energy value of each fuel.

Figure 18. Comparison of Cooking Fuel Costs in Kn per Useful kWh Equivalent



Source: ESMAP/EdL Survey, 1991

3.21 Figure 19 below highlights the comparative costs of cooking (including equipment and fuel costs and relative efficiencies) in present value terms.[17] The conclusions can be summarized as follows:

a) At Kn 14/kWh, cooking with electricity costs a household Kn 117,630 over 10 years (an average of Kn 11,763/year).[18] Cooking with electricity is the cheapest, while cooking with kerosene is the most expensive;

(b) The financial cost of cooking with woodfuels is still significantly higher than cooking with electricity: it averages Kn 22,445/household/year for charcoal and Kn 27,961/household/year for firewood;

(c) The present value of the financial cost of cooking with LPG and kerosene is Kn 43,106 and Kn 46,508/household/year respectively.

(d) The high cost of cooking with LPG is due, in part, to the high cost of the imported stove and cylinder and the higher profit margin accruing to the distributor, because of the limited market. The relatively high cost of the kerosene stove and its lower efficiency compared to LPG are the main reasons for the higher cost of cooking with kerosene;

(e) When electricity tariffs reflect economic costs (Kn 56/kWh), cooking with electricity becomes more expensive than firewood and charcoal and is competitive with LPG.

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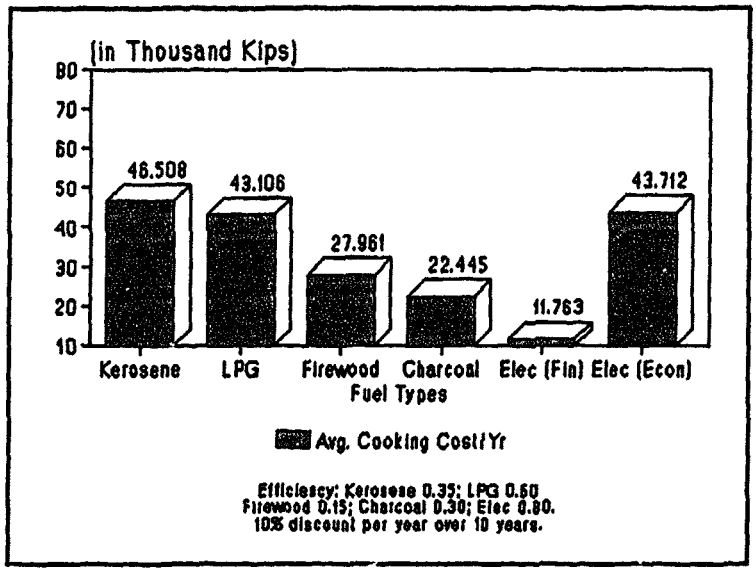
[17] Life-cycle costing: 10 years; 10% discount rate.

[18] The analysis is based on the current cost of the imported single burner hot plate.

Figure 19. Comparison of Average Annual Cooking Costs in Present Value Terms



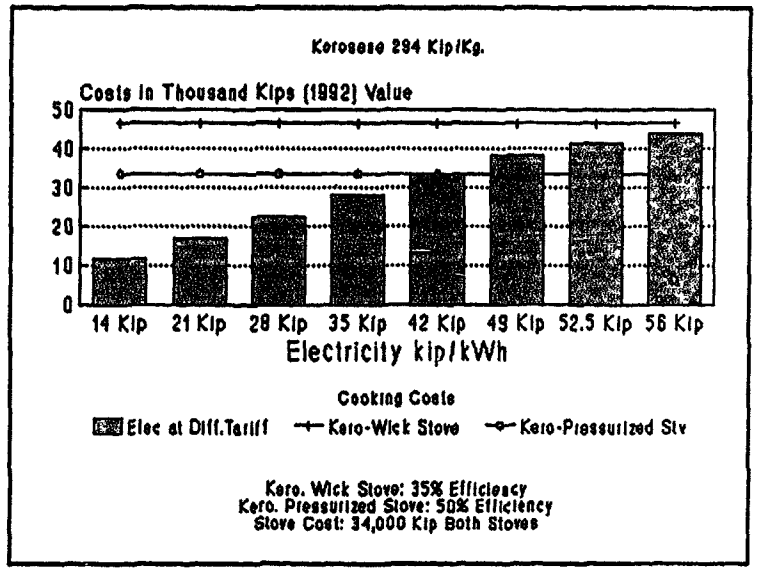
Source: ESMAP/EdL Survey, 1991

Switching to Kerosene

3.22 Figure 20 compares cooking with kerosene to cooking with electricity at different tariff levels. When taking into account current market prices of fuels and cooking equipment, relative equipment efficiencies, as well as current electricity tariffs, the above analysis has shown that kerosene is the most expensive cooking fuel. From several points of view, kerosene is unattractive as an alternative. First, both the fuel and equipment must be imported. Second, the relatively high price of a kerosene stove (starting at around Kn 30,000, or US$ 35) is unaffordable to all but the upper middle and high income households. Third, the smoke and unpleasant odors may discourage its broader penetration into Lao households.

3.23 On the other hand, kerosene is easily accessible to the consumer, who can make daily purchases at the roadside or service station (Kn 200-300/liter). If the domestic tariff were increased to Kn 56/kWh, cooking with kerosene could become financially more attractive. For households who could afford a more efficient kerosene stove (pressurized-type stove with a 48-50% efficiency), estimated cooking costs could drop to Kn 33,600/household/year, which is lower than the annual cost of cooking with electricity at an economic cost of Kn 56/kWh (Kn 43,712/household/year).

Figure 20. Cooking Costs: Electricity vs. Kerosene



Source: ESMAP/EdL Survey, 1991

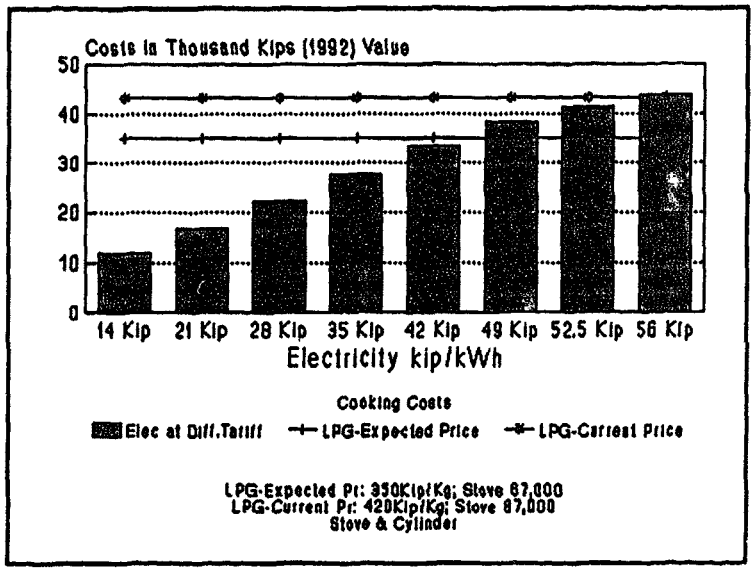
3.24 **Recommendation: The ESMAP/EdL survey did not collect data on the fuel efficiency and power ratings of the kerosene stoves on the Vientiane market. Neither did the survey analyze household cooking practices and preferences for cooking appliances. Nonetheless, experience elsewhere suggests that Government should assess the need and means to require that imported kerosene stoves meet minimum efficiency standards and be labelled to inform the Lao consumer, especially in light of the wide variation in efficiencies of kerosene stoves marketed throughout the region. This is all the more important since, as the domestic tariff rises, some households may shift to kerosene for cooking. Finally, as neighboring countries, establish their own efficiency standards for appliances, the Government of the Lao PDR needs to ensure that inefficient, lower quality equipment does not enter the Lao market.**

Switching to LPG

3.25 Table 8 and Figure 19 show that LPG is the second most expensive cooking fuel, at current market prices in Vientiane. Figure 21 below compares the costs of cooking with LPG and electricity. It shows that, at the current price of LPG and LPG cooking equipment and at a domestic tariff of Kn 56/kWh, the present value of cooking costs for consumers using LPG is an estimated Kn 43,106/household/year, which is comparable to cooking with electricity (Kn 43,712/household/year). As the LPG market in urban Vientiane expands, the costs of LPG and the associated equipment will likely drop, which will enhance the attractiveness of LPG for cooking. However, the broad penetration of LPG as a cooking fuel is and will remain severely constrained by the high initial cost of the stove and cylinder, making the prospects

unlikely for a significant switch to LPG for cooking in the Vientiane context.[19]

Figure 21. Cooking Costs: Electricity vs. LPG



Source: ESMAP/EdL Survey, 1991

3.26 On the other hand, as domestic tariffs rise, and as Vientiane continues to urbanize, a broader spectrum of households may begin to use LPG in their mix of cooking fuels, as is the trend across the developing world. As a consequence, the Government of the Lao PDR must assess the costs and benefits of promoting a broader use of this fuel, especially in light of the foreign exchange implications.

The Lao PDR: The Incremental Costs of Switching to LPG

3.27 For illustrative purposes only, and at a domestic electricity tariff of Kn 56/kWh, if 50% of households currently cooking with electricity switched to LPG, the present value of the Lao PDR's export earnings from the sale of the 8.25 MWh/year would be about US$ 2.93 million over 10 years. However, the Lao PDR would have to finance the import costs of US$ 3.27 million for 821,350 kg of LPG annually as well as the LPG stoves and cylinders. Substituting LPG for electricity under this scenario would result in a net foreign currency outflow in present value terms of US$ 337,188, as summarized below and detailed in Table 9 and Annex IV.

Import Costs of LPG/stoves/cylinders:	US$ 3.34 million
Avoided Import Cost of Hot Plates:	US$ .07 million
Net Import Cost:	US$ 3.27 million
EdL Revenue from Sale 8.25 MWh/year:	US$ 2.93 million
Net Foreign Currency Outflow:	**US$ .34 million**

[19] LPG stoves with one burner cost about Kn 53,000 (in many cases, retailers demand payment in Baht) and a 15 kg cylinder costs Kn 34,000.

Table 9. Switching to LPG for Cooking

Assumptions:	
• Annual electricity export (8,250 HH, 1,000 kWh/year/household)	8,250,000 kWh
• Time-of-day peak export tariff	US5.8¢/kWh
• 10 Year lifetime of imported LPG stove	
• LPG import cost=US$ 0.5/Kg.	
• Stove & cylinder=US $100/HH/set	
• 5 years lifetime of imported elec. hot plate	
• 10% discount rate; 10 years	
• Households can overcome initial costs of LPG cooking equipment.	
Financial Value: (in present value terms, Over 10 years)	
Total revenue from exporting electricity	US$ 2,939,904
Import cost (LPG) (821,350 kg. of LPG @ US$0.5/Kg.)	US$ 2,523,186
Import cost (LPG stoves, cylinders)	US$ 825,000
Total import cost for LPG	US$ 3,348,186
Avoided import cost of hot plates	US$ 71,094
Net Financial Loss (PV)	US$ 337,188

EdL: The Benefits of Shifting to LPG

3.28 While the Lao PDR would sustain a net foreign currency outflow under the proposed scenario as shown above, EdL would benefit from a financial point of view: it could earn US$ 478,500/year; the present value of EdL's earnings over ten years is estimated at US$ 2,939,904 from exporting electricity which would otherwise be used for cooking. Nonetheless, the high initial costs to the consumer, together with the foreign exchange implications for the Lao PDR, make this alternative undesirable.

Substituting Charcoal and Fuelwood for Electricity

3.29 Cooking with woodfuels is more expensive than electricity, but less expensive than LPG and kerosene, at current market prices for cooking fuels and equipment and taking into account relative equipment efficiencies. Due to the significantly lower efficiency of firewood, it is slightly more expensive than charcoal, but still far less costly than LPG or kerosene, which require large initial investments for stove equipment.

3.30 Apart from their lower prices, firewood and charcoal have several advantages over kerosene and LPG. First, woodfuels require a minimum investment for cooking equipment, making them very attractive to lower and middle income households. Second, households can build a larger fire to accommodate the relatively large family size. Third, firewood can still be collected in urban Vientiane as residues from the furniture factory, scrap wood from construction sites, and driftwood along the Mekong River and around the house, especially on the periphery of urban Vientiane. Fourth, and the most important factor, firewood and charcoal are indigenous

resources. On the other hand, the intensive and concentrated urban demand for fuelwood can contribute directly to environmental degradation, since wood resources on the periphery of Vientiane are mined exclusively for the urban market.

3.31 A significant increase in electricity prices will likely drive many households who have already switched to electricity back to a greater reliance on woodfuels. Moreover, as electricity tariffs rise, firewood and charcoal prices will also increase, because of the increased demand for fuelwood and charcoal. As a result, the very poorest of Vientiane's population will be the first to be affected. This suggests that higher domestic electricity prices must take into account the impacts on the population as well as on the environment.

3.32 Figures 22 and 23 depict the comparative costs of cooking with woodfuels and electricity at different electricity tariffs. Because the ESMAP/EdL survey did not investigate the supply of woodfuels and the distribution networks, there is insufficient data to estimate the extent of changes in woodfuel prices due to an increase in demand. For illustrative purposes, the following scenarios can be considered:

(a) If the tariff rises to Kn 28/kWh, the cost of cooking with electricity will be as expensive as cooking with charcoal; if the tariff rises to Kn 35/kWh, cooking with electricity will be as expensive as cooking with firewood, provided the market prices of these woodfuels remain unchanged;

(b) If firewood and charcoal prices increase 17% from Kn 30 to Kn 35/kg and Kn 85 to Kn 100/kg[20/] respectively, the present value of the costs of cooking with firewood and charcoal would be Kn 32,876/household/year and Kn 26,131/household/year[21/]. This increase in woodfuels prices would make cooking with firewood and charcoal as expensive as cooking with electricity if electricity is priced at 42 and Kn 35/kWh, respectively.

[20/] The cost of firewood and charcoal per useful kWh will rise to Kn 53 and Kn 40, respectively; also see Table 8 for comparison.

[21/] Based on life-cycle costing: 10 years; 10% discount rate.

Figure 22. Cooking Costs: Electricity vs. Firewood

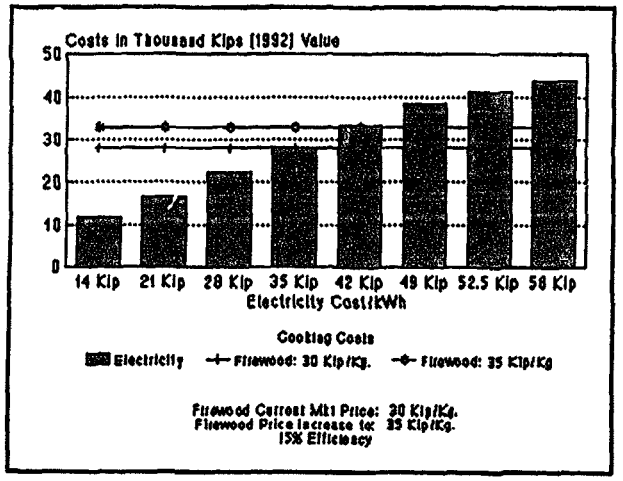
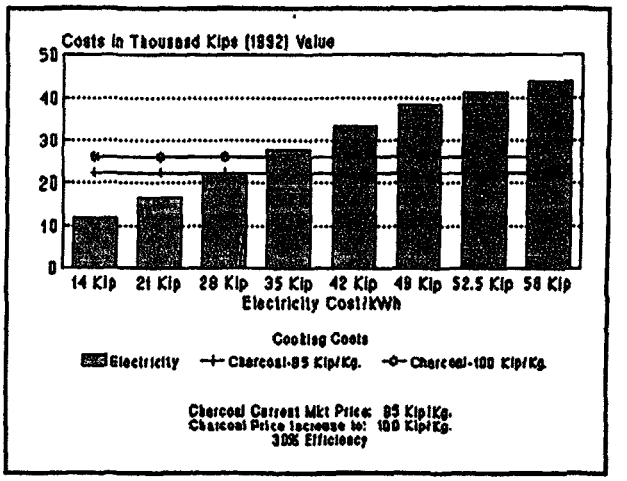


Figure 23. Cooking Costs: Electricity vs. Charcoal



Source: ESMAP/EdL Survey, 1991

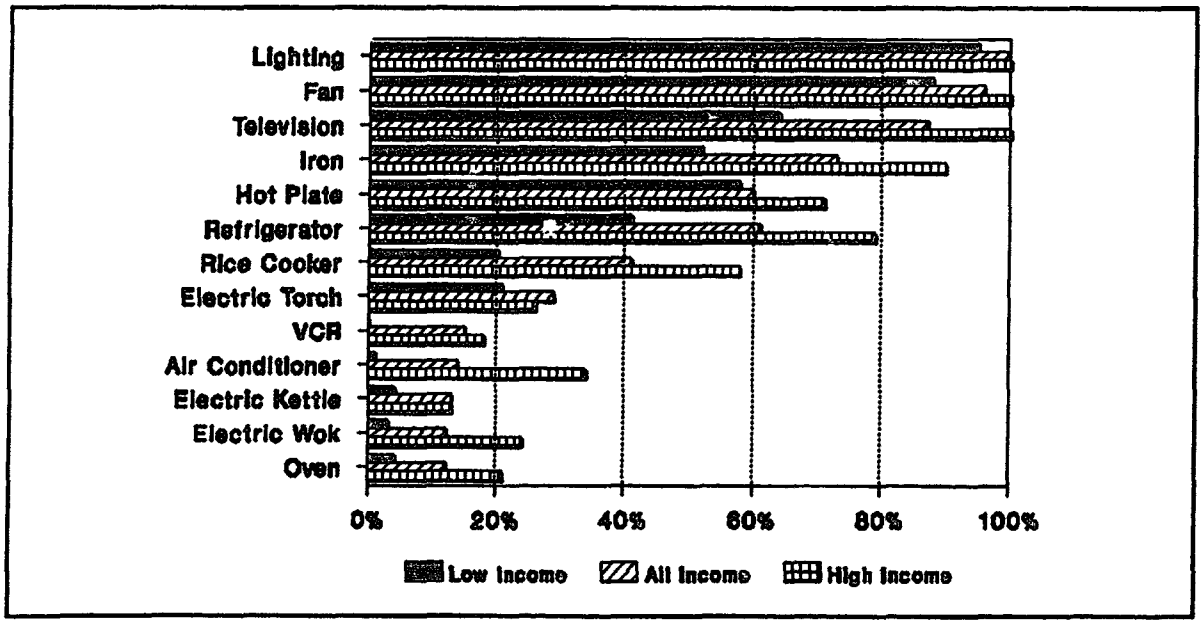
3.33 **Recommendation: Because of the pattern of the fuel mix for cooking across income groups and the relative price structure of cooking fuels, no single intervention concerning one particular fuel can be isolated from its impact on the total energy market. It is, therefore, important that the Government of the Lao PDR define a national household energy strategy that ensures the availability of affordable fuels and cooking equipment to all income groups, minimizes environmental costs and maximizes foreign exchange earnings.**

IV. APPLIANCE OWNERSHIP PATTERNS AND CHARACTERISTICS

A. Trends in Appliance Ownership

4.1 In addition to cooking with electricity, the accelerating rate of electric appliance ownership and the inefficient use of these appliances are major factors in the rise in the base and peak demand. The rapid acquisition of home electric appliances in the Lao PDR mirrors a trend across Asia. The ESMAP-EdL survey confirms that every household has at least one electric appliance, with lights/lamps and fans the most frequently cited. Figure 24 below illustrates the pattern of appliance ownership and the trend of increasing appliance ownership as incomes rise. Table 10 below shows that refrigerators, fans, televisions, and hot plates are among the most popular appliances in Lao households. Table 10 also summarizes ownership patterns by income groups. Even among the very lowest income group (households earning less than Kn 75,000/household/month) appliance ownership is high; 88% own fans; 64% own televisions; 58% own hot plates and 41% own refrigerators. Among households earning Kn 75,000-102,000/month, these figures are 96%, 80%, 52% and 46% respectively.

Figure 24. Household Appliance Ownership



Source: ESMAP/EdL Survey, 1991

4.2 The ESMAP/EdL study shows that the pace of appliance acquisition is very rapid: about 60% of households who own hot plates and 80% of households who own rice cookers made these purchases within the last five years. In addition, close to 60% of households plan to buy one or more additional electric appliances in the near future.

4.3 The trend in rice cooker ownership is one of the more perplexing phenomena in urban Vientiane, because the main food staple cannot be prepared in a standard rice cooker. Moreover, casual observation would seem to indicate infrequent use of the rice cooker in the households surveyed. One possible explanation for the popularity of this appliance could be that the dietary habits of the urban population (especially higher income households) are shifting to less time consuming dishes.

Table 10. Household Electric Appliance Ownership

Household Appliance Ownership (in Percent)	All Income	Income Class					
		Low Less Than 75,000	Low-Mid 75,000 to 102,000	Middle 103,000 to 150,000	High-Mid 151,000 to 200,000	High 201,000 to 270,000	Very Hi More Than 270,000
Refrigerator (%).....	61	41	46	52	79	79	98
Freezer (%).....	3	0	0	4	4	8	8
Fan (%).....	96	88	96	99	100	100	98
Air Conditioner (%)...	14	1	3	6	16	34	55
Iron (%).....	73	52	64	72	89	90	90
Washing Machine (%)...	7	2	1	4	11	5	23
Water Pump (%).....	6	4	5	6	10	3	5
Air Pump (%).....	2	1	1	1	4	0	3
B&W TV (%).....	40	43	47	54	27	40	22
Color TV (%).....	47	21	33	35	67	71	85
Video Machine (%).....	15	0	9	15	22	18	45
Rice Cooker (%).....	41	20	21	35	61	58	83
Hot Plate (%).....	60	58	52	51	63	71	83
Oven (%).....	12	4	2	11	16	21	37
Elec. Wok (%).....	12	3	4	2	16	24	48
Elec Kettle (%).....	13	4	7	7	17	13	42
Elec Torch (%).....	29	21	31	29	27	26	48
Total Cases.....	403	80	81	83	81	38	40

Appliance Characteristics

4.4 Electric appliances in Vientiane are based on older designs and are, therefore, not as energy efficient as recent models marketed elsewhere in the region.[22/] They are also relatively inexpensive. It is important to note, nonetheless, that the appliances found on the Lao market are no worse than models found across Asia, especially amongst the lower income segments of the population. Higher quality, newer model appliances are not available in Vientiane. Sales of appliances for entertainment as television, video players, and stereo systems are increasing rapidly; they do not as yet constitute an important share of household electricity use, due to their low wattage.

22/ The energy efficiency of the various appliances was not tested. However, a visual inspection confirmed that the appliances in the Vientiane market are based on models that are at least five years old and some based on designs that are at least 10 years old.

4.5 With the exception of the Lao-made hot plate, appliances are imported either from the former USSR or Thailand. Appliances from the former USSR are ready-made units, while those from Thailand are either manufactured in Thailand with a Thai brand or under a Japanese or European license. In the latter case, the appliances are produced from a combination of locally manufactured and imported components. The most widely used appliances from the former USSR are hot plates and air conditioners. They account for 59% and 67%, respectively, of all hot plates and air conditioners owned by Vientiane households. All other appliances (e.g. refrigerators, televisions, freezers) are imported from Thailand.

4.6 Because of the changing economic and political climate, it is expected that appliances from Thailand will dominate the Vientiane market in the near future. Nonetheless, there will continue to be an active secondhand market for appliances from the former USSR and, as a consequence, a large supply of high-demand electrical devices that will remain in circulation for years. Because of this situation, EdL will need to carefully look at the costs and benefits of consumer awareness programs that would target the optimal use and maintenance of these secondhand appliances.

B. Lighting: Prospects for Improved Efficiency

4.7 Virtually all households in urban Vientiane are electrified and use electricity for lighting. It is customary to keep one light on through the night both for safety reasons and because street lighting is generally poor off the main axes. Figure 25 shows that average monthly electricity consumption for lighting is 40 kWh/household/month and ranges from 24 kWh in the lowest income groups to 74 kWh in the highest income bracket. As shown in Figure 26, lighting represents about 24% of total electricity use in the surveyed households.

Figure 25. Average Monthly Electricity Consumption for Lighting

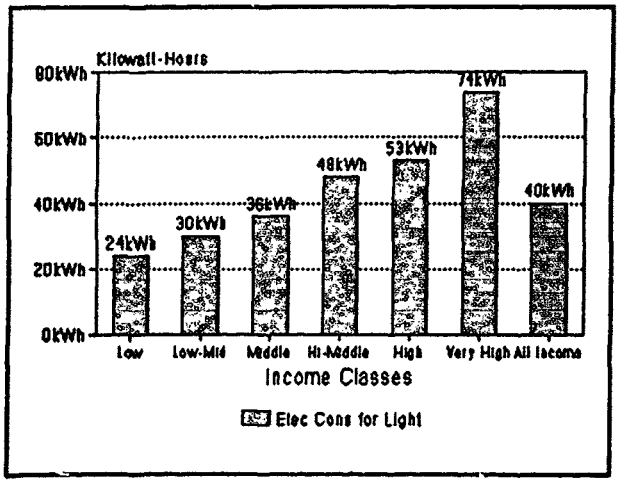
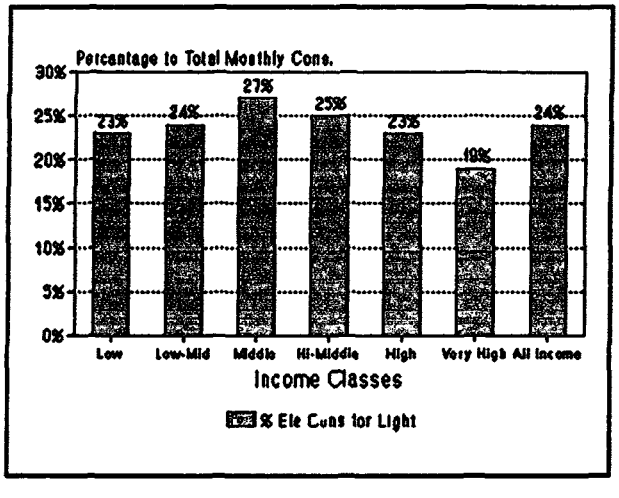


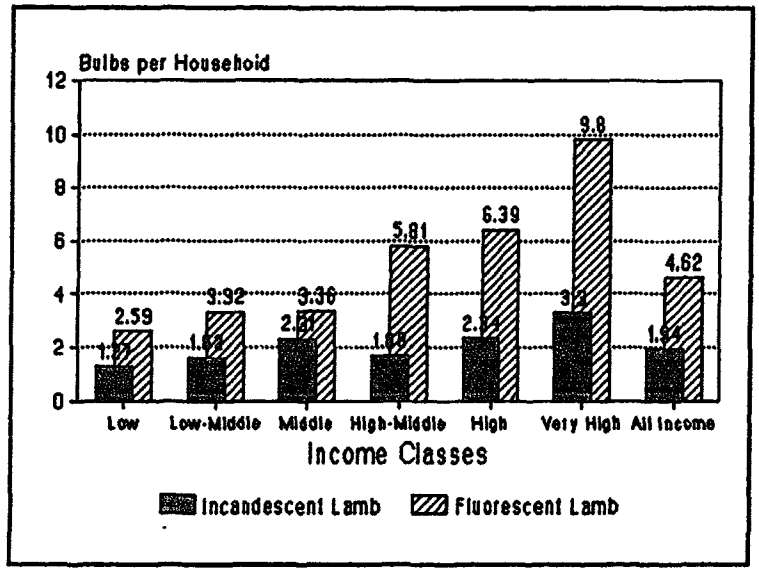
Figure 26. Average Percentage of Electricity Used for Lighting to Total Consumption



Source: ESMAP/EDL Survey, 1991

4.8 Households rely on a combination of incandescent and fluorescent bulbs. As shown in Figure 27, the average number of bulbs per household is 7 (2 incandescent and 5 fluorescents). According to the ESMAP/EdL survey, it is estimated that more than 90% of households already use either 20 or 40 watt fluorescent bulbs. Moreover, fluorescents account for about 59% of total monthly electricity use of lighting, while incandescents account for 41% This is surprising, since the cost of one 60 watt incandescent bulb and bulb holder is only Kn 400-450 ($.50), while the total cost of a 20 or 40 watt fluorescent bulb and fixture (ballast, starter and case) is Kn 2,100-2,300 ($3.00-3.25). It suggests that households are aware of the financial savings from fluorescent lighting and, despite their generally low incomes, could be responsive to information campaigns that promote affordable more efficient products and/or energy efficient behavior.

Figure 27. Average Number of Light Bulbs by Type of Bulb and Income Classes



Source: ESMAP/EDL Survey, 1991

The Benefits of Switching from Incandescent to Fluorescent Lighting

4.9 This section examines the energy savings that could result from replacing incandescents with fluorescents in Vientiane households. The analysis is based on the life cycle costs of bulb usage of 4 1/2 hr/day, or 8,212 hours of lighting over five years, and a 10% discount rate. Table 11 depicts the electricity savings and cost/benefit under 2 different assumptions of hours of usage: 4 1/2 hrs/day, which is derived from the ESMAP/EdL data and 2 1/2 hrs/day, which is provided for comparison. Details are provided in Annex V.

4.10 The lifetime of a fluorescent light is rated at 7,500 hours, whereas the incandescent is rated at 1,000 hours by the

manufacturer. However, in practice, both lifetimes could be lower.[23] Based on the ESMAP/EdL survey, each household owns an average of two 60 and/or 75 watt incandescents and five 20 and/or 40 watts fluorescents.[24] Each incandescent is used for an average of 4 1/2 hours/day, or an estimated 98.55 kWh/year for an ordinary 60 watt bulb; a 20 watt fluorescent lamp consumes 32.85 kWh/year.

4.11 **Electricity Savings:** Replacing a 60 watt incandescent with a 20 watt fluorescent could result in an annual savings of 66.7 kWh/household.[25] If the estimated 53,412 incandescents in the residential sector were replaced with 20 watt fluorescents, EdL could save about 3.5 MWh/year on lighting. (See Table 11, under 4 1/2 hrs/day of lighting.)

4.12 **Financial Benefit:** If EdL exported 50% (1.75 MWh) of the saved energy at the time-of-day peak tariff of US 5.8¢/kWh, it could realize a total revenue of US$ 385,693 in present value terms over 5 years. However, the Lao PDR would have to bear the incremental import costs of the more expensive fluorescent lamps and fixtures. The additional outflow of hard currency to import the more efficient fluorescent lamps and fixtures is valued at US$ 52,254 over 5 years or 8,212 hours of lighting.[26] Therefore, the present value of the net foreign currency gain for the Lao PDR from switching to fluorescents is estimated at US$ 333,439.

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[23] For illustrative purposes, the analysis is based on the manufacturer's rated lifetime.

[24] The 60 watt incandescent lamp emits the luminous influx of 730 lumens; the 75 watt incandescent emits 960 lumens; the 20 watt fluorescent lamp emits a luminous influx of 1030 lumens. Technically, a 20 watt fluorescent can replace a 60 watt incandescent. Whether or not the consumer prefers this type of lighting is a separate issue.

[25] A 60 watt incandescent used for 4 1/2 hours/day consumes 98.55 kWh annually, whereas a 20 watt fluorescent consumes only 32.85 kWh. Replacing one 60 watt incandescent with a 20 watt fluorescent will save 65.7 kWh/year/bulb.

[26] The present value of the cost of importing 53,412 incandescent bulbs is US$117,411; the import cost of the fluorescents is estimated at US$169,665 over 5 years (8,212 hours of lighting). Thus, the additional outflow of hard currency over 5 years is US$52,254 (US$ 169,665-US$ 117,411).

Table 11. Cost/Benefit of Replacing Two 60 Watt Incandescent with Two 20 Watt Fluorescent Lamps.

	Incandescent		Fluorescent	
	Electricity Savings for EdL from Lighting			
	Incand.	Fluore.	Incand.	Fluore.
Usage (Hrs/Day)	2.5	2.5	4.5	4.5
Annual kWh Usage/Bulb	54.75	18.25	98.55	32.85
Annual kWh Saved/Bulb	--	36.50	--	65.70
Estimated No. of Incand. Lamps to be Replaced	--	53,412	--	53,412
Total kWh Saved per Year	--	1,949,538	--	3,509,168
	Financial Benefit to EdL and Lao PDR			
Usage (Hrs/Day)		2.5		4.5
Assumption: 50% Export kWh/Year		974,769		1,754,584
Incremental Import Cost of Fluorescent Lamps (over 8,212 hrs.):		US$ 64,863		US$ 52,254
Export Revenue:		US$325,538		US$385,693
Net Foreign Currency Gain (PV 1992): (over 8,212 Hrs. of Lamps Usage)		US$260,675		US$333,439

The Consumer: Benefits of Switching to Fluorescent Lighting

4.13 For the household to invest in higher cost lighting, it must realize a financial savings. The electricity savings, cost/benefit and payback time[27] for switching from incandescent lighting to fluorescent lighting can vary considerably, due to actual number of hours of usage and the tariff structure. As in the above analysis, the following is based on residential light usage of 8,212 hours over a five year period and a 10% discount rate. Table 12 depicts the comparative energy savings and financial benefit to consumers under 2 scenarios (hours of use/day and tariff).

4.14 **Electricity Savings:** With an average of two incandescents/household and average hours of lighting at 4 1/2 hrs/day, switching to fluorescents will save a total of 131.4 kWh a year. (See Table 12, under 4 1/2 hrs/day of lighting).

4.15 **Financial Savings:** Over a five year period, at 1,642 hours of lighting/year, each household would need 8 incandescents or an equivalent of approximately 1.09 fluorescent bulbs.[28] Eight

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[27] Simple payback time = added costs of energy savings/kWh saved x tariff.

[28] Assumption: 1,000 hours lifetime for an incandescent lamp; 7,500 hours lifetime for a fluorescent lamp, as specified by the manufacturer.

incandescents cost Kn 1,539; at Kn 14/kWh, operating costs amount to Kn 5,229; the total present value costs for incandescent lighting would be Kn 6,808. One fluorescent bulb and fixture cost Kn 2,224 and operating costs amount to Kn 1,743. The present value of the total cost of fluorescent lighting is about Kn 3,967 (over the same 8,212 hours of lighting). Over a five year period, replacing one incandescent would save only Kn 2,841, or an average annual present value savings of Kn 568/household/year. At a tariff of Kn 21/kWh, replacing one incandescent would result in a present value savings of Kn 4,584 over 5 years. **These savings are probably not enough to attract consumer participation at the current domestic tariff.**

4.16 **Simple payback time:** At a tariff of Kn 14/kWh, the simple payback time for a household is 9 months. If the tariff rises to Kn 21/kWh, the payback time will be 6 months.

Table 12. Cost/Benefit of Replacing One 60 Watt Incandescent with One 20 Watt Fluorescent Light.

	Incandescent				Fluorescent	
Lamp Assumption						
Lamp and Fixture Cost	250				2,100	
Watts per Bulb	20				60	
Bulb Life (hrs.)	1,000				7,500	
Tariff (Kn/kWh)	7		14		21	
Lamp Usage (Hrs/day)	2.5	4.5	2.5	4.5	2.5	4.5
Years of Lamp Usage	9	5	9	5	9	5
Hours of Lamp Usage	8,212	8,212	8,212	8,212	8,212	8,212
Financial Benefit to Consumers						
	7 Kn/kWh					
	Incand.	Fluore.	Incand.	Fluore.		
Usage (Hrs/Day)	2.5	2.5	4.5	4.5		
Number of Lamps Used	8	1.09	8	1.09		
Total Cost for Bulb (PV)	1,334	2,184	1,539	2,224		
Added Cost for Bulb	--	850	--	685		
Total Operating Cost (PV)	2,207	736	2,615	872		
Total Cost (PV) (8,212 Hrs of Usage)	3,541	2,920	4,154	3,096		
Total Saving (1992) Value (8,212 hrs of Usage)	--	621	--	1,058		
Annual kWh Usage	54.75	18.25	98.55	32.85		
Annual kWh Saved	--	36.50	--	65.70		
Simple Payback Time (Months)		40		17.9		

	Financial Benefit to Consumers			
	14 Kn/kWh			
	Incand.	Fluore.	Incand.	Fluore.
Usage (Hrs/Day)	2.5	2.5	4.5	4.5
Number of Lamps Used	8	1.09	8	1.09
Total Cost for Bulb (PV)	1,334	2,184	1,539	2,224
Added Cost for Bulb	--	850	--	685
Total Operating Cost (PV)	4,414	1,471	5,229	1,743
Total Cost (PV) (8,212 Hrs of Usage)	5,748	3,656	6,768	3,967
Total Saving (1992) Value (8,212 hrs of Usage)	--	2,092	--	2,801
Annual kWh Usage	54.75	18.25	98.55	32.85
Annual kWh Saved	--	36.50	--	65.70
Simple Payback Time (Months)		20		8.9

	Financial Benefit to Consumers			
	21 Kn/kWh			
	Incand.	Fluore.	Incand.	Fluore.
Usage (Hrs/Day)	2.5	2.5	4.5	4.5
Number of Lamps Used	8	1.09	8	1.09
Total Cost for Bulb (PV)	1,334	2,184	1,539	2,224
Added Cost for Bulb	--	850	--	685
Total Operating PV Cost	6,621	2,207	7,844	2,615
Total PV Cost (8,212 Hrs of Usage)	7,955	4,391	9,382	4,839
Total Saving (1992) Value (8,212 hrs of Usage)	--	3,564	--	4,543
Annual kWh Usage	54.75	18.25	98.55	32.85
Annual kWh Saved	--	36.50	--	65.70
Simple Payback Time (Months)		13.3		5.9

4.17 **The consumer savings under the various scenarios of substituting fluorescents for incandescents in Vientiane households are meager in contrast to the benefits that could accrue to the Lao PDR and EdL. It is unlikely, therefore, that households would voluntarily switch to fluorescents, under the present domestic tariff structure. The low tariff is a barrier to customer investment in energy efficiency and is illustrative of a range of obstacles (e.g. lack of information, limited energy efficient equipment in the marketplace and cultural factors) to a robust energy efficiency market in Vientiane. Incentives have typically been used as a vehicle to overcome these barriers and are an essential ingredient of many demand side management programs. Unfortunately, such programs are very labor intensive and require an institutional capacity that would need to be developed in the Lao context. It is, at the same time, worthwhile for EdL to be aware of the potential energy savings that could accrue through a replacing incandescents with fluorescents, especially since lighting is coincident with the peak period.**

Other Lighting Efficiency Improvements at Little or No Cost

4.18 The above analysis has shown that there are benefits to EdL and to the Lao PDR of a switch to fluorescents in Vientiane households. On the other hand, the financial savings that could accrue to the consumer are probably too small to attract voluntary household compliance. Significant energy savings will be difficult, if not impossible to achieve, due to the prohibitive costs of the most efficient, state-of-the-art lighting alternatives, which are not even available at this time in Vientiane.[29/] The average cost of the lamps and fixtures on the Thai market range from US$ 20 for the compact fluorescent to US$ 40 for the slim fluorescent lamp with efficient electromagnetic ballast, which is beyond the financial means of most households in Vientiane.

4.19 Recently, however, limited supplies of newer fluorescent lights with a thinner tube (18 and 36 watts) and a higher efficiency have appeared on the local market. These fluorescents cost the same or a bit more than the older models, but use 10% less energy. Unfortunately, the small efficiency gain to the consumer and the low domestic tariff provide little incentive for EdL to promote this new lamp.[30/] **Nonetheless, an information campaign promoting the benefits of these newer, more efficient bulbs could begin the process of consumer energy awareness which, under any scenario, will be important to change consumer behavior. Furthermore, because the Lao PDR does not manufacture light bulbs, it will need to closely monitor the development and introduction of high efficiency light bulbs in the region. Any move to introduce minimum efficiency appliance and equipment standards in neighboring countries could have a major impact on Vientiane's energy consumption patterns, since sub-standard equipment could find a large market in Vientiane.**

[29/] Compact fluorescent lamps (CFL), slim fluorescents and halogens are standard components of lighting efficiency improvement programs.

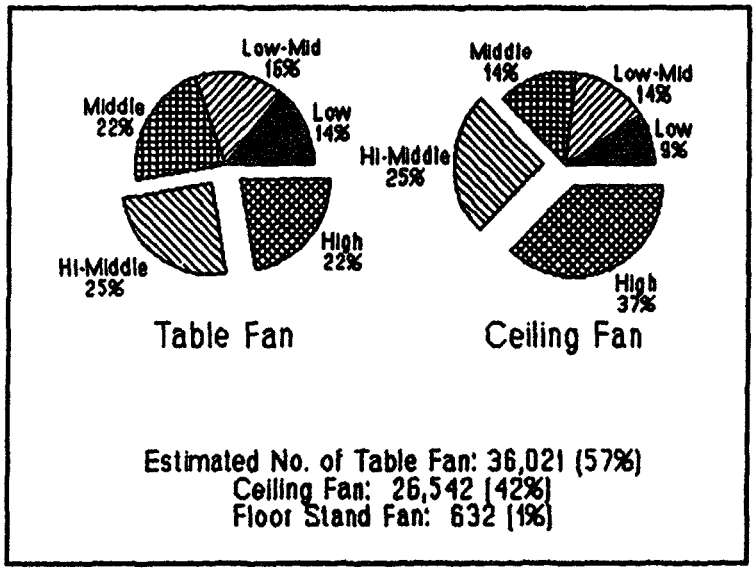
[30/] At current consumption levels, it is estimated that approximately 1.07 MWh (26,706 households using 40.3 kWh/household/month) are consumed monthly for lighting by the household sector in urban Vientiane, of which about 624,226 kWh (58%) are used by fluorescent lighting. The 10% efficiency gain from the newer fluorescent lamps could save approximately 62,423 kWh per month (assuming that all fluorescent lamps would be replaced eventually). The export of the saved kWh would result in an incremental monthly revenue to EdL of about US$ 3,600 at the current peak time-of-day tariff. While relatively small, it is the equivalent of the monthly salaries of about 20 EdL employees.

C. Household Appliances

Fans

4.20 The fan is one of the most important household appliances, with 96% of households having at least one; the average per household is about 3. Even among the lowest income households, fan ownership is close to 88%. Their popularity is undoubtedly due to their use not only for cooling, but for very important health reasons: in a generally hot and humid climate, the fan keeps the air circulating and the insects away.

Figure 28. Fan Ownership by Type Across Incomes



Source: ESMAP/EDL Survey, 1991

4.21 Figure 28 shows that table and ceiling fans are the most popular models, accounting for 57 and 42% of all household fans. The survey data shows that the ceiling fan[31/] is slightly more popular than the table fan[32/] among the top 20% of the income range; ceiling fans account for 37% and table fans 22% of fans in this income category. The ESMAP/EdL survey did not measure fan use patterns in Vientiane households. However, in other Asian countries with similar climate and lifestyle, at least one fan is in use during the day, with all fans operating during the peak period, especially on very hot days. Under this typical scenario, average annual kWh consumption can go as high as 50 kWh/per fan.

31/ at Kn 19,250 or US$ 27.50.

32/ at Kn 12,250, or US$ 17.50.

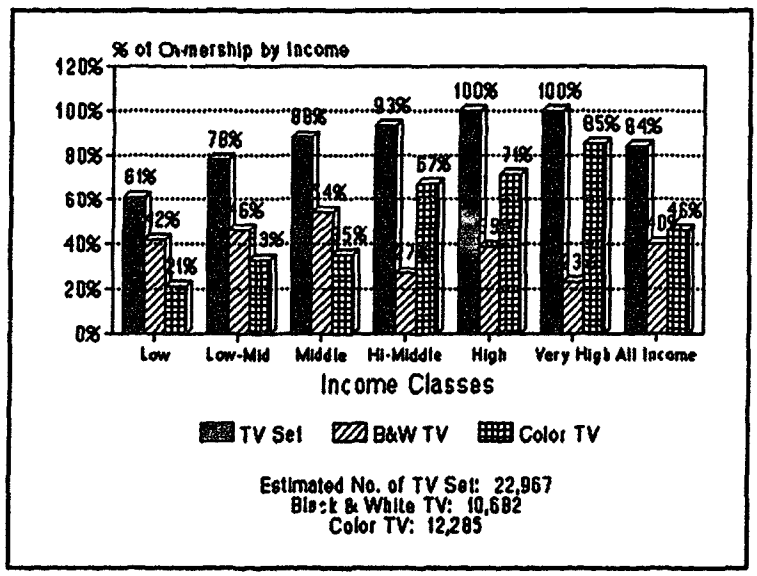
Fan use, therefore, is not a major factor in residential energy consumption.

4.22 On the other hand, there is some evidence that fan usage in new residential construction could promote a more rapid shift to the use of air conditioners than is desirable in the Vientiane context. This is because new residential construction is increasingly based on western architectural design, without the accompanying ceiling insulation. In this type of construction, ceiling fans on the second floor are less effective in circulating and cooling air, because they conduct hot air from the ceiling downward. **As this trend accelerates, it could be important for the Lao PDR to explore the need to promote more energy efficient traditional building design in new construction.**

Televisions

4.23 The television[33/] is the second most popular appliance in Vientiane households. Approximately 84% of all households have either a black and white or color television set. Similar to other developing countries, ownership is on the rise. Survey data show that 85% of color and 76% of black and white sets were bought during the past five years (1986-1990). Moreover, the pace has accelerated: 9% of households with black and white sets purchased them in 1986, while 17% purchased them in 1990. The pattern is similar among purchasers of color sets: 6% acquired them in 1986, while 13% report purchasing color sets in 1990.

Figure 29. Television Ownership by Type and Income



Source: ESMAP/EDL Survey, 1991

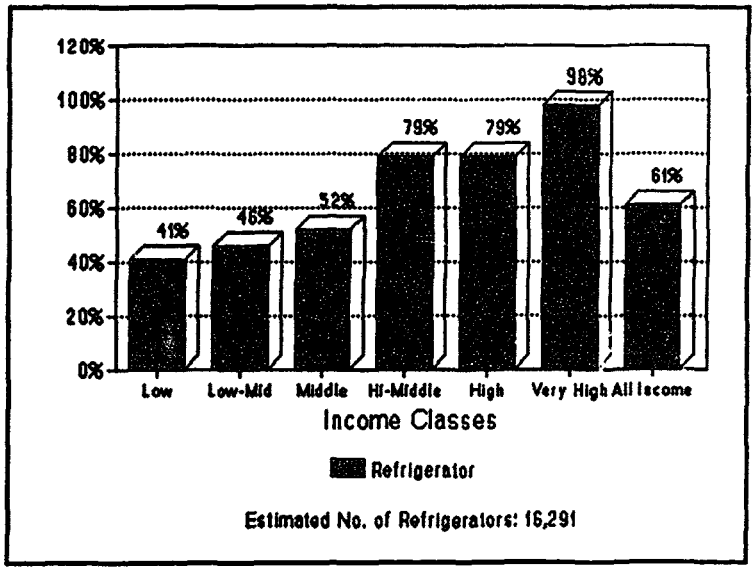
33/ Most are imported from Thailand under a Japanese brand name.

4.24 Not surprisingly, color sets are popular among higher income families, while black and white sets predominate among the lower income groups. Figure 29 shows that 42% of households in the lowest income bracket own black and white sets; this figure rises to 54% for middle income households, and declines to 20% of the very high income households. In contrast, only 21% of households in the lowest income bracket own a color set; this figure rises sharply to 85% ownership in the highest income group.

Refrigerators and Freezers

4.25 The refrigerator is one of Vientiane's more important appliances, due to its accelerating rate of acquisition, contribution to EdL's system peak and level of energy consumption.[34/] Refrigerator ownership is estimated at 61%, and refrigerators are found in households across income brackets. As illustrated in Figure 30, it ranges from 41% in lower income families, rising to 52% in middle income households, to almost 100% in top 10% of the income bracket.

Figure 30. Refrigerator Ownership



Source: ESMAP/EDL Survey, 1991

4.26 Most of the refrigerators are either imported from Thailand or the former USSR. Thai-manufactured refrigerators are more popular, accounting for 57% of all refrigerators, while those from the former USSR account for 25%. The average size is small by Western standards, measuring only 5-6 cubic feet, with an average power demand rating at 160 watts. Because the refrigerator runs continuously for 24 hours, it is one of the higher electrical

34/ A small 5-6 cubic foot refrigerator consumes an estimated 31 to 50 kWh/month.

demand appliances in the household.[35] **It is, therefore, important for EdL to examine the potential for energy efficiency strategies to curb future peak load growth. In doing so, it will be critical for the Government of the Lao PDR to explore measures to prevent the entry of refrigerators that do not meet neighboring country energy efficiency standards.** Sources of supply of high efficiency refrigerators, especially for the commercial sector, should also be identified.

4.27 In contrast to the prevalence of refrigerators in Vientiane households, only 3% of all households reported owning a freezer. The most popular freezer is manufactured in Thailand with a Thai brand name. The Thai-made freezer is an open display with sliding glass doors and is typically found in coffee shops and beverage and convenience stores. The model from the former USSR is more commonly found in households. Tests carried out on the Thai-made freezer showed unusually high electricity consumption of about 270 kWh per month. In contrast, the Russian model consumes about 75 kWh per month.

Air Conditioners

4.28 Power consumption of air conditioners (ranging between 12.5 to 28 kWh/day)[36] is the highest among household appliances. However, present ownership is limited to only about 14% of households in the surveyed area, and is largely concentrated in the upper income bracket. As illustrated in Figure 31, only 1-6% of households in the lowest to middle income bracket own a unit, the percentage rising sharply to 16% among the middle-high income households, and 55% among the top 10% income bracket.

4.29 Although air conditioner use is coincident with the period of peak demand, at current ownership levels, they have a small impact. As incomes rise and if tariffs remain low, air conditioner purchases will accelerate and its use will eventually affect both the base and peak load demand. **Ownership is probably higher in the commercial sector and its impact on the peak period is more significant.** However, the ESMAP/EdL survey did not examine the electricity consumption in the commercial sector and, is therefore, unable to provide any information.

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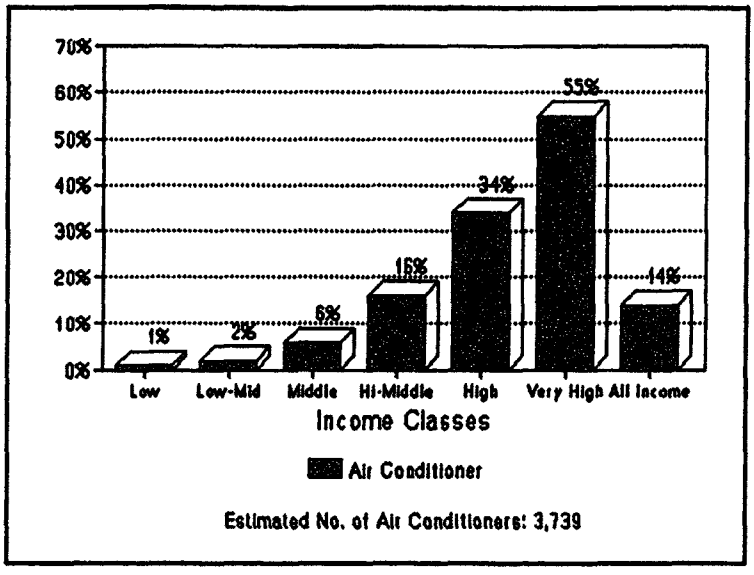
[35] A monitoring study conducted by the ESMAP/EdL team on one of the most popular brands (imported from the former USSR) measured energy consumption at 31 kWh-50 kWh per month, depending on the level of utilization. Other widely used Thai imports drew an estimated 34-62 kWh per month, based on a similar monitoring study conducted in Thailand.

[36] The ESMAP/EdL team monitored performance of the Russian-made model; at a room temperature of 24 degrees centigrade, the unit consumed 28 kWh/day; at 25 degrees centigrade, consumption is reduced to 12.5 kWh/day, or a reduction of 40%.

Figure 31. Air Conditioner Ownership



Source: ESMAP/EDL Survey, 1991

Recommendation: Low-Cost Measures to Improve Efficiency

4.30 The electricity consumption of any appliance is largely influenced by external factors such as user behavior, house design, temperature and relative humidity, and appliance efficiency. For example, studies show that up to 20% of the electricity consumption of refrigerators is caused by door opening. Room temperature and location can also affect consumption. Vientiane residents are not informed as to the benefits of the efficient use of these appliances: refrigerators and freezers placed in direct sunlight are common sights throughout Vientiane. Moreover, many consumers believe that ice deposits in the freezer compartment are normal and help the cooling process. Given these circumstances, and even in the absence of the most efficient appliances, energy awareness information can play a role in changing user behavior, although it is a difficult if not impossible task, when tariffs are low.

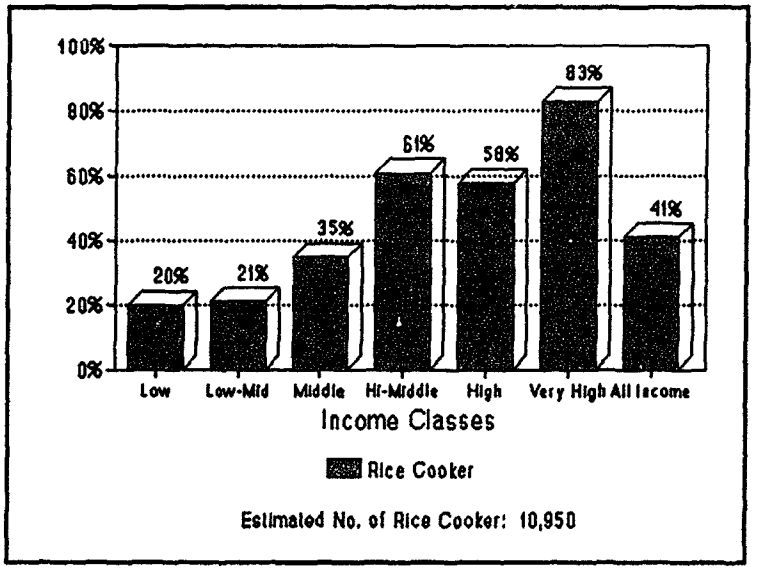
4.31 Secondly, the changing design of the typical Lao house warrants scrutiny. As incomes rise, more and more newly constructed homes reflect western architectural designs. **It is recommended that Government explore the feasibility of establishing building construction codes and standards, notwithstanding the difficulties of enforcement, especially in the residential sector.** It is understood that this initiative would, in all likelihood, be the responsibility of an entity other EdL.

Rice Cookers

4.32 Like countries across Asia, the rice cooker is becoming a standard appliance in the Lao PDR kitchen; as shown in Figure 32,

it is found in 41% of the households.[37] The percentage of ownership increases as income rises: only 20% of households in the lowest income bracket reported owning rice cooker; 61% of middle-high income households are owners of rice cookers while 83% of the top 10% of the income bracket report owning this appliance.

Figure 32. Rice Cooker Ownership



Source: ESMAP/EDL Survey, 1991

4.33 ESMAP/EdL did not collect any data on the actual use of this appliance. Its energy consumption is modest, averaging at 200 Wh per use for the medium size cooker, which is the most popular model. Therefore, it does not appear to be an appliance that warrants any special attention in terms of its peak load contribution.

4.34 **Recommendation on Appliance Efficiency in the Lao PDR: As other countries move to set minimum efficiency standards, the Lao Government will need to ensure that its markets do not become the dumping ground for lower efficiency products. One way to achieve this objective is to require that imported appliances meet these minimum efficiency standards and be labelled for the Lao consumer.**

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[37] This, despite the fact that the main food staple cannot be cooked in a Thai rice cooker.

V. BUILDING INSTITUTIONAL CAPACITY: TOWARDS A MANAGEMENT FRAMEWORK

A. Background

5.1 The previous chapters have profiled the rapid increase in the domestic demand for electricity and the transition from woodfuels to electricity for cooking in urban Vientiane. The importance of promoting efficiency in domestic consumption and end use to maintain, at a minimum, the current level of export earnings was also underscored. However, the Lao PDR faces a number of obstacles to meeting this goal. The most notable of these barriers include low electricity tariffs, the lack of available technologies, inadequate information on costs and efficient end use alternatives and the low incomes of the population. The Lao PDR's ability to act is further constrained by its total reliance on its neighbors for cooking fuel substitutes and imported appliances. Finally, the design and implementation of end-use efficiency programs is a complex and labor intensive task for which there is not adequate institutional capacity at the present time.

5.2 Overcoming these barriers is neither an easy task nor short-term process. EdL, the MOI and the Government of the Lao PDR must recognize the importance of beginning now, before electricity consumption patterns become more firmly entrenched and more difficult to manage. As Vientiane continues to urbanize and as incomes grow, the population will increase their electricity consumption and develop new uses, especially if tariffs remain at present levels. In the absence of early initiatives to change consumer attitudes vis-a-vis electricity, profits from electricity exports will continue to erode, and steep price increases in domestic tariffs could become a necessity rather than an option.

5.3 **It must also be recognized that energy management in the Lao PDR is not exclusively an electricity issue, even in the urban sector.** As stated at the outset of this report, the majority of the Lao population relies on woodfuels and will continue to do so for their energy needs well into the future. Despite the widespread use of electricity for cooking in the urban sector, woodfuels still represent about 50% of total household energy use. The ESMAP/EdL study did not examine the supply of and distribution networks for the urban woodfuels market. Nonetheless, it is clear that the depletion of the country's forests through unsustainable logging and agricultural practices could endanger the rural reliance on woodfuels as well as the urban markets. Without viable alternatives, all of the population, but especially the very poor will suffer.

B. Creating A Demand Management Capability

5.4 The Provincial Grid Integration Project, which was appraised in November, 1991, continues past efforts to strengthen EdL's capability to improve its system efficiency and overall institutional capacity to manage a rapidly growing program. These measures include an action program for technical and non-technical losses, improving maintenance practices and the establishment of a technical cooperation arrangement with an Asian utility, which was identified during the ESMAP/EdL study. In light of this emphasis, it is opportune to include some no and low-cost demand-side measures that will begin to strengthen EdL's understanding of the energy consumption behavior of its customers. The creation of the Customer Services Unit would permit a phasing in and monitoring of demand-side management approaches, using existing staffing.[38/] Over the longer term, recycling/retraining of existing staff would be required, at a minimum; more probably, the recruitment of new staff would be necessary. In the following paragraphs, several recommendations are highlighted to start that process.

Low and No-Cost Measures

5.5 The ESMAP/EdL study did not directly address pricing policy because it is already being addressed by EdL in cooperation with the World Bank Group and other international lending agencies. However, in the course of carrying out its work, the ESMAP/EdL team detected several anomalies in the present system that warrant EdL attention. They are discussed in the following paragraphs.

5.6 The "lifeline" block. In July 1992, the "lifeline" block was eliminated for all but residential consumers; under the new residential structure, their first 100kWh/month will be charged at the lifeline rate of Kn 8/kWh; their second 200 kWh/month will be charged at the subsidized rate of Kn 15/kWh; all their remaining consumption will be charged at Kn 25/kWh. The ESMAP/EdL survey revealed that 86% of households consume less than 200 kWh and were eligible for the lifeline block, prior to the July 1992 tariff changes. This situation will remain largely the same, with the new block structure.

5.7 Even in the higher income urban core of Vientiane, 55% of the customers (14,555 households) benefit from the lifeline tariff. These households have an average income of Kn 126,000/month (US$180) and fall within the middle income category as defined by the ESMAP/EdL survey. In the top 20% of the income bracket almost 30% of households benefitted from the previous lifeline tariff. As noted paragraph 2.8 of this report, about 12% of residential customers have more than one meter. Many of the customers may be high income households unduly benefitting from the lifeline block. The amounts of electricity covered by the subsidized blocks will

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38/ EdL is currently implementing a reorganization.

still need to be reduced significantly, without penalizing the very poor residential customers.

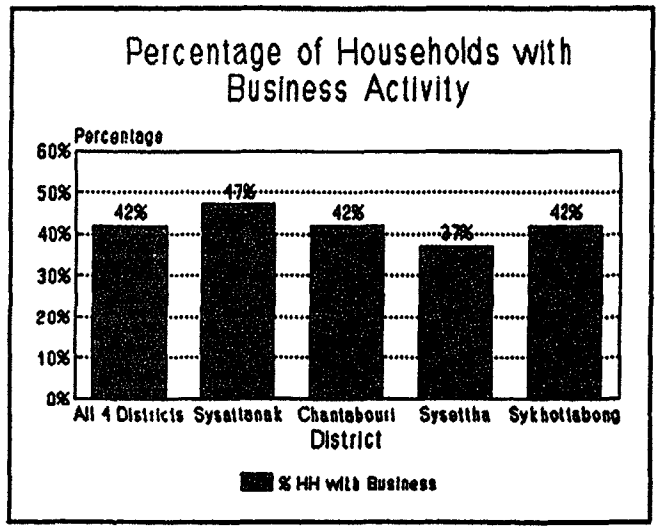
5.8 Customer classification. According to EdL data, about 245 customers classified as residential consume 33% of total monthly residential sales. These customers have an average monthly consumption of almost 10,500 kWh. The energy consumption scenario of a typical upper income household is set out below:

(i)	3 air conditioners operating 24 hrs/day:	2,520 kWh
(ii)	3 refrigerators/and two freezers	350 kWh
(iii)	2 burner electric stove	300 kWh
(iv)	Lights, TV, radio	400 kWh
(v)	Other appliances	600 kWh
	Total	4,170 kWh

5.9 This scenario, which assumes a generous array of appliances, is well below even the consumption of the 245 households classified as residential customers. This discrepancy arises either from a computer programming error or reflects an incorrect classification of these customers.

5.10 EdL presently records 2000-3000 customers in the commercial category, or less than 10% of their total customer base. However, as shown in Figure 33 below, 42% of households surveyed engaged in some kind of commercial activity. As shown in Table 13 below, half of these households engage in commercial activities that are potentially high energy consumers: restaurants; coffee shops; furniture makers, etc. Although ESMAP only surveyed the residential sector, this high level of commercial activity within the households suggests some commercial activity may not be captured in current EdL categories. **It is recommended therefore, that EdL review its classification procedures to ensure that commercial activity is correctly identified and metered.**

Figure 33. Percentage of Household with Business Activities



Source: ESMAP/EDL Survey, 1991

Table 13. Types of Business Activities

Type of Business Actv.	All 4 District	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Beauty/Barber.....	2.3%	4.0%	1.9%	.0%	2.6%
Food & Beverage.....	7.0%	6.0%	13.5%	6.7%	.0%
Tailor.....	4.7%	6.0%	7.7%	.0%	2.6%
Furniture.....	4.1%	6.0%	1.9%	3.3%	5.1%
Beverage & Conven.....	17.0%	10.0%	13.5%	16.7%	30.8%
Convenience Store Only..	11.1%	16.0%	11.5%	10.0%	5.1%
Drug Store/Clinic.....	1.2%	2.0%	.0%	.0%	2.6%
Gold/Silver.....	2.3%	.0%	5.8%	.0%	2.6%
Repair.....	5.3%	4.0%	5.8%	6.7%	5.1%
Agriculture.....	8.2%	18.0%	1.9%	3.3%	7.7%
Handicraft.....	19.9%	24.0%	9.6%	36.7%	15.4%
Others.....	17.0%	4.0%	26.9%	16.7%	20.5%
Household with Business.	171	50	52	30	39
Total Percent.....	100.0%	100.0%	100.0%	100.0%	100.0%

Source: ESMAP/EDL Survey, 1991

5.11 Non-metered and multiple-meter customers. This report has highlighted the important number of shared meters in Vientiane. Table 13 below shows the number of customers in a variety of metered and non-metered categories.

Table 14. Estimated Number of Households with Meters Installed

	Estimated Number of Households
No meter (but consume electricity)	3,418
One meter	20,377
More than one meter	2,911
Total	26,706

Source: ESMAP/EDL Survey, 1991

5.12 The high percentage of shared meters should be of concern to EdL for the following reasons:

(a) EdL has an aggressive program underway to meter all customers. The high figure of non-metered, but electricity consuming customers suggests that its effort may be facing some obstacles;

(b) The practice of shared meters can weaken the impact of demand management measures, because a higher price signal does not alter the energy consumption behavior of the unmetered consumer;

(c) Households with more than one meter, who are the highest income customers, may be benefitting from the "lifeline" block; and

(d) Multiple meters increase EdL costs by slowing the meter readers and increasing the possibility of errors in meter reading. This leads to the possibility that customers may pay less than would be the case if they had a single meter.

5.13 Redesigning Customer Bills. One way to begin to develop an understanding of energy consumption behavior is through the billing process. While the bill design is generally adequate, additional information could enhance the customer's understanding of their electricity consumption, facilitate timely payment and, over the longer term, begin to modify consumption behavior. For example, the current bill provides the amount due and kWh consumed as of the date of the meter reading. There is no information on the period of time covered by the bill. As a consequence, if a customer's bill is higher or lower the next month, there is no way for the household to determine the reason for the increase or decrease (e.g. a longer or shorter billing period.) This additional information could considerably reduce the disputes and, therefore, the amount of time EdL employees have to spend resolving

these issues. Moreover, over the longer term and as tariffs rise, the Customer Services Unit can use this information to promote and disseminate energy efficient behavior information.

C. Medium-Term Demand Management Measures

5.14 Commercial and industrial sectors. This report has focussed on residential energy consumption patterns and trends. It has also suggested that significant growth in electricity consumption in the commercial sectors could represent a major constraint to EdL's export capacity over the medium to longer term. This trend underscores the need to examine the role of the commercial sector in both the base and peak demand. Existing commercial activities (e.g. hotels, guesthouses, cafes, etc.) are good candidates for energy saving measures. However, energy efficiency improvements in new construction are far more cost effective than retrofits.

5.15 **Recommendation: EdL should conduct energy audits in a sample of existing construction in Vientiane (e.g. hotel, guesthouse, restaurant, ministry) to determine electricity consumption patterns and opportunities for improvement and develop a program for implementing audit recommendations. These audits could be carried out within the framework of the proposed cooperation arrangement with an Asian utility. It is also recommended that EdL examine the need to incorporate energy efficiency improvements in new construction.**

5.16 The ESMAP/EdL survey did not examine energy consumption patterns in existing industry on the Vientiane Plain. However, MOI and EdL need to monitor the pace of industrial development carefully to ensure that electricity is used as efficiently as possible for process heat, while, at the same time, exploring cost effective fuel substitution alternatives. At current tariff levels, electricity remains the cheapest energy source per effective kWh. **It is, therefore, important for the MOI and EdL to consider the development of a capacity to survey energy use in the industrial and commercial sectors and identify measures to promote rational energy consumption, while these sectors are still in their infancy.**

VI. RECOMMENDATIONS ON DEMAND MANAGEMENT

6.1 This report proposes several actions and makes recommendations to EdL and to the Government of the Lao PDR to begin to manage the domestic demand for electricity in urban Vientiane. They consist of: low and no-cost measures to begin to focus on the issue of demand management in the residential sector and medium-term recommendations to assess the feasibility of identified energy efficiency programs. In the latter case, some external financing will be required. The recommendations are detailed in Annex VI.

EdL: Building Institutional Capacity: No/Low Cost Short-Term Actions

Action	Impact on future peak or base demand reduction	Impact on household electricity bill reduction	Impact on EdL revenues	Implementation Prospects
1. Reclassification of at least 245 clients from household sector	No	Bill should increase for those affected, if not computer error	Yes	Check first for computer error
2. Reduction of the "lifeline" block	No	Minimal	Yes	Will not impact the very poor
3. Identify non-metered customers and those with more than one meter.	No	Bill should increase	Yes	Identify obstacles in current action program
4. Redesign customer bill	No	No	No	Establish better understanding of customer behavior

EdL: Energy Management Program: Low-Cost Recommendations over the Medium-Term

Recommendation	Impact on future peak or base demand reduction	Impact on household electricity bill reduction	Impact on EdL Revenues	Implementation Prospects
1. Discourage sale of locally manufactured electric hot plate or increase its efficiency	7.3 MW (peak)	Minimal	Yes Avoided domestic consumption of 7.3 MW	Minimal impact on customer bill will require EdL intervention
2. Replace residential use of incandescents with fluorescents	2 MW (peak)	Minimal	Yes Avoided domestic consumption of 2 MW	Minimal impact on customer bill will require EdL intervention Widespread use of FL will require compensation for lower power factor
3. Identify commercial and industrial activity using electricity for process heat	Cannot estimate at this time	n.a.	Depends on tariff structure	Early action required to curb trend
4. Conduct public information campaign on energy awareness	Yes, if implemented within a comprehensive demand-side management energy efficiency program	Minimal under current tariffs. Could be important at higher tariffs and as part of overall demand management program	Possible	Impacts are difficult to measure. Should accompany any significant tariff increase
5. Monitor regional energy efficiency developments to prevent dumping of obsolete equipment in the Lao PDR	Likely	n.a.	Possible	Should be undertaken rapidly, given the Lao PDR reliance on imported equipment
6. Audit commercial use of electricity and develop implementation program	Likely	Cannot estimate at this time	Possible	Offers important prospects in light of growing commercial activity

THE COMPARISON OF EXPORT EARNINGS WITH DOMESTIC CONSUMPTION

	1991 Lao PDR Production Costs for Non-Revalued Assets							
Cost Category	Total	Export	Domestic			Allocation Method		
(in thousands US$)			Use					
Salaries	$885	$67	$818		Export allocated based on salaries*166/1596*percentage exports from Nam Ngum			
Benefits	$83	$6	$77		Export allocated based on salaries*166/1596*percentage exports from Nam Ngum			
Bulk Purchases	$1,108	$0	$1,108		All purchases are for domestic consumption			
Other Cash Operating Expenses	$2,369	$47	$2,322		2% allocated to exports since primarily fuel, O&M for domestic use			
Depreciation	$6,413	$1,380	$5,033		Export allocated based on Nam Ngum 50 year amortized cost * % of export generation			
Major Repairs	$2,565	$1,415	$1,150		Export allocated based on Nam Ngum % of Assets * % of export generation			
Interest	$5,600	$1,000	$4,600		Export allocated based on Nam Ngum interest * % of export generation			
Principal	$1,688	$844	$844		Export allocated based on Nam Ngum % of Assets * % of export generation			
Taxes	$6,797	$4,104	$2,693		Export & Domestic are actual			
Total	$27,508	$8,864	$18,644					
Cost per kWh delivered		$0.012	$0.057					
		Basic Data For Allocations						
	Total	Nam Ngum	%	Export	%	Vientiane	%	
Generation (GWh)	927	770	83.1%	558	72.5%	212	27.5%	
Sales (GWh)	871	723	83.1%	545	75.4%	178	24.6%	
Transmission Losses (GWh)		NA	2.4%	13	2.3%	5	2.3%	
Distribution Losses (GWh)		34	16.0%	NA	NA	29	13.7%	
Assets (Mw)	197	150	76.1%	109	72.5%	41	27.5%	
Employees	1596	166	10.4%					
Data are Taken from Appendix 4, Green Cover SAR Provincial Grid Integration Project								

URBAN RESIDENTIAL/COMMERCIAL ENERGY CONSUMPTION SURVEY: VIENTIANE, LAO PDR

Introduction

1. This annex describes the main features and implementation of the Residential/Commercial Energy Consumption Survey (RECS). The RECS was a cooperative effort of ESMAP, the Ministry of Industry and Handicrafts and Electricite du Laos (EDL). It was designed and implemented in Vientiane from July 31 to September 30, 1991 and constitutes the basis for the analysis presented in the main text of this report. The field work was managed by an ESMAP Survey Coordinator and was carried out under the auspices of EDL, in particular, Mr. Khamphone Saignasane, Deputy General Manager. Mr.Na Naopphakdy, Manager of the Electronic Data Processing Department, was assigned as EDL counterpart for the duration of the survey.

2. Developing a local capacity to design and implement surveys as part of EDL's mandate was a major objective of the ESMAP activity. Prior to start-up of the ESMAP mission, EDL agreed to provide 3 personnel to be trained in survey research methods, data collection and analysis. The three EDL staff, members of the Electronic Data Processing and Planning Department, participated in all phases of the study.

3. Attention was paid to the development of both the Lao public and private sectors in skills development in energy planning. Seven local consultants and the three EDL trainees participated in a 3-week training session taught and supervised by ESMAP's Survey Coordinator. The sessions addressed issues including general survey research methodology, interviewing techniques, questionnaire design, and sampling techniques. Training and feedback continued during the implementation phase, including problem solving during survey conduct, database construction, data entry and elementary statistics. As a result, the survey project provided a comprehensive hands-on training vehicle for participating staff and has enabled the knowledge transfer research methods to a core group of EDL staff and the private sector.

Survey Objectives

4. National energy strategy and policy development has focussed overwhelmingly on the supply of electricity as an export commodity and for local economic development. Over the past decade, the Government has pursued a policy of cross-subsidizing local sales from exports. However, as the local demand for

electricity has been growing at about 7% per annum, EDL has provided increasing amounts of electricity for local consumption with high cost assets that were financed largely by debt. As a result, the financial cushion that has been built into these exports sales has gradually eroded.

5. During a decade of aggressive investment in hydroelectric generation, scant attention has been paid to the nature of the domestic demand for electricity, and patterns and trends in this demand over the longer term. This information is, nonetheless, vital for energy sector planning and policy formulation, all the more so as the growing demand for electricity services cuts into EDL's export capacity. The overall aim of the ESMAP activity was to assist EDL to assess and evaluate energy consumption patterns and trends in the residential/commercial sector in urban Vientiane, which represents about half of Lao PDR's domestic electricity consumption.

6. The objectives of the survey were to:

a) determine residential/commercial electricity and fuel preferences, energy consumption and appliance ownership in urban Vientiane;
b) identify patterns and determinants of energy use among urban residents;
c) evaluate the potential for energy efficiency improvement and conservation techniques;
d) define issues and options for policy and program intervention and remedies in critical areas of energy sector; and
e) provide hands-on experience and transfer of knowledge on survey research and analysis.

Sampling Design

7. The Vientiane municipality consists of 7 Districts (Maung) and 411 sub-districts (Ban); a total of 61,561 households live in the municipality. The area is diverse geographically and a large area is still considered rural. Based on the population density and economic activity, only 4 Districts around the center of Vientiane (along the 10 to 15 miles strip of Mekhong river) bear urban characteristics. The survey targeted these districts (Sisattanak, Chantabouri, Sysettha and Sykhottabong), the 108 sub-districts (Ban) and 26,706 households. This is where the bulk of the commercial activity occurs. It is also an area considered to be a concentration of households with a high level of energy consumption, particularly electricity.

8. The universe of the sample design included all housing units occupied as the primary residence in 108 sub-districts (Ban) of the above-mentioned 4 major districts (Maung). The total sample of 405 households (1.5 percent of the total households in each sub-district) were drawn from the Housing Registration Documents using **simple random sampling** (SRS) techniques. The Housing Registration document is required to be filed for every household. The document lists the address, names, and photographs of every household member. Any migration, death or birth in the household must be recorded and registered in this document. Tables 1B and 2B outline the number of sub-districts (Ban) and households chosen as the population, and the total number of sub-districts (Ban) and households in each district (Maung).

Table 1B. Number of Sub-District (Ban) Used as the Universe (Population Frame)

District (Maung)	Number of Ban Chosen as the Universe	Total Number of Ban in the District
Sisattanak	29	40
Chantabouri	32	37
Sysettha	20	54
Sykhottabong	27	59
Total	108	190

Source: Statistics Office, Department of Economic, Planning and Finance, Vientiane Municipality.

Table 2B. Number of Households Used as the Universe (Population Frame)

District (Maung)	Number of Ban Chosen as the Universe	Total Number of Ban in the District
Sisattanak	6,881	8,691
Chantabouri	8,227	9,768
Sysettha	5,440	10,049
Sykhottabong	6,158	10,865
Total	26,706	39,301

Source: Statistics Office, Department of Economic, Planning and Finance, Vientiane Municipality.

Data Collection

9. Fieldwork was conducted by ESMAP Survey Coordinator, local consultants and EDL staff. A pilot test began on August 22-28, 1991; the field interview work began on September 1, 1991 and was completed on October 4, 1991. The sample consisted of 405

households, of which 171 engage in some type of commercial activity from their residence. The names (head of the household) and addresses of the sampled households were given to the sub-district official where the households were located; the governing office of the sub-district contacted the sampled household and arranged an interview appointment with either the head of the household or housewife. Personal interviews were conducted on all 405 households at the respondent's home. Depending on the complexity of energy usage, and appliance ownership in the household, interview times ranged between 30-60 minutes, averaging 45 minutes. In the sub-districts where a high concentration of Vietnamese immigrants are living, enumerators fluent in Vietnamese were assigned; two interviews were conducted in Vietnamese.

10. The questionnaire was translated into the Laos language and piloted by the enumerators and EDL personnel. Questions captured socio-economic information, all types of energy used including quantity and costs, appliance ownership, and appliance characteristics such as wattage and year of acquisition. At the end of interview, respondents were asked for permission to record kilowatt-hour consumption from the electric meter. Before leaving, the interviewer informed the respondent that he/she would return within 2 to 5 weeks to record kilowatt-hours from the electric meter once more. This return visit was done to ensure that accurate kilowatt-hours of electricity consumption and expenditure data could be obtained.

Electricity Consumption Data

11. To ensure the accuracy of electricity consumption and expenditure data (and avoid missing consumption data), the individual household electric meter was read at the time of interview and the kilowatt-hours usage was recorded again during the last week of the survey fieldwork. The time period between the first and second reading ranged from 15 to 35 days. In addition to this prospective collection of kilowatt usage data, enumerators asked the respondent to show his/her previous electric bills. Enumerators were trained to read meters properly and interpreted bills correctly. Data from both of these sources were translated into survey form. By collecting electricity consumption data from both sources, the consistency and accuracy of electricity usage data was compared and cross checked.

12. After reviewing the retrospective billing data, consumption data from electric bills were only used to verify if the electric meter was read correctly. Electric billing information presented several unsolvable problems: a) meter readers who do not have access to the meter, do not estimate electric bills systematically; b) bills were discarded after

payment; c) available bills were not consecutive - the design of EDL electric bill requires 2 consecutive bills to determine the number of days between current and previous reading, and d) the billing sequence time frame presented by the householders varied significantly, some households presented bills from 1990, some from 1989. In short, electricity consumption data used throughout this report was from the prospective meter reading completed by the enumerators during August 22, 1991 to October 2,1991. Expenditure of electricity was calculated from the most current tariff structure.

Enumerators

13. The enumerators' educational training was diverse both subject-wise and geographically. Subject specialties included statistics, economics, education, veterinary medicine, with training received from university settings in the former USSR, Vietnam, Lao PDR and Cuba. All of the enumerators had at least some background in statistics but lacked formal training in survey research and interviewing techniques. As a result, extensive training was required prior to survey administration in order to reinforce the systematic process of survey research methods. All 7 enumerators initiated a 3 weeks training session taught and supervised by ESMAP's survey coordinator. The material emphasized general survey research methodology, sampling techniques, questionnaire design and interviewing techniques. During the training, all participants were given full opportunity to provide feedback and necessary changes were incorporated into the survey to ensure that clear and accurate questions applicable to the typical Lao households. As part of the training, enumerators were required to conduct and complete practice interview in class, as well as in the field. The materials from the practice were reviewed, evaluated and discussed with the enumerators by ESMAP Survey Coordinator. Training and feedback continued during the implementation phase, including problem solving during survey conduct, database construction, data entry and elementary statistics. Data entry was completed during the field work.

14. Each enumerator provided their own transportation. During the first week of survey administration, each enumerator was required to complete 1 or 2 interviews in the morning and report back to the office in the afternoon. The interview experience was discussed, problems the enumerator may have encountered discussed and solutions identified. This was in addition to the pilot work completed prior to the initiation of the field work. After the first week, each enumerator completed 4 interviews per day.

Survey Supervision

15. The survey field work was closely monitored by the ESMAP Survey Coordinator and designated survey supervisors. Enumerators were required to report to the office every day to personally check his/her completed survey forms before returning them to the supervisors and receiving a new assignment. Each completed survey form was then reviewed by the supervisors and ESMAP's survey coordinator. Necessary clarifications were gleaned from each of the enumerators. Surveys with incomplete or missing information were sent back in the field again to be completed. Random checks were performed by the ESMAP survey coordinator or supervisors to ensure proper execution of the interview by the enumerator in the field.

Table 3B. Sub-District (Ban) Used as the Population Frame and Number of Households Sampled.

1: Sisattanak

	Name of Ban	Household	No. of Sample
1.	Beunkagnong Neua	177	3
2.	Beunkagnong Tay	222	3
3.	Dongpalane Tha	258	4
4.	Dongpalane Thong	252	4
5.	Kao ngot	236	4
6.	Kcknin	103	2
7.	Nongchan	396	6
8.	Phanemane	139	2
9.	Phapho	202	3
10.	Phasay	174	3
11.	Phiawatt	137	2
12.	Phone Papao Tha	276	4
13.	Phone Papao Thong	312	5
14.	Phonesavane Neun	303	5
15.	Phonesavane Tay	145	2
16.	Phonsinouane	436	7
17.	Phosay	104	2
18.	Saphanethong Neua	259	4
19.	Saphanethong Thong	365	5
20.	Saphanethongtay	282	4
21.	Saphathong Kang	154	2
22.	Simouang	280	4
23.	Sokpalouang	138	2
24.	Suanmone	186	3
25.	Tha Phalane Say	330	5
26.	Thatkao	249	4
27.	Thongkan	316	5
28.	Vat Nak	338	5
29.	Vat Sop	112	2
TOTAL		6,881	106

2: Chantabouri

	Name of Ban	Household	No. of Sample
1.	Dongmieng	378	6
2.	Dongpalep	285	4
3.	Hatsady Neua	202	3
4.	Hatsady Tay	252	5
5.	Haysok	312	5
6.	Hong Kay Ke‹	123	2
7.	Hongka Neua	261	4
8.	Hongka Tay	258	4
9.	Hongseng	132	2
10.	Koualouang Neua	384	6
11.	Koualouang Tay	411	6
12.	Misay	280	4
13.	Phontong Chommany	391	6
14.	Savan	297	4
15.	Saylom	214	3
16.	Sibounheuang	335	5
17.	Sidamduan	292	4
18.	Sienggneune Tha	379	6
19.	Sienggneune Thong	284	4
20.	Sihom	290	4
21.	Sisavat Kang	276	4
22.	Sisavat Neua	173	3
23.	Sisavat Tay	346	5
24.	Thongkankham Neua	246	4
25.	Thongkhankham Tay	282	4
26.	Thongsannang	350	5
27.	Thontoum	285	4
28.	Vatchan Tha	229	3
29.	Vatchan Thong	280	4
TOTAL		8,227	3

3: Sysettha

	Name of Ban	Household	No. of Sample
1.	Hongke	397	6
2.	Nasay	369	6
3.	Nongbone Neua	233	3
4.	Nongsantho	234	4
5.	Phay	285	4
6.	Phonekeng Neua	154	2
7.	Phonephanao	374	6
8.	Phonesaat	232	3
9.	Phonkeng Tay	250	4
10.	Phonsay	419	6
11.	Phonthan Tay	180	3
12.	Phonthane Neua	289	4
13.	Saphanmo	253	4
14.	Sisangvone	257	4
15.	Thatlouang Kang	314	5
16.	Thatlouang Neua	292	4
17.	Thatlouang Tay	259	4
18.	Chommany	208	3
19.	Thatlouang Thong	194	3
20.	Viengchaleun	247	4
TOTAL		5,440	82

4: Sykhottabong

	Name of Ban	Household	No. of Sample
1.	Akad	314	5
2.	Dongnasok Neua	301	5
3.	Dongnasok Tay	252	4
4.	Gnapha	216	3
5.	Khounta Tha	262	3
6.	Khounta Thong	172	3
7.	Meuan Vatha	162	2
8.	Meuan Vathong	268	4
9.	Nakham	300	5
10.	Nongbuathong Neua	311	5
11.	Nongbuathong Tay	280	4
12.	Nongduang Neua	272	4
13.	Nongduang Tay	275	4
14.	Nongduang Thong	212	3
15.	Nongpanay	210	3
16.	Nongsanokham	106	2
17.	Oubmoung	181	3
18.	Sibounheuang Tha	204	3
19.	Sibounheuang Thong	184	3
20.	Sikhay Tha	254	4
21.	Sikhaythong Neua	219	3
22.	Sikhaythong Tay	157	2
23.	Sithane Neua	275	4
24.	Vattayngay Tha	169	3
25.	Vattayngay Thong	162	2
26.	Vattaynoy Tha	246	4
27.	Vattaynoy Thong	194	3
TOTAL		6,158	94

Laos Urban Residential/Commercial
Energy Demand Assessment Study
Sample Questionnaires

This survey is part of a study designed to assess and evaluate the energy consumption in the residential/commercial sector in urban Vientiane. The study is conducted under the joint cooperation between World Bank and the Ministry of Industry and Handicraft. The overall goal of the study is to assist the government to review and evaluate the current energy consumption patterns and trends of residents in the urban area of Vientiane. Relying on the questionnaires, the study will collect information regarding energy usage, energy using appliance holding, household income, expenditure and in particular total amount of monthly energy consumption and expenditure. Information collected from this survey will be used for statistical analysis only, and will be kept confidential, especially the name and address. Name and address are solely used by the manager to: (a) correct the discrepancies of the information (if there exist any); and (b) to verify whether the interview was actually taken place.

Things to do for the Survey

1. Do spot check for the customer number, meter number and see if both number correspond to the correct customer.

2. Survey the appliance market and make codebook for appliance brand, make, wattage, and size.

3. Check the normal unit of charcoal regularly sold in the market, such as tin, sack.
   For example, how many kilogram in a sack.
   how many kilogram in a tin.

4. Check the normal unit of firewood regularly sold in the market, such as small bundle, large bundle, wheel, etc.
   For example, how many kilogram in a sack.
   how many kilogram in a tin.

5. Check the normal unit of kerosene regularly sold in the market, such as bottle (.750 ml), liter, tin (20 liters, etc.).

6. Check again if there are only 2 type of cylinders for LPG regularly sold in the market, i.e., 15 Kg and 48 Kg.

7. Laos household prefers glutinous rice to sweet rice, how about non laos?

8. Make sure that we can obtain letter from the government to identify ourselves to the household.

9. Make a visit to every household prior to the interview.

10. The point in #9, is more crucial for inline measurement because we walk in and stay for some time.

Survey Form for
Laos Urban Residential/Commercial
Energy Demand Assessment Study

Identification

1.1 Customer Number: _____

1.2 Meter Number: _____ (First Meter)

Usage Reading: _____ Kilowatt-Hours

Meter Number: _____ (Second Meter)

Usage Reading: _____ Kilowatt-Hours

Meter Number: _____ (Third Meter)

Usage Reading: _____ Kilowatt-Hours

Meter Number: _____ (Fourth Meter)

Usage Reading: _____ Kilowatt-Hours

1.3 Meter Reading Date: ___/___/___ (DD/MO/YR)

1.4 Address: _____

_____

District:_____

Ban: _____

1.5 Date of Interview: _____ Time Start:_____

Time End: _____

Name of enumerator: _____

Signature of enumerator: _____

Enumerators will be given another form to record the final meter reading.

1.6 Final Meter Reading

First Meter	Second Meter	Third Meter	Fourth Meter
_____	_____	_____	_____

1.7 Date of Final Reading: ___/___/___ (DD/MM/YR)

General Coding Instruction
-9 = Missing information
-8 = Answer does not apply
-7 = Do not know answer

Section 1: Socio-Economic Information

1.1 Name of Respondent: _____ Q1.1
Code: [1] = Male; [0] = Female

Sex: _____ Sex _____
Age: _____ Years Age _____

1.2 Name of the Head of household: _____ Q1.2
Code: [1] = Male; [0] = Female

Sex: _____ Sex _____
Age: _____ Years Age _____

Educational Level: _____ Education _____
[1] = literate; [0] = Illiterate

1.3 How many persons normally eat and sleep in the household? Q1.3
(Fill in according to age).

0 - 6 yrs	_____ persons;	0 - 6 _____
7 - 17 yrs	_____ persons;	7 - 17 _____
18 - 60 yrs	_____ persons;	18 - 60 _____
61 yrs & over	_____ persons;	61 & Over _____
Total	_____ persons.	TOTAL _____

1.4 Does your household usually prepare meals for the household's own consumption? Q1.4
[1] = Yes; [0] = No; if no skip Q1.5.

1.5 Who usually prepares the meals for the household? Q1.5
[1] = Head of the Household
[2] = Head of the Household's wife or husband
[3] = Other member of the Household
[4] = Maid/servant or Cook
[5] = Other, specify.....

1.6 Education Level Q1.6
What is the highest education level of the adult member of the household?
[0] = Never Attended School
[1] = Primary (1 to 5 years of schooling)
[2] = Middle (6 to 9 years of schooling)
[3] = High School/Vocational (10 to 12 years of schooling)
[4] = College Education
[5] = Post Graduate

1.6.1 If the person never attended school, can the person read? Q1.6.1
Code: [1] = Yes; [0] = No.

1.7 Number of children currently attending school Q1.7

1.8 How many persons in your household are working? Q1.8

1.9 Number of years the household live in Vientiane municipality_____years. Q1.9

1.10 If the household have been living in Vientiane less than 15 years, please indicate where the family migrated from: _____. Q1.10

Coding Number for name of province (Q1.10)

*[1]	Vientiane Municipality	[10]	Vientiane
[2]	Phongsaly	[11]	Bolikhamsay
[3]	Luangnamtha	[12]	Khammuane
[4]	Oudomxay	[13]	Savannakhet
[5]	Bokeo	[14]	Saravan
[6]	Luangprabang	[15]	Sekong
[7]	Houphanh	[16]	Champasack
[8]	Xayaburi	[17]	Attapeu
[9]	Xiengkhuang		

* (Interviewer enter code number 1 if respondent only moved within the Vientiane municipality)

Section 2: Housing Unit

Enumerator fill in Question 2.1 information concerning housing unit:

2.1 Main type of dwelling unit:_____ Q2.1
[1] = Row House (Wood)
[2] = Row House (Brick)
[3] = Row House (Brick & Wood)
[4] = Single-detached (Modern House)
[5] = Single-detached (LAO HOUSE - MODERN)
[6] = Lao House (Traditional Lao House)
[7] = Apartment
[8] = Communal Dwelling
[9] = Other, specify .....

2.2 Is there any part of your house used for business activity or commercial purposes? Q2.2
[1] = Yes; [2] = No. If no, skip question 2.3.

2.3 If there is part of the house which is used for business activity, please indicate which type of business activity or commercial purposes? ____ _____ Q2.3
[1] = Hairdresser/barber.
[2] = Food and Beverage.
[3] = Tailor/Dress Maker.
[4] = Laundry.
[5] = Furniture Making/Carpentry/Store.
[6] = Groceries & Beverage. (Such as, coffee shop which also sell groceries)
[7] = Groceries Store (Only). (Not include coffee shop)
[8] = Clinic/Drug Store.
[9] = Gold or Silver Smith.
[10]= Clothing Store/Gift Shop/Antique Shop, Import/Export, Retail/Wholesale
[11]= Repair Shop (i.e., bicycle, car, air Conditioning, etc.).
[12]= Agriculture
[13]= Handicrafts
[14]= Others .....

2.4 Does your family own or rent this house? Q2.4
[1] = Own
[2] = Rent
[3] = Government provided Housing
[4] = Family or Relative
[5] = Other, specify .....

Section 3: Identification of Fuel types

Please indicate which of the following fuels are used in any activity in your household during the past 12 months? Coding: [1] = Used; [0] = Not Used

3.1	Electricity	3.1	_____
3.2	Charcoal	3.2	_____
3.3	Firewood	3.3	_____
3.4	Kerosene	3.4	_____
3.5	LPG	3.5	_____
3.6	Diesel	3.6	_____
Biomass or any of crop residue			_____
3.7	Sawdust	3.7	_____
3.8	Coconut Shell	3.8	_____
3.9	Other, specify	3.9	_____

Section 4: Electricity

4.1 How many years has your household had electricity: ______ years. Q4.1

4.2 Is the electricity used by your household only? Q4.2
Code: [1] = Yes; [0] = No

4.3 Does your household have to pay for the electricity service? Q4.3
[1] = Yes; [0] = No. (If No, skip Q. 4.4 to 4.8).

4.4 If yes, who do you pay for the electricity service to? Q4.4
Coding:
[1] = Pay directly to EDL Bill Collector
[2] = Pay directly to Housing Office/Office
[3] = Pay to the neighbor
[4] = Other, specify ....

4.5 Does your household pay for the electricity service in full (regular) price or did you receive a discount? Q4.5
Coding:
[1] = We pay in full (or regular) price.
[2] = We received discount for our electricity service.
[3] = Other, specify ....

4.6. If your household receives discount, please tell me the reason why does the household receives the discount or only pay part of the bill? Q4.6
Coding:
[1] = We receive discount because the head of the household works for the government.
[2] = Head of the household is a party official.
[3] = Head of the household is a Veteran.
[4] = The head of the household work for EDL.
[5] = Other, specify ....

4.7 What is the average electric bill per month last year? _______Kns. Q4.7

4.8 What is the average monthly electricity usage last year?_______kWh. Q4.8

After asking question 4.7 and 4.8, interviewer ask the respondent if he/she still have previous electric bills (2 consecutive bills for each meter are needed). See coding instructions:

Date of bill (enter the date-month-year): ___/___/___ Meter Number: __________

Last Meter Reading (kWh)	Current Meter Reading (kWh)	Total kWh (Kns)	Cost	Date Current Meter Reading
__________	__________	______	_____	___/___/___

Date of bill (enter the date-month-year): ___/___/___ Meter Number: __________

Last Meter Reading (kWh)	Current Meter Reading (kWh)	Total kWh (Kns)	Cost	Date Current Meter Reading
__________	__________	______	_____	___/___/___

Date of bill (enter the date-month-year): ___/___/___ Meter Number: __________

Last Meter Reading (kWh)	Current Meter Reading (kWh)	Total kWh (Kns)	Cost	Date Current Meter Reading
__________	__________	______	_____	___/___/___

Date of bill (enter the date-month-year): ___/___/___ Meter Number: __________

Last Meter Reading (kWh)	Current Meter Reading (kWh)	Total kWh (Kns)	Cost	Date Current Meter Reading
__________	__________	______	_____	___/___/___

Date of bill (enter the date-month-year): ___/___/___ Meter Number: __________

Last Meter Reading (kWh)	Current Meter Reading (kWh)	Total kWh (Kns)	Cost	Date Current Meter Reading
__________	__________	______	_____	___/___/___

Date of bill (enter the date-month-year): ___/___/___ Meter Number: __________

Last Meter Reading (kWh)	Current Meter Reading (kWh)	Total kWh (Kns)	Cost	Date Current Meter Reading
__________	__________	______	_____	___/___/___

Skip this page during the interview

Enumerators must calculate number of days, kWh and Kns from the billing information and filling in the section below at the office.

Meter Number: _____	Period covered:	_____	days	Days	_____
	No. Unit Consumed:	_____	kWh	kWh	_____
	Amount Due/owed:	_____	Kns	Kns	_____
Meter Number: _____	Period covered:	_____	days	Days	_____
	No. Unit Consumed:	_____	kWh	kWh	_____
	Amount Due/owed:	_____	Kns	Kns	_____
Meter Number: _____	Period covered:	_____	days	Days	_____
	No. Unit Consumed:	_____	kWh	kWh	_____
	Amount Due/owed:	_____	Kns	Kns	_____

4.9 Please tell me the reasons why the household does not have to pay for electricity? Q4.9.1
Coding:
[1] = Live in the government housing and electricity is provided.
[2] = The house is rented and electricity is included in the rent.
[3] = Friend/relative provided the house to live in for free including electricity.
[4] = Other, specify .....

4.10 Does your household use electricity for the following purposes: Q4.10
Code: [1] = Yes; [0] = No

4.10.1 Cooking Q4.10.1

4.10.2 Boiling water other than preparing meal (such as, boiling water to drink, make coffee, tea etc.). Q4.10.2

4.10.3 Hot water (use to heat water for bathing, washing clothes, etc.). Q4.10.3

4.10.4 Lighting Q4.10.4

4.10.5 Fan Q4.10.5

4.10.6 Ironing Q4.10.6

4.10.7 Refrigeration (use for refrigerator) Q4.10.7

4.10.8 Cooling (use for air condition) Q4.10.8

4.10.9 Washing Machine Q4.10.9

4.10.10 Leisure Appliances Q4.10.10

4.10.11 Pump Water Q4.10.11

4.10.12 Air Pump Q4.10.12

4.10.13 Business Activity Q4.10.13

4.11 If the electricity supply for the household is also used for business activity, please tell me what kind of business activity? Q4.11
Code:
[1] = Hairdresser/barber.
[2] = Food and Beverage.
[3] = Tailor/Dress Maker.
[4] = Laundry.
[5] = Furniture Making/Carpentry/Store.
[6] = Groceries & Beverage. (Such as, coffee shop which also sell groceries)
[7] = Groceries Store (Only). (Not include coffee shop)
[8] = Clinic/Drug Store.
[9] = Gold or Silver Smith.
[10]= Clothing Store/Gift Shop/Antique Shop, Import/Export, Retail/Wholesale
[11]= Repair Shop (i.e., bicycle, car, air Conditioning, etc.).
[12]= Agriculture
[13]= Handicrafts
[14]= Others .....

4.12 During the past 3 months do you have any problems with electricity supply? Q4.12
[1] = A Lot of Problems; [2] = A few Problems; [3] = No Problem.

4.13 Over the past one month how many power outages have you experienced? Q4.13

4.14 Please tell me whether the following problems occur: Q4.14
Coding: Fill in the answer with the code number in the provided space of each problem stated.
Code: [1] = Daily; [2] = Weekly; [3] = Monthly; [4] = Rarely; [5] = Never.

4.14.1 Voltage Drops, dimming of Lights Q4.14.1

4.14.2 Unscheduled power cuts Q4.14.2

4.14.3 Unable to pay electric bill Q4.14.3

4.14.4 Other, specify Q4.14.4

Section 5: Other Fuels

Section 5.1: Charcoal

If the respondent reports that charcoal is used in Section 3, complete section 5.1.

5.1 Does your household use charcoal? Q5.1
Code: [1] = Frequently;
[2] = Seldomly;
[3] = No, do not use charcoal. (If no, skip to other fuel and check Section 3.)

5.2 During the month when your household use charcoal what percentage is used for the following purposes: Q5.2
Code: 10%; 30%; 50%; 70%; 90%;
20%; 40%; 60%; 80%; 100%.

(1) Cooking & Boiling Water	(1)	
(2) Heating Water (washing clothes, bathing)	(2)	
(3) Ironing	(3)	
(4) Business Activities (Non-household use, such as, food, desert, business, etc.).	(4)	
(5) Other, specify	(5)	
Total (100%)	TOTAL	100 %

5.3 On the average how much does your household spend on charcoal per month? Q5.3
_____ Kns per month

5.4 In which unit and number of units of charcoal does your household usually purchase? Q5.4
Code: [1] = Big Bag;
[2] = Small Bag;
[3] = Kilogram;
[4] = Other, specify .....

Enumerator must enter unit code number,

5.4.1 In general, which type of charcoal does your household usually buy? Q5.4.1
Code: [1] = Charcoal using wood from sawmill; [2] = Charcoal using tree.

5.4.2a If buy in bag, how many bags does your household usually buy? Q5.4.2a

5.4.2b If buy in kilogram, how many kilogram does your household usually buy? Q5.4.2b

5.5a In a typical month in which your household use charcoal, how many bags of charcoal does your household use? _____ Bags Q5.5a

5.5aa What is the average per bags your household usually buys? _____ Kilograms Q5.5aa

5.5b In a typical month in which your household use charcoal, how many kilogram of charcoal does your household use? _____ Kilograms Q5.5b

5.6a Which type of charcoal did your household purchase last time? Q5.6a
Code: [1] = Charcoal using wood from sawmill; [2] = Charcoal using tree.

5.6b What was the unit, price and amount of charcoal your family bought last time? Q5.6b
UNIT _____
Code: [1] = Big Bag;
[2] = Small Bag;
[3] = Kilogram;
[4] = Other, specify .....

If bought in bag answer Q5.6b1 to Q5.6b3. Q5.6b1

PRICE/BAG _____
NO. OF BAGS _____ Q5.6b2
Weight _____ (Average weight of 1 unit in kg) Q5.6b3

If bought in bag kilogram Q5.6c1 to Q5.6c2. Q5.6c1

NO. of Kilo _____
PRICE/KILO _____ Q5.6c2

Section 5.2: Firewood

If the respondent reports that firewood is used in Section 3, complete section 5.2.

5.7 Does your household use firewood? Q5.7
Code: [1] = Frequently.
[2] = Seldomly.
[3] = No, do not use firewood. (If no, skip to other fuel and check Section 3).

5.8 During the month when your household use firewood what percentage is used for the following purposes: Q5.8
Code: 10%; 30%; 50%; 70%; 90%;
20%; 40%; 60%; 80%; 100%.

(1) Cooking & Boiling Water _____	(1)	_____
(2) Heating Water (washing clothes, bathing) _____	(2)	_____
(3) Business Activities (Non-household use, such as, food, dessert business, etc.).	(3)	_____
(4) Other, specify	(4)	_____
Total (100%)	TOTAL	100 %

5.9 How does your household usually obtain firewood? Q5.9
Code: [1] = Purchase only;
[2] = Collect only; If check this answer, go to Q. 5.15 & Q 5.16.
[3] = Both Collect & Purchase;
[4] = Other, specify; .....

For households who purchase firewood

Interviewer ask the following 3 questions to only the household who answer [1] or [3] in question 5.9

5.10 On an average how much your does household spend on firewood in a month? Q5.10
_____ Kns per month

5.11 In which unit does your household usually purchase firewood? UNIT _____ Q5.11

Respondent must enter unit code number, then check and enter the weight of firewood in kilogram per unit.
Code: [1] = Small Bundle;
[2] = Medium Bundle
[3] = Large Bundle;
[4] = Wheel Barrow
[5] = Cubic Meter
[6] = Other, specify .....

5.11.1 Average WEIGHT of 1 unit (in Kilogram) Q5.11.1

5.12 In the month your household use firewood, how many of the typical units are used? Q5.12.1
_____ Units (from the amount bought)

5.13 In the month your household use firewood, how many of the typical units are bought? Q5.13
_____ Units

5.14 Which type of unit, price per unit of firewood when your family bought last time? Q5.14

Type of Unit _____	TYPE OF UNIT	_____
Price/Unit _____	PRICE/UNIT	_____
No. of Unit _____	NO. OF UNIT	_____
Weight _____	WEIGHT	_____
(Average weight of 1 unit in Kg.)		

For households who collect firewood

Interviewer ask the question 5.15 to only the household who answer [2] & [3] in question 5.9.

5.15 During the month your household use firewood, please indicate the typical unit of firewood your household collected or stocked? 05.15

Type of Unit Coding.
Code: [1] = Big Truck;
[2] = Pickup Truck;
[3] = Tricycle Load;
[4] = Wheel barrow;
[5] = Bicycle load;
[6] = Other, specify .....

Respondent must enter unit code number, then check and enter the weight of firewood in kilogram per unit.

Type of Unit _____ TYPE OF UNIT _____
Price/Unit _____ PRICE/UNIT _____
No. of Unit _____ NO. OF UNIT _____
Weight _____ WEIGHT _____
(Average weight of 1 unit in Kg.)

Interviewer ask question 5.16 to only the household who answer [2,3] in question 5.9.

5.16 In the month your household use firewood, how many of the typical units are used? 5.16
_____ Units (from amount collected)

Section 5.3: Kerosene

If the respondent reports that kerosene is used in Section 3, complete section 5.3.

5.17 Does your household use kerosene? 5.17
Code: [1] = Frequently.
[2] = Seldomly.
[3] = No, do not use kerosene. (If no, skip to other fuel and check Section 3).

5.18 During the month when your household use kerosene what percentage is used for the following purposes: 5.18
Code: 10%; 30%; 50%; 70%; 90%;
20%; 40%; 60%; 80%; 100%.

(1) Cooking (1) _____
(2) Boiling Water (for drinking or, making beverage, etc.) (2) _____
(3) Heating Water (washing clothing, bathing) (3) _____
(4) Lighting (4) _____
(5) Business Activities (Non-household use, such as, food, dessert business, etc.). (5) _____
(6) Other, specify ..... (6) _____
Total (100%) TOTAL 100 %

5.19 On the average how much does your household spend on kerosene per month? 05.19
_____ Kns per month

5.20 In which unit and number of units of kerosene does your household usually purchase? 05.20

Type of Unit_____ TYPE OF UNIT _____
No of Units _____ NO. OF UNITS _____

Respondent must enter unit code number, then check and enter the weight in liter per unit.
Code: [1] = 0.750 ml bottle;
[2] = 1 liter;
[3] = Tin container;
[4] = 5 liters container;
[5] = 10 liters containers;
[6] = 20 liters containers
[7] = Other, specify .....

5.21 In a month in which your household use kerosene, how many of the typical unit of kerosene are used? _____ Units 05.21

5.22 What was the price of kerosene per unit when your family bought last time? 05.22

Type of Unit _____ TYPE OF UNIT _____
Price/Unit _____ PRICE/UNIT _____
No. of Units _____ No. OF UNITS _____
(Average weight of 1 unit in liter)

Section 5.4: Diesel

If the respondent reports that kerosene is used in Section 3, complete section 5.4.

5.23 Does your household use Diesel? 5.23
Code: [1] = Frequently.
[2] = Seldomly.
[3] = No, do not use kerosene.
(If no, skip to other fuel and check Section 3.)

5.24 During the month when your household use diesel what percentage is used for the following purposes: 5.24
Code: 10%; 30%; 50%; 70%; 90%;
20%; 40%; 60%; 80%; 100%.

(1) Cooking (1) _____
(2) Boiling Water (for drinking or, making beverage, etc.). (2) _____
(3) Heating Water (washing clothing, bathing) (3) _____
(4) Lighting (4) _____
(5) Business Activities (Non-household use, such as, food, dessert business, etc.). (5) _____
(6) Other, specify ..... (6) _____
Total (100%) TOTAL 100 %

5.25 On the average how much does your household spend on diesel per month? 05.25
_____ Kns per month

5.26 In which unit and number of units of diesel does your household usually purchase? 05.26
Code: [1] = 0.750 ml bottle;
[2] = 1 liter;
[3] = Tin container;
[4] = 5 liters container;
[5] = 10 liters containers;
[6] = 20 liters containers
[7] = Other, specify .....

Respondent must enter u t code number, then check and enter the weight in liter per unit.

Type of Unit_____ TYPE OF UNIT _____
No of Units _____ NO. OF UNITS _____

5.27 In a month in which your household use diesel, how many of the typical unit of diesel are used?_____ Units 05.27

5.28 What was the price of diesel per unit when your family bought last time? 05.28

Type of Unit _____ TYPE OF UNIT _____
Price/Unit _____ PRICE/UNIT _____
No. of Units _____ (Average weight of 1 unit in liter) No. OF UNITS _____

Section 5.5: LPG

If the respondent reports that LPG is used in Section 3, complete this section.

5.29 Does your household use LPG? 05.29
Code: [1] = Frequently.
[2] = Seldomly.
[3] = No, do not use charcoal. (If no, skip to other fuel and check Section 3.)

5.30 During the month when your household use LPG what percentage is used for the following purposes: Q5.30

Code: 10%; 30%; 50%; 70%; 90%;
20%; 40%; 60%; 80%; 100%.

(1) Cooking	(1)	
(2) Boiling Water (for drinking or, making beverage, etc.).	(2)	
(3) Heating Water (washing clothing, bathing)	(3)	
(4) Lighting	(4)	
(5) Business Activities (Non-household use, such as, food, dessert business, etc.).	(5)	
(6) Other, specify	(6)	
Total (100%)	TOTAL	100 %

5.31 On the average how much does your household spend on LPG per month? Q5.31
_____ Kns per month

5.32 In which size of cylinder and number of cylinders of LPG does your household usually purchase? Code of cylinder size_____ Q5.32

Code: [1] = 4 kg. orange color cylinder;
[2] = 5 Kg. orange color cylinder;
[3] = 15 kg. small cylinder;
[4] = 48 Kg. big cylinder.

5.33 How many days will the typical size of LPG cylinder your family bought last? Q5.33
_____ Days

5.34 What was the price of LPG per cylinder when your family bought last time? Q5.34

PRICE _____ Price/Cyls _____
Code of cylinder size _____ Size of Cyls _____
Numbers of cylinder _____ No. of Cyls _____

Section 6: Household Appliances

6.1: Electrical Appliances

In this section I will ask you about all of the electrical appliances which your family is using.

6.1.1 Lighting

Could you tell me how many lamps, capacity of each lamp and the number of hours used each day for lighting in your household?

Incandescent Lamp

Capacity (Watt)	No. of Bulbs	Total Hrs. used in 24 hrs of all bulbs in this Cat.	Number of Bulbs	Total Hrs.
5				
10				
25				
40				
60				
75				
100				
> 100				

Fluorescent Lamp

Capacity (Watt)	No. of Bulbs	Total Hrs. used in 24 hrs of all bulbs in this Cat.	Number of Bulbs	Total Hrs.
5				
10				
25				
40				
60				
75				
100				
> 100				

6.1.2 Household Appliances

In this sub-section, I would like to find out if the household has any of the following electrical appliances.

If the household does not own that particular appliances enter "0"; If the household has more than one, then enter the number the household owns, and add the total wattage of each type of these appliances.

	Number of Appliance	Most Often Used Brand Code Size	Total Watts	Has Since	
Refrigerator:					19__
Freezer:					19__
Electric Fan:					19__
Air Conditioning (window unit):					19__
Air Conditioning (split type):					19__
Electric Iron:					19__
Washing Machine:					19__
Electric Water Pump:					19__
Electric Air Pump:					19__
Electric Hot Water Heater:					19__
Others Appliances, specify;					19__
.....					19__
.....					19__
.....					19__

Please, provide additional information regarding the previous household appliances.

6.1.2.1 If the household has refrigerator, please indicate whether the one most often used is frost-free. Code: [1] = Yes; [2] = No. Q6.1.2.1

6.1.2.2 If the household has electric fan, please indicate the type and size of each fan your household has.
Code: [1] = Table Fan; [2] = Ceiling Fan; [3] = Floor Stand; [4] = Box Type.

Unit Number	Type of Fan	Size

6.1.2.3 If the household has window Air Conditioner unit, please indicate the size of each unit your household has.

Make/Brand	Unit Number	Size (Ton)	Watts

6.1.3 Leisure/Entertainment Electrical Appliance

In this sub-section, I would like to find out if the household has any of the following leisure/entertainment electrical appliances.

	Number of Appliance	Most Often Used Brand Code Size	Total Watts	Has Since	
B&W Television:					19__
Color TV:					19__
Video Player (VCR):					19__
Radio/Tape:					19__
Stereo Component Portable Receiver/ Radio/Tape (using AC)					19__
Stereo Component Non-Portable Receiver/ Radio/Tape (using AC)					19__
Others Appliances, specify;					19__
.....					19__
.....					19__
.....					19__

6.1.4 Electric Cooking Appliances

In this sub-section, I would like to find out if the household has any of the following electric cooking appliances or utensils.

	Number of Appliance	Most Often Used Brand Code Size	Total Watts	Has Since	
Electric Rice Cooker:					19__
Electric Stove:					19__
Electric Oven:					19__
Electric Wok:					19__
Electric Kettle:					19__
Microwave Oven:					19__
Toaster Oven:					19__
Elec. Heat Torch:					19__
Others Appliances, specify;					19__
.....					19__
.....					19__
.....					19__

6.2 Non-Electric Appliances

In this sub-section, I would like to find out if the household has any of the following non-electric appliances or utensils.

	Number of Units
Kerosene Stove:	_____
LPG Stove:	_____
Charcoal Stove:	_____
Firewood Stove:	_____
Simple Wood Stove:	_____
Sawdust Stove:	_____

Section 7: Household Attitude

7.1 Is your household planning to buy new electrical appliances in the near future? Q7.1
Coding: [1] = Yes; [2] = No

If yes, specify .....

7.2 For the following statements, please tell me whether you:
[1] Strongly Disagree; [2] Disagree; [3] Agree; [4] Strongly Agree; or
[5] Have No Opinion.

7.2.1 I prefer to cook food using charcoal because it taste better. Q7.2.1

7.2.2 I think electricity bill from EDL is expensive. Q7.2.2

7.2.3 Using electricity for cooking is very convenient and clean. Q7.2.3

7.2.4 If the price of electricity is not the main factor, I would always use electricity for cooking. Q7.2.4

7.2.5 Generally Food cooked by charcoal taste better than food cooked by electricity or LPG or kerosene. Q7.2.5

7.2.6 By comparison using electricity for cooking is the more expensive than using woodfuel. Q7.2.6

Section 8: Income and Expenditure

8.1 What is the total combined household income per month of everyone who are working? Q8.1

Salaries	_____	Kns
Wages	_____	Kns
Profit from Business	_____	Kns
Remittances Received	_____	Kns
Government Allowances or Welfare	_____	Kns
Agricultural Activities	_____	Kns
Handicraft	_____	Kns
Other	_____	Kns
Total	_____	Kns

8.2 What is the household monthly expenditure? Q8.2

Rice	_____	Kns
Foodstuff and beverage	_____	Kns
Cigarettes & alcoholic drinks	_____	Kns
Clothing	_____	Kns
Education	_____	Kns
Medical care/Medicines	_____	Kns
Travel & transportation	_____	Kns
Housing (i.e. rent, repair)	_____	Kns
Water	_____	Kns
Telephone	_____	Kns
Energy (including all types of energy)	_____	Kns
Miscellaneous	_____	Kns
Total	_____	Kns

Table 1A. Socioeconomic Indicators

	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Age of Respondent					
Mean.....	41	38	41	41	42
Valid Cases.....	405	106	123	82	94
Sex of Respondent					
Female.....	55.1%	58.5%	50.4%	59.8%	53.2%
Male.....	44.9%	41.5%	49.6%	40.2%	46.8%
Valid Cases.....	405	106	123	82	94
Highest Edu of HH Member					
Adult Education.....	.2%	.0%	.8%	.0%	.0%
Primary School.....	8.9%	8.5%	9.8%	7.3%	9.6%
Junior High School.....	22.7%	24.5%	20.3%	24.4%	22.3%
Senior High School.....	43.2%	41.5%	41.5%	42.7%	47.9%
College.....	23.5%	22.6%	26.8%	23.2%	20.2%
Above College.....	1.5%	2.8%	.8%	2.4%	.0%
Valid Cases.....	405	106	123	82	94
No. of Persons in the HH					
Mean.....	7	6	7	7	7
Valid Cases.....	405	106	123	82	94
Total Income per Month					
Mean.....	179807	154615	203554	191463	166971
.....	405	106	123	82	94

Table 2A. Households with Business Activity

Part of House is Used for Business	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
No.....	234	56	71	52	55
percent.....	57.8%	52.8%	57.7%	63.4%	58.5%
Yes.....	171	50	52	30	39
percent.....	42.2%	47.2%	42.3%	36.6%	41.5%
Total Responses.....	405	106	123	82	94
percent.....	100.0%	100.0%	100.0%	100.0%	100.0%

Table 3A. Types of Business Activity

Type of Business Actv.	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Beauty/Barber.....	2.3%	4.0%	1.9%	.0%	2.6%
Food & Beverage.....	7.0%	6.0%	13.5%	6.7%	.0%
Tailor.....	4.7%	6.0%	7.7%	.0%	2.6%
Furniture.....	4.1%	6.0%	1.9%	3.3%	5.1%
Beverage & Conven.....	17.0%	10.0%	13.5%	16.7%	30.8%
Convenience Store Only..	11.1%	16.0%	11.5%	10.0%	5.1%
Drug Store/Clinic.....	1.2%	2.0%	.0%	.0%	2.6%
Gold/Silver.....	2.3%	.0%	5.8%	.0%	2.6%
Repair.....	5.3%	4.0%	5.8%	6.7%	5.1%
Aggriculture.....	8.2%	18.0%	1.9%	3.3%	7.7%
Handicraft.....	19.9%	24.0%	9.6%	36.7%	15.4%
Others.....	17.0%	4.0%	26.9%	16.7%	20.5%
Household with Business.	171	50	52	30	39
Total Percent.....	100.0%	100.0%	100.0%	100.0%	100.0%

Table 4A. Distribution of Total Family Income per Month

Income Class	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000.....	81	32	20	15	14
(percent).....	20.0%	30.2%	16.3%	18.3%	14.9%
Income 75,000-102,000...	82	23	24	18	17
(percent).....	20.2%	21.7%	19.5%	22.0%	18.1%
Income 103,000-150,000..	83	19	26	19	19
(percent).....	20.5%	17.9%	21.1%	23.2%	20.2%
Income 151,000-200,000..	81	13	28	15	25
(percent).....	20.0%	12.3%	22.8%	18.3%	26.6%
Income 201,000-270,000..	38	9	13	5	11
(percent).....	9.4%	8.5%	10.6%	6.1%	11.7%
Income > 270,000.....	40	10	12	10	8
(percent).....	9.9%	9.4%	9.8%	12.2%	8.5%
Total Cases.....	405	106	123	82	9[illegible]
(percent).....	100.0%	100.0%	100.0%	100.0%	100.0%

Table 5A. Family Size by Total Income

Income Class	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
No. of Persons in the HH					
Mean	5	5	5	5	5
Valid Cases	81	32	20	15	14
Income 75,000-102,000					
No. of Persons in the HH					
Mean	6	6	6	7	7
Valid Cases	82	23	24	18	17
Income 103,000-150,000					
No. of Persons in the HH					
Mean	7	8	7	7	7
Valid Cases	83	19	26	19	19
Income 151,000-200,000					
No. of Persons in the HH					
Mean	7	8	7	8	7
Valid Cases	81	13	28	15	25
Income 201,000-270,000					
No. of Persons in the HH					
Mean	8	7	9	10	8
Valid Cases	38	9	13	5	11
Income > 270,000					
No. of Persons in the HH					
Mean	8	6	8	9	8
Valid Cases	40	10	12	10	8

Table 6A. Household Attitude Toward Electricity and Cooking With Electricity

	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Elec is expensive					
Strongly Disagree	9.6%	12.3%	10.6%	6.1%	8.5%
Disagree	43.2%	23.6%	44.7%	57.3%	51.1%
Agree	4.9%	8.5%	4.9%	1.2%	4.3%
Agree Strongly	35.3%	47.2%	30.9%	31.7%	30.9%
No Opinion	6.9%	8.5%	8.9%	3.7%	5.3%
Valid Cases	405	106	123	82	94
Elec cooking is clean					
Strongly Disagree	.7%	.9%	.8%	.0%	.0%
Disagree	2.5%	2.8%	.8%	1.2%	5.3%
Agree	9.9%	8.5%	8.1%	11.0%	12.8%
Agree Strongly	52.6%	46.2%	53.7%	57.3%	54.3%
No Opinion	34.3%	40.6%	36.6%	30.5%	27.7%
Valid Cases	405	106	123	82	94
If ele price is not problem, will use elec to cook					
Strongly Disagree	4.0%	5.7%	3.3%	3.7%	3.2%
Disagree	4.4%	3.8%	4.1%	7.3%	3.2%
Agree	7.9%	9.4%	8.9%	6.1%	6.4%
Agree Strongly	63.2%	56.6%	61.0%	64.6%	72.3%
No Opinion	20.5%	24.5%	22.8%	18.3%	14.9%
Valid Cases	405	106	123	82	94
Elec cooking expensive					
Strongly Disagree	13.6%	10.4%	18.7%	11.0%	12.8%
Disagree	35.1%	35.8%	36.6%	42.7%	25.5%
Agree	16.8%	15.1%	16.3%	12.2%	23.4%
Agree Strongly	28.6%	24.5%	23.6%	31.7%	37.2%
No Opinion	5.9%	14.2%	4.9%	2.4%	1.1%
Valid Cases	405	106	123	82	94

Table 7A. Household Attitude Toward Cooking With Charcoal

	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Like to cook with charcoal, because food tastes better					
Strongly Disagree	8.1%	9.4%	5.7%	9.8%	8.5%
Disagree	14.3%	13.2%	14.6%	20.7%	9.6%
Agree	18.8%	21.7%	15.4%	14.6%	23.4%
Agree Strongly	45.7%	39.6%	50.4%	42.7%	48.9%
No Opinion	13.1%	16.0%	13.8%	12.2%	9.6%
Valid Cases	405	106	123	82	94
Charcoal cook better					
Strongly Disagree	4.7%	2.8%	4.9%	4.9%	6.4%
Disagree	16.0%	15.1%	15.4%	23.2%	11.7%
Agree	18.5%	23.6%	15.4%	14.6%	20.2%
Agree Strongly	42.5%	34.9%	43.9%	43.9%	47.9%
No Opinion	18.3%	23.6%	20.3%	13.4%	13.8%
Valid Cases	405	106	123	82	94

Table 8A. Percentage of Households Using Each Type of Fuel by Income Class

Household Using Each Type of Fuel (percent)	All Income Classes	Income					
		Low	Low-Mid	Middle	High-Mid	High	Very Hi
Electricity (%).....	99.5	98.8	98.8	100.0	100.0	100.0	100.0
Charcoal (%).....	53.6	35.8	41.5	55.4	66.7	73.7	65.0
Firewood (%).....	63.5	66.7	68.3	66.3	63.0	57.9	47.5
Kerosene (%).....	2.2	2.5	1.2	1.2	4.9	2.6	.0
Diesel (%).....	8.9	3.7	8.5	12.0	9.9	10.5	10.0
LPG (%).....	1.7	.0	1.2	.0	3.7	2.6	5.0
Sawdust (%).....	19.5	25.9	22.0	24.1	13.6	18.4	5.0
Total Cases.....	405	81	82	83	81	38	40

Income Class	Income Range (Kips/Mo/HH)
Low	< 75,000
Low Middle	75,000 - 102,000
Middle	103,000 - 150,000
High-Middle	151,000 - 200,000
High	201,000 - 270,000
Very High	> 270,000

Table 9A. Percentage of Households Using Each Type of Fuel

Household Using Each Type of Fuel (percent)	All 4 Districts	District Code Number			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Electricity (%).....	99.5	99.1	100.0	100.0	98.9
Charcoal (%).....	53.6	45.3	55.3	43.9	69.1
Firewood (%).....	63.5	50.4	55.3	74.4	68.1
Kerosene (%).....	2.2	1.9	.8	1.2	5.3
Diesel (%).....	8.9	12.3	4.1	8.5	11.7
LPG (%).....	1.7	2.8	3.3	.0	.0
Sawdust (%).....	19.5	18.9	17.1	19.5	23.4
Total Cases.....	405	106	123	82	94

Table 10A. Percentage of Households Using Charcoal

Does HH use charcoal?	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Very Often/Always.....	134	28	39	21	46
(percent).....	33.1%	26.4%	31.7%	25.6%	48.9%
Sometimes.....	83	20	29	15	19
(percent).....	20.5%	18.9%	23.6%	18.3%	20.2%
Not Used.....	188	58	55	46	29
(percent).....	46.4%	54.7%	44.7%	56.1%	30.9%
Total Responses.....	405	106	123	82	94
(percent).....	100.0%	100.0%	100.0%	100.0%	100.0%

Table 11A. Percentage of Households Using Firewood

Does HH use firewood?	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Very Often/Always.....	195	45	47	49	54
(percent).....	48.1%	42.5%	38.2%	59.8%	57.4%
Sometimes.....	62	19	21	12	10
(percent).....	15.3%	17.9%	17.1%	14.6%	10.6%
Not Used.....	148	42	55	21	30
(percent).....	36.5%	39.6%	44.7%	25.6%	31.9%
Total Responses.....	405	106	123	82	94
(percent).....	100.0%	100.0%	100.0%	100.0%	100.0%

Table 12A. Percentage of Households Using Kerosene

Use kerosene?	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Very Often/Always.....	4	0	0	1	3
(percent).....	1.0%	.0%	.0%	1.2%	3.2%
Sometimes.....	5	2	1	0	2
(percent).....	1.2%	1.9%	.8%	.0%	2.1%
Not Used.....	396	104	122	81	89
(percent).....	97.8%	98.1%	99.2%	98.8%	94.7%
Total Responses.....	405	106	123	82	94
(percent).....	100.0%	100.0%	100.0%	100.0%	100.0%

Table 13A. Percentage of Households Using Diesel

Do you use diesel?	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Very Often/Always.....	21	4	3	5	9
(percent).....	5.2%	3.8%	2.4%	6.1%	9.6%
Sometimes.....	15	9	2	2	2
(percent).....	3.7%	8.5%	1.6%	2.4%	2.1%
Not Used.....	369	93	118	75	83
(percent).....	91.1%	87.7%	95.9%	91.5%	88.3%
Total Responses.....	405	106	123	82	94
(percent).....	100.0%	100.0%	100.0%	100.0%	100.0%

Table 14A. Percentage of Households Using LPG

Do you use LPG?	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Very Often/Always.....	6	3	3	0	0
(percent).....	1.5%	2.8%	2.4%	.0%	.0%
Sometimes.....	1	0	1	0	0
(percent).....	.2%	.0%	.8%	.0%	.0%
Not Used.....	398	103	119	82	94
(percent).....	98.3%	97.2%	96.7%	100.0%	100.0%
Total Responses.....	405	106	123	82	94
(percent).....	100.0%	100.0%	100.0%	100.0%	100.0%

Table 15A. Percentage of Households Using Charcoal by Income Class

Household Using Charcoal (in percent)	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Very Often/Always.....	22.2%	18.8%	20.0%	20.0%	35.7%
Sometimes.....	13.6%	21.9%	5.0%	.0%	21.4%
Not Used.....	64.2%	59.4%	75.0%	80.0%	42.9%
Total.....	81	32	20	15	14
Income 75,000-102,000					
Very Often/Always.....	29.3%	30.4%	20.8%	27.8%	41.2%
Sometimes.....	12.2%	13.0%	16.7%	16.7%	.0%
Not Used.....	58.5%	56.5%	62.5%	55.6%	58.8%
Total.....	82	23	24	18	17
Income 103,000-150,000					
Very Often/Always.....	31.3%	26.3%	23.1%	26.3%	52.6%
Sometimes.....	24.1%	21.1%	30.8%	15.8%	26.3%
Not Used.....	44.6%	52.6%	46.2%	57.9%	21.1%
Total.....	83	19	26	19	19
Income 151,000-200,000					
Very Often/Always.....	43.2%	30.8%	46.4%	33.3%	52.0%
Sometimes	23.5%	7.7%	32.1%	20.0%	24.0%
Not Used.....	33.3%	61.5%	21.4%	46.7%	24.0%
Total.....	81	13	28	15	25
Income 201,000-270,000					
Very Often/Always.....	50.0%	44.4%	46.2%	20.0%	72.7%
Sometimes.....	23.7%	11.1%	23.1%	60.0%	18.2%
Not Used.....	26.3%	44.4%	30.8%	20.0%	9.1%
Total.....	38	9	13	5	11
Income > 270,000					
Very Often/Always.....	30.0%	20.0%	41.7%	20.0%	37.5%
Sometimes.....	35.0%	40.0%	33.3%	30.0%	37.5%
Not Used.....	35.0%	40.0%	25.0%	50.0%	25.0%
Total.....	40	10	12	10	8
Grand Total.....	405	106	123	82	94

Table 16A. Percentage of Households Using Firewood by Income Class

Household Using Firewood (in percent)	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Very Often/Always.....	50.6%	34.4%	55.0%	66.7%	64.3%
Sometimes.....	16.0%	25.0%	15.0%	6.7%	7.1%
Not Used.....	33.3%	40.6%	30.0%	26.7%	28.6%
Total.....	81	32	20	15	14
Income 75,000-102,000					
Very Often/Always.....	51.2%	47.8%	33.3%	55.6%	76.5%
Sometimes.....	17.1%	17.4%	20.8%	22.2%	5.9%
Not Used.....	31.7%	34.8%	45.8%	22.2%	17.6%
Total.....	82	23	24	18	17
Income 103,000-150,000					
Very Often/Always.....	60.2%	57.9%	53.8%	73.7%	57.9%
Sometimes.....	6.0%	10.5%	3.8%	5.3%	5.3%
Not Used.....	33.7%	31.6%	42.3%	21.1%	36.8%
Total.....	83	19	26	19	19
Income 151,000-200,000					
Very Often/Always.....	42.0%	53.8%	25.0%	60.0%	44.0%
Sometimes.....	21.0%	15.4%	28.6%	20.0%	16.0%
Not Used.....	37.0%	30.8%	46.4%	20.0%	40.0%
Total.....	81	13	28	15	25
Income 201,000-270,000					
Very Often/Always.....	39.5%	33.3%	30.8%	40.0%	54.5%
Sometimes.....	18.4%	11.1%	15.4%	20.0%	27.3%
Not Used.....	42.1%	55.6%	53.8%	40.0%	18.2%
Total.....	38	9	13	5	11
Income > 270,000					
Very Often/Always.....	32.5%	20.0%	25.0%	40.0%	50.0%
Sometimes.....	15.0%	20.0%	16.7%	20.0%	.0%
Not Used.....	52.5%	60.0%	58.3%	40.0%	50.0%
Total.....	40	10	12	10	8
Grand Total.....	405	106	123	82	94

Table 17A. Percentage of Households Using Kerosene by Income Class

Household Using Kerosene (in percent)	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Very Often/Always.....	2.5%	.0%	.0%	.0%	14.3%
Not Used.....	97.5%	100.0%	100.0%	100.0%	85.7%
Total.....	81	32	20	15	14
Income 75,000-102,000					
Sometimes.....	1.2%	.0%	4.2%	.0%	.0%
Not Used.....	98.8%	100.0%	95.8%	100.0%	100.0%
Total.....	82	23	24	18	17
Income 103,000-150,000					
Sometimes.....	1.2%	5.3%	.0%	.0%	.0%
Not Used.....	98.8%	94.7%	100.0%	100.0%	100.0%
Total.....	83	19	26	19	19
Income 151,000-200,000					
Very Often/Always.....	2.5%	.0%	.0%	6.7%	4.0%
Sometimes.....	2.5%	7.7%	.0%	.0%	4.0%
Not Used.....	95.1%	92.3%	100.0%	93.3%	92.0%
Total.....	81	13	28	15	25
Income 201,000-270,000					
Sometimes.....	2.6%	.0%	.0%	.0%	9.1%
Not Used.....	97.4%	100.0%	100.0%	100.0%	90.9%
Total.....	38	9	13	5	11
Income > 270,000					
Not Used.....	100.0%	100.0%	100.0%	100.0%	100.0%
Total.....	40	10	12	10	8
Grand Total.....	405	106	123	82	94

Table 18A. Percentage of Households Using Diesel by Income Class

Household Using Diesel (in percent)	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Very Often/Always.....	1.2%	3.1%	.0%	.0%	.0%
Sometimes.....	2.5%	6.3%	.0%	.0%	.0%
Not Used.....	96.3%	90.6%	100.0%	100.0%	100.0%
Total.....	81	32	20	15	14
Income 75,000-102,000					
Very Often/Always.....	6.1%	8.7%	4.2%	5.6%	5.9%
Sometimes.....	2.4%	8.7%	.0%	.0%	.0%
Not Used.....	91.5%	82.6%	95.8%	94.4%	94.1%
Total.....	82	23	24	18	17
Income 103,000-150,000					
Very Often/Always.....	6.0%	.0%	3.8%	5.3%	15.8%
Sometimes.....	6.0%	10.5%	3.8%	5.3%	5.3%
Not Used.....	88.0%	89.5%	92.3%	89.5%	78.9%
Total.....	83	19	26	19	19
Income 151,000-200,000					
Very Often/Always.....	4.9%	.0%	3.6%	13.3%	4.0%
Sometimes.....	4.9%	15.4%	.0%	6.7%	4.0%
Not Used.....	90.1%	84.6%	96.4%	80.0%	92.0%
Total.....	81	13	28	15	25
Income 201,000-270,000					
Very Often/Always.....	10.5%	.0%	.0%	20.0%	27.3%
Not Used.....	89.5%	100.0%	100.0%	80.0%	72.7%
Total.....	38	9	13	5	11
Income > 270,000					
Very Often/Always.....	5.0%	10.0%	.0%	.0%	12.5%
Sometimes.....	5.0%	10.0%	8.3%	.0%	.0%
Not Used.....	90.0%	80.0%	91.7%	100.0%	87.5%
Total.....	40	10	12	10	8
Grand Total.....	405	106	123	82	94

Table 19A. Percentage of Households Using LPG by Income Class

Household Using LPG (in percent)	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Not Used.....	100.0%	100.0%	100.0%	100.0%	100.0%
Total.....	81	32	20	15	14
Income 75 102,000					
Very Often/Always.....	1.2%	4.3%	.0%	.0%	.0%
Not Used.....	98.8%	95.7%	100.0%	100.0%	100.0%
Total.....	82	23	24	18	17
Income 103,000-150,000					
Not Used.....	100.0%	100.0%	100.0%	100.0%	100.0%
Total.....	83	19	2o	19	19
Income 151,000-200,000					
Very Often/Always.....	2.5%	.0%	7.1%	.0%	.0%
Sometimes.....	1.2%	.0%	3.6%	.0%	.0%
Not Used.....	96.3%	100.0%	89.3%	100.0%	100.0%
Total.....	81	13	28	15	25
Income 201,000-270,000					
Very Often/Always.....	2.6%	.0%	7.7%	.0%	.0%
Not Used.....	97.4%	100.0%	92.3%	100.0%	100.0%
Total.....	38	9	13	5	11
Income > 270,000					
Very Often/Always.....	5.0%	20.0%	.0%	.0%	.0%
Not Used.....	95.0%	80.0%	100.0%	100.0%	100.0%
Total.....	40	10	12	10	8
Grand Total.....	405	106	123	82	94

Table 20A. Average Monthly Electricity Consumption (Kwh) per Household, Users Only

Total Electricity Consumption kWh/Month/Household	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean.....	198.70	231.24	221.23	130.26	116.13
Valid Cases.....	64	28	18	12	6
Income 75,000-102,000					
Mean.....	178.35	232.25	191.06	131.10	133.74
Valid Cases.....	65	20	17	17	11
Income 103,000-150,000					
Mean.....	197.22	158.85	248.26	213.34	146.11
Valid Cases.....	73	16	24	16	17
Income 151,000-200,000					
Mean.....	272.77	310.82	316.79	244.52	219.13
Valid Cases.....	78	13	27	14	24
Income 201,000-270,000					
Mean.....	384.84	377.27	533.81	360.70	223.76
Valid Cases.....	37	9	13	4	11
Income > 270,000					
Mean.....	605.55	578.02	734.59	633.29	406.50
Valid Cases.....	35	9	11	8	7
All Income Class, Kwh/Month					
Mean.....	271.07	276.84	334.20	241.38	200.23
Valid Cases.....	352	95	110	71	76

Table 21A. Average Monthly Electricity Consumption (KGOE) per Household, Users Only

Total Electricity Consumption KGOE/Month/Household	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income Class					
Income < 75,000					
Mean	17.08	19.88	19.02	11.20	9.99
Valid Cases	64	28	18	12	6
Income 75,000-102,000					
Mean	15.34	19.97	16.43	11.27	11.50
Valid Cases	65	20	17	17	11
Income 103,000-150,000					
Mean	16.96	13.66	21.35	18.34	12.56
Valid Cases	73	16	24	16	17
Income 151,000-200,000					
Mean	23.45	26.73	27.24	21.03	18.84
Valid Cases	76	13	27	14	24
Income 201,000-270,000					
Mean	33.09	32.44	45.90	31.01	19.24
Valid Cases	37	9	13	4	11
Income > 270,000					
Mean	52.07	49.70	63.16	54.45	34.95
Valid Cases	35	9	11	8	7
All Income Class, (KGOE/Month)					
Mean	23.31	23.80	28.74	20.75	17.22
Valid Cases	352	95	110	71	76

1) 1 Kilogram of Oil Equivalent (KGOE) = 11.63 Kwh
2) Cases with missing electricity consumption information are not included for this calculation.

Table 22A. Average Monthly Expenditure for Electricity per Household, Users Only

Expenditure on Electricity kWh/Month/Household	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	1826.57	2162.88	2151.84	1001.25	931.91
Valid Cases	64	28	18	12	6
Income 75,000-102,000					
Mean	1483.20	2133.52	1535.02	1017.89	939.84
Valid Cases	65	20	17	17	11
Income 103,000-150,000					
Mean	1757.77	1244.78	2402.67	1954.76	1144.74
Valid Cases	73	16	24	16	17
Income 151,000-200,000					
Mean	2638.30	3142.62	3251.56	2136.94	1967.67
Valid Cases	78	13	27	14	24
Income 201,000-270,000					
Mean	4167.39	3959.85	6239.52	3728.68	2047.84
Valid Cases	37	9	13	4	11
Income > 270,000					
Mean	7142.66	6728.01	8940.57	7493.57	4449.47
Valid Cases	35	9	11	8	7
All Income Class, Kips/Month					
Mean	2703.41	2738.87	3543.13	2329.24	1793.25
Valid Cases	352	95	110	71	76

1) Monthly Meter Fee are Excluded.

Table 23A. Average Monthly Electricity Consumption (Kwh) for Lighting per Household, Users Only

Electricity Consumption for Lighting Kwh/Month/HH	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean.....	23.67	20.78	26.91	25.72	23.40
Valid cases.....	80	32	20	15	13
Income 75,000-102,000					
Mean.....	30.44	26.67	32.32	30.27	32.82
Valid cases.....	81	22	24	18	17
Income 103,000-150,000					
Mean.....	36.23	33.10	33.69	44.59	34.47
Valid cases.....	83	19	26	19	19
Income 151,000-200,000					
Mean.....	48.36	45.22	50.52	42.17	51.28
Valid cases.....	81	13	28	15	25
Income 201,000-270,000					
Mean.....	52.56	63.20	54.28	42.57	46.36
Valid cases.....	38	9	13	5	11
Income > 270,000					
Mean.....	74.40	53.18	82.25	94.98	63.45
Valid cases.....	40	10	12	10	8
All Income Class, Kwh/Month					
Mean.....	40.34	33.99	43.07	43.57	41.04
Valid cases.....	403	105	123	82	93

1) All households that have electricity Connection are included for this Calculation.

Table 24A. Average Monthly Electricity Consumption for Lighting per Household (In KGOE), Users Only

Electricity Consumption for Lighting KGOE/Month/HH (Income Class)	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	2.03	1.79	2.31	2.21	2.01
Valid Cases	80	32	20	15	13
Income 75,000-102,000					
Mean	2.62	2.29	2.78	2.60	2.82
Valid Cases	81	22	24	18	17
Income 103,000-150,000					
Mean	3.12	2.85	2.90	3.83	2.96
Valid Cases	83	19	26	19	19
Income 151,000-200,000					
Mean	4.16	3.89	4.34	3.63	4.41
Valid Cases	81	13	28	15	25
Income 201,000-270,000					
Mean	4.52	5.43	4.67	3.66	3.99
Valid Cases	38	9	13	5	11
Income > 270,000					
Mean	6.40	4.57	7.07	8.17	5.46
Valid Cases	40	10	12	10	8
All Income Class, (KGOE/Month)					
Mean	3.47	2.92	3.70	3.75	3.53
Valid Cases	403	105	123	82	93

1) 1 Kilogram of Oil Equivalent (KGOE) = 11.63 Kwh

Table 25A. Average Percentage of Electricity Used for Lighting to Total Electricity Used, Users Only

Percentage of Elec. for Lighting to Total Elec. Used	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean.....	22.71	14.12	24.04	34.91	34.38
Valid cases.....	64	28	18	12	6
Income 75,000-102,000					
Mean.....	24.38	17.43	18.51	33.89	31.38
Valid cases.....	65	20	17	17	11
Income 103,000-150,000					
Mean.....	27.30	22.75	24.00	30.60	33.15
Valid cases.....	73	16	24	16	17
Income 151,000-200,000					
Mean.....	25.46	23.58	25.29	19.91	29.92
Valid cases.....	78	13	27	14	24
Income 201,000-270,000					
Mean.....	22.87	24.47	17.28	22.02	28.49
Valid cases.....	37	9	13	4	11
Income > 270,000					
Mean.....	19.03	14.84	15.18	19.63	29.90
Valid cases.....	35	9	11	8	7
All Income Class					
Mean.....	24.23	18.61	21.79	28.29	31.00
Valid cases.....	352	95	110	71	76

1) All households that have electricity connection are included for this Calculation.
2) Cases with missing electricity consumption information are not included for this calculation.

Table 26A. Average Number of Electric Lamps Installed in the Home, Users Only

Number of Lamps in the Household	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean.....	3.86	4.28	3.85	3.27	3.54
Valid cases.....	80	32	20	15	13
Income 75,000-102,000					
Mean.....	4.94	5.05	5.29	5.11	4.12
Valid cases.....	81	22	24	18	17
Income 103,000-150,000					
Mean.....	5.67	5.68	5.73	6.05	5.21
Valid cases.....	83	19	26	19	19
Income 151,000-200,000					
Mean.....	7.49	7.69	7.54	7.27	7.48
Valid cases.....	81	13	28	15	25
Income 201,000-270,000					
Mean.....	8.74	9.44	10.08	6.40	7.64
Valid cases.....	38	9	13	5	11
Income > 270,000					
Mean.....	13.10	12.20	14.08	15.60	9.63
Valid cases.....	40	10	12	10	8
All Income Class					
Mean.....	6.56	6.31	7.02	6.74	6.05
Valid cases.....	403	105	123	82	93

1) All households that have electricity connection are included for this calculation.

Table 27A. Average Ratio of Incandescent Wattage to Fluorescent Wattage Used for Lighting in the Household, Users Only

Ratio of Incandescent Wattage to Florescent Wattage	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean.....	1.50	2.16	.83	1.49	1.00
Valid cases.....	74	29	19	13	13
Income 75,000-102,000					
Mean.....	1.39	.83	1.21	.96	2.96
Valid cases.....	74	20	24	16	14
Income 103,000-150,000					
Mean.....	1.43	1.26	1.64	1.20	1.54
Valid cases.....	78	18	24	17	19
Income 151,000-200,000					
Mean.....	.94	.90	.86	.66	1.08
Valid cases.....	81	13	28	15	25
Income 201,000-270,000					
Mean.....	1.29	1.46	1.11	.85	1.58
Valid cases.....	38	9	13	5	11
Income > 270,000					
Mean.....	.76	.68	.81	.78	.74
Valid cases.....	40	10	12	10	8
All Income Class, Wattage Ratio					
Mean.....	1.25	1.35	1.10	1.05	1.49
Valid cases.....	385	99	120	76	90

1) All households that have electricity connection are are included for this calculation.

Table 28A. Household Electric Appliance Ownership

Household Appliance Ownership (in percentage)	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Refrigerator (%)	61.0	62.9	65.9	56.1	57.0
Freezer (%)	3.0	1.9	4.0	4.8	1.0
Fan (%)	96.3	93.3	98.4	95.1	97.8
Aircondition (%)	13.9	14.3	17.9	14.6	7.5
Iron (%)	73.4	71.4	78.0	70.7	72.0
Washing Machine (%)	6.5	6.7	7.3	7.3	4.3
Water Pump (%)	5.7	7.6	4.1	8.5	3.2
Air Pump (%)	1.7	1.9	2.4	2.4	.0
B&W TV (%)	40.4	40.0	37.4	41.5	44.1
Color TV (%)	46.7	46.7	52.0	43.9	41.9
Video Machine (%)	15.4	12.4	21.1	12.2	14.0
Rice Cooker (%)	41.2	43.8	43.9	36.6	38.7
Hot Plate (%)	59.8	68.6	60.2	62.2	47.3
Oven (%)	12.4	11.4	17.1	12.2	7.5
Elec. Wok (%)	11.9	11.4	13.0	8.5	14.0
Elec Kettle (%)	12.7	13.3	12.2	14.6	10.8
Elec Torch (%)	29.0	27.6	28.5	35.4	25.8
Total Cases	403	105	123	82	93

Table 29A. Household Electric Appliance Ownership by Income Class

Household Appliance Ownership (in percent)	All Income Classes	Income Class					
		Low	Low-Mid	Middle	High-Mid	High	Very Hi
Refrigerator (%)	61.0	41.3	45.7	51.8	79.0	78.9	97.5
Freezer (%)	3.0	.0	.0	3.6	3.7	7.9	7.5
Fan (%)	96.3	87.5	96.3	98.8	100.0	100.0	97.5
Aircondition (%)	13.9	1.3	2.5	6.0	16.0	34.2	55.0
Iron (%)	73.4	52.5	64.2	72.3	88.9	89.5	90.0
Washing Machine (%)	6.5	2.5	1.2	3.6	11.1	5.3	22.5
Water Pump (%)	5.7	3.8	4.9	6.0	9.9	2.6	5.0
Air Pump (%)	1.7	1.3	1.2	1.2	3.7	.0	2.5
B&W TV (%)	40.4	42.5	46.9	54.2	27.2	39.5	22.5
Color TV (%)	46.7	21.3	33.3	34.9	66.7	71.1	85.0
Video Machine (%)	15.4	.0	8.6	14.5	22.2	18.4	45.0
Rice Cooker (%)	41.2	20.0	21.0	34.9	60.5	57.9	82.5
Hot Plate (%)	59.8	57.5	51.9	50.6	63.0	71.1	82.5
Oven (%)	12.4	3.8	2.5	10.8	16.0	21.1	37.5
Elec. Wok (%)	11.9	2.5	3.7	2.4	16.0	23.7	47.5
Elec Kettle (%)	12.7	3.8	7.4	7.2	17.3	13.2	42.5
Elec Torch (%)	29.0	21.3	30.9	28.9	27.2	26.3	47.5
Total Cases	403	80	81	83	81	38	40

Income Class	Income Range (Kips/Mo/HH)
Low	< 75,000
Low-Middle	75,000 - 102,000
Middle	103,000 - 150,000
High-Middle	151,000 - 200,000
High	201,000 - 270,000
Very High	> 270,000

Table 35A. Average Amount (Kilogram) of Monthly Charcoal Consumption per Household, Charcoal Users Only

Total Charcoal Consumption Household/Kg/Month	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	42.60	32.15	34.50	65.00	56.25
Valid Cases	29	13	5	3	8
Income 75,000-102,000					
Mean	53.15	79.75	38.22	38.81	50.71
Valid Cases	34	10	9	8	7
Income 103,000-150,000					
Mean	46.94	36.39	38.13	59.69	54.70
Valid Cases	46	9	14	8	15
Income 151,000-200,000					
Mean	63.38	43.00	81.00	42.75	57.03
Valid Cases	34	5	22	8	19
Income 201,000-270,000					
Mean	122.25	44.00	235.11	43.00	91.50
Valid Cases	28	5	9	4	10
Income > 270,000					
Mean	69.96	16.75	104.44	58.30	81.17
Valid Cases	25	6	9	5	6
All Income Class, Kg/Month					
Mean	63.90	43.30	86.59	49.68	63.25
Valid Cases	217	48	68	36	64

Table 36A. Average Amount (in KGOE) of Monthly Charcoal Consumption per Household, Charcoal Users Only

Total Charcoal Consumption KGOE/Month/Household	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	29.52	22.28	23.90	45.03	38.97
Valid Cases	29	13	5	3	8
Income 75,000-102,000					
Mean	36.82	55.25	26.48	26.89	35.14
Valid Cases	34	10	9	8	7
Income 103,000-150,000					
Mean	32.52	25.21	26.42	41.35	37.90
Valid Cases	46	9	14	8	15
Income 151,000-200,000					
Mean	43.91	29.79	56.12	29.62	39.51
Valid Cases	54	5	22	8	19
Income 201,000-270,000					
Mean	84.70	30.48	162.89	29.79	63.39
Valid Cases	28	5	9	4	10
Income > 270,000					
Mean	48.47	11.61	72.36	40.39	56.24
Valid Cases	26	6	9	5	6
All Income Class					
Mean	44.27	30.00	59.99	34.42	43.82
Valid Cases	217	48	68	36	65

KGOE: Kilogram of Oil Equivalent

Table 37A. Average Monthly Expenditure for Charcoal, Charcoal Users Only

Household Expenditure on Charcoal (Kns/Month)	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	2034	1938	1320	2533	2450
Valid Cases	29	13	5	3	8
Income 75,000-102,000					
Mean	2188	2825	2078	1869	1786
Valid Cases	34	10	9	8	7
Income 103,000-150,000					
Mean	2339	1944	2779	2669	1990
Valid Cases	46	9	14	8	15
Income 151,000-200,000					
Mean	3791	2320	5973	1983	2414
Valid Cases	54	5	22	8	19
Income 201,000-270,000					
Mean	5904	2420	13178	850	3120
Valid Cases	28	5	9	4	10
Income > 270,000					
Mean	2734	1308	3900	2740	2407
Valid Cases	26	6	9	5	6
All Income Class, Kns/Month					
Mean	3143	2135	5137	2135	2361
Valid Cases	217	48	68	36	65

Table 38A. Average Amount (Kilogram) of Monthly Firewood Consumption per Household, Firewood Users Only

Total Firewood Consumption Household/Kg/Month	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	49.70	45.23	82.15	36.47	28.80
Valid Cases	51	18	13	10	10
Income 75,000-102,000					
Mean	87.34	111.38	41.64	120.68	70.69
Valid Cases	56	15	13	14	14
Income 103,000-150,000					
Mean	91.15	81.80	109.90	115.93	46.88
Valid Cases	55	13	15	15	12
Income 151,000-200,000					
Mean	139.59	36.28	159.71	191.00	133.45
Valid Cases	50	8	15	12	15
Income 201,000-270,000					
Mean	92.74	67.13	146.57	25.80	90.56
Valid Cases	22	4	6	3	9
Income > 270,000					
Mean	202.58	27.37	72.51	466.85	100.18
Valid Cases	18	3	5	6	4
All Income Class, Kg/Month					
Mean	99.63	68.67	102.92	149.39	79.02
Valid Cases	252	61	67	60	64

Table 39A. Average Amount (in KGOE) of Monthly Firewood Consumption per Household, Firewood Users Only

Total Firewood Consumption KGOE/Month/Household	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	18.37	16.71	30.36	13.48	10.64
Valid Cases	51	18	13	10	10
Income 75,000-102,000					
Mean	32.27	41.16	15.39	44.59	26.12
Valid Cases	56	15	13	14	14
Income 103,000-150,000					
Mean	33.68	30.22	40.61	42.84	17.32
Valid Cases	55	13	15	15	12
Income 151,000-200,000					
Mean	51.58	13.40	59.01	70.58	49.31
Valid Cases	50	8	15	12	15
Income 201,000-270,000					
Mean	34.27	24.80	54.16	9.53	33.46
Valid Cases	22	4	6	3	9
Income > 270,000					
Mean	74.86	10.11	26.79	172.51	37.02
Valid Cases	18	3	5	6	4
All Income Class					
Mean	36.81	25.38	38.03	55.20	29.20
Valid Cases	252	61	67	60	64

KGOE: Kilogram of Oil Equivalent

Table 40A. Average Monthly Expenditure for Firewood, Firewood Users Only

Household Expenditure on Firewood (Kns/Month)	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	1812	2005	1980	1525	1467
Valid Cases	33	11	10	6	6
Income 75,000-102,000					
Mean	2346	3185	1500	2310	2383
Valid Cases	42	10	10	10	12
Income 103,000-150,000					
Mean	2558	2635	3002	2675	1740
Valid Cases	47	10	13	14	10
Income 151,000-200,000					
Mean	4306	3075	4696	4733	3935
Valid Cases	41	4	13	11	13
Income 201,000-270,000					
Mean	3182	2167	6075	1125	2631
Valid Cases	17	3	4	2	8
Income > 270,000					
Mean	9389	2000	7500	15750	4000
Valid Cases	9	1	1	4	3
All Income Class, Kips/Month					
Mean	3142	2591	3268	3979	2673
Valid Cases	189	39	51	47	52

Table 41A. Average Amount (Liter) of Monthly Kerosene Consumption per Household, Kerosene Users Only

Total Kerosene Consumption Household/Kg/Month	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	2.00	.	.	.	2.00
Valid Cases	2	0	0	0	2
Income 75,000-102,000					
Mean	2.00	.	2.00	.	.
Valid Cases	1	0	1	0	0
Income 103,000-150,000					
Mean	1.13	1.13	.	.	.
Valid Cases	1	1	0	0	0
Income 151,000-200,000					
Mean	6.13	1.00	.	2.00	10.75
Valid Cases	4	1	0	1	2
Income 201,000-270,000					
Mean	10.00	.	.	.	10.00
Valid Cases	1	0	0	0	1
All Income Class, Lr/Month					
Mean	4.63	1.06	2.00	2.00	7.10
Valid Cases	9	2	1	1	5

Table 42A. Average Amount (in KGOE) of Monthly Kerosene Consumption per Household, Kerosene Users Only

Total Kerosene Consumption KGOE/Month/Household	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	1.63	.	.	.	1.63
Valid Cases	2	0	0	0	2
Income 75,000-102,000					
Mean	1.63	.	1.63	.	.
Valid Cases	1	0	1	0	0
Income 103,000-150,000					
Mean	.92	.92	.	.	.
Valid Cases	1	1	0	0	0
Income 151,000-200,000					
Mean	5.00	.82	.	1.63	8.78
Valid Cases	4	1	0	1	2
Income 201,000-270,000					
Mean	8.17	.	.	.	8.17
Valid Cases	1	0	0	0	1
All Income Class					
Mean	3.78	.87	1.63	1.63	5.80
Valid Cases	9	2	1	1	5

KGOE: Kilogram of Oil Equivalent

Table 43A. Average Monthly Expenditure for Kerosene, Kerosene Users Only

Household Expenditure on Kerosene (Kns/Month)	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	475	.	.	.	475
Valid Cases	2	0	0	0	2
Income 75,000-102,000					
Mean	640	.	640	.	.
Vali . Cases	1	0	1	0	0
Income 103,000-150,000					
Mean	480	480	.	.	.
Valid Cases	1	1	0	0	0
Income 151,000-200,000					
Mean	1428	240	.	470	2500
Valid Cases	4	1	0	1	2
Income 201,000-270,000					
Mean	2000	.	.	.	2000
Valid Cases	1	0	0	0	1
All Income Class, Kips/Month					
Mean	1087	360	640	470	1590
Valid Cases	9	2	1	1	5

Table 44A. Average Amount (Liter) of Monthly Diesel Consumption per Household, Diesel Users Only

Total Diesel Consumption Household/Kg/Month	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	2.7	2.7	.	.	.
Valid Cases	3	3	0	0	0
Income 75,000-102,000					
Mean	2.0	1.0	5.0	2.0	3.0
Valid Cases	7	4	1	1	1
Income 103,000-150,000					
Mean	2.1	1.3	2.0	1.5	2.8
Valid Cases	10	2	2	2	4
Income 151,000-200,000					
Mean	1.6	.8	5.0	1.3	1.0
Valid Cases	8	2	1	3	2
Income 201,000-270,000					
Mean	1.1	.	.	.5	1.3
Valid Cases	4	0	0	1	3
Income > 270,000					
Mean	1.9	2.8	1.0	.	1.0
Valid Cases	4	2	1	0	1
All Income Class, Lr/Month					
Mean	1.9	1.7	3.0	1.4	1.9
Valid Cases	36	13	5	7	11

Table 45A. Average Amount (in KGOE) of Monthly Diesel Consumption per Household, Diesel Users Only

Total Diesel Consumption KGOE/Month/Household	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	2.16	2.16	.	.	.
Valid Cases	3	3	0	0	0
Income 75,000-102,000					
Mean	1.62	.81	4.04	1.62	2.43
Valid Cases	7	4	1	1	1
Income 103,000-150,000					
Mean	1.66	1.01	1.62	1.21	2.22
Valid Cases	10	2	2	2	4
Income 151,000-200,000					
Mean	1.26	.61	4.04	1.08	.81
Valid Cases	8	2	1	3	2
Income 201,000-270,000					
Mean	.91	.	.	.40	1.08
Valid Cases	4	0	0	1	3
Income > 270,000					
Mean	1.52	2.22	.81	.	.81
Valid Cases	4	2	1	0	1
All Income Class					
Mean	1.51	1.34	2.43	1.10	1.54
Valid Cases	36	13	5	7	11

KGOE: Kilogram of Oil Equivalent

Table 46A. Average Monthly Expenditure for Diesel, Diesel Users Only

Household Expenditure on Diesel (Kns/Month)	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	623.33	623.33	.	.	.
Valid Cases	3	3	0	0	0
Income 75,000-102,000					
Mean	467.43	236.50	1190.00	476.00	660.00
Valid Cases	7	4	1	1	1
Income 103,000-150,000					
Mean	978.30	287.50	450.00	375.00	1889.50
Valid Cases	10	2	2	2	4
Income 151,000-200,000					
Mean	374.50	175.00	1250.00	306.00	239.00
Valid Cases	8	2	1	3	2
Income 201,000-270,000					
Mean	257.50	.	.	119.00	303.67
Valid Cases	4	0	0	1	3
Income > 270,000					
Mean	447.50	652.50	240.00	.	245.00
Valid Cases	4	2	1	0	1
All Income Class, Kns/Month					
Mean	576.14	388.15	716.00	323.29	895.64
Valid Cases	36	13	5	7	11

Table 47A. Average Amount (Kilogram) of Monthly LPG Consumption per Household, LPG Users Only

Total LPG Consumption KGOE/Month/Household	All 4 Districts	District	
		Sysattanak	Chantabouri
Income 75,000-102,000			
Mean	15.00	15.00	.
Valid Cases	1	1	0
Income 151,000-200,000			
Mean	21.67	.	21.67
Valid Cases	3	0	3
Income 201,000-270,000			
Mean	15.00	.	15.00
Valid Cases	1	0	1
Income > 270,000			
Mean	5.25	5.25	.
Valid Cases	2	2	0
All Income Class			
Mean	15.07	8.50	20.00
Valid Cases	7	3	4

Table 48A. Average Amount (in KGOE) of Monthly LPG Consumption per Household, LPG Users Only

Total LPG Consumption KGOE/Month/Household	All 4 Districts	District	
		Sysattanak	Chantabouri
Income 75,000-102,000			
Mean	15.90	15.90	.
Valid Cases	1	1	0
Income 151,000-200,000			
Mean	22.97	.	22.97
Valid Cases	3	0	3
Income 201,000-270,000			
Mean	15.90	.	15.90
Valid Cases	1	0	1
Income > 270,000			
Mean	5.57	5.57	.
Valid Cases	2	2	0
All Income Class			
Mean	15.98	9.01	21.20
Valid Cases	7	3	4

KGOE: Kilogram of Oil Equivalent

Table 49A. Average Monthly Expenditure for LPG, LPG Users Only

Household Expenditure on LPG (Kns/Month)	All 4 Districts	District	
		Sysattanak	Chantabouri
Income 75,000-102,000			
Mean	6450.00	6450.00	.
Valid Cases	1	1	0
Income 151,000-200,000			
Mean	9355.56	.	9355.56
Valid Cases	3	0	3
Income 201,000-270,000			
Mean	6500.00	.	6500.00
Valid Cases	1	0	1
Income > 270,000			
Mean	2150.00	2150.00	.
Valid Cases	2	2	0
All Income Class, Kns/Month			
Mean	6473.81	3583.33	8641.67
Valid Cases	7	3	4

Table 50A. Total Monthly Energy (in KGOE) Consumption per Household

Total Energy Consumption KGOE/Month/Household	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	40.93	40.41	47.59	27.09	49.68
Valid Cases	65	28	18	12	7
Income 75,000-102,000					
Mean	51.29	75.60	34.08	39.55	49.61
Valid Cases	66	21	17	17	11
Income 103,000-150,000					
Mean	57.17	43.52	61.35	67.62	54.30
Valid Cases	73	16	24	16	17
Income 151,000-200,000					
Mean	85.58	46.59	108.38	89.65	78.68
Valid Cases	78	13	27	14	24
Income 201,000-270,000					
Mean	118.28	60.40	184.89	67.71	105.29
Valid Cases	37	9	13	4	11
Income > 270,000					
Mean	115.91	58.87	115.73	198.68	94.92
Valid Cases	35	9	11	8	7
All Income Class					
Mean	71.55	53.07	86.46	73.17	71.79
Valid Cases	354	96	110	71	77

KGOE: Kilogram of Oil Equivalent

Table 51A. Total Monthly Energy (in KGOE) Consumption per Person in the Household

Total Energy Consumption KGOE/Month/Person	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	10.20	9.80	13.54	5.30	11.59
Valid Cases	65	28	18	12	7
Income 75,000-102,000					
Mean	9.29	14.09	6.06	7.12	8.50
Valid Cases	66	21	17	17	11
Income 103,000-150,000					
Mean	9.82	5.95	10.66	13.58	8.73
Valid Cases	73	16	24	16	17
Income 151,000-200,000					
Mean	11.89	6.39	15.43	11.31	11.23
Valid Cases	78	13	27	14	24
Income 201,000-270,000					
Mean	14.31	8.90	20.63	6.73	14.01
Valid Cases	37	9	13	4	11
Income > 270,000					
Mean	15.59	12.50	14.52	23.65	12.04
Valid Cases	35	9	11	8	7
All Income Class					
Mean	11.29	9.80	13.16	10.94	10.79
Valid Cases	354	96	110	71	77

KGOE: Kilogram of Oil Equivalent

Table 52A. Total Monthly Energy (in KGOE) Consumption per Household, All Households

Total Energy Consumption KGOE/Month/Household	FUELTYPE						
	Electric (KGOE)	Charcoal (KGOE)	Firewood (KGOE)	Kerosene (KGOE)	Diesel (KGOE)	LPG (KGOE)	Total (KGOE)
Cooking							
Mean	6.51	19.39	15.46	.06	.00	.25	41.68
Valid Cases	354	354	354	354	354	354	354
Ironing							
Mean	2.04	.01	.00	.00	.00	.00	2.05
Valid Cases	354	354	354	354	354	354	354
Lighting							
Mean	3.59	.00	.00	.01	.01	.00	3.61
Valid Cases	354	354	354	354	354	354	354
Business							
Mean	N/A	5.60	5.43	.00	.01	.07	11.10
Valid Cases	354	354	354	354	354	354	354
Other Uses							
Mean	11.03	.07	1.87	.01	.11	.00	13.10
Valid Cases	354	354	354	354	354	354	354
TOTKGOE							
Mean	23.17	25.07	22.77	.09	.13	.32	71.54
Valid Cases	354	354	354	354	354	354	354

1) KGOE: Kilogram of Oil Equivalent
2) Electricity Consumption for Cooking, Ironing, and Other are estimated.
3) Electricity Use for Business Available for this Calculation

Table 53A. Percentage of Energy Share in the Houseold

Type of Energy Average % Share	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Electricity					
Mean Percent Share.....	49.55	59.44	51.70	50.21	33.55
Valid Cases.....	354	96	110	71	77
Charcoal					
Mean Percent Share.....	25.01	19.64	25.72	16.64	38.42
Valid Cases.....	354	96	110	71	77
Firewood					
Mean Percent Share.....	24.66	19.79	21.99	32.84	27.02
Valid Cases.....	354	96	110	71	77
Kerosene					
Mean Percent Share.....	.20	.06	.00	.04	.79
Valid Cases.....	354	96	110	71	77
Diesel					
Mean Percent Share.....	.31	.56	.19	.27	.22
Valid Cases.....	354	96	110	71	77
LPG					
Mean Percent Share.....	.26	.51	.40	.00	.00
Valid Cases.....	354	96	110	71	77
Total Energy Consumed					
Mean (KGOE/Month).....	71.55	53.07	86.46	73.17	71.79
Valid Cases.....	354	96	110	71	77

Table 54A. Overall Household Energy Share (KGOE)

Energy Consumption KGOE/Month/Household	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Total Electricity Consumed					
Mean.....	23.18	23.56	28.74	20.75	16.99
Valid Cases.....	354	96	110	71	77
Total Charcoal Consumed					
Mean.....	25.07	14.53	34.91	14.93	33.49
Valid Cases.....	354	96	110	71	77
Total Wood Consumed					
Mean.....	22.77	14.50	21.98	37.36	20.77
Valid Cases.....	354	96	110	71	77
Total Kerosene Consumed					
Mean.....	.09	.02	.00	.02	.37
Valid Cases.....	354	96	110	71	77
Total Diesel Consumed					
Mean.....	.13	.18	.07	.11	.17
Valid Cases.....	354	96	110	71	77
Total LPG Consumed					
Mean.....	.32	.28	.77	.00	.00
Valid Cases.....	354	96	110	71	77
Total Energy Consumed					
Mean (KGOE/Month).....	71.55	53.07	86.46	73.17	71.79
Valid Cases.....	354	96	110	71	77

KGOE: Kilogram of Oil Equivalent

Table 57A. Percentage of Energy Share in the Household by Income

Type of Energy Average % Share	All Income Classes	Income					
		Low	Low-Mid	Middle	High-Mid	High	Very Hi
Electricity							
Mean Percent Share (%).....	49.55	53.93	47.73	44.35	47.43	45.35	64.88
Valid Cases.....	354	65	66	73	78	37	35
Charcoal							
Mean Percent Share (%).....	25.01	17.56	22.01	25.70	28.48	35.93	23.81
Valid Cases.....	354	65	66	73	78	37	35
Firewood							
Mean Percent Share (%).....	24.66	27.92	29.63	29.40	22.79	18.14	10.42
Valid Cases.....	354	65	66	73	78	37	35
Kerosene							
Mean Percent Share (%).....	.20	.09	.00	.04	.69	.19	.00
Valid Cases.....	354	65	66	73	78	37	35
Diesel							
Mean Percent Share (%).....	.31	.50	.20	.51	.18	.11	.29
Valid Cases.....	354	65	66	73	78	37	35
LPG							
Mean Percent Share (%).....	.26	.00	.43	.00	.43	.28	.59
Valid Cases.....	354	65	66	73	78	37	35
Total Energy Consumed							
Mean (KGOE/Month).....	71.55	40.93	51.29	57.17	85.58	118.28	115.91
Valid Cases.....	354	65	66	73	78	37	35

Income Class	Income Range (kips/Mo/HH)
Low	< 75,000
Low-Middle	75,000 - 102,000
Middle	103,000 - 150,000
High-Middle	151,000 - 200,000
High	201,000 - 270,000
Very High	> 270,000

Table 58A. Household Energy Share (KGOE) by Income

Energy Consumption KGOE/Month/Household	All Income Classes	Income					
		Low	Low-Mid	Middle	High-Mid	High	Very Hi
Total Electricity Consumed							
Mean	23.18	16.82	15.10	16.96	23.45	33.09	52.07
Valid Cases	354	65	66	73	78	37	35
Total Charcoal Consumed KGOE/Month							
Mean	25.07	10.93	16.68	18.76	30.21	64.06	27.59
Valid Cases	354	65	66	73	78	37	35
Total Wood Consumed							
Mean	22.77	13.04	19.19	21.24	30.64	20.38	35.75
Valid Cases	354	65	66	73	78	37	35
Total Kerosene Consumed							
Mean	.09	.04	.00	.01	.26	.22	.00
Valid Cases	354	65	66	73	78	37	35
Total Diesel Consumed							
Mean	.13	.10	.07	.20	.13	.10	.17
Valid Cases	354	65	66	73	78	37	35
Total LPG Consumed							
Mean	.32	.00	.24	.00	.88	.43	.32
Valid Cases	354	65	66	73	78	37	35
Total Energy Consumed							
Mean (KGOE/Month)	71.55	40.93	51.29	57.17	85.58	118.28	115.91
Valid Cases	354	65	66	73	78	37	35

Income Class	Income Range (kns/Mo/HH)
Low	< 75,000
Low-Middle	75,000 - 102,000
Middle	103,000 - 150,000
High-Middle	151,000 - 200,000
High	201,000 - 270,000
Very High	> 270,000

Table 61A. Total Monthly Expenditure (in Kips) for Energy Household

Total Energy Expenditure Kns/Month/Household	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	3470.77	3899.67	3618.51	1997.08	3901.64
Valid Cases	65	28	18	12	7
Income 75,000-102,000					
Mean	3808.03	5246.02	2899.73	3178.24	3439.84
Valid Cases	66	21	17	17	11
Income 103,000-150,000					
Mean	4580.14	3457.60	5604.75	4814.13	3969.91
Valid Cases	73	16	24	16	17
Income 151,000-200,000					
Mean	7895.77	5026.46	11454.03	6693.94	6148.00
Valid Cases	78	13	27	14	24
Income 201,000-270,000					
Mean	10349.28	6026.52	17731.83	5120.93	7062.48
Valid Cases	37	9	13	4	11
Income > 270,000					
Mean	10847.81	8167.45	11380.57	16143.57	7404.47
Valid Cases	35	9	11	8	7
All Income Class					
Mean	6185.73	4872.59	8308.20	5610.83	5320.89
Valid Cases	354	96	110	71	77

Table 61A. Total Monthly Expenditure (in Kips) for Energy Household

Total Energy Expenditure Kns/Month/Household	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	3470.77	3899.67	3618.51	1997.08	3901.64
Valid Cases	65	28	18	12	7
Income 75,000-102,000					
Mean	3808.03	5246.02	2899.73	3178.24	3439.84
Valid Cases	66	21	17	17	11
Income 103,000-150,000					
Mean	4580.14	3457.60	5604.75	4814.13	3969.91
Valid Cases	73	16	24	16	17
Income 151,000-200,000					
Mean	7895.77	5026.46	11454.03	6693.94	6148.00
Valid Cases	78	13	27	14	24
Income 201,000-270,000					
Mean	10349.28	6026.52	17731.83	5120.93	7062.48
Valid Cases	37	9	13	4	11
Income > 270,000					
Mean	10847.81	8167.45	11380.57	16143.57	7404.47
Valid Cases	35	9	11	8	7
All Income Class					
Mean	6185.73	4872.59	8308.20	5610.83	5320.89
Valid Cases	354	96	110	71	77

Table 62A. Percentage of Monthly Household Expenditure (in Kns) for Energy by Income

Percentage/Energy Expenditure Kns/Month/Household	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	6.50	7.35	6.60	3.57	7.88
Valid Cases	65	28	18	12	7
Income 75,000-102,000					
Mean	4.35	6.09	3.24	3.73	3.70
Valid Cases	66	21	17	17	11
Income 103,000-150,000					
Mean	3.78	2.93	4.61	3.98	3.23
Valid Cases	73	16	24	16	17
Income 151,000-200,000					
Mean	4.53	2.91	6.53	4.12	3.40
Valid Cases	78	13	27	14	24
Income 201,000-270,000					
Mean	4.33	2.72	7.34	2.25	2.86
Valid Cases	37	9	13	4	11
Income > 270,000					
Mean	2.19	1.37	2.28	3.43	1.69
Valid Cases	35	9	11	8	7
All Income Class					
Mean	4.45	4.74	5.29	3.72	3.58
Valid Cases	354	96	110	71	77

Table 64A. Percentage of Monthly Expenditure for Energy to Total Income per Household

Percentage Energy Expenditure Kns/Month/Household	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	6.18	7.12	6.60	4.22	5.45
Valid Cases	73	29	18	13	13
Income 75,000-102,000					
Mean	4.10	6.09	3.14	3.64	3.39
Valid Cases	78	21	22	18	17
Income 103,000-150,000					
Mean	3.70	2.86	4.49	3.99	3.19
Valid Cases	82	19	25	19	19
Income 151,000-200,000					
Mean	4.42	2.91	6.30	4.03	3.31
Valid Cases	81	13	28	15	25
Income 201,000-270,000					
Mean	4.22	2.72	7.34	1.82	2.86
Valid Cases	38	9	13	5	11
Income > 270,000					
Mean	2.14	1.27	2.29	3.34	1.65
Valid Cases	39	10	12	9	8
All Income Class					
Mean	4.29	4.59	5.08	3.74	3.40
Valid Cases	391	101	118	79	93

Including households that share electricity with others.

Table 65A. Percentage of Monthly Expenditure for Electricity to Total Income per Household

Percentage Elec. Expenditure Kns/Month/Household	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	3.46	4.23	4.02	1.76	1.56
Valid Cases	64	28	18	12	6
Income 75,000-102,000					
Mean	1.71	2.48	1.75	1.22	.99
Valid Cases	65	20	17	17	11
Income 103,000-150,000					
Mean	1.43	1.07	1.92	1.59	.92
Valid Cases	73	16	24	16	17
Income 151,000-200,000					
Mean	1.52	1.80	1.88	1.30	1.11
Valid Cases	78	13	27	14	24
Income 201,000-270,000					
Mean	1.80	1.78	2.67	1.64	.84
Valid Cases	37	9	13	4	11
Income > 270,000					
Mean	1.26	1.03	1.54	1.28	1.07
Valid Cases	35	9	11	8	7
All Income Class					
Mean	1.89	2.46	2.28	1.44	1.04
Valid Cases	352	95	110	71	76

Including households that share electricity with others.

Table 67A. Percentage of Monthly household Expenditure for Charcoal by Income

Percentage Charcoal Expenditure Kns/Month/Household	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	3.97	3.72	2.32	4.71	5.13
Valid Cases	29	13	5	3	8
Income 75,000-102,000					
Mean	2.53	3.39	2.25	2.22	2.03
Valid Cases	34	10	9	8	7
Income 103,000-150,000					
Mean	1.93	1.69	2.26	2.18	1.62
Valid Cases	46	9	14	8	15
Income 151,000-200,000					
Mean	2.12	1.39	3.28	1.22	1.35
Valid Cases	54	5	22	8	19
Income 201,000-270,000					
Mean	2.40	1.08	5.29	.35	1.28
Valid Cases	28	5	9	4	10
Income > 270,000					
Mean	.67	.37	.88	.76	.58
Valid Cases	26	6	9	5	6
All Income Class					
Mean	2.25	2.33	2.81	1.79	1.87
Valid Cases	217	48	68	36	65

Table 68A. Percentage of Monthly Household Expenditure for Firewood by Income

Percentage Firewood Expenditure Kns/Month/Household	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	3.29	3.27	3.48	3.27	3.06
Valid Cases	33	11	10	6	6
Income 75,000-102,000					
Mean	2.66	3.66	1.70	2.64	2.64
Valid Cases	42	10	10	10	12
Income 103,000-150,000					
Mean	2.17	2.12	2.59	2.30	1.51
Valid Cases	47	10	13	14	10
Income 151,000-200,000					
Mean	2.55	1.76	2.98	2.87	2.07
Valid Cases	41	4	13	11	13
Income 201,000-270,000					
Mean	1.35	1.03	2.61	.53	1.04
Valid Cases	17	3	4	2	8
Income > 270,000					
Mean	2.33	.33	2.56	4.00	.70
Valid Cases	9	1	1	4	3
All Income Class					
Mean	2.49	2.67	2.69	2.70	1.97
Valid Cases	189	39	51	47	52

Table 69A. Percentage of Monthly Household Expenditure for Kerosene by Income

Percentage Kerosene Expenditure Kns/Month/Household	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	1.03	.	.	.	1.03
Valid Cases	2	0	0	0	2
Income 75,000-102,000					
Mean	.83	.	.83	.	.
Valid Cases	1	0	1	0	0
Income 103,000-150,000					
Mean	.39	.39	.	.	.
Valid Cases	1	1	0	0	0
Income 151,000-200,000					
Mean	.95	.15	.	.30	1.67
Valid Cases	4	1	0	1	2
Income 201,000-270,000					
Mean	.80	.	.	.	.80
Valid Cases	1	0	0	0	1
Income > 270,000					
Mean	.	.	.	.	.
Valid Cases	0	0	0	0	0
All Income Class					
Mean	.87	.27	.83	.30	1.24
Valid Cases	9	2	1	1	5

Table 70A. Percentage of Monthly Household Expenditure for Diesel by Income

Percentage Diesel Expenditure Kns/Month/Household	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	1.28	1.28	.	.	.
Valid Cases	3	3	0	0	0
Income 75,000-102,000					
Mean	.51	.26	1.24	.51	.79
Valid Cases	7	4	1	1	1
Income 103,000-150,000					
Mean	.74	.24	.41	.33	1.36
Valid Cases	10	2	2	2	4
Income 151,000-200,000					
Mean	.22	.11	.74	.19	.13
Valid Cases	8	2	1	3	2
Income 201,000-270,000					
Mean	.11	.	.	.06	.12
Valid Cases	4	0	0	1	3
Income > 270,000					
Mean	.10	.12	.08	.	.07
Valid Cases	4	2	1	0	1
All Income Class					
Mean	.48	.45	.58	.26	.63
Valid Cases	36	13	5	7	11

Table 71A. Percentage of Monthly Household Expenditure for LPG by Income

Percentage LPG Expenditure Kns/Month/Household	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	.	.	.	.	.
Valid Cases	0	0	0	0	0
Income 75,000-102,000					
Mean	6.66	6.66	.	.	.
Valid Cases	1	1	0	0	0
Income 103,000-150,000					
Mean	.	.	.	.	.
Valid Cases	0	0	0	0	0
Income 151,000-200,000					
Mean	4.73	.	4.73	.	.
Valid Cases	3	0	3	0	0
Income 201,000-270,000					
Mean	2.60	.	2.60	.	.
Valid Cases	1	0	1	0	0
Income > 270,000					
Mean	.32	.32	.	.	.
Valid Cases	2	2	0	0	0
All Income Class					
Mean	3.44	2.44	4.20	.	.
Valid Cases	7	3	4	0	0

Table 72A. Percentage of Monthly Household Expenditure (in Kips) for Energy to Total Income per Household: All Electric Homes Only

Percentage Energy Expenditure Kns/Month/Household	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Mean	7.77	3.25	16.45	3.96	.
Valid Cases	6	3	2	1	0
Income 75,000-102,000					
Mean	1.58	.	1.80	.55	1.51
Valid Cases	7	0	5	1	1
Income 103,000-150,000					
Mean	.62	.80	.68	.18	.
Valid Cases	5	2	2	1	0
Income 151,000-200,000					
Mean	.97	.67	.33	2.66	.60
Valid Cases	5	1	1	1	2
Income 201,000-270,000					
Mean	1.51	.81	2.22	.	.
Valid Cases	4	2	2	0	0
Income > 270,000					
Mean	2.69	.	4.00	1.38	.
Valid Cases	4	0	2	2	0
All Income Class					
Mean	2.66	1.71	4.00	1.68	.90
Valid Cases	31	8	14	6	3

Table 73A. Number of Households by Number of Electric Meters Installed

Number of Meters	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
None	52	10	12	13	17
(percent)	12.8%	9.4%	9.8%	15.9%	18.1%
One	309	81	97	59	72
(percent)	76.3%	76.4%	78.9%	72.0%	76.6%
Two	36	13	12	8	3
(percent)	8.9%	12.3%	9.8%	9.8%	3.2%
Three	6	2	1	1	2
(percent)	1.5%	1.9%	.8%	1.2%	2.1%
Four	2	0	1	1	0
(percent)	.5%	.0%	.8%	1.2%	.0%
Total	405	106	123	82	94
(percent)	100.0%	26.2%	30.4%	20.2%	23.2%

There are 2 households from the total of 52, without meter, do not use electricity.

Table 74A. Percentage of Households Classified by Number of Electric Meters Installed

Number of Meters Installed	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
None	27.2%	12.5%	15.0%	40.0%	64.3%
1 Meter	70.4%	81.3%	85.0%	60.0%	35.7%
2 Meters	2.5%	6.3%	.0%	.0%	.0%
Total	81	32	20	15	14
Income 75,000-102,000					
None	26.8%	21.7%	29.2%	22.2%	35.3%
1 Meter	69.5%	78.3%	66.7%	66.7%	64.7%
2 Meters	3.7%	.0%	4.2%	11.1%	.0%
Total	82	23	24	18	17
Income 103,000-150,000					
None	7.2%	5.3%	7.7%	15.8%	.0%
1 Meter	88.0%	89.5%	88.5%	78.9%	94.7%
2 Meters	3.6%	5.3%	3.8%	.0%	5.3%
3-4 Meters	1.2%	.0%	.0%	5.3%	.0%
Total	83	19	26	19	19
Income 151,000-200,000					
None	1.2%	.0%	.0%	.0%	4.0%
1 Meter	85.2%	76.9%	85.7%	93.3%	84.0%
2 Meters	9.9%	15.4%	10.7%	6.7%	8.0%
3-4 Meters	3.7%	7.7%	3.6%	.0%	4.0%
Total	81	13	28	15	25
Income 201,000-270,000					
1 Meter	76.3%	66.7%	69.2%	80.0%	90.9%
2 Meters	21.1%	33.3%	30.8%	20.0%	.0%
3-4 Meters	2.6%	.0%	.0%	.0%	9.1%
Total	38	9	13	5	11
Income > 270,000					
None	2.5%	.0%	.0%	.0%	12.5%
1 Meter	60.0%	40.0%	66.7%	50.0%	87.5%
2 Meters	30.0%	50.0%	25.0%	40.0%	.0%
3-4 Meters	7.5%	10.0%	8.3%	10.0%	.0%
Total	40	10	12	10	8
Grand Total	405	106	123	82	94

Table 75A. Number of Households by Type of Electricity Connection

Whether HH share elec.	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Does not share elec.	295	78	81	65	71
(percent)	73.2%	74.3%	65.9%	79.3%	76.3%
Share elec. to other	58	18	30	4	6
(percent)	14.4%	17.1%	24.4%	4.9%	6.5%
No Meter but use elec.	50	9	12	13	16
(percent)	12.4%	8.6%	9.8%	15.9%	17.2%
Total	403	105	123	82	93
(percent)	100.0%	100.0%	100.0%	100.0%	100.0%

Table 76A. Percentage of Households by Type of Electricity Connection

Whether household share electricity?	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
Does not share elec...	60.0%	68.8%	60.0%	60.0%	38.5%
Share ele to other....	13.8%	18.8%	25.0%	.0%	.0%
No Meter but use ele..	26.3%	12.5%	15.0%	40.0%	61.5%
Total.....	80	32	20	15	13
Income 75,000-102,000					
Does not share elec...	65.4%	68.2%	62.5%	77.8%	52.9%
Share ele to other....	8.6%	13.6%	8.3%	.0%	11.8%
No Meter but use ele..	25.9%	18.2%	29.2%	22.2%	35.3%
Total.....	81	22	24	18	17
Income 103,000-150,000					
Does not share elec...	77.1%	84.2%	65.4%	78.9%	84.2%
Share ele to other....	15.7%	10.5%	26.9%	5.3%	15.8%
No Meter but use ele..	7.2%	5.3%	7.7%	15.8%	.0%
Total.....	83	19	26	19	19
Income 151,000-200,000					
Does not share elec...	86.4%	92.3%	67.9%	100.0%	96.0%
Share ele to other....	12.3%	7.7%	32.1%	.0%	.0%
No Meter but use ele..	1.2%	.0%	.0%	.0%	4.0%
Total.....	81	13	28	15	25
Income 201,000-270,000					
Does not share elec...	86.8%	88.9%	84.6%	60.0%	100.0%
Share ele to other....	13.2%	11.1%	15.4%	40.0%	.0%
Total.....	38	9	13	5	11
Income > 270,000					
Does not share elec...	67.5%	50.0%	58.3%	90.0%	75.0%
Share ele to other....	30.0%	50.0%	41.7%	10.0%	12.5%
No Meter but use ele..	2.5%	.0%	.0%	.0%	12.5%
Total.....	40	10	12	10	8
Grand Total.....	403	105	123	82	93

Table 77A. Number of Households Using Electricity Without Meters Installed

Number of Households Without Meter	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000					
No. of Households.....	21	4	3	6	8
Income 75,000-102,000					
No. of Households.....	21	4	7	4	6
Income 103,000-150,000					
No. of Households.....	6	1	2	3	0
Income 151,000-200,000					
No. of Households.....	1	0	0	0	1
Income > 270,000					
No. of Households.....	1	0	0	0	1
All Income Class.....	50	9	12	13	16

Table 78A. Number of Households With Meters Who Share Electricity with Others

Number of Households Sharing Electricity to Others	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000 No. of Households.....	11	6	5	0	0
Income 75,000-102,000 No. of Households.....	7	3	2	0	2
Income 103,000-150,000 No. of Households.....	13	2	7	1	3
Income 151,000-200,000 No. of Households.....	10	1	9	0	0
Income 201,000-270,000 No. of Households.....	5	1	2	2	0
Income > 270,000 No. of Households.....	12	5	5	1	1
All Income Class.....	58	18	30	4	6

Table 79A. Number of Households Sharing Electricity With and Without Meters

Number of Households Sharing Electricity	All 4 Districts	District			
		Sysattanak	Chantabouri	Sysettha	Sykhottabong
Income < 75,000 No. of Households.....	32	10	8	6	8
Income 75,000-102,000 No. of Households.....	28	7	9	4	8
Income 103,000-150,000 No. of Households.....	19	3	9	4	3
Income 151,000-200,000 No. of Households.....	11	1	9	0	1
Income 201,000-270,000 No. of Households.....	5	1	2	2	0
Income > 270,000 No. of Households.....	13	5	5	1	2
All Income Class.....	108	27	42	17	22

COMPARATIVE COSTS OF COOKING

COMPARISON OF FUEL AND COST OF STOVE

Fuel Type Plate	Energy Value (MJ/Kg)	Price per KG.	kWh/Kg.	Efficiency Rating	Useful kWh	Kns/ Useful kWh	Fuel Cost Kns/Yr.	Stove Cost One-
LPG	45.2	420	12.6	0.60	7.53	56	56000	87000
Kerosene	43.2	294	12.0	0.35	4.20	70	70000	35000
Firewood	16.0	30	4.4	0.15	0.67	45	45000	2000
Charcoal	30.0	85	8.3	0.30	2.50	34	34000	4700
Electric	3.6	14/kWh	na	0.80	na	18	18000	4500
Electric (MJ/kWh)	3.6	56/kWh	na	0.80	na	70	70000	4500
LPG								
	45.2	300	12.6	0.6	7.53	40	40000	87000
	45.2	325	12.6	0.6	7.53	43	43000	87000
	45.2	350	12.6	0.6	7.53	46	46000	87000
	45.2	375	12.6	0.6	7.53	50	50000	87000
	45.2	400	12.6	0.6	7.53	53	53000	87000
****	45.2	350	12.6	0.6	7.53	46	46000	67000
KEROSENE								
Wicked Type	43.2	294	12.0	0.35	4.20	70	70000	34000
Pressured	43.2	294	12.0	0.50	6.00	49	49000	34000
Wicked	43.2	350	12.0	0.35	4.20	83	83000	34000
Pressured	43.2	350	12.0	0.50	6.00	58	60000	34000
FIREWOOD								
	16.0	30	4.44	0.15	0.67	45	45000	2000
	16.0	35	4.44	0.15	0.67	53	53000	2000
	16.0	50	4.44	0.15	0.67	75	75000	2000
CHARCOAL								
	30.0	60	8.33	0.30	2.50	24	24000	4700
	30.0	85	8.33	0.30	2.50	34	34000	4700
	30.0	100	8.33	0.30	2.50	40	40000	4700
	30.0	120	8.33	0.30	2.50	48	48000	4700

COMPARISON OF COOKING COSTS

COMPARISON OF ELECTRICITY COSTS AT DIFFERENT TARIFFS

Fuel Type Plate	Energy Value (MJ/Kg)	Price per kWh	kWh/Kg.	Efficiency Rating	Efficient kWh	Kns/ Useful kWh	Fuel Cost Kns/Yr.	Stove Cost One-
Electric	3.6	14.0	1.00	0.80	0.80	18	18000	4500
	3.6	21.0	1.00	0.80	0.80	26	26000	4500
	3.6	28.0	1.00	0.80	0.80	35	35000	4500
	3.6	35.0	1.00	0.80	0.80	44	44000	4500
	3.6	42.0	1.00	0.80	0.80	53	53000	4500
	3.6	49.0	1.00	0.80	0.80	61	61000	4500
	3.6	52.5	1.00	0.80	0.80	66	66000	4500
	3.6	56.0	1.00	0.80	0.80	70	70000	4500
	3.6	59.5	1.00	0.80	0.80	74	74000	4500

COMPARISON OF COOKING COSTS

LPG (Current Market Price)
(56 Kn/Useful kWh) 420Kn/Kg 1000 kWh/Yr

Year	Stove Cost 87000	Operating Cost/Yr 56000	Total PV Cost/Yr	Discount 10%/Yr
1st	87000	50904	137904	0.909
2nd	0	46256	46256	0.826
3rd	0	42056	42056	0.751
4th	0	38248	38248	0.683
5th	0	34776	34776	0.621
6th	0	31584	31584	0.564
7th	0	28728	28728	0.513
8th	0	26152	26152	0.467
9th	0	23744	23744	0.424
10th	0	21616	21616	0.386
Total PV Cost	87000	344064	431064	

LPG (Expected Price)
(46 Kn/Useful kWh) 350Kn/Kg 1000 kWh/Yr

Stove Cost 67000	Operating Cost/Yr 46000	Total PV Cost/Yr
67000	41814	108814
0	37996	37996
0	34546	34546
0	31418	31418
0	28566	28566
0	25944	25944
0	23598	23598
0	21482	21482
0	19504	19504
0	17756	17756
67000	282624	349624

Note: Discount 10% per Year

KEROSENE (Wicked Type; 35% Effi.)
(70 Kn/Useful kWh) 294Kn/Kg 1000 kWh/Yr

Year	Stove Cost 34000	Operating Cost/Yr 70000	Total PV Cost/Yr	Discount 10%/Yr
1st	34000	63630	97630	0.909
2nd	0	57820	57820	0.826
3rd	0	52570	52570	0.751
4th	0	47810	47810	0.683
5th	0	43470	43470	0.621
6th	0	39480	39480.	0.564
7th	0	35910	35910	0.513
8th	0	32690	32690	0.467
9th	0	29680	29680	0.424
10th	0	27020	27020	0.386
Total PV Cost	34000	430080	464080	

KEROSENE (Pressured Type; 50% Effi)
(49Kn/Useful kWh) 294Kn/Kg 1000 kWh/Yr

Stove Cost 34000	Operating Cost/Yr 49000	Total PV Cost/Yr
34000	44541	78541
0	40474	40474
0	36799	36799
0	33467	33467
0	30429	30429
0	27636	27636
0	25137	25137
0	22883	22883
0	20776	20776
0	18914	18914
34000	301056	335056

Note: Discount 10% per Year

FIREWOOD (15% Effi)
(45 Kn/Useful kWh) 30Kn/Kg 1000 kWh/Yr
kWh/Yr

Year	Stove Cost 2000	Operating Cost/Yr 45000	Total PV Cost/Yr	Discount 10%/Yr
1st	2000	40905	42905	0.909
2nd	0	37170	37170	0.826
3rd	0	33795	33795	0.751
4th	0	30735	30735	0.683
5th	0	27945	27945	0.621
6th	1128	25380	26508	0.564
7th	0	23085	23085	0.513
8th	0	21015	21015	0.467
9th	0	19080	19080	0.424
10th	0	17370	17370	0.386
Total PV Cost	3128	276480	279608	

Note: Discount 10% per Year

CHARCOAL (30% Effi)
(34Kn/Useful kWh) 85Kn/Kg 1000

Stove Cost 4700	Operating Cost/Yr 34000	Total PV Cost/Yr
4700	30906	35606
0	28084	28084
3530	25534	29064
0	23222	23222
2919	21114	24033
0	19176	19176
2411	17442	19853
0	15878	15878
1993	14416	16409
0	13124	13124
15552	208896	224448

FIREWOOD (15% Effi)
(53 Kn/Useful kWh) 35Kn/Kg 1000 kWh/Yr
kWh/Yr

Year	Stove Cost 2000	Operating Cost/Yr 53000	Total PV Cost/Yr	Discount 10%/Yr
1st	2000	48177	50177	0.909
2nd	0	43778	43778	0.826
3rd	0	39803	39803	0.751
4th	0	36199	36199	0.683
5th	0	32913	32913	0.621
6th	1128	29892	31020	0.564
7th	0	27189	27189	0.513
8th	0	24751	24751	0.467
9th	0	22472	22472	0.424
10th	0	20458	20458	0.386
Total PV Cost	3128	325632	328760	

Note: Discount 10% per Year

CHARCOAL (30% Effi)
(40Kn/Useful kWh) 100Kn/Kg 1000

Stove Cost 4700	Operating Cost/Yr 40000	Total PV Cost/Yr
4700	36360	41060
0	33040	33040
3530	30040	33570
0	27320	27320
2919	24840	27759
0	22560	22560
2411	20520	22931
0	18680	18680
1993	16960	18953
0	15440	15440
15552	245760	261312

ELECTRIC (14 Kn/kWh; 80% Effi)
(18 Kn/Useful kWh) 1000 kWh/Yr

Year	Stove Cost 4500	Operating Cost/Yr 18000	Total PV Cost/Yr	Discount 10%/Yr
1st	4500	16362	20862	0.909
2nd	0	14868	14868	0.826
3rd	0	13518	13518	0.751
4th	0	12294	12294	0.683
5th	0	11178	11178	0.621
6th	2538	10152	12690	0.564
7th	0	9234	9234	0.513
8th	0	8406	8406	0.467
9th	0	7632	7632	0.424
10th	0	6948	6948	0.386
Total PV Cost	7038	110592	117630	

Note: Discount 10% per Year

ELECTRIC (56 Kn/kWh' 80% Effi.)
(70 Kn/Useful kWh) 1000 kWh/Yr

Stove Cost 4500	Operating Cost/Yr 70000	Total PV Cost/Yr
4500	63630	68130
0	57820	57820
0	52570	52570
0	47810	47810
0	43470	43470
2538	39480	42018.
0	35910	35910
0	32690	32690
0	29680	29680
0	27020	27020
7038	430080	437118

ELECTRIC (21 Kn/kWh; 80% Effi)
(26 Kn/Useful kWh) 1000 kWh/Yr

Year	Stove Cost 4500	Operating Cost/Yr 26000	Total PV Cost/Yr	Discount 10%/Yr
1st	4500	23634	28134	0.909
2nd	0	21476	21476	0.826
3rd	0	19526	19526	0.751
4th	0	17758	17758	0.683
5th	0	16146	16146	0.621
6th	2538	14664	17202	0.564
7th	0	13338	13338	0.513
8th	0	12142	12142	0.467
9th	0	11024	11024	0.424
10th	0	10036	10036	0.386
Total PV Cost	7038	159744	166782	

Note: Discount 10% per Year

ELECTRIC (28 Kn/kWh' 80% Effi.)
(35 Kn/Useful kWh) 1000 kWh/Yr

Stove Cost 4500	Operating Cost/Yr 35000	Total PV Cost/Yr
4500	31815	36315
0	28910	28910
0	26285	26285
0	23905	23905
0	21735	21735
2538	19740	22278
0	17955	17955
0	16345	16345
0	14840	14840
0	13510	13510
7038	215040	222078

ELECTRIC (35 Kn/kWh; 80% Effi)
(44 Kn/Useful kWh) 1000 kWh/Yr

Year	Stove Cost 4500	Operating Cost/Yr 44000	Total PV Cost/Yr	Discount 10%/Yr
1st	4500	39996	44496	0.909
2nd	0	36344	36344	0.826
3rd	0	33044	33044	0.751
4th	0	30052	30052	0.683
5th	0	27324	27324	0.621
6th	2538	24816	27354	0.564
7th	0	22572	22572	0.513
8th	0	20548	20548	0.467
9th	0	18656	18656	0.424
10th	0	16984	16984	0.386
Total PV Cost	7038	270336	277374	

Note: Discount 10% per Year

ELECTRIC (42 Kn/kWh' 80% Effi.)
(53 Kn/Useful kWh) 1000 kWh/Yr

Stove Cost 4500	Operating Cost/Yr 53000	Total PV Cost/Yr
4500	48177	52677
0	43778	43778
0	39803	39803
0	36199	36199
0	32913	32913
2538	29892	32430
0	27189	27189
0	24751	24751
0	22472	22472
0	20458	20458
7038	325632	332670

ELECTRIC (49 Kn/kWh; 80% Effi)
(61 Kn/Useful kWh) 1000 kWh/Yr

Year	Stove Cost 4500	Operating Cost/Yr 61000	Total PV Cost/Yr	Discount 10%/Yr
1st	4500	55449	59949	0.909
2nd	0	50386	50386	0.826
3rd	0	45811	45811	0.751
4th	0	41663	41663	0.683
5th	0	37881	37881	0.621
6th	2538	34404	36942	0.564
7th	0	31293	31293	0.513
8th	0	28487	28487	0.467
9th	0	25864	25864	0.424
10th	0	23546	23546	0.386
Total PV Cost	7038	374784	381822	

Note: Discount 10% per Year

ELECTRIC (52.5 Kn/kWh' 80% Effi.)
(66 Kn/Useful kWh) 1000 kWh/Yr

Stove Cost 4500	Operating Cost/Yr 66000	Total PV Cost/Yr
4500	59994	64494
0	54516	54516
0	49566	49566
0	45078	45078
0	40986	40986
2538	37224	39762
0	33858	33858
0	30822	30822
0	27984	27984
0	25476	25476
7038	405504	412542

COSTS AND BENEFITS OF SWITCHING TO LPG

(Assumption: 50% (8,250 households) Switching to LPG)

Year	Export Revenue $957,000	Accumulated Revenue	Import Elec Hot Plate	Import LPG Stove ($16,500 x100)	Import LPG (Kg) 1642699.12	Import Fuel Cost 821349.55	Accumulated Fuel Cost
1st	$869,913	$869,913	$71,500	$1,650,000	1642699.12	$746,607	$746,607
2nd	$790,482	$1,660,395	$5,369	$0	1642699.12	$678,435	$1,425,041
3rd	$718,707	$2,379,102	$4,882	$0	1642699.12	$616,834	$2,041,875
4th	$653,631	$3,032,733	$4,440	$0	1642699.12	$560,982	$2,602,857
5th	$594,297	$3,627,030	$4,037	$0	1642699.12	$510,058	$3,112,915
6th	$539,748	$4,166,778	$40,326	$0	1642699.12	$463,241	$3,576,156
7th	$490,941	$4,657,719	$3,335	$0	1642699.12	$421,352	$3,997,508
8th	$446,919	$5,104,638	$3,036	$0	1642699.12	$383,570	$4,381,078
9th	$405,768	$5,510,406	$2,756	$0	1642699.12	$348,252	$4,729,331
10th	$369,402	$5,879,808	$2,509	$0	1642699.12	$317,041	$5,046,372
Total PV Cost	$5,879,808		$142,188	$1,650,000		$5,046,372	$5,046,372
Rev. Fuel	$833,436						
Total Loss	-$674,376						

TABLE: COST AND BENEFIT OF SWITCHING TO LPG
(Assumption: 50% (8,250 households) Switcg to LPG

Year	Export Revenue $478,500	Accumulated Revenue	Import Elec Hot Plate	Import LPG Stove ($8,250x100)	Import LPG (Kg) 821349.558	Import Fuel Cost 410674.775	Accumulated Fuel Cost
1st	$434,957	$434,957	$35,750	$825,000	821,350	$373,303	$373,303
2nd	$395,241	$830,198	$2,685	$0	821,350	$339,217	$712,521
3rd	$359,354	$1,189,551	$2,441	$0	821,350	$308,417	$1,020,937
4th	$326,816	$1,516,367	$2,220	$0	821,350	$280,491	$1,301,428
5th	$297,149	$1,813,515	$2,018	$0	821,350	$255,029	$1,556,457
6th	$269,874	$2,083,389	$20,163	$0	821,350	$231,621	$1,788,078
7th	$245,471	$2,328,860	$1,667	$0	821,350	$210,676	$1,998,754
8th	$223,460	$2,552,319	$1,518	$0	821,350	$191,785	$2,190,539
9th	$202,884	$2,755,203	$1,378	$0	821,350	$174,126	$2,364,665
10th	$184,701	$2,939,904	$1,255	$0	821,350	$158,520	$2,523,186
Total PV Cost	$2,939,904		$71,094	$825,000		$2,523,186	$2,523,186
Rev. Fuel	$416,718						
Total Loss	-$337,188						

LIGHTING EFFICIENCY ANALYSIS

TABLE: COST AND BENEFIT OF SWITCHING TO FLUORESCENT LAMP (IN LOCAL CURRENCY)

40.6 Kips/kWh (4.5 Hrs/Day)

	60 W Incandescent Lamp				20 W Fluorescent Lamp		
Year	kWh Lighting 5,263,753	Light Bulbs Imp. Cost (250*1.6)	Light Bulb (PV) Imp. Bulb	Accumul.	kWh Lighting 1,754,584	Cost of Lamp & Fixture Imp. Cost	Accumul.
kWh Save/Yr	3,509,168	1,754,584				1,754,584	
	Export Revenue				Export Revenue		
1st	64,753,632	21,364,800	20,635,726	85,389,358	64,753,632	112,165,200	176,918,832
2nd	58,841,034	21,364,800	17,647,325	161,877,717	58,841,034	0	235,759,866
3rd	53,498,325	21,364,800	16,044,965	231,421,006	53,498,325	0	289,258,191
4th	48,654,269	21,364,800	14,592,158	294,667,434	48,654,269	0	337,912,460
5th	44,237,630	21,364,800	13,267,541	352,172,604	44,237,630	6,600,602	388,750,691
US$	$385,693	$122,085	$117,411	$503,104	$385,693	$169,665	$555,358
Total PV Costs	269,984,889	85,459,200	82,187,715	352,172,604	269,984,889	118,765,802	388,750,691

Table: Cost and Benefit of Switching to Fluorescent Lamp

5.8 Cent/kWh (4.5 Hrs/Day)

	60 W Incandescent Lamp				20 W Fluorescent Lamp		
Year Accumul.	kWh Lighting 5,263,753	Light Bulbs Import Cost ((250*1.6)/700)	Light Bulb (PV) Imp. Bulb	Accumul.	kWh Lighting 1,754,584	Cost of Lamp & Fixture Imp. Cost	
kWh Save/Yr	3,509,168	1,754,584				1,754,584	
	Export Revenue				Export Revenue		
1st	92,505	30,521	29,480	121,985	92,505	160,236	252,741
2nd	84,059	30,521	25,210	231,254	84,059	0	336,800
3rd	76,426	30,521	22,921	330,601	76,426	0	413,226
4th	69,506	30,521	20,846	420,953	69,506	0	482,732
5th	63,197	30,521	18,954	503,104	63,197	9,429	555,358
Total PV Costs	385,693	122,085	117,411	503,104	385,693	169,665	555,358

5.8 Cent/kWh (2.5 Hrs/Day)

	60 W Incandescent Lamp				20 W Fluorescent Lamp		
Year	kWh Lighting 2,924,307	Light Bulbs Import Cost ((250*1.6)/700)	Light Bulb (PV) Imp. Bulb	Accumul.	kWh Lighting 974,769	Cost of Lamp & Fixture Imp. Cost	Accum.
kWh Save/Yr	1,949,538	974,769				974,769	
	Export Revenue				Export Revenue		
1st	51,392	17,407	17,407	68,798	51,392	160,236	211,628
2nd	46,699	17,407	14,378	129,875	46,699	0	258,327
3rd	42,459	17,407	13,072	185,407	42,459	0	300,786
4th	38,614	17,407	11,889	235,910	38,614	0	339,400
5th	35,109	17,407	10,809	281,829	35,109	0	374,510
6th	31,887	17,407	9,817	323,533	31,887	0	406,396
7th	29,003	17,407	8,930	361466	29,003	0	435400
8th	26,403	17,407	8,129	395997	26,403	0	461802
	23,972	17,407	7,380	427349	23,972	6438	492212
Total PV Cost	325,538		101,811		325,538	166,674	

TABLE: COST AND BENEFIT OF SWITCHING TO FLUORESCENT LAMP

14 Kips/kWh (4.5 Hrs/Day)

	60 W Incandescent Lamp				20 W Fluorescent Lamp		
Year	Elec. Cost 98.55 1380	Cost of Light Bulb 400	PV Cost Bulb 1.6 Bulb/yr	Accumul.	Elec. Cost 32.85 460	Cost of Lamp & Fixture	Accumul.
1st	1254	400	386	1640	418	2100	2518
2nd	1140	400	330	3110	380	0	2898
3rd	1036	400	300	4447	345	0	3243
4th	942	400	273	5663	314	0	3557
5th	857	400	248	6768	286	124	3967
Total PV Costs	5229	1600	1539	6768	1743	2224	3967

21 Kns/kWh (4.5 Hrs/Day)

	60 W Incandescent Lamp				20 W Fluorescent Lamp		
Year	Elec. Cost 98.55 2070	Cost of Light Bulb	PV Cost Bulb 1.6 Bulb/yr	Accumul.	Elec. Cost 32.85 690	Cost of Lamp & Fixture	Accumul.
1st	1881	250	386	2268	627	2100	2727
2nd	1709	250	330	4307	570	0	3297
3rd	1554	250	300	6162	518	0	3815
4th	1414	250	273	7849	471	0	4286
5th	1285	250	248	9382	428	124	4838
6th							
Total PV Costs	7844	1250	1539	9382	2615	2224	4838

14 Kips/kWh (2.5 Hrs/Day)

	60 W Incandescent Lamp				20 W Fluorescent Lamp		
Year	Electric 54.75 767	Cost of Light Bulb	PV Cost Bulb 1.6Bulb/yr	Accumulated	Electric 18.25 256	Cost of Lamp & Fixture	Accumul.
1st	697	228	228	925	232	2100	2332
2nd	633	228	188	1746	211	0	2543
3rd	576	228	171	2493	192	0	2735
4th	524	228	156	3173	175	0	2910
5th	476	228	142	3790	159	0	3068
6th	432	228	129	4351	144	0	3297
7th	393	228	117	4862	131	0	3428
8th	358	228	107	5326	119	0	3547
9th	325	228	97	5748	108	84	3656
Total PV Costs	4414	1656	1334	5748	1471	2184	3656

21 Kips/kWh (2.5 Hrs/Day)

Year	60 W Incandescent Lamp: Elec. Cost 54.75	Cost of Light Bulb	PV Cost Bulb	Accumul. 1150	20 W Fluorescent Lamp: Elec. Cost 18.25	Cost of Lamp & Fixture	Accumul. 383
1st	1045	228	228	1273	348	2100	2448
2nd	950	228	188	2411	317	0	2765
3rd	863	228	171	3446	288	0	3053
4th	785	228	156	4387	262	0	3315
5th	714	228	142	5243	238	0	3553
6th	648	228	129	6020	216	0	3769
7th	590	228	117	6727	197	0	3965
8th	537	228	107	7370	179	0	4144
9th	487	228	97	7955	162	84	4391
Total PV Costs	6620	1369	1334	7955	2207	2184	4391

7 Kips/kWh (4.5 Hrs/Day)

Year	60 W Incandescent Lamp: Electric 98.55	Cost of Light Bulb	PV Cost Bulb	Accumul. 690	20 W Fluorescent Lamp: Electric 32.85	Cost of Lamp & Fixture	Accumul. 460
1st	627	400	386	1013	209	2100	2309
2nd	570	400	330	2540	190	0	2499
3rd	518	400	300	3928	173	0	2672
4th	471	400	273	5191	157	0	2829
5th	428	400	248	6340	143	124	3095
Total PV Costs	2615	1600	1539	4153	872	2224	3095

7 Kns/kWh (2.5 Hrs/Day)

Year	60 W Incandescent Lamp: Electric 54.75	Cost of Light Bulb	PV Cost Bulb	Accumul. 383	20 W Fluorescent Lamp: Electric 18.25	Cost of Lamp & Fixture	Accumul. 128
1st	348	228	228	576	116	2100	2216
2nd	317	228	188	1081	106	0	2322
3rd	288	228	171	1541	96	0	2418
4th	262	228	156	1958	87	0	2505
5th	238	228	142	2338	79	0	2584
6th	216	228	129	2683	72	0	2656
7th	197	228	117	2996	66	0	2722
8th	179	228	107	3282	60	0	2781
9th	162	228	97	3541	54	84	2920
Total PV Costs	2207	913	1334	3541	736	2184	2920

EdL: BUILDING INSTITUTIONAL CAPACITY: NO/LOW COST SHORT TERM ACTIONS

Action 1

Objective: To reclassify 245 EdL residential customers whose consumption averages 10,442 kWh/month. This level of residential monthly consumption is highly unusual, even for a household with a very generous array of electric appliances. It is, therefore, possible that commercial and, perhaps, industrial customers who should be paying higher tariffs are included. Identifying and reclassifying these customers will send an important signal to consumers on rational energy use.

Monetary benefit to EDL: If not a computer error, EdL revenues should increase as a result of the addition of industrial and/or commercial customers.

Electricity savings: Electricity consumption patterns will not be affected.

Peak demand reduction in MW: None.

Risks for implementation: There are no risks in implementing this action.

Steps to be taken:

- Check computer program for possible error.
- If no error found, identify the customers through computer printouts and EdL files.
- Reclassify customers according to type or nature of commercial or industrial activity.

Local implementation costs: None.

Foreign implementation costs: External technical assistance is not required.

Action 2

Objective: To reduce the amount of electricity covered by the subsidized blocks. The July 1992 tariff increase eliminated the lifeline block for all but residential consumers. Nonetheless, 86% of residential consumers would have their full electricity requirement fall within the lifeline block. Many of these customers are middle and higher income households whose consumption patterns suggest that electricity is inexpensive. Furthermore, because about 12% of Vientiane households have more than one meter, some of these households could be unduly benefiting from the lifeline block.

Monetary benefit to EDL: There are monetary benefits to EdL from identifying customers who can pay tariffs that reflect the costs of service delivery and/or who have more than one meter and are benefiting from the lifeline block.

Electricity savings: There would be no immediate electricity savings. Nonatheless, customers facing higher tariffs can, over the longer term, change their consumption behavior.

Peak demand reduction in MW: None.

Risks for implementation:

- There is little risk to the very poor.

Steps to be taken:

- Review ESMAP/EdL study data for income distribution and household consumption patterns.
- Carry out new survey, if deemed necessary to supplement information.

Local implementation costs: Household survey.

Foreign implementation costs: EdL staff and Department of Statistics can carry out required work.

Action 3

Objective: Identify non-metered and multiple-metered customers. About 12% of households across income groups have no meter, either sharing with a neighbor/relative or living in Government housing with master meters. About 12% have more than one meter. The practice of shared meters can weaken the impact of demand management measures, because a higher price signal will have little impact on the unmetered customer. Households with more than one meter are either higher income households or commercial customers, who may be unduly benefitting from the lifeline block.

Monetary benefit to EDL: There are monetary benefits to EdL from metering nonmetered customers; identifying high income households with more than one meter; and reclassifying multiple metered dwellings which may be commercial activity.

Electricity savings: There would be no immediate electricity savings. Nonetheless, customers facing higher tariffs can, over the longer term, change their consumption behavior.

Peak demand reduction in MW: None.

Risks for implementation: There are no implementation risks.

Steps to be taken:

- Review ESMAP/EdL study data on non-metered and multiple metered households.
- Carry out new survey, if necessary, to supplement information.

Local implementation costs: Survey of households, if needed.

Foreign implementation costs: External technical assistance is not required.

Action 4

Objective: Redesign customer bill. Additional information on the bill could improve customers' understanding of their electricity consumption patterns, facilitate timely payment and, over the longer term, begin to modify consumption behavior.

Monetary benefit to EDL: There are no immediate monetary benefits. Nonetheless, a "user-friendly" bill can improve cost recovery prospects. In addition, more information can be collected on EdL customers.

Electricity savings: There would be no immediate electricity savings. However, EdL's Customer Services Unit can use billing information to promote and disseminate energy efficient behavior information.

Peak demand reduction in MW: None.

Risks for implementation: There are no risks.

Steps to be taken:

- Identify information needed to reach objective.
- Re-program computer to include new information.
- Test new bill with EdL customers.

Local implementation costs: Bill design; computer costs.

Foreign implementation costs: EdL can carry out work.

EDL: ENERGY MANAGEMENT PROGRAM
LOW-COST RECOMMENDATIONS OVER THE MEDIUM-TERM

Recommendation 1

Objective: To lower residential peak demand by replacement of the locally manufactured hot plate with a more efficient import, or by improving the efficiency of the locally produced device.

Monetary benefit to EDL: Avoided domestic consumption of 7.3 MW/day and export at the higher, time-of-day export tariff.

Electricity savings: The locally manufactured stove has a slightly lower efficiency of 70% compared to 80% for the imported stove. As a result, electricity savings of 100 kWh per household/year are possible.

Peak demand reduction in MW: 7.3

Risks for implementation:

- Uncertainty regarding supply of imported stove.
- Manufacture of local stoves generates employment and provides business opportunities, the impact of which on the local economy is unknown at the present time.
- Customer savings too low for "voluntary" compliance.
- Requires public information campaign, and/or incentive program and Government regulation.

Steps to be taken:

- Identify enterprises that manufacture the stove and determine impact on the local economy.
- Assess feasibility of improvements to local stove.
- Examine alternatives to imported model.

Local implementation costs: Survey of local stove manufacturers.

Foreign implementation costs: Yes. Technical assistance may be required if MOI decides to investigate alternative cooking devices. Program would require information campaign to promote objectives.

Recommendation 2

Objective: To lower residential electricity consumption during the peak and improve lighting efficiency. Lighting accounts for about 25% of total household electricity consumption. Incandescents account for 41% of lighting, with fluorescents accounting for the rest.

Monetary benefit to EDL: If fluorescents are substituted for incandescents in Vientiane households, the present value of export revenues could amount to US$ 385,700 over 5 years (8,200 hours of lighting/year).

Electricity savings: If 53,000 60 watt incandescents are replaced with 20 watt fluorescents, total electricity savings/year could amount to 3.5 million kWh.

Peak demand reduction in MW: estimated 2 MW

Risks for implementation:

- Possible impact on power factor.
- Meager financial savings to households who replace their incandescents provides little incentive for voluntary compliance.
- Requires public information campaign, and/or incentive program to mobilize consumer participation.

Steps to be taken:

- Determine potential impact on power factor
- Assess cost/benefit of incentive program to replace incandescents
- Design public information campaign targeting residential as well as commercial customers.

Local implementation costs: Depends on need for incentive program.

Foreign implementation costs: Amount of technical assistance would be based on the type of program desired by EdL.

Recommendation 3

Objective: To introduce preventive measures to discourage the inefficient use of electricity for process heat during the peak period. At current tariff levels, electricity remains the cheapest energy source per effective kWh.

Monetary benefit to EDL: Depends on pace of economic development.

Electricity savings: Not possible to estimate at this time.

Peak demand reduction in MW: Not possible to estimate at this time.

Benefits to customer group: None at present, because generation of process heat with electricity is currently the cheapest energy source.

Risks for implementation: There is a significant risk for EDL if these developments are not checked, because traditional industrial process heat equipment (e.g. dryers, furnaces, boilers, warm water heaters, ovens) can carry large electrical loads.

Steps to be taken:

- Conduct survey and energy audit for industry and business to determine to what extent electrical equipment to generate process heat is installed or planned to be installed and prospects for co-generation.
- Based on survey results, potential for use of electricity for process heat and expected tariff structure, design an action program.

Local implementation costs: Staff inputs into survey design and implementation.

Foreign implementation costs: 12 man-months of technical assistance (including reconnaissance mission to agree with EdL on scope of work; field work for survey design and implementation and energy audits; data analysis and formulation of recommendations and strategy).

Recommendation 4

Objective: To introduce "energy awareness" among EdL residential and commercial customers, by promoting the more efficient use of already installed air conditioners, refrigerators and other electric appliances.

Monetary benefit to EDL: If information campaign is successful, export revenues could be increased.

Electricity savings: Greatest savings potential is for the proper use of air conditioners. Efficient use could cut electricity consumption by half from an estimated 3000 kWh/year/unit to 1500 kWh/year/unit. Other appliances (refrigerators, freezers, etc.) could also be used more efficiently, although the savings are less significant.

Peak demand reduction in MW: None, because power demand does not change.

Risks for implementation: It is difficult to change consumer behavior, especially when tariffs are low.

Steps to be taken:

- Further field tests should be conducted with respect to lowering the temperature settings of air conditioners as well as the time required to cool down rooms to the present temperature.
- Design an energy awareness campaign to publicize potential savings and demonstrate efficient installation and use of air conditioners and refrigerators/freezers.

Local implementation costs: Yes.

Foreign implementation costs: Yes.

Recommendation 5

Objective: To monitor energy efficiency developments in the region, with particular attention to the recently passed legislation in Thailand and to prevent the Lao PDR from becoming a dumping ground for sub-standard appliances and other electrical equipment

Monetary benefit to EDL: Yes. The use of more efficient appliances can contribute to reducing the erosion of export earnings from electricity sales.

Electricity savings: Yes.

Peak demand reduction in MW: Yes. Because appliance use coincides with Vientiane's peak, which is the same as Thailand's peak, the use of more efficient appliances can contribute to a peak demand reduction.

Risks for implementation:

- Institutional capacity for demand management has to be developed.
- Higher initial costs of more efficient appliances can be a deterrent to residential customers.

Steps to be taken:

- Designate Government entity to monitor efficiency developments in the region.
- Establish a cooperative agreement with Thailand to assist the Lao PDR to prevent spillover of inefficient equipment.
- Determine the feasibility of establishing minimum efficiency standards and appropriate labelling for imported appliances.
- Put in place institutional framework and develop capacity to implement program.

Local implementation costs: Yes.

Foreign implementation costs: Yes.

Recommendation 6

Objective: To promote the use of energy-efficient equipment in existing and new commercial buildings. The ESMAP/EdL survey did not examine energy consumption trends in the commercial sector. However, evidence suggests that the commercial sector represents an important opportunity to manage load during the peak period.

Monetary benefit to EDL: There are potential monetary benefits to EdL from a more energy efficient commercial sector.

Electricity savings: Yes.

Peak demand reduction in MW: Yes.

Benefits to customer group: Yes.

Risks for implementation:

- Local availability of high efficiency equipment.
- At present tariffs, "voluntary" compliance is unrealistic.
- Will require a Government incentive program to be successful.

Steps to be taken:

- Conduct a survey and energy audits in urban Vientiane of a sample of commercial buildings/establishments and, if possible, new construction.
- Based on the results of the energy audits, determine energy efficient measures and costs and identify barriers to implementation.

Local implementation costs: Yes.

Foreign implementation costs: Technical assistance costs to carry out five audits, review new construction plans, and make recommendations. Six months. US$ 120,000.

Joint UNDP/World Bank

ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME (ESMAP)

LIST OF REPORTS ON COMPLETED ACTIVITIES

Region/Country	*Activity/Report Title*	*Date*	*Number*
	SUB-SAHARAN AFRICA (AFR)		
Africa Regional	Anglophone Africa Household Energy Workshop (English)	07/88	085/88
	Regional Power Seminar on Reducing Electric Power System Losses in Africa (English)	08/88	087/88
	Institutional Evaluation of EGL (English)	02/89	098/89
	Biomass Mapping Regional Workshops (English - Out of Print)	05/89	--
	Francophone Household Energy Workshop (French)	08/89	103/89
	Interafrican Electrical Engineering College: Proposals for Short- and Long-Term Development (English)	03/90	112/90
	Biomass Assessment and Mapping (English - Out of Print)	03/90	--
Angola	Energy Assessment (English and Portuguese)	05/89	4708-ANG
	Power Rehabilitation and Technical Assistance (English)	10/91	142/91
Benin	Energy Assessment (English and French)	06/85	5222-BEN
Botswana	Energy Assessment (English)	09/84	4998-BT
	Pump Electrification Prefeasibility Study (English)	01/86	047/86
	Review of Electricity Service Connection Policy (English)	07/87	071/87
	Tuli Block Farms Electrification Study (English)	07/87	072/87
	Household Energy Issues Study (English - Out of Print)	02/88	--
	Urban Household Energy Strategy Study (English)	05/91	132/91
Burkina Faso	Energy Assessment (English and French)	01/86	5730-BUR
	Technical Assistance Program (English)	03/86	052/86
	Urban Household Energy Strategy Study (English and French)	06/91	134/91
Burundi	Energy Assessment (English)	06/82	3778-BU
	Petroleum Supply Management (English)	01/84	012/84
	Status Report (English and French)	02/84	011/84
	Presentation of Energy Projects for the Fourth Five-Year Plan (1983-1987) (English and French)	05/85	036/85
	Improved Charcoal Cookstove Strategy (English and French)	09/85	042/85
	Peat Utilization Project (English)	11/85	046/85
	Energy Assessment (English and French)	01/92	9215-BU
Cape Verde	Energy Assessment (English and Portuguese)	08/84	5073-CV
	Household Energy Strategy Study (English)	02/90	110/90
Central African Republic	Energy Assessement (French)	08/92	9898-CAR
Comoros	Energy Assessment (English and French)	01/88	7104-COM
Congo	Energy Assessment (English)	01/88	6420-COB
	Power Development Plan (English and French)	03/90	106/90
Côte d'Ivoire	Energy Assessment (English and French)	04/85	5250-IVC
	Improved Biomass Utilization (English and French)	04/87	069/87
	Power System Efficiency Study (Out of Print)	12/87	--
	Power Sector Efficiency Study (French)	02/92	140/91
Ethiopia	Energy Assessment (English)	07/84	4741-ET
	Power System Efficiency Study (English)	10/85	045/85

Region/Country	*Activity/Report Title*	*Date*	*Number*
Ethiopia	Agricultural Residue Briquetting Pilot Project (English)	12/86	062/86
	Bagasse Study (English)	12/86	063/86
	Cooking Efficiency Project (English)	12/87	--
Gabon	Energy Assessment (English)	07/88	6915-GA
The Gambia	Energy Assessment (English)	11/83	4743-GM
	Solar Water Heating Retrofit Project (English)	02/85	030/85
	Solar Photovoltaic Applications (English)	03/85	032/85
	Petroleum Supply Management Assistance (English)	04/85	035/85
Ghana	Energy Assessment (English)	11/86	6234-GH
	Energy Rationalization in the Industrial Sector (English)	06/88	084/88
	Sawmill Residues Utilization Study (English)	11/88	074/87
Guinea	Energy Assessment (Out of Print)	11/86	6137-GUI
Guinea-Bissau	Energy Assessment (English and Portuguese)	08/84	5083-GUB
	Recommended Technical Assistance Projects (English & Portuguese)	04/85	033/85
	Management Options for the Electric Power and Water Supply Subsectors (English)	02/90	100/90
	Power and Water Institutional Restructuring (French)	04/91	118/91
Kenya	Energy Assessment (English)	05/82	3800-KE
	Power System Efficiency Study (English)	03/84	014/84
	Status Report (English)	05/84	016/84
	Coal Conversion Action Plan (English - Out of Print)	02/87	--
	Solar Water Heating Study (English)	02/87	066/87
	Peri-Urban Woodfuel Development (English)	10/87	076/87
	Power Master Plan (English - Out of Print)	11/87	--
Lesotho	Energy Assessment (English)	01/84	4676-LSO
Liberia	Energy Assessment (English)	12/84	5279-LBR
	Recommended Technical Assistance Projects (English)	06/85	038/85
	Power System Efficiency Study (English)	12/87	081/87
Madagascar	Energy Assessment (English)	01/87	5700-MAG
	Power System Efficiency Study (English and French)	12/87	075/87
Malawi	Energy Assessment (English)	08/82	3903-MAL
	Technical Assistance to Improve the Efficiency of Fuelwood Use in the Tobacco Industry (English)	11/83	009/83
	Status Report (English)	01/84	013/84
Mali	Energy Assessment (English and French)	11/91	8423-MLI
	Household Energy Strategy (English and French)	03/92	147/92
Islamic Republic of Mauritania	Energy Assessment (English and French)	04/85	5224-MAU
	Household Energy Strategy Study (English and French)	07/90	123/90
Mauritius	Energy Assessment (English)	12/81	3510-MAS
	Status Report (English)	10/83	008/83
	Power System Efficiency Audit (English)	05/87	070/87
	Bagasse Power Potential (English)	10/87	077/87
Mozambique	Energy Assessment (English)	01/87	6128-MOZ
	Household Electricity Utilization Study (English)	03/90	113/90
Niger	Energy Assessment (French)	05/84	4642-NIR
	Status Report (English and French)	02/86	051/86
	Improved Stoves Project (English and French)	12/87	080/87

Region/Country	*Activity/Report Title*	*Date*	*Number*
Niger	Household Energy Conservation and Substitution (English and French)	01/88	082/88
Nigeria	Energy Assessment (English)	08/83	4440-UNI
Rwanda	Energy Assessment (English)	06/82	3779-RW
	Energy Assessment (English and French)	07/91	8017-RW
	Status Report (English and French)	05/84	017/84
	Improved Charcoal Cookstove Strategy (English and French)	08/86	059/86
	Improved Charcoal Production Techniques (English and French)	02/87	065/87
	Commercialization of Improved Charcoal Stoves and Carbonization Techniques Mid-Term Progress Report (English and French)	12/91	141/91
SADCC	SADCC Regional Sector: Regional Capacity-Building Program for Energy Surveys and Policy Analysis (English)	11/91	--
Sao Tome and Principe	Energy Assessment (English)	10/85	5803-STP
Senegal	Energy Assessment (English)	07/83	4182-SE
	Status Report (English and French)	10/84	025/84
	Industrial Energy Conservation Study (English)	05/85	037/85
	Preparatory Assistance for Donor Meeting (English and French)	04/86	056/86
	Urban Household Energy Strategy (English)	02/89	096/89
Seychelles	Energy Assessment (English)	01/84	4693-SEY
	Electric Power System Efficiency Study (English)	08/84	021/84
Sierra Leone	Energy Assessment (English)	10/87	6597-SL
Somalia	Energy Assessment (English)	12/85	5796-SO
Sudan	Management Assistance to the Ministry of Energy and Mining	05/83	003/83
	Energy Assessment (English)	07/83	4511-SU
	Power System Efficiency Study (English)	06/84	018/84
	Status Report (English)	11/84	026/84
	Wood Energy/Forestry Feasibility (English - Out of Print)	07/87	073/87
Swaziland	Energy Assessment (English)	02/87	6262-SW
Tanzania	Energy Assessment (English)	11/84	4969-TA
	Peri-Urban Woodfuels Feasibility Study (English)	08/88	086/88
	Tobacco Curing Efficiency Study (English)	05/89	102/89
	Remote Sensing and Mapping of Woodlands (English)	06/90	--
	Industrial Energy Efficiency Technical Assistance (English - Out of Print)	08/90	122/90
Togo	Energy Assessment (English)	06/85	5221-TO
	Wood Recovery in the Nangbeto Lake (English and French)	04/86	055/86
	Power Efficiency Improvement (English and French)	12/87	078/87
Uganda	Energy Assessment (English)	07/83	4453-UG
	Status Report (English)	08/84	020/84
	Institutional Review of the Energy Sector (English)	01/85	029/85
	Energy Efficiency in Tobacco Curing Industry (English)	02/86	049/86
	Fuelwood/Forestry Feasibility Study (English)	03/86	053/86
	Power System Efficiency Study (English)	12/88	092/88
	Energy Efficiency Improvement in the Brick and Tile Industry (English)	02/89	097/89
	Tobacco Curing Pilot Project (English - Out of Print)	03/89	UNDP Terminal Report

Region/Country	*Activity/Report Title*	*Date*	*Number*
Zaire	Energy Assessment (English)	05/86	5837-ZR
Zambia	Energy Assessment (English)	01/83	4110-ZA
	Status Report (English)	08/85	039/85
	Energy Sector Institutional Review (English)	11/86	060/86
	Power Subsector Efficiency Study (English)	02/89	093/88
	Energy Strategy Study (English)	02/89	094/88
	Urban Household Energy Strategy Study (English)	08/90	121/90
Zimbabwe	Energy Assessment (English)	06/82	3765-ZIM
	Power System Efficiency Study (English)	06/83	005/83
	Status Report (English)	08/84	019/84
	Power Sector Management Assistance Project (English)	04/85	034/85
	Petroleum Management Assistance (English)	12/89	109/89
	Power Sector Management Institution Building (English - Out of Print)	09/89	--
	Charcoal Utilization Prefeasibility Study (English)	06/90	119/90
	Integrated Energy Strategy Evaluation (English)	01/92	8768-ZIM

EAST ASIA AND PACIFIC (EAP)

Asia Regional	Pacific Household and Rural Energy Seminar (English)	11/90	--
China	County-Level Rural Energy Assessments (English)	05/89	101/89
	Fuelwood Forestry Preinvestment Study (English)	12/89	105/89
Fiji	Energy Assessment (English)	06/83	4462-FIJ
Indonesia	Energy Assessment (English)	11/81	3543-IND
	Status Report (English)	09/84	022/84
	Power Generation Efficiency Study (English)	02/86	050/86
	Energy Efficiency in the Brick, Tile and Lime Industries (English)	04/87	067/87
	Diesel Generating Plant Efficiency Study (English)	12/88	095/88
	Urban Household Energy Strategy Study (English)	02/90	107/90
	Biomass Gasifier Preinvestment Study Vols. I & II (English)	12/90	124/90
Lao PDR	Urban Electricity Demand Assessment Study (English)	03/93	154/93
Malaysia	Sabah Power System Efficiency Study (English)	03/87	068/87
	Gas Utilization Study (English)	09/91	9645-MA
Myanmar	Energy Assessment (English)	06/85	5416-BA
Papua New Guinea	Energy Assessment (English)	06/82	3882-PNG
	Status Report (English)	07/83	006/83
	Energy Strategy Paper (English - Out of Print)	--	--
	Institutional Review in the Energy Sector (English)	10/84	023/84
	Power Tariff Study (English)	10/84	024/84
Solomon Islands	Energy Assessment (English)	06/83	4404-SOL
	Energy Assessment (English)	01/92	979/SOL
South Pacific	Petroleum Transport in the South Pacific (English-Out of Print)	05/86	--
Thailand	Energy Assessment (English)	09/85	5793-TH
	Rural Energy Issues and Options (English - Out of Print)	09/85	044/85

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Thailand	Accelerated Dissemination of Improved Stoves and Charcoal Kilns (English - Out of Print)	09/87	079/87
	Northeast Region Village Forestry and Woodfuels Preinvestment Study (English)	02/88	083/88
	Impact of Lower Oil Prices (English)	08/88	--
	Coal Development and Utilization Study (English)	10/89	--
Tonga	Energy Assessment (English)	06/85	5498-TON
Vanuatu	Energy Assessment (English)	06/85	5577-VA
Western Samoa	Energy Assessment (English)	06/85	5497-WSO
	SOUTH ASIA (SAS)		
Bangladesh	Energy Assessment (English)	10/82	3873-BD
	Priority Investment Program	05/83	002/83
	Status Report (English)	04/84	015/84
	Power System Efficiency Study (English)	02/85	031/85
	Small Scale Uses of Gas Prefeasibility Study (English - (Out of Print)	12/88	--
India	Opportunities for Commercialization of Nonconventional Energy Systems (English)	11/88	091/88
	Maharashtra Bagasse Energy Efficiency Project (English)	05/91	120/91
	Mini-Hydro Development on Irrigation Dams and Canal Drops Vols. I, II and III (English)	07/91	139/91
	WindFarm Pre-Investment Study (English)	12/92	150/92
Nepal	Energy Assessment (English)	08/83	4474-NEP
	Status Report (English)	01/85	028/84
Pakistan	Household Energy Assessment (English - Out of Print)	05/88	--
	Assessment of Photovoltaic Programs, Applications, and Markets (English)	10/89	103/89
Sri Lanka	Energy Assessment (English)	05/82	3792-CE
	Power System Loss Reduction Study (English)	07/83	007/83
	Status Report (English)	01/84	010/84
	Industrial Energy Conservation Study (English)	03/86	054/86
	EUROPE AND CENTRAL ASIA (ECA)		
Eastern Europe	The Future of Natural Gas in Eastern Europe (English)	08/92	149/92
Poland	Energy Sector Restructuring Program Vols. I-V (English)	01/93	153/93
Portugal	Energy Assessment (English)	04/84	4824-PO
Turkey	Energy Assessment (English)	03/83	3877-TU

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	MIDDLE EAST AND NORTH AFRICA (MNA)		
Morocco	Energy Assessment (English and French)	03/84	4157-MOR
	Status Report (English and French)	01/86	048/86
Syria	Energy Assessment (English)	05/86	5822-SYR
	Electric Power Efficiency Study (English)	09/88	089/88
	Energy Efficiency Improvement in the Cement Sector (English)	04/89	099/89
	Energy Efficiency Improvement in the Fertilizer Sector(English)	06/90	115/90
Tunisia	Fuel Substitution (English and French)	03/90	--
	Power Efficiency Study (English and French)	02/92	136/91
	Energy Management Strategy in the Residential and Tertiary Sectors (English)	04/92	146/92
Yemen	Energy Assessment (English)	12/84	4892-YAR
	Energy Investment Priorities (English - Out of Print)	02/87	6376-YAR
	Household Energy Strategy Study Phase I (English)	03/91	126/91
	LATIN AMERICA AND THE CARIBBEAN (LAC)		
LAC Regional	Regional Seminar on Electric Power System Loss Reduction in the Caribbean (English)	07/89	--
Bolivia	Energy Assessment (English)	04/83	4213-BO
	National Energy Plan (English)	12/87	--
	National Energy Plan (Spanish)	08/91	131/91
	La Paz Private Power Technical Assistance (English)	11/90	111/90
	Natural Gas Distribution: Economics and Regulation (English)	03/92	125/92
	Prefeasibility Evaluation Rural Electrification and Demand Assessment (English and Spanish)	04/91	129/91
	Private Power Generation and Transmission (English)	01/92	137/91
Chile	Energy Sector Review (English - Out of Print)	08/88	7129-CH
Colombia	Energy Strategy Paper (English)	12/86	--
Costa Rica	Energy Assessment (English and Spanish)	01/84	4655-CR
	Recommended Technical Assistance Projects (English)	11/84	027/84
	Forest Residues Utilization Study (English and Spanish)	02/90	108/90
Dominican Republic	Energy Assessment (English)	05/91	8234-DO
Ecuador	Energy Assessment (Spanish)	12/85	5865-EC
	Energy Strategy Phase I (Spanish)	07/88	--
	Energy Strategy (English)	04/91	--
	Private Minihydropower Development Study (English)	11/92	--
Haiti	Energy Assessment (English and French)	06/82	3672-HA
	Status Report (English and French)	08/85	041/85
	Household Energy Strategy (English and French)	12/91	143/91
Honduras	Energy Assessment (English)	08/87	6476-HO
	Petroleum Supply Management (English)	03/91	128/91

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Jamaica	Energy Assessment (English)	04/85	5466-JM
	Petroleum Procurement, Refining, and Distribution Study (English)	11/86	061/86
	Energy Efficiency Building Code Phase I (English-Out of Print)	03/88	--
	Energy Efficiency Standards and Labels Phase I (English - Out of Print)	03/88	--
	Management Information System Phase I (English - Out of PRint)	03/88	--
	Charcoal Production Project (English)	09/88	090/88
	FIDCO Sawmill Residues Utilization Study (English)	09/88	088/88
	Energy Sector Strategy and Investment Planning Study (English)	07/92	135/92
Mexico	Improved Charcoal Production Within Forest Management for the State of Veracruz (English and Spanish)	08/91	138/91
Panama	Power System Efficiency Study (English - Out of Print)	06/83	004/83
Paraguay	Energy Assessment (English)	10/84	5145-PA
	Recommended Technical Assistance Projects (English-(Out of Print)	09/85	--
	Status Report (English and Spanish)	09/85	043/85
Peru	Energy Assessment (English)	01/84	4677-PE
	Status Report (English - Out of Print)	08/85	040/85
	Proposal for a Stove Dissemination Program in the Sierra (English and Spanish)	02/87	064/87
	Energy Strategy (Spanish)	12/90	--
Saint Lucia	Energy Assessment (English)	09/84	5111-SLU
St. Vincent and the Grenadines	Energy Assessment (English)	09/84	5103-STV
Trinidad and Tobago	Energy Assessment (English - Out of Print)	12/85	5930-TR
	GLOBAL		
	Energy End Use Efficiency: Research and Strategy (English - Out of Print)	11/89	--
	Guidelines for Utility Customer Management and Metering (English and Spanish)	07/91	--
	Women and Energy--A Resource Guide The International Network: Policies and Experience (English)	04/90	--
	Assessment of Personal Computer Models for Energy Planning in Developing Countries (English)	10/91	--
	Long-Term Gas Contracts Principles and Applications (English)	02/93	152/93

ESMAP
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The World Bank
1818 H Street, N.W.
Washington, D.C. 20433
U.S.A.