Power Sector Development Plan for Timor-Leste

Pacific Department
Asian Development Bank

September 2004


TIMOR-LESTE
124°30'E
126°30'E
8°30'S
9°30'S
N
0 5 10 15 20 25
Kilometers
National Capital
District Capital
Town
Port
Main Road
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District Boundary
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Boundaries are not necessarily authoritative.
Atauro Island
Maumeta-Atauro
Strait of Wetar
Joco Island
Savu Sea
Timor Sea
Liquisa
Maubara
LIQUICA
DILI
Port Hera
Metinaro
Railako
AILEU
Aileu
Ermera
Fatubessi
Lacluta
Atabae
Hatolina
ERMERA
BOBONARO
Balibo
Maliana
Atsabe
Maubisse
Turiscai
Hato-Builico
MANUFAHI
Same
Alas
Ainaro
Bobonaro
AINARO
Hato-Udo
Betano
Zumalai
Fatalulic
COVA-LIMA
Fohorem
Suai
Cape Suai
Pane Macassar
OECUSSI
Nitibe
Oe-Silo
Passabe
Manatuto
Laleia
Lakló
MANATUTO
Laclubar
Barique
Natar-Bora
Viqueque
VIQUEQUE
Ossu
Beacu
Baucau
Laga
Vemasse
BAUCAU
Quelicai
Baquia
Venilale
Iliomar
Lauten
Laivai
Tutuala
Cape Cutcha
Lospalos
Iralalaro
Luro
LAUTEM
Lore
PACIFIC OCEAN
South China Sea
Java Sea
INDIAN OCEAN
KALIMANTAN
SULAWESI
SUMATRA
JAVA
BALI
FLORES
TIMOR
TIMOR-LESTE
110°00'E
130°00'E
10°00'N
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Contents

Abbreviations

ADB	Asian Development Bank
BOT	build-operate-transfer
CDM	clean development mechanism
CFET	Consolidated Funds for East Timor
CFL	compact flourescent lamp
EDTL	Electricidade de Timor Lorosae
ETPA	East Timor Public Administration
ETTA	East Timor Transitional Administration
GWh	gigawatt hour
IT	information technology
JICA	Japan International Cooperation Agency
km	kilometer
kV	kilovolt
kW	kilowatt
kWh	kilowatt hour
LNG	liquified natural gas
MTCPW	Ministry of Transport, Communications and Public Works
MV	megavolt
MW	megawatt
NDP	National Development Plan
NORAD	Norwegian Agency for International Cooperation
O&M	operation and maintenance
PLN	Perusahaan Listrik Negara
SIP	Sector Investment Packages
TFET	Trust Fund for East Timor
UN	United Nations
UNTAET	United Nations Transitional Authority in East Timor
Wp	peak watt

NOTES

In this Report, "$" refers to US Dollars.

Background

This study report presents the results of a 20-year power sector development plan for Timor-Leste (East Timor). The study was financed by Asian Development Bank (ADB) under its TA No. 3748-TIM: Preparing the Power Sector Development Plan.

This study is the first of its kind, and establishes the basis for future development of the power sector in Timor-Leste, including generation, transmission, distribution and electrification, and additionally discusses institutional and policy issues important for the world's newest independent state.

After the submission of the Draft Final Report of this study in September 2003, ADB and the World Bank supported the Ministry of Transport, Communications and Public Works (MTCPW) of Timor-Leste in the preparation of a medium-term Sector Investment Program (SIP) for the power sector in Timor-Leste,[1] under the direction and guidance of the MTCPW. During this SIP exercise, more detailed project proposals were prepared for the medium-term power sector development in Timor-Leste, which were based on the Draft Final Report and its findings and recommendations, and were coordinated with the study team. As recommended by ADB, the power sector summary produced for the SIP exercise, including short summaries of the proposed medium term projects, has also been adopted in this Report.

[1] Power Sector Priorities and Proposed Sector Investment Package, Ministry of Transport, Communications and Public Works, November 2003.

Chapter 1

Setting for the Power Sector

I. Setting for the Power Sector

1.1 Access to Electricity

As recently as 1985 the electrification ratio of Timor-Leste was only 3.9%. By 1998, after 13 years of relatively intense efforts, 28.7% of all villages were electrified and about 70% of the households in the electrified villages were connected to the grid. Development was relatively rapid during the later years of Indonesian rule, and between 1996 and 1998 the length of the 20 kilovolt (kV) line increased from 485 kilometer (km) to 669 km, and low-voltage lines from 146.9 km to 836.3 km. Even then, East Timor had the second lowest electrification ratio of Indonesian provinces. The events of 1999 resulted in widespread destruction of almost all power sector assets, including administrative buildings, power stations, power lines, and associated records and documentation. Even solar panels and connection boxes at individual home installations were purposely damaged.

Over the past 4 years there has been considerable progress in restoring electricity services to consumers, particularly in Dili. There are presently about 23,000 customer connections in Dili and its environs, with a consumer load of about 12 megawatts (MW). Outside Dili, some 17,000 customers are connected to 57 isolated, small power grids. There are varying estimates of the number of households with access to electricity. The 2001 Poverty Assessment Survey indicated that about 28% of the population (about 237,000 people) had access to electricity. This estimate is somewhat at variance with surveys carried out as part of this study in mid-2003; based on independent surveys it has been concluded that approximately 36,000 households had access to electricity in mid-2003 and the electrification ratio for households was 20.7% (Table 1).[2]

Table 1: Estimated Electrification Ratios in Timor-Leste

	PLN 1998	Mid-2003 Estimate
Electrified villages	127	184
Total villages	442	498
Electrification ratio (%)	28.7	36.9
Electrified households	38,133	36,471
Total households	189,600	175,860
Electrification ratio (%)	20.1	20.7

PLN = Perusahaan Listrik Negara.

[2] There is uncertainty over the precise number of households that are electrified. In this report a figure of 175,860 for the number of households in Timor-Leste in mid-2003 has been used. The SIP exercise used the 2001 Survey estimate of 180,283 households in the country and on that basis, estimated total households at 190,000 in mid-2003, implying an average increase of 2.7% a year during 2001-2003. If the estimate made in this study of the number of households with electricity is reasonably robust, the implied electrification ratio would be 19.2%. If the estimated electrification ratio is the more robust estimate, it implies that some 41,000 households were electrified in 2003.

It is estimated that the network serves 85% of households in Dili and the immediate rural surroundings. In other district capitals and their immediate rural outskirts, some 18% of households are electrified, but only 5% of rural households are electrified. The main reason for the large discrepancy with the 2001 Survey data is the widely differing estimate of rural households with electricity. According to the latter, some 12% of rural households were electrified in 2001.

1.2 Legal and Institutional Framework

The legal framework

Progress in re-establishing electricity services after the events of 1999 was hampered by something of a legal vacuum that was not fully addressed by early regulations issued by the United Nations Transitional Authority in East Timor (UNTAET). The general legal principle of UNTAET's initial Regulation 1999/1 was that the laws that applied in Timor-Leste prior to 25 October 1999 would continue to apply. However, Indonesian law contained explicit references to Indonesian agencies no longer in authority in Timor-Leste. UNTAET therefore established Electricidade de Timor Lorosae (EDTL) from the remnants of the Perusahaan Listrik Negara (PLN) power system and associated staff, placing international personnel in managerial positions. The United Nations (UN) led intensive efforts to restore the power system with bilateral support from the governments of Australia, Japan, Norway, Portugal, United Kingdom and United States. ADB administered assistance to the power sector under the Trust Fund for East Timor (TFET).

Progress in re-establishing legal frameworks and managerial capacities was slower than anticipated. It was not until June 2001 that EDTL's relationship to the East Timor Public Administration (ETPA) was legally defined, and not until August 2001—immediately prior to the end of the UN administration—that EDTL gained the right to charge Dili consumers for electricity. This right was extended to customers in the districts only in February 2003. Responsibility for the administration of EDTL was transferred to East Timor Transitional Administration (ETTA) in August 2001, and after independence in May 2002, to the Government of Timor-Leste.

Four main laws have shaped the development of the electricity sector since 1999. These are as follows:

- The initial Regulation 1999/1 of UNTAET, which sets the general legal principle that the laws that applied in East Timor prior to 25 October 1999 would continue to apply.
- The UNTAET Tariff Directive effective in August 2001, giving EDTL the right to charge consumers for electricity services in Dili and including provisions for tariff setting, billing and collection, connection and disconnection.
- The Basic Law for the National Power System enacted in May 2003, which defines the role of the Government in the power system and delegates most of its tasks to a Regulatory Authority, and favors outsourcing of electricity services to the private sector through a long-term concession contract.
- Directive No. 7/2002 and Ministerial Decree No.1/2003, which specify electricity services, fees and charges, and collection of fees and charges.

While the Basic Law specifies general principles and overall responsibilities, it is designed to be complemented by decrees and directives in various areas. Progress and plans

in preparing and implementing such complementary legislation is discussed later in this report.

Sector responsibilities within Government

MTCPW which administers the power sector, is divided into 12 directorates and three administrative offices covering various infrastructure sectors from water and power to telecommunications and ports. MTCPW has a permanent Vice Minister and two secretaries of state: one for Electricity and Water, the other for Public Works. Power sector administration is under the Directorate for Electricity Services.

As in most other countries, the management of the power sector also requires close coordination with other branches of government. In Timor-Leste, power sector operations need to conform to Government policies and regulations particularly in regard to (a) the priorities and responsibilities for development of indigenous energy resources; (b) the provision of water rights for development of hydropower plants; (c) environmental impacts and management of power system expansion and operation; and (d) the rights and responsibilities relating to acquisition of land and resettlement. Government preference for development of indigenous resources is clear from existing policy documents and legislation. It is also clear that the responsibility for providing rights for development of onshore oil and gas is with the Minerals and Energy Directorate of the Department of Development and Environment. Responsibilities for provision of water rights, environmental obligations, and rights and obligations in relation to land acquisition and resettlement are not yet fully defined.

1.3 Service Provision and Tariffs

Responsibilities for service provision

Responsibility for the provision of electricity services has evolved rapidly since 1999. Most of the early power system restoration works were carried out with the assistance of the UN and several bilateral and multilateral agencies. Coordination of these activities under ETTA was carried out through a Special Electricity Coordination Committee. This Committee was later converted to a Power Sector Steering Committee. The Committee was very active during the rehabilitation period, but last met in November 2002. It consists of permanent members from the Government and private sector representing the country's stakeholders. Members from the international community act as advisors and observers with no voting rights.

In May 2003, a new organizational structure was established for EDTL, and 205 staff positions were advertised with targeted reduction of 26 positions from the previous level. Existing staff needed to re-apply for their positions. EDTL is led by a Director, and is divided in two directorates and six departments: Technical Operations (Director); Planning and Projects Department (Manager, 6 staff); Production Department (Manager, 41 staff); Distribution Department (Manager, 32 staff); District Services and Operation and Maintenance (O&M) Department (Manager, 174 staff); Administration and Finance (Director); Administration and Finance Department (Manager, 28 staff); Commercial Department (Manager, 47 staff). The current focus is on operations, with very few staff devoted to system planning and expansion. The Government intends to convert EDTL into an autonomous public company, and legislation in this regard is in the final stages of approval.

The Power Sector Steering Committee will be replaced by an EDTL Board of Directors when new legislation is approved.

A number of small entities at the district level have also been set up under donor-funded programs to provide power to local communities. Rehabilitation projects funded by Portugal and Japan, and the ADB-led Emergency Infrastructure Rehabilitation Project, supported the development of these local service providers.

Tariffs

Current tariffs were established in Ministerial Decree No 1/2003 of MTCPW. The decree provides that all consumers must have an adequate kilowatt-hour (kWh) meter installed, obligates EDTL to organize an adequate metering and billing system in the country, establishes disconnection rights for cases of nonpayment and delayed payment, and specifies procedures for legalization of informal connections. The following tariffs were set:

- Commercial consumers and Government agencies, $0.20/kWh.
- Domestic and social sector consumers, $0.16/kWh.

For consumers who are not metered and are located outside the Dili system, the decree establishes a system of flat rate charges based on duration of daily service and amperage of connection. The flat rates vary from $3 per month for low-income consumers with a two-amp connection and 6-hour daily provision of power, to $25 per month for connection above four amps and 24-hour access to power.

Chapter 2

Power Demand and Sources of Energy

II. Power Demand and Sources of Energy

2.1 Current Supply and Demand for Power

In 1998, the total peak load of Timor-Leste was reported at 17.1 MW. Power sales stood at 66.87 gigawatt hour (GWh) per annum, 60% of which was residential consumption and less than 4% industrial consumption. District capitals outside Dili accounted for about 22.4% of power consumption, while the share of rural areas was only 4.5%. No precise information on the present situation is available. Table 2 gives a rough estimate, based on information gathered during this study. It suggests that peak load was about 18.6 MW in 2002, some 9% above the 1998 level.

The estimates in Table 2 suggest that Dili currently accounts for about 85% of power consumption in Timor-Leste compared with 78% in 1998. Rural areas account for 2%. There is no reliable information on how power consumption is divided among residential, commercial, industrial, and public sectors. This lack of information stems from shortcomings in the billing system and the use of fixed connection and flat rates.

Table 2: Power Generation in Timor-Leste in 2002 (Estimated)

Service Area	Power Generation (net)		Peak Power Generation (net)	
	GWh	% of total	kW	% of total
Dili	53.3	84.7	12,500	67.2
Other district capitals	8.5	13.5	5,234	28.1
Rural areas	1.1	1.8	878	4.7
Total	62.9	100.0	18,612	100.0

GWh = gigawatt hour, kW = kilowatt.

Currently, all electricity generation in Timor-Leste is through diesel engines burning automotive diesel oil. Timor-Leste has only one bulk import terminal for oil products, located in Dili. This is operated by Pertamina, the Indonesian national oil and gas company. Other companies presently are not allowed to use the bulk import terminal. As a result, Pertamina is responsible for about 80% of all imported oil products. A few other companies import small amounts of oil, mainly from Australia. Pertamina's import prices appear to be considerably higher than those paid by nonsubsidized consumers in Indonesia and by comparable countries in the South Pacific.

Dili's present demand of about 12.5 MW is supplied by a diesel generator capacity of about 16 MW in Comoro power station. Due to the poor status of power supply and high electricity tariffs, Dili has a captive diesel generator capacity of about 10.2 MW, of which about 4.4 MW is in production and 5.8 MW remains as standby. The district capitals and rural areas are supplied through a cumulative operational capacity of 12.1 MW. There is no transmission grid in Timor-Leste and the highest distribution voltage level is 20 kV. All power generation is based on diesel generation, using automotive diesel oil as fuel. Comoro power

station has several medium-speed diesel engines, while in all the other systems only high-speed diesel units are being used.

Despite intensive rehabilitation efforts, the operational level of the system is still lower than before the violence. The Dili system operates 24 hours per day, but all district and subdistrict power systems outside Dili operate approximately 5–6 hours per day, except for the Baucau system, which operates 18 hours per day. Only 45 out of 57 isolated systems are operational in other formerly electrified areas. Seven are nonoperational, but already scheduled for rehabilitation. Five are without any rehabilitation plans. There are a total of 142 system-connected diesel engines located outside Dili, of which 77 are currently in working condition. A further 13 diesel engines installed by the Japanese Government are in working condition, but cannot be operated until their associated distribution networks are rehabilitated. Even with implemented and ongoing rehabilitation projects, EDTL still has insufficient generation capacity in many areas, and regular load shedding is practiced. Some areas are also without electricity due to damaged distribution lines that have not been rehabilitated, although in many cases rehabilitation would be relatively simple. In the majority of the power systems there is little or no spare capacity. The exception to this are the power systems rehabilitated by the Japanese and Portuguese governments, which have one diesel unit operating for 6 hours per day and 1 for standby.

2.2 Prospective Demand for Power

The growth of future power demand will depend on the country's economic growth, the technical and financial performance of EDTL, and on the extent to which the present very low levels of rural electrification can be systematically increased. This, in turn, will depend on national expenditure priorities, and the availability of domestic and external financing for the power sector. Given the uncertainties concerning the country's projected economic growth rate and resources likely to be available for power sector development, different power demand scenarios were studied in this report. The study includes plans, cost estimates, and economic analysis for various scenarios.

The Government has not yet completed its review of these various scenarios and has not finalized its own internal load forecasts. For the purposes of the SIP exercise, the scenario proposing that 80% of households have access to electricity by 2025 was considered to be the one that most closely corresponds to the objectives of the National Development Plan. Table 3 sets out the load forecast for this scenario and compares it with a scenario that assumes slower expansion because of funding constraints.

Table 3 suggests that over the next two decades, Timor-Leste will need to plan for somewhere in the range of 50–100 MW of additional generation capacity, depending on the growth in demand and the pace of electrification. The capital cost of this additional capacity, not including the cost of transmission and distribution, is likely to be in the range of $35–$70 million at current prices for diesel generation.

The cost of service for the target "80% scenario" is calculated at 13.7 c/kWh, on the basis that diesel oil continues to be tax-free. Continued reliance on relatively high cost diesel generation could be a deterrent to economic growth and competitiveness. A key issue for

Table 3: Forecasts of Load Growth in Timor-Leste

Scenario	Electrification Ratio (%)		Peak Load Forecast (MW)				Load Growth
	2002	2025	2002	2010	2020	2025	2002–2025 (%)[a]
Constrained expansion	21	50	18.6	28.0	39.5	75.2	6.3
80% electrification target	21	80	18.6	37.5	75.0	108.6	8.0

MW = megawatt.

the Government therefore is the prospect for developing alternative, cheaper sources of energy for power generation.

2.3 Energy Sources for Power Generation

It is clear that Timor-Leste should look to indigenous energy resources for potentially economical power generation. Of these, hydropower, wind and onshore oil and gas are the most promising.

Hydropower

Timor-Leste is a mountainous country with good rainfall indicating a potential for hydropower. Previous studies, reviewed in this study, identified five schemes with a total installed capacity of about 80 MW and annual energy generation of 434 GWh. The most feasible of these, based on least cost generation planning, is the 27 MW Ira Lalaro hydropower project on the eastern tip of the island. The scheme is based on the Ira Lalaro lake, which would provide natural storage for the plant, resulting in an expected high annual capacity factor of about 80%.[3] Due to the steep topography of the country, there are few opportunities to form artificial reservoirs. All the other identified schemes are of run-of-river type, which might however still prove to be economical for fuel displacement, given the high costs of diesel generation. Of these schemes, the Gleno (Alternative 1) project seems to be the most feasible, and is also interesting for its proximity to Dili. Besides Ira Lalaro and Gleno, the Belulic and Laclo projects should also be studied more carefully. Micro and mini hydro is likely to have a significant role in electrification of isolated villages or groups of villages unlikely to be connected to the grid within a 10 or 15-year time frame. A mini and micro hydro resource assessment study is proposed in the present SIP program to identify such areas.

[3] Between 1985 and 1989 a group of consultants employed by PLN carried out comprehensive studies on the Ira Lalaro hydropower project. The studies concluded the project was technically feasible and economically attractive, with an output of about 27 MW, likely to generate an average of 190 GWh of energy per annum. PLN generation plans for the region show that PLN intended that the project be constructed and commissioned in FY1999/2000. Also this study concludes that Ira Lalaro is the most feasible of identified hydropower projects. As the SIP for Natural Resources and Environment points out, the Ira Lalaro ecosystem may have some unique features. Further careful assessment of the potential environmental impact of a hydro project in the area will be required.

Wind power

Another domestic renewable energy source with substantial future power generation potential is wind. A USAID-funded wind project has been on going in the "NTT Province" of Indonesia that also includes West Timor. Based on West Timor data, this study concludes that wind power is probably not economic in coastal areas, but it may prove to be economic in the uplands and mountains of Timor-Leste both for grid connected and off-grid applications. An interesting feature of the wind resources is that the dry season from April to October is also the windy season, which means that there would be good complementarities with hydropower generation. A potential location for a 10–15 MW wind power project was identified in Foho Bagarkoholau and the nearby mountaintops, some 10 km south of Dili. Indications are that it would not compete with the best hydropower projects at current wind generator equipment costs, but these are gradually reducing with improved technology and increased market penetration. Carbon credits may accrue to Timor-Leste from a suitable wind project. A study of wind power potential is included in this SIP program.

Offshore oil and gas

Timor-Leste has considerable offshore oil (and especially) gas reserves in Timor Sea, but the utilization of these resources for domestic power generation is presently not considered feasible due to their long distance from the shore, water depth between the gas fields and Timor, and small size of the power system. This situation could change if the liquified natural gas (LNG) facility for Greater Sunrise gas field were to be built in Timor-Leste, which would allow the utilization of gas in a more feasible way. However, this is contrary to the current plans of the developer, who plans floating LNG facilities.

Onshore oil and gas

There is potential for onshore oil- and gas-fuelled generation, at least in the southern coastal areas, and if significant reserves are found, this could offer an alternative to, or complement, a program of hydropower/diesel generation. More than 30 documented oil and gas seeps in Timor-Leste give a clear indication of hydrocarbon potential in the area. A small number of oil wells were drilled in the 1970s, and while these wells are now capped, fresh investigations involving geological and gravimetric studies are now being carried out by PetroChina, with reportedly promising results. An additional 200 km of exploratory seismic lines are planned in the near future to complement PetroChina's investigations. The willingness of prospective developers (some with access to earlier exploration data) to invest in south coast oil and gas exploration gives rise to positive expectations regarding the successful development of these reserves.

Geothermal potential

Preliminary assessment of this study leads to the conclusion that it is unlikely that there are any large, hot geothermal systems. Several moderately hot springs were located during the study, but it was concluded that these are likely to have a deep-seated tectonic origin and therefore will not have significantly greater temperature at depth. However, the springs on Atauro Island, which could be an ideal location for an up-market eco-tourism resort, appear to indicate the existence of a higher temperature, possibly magmatic-related

geothermal system, recharged by seawater. Therefore, it may well be possible to develop this resource to power a small generator to supply the resort at a premium price, and the local residents with surplus power at low marginal cost.

Solar power potential

Solar power offers good potential for off-grid electrification in Timor-Leste. There were some solar home systems installed around 1996–1997; however, many of these have been damaged, either purposely or due to lack of maintenance. Considering the low population densities and low incomes in the rural areas in Timor-Leste, solar home systems would be a lower-cost electrification option compared to grid extension for small hamlets of households remote from the grid where main requirement is for lighting. A typical solar home system involving a 50 peak watt (Wp) panel would provide electricity for a daily average consumption of 150 Watt-hours; that is, a 25 watt load for 6 hours per day. Such a system would therefore be sufficient to produce enough electricity for lighting, radio, and television for a small household. Operation and maintenance costs are low. However, due to the high capital cost the total production costs for a standard 50 Wp solar home system are in a range of $1.25 per kWh, or about $5.50 per month. In order to make the cost of solar home system more affordable to the poor rural households, capital subsidies would be required.

Other resources for power generation

Indications are that there are insufficient biomass reserves in Timor-Leste to allow commercial utilization as energy sources. Coal- /oil-fired steam power generation, offshore gas and nuclear power are all large-scale options, and are not considered feasible for Timor-Leste, which has a relatively small power system.

Chapter 3

Goals and Objectives for the Sector

III. Goals and Objectives for the Sector

3.1 Goals and Objectives

The issues and challenges facing the power sector were recognized and addressed in the May 2002 National Development Plan (NDP) and in subsequent policy developments. The Government's vision for the next generation in 2020, as stated in the NDP, includes that "people will no longer be isolated because there will be good roads, transport, electricity and communications in the towns and villages in all the regions of the country." Further, the NDP recognizes that "an effective system of infrastructure and services is crucial for agricultural productivity and poverty reduction, a determinant of business investment, instrumental to human development, and the foundation for private sector development," and the need "to plan for, provide and manage physical infrastructure that is efficient, cost-effective, and financially sustainable, and which supports the social and economic development priorities of the people Timor-Leste."

This vision sets the following requirements for the power sector:

- The power sector will create and maintain reliable and affordable power supplies that meet the needs of immediate areas served, to support economic productivity and quality of life, throughout Timor-Leste.
- Supplies will be developed to achieve lowest possible costs in the long run, tapping the economic potential of indigenous resources to displace costly imported fuels; indigenous resources to be developed may include natural gas, hydropower, solar, and others.

3.2 The Electrification Program

No specific numerical or percentage targets were set out in the NDP for the electrification of the country. There is, however, a compelling case for strong expansion of electrification, consistent with implementation capacities and funding availability. As noted earlier, for the purposes of the SIP exercise, the Government has adopted a scenario aimed at ensuring that at least 80% of households have access to electricity by 2025. Under this program, installed capacity would grow by an average of 8% a year and increase to almost 110 MW by 2025 (see Table 4).

3.3 Options for Generation and Transmission

This study envisages the development of a mixed hydro-diesel generation system and, over the 20-year planning period, gradual interconnection of the separate systems into a single grid. The existing diesel based system would be reinforced in the short term and, as soon as possible, supplemented by the 27 MW Ira Lalaro hydropower plant and associated 132 kV transmission line to Dili. This transmission line would allow connection of the major towns along the way (Baucau, Los Palos) and, depending on power demand growth, possibly

Table 4: Expansion Plan for Electrification

	2002	2005	2010	2020	2025	Annual Increase (%)[a]
Total households *('000)*	184.4	201.5	223.0	271.0	300.0	2.1
Electrification ratio *(%)*	20.0	30.0	40.0	70.0	80.0	
Households electrified *('000)*	36.9	60.5	89.2	189.7	240.0	8.5
Total power supply *(GWh)*	62.9	79.8	152.1	340.0	469.7	9.1
Total demand *(MW)*	18.6	20.6	37.5	75.0	108.6	8.0

GWh = gigawatt hour, MW = megawatt.

Manatuto and some smaller towns and villages. Under the proposed program, the hydropower plant and transmission line would become operational by 2010. After commissioning of Ira Lalaro, new generation in the interconnected system could be hydropower (Gleno, Belulic or Laclo), heavy fuel oil-fired diesel generators, or wind depending on relative economics of these technologies at the time of investment decisions. After the Ira Lalaro-Dili interconnection, the next major transmission investment would be the Dili south 132 kV transmission line connecting the district capitals of Aileu, Gleno, Maliana, Same, and Suai to Dili.

Discovery of substantial low-cost oil and gas reserves in the southern coastal area could change significantly the overall configuration of the power sector development. Initial thermal power plants could be constructed in the South, with north-south 132 kV transmission lines to Dili, connecting load centers along the route. It is important therefore that the exploration and licensing activities in relation to onshore oil and gas be accelerated so that the results are known prior to commencement of major generation investments in Ira Lalaro.

3.4 Rural Electrification

Various possibilities for rural electrification are discussed in this report. Typically, electrification with grid extension incurs the highest investment costs, but also provides the greatest potential for income-earning activities and social benefits of electrification. As the economic benefits of grid extension are higher due to its larger income-generating potential, the first priority, based on purely economic considerations, would be to electrify those parts of the country earmarked for grid extension, i.e., the main population centers. For social reasons, however, it may be better to advance grid and off-grid electrification in parallel. Off-grid electrification, typically based on solar home systems, has relatively low potential for income-generating activities. The two electrification methods are normally complementary. Grid extension is used in main population areas and village centers, while solar home systems are used for electrification of more isolated areas. In parts of Timor-Leste with low population densities, solar home systems are likely to be the only feasible solution for electrifying small hamlets of 5–30 households at least a few kms from the existing grid, as well as very small villages remote from the power grid.

Prior to connection to the main system, generation in the rural power systems would continue to be diesel based, except in those areas where micro hydro or small wind installations are found to be economically feasible in comparison to diesel generation. Proposals for study of these options are discussed later in this Report.

Rural distribution in Timor-Leste has been based on PLN standards. These standards were designed many years ago for urban distribution and have been extended into rural areas virtually unchanged. It is considered in this study that by adopting a design more appropriate to the requirements of rural communities, the cost of rural distribution could be halved. Cost reductions can be achieved through the use of smaller conductor sizes for megavolt (MV) lines appropriate to anticipated loads, increased span lengths, a more flexible approach to overhead line routing, use of single-phase spur lines to remote villages, and wherever possible, use of single-phase instead of three-phase transformers.

A feature of rural electrification programs is that they require considerable capital expenditure and are typically not able to generate sufficient revenue to cover operating and capital replacement costs. Because of this, it is recommended that the program is financed and supervised by a rural electrification agency (or fund) that is separate from the commercial operations of EDTL. The latter would then manage the program on an agency basis through a separate unit within the organization. The rural electrification fund/agency would receive financing for its activities from the Government, or grants or loans with subsidized interest rates from the donor community. Subsidies would be targeted at providing access to electricity, i.e., subsidizing the cost of connection (currently estimated at $500–$1,000 per household), which rural households rarely can afford. The fund could also be used to provide subsidies to communities or the private sector in case of concessioning of distribution areas (whether on-grid or off-grid) to them.

It is widely known that electricity service has good income-producing potential for the rural population; however, electricity is only one pre-requisite for these income-producing activities, and if the other pre-requisites are lacking, such as capital or access to land, provision of electricity service alone may have little impact. The Government recognizes that specific actions will be needed to maximize the impact of the program. A key issue that has emerged from many rural electrification projects worldwide is the importance of greater coordination and/or integration of rural electrification with programs that provide water, health and education services, and that develop small-scale agriculture and small business. In many cases, the full potential of electrification has not been realized due to uncoordinated development efforts.

3.5 Economic Benefits of Electrification

Results of economic analyses for the load growth scenario based on 80% electrification by 2025 using a combination of hydropower and diesel generation are summarized in Table 5.[4] The overall program shows acceptable economic internal rate of returns. Calculations for a

[4] In these analyses, the economic benefit is considered to be the current retail cost of power and does not take into account consumer surplus, thus it is considered to be a lower bound of the economic benefit of electrification. ERRs with consumer surplus taken into account would be somewhat higher.

Table 5: Economic Benefits from Expansion Program Based on Hydro and Diesel

Project/Program	ERR (%)	NPV ($ million)
New diesel engines in Dili	21.9	21.4
New diesel engines outside Dili	< 0	-33.0
Ira Lalaro hydropower project	19.3	44.4
Gleno hydropower project	14.9	3.1
Wind power project	10.0	0.0
Oil pipeline to Comoro	28.3	1.1
Total program for 80% electrification	14.2	37.1

Note: ERR refers to economic rate of return and NPV to the net present value of benefits from the investment(s).

possible expansion program based on onshore oil and gas cannot yet be made as the resources and their development costs are not known.

In the analysis, rural electrification is actually shown to be uneconomical if benefits are assumed only equal to the power tariff. However, studies in other countries have shown that the full economic benefits of rural electrification are substantially higher than the tariff level. International experience clearly points to the close linkages between electrification and rural economic growth. Simulations carried out as part of the Poverty Assessment Project indicated a strong correlation between household electrification and real per capita consumption and poverty reduction.[5] The relevant simulation indicated that if electricity were to be expanded to all households in the country there would be a 26% reduction in the poverty headcount and an increase of 21% in real per capita consumption among affected households. Results were similar whether newly electrified households were in urban or rural areas. These effects were the fourth highest among 17 interventions evaluated. The effect on national consumption and poverty levels was equally striking. Expanding electrification to all households would increase national per-capita consumption by 13% overall, with much of this increase occurring in rural households where an overall increase of 17% was projected.

[5] See Government of Timor-Leste et al., Timor Leste: Poverty in a New Nation: Analysis for Action. 2003.

Chapter 4

Progress, Issues, and Challenges

IV. Progress, Issues, and Challenges

4.1 Recent Progress

Electricity sector emergency plan

The Electricity Sector Emergency Plan incorporated in the Electricity Sector Policy Paper was designed to achieve the preconditions for full corporatization and commercialization of EDTL. It dealt with the subjects (a) EDTL billing and collections, (b) commercialization of EDTL, (c) upgrading of the capacity of the Comoro Power Station, (d) preventive maintenance at Comoro power station, and (e) training of Timorese maintenance staff. For the long term, it was considered that sector objectives and development targets of the electricity sector could best be achieved through a concession of the national power system under a build-operate-transfer (BOT) arrangement with a private investor. The Plan provided for a maximum of 20 years for the BOT contract. It also provided for the establishment of a public regulatory authority with the responsibility to monitor the concession contract and to prepare the legislation and regulations for the electricity sector. It was considered that the need for sector regulation could best be met by merging the regulating authorities for the electricity, water and sanitation, and telecommunications sectors into one authority, which would regulate all the activities and public service providers in these sectors irrespective of whether they are publicly or privately owned.

Action plan

On the basis of the Electricity Sector Policy an Action Plan was developed. Many of the above-listed issues were addressed through the contractual arrangements for a 3-year Power Sector Management Contract that is expected to provide the foundation for a more sustainable, commercialized utility operation over the long term. For some immediate rehabilitation needs (Comoro power station upgrade and maintenance), an interim short-term management contract was concluded with Jacobsen Electro and financed by the Government of Norway. Table 6 sets out the elements of the Action Plan, their original scheduling, and the actual implementation as at September 2003.

4.2 Issues for the Immediate Future

The Government faces a number of challenges in the immediate future, early action on which can have significant implications for the financial position of the industry and the national budget. These relate to the high cost of fuel imports, low collection rates from EDTL customers, and lack of staff capacities for management and implementation of power sector related programs.

High cost of imported diesel fuel

In the short term, there is little alternative to diesel generation, but overall fuel costs, already elevated due to high world market prices, are increased further because of inefficient

Table 6: Power Sector Action Plan

Action	Original Schedule	Action/Update	Remark
Approval of Electricity Sector Policy Paper	September 2002	18 September 2002	Completed
Emergency contract with electricitysector company for EDTL billing and collection organization and training	October 2002	Installation of 10,000 prepayment meters started in July 2003	Installation of only about 600–700 meters completed against October 2003 target of 3,000; Council of Ministers has ordered rapid acceleration and enforcement.
Initiation of a 3-year ManagementContract with EDTL (production, distribution, and commercialization of EDTL)	October 2002	Negotiated contract approved by Councilof Ministers on29 October 2003	Management Contract will besigned at end-November 2003; commencement will be on 1 January 2004.
Executive Order to convert EDTL into Autonomous Public Company	October 2002	Considered by Council of Ministers September 2003; returned for revision	Basic Law for the National Power Supply (Electricity Law) approved by Council of Ministers and promulgated by President in November 2003
Government authorization for EDTL to lease generating capacity for Dili toreduce power cuts	November 2002	November 2002	Purchase of 6x1 MW diesels for EDTL ($1.8m)
Launch international public tender for a 20 year BOT on all operations of EDTL (production, distribution, and commercialization)	December 2002	July 2002 Award foreseen laterafter completion of Masterplan and Hydropower studies	Deferred for consideration after 3-year Management Contract Institutional and Regulatory Study proposed under SIP initiative
Establishment of Regulatory Authorityfor the Electricity Sector (possibly multisector regulator) to regulate the sector and to monitor the BOT concession contract	October 2003	Foreseen in 1–2 years	Institutional and Regulatory Study proposed under SIP initiative

EDTL = Electricidade de Timor Lorosae, MW = megawatt, BOT = build-operate-transfer, SIP = Sector Investment Package.

Note: The status of the Action Plan updated in September 2003 as part of the SIP exercise.

procurement and high costs at the Pertamina terminal. EDTL imports about 22 million liters of fuel per year through the Pertamina terminal. The current price is about 34 cents per liter, which is about $0.09 per liter above the price paid by nonsubsidized consumers in Indonesia for the same product. This is also about equal to the median price in the Pacific Islands. Potential savings of around $1 million a year, or even more, could be realized from competitive procurement of oil for EDTL.

The Ministry of Planning and Finance is planning to institute a bidding process for EDTL procurement. Before commencing that process, various procurement options could be considered: (a) competitive procurement to supply EDTL fuel oil requirements (under a long term contract); (b) extending the scope of this procurement to all Government oil products; (c) competitive procurement of a contractor to operate Pertamina terminal to cover all oil imports (assuming Government successfully completes negotiations with Indonesia to take over the terminal), possibly combining this procurement with (a) or (b) above; and (d) competitive procurement of a contractor to provide all oil products to Timor-Leste for, say, a 5-year period; this option may include obligations with regard to distribution system such as oil pipeline from terminal to Comoro. The latter method was used very successfully in Samoa. If the Samoan price was achieved for all imports of fuel (for the power and transport sectors combined) overall annual savings might approach $5 million per year. Not all of these savings would accrue to the Government, but it might be able to claw back some of the private sector gains by increasing fuel taxes which are currently among the lowest in the Pacific. An oil products procurement, storage, and delivery study is proposed later in this Report.

Demand side management

Timor-Leste also has considerable potential for reducing non-essential electricity consumption by demand side management. No sophisticated methods are required. One of the most effective initiatives would be promotion of energy-efficient lamps (fluorescent lamps). The use of compact fluorescent lamps (CFLs) and fluorescent tubes as direct replacements for traditional incandescent bulbs can have immediate benefits for EDTL, the village-based community power schemes and the consumers themselves. A survey by the Japan International Cooperation Agency (JICA) mission of 13 Japan-financed community-run power stations indicates that approximately 57% of the installed lamps (by wattage) are traditional incandescent type. Replacing these by CFLs or tubes can reduce power consumption by up to 46%, substantially reducing fuel import costs and making the operation of both EDTL and the village-based power schemes immediately more sustainable. Assuming, for instance, that 20,000 consumers (half of the total) would replace three 60 watt bulbs by 11 watt high-efficiency fluorescent lights, this would result in annual savings in EDTL's fuel bill of $550,000 at current fuel prices. In addition, this would reduce the peak loading by 2.9 MW, and capital investment in generation capacity by $1.7 million. A consumer's monthly electricity bill would reduce by $3.65. If the lamps would be given to the consumers free of charge, assuming a cost of $1.50 per lamp, the total investment would be $90,000, with a simple payback of just a couple of months. EDTL intends to include both new and existing consumers in this program. A proposed Lamp Replacement Study and Supply Program is discussed later on in this Report.

Other cost reducing initiatives

The cost of transporting fuel to Comoro power station, at two cents per litre, is unduly high because of inefficient road transport from the Pertamina terminal. About $370,000 per year could be saved through construction of a pipeline, the construction cost of which is estimated at less than $1 million. The cost structure of EDTL is also affected by the low generation efficiencies. These stem from the large proportion of energy that is generated by high speed rather than medium speed diesel engines. In addition, technical losses in the Dili system are estimated to be in the order of 15%, rather than the 5–6% that could be expected in such a small concentrated system.

Low collection rates for delivered energy

Despite tariff levels that should be generally adequate to support the operation of the existing system, EDTL continues to require substantial subsidies from the Government budget. The financial position of EDTL can be improved significantly through better collections from consumers. Poor collections stem from (a) incorrect meter readings arising from non-standardization of meters and inexperienced meter readers; (b) nonfunctional or faulty meters; (c) informal connections with no meter installed; (d) billing system problems, including incomplete and inaccurate customer database and inadequate maintenance of the billing system due to lack of skilled information technology (IT) personnel; (e) difficulties in collecting payments as a result of the loss of consumer discipline during the extended period of free electricity under UNTAET; (f) reluctance of consumers to pay what they consider to be incorrect bills; and (g) limitation of power supply and power cuts to large industrial and commercial consumers.

Lack of managerial capacity of EDTL

As noted earlier, EDTL has an authorized staffing level of 205 positions; however, many positions remain unfilled. Among existing staff, there are only two engineers (the Director and Technical Operations Director) and less than a dozen qualified technicians. Most staff are middle school graduate level. The human resources vacuum that resulted from the 1999 events has exacerbated difficulties faced in restoring power sector operations. When the power system was operated as a branch of PLN, management and workers were mainly Indonesian, most of whom left Timor-Leste in 1999.

4.3 Challenges for the Medium Term

In the medium to long term, the Government is faced with three main challenges:

- Identifying and developing economical, indigenous energy resources that will allow lower energy generation costs and reduced dependence on imported fuels.
- Providing electricity to 80% of the population who are currently not served.
- Developing a legal and regulatory framework that will minimize development and operation costs and maximize the mobilization of capital from both public and private sources.

The broad outlines of the available options for developing indigenous energy sources and for electrification of the country were discussed earlier. More detailed discussion of the program for the medium term to address these issues is set out below.

Chapter 5

Development of Power Utilities and Pricing Policies

V. Development of Power Utilities and Pricing Policies

5.1 Development of EDTL

EDTL management contract

As part of the Electricity Sector Policy approved in September 2002, the Government decided to outsource the management of all EDTL's operations under a Management Contract for a period of 3 years. The contractor is expected to implement urgent measures to improve the overall technical and financial performance of the utility and to provide systematic training to the local staff. After certain preparatory technical assistance (tariff studies, asset valuation, and preparation of draft Management Contract) tender invitations for the management contract were issued, and three proposals were received in March 2003. After somewhat protracted evaluation and negotiations, the Council of Ministers approved the negotiated contract on 29 October 2003. The Management Contractor was expected to take over operations of EDTL from 1 January 2004. There is a strong emphasis on training in the contract and fixed fees are related only to training. There are no fixed fees involved for management, and payments to the contractor will be related to improved technical and financial performance only. The contractor's performance will be measured against key performance indicators as set out in Table 7.

Table 7: EDTL Management Contract

Key Performance Indicator	Description	Target over 3-Year Contract
Reliability Index (Dili only)	Average availability of 20 kV feeders in Dili	From 93–98% to 97–99.4%
Distribution Efficiency Index (Dili only)	Energy billed/ Energy distributed	From less than 30% to 80%
Generation Efficiency Index (Dili only)	Average heat rate	For every 1/1,000 of decrease of the index, a predefined bonus will be paid
Financial Performance Index: Government subsidy	Base line subsidy of $6.4 million	For reducing subsidy, contractor will be paid 25% of reduction in first year, 20% in second year, and 15% in third year

EDTL = Electricidade de Timor Lorosae, kV = kilovolt.

EDTL has been concentrating on installing new meters, replacing defective meters, registering informal consumers, expanding and correcting its customer database, and improving the payment discipline with the large commercial customers in Dili. In an attempt to increase the collection rate, the Government also contracted for the supply and installation of 10,000 prepayment meters accounting for half the consumers in Dili. However, the

installation of these meters has only just begun and is meeting considerable consumer resistance. Only about 700 meters have been installed compared to an expected 3,000. The meter installation program is being offered to defaulting consumers as an alternative to disconnection, but by mid-October 2003 no disconnections had been made

Financial position of EDTL

The historical and projected financial position of EDTL is set out in Table 8. This shows significantly increased collections starting from FY2001/02, but the drain on the Government budget continued to increase up until FY2002/03 because of increased quantities of power being generated and higher fuel prices. Budget support is projected to sharply decline from FY2003/04 onwards.

Figure 1 shows public and nonpublic revenues for FY2002/03 and the first 4 months of FY2003/04. If Government budgets are not increased at midyear, and nonpublic collections continue at the same rate, EDTL revenues for FY2003/04 are projected at $3.5 million, representing a $1.8 million shortfall from projected revenues in Table 8. In these circumstances, EDTL will continue to have difficulty in financing fuel purchases. Much of the above projected shortfall can be attributed to the delay in employment of the Management Contractor and to the slow pace of the prepayment meter installation.

It is clear that only with (a) drastic increase in collections from nongovernment users; (b) increased Government budgets for utilities; and (c) an increased proportion of Government utilities budgets going to electricity, will EDTL revenue approach the budgeted level. To

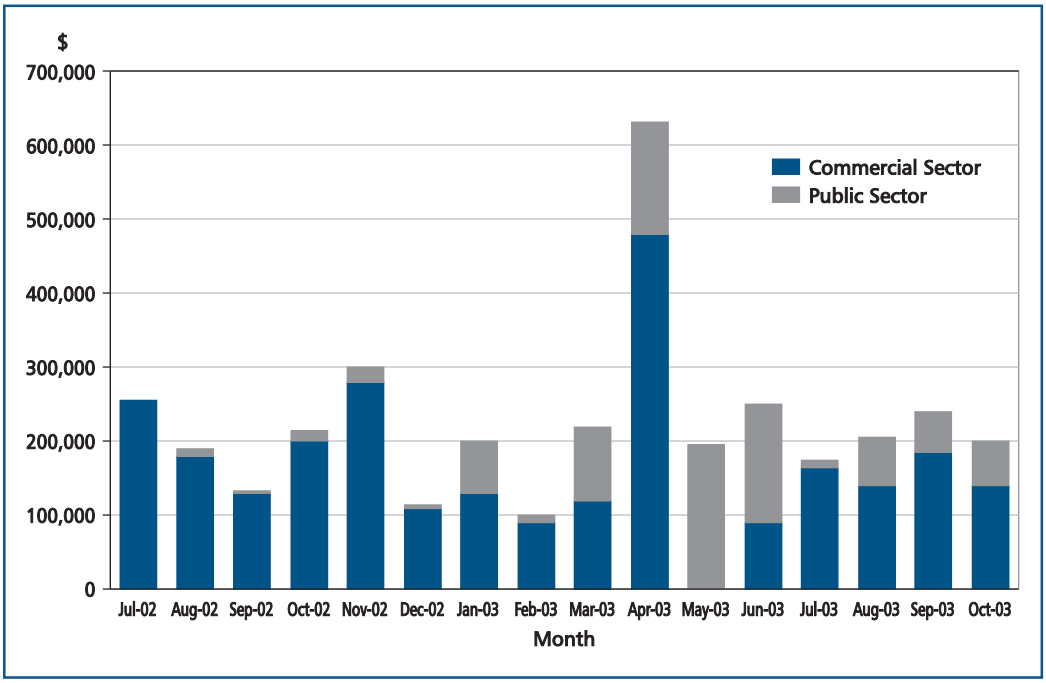
Table 8: EDTL Financial Performance

Function	FY01 Actual	FY02 Actual	FY03 Estim.	FY04 Budget	FY05	FY06 MTFF	FY07
EDTL Revenues	258	1,997	2,871	5,300	7,600	9,250	9,900
EDTL Recurrent Expenditure	7,886	8,031	9,152	11,676	12,292	12,405	12,521
Salary and Wages	363	309	309	389	506	530	530
Goods and Services	7,524	7,722	8,843	11,287	11,786	11,875	11,991
Operating Balance	(7,628)	(6,033)	(6,350)	(6,376)	(4,692)	(3,155)	(2,621)
EDTL Capital Expenditure	493	822	2,049	458	551	437	379
Overall Balance/CFET Subsidy	(8,121)	(6,855)	(8,399)	(6,834)	(5,243)	(3,592)	(3,000)
Revenue Growth (%)		673	40	89	43	22	7
Revenues % Recurrent Expenditures	3	25	31	45	62	75	79
Actual Revenues % Target		40	56				
CFET Subsidy % Total CFET Expenditures	16	13	11	9	6	4	3

EDTL = Electricidade de Timor Lorosae, CFET = Consolitated Funds for East Timor.

Sources: FY2000–01 and FY2001–02 from audited Financial Statements; FY2002–03 from draft Financial Statements; FY2003–04–FY2006–07 from Budget Papers. FY2003 capital expenditure includes $1.9 million of Government contribution to prepayment meters.

Figure 1: EDTL Revenues, July 2002–October 2003



EDTL = Electricidade de Timor Lorosae.

Sources: Total EDTL collections and Government expenditures on electricity to end-September from the Ministry of Planning and Finance (MPF) system. October total figures to 29 October (EDTL), Government to 27 October (MPF).

reduce the subsidy, cutting off power to nonpaying consumers will also be required. In a new initiative, the Council of Ministers, in their meeting of 29 October 2003, instructed full and immediate enforcement of power disconnections and installation of prepaid meters with police assistance as necessary. Government departments have been slow in making payments (only having paid about one third of their bills). EDTL recorded Government arrears of $411,445 at end- September 2003, for which the Secretary of State had requested the Ministry of Planning and Finance to arrange payment (using a similar process to that used in April 2003). The basic problem is that appropriations for utilities do not support the current rate of usage of Government departments on electricity. Current rates of electricity consumption imply Government payments of $2.205 million for the year as a whole. However, the total Government budget for all utilities, including electricity, is only $2.273 million. Last year electricity accounted for only 40% of total utilities expenditures. Implementation of such measures, together with a midyear Government budget increase in the utilities category, will be necessary for EDTL to continue to provide uninterrupted supply to law abiding consumers.

Concessioning of EDTL

The Basic Law for the Power Sector allows the Government to assume many alternative development paths for organization of the sector and is generally conducive toward private sector participation. However, in line with the Power Sector Policy document of 18 September 2002, it foresees the launching an international public tender for a 20-year BOT on all

operations of EDTL. The Government is presently reviewing these recommendations, and is aware that this study (and a number of donors) does not support this approach, mainly because the proposed concessioning is unlikely to generate the benefits it expects of privatization, such as proceeds of asset sales, increased competition and consequent dynamism, and efficiency in operations. Overall, risk premiums are likely to be high, considering the lengthy term of the concession, perceived political, legal, and contractual risks of a newly independent state, and technical and O&M issues associated with poorly maintained distributed assets. Consequently, a fixed long-term concession might not be competitive with more short-term and less binding alternatives for involving the private sector in the development of the power sector in Timor-Leste. A number of other specific concerns have arisen:

- The current assets of EDTL represent only a small core of ultimate sector assets. Future operations will be heavily focused on system expansion and require high capital investments, such as for the Ira Lalaro project, and a strong focus on not-so-profitable rural electrification, which may not occur given the private operator's aim to maximize returns by concentrating on profitable areas.
- Since major investments are scheduled around years 2010 and 2017, the time span is too long to estimate investment programs to the accuracy level required for a sensible financial analysis of the BOT offer for 20 years.
- In order to allow other operators in the sector, for example to implement mini-grid and hydropower schemes and to take advantage of potential Government and donor funding at concessional terms to facilitate access to electricity for the rural poor, the contractual and legal arrangements for the BOT concession would be extremely complicated.
- The perceived legal risk associated with the BOT concession would be high, given that much of the basic legislation is still under preparation, completely untested and without precedent in Timor-Leste.
- The BOT agreement would probably need to be fully backed by international agencies, as the Government's ability to provide sufficient guarantees might be limited.
- EDTL is a small company, and the business prospects offered by a concession to operate the national power system would not be attractive to large, well-established international and regional players. Consequently, international bidding might be restricted to less known and smaller players who might be prepared to assume higher risks for higher returns, but be less professional and experienced in utility operations and international investments. The response to the bidding for the 3-year management contract (where much less risk is involved) is somewhat indicative in this respect.

5.2 Other Service Providers

In rural areas, local communities operate some of the power systems. These were established under the rehabilitation projects financed by the Portuguese and Japanese governments, and the ADB-led Emergency Infrastructure Rehabilitation Program. While some have operated successfully, others have since run into problems and have asked for EDTL assistance. The current plan of the Government and EDTL is to gradually take over these systems, a move that is supported here, mainly to facilitate the long-term development of the power system. The Government is aware that EDTL's track record in operating small

power systems is poor. In taking over community-run systems, EDTL will need to avoid introducing heavy and costly utility-type organizations that rural consumers cannot afford. This study suggests a combination of the best of both by continuing to utilize the villagers for day-to-day operation and billing functions so that communal loyalty remains. EDTL could take over the ownership, management, fuel supply, maintenance and planning functions, once its institutional capacity is adequate.

5.3 Pricing Policies

The current electricity tariff level and structure is considered to be reasonably appropriate to the current situation in Timor-Leste. However, in the longer run it is recommended that a cost-based tariff structure, including indexation of tariffs to fuel prices, will be implemented. In the absence of this, there is danger that self-generation will become a more feasible option for the larger customers, which would have a negative impact on EDTL and the economy as a whole.

Chapter 6

Programs for the Medium-Term

VI. Programs for the Medium-Term

In order to address the challenges facing the power sector—some of which require urgent action—a program consisting of a number of studies and power system investments has been formulated as part of the SIP exercise, based on the findings and recommendations of the Draft Final Report of this study. The proposed projects are described more fully in the individual Project Profiles attached to this Report. The main elements of the program are (i) high-priority studies for legal, regulatory, institutional framework, and standards; (ii) high-priority resource assessment, planning, feasibility, and project preparation studies; (iii) high priority power system investments; and (iv) medium-term power investment projects. Proposals for investigation of onshore oil and gas that might be used by the power sector have also been put forward, and are dealt with more fully in the SIP for Natural Resources and Environment.

6.1 Legal and Regulatory Framework and Standards

There are two high priority studies that the Government wishes to undertake. One relates to the legal and regulatory framework required for sound development of the power sector; the other is a study of rural electrification standards. As noted earlier, the choice of standards appropriate for Timor-Leste can have a significant bearing on the final cost of the rural electrification program.

Legal, regulatory, and administrative framework study

In view of the above-mentioned reservations about a long-term BOT concession, the Government proposes to carry out a review of the envisaged institutional and regulatory framework of the power sector leading to detailed recommendations as to the best combination of options for achieving efficient development and operation of the power sector through a partnership of public, private, and community participants. The proposed study would be done in two phases.

Phase 1 – Power Sector Institutional Framework Review. This study would review the structure of the power sector. There are two main options: (a) a closed structure where all electricity is provided by a vertically integrated regulated monopoly whether public or private (EDTL or concessionaire); or (b) a principal buyer option where the main transmission grid would be owned and operated by EDTL, while the separate functions of generation, distribution and supply (billing, collection, and customer service) for both grid-connected and off-grid systems could be through public, private, or community participants with all operations supervised by a regulator. In principle, there could be a combination of the two options but regulation would then be extremely complicated.

The future role of EDTL participation in electrification of the country, whether as public participant or public partner, should also be considered as part of the review. Phase 1 activities would include the (a) design of a rural electrification framework; (b) basic design of government functions of regulation and rural electrification; (c) if a rural electrification

fund is recommended, developing the basic design for such a fund, covering responsible entities, sources of funds, arrangements for financial management, lending and grant operations, etc. The basic design studies would also consider EDTL organization insofar as it is necessary to carry out its own rural electrification responsibilities, conform with proposed rural electrification framework, and to interface and partner with other sector participants. This review would be followed by a second phase consisting of development of detailed design of government functions associated with the proposed institutional structure, and assistance in establishing the government component of the framework.

Phase 2 – Detailed Design/Establishment of Government Institutional Framework.

(a) *Detailed Design of Institutional Arrangements*. Based on Government decisions concerning the Phase 1 recommended options, the second phase of the study would be designed to assist the Government in carrying out detailed design of the envisaged institutional arrangements including the drafting of relevant sections of decrees and policy documents; developing detailed regulations; developing operations manuals for Rural Electrification Fund; and developing solicitation documents, draft concession contracts, etc. It is assumed that the Management Contractor would assist EDTL to implement necessary changes to its organization and operations.

(b) *Establishment of a Power Sector Regulatory Function*. It is assumed that regulatory staff would be appointed at the outset of the Detailed Design Phase (key staff should preferably have also been involved in the Basic Design Phase). On-the- job training while developing detailed design of regulations would be accompanied by formal training programs, study tours, and seconding to similar regulation entities in relevant countries. This phase would end with initial regulator operations carried out in conjunction with the First Rural Electrification Project and regulation of EDTL at end of the Management Contract period.

(c) *Electricity Law Revision and Complementary Decrees*. In parallel with second phase studies of the above modules, the existing Basic Law would be reviewed and any necessary changes drafted to conform to the adopted institutional, regulatory structure for the sector. For example, it is not clear whether the concessioning out of distribution and supply functions are permitted under the current law. Decrees or regulations needed to complement the basic law, such as those pertaining to the responsibilities for government functions of regulation and the rural electrification fund, would also be drafted.

Rural electrification standards study

While this activity might logically be part of the regulatory reviews outlined above, the Government believes that this study should proceed separately due to the urgency of establishing appropriate standards that could be applied in completing rehabilitation work and adopting them for rural electrification expansion in districts and subdistricts.

As noted earlier, only 20% of households in Timor-Leste have access to electricity. The Government intends to address this situation in the decade ahead with a sustained program of rural electrification. Before this program is launched it will be important to review current standards that were designed many years ago for urban distribution and have been extended

into rural areas virtually unchanged. As the foregoing discussion highlighted, this study considers that, if a design appropriate to the requirements of rural communities were to be adopted, the cost of rural distribution could be halved. In addition, appropriate standards for small generating units need to be established to ensure that investments are cost effective and supply reliability is appropriate to the area served. The activities foreseen under the project include (a) a study of similar countries where cost-effective rural electrification standards are in use to collect information on the relevant standards applied and to see practical application of the standards; and (b) selection of one set of standards as a model and adaptation for Timor-Leste.

6.2 Resource Assessments and Planning Studies

As the discussion earlier indicated, Timor-Leste may be able to tap renewable sources of energy supply for the proposed electrification program. Before major investments are made in additional generation capacity and transmission, a series of studies are needed to assess the extent of the resource base and to plan for the electrification of the country.

Wind resource assessment study

Before carrying out a feasibility study of grid and off-grid wind generation, better data need to be obtained on the adequacy and persistence of the wind resources in accessible wind farm sites. The attachments to the Report describe the detailed components of the proposed study. The review of relevant data relating to wind resources of Timor-Leste concluded that in the uplands and mountains there is likely to be good potential. The best locations may have average wind speed in excess of 8 meters per second and wind power density of 600 W/m^2 or more. However, more on-site measurements will be required to verify these promising figures. The measurement period should preferably cover several years to conclude if there are remarkable year-to-year variations, due for example to El Niño.

Based on rough estimates of production costs, it can be concluded that compared to the best hydropower schemes such as Ira Lalaro, wind power will not be the least-cost option for supplying power to the grid, at least not in the short term. Moreover, wind power should not be seen as an alternative for hydro schemes, but rather as a complement to them. However, the situation could change in comparison to later less economical hydropower plants particularly if wind resources prove to be better than anticipated and/or if the trend toward reducing investment costs continues. Clean development mechanism (CDM) carbon credits would also serve to improve financial viability in comparison to diesel. Subsequent feasibility studies would need to consider other factors such as restrictions and extra costs caused by the bad road connections and handling capacity of large and heavy components at the Dili harbor.

With regard to off-grid applications, there may be cases where these are feasible in the short term, both in the uplands and mountains, and along the eastern/southern coast. Preliminary estimates indicated that for small villages with no more than 30 households, a local wind system would be competitive against grid extension in windy areas if the required transmission line length is more than 1 km. In less windy areas, the wind system breaks even at the transmission line length of around 3 km for small villages. For large villages of around

200 households, wind systems would be more cost effective than distribution line extension at the distance of 7 km in windy areas and 15–20 km in less windy areas.

Mini and micro hydropower resource inventory

A more thorough assessment of micro hydropower resources is required to provide input to the National Rural Electrification Planning Study proposed below. At three villages between Maubisse and Ainaro substantial tributaries of the Belulic river cascade from the face of Tatamailau and are likely to provide good opportunities for low-cost micro hydro installation. Similar opportunities might exist for perhaps 50 sites in the higher parts of the country. Similarly, a Norwegian mission previously identified a number of micro hydro sites, some of these based on spring-fed rivers with a relatively constant flow throughout the year. One of them is at Baucau where a 350 kW scheme could be developed relatively easily and quickly, capable of producing 3 gigawatt-hours (GWh) per annum. The same team also found other springs that appear to have very good micro hydro potential. Micro hydro is likely to have a significant and continuing role in rural electrification in a number of isolated locations with mountainous terrain and high rainfall. In these areas, where grid connection would not occur for many years if ever, micro hydro can provide the opportunity for mini-grid development. Even if these areas are eventually connected to the main grid, the micro hydropower project can continue to function as a supplier of power to the main grid.

National Rural Electrification Planning Study

It is considered that in the long term, connection to the grid would be the most economical solution for the majority of households in the country. However, it also recognized that for smaller more remote villages mini-grids based on micro hydropower, wind or diesel might be more economical in the short term (pre-grid) or in some cases even for the longer term. It is also noted that for some smaller villages the cost of grid-based electrification may be prohibitive and solar home systems may be the most economical alternative. This Report provides guidance on likely economical forms of electrifying areas depending on load size and density and distance from the grid, as well as suggests criteria to be used in prioritizing rural electrification. The Government proposes to build on this study by carrying out rural electrification planning down to the subdistrict level.

The proposed project would develop a plan for electrifying each subdistrict in the country, determining how it is likely to be electrified and when. The plan would have three main purposes: (a) prioritizing areas for grid extension; (b) defining areas that could be more economically developed by locally resource based mini-grids; and (c) defining areas that are unlikely to be feasible for grid based development even in the longer term, enabling alternative electrification arrangements such as solar home systems to be made for these areas that could proceed in parallel with conventional grid extension and mini-grid establishment. The planning would take into account resource assessments described above, population size, distance from the grid and from other load centers, etc. The plan would be in varying levels of detail depending on when electrification is likely to occur, being very detailed for, say, the first 5 years of rural electrification with progressively less detail for the later years. The intention would be to update the plan on a rolling basis.

6.3 Feasibility and Pre-investment Studies

The Government also attaches a high priority to moving ahead with feasibility studies for various power generation and transmission programs. By taking a simultaneous approach with resource assessments and power investment feasibility studies, the Government would be able to make informed and timely decisions on the best options for further development of the power sector as soon as the results of the resource assessments are available (in approximately 18–24 months). The various project preparation activities will build on earlier studies and be closely coordinated with earlier-mentioned proposed new studies.

Preparation studies for Ira Lalaro hydropower project

The feasibility study update is currently underway with funding from the Norwegian Agency for International Cooperation (NORAD). This study also confirms the necessity of additional geo-technical studies, and also recommends update and elaboration of the environment impact assessment and consideration of alternative designs for Ira Lalaro. The project also includes the preparation of bid documents.

Preparation studies for Baucau mini hydropower plant

A feasibility study also supported by NORAD is underway. A recent Norwegian mission (October 2002) identified several micro hydro schemes that appeared to have good potential. One of them is close to Baucau town where a 350 kW, 3 GWh/year scheme could be developed to utilize water flowing from a spring (after water supply needs have been met). Estimates comparing the cost of diesel generator and a hydropower plant of the same size showed that hydropower energy would be less expensive than diesel generation. The consultant's contract also includes preparation of bid documents.

First rural electrification project preparation

The Government's intention is to move ahead with a strong program for rural electrification in the decade ahead. Preparatory activities for the First Rural Electrification Project are therefore needed. These will involve:

- Setting up institutional arrangement for project preparation;
- Identifying potential areas to be electrified through both grid extension and various off-grid technologies. These choices would be guided by or done in parallel with the proposed National Rural Electrification Planning Study and the Rural Electrification Standards Study;
- Preparing preliminary designs and cost estimates for potential electrification areas;
- Based on agreed selection criteria, prioritizing electrification programs and define the physical scope of subprojects;
- Preparing environmental assessments, acquisition/resettlement plans and baseline social-economic surveys;
- Considering appropriate institutional and financing models (including need for subsidies) for various components taking into account investor interest and availability of finance;
- Preparing bidding documents for procurement of first tranche of equipment in the case of public development and/or documents for soliciting concessionaires in case of private development; and

- Preparing comprehensive implementation strategy for individual projects. For publicly developed projects, this would include (a) implementation schedules, (b) organizational and personnel arrangement for project management during implementation, and (c) a management system for project implementation. Similar but not identical arrangements would be needed for private development.

6.4 Priority Investments in the Power System

The Government is proposing a number of high priority, new investments in the power system. These include the Dili Generation and Distribution Project, the Comoro Pipeline Project, the District and Subdistrict Rehabilitation Program, and the Lamp Replacement Program. A number of other specific investments discussed below are proposed for the medium-term.

Dili generation and distribution

While the Dili generation and distribution system is now generally restored and returned to operation, further investment is needed to supplement generation capacity at Comoro Power Station, and also to reinforce and improve reliability of the Dili distribution system. The Comoro Power Plant has four medium-speed and eight high-speed diesel units. One of the medium-speed units is out of service and, based on a JICA mission's assessment, is not repairable. As a result, the newer high-speed units financed by Norway are being run at high capacity on a sustained basis. This will accelerate degradation of their output and lifetime.[6] A project is under final preparation by JICA to provide a new 4 MW medium-speed generator and distribution reinforcement, including autoreclosers, switchgear, and subtransmission and distribution lines and auxiliaries, at a cost of about $7 million. Funding is expected within FY2003/04. The additional investment in distribution will address the problem mentioned earlier of high technical losses that are currently around 15% (due mainly to overloaded power transformers).

Comoro pipeline

The Comoro Power Station in Dili consumes about 18.5 million liters of diesel oil per year. The oil is transported by truck from the wharf to the Comoro Power Station, a distance of about 2–3 kilometers at a cost of about $370,000 per year. An alternative to truck transport would be an oil supply pipeline from the wharf to the Comoro Power Station. Besides reducing the transport cost, there would be environmental benefits from reduced oil spills relating to truck transport. Oil supply security would also be improved. It is estimated that the cost of the pipeline is about $1 million. The payback time for the investment would thus be less than 3 years.

Lamp replacement program

Demand side management actions to improve the efficiency of energy use are considered crucial for reduction of current large oil import costs and improved profitability of utilities. As noted earlier, the use of compact fluorescent lamps (CFLs) and fluorescent tubes as direct replacements for traditional incandescent bulbs are projected to achieve

[6] High-speed diesel engines have lower generation efficiencies and are normally used for standby duty and short-term operation.

significant savings. A calculation on the benefits of using CFLs has been prepared, indicating the installation of 60,000 CFLs in Dili would result in annual savings in EDTL's fuel bill of $550,000 and deferred capital investment in generation capacity of about $1.7 million. The cost of the lamps would be about $90,000 indicating a simple payback of a few months. A lamp replacement program is proposed as a priority SIP initiative.

District and subdistrict rehabilitation program

Electricity services have still not been restored to some villages that were served with electricity before the outbreak of violence in 1999. In four cases, this is due to destroyed power stations and lines; in several other cases the main reason is damaged distribution lines that could be rehabilitated with only small investments. This rehabilitation program could also demonstrate the new rural electrification distribution standards.

6.5 Power System Investments for the Medium-Term

First rural electrification project

This project will follow from the feasibility study described above. It is envisaged that this first rural electrification expansion project would include both grid-connected and off-grid components and pilot the policy reforms described in the Rural Electrification Framework project description and utilize the new rural electrification standards. The proposed project would aim to provide grid connections to about 21,000 households and install solar home systems to another 7,000 households. The project would be implemented over 3–4 years and is estimated to cost about $8.7 million.

Suai oil well associated power plant

This investment would proceed if sufficient quantity and quality of oil were produced from the rehabilitated Suai oil well. The associated power plant could be installed in the Suai power station (a short distance away from the well) to generate power either from the oil or gas produced from the well, or alternatively the produced oil could be transported to Dili to be utilized there. Preliminary survey indicates the output from the oil well rehabilitation could support power generation of 400 kW.

Seep harvest associated power plant

A power plant associated with the seep harvest at Aliambata could be installed to generate power with gas harvested from the site. A preliminary survey indicates the seep harvest could support a power plant of 300 kW.

132 kV transmission reinforcement

The project—as yet undefined—would be for the evacuation of power to Dili from a major generation source. This could be Ira Lalaro Hydropower or alternatively a southern coast indigenous oilgas generation facility (or facilities) in case sufficient low-cost oil and gas resources are located in the area. It would also supply power to adjacent load growth areas. The project would be preceded by a study. The medium-term generation and transmission plan for Timor-Leste currently recognizes two alternative scenarios:

- ***Scenario 1***. The development of a mixed hydro-thermal generation system and gradual interconnection of the separate systems into a single grid over a 20-year period. The existing diesel-based system would be reinforced in the short term and as soon as possible supplemented by the 27 MW Ira Lalaro hydropower plant and associated 132 kV transmission line to Dili, a distance of some 190 km. This transmission line would allow connection of the major towns and other load growth areas along the way. It is assumed that the hydropower plant and transmission line would become operational by 2010.
- ***Scenario 2***. If significant quantities of low-cost oil and gas are proven onshore and nearshore in the southern coastal area, such reserves could be used for (i) fuelling local diesel generating stations (that are very costly to supply with oil from Dili); (ii) fuelling larger generating stations and evacuating power by 132 kV transmission to Dili and adjacent load growth areas; or (iii) a combination of the above.

The first 132 kV Transmission Expansion Project would therefore likely comprise either an East–West 132 kV line from Ira Lalaro to Dili or a north-south 132 kV line from the southern coastal area to Dili. Power supplies to adjacent load growth areas would be reinforced in either case.

Ira Lalaro hydropower project

The original estimate contained in the 1989 PLN study put the cost of the Ira Lalaro Project at $52.5 million. A Norwegian Water and Energy Directorate mission that visited Timor-Leste in late-2002 recommended the Ira Lalaro hydropower scheme as a priority project because of its obvious capacity to generate low cost electricity. The mission estimated the cost at about $160 million, including the transmission line, which represented approximately one third of the cost estimate. In this power sector master plan study the total project cost is estimated at about $60 million, of which $42 million would be for the hydropower plant and $18 million would be for the 190 km transmission line to connect the plant to the Dili system. This is considered a more realistic estimate, provided that procurement packaging is appropriate and international competitive bidding is employed. More precise cost estimates of the investment costs will be available later on from the ongoing feasibility study.

In the following table, the actual CFET appropriations and completed donor expenditure programs for FY1999–FY2003 are shown.

Table 9: Government and Donor Expenditures in the Power FY1999/00–FY2002/03 ($)

Source of Funding	Annual Disbursements				Total	
	FY99/00	FY00/01	FY01/02	FY02/03	Amount	%
Donor programs	883,966	5,226,039	5,088,799	2,461,301	13,660,105	32.5
EDTL revenue funded expenses	–	258,000	1,997,000	2,871,365	5,126,365	12.2
CFET appropriations	–	8,121,000	6,856,000	8,329,994	23,306,994	55.4
Total	883,966	13,605,039	13,941,799	13,662,660	42,093,464	100.0

EDTL = Electricidade de Timor Lorosae, CFET = Consolidated Funds for East Timor.
Source: SIP exercise

Chapter 7

Expenditure Programs and Funding

VII. Expenditure Programs and Funding

7.1 Current Levels of Expenditure

Over the past 4 years, a total of $42.1 million has been spent on the power sector, with expenditure over the last 3 years remaining very stable at a little under $14 million a year (Table 10). Donors have funded about one third of the outlays directly—although their indirect support has been much higher. With donor funding of three quarters of total CFET appropriations during this period, direct and indirect donor funding for the power sector has been about $30 million (including indirect support of about $13 million), equivalent to a little over 70% of total outlays.

Operating expenses of EDTL, which amounted to $25.1 million over the past 4 years, account for 60% of total spending. Donors indirectly funded $18 million of these expenses via their support for the CFET budget. The single largest expenditure item during this period has been for fuel, which accounted for 51% of total spending. Capital spending, mainly for generation in Dili, amounted to $15.8 million. A little over $1 million of donor funding has been spent on technical studies and other assistance.

Table 10: Expenditures by Program Category for the Power Sector FY1999/00–FY2002/03

Program	Funding Source			Total	
	CFET	EDTL	Donors	Amount	%
Studies and technical assistance	–	–	1,222,000	1,222,000	2.9
Generation, transmission, etc.	3,364,000	–	12,438,105	15,802,105	37.5
Operations					
Fuel			–	21,594,656	51.3
Other operating expenses			–	3,474,703	8.3
Subtotal	19,942,994	5,126,365	–	25,069,359	59.6
Total	23,306,994	5,126,365	13,660,105	42,093,464	100.0

CFET = Consolidated Funds for East Timor, EDTL = Electricidade de Timor Lorosae.
Source: SIP exercise

7.2 Proposed Expenditure Program

Projected total expenditures in the power sector, as proposed in the SIP exercise, is approximately $100 million for FY2003/04–FY2006/07, a half of which is EDTL operating expenses. The balance of $50 million represents new spending on the studies, resource assessments, technical assistance and power generation, transmission and distribution over the next 4 years that were summarized before. As Table 11 makes clear, there is only a little over $1 million of ongoing donor funding committed for the proposed program. Implementation of the proposed program therefore depends heavily on raising new money for the sector.

Table 11: Allocation of Proposed Program Expenditures FY2003/04–FY2006/07 ($)

Program	Annual Expenditures				Total	
	FY03/04	FY04/05	FY05/06	FY06/07	Amount	%
Policy and planning						
Ongoing	–	–	–	–	–	–
Proposed new	250,000	900,000	–	–	1,150,000	1.2
Subtotal	250,000	900,000	–	–	1,150,000	1.2
Renewable energy development						
Ongoing	–	–	–	–	–	–
Proposed new	450,000	850,000	8,000,000	15,000,000	24,300,000	24.5
Subtotal	450,000	850,000	8,000,000	15,000,000	24,300,000	24.5
Power generation						
Ongoing	250,000	–	–	–	250,000	0.3
EDTL capital expenditures	458,000	551,000	437,000	379,000	1,825,000	1.8
Proposed new	3,600,000	5,800,000	300,000		9,700,000	9.8
Subtotal	4,308,000	6,351,000	737,000	379,000	11,775,000	11.9
Transmission and distribution						
Ongoing	1,096,000	–	–	–	1,096,000	1.1
Proposed new	700,000	1,870,000	–	2,500,000	5,070,000	5.1
Subtotal	1,796,000	1,870,000	–	2,500,000	6,166,000	6.2
Rural electrification						
Ongoing	–	–	–	–	–	–
Proposed new	–	2,800,000	2,000,000	2,000,000	6,800,000	6.9
Subtotal	–	2,800,000	2,000,000	2,000,000	6,800,000	6.9
EDTL operations						
Ongoing	11,670,000	12,292,000	12,405,000	12,521,000	48,888,000	49.3
Total power sector						
Ongoing (excl. EDTL)	1,346,000	–	–	–	1,346,000	1.4
EDTL operations	11,670,000	12,292,000	12,405,000	12,521,000	48,888,000	49.3
Proposed new	5,458,000	12,771,000	10,737,000	19,879,000	48,845,000	49.3
Total	**18,474,000**	**25,063,000**	**23,142,000**	**32,400,000**	**99,079,000**	**100.0**

EDTL = Electricidade de Timor Lorosae.
Source: SIP exercise

The proposed program would be developed in three distinct phases:

- For the remainder of FY2003/04, emphasis will continue on EDTL revenue collection and capacity building; accelerated investigation of the energy resource base, and continuing rehabilitation works in the system to improve efficiency and reliability.
- In approximately 2 years, with more accurate information on the domestic oil and gas resources and their cost of development, and with the feasibility results and costs of the 27 MW Ira Lalaro Hydropower Project, informed decisions will be made on the country's optimal generation expansion program.

- With a clear strategy in place, emphasis would then move to an accelerated program of rural electrification beginning around FY2006/07, at a measured rate that will meet an electrification target of 80% of households by 2025.

The key features of the proposed expenditure program are as follows:

- A significant improvement in the financial position of EDTL with operating losses projected to decline from an expected $6.8 million this year to $3 million by FY2006/07.
- The various high priority studies described earlier would require a total of $3.6 in funding, some of which are expected to attract support from Norway.
- Investments in new power generation, transmission and distribution infrastructure would require outlays of a little less than $20 million over the next 4 years, some $7 million of which is for the urgently needed improvements at the Comoro Station. Japan has expressed interest in providing support for the Comoro Station upgrades. A further $6 million would be disbursed under the proposed First Rural Electrification Project.
- The proposed program also includes disbursements of $23 million for the Ira Lalaro Hydro Project. Funding for this project would have to be borne mostly, if not exclusively, by the public sector. However, if low-cost domestic oil and gas resources are significant, there would be a major change in the financing picture for the power sector. In these circumstances, the required amount of public funding for power generation could be substantially reduced, since the private sector would be expected to develop the oil and gas resources.

7.3 Funding

The Government faces a major task in raising the new funding needed for the proposed program (Table 12). Central to successful efforts to fund these requirements will be revenue collections from consumers. These are projected to be about $32 million for the 4-year period and as noted earlier, would increasingly cover the operating costs of EDTL. In the event that fuel costs can be lowered through the use of international competitive bidding and by the demand management measures outlined earlier, the fuel savings to EDTL could approximate $3 million a year by FY2006/07. Strong action on revenue collections, in combination with these cost reducing initiatives, could therefore result in a small operating surplus for EDTL by FY2006/07.

With CFET appropriations currently set at $19 million for the period, and after allowing for reduced payments for fuel, some $38 million would need to be raised from other sources. There are good prospects for funding from Japan for the Dili generation and distribution projects, for support from Norway for the proposed studies on the Ira Lalaro Hydro Project. A total of $8 million may be available from these sources, leaving a balance of $30 million to be found. In the event that domestic oil and gas resources can be used as the primary energy source rather than the Ira Lalaro Hydro project, the public funding requirement could decline substantially since the above funding requirement of $30 million includes $23 million of disbursements for the hydro project. Most of the remaining funding requirement would be for the start up of the proposed rural electrification program and related studies.

Table 12: Sources of Funding for Power Sector Expenditure Program ($)

Source of Funding	FY99/00–FY02/03		FY03/04–FY06/07		Total	
	Amount	%	Amount	%	Amount	%
Total Expenditures	42,093,464	100.0	99,079,000	100.0	141,172,464	100.0
Sources of Funding						
Donor programs approved						
Japan	6,011,335	14.3	–	–	6,011,335	4.3
TFET	4,170,000	9.9	–	–	4,170,000	3.0
Norway	2,160,770	5.1	1,346,000	1.4	3,506,770	2.5
Other donors	1,318,000	3.1	–	–	1,318,000	0.9
Subtotal	13,660,105	32.5	1,346,000	1.4	15,006,105	10.6
EDTL revenues	5,126,365	12.2	32,050,000	32.3	37,176,365	26.3
CFET appropriations	23,306,994	55.4	18,669,000	18.8	41,975,994	29.7
Total available funding	42,093,464	100.0	52,065,000	52.5	94,158,464	66.7
Unfinanced gap	–	–	47,014,000	47.5	47,014,000	33.3
Possible sources of funding						
Fuel import price savings	–	–	7,200,000	7.3	7,200,000	5.1
Energy efficiency programs	–	–	1,900,000	1.9	1,900,000	1.3
Possible donor funding	–	–	37,914,000	38.3	37,914,000	26.9
Total	**–**	**–**	**47,014,000**	**47.5**	**47,014,000**	**33.3**

TFET = Trust Fund for East Timor, EDTL = Electricidade de Timor Lorosae, CFET = Consolidated Funds for East Timor.

Source: SIP exercise

7.4 Uncertainty

The proposed development program for the power sector faces a number of uncertainties. Three of the more important ones are as follows:

- Revenue collections over the medium term. Failure to meet the currently projected revenue targets for EDTL will put additional pressures on the CFET budget and undermine potential donor support for other elements of the power development program.
- The size of the investment requirements for the power infrastructure is uncertain. The capital costs of the proposed program are rough estimates and can only be firmed up once the necessary feasibility studies are completed.
- If the country has substantial low-cost onshore oil and gas resources that are suitable for use by the power sector, the optimum investment in generation and transmission sectors might be different from the current estimates. In this case, less public funding would be needed since private capital is likely to be available for development of the onshore oil and gas industry.

Appendixes

Project proposals prepared as part of the SECTOR INVESTMENT PACKAGE exercise

Project

Appendix 1

Inventory of Mini/Micro Hydropower Resources

Sector	**POWER**	
Project Name	**Inventory of Mini/Micro Hydropower Resources**	
Country/Organization	**Unidentified**	
Agency	**Unidentified**	
DAC	**Power Generation/Renewable Sources**	**Code: 23030**
Donor Project Code		
Budget Status	✓ On Budget Off Budget	

Project Objective ☐ Attached Document

To undertake an inventory of mini and micro hydropower resources in Timor-Leste suitable for district and subdistrict electrification

Project Description ☐ Attached Document

Background: The Asian Development Bank's Power Sector Development Plan consultants reported that substantial tributaries of the Belulic river cascade from the face of Tatamailau at three villages between Maubisse and Ainaro. These are likely to provide good opportunities for low-cost micro hydro installations, and that similar opportunities might exist for perhaps 50 similar sites in the higher parts of the country. Similarly a Norwegian mission referred to a number of previously identified micro hydro sites, some of these based on spring-fed rivers with a relatively constant annual flows. The same team also found other springs that appear to have very good mini or micro hydro potential. Micro hydro could have a significant and continuing role in rural electrification in a number of isolated locations with mountainous terrain and high rainfall. In these areas, where grid connection is not practical, micro hydro can provide the opportunity for mini-grid development. Certain micro hydropower project areas could eventually be connected to and reinforce the main grid. A more thorough assessment of micro hydropower resources is required to provide input to the proposed Rural Electrification Plan. (It is noteworthy that a feasibility study for a 350 kilowatt/3 gigawatt-hour/mini-hydro scheme at Baucau is under preparation with Norwegian assistance.)

Project Description: The study will provide consulting services (consulting firm experienced in mini and micro hydro development) to undertake the hydro resource inventory and prepare prefeasibility studies for viable projects within reasonable reach of load centres.

Scope of Services:

- Review all previous studies;
- Undertake prospective load studies to identify potential load centres in areas of steep topography and high rainfall;
- Undertake a desk study to review topographic mapping and aerial photographs in prospective areas;
- Undertake field trips to promising areas to take advantage of local knowledge of prospective flows and springs;
- Establish gauging arrangements in promising areas;
- Establish a preliminary resource inventory in data base form (to be updated as future data is collected); and
- Undertake prefeasibility studies of prospective sites.

Project Component

Project Component	DAC Code	Allocation		Implementing Agency
		National Currency	US$	
Inventory of mini and micro hydropower resources			400,000	Ministry of Transport, Communications and Public Works
Total			**400,000**	

Appendix 2

Institutional and Regulatory Framework

Sector	**POWER**
Project Name	**Institutional and Regulatory Framework**
Country/Organization	**Unidentified**
Agency	**Unidentified**
DAC	**Energy Policy and Administrative Management** **Code: 23010**
Donor Project Code	
Budget Status	✓ On Budget Off Budget

Project Objective ☐ Attached Document

To review the institutional/regulatory framework of the power sector and to develop detailed recommendations as to the best combination of options to achieve efficient development and operation of the power sector, and to assist the Government in implementing agreed recommendations

Project Objective ☐ Attached Document

Phase 1: Sector Studies

Sector Structure would consider a number of options including (a) a closed structure where all electricity is provided by a vertically integrated regulated monopoly whether public or private (Electricidade de Timor Lorosae [EDTL], or concessionaire); (b) a principal buyer option where the main transmission grid would be owned and operated by EDTL, while the separate functions of generation, distribution, and supply (billing, collection and customer service) for both grid-connected and off-grid systems could be through public, private or community participants with all operations supervised by a regulator. In principle, there could be a combination of the two options but regulation would then be extremely complicated. The future role of EDTL participation in electrification of the country, whether as public participant or public partner, should also be considered as part of the study.

Rural Electrification Framework. Review (a) Government's objectives, policies and existing legal framework for rural electrification and for private participation in the power sector; (b) EDTL' s existing organization and management for operation and extension of district and subdistrict systems bearing in mind the need to clearly separate EDTL's commercial operations from its rural extension activities that may be subsidized to achieve Government social development objectives; (c) the operation of the existing community-run power generation and distribution assets. Models would be formulated for construction and operation of rural electrification, appropriate to conditions of Timor-Leste, and taking into account best practices in the region and in other similar countries. Examine the possibility of establishing a rural electrification fund as a vehicle for attracting Government and donor social development funding to provide loans and grants for rural electrification to various parties contracting to provide such services. The above reviews should specifically consider encouragement of private sector participation, analysis of barriers to such participation and recommendations for barrier removal.

Basic Design of Government Functions. The Basic Law provides for Government functions to be delegated to the Regulator. The study would consider and present various options for regulation of EDTL and recommend preferred options. Principles would be developed for (i) awarding concessions to Power Producers; (ii) regulating prices of both EDTL and Power Producers; (iii) subsidization and cross-subsidization; (iv) institutional arrangements for organization, staffing and necessary capacity building; (v) payment for regulator operations; and (vi) creation of a Rural Electrification Fund.

Phase 2: Detailed Design and Establishment of Government Institutional Framework

Detailed Design of Institutional Arrangements. Detailed design of the envisaged institutional arrangements including drafting of relevant sections of decrees and policy documents; development of detailed regulations; development of an operations manual for the Rural Electrification Fund; and development of solicitation documents, draft concession contracts, etc. It is assumed that the Management Contractor would assist EDTL to implement necessary changes to its organization and operations.

Establishment of a Power Sector Regulator. It is assumed that Regulator staff would be appointed at the outset of the detailed design phase. On-the-job training and study tours would be provided while developing detailed design of regulations. Initial regulator operations would be carried out in conjunction with the First Rural Electrification Project, and regulation of EDTL at end of Management Contract period.

Electricity Law Revision and Complementary Decrees. In parallel with second phase studies of the above modules, the existing Basic Law would be reviewed and any necessary changes drafted to conform to adopted institutional, regulatory structure for the sector. Decrees or regulations needed to complement the basic law, such as those pertaining to the duties and responsibilities of the regulator and to the Rural Electrification Fund, would also be drafted.

Scope of Services. As described above.

Project Component

Project Component	DAC Code	Allocation		Implementing Agency
		National Currency	US$	
Legal, regulatory, and institutional framework – Phase I			250,000	Ministry of Transport, Communications and Public Works (MTCPW)
– Phase II			750,000	MTCPW
Total			**1,000,000**	

Appendix 3

Preparation of Rural Electrification Standards

Sector	**POWER**	
Project Name	**Preparation of Rural Electrification Standards**	
Country/Organization	**Unidentified**	
Agency	**Unidentified**	
DAC	**Energy Policy and Administrative**	**Code: 23010**
Donor Project Code		
Budget Status	✓ On Budget Off Budget	

Project Objective ☐ Attached Document

To design and adopt optimized least-cost rural electrification standards to minimize costs of rural electrification expansion

Project Objective ☐ Attached Document

Background: Currently, only 20% of the households in Timor-Leste have access to electricity and the Government intends to address this situation with a sustained rural electrification program. Rural distribution in Timor-Leste is based on Perusahaan Listrik Negara standards that were designed many years ago for urban distribution and have been extended into rural areas virtually unchanged. ADB consultants under the Power Sector Development Plan consider that by adopting optimized designs for rural communities the cost of rural distribution could be halved. Cost reductions can be achieved through (a) use of smaller conductor sizes for megavolt lines appropriate to anticipated loads, (b) increased span lengths, (c) a more flexible approach to overhead line routing, (d) use of single-phase spur lines to remote villages, and (e) use of single-phase transformers instead of 3-phase type wherever possible. It is important to give priority to development of these standards, such that they can be adopted in the completion of rehabilitation and new rural electrification programs.[Note: While this activity is logically part of the Power Sector Regulator's activities outlined above, the project is listed separately due to the urgency of establishing appropriate standards that could be applied in completing rehabilitation work in districts and subdistricts.

Project Description: Consulting services or the services of a power utility will be recruited to prepare appropriate rural electrification standards for Timor-Leste. Close coordination will be required with rural electrification institutions in selected countries to secure appropriate documentation and drawings for optimal rural electrification standards.

Scope of Services: The activities foreseen under the project include:

- A study of countries where optimal and cost-effective rural electrification standards are in use;
- Collection of information on the applied relevant standards, and determination of practical application of the standards in Timor-Leste;
- Selection of one set of standards as a model and adaptation to Timor-Leste conditions; and determination of appropriate standards for small generating units to ensure that investments are cost effective and supply reliability is appropriate to served areas.

Project Component

Project Component	DAC Code	Allocation		Implementing Agency
		National Currency	US$	
Rural Electrification Standards			150,000	Ministry of Transport, Communications and Public Works
Total			**150,000**	

Appendix 4

Wind Resource Assessment

Sector	**POWER**	
Project Name	**Wind Resource Assessment**	
Country/Organization	**Unidentified**	
Agency	**Unidentified**	
DAC	**Wind Power**	**Code: 23068**
Donor Project Code		
Budget Status	✓ On Budget Off Budget	

Project Objective ☐ Attached Document

To determine if wind power is economically viable in Timor-Leste

Project Objective ☐ Attached Document

Background: Timor-Leste is believed to have areas with good wind resource, based on its geography and limited measurement both in East and West Timor. The island is on the fringes of the Pacific northeast trade winds, and some areas are up to 3,000 meters above sea level. During 1992–1995 four masts in East Timor collected surface wind data for the Indonesian Meteorological Institute. The sites were all coastal: Dili, Baucau, Comoro, and Oecussi. Maximum mean wind speed at 24 meters was 4.3 meters/second. Neither the stations nor records appear to have survived. Anecdotal evidence suggests that there may be other more suitable sites that are not sheltered. A wind mapping exercise undertaken in West Timor by the National Renewable Energy Laboratory of the United States indicated some sites with annual mean wind speeds in the range of 8.2–10.1 meters per second at 30 meters. There were indications of seasonal wind patterns, with June–September being the windiest, and October–March being the least windy, suggesting some synergy between wind and hydro on Timor-Leste, because of the coincidence between the dry season and high average wind speeds. There is some evidence to suggest that there are at least two sites that may potentially be worth developing, at Foho Bagarkoholau and Ira Lalaro, with the latter possibly in parallel with the proposed 27 megawatt Ira Lalaro hydro scheme, for which the feasibility study is currently being updated.

Project Description: The project will provide wind resource mapping and verification. Advanced technology and modelling will allow mapping the wind resource based on upper-air wind measurements and topographical data. The derived countrywide wind resource map will then be verified against actual measurements taken from ground meteorological stations. This resource map will be used to determine where the best resources are to a resolution of about 1 square kilometer, from where more detailed analysis will be undertaken for individual project development (grid-connected or village-scale). The project would provide a 3-year study to prepare a wind map of the most promising locations, and to prepare a feasibility study of economically viable grid-connected and isolated wind power potential in Timor-Leste.

Scope of Services: The study will have the following general scope:

- Collection of all existing wind measurement and topographical data available from previous studies in West Timor and Timor-Leste;
- Computer modeling of air flows over the Timor-Leste terrain, and having regard to proximity of load centers;
- Identify promising areas for wind developments, and locations for establishment of wind measurement masts;

- Site visits to confirm selected sites;
- Setting up wind measurement masts;
- Data collection initially for two years;
- Use of collected data to calibrate computer models and develop resource maps over the island; and feasibility studies of selected wind generation plants.

Project Component

Project Component	DAC Code	Allocation		Implementing Agency
		National Currency	US$	
Wind power inventory, resource mapping, and verification			200,000	Ministry of Transport, Communications and Public Works
Total			**200,000**	

Appendix 5

Solar Energy Demonstration Project

Sector	**POWER**
Project Name	**Solar Energy Demonstration Project**
Country/Organization	**Unidentified**
Agency	**Unidentified**
DAC	**Solar Energy**
Donor Project Code	
Budget Status	✓ On Budget Off Budget

Code: 23067

Project Objective ☐ Attached Document

Project Objective ☐ Attached Document

Project Component

Project Component	DAC Code	Allocation		Implementing Agency
		National Currency	US$	
Solar Energy Demonstration Project			625,000	Ministry of Transport, Communications and Public Works
Total			**625,000**	

Appendix 6

National Rural Electrification Planning

Sector	**POWER**	
Project Name	**National Rural Electrification Planning**	
Country/Organization	**Unidentified**	
Agency	**Unidentified**	
DAC	**Energy Policy and Administrative Management**	**Code: 23010**
Donor Project Code		
Budget Status	✓ On Budget Off Budget	

Project Objective ☐ Attached Document

To develop a distribution plan for systematic rural electrification of Timor Leste

Project Objective ☐ Attached Document

Background: The Power Sector Development Plan (PSDP) study concluded that in the long term, connection to the grid is the most economical solution for the majority of rural households in the country. However, it also recognized that for smaller more remote villages mini-grids based on micro hydropower, wind or diesel might be more economical in the short term (pre-grid) or in some cases even for the longer term. It also noted that for some smaller villages the cost of grid-based electrification may be prohibitive and solar home systems the most economical alternative. The PSDP provided useful guidance, in the form of curves, on likely economical forms of electrifying areas depending on load size and density and distance from the grid; it also suggested criteria to be used in prioritizing rural electrification. It is therefore proposed to follow on from the PSDP by carrying out specific rural electrification planning.

Project Description: The proposed project would develop a plan for electrifying each suco (subdistrict) in the country, determining how it is likely to be electrified and when. The planning would take into account resource assessments described above, population size, and distance from the grid and other load centers, etc. The plan would be in varying levels of detail depending on when electrification is likely to occur, being very detailed for, say, the first five years of rural electrification with progressively lesser degree of detail over the later years. The intention would be to update it on a rolling basis. The plan would have three main purposes: (a) prioritizing areas for grid extension; (b) defining areas that could be more economically developed by locally resource based mini-grids; and (c) defining areas that are unlikely to be feasible for grid-based development even in the longer term, enabling alternative electrification arrangements such as solar home systems to be made for these areas that could proceed in parallel with conventional grid extension and mini-grid establishment. In addition, the project may include preparation of "Rural Electrification Standards", if this is not separately taken up on a priority basis. This component is separately described in another Sector Investment Program Project Profile.

Procurement and Services: A consulting firm experienced in rural electrification would be retained to undertake this study.

Implementation Schedule: This study should proceed as soon as possible, with completion anticipated during 2004. If possible it should provide inputs to the First Rural Electrification Project preparation study.

Project Component

Project Component	DAC Code	Allocation		Implementing Agency
		National Currency	US$	
Rural Electrification Framework			400,000	Ministry of Transport, Communications and Public Works
Total			**400,000**	

Appendix 7

Oil Products Procurement and Distribution Study

Sector	**POWER**	
Project Name	**Oil Products Procurement and Distribution Study**	
Country/Organization	**Unidentified**	
Agency	**Unidentified**	
DAC	**Oil Fired Power Plants**	**Code: 23061**
Donor Project Code		
Budget Status	✓ On Budget Off Budget	

Project Objective ☐ Attached Document

(i) To reduce the cost of oil imports by adopting optimal international competitive bidding procedures; (ii) to optimize fuel distribution within the country; (iii) to undertake a feasibility study and prepare detailed designs/bidding documents for an oil pipeline from the Dili oil terminal to Comoro power station; and (iv) to study the adequacy of fuel storage facilities at Dili oil terminal and Electricidade de Timor Lorosae (EDTL) power stations with regard to oil and power security.

Project Objective ☐ Attached Document

Background: Timor-Leste has only one bulk import terminal for oil products, located in Dili and operated by Pertamina (the Indonesian national oil and gas company). Other companies are not allowed to use the bulk import terminal, such that Pertamina is responsible for about 80% of all imported oil products. A few other companies import small amounts of oil mainly from Australia. Based on data from both Indonesia and Timor-Leste, the Power Sector Development Plan consultants concluded that the tax-free price of diesel oil in Timor-Leste is about 60% higher than nonsubsidized Pertamina customers pay in Indonesia for the same product (in mid-2003 about $0.28 per liter including 10% Indonesian General Sales Tax or "GST"). Shipping cost to Timor-Leste and terminal costs would account for part of this difference, but there still appears to be a large unexplained component. The World Bank transport mission in September 2003 provided figures for retail prices in Asia Pacific Economic Cooperation countries indicating the most common retail price was about $0.30 per liter with the lowest being Samoa at $0.28 per liter, which procures oil through long-term contracts awarded through a competitive bidding process. These retail prices would translate into wholesale prices of about $0.25 per liter and $0.23 per liter, respectively. Therefore, there is good consistency between the Indonesian nonsubsidized wholesale price (before GST) and the medium wholesale price in APEC countries. The conclusion is that large savings would probably accrue to EDTL if oil imports were contracted using a similar procedure to that used in Samoa.

Project description: The project will provide for the services of a Hydrocarbons Procurement and Contracts Expert and a Petroleum Engineer for 3 person-months. Overall options and combinations that may be considered include (i) awarding the oil terminal operating contract either separately or together with long-term oil supply contract(s); (ii) including domestic oil distribution contracts (partially or wholly) with the terminal operating contract and/or fuel supply contract; (iii) procuring oil products under a combined contract or separate product-by-product contracts; and (iv) separate oil procurement and delivery arrangements for EDTL for its own oil and oil products needs.

Procurement and Services: No procurement of goods is anticipated. A counterpart team will assist the foreign consultants. Technology transfer and training will be provided.

Implementation Schedule: This project is most urgent. Annual savings of $3.5 million are anticipated from the successful implementation of the project.

Scope of Services:

- Evaluate the present position with regard to ownership and operation of the Dili fuel terminal, and recommend a future course of action that would lead to the terminal becoming available for fuel supplies acquired under international competitive bidding;
- Make recommendations for the most advantageous oil supply contractual arrangements, including consideration of medium- and long-term contracts with a single supplier (Samoa model); more frequent competitive bidding exercises; multi-product and single product procurement, and other options that would obtain best international prices of oil products;
- Make recommendations for an "operations contract" for the oil terminal, including consideration of operations by an oil company, the Government, or an independent operator;
- Evaluate the present oil distribution system in Timor-Leste, and make recommendations with regard to improvements that would achieve reductions in oil delivery costs;
- Examine the feasibility and economic advantages of a fuel pipeline from the oil terminal to Comoro power station, and prepare a technical feasibility report, cost estimates, and implementation arrangements; and
- Evaluate the adequacy of fuel storage arrangements for EDTL's Dili and provincial generation facilities.

Project Component

Project Component	DAC Code	Allocation		Implementing Agency
		National Currency	US$	
Oil Products Procurement and Distribution Study			160,000	Ministry of Planning and Finance
Total			**160,000**	

Appendix 8

Comoro Pipeline

Sector	**POWER**
Project Name	**Comoro Pipeline**
Country/Organization	**Unidentified**
Agency	**Unidentified**
DAC	**Oil-Fired Power Plant**
Donor Project Code	
Budget Status	✓ On Budget Off Budget

Code: 23061

Project Objective ☐ Attached Document

To replace costly truck delivery of diesel oil from the Dili oil terminal to the Comoro Power station

Project Objective ☐ Attached Document

Background: The l6 MW Comoro Power Station in Dili consumes just under 19 million liters of diesel per year. Oil is transported by truck from the wharf to the Comoro Power Station, a distance of about 2–3 kilometers, at a cost of about $380,000 per year. To supersede truck transport an oil supply pipeline will be constructed from the wharf to the Comoro Power Station. Besides reducing the oil transport cost, environmental benefits will accrue from reduced oil spills relating to truck transport. Oil supply security will also be improved.

Procurement and Services: The project will be carried out in two phases:
- Consultants will carry out a brief feasibility study and an environmental analysis, and prepare detailed designs and tender documents; and
- The project will be awarded and implemented on a turnkey basis.

Implementation Schedule: The project is urgent. It will achieve large cost savings, and is estimated to have a pay-back period of only a few weeks. (***Note:*** *This project is also under consideration for inclusion in the Oil Procurement Project. Duplication to be avoided.)*

Scope of Services:
- Prepare brief feasibility study to include pipeline sizing, termination configurations, right-of-way considerations, environmental analysis, cost estimates economic analysis, and implementation schedule;
- Seek Government approval and funding agency approval for feasibility study recommendations;
- Prepare detailed designs and turnkey contract bidding documents;
- Assist with bid analysis and contract negotiations and award; and
- Supervise project implementation.

Project Component

Project Component	DAC Code	Allocation		Implementing Agency
		National Currency	US$	
Comoro oil pipeline			1,000,000	Ministry of Transport, Communications and Public Works
Total			**1,000,000**	

Appendix 9

Lamp Replacement Program/CFL Initial Program

Sector	**POWER**	
Project Name	**Lamp Replacement Program/CFL Initial Program**	
Country/Organization	**Unidentified**	
Agency	**Unidentified**	
DAC	**Emergency Demand Management**	**Code: 23083**
Donor Project Code		
Budget Status	✓ On Budget Off Budget	

Project Objective ☐ Attached Document

To replace incandescent bulbs with compact fluorescent lamps (CFLs) and fluorescent tubes to achieve significant fuel and generation expansion savings

Project Objective ☐ Attached Document

Background: Energy efficiency demand side management actions and, in particular, use of CFLs, and fluorescent tubes as direct replacements for traditional incandescent bulbs are considered crucial to reduction of current large oil import costs. A survey by the Japan International Cooperation Agency mission of community-run power stations indicates that approximately 57% of the installed lamps (by wattage) are traditional incandescent type. Replacing these by CFLs or tubes would reduce power consumption by up to 46%, making the operation of these village-based power schemes immediately more affordable. The proposed project needs to be formulated, but in principle consists of (a) provision (possibly free) to every residential consumer of two CFLs in exchange for incandescent bulbs; and (b) reparation and implementation of a program for full-scale application of that equipment for lighting in the whole country. As proposed in the Power Sector Development Plan (PSDP), this should include an information campaign in media via television, newspapers and community consultations, targeted to existing consumers, motivating consumers with simple examples on the use of energy efficient lights and fluorescent tubes. During negotiations, the selected bidder for the Management Contract agreed to prepare such a program.

Project Description and Benefits: The project would comprise procurement of about 120,000 CFLs and providing these free to existing and new electricity consumers. A calculation on the benefits of using CFLs is presented in the PSDP report. Assuming that 20,000 customers in Dili would replace three 60 watt bulbs by 11 watt high-efficiency CFLs, two for indoors (3.5 hours/day) and one for outdoor (12 hours/day), this would result in annual savings in Electricidade de Timor Lorosae's (EDTL's) fuel bill of $550,000 (with fuel costs $0.33/liter), and reduction of peak loading by 2.9 megawatts. The corresponding deferred capital investment generation capacity would be approximately $1.7 million. If the lamps, costing about $1.50 each, were to be given to consumers free of charge, the total investment would be $90,000, and the simple payback just a couple of months. The PSDP consultants had some reservations concerning provision of lamps to existing consumers including the possible diversion of lamps to the secondary market. However, if they end up in sockets, the primary objective of reduced oil imports will be achieved. It is considered that a Government-sponsored Lamp Replacement Program could result in considerable and immediate reduction in fuel consumption and more affordable electricity to the poor in Timor-Leste. Experiences in several developing and developed countries have shown this type of program to be extremely cost and efficiency effective.

Procurement and Services: The project would have two phases:
- A consultant (energy efficiency expert) would undertake a brief study to develop and agree with EDTL and the Government on the most effective methodology for the program, and would thereafter prepare procurement documents; and
- Brief assistance would be given with procurement and the initial distribution/installation program.

Implementation Schedule: Urgent. Considerable fuel and generation expansion savings will accrue, and a payback period of only a few months is calculated.

Scope of Services: The following scope of services is planned:

- Prepare a brief feasibility study, formulating an optimal lamp replacement program;
- Prepare an appropriate media campaign;
- Obtain Government and EDTL endorsement;
- Prepare bidding documents for procurement of CFLs and fluorescent light fixtures; and
- Coordinate with EDTL on a suitable initial installation progam.

Project Component

Project Component	DAC Code	Allocation		Implementing Agency
		National Currency	US$	
Replacement of incandescent bulbs with compact fluorescent lamps			205,000	Electricidade de Timor Lorosae
Total			**205,000**	

Appendix 10

District and Subdistrict Power Rehabilitation

Sector	**POWER**	
Project Name	**District and Subdistrict Power Rehabilitation**	
Country/Organization	**Unidentified**	
Agency	**Unidentified**	
DAC	**Rehabilitation of Power Systems**	**Code: 23090**
Donor Project Code		
Budget Status	✓ On Budget Off Budget	

Project Objective ☐ Attached Document

To rehabilitate high voltage (HV) and low voltage (LV) power distribution network in districts and subdistricts

Project Objective ☐ Attached Document

Background: The Dili distribution system is mostly restored and in operation with adequate 20 kilovolt (kV) line capacity for the existing load. Under the Japan International Cooperation Agency financing of about $7 million, additional rehabilitation on Dili has recently been committed (four megawatt diesel generator, transformers, autoreclosers, switchgear, etc.). In the provinces, however, there are still a number of villages that were served with electricity before 1999 where electricity service has not yet been restored, and in certain others costly provision of power by small size high speed diesel sets needs to be superseded by the rebuilding/remodeling of former distribution network. Investment is needed for transformers, autoreclosers, switchgear relay protection, control and metering equipment, and also supplementary distribution lines to provide economies of scale and supply security. The reinforcement will also serve as a demonstration project to adopt new optimized distribution standards for rural electrification, as recommended by the Power Sector Development Plan consultants.

Project Description: The project includes (a) preventive maintenance and rehabilitation of generating stations; (b) refurbishment of about 30 substations; (c) replacement and reconductoring and wooden cross-arms on 20 kilovolt lines; (d) replacement/reconductoring of damaged and/or undersized low voltage lines; (e) installation of autoreclosers and switchgear on key feeders to allow isolation of faults to increase reliability of supply; (f) fire fighting and safety equipment; (g) workshops, maintenance equipment, and spare parts; and (h) other materials and services to enable competent rehabilitation of the district and subdistrict networks.

Procurement and Services: The project will be carried out in two phases:
- Consulting services for a brief feasibility study, detailed design, and bidding documents; and
- Project implementation on a turnkey basis.

Implementation Schedule: Urgent. Project commencement as soon as possible.

Scope of Services: The project would be carried out in two phases:

Phase 1. **Feasibility study and bidding document preparation for standard materials**
- Review of present status of rehabilitation works;
- Assessment of highest priority areas for continued power rehabilitation works;
- Concurrently prepare bidding documents for standard distribution materials;
- Prepare brief feasibility study including environmental review; and
- Obtain Government and funding agency endorsement of proposals.

Phase 2. **Implementation**
- Prepare detailed designs and tender documents;
- Assist in bid evaluation/contract negotiations/contract awards; and
- Assist in project supervision and commissioning.

Project Component

Project Component	DAC Code	Allocation		Implementing Agency
		National Currency	US$	
Rehabilitation of HV and LV power distribution network			2,800,000	Ministry of Transport, Communications and Public Works
Total			**2,800,000**	

Appendix 11

First Rural Electrification Project

Sector	**POWER**	
Project Name	**First Rural Electrification Project**	
Country/Organization	**Unidentified**	
Agency	**Unidentified**	
DAC	**Electrical Transmission/Distribution**	**Code: 23040**
Donor Project Code		
Budget Status	✓ On Budget Off Budget	

Project Objective ☐ Attached Document

To undertake the first phase of rural electrification expansion

Project Objective ☐ Attached Document

Background: The project was formulated under the Power Sector Development Plan (PSDP). The PSDP consultants have examined three scenarios for load growth, based on household electrification rates of 60%, 80%, and 95% by 2025. Actual rates will to a large extent depend on power sector financial and technical performance and investment fund availability. Targets include rural economic growth, poverty alleviation and social equality, and will to an extent depend on indigenous oil and gas becoming available, and the cost of power from longer-term hydro and indigenous hydrocarbon-fuelled generation. Rural electrification expansion will include both grid-connected and off-grid components and it will pilot the policy reforms described in the Rural Electrification Framework (Regulatory Study) and adopt the new Rural Electrification Standards.

Project Description: The project is to be prepared under a feasibility study, which is awaiting funding. It would include generators, lines, metering, and consumer connections and grid connections to allow electrification of 28,000 new consumers per year with about 21,000 grid connected and 7,000 using solar home systems.

Procurement and Services: Project preparation is to be carried out under a separate technical assistance project. Procurement will be under the concerned funding agencies procurement rules/guidelines. Consulting services will be necessary to supervise project implementation.

Cost Estimate: Present estimate is $8.7 million. Cost estimates will be updated and refined under the feasibility study.

Implementation Schedule: The project would commence after completion of a feasibility study. Execution period would be about 3.5 years. Target commencement 3Q 2004.

Scope of Services:
- Review of earlier feasibility study;
- Supervision of equipment procurement under funding agency's guidelines;
- Contract negotiations with suppliers; and
- Supervision of erection.

Project Component

Project Component	DAC Code	Allocation		Implementing Agency
		National Currency	US$	
First Rural Electrification Project			8,700,000	Ministry of Transport, Communications and Public Works
Total			**8,700,000**	

Appendix 12

Ira Lalaro Hydropower Plant: Feasibility Study

Sector	**POWER**
Project Name	**Ira Lalaro Hydropower Plant: Feasibility Study**
Country/Organization	**Norway**
Agency	**Norway**
DAC	**Hydro-Electric Power Plants** **Code: 23065**
Donor Project Code	
Budget Status	✓ On Budget Off Budget

Project Objective ☐ Attached Document

To prepare a comprehensive study and development strategy for Ira Lalaro hydropower plant

Project Objective ☐ Attached Document

By taking a simultaneous approach with resource assessments and power investment feasibility studies, the Government would be able to make informed and timely decisions on the best options for further development of the power sector as soon as the results of the resource assessments are available. Project preparation activities will build on earlier studies and be closely coordinated with earlier-mentioned proposed new studies. The feasibility study update is currently underway with funding from the Norwegian Agency for International Cooperation.

Project Component

Project Component	DAC Code	Allocation		Implementing Agency
		National Currency (Kron)	US$	
Ira Lalaro Hydropower Plant: Feasibility Study		3,649,635		Ministry of Transport, Communications and Public Works
Total		**3,649,635**		

Appendix 13

Baucau Minihydro Power Plant Feasibility Study

Sector	**POWER**	
Project Name	**Baucau Minihydro Power Plant Feasibility Study**	
Country/Organization	**Norway**	
Agency	**Norway**	
DAC	**Hydro-Electric Power Plants**	**Code: 23065**
Donor Project Code		
Budget Status	✓ On Budget Off Budget	

Project Objective ☐ Attached Document

To prepare a comprehensive study and development strategy for the Baucau micro hydropower plant

Project Objective ☐ Attached Document

Several micro hydro schemes in Timor-Leste were identified to have good potential. One of them is close to Baucau Town where a 350 kilowatt, 3 gigawatt-hour/year scheme could be developed to utilize water flowing from a spring (after water supply needs have been met). Estimates comparing the cost of diesel generator and a hydropower plant of the same size showed that hydropower energy would be less expensive than diesel generation.

Project Component

Project Component	DAC Code	Allocation		Implementing Agency
		National Currency	US$	
Baucau Minihydro Plant Feasibility Study		1,459,854		Ministry of Transport, Communications and Public Works
Total		**1,459,854**		

Appendix 14

Ira Lalaro Hydropower Plant

Sector	**POWER**
Project Name	**Ira Lalaro Hydropower Plant**
Country/Organization	**Unidentified**
Agency	**Unidentified**
DAC Code	**Hydro-Electric Power Plants** **Code: 23065**
Donor Project Code	
Budget Status	✓ On Budget Off Budget

Project Objective ☐ Attached Document

To provide electricity to the majority of population of Timor-Leste

Project Objective ☐ Attached Document

Currently, all electricity generation in Timor-Leste is through diesel engines burning high-speed diesel oil. The advantage of being a mountainous country with good rainfall is that there is a potential to explore and develop hydropower. Previous studies reviewed by the Power Sector Development Plan have identified several indigenous energy resources for potentially economical power generation. The most feasible of these, based on least cost generation planning, is the 27 megawatt Ira Lalaro hydropower, which would provide electricity to the major cities at low cost.

Project Benefits ☐ Attached Document

Improved access to electrification to stimulate and increase private sector activities

Project Component

Project Component	DAC Code	Allocation		Implementing Agency
		National Currency	US$	
Ira Lalaro Hydropower Plant			42,000,000	Ministry of Transport, Communications and Public Works
Total			**42,000,000**	

Appendix 15

Associated Gas Seep Power Plant

Sector	**POWER**
Project Name	**Associated Gas Seep Power Plant**
Country/Organization	**Unidentified**
Agency	**Unidentified**
DAC	**Oil-Fired Power Plants**
Donor Project Code	
Budget Status	✓ On Budget Off Budget

Code: 23062

Project Objective ☐ Attached Document

To improve access to electricity in the South Coast region

Project Objective ☐ Attached Document

A power plant associated with the seep harvest at Aliambata could be installed to generate power with gas harvested from the site.[1] A preliminary survey indicates the seep harvest could support a power plant of 300 kilowatts.

Project Benefits ☐ Attached Document

Increased household access to electricity and promote private business, particularly in the southern areas

Project Component

Project Component	DAC Code	Allocation		Implementing Agency
		National Currency	US$	
Associated Gas Seep Power Plant			300,000	Ministry of Transport, Communications and Public Works
Total			**300,000**	

[1] See the Sector Investment Program for Natural Resources and Environment for a detailed discussion of the project.

Appendix 16

Associated Oilwell Power Plant

Sector	**POWER**
Project Name	**Associated Oilwell Power Plant**
Country/Organization	**Unidentified**
Agency	**Unidentified**
DAC	**Oil-Fired Power Plants**
Donor Project Code	
Budget Status	✓ On Budget Off Budget

Code: 23061

Project Objective ☐ Attached Document

To diversify power generation in Timor-Leste

Project Objective ☐ Attached Document

This investment would proceed if sufficient amount and quality oil is produced from the rehabilitated Suai oil well. The associated power plant could be installed in the Suai power station (a short distance away from the well) to generate power either from the oil or gas produced from the well, or possibly both (depending on quantities). Preliminary survey indicates the output from the oil well rehabilitation could support power generation of 400 kilowatts.

Project Benefits ☐ Attached Document

Increased access to electricity, particularly those in the South Coast

Project Component

Project Component	DAC Code	Allocation		Implementing Agency
		National Currency	US$	
Associated Oilwell Power Plant			320,000	Ministry of Transport, Communications and Public Works
Total			**320,000**	

Appendix 17

Comoro Power plant

Sector	**POWER**	
Project Name	**Comoro Power plant**	
Country/Organization	**Japan**	
Agency	**Japan**	
DAC Code	**Oil-Fired Power Plants**	**Code: 23061**
Donor Project Code		
Budget Status	✓ On Budget Off Budget	

Project Objective ☐ Attached Document

To reinforce and improve reliability of the Dili distribution system

Project Objective ☐ Attached Document

Although the Dili generation and distribution system is restored and well operated, there is a need to supplement generation capacity at Comoro Power Station. This would also reinforce and improve the reliability of the Dili distribution system.

Project Benefits ☐ Attached Document

Improved generation capacity of the Comoro power plant

Project Component

Project Component	DAC Code	Allocation		Implementing Agency
		National Currency (Kron)	US$	
Comoro Power Plant		JPY 602,409,638		Ministry of Transport, Communications and Public Works
Total		**JPY 602,409,638**		

Appendix 18

Dili Distribution Rehabilitation

Sector	**POWER**	
Project Name	**Dili Distribution Rehabilitation**	
Country/Organization	**Japan**	
Agency	**Japan**	
DAC Code	**Electrical Transmission/Distribution**	**Code: 23040**
Donor Project Code		
Budget Status	✓ On Budget Off Budget	

Project Objective ☐ Attached Document

To reinforce and improve reliability of the Dili distribution system

Project Objective ☐ Attached Document

Although the Dili generation and distribution system has been restored and is operating well, there is a need to supplement generation capacity at the Comoro Power Station. This would also reinforce and improve reliability of the Dili distribution system.

Project Benefits ☐ Attached Document

Improved reliability of the Dili distribution system

Project Component

Project Component	DAC Code	Allocation		Implementing Agency
		National Currency	US$	
Dili Distribution Rehabilitation			2,020,000	Ministry of Transport, Communications and Public Works
Total			**2,020,000**	

Appendix 19

Ira Lalaro–Dili Transmission Line Study

Sector	**POWER**	
Project Name	**Ira Lalaro–Dili Transmission Line Study**	
Country/Organization	**Unidentified**	
Agency	**Unidentified**	
DAC Code	**Electrical Transmission/Distribution**	**Code: 23040**
Donor Project Code		
Budget Status	✓ On Budget Off Budget	

Project Objective ☐ Attached Document

To provide input to the Ira Lalaro–Dili Transmission Line project proposed below

Project Objective ☐ Attached Document

The Government of Timor-Leste is proposing a number of high priority, new investments in the power system. To address the above, resource assessments and investment feasibility studies need to be undertaken by the Government.

Project Benefits ☐ Attached Document

The Government would be able to make informed and timely decisions on the best options for further development of the power sector.

Project Component

Project Component	DAC Code	Allocation		Implementing Agency
		National Currency	US$	
Unidentified			350,000	Ministry of Transport, Communications and Public Works
Total			**350,000**	

Appendix 20

Ira Lalaro–Dili Transmission Line

Sector	**POWER**	
Project Name	**Ira Lalaro–Dili Transmission Line**	
Country/Organization	**Unidentified**	
Agency	**Unidentified**	
DAC Code	**Electrical Transmission/Distribution**	**Code: 23040**
Donor Project Code		
Budget Status	✓ On Budget Off Budget	

Project Objective ☐ Attached Document

To connect the Ira Lalaro transmission line to the Dili system

Project Objective ☐ Attached Document

The Government of Timor-Leste is proposing a number of high priority, new investments in the power system, and this includes the Ira Lalaro Transmission Line Project. It is expected to increase access to electricity and subsequently stimulate private business in the whole country.

Project Benefits ☐ Attached Document

Number of households electrified and private business will also increase

Project Component

Project Component	DAC Code	Allocation		Implementing Agency
		National Currency	US$	
Ira Lalaro–Dili Transmission Line			18,000,000	
Total			**18,000,000**	