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Economic Growth/Energy Integration Strategy

Sri Lanka

Prepared by

Nexant

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Acronyms and Abbreviations

ABB	Asea Brown Boveri
ADB	Asian Development Bank
CEB	Ceylon Electricity Board
CEnS	Center for Energy Studies, University of Moratuwa
CFL	compact fluorescent lamp
CNG	compressed natural gas
CPC	Ceylon Petroleum Corporation
DFCC	Development Finance Corporation of Ceylon
DistCo	distribution company
DSM	demand-side management
ECF	Energy Conservation Fund, Sri Lanka
ECS	electricity consumer society
EIA	environmental impact assessment
ENERCON	Center for Energy Conservation, Pakistan
ESCO	energy service company
ESD	Energy Services Delivery project, Sri Lanka
GDP	gross domestic product
GenCo	generation company
GOSL	government of Sri Lanka
GTZ	German Technical Corporation
ICE	internal combustion engine
INR	Indian rupee
IOC	Indian Oil Company
IPP	independent power producer
IT	information technology
ITDG	Intermediate Technology Development Group
JBIC	Japan Bank for International Co-operation
JICA	Japan International Co-operation Agency
KFW	German Credit Institution for Reconstruction
km	kilometer
kV	kilovolt
kVA	kilovolt ampere
kW	kilowatt
kWh	kilowatt hour
LECO	Lanka Electricity Company
LPG	liquid petroleum gas
MAC	Monitoring and Advisory Committee, Sri Lanka
MDB	multilateral development bank
MOPE	Ministry of Power and Energy, Sri Lanka
MW	megawatt
NERD	National Engineering Research and Development Center, Sri Lanka
NGO	non-governmental organization
NREL	National Renewable Energy Laboratory, Sri Lanka
PCRA	Petroleum Conservation Research Association, India
PPA	power purchase agreement
PRS	poverty reduction strategy

PSA	power supply agreement
PUC	Public Utility Commission, Sri Lanka
PV	photovoltaic
RERED	Renewable Energy for Rural Economic Development
RES	rural electrification scheme
SARI/Energy	South Asia Regional Initiative in Energy
SCADA	supervisory control and data acquisition
SEEDS	Sarvodaya Economic Enterprises Development Services
Selco	Solar Electric Light Company
SGF	sustainable guarantee fund
SIDA	Swedish International Development Agency
SLEMA	Sri Lanka Energy Managers Association
SLR	Sri Lankan rupee
SME	small and medium-sized enterprise
SOE	state-owned enterprise
TA	technical assistance
TCI	The Competitiveness Initiative
UDA	Urban Development Authority
UN	United Nations
USAEP	US-Asia Environmental Partnership
USAID	United States Agency for International Development
USTDA	United States Trade and Development Agency

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Executive Summary

To attract foreign investment, improve competitiveness in the global market, and stimulate economic growth, a reliable supply of energy at an affordable price has become a national imperative for Sri Lanka.

With many critical issues facing the energy sector and the country at large, such as oil imports amounting to about 11 percent of net export income, US$ 4.5 billion worth of power-sector capacity additions needed over the next 10 years to meet projected demand and extend the national grid to the north and east, and unbundling of the energy sector, an independent multi-sector regulatory body has been tasked with the intention of creating a favorable environment for investment in the energy sector.

The objective of this activity is to assist the United States Agency for International Development (USAID) mission in Sri Lanka to determine those short- and medium-term interventions in the energy sector, for inclusion in the USAID/Sri Lanka Economic Growth Program Strategy: 2004-2007, that would most aid the effort to provide reliable/quality energy at an affordable price.

The interventions identified would support efforts of the government of Sri Lanka (GOSL) to realize an average gross domestic product (GDP) growth rate of 6.75 percent from 2004-2007, strengthen USAID's The Competitiveness Initiative Program and South Asia Regional Initiative in Energy, and complement the efforts of other multilateral donor agencies (discussed in detail in Section 4):

- The Asian Development Bank (ADB) is a major supporter of the current energy sector reforms, having provided assistance for both phase 1 and 2 of the restructuring, and will soon assist in the development of an energy sector master plan and provide the necessary support for a "power fund for the poor". ADB, a long-time supporter of rural electrification, recently initiated support for an additional 630 rural electrification schemes (RES) and is promoting oil and gas exploration off the shores of Sri Lanka.
- The World Bank has had a program, Energy Service Delivery (ESD) to implement viable renewable energy projects, strengthen demand-side management (DSM) within the Ceylon Electricity Board (CEB), and support a 3 MW pilot wind project. Building on the success of this project, a second program has been designed to increase renewable energy power to the grid by 85 MW. The bank is supporting the creation of a multi-sector regulatory commission, initially for the electrical sector and the liberalization of the petroleum sector.
- The Japan Bank for International Cooperation (JBIC) is currently funding two hydropower projects, a transmission link between a new thermal power plant and grid extensions, and a system optimization study of the hydropower system.
- The Trade and Development Agency of the US (USTDA) will fund a technical assistance program for the development of a 300 MW coal-fired power plant.
- The German Technical Corporation (GTZ) is looking into renewable power applications in the north and east and, with the German Credit Institution for Reconstruction (KFW), is involved in the new construction and rehabilitation of grid/distribution systems.
- The Chinese government has pledged assistance in the implementation of 500 RESs Sri Lanka wide, affecting approximately 70,000 households.

With the key risks associated with the energy sector being reliability/quality and cost of energy supply, the proposed energy sector interventions focus on regulatory reform,

deregulation of the power and petroleum sectors, power sector reliability/quality improvements, promotion of renewable energy, and energy efficiency improvements to strengthen the on-going USAID's The Competitiveness Initiative Program.

Nexant consulted over 60 stakeholders representing 40 stakeholder organizations in developing the sector interventions, which mainly focus on training and capacity building, which are imperative to ensure the smooth transition and effective functioning of the unbundled electricity sector; the deregulated petroleum industry; and the regulatory body. The proposed interventions were presented and finalized at a seminar conducted by Nexant with a group of 25 key stakeholders, identified by the USAID mission in Sri Lanka.

Menu of Options for Interventions in the Energy Sector

No	Term	Intervention	Est. Cost($)
Institutional Support			
1.	Short	National energy model and policy analysis tool	315,000
Power Sector			
2.	Immediate	Assistance to PUC for training of staff	360,000
3.	Immediate	Definition of the legal/regulatory status of off-grid RES	105,000
4.	Immediate	Technical assistance to TransCo management on systems operations and new bulk supply/sale	175,000
5.	Immediate	Technical assistance to DistCo management for improving operational performance	350,000
6.	Immediate	Technical assistance to DistCos to meet new regulatory requirements	180,000
7.	Immediate to short	Technical assistance to improve reliability of the power grid	100,000
8.	Immediate	Financial support for training on small wind-energy systems	8,000
9.	Short	Capacity enhancement in hydroelectric power plants	200,000
10.	Short	Assistance to institutional energy users (schools, clinics) to implement small-scale energy systems	222,000
11.	Short	Technical assistance to develop an investment-grade project report for distribution loss reduction/capital upgrades	238,500
12.	Short	Capacity building for TransCo to negotiate PPA contracts	150,000
13.	Short	Energy survey and needs assessment for the north and east	167,805
14.	Short to medium	Development of a national renewable energy resources database and user-friendly resource guide	141,000
Industrial and Commercial Sectors			
15.	Immediate	Fuel switching for drying process in tea industry	37,000
16.	Immediate to short	Fuel switching for spray dryers in ceramic industry	250,000
17.	Immediate	Development of a web-based bench marking database for hospitality/tourism industry – funded	35,000
18.	Short	Improvement in service delivery of ESCOs and project developers	225,000
19.	Short to medium	Establishment of an energy efficiency advisory cell for The Competitiveness Initiative	60,000
20.	Short to medium	Facilitation of establishment of a sustainable guarantee fund (SGF)	90,000
21.	Short	Promotion and dissemination of information on renewable energy applications in tourism Sector	260,000
Transport Sector (Including Petroleum Industry)			
22.	Immediate	Development of an updated petroleum products accounting system for Ceylon Petroleum Corporation	450,000
23.	Short to medium	Establishment of a transport sector baseline database	375,000
24.	Short to medium	Establishment of a national vehicle inspection and tune-up program	320,000
25.	Short to medium	Establishment of a petroleum conservation and resource center	175,000
26.	Medium	Introduction of zero-emissions electric vehicles	286,000
27.	Medium	Replacement of Colombo taxi fleet with hybrid vehicles	460,000
		TOTAL	**5,735,305**

Nexant recommends the implementation of selected interventions through the on-going Competitiveness Initiative Program by creating a separate cluster for energy in order to strengthen activities in existing industry clusters.

1 Background on Energy in Sri Lanka

Figure 1-1 summarizes the energy sector in Sri Lanka. The widths of the lines depicting the value of the energy sources (in tons of oil equivalent, TOE) of imported versus domestic energy may change in the future, as well as the sectors to which the energy flows, but the scenario will remain substantially the same for years to come – unless oil and gas are discovered off the coast of Sri Lanka or plans to introduce coal-fired electricity generation succeed.

Of striking importance is that

- All hydrocarbon-based energy (crude oil, finished petroleum products, and coal) is imported, but accounts for only 39 percent of the energy in the scenario
- Biomass currently makes a considerable contribution to the energy balance, approximately 53 percent of the total energy – primarily in the domestic and commercial areas
- The other energy source, hydropower, accounts for approximately eight percent of the energy input, used exclusively to generate electrical power

  The installations generating this power, however, contribute significantly as a storage source for the water used in the country-wide irrigation scheme, and use of water for irrigation takes precedence over that for power generation. As late as 1990, hydro supplied over 99 percent of the electrical power needs of Sri Lanka, but this contribution declined to 39.6 percent in 2002 (most recent data available). This percentage is likely to continue to decline as the economy grows, given the general correlation of GDP with electricity consumption and the fact that the potential for hydro is nearly totally exploited

Essentially, all the biomass is used for industry and domestic/commercial purposes, with the domestic/commercial sectors using 76 percent of the total biomass energy. Of the crude oil and finished petroleum, all of which is imported, 62 percent is used by the transport sector (81 percent in the form of diesel fuel), and only approximately 20 percent is utilized to generate electricity (in the year 2000).

The significance of 39 percent of the total energy in the scenario being imported (primarily petroleum) is best depicted by the fact that in 2002 it was estimated that the cost of procuring this energy was US$ 670 million, about 11 percent of net export income. It is anticipated that the percentage of the petroleum used in the total energy balance increased in 2002 as a result of a one percent increase in total thermal power generation (using petroleum products) in 2001. Thus, implementing savings in petroleum imports, be it for more efficient thermal electrical power generation/transmission/distribution or use in the transport sector, has the direct effect of reducing the drain on Sri Lanka's trade balance – allowing more funds to go into stimulating economic growth and reducing poverty. This is proving a challenge, since all "short-term fixes" of electrical shortages are being solved primarily with petroleum-fueled power generation.

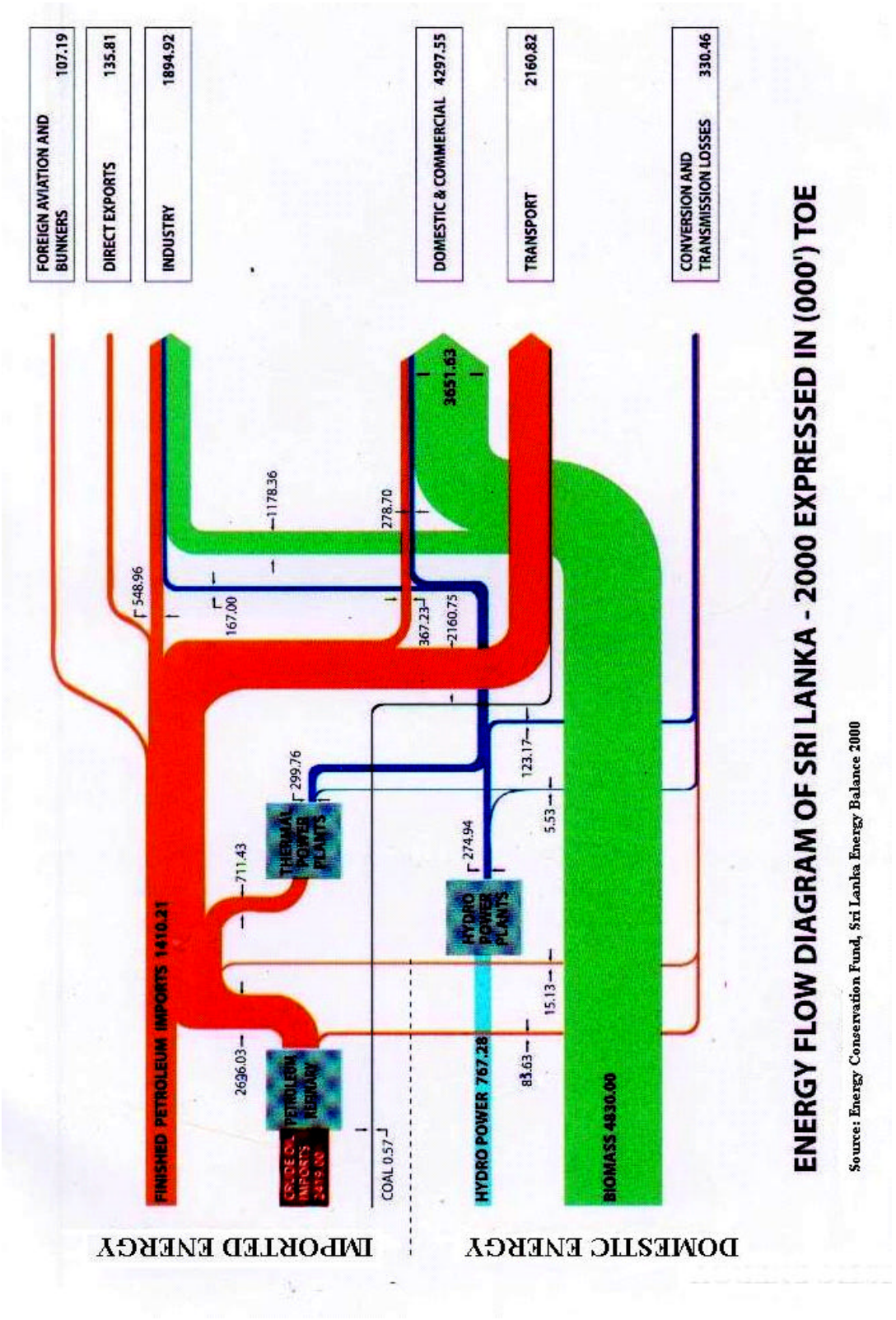


Figure 1-1 Energy Flow Diagram for Sri Lanka

On the economic scene, which is strongly related to energy use, despite a long and bitter conflict, various external shocks, and the first major downturn in economic performance since independence, during 2001 Sri Lanka still managed a relatively good economic growth rate of around four percent. Current forecasts expect the growth rate for 2003 to be around 5.2 percent[1]. The government of Sri Lanka (GOSL) has in recent years also achieved some progress with a number of privatizations, including that of the state airline, telecommunications, plantations, and the liquid petroleum gas (LPG) and banking sectors.

Sri Lanka has also developed one of the most favorable trade and foreign investment regimes in South Asia and has provided fiscal incentives to a number of designated "thrust industries" as a catalyst for the private sector to act as a vehicle to drive economic growth. The designated industries include electronics, ceramics, glassware, rubber-based industries, engineering, advanced technologies, and information technology (IT). Table 1-1 provides an indication of the structure of the Sri Lanka economy for the period 1998-2002.

Table 1-1 GDP by industrial Origin at Current Producer Prices and Percentage Contribution of Major Economic Activities to GDP (in Rs. Million)

	1998		1999		2000		2001		2002	
Major Divisions	SLR M	%	SLR M	%	SLR M	%	SLR M	%	SLR M	%
1. Agriculture, livestock, and fisheries	175,478	17.2	191,577	17.3	200964	16	214,482	15.4	237,282	15.1
2. Mining and quarrying	10,909	1.1	12,862	1.2	17,151	1.4	17,968	1.3	19,887	1.3
3. Manufacturing	185,736	18.2	201,847	18.2	232,147	18.5	261,657	18.7	297,741	19
3.1 Export processing (tea, rubber, and coconut)	10,760	1.1	11,178	1	11,066	0.9	12,323	0.9	13,531	0.9
3.2 Factory industry	162,963	16	177,710	16	207,054	16.5	233,971	16.8	266,236	17
3.3 Cottage industry	12,013	1.2	12,959	1.2	14,027	1.1	15,363	1.1	17,974	1.1
4. Electricity, gas, and water	20,188	2	21,817	2	24,220	1.9	33,226	2.4	36,850	2.3
5. Construction	67,924	6.7	75,352	6.8	84,210	6.7	93,594	6.7	100,404	6.4
6. Wholesale and retail trade (restaurants and hotels)	261,424	25.7	279,767	25.2	323,381	25.8	348,173	24.9	386,234	24.6
7. Transport and communication	105,593	10.4	116,765	10.5	131,500	10.5	154,866	11.1	172,700	11
8. Banking, insurance, and real estate	70,449	6.9	79,337	7.2	93,711	7.5	108,055	7.7	129,137	8.2
9. Ownership of dwellings	7,872	0.8	8,292	0.7	8,679	0.7	9,771	0.7	10,965	0.7
10. Government services	86,729	8.5	93,843	8.5	107,495	8.6	120,560	8.6	140,474	8.9
11. Private services	26,029	2.6	27,386	2.5	30,164	2.4	33,962	2.4	38,586	2.5
Total	1,018,330	100	1,108,845	100	1,253,622	100	1,396,314	100	1,570,260	100
Add: Import duties										
Gross Domestic Product	1,018,330		1,108,845		1,253,622		1,396,314		1,570,260	

Note: GDP by industrial origin at current producer prices and percentage contribution of major economic activities to GDP

Source: Department of Census and Statistics, 2003

In the past, however, the government has in effect competed with private sector participation in the provision of infrastructure and utilities and these services have been priced below commercially viable levels. In this manner, not only had the quality and reliability of energy

[1] Economist Intelligence Unit 2003

services suffered, but also the government had accumulated huge budgetary losses, resulting in a heavy debt load. Since late 2001, however, with the election of a more market-oriented government, Sri Lanka has begun to move forward with a comprehensive array of reforms spanning economic sectors.

In May 2003, the government further articulated an economic recovery program and poverty reduction strategy (PRS) that targets the elimination of barriers and constraints to private sector activities, changing the role of the state and addressing the critical elements of economic and social development and rehabilitation. This is after the many years of internal conflict and is considered vital to the long-term prosperity of the nation. The major objectives of this program, contained in the report, Regaining Sri Lanka: Vision and Strategy for Accelerated Development (GOSL)[2], are

- Building a supportive macro-economic framework
- Reducing the impacts of conflict-related poverty
- Identifying and developing opportunities for more pro-poor growth
- Investing in human resources
- Developing and establishing an effective monitoring and evaluation system

The PRS, described in the above-cited government document, concluded that Sri Lanka has a large number of state-owned enterprises (SOEs) involved in commercial activities, including in the power, transport, and petroleum sectors, that have acted as a significant negative factor on the national economy and have been a major burden on government budgets.

It was estimated that SOE losses equaled 1.5 percent of GDP in 2000 and that budgetary transfers to SOEs amounted to three percent of GDP in 2001. Therefore, the PRS calls for continuing the process of restructuring of the major SOEs and seeking to encourage private sector participation in infrastructure.

The Regaining Sri Lanka document also clearly states that

> High electricity prices that are a result of past mismanagement of the power sector increases production costs and has forced firms to make additional investments in generator capacity to cope with the frequent power outages in recent years. Since electricity is an input into virtually all goods and services, these added costs have far reaching negative impacts on productivity.

Since an estimated 75 percent of the population and almost 90 percent of the country's poor live in rural areas, supporting and improving rural infrastructure, including providing greater access to electricity, better communication, the development of water and sanitation systems, and improving the road and other transport networks, will not only provide for increased connectivity and integration of the nation but also for greater economic opportunities for rural communities, thus stimulating economic growth. Figure 1-2 below shows the electricity sales of CEB and Lanka Electricity Company (LECO) by major consumer groups for the last available year.

[2] GOSL 2003

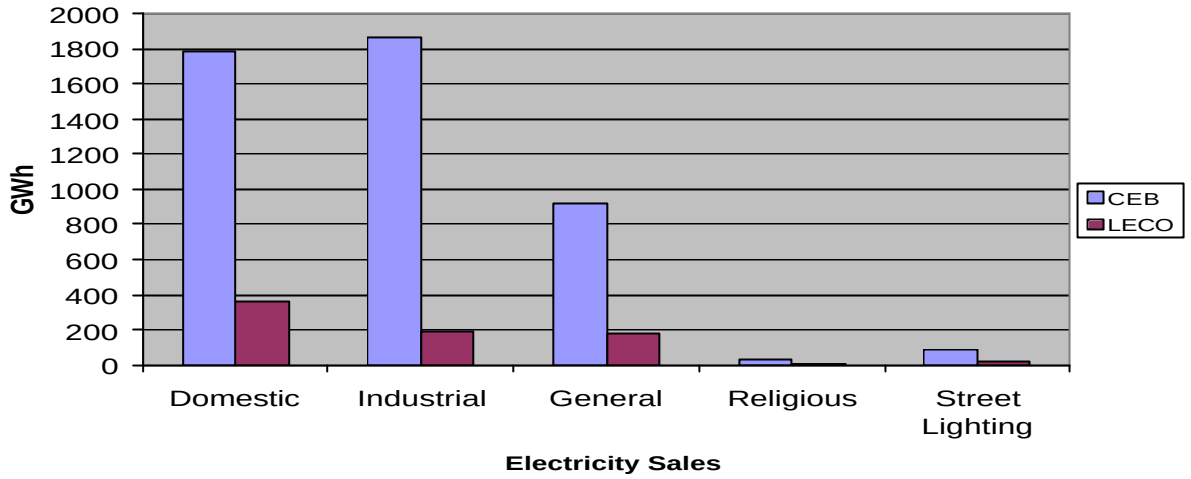


Figure 1-2 Electricity Sales, 2002

Source: Ceylon Electricity Board Statistical Digest (2002)

The development of the overall energy sector in Sri Lanka needs to recognize that there are fundamental links between ensuring adequate and growing supplies of energy/electricity; obtaining the required levels of investments for energy facilities; widening the scope for private sector initiatives to spur economic growth; facilitating public-private partnerships for provision, operation, and management of basic energy services – including for rural areas; and the importance of fiscal accountability and responsibility and good governance.

The exigency of the energy, and especially the electric power, situation that Sri Lanka is facing in the coming years requires that significant attention be paid particularly to mechanisms that will foster added investments in base-load generation and the strengthening and expansion of the transmission grid network in order to meet some of the economic and social goals set out in the PRS.

The dynamics between the petroleum sector and electricity generation and between the petroleum and transport sectors and rural community development need to be understood by policy analysts to determine some of the impacts of energy on the overall development planning process. Developing the parameters for upgrading energy databases and improved information management flows will enhance and expedite critical decision-making at national energy institutions. (Power sector planning is now conducted by the CEB; for insight into these plans, refer to the CEB Long-Term Generation Expansion Plan, 2003-2017, and the CEB Long-Term Transmission Plan, 2003-2017, both updated annually.)

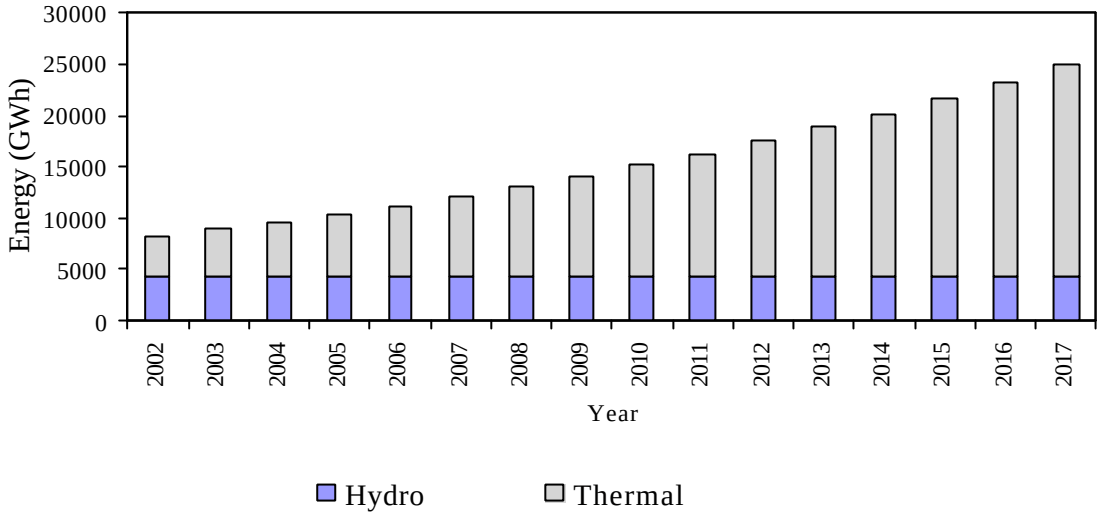


Figure 1-3 Growth of the Electricity Generation Sector 2002–2017

Source: USAID-SARI/E, Nexant Inc, Assessment of Economic Impact of Poor Power Quality on Industry, Sri Lanka (January 2002)

The Central Bank of Sri Lanka has predicted an average economic growth of 5.6 percent for the next four years, and since GDP growth tracks the increase in demand for electricity, CEB attempts to exceed this growth rate in generation and delivery system capacity to help increase the potential for economic growth. CEB does three load-growth forecasts – a medium, low, and high – using the medium-growth forecast as the base case. The average baseline growth rate projected over the next 15 years is 7.45 percent. The Sri Lankan power system, which is predominantly hydro-based at present, will have to transform gradually into a thermal-based system in the future. Although some 266 MW of hydro expansion potential has been identified, this comes at a cost of US$ 2 to 3 million per MW[3], which is more than double to triple the cost of a thermal plant.

Sri Lanka has been experiencing electricity shortages from time to time since early 1990s mainly because of generation shortages and the hydropower plants' inability to compensate adequately during droughts. The extent of such electricity shortages has been increasing in recent years due to growing electricity demand, coupled with inadequate additions of thermal power in a timely manner. A study conducted under the USAID SARI/E project estimates the economic loss due to planned and unplanned power outages on industry to be US$ 126 million, equivalent to one percent of national GDP, which is a significant loss in comparison with four percent to five percent average growth rates in the country during the last few years.

Renewable energy will continue to add to the generation capacity in Sri Lanka, but it is unlikely to be a dominant factor in increasing generation capacity. Many assumptions go into CEB's forecast analysis, the most critical being when the new power generation unit will be operational – which has typically been a matter of years after the initial projection of a project's completion date. The next major "if" in the CEB assumptions is that the 300 MW

[3] CEB 2003

combined cycle power plant will be available at Kerawalapitiya from January 2006 and the 300 MW coal-fired power plant will be available by January 2008. If these major additions become available, by the assumed date, the system growth will be able to accommodate the projected economic growth and increase in electricity demand. If not, the power sector could act as a drag on economic growth.

The use of energy always generates environmental concerns. An assessment of environmental issues as they pertain to the energy sector in Sri Lanka must begin with a review of the variety of legislation in the country. The present system of provincial administration was introduced in Sri Lanka in 1987 under the 13th Amendment to the Constitution. Important aspects pertaining to the energy sector under the umbrella of "protection of environment" were devolved to the newly elected provincial councils as contained in Section 154-G of the said amendment.

In implementing of environmental standards, however, the administrative links between the central government and the provinces need to be strengthened. The Energy Supply Committee, the Public Utility Commission (PUC), the Central Environmental Authority, the Urban Development Authority (UDA), local government agencies, and several other governmental organizations are all empowered to take various steps in strategic environmental management, such as appropriate zoning, depending on their jurisdictions.

In this same vein, application of energy efficiency and conservation bring several long-term benefits to all stakeholders in the Sri Lankan economy. The electric utilities are able to reduce their financial commitments as a result of reduced capacity and energy requirements. Consumers often gain significant savings through better management of their energy needs. Society as a whole benefits from reduced fuel costs and improved environment. Countries that heavily rely on imported petroleum fuel, such as Sri Lanka, also benefit from reduced spending on imports without sacrificing productivity. In general, energy efficiency and conservation is economically beneficial to the country as a whole as it reduces costly captive generation, avoids load shedding and its associated economic costs, and has numerous environmental benefits associated with reduced fuel consumption. The key to success in any energy efficiency measure is that such a measure costs less than what it would cost to produce.

2 Current Energy Status of Key Sectors

2.1 THE POWER SECTOR

2.1.1 CEB Status

It must be recognized that Sri Lanka's electricity supply system is in transition from a predominantly hydroelectric system to a more mixed hydro/thermal system. The overall customer base for electricity is on the increase, although the market shares of different customer classes have been steady for several years. Figure 2-1 gives a breakdown of the various supply sources of electricity supply in 2002.

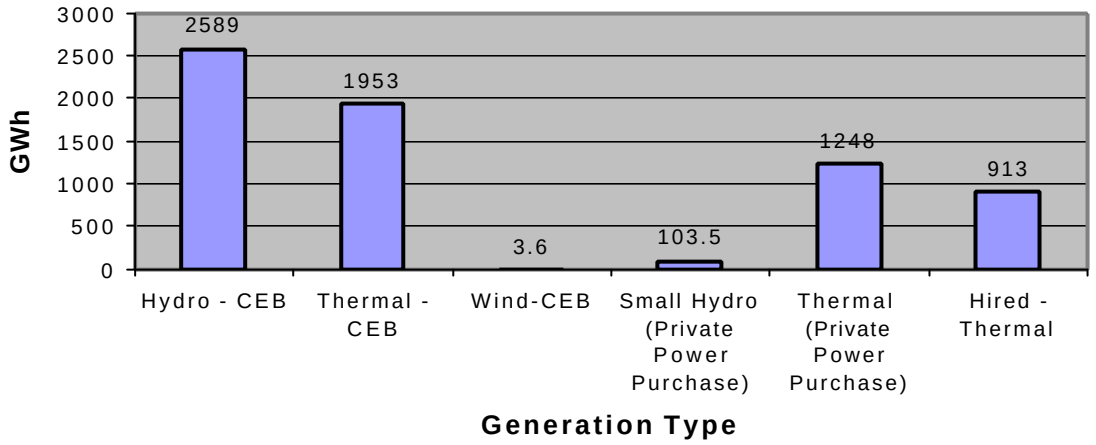


Figure 2-1 Electricity Supply, 2002

Source: Ceylon Electricity Board Statistical Unit

From the information gathered and discussions held during this study, it is estimated that the demand for electricity is expected to increase in the coming years by seven to 10 percent a year, given the optimistic views expressed on economic growth that the peace process is anticipated to trigger. However, in recent years (2001-2003) the demand has only grown by a much more modest 3.5 percent, about half the historic average growth rate per year.

2.1.1.1 Generation

CEB prepares a rolling 15-year long-term generation expansion plan. The current version covers the period 2003-2017 and outlines the government's strategy for the development of the power sector in the medium-term (2002-2005). With recorded CEB financial losses of an aggregate SLR 14.3 billion (approximately US$ 148 million) in 2000 and 2001, the ability to implement the medium-term plan may be questionable. GOSL itself estimates that about US$ 250 million per year will be required through 2007 to increase and upgrade CEB system facilities. Delays in the decision-making process have been another major constraint to adding new base-load power generation to the system.

If this generation plan were adhered to, neither power shortages nor the cost of power would hamper economic growth and development. CEB added their 165 MW combined cycle plant

in 2002 and an independent power producer (IPP) is establishing the commercial validation of a similar 163 MW combined cycle plant in an adjacent area (to be completed in 2003). Also anticipated to be operational at the end of 2003 is a new 70 MW hydropower station, which should be commissioned by the time this report is published. A tendering process is underway for a 300 MW (2 x 150 MW) combined cycle plant at Kerawalapitiya, with the goal of having some power generation by the end of 2005. It is projected that an additional 150 MW hydropower station will be available in 2009.

The government is also seeking funding for a 300 MW coal-fired plant on a build-own-operate basis that would eventually add two more units at the site for a total capacity of 900 MW (the site is yet to be defined). The generation plan also denotes that a base-load, coal-fired power plant has the lowest cost of electricity of any type of plant installed. Because this coal-fired plant is the least cost of electricity option, CEB views this plant as the most important project in the sequence of generation capacity additions in the generation plan. (In this effort, the US government has awarded a US$ 560,000 grant to the GOSL [Energy Supply Committee] to fund TA for providing consultancy services on the development of this plant. The US Trade and Development Agency announced this grant award in July 2003.)

In addition to the power projects in the CEB long-term generation plan, two medium-term 100 MW IPP plant additions are underway: a 100 MW diesel plant (using furnace oil fuel) which is a Hemas-Lakdhanavi joint-venture located at Puttalam on the West coast; and a similar Caterpillar-ACE Power joint-venture located at Embilipitiya in the South.

Renewable energy power generation is a contributor to the overall CEB generation scheme and has been used in Sri Lanka for well over a century in the form of electricity generation from small-scale hydro projects. Today most forms of commercially viable renewable energy technologies are in use in Sri Lanka. But all these systems represent less then one percent of the energy needs of households in the country[4]. The public, private, and non-profit communities are well versed in many applications and have implemented numerous projects.

Sri Lanka has over 25 commercial, grid-connected small hydroelectric power plants, approximately 200 off-grid small hydroelectric power plants, including micro-hydro based village power schemes (reaching in the order of 7,000 households), one 3 MW wind power plant, thousands of solar photovoltaic (PV) systems, and a small number of biomass and wind turbine systems.

Approximately 15 mini-hydro and 36 village hydro schemes had been completed under the Energy Services Delivery (ESD) program, with another 50 or so still to be completed under the current Renewable Energy for Rural Economic Development (RERED) program. In addition, approximately 20,000 solar systems for individual homes were installed under ESD and another 90,000 homes are to similarly have solar PV systems installed under RERED. The installation rate for solar systems has risen from an initial level of approximately 1,000 per year to a current rate of approximately 1,000 per month.

The potential for large-scale commercialization of renewable energy, however, is still relatively low. Some of the reasons often cited include, among others, the marginal

[4] GOSL 2002

commercial viability of grid-connected wind power plants under the small power purchase tariff and the need to develop large, commercial biomass plantations.

The USAID-developed wind resource map provides information on the technical potential for wind energy in Sri Lanka (Technical potential is estimated at 24,000 MW). A large number of mini-hydro schemes operate in Sri Lanka due to the larger number of fast moving rivers in regions near or connected to the grid. Under the provisions of the standardized small power purchase agreements (PPAs), numerous projects have been selling into the grid since 1997. These projects are traditionally under 5 MW (averaging 1 to 3 MW, but the standardized agreement is applicable up to 10 MW) and have been developed by Sri Lankan investors on a commercial basis. Concessionary credit has been available to them previously under the ESD project and currently under the RERED project.

Wind is perhaps the least developed renewable energy resource in Sri Lanka. One major project was financed under the World Bank ESD project that lent funds to CEB in 1999 to install and operate a 3 MW pilot wind power generator in the south. This project is currently generating at a cost of US$ 0.098 per kWh, which is well above the average retail price for Sri Lanka energy users. Many stakeholders expressed their concern as to whether wind could be a commercially viable energy resource in Sri Lanka. But the CEB long-term generation plan indicates an IPP will install a 20 MW wind-farm project in 2004.

Recently, the US National Renewable Energy Laboratory (NREL) conducted a wind assessment for Sri Lanka. This study indicated that there were numerous good wind zones in the country. These include the northwestern coastal region from the Kalpitiya Peninsula north to Mannar Island, the Jaffna Peninsula, the Central Province and also parts of Sabaragamuwa and Uva Provinces in the interior of the country. The NREL assessment indicates that there is potential for 20,000 MW of land-based installed capacity (and an additional 4,000 MW in "windy lagoons")[5]. It should be noted that this analysis was conducted using satellite and other meteorological data. Specific site assessments should be conducted to qualify this estimate. (Solar PV systems can provide for basic energy requirements for smaller energy users in most areas of Sri Lanka and is discussed in more detail under the off-grid category.)

Several forms of biomass power generation are under consideration in Sri Lanka. These include: wood, rice husk, and animal waste fueled systems, while baggasse (sugarcane waste) is currently used in sugar plantations. An otherwise little known plant, Gliricidia Sepium, has been successfully tested on a gasifier-based 35 kW power facility. This plant is common in Sri Lanka and is nitrogen fixing, offering the ability to improve soils in the process of providing fuel to a nearby power project. The 35 kW pilot project using this fuel is operational at a steel galvanization plant near Colombo using gasification technology. This project has shown that gasification technology can reduce the pollution that would result from the direct combustion of wood and produce a fuel gas that can be used in more efficient technologies, such as, micro turbines or used directly in a diesel generator system, with some de-rating.

The development of a 1 MW dendro project with *Gliricidia sepium* as fuel wood is currently underway. The cost is estimated to be US$ 800 per installed kW. If this technology and fuel source is proven effective, multiple more projects could be developed using the same fuel.

[5] USAID-SARI/Energy, "Wind Energy Resource Atlas of Sri Lanka and the Maldives", August 2003.

One small but growing community that is buying and using renewable energy systems is the tourism business. Several "eco-lodges" have been developed catering to the high priced European adventure travel community. These tourism operators are purchasing solar water heaters, solar home systems, micro-hydro systems, and small wind turbines. As more operators learn of the higher revenues that can be had from this "green tourism" demand should grow for these systems.

2.1.1.2 Off-grid Generation

Those residential and small-scale commercial off-grid energy consumers that have found a source of electric power have done so mainly through solar PV and micro-hydro. Larger scale commercial and industrial applications use a combination of systems including: heavy fuel oil, biomass (in sugar factories only), and diesel fueled generator systems. This activity has taken place mostly in the South and parts of the East. Isolated areas of the North and East are only started to benefit from distributed generation systems.

Micro-hydro represents a major success for off-grid renewable energy in Sri Lanka. Existing village hydro systems range from 0.5 to 50 kW and have an average all-inclusive cost of US$ 275 per household installation[6]. This represents an average installed cost of approximately US$ 1,500 per installed kW. In addition, an estimated 60 off-grid micro-hydro power plants operate to serve the tea and rubber industries.

Perhaps the most successful community-driven development programs in Sri Lanka are the electricity consumer societies (ECS) set up to aggregate rural customers into cooperatives to purchase electricity from micro-hydro projects. These ECSs operate as independent cooperatives and charge a membership fee to consumers. Under the Electricity Act, only the CEB is allowed to generate and sell electricity to consumers in Sri Lanka. At present, micro-hydro projects and other small projects are not legal and have no regulatory rights. To date, the CEB and the Ministry of Power and Energy have allowed these cooperatives to operate because they understand the need for this source of electricity in these un-electrified areas.

Solar PV systems can provide the basic electrical power requirements for mainly individual users in most areas of Sri Lanka. While more expensive than other energy supplies for rural households, this technology offers a steady supply of electricity for basic needs and does not require major upkeep or maintenance. Over the past 10 years approximately 25,000 individual solar home systems have been installed in Sri Lanka at a cost of US$ 300 to US$ 700 per household (representing an average cost of US$ 10,000 per installed kW). Currently five commercial companies (Shell, Selco, Solar-Thermal, Access, Energyworks) have sales centers throughout the country. Approximately 300,000 Sri Lankan rural households currently use automotive batteries to power lights, televisions, and radios[7]. These households and others represent the growing market for solar PV systems in Sri Lanka, which has been actively supported by the World Bank, the Development Finance Corporation of Ceylon (DFCC), micro-finance institutions, and several NGOs. The World Bank and DFCC RERED project will continue to target this market.

[6] World Bank 1997
[7] World Bank 1997

2.1.1.3 Transmission

Sri Lanka needs to rapidly improve power quality in terms of reliability and voltage stability. The current reliability of the transmission grid is low. Sri Lanka has experienced power shortages in 1979, 1983, 1984, 1987, 1992, 1996, and 2001-2002. The growing demand for electricity, delays in the implementation of new power generation projects in CEB plans, and a shortage of available supply (due to the reduction in hydro generation during drought conditions), have led to load shedding and demand reduction. This has led to planned and un-planned outages, which have had a negative impact on the economy. A study recently conducted under the USAID's SARI/E project estimates economic loss due to planned and unplanned power shortages in 2001 to be one percent of the national GDP, which is significant in comparison to the average GDP growth rates of four to five percent of the country. Stability problems, caused by the inability of system operations to respond quickly enough to changes in demand and available supply, also periodically cause system-wide blackouts, affecting the competitiveness of industry in Sri Lanka. A reliable power system is essential to the economic growth of the country.

The stability problems are due in part to a lack of real-time information on the transmission system and of effective use of generation and transmission planning tools. The lack of a supervisory control and data acquisition (SCADA) system means that CEB does not have real-time information on the output of each generation plant, thereby reducing system reliability. A SCADA system could also be used as reconciliation tool for commercial operations to verify generation output for PPA contracts. CEB has undertaken the development of specifications for the purchase of a SCADA system.

2.1.1.4 Distribution

Another high priority is the reduction of network losses, now reported at around 19.2 percent, compared to economically optimal levels estimated at 14 percent. The existing CEB distribution system is in a dilapidated state in many areas. Widespread technical overloading problems lead to curtailment of service to customers. Distribution losses increase the overall cost of service, put additional strain on limited generation capacity, and increase Sri Lanka's fuel import bill.

Customers report low voltages, breakdowns/brownouts, slow maintenance services, and sometimes billing errors. On the distribution system, in some regions, particularly the northeast, the equipment and wiring is in poor condition, and the condition of the safety equipment is poor and neglected.

The distribution system requires further investments in order to reduce system losses, increase voltage and reliability of supply, improve the billing and revenue collections of the distribution function, and improve the connection, repair, and maintenance of the distribution grid.

The LECO investment projects, financed by the ADB during 1988-94, showed that it is possible to restore dilapidated distribution systems so that they are financially and technically viable. Technical improvements increased the voltage in some extreme cases from 115 volts to its design value of 230 volts, reduced outages by two thirds, and reduced system losses from over 30 percent in 1988 to less than 10 percent in 1996. Since then LECO, through

improved management practices, which include metering and monthly monitoring at each distribution transformer, have further reduced system losses to approximately six percent. Institutional strengthening within LECO has also led to improved billing and collection systems and faster maintenance services. Such improvements could be available to the overall system, if replicated for the CEB distribution system as a whole.

Energy efficiency and conservation was provided in the CEB by the Demand-side Management Branch to undertake a wide range of conservation activities focused on electrical energy. These activities, primarily related to distribution, include commercially viable energy efficiency as well as matters related to general energy efficiency policy. The branch also plays a facilitator role by performing energy efficiency monitoring and verification and undertaking load research. Major activities of the branch are energy audits for large consumers, power quality studies for utilities, an energy efficiency lighting program/easy payment scheme for CFLs, implementation of an energy efficiency building code, load research, energy efficiency/conservation awareness programs, and standard setting and labeling for end-use appliances. There is an ambiguity over the future of the DSM Branch and its function after the unbundling of CEB.

2.1.1.5 Rural Electrification

The government's current rural electrification plan calls for the expansion of energy services to 75 percent of the population by 2007 by connecting them to the main grid or, when this is not possible, provision of mini-grid or home systems. Current estimates indicate that only 80 percent of the total Sri Lanka population can realistically be connected to the main grid. Thus, the remaining population will need to be provided with other solutions. The estimated cost to extend the grid to rural households is SLR 38,000 per household (or approximately US$ 400), based on the current program that expects to extend the grid to 80 percent of households by 2010[8]. The current level of electrification is approximately 62 percent of households.

Approximately 38 percent of the population lives in areas that are not electrified via national grid. These households use a wide variety of fuels and technology to meet their daily energy needs. An estimated 500,000 automotive batteries are currently being used for lighting and entertainment (television and radio), indicating that a large part of the off-grid community could directly benefit from better electrification. Off-grid households spend on average over 40 percent of their income on energy (for kerosene, dry cell batteries, battery charging, et cetera), as opposed to less than 10 percent in urban areas[9].

Most rural households only have a demand of less than 50 kWh per month for lighting, representing approximately 250 watts of installed capacity. In many cases, electrifying these households is not economically viable for CEB. Once CEB is unbundled, it is unclear what types of rural electrification strategies will be implemented to expand grid-based energy services. At present, CEB has a 12 percent internal rate of return requirement to accept proposals for new RESs for implementation, which means that it will not be viable to extend services to approximately 20 percent of rural households.

[8] GOSL 2002
[9] Gunaratne, L. 2002

Regulatory uncertainties (discussed in more detail in other parts of this document). have restricted the level of off-grid power generation due to the unknown legal standing of small-scale generators. While CEB has allowed these small generators to operate (in violation of current regulations), larger projects in remote areas are not being developed because developers do not want to risk seizure of expensive capital assets. Until this legal issue is resolved, major independent development in these areas will no take place.

2.1.2 The Status of the Unbundling of the Power Sector

The unbundling of the CEB is due to take place in December 2003. At that time, new companies will be established and will begin operating as independent entities, with their own management structures and balance sheets. Assets will be allocated to the new companies, along with staff from the CEB. The new industry structure is shown in Figure 2-2. The Power Sector Reforms Unit is managing the unbundling process. They are currently receiving technical assistance from the ADB to assist with this activity. This assistance will end at approximately the time the unbundling takes place, in December 2003. At this time, the expectation is that the new companies will be fully operational.

A summary of the unbundling process is as follows:

- The establishment of a monitoring and advisory committee (MAC) responsible for oversight of the commercial operations of the newly formed generation, transmission, and distribution companies, while they remain in state ownership. This committee has been already established
- The unbundling of CEB into separate companies – a generation company (GenCo), a transmission company (TransCo) and five separate distribution companies (DistCos)
- The dividing of LECO, an independent government DistCo, into three of the newly formed DistCos
- The creation of a public utilities commission (PUC), an independent regulatory agency responsible for the overall regulation of the sector; The commissioners of the PUC have already been appointed
- The termination of power industry oversight by the Energy Supply Committee (policy-making will revert to the Ministry of Power and Energy)

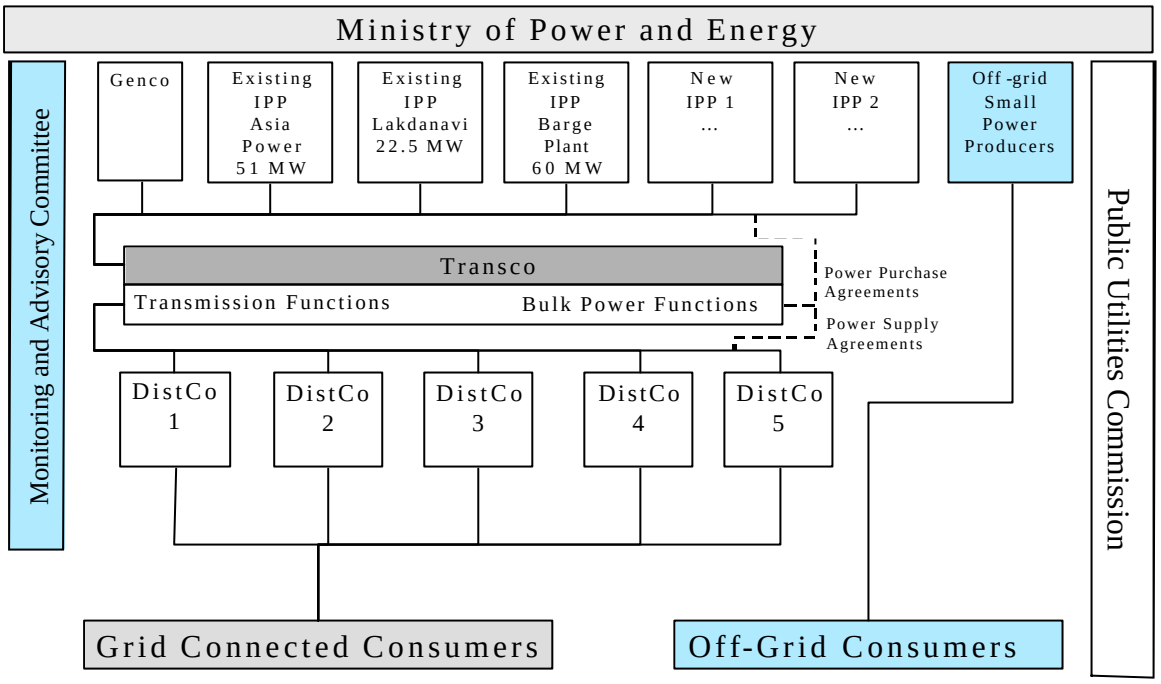


Figure 2-2 New Industry Structure

Source: Public Sector Reforms Office, Sri Lanka, August 2003

2.1.2.1 Monitoring and Advisory Committee (MAC)

The MAC has been established under the Ministry of Power and Energy. Its role is to monitor the commercial operations of the newly formed companies (the unbundled entities) listed below and to keep the relationship between the ministry and the companies at arm's length. The MAC will be responsible for appointing and dismissing board members for the companies and reviewing the corporate intent of the companies.

2.1.2.2 Generation

The existing generation assets of CEB, including both their hydro- and thermal-generating plants, will be transferred to a single company – GenCo. Existing IPPs will continue to operate according to their existing PPAs. The GenCo will operate under a PPA with the newly formed TransCo, which will act as the single buyer for all of GenCo's output. The PPA will define the terms and agreements for power sales between the GenCo and TransCo. GenCo will not play any role in new generation capacity. All future generation investments will take the form of IPPs.

2.1.2.3 Transmission

The newly formed TransCo will have two distinct functions. It will be responsible for the operation and maintenance of the transmission grid and the operation of the bulk power purchase and sale function. TransCo will take over the existing high-voltage transmission functions, including the system dispatch that is currently carried out by the CEB. In addition, TransCo will be responsible for the purchase and sale of the bulk power in the restructured

environment. It will act as the single buyer of all power supplied to the transmission grid[10], and sales of power from the transmission grid to the DistCos. This will include management of existing PPAs and the negotiation of new agreements, as well as the management of power supply agreements (PSAs) with the DistCos.

2.1.2.4 Distribution

The existing distribution functions of the CEB and LECO will be divided into five new DistCos. The role of the DistCos will be the operation and maintenance of the low-voltage distribution grid (33 kV and lower), as well as the purchase of power from the TransCo and supply to end-use customers. With the exception of one industrial customer that is directly served from the transmission grid, all other electricity consumers are connected to the distribution grid. The DistCos will purchase all their power from the TransCo, under a PSA. In addition, each DistCo will operate under a license issued by the PUC. The licenses will permit each DistCo to operate within a pre-defined "authorized area". Within their authorized areas, the DistCos will be responsible for the expansion of the distribution grid to currently un-served areas. To the extent that any such expansion is uneconomical, the government, according to the Electricity Reform Act, will subsidize the required investment.

2.1.2.5 Off-grid Electricity Supply

An estimated one percent of households in Sri Lanka currently receives electricity through off-grid electricity suppliers, primarily through solar home systems and village hydro schemes[11]. Individual generation systems supply customers in the local area, directly from the generator to the customer, without transporting the power over a high-voltage system. There are around 120 community-owned village micro-hydro schemes supplying electricity to around 5,000 households, and approximately 20,000 households are supplied with solar PV systems. These systems tend to be community owned and operated. The status of these systems is not defined under the two acts, Electricity Reform and Electricity that define the restructured industry.

2.2 INDUSTRIAL AND COMMERCIAL SECTOR

As previously seen in Figure 1-1, almost all biomass use goes into the industrial, commercial, and domestic sectors. All the biomass is used for thermal energy requirements and not for electricity generation, except in sugar industries where baggasse is used for combined heat and power generation.

There are currently several organizations, including three energy service companies (ESCOs) that promote energy efficiency and conservation in the industrial and commercial sector in Sri Lanka. These are entities that can reduce the cost of production, lower process energy consumption, and in general increase the competitiveness of the industries and commercial establishments that use their services. A brief description of their institutional arrangements and key activities follows.

[10] The status of existing mini- and micro-hydro systems and co-generators that could have the ability to sell to TransCo is unclear at this time.
[11] GOSL 2002

2.2.1 Energy Conservation Fund (ECF)

The Energy Conservation Fund (ECF) is an institution under the Ministry of Power and Energy. The key objectives of the ECF are to promote energy efficiency in the agricultural, industrial, commercial, domestic, and transport sectors. These objectives encompass a wide range of energy demand management and conservation programs not confined to electrical energy efficiency alone. Some of the key activities of ECF are general public awareness on energy conservation, professional development of related professionals, pilot projects on agricultural residue, dedicated energy plantations, improved (low-emission) cooking stoves, improving quality of energy audits, standardizing, team building, substitution of high-quality sources with low-quality sources, and development of renewable sources (e.g., waste to heat), and development of the Sri Lanka Energy Balance.

The ECF also has authority to raise funds or receive grants and to invest those funds. The ECF has not exercised these powers sufficiently, creating a void of funding sources for energy conservation, which has been a main obstacle for energy conservation measures so far.

2.2.2 Sri Lanka Standards Institution

Owing to the lack of enforcement power in the ECF or in any other legislation (other than by electricity tariffs), some energy efficiency enforcement measures are currently performed through the Sri Lanka Standards Institution. But as at present undertaken, these energy efficiency standards are formulated and implemented on a voluntary basis.

2.2.3 National Engineering Research and Development Center (NERD)

Funded by the government, many of the research and development (R&D) activities of National Engineering Research and Development Center (NERD) are devoted to developing and improving renewable energy and energy efficiency equipment. The Sri Lanka Standards Institution has accredited the lighting laboratory of NERD for the purposes of energy labeling of compact fluorescent lamps. Key activities of the center are developing and improving renewable energy and energy efficiency equipment (e.g., energy efficient lamp systems) and consulting on the application of energy conservation technologies and testing facilities to energy-related projects (e.g., electric lamps and solar home systems).

2.2.4 Sri Lanka Energy Managers Association (SLEMA)

SLEMA, a non-governmental institution active in energy conservation, has the general objectives of encouraging and promoting practices relating to energy management and sharing of knowledge concerning energy management practices. This is a voluntary organization and has neither legislative powers nor enough resources to enforce energy management practices. The main focus of SLEMA is industrial and business facilities. Through the network of its members, most of whom happen to be industrial engineers, SLEMA has been involved in strengthening energy audit and management capabilities in the commercial, institutional, and industrial sectors, and has produced energy audit manuals. SLEMA is currently conducting several study/research projects under SARI/E and the US-Asia Environmental Partnership (USAEP).

2.2.5 Center for Energy Studies

Established by the University of Moratuwa, the Center for Energy Studies (CEnS) is involved in research activities in energy efficiency and the environment related to energy. Continuing professional development activities and advisory services in above areas are also undertaken by CEnS, which also plays a facilitating role in appliance testing, which affects various industries.

2.2.6 Private Sector Initiatives for Energy Efficiency

Recently a stronger contribution from the private sector to the energy efficiency scene has emerged in the form of energy service companies (ESCOs). With growing energy prices the inclination towards energy savings is increasing in Sri Lanka. The ESCOs have identified that significant potential in the energy efficiency business exists in Sri Lanka. Currently there are three major ESCOs that are providing services in energy efficiency and other energy-related services. The ESCOs have identified energy savings potential in various industries including loss reduction by DistCos. Nevertheless, the lack of an attractive financial mechanism and the absence of standard monitoring and verification protocols are major barriers to their business growth in Sri Lanka. At least one ESCO is at present capable of providing energy efficiency guarantees to their customers.

2.3 TRANSPORT SECTOR, INCLUDING THE PETROLEUM INDUSTRY

2.3.1 Transport Sector

Urban air pollution is a growing problem for many cities in developing countries. While difficult to quantify, it is reasonable to conclude that mortality and morbidity rates are adversely affected, dampening economic development and the quality of life.

While insufficient urban planning and/or insufficient funds to develop the urban infrastructure are often the root cause, vehicle exhaust emissions are generally cited as the primary pollutant. Higher tailpipe emissions generally are due to these key factors:

- Inefficient technology
- Poorly maintained technology
- Lax enforcement practices
- Traffic congestion

In developed countries and in certain developing countries, significant attention is being paid to developing cleaner transportation options. During the past few years, hydrogen, in applications such as fuel cells and as a primary or supplemental fuel, has received considerable attention. Other technologies or fuel options are being developed and in some cases are being successfully implemented. Mass-produced hybrid-electric cars are operating in Asia (Japan) and in Europe and the US. Pure electric-driven vehicles are also feasible. Compressed natural gas (CNG) and bio-fuels have been successfully implemented in South America and the US. Reformulated gasoline, lower sulfur diesel, and more efficient internal combustion engines (ICEs) have been effectively employed globally. Each of these options has benefits and also limits, be it economic and/or technical.

Hydrogen holds considerable promise as a distant future fuel source for vehicles. The current status of hydrogen, in any application for vehicular transportation, can generally be described as being in development. Unfortunately, hydrogen does not occur spontaneously in nature: it has to be produced and this requires energy. Currently, about 80 percent of hydrogen is obtained from natural gas (by a process called steam reforming). Hydrogen can also be produced by electrolysis out of water, but this process requires relatively large amounts of electrical energy and costs approximately three times as much as hydrogen produced from steam reforming of natural gas. Given the proliferation of R&D activities in the developed countries, over the next decade or two the technical questions will be settled for most of the current issues. At this time neither the technology for commercialization nor the funding for infrastructure are available. Therefore, is a "hydrogen economy" is an unrealistic expectation in the near-term.

Hybrid-electric vehicles are more complicated than conventional internal combustion engines (ICEs) and have higher initial costs. CNG is certainly technically feasible but requires an infrastructure for fuel transportation and distribution. Pure electric can have a role but initial costs, range, and infrastructure can be constraints. Bio-fuels work, but generally production costs are higher. Other key factors affecting policy, notwithstanding these limitations, include national security and available indigenous resources.

2.3.2 Petroleum Industry

The Ceylon Petroleum Corporation (CPC) indicates the demand for most categories of petroleum products has grown at a moderate two to five percent, and the specific challenge on the supply-side is to cope with the higher demand for diesel (for transportation) and fuel oil (for power generation). The GOSL has already acted on its intention to eliminate the monopoly of the CPC by granting import licenses to the first (the Indian Oil Corporation, beginning in June 2002) of at least two new companies to enter the Sri Lanka petroleum products market, including operation of retail outlets. During the course of the field mission, the Public Enterprises Reform Commission on 29 August revealed that 24 international, regional, and local energy companies had expressed interest in becoming the designated third player. A technical evaluation committee and a cabinet-appointed negotiating committee are undertaking the evaluation process.

New legislation has also been drafted with respect to encouraging private sector participation in petroleum exploration and development. The ADB has funded technical assistance to re-evaluate the existing drilling and seismic data, which will be presented in the near future to interested oil/gas companies for possible development. Yet, as the number of players increases in the sector, there will be an attendant and requisite need for more accurate and timely petroleum and petroleum products information and data, especially with respect to developing national petroleum accounts that will also feed into a national energy database and model to assist policy-makers with understanding the various interplays and fuel substitution possibilities.

3 Overview of Donor Activities in the Energy Sector

3.1 GOVERNMENT OF SRI LANKA (GOSL)

GOSL, recognizing the need to satisfy the growing demand for energy in the country and to ensure the financial sustainability of the sector, has taken a series of steps, including developing a framework for restructuring the power sector (unbundling of CEB), the creation of a multi-sector regulatory commission, and the development and enactment of a Petroleum Industry Act and a Petroleum Sector Reform Bill. The overall goals are to define and implement an energy-sector restructuring process that would effectively create rational and commercially sound energy sub-sector operations, including a viable renewable and rural energy sector. With support from the multilateral development banks (MDBs) and bilateral donors the GOSL has already undertaken some of the preparatory work for restructuring and is at present moving forward with crucial implementation stages at different levels.

3.2 THE ASIAN DEVELOPMENT BANK (ADB)

The ADB is a major supporter of the current energy sector reforms in Sri Lanka, having provided assistance for both phase 1 and 2 of the restructuring of the electricity sector. The ADB is also expected shortly to fund technical assistance for an energy sector master plan and provide the necessary support for a "power fund for the poor".

The ADB, a long-time supporter of rural electrification, has recently initiated additional support for RESs by working with the CEB to help it meet the government's rural electrification target of 70 percent by 2007. Under the current agreement between the CEB and the ADB, as CEB meets the agreed-upon goals for reform, funds are released to further RESs. Under these program guidelines, funds were recently released by the ADB to implement the 630 new RES that will electrify 150,000 households at a cost of approximately SLR 5.2 billion.

It should be noted that the ADB also provides support to a number of sectoral activities in Sri Lanka that will directly benefit from increased availability and reliability of power. These projects include agriculture and natural resource management; water supply and sanitation; road and transport infrastructure; small- and medium-sized enterprise (SME) development; boosting productivity in the tea sector; and the social rehabilitation and development of the north and east.

3.3 THE WORLD BANK

The World Bank's ESD program, executed by the DFCC, was designed to

1. Promote the commercially viable dissemination of renewable energy projects
2. Strengthen the environment for DSM activities
3. Support the development of a wind pilot project

The program worked with CEB to develop the 3 MW wind project. The ESD Credit Program was very successful at proving the viability of using micro-finance institutions, such as Sarvodaya Economic Enterprises Development Services (SEEDS), DFCC, and Hatton

National Bank to provide medium- and long-term financing to the private sector and village cooperatives for household solar PV and village hydro off-grid electric projects. Under the program, approximately 20,000 solar PV systems, 15 mini-hydro, and 36 village hydro systems were financed and installed. The program also offered a direct grant to the suppliers of solar PV systems (US$ 100/unit) and micro-hydro systems (US$ 400/unit), representing a 30 to 40 percent subsidy. This is being phased out in the new RERED Project.

Building on the success of the ESD project, the World Bank's RERED project has been designed to expand energy services to off-grid rural communities in Sri Lanka. The main focus areas of the project are[12]

1. Promoting grid-connected and off-grid hydro, wind, and biomass renewable energy technologies
2. Continuing the financing and grant mechanisms for solar home systems and in rural areas through private companies, non-governmental organizations (NGOs), and micro-finance institutions
3. Providing technical assistance for income generation and social service delivery improvements
4. Providing technical assistance to promote energy efficiency, development of carbon trading mechanisms, and integration of renewable energy systems into government policy, provincial council development strategies, and sector reform initiatives

The specific objectives include adding 85 MW of grid-connected renewable energy capacity and providing electricity access to 100,000 households and 1,000 rural small- and medium-enterprises and public institutions directly through off-grid systems (solar, community-hydro, and biomass schemes).

With the unbundling of CEB, the World Bank is providing technical assistance to set up the PUC that will establish an independent regulatory body with responsibility for implementing economically sound tariff policy, regulating the sector, and issuing licenses.

The World Bank also plans to provide technical assistance to Sri Lanka, in the near future, for developing regulations to liberalize the petroleum sector.

3.4 THE US GOVERNMENT

The US government has awarded a US$ 560,000 grant to GOSL through the Trade and Development Agency (USTDA) to fund a technical assistance program for the development of a 300 MW coal-fired power plant.

3.5 OTHER ASSISTANCE TO THE ENERGY SECTOR

The government of Japan is the single largest bilateral donor to Sri Lanka, accounting for almost 50 percent of the total overseas development assistance. This development assistance is processed through both the Japan International Co-operation Agency (JICA) and Japan Bank for International Co-operation (JBIC). Technical assistance and loans are given mainly to the following: modernization of ports and airports; construction of power plants;

[12] World Bank 2002

improvements in roads and bridges; expansion of the water supply; improvement of equipment for industrial standardization; transfer of technology and development of industrial zones; as well as in agriculture (including forestry and fisheries projects), education, health, and medical facilities.

The government of Norway has been a major facilitator of the reconciliation process in Sri Lanka and has also provided some critical technical assistance oriented towards the development of the private sector and job creation, especially through the matchmaking program. Norway provided further technical assistance support for capacity building in undertaking environmental impact assessments (EIAs) and has facilitated joint ventures between Norwegian and Sri Lankan firms for developing smaller power projects. Economic infrastructure, micro-credits, and capacity building at the rural level have been the focus. Norwegian expertise has also been utilized for improving water and energy supplies in cooperation with Statkraft & Grøner and Asea Brown Boveri (ABB), respectively[13].

The German development organization, German Technical Corporation (GTZ), has offices in Colombo and Jaffna and is looking into how renewable energy applications can be used to meet the energy needs of the north and east. The German aid agency, German Credit Institution for Reconstruction (KFW), is assisting with the rehabilitation of the 33 kV distribution systems around Chunnakam, and around Kilinochchi. They are also financing a new 2 MW diesel plant at Kilinochchi. KFW has indicated that it would also finance a 33 kV connection from Chunnakam to Kilinochchi.

The Chinese government has pledged their assistance for the implementation of 500 RES impacting approximately 70,000 households. The project is estimated to cost SLR 2.7 billion and will be implemented in seven provinces, including Southern, Sabaragamuwa, Central, and North-West.

The Swedish International Development Agency (SIDA) is providing technical assistance to implement rural electrification projects.

3.6 THE ECONOMIC REHABILITATION AND DEVELOPMENT OF THE NORTH AND EAST

Little information is currently available on the state of energy needs in much of the north and east of the country, following the end to hostilities. There have been several direct interventions (diesel generator in Jaffna, purchase of a wind turbine for Kilinochchi, and several small systems for small institutional energy users).

The Regaining Sri Lanka document specifically identified electrification as a crucial step in commencing development activities in those regions that have witnessed the results of conflict:

> Access to electricity is necessary for practically any off-farm activity. Without access to electricity, rural areas cannot host the industries and other off-farm income-generating activities that are essential to a pro-poor process of structural change.

[13] Norwegian Agency for Development Cooperation 2003

While not a major component of the government's plan to reduce poverty and carry out reconstruction and rehabilitation of the north and east, energy development will be integral to ensuring its long-term success.

In addition, ADB, United Nations (UN), and World Bank supported the preparation of two documents[14] that provided inputs to a synthesis paper presented to the Donor Conference for Sri Lanka held in Tokyo in July 2003[15]. Taken together, these documents provide an indication of the overall development and infrastructure rehabilitation requirements across a broad range of sectors and activities and also highlight some of the specific expected requirements in the power sector in various regions of the north and east, based on the following observations:

- The total demand for power in the north and east is about 110 MW, of which 27 MW is being met by private power suppliers in Jaffna and the balance from the national grid. The share of households currently electrified in the north is 22 percent, and in the east 40 percent, as against a national average of 56 percent
- There are two private power producers in Jaffna generating 22 MW from an installed capacity of 35 MW. With the repair of damaged generators, additional capacity will come on-stream
- About 150 km of transmission line between Vavuniya and the north has been destroyed. In the east, a 132 kV line and a grid sub-station, which had been under construction, were not completed or commissioned
- There has been considerable damage to the distribution system in the north and east, though the damage in the east is less acute. In the north 90 percent of the distribution system suffered damage, but nearly 50 percent of the lines in the Jaffna district have now been repaired. In Mannar District there was about 50 percent damage, but most repairs have been done. Vavuniya suffered about 70 percent damage, and 20 percent still needs to be repaired. Systems in Mullaitivu and Kilinochchi were totally damaged and no repairs have been carried out so far
- Forty-three buildings (offices, stores, and so on) and equipment belonging to the power utility have been damaged or destroyed in various parts of the north and east[16]

The documents estimate that the immediate and medium-term investments required for the power sector for the north and east and contiguous areas is on the order of US$ 146 million, with another US$ 84.8 million required beyond that period[17]. They caution that a comprehensive study of power requirements should be made prior to final decisions on generation and transmission alternatives but note specifically that "solar and/or wind powered renewable energy can be installed in the north to meet the immediate needs and to generate electricity in remote areas"[18]. The document also stresses that "there is insufficient capacity to implement such projects in the north and east"[19]. The Conference on Reconstruction and

[14] ADB, UN, World Bank 2003b
[15] ADB, UN, World Bank 2003a
[16] ADB, UN, World Bank 2003b, 45-47
[17] ADB, UN, World Bank 2003b, 45-47
[18] ADB, UN, World Bank 2003a, 14
[19] ADB, UN, World Bank 2003a, 14

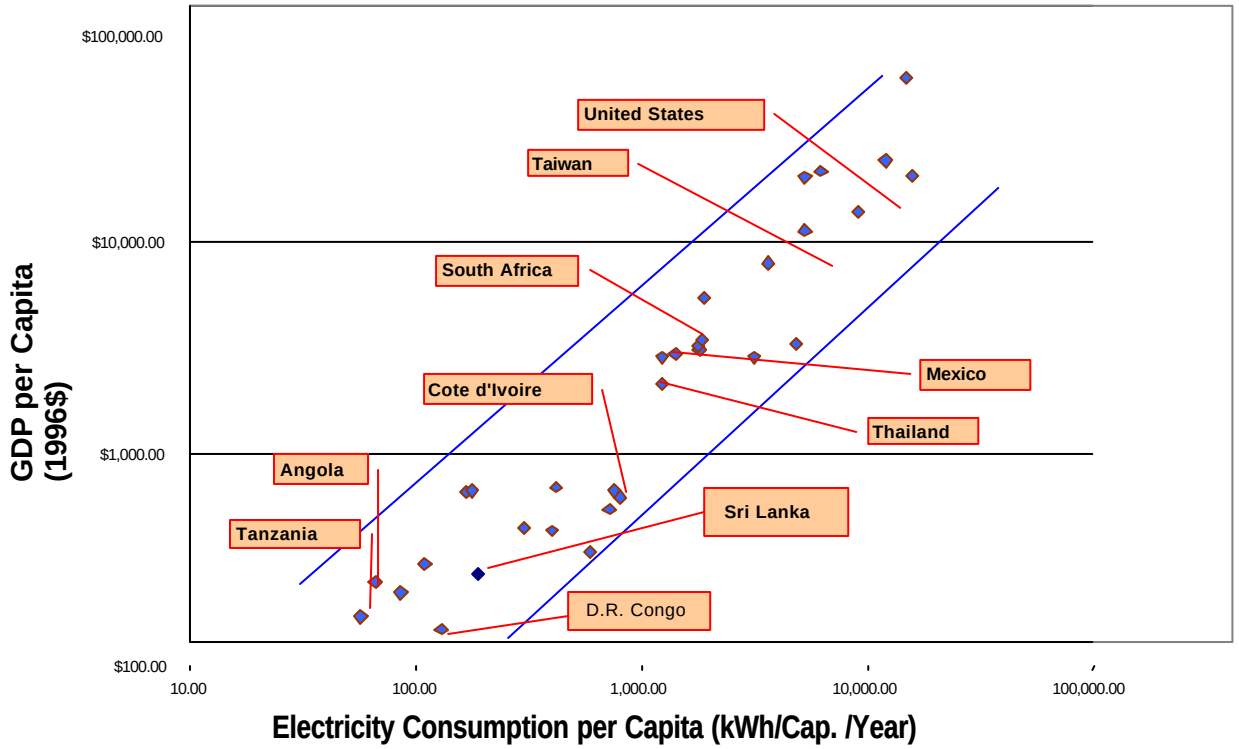
Development of Sri Lanka, organized by the United States, Norway, the European Union and Japan, ended in Tokyo with pledges from 51 donor nations and 20 international institutions, totaling US$ 4.5 billion.

3.7 JUSTIFICATION FOR USAID INTERVENTIONS

The proposed interventions are expected to contribute to the economic growth of Sri Lanka by increasing the industrial competitiveness as a result of better quality and more reliable energy at an affordable price. Economic stability coupled with peace dividends can significantly improve the quality of life of people by breaking the cycle of poverty for a majority of Sri Lankans.

The lack of access to commercial energy for rural communities is also a constraint and needs to overcome. If not, it will deny opportunity for these rural communities to participate in a broader range of economic activities, to generate income, and engage in personal, community, and national development.

Experience has shown that macroeconomic stability and economic growth are difficult to sustain when a country's energy sector is functioning unsatisfactorily. Similarly, poverty alleviation, growth, and equity in development are all severely constrained by lack of access to energy. This traps people in a cycle of subsistence activity and prevents them from focusing on education, health programs, and other productive activities. The struggle against poverty is also made more difficult through unsustainable exploitation of traditional fuels in many countries.



Source: United Nations Statistical Office, 1998

Figure 3.1 Correlation between Electricity Consumption and GDP

The majority of people, therefore, have a fundamental need for access to commercial energy in order to participate fully in the development process. The correlation between access/consumption of commercial energy (grid or off-grid) and income is illustrated in Figure 3-1 above.

The provision of energy through the private sector has some positive benefits for a national economy, through the implementation of best practices, good governance, and attractiveness for domestic and foreign direct investments, thereby reducing some budgetary constraints on the government by sharing risks associated with energy development. The government then has more resources to devote to other public requirements, such as building schools and health facilities.

Given the needs identified during the numerous meetings and discussions with a variety of stakeholders in Sri Lanka, the budgetary realities faced by USAID, and the traditional strengths of USAID programs and experience from around the region and world, a menu of options has been developed that we believe best reflect a realistic and pragmatic program of interventions that addresses critical gaps in the development and evolution of the energy sector of Sri Lanka for the short- to medium-term.

The following sections provide the details of the interventions, which have been identified by the Nexant team for consideration by USAID/Sri Lanka, over the short- and medium-term.

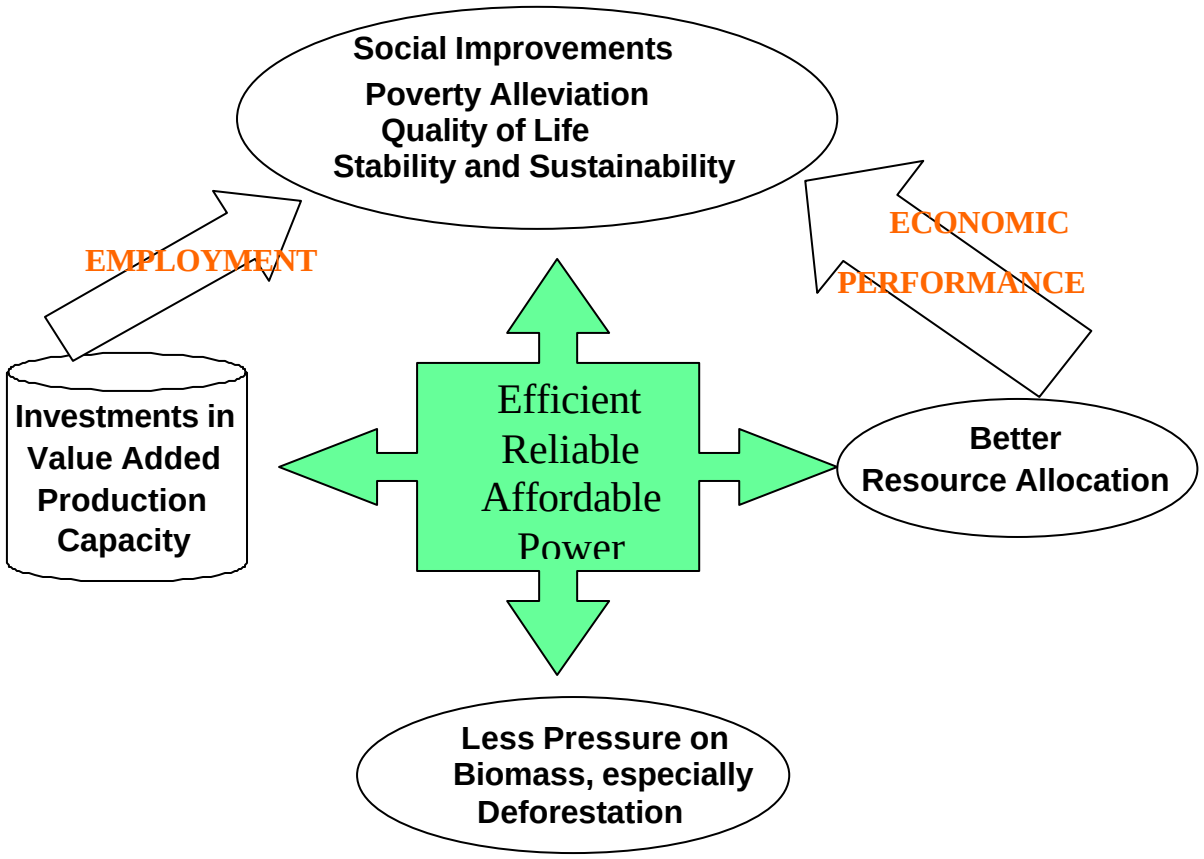


Figure 3-2 Commercial Energy Links

4 Areas for Potential Support of the Key Sectors

4.1 INSTITUTIONAL ISSUES

Integrated energy resource planning in Sri Lanka is hampered by the absence of reliable data at sufficiently disaggregated levels, even for commercial fuels. The absence of reliable time series data on consumption makes it difficult to identify trends in total demand or to relate them to other economic variables.

Poor coordination between various line agencies, delays in decision-making, inadequate preparation for new projects, and consequent delays in their implementation are all factors contributing to problems in the energy sector. At present the two main energy suppliers in the country, CEB and CPC, prepare their plans independent of each other. With the restructuring taking place there will be more organizations involved in the future.

An integrated energy planning process will estimate future energy requirements and identify the appropriate supply technologies and investment needed to satisfy the energy requirement. A dynamic energy database and model is, therefore, essential to integrate current discrete sets of information to assist the Ministry of Power and Energy (MOPE) in fully analyzing energy linkages across energy sub-sectors, including renewable energy and rural off-grid systems, and to provide essential inputs for national accounting systems and other sector plans.

4.2 THE POWER SECTOR

The electricity industry in Sri Lanka is undergoing a comprehensive reform program, including

- The unbundling of CEB into separate companies – a GenCo, a TransCo, and five separate DistCos
- The separation of LECO into three of the newly formed DistCos
- The creation of the PUC, an independent regulatory agency responsible for the overall regulation of the sector
- The termination of industry oversight by the Energy Supply Committee; policymaking will revert to the Ministry of Power and Energy, while the regulatory functions will be assumed by the PUC
- The establishment of a MAC responsible for oversight of the commercial operations of the newly formed generation transmission and DistCos, while they remain in state ownership

The following sections discuss the status of the

- Legal reforms
- CEB unbundling
- Establishment of the PUC

4.2.1 Legal Reforms

The legal and regulatory framework for the sector is well developed and is in the process of being implemented. The restructuring of the industry has been supported by two major legal reforms, both of which have been passed by parliament: the Electricity Reform Act and the Public Utilities Commission Act.

The Electricity Reform Act was passed in December 2002. This is the overriding legislation for the sector, separating the functions of operation, regulation, and policymaking into separate entities by

- Establishing the role of the Public Utilities Commission
- Unbundling the CEB and creating seven new companies – five new DistCos (Lanka Electric Company will be incorporated within these), a new GenCo that will own CEB's existing thermal and hydro-generation assets[20], and a TransCo
- Defining the role of the Ministry of Power and Energy

The Public Utilities Commission Act was passed in December 2002 and outlines the establishment of the commission to regulate public utilities in Sri Lanka. The act covers the

- Appointment and removal of commissioners
- Appointment of a director general and staff of the PUC
- Objectives of the PUC
- Powers of the PUC to require information from the companies that it regulates
- Functions of the PUC, which include:
  - Advising the government on all matters concerning any industry that is covered by the PUC Act
  - Exercising licensing, regulatory and inspection functions
  - Enforcing the provision of licenses and contracts
  - Regulating tariffs and other charges levied by regulated industries
  - Mediating disputes arising in the public utilities industry
  - Setting and enforcing technical standards
  - Holding public hearings where appropriate
  - Regulating and enquiring into any anti-competitive practices by the companies that are subject to regulation
  - Responsibility for consumer protection, including the appointment of a "consumer consultative committee" to advise the PUC on appropriate standards, and monitoring whether the needs of consumers are being satisfied
- Responsibility of the ministry to set general policy guidelines for the PUC

[20] Existing IPPs will remain under their current ownership and management of the IPP contracts will be transferred to the TransCo.

- Sources of funding for the PUC

Having reviewed the existing legal and regulatory framework, gaps in the current legal and regulatory framework with respect to the regulation of rural electrification systems have been identified. Both the Electricity Reform Act and the Public Utilities Commission Act have not touched on the issue of rural electrification through renewable energy-based off-grid systems.

Given that the GOSL policy is to expand access to electricity to 75 percent of the population by 2007, rural electrification is high investment priority. The lack of a clear legal and regulatory status is, according to stakeholders[21], already affecting investments. In particular, the proposed reforms require all generators and distributors of electricity to have a separate license to carry out these respective activities. The existing regulations prevent a single license holder from both generating and distributing electricity, which is the norm for these off-grid renewable systems. There is a danger that the absence of a well-defined legal and regulatory structure for rural electrification projects, through renewable energy, will prevent new investments from taking place.

4.2.2 Public Utilities Commission (PUC)

The PUC has been established to regulate the electricity and petroleum industries and may later assume the regulatory functions for water supply and other utilities. The PUC will regulate tariffs charged by the DistCos to end-use customers and the tariffs charged to the DistCos by the TransCo. They will also be responsible for issuing licenses to generation and distribution companies. The PUC will be independent of both the industry and the Ministry of Power and Energy. Issues related to the formation of the PUC are discussed in more detail in the relevant section below.

4.3 ISSUES IN THE ELECTRICITY SECTOR

This section outlines some of the issues faced by the electricity sector that assistance from USAID could help to resolve. These issues can be divided into two groups – those that exist as a result of current operations of the sector and those that, we believe, will arise from the unbundling of CEB into seven new companies and the transition from an integrated monopoly to an industry that will be subject to independent regulation.

The electricity sector has in recent years faced a number of issues related to operation. These issues, outlined below, will continue to exist when the CEB is unbundled. Indeed, the unbundling may exacerbate some of these problems.

The GOSL, to correct what they perceive as a power crisis, has launched a coordinated effort. An Energy Supply Committee was created with a two-year mandate to overcome immediate power shortages and make improvements to the legal framework for overriding the Electricity Act, the Ceylon Petroleum Corporation Act, and other acts that concern power, with a view to ensuring a stable and reliable power supply for economic growth in the future. More private sector participation in the power sector, a rational tariff structure, and greater competition are needed to put an end to the power crises once and for all.

[21] ITDG, Energy Forum, and DFCC all mentioned this issue during discussions.

4.3.1 Hydroelectric Power

The generating system is moving from a predominantly hydroelectric system to a mixed hydro-thermal system. Existing hydroelectric power plants designed to operate on base load will now gradually move to peaking duties. Some hydroelectric power plants have large reservoir capacity upstream, and hence they can deliver more capacity in the peaking mode.

Previous studies under the Electricity Master Plan (1989, co-funded by GTZ) and Hydropower Optimization Study (2003 on-going, co-funded by JICA) have identified the potential to add capacity to the existing hydroelectric power plants:

4.3.2 Rural Electrification

The GOSL has planned an aggressive rural electrification program to expand access to 75 percent of Sri Lanka's population by 2007, through either connections to the main transmission grid or, where this is not feasible, through off-grid services at the village or household level. Rural electrification is a priority for the GOSL, to promote increased economic activity in rural areas, as well as to ensure opportunities for the poorer segments of the population to have access to electricity, leading to additional income, better health conditions, and enhanced education opportunities.

Currently, the CEB is responsible for rural electrification. Under the proposed power reforms, the responsibility for rural electrification, in particular rural electrification to areas that are not cost effective, is not clear. Since this is an important component of government policy for the sector and the ADB and the Chinese government will fund some of the investment costs, it will be important to clarify these responsibilities and put in place a mechanism for the responsible parties, probably the DistCos, to meet the stated targets. It is appreciated that RESs are not cost-effective, with the potential to drain the already tight DistCo budgets. The Electricity Act includes a requirement for the government to fund any un-economic requirements that they place on any of the newly formed companies. The costs of rural electrification would fall under this category.

4.3.3 Renewable Energy

Renewable energy is and will be in the future an important contributor to the energy sector in Sri Lanka. As previously stated, a maximum of 80 percent of population will benefit from grid electricity over the next 10 years. Clarification on which communities will make up this 80 percent and resolution of the regulatory uncertainties associated with providing services to unconnected regions will allow for private sector parties to enter the market and begin connecting homes and small business to distributed generation systems. Renewable energy systems (and other forms of hybrid generation systems) will play an important role in this process. Therefore, a clear understanding of what renewable energy resources are available and what technology can be applied is vital.

While plans are under development to reconstruct the infrastructure of the North and East, this process will likely take several years until services levels are back to levels pre-conflict. Small-scale renewable energy systems can play an important role during this critical period (this issue is discussed further in the following section).

Several resource assessment activities related to commercially viable renewable technologies, such as, hydro, wind, solar and biomass have already been completed. USAID under the SARI/Energy program has just completed a satellite map of wind resources. This study also included an assessment of the country's solar resource. ITDG had completed a preliminary catalog of mini and micro hydro resources and USAID is already planning to make a more through hydro resource assessment. However, these information sources are not centralized and are not usually available to the public at large. Wider dissemination of this information could greatly enhance the ability of customers and developers to promote sound energy solutions.

Wind power is slowly growing in Sri Lanka. CEB is currently operating a 3 MW pilot project in the South, several small wind systems have been implemented around the country, and a larger 10-20 MW project is under consideration. However, training on the design and implementation of wind energy systems to enhance the technical expertise in wind power development, specifically in design and manufacture of small systems, wind resource assessment, and management of wind power systems would strengthen ongoing activities. This would substantial improve the operation of current and future systems and improve the quality of power supplied to customers.

There are multiple groups (developers and ESCOs) in Sri Lanka that have a strong technical understanding of a few energy technologies, but no one group currently can offer rural, commercial, or industrial customers a technology neutral approach to assessing their energy needs. Training and capacity building support would allow for the creation of diversified private sector energy service companies and developers that would allow isolated and connected communities alike to benefit from the best available technologies on the international market, providing the highest quality service at the lowest possible cost.

4.3.4 Rehabilitation of North and East System

Since the conflict in the north, the region has not been connected to the transmission grid – the main transmission line used to connect Anuradhapura to Chunnakam. In the absence of this connection, electricity needs in the north have been met through a 40 MW diesel-fired generation plant based at Chunnakam. The German aid agency, KFW, is assisting with the rehabilitation of the 33 kV distribution systems around Chunnakam and Kilinochchi. It is also financing a new 2 MW diesel plant at Kilinochchi. There is a plan to replace the existing 40 MW generating capacity in Jaffna with a 60 MW barge-mounted plant to meet demand in the area. Upon installation of this new plant, KFW has indicated that it would finance a connection from Chunnakam to Kilinochchi to connect areas to the south of the Jaffna peninsula to the Jaffna grid. Further strengthening of the transmission and distribution systems to provide a reliable electric supply to the north and east will be required.

At present, 33 percent of medical facilities (66 sites) and 44 percent of secondary schools (176 sites) are not connected to the grid in the north and east. The DFCC under the World Bank sponsored RERED program is financing the initial site selection and community outreach program necessary to bring distributed energy generation to government, medical, and educational facilities in the north and east. This DFCC activity will not cover the actual cost of hardware purchases and installation. Funding is required to purchase hardware for those medical and educational facilities identified by the DFCC in isolated communities in

the north and east. This will provide substantial health and social development benefits to the region at a very important stage in the country's transition to lasting peace.

4.3.5 Issues Arising from the Unbundling of CEB

4.3.5.1 Management Capabilities

The success of the program to unbundle CEB will require the sound, viable operation of the offspring companies. Although the seven newly created companies will remain under government ownership, they will be required to operate according to detailed commercial principles. There is a danger, however, often expressed to the Nexant team, that the unbundling process will replace one large inefficient monopoly – CEB, with seven smaller, but equally inefficient monopolies.

When the companies are unbundled, institutional weaknesses will exist in the areas of financial and human resource management, management information systems, and customer relationships. It will be important to enhance the cultural focus of the new DistCos, to focus their operations on customer service and satisfaction metrics, as well as changing the emphasis of their activities from engineering targets to overall operational efficiency, focusing on quality of customer supply (voltage and outages), speed of response to public complaints, and profitability. This will require the development of performance indicators, and the management of all systems to meet those indicators. Comparative regulation by the PUC will encourage this through comparison of the results of the new DistCos. This comparative regulation should focus on technical efficiency and service goals, such as loss reduction, voltage reliability, customer satisfaction, and other measures of operational efficiency. While setting targets for the companies to meet is a necessary exercise, it alone will not lead to the desired results without competent and motivated management within the companies.

The lack of management capability within the companies is a serious concern, and could have a serious detrimental effect on the overall success of the reform program. This concern was raised by a number of sector participants, who believe that the lack of management skills in the newly formed companies – and the lack of capacity building or a training program to support the companies – may adversely affect the outcome[22]. While ADB-funded technical assistance is designed to create the organizational structure of the new companies, this assistance to the new companies ends when the unbundling process is complete. Particular areas of concern are identified for each of the companies below.

4.3.5.2 Internal Capacity to Respond to PUC Regulation

With the unbundling of the sector, each of the newly created companies (DistCos and TransCo) will be subject to a new regulatory environment. This is a completely new situation for each of these companies, since the CEB has been operating as an integrated monopoly, reporting only to the Ministry of Power and Energy, which has acted as the de facto policy maker, owner, and regulator of the electricity sector. Hence, the skills and experience to respond to the regulator are largely absent from the industry. The success of the restructuring

[22] This concern was cited by the Power Sector Reforms Office, ADB, and the Public Interest Program Unit (responsible for the establishment of the PUC)

process will rely on a well functioning regulatory system, which in turn will depend on skilled and well- trained staff within both the companies that are subject to regulation and the PUC, as well as the necessary procedures and management information systems.

4.4 ISSUES IN THE INDUSTRIAL AND COMMERCIAL SECTOR

Energy contributes significantly to the total production costs in many developing countries. Consequently energy efficiency is a critical factor for the competitiveness of various export industries of Sri Lanka. Typically the contribution of energy to the total production cost ranges from four percent to 30 percent for key export industries in Sri Lanka. In contrast, the typical contribution of energy to production cost is less than five percent for a large number of industries in many developed countries. Energy efficiency in Sri Lanka, therefore, can play a significant role in enhancing the competitiveness of its export industries in the global markets.

There are three major barriers to on-going energy efficiency activities:

1. **Lack of Funding for Energy Efficiency Programs.** Most of the conservation measures recommended for consumers require capital expenditure, and sources of funding such measures are limited
2. **Lack of Institutionalized Policy, Planning, and Enforcement to Promote Energy Efficiency.** No single entity is responsible for energy conservation policy and its enforcement, though several governmental institutions have the subject of energy conservation in their objectives
3. **Lack of Information, Awareness, and Benchmark Data.** Lack of a centralized institutional arrangement responsible for energy efficiency has also meant that there is no centralized source of benchmark data on energy consumption by industrial segment, no development and execution of public awareness campaigns, and no identification and delivery of information on the latest developments in technology and practices

Significant energy savings potential has been identified in residential, industrial, commercial, and transport sectors. According to the studies conducted by ESCOs, major industries in Sri Lanka could realize 25 to 30 percent savings on total energy consumption, which would increase profitability and competitiveness significantly.

4.5 ISSUES IN THE TRANSPORT SECTOR

Sri Lanka can, in the medium-term, build on recent experience and success in Asia (Thailand, Nepal, and India) to address some local transportation problems and also achieve some of the positive environmental and energy efficiency benefits from developing alternative transport options. In the long-term, when a hydrogen economy emerges as a viable solution, an examination and evaluation can take place on what is to be done in order to facilitate the deployment of hydrogen transport applications in the country.

While the introduction of a modern urban public transportation system based on fuel-efficient buses is sensible, this is obviously a long-term and costly endeavor for Sri Lanka. One cannot escape noticing that the major problem in urban Sri Lanka is not the pollution caused by the taxis but by the abundant number of two-stroke engines on the two and three-wheelers. CNG

hybrid three-wheelers are quite common in India and are in the process of being introduced in Bangladesh.

The idea of a national tune-up inspection program has, in the past, attracted much interest in many USAID energy/environment circles. It has the potential of significantly reducing pollution from automobiles and two- and three-wheelers for a relatively small investment (cost of inspection equipment), making for a low-cost intervention for a donor.

It turns out that the critical element of such a cost-effective program is cultural. Unless the inspection system is enforceable and free of corruption it will have no meaning. Collaboration between USAID and the relevant GOSL agencies is proposed as a possible option and specifically elaborated on in Appendix.

Another innovative approach to the improvement in fuel efficiency and pollution reduction is to replace all Colombo taxis with hybrid vehicles. This will be elaborated on later in the report.

In the future, one way to reduce urban pollution and the associated health and economic costs is to shift the pollution to the source, the power plant (especially if a coal-fired plant), by introducing battery-operated two- and three-wheel vehicles. This by itself has a number of benefits. Pollution can be better controlled at the power plant and battery charging can (and should) take place at night when some excess generation capacity exists, thus improving overall electricity generation efficiency. Furthermore, the PUC may find it worthwhile to introduce reduced night tariffs for battery charging. The technology for these types of electric vehicles is currently available. Collaboration between USAID and the foremost manufacturer of two- and three-wheel vehicles in Asia has proven the concept and the technology, although full-scale production has not yet been achieved. The major infrastructure investments necessary for effective implementation would be a well-developed network of charging facilities at the fleet owners' depots in major cities and towns. The possible demonstration and introduction of these two types of electric vehicles is proposed as a possible option and elaborated on later in the report.

The petroleum sector in Sri Lanka is also subject to deregulation, with Indian Oil Company (IOC) taking over the oil storage facility in Trincomalee and 100 retail filling stations. A third player to the sector is also expected shortly. CPC will continue to maintain the basic infrastructure, including the main oil storage facilities and the refinery in Colombo and the distribution system.

For CPC to be competitive in a deregulated petroleum market, it must have a modern oil accounting system. The system used now is largely manual, with no significant degree of modernization in the recent past.

The GOSL has already introduced regulations aimed at improving fuel efficiency in the transport sector. Potential for efficiency improvements in other sectors, such as the household and industrial, is also high, but present awareness programs are ineffective and need strengthening.

5 Justification and Priority of Short- and Medium-term Interventions

5.1 INSTITUTIONAL SUPPORT

There is a clear need for integrated energy resource planning to estimate future energy requirements and identify the appropriate supply technologies and required investments needed to satisfy energy requirements. A dynamic energy database and model are essential to integrate current discrete sets of information so that the Ministry of Power and Energy (MOPE) can analyze fully linkages across energy sub-sectors, including renewable energy and rural off-grid systems and provide essential inputs for national accounting systems and other sectoral plans.

The MOPE lacks the staff capability to undertake this exercise alone. Sri Lanka has in the past maintained a national energy database and a national energy balance (since 1975), and the Energy Conservation Fund has prepared and annually published the energy balance (through 2000). The MOPE, the current Energy Supply Committee, and the Energy Conservation Fund have recently resolved to work together to further expand, develop, and update the Sri Lanka Energy Database and the Energy Balance and to identify appropriate energy-planning tools. A national energy model will also provide the basis for understanding energy/power sector requirements for the rehabilitation and re-integration of the development process in the north and east within a national context and framework.

5.1.1 Proposed Assistance Program to MOPE

Technical assistance will provided to the MOPE to identify an appropriate integrated energy resource planning model, develop the critical parameters and framework, and integrate current data sets to suit the operational requirements. This contribution towards an effective and truly dynamic integrated resource planning policy tool will lead to more informed decision-making and better governance of various inter-related energy sub-sectors.

It is proposed that the MOPE retain "ownership" of the identified and developed national energy model, but that, for the day-to-day collection, collation of data and information sets and resources, integration of the current Sri Lanka Energy Balance and the Wind Energy Resource Atlas of Sri Lanka, electric power and petroleum sector data, and other energy data sets into the model and for dissemination and outreach to a broad group of users, USAID consider placing this support at a suitable institution.

The institution would be responsible for providing qualified counterpart staff that would be selected after further consultation with stakeholders. The model could also be co-hosted by a university to ensure that a more varied and sustainable level of cross-thematic policy analyses takes place.

The proposed intervention would include support for energy modeling and development of a database for National Energy Planning by the Energy Supply Committee.

5.2 THE POWER SECTOR

A list of future needs for the electric power sector has been developed. These cover expected requirements arising out of both the current operation of the sector and additional needs that will arise as a result of the proposed reform program, especially the unbundling. The focus areas are outlined below, grouped by target beneficiary, e.g., TransCo, DistCos, and the PUC.

5.2.1 GenCo

The generating system is moving from a predominantly hydroelectric system to a mixed hydro-thermal system. Existing hydroelectric power plants designed to operate on base load will now gradually move to peaking duties. Some hydroelectric power plants have large reservoir capacity upstream, and hence they can deliver more capacity in the peaking mode.

Previous studies under the Electricity Master plan (1989, co-funded by GTZ) and Hydropower Optimization Study (2003 on-going, co-funded by JICA) have identified the potential to add capacity to the existing hydroelectric power plants.

The potential for capacity addition at Victoria and Samanalawewa had been identified in the design stage and physical provisions have been made to enable capacity additions. However, in other power plants, no studies have been conducted about the feasibility and ground conditions to enable capacity additions. The on-going study as well as the 1989 study attempt to justify capacity additions from a hydro system analysis and optimization points of view, and the need now is to translate those findings into site-specific feasibility reports for each power plant.

5.2.1.1 Proposed Assistance to GenCo

The proposed intervention would include technical assistance to conduct site-specific feasibility studies for hydropower capacity enhancements at six sites.

5.2.2 TransCo

The newly formed TransCo will have two areas of responsibility: the Wires Business (covering the existing transmission maintenance and operation functions) and the Bulk Purchases and Sales Business. These two business units will be ring-fenced from each other. The Bulk Purchase and Sales Business Unit is an entirely new division, created to support the unbundled industry. The unit will be responsible for managing the purchase of generation from the newly created GenCo, and IPPs, and the sale of bulk power to the DistCos.

The success of future private sector participation in the industry will be dependent on the transparent operation of this business unit. The private sector will not invest in new PPAs if it is not confident that it will be treated in an equitable manner by the TransCo, and that it is able to monitor the revenue flow mechanisms to ensure payment under its contracts. This requires transparency in the following three areas.

5.2.2.1 Dispatch Procedures

Transparency in dispatching generation requires the creation and implementation of transparent dispatch procedures, usually using a dispatch model, based on least-cost

principles. Generators are dispatched in merit order based on their marginal cost. Using a dispatch model provides transparency to the generators by removing, or minimizing, the amount of discretion the system operator has over the selection of generators to be dispatched to meet load. Currently, the CEB System Operations Division does not have a dispatch model. The Power Sector Reforms Unit is managing the process of purchasing a dispatch model to meet these needs. The specifications for the model have already been developed, and the tendering and procurement process is scheduled to begin in September 2003.

CEB uses the Power System Simulation for Engineering (PSS/E) model (supplied by PTI) for medium-term transmission planning – with up to a 15-year timeframe. PSS/E is also used for load flow analysis to identify any constraints on the transmission grid. Its capabilities to model and plan for emergency restoration and stability analysis have not been fully implemented. The number of employees trained to use the model is limited.

5.2.2.2 Negotiation of PPA Contracts

The responsibility for negotiation of the PPA contracts currently rests with the Energy Supply Committee. In the restructured industry, this responsibility will reside within the newly formed TransCo. Since all future generation capacity needs will be met through PPA contracts, future generation costs will be driven by the prices in these PPAs. Keeping a lid on future generation costs, therefore, will require well-negotiated PPA contracts.

5.2.2.3 Proposed Assistance Program to TransCo

The proposed assistance to TransCo falls into two areas: improving the current system reliability and stability and assisting TransCo with capacity building for its new functions:

1. Capacity building in the area of PPA contract negotiation
2. Technical assistance for developing of technical specifications for wind generation
3. On-going training of TransCo staff on the PSS/E model
4. Update of study for specifications of SCADA system
5. Technical assistance on how to incorporate different types of generation technologies into system stability analysis
6. Training on the use of the dispatch model and importance for transparency in operating procedures

5.2.3 DistCos

5.2.3.1 Tariff Filings

The unbundling plan calls for the creation of five new DistCos from the distribution functions of CEB and LECO. The staff for the DistCos will come from CEB and LECO. The organizational structures of the DistCos and the allocation of staff are being prepared by the Power Sector Reforms Unit, with assistance from ADB-financed consultants. The DistCos will be responsible for the distribution and supply of power to customers within a pre-authorized service territory. The proposed service territories have already been defined. They will purchase power from the TransCo and deliver it to customers. The commercial and technical activities of the DistCos will be regulated by the PUC.

The DistCos are required to submit annual tariff filings to the PUC. This will be an entirely new function for the existing staff of CEB and LECO. Submission of tariff filings will also require new operating procedures for the DistCos, with regard to the collection and management of data, including customer usage data, operating costs, and costs by customer classification. It is unlikely that any of this information is available in a useful format within the existing companies. Effective regulation by the PUC is dependent upon the companies being regulated submitting accurate data to the PUC. For regulation to be effective, the DistCos will require new data collection and analysis systems and procedures, based on the tariff principles and procedures to be developed by the PUC, in order to submit the required tariff information in a timely manner. They will also require staff trained in implementing these operating procedures.

5.2.3.2 DistCo Management

DistCos will also be lacking general management skills, in particular human resource development and corporate planning. No assistance to the DistCos will be provided under the current ADB-provided technical assistance.

5.2.3.3 Reduction in Distribution Losses

CEB's average distribution losses are around 16 to 20 percent. Through an investment plan, LECO reduced their distribution losses from approximately 25 percent to six percent from 1984 to 2003. With a demand of 250 MW, this reduction of 20 percent in distribution losses is the equivalent to an increase in available generation capacity of 50 MW, or the capacity of a small thermal generator. Similar improvements in distribution losses could be achieved for the rest of the distribution system through a program of investment in new meters, distribution system upgrades, and an aggressive management plan, as undertaken by LECO.

5.2.3.4 Proposed Assistance Program to DistCos

1. Overall training plan for new DistCo management
2. Distribution loss reduction program
3. Training program for staff of DistCos to meet tariff-filing requirements
4. Capacity-building for new procurement, financed by ADB funds
5. Creation of training center for DistCo workers to improve technical quality of service

5.2.4 Public Utilities Commission

The PUC has been established as of August 2003. Five persons have been identified as commissioners. It is planned for the PUC to have a total of 100 staff in future, with an immediate staff of 50.

The Power Sector Reforms Office, with the assistance of ADB-funded consultants, is developing much of the primary regulatory documents, including the grid code and the PPAs and PSAs that will govern the relationship between GenCo and TransCo and between TransCo and the DistCos, respectively. The PUC will review these agreements prior to their approval. They will receive support from World Bank-financed consultants for this process. In addition, some training will be provided to the PUC Commissioners, but the duration of

this training is limited. At this time there are no plans to provide any external training to the newly appointed staff.

5.2.4.1 PUC Secretariat

The PUC secretariat will be responsible for implementing the operating principles and procedures of the PUC to ensure that the industry is operating efficiently, balancing the needs of industry and customers. In terms of day-to-day operation of the PUC, the secretariat staff will carry out most of the analysis, making recommendations to the commissioners, who in turn will make the final decisions and recommendations. The staff, therefore, will require a high-level understanding of utility regulation principles and procedures, in general, and their proposed application to Sri Lanka in particular. Given that their responsibilities will include analysis of tariff filings made by the TransCo and the DistCos, review of generation license applications and grid operating procedures, the skills necessary will include utility accounting principles, engineering, and customer service.

Given the crucial nature of the activities to be carried out by the PUC, its success will depend on the availability of experienced and well-trained staff. To date, the staff has not yet been appointed and it is unlikely that upon their appointment they will have the full range of skills required.

5.2.4.2 MAC Secretariat

The MAC will be responsible for approval and removal of company board members and review of the corporate intent of the companies to ensure that the companies are meeting their overall commercial objectives. The MAC will report to and be financed by the Ministry of Power and Energy. It will be supported by a secretariat, which has not yet been appointed.

5.2.5 Regulatory Ambiguities or Voids

5.2.5.1 Legal and Regulatory Issues Related to Rural Electrification

As currently written, the Electricity Reform Act requires all entities that distribute electricity to apply for and receive a distribution license from the PUC. In addition, any entity installing a generation facility is also required to apply for and receive a generation license. In the act, there is no differentiation between on-grid or off-grid generators, nor is there any minimum MW capacity requirement for licensing. This leads to the conclusion that, legally, all generators, irrespective of their size or fuel source (hydro, renewable, thermal), require a license. A further wrinkle in the legislation is the restriction on any single entity from owning both a generation and distribution license. While this requirement was undoubtedly included to prevent the re-integration of CEB, it would appear to apply to all companies or organizations that generate and distribute electricity, including small, off-grid RESs.

To date, none of the local electrification projects have applied for and received licenses from the government. This would, in theory, make them illegal. There is no indication, at this time, that they will be prevented from operating, but concerns have been voiced by stakeholders/CEB that it could become a problem in the future, particularly for systems larger than the current 1 MW. The GOSL has proposed that RES be subject to "light-handed"

regulation, in the form of fast-track and less cumbersome licensing processes[23], but these have not yet been defined.

An associated concern is the parallel role of the newly unbundled DistCos in rural electrification. Each of the new DistCos will be given a license to serve an "authorized area", which will cover rural communities that are not currently connected to the grid, but have the potential to be connected through expansion of the low-voltage distribution system. It is not clear, under the proposed legal and regulatory system, what will happen when a DistCo connects an area that is an existing off-grid system. Will the original investors in the off-grid system receive compensation for their investments? Will the customers served by the off-grid system have the choice of whether or not to be connected? Again, the lack of clarity regarding the legal status of the off-grid systems does not seem to be acting as a deterrent to the rural electrification process at the moment, given the small scale of the current systems. Concerns, however, have been expressed that this may be a problem in the future.

5.2.5.2 Transmission and Generation Planning

When the CEB is unbundled into separate generation, transmission, and distribution companies, the responsibility for generation and transmission planning will reside in the newly created TransCo, which will be responsible for

- Forecasting demand
- Identifying the gaps between forecast demand and available generation capacity
- Transmission capacity requirements to transmit generation from the generation plants to the load centers

Based on the output of the transmission and generation plan, the TransCo will be responsible for negotiating PPA contracts to meet those requirements. The quantity purchased under these contracts, the fuel mix, location (and any additional transmission capacity upgrades), and prices paid will all impact the generation prices to be charged to the DistCos. While the TransCo will operate under purchasing guidelines developed by the PUC, it will continue to have a certain amount of discretion regarding the total quantity of power purchased under the PPAs, as well as fuel mix and ultimately the prices paid.

This function of the TransCo should be subject to comprehensive review by the PUC. This review should be broader than just overseeing the PPA procurement process and include the overall generation and transmission plan.

5.2.5.3 Proposed Regulatory Technical Assistance Program

This program, intended to provide assistance for quickly establishing the PUC as an effective, independent, well functioning regulatory agency for supporting the unbundled industry, includes

1. Support for a training program for the PUC secretariat
2. Technical assistance to define the regulation of off-grid systems and to the provincial councils to carry out these activities

[23] GOSL 2002

3. Assistance with the establishment of procedures and staff for the generation and transmission planning function within the PUC
4. Support for a training program for the MAC secretariat

5.2.6 Renewable Energy Resources

The initiatives taken by the GOSL to increase renewable energy will require good information outlining the renewable energy resources in Sri Lanka. A satellite map of wind resources completed under the USAID SARI/E project, an assessment of the country's solar resource by the developers, and ITDG's preliminary catalog of mini- and micro-hydro resources are at present available. But this information is not centralized and is not usually available to the public at large. Wider dissemination of this information could greatly enhance the ability of customers and developers to promote sound energy solutions.

5.2.6.1 Proposed Assistance to MOPE

The proposed intervention would include creating a renewable energy resource handbook by gathering all available data on renewable energy potential in Sri Lanka into one database or document, identifying and filling gaps in the data, and developing and implementing an information dissemination strategy. This resource could be housed at a Sri Lankan university and updated every five years.

5.3 THE INDUSTRIAL AND COMMERCIAL SECTOR

5.3.1 Energy Efficiency Issues in Restructured Industries

Under the on-going energy sector reforms, CEB will be unbundled into distribution, transmission, and generation companies as independent entities. The petroleum industry is already in the process of privatization, with government-owned CPC already sharing the retail market with the IOC and bidding for a third player already in the process.

It is well understood that energy efficiency at face value is not perceived as a core business activity by the energy utilities. In fact, energy efficiency and conservation are rather conflicting with commercial objectives of higher profitability of these utilities. For example, while the generators of electricity may have an interest in DSM from the point of view of improving system load factor, distribution companies find no interest in promoting energy conservation that would result in a decline in their revenues. Similarly, the petroleum industry finds no incentive in promoting conservation other than for improving the industry image.

End users are the only direct and apparent beneficiaries from active energy efficiency and conservation programs and activities. Nonetheless, energy efficiency brings significant benefits to the society as a whole. Therefore, often energy efficiency and conservation are driven by direct or indirect government intervention in the form of dedicated institutions and regulatory requirements imposed upon utilities. Consequently, the promotion of energy efficiency must be given serious consideration during the process of restructuring the energy industry.

Unfortunately, under the restructured energy market scenario in Sri Lanka, there is no evidence that energy efficiency has been given serious consideration. For example, currently

the most active government organization responsible for promoting energy efficiency is the DSM Cell at CEB. This cell is to be abolished when CEB is unbundled. It is proposed that the research part of services (e.g., load research) be transferred to the new TransCo, policy-related issues, including standards and labeling of end-use appliances, may come under the PUC and/or ECF, with the commercial activities expected to be taken over by the operating ESCOs in the country. This scenario provides an ambiguous future for the continuation of current services and continued use of work done by the cell.

ECF is another government institution that is responsible for promotion of energy efficiency. But based on its past performance and considering the critical lack of resources currently available, it is unlikely that it can play an active and effective role. On the other hand the PUC will be the most resourceful organization with a mandate to look after consumer interest, but it is not clear to what extent the PUC will engage itself in promoting energy efficiency.

Under this situation, the promotion of energy efficiency is left to the unregulated private sector, such as ESCOs and voluntary organizations, such as SLEMA. While SLEMA has provided effective services, it faces a critical scarcity of resources. The ESCOs on the other hand have commercial objectives and the industry is still in its infancy. Currently, there are only three active ESCOs in Sri Lanka. One of the key issues that have surfaced is the inability of ESCOs in Sri Lanka to stay up to date with latest developments in trends and technologies elsewhere in the world. Consumer awareness/education is one key area that will require direct intervention by the government or other public body to ensure a gradual increase in interest and involvement in energy efficiency in Sri Lanka.

5.3.2 Energy Efficiency in Cluster Industries through Private Participation

USAID is currently sponsoring a large-scale project on improving the competitiveness of eight cluster industries in Sri Lanka. "The Competitiveness Initiative" (TCI) is aimed at helping these industrial clusters enhance their competitiveness in regional and global markets by improving product quality and reducing production costs. The tea, rubber, ceramics, coir, and tourism industries are highly energy intensive, with energy roughly accounting for between eight and 35 percent of total production costs. These production costs can be reduced by up to six percent through active energy efficiency measures.

Some of the key barriers to identifying and implementing energy efficiency potentials include a lack of awareness of the available background information, an inability to make sophisticated assessments, the reluctance for investment, and little interaction with support organizations. Interventions aimed at removing these barriers can help these industries to improve their competitiveness in regional and global markets by reducing their production costs.

5.3.3 New Energy Efficient Technologies through Pilot Projects

Technological developments often face reluctance for the fear of loss of production or quality. Some of Sri Lanka's key export industries have been offered technological developments that could help them reduce their energy costs by up to 33 percent. For example, fuel switching from diesel or kerosene to firewood gasifier technology for both the tea and ceramic industries offer significant cost reductions. But both industries are currently

facing tough competition and are not willing to risk experimenting at the cost of loosing the market due to resulting poor quality. Demonstration of the effectiveness of the new technologies will encourage industry operators to adopt the technology that will help them to reduce their costs.

5.3.4 Consumer Awareness and Education Program

Consumer awareness about the benefits and availability of energy efficiency options plays an important role in the development of energy efficiency markets. While a number of programs have aimed at promoting awareness about end-use efficiency for electricity, not much has been done to enhance public awareness about conserving petroleum fuels.

The government has introduced regulations that aim to improve the end-use efficiency in the transport sector. This includes maximum vehicular emission levels and contents in the petroleum fuels. Unfortunately, little has been done to increase consumer awareness on the importance of end-use efficiency and conservation. For example, vehicle owners may improve the fuel efficiency of their vehicles by as simple a means as regularly checking tire pressure and periodically tuning up their vehicles. Similarly, householders may use several tips to reduce use of gas at home. Establishment of an information development and dissemination program can help the country to cut unnecessary wastage of imported petroleum fuels.

5.3.5 A Guarantee Fund for Third-party Financing of Energy Efficient Projects

Availability of funds is one of the key barriers in implementing viable and practical energy efficiency projects. ESCOs in Sri Lanka started operating in 2001 and have since provided a significant boost to the confidence of investors in such viable options. The guaranteed savings and partial undertaking of financial risk offered by ESCOs on turn-key projects have encouraged third-party financiers to lend money for energy efficiency projects at normal or even lower commercial rates.

The financial institutes are, however, still skeptical about the success of energy efficiency projects and their evaluation criteria are still dominated by the financial strength of the client rather than the energy savings potential offered by the project. Consequently, most small- and medium-scale businesses or industries are unable to secure funding at competitive rates and are offered loans at higher than normal commercial rates. The lending institutes have shown their willingness to provide funds for energy efficiency projects at lower rates, but only if risk to their loans is reduced through additional guarantees.

The concept of a guarantee fund has been coined to create such additional guarantees. The USAID based SARI/E initiative has identified and developed the conceptual framework of such a fund – Sustainable Guarantee Fund (SGF) – which is based on a financial model that has been found to be most suitable for countries in South Asia.

5.3.6 Use of Industry-specific Benchmark Energy Consumption Data

Industry-specific benchmark data provides the opportunity for industry operators to compare and improve their own performance against industry best practices. But establishment of such benchmark data requires acquisition, processing, management, and dissemination of the data on a regular basis. For example, tea industry benchmarks may require data on consumption of

all fuel types at all stages of tea processing, and the total tea production, to arrive at energy consumption per kg production of tea.

Internet-based data acquisition and dissemination is becoming increasingly common for establishing industry-specific benchmark databases that are regularly updated by the member organizations. These web-based databases serve two purposes: providing privileged access to members for entering and viewing results and providing industry-specific background information to the general public through the Internet.

Since submission of somewhat confidential data is involved, such databases are implemented successfully within strongly integrated industry associations, such as the tourism industry in Sri Lanka. The establishment of such a benchmark database for one type of industry is likely to pique interest among other industries.

The tourism and hospitality industry has shown its willingness to fund the operation of such a database for the industry, if development costs are funded by a donor agency. Our investigations have established that the operators of establishments within the hospitality industry have taken a number of energy efficiency measures, but they are not sure how each establishment's performance compares with others. Indicative values and performance measures can help them search and explore options for further improvements.

5.3.7 Proposed Assistance to Energy Efficiency in Industry

Provided the importance of energy efficiency and conservation for the economy and the society as a whole, there is a need for intervention in several areas. While large-scale interventions, such as regulatory requirements and the establishment of dedicated institutes with sufficient resources, may not be within the objectives and scope of USAID, USAID may provide assistance in maintaining the momentum of current energy efficiency activities through the following programs:

1. Promotion of energy efficiency in cluster industries through private sector participation
2. Promotion of new energy efficient technologies through pilot projects
3. Consumer awareness and education program
4. Facilitation of third-party financing of energy efficient project through establishment of a guarantee fund
5. Promotion of use of industry-specific benchmark energy consumption data

5.4 TRANSPORT SECTOR, INCLUDING THE PETROLEUM INDUSTRY

5.4.1 Transport Sector

An innovative approach to improving the fuel efficiency and reducing the pollution caused by the Colombo taxi fleet could be the replacement of all taxis by hybrid vehicles. This would provide significant publicity value for the hybrid vehicle manufacturers and a similar benefit to USAID. If the GOSL can be convinced of the appropriateness of reducing the import duty and taxes on such environmental "equipment" or to give a one-time tax and duty exemption, then the possibility of selling these vehicles below "sticker-price" and providing on-going

service through existing dealerships could be created. The existing taxis would be sold (traded in) and USAID could pick up the differential cost and, together with the environmental authorities of Sri Lanka and possible contributions from the auto manufacturers, monitor the reductions in pollutants.

The idea of a national tune-up inspection program has, in the past, attracted much interest in many USAID energy/environment circles. It is important to recognize that the numerous two- and three-wheelers operating with two-stroke engines in Sri Lanka use as fuel a mixture of motor oil and gasoline. This is a high polluting fuel that, when coupled with the inherent problems of the two-stroke engine, creates enormous health/environmental problems in urban centers in Bangladesh, India, Indonesia, Nepal, Thailand, and Sri Lanka. (And the pollution problem is often exacerbated by vehicle owners who try to save money by using spent motor oil in their fuel mixture.)

Indian manufacturers, including Bajaj, Mahindra & Mahindra, Scooter India Limited and REVA, have developed electric-driven transport products that might be adapted to the driving profiles experienced by many individual users in urban settings in Sri Lanka.

The main barriers encountered to the mass production and usage in India seem to be gaining full acceptance by the fleet owners and riders of the new technology and overcoming the general conservatism of the private sector in India to expending the necessary money to undertake the required mass production tooling and to create market awareness among the general public about the merits of the new vehicles.

Currently, any limited production means higher retail costs: for now, about US$ 2,500 per vehicle, not including taxes. This is more than double the current retail cost of the conventional vehicles. Indicative operating costs for the conventional vehicle are SLR 4.5/km and for the electric-operated one about SLR 3.4/km. It should also be noted that, with the electric vehicle, there are practically no costs related to maintenance and replacement of parts.

The social and economic benefits of demonstrating such vehicles could be significant, in addition to the high visibility and pioneering value.

5.4.2 Petroleum Industry

The petroleum industry in Sri Lanka is also subject to deregulation, with IOC taking over the oil storage facility in Trincomalee and 100 retail filling stations. A third player in the sector is also expected shortly. CPC at present owns the only refinery in the country (50,000 bbl/day), and all the delivery and storage facilities.

In the final industry structure, it is likely that CPC would retain the refinery and bulk of storage facilities, and well over 100 retail outlets. CPC's ownership will remain with the government, at least for a few years to come.

CPC's oil accounting system is largely manual, with no significant degree of modernization to meet the challenges of a modern industry and a competitive business environment. To enable the state-owned petroleum supplier to remain competitive and to maintain its strategic

objectives, an up-to-date oil accounting system is essential. This will require significant improvements to the system to match with international best practice in the

- Accounting and reconciliation of imported crude oil received
- Accounting of daily product balance and inventories
- Accounting for product transfers from refinery to storage facilities
- Tabulation of oil movements between refinery tanks
- Estimation of losses (including methodology)
- Instrumentation and telemetering required to implement the accounting system

With petroleum product imports to the country accounting for 11 percent of net export income, the government has already introduced regulations aimed at improving fuel efficiency in the transport sector. Potential for efficiency improvements in other sectors, such as household and industrial, is also high, but present awareness programs are ineffective and need strengthening.

Experience elsewhere in the world, including many developing countries, suggests that a significant reduction in fuel consumption can be achieved by enhancing consumer awareness. Dedicated consumer groups with sufficient technical background can create such awareness materials and disseminate them through appropriate media channels, but these awareness campaigns need long-term fund commitments either from the government or the petroleum industry itself. Improved industry image is the key advantage that the petroleum industry gains from sponsoring such group/awareness programs.

For example, the USAID-sponsored Center for Energy Conservation (ENERCON), which is now operated by the government of Pakistan, and the Petroleum Conservation Research Association (PCRA) in India, which is sponsored by key petroleum industry players in the country. These groups conduct research or obtain information from other research groups and produce consumer awareness material by targeting specific end-uses, end-use technologies, and consumer types.

A similar institution in Sri Lanka, if and when established, can engage in petroleum conservation activities.

5.4.2.1 Proposed Assistance to the Transport Sector including the Petroleum Sector

Proposed interventions are aimed at enabling the state-owned CPC to be competitive in a deregulated market and at increasing fuel sector end-use efficiency to reduce petroleum imports to Sri Lanka.

The proposed interventions include

1. Development of an updated petroleum products accounting system for CPC
2. Establishment of a transport sector baseline database
3. Establishment of a national vehicle inspection and tune-up program
4. Establishment of a petroleum conservation and resource center

5. Introduction of zero-emissions electric vehicles
6. Replacement of the Colombo taxi fleet with hybrid vehicles

6 References

ADB, UN, World Bank. 2003a. Building a Foundation for Peace and Economic Growth: Setting National Priorities. (May)

ADB, UN, World Bank. 2003b. Sri Lanka – Assessment of Needs in the Conflict Affected Areas – Districts of Jaffna, Kilinochchi, Mullaitivu, Mannar, Vavuniya, Trincomalee, Batticaloa and Ampara. (May)

ADB, UN, World Bank. 2003c. Sri Lanka – Assessment of Needs in the Conflict Affected Areas – Districts of Puttalam, Polonnaruwa, Anuradhapura and Moneragala. (May)

CEB. 2003. Long Term Generation Expansion Plan, 2003-2017. Table 5.2 Capital Cost Details of Hydro Expansion Candidates Considered in the Study, 5-2

Economist Intelligence Unit. 2003. (22 July)

GOSL. 2002. Rural Electrification Policy

GOSL. 2003. Regaining Sri Lanka: Vision and Strategy for Accelerated Development

Gunaratne, L. 2002. Presentation at a conference in Addis Ababa

Norwegian Agency for Development Cooperation. 2003. Web site

USAID-SARI/E. 2003. Wind Energy Resource Atlas of Sri Lanka and the Maldives

World Bank. 1997. Project Appraisal Document for the Energy Service Delivery (ESD) Project. (February 27)

World Bank. 2002. Project Appraisal Document for the Renewable Energy and Rural Economic Development Project. (May 24)