ASSESSMENT OF POWER SECTOR REFORMS IN SRI LANKA

Country Report

ASIAN DEVELOPMENT BANK

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PREFACE

The demand for energy and electricity in many developing countries in Asia and the Pacific will continue to rise owing to their rapid population growth and their expanding economies. Aside from improving energy availability and ensuring electricity access for all, these countries need to make their power sector stronger and more responsive so it can support a more inclusive and environmentally sustainable economic growth. A number of these countries have already started reforms in their power sector to achieve these goals, and a three-country study undertaken by the Asian Development Bank (ADB) makes an assessment of the effectiveness of their respective reforms in achieving the targeted outcomes.

Sri Lanka, one of the three countries covered by the study, has focused its reform process on restructuring the Ceylon Electricity Board and its associated regulatory bodies. The reforms have already brought about wider access to the grid, lower transmission and distribution losses, and a more efficient generation system. However, there has been limited success in unbundling the power system and in rationalizing tariffs. The power sector remains neither independently operated nor independently regulated, pricing for electricity is still inefficient, and least-cost long-term investment planning has yet to be implemented. This country report assesses the economic, social, and environmental outcomes of these power sector reforms by using internationally recognized energy indicators for sustainable development. We believe that the Sri Lanka experience can provide other ADB member economies with useful insights for better power sector planning and decision making as well as policy and strategy formulation. The report's findings should also serve as invaluable guidance for improving ADB's country and regional energy operations and assistance.

The study was conducted by ADB's Economic Analysis and Operational Support Division, Economic Research and Regional Cooperation Department, under the overall guidance of Director Cyn-Young Park. The report was prepared by Kee-Yung Nam, John Weiss, Lucille Langlois, Jindra Nuella Samson, and Paulo Rodelio Halili, with valuable inputs from Tilak Siyambalapitiya and Asanka Rodrigo. Assistance in preparing the report was provided by Lotis Quiao, Lyndree Malang, Gee Ann Carol Burac, Ricasol Cruz-Calaluan, and Rhina Ricci Lopez-Tolentino. The work benefitted from valuable inputs and comments of colleagues from the South Asia Department and the Energy Sector Group. The report was edited by Jill Gale de Villa and Carlos Llorin Jr.; layout and typesetting was by Mike Cortes.

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ABBREVIATIONS

ADB	—	Asian Development Bank
BST	—	bulk supply tariff
CEB	—	Ceylon Electricity Board
CO_2	—	carbon dioxide
CPC	—	Ceylon Petroleum Corporation
GDP	—	gross domestic product
IPP	—	independent power producer
LECO	—	Lanka Electric Company
MOPE	—	Ministry of Power and Energy
NCRE	—	nonconventional renewable energy
PUCSL	—	Public Utilities Commission of Sri Lanka
SLR	—	Sri Lanka rupee
SPP	—	small power producers
TOU	—	time of use

WEIGHTS AND MEASURES

GWh	—	gigawatt-hour
kV	—	kilovolt
kVA	—	kilovolt-ampere
kW	—	kilowatt
kWh	—	kilowatt-hour
MW	—	megawatt
V	—	volt

SUMMARY ASSESSMENT OF POWER SECTOR REFORMS IN SRI LANKA

Power Sector Reforms

Prereform situation. In the early years of Sri Lanka's independence, its power sector was run as a government department. In 1969, however, the government created the Ceylon Electricity Board (CEB), a public sector utility that operated as a vertically integrated monopoly regulated by the Ministry of Power and Energy. The CEB carried out all the functions of electricity generation, transmission, distribution and retail supply, with no competition at any level.

Phase 1 of reform (1983–2008). As early as 1983, initial moves toward reform were started with the establishment of a state-owned distribution company, Lanka Electricity Company (LECO), to distribute power in designated areas previously served by local authorities and municipal councils. In 1996, private sector participation in generation commenced with the entry of independent power producers (IPPs) and small power producers (SPPs). Four years later, in 2000, the CEB was unbundled internally into six divisions—one for generation, another for transmission, and four for distribution. This was done through an administrative CEB decision, without effecting legal or financial separation of these divisions from the CEB structure.

In 2002, the first legally binding power sector reform came about with the enactment of the Electricity Reform Act No. 28. This was followed in December of that year with the enactment of the Public Utilities Commission Act, No. 35 of 2002. The Public Utilities Commission of Sri Lanka (PUCSL) was then created as the power sector regulator effective July 2003. However, before the PUCSL could exercise its mandated powers over the power sector, the Electricity Reform Act still needed to be made fully operational through a Ministerial order. This order was never issued owing to political opposition, including opposition from the CEB staff themselves. It took a change of government in 2004 for an entirely new electricity bill to be prepared. That bill was then presented to the Parliament for ratification in February 2008.

Phase 2 of reform (2009 onward). The following year, after several rounds of discussions and significant amendments, the new electricity bill was finally approved and ratified as Electricity Act No. 20 of 2009. This legislation allowed the PUCSL to finally operate as the power sector regulator, but it authorized less restructuring of the CEB than had been originally proposed in the 2002 Electricity Reform Act. A single-buyer model was introduced, with the CEB transmission entity as the single buyer, but contrary to what is usually done in unbundling reform elsewhere, the business units or divisions within the CEB were not spun off as separate entities with independent ownership structure and management. As a result, the CEB now holds a total of six power sector licenses, as follows: (i) one generation license for about 66% of all generating capacity in the grid; (ii) one transmission license for 100% of transmission and for 100% of bulk supply in accordance with the single-buyer model; and (iii) four distribution licenses that in total covers approximately 90% of power customers.

Generation, transmission, and distribution. Over the past two decades, Sri Lanka's electricity generating system has been in transition from a system dominated by hydro to a mixed hydrothermal system, with the thermal power fueled mainly by imported oil. In 2012, oil-fired thermal power provided nearly 60% of generation, with hydropower providing 23%. In 2013, however, there was a major shift to hydropower, which saw its share rising to about 50% of total generation and that of oil-fired thermal power dropping to 28%. In 2013, the share of nonconventional renewable energy (NCRE) increased from 6% in 2012 to 10%, already reaching the share targeted for 2015. The transmission grid now covers the whole of Sri Lanka, as the war-damaged northern Jaffna peninsula has now been rehabilitated; there are therefore no more physical difficulties in the transmission or distribution network that could possibly lead to load shedding. Electrification rates have improved significantly, and the share of households having no grid access has decreased substantially from 71% in 1990, to 35% in 2002, and to only 4% by 2013.

Tariff reform. One main reason for the poor financial condition of Sri Lanka's power sector has been the ad-hoc and negotiated pricing for power tariffs, dictated by different governments over the years. This practice of charging tariffs inadequate to cover costs has saddled the CEB with accumulated debts. To alleviate the problem, the PUCSL in 2009 addressed the issue of transfer prices and subsidies by starting discussions with licensees on a new tariff methodology to unbundle rates. In principle, a new tariff methodology should have become effective in January 2011 with the following provisions: (i) the tariff schedule should reflect separately the costs of each generating, transmission, and distribution licensee providing electricity at specified times of the year, days of the week, and times of the day and night; (ii) the tariff schedule should permit each licensee to recover all reasonable costs incurred in carrying out its authorized activities on an efficient basis; and that in principle, each licensee is ring-fenced, which makes the licensee responsible for the components of its business within its control and entitles it to compensation for external features of the business not within its control. The components of the tariff would then be grouped in this manner: (i) Bulk Supply Tariffs or BST, covering the use of the transmission system and the tariff related to electricity generation; (ii) Distribution Tariff, covering the use of the licensee's distribution system; and (iii) Retail Supply Tariff, covering the cost of supply of electricity from the distribution system to the customer. The implementation of the tariff adjustments for both customer and bulk supply has encountered considerable delays, however, thus eroding public confidence in the tariff-setting process.

Future developments. A wholesale market with limited competition is being considered for 2016. The details have not yet been announced, but the plan is expected to involve the following: (i) moving the IPPs to a competitive market; (ii) introducing merchant power plants; (iii) allowing the wheeling of power, initially between the same legal entities (for example, from a microhydro in a tea estate to the company headquarters in the city) and within local areas (for example, from one block of a large tea estate to another block, using the local utility distribution network), and subsequently from one entity to another; and (iv) a review and revision of tariffs for all affected parties. Still needed is a more substantial reform that would go beyond the Electricity Act of 2009: extending the unbundling process to spin off and establish the six CEB licensees into independent companies. All would report to the CEB as their holding company and would operate as separate profit centers in an arrangement similar to that now in place for the government-owned distribution company LECO.

Outcomes of Power Sector Reform

The outcomes of the reforms are assessed in three dimensions: economic, social, and environmental.

Economic Outcomes

For economic effects, three indicators are used: (i) electricity use per capita, which rises with income and the modernization of an economy; (ii) electricity intensity/productivity (kilowatt-hour[kWh]/real gross domestic product [GDP]), which varies with the structure of production; and (iii) efficiency losses (electricity consumption/electricity production -1), which varies with the age of the network.

By 2013, electricity use per capita had grown rapidly to 514 kWh per person from 141 kWh per person in 1990, reflecting both rising incomes and greater access to the national grid.

The electricity intensity of GDP also rose consistently from 0.23 kWh/GDP in 1996 to 0.30 kWh/GDP in 2006; however, it declined between 2007 and 2009 to 0.28 kWh/GDP, reflecting a shift in economic structure and, to some extent, changes in relative sector intensities. It stabilized in recent years, reaching 0.26 kWh/GDP in 2013. The drop in electricity intensity of GDP from 2006 was likely associated with the rise in the share of GDP of the services sector relative to industry, as the former is less electricity-intensive. Incipient energy-efficiency initiatives might have also contributed to the drop.

The initial postreform period saw a reduction in losses as well as improved efficiency in power generation, transmission, and distribution. By 2013, the CEB's transmission and distribution losses (both technical and commercial) had fallen to 9.5%, while those of LECO had gone down to 6.6%. With the introduction of system loss reduction programs, the national energy supply efficiency has improved from 78% in 2000 to about 88% in 2013, with the main improvement realized during the eight-year period after 2005.

In 2011, in accordance with Sri Lanka's new cost-reflective tariff policy, tariff rates of all customer categories were increased; as noted earlier, however, there have been delays in further adjustments. That same year, commercial and industrial customers experienced steeper tariff rises than residential customers; this was after households with low electricity consumption were exempted from the full-cost pricing policy and are thus now paying less than the cost of supply.

Social Outcomes

For social effects, three indicators are used: (i) access to electricity (percentage of population with access to electricity), (ii) affordability of electricity (percentage of average household income spent on electricity), and (iii) affordability to the poor (percentage of household income for the bottom quintile spent on electricity).

As noted above, Sri Lanka's electrification rate has grown rapidly since 1990 and is now relatively high for the country's income level. The overall level of electrification was 96% in 2013, but there were significant differences in the level among provinces. The Eastern and Northern provinces, which were most affected by the 30-year civil war in Sri Lanka, had lower levels of electrification and were thus granted postwar rehabilitation electrification programs. The goal is to raise the electrification level in all provinces to 100% by 2015 with a mix of grid extensions and off-grid solutions.

In terms of affordability, the share of household income spent on electricity was just under 4% in 2012, on average changing very little since 1990. With the implementation of tariff increases between 2010 and 2012, this share rose by about one half a percentage point. Significantly, the share of electricity expenditures in the income of the poorest quintile of the population has been declining since 1991; in 2012 it was just under 5%, down from over 7% in 1991.

Environmental Outcomes

The main environmental indicators are the following: (i) CO_2 emissions per capita and (ii) CO_2 emissions per unit of GDP. As the country has moved to a generating system that is more fossil fuel-based, there has been a gradual increase in CO_2 emissions per capita. This rise became particularly noticeable after 1996, the year the oil-fired IPPs began operating. As of 2011, the CO_2 emission per capita specifically attributable to electricity generation was 262 kg, a level that, while not high by global standards, is nevertheless a very substantial 60% increase from the level of 164 kg per person in 2000. Sri Lanka's current energy policy emphasizes the need to resort to sustainable energy, but it remains to be seen how successful this will be in reversing this rising trend in emissions. As to CO_2 emissions from electricity per unit of GDP, the level follows a broadly similar increasing trend as the per capita figures, with the exception that the peak in 2005 was greater than the more recent figures. From 2006 onward, however, CO_2 emissions per unit of GDP dropped owing to a combination of lower use of diesel for power generation and a shift in the structure of economic growth toward the less energy-intensive services sector.

Lessons Learned and Next Steps

To date, Sri Lanka's reform process has focused on restructuring the CEB and the associated regulatory bodies, with limited success in unbundling the power system and in rationalizing tariffs. On the other hand, the reforms have already brought about wider access to the grid, lower transmission and distribution losses, and a power generation system that is no longer prone to frequent or continuous load shedding. The two reform goals of physical security of the system and reliability of supply have already been achieved. As yet, however, the system has not implemented definite grid and distribution codes.

The two most urgent reforms of efficient cost-based pricing for electricity and of least-cost long-term investment planning, although started in part in 2009, have not been fully executed and implemented. With its continuing below-cost pricing for electricity, Sri Lanka's power sector remains hobbled by lack of capital for investment and expansion and by the financial stress of its mounting deficits. The methodical adoption of a cost-based tariff is further undermined by the fact that power transmission and distribution costs are not submitted by the licensees to the PUCSL in a timely fashion.

The operations of the power sector can become more transparent and efficient once the revenue streams of the various licensees are separated and allocated properly. This is not happening because despite the partial unbundling of the CEB, the four CEB-owned distribution licensees and the transmission licensee have not yet been made independent of each other. Thus, the income from sales to customers and from sales of the transmission licensee to LECO continues to be credited untransparently to the CEB's general corporate account. Moreover, the transmission licensee needs to manage the bulk supply transactions account transparently by reporting both to the PUCSL and to the public as required under the adopted tariff methodology. There must be full disclosure of costs of supply on customer bills as well as regular reporting on the licensee's performance on its revenues and allowed provisions for losses, and on generation cost-control measures that need to be instituted.

Still lacking in Sri Lanka is a truly independent regulation and operation of the system. Currently, neither the PUCSL nor the CEB can make independent decisions without possible government interference intended to block politically unpopular moves, thus resulting in a nontransparent, ad hoc, and sometimes distortionary decision-making process. In particular, despite the new regulatory regime established in 2010, the transmission licensee continues to make decisions on selection and design of mainstream power generation projects following the prereform administrative structure. There should be a new procedure providing for formal consultations between the PUCSL and the transmission licensee to ensure transparent review of the generation expansion plan, the power purchase agreements (PPAs) including feed-in tariffs, and other preferential PPA provisions.

The need of Sri Lanka's power sector for efficient and transparent pricing as well as independent regulation was addressed in Phase 2 of the reform process, but the principles that have since been enacted into law have yet to be implemented. Eliminating this primary root of the inefficiencies in Sri Lanka's power sector needs to be considered as the primary rationale for further reform.

1. INTRODUCTION

Many developing countries have embarked on power sector reforms. In general, such reforms have led to advances in power sector development in the relevant countries. However, progress in physical, economic, and institutional change is mixed, particularly in the areas of market structure, private participation, and regulatory framework (Besant-Jones 2006). Good beginnings have been made and progress noted, but many shortcomings in implementing policy for the scope and pace of the reform have been seen. Some changes are tentative, incomplete, and are still works in progress. As a complement to such general findings, and to highlight lessons learned from different reform experiences in the region, the Asian Development Bank (ADB) is reviewing and assessing the more detailed results of power sector reform on a country-specific basis, for selected countries, including Sri Lanka.

Since the early 1980s, countries at very different levels of income have had a wide range of experience with power sector reform. Broadly, reforms are based on the following steps:

- introducing competition to improve efficiency, enhance customer responsiveness, and stimulate innovation;
- restructuring the sector to introduce competition by breaking up or "unbundling" the incumbent monopoly utilities, possibly into separate generation, transmission, distribution, and supply services, and to make each business entity accountable only for factors it can control, with penalties for underperformance and incentives for exceeding targets;
- introducing private capital into the unbundled generators and suppliers, with the expectation that private investors and operators will bring not only financial resources but also managerial expertise; and
- developing a new regulatory framework to prevent the new entrants and existing market players from using market power exploitatively, with a preference for regulation by independent or quasi-independent regulatory bodies.

While the reform programs for the electricity sector have been built around these four elements, the details reflect local circumstances, with varying mixes of unbundling, ownership, degrees of competition, and forms of regulation. In many developing countries, particularly in Asia, power sector reform starts from a market structure that is dominated by a state-owned national power utility with a legally endowed monopoly and a vertically integrated supply chain encompassing power generation, transmission, distribution, and customer services. The rationale for this structure has been to minimize the costs of coordination between these functions and of financing the development of power systems.

In Sri Lanka, efforts to restructure the power sector commenced in 1996 with the entry of the private sector in thermal generation. This was followed by unbundling the Ceylon Electricity Board (CEB)—the government-owned monopoly—and creating an independent regulatory commission. In 2002, the Public Utilities Commission of Sri Lanka (PUCSL) Act and the Electricity Act were approved. The

latter, however, was never made effective. Since its enactment, several attempts have been made to revise the Electricity Law, and only in 2009 was a revised Electricity Reform Act passed.

This study discusses the details of power sector reform in Sri Lanka, including the evolution of the power sector's structure, the policies and regulations toward reforms, and the obstacles limiting reforms. The outcomes of reforms are examined to the extent possible, by analyzing the trends in a set of commonly agreed and internationally accepted social, economic, and environmental indicators.

The study begins with a brief discussion of Sri Lanka's socioeconomic development. The second section describes developments in the energy sector, with a particular focus on electricity. The third section discusses policies and regulations leading to reforms, and outlines the reform experience of Sri Lanka. The outcomes of reforms are analyzed in the fourth section. The last section concludes with a discussion on recommendations.

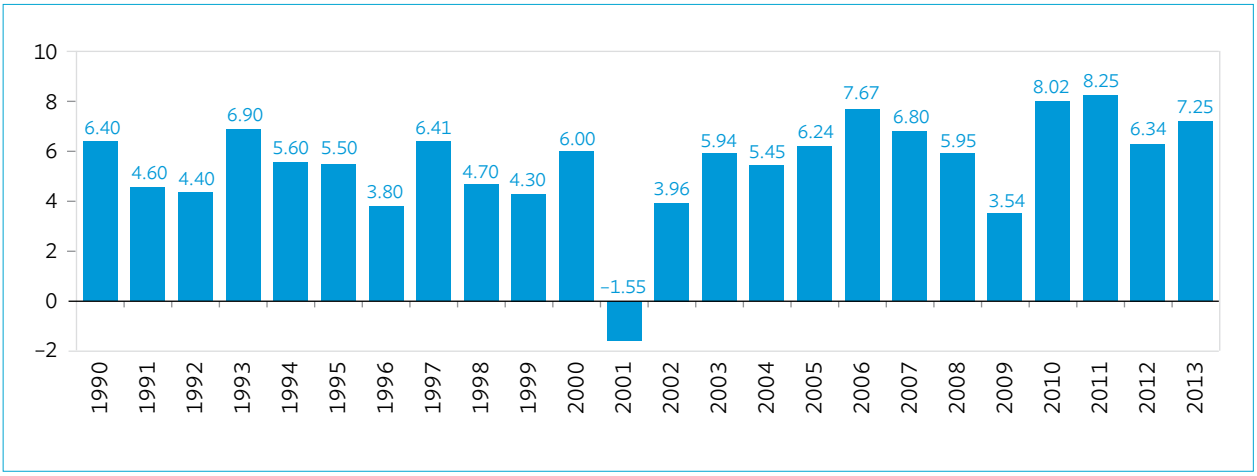
2. SOCIOECONOMIC DEVELOPMENT AND TRENDS IN THE POWER SECTOR

2.1 Socioeconomic Development

After independence in 1948, the government made various attempts to boost both economic and social development in the country. From 1948 to 1977, relatively interventionist economic policies influenced by socialist ideals were often applied. Since 1977, economic policy shifted toward a greater focus on markets and deregulation, as the country strives to transition from a lower-middle-income to an upper-middle-income status. The political decision process was gradually decentralized from the national to the provincial and district levels, providing significant support for rural areas and boosting development of tea, rubber, coffee, sugar, and other agricultural commodities for export.

The growth of Sri Lanka's gross domestic product (GDP) averaged 5.2% between 1990 and 2000, before it contracted at –1.6% in 2001; however, since then the country has experienced robust growth. Between 2003 and 2013, GDP expanded by an average of 6.5% per year, peaking at 8.3% in 2011 and recording a low of 3.5% in 2009, influenced by the civil war (Figure 2.1). The average per capita income in 2013 is estimated at $2,004 in constant

Figure 2.1: GDP Growth Rate in Sri Lanka (%)

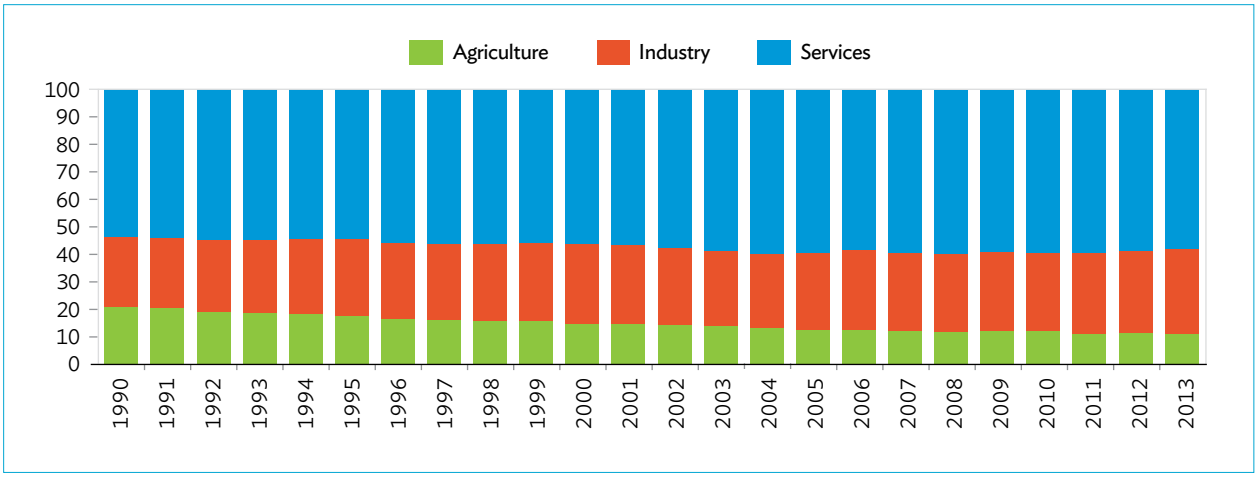


GDP = gross domestic product.
Source: World Bank, World Development Indicators (accessed July 2014).

United States 2005 dollars,[1] about 76% higher than the 2003 level.

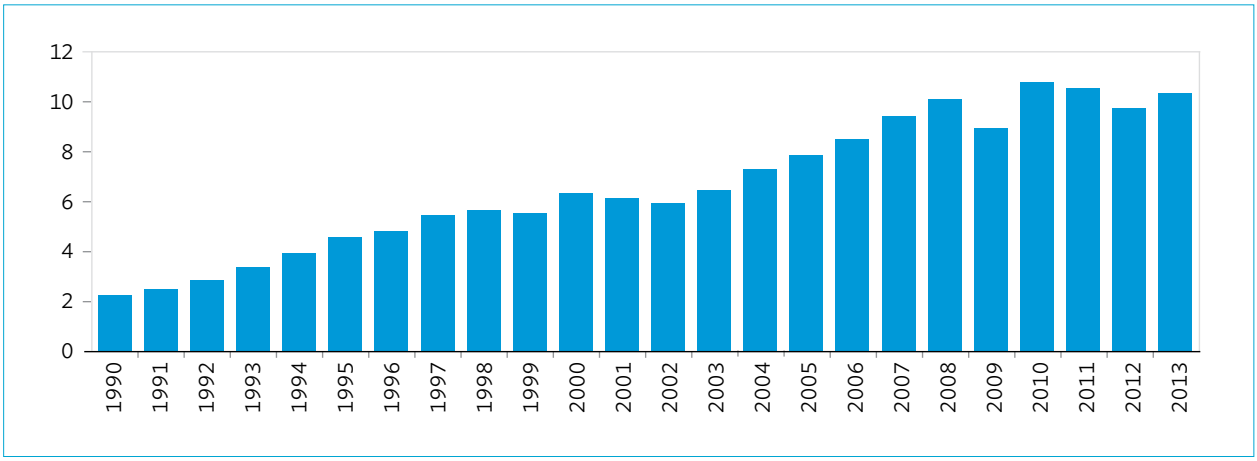
Economic growth since 1990 has largely been driven by the services sector, owing to growth in finance and trade. Industry's contribution to GDP has increased in a very gradual manner, stemming from the manufacturing subsector (textiles, clothing, and food processing, for example) while the share of agriculture declined steadily, partly due to trends in export prices of agricultural products (Figure 2.2). Exports have grown significantly in recent years. The export basket is dominated by textiles and garments (approximately 40% of total exports) and tea (17%). Other exports include spices, gems, coconut products, rubber, and fish. Figure 2.3 shows the trend of total exports. The economic growth has had a significant impact on the pattern of electricity consumption.

Figure 2.2: Sectoral Composition of GDP (%)



GDP = gross domestic product.
Sources: Central Bank of Sri Lanka (various years).

Figure 2.3: Sri Lanka's Exports ($ billion)



Sources: Central Bank of Sri Lanka (various years).

[1] World Bank, World Development Indicators (accessed 31 July 2014).

The country suffered greatly from a civil war that lasted for 30 years. During the war, Sri Lanka's development in general was affected, significantly in the Northern and Eastern provinces. These two provinces carry two-thirds of the country's coastal and maritime resources, and about one-third of the country's fertile land. After the war, the two provinces experienced a significant level of development in agriculture, fishery, and related industries, and prospects for the economy appear much stronger. To rehabilitate and resettle internally displaced persons and to develop infrastructure in the Northern and Eastern provinces, the government has initiated several specific programs in these areas, such as the Uthuru Wasantham (Northern Spring) and Nagenahira Navodaya (Eastern Revival) programs.

The country's total population was about 20.48 million in 2013 (Central Bank of Sri Lanka 2014) and population growth was relatively low, at about 0.8%[2] per year from 1990 to 2013. Although the civil war only ended in 2009, living standards have improved significantly during the last decade. As a result of past emphasis on human capital development and welfare, a significant level of human and social development has been achieved. In 2012, the literacy rate was 95.7% and life expectancy at birth was 71.7 years for males and 77.7 years for females. The human development index for Sri Lanka was 0.75 in 2013, placing Sri Lanka 73rd among 187 countries (UNDP 2014). The ADB social protection index[3] for Sri Lanka was 0.11 for 2010, placing Sri Lanka 14th among the 33 Asian and Pacific countries in the index.

[2] Computed using population data from the World Bank, World Development Indicators (accessed July 2014).

[3] ADB, Social Protection Index Database. The social protection index is calculated as total social protection expenditures for total potential beneficiaries times 25% of the GDP per capita (representing average poverty line expenditures). In other words, the total social protection expenditures spread across all potential beneficiaries are compared to poverty-line expenditures in each country.

2.2 Overview of the Energy Sector

2.2.1 Energy Mix

In Sri Lanka, energy from biomass is predominantly used by households and industry, accounting for 42% of the country's energy supply, followed by petroleum at 38%, then hydropower and other renewable energy sources at 15%. With the first coal-fired power plant commissioned in 2011, coal contributed 2% to the primary energy mix in that year, which increased to 4% in 2013.

About 50% of the country's petroleum requirement is imported as crude oil, which is then processed at the Ceylon Petroleum Corporation (CPC) refinery at Sapugaskanda, east of the capital, Colombo. The rest of the petroleum requirements are imported as refined products (Table 2.1).

Table 2.1: Petroleum Products Used in Sri Lanka, 2013

Product	'000 Tons
Liquefied Petroleum Gas	230.92
Naphtha	71.73
Gasoline	786.90
Kerosene	126.12
Auto Diesel	1,717.78
Super Diesel	24.88
Furnace Oil	674.25
Total	**3,632.58**

Source: Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance data for 2013 (accessed 15 October 2014).

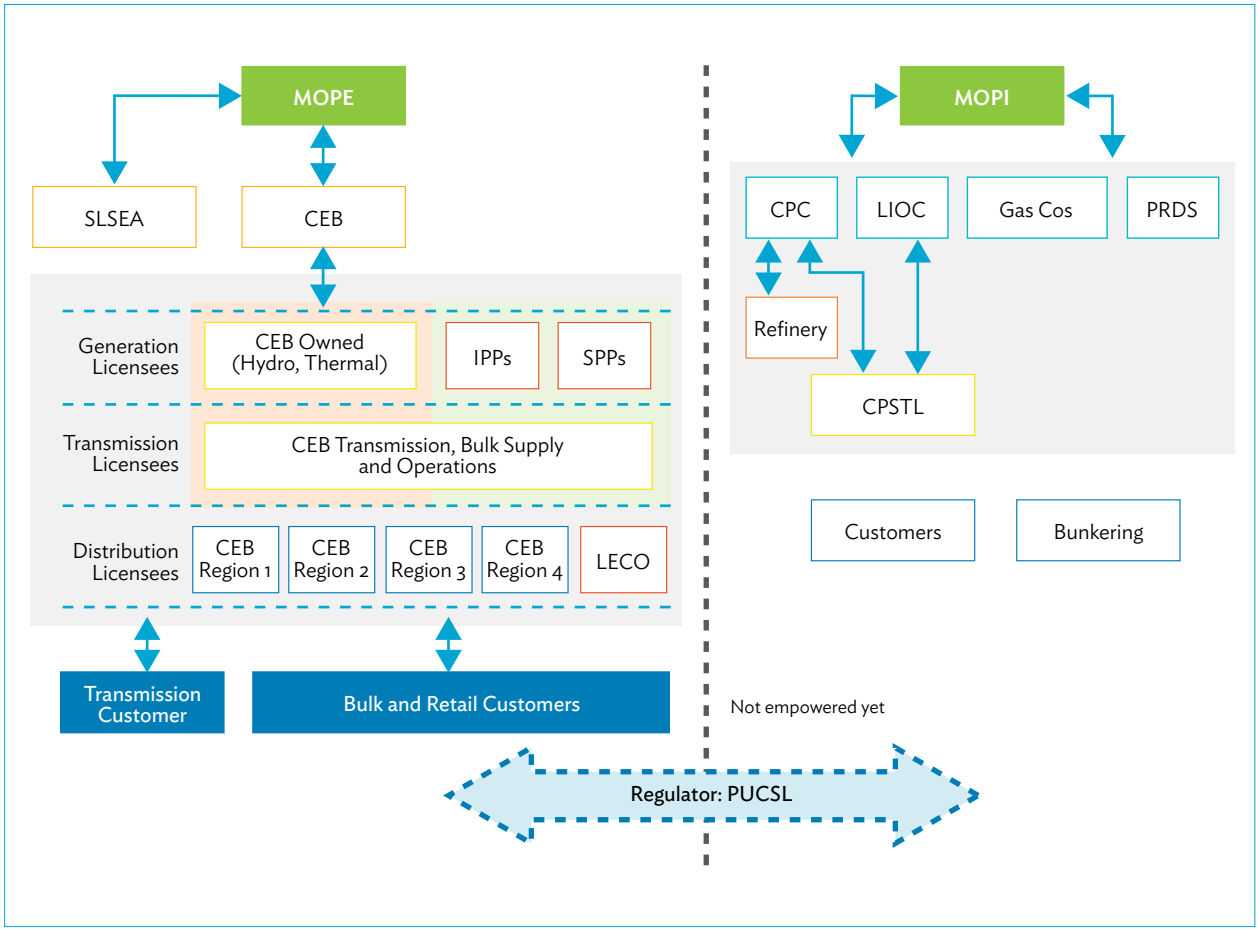
Conventional hydropower is the dominant source of renewable energy used to generate electricity, providing 83% of renewable-based power generation to the grid in 2013, followed by small hydro (14%), wind energy (3%), biomass (0.4%), and a small amount from solar photovoltaic systems. Additionally, about 34,000 households used off-grid solar photovoltaic systems in 2012 (Department of Census and Statistics 2014).

2.2.2 Key Players in the Electricity and Petroleum Industry

Electricity and petroleum industries are managed largely by state-owned corporations, but with private sector participation in power generation, petroleum distribution, bunker supplies, gas distribution, and oil exploration. There are two regulatory agencies: the Public Utilities Commission of Sri Lanka (PUCSL) and Sri Lanka Sustainable Energy Authority. The PUCSL was formed on the basis of the Public Utilities Commission of Sri Lanka Act of 2002 to function as a general regulator of public utilities in the energy and water sectors. Figure 2.4 presents the key players in the electricity and petroleum sectors and the interactions among them. Box 1 explains the role of each player in the energy sector.

The petroleum industry was previously owned entirely by the state enterprise, CPC. However, in 2002 the CPC was restructured by (i) privatizing one-third of the retail supply network to Lanka Indian Oil Company; and (ii) establishing a joint company between the government, CPC, and Lanka Indian Oil Company to own and operate the

Figure 2.4: Structure of the Electricity and Petroleum Industry in Sri Lanka



CEB = Ceylon Electricity Board, CPC = Ceylon Petroleum Corporation, CPSTL = Ceylon Petroleum Storage Terminals, Ltd., Gas Cos = gas companies, IPP = independent power producer, LECO = Lanka Electricity Company, LIOC = Lanka Indian Oil Company, MOPE = Ministry of Power and Energy, MOPI = Ministry of Petroleum Industries, PRDS = Petroleum Resources Development Secretariat, PUCSL = Public Utilities Commission of Sri Lanka, SLSEA = Sri Lanka Sustainable Energy Authority, SPP = small power producer.
Source: Siyambalapitiya and Rodrigo (2014).

Box 1: Roles of Key Players in the Energy Sector

The Ministry of Power and Energy (MOPE) is mandated to formulate and implement policies, programs, and projects pertaining to power and energy, and all subjects that come under the purview of the institutions within the MOPE; provide all public services that come under the MOPE's purview; reform all systems and procedures to ensure the efficient conduct of business; monitor, investigate, plan, and develop electricity facilities throughout Sri Lanka, including hydropower, thermal power, mini hydro, coal, and wind power; extend rural electrification; develop a sound, adequate, and uniform electricity policy for the control, regulation, and utilization of energy resources; promote energy efficiency; and develop indigenous renewable energy resources.[a]

The Ceylon Electricity Board (CEB) is a state-owned corporation established on 1 November 1969 under the Ceylon Electricity Board Act No. 17 of 1969. The CEB is engaged in power generation (the CEB has one license and 23 power plants); transmission (one license); distribution (four licenses, serving about 4.5 million customers across four distribution regions); and collection of revenue. The CEB is also empowered to acquire assets, and to appoint and promote its officers, following the approved procedures. The license for the CEB Generation Division caters to 66% of the installed capacity on the Sri Lanka grid. The remaining generation capacity is held by the private sector.[b]

Lanka Electricity Company (LECO) is a state-owned distribution company that was formed in 1983 and started operating in June 1984. The LECO purchases bulk power from the CEB Transmission Licensee, and distributes it to consumers. The LECO serves 498,000 consumers in the western and coastal belt townships between Negombo and Galle. The LECO operates under the Sri Lanka Companies Act, and has the CEB and the Ministry of Finance (on behalf of the state) as major shareholders; other shareholders are also state entities.[c]

Independent power producers as classified in Sri Lanka are private power plants engaged in thermal generation—diesel engine and combined cycle. The power crises of the mid-1990s have prompted the entry of independent power producers, which use oil-fired power plants. By the end of 2013, seven independent power producers were operating.

Small power producers are independent private power plants engaged in nonconventional renewable energy-based generation—hydro, combined heat and power, solar power, biomass, and wind. Electricity generation from nonconventional renewable energy sources received a new impetus in 1996, when the government announced a standardized power purchase agreement and a standardized tariff for private developers of power plants with less 10 megawatts capacity and based on nonconventional renewable energy sources. More than 130 small power producers are operating.

The Public Utilities Commission of Sri Lanka (PUCSL) is structured as a multisector regulator, and is currently mandated to act as the economic, technical, and safety regulator for the electricity industry, as well as for petroleum and water industries of Sri Lanka under the purview of the PUCSL Act No. 35 of 2002. The PUCSL was established in July 2003. In 2009, through the passage of Electricity Act No. 20, the PUCSL was empowered to regulate the generation, transmission, distribution, supply, and use of electricity. The PUCSL is answerable to the Parliament.[d]

The Sri Lanka Sustainable Energy Authority was established in October 2007, through the Sri Lanka Sustainable Energy Authority Act No. 35 of 2007, with a mandate to assist in developing the national policy on energy; to implement policy for renewable energy, and for energy efficiency and conservation; to promote development of renewable energy projects through private investment; and to conduct research on the development of indigenous energy resources. The Authority currently functions under the purview of the Ministry of Environment and Natural Resources.[e]

Sources:
[a] Ministry of Power and Energy.
[b] Ceylon Electricity Board
[c] Amarawickrama and Hunt (2005); ADB (2007).
[d] Government of Sri Lanka (2009); Perera (2010).
[e] ADB (2011).

common user facilities. No further restructuring or reforms have been implemented and the plan to privatize a further third of the retail network has been shelved.

However, a new industry act, which has been in draft form for several years, aims to guide reforms and to empower the PUCSL to regulate the petroleum industry. Pricing reforms implemented in 2003–2004 establishing a pricing formula have been abandoned, and pricing has since been largely done through administrative decisions.

The reform plans for the petroleum industry were abandoned largely as a result of the change of government in 2004, and pledges made to employees of the government-owned CPC about the future of the corporation, especially with regard to the downstream retail business. Even given this scenario, pricing reforms could have continued under the duopoly structure of the retail market (the CPC and Lanka Indian Oil Company). However, no initiatives have been taken to reestablish the pricing formula for retail sales of petroleum products. One reason for abandoning the pricing formula is political criticism. The CPC has reported losses for several years, largely because the pricing of its products does not reflect its costs.

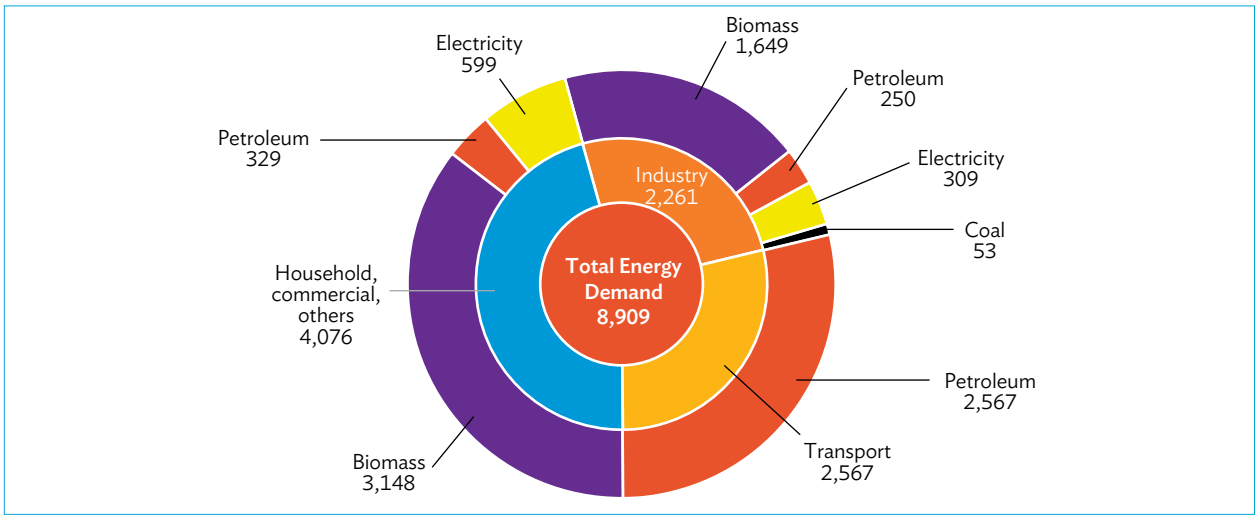
2.3 Status and Trends in the Power Sector

2.3.1 Electricity Demand

On the demand side, households and commercial activities take the largest share of total energy consumption (45.8%), followed by transport (28.8%), industry (25.4%), and agriculture (0.06%). Figure 2.5 summarizes the demand for various forms of energy.

In the 1990s and early 2000s, electricity consumption was dominated by industry; however, since 2003, the household subsector has overtaken industry as the largest user, and the commercial subsector's share has also been increasing (Figure 2.6).[4]

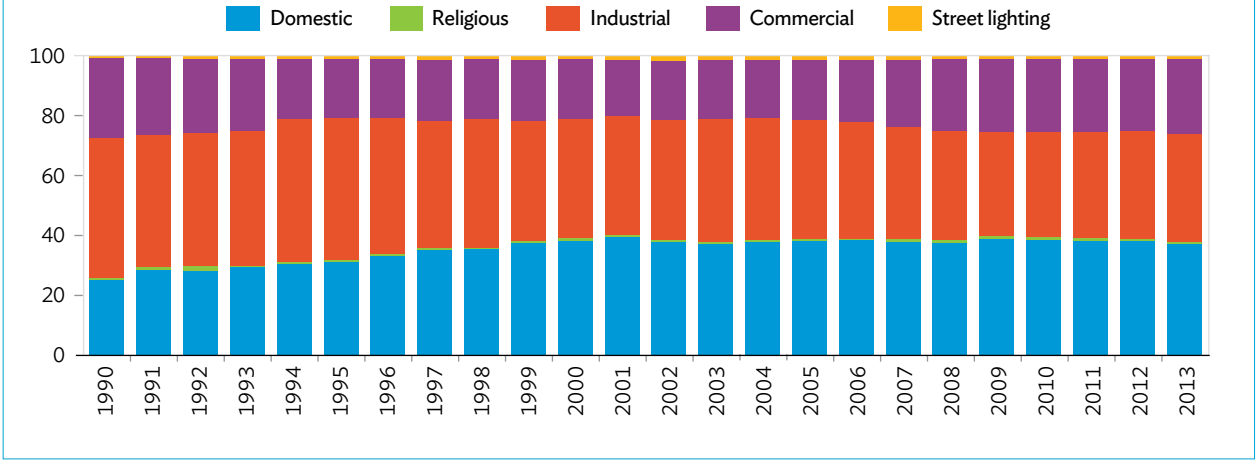
Figure 2.5: Energy Demand by Source and Subsector, 2013 ('000 tons of oil equivalent)



Note: Agriculture's energy demand, which amounts to 5.53 thousand tons of oil equivalent, is too small to appear in the graph. The agriculture sector uses petroleum, namely diesel and fuel oil.
Source: Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance data for 2013 (accessed 20 October 2014).

[4] The classifications of household, industry, and commerce are used for setting tariffs. Thus, for example, parts of the food and beverages industry may, for the purpose of electricity tariffs, be defined as a commercial entity.

Figure 2.6: Market Use of Electricity (%)



Note: Based on Ceylon Electricity Board sales.
Source: Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance data (accessed 20 October 2014).

The demand for electricity is forecast to grow about 6.5% per year in the longer term. Recent annual sales growth rates were 8.5% (2011), 4.2% (2012), and 1.41% (2013). Although the growth rate fell in 2013, the longer-term trend is indicative of annual growth rates of above 5%. The CEB conducts forecasting studies using econometric models, and then develops least-cost generation expansion plans for three demand scenarios (most likely, higher, and lower growth), and for several policy scenarios. The plans have been updated every year, but recent regulatory decisions require the plan to be updated every 2 years.

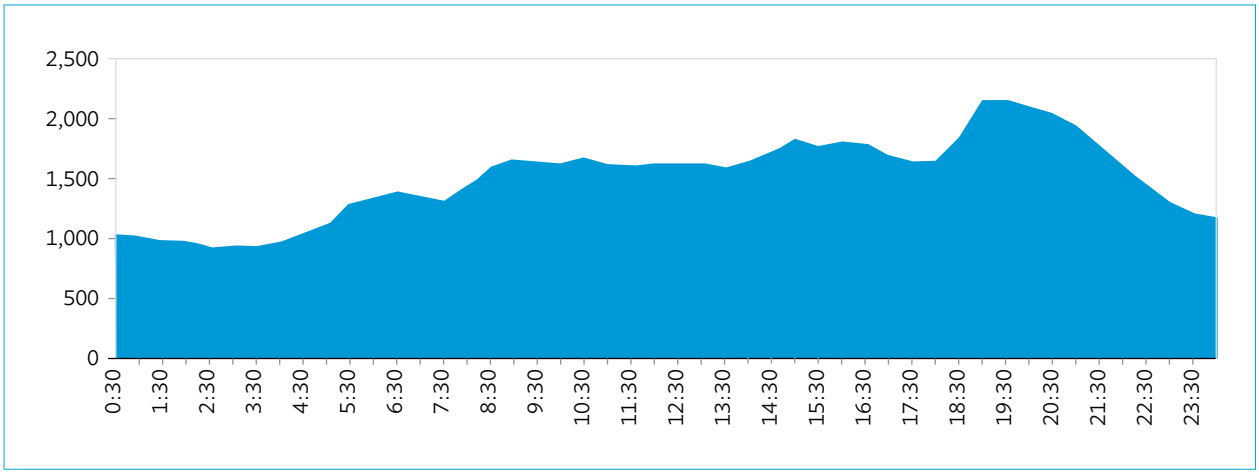
Peak demand in 2013 was about 2,164 megawatts (MW), which was met fully with no load shedding, planned or unplanned.[5] The last planned load shedding in Sri Lanka occurred on 15 May 2002, and ended a long period of capacity shortages that required load shedding from mid-2001 and earlier in 1992 and 1996. The main reason for capacity shortages during 2001–2002 was the delay in implementing the long-term generation expansion plan, caused by political indecision. In response, the construction of several power plants was planned, while thermal independent power producers (IPPs) provided capacity at a higher cost than the long-term least-cost options. Additionally, the first coal-fired generating plant, with a capacity of 300 MW, was commissioned in March 2011.

Sri Lanka's load profile has a relatively high evening peak caused largely as lighting comes on for household use. The system load factor shows a gradual increase because of the energy contribution from embedded generation (generators that are connected to the distribution grid but do not have direct access to the transmission network). The contribution of embedded generation is not included in the peak demand assessments.

Figure 2.7 shows the system load profile on the peak day of 2013; Table 2.2 shows the assessed system load factor, with and without embedded generation.

[5] Measured at the gross generation level. The contribution from embedded generation—generators that are connected to the grid but do not have direct access to the transmission network—comes largely from small hydroelectric power plants, and is not included here but is estimated to be about 100 MW coincident with the reported peak. However, unofficial load shedding occurred in 2012 (*Lanka Business Online* 2013).

Figure 2.7: System Load Profile, 8 April 2013 (gross generation, MW)



MW = megawatt.
Note: On 8 April 2013, the maximum demand of centrally dispatched power plants occurred. The profile is not adjusted for embedded generation.
Source: Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance data for 2013 (accessed 20 October 2014).

Table 2.2: System Peak Demand and Load Factor

	2005	2006	2007	2008	2009	2010	2011	2012	2013
System Peak Demand									
(MW; excluding embedded generation)	1,748	1,893	1,842	1,922	1,868	1,955	2,163	2,146	2,164
Gross Generation to National Grid (GWh)									
Including embedded generation	8,844	9,443	9,845	9,987	9,962	10,784	11,528	11,803	11,960
Excluding embedded generation	8,562	9,095	9,498	9,549	9,410	10,052	10,806	11,069	10,784
System Load Factor (%)									
Including embedded generation	57.8	56.9	61.0	59.3	60.9	63.0	60.8	62.8	63.1
Excluding embedded generation	55.9	54.8	58.9	56.7	57.5	58.7	57.0	58.9	56.9

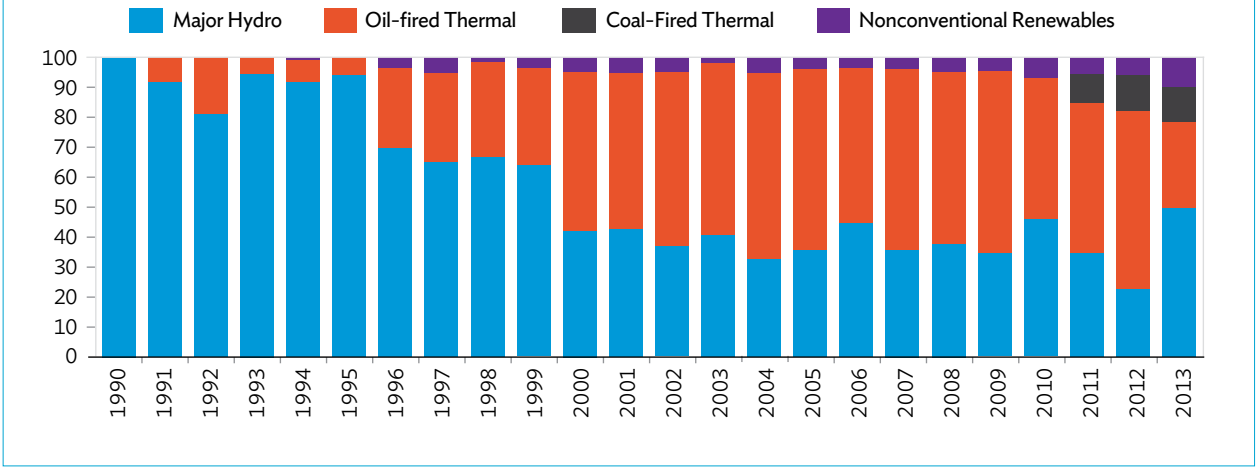
GWh = gigawatt-hour, MW = megawatt.
Source: PUCSL, *Generation Performance in Sri Lanka* (various years, accessed 20 October 2014).

2.3.2 Electricity Generation

The rapid growth in electricity use during the last 15 years required an increase in the share of electricity from oil-fired thermal plants (Figure 2.8), as large hydropower development was often limited and construction of the planned medium-scale hydropower projects was often delayed. Along with the expanded use of fuel for transport, expenditure on oil imports increased significantly, from $0.311 billion in 1990 to $4.895 billion in 2012, which was about 8% of GDP. The volume and cost of imported oil has increased almost yearly from 1990 (Figure 2.9). Sri Lanka does not produce fossil fuels and imports all its requirements.[6] Sri Lanka started importing coal in 2011, with the commissioning of the first coal-fired power plant.

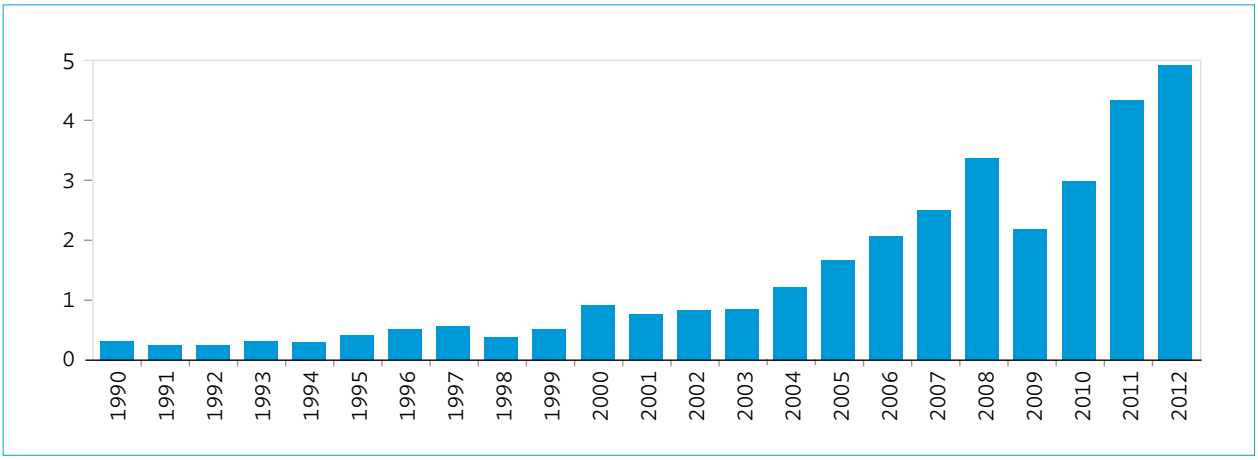
[6] Exploration for oil and gas, however, is being conducted in the Gulf of Mannar, in the northeast of Sri Lanka.

Figure 2.8: Changing Fuel Mix in Electricity Generation (%)



Source: Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance data (accessed 20 October 2014).

Figure 2.9: Cost of Oil Import ($ billion)



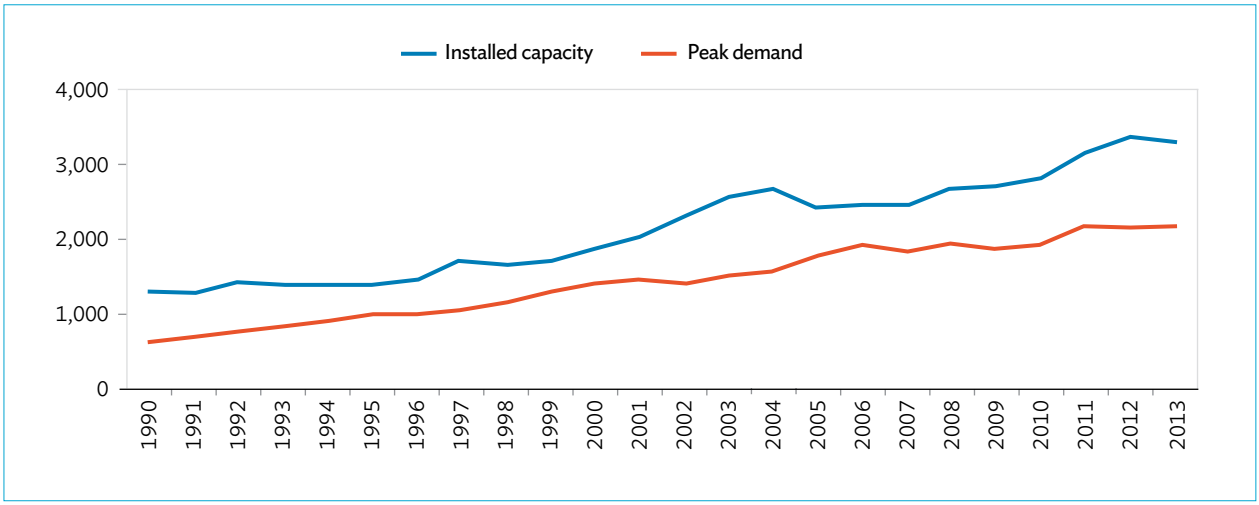
Note: Includes oil imports for all subsectors (electricity generation, transport, industry, other users).
Source: Central Bank of Sri Lanka (various years).

Generation capacity has always been above the peak demand, as shown in Figure 2.10; however, the dependence on hydroelectric generation has resulted in supply shortages during dry seasons, requiring load shedding in 1992, 1996, 2001, and 2002.

The CEB Generation Division's license accounted for 66% of the installed capacity on the grid as of 2013. The remaining generation capacity is held by the private sector (Figure 2.11), as IPPs and small power producers (SPPs).

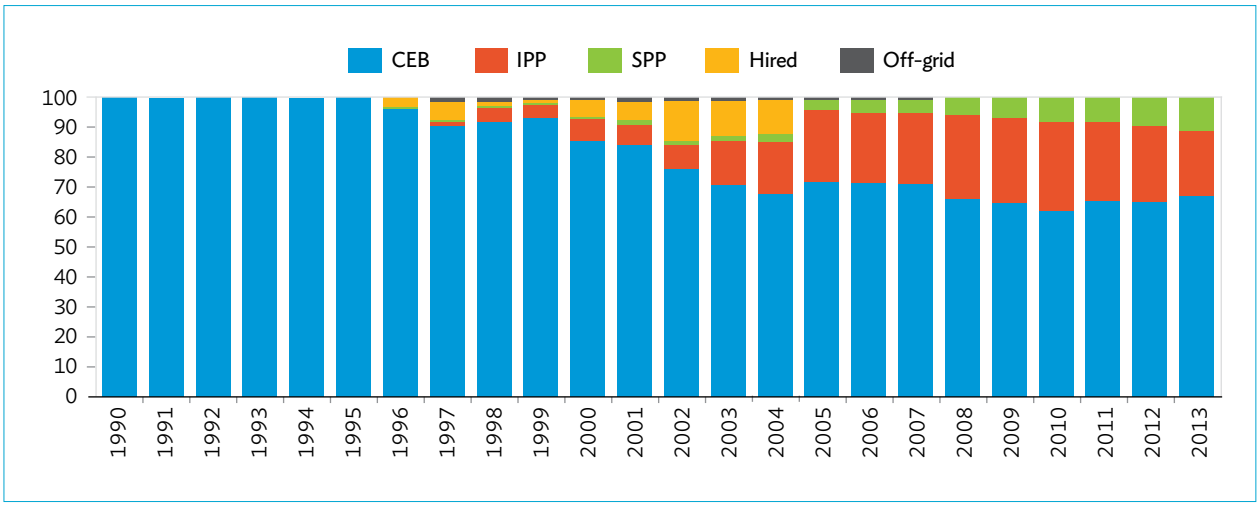
During the last 2 decades, Sri Lanka's electricity generating system has been transitioning from a predominantly hydroelectric system to a mixed hydrothermal system. In 2012, oil-fired thermal power plants provided 59% of generation, followed by hydropower at 23%. Owing to significantly above-average rainfall, there was a quick shift to hydropower generation in 2013, which provided 49% of generation while oil-fired thermal generation was reduced to only 28% of generation (Table 2.3).

Figure 2.10: Installed Generation Capacity and Peak Demand (MW)



MW = megawatt.
Source: Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance data (accessed 20 October 2014).

Figure 2.11: Installed Capacity Share of CEB and Private Power Plants (%)



CEB = Ceylon Electricity Board, IPP = independent power producer, SPP = small power producer.
Note: IPPs typically hold 10–20-year contracts; SPPs all use renewable energy sources, and hold 15–20-year contracts; hired power plants are short-term rented capacity—currently there are no hired power plants in the network.
Source: Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance data (accessed 20 October 2014).

The Mahaweli River Complex, with a cascade of six power plants totaling 660 MW, is the country's largest hydroelectric scheme. It was built during 1970–1990. The Kelani Complex (built during 1950–1983) comprises a cascade of five power plants with a total capacity of 335 MW. Smaller capacity additions to these power plants and new medium-scale (10–50 MW) run-of-river power plants are still to be added to both the cascades. Small thermal power plants have been operating since 1962 to bridge capacity shortages during dry spells, but, since mid-1990s oil-fired thermal generating plants have been instrumental in meeting demand.

Table 2.4 summarizes the power plants and their ownership as of mid-2014. Oil-fired thermal power plants are providing an increasing portion of Sri Lanka's electricity. Fuels used for electricity generation are coal, residual oil, furnace oil, auto diesel, and naphtha.

Table 2.3: Electricity Generation, by Type

	Total Installed Capacity (MW)		Generation (GWh)		Share of Generation (%)	
	2012	2013	2012	2013	2012	2013
Major Hydro[a]	1,337	1,341	2,684	5,937	23	49
Thermal (oil)	1,395	1,275	7,013	3,350	59	28
Thermal (coal)	300	300	1,404	1,469	12	12
NCRE[b]	336	375	778	1,245	7	10
Total	**3,368**	**3,291**	**11,879**	**12,001**	**100**	**100**

GWh = gigawatt-hour, MW = megawatt, NCRE = nonconventional renewable energy.
Notes:
[a] Of the 17 major hydro plants, 11 operate in two cascades.
[b] Installed capacity of and generation from NCRE do not include off-grid nonconventional generation units. NCRE includes small hydro, wind, biomass, and solar.
Note: Percentages may not total 100% due to rounding.
Sources: Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance data (accessed 20 October 2014).

Table 2.4: Power Sources, mid-2014

Resource	Type	Megawatt
Renewables	CEB hydro	1,356
	CEB wind	3
Small Renewables (SPPs)	Private hydro	281
	Private biomass	19
	Private wind	99
	Private solar	1
	Total renewable	*1,758*
Thermal	CEB oil-fired	537
	CEB coal-fired	600
	Private oil-fired (IPPs)	796
	Total thermal	*1,933*
Total Installed Capacity		**3,691**
Peak Demand (excluding small renewables)		2,152
Surplus Available (excluding small renewables)		1,139
Reserve Margin		53%

CEB = Ceylon Electricity Board, IPP = independent power producer, SPP = small power producer (with capacity of less than 10 megawatts).
Note: The peak demand for 2013 is used as proxy for the peak demand for mid-2014. Numbers may not add up due to rounding.
Source: CEB data on power plants.

CEB Power Plants. The CEB presently has one combined cycle power plant that can be operated either on naphtha or auto diesel, and gas turbine plants operating on auto diesel. All the CEB's diesel power plants operate on residual oil. There were seven IPPs at the end of 2013, which have 10- to 20-year contracts with CEB to build, own, and operate power plants. These IPPs also use diesel, furnace oil, or residual oil. They have a total contracted capacity of 796 MW.

At the end of 2013, in addition to the 796 MW from thermal IPPs, the CEB had 872 MW of installed thermal generating capacity (Table 2.5). The CEB power plants were mostly built using concessionary loans from multilateral and bilateral agencies, which the government on-lent to the CEB. When the loans are repaid, the CEB will only bear yearly maintenance costs of power plants.

The second stage of the first coal-fired power plant is of 600-MW installed capacity and was commissioned in October 2014, raising the total coal-fired generating capacity to 900 MW.

Table 2.5: CEB Thermal Power Plants, End of 2013

Plant Type		Units x Capacity	Gross Generation Capacity (MW)	Effective Capacity Gross (MW)	Date Commissioned	Annual Max. Energy (GWh)
Kelanitissa Power Station						
Gas Turbine (old)	Auto Diesel	5 x 20	100	85	Dec '81, Mar '82, Apr '82	417
Gas Turbine (new)	Auto Diesel	1 x 115	115	115	Aug '97	707
Combined Cycle	Naphtha/ Auto diesel	1 x 105, 1 x 60	165	165	Aug '02	1,290
Kelanitissa Total			**380**	**365**		**2,414**
Sapugaskanda Power Station						
Diesel	FO 180cSt	4 x 20	80	72	2 units May '84	472
					Sep '84, Oct '84	
Diesel (extension)	FO 180cSt	8 x 10	80	72	4 Units Sept '97	504
					4 Units Oct '99	
Sapugaskanda Total			**160**	**144**		**976**
Small Thermal Plants						
Chunnakam	FO 180cSt	1 x 8	8	8	1999	58[a]
Chunnakam		1 x 24	24	24	2013	176
Small Thermal Total			**32**	**32**		**234**
Puttalam Coal-fired Power Plant						
Coal Puttalam	Bituminous coal	300	300	275	May '11	2,102
Puttalam Total			**300**	**275**	**2011**	**2,102**
Total Thermal			**872**	**816**		**5,726**

FO 180cST = fuel oil 180 centistokes, GWh = gigawatt-hour, MW = megawatt.
[a] Approximate.
Note: The Puttalam coal-fired power plant is a 900 MW power complex with the remaining two units of 300 MW each starting operation in January and October 2014.
Source: CEB (2013); Ministry of Power and Energy (n.d.).

Power Plants under Construction. The CEB plans to commission the second coal-fired power plant by 2018, which will increase its generating capacity by 500 MW. Additionally, construction work on Uma Oya hydroelectric power plant (80 MW) has commenced.

Financing for Sri Lanka's first coal-fired power plant (900 MW) cost $1,350 million, including the 220-kilovolt (kV) transmission interconnections to two locations. The financing has been obtained from the Export-Import Bank of China. The plant is being constructed by a nominated contractor. The first phase costs $450 million at 2% interest rate for two-thirds of the amount and 6% for the rest. The second phase costs $891 million, reportedly lent at 4% interest rate (Sirimanna 2011). The second coal-fired power plant is to be in the eastern port city of Trincomalee, as a joint venture between the National Thermal Power Corporation of India and CEB, as an IPP. The joint venture company has been established, and the power purchase agreement

Table 2.6: Nonconventional Renewable Energy Power Plants Serving the Grid and Share of Generation, 2013

Type of Plant	Total Installed Capacity (MW)	Generation (GWh)	Share of Generation from NCRE (%)
Hydro (small)	276.2	981.9	78.9
Wind	81.5	234.6	18.8
Biomass	16.0	26.4	2.1
Solar	1.4	1.7	0.1
Total	**375.1**	**1,244.5**	**100.0**

GWh = gigawatt hour, NCRE = nonconventional renewable energy.
Note: Numbers may not add up due to rounding.
Source: Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance data (accessed 20 October 2014).

was signed in 2013. The joint venture project company has indicated that loans will be raised from international banks.

About 25 small hydroelectric power plants (less than 10 MW each, but in general, in the range of 1–3 MW) are under construction, and the small hydroelectric capacity (281 MW as of mid-2014) is expected to reach 300 MW by the end of 2015. As of mid-2014, wind power generating capacity is 99 MW and is expected to reach 130 MW by the end of 2014. All SPP projects have been financed through loans from local banks. Initially, the loans were refinanced through two World Bank-funded projects.[7] Because the World Bank credit facility ended in 2012, further SPP projects are being financed by banks on commercial terms.

More contracts have been signed for small hydropower development. SPP wind power development is being reviewed, and is likely to move to a better streamlined mechanism of solicitation, including public–private partnerships and competitive bidding.

Small Power Plants and Nonconventional Renewable Energy. The national energy policy targets 10% of the total electricity generation to be from nonconventional renewable energy (NCRE),[8] by 2015. By 2013, the NCRE target had been achieved. Table 2.6 lists the types of NCRE power plants currently operating on the grid.

Currently, small hydropower plants are developed as grid-connected private power plants feeding the grid on a commercial basis. By mid-2014, 131 small hydropower plants (all privately owned) were connected to the grid, with an aggregate capacity of about 281 MW. Over 300 micro hydropower plants (typically less than 20 kilowatts [kW]) were used to provide the basic electricity needs of remote communities with no involvement of the grid or CEB. About 50 off-grid micro hydropower plants (typically less than 100 kW) are still used by tea and rubber estates to provide power to their factories and bungalows. A few estates have been connected to the grid and are charged on the basis of net metering regulations.[9]

In 1999, the CEB set up the country's first wind power generation plant, of 3 MW capacity in Hambantota, as a pilot project.[10] The CEB has issued nine contracts to private investors to develop wind power plants, on the basis of the standardized feed-in tariffs. About 79 MW of capacity was operational by the end of 2013 and 99 MW by mid-2014, mostly in Puttalam District in the North Western Province.

Solar photovoltaic systems are being used for small-scale applications in remote regions. About 110,000

[7] These are the Energy Services Delivery Project and the Renewable Energy for Rural Economic Development Project. They financed loans to SPPs during 1997–2012 at concessionary rates, typically 2%–4% below market rates. All loans were denominated in Sri Lankan rupees.

[8] NCRE covers all renewable energy for power generation except major hydropower.

[9] The Guide to Net Metered Facilities was published in the Distribution Code of Sri Lanka in 2012. The latest NCRE tariff announcement was approved by the Cabinet on 3 July 2014 (CEB 2014c).

[10] Energy Services Delivery project.

solar home systems were in use by the end of 2008.[11] In 2011, four grid-connected solar photovoltaic systems were commissioned.

Net-metered solar photovoltaic systems are allowed, and about 50 such systems were operating on roof tops of commercial buildings and 500 smaller net-metered systems were operating in households by the end of 2013.

Generation of electricity using biomass grown in dedicated plantations ("dendro power") is considered to be a promising power option for Sri Lanka. Biomass used for power generation includes rice husk, waste gas from coconut shell pyrolysis, and wood. Thermal energy from woody biomass harvested from plantations of fast-growing tree species could power a conventional steam power plant or gasifier-based diesel or gas turbine plants. The first commercial dendro power plant, of 1 MW, was commissioned in 2004, but it is not presently operating. A smaller power plant, of 500 kW, is currently operating. Rice husk is used in two power plants, with a total capacity of 11 MW.

In 1996, a feed-in tariff was established for power plants of capacity up to 10 MW and using renewable energy resources. The "net" metering facility first introduced in 2009 is available to all electricity customers. The customer is free to use any renewable energy source, including waste heat and based on resource availability and customer's affordability. The capacity limit is the demand the customer already has contracted for with the distribution licensee, subject to a maximum of 42 kilovolt-amperes.[12] Each month, the customer will be billed for the net purchase from the grid. Exports to the grid are credited to the customer's bill, to be used at any time, in any month in the future. There is no cash payment for surplus energy sent to the grid, and all credits are held in terms of energy units (kilowatt-hours [kWh]). Credits can be carried through until the end of the net metering contract (10 years). A project to rehabilitate microhydro facilities in the tea industry (typically 20–200 kW) and the grid to connect them under net metering regulations is under way.

Forecast of Energy Mix in Power Generation. Figure 2.12 presents the historical and planned energy mix in power generation, as of 2011, which is consistent with the national policy objective of developing NCRE facilities to provide 10% of generation. The forecast also reflects the moratorium presently in place on the construction of new oil-fired thermal generating facilities. The purpose is to ensure that lower cost (i.e., coal-fired) generating facilities and renewable energy facilities are built, which will manage the costs of generation and ensure that the renewable energy targets are met. The forecast energy mix is expected to reduce the real cost of electricity generation from thermal (Figure 2.13), although the inclusion of the renewable targets raises overall generation costs above what they would otherwise be.

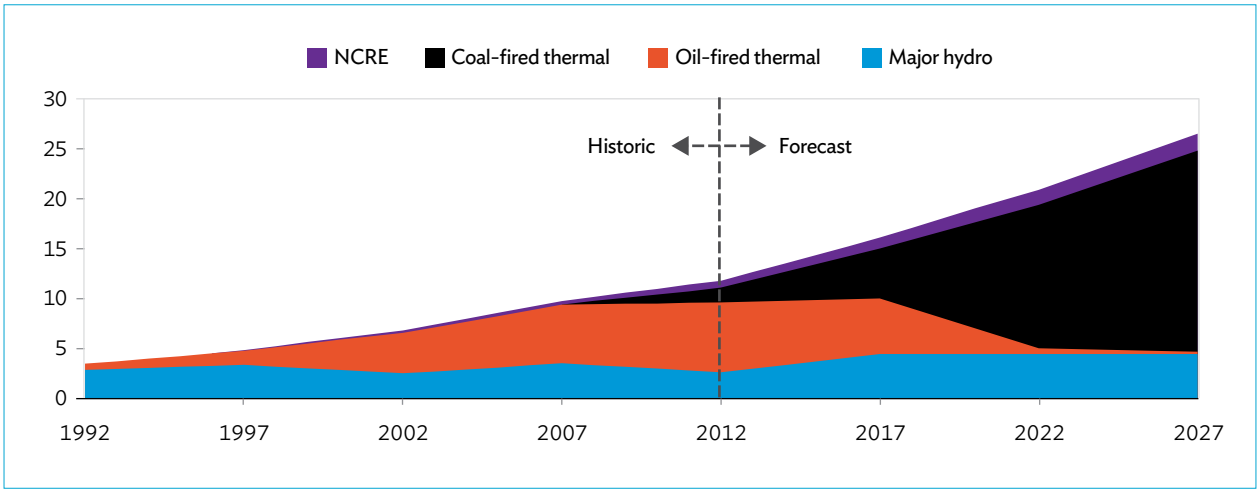
The share of oil-fired generation in the grid is expected to decline from the 60% level in 2012 to less than 10% by 2020. The gap will be filled mostly with newly built coal-fired generating plants and, to a lesser extent, by renewable energy-based generating facilities. Accordingly, the fuel cost of producing electricity from thermal sources, on average, will decline significantly. All major thermal power plants to be added to the system from 2012 on are coal-fired, thus bringing the average cost of fuel for producing electricity from thermal sources to approach that of a coal-fired power plant (i.e. $0.06/kWh at a coal price of $150 per metric ton in constant prices) in the long term.

While lower production costs are the attractive feature of coal-fired power plants, two issues are of concern: (i) difficulties expected when coal power plants are required to cycle daily to match the demand profile; and (ii) security of supply because in the longer term, imported coal would provide about 75% of the country's electricity supply. Some corrective action is needed to address both issues.

[11] By mid-2007, about 130,000 solar photovoltaic systems were operating for household use. There were reductions owing to rapid expansion of the grid.

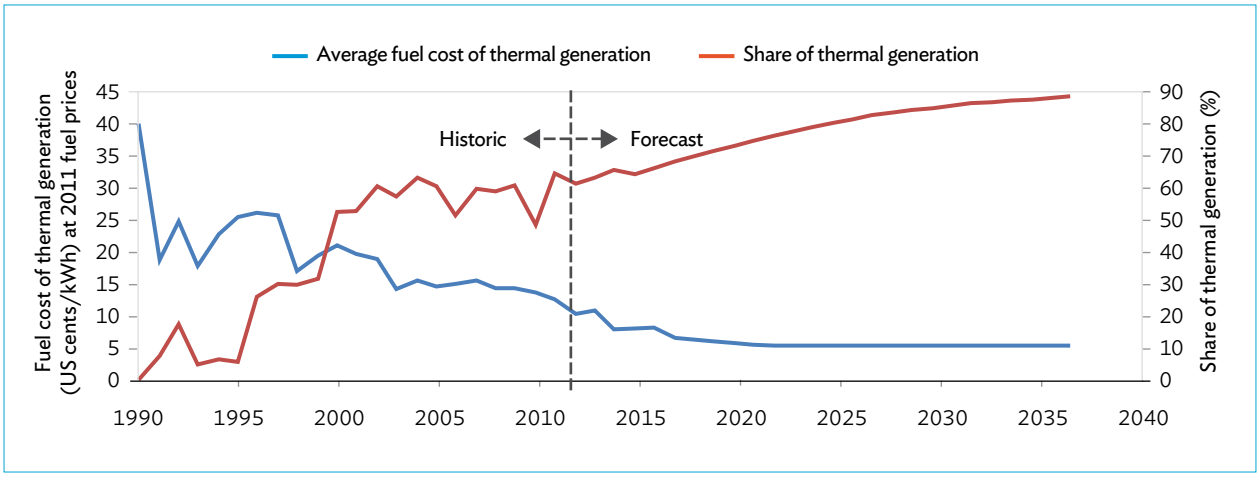
[12] Corresponds to a three-phase, 60-ampere supply, which is the highest rating for a retail supply. In 2012, the capacity limit for net-metered generating facilities was increased to the customer's contract demand, allowing larger customers to install larger renewable energy-based generating systems.

Figure 2.12: Hydro, Thermal, and NCRE Share of Electricity Generation: Historic and Planned (TWh)



TWh = terawatt-hour, NCRE = nonconventional renewable energy.
Source: CEB (2013).

Figure 2.13: Forecast Average Energy Cost of Thermal Generation



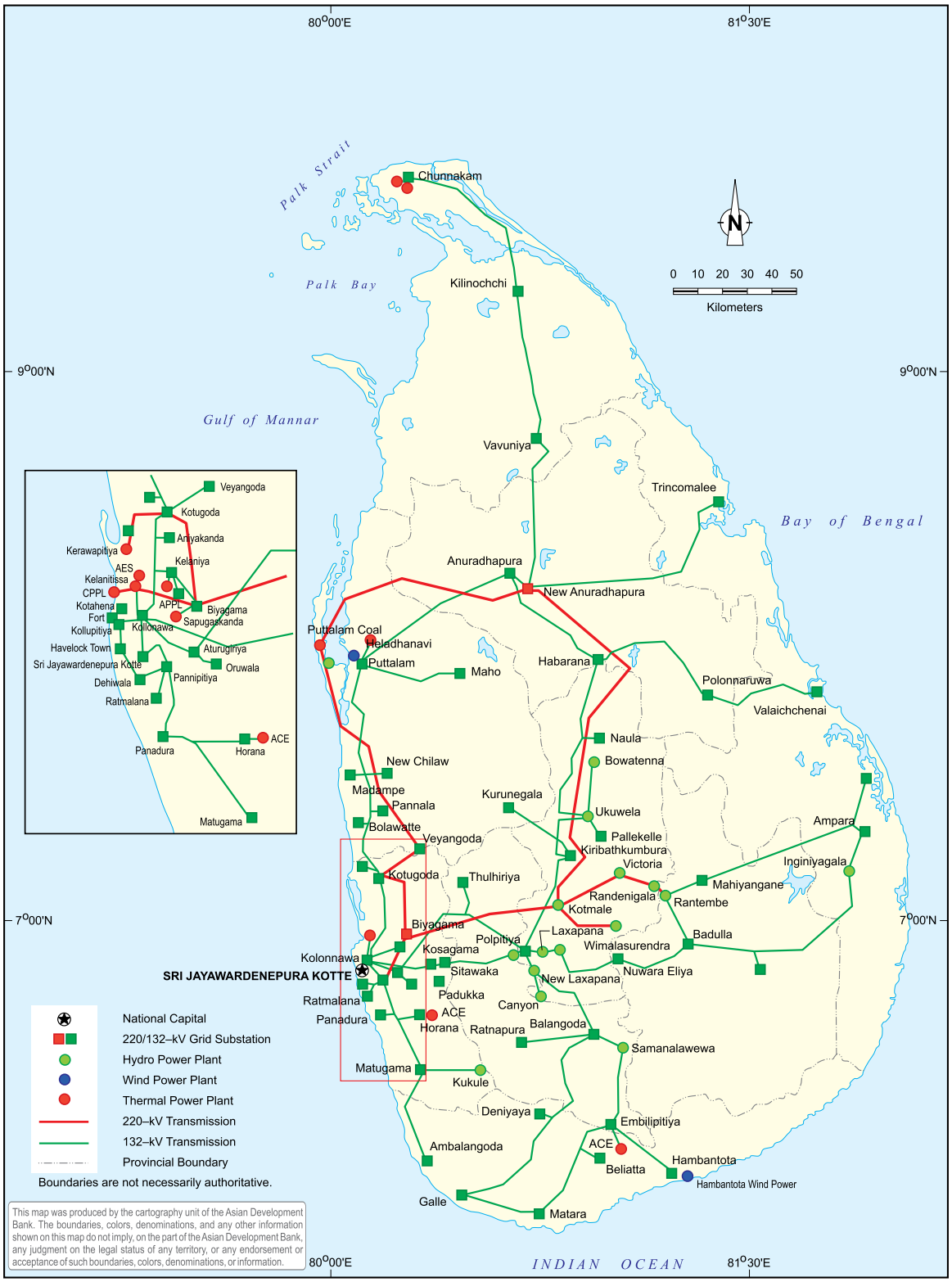
kWh = kilowatt-hour.
Note: Based on July 2011 fuel prices in Sri Lanka in financial terms for power generation, equivalent to the following: diesel at $131.5/barrel, fuel oil 180 centistokes at $91.1/barrel, fuel oil 380 centistokes for $86/barrel, naphtha for $77.8/barrel, coal for $150/metric ton, and biomass (grown) for $108/ton. Historic fuel consumption was multiplied by the July 2011 prices to obtain the equivalent historic fuel costs of electricity production during 1990–2010.
Source: Calculated using dispatch information available in CEB (2011).

2.3.3 Electricity Transmission

The license for the transmission and bulk supply function is held exclusively by the CEB, as stipulated in the Electricity Act 2009. The transmission network (Figure 2.14, Table 2.7) consists of 62 grid substations (132/33 kV, 220/132/33 kV, 220/132 kV, and 132/11 kV) and about 2,436 kilometers of high-voltage lines (both 220 kV and 132 kV).

The transmission grid provides for the requirements of all cities and towns in Sri Lanka. During the civil war, however, the transmission line of the northern Jaffna peninsula was damaged. Since the end of the war in 2009, many towns in the Northern Province have been reconnected to the grid. In mid-2013, the transmission grid reached the Jaffna peninsula, thus covering the entire country once again. There is no load shedding due to transmission or

Figure 2.14: Power Plants and the Transmission Network



kV = kilovolt, kW = kilowatt.
Notes: Nonconventional renewable energy power plants (small hydro, wind, and biomass) are not marked. The transmission line from Vavuniya to Chunnakam was reconnected by the end of 2013.
Source: CEB (2015).

Table 2.7: Facilities of the CEB Transmission Licensee, 2013

Parameter	Measure
Number of 220-kV Grid Substations	8
Number of 132-kV Grid Substations	54
Length of 220-kV transmission lines	501 Ckt-km (overhead)
Length of 132-kV Transmission Lines	1,885 Ckt-km (overhead) 50 Ckt-km (underground)

CEB = Ceylon Electricity Board, Ckt-km = circuit kilometer, kV = kilovolt.
Source: CEB, *Statistical Digest 2013*.

distribution network limitations. The annual transmission planning exercise by the CEB ensures that the growth of demand in all the load centers is identified. Network strengthening projects address any imminent capacity shortages as demand grows.

2.3.4 Distribution, Customers, and Sales

Sri Lanka is divided into five regions for power distribution, supply, and sales, where each distribution entity holds a license. Four of the distribution licenses are held by the CEB and cover more than 97% of the country and 91% of customers. Lanka Electricity Company Ltd. (LECO), established in 1983 as a subsidiary of the CEB, covers the remaining areas and serves 478,500 customers. The CEB electricity distribution network consists of medium-voltage lines (33 kV and 11 kV), primary substations (33 kV/11 kV), distribution substations (33 kV/400 volt [V] and 11 kV/400 V), and low-voltage lines (400 V). The LECO distributes at 11 kV and 400 V.

The CEB's network of 400 V/230 V distribution lines (overhead and underground) stretches over 104,153 kilometers, and the total length of all low-voltage lines stretches to 121,349 kilometers (CEB 2013a). The LECO purchases electricity from the CEB and distributes it among retail and bulk customers in their designated areas, between Galle and Negombo along the Western coastal belt. At the end of 2013, the national grid served 5.7 million customers of the CEB and LECO, 88% of which were households. Commercial customers (all public buildings, offices, and shops) were a further 11%, and industrial customers accounted for most of the rest (Table 2.8 and Table 2.9)

Table 2.8: CEB and LECO Customers, 2013

Customer Class	CEB	LECO	Total
Household	4,589,929	434,148	5,024,077
Religious	31,627	2,441	34,068
Industrial	53,162	3,476	56,638
Commercial	536,041	75,744	611,785
Others	2	4,650	4,652
Total	**5,210,761**	**520,459**	**5,731,220**

CEB = Ceylon Electricity Board, LECO = Lanka Electricity Company Ltd.
Source: CEB (2013a).

Table 2.9: CEB and LECO Sales (GWh)

Customer Class	2006	2007	2008	2009	2010	2011	2012	2013
Households	3,056	3,208	3,230	3,363	3,641	3,917	4,053	4,001
Religious	51	50	49	51	55	59	63	67
Industry	2,901	2,911	2,950	2,765	3,141	3,372	3,521	3,583
Commercial	1,633	1,864	1,986	2,059	2,224	2,490	2,614	2,752
Street Lighting and Others	125	136	135	133	130	133	139	133
Total Sales	**7,766**	**8,169**	**8,350**	**8,372**	**9,191**	**9,972**	**10,390**	**10,536**
Sales Growth	7.9%	5.2%	2.2%	0.3%	9.8%	8.5%	4.2%	1.4%

CEB = Ceylon Electricity Board, GWh = gigawatt-hour, LECO = Lanka Electricity Company Ltd.
Note: Numbers may not sum precisely because of rounding.
Sources: Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance.

For 2013, the CEB reported a transmission and distribution loss of 9.5% (on net generation) and the LECO reported a distribution loss of 6.6%. The total actual national transmission and distribution loss for 2013 is estimated at 10.2% of net generation. This is lower than the 12.9% target set by the PUCSL for 2013.

2.4 National Energy Policy and Strategies

In 2006, a panel of experts drafted the National Energy Policy and Strategies of Sri Lanka (Ministry of Power and Energy 2008). The draft was approved by the Parliament in 2008. The key policy elements of the document related to (i) providing basic energy needs, (ii) ensuring energy security, (iii) promoting energy efficiency and conservation, (iv) promoting the use of indigenous resources, (v) adopting an appropriate pricing policy, (vi) enhancing energy sector management capacity, (vii) protecting consumers and ensuring a level playing field, (viii) enhancing the quality of energy services, and (ix) preventing adverse environmental impacts of energy facilities.

The 10-year plan to implement the strategy identified a set of investments needed to achieve the specific outcomes of each aspect of policy (Table 2.10).

Some of the relevant highlights of the Energy Policy include:

- NCRE was to be the fourth energy resource in the diversification and security strategy, to supply a minimum of 10% of electrical energy to the grid by 2015.This was to be achieved by a process of facilitation, including access to green funding such as the Clean Development Mechanism. Subsequently, the government raised the target to 20% of total generation from NCRE by 2020. Household electrification was to reach 95% by 2015, with 89% provided from the grid. The government revised this target to 100% electrification by 2012.
- Transmission and distribution energy losses (the sum of technical and commercial losses) in electricity will be gradually brought down to a maximum of 13.5% of net generation by the end of 2009. The target is 12.0% by 2015.

Table 2.10: Energy Sector Investments Planned for 2006–2016

	Projects		Total Investment 2007–2016	Investment Requirements (SLR million) 2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1	Electrification of Households	FC	16,676.7	4,027.4	2,189.0	1,200.0	1,444.0	1,466.0	1,110.1	1,354.1	1,232.1	1,410.1	1,244.0
		LC	7,377.8	0.0	418.0	627.0	979.5	946.8	881.3	1,233.8	1,057.6	881.3	352.5
2	Tariff Rationalization, Debt Restructuring, and Targeted Subsidies	Total	181,839.2	126,053.7	26,513.8	4,196.2	4,733.5	3,531.0	3,206.0	3,381.7	3,434.4	3,337.7	3,451.2
3	Fuel Diversity, Energy Security and Reliability in Bulk Power Generation	FC	451,582.5	33,637.1	57,452.7	71,287.4	85,970.6	60,682.9	48,672.3	26,957.3	21,921.8	26,107.9	18,892.4
		LC	88,810.8	784.3	3,351.1	6,937.1	9,527.7	8,553.9	8,430.3	8,317.4	14,055.8	16,739.8	12,113.4
4	Fuel Diversity: Renewable Energy for Power Generation		56,146.1	2,726.7	5,426.7	6,774.8	6,124.8	6,124.8	6,125.8	6,125.8	6,125.8	6,128.8	4,462.1
5	Transmission and Distribution Network Development	FC	105,520.0	9,510.7	16,798.4	14,640.0	37,488.8	11,300.6	8,083.3	4,971.0	1,227.2	750.0	750.0
		LC	29,949.3	4,137.5	6,317.7	3,718.3	6,382.3	2,843.5	2,491.2	1,709.5	849.3	750.0	750.0
6	Supply-Side Energy Efficiency	Total	9,580.0	948.0	1,204.0	1,248.0	904.0	836.0	872.0	812.0	860.0	916.0	980.0
7	Demand-Side Energy Efficiency	Total	5,060.0	1,540.0	1,098.0	642.0	665.0	180.0	145.0	140.0	255.0	255.0	140.0
8	Energy Sector Knowledge Management, Planning, and Funding	Total	28,953.3	285.7	505.8	967.8	652.2	2,940.0	3,694.3	3,328.2	6,452.0	5,263.7	4,863.5
9	Reforms and Regulatory Development	FC	1,550.0	775.0	775.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total Investments		**983,045.8**	**184,426.1**	**122,050.2**	**112,238.7**	**154,872.5**	**99,405.6**	**83,711.6**	**58,330.8**	**57,470.9**	**62,540.2**	**47,999.2**

LC = local cost, FC = foreign cost, SLR = Sri Lanka rupee.
Source: Department of National Planning (2007).

3. POWER SECTOR REFORM EXPERIENCE

3.1 Drivers of Power Sector Reform

All political parties, electricity industry participants, consumers, and the general public agree that the electricity sector needs reform, but views on what should be done and how are diverse. Most efforts to reform the sector have faltered, so that all South Asian countries, except Nepal, have now overtaken Sri Lanka with implementing power sector reform.

Reforms in Sri Lanka have been driven predominantly by inefficient delivery, financial problems, and the worldwide trend of reforming power sectors into competitive markets. Transmission and distribution losses were high by historical standards during the early to mid-2000s. This provides a strong indication of the electricity industry's inefficiency, both internal and external to the utilities. The perceived structural and managerial weaknesses and operational inefficiencies within the monolithic power utility, the CEB, were a key driver for reform.

Restructuring the Sri Lanka electricity sector was identified as part of a solution to numerous problems the electricity sector faces, including severe financial issues created by mismatches in cost and price of electricity, and administrative inefficiencies largely due to politicization of the sector. The CEB has been reporting losses ever since 1999. Its long-term debt as of 2012 exceeded SLRs200 billion (about $1.8 billion), and is projected to increase to SLRs500 billion (about $4 billion) by 2015.

A main reason for the poor financial performance in Sri Lanka's electricity sector is the ad-hoc pricing policy dictated by the different governments over the years. The CEB is saddled with large debts accumulated from years of not being allowed to charge cost-reflective tariffs. The CEB's average income from sales has not increased significantly since 2008, and has remained at about SLRs13.25/kWh, while the costs have increased. Because tariffs have not been adjusted to cover costs, financial instability persists in the industry. The once-large network losses have been greatly reduced, but the benefit from this is not evident because of the large financial deficits.

Reform and unbundling have been seen as attractive solutions to this problem, hoping that with improved accountability, smaller business units operating commercially would move gradually to profitability.

However, the CEB's current financial status is not creditworthy and the needed reform of prices and the pricing structure is yet to be implemented. This is despite the PUCSL being fully empowered to issue tariff orders to recover costs. The tariff-setting methodology requires that tariff prices be reviewed and reset every 6 months, but the PUCSL implemented only two of the eight tariff adjustments due from 1 January 2011 to 1 July 2014.

Historically, the government has financed the CEB's capital requirements, supplemented with multilateral development bank and bilateral loans. All of the CEB's hydroelectric power plants and thermal plants until 1996 were financed through such loans. For some larger multipurpose (irrigation, water supply, and power generation) hydroelectric projects, loans were secured directly by the government and subsequently on-lent to the CEB when the hydroelectric power plant was transferred to CEB ownership.

By the 1990s, the government recognized that private investment should be secured for the power sector, especially for power generation. The Power Sector Policy Guidelines of 1997 and 1998 calls for private sector investment in small hydropower plants and renewable energy sources. The CEB's inability to implement the long-term generation expansion plan for setting up large-scale, low-cost base-load plants in the last 3 decades was attributed to lack of funding or lack of effort to seek out any such funding.[13] The generation expansion plan prepared at least 10 years ago needs to be examined. This is because it takes a long time to formulate, call for bids, build, and commission a power plant.

Table 3.1: Implementation of the 2002 Long-Term Generation Expansion Plan

Year	Hydro Additions	Thermal Additions	Status, 2013
2003		**20-MW ACE Power Horana Diesel Plant** Entered the plan on the basis of government insistence Implemented as an IPP, 10-year PPA	PPA matured, plant not operating
2004	**70 MW Kukule** Entered the plan as a least-cost alternative; implemented	**163-MW AES Combined Cycle Plant at Kelanitissa** Entered the plan as a stop-gap measure until the coal-fired plant is operating Implemented as an IPP, 25-year PPA	PPA active, power plants operating
2005		**Two 100-MW Medium-Term Power Plants** Entered the plan through government insistence Implemented as an IPP, 10-year PPA	PPA active, power plants operating
2006		**Two 150-MW Combined Cycle Plants at Kerawalapitiya** Entered the plan as a stop-gap measure until the coal-fired plant is operating Implemented as a negotiated IPP, 25-year PPA	PPA active, power plants operating
2007			
2008		**300-MW Coal Steam Plant** Entered the plan as a least-cost option	Implemented many years behind schedule, in 2011
2009	**150-MW Upper Kotmale** Entered the plan as a least-cost option		Implemented 3 years behind schedule, in 2012
2010		**300-MW Coal Steam Plant** Entered the plan as a least-cost option	Commissioned in 2014
2011			
2012		**300-MW Coal Steam Plant** Entered the plan as a least-cost option	Commissioned in 2014
2013		**300-MW Coal Steam Plant**	Scheduled to be commissioned in 2018
2014		**245-MW Gas Turbines** Entered the plan as a least-cost option	Not scheduled for construction.
2015		**300-MW Coal Steam Plant** Entered the plan as a least-cost option **105-MW Gas Turbines** Entered the plan as least-cost options	Scheduled to be commissioned in 2018. Not scheduled for construction
2016		**300-MW Coal Steam Plant** Entered the plan as a least-cost option	Not scheduled for construction
2017		**315-MW Gas Turbines** Entered the plan as a least-cost option	Not scheduled for construction

IPP = independent power producer, MW = megawatt, PPA = power purchase agreement.
Source: ADB.

[13] However, in 2005, a $1.38 billion coal-fired power plant was fully financed through Export-Import Bank of China credit.

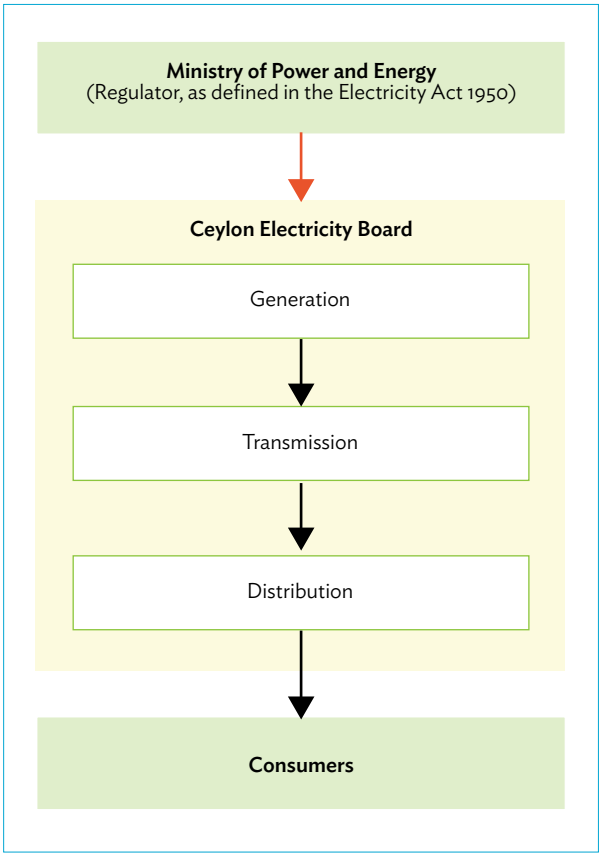
Table 3.1 shows the basis on which generating plants entered the long-term plan and the status of each power plant as of 2013.

3.2 Traditional Monopoly Structure (1969–1983)

Similar to other countries in the region, former Sri Lankan governments presumed that the electricity industry could best be served by a single organization carrying out all the functions from generation to retail supply. The CEB was established under Act No. 17 of 1969 to operate the electricity industry, replacing the Government Electricity Department. Since then, the industry has been run as a vertically integrated monopoly. The CEB, as a "board," enjoys a higher degree of financial independence than a government department, and is expected to make all its administrative and financial decisions independently.[14] Before the reforms, there was no competition at any level—generation or retail. The CEB controlled and undertook all business functions and had to serve all customers in the country. Under the Electricity Act of 1950, the government, via the Ministry of Power and Energy, regulated the utility, ideally to prevent monopoly abuse.

Figure 3.1 shows the structure of the electricity industry prior to the reforms. In areas not served by the CEB (which constitutes about 20% of total consumers), local government authorities were responsible for distribution of electricity.

Figure 3.1: Prereform Structure of Sri Lanka's Electricity Industry: 1969–1983



Source: ADB.

3.3 Slow Transformation to Functionally Unbundled Monopoly and Regulated Industry (1983–2008)

Power sector reform in Sri Lanka commenced in 1983, when the government established a state-owned company to distribute power in certain designated areas.

In 1996, the private sector commenced generating power. Studies and stakeholder consultations during 1995–2001 searched for the best model for reform. Meanwhile, the CEB was internally unbundled into generation, transmission, and four distribution divisions through an administrative CEB decision in 2000. However, no legal or financial separation transpired.

Electricity sector reforms were legally initiated in December 2002 with the Electricity Reform Act No. 28 of 2002 (Box 2), which envisaged restructuring the electricity industry by breaking the CEB and LECO into several independent state-owned

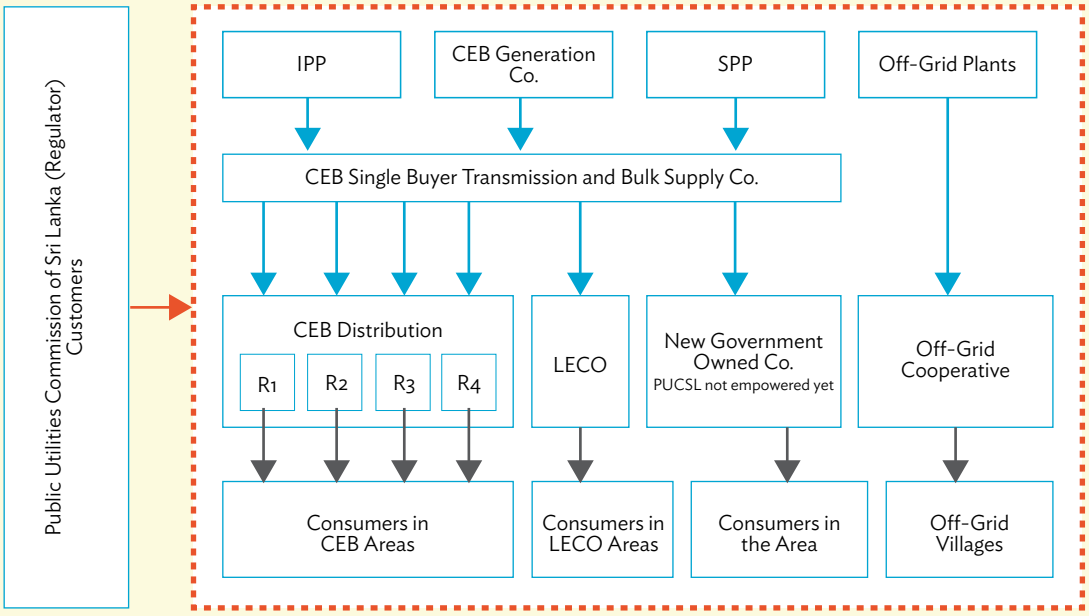
[14] However, the actual practice differs from the degree of independence enshrined in Act No. 17. Most decisions are influenced by various arms of the government, and the CEB remains obliged to follow state procedures in procurement and recruitment of staff. For example, the CEB cannot recruit staff at midcareer level, and requires the Ministry of Power and Energy's approval for all recruitments and for higher value procurements.

companies to carry out generation, transmission, and distribution functions. The Public Utilities Commission Act No. 35 of 2002 was also enacted in December 2002, establishing the PUCSL in July 2003. The PUCSL was formed as the regulatory body of the electricity and water service industries. However, for the PUCSL to exercise its assigned powers over the electricity sector, the Electricity Reform Act had to be made fully operational through a ministerial order.[15] Due to resistance by CEB staff and political reasons, the order was not issued. A change of government in 2004 put the reform process on hold. Responding to the opposition to the reform, the government tried to introduce legislative amendments. Accordingly, the Sri Lanka Electricity Bill and the CEB Amendment Bill were prepared and put up for discussions. However, the Supreme Court ruled that some amendments proposed were unconstitutional.

Box 2: Planned Comprehensive Single Buyer Model Defined in Electricity Act 2002

The new structure for the electricity industry defined by the Electricity Reform Act of 2002 was to unbundle the Ceylon Electricity Board's functions to independent and separate legal entities. Therefore, it was proposed in 2002 to create one company for all the Ceylon Electricity Board's generation and a separate company for transmission and bulk electricity trade. Other power generation companies, such as independent and small power producers, would continue to operate separately. Distribution was to be handled by several distribution companies. Competition could occur at the generation level, but not at the retail level. All customers in a region would buy energy from the retail utility in the area. This single buyer (the company for transmission and bulk electricity trade) structure of the industry implied by the 2002 Act is shown in Figure B2; however, no significant steps were taken to implement the proposed model, and a change of government in 2004 put the entire reform plan on hold.

Figure B2: Proposed New Structure for the Electricity Sector, 2002



CEB = Ceylon Electricity Board, IPP = independent power producer, LECO = Lanka Electric Company, PUCSL = Public Utilities Commission of Sri Lanka, R1 = Region 1, R2 = Region 2, R3 = Region 3, R4 = Region 4, SPP = small power producer.
Note: The model was envisaged under the year 2002 reform plan, but was not implemented. However, the single buyer concept was implemented under the year 2009 reform model, and is currently operational.
Source: Based on the Electricity Reform Act No. 28 of 2002 (Government of Sri Lanka 2002).

[15] Certain broad powers embedded in the PUCSL were previously available to it, such as advising the government on policies.

3.4 Moving Forward with Reforms: The Electricity Act (2009 on)

In 2005, the government decided to present a new electricity bill to Parliament, which took 3 years to pass. As a result, the Electricity Reform Act of 2002 was repealed and the Sri Lanka Electricity Act 2009 was certified on 8 April 2009 with the following key provisions:

- The CEB and other operators will be required to obtain licenses from the PUCSL to generate, transmit, distribute, and supply electricity.
- The PUCSL will determine tariffs, followed by distribution licensees and a public hearing process.
- The CEB will remain a public corporation and will be issued with multiple licenses for generation, transmission, distribution, and supply of electricity. However, licensing conditions would require that the CEB's functions are ring fenced[16] to allow separation of accounts and facilitate effective performance monitoring.
- Functional business units would be established within the CEB to handle the separate licensed functions. An internal power trading system would be established to facilitate power trading among the business units.
- The PUCSL would be responsible to safeguard the interests of consumers, investors, policy makers, and all operators of the power industry.

More aggressive restructuring plans for fully unbundling the CEB's functions to independent and separate legal entities, which were featured in the Electricity Act 2002, had not been implemented, and the low level of restructuring introduced by the Electricity Act 2009 resulted in the CEB retaining almost the same structure as prior to the reform.

Unlike reform models in other countries, the CEB business units within the vertically integrated utility structure were licensed separately. Thus, the CEB now holds (i) one generation license (amounting to about 66% of all generating capacity in the grid); (ii) one transmission license (100% of transmission and of bulk supply, in accordance with the single buyer model); and (iii) four distribution licenses (in total, accounting for approximately 90% of customers and 88% of sales in 2013). Figure 3.2 illustrates the structure of Sri Lanka's present electricity industry.

[16] "Ring fencing" refers to separating an entity's assets and finances without legally separating the entity from its umbrella organization.

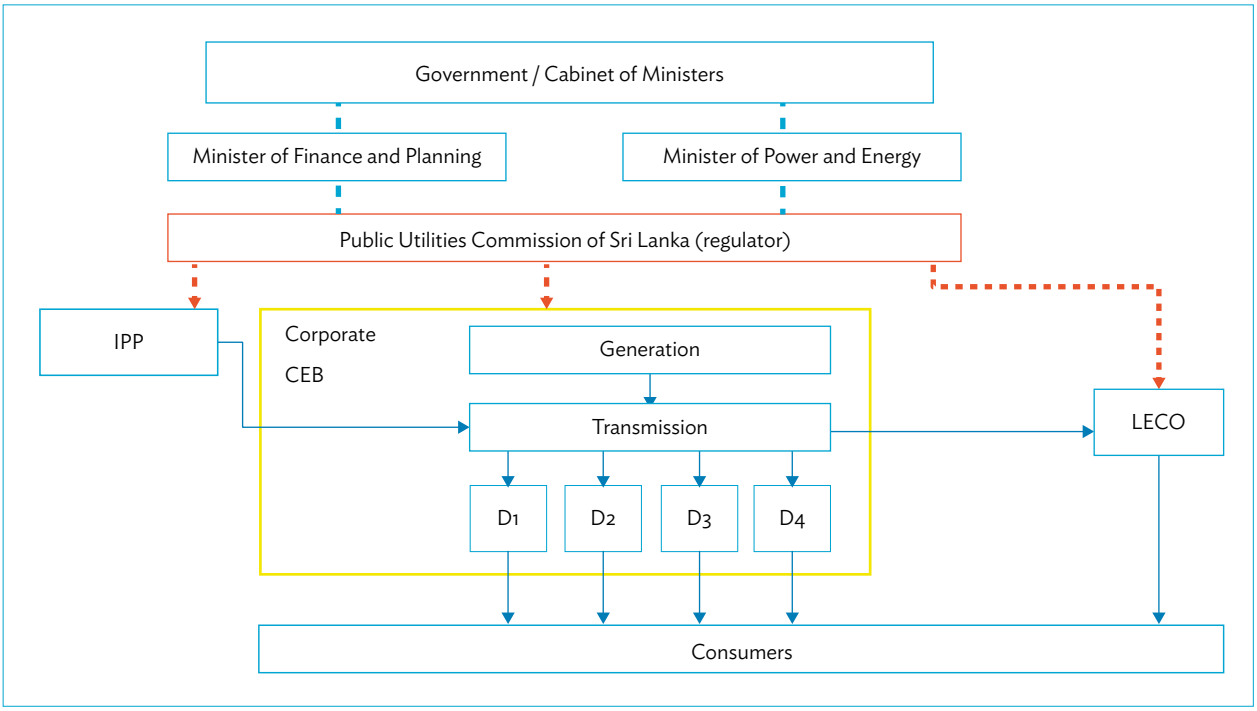
3.5 The Key Elements of Power Sector Reforms

3.5.1 Introduction of Competition—Efficiency, Customer Responsiveness, and Innovation

Optimum economic efficiency can be achieved when goods are produced and distributed at the least cost. Electricity market reforms intend to create competition in order to reduce prices and increase consumer choice. Furthermore, market competition is expected to introduce commercial principles that will attract investment and improve the reliability, quality, and coverage of service. That the CEB's monopolistic structure could not be suddenly converted to a retail model was obvious from the early stages of reform. As generation costs are the dominant component of electricity costs, and with several years of delays and underinvestment in generation, generation has received the highest priority from the government since 2005. Sector reforms, although seen initially as equally important, have received less attention from decision makers.

The first reform model, proposed in 1997, suggested giving complete commercial freedom to new generation entities to operate in a competitive market environment. The plan was to create many generating companies—IPPs, SPPs, and entities created out of state-owned assets—that could ultimately operate in a competitive market, with improved efficiency. All power purchases were to be

Figure 3.2: Functionally Unbundled Monopoly, 2009 On



CEB = Ceylon Electricity Board, D1 = Distribution Licensee 1, D2 = Distribution Licensee 2, D3 = Distribution Licensee 3, D4 = Distribution Licensee 4, IPP = independent power producer, LECO = Lanka Electricity Company Ltd.
Note: The CEB's generation, transmission, and four distribution regions are separately licensed, but all report to the same Board. IPPs, SPPs, and LECO are also licensed.
Source: Kumarasinghe (2014).

done through power purchase agreements and sales through power sales agreements with the PUCSL operating with complete independence, autonomy, and authority.

However, after many discussions, Sri Lanka implemented only limited electricity sector reforms, and thus competition in the electricity market was limited. Private sector power generation was allowed for IPPs and SPPs, and competition existed only for IPPs at the stage of bidding.

Sri Lanka signed 10 IPP agreements during 1996–2010, for projects that were commissioned during 1997–2013 (CEB 2013b). All are oil-burning diesel engines and combined cycles. Three of the power purchase agreements have expired and have not been extended, although there have been calls for their extension. Some IPPs were procured on a competitive basis through a structured procedure and detailed tariff proposals; others were procured through negotiation. All IPPs have been provided with the following concessions by the government:

- exemption from import taxes for capital equipment,
- exemption from corporate taxes for 5–8 years, and
- provision of fuel at the market price in Sri Lanka (which at times carries a subsidy).

These are the typical concessions provided for major investments in all sectors. Sri Lanka's IPPs have not been provided with special subsidies beyond what other investors enjoy, and the IPPs are paid on a two-part tariff: capacity and energy, allowing the single buyer (the CEB Transmission Licensee) complete freedom to dispatch all power plants in the system (major hydro, CEB's own thermals, and IPPs) on economic terms. The output of SPPs (all NCRE projects, each producing less than 10 MW) is purchased at all times up to the contract capacity, with no limitation. However, if for any reason (such as a transmission outage) their outputs cannot be purchased, then they are not paid. (A later section discusses the IPP and SPP tariffs.)

3.5.2 Restructuring the Sector: Unbundling into Separate Businesses

The electricity sector was restructured in an attempt to ensure increased efficiency, transparency, autonomy, accountability, competition, and financial viability. The CEB functions were to be vertically and horizontally unbundled. For this purpose, CEB-owned subsidiary companies were planned to be established under the Companies Act No. 17 of 1982. The proposal was to unbundle the CEB into separate legal entities operating independently:

- one company for generation,
- one company for transmission and bulk electricity trade, and
- two or more companies for distribution.

However, due to the strong political opposition and CEB employees' resistance, the government suspended the reform process and drafted a new legislation. Subsequently, the reforms were continued, but with the CEB's distribution activities subdivided into four functional divisions (labeled as "DL" in Figure 3.3) that are allowed to operate separately under the CEB umbrella.

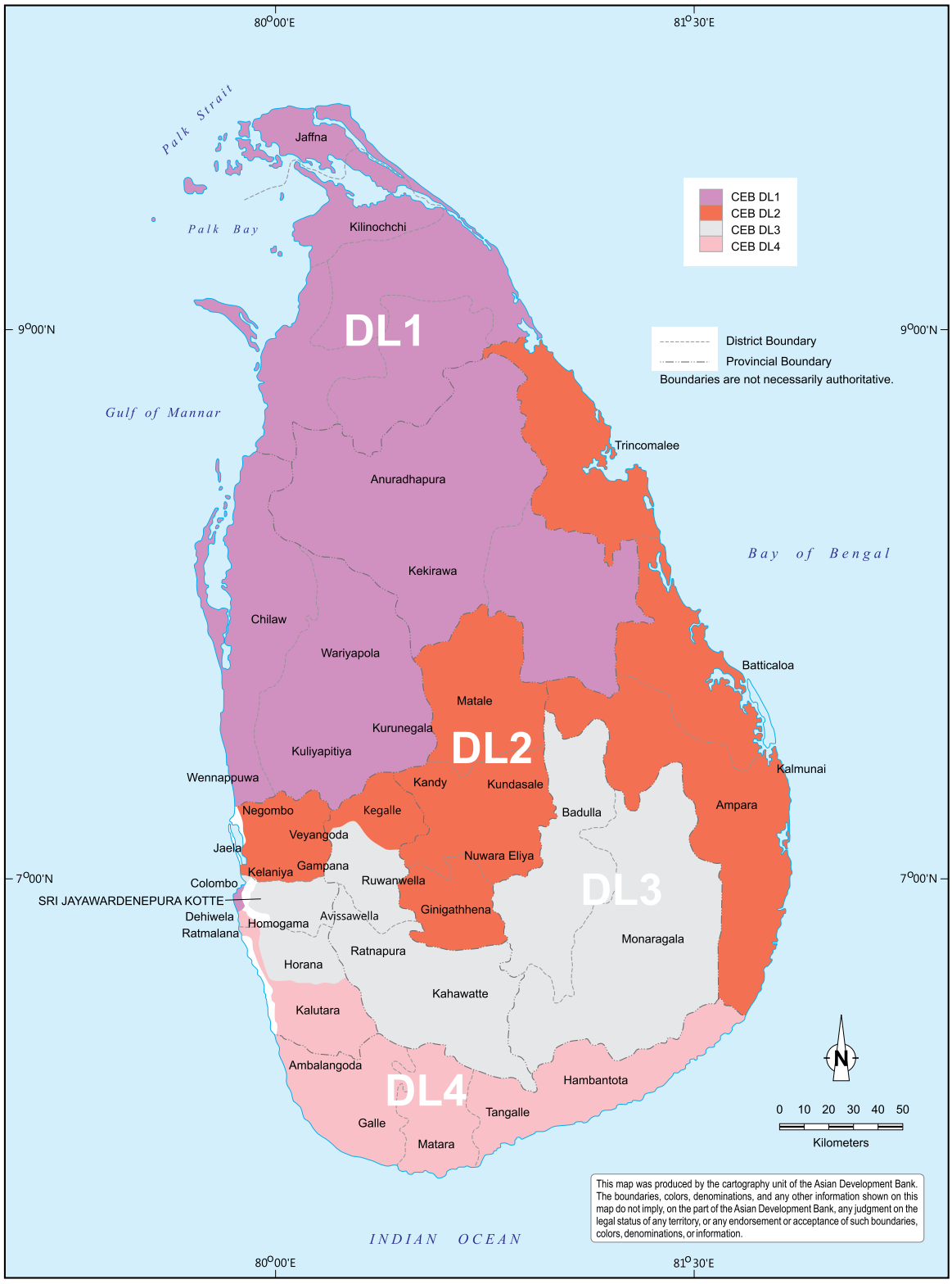
3.5.3 Private Sector Participation

Experience with restructuring and regulatory reform in some countries has shown that efficiency may be improved by privatizing vertically integrated electricity utilities. However, Sri Lanka's experience is somewhat different. The private sector involvement in generation since 1996 is not generally considered to be a success story.[17] The policy of the present government, as embodied in the Sri Lanka Electricity Act No. 20 of 2009 is not to privatize state entities, so that the CEB's functional business units will not be privatized.

However, the LECO, a state-owned company established in 1984 to distribute electricity in areas previously served by local authorities (municipal councils, etc.), continues to function as a successful commercially-run company, with good technical performance. The LECO is a good example of a government-owned structure established as a company, showing considerable promise as a distribution utility that operates with a very low level of losses (Figure 3.4) comparable with those in developed countries. The LECO is a successful entity because its status as an independent company insulates it from effects of the government's policies of rural electrification and underpricing of electricity to customers. Thus, the bulk selling price of electricity from the CEB Transmission Licensee to the LECO has always (even before the tariff methodology became operational in January 2011) been at rates that enable the LECO to report profits, while allowing it the freedom to improve its performance and retain the allowed distribution revenue as additional profits. The new tariff regulatory structure implemented since January 2011 has continued this policy, and extended the same status to the CEB's distribution entities for their purchases from the CEB Transmission Licensee, and to the CEB's purchases from generation, by ring fencing them. However, the CEB's licensees have not been completely ring fenced, as the CEB uses profits from its transmission and distribution licensees to bridge the deficits in the bulk supply transactions account, thus impinging on the transmission and distribution licensees' ability to improve their financial performance and retain any financial surplus.

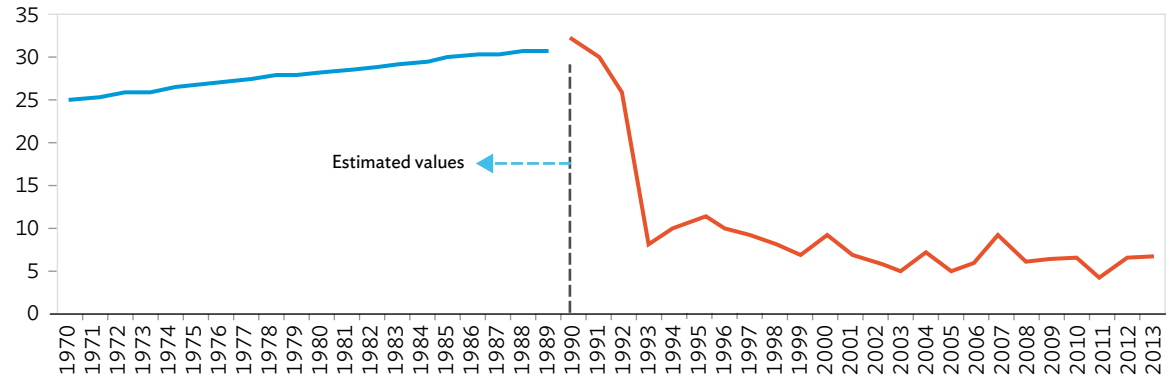
[17] There are mixed opinions on whether IPPs have been effective at improving performance. On the one hand, as of the end of 2012, all IPPs produced electricity at costs that were at least 30% above the average selling price of SLRs15/kWh, and the CEB's hydro and coal-fired power plants were the only sources producing below the average selling price. On the other hand, the IPPs have provided the required supply security to Sri Lanka, whereas many South Asian countries do not have their required supply.

Figure 3.3: Functional Divisions of the CEB Distribution System



CEB = Ceylon Electricity Board; DL= distribution licensee.
Source: Ceylon Electricity Board (2014b).

Figure 3.4: Distribution Losses in the LECO Network (%)



LECO = Lanka Electric Company.
Notes: The LECO is a distribution company, purchasing from the CEB at 11 kilovolts and distributing to customers at 11 kilovolts and 400 volts. The LECO was established in 1983. High losses until 1988 are because the LECO took over local authority (city and town council) networks in the Western Province and rehabilitated them. Data before year 1990 are estimates.
Source: Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance data (accessed 20 October 2014).

3.5.4 Development of a New Regulatory Framework

Development of a New Tariff-Setting System. The reforms of tariffs and a move to cost-reflective pricing are an important element of economic regulation. The new tariff methodology allows licensees to recover the costs of operations as authorized by their license. Box 3 shows the features of the tariff methodology implemented in Sri Lanka following the 2009 Act.

Table 3.2 describes the risk allocation reflected in the tariff methodology to each licensee. All the risks not borne by the licensees are passed on to customers in 6-monthly intervals through customer tariff revisions.

Box 3: Tariff Methodology Features

The tariff methodology summarized here was issued by the Public Utilities Commission of Sri Lanka (PUCSL) per Section 30 of the Sri Lanka Electricity Act No. 29 of 2009. The tariff has three components: bulk supply tariffs, the distribution tariff, and the retail supply tariff.

Generation and Transmission Cost—Bulk Supply Tariffs

Generation Cost. All generation is priced on the basis of power purchase agreements between the transmission licensee (a single buyer) and each generation licensee.[a] The single buyer determines the generation costs used to calculate the bulk supply tariffs. Generation costs are passed through by the purchaser (transmission) to distribution. Distribution licensees pass them through to end users.

Transmission Allowed Revenues. These are the revenue that the transmission licensee is allowed to collect from the transmission users, excluding connection charges. It is the sum of two components: the base allowed revenue and the large infrastructure development allowances. These revenues are adjusted annually.

continued

The transmission base allowed revenue is calculated based on a forecast cash flow for a firm discounted at the allowed rate of return on capital for the tariff period, considering (i) the initial regulatory asset base; (ii) rolling forward of the initial regulatory asset base, considering minor capital expenditure for the period; (iii) depreciation; (iv) return on capital; (v) efficient operational expenditure; and (vi) taxes. Revenue with regard to capital expenditure classified as large infrastructure development allowances in the Long-Term Transmission Development Plan and approved by the PUCSL will be collected from transmission system users by adding an allowance to the transmission base allowed revenue from time to time.

Determination of the Bulk Supply Tariff. The bulk supply tariff (BST) is the sum of the generation tariff, transmission tariff, and bulk supply and operations business tariff. The BST has two parts: capacity charge and energy charge. The energy charge varies according to the time of day: 5:30 a.m. to 6:30 p.m.; peak, 6:30 p.m. to 10:30 p.m.; and off-peak, 10:30 p.m. to 5:30 a.m.

The forecast BSTs are used to determine the end-use customer tariffs. The forecast bulk supply tariffs are passed through to the end-use customer tariffs, and are calculated and filed once every 6 months by the transmission licensee. The filing should include (i) the forecast for the corresponding (upcoming) 6-month period, and (ii) an adjustment factor to compensate for the differences between forecast and actual BSTs for the 6-month period completed.

The actual BSTs are not passed through to the end-user tariffs each month. End users are compensated for deviations between forecast and actual BSTs at the end of each 6-month period.

Distribution Tariffs

The distribution allowed revenue is the revenue that a distribution and supply licensee is allowed to collect from the distribution users, excluding allowed charges (connection, reconnection, meter testing, etc.) that are separately regulated. Distribution allowed revenue is calculated based on a multiyear tariff system with a limit ("cap") on overall revenues during the tariff period. The cap is adjusted for changes in the number of distribution users and energy distributed as prescribed by the revenue control formula, and changes in the indexes contained in that formula.

Each distribution and supply licensee makes a tariff filing to the PUCSL. Before the beginning of the tariff period, the filing must be completed, including approval of cost components and revenue control formulas. Once a year after the initial filing, during the tariff period, a simplified filing is made to demonstrate that the revenue control formulas are properly applied.

The distribution allowed revenue is calculated based on a forecast cash flow for the tariff period, considering the initial regulatory asset base (the value of the licensee's assets for providing the distribution service); rolling forward of the initial regulatory asset base, considering the forecast capital expenditure for the period; depreciation of assets that have not been depreciated; return on capital; operating expenses; and taxes.

Retail Tariffs

The retail supply tariff includes the retail service tariff and the bulk supply "pass-through" tariff.

The retail service tariff includes all the costs related to the commercial cycle (meter reading, invoicing, and collection); routine meter testing; and an allowance for bad debt if the PUCSL deems such allowance is appropriate. The retail service tariff is calculated based on a multiyear tariff system that is capped during the tariff period.

Retail supply customers pay the bulk supply "pass-through" tariffs, which are based on the BSTs defined above and adapted in order to be applied to retail customers. Bulk supply "pass-through" tariffs consist of two parts: capacity charge and energy charge. The energy part is divided into the three daily time intervals.

PUCSL = Public Utilities Commission of Sri Lanka.
[a] Ceylon Electricity Board generation licensee, which is not a separate corporate entity but a business unit of the Ceylon Electricity Board, sells on the basis of a memo, rather than a legally established power purchase agreement. The 10 independent power producers (of which 8 are operating because some agreements terminated in 2012) and over 120 small power producers sell to the transmission licensee.
Source: PUCSL (2011b).

Table 3.2: Risk Allocation

Risk	Licensee Responsibility against Variations
Generation Capacity Costs and Penalties for Nonavailability	Generation licensees, as stated in the power purchase agreement
Generation Fuel Costs	None; passed through to customers through 6-monthly bulk supply tariff revisions
Transmission Capacity (wires)	None
Transmission System Capacity and Energy Losses	Transmission licensee (bulk supply operation business is given a loss target)
Distribution Capacity (wires)	None
Distribution System Capacity and Energy Losses	Distribution licensee (supply services business is given a loss target)
Market Risk (risk of lower or higher sales, customer tariff classification, sales in each time-of-use interval)	None on distribution licensee; passed on to customers in 6-monthly adjustments

Source: ADB.

Box 4: Timeline of Bulk Supply Tariff Announcements

January 2011: First announcement of bulk supply tariff (BST) was on schedule, and supported with a comprehensive consultation paper.

July 2011: Second BST announcement, issued about 4 months behind schedule.

January 2012: BST was due on 1 January, but was published by the Public Utilities Commission of Sri Lanka in July 2012, 6 months behind schedule, with minimal analyses of the calculations presented. Licensees claim that arbitrary information has been used to derive the BST. The adjustments for the previous interval (January–June 2011), as required in the approved tariff methodology, have not been included in the BST.

July 2012: Published, date not specified.

January 2013: Published in June 2013, 6 months behind schedule.

July 2013: Published, date not specified.

January 2014: Published, date not specified.

July 2014: Published, date not specified.

Source: Compiled from PUCSL, Decisions and Orders.

Bulk Supply Tariffs. The succeeding subsections describe the implementation of the tariff methodology beginning in January 2011. The PUCSL has not been able to decide on and declare bulk supply tariffs in a timely manner (Box 4).

As 2011 was the first year the bulk supply tariff was applied, the assumptions that were used in deriving it have to be validated. A large cash surplus was reported by one distribution licensee, the obvious result of an overestimate of the expected coincident peak demand of the licensee, on which the capacity charge is based. This crucial correction was not done in the bulk supply tariff announcement for January–June 2013 (Table 3.3), a major deviation from the approved methodology and the planned outcome. However, subsequent revisions have corrected the mismatch.

End-User Tariffs. End-user tariffs too have not been adjusted in value and structure in a timely manner as envisaged at the outset. Adjustments have been implemented, largely in an ad-hoc manner, with no relevance to the overall objective of moving toward cost-reflective pricing. Box 5 lists events, as of the end of August 2014.

Table 3.3: Bulk Supply Tariffs January–June 2013 (announced in June 2013)

Description	Units	DL1: CEB Region 1	DL2: CEB Region 2	DL3: CEB Region 3	DL4: CEB Region 4	DL5: LECO	Total
Sales to End Users	GWh	3,124	3,121	2,026	1,428	1,250	10,950
Revenue Based on Approved Customer Tariffs (Jan-June, excluding fuel adjustment charge)	SLRs million	24,811	20,803	13,294	10,534	10,346	79,788
Coincident Peak Demand for Purchases from Transmission	MW	575	629	423	303	240	
Approved Bulk Supply Tariff for Payment in Coincident Maximum Demand	SLRs/ MW/ month	1,455,358	1,455,358	1,455,358	1,455,358	1,455,358	
Amount Payable to Transmission on Account of Demand (Jan–June)	SLRs million	5,022	5,490	3,693	2,647	2,095	18,947
Revenue to be Recovered by Transmission through Energy Charges	SLRs million	16,267	11,318	7,318	5,912	6,991	47,806
Energy Sold from Transmission at Medium Voltage	GWh	1,684	1,724	1,087	773	664	5,932
Approved Bulk Supply Tariff in Each Time-of-Use Interval							
Day (5:30 a.m.–6:30 p.m.)	SLR/ kWh	9.56	6.50	6.66	7.57	10.42	
Peak (6:30 p.m.–10:30 p.m.)	SLR/ kWh	11.97	8.13	8.34	9.48	13.04	
Off Peak (10:30 p.m.–5:30 a.m.)	SLR/ kWh	7.19	4.88	5.01	5.69	7.83	

CEB = Ceylon Electricity Board, DL = distribution licensee, GWh = gigawatt-hour, kWh = kilowatt-hour, LECO = Lanka Electricity Company, MW = megawatt, SLR = Sri Lanka rupee.
Source: PUCSL (2013).

Clearly, the PUCSL is not diligently implementing the tariff methodology established in January 2011 after much discussion between licensees, the PUCSL, and the policy makers. Licensees, however, have generally adhered to tariff-related initiatives (Box 6).

The government allocated to the PUCSL the process of determining the feed-in tariff for SPPs, which was previously done by the Ministry of Power and Energy. In mid-2010, the PUCSL held a public consultation and unilaterally increased the tariff submitted by the CEB Transmission Licensee and announced the increase. This created a major deviation in the legal process, because the licensee, and not the PUCSL, should announce the feed-in tariffs. Further, the PUCSL did not provide or define the means for financing the purchases from SPPs.[18] In mid-2012, the same process was repeated, and the licensee refrained from implementing the feed-in tariffs announced by the PUCSL. As such, SPPs that came up for signing since January 2012 were stalled, because of a lack of a feed-in tariff. The dispute between the PUCSL and the CEB Transmission Licensee dragged on for over 2 years, until the Ministry of Power and Energy intervened in March 2014 to resolve the issue through a separate calculation of feed-in tariffs.

[18] SPPs are in the distribution network but are paid for by the CEB Transmission Licensee.

Box 5: Timeline of End-Use Tariff Announcements

January 2011: First announcement of new customer tariffs (supported with a comprehensive consultation paper, which was then discussed in a public hearing. The road map for tariff reforms that was subject to public consultation (with no adverse comments from the public) was removed by the Public Utilities Commission of Sri Lanka from the final determination with no reasons given, a major deviation in the path to tariff reforms and rebalancing. The road map for tariff reforms and rebalancing was published but subsequently abandoned with no reasons given.

July 2011: The required 6-monthly adjustment stipulated in the methodology was not applied.

January 2012: The required 6-monthly adjustment stipulated in the methodology was not announced, despite licensees making an extraordinary tariff filing in September 2011 for the period 2012–2015.

February 2012: The Public Utilities Commission of Sri Lanka announced a fuel surcharge for certain customer categories. As there is no provision in the approved tariff methodology to apply a fuel surcharge, this is effectively illegal. The practice continues, however. A public hearing was promised in 2012 through an official announcement, but was not held.

July 2012: 6-monthly adjustment was not announced.

January 2013: 6-monthly adjustment was not announced, but the delayed announcement was made in June 2013.

July 2013: 6-monthly adjustment was not announced.

January 2014: 6-monthly adjustment was not announced.

July 2014: 6-monthly adjustment was not announced.

Source: Compiled from PUCSL, Electricity Tariffs—Domestic.

Box 6: Licensees' Tariff Filings

September 2010: The first tariff filing was completed on schedule. Despite some information lapses, the licensees have participated in the new tariff making process.

November 2010: Licensees actively participated in the public consultation process, making presentations and justifying their cost submissions.

January–March 2011: Licensees implemented the first step of tariff reforms. For example, all low- and medium-volt bulk customers were provided with electronic meters, so they could be billed on the new mandatory time-of-use tariff. The Ceylon Electricity Board (CEB) Transmission Licensee also completed installing meters for transfers between licensees, which for some time was billed on estimated values.

January 2011: Licensees and the Public Utilities Commission of Sri Lanka (PUCSL) agreed on a new format of the customer invoice (bill), to provide the essential information on the costs of supply, as required by the Electricity Act. Although the distribution licensee submitted a finalized format for the bill, the PUCSL has not used it. Accordingly, from the customers' point of view, no information is regularly available to assure them that tariff reforms have brought transparency to the pricing process and that the cost of electricity is decreasing as a benefit of the reform process.

February 2011: The CEB Transmission Licensee was required to make operational a transparent dispatch methodology, in keeping with the requirements of the new tariff methodology, but has not done so on schedule. However, the CEB Transmission Licensee had (by mid-2013) implemented the transparent dispatch model, but the day-ahead, week-ahead, and month-ahead forecasts required by regulatory documents are not available in the public domain. Ex-post information on power plant dispatches is, however, publicly available.

March 2011 on: Distribution licensees filed detailed sales information on a monthly basis, on the newly established on-line Licensee Information Submission System hosted by the PUCSL. However, the CEB Transmission Licensee has not submitted the monthly information online in a timely manner. Thus, the PUCSL has a major handicap in determining the revisions to the bulk supply tariff, and has to rely on paper submissions.

Source: Compiled from PUCSL, Electricity Tariffs—Domestic, and Tariff Revision 2013.

Implementation of the Tariff Methodology. Sri Lanka's experience with unbundled tariffs and the tariff methodology starting in January 2011 is mixed, and is largely negative, as described below.

The strengths of the first tariff announcement are as follows:

- For the first time in Sri Lanka's electricity industry, unbundled tariffs were issued for each business in the industry. The cost of supply was clearly presented. For example, when a dry spell affects the country, the 6-month bulk supply tariff (BST) adjustment issued by the PUCSL in January and July each year should reflect the need for increased generation from oil-fired thermal generation. Similarly, with above-average rainfall, the hydroelectric system would produce more electricity, which would be reflected in the BST announcement and lower prices if no deficits are carried over.
- All input information, calculations, and calculated costs of supply were to be published for public debate.
- The end-use customer tariff structure was substantially reformed by reducing the number of customer categories from 27 to 20.
- All medium and large industrial customers and hotels were required to pay the time-of-use tariff.
- The tariff reform plan envisages the number of customer categories to be further reduced to four.

No further progress has been made with improving economic regulation and achieving cost-reflective tariffs. A tariff methodology has been established, and an implementation procedure installed, but maintenance of the procedure is in serious doubt due to (i) significant delays in implementing tariff adjustments (customer tariffs and BSTs, both up and down); (ii) delays or lack of initiative to implement the road map for tariff reforms and rebalancing; and (iii) the resulting erosion of public confidence in the tariff-making process.

Shortfalls of the new tariff methodology are as follows:

- The customer tariffs are not yet cost reflective (the target is now to revise these gradually, to be cost reflective by 2015). The PUCSL prepared a road map for a systematic transition to cost-reflective tariffs (Table 3.4), which includes reducing customer categories and introducing time-of-use tariffs. The government, while dictating to the PUCSL what the tariffs should be, did not provide a clear indication of how the subsidy was to be provided while in transition toward cost reflectivity. The estimated subsidy needed to support the government's tariff was SLRs11.7 billion (about $105.8 million) for 2011.[19] The PUCSL did not announce a specific mechanism to secure this subsidy. The subsidy was not paid to the CEB, the single buyer. Therefore, the CEB resorted to a mix of (i) short-term borrowing; and (ii) not paying its fuel bills to the petroleum supplier, the Ceylon Petroleum Corporation, another government entity. The situation worsened in the second half of 2011 and 2012 because a severe drought necessitated additional thermal generation, and, with no tariff adjustments, the deficit in 2012 was estimated to be about SLRs80,000 billion ($627.0 billion).[20] The PUCSL has not published the actual deficit figures, so the cost of the problem cannot be ascertained.
- The reverse situation occurred in 2013, with above-average rainfall. If the tariff methodology was properly implemented, customer tariffs should have been reduced, but as the outstanding debts (for generation above the allowed costs as well as to finance subsidies) had to be settled, the CEB transmission entity announced that the savings in 2013 would be used to settle fuel bills of 2011 and 2012. Thus, the CEB Transmission Licensee bypassed the PUCSL's tariff methodology.

[19] Estimated using $1 = SLRs110.6, average for 2011 (ADB 2014).
[20] Estimated using $1 = SLRs127.6, average for 2012 (ADB 2014).

Table 3.4: Road Map for Tariff Reforms and Rebalancing

Year	Households	Religious	Other Retail (industry, general, hotel)	Bulk Consumers
2011	Continue with the lower tariffs for low-income groups.	25% reduction.	Introduce a category for government schools, hospitals, and divisional secretariat offices.	TOU tariffs made mandatory for industrial consumers. Flat tariffs mandatory for other groups of consumers.
2012	Reduce the number of blocks.	No change.	Reduce the price gap between the classes of customers.	All classes of bulk customers to be unified and TOU tariffs to be mandatory. Introduce a charge for reactive power.
2013	Reduce blocks.	No change.	No difference between the customer classes, except in voltage at which service is provided. For the purpose of retaining a database, customer classification will be retained in the accounting system. TOU tariffs will be mandatory for all retail and bulk customers in industry, hotel, and general purpose categories. Any subsidies will be addressed outside the licensee tariffs.	
2014	Retain 3 blocks. Optional TOU tariff for all 3-phase customers.	No change.	No further change.	
	Tariffs yield adequate revenue to break even and meet all commitments including debt service, but excluding return on assets to government.			
2015	Abolish block tariffs. Optional TOU tariffs to all customers.	No change.	No further change.	
	Tariffs to all customers are targeted to be fully cost reflective. Government earns a return on assets on the sectors.			

TOU = time-of-use.
Source: PUCSL (2010).

- Licensees have not been able to finance licensed activities. Sales revenues have been significantly below their total expenditures. Notably, in 2012, CEB sales revenues were only SLRs170 billion ($1.3 billion) while expenditures amounted to SLRs248 billion ($1.9 billion).[21]
- While the desire was to reduce the number of customer categories, the government again intervened and introduced here more categories, stating that government schools and similar institutions should be given a discount.

Table 3.5 presents actions proposed to move toward a cost-reflective tariff. The list was prepared by the PUCSL when the new tariff methodology was announced in 2011.

Technical Regulation. Key initiatives of technical regulation are generally embedded in several documents that were prepared after 2009. Their coverage and current status are listed here.

The PUCSL published the Distribution Code in 2012, but the code has not been implemented. Its primary objectives are to (i) establish an equitable and coordinated approach to connect, supply, and maintain the supply of electricity to consumers of the distribution licensees; (ii) establish an effective and coordinated approach for operation, maintenance, and development of the electricity

[21] Estimated using $1 = SLRs127.6, average for 2012 (ADB 2014).

Table 3.5: Tariff Methodology Actions to be Implemented

Action By	Action
Transmission Licensee (Single Buyer)	Present to the Public Utilities Commission of Sri Lanka (PUCSL) the pricing agreements with the Ceylon Electricity Board (CEB) Generation Licensee, and associated agreements such as Fuel Supply Agreements.
PUCSL	Define the X-factor for the remaining years (2012–2015) of the first tariff implementation period. The X-factor refers to the operational expenditure efficiency index in the revenue control formula applied to transmission and distribution licensees.
PUCSL	Issue a methodology for setting the X-factor for the second implementation period.
PUCSL	Issue a methodology for setting the parameter "a" for transmission and distribution activities. The parameter "a" represents the share of local cost in total cost of the transmission and distribution licensees (to be approved by the PUCSL based on the proposal of the licensee) in the revenue control formula applied to transmission and distribution licensees.
CEB/Government	Ensure funding of the bulk supply transactions account.
CEB/Government	Ensure funding of working capital (both capital and interest) for large infrastructure development of the CEB Transmission Licensee, and any similar expenses of all CEB licensees.
CEB/Government	Establish a settlement mechanism for debtors and creditors as of 31 December 2011, including and not limited to • short-term debts, including overdrafts; • dues to suppliers, including independent and small power producers and fuel suppliers; and • dues from customers (both invoiced and not invoiced).
PUCSL	Define the factors related to time-of-use tariffs.
Generation Licensees	Send monthly invoices to the single buyer.
Single Buyer	Make the payment out of the bulk supply transactions account to generation licensees.
Single Buyer	Invoice distribution licensees and transmission customers for bulk supply tariffs.
Distribution Licensees, Transmission Customers	Deposit due amount in the bulk supply transactions account.
Transmission Licensee	Send monthly invoices to the single buyer for the amount due. (A month's invoice consists of one-twelfth of the transmission system allowed revenues for the year.)
Single Buyer	Pay the due amount to the CEB Transmission Licensee out of the bulk supply transactions account.
Single Buyer	Pay the amount due to the CEB Transmission Licensee out of the bulk supply transactions account.
PUCSL	Create model, templates, and procedures for monitoring actual capital expenditures.
PUCSL	Formulate guidelines for the preparation of regulatory accounts by licensees.
PUCSL	Create model, templates, and procedures for calculating revenue control formula for transmission and distribution.
PUCSL	Set detailed regulations for assessing large infrastructure development charges.
PUCSL (should be agreed with the government)	Set transaction account management rules.
PUCSL	Set the model, templates, and procedures for calculating compensation because of the uniform national tariff.
Transmission and Distribution Licensees	Submit audited accounts to the PUCSL.

Note: The Transmission Allowed Base Revenue formula is

$$AR_y = AR_{y-1} \times (1-X) \times [a \times (1+SLCPI_{y-1}) + (1-a) \times (FX_y/FX_{y-1} + PPIUS_{y-1})];$$

and the Distribution Allowed Base Revenue formula is

$$AR_y = AR_{y-1} \times (1-X) \times [a \times (1+SLCPI_{y-1}) + (1-a) \times (FX_y/FX_{y-1} + PPIUS_{y-1})] \times [b \times (1+Dcust)+c \times (1+DkWh)+d]-Diff_y;$$

where ARy = allowed base revenue in year y (SLR); AR y-1 = allowed base revenue in year y-1, a = share of local costs in total costs of the CEB Transmission Licensee, SLCPI y-1 = accumulated change in Sri Lanka Consumer Price Index (%) during year y-1; FXy/FX y-1 = average change in the SLR:USD exchange rate during last quarter of year y-1; PPIUS = accumulated change in the Produces Price Index of USA (%) during year y-1; X = OPEX Efficiency Factor (%), Diffy = [AREV y-2 x (1-(ALy-2 –ACLy-2)) –ARy-2] x (1+ry-1); Diffy = interim adjustment factor to compensate differences between actual distribution revenues and allowed distribution revenues (SLR) of the year y-2; AREVy-2 = actual distribution revenue based on invoicing (SLR) of the year y-2; ARy-2= allowed revenue (SLR) of the year y-2; ry-1 = average reference interest rate of year y-1 to be defined by the PUCSL, b=allowed revenue coefficient to adjust for increases in the number of customers; Dcust = percentage of customers in excess (negative if in deficit) of the level forecast at the times of setting tariff for the period; c= allowed revenue coefficient for energy increase; d = 1-b-c; DkW h = percentage of energy distributed in excess (negative if in deficit) of the level forecast at the time of setting the tariff for the period; ALy-2 = aggregated allowed level of energy losses for year y-2 (%); ACLy-2 = aggregated actual level of energy losses for year y-2 (%).

Source: Compiled based on PUCSL (2011b).

distribution networks; and (iii) ensure equitable management of technical matters in the interest of all parties connected to the distribution system, including customers, the CEB Transmission Licensee, distribution licensees, and other users of the distribution system (PUCSL 2012a).

Regulations on performance standards include the important elements of technical regulation such as power supply quality and service reliability, and disclosure of such information. Customers were to be individually or collectively compensated for underperformance of distribution licensees with regard to the quality of supply. The Distribution Performance Standards Regulations are still in draft form.

The Grid Code was approved in March 2014. The Grid Code contains important elements such as planning guidelines for investments in generation and transmission, as well as the key guidelines and disclosure requirements for daily, short-term, and medium-term operations plans, and ex-post dispatch information (CEB 2014a).

The Supply Services Code, dealing with the customers' relationship with distribution and supply licensees, has been in draft form since 2011 but has not been published or implemented (CEB 2012). A PUCSL press release on 5 July 2012 states that the Supply Services Code will consist of the following main areas: (i) procedure for contacting the service provider; (ii) metering and billing information; (iii) procedure for accessing consumer premises; (iv) payments against the statement of accounts; (v) consumers in default; (vi) connections and disconnection; (vii) planned and unplanned power interruptions; (viii) consumer complaints; and (ix) provision of meters, and testing and reporting of meter-related issues (PUCSL 2012b).

Although public campaigns have been waged to improve safety and routine inspections, no specific regulatory initiatives to improve and enforce safety on the supply side or for end users of the electricity industry have been reported. About 100–150 people are killed by electrocution each year, and the PUCSL is working to reduce such deaths. Current results indicate that the number of such fatalities is decreasing.[22]

3.6 Assessment of Longer-Term Reforms

Various power sector reforms have been implemented since 1983. The establishment of the LECO reduced the distribution losses of local authority (municipal and town council) networks from an estimated 20% to less than 6%. The LECO, still government-owned, has taken the lead in establishing new practices in technical design and monitoring of distribution networks, and in customer outreach to provide improved service. In 1996, power generation was opened to the private sector, and has brought mixed results. The initiative has allowed Sri Lanka to quickly procure power plants when faced with delays in the CEB's mainstream power generation projects and helped to largely avoid load shedding. However, all the IPP projects commissioned were oil-fired power plants, which have resulted in Sri Lanka's electricity costs being high by international standards.

The opening of renewable energy development to the private sector in 1996 has brought mixed results. The country has now developed almost all its small hydropower resource sites through this initiative, and Sri Lanka shows how the private sector can enter an area that a conventional utility may not be interested in developing—small, site-specific renewable energy facilities. However, Sri Lanka's experience in developing biomass-based power generation and wind power with the private sector is not a success. The expected large-scale biomass plantations did not materialize and only power plants fuelled by rice husks are operating. Wind power feed-in tariffs were increased significantly, to levels exceeding $0.20/kWh, and the procurement of wind power into the grid was not done competitively.

[22] PUCSL (2014) reports that electrocutions have decreased from 180 in 2012 to 76 in 2013. For the first 4 months of 2014, 18 electricity-related deaths were reported.

Box 7: Key Milestones of Sri Lanka Power Sector Reforms

1983: The Lanka Electric Company (LECO) established.

1990: Transfer of all local authority (municipal and city council networks) to either the LECO or the Ceylon electricity Board (CEB) completed.

1996: First independent power producer project commissioned.

1997: First small power producer project commissioned.

2002: Electricity Reform Act approved by Parliament (but not implemented).

2003: Public Utilities Commission of Sri Lanka established to regulate the electricity industry.

2009: 10th independent power producer project commissioned.

2009: Sri Lanka Electricity Act approved by Parliament and implementation started.

2010: Licenses issued to six business entities within the CEB, and to the LECO under the new Electricity Act.

2010: The new tariff methodology approved, tariff filing conducted, and the first public hearing held.

2011: New tariff methodology became operational.

2013: Second public hearing on tariffs held.

Source: Compiled by ADB.

Initiatives to reduce network technical and commercial losses have been effective. Transmission and distribution losses (both technical and commercial) as a share of net generation from power plants decreased from the highest reported level of 24.9% in 1981 to an estimated 10.3% in 2013. The target of 12.0% stated in the national energy policy to be achieved by 2015, was already achieved in 2012.

The functional unbundling of the CEB into six business entities in 2002 (and their subsequent licensing under the Electricity Act of 2009) has had very little impact on customer service and operational transparency. The expected "benchmark competition" between the distribution entities did not materialize even after they were licensed in 2009, and the tariff methodology introduced in 2011 has not been fully applied. Independent and separate reporting of technical, financial, and customer service performance indexes and revenue has not happened.[23] Box 7 summarizes the key milestones of power reform efforts in Sri Lanka.

[23] Customer service includes indexes such as the average time to provide a cost estimate for a service, the period taken to provide a service, and the time to respond to a service call. System performance indexes include the duration and frequency of power interruptions, and supply quality in terms of voltage and frequency.

4. ANALYSIS OF POWER SECTOR REFORM OUTCOME INDICATORS

This section assesses the measureable outcomes of the changes introduced in the electricity sector during the last few years by drawing on a set of social, economic, and environmental indicators. Given the partial nature of implementing recent reforms in Sri Lanka, a causal link cannot be established with changes in specific indicators; but the indicators' movements do provide an important measure of the changing effectiveness and impact of the sector.

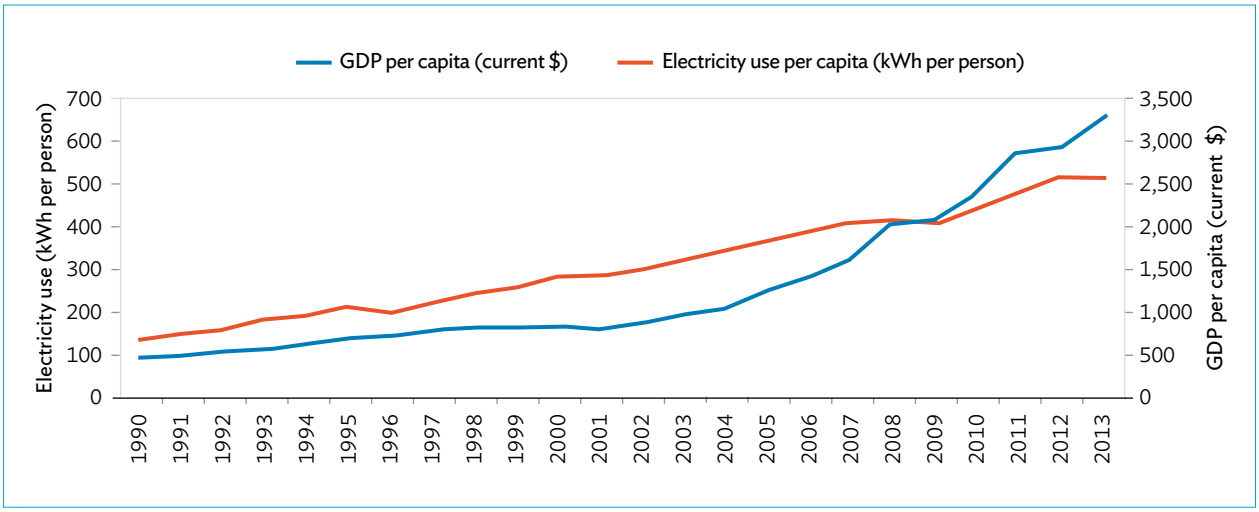
4.1 Economic Sustainability

4.1.1 Electricity Use

Figure 4.1 shows the growth in GDP per capita and in electricity use per capita from 1990 to 2013. The power crises of the mid-1990s are evident in the decelerating year-on-year growth of electricity use per capita from 1993 as a result of supply-side bottlenecks and absolute declines in 1995 and 1996. Usage dropped by 4.5% in 1996 from the previous year, to 202 kWh per capita.

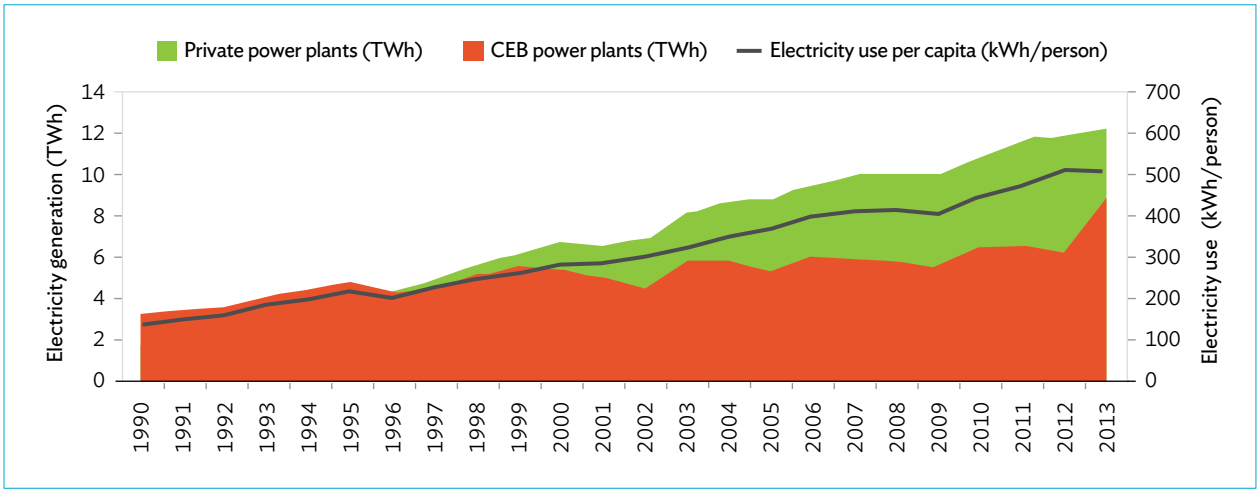
The increasing participation of IPPs coincided with the subsequent growth in power generation (Figure 4.2), which translated into growing electricity use per capita. From 1997 on, electricity use per capita has grown consistently year-on-year except for a slight decline in 2009 of −0.9%, the year in which the conflict in Sri Lanka's north and east was intense and concluded. In 2013, electricity use stood at 514 kWh per capita.

Figure 4.1: Electricity Use and GDP per Capita



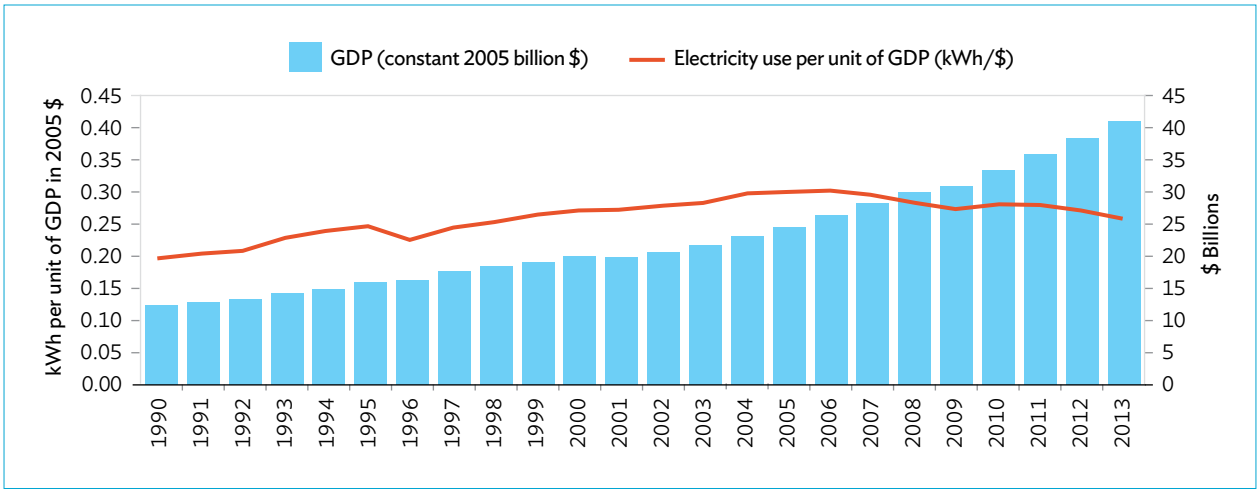
GDP = gross domestic product, kWh = kilowatt-hour.
Sources: Sri Lanka Sustainable Energy Authority of Sri Lanka, Sri Lanka Energy Balance data for electricity use (accessed October 2014); Central Bank of Sri Lanka (various years), Annual Reports for population; and World Bank, World Development Indicators for GDP per capita (accessed July 2014).

Figure 4.2: Electricity Use and Electricity Generation by CEB and Private Plants



CEB = Ceylon Electricity Board, kWh = kilowatt-hour, TWh = terawatt-hour.
Note: Private power plants comprise small and independent power producers.
Sources: Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance data for electricity generation and use; Central Bank of Sri Lanka (various years), Annual Reports for population.

Figure 4.3: Electricity Intensity and GDP

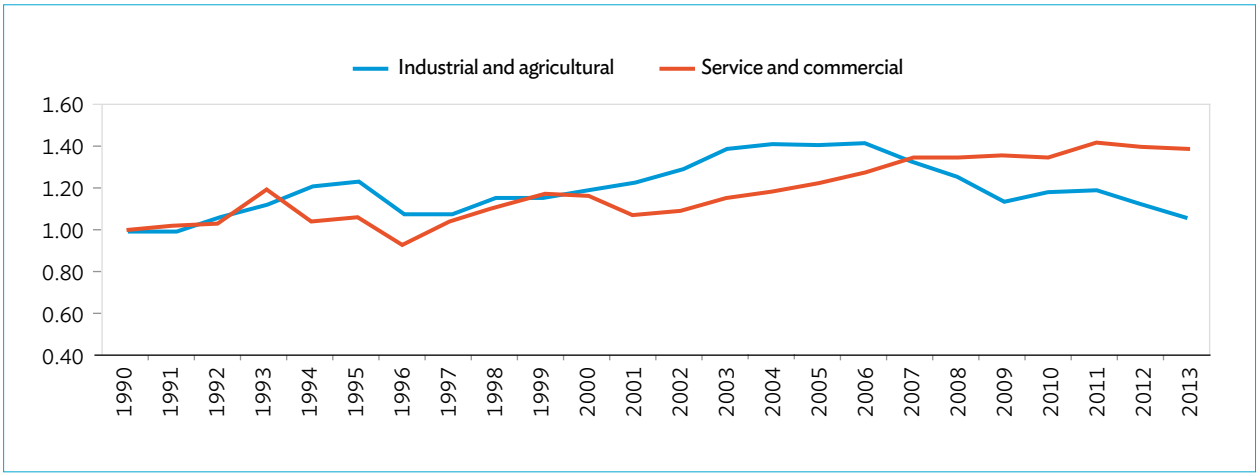


GDP = gross domestic product, kWh = kilowatt-hour.
Sources: Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance 2013 data for electricity use (accessed October 2014); and World Bank, World Development Indicators, for GDP (accessed July 2014).

Electricity intensity measured as kilowatt-hour usage per unit of real GDP responds to changes in economic structure. The general decrease in electricity intensity from 2007 to 2009 and its subsequent stabilization is likely to be associated with the rise in the service sector's share of GDP relative to industry, as services are less electricity-intensive than industry (Figure 4.3). Industrial electricity intensity (which includes agriculture) trended down from 2005 to 2013, falling by 3% annually.[24] Electricity intensity of the service and commercial sector increased continuously at a modest annual average of 2% during the same period (Figure 4.4 and Figure 4.5).

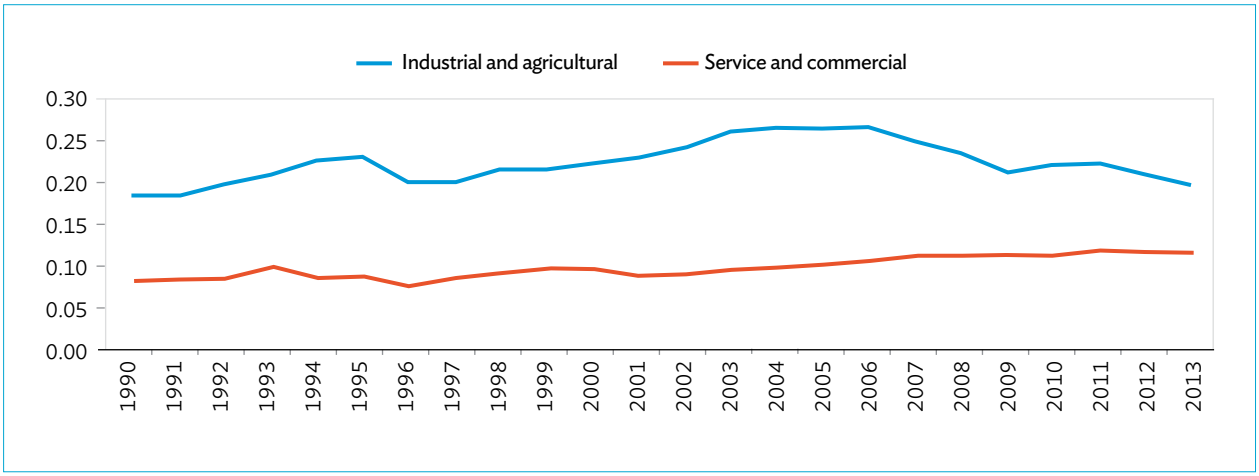
[24] In Sri Lanka, agriculture is classed as part of industry for the purpose of energy accounting. However, electricity use for pumping water for lift irrigation is negligible. Electricity use in agricultural processing, mostly of rice and tea, is accounted for under industry.

Figure 4.4: Industrial and Service and Commercial Electricity Intensities (1990 index)



Note: Sri Lanka's industry sector includes agriculture. World Bank's constant United States dollar 2005 data is used for the gross value added of the sectors.
Sources: Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance data for 2013 for sector electricity use (accessed October 2014); and World Bank, World Development Indicators for sector gross value added (accessed July 2014).

Figure 4.5: Sector Electricity Intensities (kWh/$)



kWh = kilowatt-hour.
Sources: Sustainable Energy Authority of Sri Lanka, Sri Lanka Energy Balance data for sector electricity use (accessed October 2014); and World Bank, World Development Indicators for sector gross value added (accessed July 2014).

Energy efficiency initiatives have also contributed to the modest overall reduction in energy intensity in recent years. The government has emphasized energy conservation and customers are well aware of the need for it. Regulatory instruments such as appliance labeling are in place and inefficient devices and appliances are being phased out of the market. The relatively high electricity price in Sri Lanka (Table 4.1), when compared with other countries in the region, also encourages efficient use of electricity, and discourages energy intensive industries. Manufacturing has gradually moved toward less energy intensive industries, while some energy intensive industries have started to switch to other fuels including biomass.

Household energy intensity (kilowatt-hours per household) decreased up to 1996, with no significant change thereafter (Figure 4.6). A combination of rapid rural electrification,[25] energy

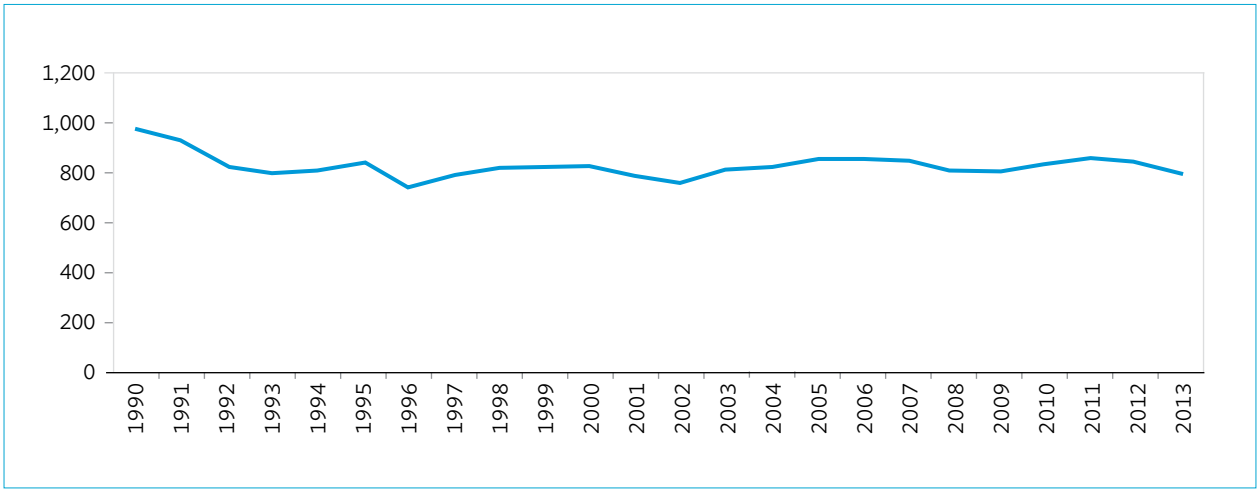
[25] New household customers use less electricity in the few years after being connected to electricity.

Table 4.1: Electricity Tariff, Selected Economies

Customer	Class	Electricity Usage (kWh/month)	Maximum Demand (kW)	Average Unit Price in Equivalent SLR per kWh												
				Bangladesh	Kerala, India	Maharashtra, India	Tamilnadu, India	Korea, Republic of	Malaysia	Nepal	Pakistan	Philippines	Singapore	Sri Lanka	Thailand	Viet Nam
Household	Small	30	...	6.12	3.72	2.81	3.16	9.26	8.96	7.53	3.46	15.04	28.11	4.75	11.56	6.26
	Medium	90	...	5.38	4.39	8.93	3.81	8.49	8.96	9.69	9.49	22.83	28.11	8.09	13.23	7.83
	Large	300	...	6.32	7.88	12.58	9.53	14.09	10.54	11.09	10.83	29.08	28.11	33.00	15.22	9.81
Commercial	Small	1,000	...	6.34	22.43	19.22	17.42	11.95	17.66	13.36	18.42	31.67	28.11	24.62	16.73	12.77
	Medium	58,000	180	12.49	15.88	29.08	18.77	11.24	16.12	12.21	16.20	24.87	28.11	26.94	15.19	12.43
	Large	600,000	1,500	9.55	11.71	26.36	18.35	10.67	15.48	11.72	11.55	22.13	19.98	25.76	14.26	11.63
Industrial	Small	5,000	...	9.66	8.48	17.23	13.10	7.03	15.49	9.90	12.33	21.74	28.11	12.12	17.34	8.05
	Medium	65,000	180	7.44	9.58	16.06	15.45	8.50	14.71	9.48	11.60	24.26	28.81	13.98	14.88	7.72
	Large	270,000	600	9.06	9.23	17.35	15.06	7.36	11.38	9.13	10.93	23.29	28.19	13.03	14.03	7.49
	Very large	1,050,000	2,250	8.89	8.87	17.32	15.00	7.79	10.57	7.34	10.49	21.43	19.36	12.96	13.97	7.26

... = data not available, kW = kilowatt, kWh=kilowatt-hour, SLR = Sri Lanka rupee.
Notes:
(i) Numbers in green indicate the lowest price in the row; numbers in red indicate the highest.
(ii) Electricity use and maximum demand have been defined for typical customers. Thus, the average prices calculated reflect the price for each typical customer in selected countries. Analysis is based on published tariffs. Whether the tariffs are cost reflective or not and whether the utilities are profitable or not have not been considered.
(iii) Sales taxes are not included. Fuel surcharges are included. For Maharashtra and Kerala, "Electricity Duty" is included.
(iv) Based on published tariffs. Special concessions given to identified customers or within special economic zones are not included.
(v) Optional tariffs (such as time-of-use) are not included. When time-of-use tariffs are mandatory, a flat load profile has been assumed.
(vi) Unity power factor is assumed, where relevant.
(vii) Prices updated as of 7 June 2012.
Source: Calculated based on published tariffs.

Figure 4.6: Household Electricity Intensity (kWh/household)



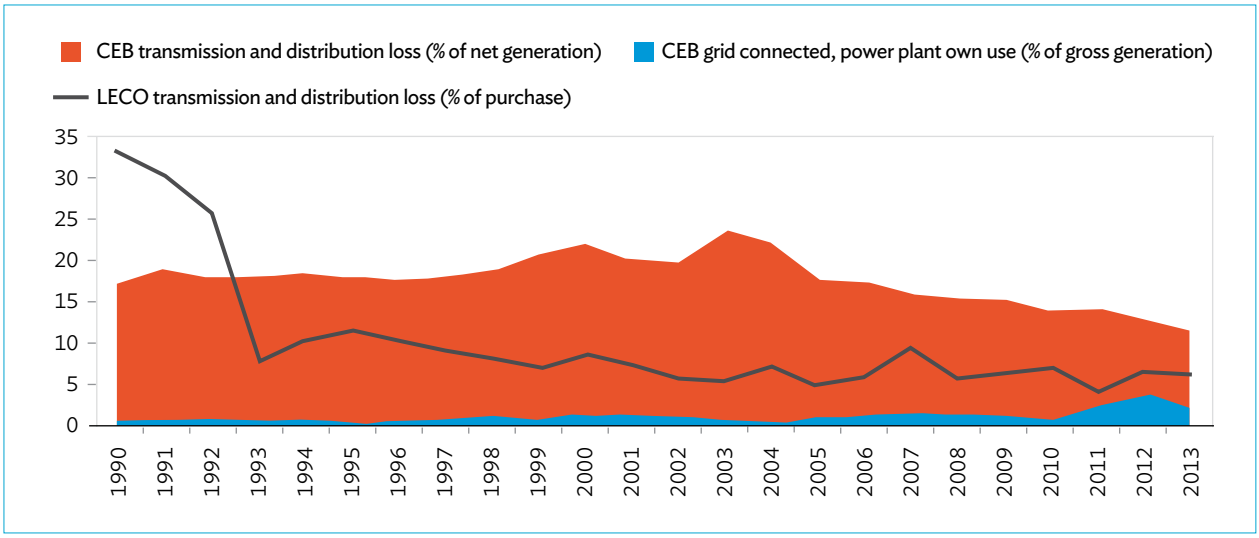
kWh = kilowatt-hour.
Source: Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance data (accessed October 2014).

efficiency measures, and pricing under increasing block tariffs is behind the relatively flat trend from 1997. Households have been keen to replace inefficient incandescent bulbs with efficient compact fluorescent lamps and to use energy-efficient appliances.

4.1.2 System Losses

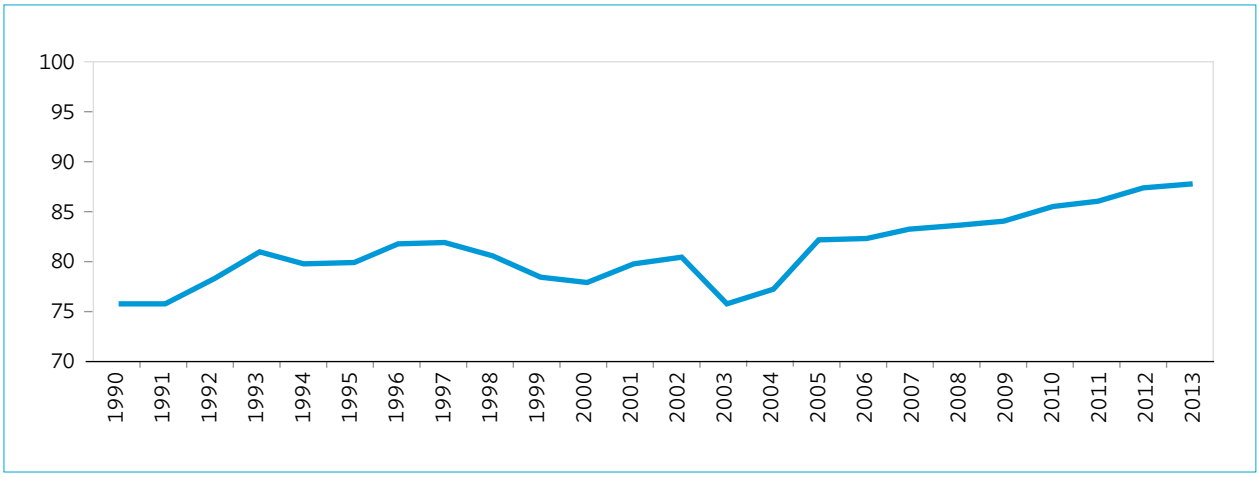
Transmission and distribution losses have decreased significantly. The vertically integrated CEB published the total loss (power generation auxiliaries, transmission, and distribution) as the network loss (Figure 4.7). However, by 2013 the transmission and distribution loss (both technical and commercial) in CEB networks decreased to 11.5% when the power plant own-use is removed from the loss figure. With the introduction of system loss reduction programs, national energy supply efficiency improved from 78% in 2000 to 88% in 2013 (Figure 4.8). Figure 4.9 shows the allowed losses the PUCSL declared for each entity for tariff setting purposes.

Figure 4.7: Electricity Losses (%)



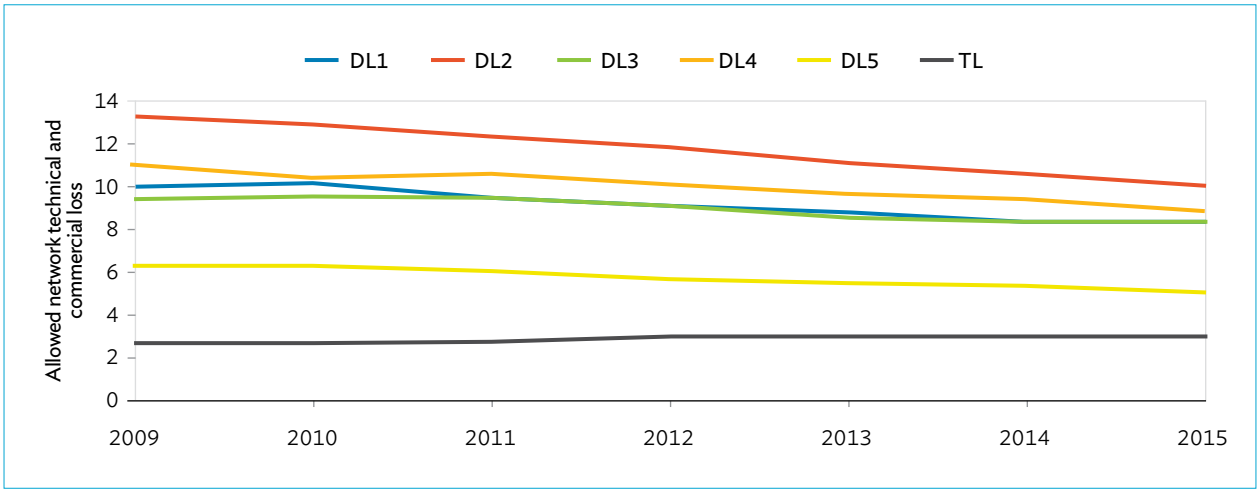
CEB = Ceylon Electricity Board, LECO = Lanka Electricity Company.
Source: Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance data (accessed 20 October 2014).

Figure 4.8: Electricity Supply (Conversion and Distribution) Efficiency (%)



Source: Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance data (accessed 20 October 2014).

Figure 4.9: Target Network Efficiency of Transmission and Distribution Licensees (%)



DL= distribution licensee, TL= transmission licensee.
Note: Figure shows the allowed losses of each entity for tariff-setting purposes.
Source: PUCSL (2011a).

4.1.3 Electricity Prices

Table 4.2 shows that, in 2011, households with low electricity usage received a relatively high subsidy. Average tariffs for households remain well below commercial tariffs and a little below industrial ones.

The reform plan intends to gradually simplify the categories, adopt time-of-use pricing, and move to cost-reflective tariffs. The 5-year road map previously presented targets cost-reflective pricing for all customers by 2015; however, in the absence of a commitment by the PUCSL and the licensees to implement the road map, all its targets for each year during 2012–2014 were missed. The true cost of services to remote and rural areas, and consequent losses to distribution entities, would be seen clearly in a transparent pricing mechanism, which would highlight the costs of rural electrification and compensate the distribution licensees. In the present mechanism, rural electrification investments are added to the CEB assets as additional government equity, while the CEB is required to maintain the assets and to serve customers with tariffs that do not reflect costs. Thus, the electricity is provided below cost to low-using households. This includes most customers in rural electrification schemes built with the objective of increasing network coverage.

The 2013 tariff decision published only the summary information about subsidies and cross-subsidies for that year and Table 4.3 compares 2011 and 2013.

In accordance with the cost-reflective tariff policy, tariff rates of all customer categories were increased in 2011, but further adjustments have been delayed. Commercial and industrial customers experienced steeper tariff rises than residential customers in 2011 as households with low electricity consumption are exempted from the increase and pay less than the cost of supply. Prior to 2011, significant tariff hikes occurred in 2008 in an attempt to increase the CEB's revenue and curtail its loss[26] (Figure 4.10).

[26] The CEB imposed a mandatory 30% fuel surcharge on consumers using over 90 units of electricity per month (*The Sunday Times* 2013).

Table 4.2: Costs and Subsidies Required in 2011 with the Approved Tariffs

Customer Category in Year 2010 Tariffs (and kWh/month for households)	Total Sales (GWh)	Total Cost (SLR million)	Total Revenue (SLR million)	Total Subsidy or Surcharge on Customers (SLR million)	Cost of Supply (SLR/ kWh)	Forecast Revenue (SLR/ kWh)	Subsidy as a Share of Cost
Low-Voltage Retail							
0–30	233	5,487	1,113	(4,373)	23.53	4.77	80%
31–60	756	15,830	3,695	(12,135)	20.94	4.89	77%
61–90	1,018	19,975	5,974	(14,001)	19.61	5.87	70%
91–120	666	11,747	7,075	(4,672)	17.64	10.62	40%
121–180	588	10,363	8,297	(2,066)	17.62	14.11	20%
181–600	492	8,303	10,732	2,429	16.89	21.83	-29%
>600	100	1,472	3,275	1,802	14.79	32.91	-122%
Subtotal	**3,853**	**73,177**	**40,161**	**(33,016)**	**18.99**	**10.42**	**45%**
Other Low Voltage							
Religious	57	1,010	396	(614)	17.77	6.97	61%
General Purpose	1,034	15,869	21,549	7,500	15.34	20.83	-36%
Government	115		1,820			15.83	-3%
Industrial	238	3,169	2,611	(558)	13.31	10.96	18%
Hotel	1	19	26	7	15.10	20.23	-34%
Street Lighting	148	2,310	0	(2,310)	15.56	0	100%
Subtotal	**1,594**	**22,378**	**26,401**	**4,024**	**14.04**	**16.56**	**-18%**
Low Voltage Bulk							
General Purpose	788	9,719	18,175	9,942	12.34	23.08	-87%
Government	88		1,486			16.98	-38%
Industrial	1,561	19,817	21,763	1,947	12.69	13.94	-10%
Industrial TOU	174	2,147	2,361	214	12.34	13.57	-10%
Hotels TOU	2	26	35	9	11.04	14.64	-33%
Hotels (GP)	73	822	1,122	299	11.19	15.27	-36%
Hotels (IP)	54	653	848	195	12.21	15.85	-30%
Subtotal	**2,739**	**33,184**	**45,790**	**12,606**	**12.11**	**16.72**	**-38%**
Medium Voltage							
General Purpose	201	2,259	4,268	2,347	11.24	21.24	-89%
Government	22		338			15.14	-35%
Industrial	1,035	10,943	12,526	1,583	10.57	12.10	-14%
Industrial TOU	143	1,373	1,776	403	9.62	12.44	-29%
Hotels	8	77	108	31	9.65	13.51	-40%
Hotel TOU	71	629	885	256	8.88	12.50	-41%
Subtotal	**1,480**	**15,281**	**19,900**	**4,619**	**10.32**	**13.44**	**-30%**
Total	**9,666**	**144,020**	**132,252**	**(11,767)**	**14.90**	**13.68**	**8%**

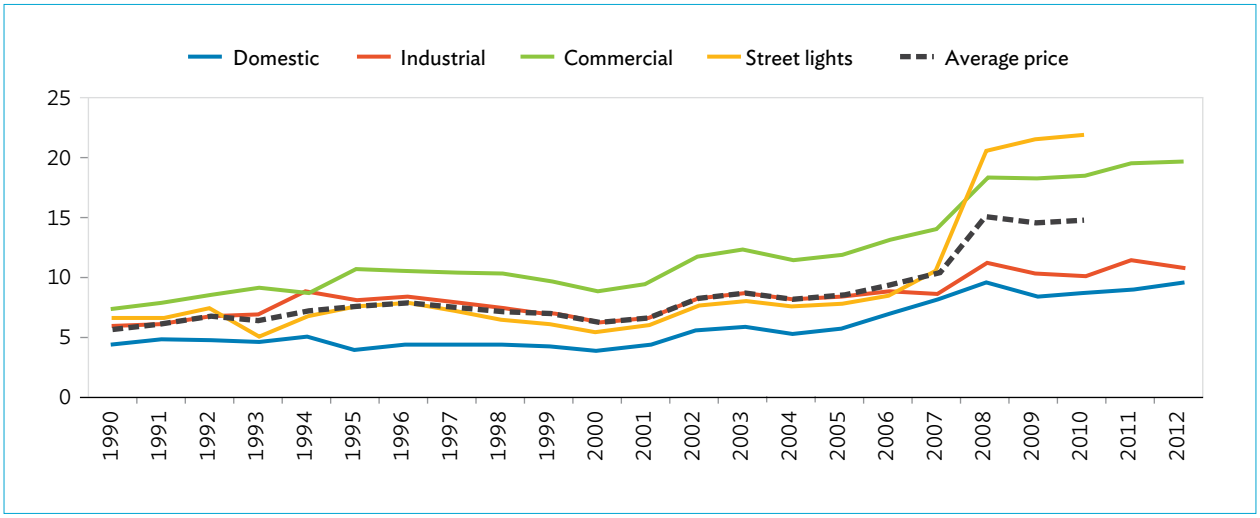
GP = general purpose, GWh = gigawatt-hour, IP= industrial purpose, kWh = kilowatt-hour, SLR = Sri Lanka rupee, TOU = time-of-use.
Source: PUCSL (2011a).

Table 4.3: Costs of Supply and Subsidies, 2011 and 2013

Customer Category	Tariff Decision 2011			Tariff Decision 2013		
	Average Revenue (SLR/kWh)	Cost of Supply (SLR/kWh)	Subsidy (+) or Surplus (-)	Average Revenue (SLR/kWh)	Cost of Supply (SLR/kWh)	Subsidy (+) or Surplus (-)
Low Voltage Retail						
Domestic	10.42	18.99	45%	17.54	26.02	33%
Religious	6.97	17.77	61%	6.83	24.61	72%
General	20.83	15.34	-36%	24.99	22.30	-12%
Industrial	10.96	13.31	18%	14.22	19.55	27%
Hotel	20.23	15.10	-34%	22.48	21.65	-4%
Street Lighting		15.56	100%		22.14	100%
Total LV Retail	**12.22**	**17.54**	**30%**	**18.51**	**20.35**	**9%**
Low Voltage Bulk						
General	23.08	12.34	-87%	27.28	18.50	-47%
Industrial	13.94	12.69	-10%	16.36	18.05	9%
Hotel	15.27	11.19	-36%	19.39	16.69	-16%
Total LV Bulk	**16.72**	**12.11**	**-38%**	**20.06**	**17.82**	**-13%**
Medium Voltage Bulk						
General	21.24	11.24	-89%	24.76	17.25	-44%
Industrial	12.10	10.57	-14%	15.00	14.98	0%
Hotel	13.51	9.65	-40%	16.27	14.09	-15%
Total MV	**13.44**	**10.32**	**-30%**	**16.59**	**15.75**	**-5%**
Total	**13.68**	**14.90**	**8%**	**18.63**	**20.19**	**8%**

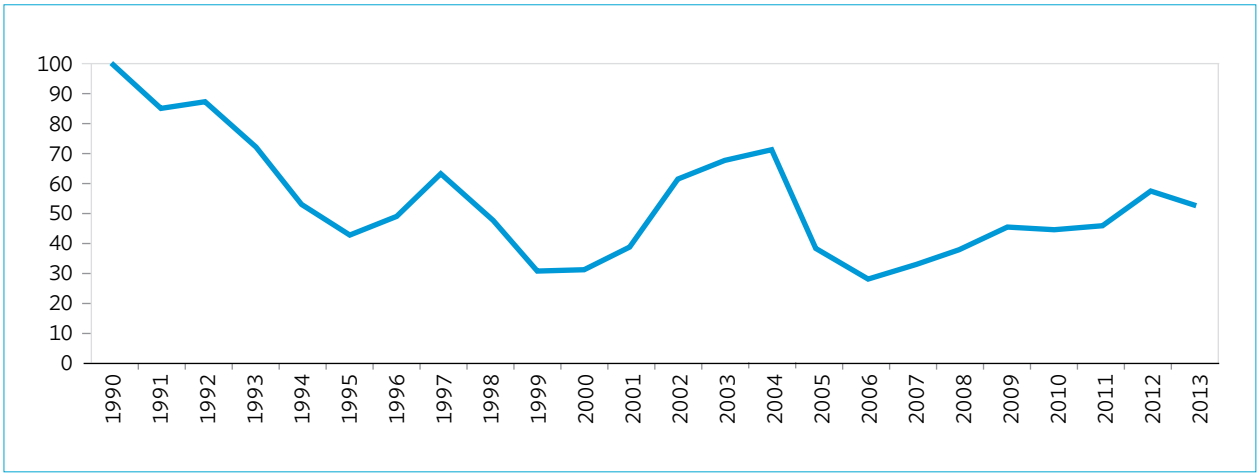
kWh = kilowatt-hour, LV = low voltage, MV = megavolt, SLR = Sri Lanka rupee.
Source: PUCSL (2011a, 2013).

Figure 4.10: End-Use Electricity Price (US cents/kWh)



kWh = kilowatt-hour, US = United States.
Note: Prices are the average per customer category, in nominal US cents per kWh.
Sources: CEB (various years), Annual Reports.

Figure 4.11: Reserve Margin in the Generating System (%)



Source: Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance data (accessed 20 October 2014).

4.1.4 Electricity Security

From 2000 to 2012, the bulk of the electricity generation was from thermal power sources, and coal, fuel oil, and diesel produced nearly 60% of electricity supply. The rest was provided by hydropower, with wind and solar power plants providing a small fraction. Sri Lanka lacks indigenous fossil fuels, and is thus highly dependent on imports. The volatility in world oil prices places unexpected and large burden on the country's foreign exchange reserves. To improve its energy security, Sri Lanka has ambitious plans to increase the use of large-scale renewable energy sources such as biomass, wind energy, and photovoltaic systems for on-grid and off-grid, localized use. Sri Lanka's large hydroelectric capacity is seasonal and allows the country to have a high reserve capacity: 52% in 2013 (Figure 4.11).

4.2 Social Sustainability

4.2.1 Access to Electricity for Households and Industries

The entire country is served by one national grid. Northern Jaffna, which was disconnected from the main grid in 1987, was reconnected in 2013.[27]

The national grid has been rapidly extended into villages. The CEB estimates the national household electrification level at 94% in 2012 and 96% in 2013.[28] This is a positive outcome of several decades of effort by governments and the utility. That most of the connections predate the reforms indicates that reforms and unbundling are not essential to ensure universal coverage.

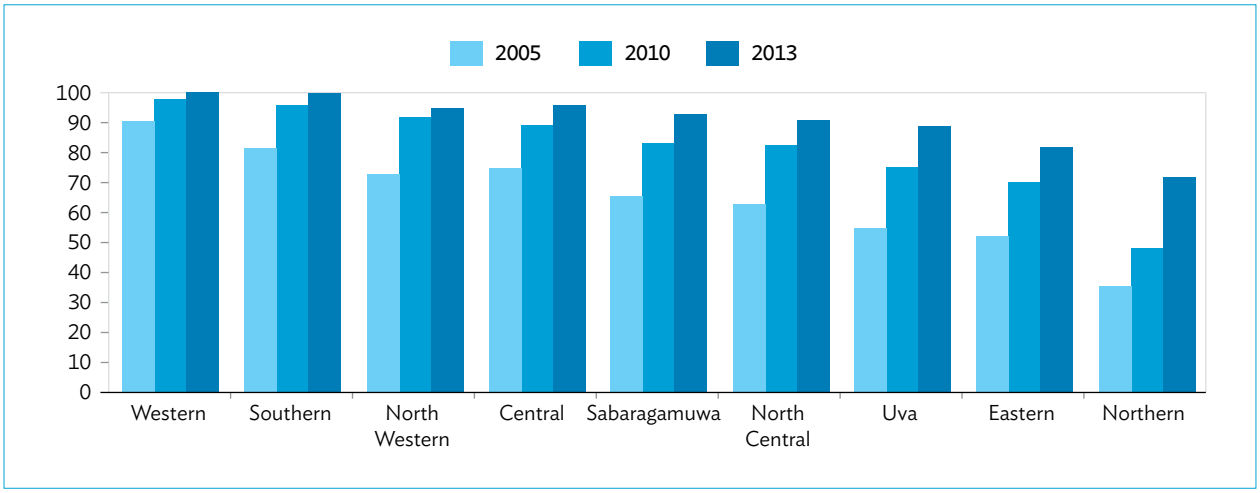
Extending the grid to remote villages is expensive, and this results in disparity in access to electricity (Figure 4.12 and Figure 4.13). The areas affected by the 30 years of civil war, such as the Eastern and Northern provinces, had lower levels of electrification. Since the war ended, the government has launched electrification efforts in areas such as the Nagenahira Navodaya (Eastern Revival) and Uthuru Wasantham (Northern Spring) programs.[29] As a result, only 4% of households were without electricity in 2013 (Figure 4.14). The government plans to raise this to 100% by 2015 with a mix of grid extensions and off-grid solutions. Compared to three countries in South Asia, Sri Lanka's electrification

[27] It was temporarily served by a 50-MW minigrid during 1987–2013.

[28] In calculating electrification rates, the CEB adds all household customers and a share of commercial customers who conduct small businesses to calculate the number of electrified households. However, the CEB's accounts include a high share of household accounts with zero readings. When adjusted for these, the actual ratio is lower than the CEB-reported figure.

[29] While disparity in access to electricity still exists, Figure 4.13 shows that the government electrification efforts have helped narrow this disparity across districts with 75% as lowest electrification rate in only one district.

Figure 4.12: Provincial Electrification Levels (% of households)



Source: Central Bank of Sri Lanka (various years).

rate in 2013 is the second highest after Maldives (99.8%). Other comparator countries, Bhutan and Bangladesh, recorded electrification rates of 90% and 62%, respectively.[30]

Proposed rural electrification schemes are surveyed and analyzed, and packaged into projects and presented for financing. The CEB has implemented seven such projects that have catalyzed electrification of remote areas. This rapid expansion has been made possible largely owing to concessionary financing, particularly from multilateral development banks and, more recently, from the governments of the People's Republic of China, India, Kuwait, and Sweden. The Government of Sri Lanka provides investments as additional equity to the CEB, and the CEB is not required to repay them.

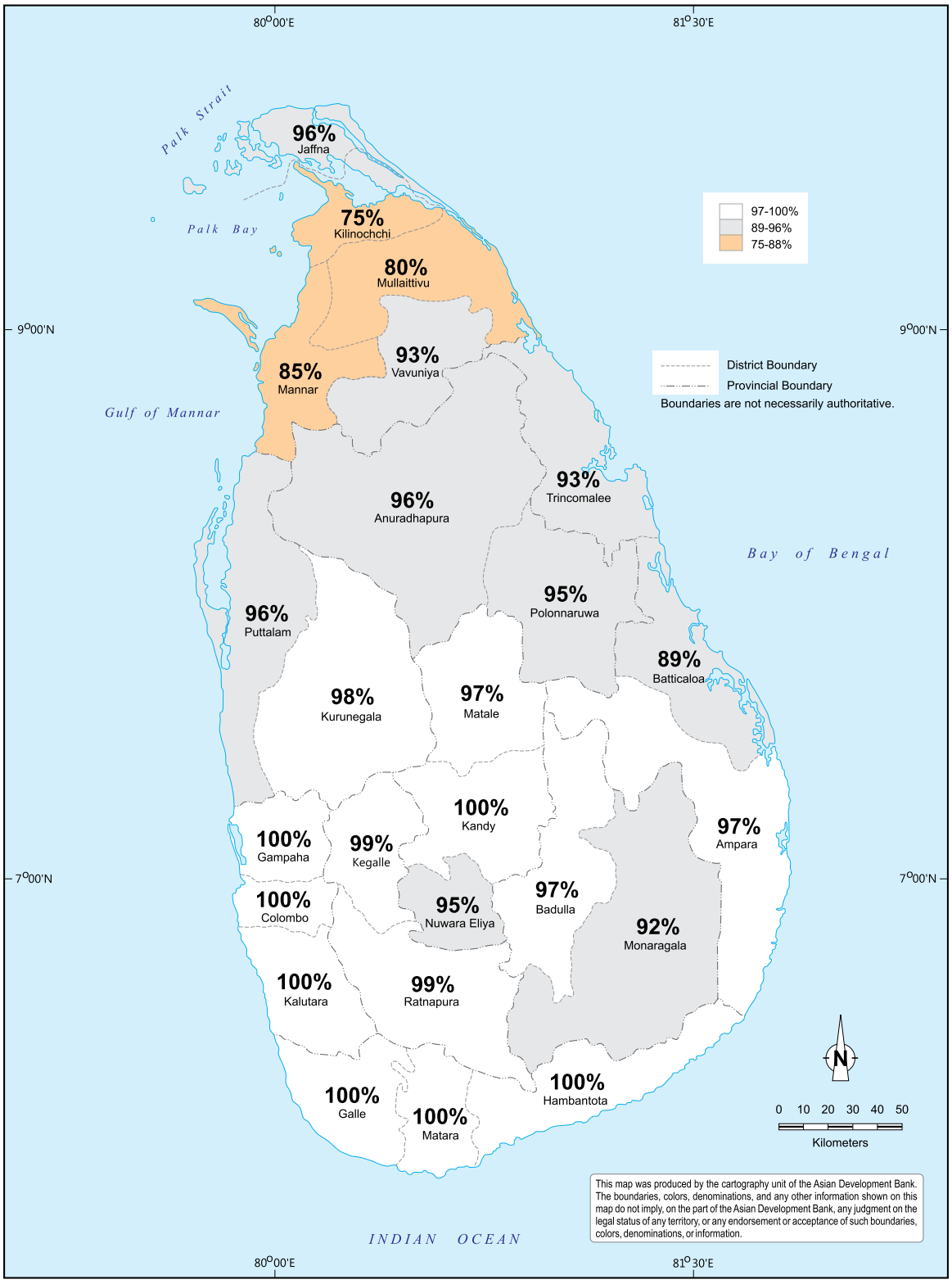
In 2002, a program to provide remote and rural households with off-grid services was established with the support of the World Bank and, by the end of 2008, microhydro (community), solar photovoltaic (household modules), and wind generating systems (community) are estimated to have served 2% of households (Figure 4.15).

The 10-year plan published in 2007 explains the government strategy for rural electrification and states that: "Investments will be made on grid extensions as well as to establish off-grid energy services, to ensure access is available to 96% of households by 2016. Measures will be implemented to support connection costs of households that already have access" (Department of National Planning 2007).

The government later revised the access target to 100% by 2012, which may include some households to be served with off-grid supply, in addition to the estimated 2% already served with off-grid systems. However, the target of 100% by 2012 was not achieved, and about 87% of households had active electricity accounts in 2012, according to the Census of Population and Housing for 2012 (Table 4.4).

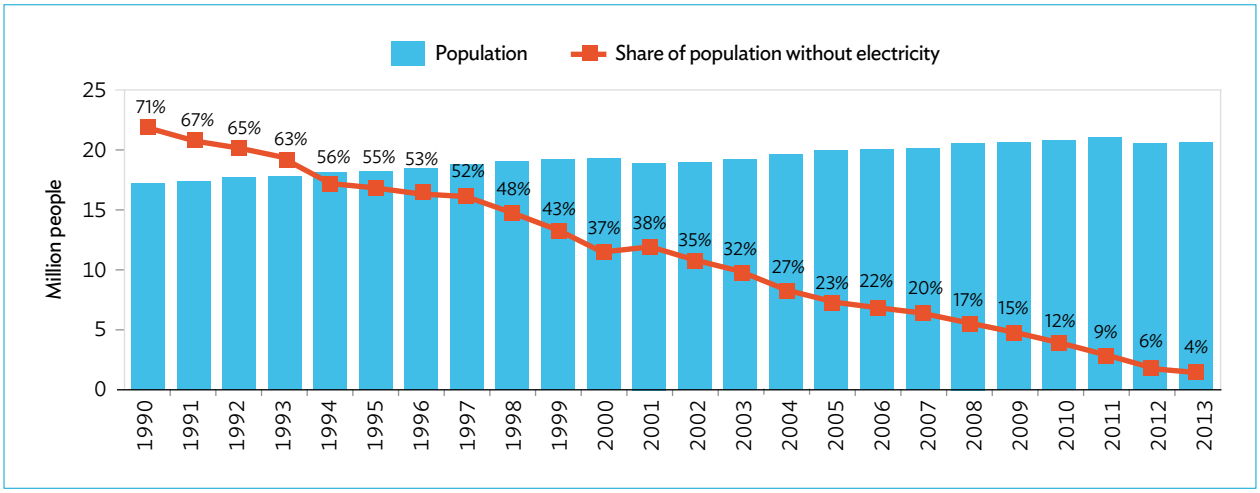
[30] Data are sourced from World Bank (2014) for Bangladesh; and ADB, Australian Agency for International Development, and Japan International Cooperation Agency (2013) for Bhutan. Other comparator countries did not have 2013 data available at the time of writing this report.

Figure 4.13: District Electrification Rates, 2014



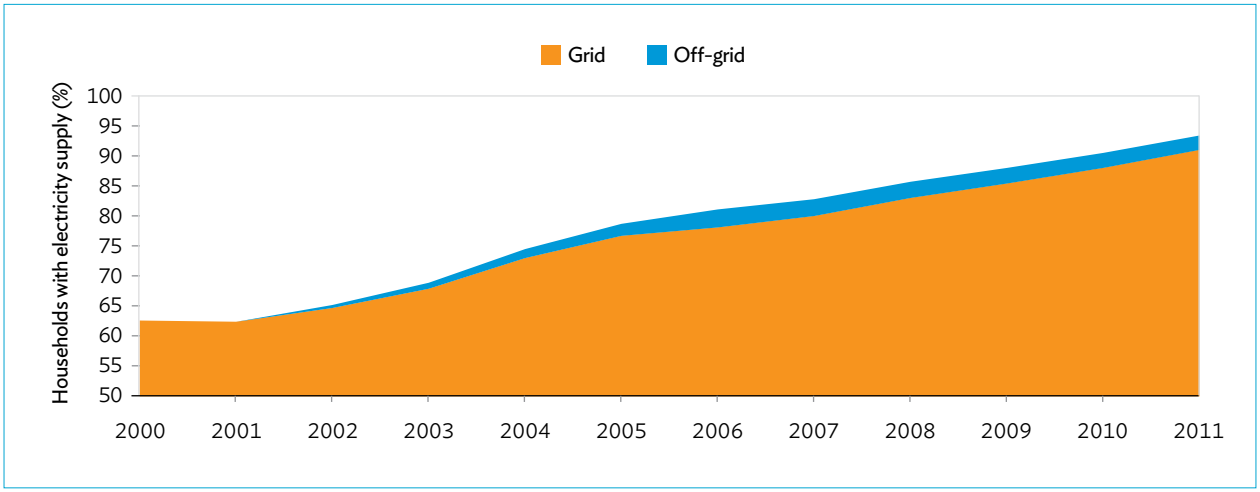
Source: Ceylon Electricity Board (2015).

Figure 4.14: Population without Electricity



Source: Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance data (accessed October 2014) for population without electricity; Central Bank of Sri Lanka, Annual Report (various years) for population.

Figure 4.15: Electrification, Grid and Off-Grid (%)



Note: The National Census of 2012 established a lower electrification rate for both on-grid and off-grid customers than the rate presented here.
Source: Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance data for grid electrification information (accessed October 2014).

Table 4.4: Sources and Coverage of Energy for Household Lighting, 2012

Source of Energy for Lighting	Number of Households	Percent
Electricity (grid)	4,514,182	87.0
Electricity (community hydro)	36,904	0.7
Kerosene	597,360	11.5
Solar Photovoltaic	34,315	0.7
Biomass	840	0.0
Other	4,446	0.1
Total	**5,188,047**	**100.0**

Source: Department of Census and Statistics (2013).

4.2.2 Electricity Affordability

Due to the rapid growth in the economy, average household income has increased rapidly. Among the poorest 20%, the share of income spent on electricity has decreased over the time to just under 5% in 2012, although the share has risen slightly overall since 2002 (Figure 4.16).

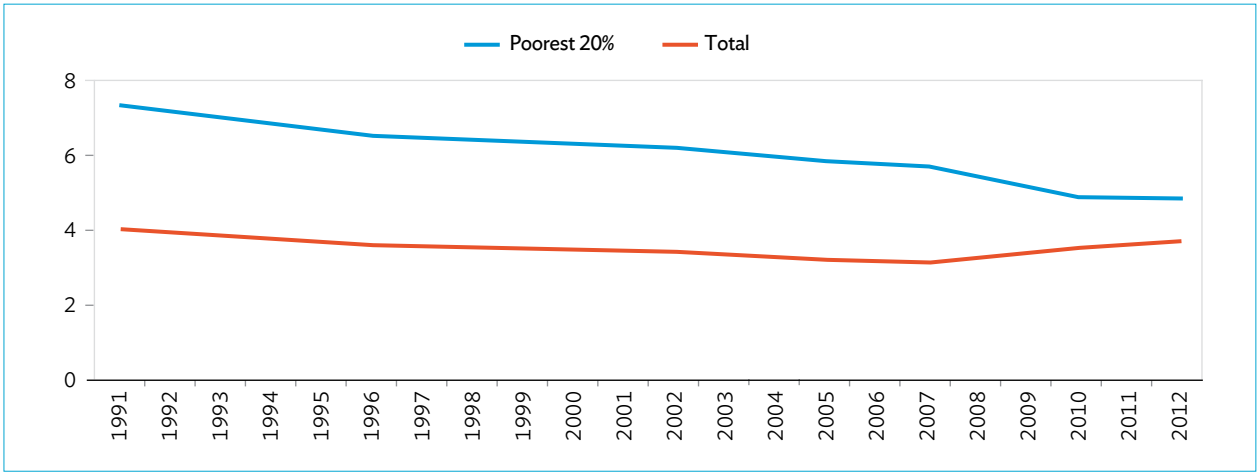
4.3 Environmental Sustainability

The future mix of inputs for generating electricity is a key factor for environmental impacts. Hydro was the main source of power generation until about the mid-1990s. Its share has declined due to limited hydro sources and investment, and major droughts in 1992, 1996, 2001–2002 (see Figure 2.8). Available hydro resources have been almost exhausted. The long-term generation expansion plan involves shifting the energy mix from hydro to thermal power, favoring coal rather than petroleum fuels, for reasons of cost. NCRE sources such as biomass, wind, and solar energy are expected to supplement the country's power requirements.

The increased use of fossil fuels for power generation means that the shares of noncarbon and renewables have decreased in the last decade (Figure 4.17 and Figure 4.18). The noncarbon share is mainly from major hydropower plants and other renewables such as small hydro, wind, biomass, and solar photovoltaics. The noncarbon share in total generation declined rapidly from 94% in 1995 to 28% in 2012, then rose to 60% in 2013, with good rainfall. The Energy Policy and Strategy emphasizes the need for sustainable energy and targets achieving 10% of grid energy from NCRE sources by 2015. The target was attained in 2013.

Sri Lanka is gradually moving toward an electricity generation system dominated by thermal power plants using fossil fuels. This transition has resulted in increases in per capita carbon dioxide (CO_2) emissions since 1996, with the emissions rising by an average of 27% per year up to 2011. As of 2011, the CO_2 emissions from electricity generation were equivalent to 262 kilograms per person (Figure 4.19). Although this level is well below the average global value (1,878 kilograms CO_2 per capita),[31] the government has implemented many initiatives to mitigate CO_2 emissions. The measures encompass all sectors including energy (power, transport, industry, and household and commercial users); land use; and waste.

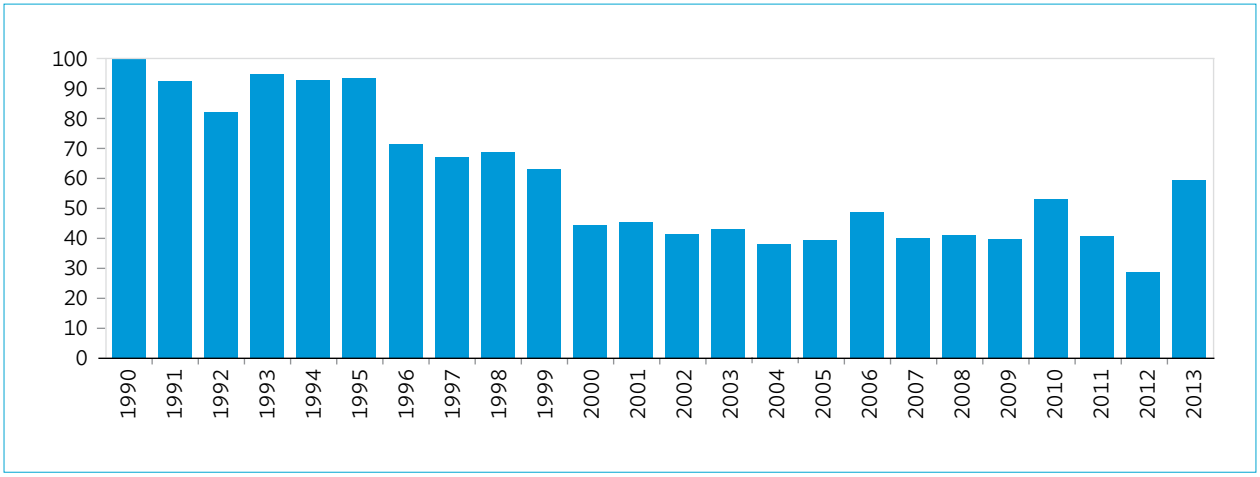
Figure 4.16: Electricity Affordability: Share of Household Income Spent on Electricity (%)



Source: Department of Census and Statistics (2013).

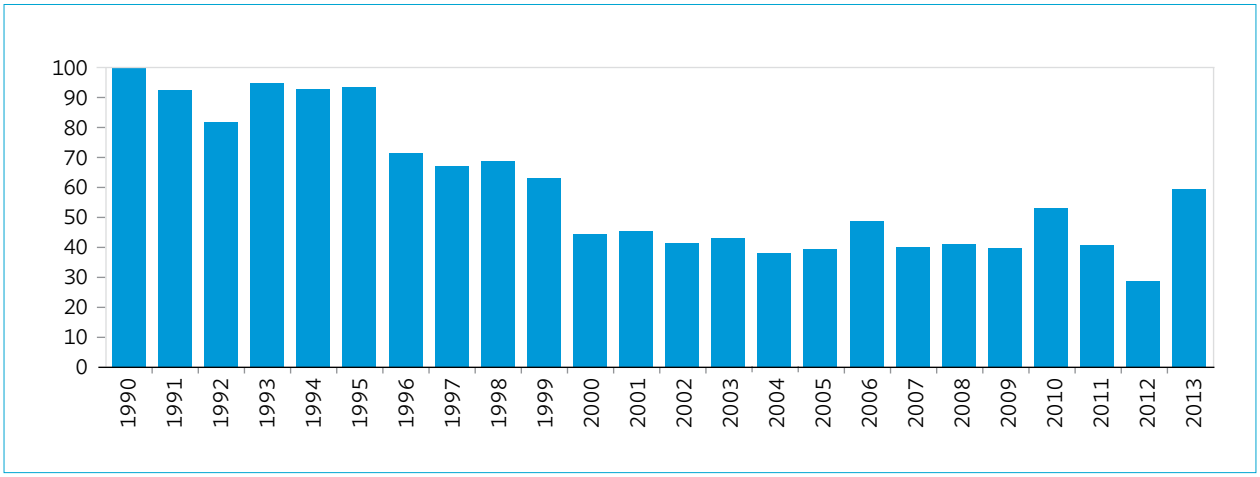
[31] The global average refers to CO_2 emission from electricity and heat production in 2011 (International Energy Agency 2013).

Figure 4.17: Share of Noncarbon Energy in Electricity Generation (%)



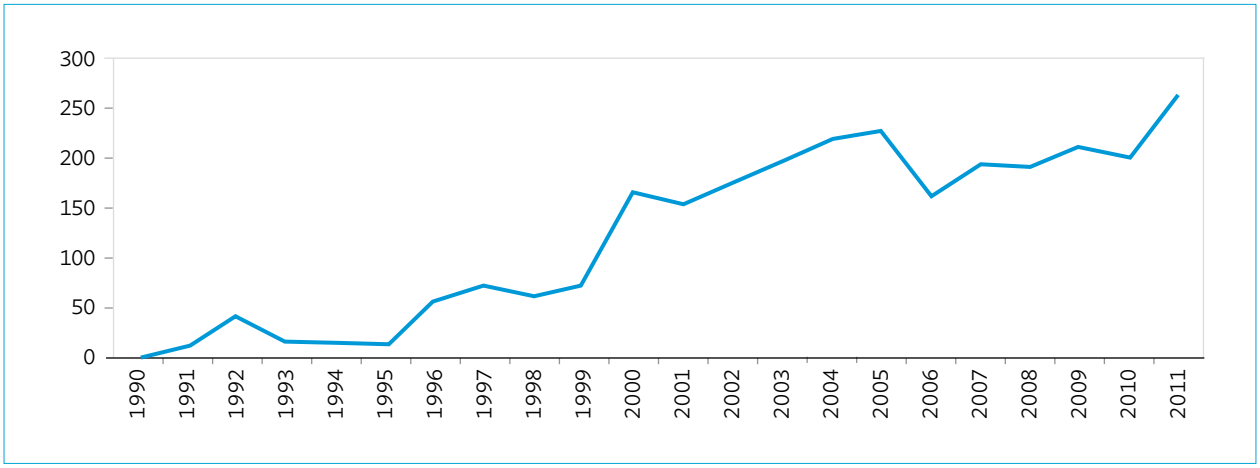
Source: Adapted from information in Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance data (accessed 20 October 2014).

Figure 4.18: Share of Renewables in Grid Electricity (%)



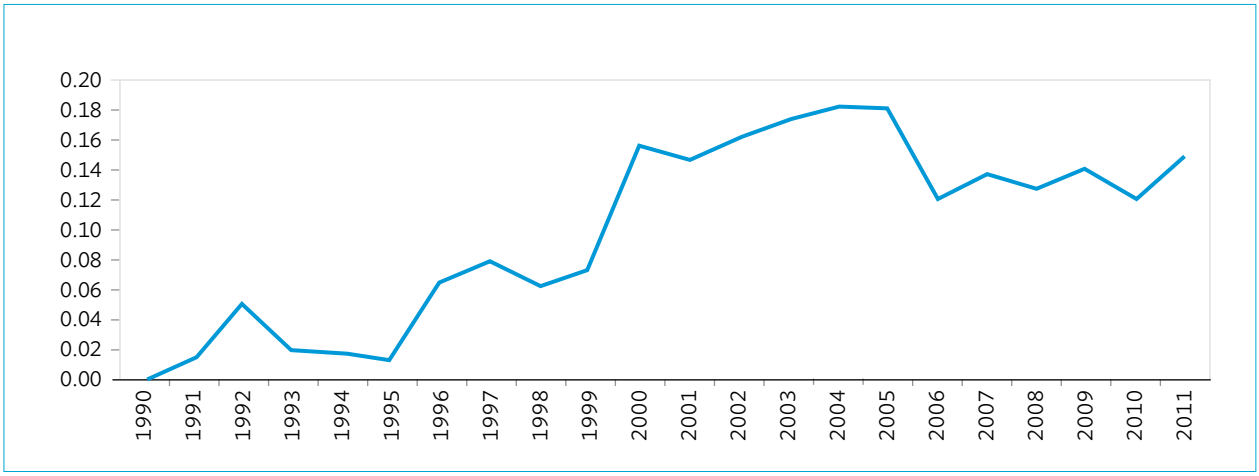
Source: Adapted from information available in Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance data (accessed 20 October 2014).

Figure 4.19: Per Capita CO_2 Emissions from Electricity Production (kilograms)



CO_2 = carbon dioxide.
Sources: International Energy Agency (2013) for CO_2 emissions (accessed September 2014); Central Bank of Sri Lanka (various years) for population.

Figure 4.20: CO_2 Emissions from Electricity Production per Unit of GDP (kg/unit of GDP in year 2005 US dollars)



CO_2 = carbon dioxide, GDP = gross domestic product, kg = kilogram US = United States.
GDP is in constant 2000 US dollars.
Source: International Energy Agency (2013) for CO_2 emissions (accessed September 2014); World Bank, World Development Indicators for GDP (accessed July 2014).

Sri Lanka has been moving toward a less energy-intensive pattern of production (see Figure 4.3) and CO_2 emissions from electricity production per unit of GDP decreased during 2005–2010. However, the trend has reversed in 2011. The commissioning of the country's first coal-fired power plant has brought the overall CO_2 emissions level nearly back to that in 2000 (Figure 4.20).

4.4 Summary of Trends

Star diagrams based on selected years (1991, 1996, 2002, and the latest year for which data are available) illustrate the trends in the Sri Lankan power sector as measured by three sets of indicators—economic, social, and environmental. The year 1991 represents the prereform period, 1996 is the year the private sector started to play a role as IPPs commissioned oil-fired power plants, 2002 is the year when serious discussion of reform started, and the latest years are early post reform years. Table 4.5 gives the values in the star diagrams with 1991 as the base year.

Electricity use per capita more than tripled from 1991 to 2013, reflecting greater access to grid electricity combined with significant increases in income per capita, which, in turn dampened the effect of higher tariffs on electricity sales. From the base year, the average electricity prices in current terms increased by 28% in 2002 and more than doubled by 2013.[32]

Overall electricity intensity increased remarkably in 2002, but declined slightly in 2013 when the services became the dominant sector and electricity efficiency and conservation measures were introduced in 2006 (Figure 4.21). The electricity intensity of the commercial and services sector increased from the base year to 2013 by 37%, while that of industry and agriculture only grew by 6%.

Access of the population to grid electricity has been improving through the years. The share of the population without electricity decreased by 91% in 2012 relative to the 1991 level, as a result of the successful electrification programs. Consumption of electricity per household has declined slightly from the base year, which may be due to conservation measures following increases in tariffs. With the decline in electricity use combined with steep increases in income, the share of household income spent on electricity has declined in 1996 and 2002 but increased in 2012 when the government raised

[32] Used 2010 data as proxy for 2013.

Table 4.5: Values for the Star Diagrams (1991 index)

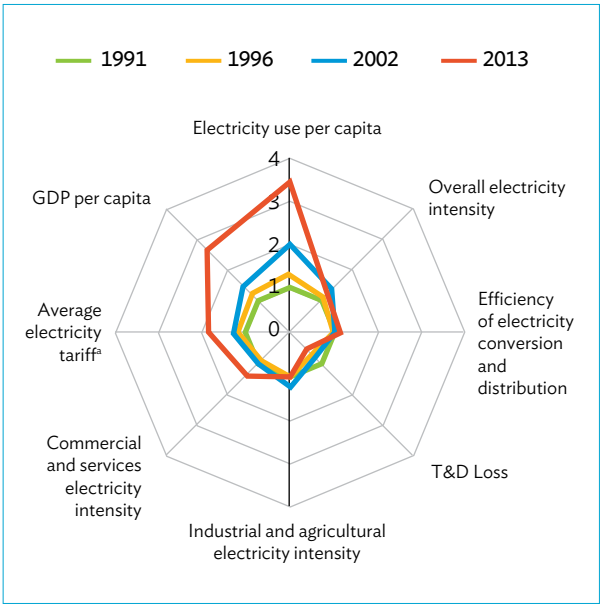
Economic Indicators	1991	1996	2002	2013
Electricity Use per Capita	1.00	1.36	2.03	3.46
Overall Intensity	1.00	1.12	1.37	1.27
Efficiency of Electricity Conversion and Distribution	1.00	1.08	1.06	1.16
Transmission and Distribution Losses	1.00	0.76	0.81	0.51
Industrial and Agricultural Electricity Intensity	1.00	1.08	1.29	1.06
Commercial and Services Electricity Intensity	1.00	0.92	1.07	1.37
Average Electricity Tariff in Current Terms	1.00	1.24	1.28	2.31[a]
GDP per Capita	1.00	1.21	1.48	2.74
Social Indicators	**1991**	**1996**	**2002**	**2012**
Share of Population without Electricity (%)	1.00	0.79	0.53	0.09
Share of Household Income Spent on Electricity, All	1.00	0.90	0.85	0.92
Share of Household Income Spent on Electricity, Poorest 20%	1.00	0.90	0.85	0.67
Electricity Tariff in Current Terms, Domestic Consumers	1.00	0.94	1.08	1.94
Electricity Use per Household	1.00	0.80	0.82	0.90
Environmental Indicators	**1991**	**1996**	**2002**	**2011**
CO_2 Emissions from Electricity Production per Capita	1.00	5.36	16.48	24.49
CO_2 Emissions from Electricity Production per Unit of GDP	1.00	4.41	11.10	10.39
Oil Sources (% of total generation)	1.00	3.65	8.01	7.69
Hydroelectric Sources (% of total generation)	1.00	0.78	0.41	0.44
Renewable Energy (hydro+NCRE) Share in Electricity (%)	1.00	0.78	0.42	0.44
Electricity Use per Capita	1.00	1.36	2.03	3.22

CO_2 = carbon dioxide, GDP = gross domestic product, NCRE = nonconventional renewable energy.
[a] Used 2010 data as proxy.
Source: Calculations based on data from Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance; World Bank, World Development Indicators; Department of Census and Statistics (2013); CEB (various years), Annual Reports; Central Bank of Sri Lanka (various years), Annual Reports. (All accessed July–October 2014.)

tariffs substantially. The poorest 20% of households have subsidized electricity rates, and the share of their income spent on electricity decreased more than that of the average household (Figure 4.22).

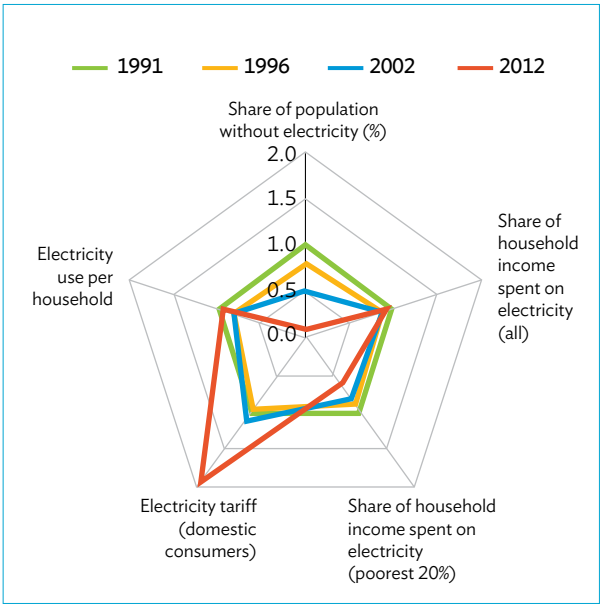
The increase in electricity consumption per capita accompanied a major increase in CO_2 emissions from electricity production per capita and in CO_2 emissions from electricity production per unit of GDP relative to the base year of 1991. Shares of noncarbon and renewable energy in electricity production declined with the growing share of thermal generation over hydro, as the energy contribution from thermal generation had overtaken hydropower by 2000 (Figure 4.23).

Figure 4.21: Economic Indicators



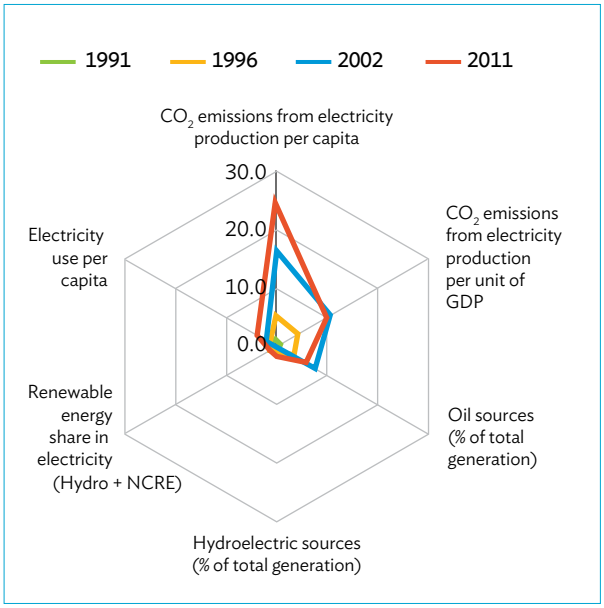
GDP = gross domestic product, T&D = transmission and distribution.
[a]Used 2010 data as proxy for 2013.
Sources: Computations from Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance data, for electricity use and generation (accessed October 2014); CEB (various years) Annual Reports, for tariff; Central Bank of Sri Lanka (various years) Annual Reports, for population; World Bank, World Development Indicators, for GDP (accessed July 2014).

Figure 4.22: Social Indicators



Sources: Computations from Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance data, for electricity use and population without electricity (accessed October 2014); Department of Census and Statistics (2013), for the share of household income spent on electricity; Central Bank of Sri Lanka (various years) Annual Reports, for population; CEB (various years) Annual Reports, for tariff.

Figure 4.23: Environment Indicators



CO_2 = carbon dioxide, GDP = gross domestic product, NCRE = nonconventional renewable energy.
Sources: Computations from data sourced from International Energy Agency (2013), for CO_2 emissions from electricity production; Sri Lanka Sustainable Energy Authority, Sri Lanka Energy Balance data (accessed October 2014) for electricity use and generation; Central Bank of Sri Lanka (various years) Annual Reports, for population; World Bank, World Development Indicators, for GDP (accessed July 2014).

5. WAY FORWARD

Several measures need to be implemented to complete the reform program that commenced in 2009. The data presented here suggest that power use has expanded greatly, that affordability has not been a key issue, and that network losses have decreased significantly. Therefore, key initiatives should focus on better economic regulation. These initiatives are required to complete the unbundling process and truly ring fence the unbundled entities to achieve the next phase of reform. The required actions are divided into two segments.

5.1 Licensee Efficiency and Customer Outreach

Table 3.5 lists the actions pending to unbundle tariffs and implement the tariff methodology. The PUCSL is responsible for implementing most of the pending initiatives; a few are the licensees' responsibilities.

Implement the Road Map for Tariff Reforms and Restructuring. Tariff reforms and restructuring are essential to achieve cost-reflective pricing by 2015 and sector profitability by 2017. This requires a renewed dialogue and that an agreed, revised road map be formulated to achieve profitability by 2017 and to sustain it thereafter. The previous road map that targeted breakeven in 2015 is available and should be applied.

Separate Licensees' Revenue Streams. The streams should be separated immediately. As a legacy of the vertically integrated monopoly, the four CEB-owned distribution licensees and the CEB Transmission Licensee have not been made independent from each other and from the CEB corporate accounts. The income from sales by the distribution licensees to customers and by the CEB Transmission Licensee to the LECO continues to be credited to the CEB corporate account, violating the basic requirement for the licensees to be financially independent.

Disclose and Pay Subsidies. The subsidies and their timely payment to licensees should be declared. Indirect subsidies (principally for fuel) need to be clearly identified, and subsidies promised and not paid should be paid immediately by the government to the distribution and transmission licensees.

Establish the Bulk Supply Transactions Account. This account manages all income from distribution licensees and payments for generation and transmission. As such, the account is a key element of unbundling tariffs. The CEB Transmission Licensee should manage the account transparently and report it to the PUCSL and to the public. Initial attempts since 2011 to establish a financial account have not been taken forward by the CEB Transmission Licensee, when the tariff methodology required the establishment of such an account. The guidelines the PUCSL prepared for establishing and operating this account have not been adhered to.

Publish Operating and Other Information. Fully disclose costs of supply on customer bills, and provide information about licensee performance with regard to sales and allowed revenues and losses.

5.2 Streamlining Generation Procurement

The following regulatory actions are pending:

- **Regulatory review of new generation projects and power purchase agreements, and the long-term generation expansion plan**. Although the new regulatory regime was established in 2010, the CEB Transmission Licensee continues to make unilateral decisions on the mainstream power generation projects, in association with the prereform administrative structure. The PUCSL and the CEB Transmission Licensee need to ensure a transparent procedure to review the generation expansion plan and power purchase agreements. In December 2013, for the first time, the PUCSL issued the CEB Transmission Licensee's Long-term Generation Expansion Plan for public comments.
- **Resolution of shortcomings in the feed-in-tariff determination**. The feed-in-tariff has been the subject of much debate. The PUCSL's unilateral decisions on raising the feed-in-tariff to levels that require a significant subsidy to producers need to be resolved to ensure that the licensees are not penalized for purchasing renewable energy.

5.2.1 Initiatives Related to Technical Regulation

The two cornerstones of technical regulation are the Grid Code and the Distribution Code, both of which provide the basis for technical regulation, including performance standards. The Distribution Code has been published and is operational. The Grid Code was drafted in 2011. It was finalized in 2014, but not implemented, despite being ready for implementation after stakeholder consultations. Both codes need to be implemented, based on a road map to be prepared jointly by the PUCSL and the licensees, as provided for in the codes themselves.

5.2.2 Initiatives in Safety Regulation

Sri Lanka lacks proper regulations on safety, the current ones need to be streamlined, and the following key initiatives are awaiting implementation:

- establishment of national standards for distribution system design and safety,
- licensing of electricians for wiring and testing of installations,
- licensing of engineers for design and testing of installations, and
- safety and standardizations issues related to electrical devices and appliances.

5.3 The Future of Reforms

Although Sri Lanka is yet to implement many of the reforms contained in the 2009 Electricity Act and the new regulatory initiatives that commenced in 2011, the next phase of reforms must be anticipated. The country needs to move toward creating a competitive wholesale market for electricity, and eventually a retail market.

5.3.1 Unbundling and Institutional Reforms

The current functional unbundling has the major weakness that five of the six licensees are unable to act independently in their investment, financial, and (to a large extent) operational decisions. The next stage of reform requires establishing six independent companies out of the CEB's generation, transmission, and four distribution licensees. The organization culture in the government-owned company LECO needs to be replicated in the CEB's distribution licensees by creating corporate entities that report to the CEB holding company. The functional business units currently established within the CEB are adequately staffed and organized to enable the formation of six corporate entities.

5.3.2 Competition and Market Operations

A competitive electricity market has not yet been established in Sri Lanka. Except when solicitations are issued for new IPPs (the last such solicitation was issued in 2007 for a power plant in the Northern Jaffna peninsula), there is no competition in any of the industry's segments: generation, wholesale, or retail. Before establishing a competitive wholesale market, it is necessary to ensure that no major generation capacity shortages will occur in the country, and that the competition (either real time or short-term) would not lead to a rapid rise in wholesale prices. As the major issues in generation supply are being resolved with the commissioning of power plants (Upper Kotmale hydro and Puttalam coal-fired power plant during 2011–2014, and the Trincomalee power plant in 2018), the wholesale market is likely to be ready for the introduction of limited competition from 2016 on.

Several options that may be considered for establishing a wholesale market:

- Move a few or all the retiring oil-fired power plants from the seven oil-fired IPPs to a competitive market, as and when their power purchase agreements reach their end of term. The market rules should have adequate safeguards to ensure that prices are kept within a reasonable range to prevent a significant rise during droughts and unforeseen outages of mainstream, lower-cost power plants. A few CEB-owned power plants could be placed on this short-term competitive market. The first three 20-MW oil-fired IPPs have already reached their end of term.
- Allow market-based power plants to operate as a means of checking market conditions, subject to guidelines and licensing restrictions on such plants.
- Allow wheeling of power, initially between the same legal entities (within local areas, and subsequently from one entity to another), but only after the cost-reflective pricing regime has been established. This is to ensure that cross-subsidies between customer categories and contributions required from certain types of customers are not bypassed by direct transactions between generators and buyers, through wheeling.

5.4 Conclusions

Sri Lanka's achievements in power sector reforms by unbundling and market liberalization are still very limited. However, the population has a high level of access to the grid (exceeding 94%), low transmission and distribution losses (10.3% of net generation in 2012 and decreasing), and a generating system that is not subject to frequent or continuous load shedding.[33] These achievements cannot be attributed to reform-related initiatives, but to two key government initiatives of the past: to accelerate electrification; and to build power plants to meet the growing needs of the population, at times ignoring the impacts on electricity costs and customer prices.

However, Sri Lanka's electricity costs and hence prices are relatively high by regional norms. One reason is Sri Lanka's lack of fossil fuel reserves. Another is that projects to establish key coal-fired power plants, proposed since 1982 as part of the long-term generation plan, were not implemented in a timely manner (owing to internal debates and misunderstanding and external pressure to open the market for IPPs). Consequently, the shortfall had to be covered by smaller, oil-fired power plants. The country is gradually moving out of this situation and, based on current plans, the transition to oil that prevailed during 1995–2005, should be fully reversed by about 2020.

As the country continues to have wide coverage of its electricity network; a good level of technical efficiency in the network; and (by the end of this decade), the lowest possible generation costs in a fuel-importing country, the next focus should be to improve institutional efficiency and to enhance

[33] The last major load shedding was in 2001–2002. Limited load shedding for about 4 weeks was required in August 2012 owing to a power plant outage during a severe drought.

customer service reliability. Initiatives established under the Electricity Act 2009 are adequate to meet the challenge of improving the institutional efficiency and service reliability to higher levels. However, the CEB generation, transmission, and distribution licensees need to be corporatized. This is needed to enable independent decision making and to secure the full benefits of the tariff methodology that in theory is already operational, but is currently fraught with delays, government interference, and weaknesses. The corporatization need not involve privatization if political decision makers do not wish to involve private capital more fully in the sector, provided the state-owned firms operate as independent commercial companies.

Full liberalization of the electricity market is still a few years away, and must wait until the regulator (PUCSL) displays the ability to supervise the current structure and to implement the regulatory instruments already in place. Wholesale or retail market liberalization cannot work with a weak regulator that is unable to enforce reforms or manage the industry information efficiently, and lacks experience with implementing benchmark competition.[34] Such a market requires efficient pricing of electricity.

However, limited wholesale competition may be introduced in the generation market. This small step toward market liberalization could commence in 2016. To start, a road map for market liberalization must be completed, for implementation from 2016 on. The currently approved tariff methodology ends in December 2015, by which time a new methodology including the limited opening of the wholesale market should be discussed and prepared for implementation. As stipulated in the Electricity Act 2009 and in the National Energy Policy 2008, full cost-based pricing should be achieved for all customers, with targeted subsidies strictly limited to the very poor and provided through means other than electricity charges. This is an essential prerequisite to any new reforms.

[34] The limited reforms so far only allow competition between licensees to achieve financial and technical performance benchmarks. With functional unbundling, ring fencing, and setting of fixed revenue, additional sales do not make a licensee more profitable. However, if the benchmark loss targets and customer service targets are met, licensees are rewarded.

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Assessment of Power Sector Reforms in Sri Lanka
Country Report

Sri Lanka's power sector reforms were undertaken as part of a larger overall economic recovery effort and much-needed reconstruction program following a 30-year civil war. The power sector's restructuring, primarily geared toward encouraging more competition and improved regulation, has brought about wider access to the grid, lower transmission and distribution losses, and a more efficient generation system; but it was met with limited success in unbundling the power system and in making electricity tariffs cost-based and more efficient. This country report by the Asian Development Bank assesses Sri Lanka's experience in reforming its power sector for lessons and insights that other economies could find useful when pursuing their own power sector planning and policy and strategy formulation.

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