Sri Lanka
Energy Balance 2021

An Analysis of the Energy Sector Performance

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Sri Lanka Sustainable Energy Authority
No. 72, Ananda Coomaraswamy Mawatha, Colombo 07, Sri Lanka.

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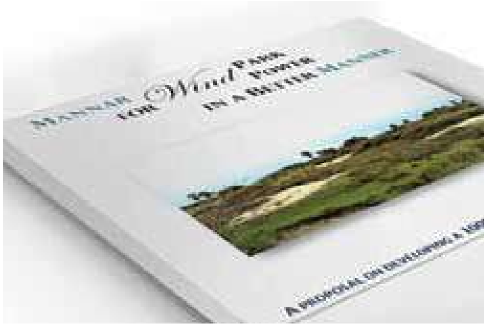

From the moment something or someone is born, that particular thing or the person makes many encounters until it ceases to exist. Many see these encounters as ***journeys***. These ***journeys*** become even more interesting, when a concept is ‘born’. The ***journey*** spans the entire length of period from the birth of the concept to the realisation of some goal and may be even beyond that realisation right until the end of life of the concept.

The ***journey*** of the Mannar wind which we have chosen to adore our cover this year is an incredible one. From the concept born on 2011 October 31 to the 2021 September 11 on which the Mannar wind power plant yielded its full power, it indeed was an incredible ***journey***. The Ceylon Electricity Board (CEB) which probed the Mannar island during the early 2000s’ was quick to install a wind measuring mast, clearing the untrodden path to continue the ***journey*** amidst a ravaging terrorist war engulfing the area of interest. After the establishment of SLSEA in 2007, a regional wind resource assessment was carried out based on this early wind measurement campaign paving the way to discover the excellent wind electric potential in the Mannar region. In 2012 with the technical assistance from Asian Development Bank (ADB), SLSEA successfully implemented a high-quality wind resource measurement programme which resulted in Master Plan for Mannar Wind Power Development. This plan enabled the CEB to attract and mobilise funding from ADB to develop the wind farm component and associated grid infrastructure development fueling the most decisive phase of the ***journey***.

The CEB managed to implement this landmark development in Sri Lanka, overcoming numerous obstacles, both manmade and natural, using USD 128 million loan proceeds from the ADB. The ***journey*** continued even during the devastating pandemic to start generating in late 2020. In 2021, even before deploying the full capacity, the plant supplied 326 GWh of clean electrical energy (1.84% of the total generation) to the national grid. The plant is capable of delivering 380 GWh of electricity during a typical meteorological year, corresponding to an annual average plant factor of 42%.

The pictures here, from the humble birth of the concept to the completion of the project are a testimony to this incredible ***journey***. This, indeed is a Better Manner to develop wind energy in Sri Lanka we reckon.

Executive Summary

Year 2021 proved to be a better year compared to the pandemic affected 2020 but with most of the problems which affected the national economy in 2020 persisting throughout the year.

Electricity generation grew noticeably, ending a three-year period of stagnation around 16,000 GWh to reach 17,947 GWh in 2021. Similarly, demand for petroleum products grew by a margin of 9%. With reduced work days and crippling travel restrictions, most of the energy sector development programmes failed to progress as expected in 2021. The electricity demand of the country was expanding in 2021, in line with the slow recovery of the economic activities. Due to these reasons and many other reasons, the implementation of the National Energy Policy and Strategies of Sri Lanka did not happen as expected at its publication in 2019.

The country spent 29.7% of all non-petroleum export earnings on fossil fuel imports in 2021, which caused an increase in the fuel import bill from USD 2,778 million in 2021 to USD 4,067 million. The continuous escalation of global crude oil prices warranted the Government to increase the domestic retail prices of key petroleum products in 2021 after a break of over eighteen months. The revisions reached historical highs, as they were a reflection of the sharp rise in global crude oil prices and the impact of the depreciation of the rupee. This phenomenon emphasises the need to urgently institutionalise a cost reflective pricing mechanism that improves transparency regarding pricing among all stakeholders.

The new renewable energy development suffered a major blow due to the non-payment of invoices from early 2021. This ended the unblemished record kept by the CEB as a trusted power purchaser since 1996, disrupting the sound investment climate which gave birth to the new renewable energy industry of Sri Lanka. The new renewable energy programme, however, continued with the capacity additions resulting from the two rounds of competitive bidding for the procurement of solar and wind energy from various locations in the country. The local wind industry was marked with a major achievement, with the commissioning of the large-scale wind power project in the Mannar island. Named *Thambapavani*, this power plant started to generate at its full capacity, increasing the share of wind energy in the national grid on 2021 September 11.

Petroleum remained as the prominent energy supply source in the country (38%), followed by biomass (32%). Coal accounted for 13% in the energy supply portfolio, while hydro power accounted for 11% and new renewable energy providing 6% of the share. The total amount of electricity generated during 2021 was 17,947.7 GWh out of which 49% was from thermal plants. Contribution from the new renewable energy (NRE) reached 12% in 2021. The contribution from micro power producers (solar rooftop systems) was 5%, while the three schemes, net-metering, net plus and net accounting generated approximately 921.7 GWh of electrical energy in 2021.

The CEB reported a poor financial performance with a negative (1.7)% return on assets for the fifth consecutive year. The LECO however, recorded a positive 16.0% return on assets.

The petroleum distribution continued with two parties; CPC and Lanka Indian Oil Company (LIOC) operating a widespread distribution network around the country. The petroleum industry returned to its normal size, recovering quickly from the pandemic conditions.

The largest share of energy use in 2021 was used by the household, commercial and other sectors, accounting for a share of 35.3% of the country's total energy demand. Transport sector share of energy use, which was mainly met through liquid petroleum, accounted for a share of 34.6%. The share of the industrial use was 30.1%.

Global crude oil prices rose sharply in 2021, supported by the steady recovery of the global economy, albeit some sporadic declining trends observed due to the resurgences of COVID-19. The average crude oil price (Brent price) stood at USD 70.80 per barrel in 2021 which was USD 43.35 per barrel in 2020. This resulted in a sharp 63.3% increase, a possible warning for the energy sector planners to prepare for a difficult period ahead.

In line with rising trends in global crude oil prices, the average price of crude oil imported by the CPC increased by 51.1% to USD 68.86 per barrel in 2021 compared to the average of USD 45.57 per barrel realised in 2020.

The Grid Emission Factors calculated for 2021 gives the Simple Operating Margin as 0.7208 kg-CO_2/kWh, the Build Margin as 0.6990 kg-CO_2/kWh and the Combined Margin as 0.6949 kg-CO_2/kWh. The Average Emission Factor was calculated and was 0.4278 kg-CO_2/kWh for the same period.

Key Energy Statistics

Primary Energy (PJ)	2020	2021
Biomass	172.0	172.5
Petroleum	198.5	205.6
Coal	70.5	70.4
Major hydro	39.5	56.9
New Renewable Energy	23.3	34.1
Total	**503.8**	**539.4**

Imports (kt)	2020	2021
Crude Oil	**1,666.8**	**1,130.2**
Finished Products	**3,294.1**	**3,941.8**
LPG	437.0	422.0
Gasoline	1,057.0	1,186.5
Avtur	101.1	178.1
Auto Diesel	1,192.0	1,779.7
Fuel Oil	487.0	359.3
Avgas	0.1	0.2
Mineral Gas Oil	19.9	16.0
Coal	**2,543.6**	**2,204.4**

Refined Products (kt)	2020	2021
Crude Input	1,752.4	1,272.2
Naphtha	157.0	107.0
Petrol	164.4	124.1
Avtur	157.3	130.6
Kerosene	109.2	98.3
Diesel	537.6	370.6
Furnace Oil	465.4	359.0
Solvents	0.9	3.0
Total Output	**3,344.1**	**2,464.8**

Grid Capacity (MW)	2020	2021
Major Hydro	1,382.9	1,382.9
Thermal Power	2,098.0	2,098.0
CEB Wind (Mannar Project)	31.1	103.50
New Renewable Energy	707.8	816.6
Micro Power Producers (µPP)	353.6	515.6
Total	**4,542.3**	**4,813.0**

Gross Generation (GWh)	2020	2021
Major Hydro	3,929.4	5,658.5
Thermal (Oil)	4,306.4	2,716.2
Thermal (Coal)	6,364.9	6,110.9
CEB Wind (Mannar Project)	7.7	325.9
New Renewable Energy	1,614.9	2,540.4
Micro Power Producers (µPP)	701.2	921.7
Total	**16,916.9**	**17,947.7**

Average electricity price (LKR/kWh)	17.2	17.3
Net oil imports as % of non petroleum exports	24.9	29.7

Total Demand (PJ)	2020	2021
Biomass	169.3	169.9
Petroleum	154.8	177.9
Coal	2.1	2.1
Electricity	52.0	55.6
Total	**378.2**	**405.5**

Demand by Sector (PJ)	2020	2021
Industry	111.8	121.2
Transport	121.3	139.1
Household & Commercial	145.9	142.3
Total	**379.0**	**402.6**

Industry Demand (PJ)	2020	2021
Biomass	85.9	87.4
Petroleum	7.6	13.2
Coal	2.1	2.1
Electricity	16.1	18.6
Total	**111.8**	**121.2**

Transport Demand (PJ)	2020	2021
Petroleum	121.3	139.1
Total	**121.3**	**139.1**

HH, Comm, Other (PJ)	2020	2021
Biomass	83.4	82.5
Petroleum	25.9	22.0
Electricity	36.6	37.7
Total	**145.9**	**142.3**

Electricity Demand (GWh)	2020	2021
Domestic	5,977.3	6,182.1
Religious	94.9	93.9
Industrial	4,485.1	5,153.2
Commercial	3,967.0	4,079.4
Streetlighting	131.2	120.2
Total	**14,655.5**	**15,628.8**

Grid Emission Factors (kg-CO_2/kWh)	2020	2021
Operating Margin	0.7084	0.7208
Build Margin	0.7641	0.6690
Combined Margin	0.7363	0.6949

Average Emission Factor	2020	2021
(kg-CO_2/kWh)	0.5229	0.4278

GDP at 1982 factor cost prices (million LKR)	345,627	473,509
Commercial Energy Intensity (TJ/LKR million)	0.60	0.50
Electricity Sold (kWh/person)	659.2	696.4
Petroleum Sold (kg/person)	197.8	214.3

Acknowledgement

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Ministry of Power and Renewable Energy

Ministry of Petroleum Resources Development

Ceylon Electricity Board

Lanka Electricity Company (Pvt) Ltd.

Ceylon Petroleum Corporation

Petroleum Resources Development Secretariat

Sri Lanka Railways

Department of Motor Traffic

Department of Census and Statistics

Central Bank of Sri Lanka

State Timber Corporation

All institutions, which responded positively to our request to provide relevant data

Sri Lanka Energy Balance 2021 was compiled by the
Sri Lanka Sustainable Energy Authority

List of Abbreviations

C&F	Cost and Freight
CEB	Ceylon Electricity Board
CHP	Combined Heat and Power
CPC	Ceylon Petroleum Corporation
DG	Distributed Generation
ECF	Energy Conservation Fund
ESCO	Energy Service Company
FOB	Free On Board
GCal	Giga calorie
GDP	Gross Domestic Product
GEF	Grid Emission Factor
GWh	Giga Watt hour
IPP	Independent Power Producer
kCal	kilo calorie
kg	kilo gram
kJ	kilo Joule
kVA	kilo Volt Ampere
LA	Local Authority
LECO	Lanka Electricity Company
LIOC	Lanka Indian Oil Company
LKR	Sri Lankan Rupees
LNG	Liquid Natural Gas
LPG	Liquid Petroleum Gas
µPP	Micro Power Producer
MT	Metric Tonnes
MW	Mega Watt
NERD Centre	National Engineering Research and Development Centre
NRE	New Renewable Energy
NREL	National Renewable Energy Laboratory of United States
PJ	Peta Joule
RDA	Road Development Authority
RERED Project	Renewable Energy for Rural Economic Development Project
SEA	Sri Lanka Sustainable Energy Authority
SCADA	Supervisory control and data acquisition
SLSI	Sri Lanka Standards Institute
SPP	Small Power Producer
SPPA	Standardised Power Purchase Agreement
toe	Tonnes of Oil Equivalent
ToU	Time of Use
TJ	Tera Joule
VET	Vehicle Emissions Testing

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1 Introduction to the Energy Sector

1.1 Highlights of 2021

Responding to the gradual easing of lockdown conditions which consumed most of the 2020, demand for petroleum products recovered to a certain extent in 2021. This recovery resulted in a substantial increase of petroleum fuel imports, a 16.4% increase from the 3,294.1 tonnes in 2020 to 3,941.8 tonnes in 2021.

In 2020, although the average Brent price stood at USD 43.35 per barrel, owing to the contraction in global demand induced by the COVID-19 pandemic, with the turnaround in the global economy and the relaxation of the pandemic related mobility restrictions, the average crude oil price in international markets rose by 63.3%, amounting to USD 70.80 per barrel in 2021. The recovery in global crude oil prices that began in mid-2020 gained pace and reached pre-pandemic levels by March 2021 before reaching seven-year highs in October 2021.

Sri Lanka spent 29.7% of all non-petroleum export earnings on fossil fuel imports in 2021. This value has increased from 24.9% in 2020, causing an increase of the fuel import bill from USD 2,778 million to USD 4,067 million in 2021. The petroleum sector operated without a pricing formula for a second year with adverse impacts on the petroleum industry. The implantation of the National Energy Policy and Strategies of Sri Lanka was too suffered due to the pandemic conditions which prevailed in the country.

The country experienced long queues at fuel stations owing to panicked motorists who expected a crippling strike caused by an industrial unrest and proceeded to purchase fuel. Change of composition of LP gas in 2021 followed by an acute shortage of supply caused a major crisis in cooking energy supply. The country experienced a series of LP gas related explosions in the latter part of 2021 causing immense hardships to users.

The year 2021 has seen the most comprehensive changes to the national upstream oil and gas sector. Changes include a radically revised offshore exploration block map, a policy decision to offer all three of Sri Lanka's basins on Joint Study basis and putting forth a new Petroleum Resources Act. The new Petroleum Resources Act No: 21 of 2021 was enacted on the October 8, 2021, with the primary aim of establishing an independent, efficient and transparent upstream legislation, enabling the formulation of a clear national upstream policy, a regulatory and an operational framework to better govern and manage the Petroleum Resources and related operations. Further, as a direct outcome of the enactment of the new Petroleum Resources Act, the Petroleum Development Authority of Sri Lanka was established in October 2021, which now is an independent regulatory authority for the regulation and management of all petroleum exploration, development and production operations undertaken by the government of Sri Lanka.

The new renewable energy development suffered a major blow due to the non-payment of invoices in early 2021. This ended the unblemished record kept by the CEB as a trusted power purchaser since 1996 disrupting the sound investment climate which gave birth to the new renewable energy industry of Sri Lanka. The adverse conditions started to spread to energy purchases from rooftop solar plants affecting this booming industry. However, on a positive note, the new renewable energy programme continued with the capacity additions resulting from the two rounds of competitive bidding for the procurement of solar and wind energy from various locations in the country. Twenty two 1 MW power plants started commercial operations in 2021, bringing the total ground mounted capacity in operation to 100.36 MW.

As the small power development continued to suffer due to a legal issue, only three hydropower plants were commissioned in 2021, adding a capacity of 4.60 MW. Amidst all obstacles, the large scale wind power project in Mannar started to generate at its full power, increasing the share of wind energy in the national grid on 2021 September 11.

1.2 Sector Governance and Organisations

1.2.1 Energy Sector Governance

The two Ministries, the Ministry of Power, the Ministry of Energy and the State Ministry of Solar, Wind and Hydro Power Generation Projects Development governed the energy sector. Biomass sector continued to operate independently and informally, with very little interaction with the energy sector governing structure.

In addition to the involvement of the government, private organisations and the general public are also stakeholders of the energy sector. Public Utilities Commission of Sri Lanka (PUCSL) is responsible for regulatory oversight of sector operations, presently with powers to monitor and regulate the electricity industry operations.

1.2.2 Public Sector Institutions

Ministry of Power and Energy

The Ministry of Power and the State Ministry of Solar, Wind and Hydro Power Generation Projects Development are responsible for the power sector and sustainable energy. The Ministry of Energy is responsible for the petroleum sector.

The Ministry of Power is the main body responsible for the management of the power sector. The Ministry comprises several divisions, discharging its functions in planning, and in the supervision of sub-sectoral state institutions. From time to time, the subject of Energy has been combined with others such as Irrigation and Lands, in the establishment of the Ministry. The following state-owned energy institutions presently operate under the supervision of Ministry of Power and the State Ministry of Solar, Wind and Hydro Power Generation Projects Development.

Sri Lanka Sustainable Energy Authority (SEA)

The Sri Lanka Sustainable Energy Authority (SEA) established in 2007 by enacting the Sri Lanka Sustainable Energy Authority Act No. 35 of 2007, comes under the purview of the State Ministry of Solar, Wind and Hydro Power Generation Projects Development. The SEA continued to consolidate gains realised in the sustainable energy sector, in both renewable energy and energy efficiency spheres in 2021. With the strong commitment of the Government, towards sustainable energy, the SEA undertook to develop two major thrusts on developing renewable energy and increasing energy efficiency.

Ceylon Electricity Board (CEB)

Established in 1969, the CEB is empowered to generate, transmit, distribute and supply electricity in the country. The Electricity Act of 2009 caused CEB's businesses of (i) generation, (ii) transmission and bulk supply operations and (iii) distribution and supply to be separately licensed. In 2021, CEB generated 75%

of electrical energy supplied through the national grid, while the balance was generated by private power plants.

The entire 220 kV, 132 kV and 33 kV network is owned and operated by the CEB. CEB directly serves about 92% of gird connected electricity consumers in the country. It operated 3,219 km of transmission lines and 185,788 km of distribution lines at the end of 2021, serving a total of 6,809,527 customers.

Lanka Electricity Company (Pvt) Ltd (LECO)

The LECO is an institution established in 1983 to distribute electricity in areas previously served by Local Authorities (Municipal Councils etc.). LECO receives electricity from CEB at 11 kV and distributes in LECO franchise areas. LECO serves about 8% of the electricity customers in the country. LECO's franchise area steadily expanded from 1983 to 1990, and the company implemented a major rehabilitation program in the newly acquired distribution networks, which has reduced losses substantially. It served 608,435 customers by end-2021, through a 4,893 km of distribution lines.

Ministry of Petroleum and Petroleum Resources Development

The following Departments and Statutory Institutions are presently operational under the supervision of the Ministry of Petroleum and Petroleum Resources Development.

- Ceylon Petroleum Corporation
- Ceylon Petroleum Storage Terminal Ltd.
- Petroleum Resources Development Secretariat

While the role of Ceylon Petroleum Corporation is quite significant in the present context, the other three institutions perform facilitating roles to the petroleum supply and exploration ventures recently initiated by the government.

Ceylon Petroleum Corporation (CPC)

Established in 1961, CPC imports, refines and distributes petroleum products in the country. CPC owns and operates the only refinery in Sri Lanka, with a daily throughput of 50,000 barrels. The demand for petroleum products has significantly increased, with the sale of all petroleum products for all sectors recording an increase from 4,335.7 kt in 2020 to 4,747.6 kt in 2021.

Lanka Coal Company (LCoC)

With the commissioning of the first coal plant in Puttalam in 2011, a new company was established under the Ministry of Power and Energy to streamline the supply of coal required for the plant. This new organisation continues supplying coal to the 900 MW power plant, with a supply of 2,301.3 kt in 2021.

Ceylon Petroleum Storage Terminals Limited (CPSTL)

With the liberalisation of the petroleum industry in 2002 and the entry of Lanka Indian Oil Company, a necessity was felt to share storage infrastructure among downstream vendors. At the time there was an expectation of a third player entering the downstream petroleum business. A company was incorporated with equal share holdings of CPC, LIOC and the Treasury. CPSTL is now managing a major part of storage, pipeline and distribution facilities including two major terminals in Kollonnwa and Muthurajawela.

Petroleum Resources Development Secretariat (PRDS)

This Secretariat was established in 2003 to manage the petroleum exploitation activities of the country. PRDS has successfully attracted oil exploring company to explore the Petroleum resources in the Mannar offshore region. This Secretariat was assigned to the Ministry of Petroleum Resources Development on 2015 September 21 after the upstream development activities were placed within the purview of this Ministry. Plans are underway to elevate this secretariat to a fully fledged authority.

1.2.3 Private Sector Organisations

There are numerous private sector organisations participating in the supply, distribution and sale of electricity, petroleum and biomass. The private sector organisations in the electricity sector include Independent Power Producers (IPPs) supplying electricity to the CEB for resale and Small Power Producers (SPPs) producing power using renewable technologies. Annex 1 provides a list of all IPPs and SPPs operational by end 2020. With the launch of the national solar programme "Sooryabala Sangramaya" in 2016, there is a significant increase in the Renewable Energy Service Providers (RESCos) in the country.

In the petroleum sector, in addition to the CPC, several private companies distribute and sell petroleum products, lubricants and LP gas. Details of these companies are given in *Annex 1*.

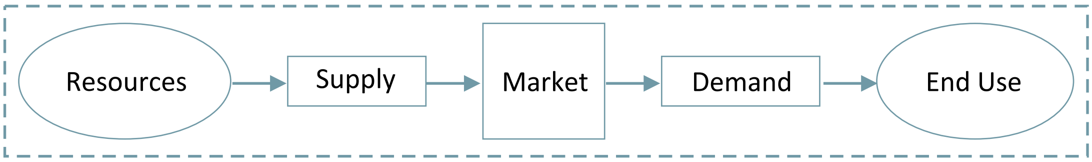
Stages in Energy Flow

Energy used in a country is found in different forms at different stages of its flow from the raw form found in nature to the actual end use form. Broadly, these stages can be categorised as;

- Energy Resources
- Energy Supply including conversion/production and distribution
- Energy Demand
- End Use

Energy sector is the combination of all the above stages of different energy forms which are interrelated, as illustrated below.

Energy Sector Composition



The above flow diagram explains that, owing to various end uses of energy, a demand exists in the market, which is fulfilled by the energy supply using the available resources. This follows the basic demand supply economic model valid for any scarce resource.

Energy Resources

A natural resource is considered an energy resource, if it can be converted to a usable form of energy. There are numerous forms of energy sources in the world and different countries use different resources, primarily selected on economic principles. However, environmental and political reasons also influence the selection of a country's energy portfolio.

Availability, either locally or globally, is not necessarily the only factor considered for using a particular resource as an energy supply source. More importantly, the use must be economical compared with other available sources. Hence, the technology available for converting the resource to a more usable form is important in the selection of an energy resource for energy supply. Change of technology and availability of resource over time can change the economics of using the resource for energy supply. Therefore, the resources used by a country for energy requirements also change with time.

Indigenous Resources

Attributed to geo-climatic settings, Sri Lanka is blessed with several types of renewable energy resources. Some of them are widely used and developed to supply the energy requirements of the country. Others have the potential for development when the technologies become mature and economically feasible for use. Following are the main renewable resources available in Sri Lanka.

- Biomass
- Hydro Power
- Solar
- Wind

In addition to the above indigenous renewable resources, the availability of petroleum within Sri Lankan territory is being investigated.

Global Resources

In the international market, many forms of energy sources are available for Sri Lanka to import and use for its energy needs. However, up to now, Sri Lanka has been largely using only petroleum fuels for this purpose. Increasing petroleum prices have prompted Sri Lanka to examine the feasibility of using other sources such as coal and Liquefied Natural Gas (LNG) to replace liquid petroleum in certain applications. Following are the most common energy sources globally available for energy supply on a commercial scale.

- Petroleum
- Coal
- Natural Gas
- Nuclear Energy

More recently, new energy supply technologies such as biofuels and energy carriers such as hydrogen and electricity storage have emerged as alternatives to the above conventional technologies and transfer options. However, use of these technologies for energy supply purposes is still limited in Sri Lanka.

Energy Supply

To understand the status of the energy sector of a country, what is more important is not the availability of different energy resources, but the extent of use of these resources. As explained earlier, mere availability of a resource within a country does not enable its utilisation. Therefore, it is more important to analyse the resources which are actually being used to meet the energy demand of the country. Following are the four main energy supply forms in Sri Lanka.

- Biomass
- Petroleum
- Coal
- Electricity

Energy supply is essentially the conversion of energy resources from one form to a more usable form. However, this conversion can vary from producing electricity from the potential energy in a hydro reservoir to refining crude oil into gasoline or diesel.

Transmission/Distribution

For each energy supply source, there must be a distribution mechanism through which it can be served to the points of end use. From the production or storage facilities of the energy supply system, the distribution system transports energy to the end user.

The biomass distribution network is quite simple, and in the case of most users, a formal network does not exist. The major use of biomass is in households, where the source and the point of use, both are within the same home garden. Even in industrial use, distribution is a one-to-one arrangement, which links the source to the user through a direct biomass transport. More recently, with large scale conversion of industrial thermal energy for petroleum fuels, to biomass, the emergence of a supplier is witnessed. Then suppliers are essentially middlemen, who felicitate the market by connecting the resource owners with uses.

In the case of petroleum, distribution is from the petroleum storage facilities up to end user points such as vehicles, power plants and industries, channelled through regional storage facilities and filling stations.

For electricity, distribution starts from the generating station (power plant) and ends at consumer points such as households and industries. The high voltage transmission network, medium voltage regional networks and low voltage local distribution networks are collectively considered as the energy distribution system of electricity. With the introduction of net-metering scheme in the country in 2010, some customers have installed small scale generators at the end-use point, changing this traditional supply architecture. With the broadening of on-site solar PV rooftop scheme in 2016, these micro power producers are becoming a formidable supply source as per the trends observed during the period up to end 2020.

Demand

For the energy sector, demand drives the market. Demand arises owing to energy needs of households, industries, commercial buildings, etc. According to the needs of the user, the supply of energy has to take different forms. For example, the energy demand for cooking is in the form of biomass in rural areas, while it is in the form of either LP gas or electricity in urban areas. Therefore, not only the quantity of energy, even the quality and the form it is delivered, is determined by the demand.

In this report, the demand is categorised in terms of end-use sectors and is not based on the actual usage or the application of energy at appliance level.

2 Energy Resources

2.1 Indigenous Energy Resources

2.1.1 Biomass

The Household Survey on the Usage of Electrical Equipment carried out in 2019, in collaboration with the Department of Census and Statistics, reveals that nearly half of the population depends on biomass to suffice the needs in domestic cooking energy. Although large quantities of firewood and other biomass resources are used for cooking in rural households, lesser quantities are used in the urban households. This situation changed drastically due to the crisis in the LP gas industry during the latter part of 2021, caused by supply disruptions and explosions allegedly caused by the change of composition. Many households started to reintroduce biomass as a cooking fuel, venturing into various cookstove types and cooking fuel ranging from saw dust to charcoal briquettes.

Even though a large portion of energy needs of the rural population is fulfilled by firewood, there are possibilities to further increase the use of biomass for energy in the country, especially for thermal energy supply in the industrial sector. Furnace oil prices have been maintained without subsidies since 2012, and continue to be expensive at LKR 110.00 per litre, even after a downward revision at the beginning of 2015. Therefore, the business case for large industrial thermal plants to be operational on biomass continued in 2021, further consolidating the supply chains. With no sign of new fuel wood plantations, the biomass supply chain of industrial thermal plants continued to grow.

2.1.2 Hydro

Hydro power is a key energy source used for electricity generation in Sri Lanka. A large share of the major hydro potential has already been developed and delivers valuable low cost electricity to the country. Currently, hydro power stations are operated to supply both peaking and base electricity generation requirements. A substantial number of small hydro power plants which operate under the Standardised Power Purchase Agreement (SPPA) and many more are expected to join the fleet during the next few years. The momentum gained by the small hydropower industry from the streamlined approval process was somehow lost due to legal impediments to approve new projects. Figure 2-2 indicates SPP hydro cumulative capacities by district.

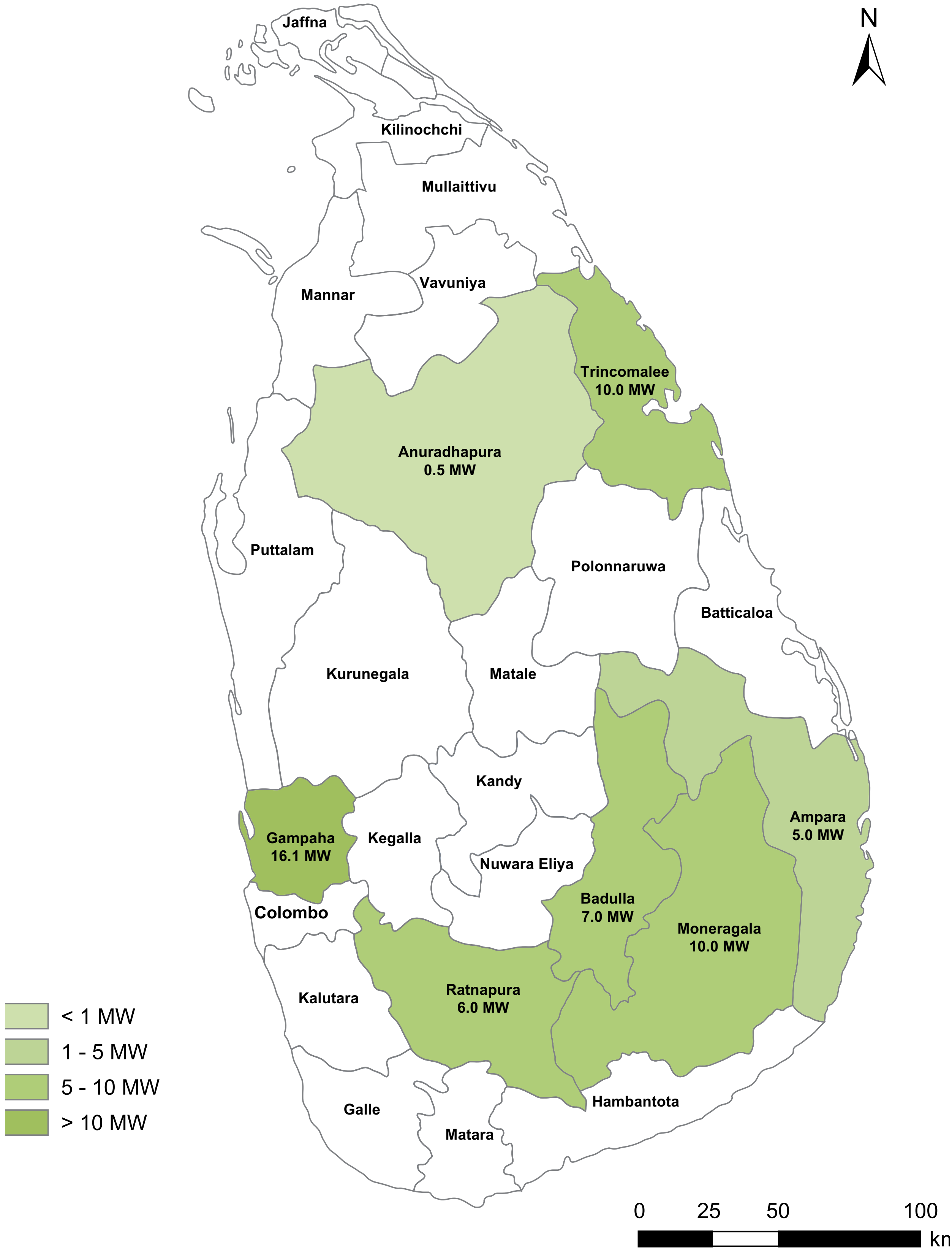


Figure 2.1 – Cumulative Capacity Additions of Biomass (2021)

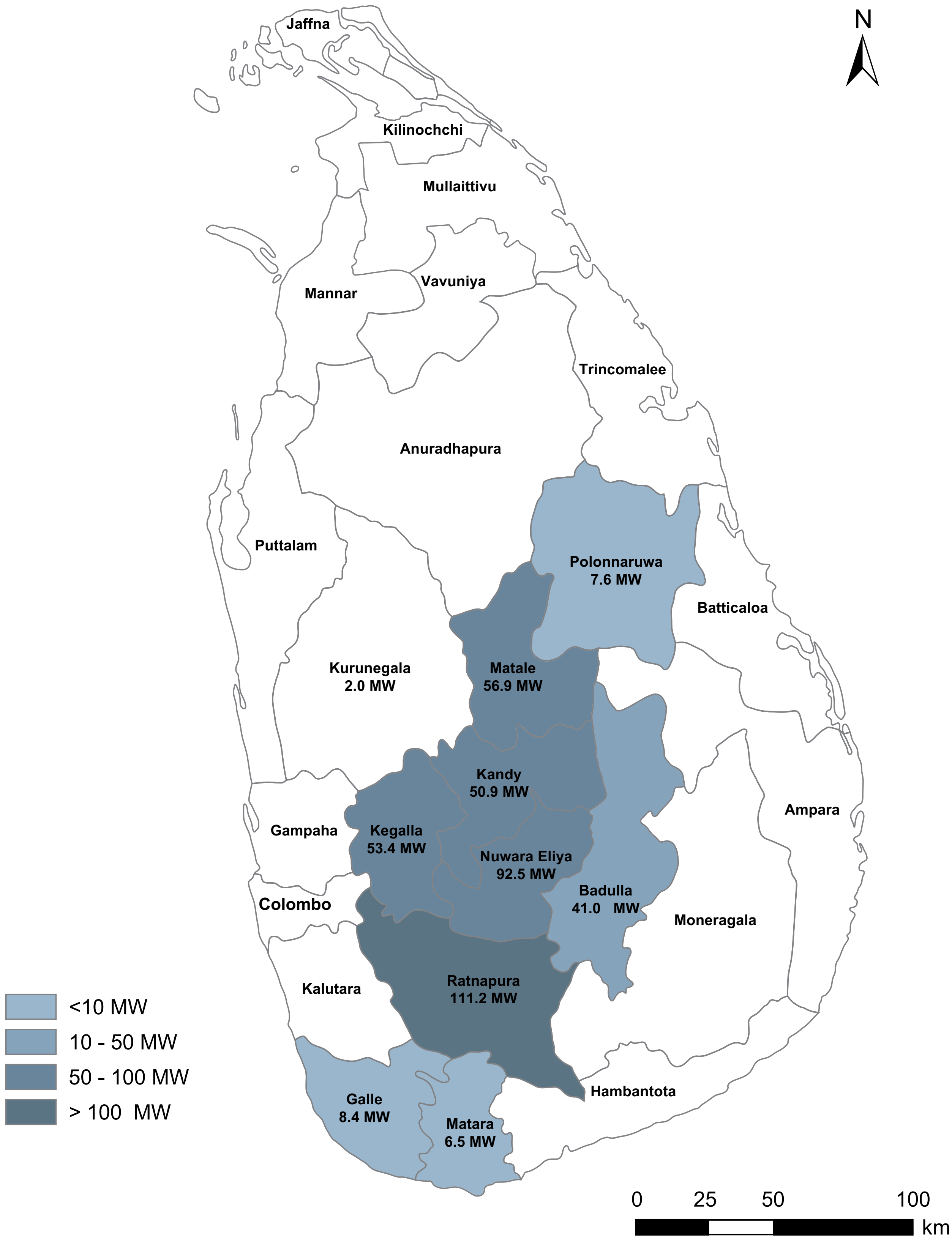


Figure 2.2 – Cumulative Capacity Additions of SPP Hydro (2021)

2.1.3 Solar

The two pilot projects operated by SEA realised annual plant factors of 11.88% for the 737 kW plant and 12.16% for the 500 kW plant, in 2021 The lower than expected plant factors resulted from the failure of some key components in the power plant. In the commercial development sphere, 22 solar power plants resulting from the competitive bidding process commenced commercial operations in 2020. The capacity additions produced impressive results yielding an aggregate plant factor of 20.10%. 78.36MW capacity available at the beginning of the year increased to 100.36MW at the end of 2021. The capacity additions, energy yields and monthly plant factors are given in Figure 2.3 below.

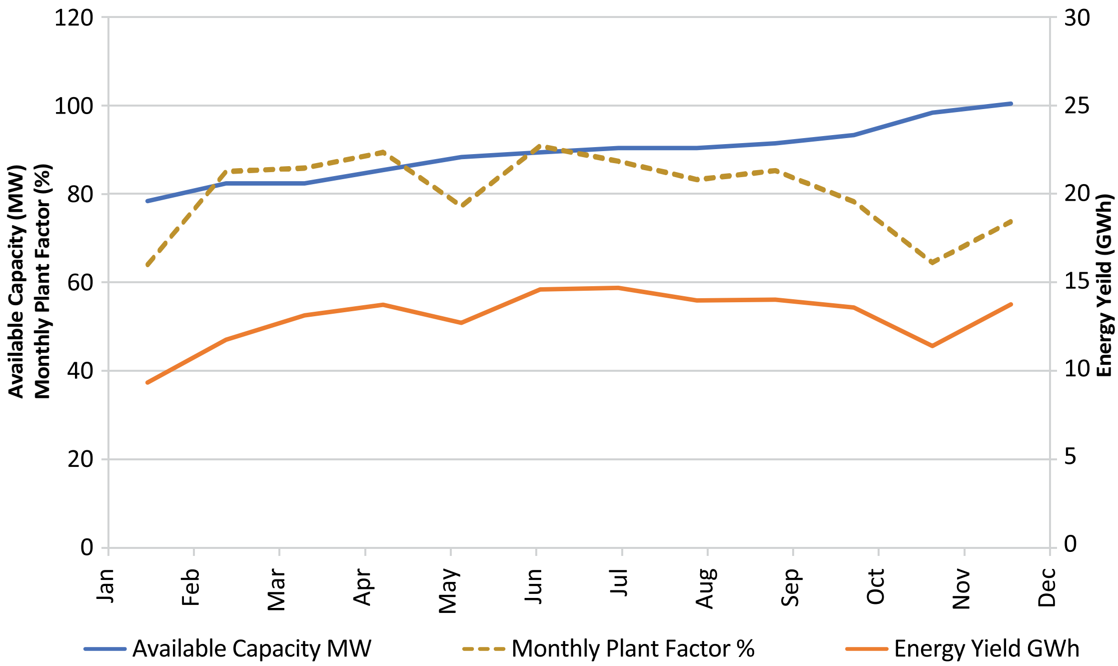


Figure 2.3 – Solar Power Generation

The installation of solar rooftop PV systems gathered momentum, and by end 2021, a total of 37,427 systems were in operation, with a total capacity of 516 MW generating 922 GWh. Generation statistics were estimated based on average energy yields expected in a Typical Meteorological Year (TMY), and will be derated by an end of lifecycle derating of 15% based on each project's age from 2021 to increase the accuracy of the estimate.

Figure 2.4 shows the SPP cumulative solar capacities by district.

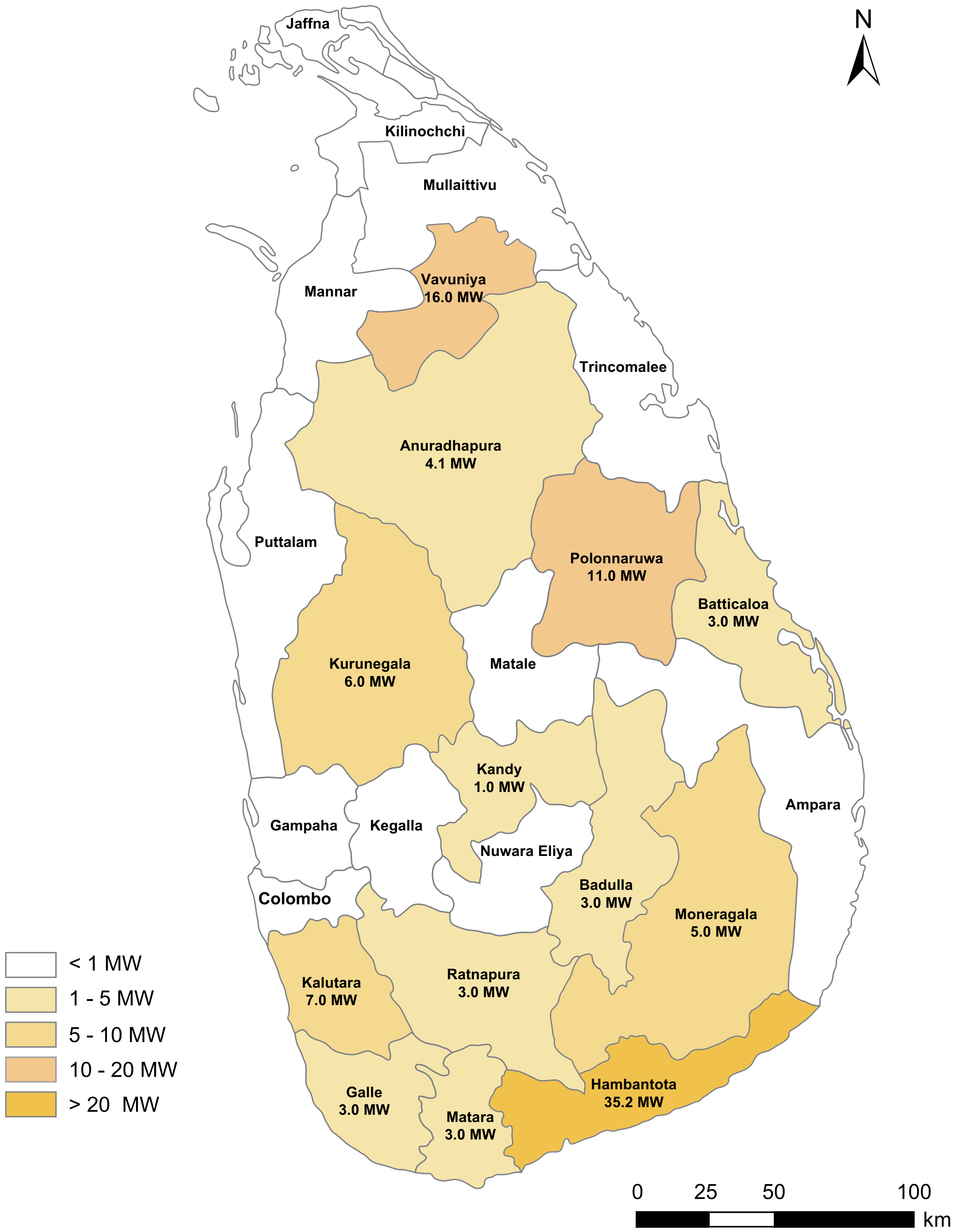


Figure 2.4 – Cumulative SPP Solar Capacity Additions (2021)

2.1.4 Wind

The ADB funded 100 MW Mannar Wind Project started full scale operations in May 2021, with the onset of the Southwestern monsoons and progressed to yield clean wind energy at its full capacity on 2021 September 11.

A capacity of 148.45 MW was available throughout the year 2021, yielding an aggregate plant factor of 25.14%. The energy yields and monthly plant factors are given in Figure 2.5 below.

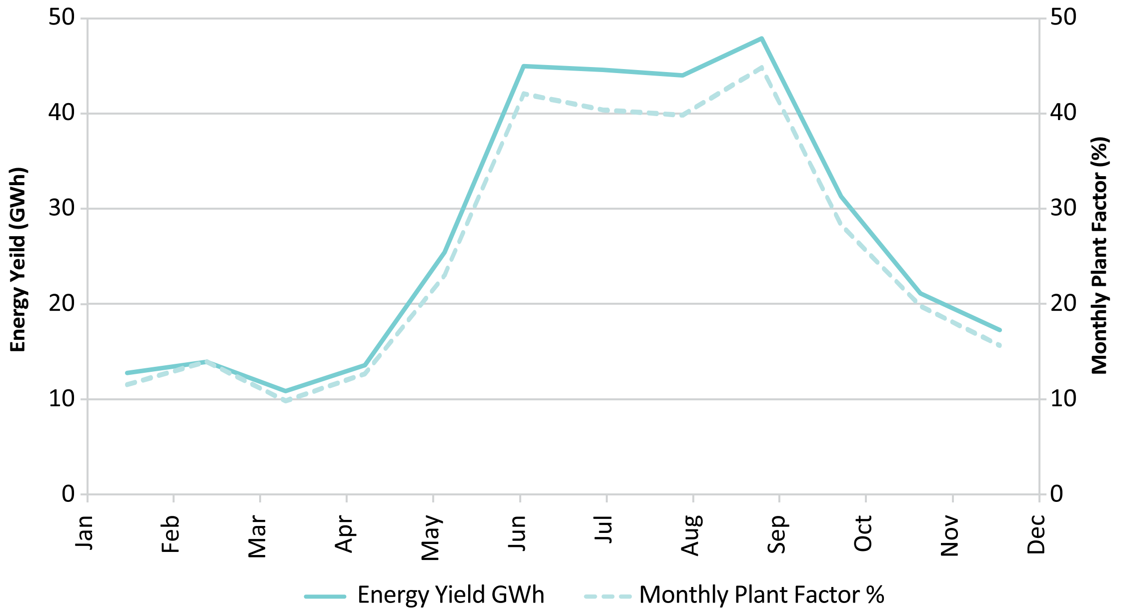


Figure 2.5 – Wind Power Generation

2.1.5 Oil/Gas Exploration

The year 2021 has seen the most comprehensive changes to the national upstream oil and gas framework, since the PRDS was established in 2003. These changes were initiated based on the long-standing recommendations of the industry and as a response to the post-pandemic energy industry outlook. Changes include a radically revised offshore exploration block map, a policy decision to offer all three of Sri Lanka's basins on Joint Study basis and putting forth a new Petroleum Resources Act. The latter carries significant improvements and one of the key aspects is to replace the PRDS with an independent new regulator to be known as the Petroleum Development Authority of Sri Lanka (PDASL).

The formulation of Sri Lanka's National Policy on Natural Gas(NPNG) utilisation initiated by the PRDS in 2016 has been successfully completed in 2020. The new Petroleum Resources Act No: 21 of 2021 was enacted on the October 8, 2021, with the primary aim of establishing an independent, efficient and transparent upstream legislation, enabling the formulation of a clear national upstream policy, a regulatory and an operational framework to better govern and manage the Petroleum Resources and related operations. Further, as a direct outcome of the enactment of the new Petroleum Resources Act, the Petroleum Development Authority of Sri Lanka was established in October 2021, which now is an independent regulatory authority for the regulation and management of all petroleum exploration, development and production operations undertaken by the government of Sri Lanka.

The PDASL at present is in the process of developing its offshore hydrocarbon data library, the content of which would help in meeting investor expectations from a technical perspective. An international marketing campaign was launched during the period commencing from September to December 2021 by obtaining the assistance of 'Upstream', which was the market- leading news source for the global oil and gas industry, in order to promote the new Sri Lanka upstream offerings amongst the key decision-makers of the global exploration and production community. The reprocessing of legacy data continued well into 2021, which was initaited in the previous years. A study was initiated in September 2021 to identify strategic options , the implementation of which will help accelerate the development of the "Dorado" natural gas discovery made in 2011 in the Mannar Basin. These studies are also designed to demonstrate the intent of the government to attract investors, who would be keen to bring these discoveries on stream.

2.1.6 Indigenous Resources in Sri Lanka

Table 2.1 - Indigenous Primary Sources of Energy in Sri Lanka

Indigenous Energy Source	Typical User Groups	Typical Applications	Scale of Use by End 2021
Biomass	Household	Cooking	Widespread
	Commercial	Hotels, Bakeries	Widespread
	Industry	Tea drying, Brick and tile	Widespread
		Steam generation	Growing
	Private power plant	For sale to utility	13 power plants
		Own consumption	Several villages and factories
Hydro Power	Electricity utility owned large multipurpose systems	For retail to customers	Major power plants
	Commercial grid-connected	For sale to utility	213 power plants
	Village-level off-grid electricity	Household use	A few plants operating in the grid-connected mode, however, many now in disuse
	Industrial off-grid electricity	Tea industry	A few power plants
	Industrial mechanical drives	Tea Industry	Negligible, one or two remaining
Solar Power	Solar photovoltaic	Rooftop systems	37,427 installations
		Household lighting	No longer reported in large numbers.
	Grid connected PV	For sale to utility	57 power plants
	Solar Thermal	Hot water systems in commercial and domestic sectors	Widespread
	Informal use	Household and agricultural use	Widespread
Wind Power	Grid Connected Wind	For retail to customers	17 power plants
	Off-grid power plants	For residential use	A few dozens, most in disuse
	Water pumping	Agriculture	A few dozens, one or two in operation

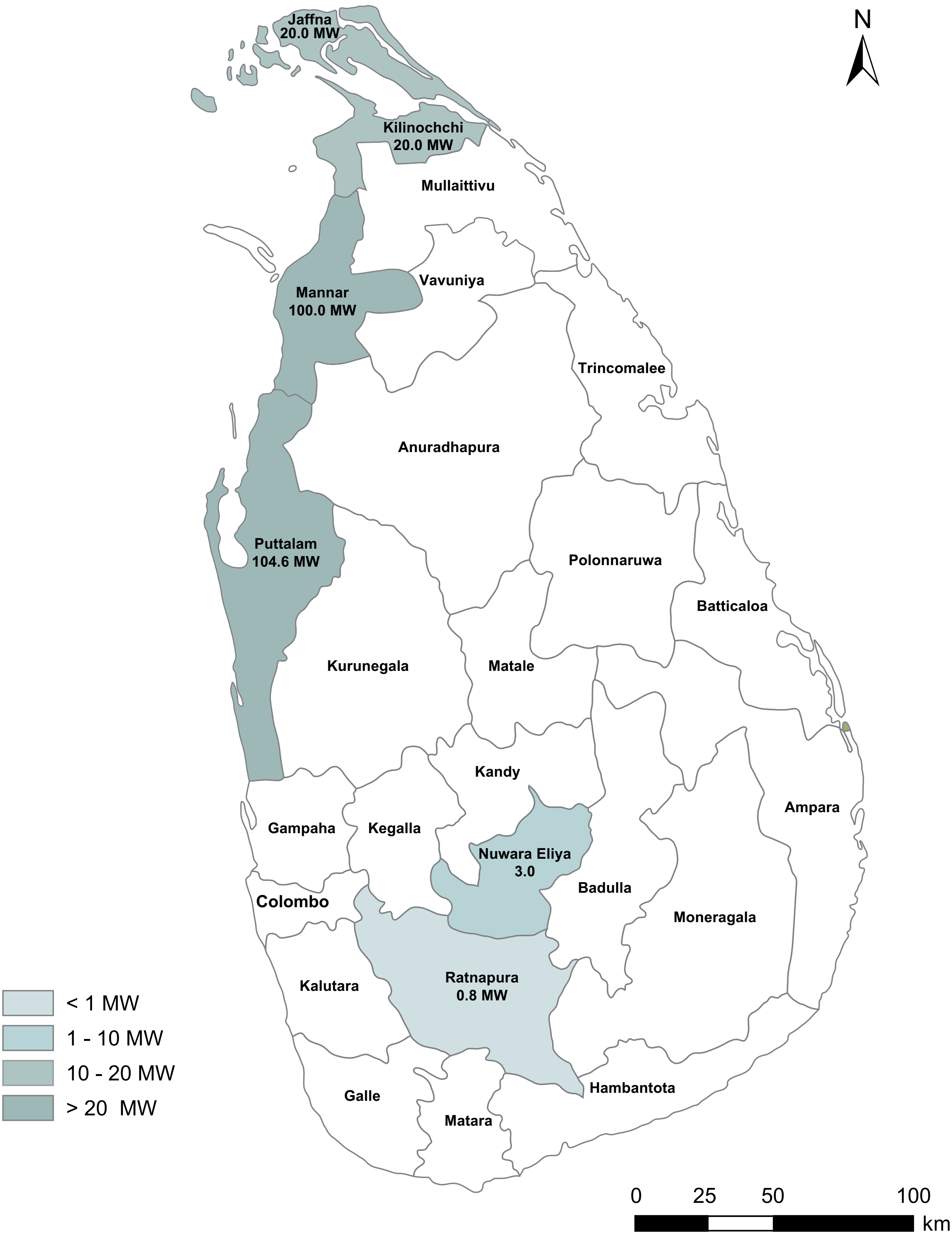


Figure 2.6 – Cumulative Capacity Additions of Wind (2021)

2.2 Global Energy Resources

As explained previously, petroleum, coal, natural gas and nuclear energy are the four main energy sources used in other countries. However, in Sri Lanka, petroleum and coal are imported in large scale to the country as a source of energy while the use of other sources is still being at lower levels. The use of refined petroleum products and coal is described in Table 2.2.

Table 2.2 – Use of Global Energy Resources in Sri Lanka

Imported Energy Source	Typical User Groups	Typical Applications	Scale of use at Present
Crude Oil and refined products including LPG	Household	Lighting, cooking	Widespread
	Commercial	Hotels, bakeries	Widespread
	Industry	Furnaces, kilns, boilers	Widespread
	Power generation	Combined cycle, gas turbine, diesel engines, steam turbines	A number of thermal power plants
	Transport	Rail, road, air and sea	Widespread
Coal	Railways	Rail	Negligible
	Industry	Kilns	Cement industry and foundries
		Boiler	Two or more
	Power Generation	Boiler	3 units of 300 MW (900 MW)

3 Energy Supply

Energy needs of the country are fulfilled either directly by primary energy sources such as biomass and coal, or by secondary sources such as electricity produced using petroleum, biomass, hydro power and refined petroleum products.

3.1 Supply from Primary Energy Sources

3.1.1 Evolution of Energy Supply

The primary energy supply of Sri Lanka consists of biomass, petroleum, coal, major hydro and new renewable energy. Table 3.1 summarises the contribution of supply energy forms by source.

Table 3.1 – Primary Energy Supply by Source

PJ	2010	2015	2018	2019	2020	2021
Biomass	180.5	174.6	165.5	169.0	172.0	172.5
Petroleum	181.2	186.1	215.4	223.8	198.5	205.6
Coal	2.5	51.9	55.0	58.7	70.5	70.4
Major hydro	50.1	49.3	51.9	38.2	39.5	56.9
New Renewable Energy	7.5	15.3	19.9	19.9	23.3	34.1
Total	**421.9**	**477.2**	**507.7**	**509.6**	**503.8**	**539.4**
%						
Biomass	42.8	36.6	32.6	33.2	34.1	32.0
Petroleum	43.0	39.0	42.4	43.9	39.4	38.1
Coal	0.6	10.9	10.8	11.5	14.0	13.1
Major hydro	11.9	10.3	10.2	7.5	7.8	10.5
New Renewable Energy	1.8	3.2	3.9	3.9	4.6	6.3

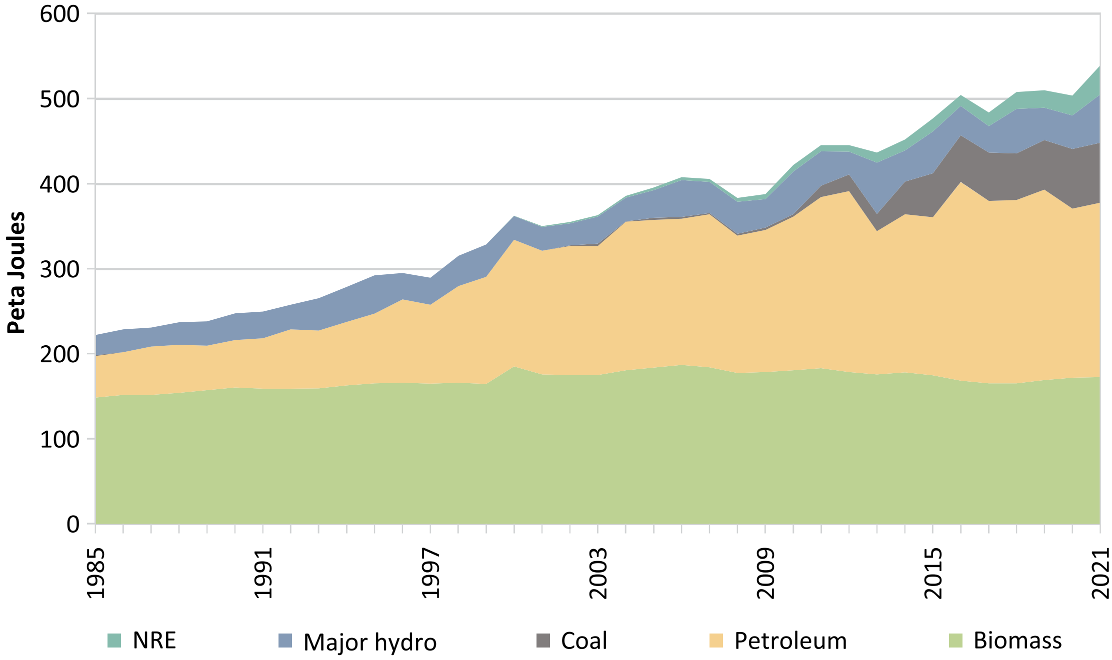


Figure 3.1 – Evolution of Energy Supply Forms

IIn early years (1970's, at which the earliest comprehensive energy accounts are available), the primary energy supply was dominated by biomass and petroleum. By end 2021, the share of biomass in the primary energy supply has gradually declined upto 32.0%, whilst the share of petroleum too has gradually decreased to 38.1%, over the years. The contribution of NRE has and major hydro increased, owing to climatic conditions experienced in 2021.

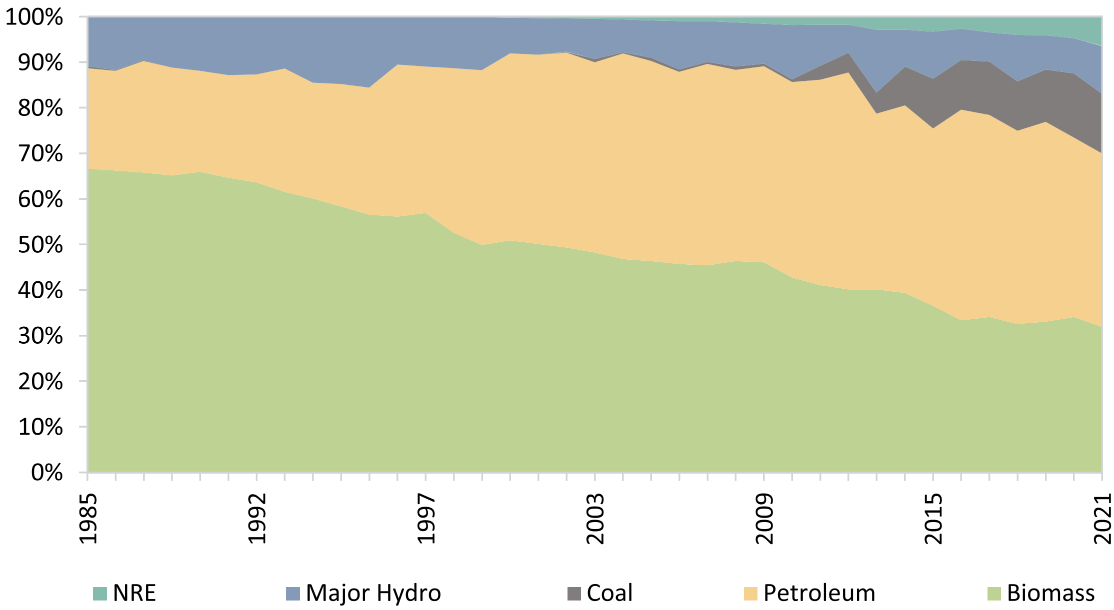


Figure 3.2 – Percentage Share of Primary Energy Supply

Biomass is the most widely available cooking fuel used by nearly half of the population in the domestic sector for cooking purposes. Due to the abundant availability, only a limited portion of the total biomass use is channelled through a commodity market and hence the value of the energy sourced by biomass is not properly accounted. However, this situation is fast changing with many industries switching fuel to reduce the cost of thermal energy. There is a growing demand from the users to regularise the biomass market by way of introducing quality traceability and sustainability assurance schemes. However, the growing industrial demand sans an appreciable expansion of the supply sector is already causing shortages, eroding the economic gains enjoyed by the industrial users immediately after conversion. The biomass industry can look forward to a better future only if the regulatory instruments now available for adoption in Sri Lanka are fully implemented to ensure a sustainable supply.

Sources of Production of Biomass

Biomass comes in different forms. Following are the most common forms of biomass available in Sri Lanka.

- Fuel wood (unprocessed logs)
- Fuel wood (processed chips)
- Municipal Waste
- Industrial Waste
- Agricultural Waste

General biomass conversions are given in Table 3.2

Table 3.2 – Biomass Conversions

Primary Source	Conversions
Firewood (natural yield, home gardens, dedicated woodlots)	Thermal energy for boilers to generate steam for industry uses and electricity generation and combustible gases to drive Internal Combustion engines for electricity generation
Coconut Shell	Charcoal, activated carbon; mostly for export as a non-energy product
Bagasse	Thermal energy to generate steam for boiler-turbine units used for electricity generation
Wood	Charcoal; mostly for the hotels and household markets
Municipal waste	A single 10 MW capacity plant in operation

3.1.2 Energy Supply from Petroleum

As a country with no proven indigenous petroleum resources yet, Sri Lanka totally depends on petroleum imports, both in the form of crude oil and as finished products. Table 3.3 summarises the imported petroleum products.

Table 3.3 – Importation of Petroleum Products

kt	2010	2015	2018	2019	2020	2021
Crude Oil Import	**1,819.4**	**1,676.8**	**1,763.0**	**1,842.7**	**1,666.8**	**1,130.2**
Product Imports	**2,495.8**	**2,995.3**	**4,085.7**	**4,099.4**	**3,294.1**	**3,941.8**
LPG	137.1	277.0	413.0	430.0	437.0	422.0
Gasoline	451.8	899.0	1,128.5	1,159.9	1,057.0	1,186.5
Avtur	222.8	270.8	461.0	397.3	101.1	178.1
Auto Diesel	1,199.2	1,288.8	1,482.6	1,587.3	1,192.0	1,779.7
Fuel Oil	423.0	203.3	553.3	504.0	487.0	359.3
Avgas	0.3	0.1	0.1	-	0.1	0.2
Bitumen	44.7	32.2	28.2	3.0	-	-
Mineral Gas Oil	16.9	24.1	19.0	17.9	19.9	16.0

Both the importation of crude oil and finished products have decreased in 2021 compared to 2020. The importation of crude oil had decreased by 47.5%, whereas the importation of finished products had increased by 16.4% in 2021.

3.1.3 Energy Supply from Coal

The demand for coal decreased in 2021 as the primary demand for coal is from the power generation sector (Figure 3.3 and Table 3.4).

Table 3.4 – Importation of Coal

kt	2010	2015	2018	2019	2020	2021
Coal Imports	108.1	1,881.5	2,166.0	2,388.6	2,543.6	2,204.4

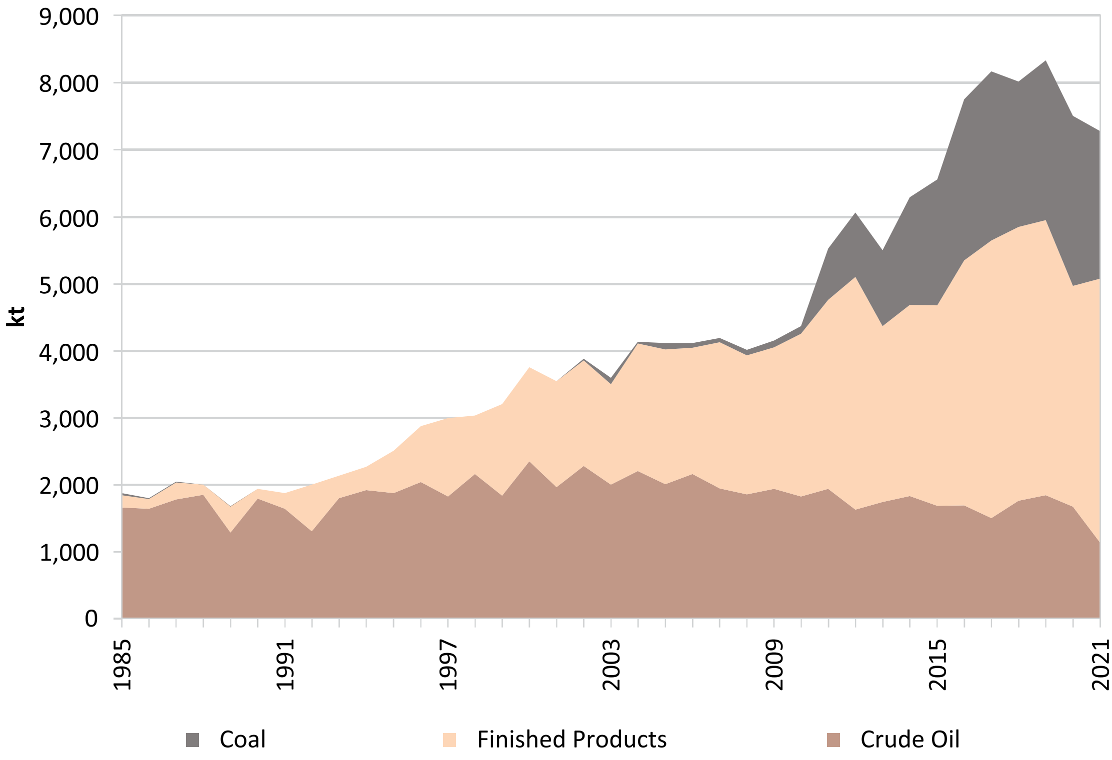


Figure 3.3 – Importation of Petroleum Products

3.1.4 Supply from Major Hydro

The topography of the country provides an excellent opportunity to harness the energy stored in river water which flows from the central hills of the country to the Indian Ocean surrounding the island. The contribution of hydro as an energy supply source is always through its secondary form, which is electricity. Having an early start in the hydro electricity generation, Sri Lanka has nearly exhausted the hydro power potential in its river systems. With the commissioning of the remaining four projects under construction the era of major hydropower development will come to an end. The key hydropower projects, namely, the Uma Oya (120 MW) and Broadlands (35 MW) projects were nearing completion as at end 2021 and both were expected to be commissioned in 2022. Work of several other projects like the Moragolla, Gin Ganga, and Thalpitigala, were in progress in 2021.

3.1.5 Supply from New Renewable Energy

The New Renewable Energy (NRE) is seen in many forms such as small hydro, solar, wind and biomass power plants. Contrary to previous years, only three hydro power projects and 25 new solar power plants were commissioned in 2021. Apart from the large scale orthodox use of solar energy in drying and crop processing, large scale deployment of solar hot water systems are seen in new home construction. Also, the interest in solar roof top systems is seen to be increasing at a rapid rate. By end 2021, there were 431 service providers actively engaged in this trade.

The contribution of major hydro and NRE to the primary energy supply is depicted in Table 3.1, Figures 3.1 and 3.2 above.

3.2 Petroleum Refinery Operations

3.2.1 Refinery Product Output

The country's petroleum product requirements are met partly by direct import of finished products and partly by processing imported crude oil. The only refinery in Sri Lanka, located in Sapugaskanda, converts imported crude oil to refined products to supply approximately half of the petroleum demand of the country. The refinery produces its output at a rate of 2.3 million tonnes per year (50,000 bbl/stream day) and the refinery process flow is illustrated in Figure 3.4.

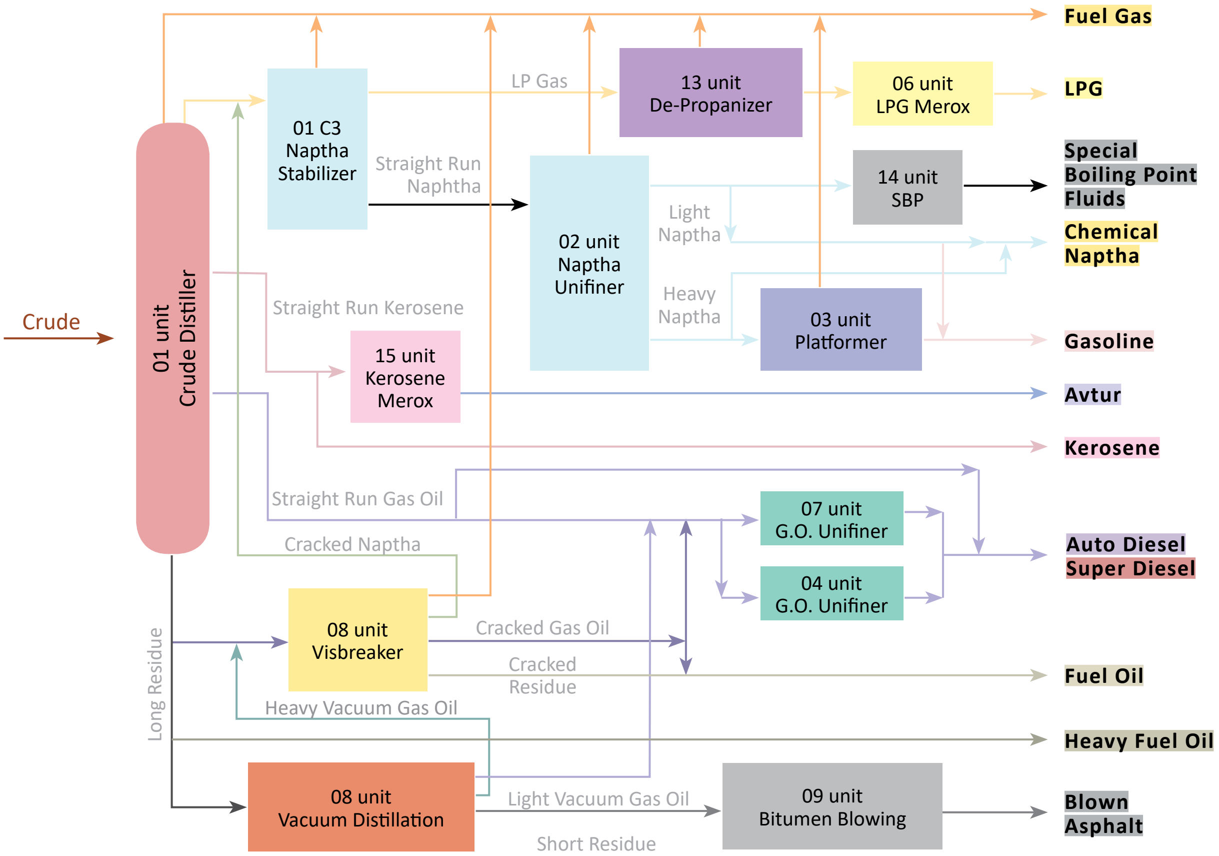


Figure 3.4 – Sapugaskanda Refinery Process Flow Diagram

Only Murban Crude oil was processed in the Sapugaskanda refinery in 2021. Details of crude refined are given in Table 3 5. The CPC had to look for new sources of crude, owing to the on-going embargo which prevented any Iranian Light crude from reaching the refinery. This affected the throughput and process efficiency of the refinery.

Table 3.5 - Types of Crude Oil Refined at Sapugaskanda Refinery

kt	2010	2015	2018	2019	2020	2021
Arabian light	134.61	-	-	-	-	-
Iranian light	1,618.10	-	-	-	-	-
Miri Light	-	-	-	-	-	-
Upper zakum	-	-	-	-	-	-
Oman Crude	-	304.30	-	-	-	-
Dubai Crude	-	-	-	-	-	-
Murban Crude	-	1,387.77	1,570.25	1,861.30	1,752.36	1,272.21
DAS	-	-	-	-	-	-
Saharan Blend Crude	-	-	93.14	3.52	-	-
Total	**1,752.72**	**1,692.07**	**1,663.39**	**1,864.82**	**1,752.36**	**1,272.21**

The refinery maximum throughput is far less than the country requirement for petroleum products. Besides, its production slate differs from the mix of product demand. Although the refinery is operated at maximum design capacity to meet the demand for middle distillates, petrol, kerosene, Jet A-1 and diesel are still in deficit with a need for supplementary imports. All petroleum products had to be imported to supplement refinery production in 2021. Details of refinery output are given in Table 3.6 and Figure 3.5.

Table 3.6 - Refined Products from the Refinery

kt	2010	2015	2018	2019	2020	2021
Crude Input	**1,752.72**	**1,692.07**	**1,675.34**	**1,864.82**	**1,752.36**	**1,272.21**
LPG	22.93	9.65	22.08	26.99	25.25	16.65
Chemical Naphtha	84.29	136.56	140.66	162.02	156.95	106.96
Naphtha Total	**84.29**	**136.56**	**140.66**	**162.02**	**156.95**	**106.96**
Super Petrol	-	-	-	-	-	-
Regular Petrol	157.97	154.24	165.43	185.92	164.42	124.09
Petrol Total	**157.97**	**154.24**	**165.43**	**185.92**	**164.42**	**124.09**
Avtur	126.41	154.57	237.27	258.99	157.28	130.57
Kerosene	92.78	75.23	35.20	38.35	109.17	98.28
Auto Diesel	441.55	516.65	567.58	624.46	537.65	370.59
Super Diesel	-	-	-	-	-	-
Diesel Total	**441.55**	**516.65**	**567.58**	**624.46**	**537.65**	**370.59**
Furnace Oil 500'	-	-	-	-	-	-
Furnace Oil 800'	47.92	336.28	424.39	303.43	465.42	359.02
Furnace Oil 1000'	-	-	-	-	-	-
Furnace Oil 1500'	396.03	204.85	-	179.81	-	-
Furnace Oil 3500'	241.93	11.37	-	-	-	-
Furnace Oil Total	**685.88**	**552.50**	**424.39**	**483.24**	**465.42**	**359.02**
S.B.P.	2.73	1.51	1.56	1.66	0.90	3.04
Solvents Total	**2.73**	**1.51**	**1.56**	**1.66**	**0.90**	**3.04**
Bitumen	34.94	-	-	-	-	-
Total Output	**1,649.47**	**1,600.91**	**1,594.17**	**1,781.62**	**1,630.59**	**1,216.09**
Crude Input	1,753	1,692	1,675	1,865	1,752	1,272
Own Use and Losses (kt)	101	92	98	102	86	71
Own Use & loss as Percentage of Input	5.8%	5.5%	5.8%	5.5%	4.9%	5.6%

In 2021, the total refinery output decreased to 1,216.09 from 1,630.59 kt in 2020.

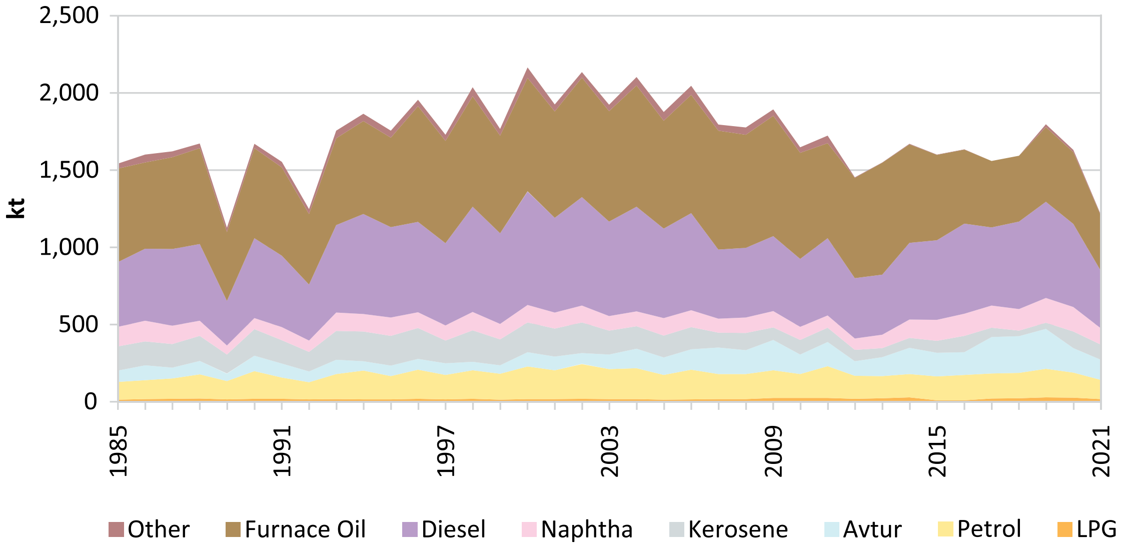


Figure 3.5 - Refined Product Output

3.2.2 Export of Surplus Products

Surplus production of the refinery is exported by the CPC, but the exported quantities are not significant in comparison with the imports. Table 3-7 summarises re-exported products, where naphtha and fuel oil were re-exported in 2021.

Table 3.7- Surplus Exports of Petroleum Products

kt	2010	2015	2018	2019	2020	2021
Naphtha	26.69	22.39	65.00	-	164.65	114.41
Fuel Oil	-	184.56	26.00	-	-	31.39
Bitumen	-	-	-	-	10.50	-
Total re-exported	**26.69**	**206.95**	**91.00**	**-**	**175.15**	**145.80**

4 Energy Conversion

4.1 Grid Electricity Generation

As far as the supply from secondary energy sources is concerned, conversion of primary energy in the form of hydro potential or petroleum to electricity is the most prominent. However, the conversion of petroleum fuel to steam which is used as an energy source in industries for their thermal application can also be considered a secondary form of energy. Though widely used, the quantum of steam generated, the quality and the end use is not recorded properly, which causes the discussion on supply from secondary energy sources to be limited to electricity.

Electricity generation in the country which was broadly divided into two parts based on whether they are connected to the national grid or whether they run isolated. Sri Lanka has a national grid, which now covers the whole country. It is very unlikely that further development of the off-grid sector will take place in the near term. However, the scope for the off-grid sector remains open in areas where grid electricity cannot be provided, such as the few inhabited islands.

Grid connected generation comprises of the following genre.

(i) CEB hydro power plants

(ii) CEB non-conventional power plants (only wind power at present)

(iii) CEB thermal power plants (oil fired and coal powered)

(iv) Independent Power Producers (IPPs) (presently oil-fired thermal power plants)

(v) Small Power Producers (SPPs) (presently mini hydro, one CHP plant, one solar power plant, wind power plants and biomass based power plants, all embedded in the distribution network)

(vi) Emergency Power Plants

(vii) Micro power producers (µPP), small scale power generators connected at the customer location, through one of the three schemes on offer.

Due to the significance of the grid supply compared with the diminishing role of off-grid supply, most of the analyses presented in the report will be for grid connected electricity supply.

4.1.1 Grid Connected Power Plants

As explained above, the electricity supply in Sri Lanka flows through the national grid and a brief description of the national grid is given in this section. Off-grid electricity generation is described in the next section.

Both CEB and private power producers generate electricity and supply to the national grid. All the large-scale hydro power plants in the country are owned by the CEB. Oil-fired thermal power plants and the coal power plant as well are owned by CEB. In addition to its own power plants, CEB as the single buyer of electricity, purchases electricity to the national grid from private Independent Power Producers (IPPs) who have entered into contracts with the CEB. All large IPPs are oil fired, while the mechanism to purchase electricity from renewable based power plants has enabled many Small Power Producers (SPPs) to generate and sell hydro power to the national grid. With the increase of electricity demand and delays in construction of CEB's own power plants, the contribution from private power plants has increased significantly in the recent years.

Different Categories of Power Plants in the National Grid

CEB Power Plants

As the sole operator of the Sri Lankan power system, until 1997, the CEB owned and operated almost all the power plants in the national grid.

Independent Power Producers

Starting from 1997, many IPPs entered the electricity market, supplying electricity to the national grid. IPPs operate by entering into long term agreements with CEB. These contracts are individually executed under different terms and conditions. By 2021 five IPPs were in operation.

Small Power Producers

The number of small power producers increased rapidly over the period, under the enabling environment created by the Government, and implemented by the SEA through its facilitation of the project development through the newly introduced transparent resource allocation process. These power plants are operated by private sector investors and the installed capacity is limited to 10 MW since the plants are non dispatchable. Attractive tariffs offered through the cost-based, technology-specific tariff scheme, a policy intervention of the Ministry of Power and Renewable Energy and the flow of commercial financing provided by commercial banks contributed to the development of the industry.

However, the great strides made by the industry caused several issues, which in turn re-affected the industry. Most of the small hydropower developers were cautioned by activists opposing these projects on environmental and social grounds. This caused the environmental approval processes to become stricter, resulting in considerable delays. These delays affected the projects as most other time-restricted approvals realised by them expired before gaining the environmental approval. Lobbying against renewable energy projects escalated to legal action in 2018, causing more delays in project approval cycle.

On the regulatory front, suspension of purchase of electricity from producers at pre-determined feed-in-tariffs by CEB continued. Accordingly, no Standardised Power Purchase Agreements were signed in 2021 for pre-determined tariffs.   However, the CEB carried on with the projects developed from the tendering process and executed 22 PPAs adding 22 MW of capacity to the national grid. The Government is making strenuous efforts to resolve these issues and it is expected that a new regulatory mechanism will be designed and operated in the near futuree.

Emergency Power Producers

These are power plants connected to the national grid on temporary basis to avoid electrical energy shortages for brief periods, especially during prolonged droughts. Sometimes, these generators are connected to bridge the capacity deficits resulting from dwindled hydropower resources.

Net-metered Projects or micro power producers (µPP)

The net-metering scheme, which was introduced in 2010 continued to serve the solar PV rooftop industry with large scale implementation across the country. However, it failed to encourage other renewable energy projects as envisaged. By end 2021, 37,427 systems were connected to the national grid, adding 516 MW of capacity.

Rooftop Solar PV Proramme under the theme 'Sooryabala Sangramaya' launched in 2016 progressed as expected. In this scheme, excess energy exported to the grid can either be carried forward (as originally done in the net-metering scheme) or encashed (this scheme is identified as net-accounting), at a tariff of LKR 22.00 per kWh during the first seven years and LKR 15.50 per kWh during the remaining thirteen years. The programme attempts to encourage institutional users through a third scheme, known as the micro power producers scheme, where all generation is exported through a separate export meter without making any change to the electricity users metering method.

With the significant reduction of cost of solar PV components, the service providers have quickly moved to tap large industrial customers who own large buildings with good roofs for solar PV systems.

Table 4.1 summarises the total grid connected capacity by type of power plant

Table 4.1 - Total Installed Capacity

MW	2010	2015	2018	2019	2020	2021
Major Hydro	1,207.45	1,376.95	1,398.85	1,398.85	1,382.85	1,382.85
Thermal Power Producers (CEB+IPP+Hired)	1,389.50	1,128.00	2,046.00	2,198.00	2,098.00	2,098.00
CEB Wind	3.00	3.00	3.00	-	31.05	103.50
New Renewable Energy	217.63	451.98	581.43	628.03	676.75	713.05
Micro Power Producers	-	27.71	153.50	283.84	353.61	515.57
Total Installed Capacity	**2,817.58**	**2,987.64**	**4,182.78**	**4,508.72**	**4,542.26**	**4,812.97**
%						
Major Hydro	42.9	46.1	33.3	30.9	30.4	28.7
Thermal Power Producers (CEB+IPP+Hired)	49.3	37.8	48.7	48.5	46.2	43.6
CEB Wind	0.1	0.1	0.1	-	0.7	2.2
New Renewable Energy	7.7	15.1	14.4	14.4	14.9	14.8
Micro Power Producers	-	0.9	3.7	6.3	7.8	10.7

Figure 4.1 depicts the total installed capacities serving the grid by type of power plant.

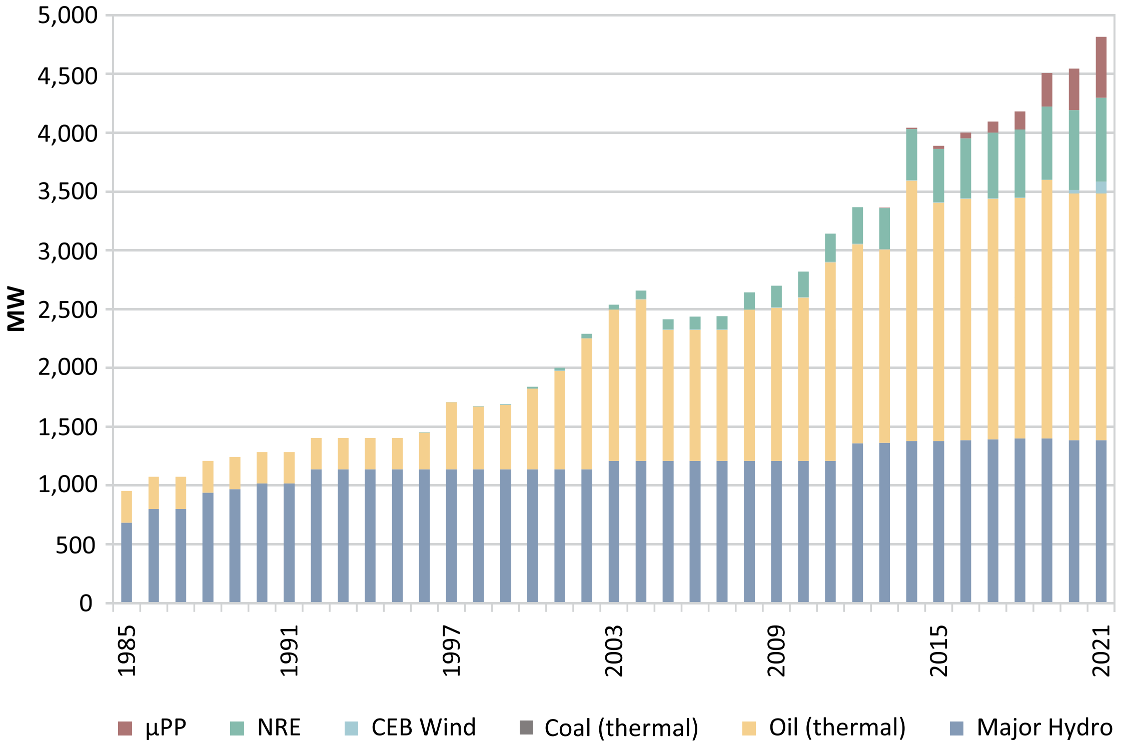


Figure 4.1 - Total Installed Capacity by Type of Power Plant

In the early stages, major hydro played a dominant role in power generation and continued until about 1996. Once the economically feasible major hydro schemes reached their saturation, the share of thermal plants in power generation increased. At present, 64% of power generation is from thermal power.

4.1.1.1 Major Hydro

Sri Lanka has two main hydro power complexes; namely Laxapana and Mahaweli, each consisting of several power plants. Laxapana complex is based on Kelani River while Mahaweli complex is based on Mahaweli River. Other than these major schemes, there are two independent large scale hydro power stations, namely Samanalawewa and Kukule Ganga while small scale power plants such as Inginiyagala and Uda Walawa are also generating hydropower using their respective reservoir storages. For administrative purposes, these smaller hydropower plants are grouped together as a single complex identified by the CEB as the 'Other Hydro' Complex, although these plants are located in different river systems.

Table 4.2 provides a list of major hydro power plants and their corresponding water storage capacities.

Table 4.2 - Storage Capacities and Generation of Major Hydro Power Stations

Name of Hydro Power Station	Plant Capacity (MW)	Name of the Reservoir	Reservoir Live Storage (million m^3)	Generation in 2021 (GWh)	Share in Generation (%)
Laxapana Complex					
Wimalasurendra	50	Castlereigh Reservoir	44.8	143.0	2.5
Canyon	60	Maussakelle Reservoir	123.4	178.9	3.2
Laxapana	53.8	Norton Pond	0.4	352.5	6.2
Samanala	75	Laxapana Pond	0.4	531.1	9.4
New Laxapana	100	Canyon Pond	1.2	611.4	10.8
Mahaweli Complex					
Kotmale	201	Kotmale Reservoir	172.6	567.5	10.0
Nilambe	3.2	-	-	14.6	0.3
Ukuwela	40	Polgolla Barrage	-	213.0	3.8
Bowatenna	40	Bowatenna Reservoir	49.9	94.5	1.7
Victoria	210	Victoria Reservoir	721.2	974.4	17.2
Randenigala	122.6	Randenigala Reservoir	875	426.2	7.5
Rantembe	49	Rantembe Pond	21	195.8	3.5
Upper Kotmale	150	Upper Kotmale	0.8	509.8	9.0
Other Hydro Complex					
Inginiyagala	11.25	Inginiyagala Reservoir	-	22.6	0.4
Uda Walawa	6	Uda Walawa	-	14.1	0.2
Samanalawewa	120	Samanalawewa Reservoir	278	407.9	7.2
Kukule Ganga	70	-	-	401.1	7.1
Total	**1,362**	**-**	-	**5,658.5**	**100.0**

By the end of 2021, a total of seventeen hydro power plants were in operation under the ownership of CEB.

4.1.1.2 Thermal Power

There are six oil-fired thermal power plants and three coal-fired plants that operate under the CEB, whereas four IPPs operate in private capacity.

Table 4.3 summarises thermal power generation in 2021.

Table 4.3 - Installed Capacities and Generation of Thermal Power Plants

Name of Power Station	Technology Type	Fuel Type	Capacity (MW)	Gross Generation (GWh)	Share in Generation (%)
CEB					
Kelanitissa Power Station	Gas Turbine (stg 2)	Auti Diesel	115	79.2	1.0
Kelanitissa Power Station	Gas Turbine (stg 3)	Auto Diesel	80	11.5	0.1
Sapugaskanda Power Station	Diesel Engine	Auto Diesel	80	2.2	-
		HSFO 380 cst (FO 3500)		245.2	3.1
Sapugaskanda Power Station Extension	Diesel Engine	Auto Diesel	80	7.2	0.1
		HSFO 380 cst (FO 3500)		340.1	4.3
Kelanitissa Power Station	Combined Cycle	Auto Diesel	165	63.3	0.8
		Naphtha		73.0	0.9
Uthuru Janani	Diesel Engine	HSFO 180 cst (FO 1500)	24	91.5	1.2
Barge Mounted Power Plant	Diesel Engine	HSFO 180 cst (FO 1500)	60	319.1	4.0
Emergency Power	Diesel Engine	Auto Diesel	50	41.9	0.5
Puttalam Coal Power Station	Steam	Auto Diesel	900	3.6	-
		Coal		6,107.4	77.0
IPP					
Asia Power	Diesel Engine	HSFO 380 cst (FO 3500)	51	65.0	0.8
Ace Power Matara	Diesel Engine	HSFO 180 cst (FO 1500)	20	36.7	0.5
AES - Kelanitissa	Combined Cycle	Auto Diesel	163	275.2	3.5
Ace Power Embilipitiya	Diesel Engine	HSFO 180 cst (FO 1500)	100	168.3	2.1
Yugadhanavi-Kerawalapitiya	Combined Cycle	LSFO 180 cst	270	-	12.5
Total			**2,046**	**7,930.4**	**100.0**

The oil-fired CEB power plants generated 1,232.3 GWh, while the coal-fired power plant generated 6,107.4 GWh. The contribution of the coal power plant to generation is 77.1%. The five IPPs generated 545.2 GWh in total.

4.1.1.3 CEB Wind Power

The Thambapavani Mannar wind power plant was in operation in 2021 as indicated in Table 4.4. It is owned and operated by the CEB.

Table 4.4 - Installed Capacity and Generation of the Mannar Wind Power Plant

Name of the Power Station	Plant Capacity (MW)	Generation in 2021 (GWh)
Wind Power - Mannar	103.5	325.9

4.1.1.4 New Renewable Energy

New Renewable Energy power plants are operated by private sector investors and the installed capacity is limited to 10 MW since the plants are non-dispatchable. At present, the number and variety of SPPs have increased by several folds, and is scattered countrywide. Table 4.5 summarises the installed capacities and generation of SPPs contributing to the NRE industry.

Table 4.5 - Installed Capacities and Generation of NRE Power Plants by end 2021

Type of Power Station	Number of Plants	Total Installed Capacity (MW)	Generation in 2021 (GWh)	Share in Generation (%)
Hydro	213	414.2	1,568.1	70.8
Combined heat and power	1	10.0	70.0	3.2
Biomass	13	40.1	92.8	4.2
Solar	57	100.4	156.0	7.0
Wind	17	148.5	327.5	14.8
Total	**301**	**713.1**	**2,214.5**	**100.0**

Only three SPP hydro plants and 25 solar plants were commissioned in 2021, with installed capacities of 4.60 MW and 25 MW, respectively. There were no capacity additions of other types of NRE plants in 2021. Figure 4 2 depicts the cumulative capacity additions and number of SPPs up to end 2021.

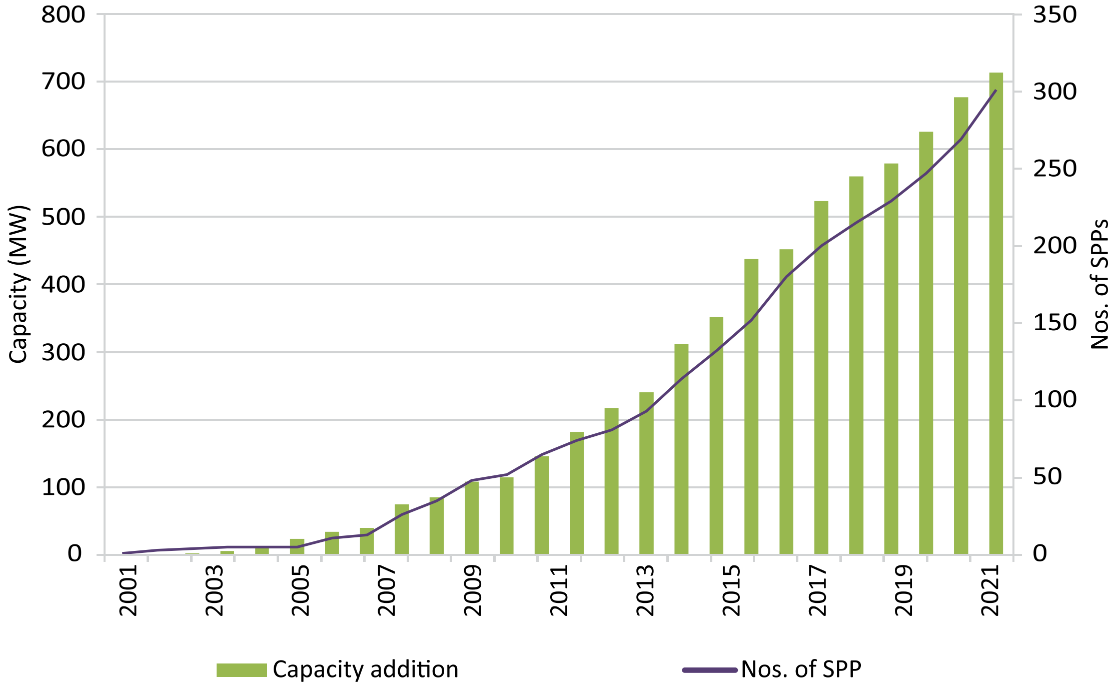


Figure 4.2 - Cumulative Capacity Additions and Number of SPPs

4.1.1.5 Micro Power Producers

By end 2021, 516 MW of µPP were in operation, generating approximately 921.7 GWh.

Table 4.6 - Cumulative Capacities and Generation of Net-metered Projects

Type of Net-metered Project	Number of Projects	Cumulative Capacity (MW)	Generation in 2021 (GWh)
Solar	37,427	516	921.7

4.1.2 Gross Generation of Grid Connected Power Plants

The total generation from major hydro plants, thermal plants, new renewable energy plants and net-metered project in 2021 was 17,947.7 GWh. Compared with the gross generation of 2020, which was 16,916.9 GWh, the generation in 2021 increased marginally as indicated in Table 4.7.

Table 4.7 - Gross Generation to the CEB Grid

GWh	2010	2015	2018	2019	2020	2021
Major Hydro	4,988.5	4,904.4	5,168.7	3,800.9	3,929.4	5,658.5
Thermal (Oil)	5,063.3	2,343.5	3,760.9	5,067.4	4,306.4	2,716.2
Thermal (Coal)	-	4,457.2	5,309.4	5,916.9	6,364.9	6,110.9
CEB Wind	3.0	1.1	1.3	-	7.7	325.9
New Renewable Energy	728.5	1,466.0	1,742.4	1,579.3	1,607.2	2,214.5
Micro Power Producers	-	38.8	215.1	397.8	701.2	921.7
Gross Generation to CEB Grid	**10,783.2**	**13,211.1**	**16,197.8**	**16,762.3**	**16,916.9**	**17,947.7**
Year-on-year growth rate	8.2%	2.9%	7.9%	3.9%	(0.9%)	6.2%

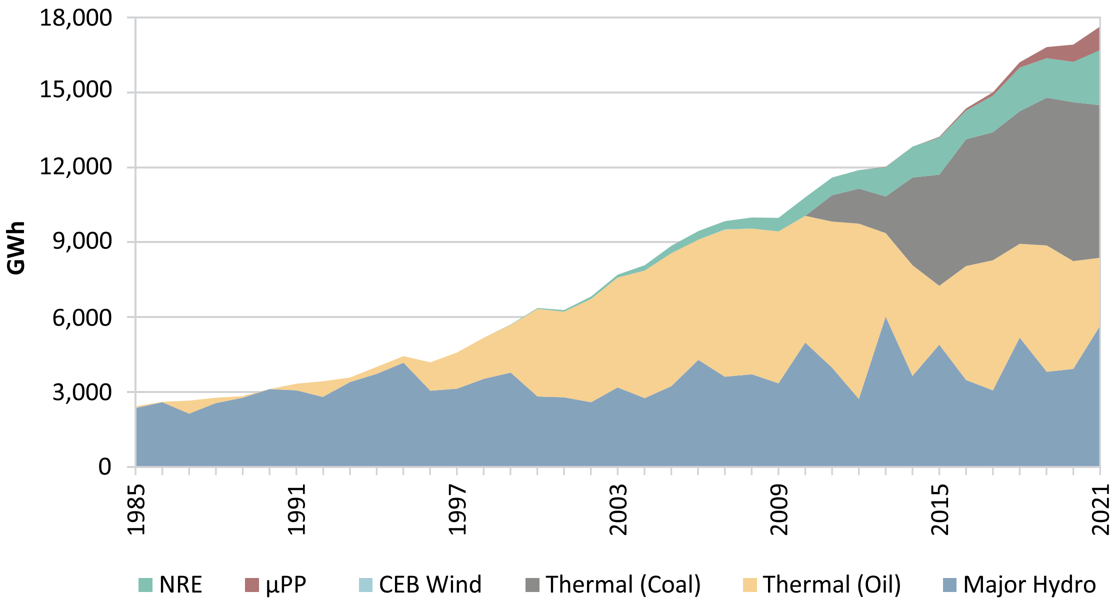


Figure 4.3 - Gross Generation to CEB Grid

In early stages, the energy mix included only major hydro plants and oil-fired thermal plants. The generation mix started diversifying from 1996 and the trend continues to date. At present however, the thermal share is dominant and it would continue to remain with the entry of coal power plants as base load generators.

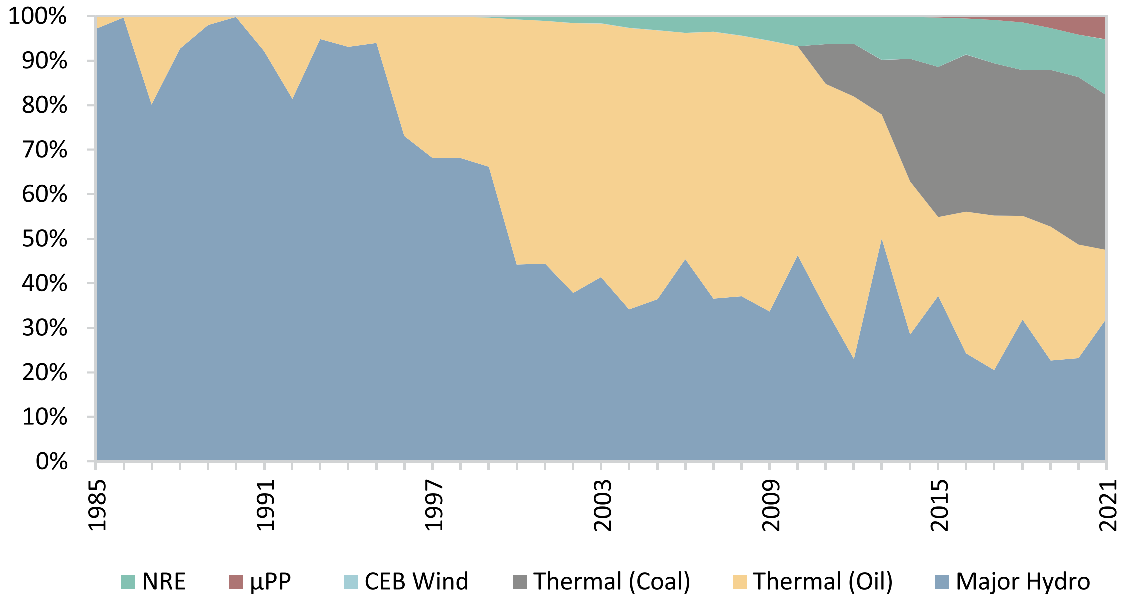


Figure 4.4 - Evolution of Generation Mix: 1985 to 2021

The NRE industry, which commenced in 1996 has progressed expeditiously, increasing in capacity each year. Figure 4.5 depicts the growth of the industry since inception to date.

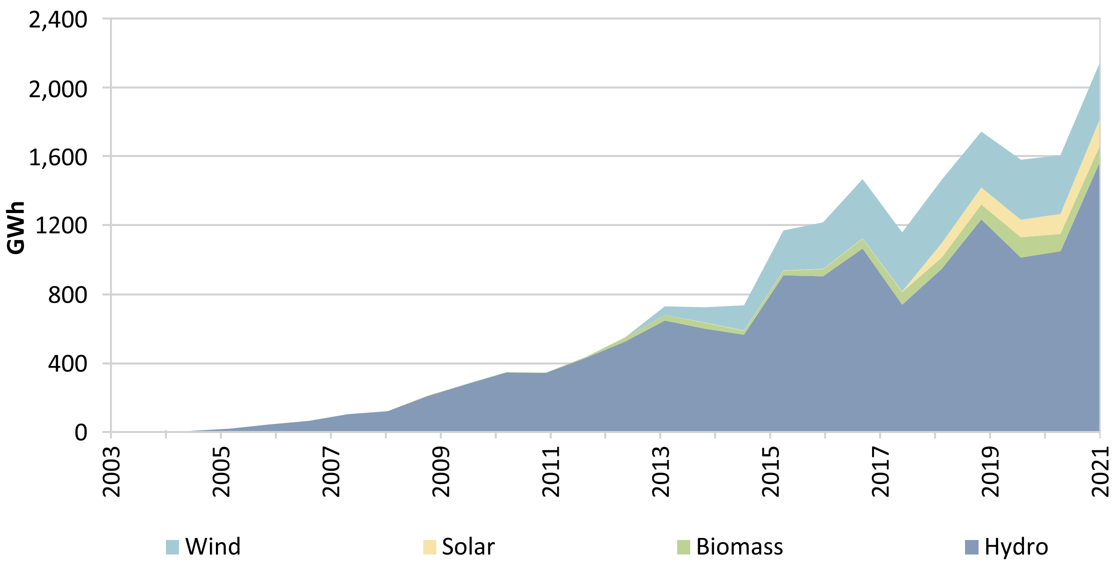


Figure 4.5 - Gross Generation of New Renewable Energy Power Plants

The share of NRE generation was 12.3% in the total gross generation to the CEB grid in 2021. The share of hydro power was low from 2018 – 2020, however has increased in 2021, owing to favourable rain patterns, as indicated in Figure 4.5.

4.1.3 Different Technologies used by Power Plants in the National Grid

Table 4.8 - Grid Connected Power Plant Capacities (MW) by Technology Type

Technology	2010	2015	2018	2019	2020	2021
CEB Power Plants						
Major Hydro	1,207	1,377	1,399	1,399	1,383	1,383
Conventional Wind	3	3	3	-	31	104
Steam, Fuel Oil	-	-	-	-	-	-
Steam, Coal	-	900	900	900	900	900
Sub total, Steam	**-**	**900**	**900**	**900**	**900**	**900**
Diesel Engine, Residual Oil	160	160	160	160	160	160
Diesel Engine, Fuel Oil	-	24	24	24	24	24
Diesel Engine, Diesel Oil	8	-	-	150	50	50
Sub total, Diesel Engines	**168**	**184**	**184**	**334**	**234**	**234**
Gas Turbines, Diesel Oil	215	195	195	195	195	195
Sub total, Gas Turbines	**215**	**195**	**195**	**195**	**195**	**195**
Combined Cycle, Naphtha, Diesel	165	165	165	165	165	165
Sub total, Combined Cycle	**165**	**165**	**165**	**165**	**165**	**165**
IPP						
Diesel Engine, Residual Oil	51	51	51	51	51	51
Diesel Engine, Fuel Oil	343	100	118	120	120	120
Diesel Engine, Diesel Oil	15	-	-	-	-	-
Combined Cycle, Diesel, Fuel Oil	433	433	433	433	433	433
Sub total IPP	**842**	**584**	**602**	**604**	**604**	**604**
SPP						
Hydro	175.4	306.7	387.0	399.6	402.9	414.2
Combined heat and power	-	-	-	-	10.0	10.0
Solar	-	1.4	51.4	57.4	75.4	100.4
Biomass	12.0	20.1	37.1	40.1	40.1	40.1
Wind	30	123.9	128.5	128.5	148.5	148.5
Sub total SPP	**218**	**452**	**603.9**	**626**	**677**	**713**
µPP						
Solar	-	27.7	153.5	283.8	353.6	515.6
Sub total µPP	-	**28**	**154**	**284**	**354**	**516**

Table 4.9 - Fuel Usage and Generation by Technology Type

Technology Type	2010	2015	2018	2019	2020	2021
CEB Gross Generation (GWh)						
Steam, Coal	-	4,447.2	5,299.3	5,910.2	6,358.9	6,107.4
Steam, Diesel	-	10.0	10.1	6.7	6.0	3.6
Diesel Engine, Residual Oil	830.9	271.9	620.4	630.3	759.9	585.3
Diesel Engine, Fuel Oil	-	228.4	440.6	473.3	525.0	410.6
Diesel Engine, Diesel	16.8	22.5	25.2	212.6	174.4	60.1
Gas Turbines, Diesel Oil	53.3	25.1	222.0	326.5	133.9	90.7
Combined Cycle, Diesel Oil	255.7	119.5	248.5	103.5	-	63.3
Combined Cycle, Naphtha	237.6	540.3	386.2	590.7	-	73.0
CEB Fuel Use (million litres)						
Steam, Coal (million kg)	-	1,880.0	2,009.1	2,208.9	2,349.3	2,301.3
Steam, Diesel	-	3.0	3.9	3.4	2.9	2.7
Diesel Engine, Residual Oil	184.9	60.6	137.4	140.7	169.4	130.5
Diesel Engine, Fuel Oil	-	19.3	95.9	102.5	113.2	88.5
Diesel Engine, Diesel	5.3	6.7	7.7	62.0	50.9	20.5
Gas Turbines, Diesel Oil	21.6	9.2	81.0	119.3	50.1	33.8
Combined Cycle, Diesel Oil	59.3	26.7	56.6	24.0	-	16.6
Combined Cycle, Naphtha	78.0	144.7	102.2	174.4	-	22.5
IPP Gross Generation (GWh)						
Diesel Engine, Residual Oil	325.0	101.1	56.9	74.0	169.8	65.0
Diesel Engine, Fuel Oil	2,245.1	235.5	382.4	534.9	587.1	205.0
Diesel Engine, Fuel Oil (LSFO 180 cst)	87.8	-	37.2	-	-	-
Diesel Engine, Diesel Oil	-	-	-	-	-	-
Combined Cycle, Diesel Oil	464.1	264.0	301.0	814.8	441.9	275.2
Combined Cycle, Fuel Oil (LSFO 180 cst)	547.1	671.4	1,040.4	1,385.9	1,514.5	890.7
Combined Cycle, Fuel Oil (HSFO 180 cst)	-	-	-	-	-	-
IPP Gross Fuel Use (million litres)						
Diesel Engine, Residual Oil	72.6	23.0	13.1	18.4	38.8	14.2
Diesel Engine, Fuel Oil	490.7	51.5	85.6	119.8	130.5	42.8
Diesel Engine, Diesel Oil	24.9	-	9.8	-	-	0.2
Combined Cycle, Diesel Oil	99.1	56.0	55.3	181.8	92.9	69.5
Combined Cycle, Fuel Oil (LSFO 180 cst)	120.5	152.3	229.9	291.7	328.9	199.8

4.1.4 Fuel Usage and Conversion Efficiency in Thermal Power Generation

Thermal power plants operating in Sri Lanka primarily use petroleum fuels such as diesel, fuel oil, residual oil and naphtha. Table 4.10 details the total quantities of common fuels used in power generation by thermal power plants.

Table 4.10 - Total Petroleum Fuels Used in Power Generation

	2010	2015	2018	2019	2020	2021
Fuel Oil (HSFO 180 CST, FO 1500) (million litres)	490.7	70.8	181.6	222.4	243.8	131.3
Coal (million kg)	-	1,880.0	2,009.1	2,208.9	2,349.3	2,301.3
Residual Oil (HSFO 380 CST, FO 3500) (million litres)	257.5	83.6	150.5	159.1	208.2	144.7
Diesel (million litres)	210.2	98.6	210.4	387.1	193.8	141.4
LSFO 180 CST (million litres)	120.5	152.3	229.9	291.7	328.9	199.8
Naphtha (million litres)	78.0	144.7	102.2	174.4	-	22.5

The consumption of liquid petroleum fuels has decreased for all fuel types in 2021. The major share of thermal power generation was borne by coal power. At present, the types of fuel used in power generation have increased in variety, owing to the large share of thermal power, as shown in Figure 4.6. Liquid fuels have been converted into corresponding weights at 30^0C (ambient temperature).

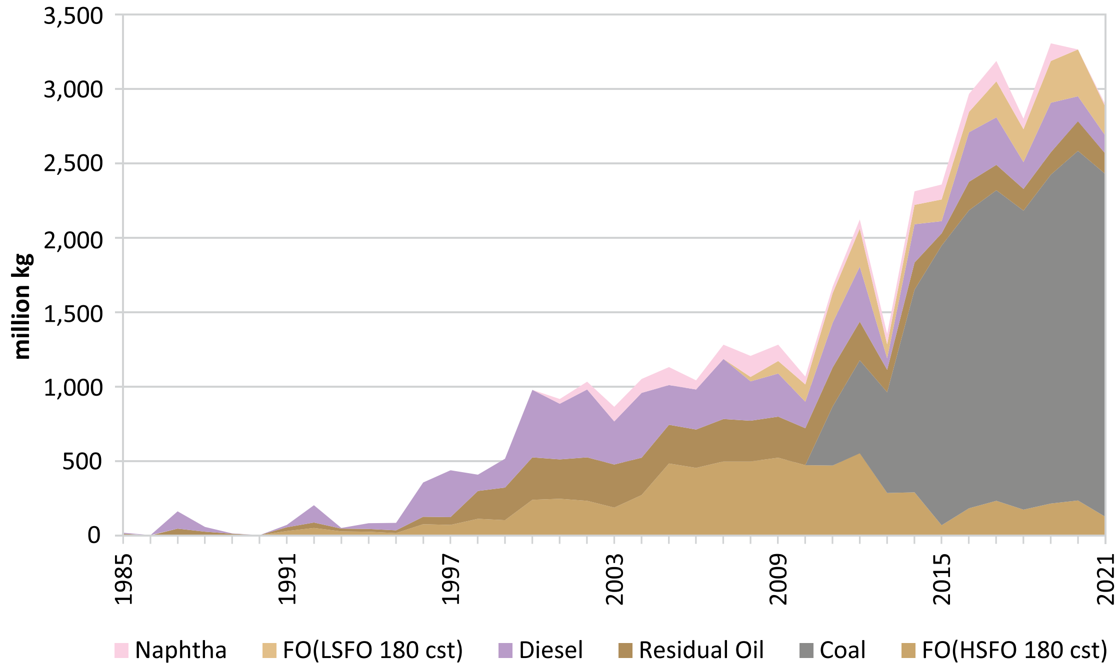


Figure 4.6 - Fuel Consumption in Thermal Power Generation by Type

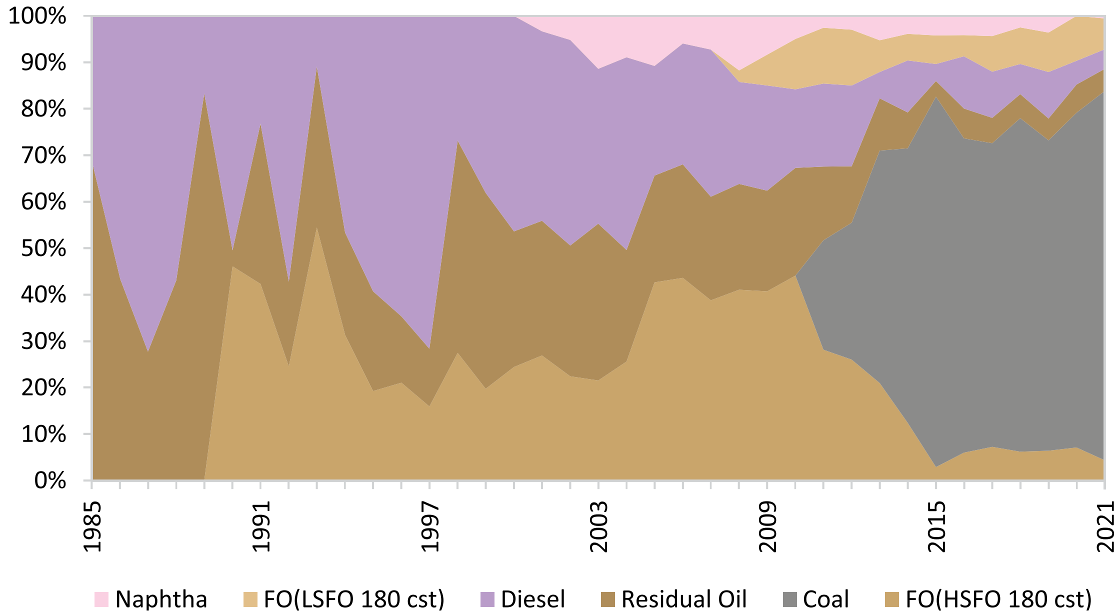


Figure 4.7 - Percentages of Fuel Mix in Thermal Power Generation

Table 4.11 summarises the efficiencies of thermal power plants by technology type.

Table 4.11 – Thermal Power Plant Efficiencies

Power Plant Efficiencies	2010	2015	2018	2019	2020	2021
CEB						
Steam, Coal	-	35.5%	39.6%	40.1%	40.6%	39.8%
Steam, Diesel	-	31.4%	24.3%	18.5%	19.5%	12.4%
Diesel Engine, Residual Oil	39.5%	39.4%	39.7%	39.3%	39.4%	39.4%
Diesel Engine, Fuel Oil	-	40.5%	40.4%	40.5%	40.7%	40.8%
Diesel Engine, Diesel	29.8%	31.9%	30.8%	32.5%	32.5%	26.7%
Gas Turbines, Diesel Oil	23.4%	25.8%	26.0%	26.0%	25.4%	25.4%
Combined Cycle, Diesel Oil	40.9%	42.5%	41.6%	40.8%	-	36.2%
Combined Cycle, Naphtha	33.7%	41.3%	41.8%	37.5%	-	35.9%
CEB Gross Thermal Generation (Gcal)	1,199,040	4,871,737	6,237,052	7,098,249	6,843,975	6,356,420
CEB Fuel Energy Input (Gcal)	3,198,724	13,370,308	15,918,569	18,266,560	17,156,043	16,159,443
CEB Power Plant Efficiency	**37.5%**	**36.4%**	**39.2%**	**38.9%**	**39.9%**	**39.3%**
IPP						
Diesel Engine, Residual Oil	39.3%	38.6%	38.2%	35.3%	38.4%	40.1%
Diesel Engine, Fuel Oil	40.2%	40.2%	39.2%	39.2%	39.5%	42.1%
Diesel Engine, Diesel Oil	33.4%	-	36.0%	-	-	-
Combined Cycle, Diesel Oil	44.4%	44.7%	51.6%	42.5%	45.1%	37.5%
Combined Cycle, Fuel Oil (LSFO 180 cst)	0.40	38.4%	39.4%	41.3%	40.1%	38.8%
Combined Cycle, Fuel Oil (HSFO 180 cst)	-	-	-	-	-	-
IPP Net Thermal Generation (Gcal)	2,684,904	516,533	668,650	1,224,343	1,030,934	468,891
IPP Fuel Energy Input (Gcal)	6,639,385	1,237,795	1,557,105	3,002,410	2,500,356	1,191,159
IPP Power Plant Efficiency	**40.4%**	**41.7%**	**42.9%**	**40.8%**	**41.2%**	**39.4%**

4.2 Off-Grid Electricity Generation

Isolated power generating facilities are available in some locations owing mainly to the unavailability of the national grid. In addition, standby power supplies are also available in most industries and commercial facilities, although their generation is very minimal due to the short-term nature of operation. The capacities and energy converted at these standby generators are not accounted for in this report.

Three main contexts in which off-grid electricity is used are as follows.

(i) Diesel generators are maintained only as a standby option and run only for short durations during grid failures, periodic testing and during generator servicing.

(ii) Renewable energy systems, such as small hydro (for industries and households), wind and solar photovoltaic systems for households are also operated off-grid due to unavailability of grid and technical reasons.

(iii) Four Northern islands which were provided with diesel generators, received utility level services from the CEB, were considered for hybrid solutions and the first island the Eluvaithivu Island continued to reap the benefits in 2020. Remaining three islands too will become hybrid powered islands with the debt financing provided by the ADB in 2021.

The non-conventional off grid energy systems such as village and estate hydro plants and household solar photovoltaic systems are discussed separately in this report. Off-Grid generation broadly comprises the following genre.

(i) Self-Generation: Using own generating plants, even if the grid is available. Only a few locations, and they too are used sparingly.

(ii) Off-grid (Industrial): Industries using their own generation either as a matter of policy, keeping the grid supply only as backup or owing to non-availability of the grid in close proximity. Only a few locations, and they too are used sparingly.

(iii) Off-grid (non-industrial): Mostly rural systems of small micro hydro, wind, solar and other renewable energy based systems.

With the rapid expansion of the national grid, the role of off-grid electrification ceased in the country, except in certain inaccessible locations. The advent of energy storage solutions coupled with solar PV power generation now offers cost effective solutions to electrify far corners of the country. In time to come, rooftop solar PV/ESS solutions may become a serious contender for electrifying not only remote villages but also urban dwellings.

4.3 Total Generation

The bulk of electricity generation in Sri Lanka is from grid-connected power plants. Table 4 11 gives the summary of electricity generation from grid-based and off-grid, conventional and non-conventional sources.

Table 4.12 – Total Gross Generation in Sri Lanka

GWh	2010	2015	2018	2019	2020	2021
Major Hydro Power	4,988.5	4,904.4	5,168.7	3,800.9	3,929.4	5,658.5
Thermal Power	5,063.3	6,796.4	9,070.3	11,063.4	10,671.4	8,827.1
CEB Wind Power	3.0	1.1	1.3	-	7.7	325.9
New Renewable Energy	728.5	1,466.0	1,742.4	1,579.3	1,607.2	2,214.5
Micro Power Producers	-	38.8	215.1	397.8	701.2	921.7
Off-grid Non-Conventional (Off-grid Renewables)	17.5	18.8	18.8	-	-	-
Gross Generation	**10,800.7**	**13,225.5**	**16,216.6**	**16,841.3**	**16,916.9**	**17,947.7**
%						
Major Hydro Power	46.2	37.1	31.9	22.6	23.2	31.5
Thermal Power	46.9	51.4	55.9	65.7	63.1	49.2
CEB Wind Power	-	0.01	0.01	-	-	1.8
New Renewable Energy	6.7	11.1	10.7	9.4	9.5	12.3
Micro Power Producers	-	0.3	1.3	2.46	4.1	5.1
Off-grid Non-Conventional (Off-grid Renewables)	0.2	0.1	0.1	-	-	-

5 Energy Distribution and Pricing

Energy sources and energy demand are separated by vast swaths of time and space. Therefore, to provide a sound energy supply, vast transport/transmission network, storage and transaction elements are required. The supply of energy includes generation/conversion and distribution to end users. Distribution is the process of delivering energy from its source to the ultimate end use. For convenience, the terminal points of distribution are considered to be from the measuring point at generation/conversion to the measuring point at the end user.

5.1 Electricity Distribution and Prices

Distribution of electrical energy is through the transmission and distribution network, the main difference between the two being the voltage at which the power is delivered. Transmission is at voltages 132 kV and 220 kV, whereas distribution is done at 33 kV, 11 kV and 400V.

5.1.1 Transmission and Distribution Networks

5.1.1.1 Electricity Transmission Network

Sri Lanka has a single transmission network spanning the whole country with the exception of four small inhabited islands in the Northern Province. The national grid consists of overhead transmission lines interconnecting large scale power plants scattered mostly in the central region and the Western province, and grid substations where the distribution networks spread from. Apart from the most common transmission lines carrying power at 132 kV, a limited number of 220 kV transmission lines are also available in the network. These 220 kV transmission lines strengthen the network, especially between nodes having heavy power flows, such as Kotmale-Biyagama and Kotmale-Anuradhapura.

5.1.1.2 Electricity Distribution Network

Electricity distribution and sales in Sri Lanka is the responsibility of the following organisations;

- Ceylon Electricity Board (CEB)
- Lanka Electricity Company (Pvt) Ltd. (LECO)

At grid substations, the high voltage electricity in the transmission network is converted to 33 kV to be distributed within the locality. In some instances, the electricity at 33 kV is again converted to 11 kV at primary substations and then distributed to consumers. Distribution networks operated by LECO use 11 kV as the distribution voltage. However, both CEB and LECO step down the distribution voltage again to 400 V prior to delivering power to small scale consumers such as households and commercial buildings. For a limited number of industrial and commercial establishments, electricity is provided and metered at the distribution voltage itself. The distribution responsibility ends at the consumer metering point up to which the maintenance work is carried out by the corresponding service provider (*i.e.* CEB or LECO).

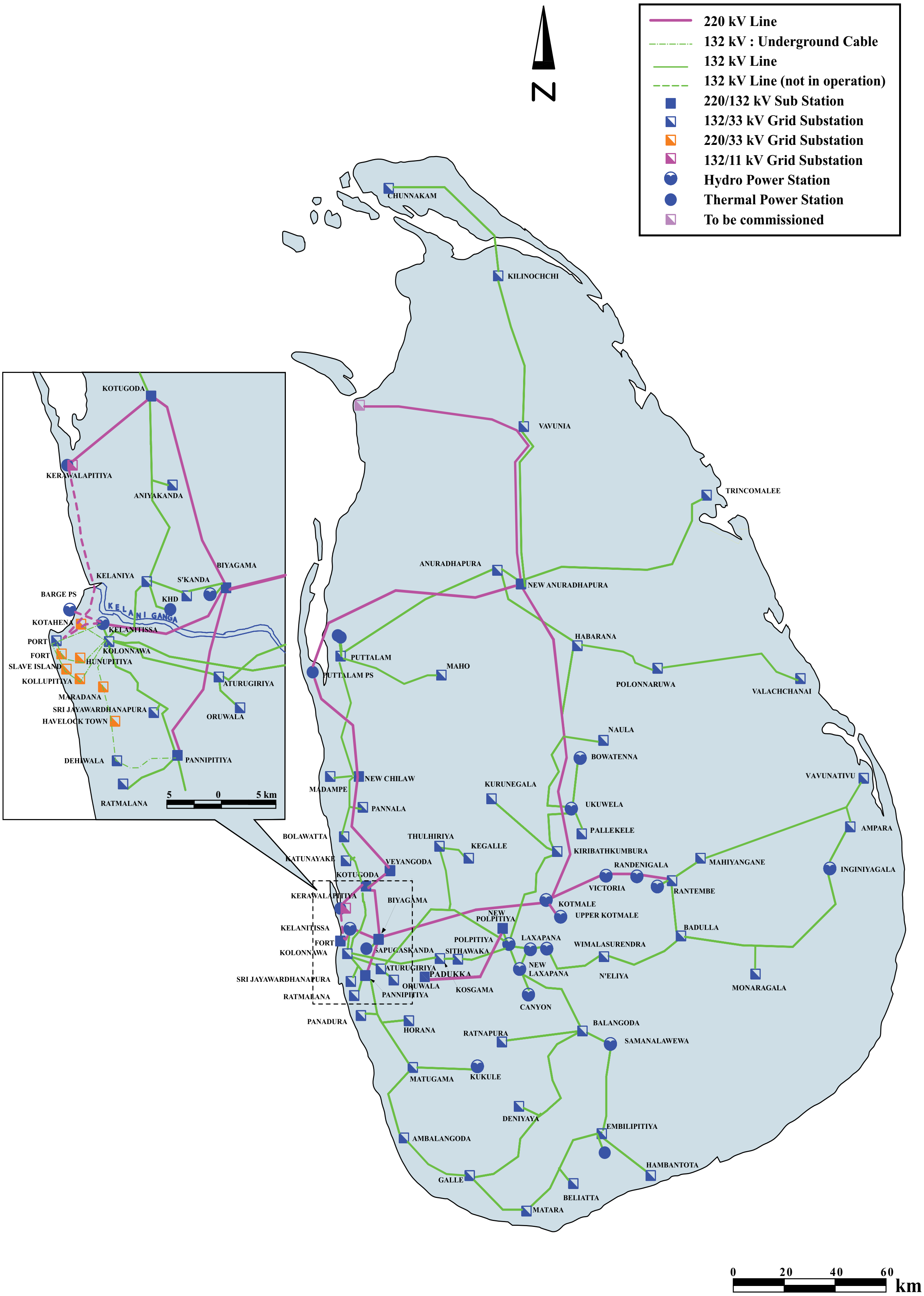


Figure 5.1 – Electricity Transmission Network (2021)

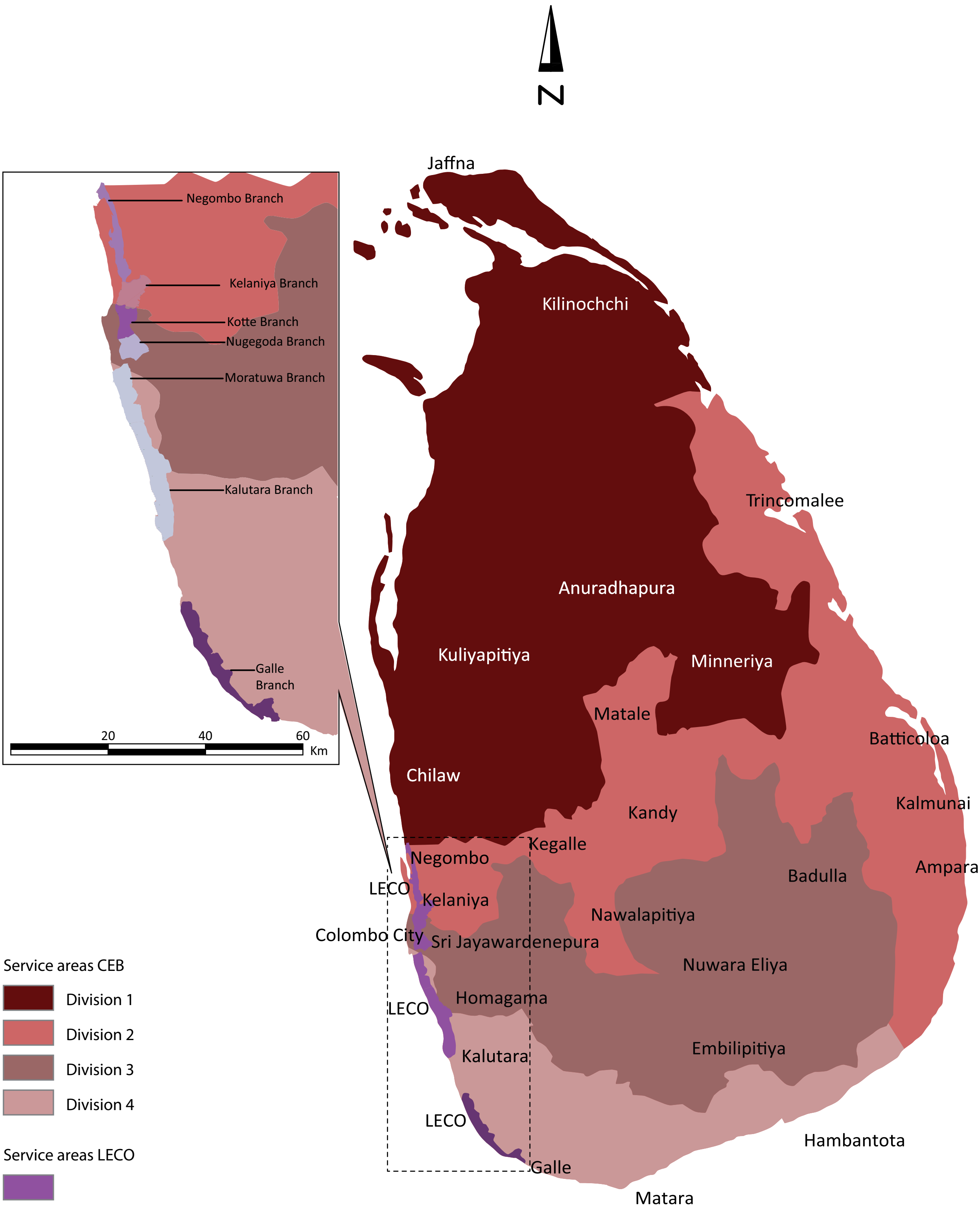


Figure 5.2 – Service Areas of the CEB and LECO

5.1.2 Electrification

All the categories of grid electricity consumers increased in number in 2021. Although a new category was introduced for Agriculture in 2019, no consumers were reported for 2020 and 2021. While Table 5.1 shows the number of electricity consumers in the grid, Table 5.2 shows the share of electricity consumers of CEB and LECO separately.

Table 5.1 – Electricity Consumers Served by the Grid

Total Number of Consumer Accounts	2010	2015	2018	2019	2020	2021
Domestic	4,363,324	5,407,644	6,010,765	6,123,875	6,243,246	6,374,253
Religious	29,050	37,201	42,001	43,335	44,491	45,325
Industrial	48,461	59,820	65,648	67,327	70,250	73,013
Commercial	514,292	666,475	793,760	831,304	875,343	921,695
Agriculture	-	-	-	56	-	-
Streetlighting	2,931	3,065	2,892	2,993	3,664	3,676
Total	**4,958,058**	**6,174,205**	**6,915,066**	**7,068,890**	**7,236,994**	**7,417,962**

The number of total accounts served by the grid has increased by 2% in 2021 compared with 2020.

Table 5.2 – Electricity Consumers in the Grid, CEB and LECO

Total Number of Consumer Accounts	2010	2015	2018	2019	2020	2021
CEB						
Domestic	3,958,829	4,966,395	5,543,137	5,651,452	5,750,281	5,875,558
Religious	26,763	34,710	39,422	40,724	41,805	42,638
Industrial	45,059	56,681	62,570	64,241	66,831	69,600
Commercial	449,733	590,344	709,150	744,166	777,347	821,730
Agriculture	-	-	-	56	-	-
Streetlighting	1	1	1	1	1	1
Sub total CEB	**4,480,385**	**5,648,131**	**6,354,280**	**6,500,640**	**6,636,265**	**6,809,527**
LECO						
Domestic	404,495	441,249	467,628	472,423	492,965	498,695
Religious	2,287	2,491	2,579	2,611	2,686	2,687
Industrial	3,402	3,139	3,078	3,086	3,419	3,413
Commercial	64,559	76,131	84,610	87,138	97,996	99,965

Total Number of Consumer Accounts	2010	2015	2018	2019	2020	2021
Streetlighting	2,930	3,064	2,891	2,992	3,663	3,675
Sub total LECO	**477,673**	**526,074**	**560,786**	**568,250**	**600,729**	**608,435**

Note: CEB considers street lighting as one account, while LECO counts the street lighting systems individually as separate accounts.

The total number of accounts of the CEB increased by 3%, while the number of accounts of the LECO increased by 1% in 2021.

5.1.3 Electricity prices

A major role in electricity generation is played by the CEB while the IPPs and the SPPs play supportive roles. Unlike generation, CEB has a monopoly over electricity transmission. The distribution business is shared by CEB and LECO. Hence, the role of the CEB in the electricity industry in Sri Lanka is significant. As a result, analysis of the electricity sector financial performance is dominated by its main player; the CEB. Being a subsidiary of CEB and having a key presence in electricity sales, LECO financial performance is also important. Table 5.3 shows the sales and revenue of the two electricity utilities CEB and LECO, their annual revenue and average selling prices.

Table 5.3 – Average Electricity Sales, Selling Prices and Revenue of CEB and LECO

	2010	2015	2018	2019	2020	2021
CEB						
Sales (GWh)	8,067	10,340	12,451	12,927	12,682	13,581
Revenue from sales (LKRM)	105,710	165,741	204,078	215,231	213,194	226,172
Other Revenue (LKRM)	3,063	9,679	9,374	12,058	10,155	12,975
Total revenue (LKRM)	108,773	175,420	213,452	227,289	223,349	239,147
Average Selling price (LKR/kWh)	13.10	16.03	16.39	16.65	16.81	16.65
LECO						
Sales (GWh)	1,124.00	1,382.15	1,549.93	1,646.66	1,607.04	1,598.93
Revenue from sales (LKRM)	14,035.00	26,193.59	30,947.01	32,459.00	32,369.77	36,664.62
Total revenue (LKRM)	14,035.00	26,193.59	30,947.01	32,459.00	32,369.77	36,664.62
Average Selling price (LKR/kWh)	12.49	18.95	19.97	19.71	20.14	22.93

The national average selling price of electricity is given in Table 5.4 and the growth of the price is depicted in Figure 5.3.

Table 5.4 – National Average Selling Price of Electricity

	2010	2015	2018	2019	2020	2021
Average Selling price (LKR/kWh)	13.03	16.37	16.79	17.00	17.19	17.31

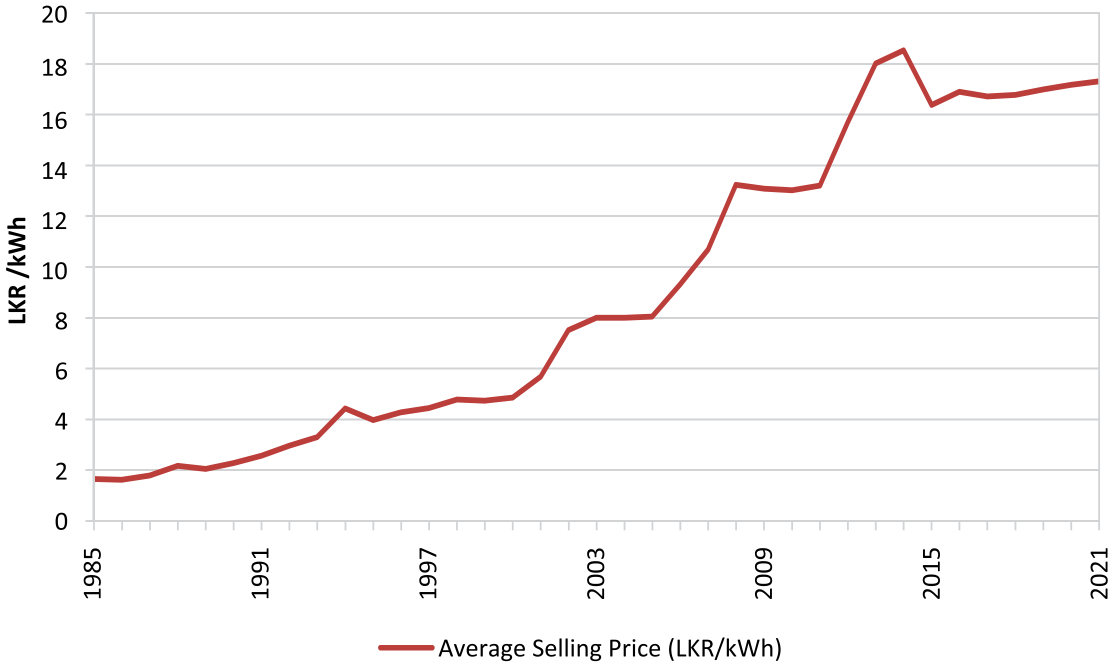


Figure 5.3 – National Average Selling Price of Electricity

The average selling price of electricity per kWh depends on the tariff structure and the sales to different consumer categories.

5.1.4 Electricity Tariff

As illustrated in Figure 5.3, the average selling price of an electricity unit in Sri Lanka increased over the time. The utilities reported that a total of 315 customers migrated to the Time of Use (ToU) tariff offered to encourage at specific electricity use, as the peak time tariff was quite high. Nevertheless, this offer will continue to benefit electric vehicle users in future.

Effective date:

Domestic – September 16, 2014

Non-domestic categories – November 15, 2014

ToU for domestic category – September 15, 2015

Table 5.5 – Electricity Prices in Year 2021

	Unit Rate (LKR/Unit)	Fixed Charge (LKR)
Domestic		
Usage 0 – 60 kWh/month		
Block 1 – First 30 units	2.50	30.00
Block 2 – 31 – 60 units	4.85	60.00
Usage above 60 kWh/month		
Block 1 - First 60 units	7.85	N/A
Block 2 - 61 - 90 units	10.00	90.00
Block 3 - 91 - 120 units	27.75	480.00
Block 4 - 121 - 180 units	32.00	480.00
Block 5 - Above 180 units	45.00	540.00
Religious and Charitable Institutions		
Block 1 – First 30 units	1.90	30.00
Block 2 – 31 – 90 units	2.80	60.00
Block 3 – 91 – 120 units	6.75	180.00
Block 4 – 121 – 180 units	7.50	180.00
Block 5 – Above 180 units	9.40	240.00

Time of Use Electricity Tariff for Domestic Consumers

The following optional Electricity Tariffs based on Time of Use (TOU) for Domestic Consumers who are connected with 3 -phase 30A or above.

Time of Use (ToU)	Energy Charge (LKR/kWh)	Fixed Charge (LKR/month)
Peak (18.30-22.30)	54.00	540.00
Day (5.30-18.30)	25.00	
Off-peak (22.30-05.30)	13.00	

	General Purpose	**Government (Schools, hospitals, ..etc**	**Industrial**	**Hotels**
Rate - 1 Supply at 400/230 V				
Contract Demand < or = 42 kVA Unit Charge (LKR/unit) Fixed Charge (LKR/month)	GP1-1 For≤300 kWh/month 18.30 + 240.00 GP1-2 For>300 kWh/month 22.85 + 240.00	14.65 + 600.00	12.50 + 600.00	22.00 + 600.00
Rate – 2 Supply at 400/230 V				
Contract Demand above 42 kVA Unit Charge (LKR/unit) Demand Charge (LKR/kVA) Fixed Charge (LKR/month)	Day 20.80 (5.30 am – 6.30 pm) Peak 26.60 (6.30 pm – 10.30 pm) Off-peak 14.50 (10.30 pm – 5.30 am) + 1,100.00 + 3,000.00	14.55 + 1,100.00 + 3,000.00	Day 11.00 (5.30 am – 6.30 pm) Peak 20.50 (6.30 pm – 10.30 pm) Off-peak 6.85 (10.30 pm – 5.30 am) + 1,100.00 + 3,000.00	Day 14.65 (5.30 am – 6.30 pm) Peak 23.50 (6.30 pm – 10.30 pm) Off-peak 9.80 (10.30 pm – 5.30 am) + 1,100.00 + 3,000.00
Rate – 3 Supply at 11 kV and above				
Unit Charge (LKR/unit) Demand Charge (LKR/kVA) Fixed Charge (LKR/month)	Day 19.50 (5.30 am – 6.30 pm) Peak 24.00 (6.30 pm – 10.30 pm) Off-peak 13.50 (10.30 pm – 5.30 am) + 1,000.00 + 3,000.00	14.35 + 1,000.00 + 3,000.00	Day 10.50 (5.30 am – 6.30 pm) Peak 24.00 (6.30 pm – 10.30 pm) Off-peak 6.00 (10.30 pm – 5.30 am) + 1,000.00 + 3,000.00	Day 14.00 (5.30 am – 6.30 pm) Peak 23.00 (6.30 pm – 10.30 pm) Off-peak 9.00 (10.30 pm – 5.30 am) + 1,000.00 + 3,000.00
Street Lighting	at LKR 17.00 per Unit			

Note: 1. No Fuel adjustment charge is applicable for the above Tariff Structure.
2. Tariff for Religious & Charitable Institutions is not revised.

5.2 Petroleum Distribution and Prices

As described previously, Sri Lanka meets the country petroleum demand entirely by imported petroleum brought in as either crude oil or refined products. Since the processing capacity of the CPC-owned refinery is not sufficient to meet the country demand, considerable amounts of petroleum products have to be imported and directly sold in the local market.

5.2.1 Distribution Structure

Until 2002, CPC was responsible for all aspects of petroleum supply, with the exception of retail marketing of LPG. By 2002, CPC owned and operated the refinery, all the import, storage and distribution terminals, and about 350 filling stations. In addition, there were about 700 privately-owned filling stations.

The refinery located in Sapugaskanda consists of 50,000 barrels/day processing plant and a 540,000 tonne crude oil tank farm. The refinery gets crude oil either directly from the Single Point Buoy Mooring (SPBM) facility installed about 10 km offshore or from the four crude oil storage tanks of 40,000 tonnes (each), located in Orugodawatta. Part of the refinery output is stored at Sapugaskanda storage facility for distribution and the balance is pumped to the Kolonnawa storage facility. The Sapugaskanda tank farm (mini-distribution facility) receives products only from the refinery. This has a total storage capacity of 60,000 tonnes in twelve tanks for diesel, kerosene and fuel oil.

Refined products from the refinery as well as imported products are received via a 5.5 km long pipeline to tanks at Kolonnawa. This aging pipeline transport system will be improved through a new pipeline installation by 2018. The Kolonnawa installation has a total capacity of 250,000 tonnes in 40 tanks for finished products and product loading facilities for loading railway bogies, which transport products to most of the bulk depots and to road tankers. Construction of a new tank with a capacity of 15,000 m^3 to cater to the increased gasoline demand commenced in late 2017, adding more capacity to Kolonnawa facility. Aviation fuel to the Katunayake airport is supplied from the Kolonnawa terminal through rail and road tankers.

The Muthurajawela tank farm commenced operations in 2004. With the construction of this tank farm, Sri Lanka's storage capacity for finished petroleum products increased by 250,000 tonnes. Muthurajawela tank farm consists of 21 tanks of 10,000 m^3 capacity and 8 tanks of 5,000 m^3 capacity. These tanks store and distribute diesel and kerosene. Along with the tanks, CPC installed a new SPBM system, where 60,000 DWT (deadweight tonnage) ships could use the buoy for discharging imported finished products direct from sea to tanks via a submarine pipeline. This terminal includes a loading facility to distribute products by road tankers. However, rail transportation of petroleum products stored in the Muthurajawela tank farm is constrained due to the absence of a railway line. A dual pipeline transport systems named the 'cross country pipeline' with a length of 6.5 km is expected to link Muthurajawela tank farm with the Supugaskanda facility in the near future.

Petroleum supply for retail sale is done at the following storage/distribution facilities

1. Muthurajawela
2. Kolonnawa
3. Sapugaskanda mini distribution facility
4. China Bay storage facility
5. 13 regional depots.

Of the thirteen regional depots, Kurunagala depot added a new fire pump house and a distribution gantry to its assets in 2017, expanding its capabilities further.

Lanka Marine Services (LMS) located at Bloemandhal in Colombo receives imported products directly as well as from the Kolonnawa terminal via pipelines, and provides bunker fuel to ships via pipelines connected to Dolphin pier and also from South jetty. LMS terminal has a storage capacity of 23,000 tonnes of fuel oil and 6,800 tonnes of diesel.

Some amount of LPG is produced at the CPC refinery for local consumption. However, most of the country's LPG requirement is met through direct imports. LPG is imported through the Colombo Port, and also via a conventional buoy mooring system (CBM) for Litro Gas Lanka Limited facilities at Muthurajawela.

Residual oil (heavy furnace oil) is transferred directly from the refinery to the 160 MW Sapugaskanda power plant owned by the CEB and to the 51 MW residual oil power plant owned by Asia Power to produce electricity for the national grid. The refinery LPG production is delivered to the private distributor by means of road tankers and then filled into bottles for onward distribution to consumers.

As previously explained in this report, Sri Lanka meets all its petroleum demand by imported petroleum brought in as crude oil or refined products. Since the refining capacity of the CPC-owned refinery is not sufficient to meet the country demand, considerable amounts of petroleum products have to be imported and directly sold in the local market. Whether locally refined or directly imported, petroleum is channelled through the same distribution network which consists of several tank farms located in Kolonnawa, Sapugaskanda and Trincomalee and the local depots and the distribution stations (filling stations) spread all around the country.

5.2.2 Petroleum Prices

5.2.2.1 Prices of Crude Oil and Imported Finished Products

Crude oil imports decreased further in 2021 compared with 2020 as shown in Table 5.6.

Table 5.6 – Costs of Crude Oil Imports

Crude Oil Import Price Movements (F.O.B, Freight and C&F)	2010	2015	2018	2019	2020	2021
Quantity (kt)	1,819.43	1,676.76	1,763.00	1,842.74	1,667.00	1,130.00
Quantity (million bbl)	13.38	13.00	13.53	14.11	12.77	8.66
Crude Oil Import Unit Price (USD/bbl)						
F.O.B. Price	78.27	-	-	-	-	-
Freight Rate	0.97	-	-	-	-	-
C&F Price	79.24	105.38	75.69	68.80	45.66	62.06
Crude Oil Import Unit Price (LKR/bbl)						
F.O.B. Price	8,910.69	-	-	-	-	-
Freight	109.99	-	-	-	-	-
C & F Price	9,020.68	13,779.16	-	-	-	-

The import prices of finished petroleum products are shown in Table 5.7.

Table 5.7 – Finished Product Import Price Variation

Product Import Price Variation (F.O.B)	2010	2015	2018	2019	2020	2021
Mogas 92 Unl (USD/bbl)	86.23	71.147	81.56	73.93	50.91	80.05
Mogas 95 Unl (USD/bbl)	88.4	74.356	85.06	76.34	53.05	83.30
Naphtha (USD/bbl)	-	44.354	-	-	-	-
Kerosene (USD/bbl)	90.18	-	-	-	-	-
Gas Oil 0.05% S (USD/bbl)	90.35	68.491	87.68	80.64	50.49	76.86
Gas Oil 0.25% S (USD/bbl)	89.97	-	-	-	-	-
Gas Oil 0.5% S (USD/bbl)	89.55	68.269	-	-	-	-
Gas Oil 1.0% S (USD/bbl)	-	-	-	-	-	-
Gas Oil 0.001% S (USD/bbl)	-	-	88.72	82.85	56.06	78.37
FO 180Cst (USD/t)	470.28	-	-	-	-	-
FO 380Cst (USD/t)	462.59	-	-	-	-	-
LSFO (US$/t)	-	-	450.86	505.64	351.77	504.85
HSFO (US$/t)	-	-	491.89	483.86	408.41	509.56
LPG (USD/t)	714.46	-	-	-	-	-
Jet A-1 (USD/bbl)	-	69.66	87.13	80.29	63.12	83.45

5.2.2.2 Petroleum Product Prices in the Local Market

Table 5.8 summarises the price variations of locally sold petroleum products.

Month	Petrol (LKR/l)		Kerosene (LKR/l)		Diesel (LKR/l)		Furnace Oil (LKR/l)		LPG LKR/kg	
	90 Oct	95 Oct	Industrial	Domestic	Super	Auto	800 sec	1500 sec	Litro	Laugfs
2020-end Price	137.00	161.00	101.86	68.69	132.00	104.00	82.20	80.00	119.44	119.44
2021 prices										
June 11	157.00	184.00	110.00	77.00	144.00	111.00	92.00	96.00		
August 12										227.20
October 11									214.00	
December 21	177.00	207.00		87.00	159.00	121.00				
December 27							110.00	110.00		

Table 5.8 – Price Variation of Locally Sold Petroleum Products (Colombo Spot)

Figure 5.4 depicts the historical price changes of common petroleum products. The price indicated in the graph is the weighted average of monthly price revisions for a given year. The price of LPG is the average price of both Litro and LAUGFS.

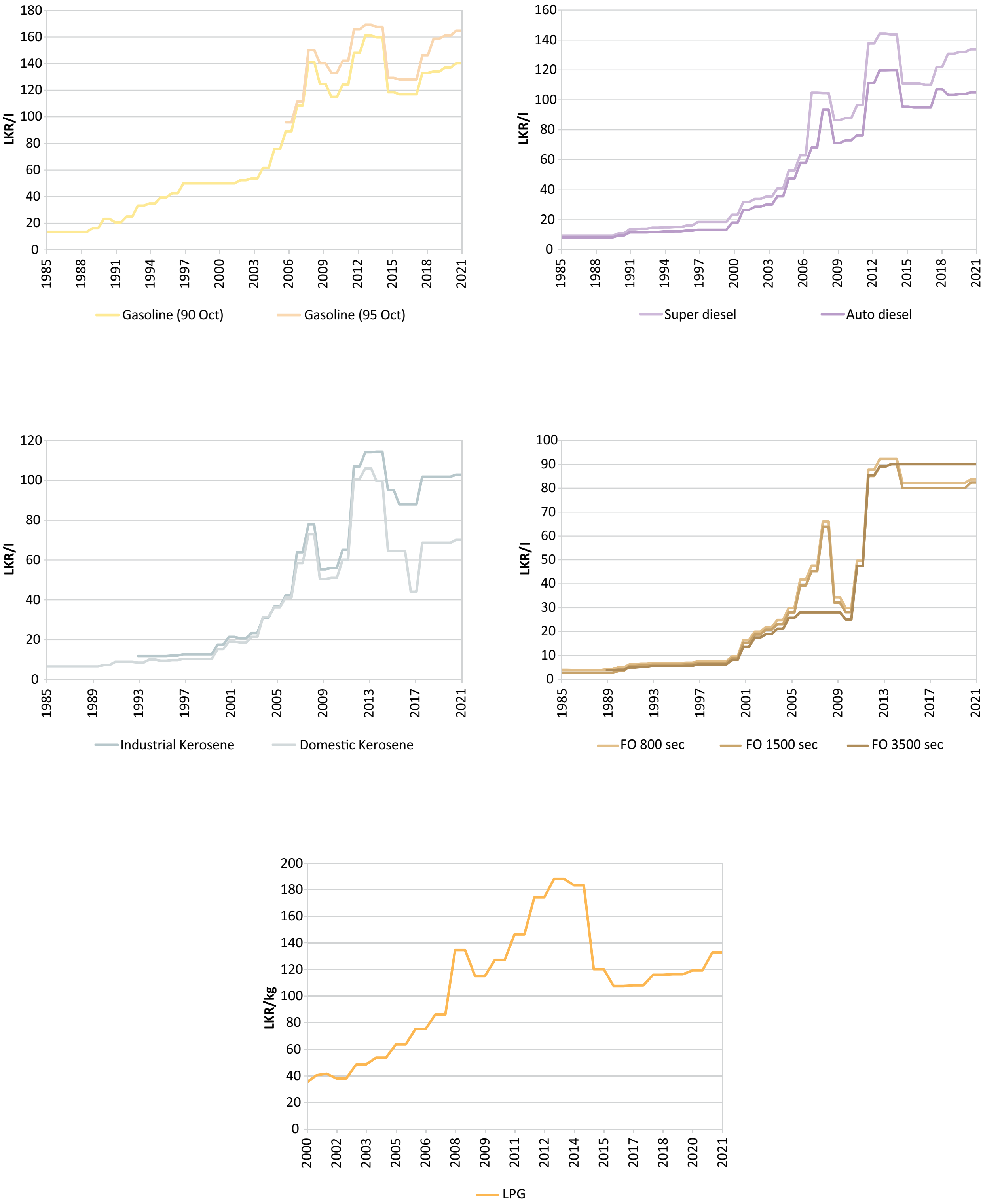


Figure 5.4 – Historical Price Variations of Petroleum Products

5.3 Coal Imports and Prices

The total quantities of coal imported are given in Table 5.9. Coal consumption has increased over time, with the commissioning of new coal power plants in 2014.

Table 5.9 – Coal Imports and Prices

	2015	2018	2019	2020	2021
Imported Qty (t)	1,881,462	2,165,987	2,388,617	2,543,582	2,204,413
Imported price (LKRM)	21,542	38,660	38,635	39,253	54,971
Price (LKR/kg)	11.45	17.85	16.17	15.43	24.94

5.4 Biomass Distribution and Prices

Biomass meets more than a third of the energy demand of the country. Abundant availability, especially in rural areas where the usage is most common, has simplified the distribution of biomass. The actual value of biomass is often misrepresented by its discounted price due to the simplified sourcing options. In terms of the cost of alternate fuels avoided, biomass has a significantly higher value to the economy.

With the increased household income levels, fuelwood used in cooking is reducing in volume. However, without a survey of the residential sector, the actual trends remain unreported. In contrast, with the advent of formal supply chains, biomass use in industrial thermal energy use is gaining rapid grounds, due to cost benefits. Table 5.10 gives the quantity of firewood produced and sold for industries.

Table 5.10 – Firewood Production and Sale for Industries

Firewood (m^3)	2010	2015	2018	2019	2020	2021
Quantity Produced	118,544	87,159	101,172	107,914	82,856	86,971
Quantity Sold	129,502	83,041	95,680	91,957	60,671	70,075

6 Energy Demand

Energy is a vital building block for economic growth, and energy demand provides vital signs for better management of an economy. Supply of energy discussed up to now is a direct consequence of the demand for energy, which is analysed in detail in this chapter. This chapter presents the analyses of energy demand from electricity, petroleum and biomass.

6.1 Electricity Demand

6.1.1 The System Demand

Electricity demand has two aspects. The first being the energy demand where the cumulative electrical energy requirement is met by the supply system. The peak demand is the other criterion to be fulfilled in meeting the national electricity demand. The generating system needs to be able to meet the peak demand of the national grid. Since the national demand profile has an evening peak, the capability of the supply system in meeting the demand during the evenings (*i.e.* peak period) is important. Figure 6.1 shows the hourly demand profiles of April 6, 2021, the day the system recorded the maximum peak. On 2021 December 3, a countrywide power failure occurred and the system was recovered subsequently.

In spite of being equipped with state of the art supervisory control and data acquisition (SCADA) systems, even the newly connected wind and solar power plants are not reporting real time data to the system control centre. Accordingly, the demand estimates are continued to be based on monthly energy data provided by the small power producers.

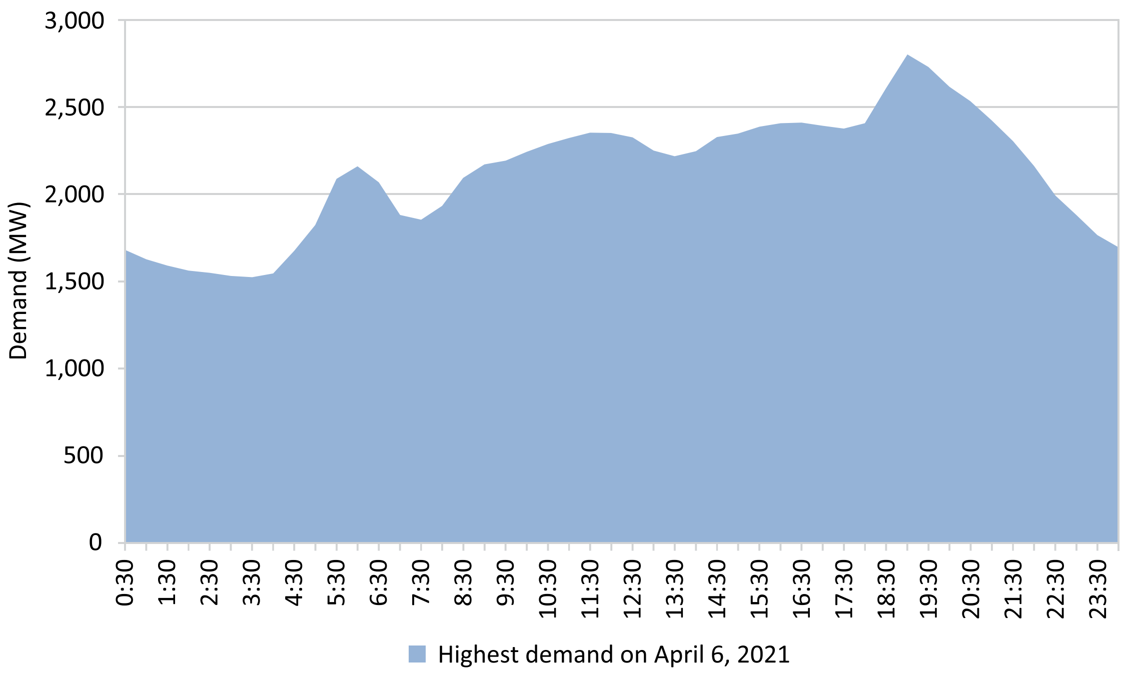


Figure 6.1 – System Demand Profile of 2021

Table 6.1 shows the development of the system peak demand over the years.

Table 6.1 - The Growth in System Capacity and Demand

System Parameters	2010	2015	2018	2019	2020	2021
Total Gross Generation (GWh)	10,800.7	13,226.6	16,216.6	16,855.6	16,703.6	17,748.6
Total Grid Connected Capacity (MW)	2,817.6	3,888.4	4,186.8	4,506.2	4,542.3	4,813.0
Maximum Demand (MW)	1,954.7	2,283.4	2,616.0	2,662.3	2,707.2	2,801.6
Reserve Capacity	862.9	1,605.0	1,570.8	1,843.9	1,835.1	2,011.4
System Load Factor	63.0%	66.0%	70.3%	72.2%	70.5%	72.3%
System Reserve Margin	44.1%	70.3%	60.0%	69.3%	67.8%	71.8%

System load factors in the range 60% - 70% are typical of a customer mix dominated by households with a high demand for electricity used for lighting in the evening. The peak demand in 2021 was 2,802 MW. The system reserve margin increased by 4.0% in 2021. Figure 6.2 depicts the development of the system load factor, reserve margin and peak demand from 1979 to presentt.

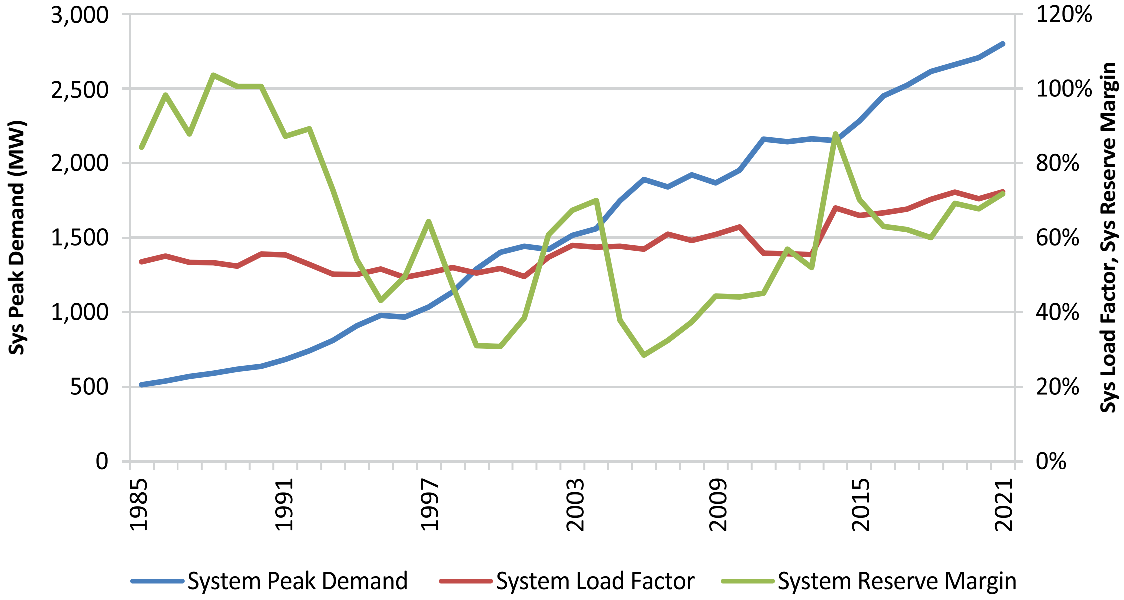


Figure 6.2 – Development of System Load Factor, Reserve Margin and Peak Demand

Figure 6.3 depicts the historic growth of the load curve.

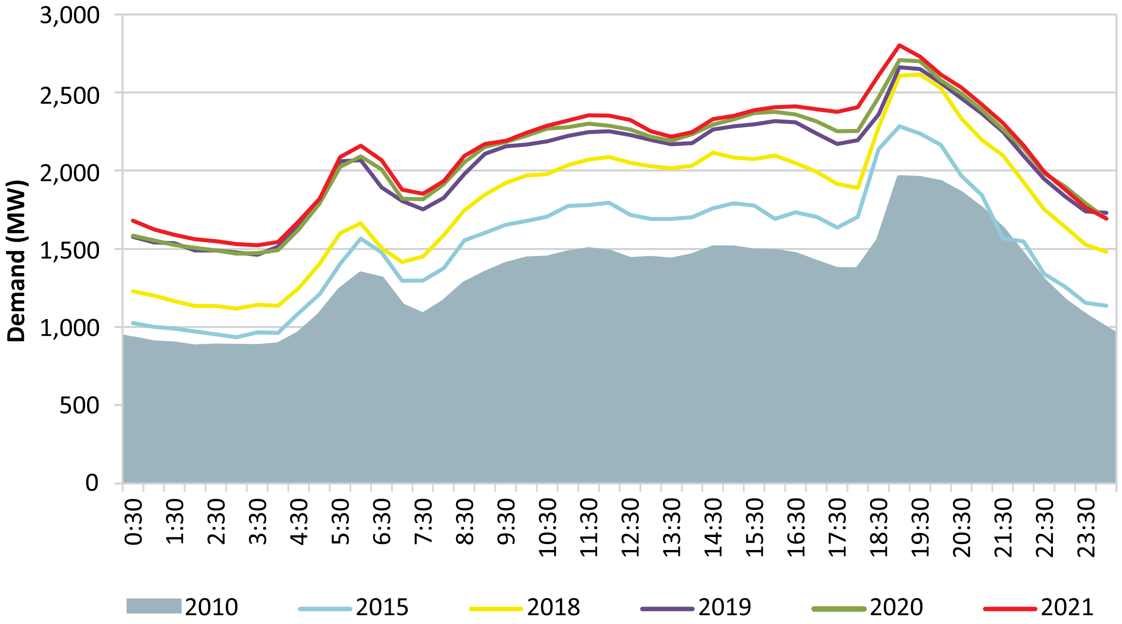


Figure 6.3 – The Growth in System Peak Demand

6.2 Petroleum Demand

6.2.1 Demand for Different Petroleum Products

The demand for different petroleum products varies primarily on their potential usage. For instance, auto diesel is widely used for transportation and power generation; in contrast to kerosene, which is used only for rural household energy needs, some industrial applications, agriculture and fisheries. Therefore, the demand for auto diesel is substantially higher than for kerosene. The refinery production process is adjusted to produce more of the high demand products while some products are directly imported to bridge the gap between refinery output and the demand.

The demand for LP gas and furnace oil increased in 2021, while the demand for all other products decreased. Table 6.2 summarises the demand for different petroleum products.

Table 6.2 – Demand for Different Petroleum Products

kt	2010	2015	2018	2019	2020	2021
LPG	187.5	293.4	435.0	430.0	437.0	422.00
Naphtha	54.1	97.2	69.4	124.6	-	10.63
Gasoline	616.5	1,009.0	1,358.7	1,421.5	1,250.6	1,353.60
Kerosene	165.1	130.2	209.5	206.1	176.7	188.22
Auto Diesel	1,696.8	1,996.0	1,766.3	1,979.9	1,576.8	1,875.00
Super Diesel	12.2	46.4	101.2	81.7	68.9	74.55
Furnace Oil	994.5	956.4	623.3	743.7	825.8	823.66
Total	**3,726.7**	**4,528.4**	**4,563.4**	**4,987.5**	**4,335.7**	**4,747.65**

Figure 6.4 depicts the evolution of the demand for different petroleum products through time. The demand for transport fuels like auto diesel, gasoline which was on the rise and power generation fuels like auto diesel and furnace oil which were increasing over time experienced a sudden decline due to the reduced economic activities and transport demand. The demand for LP gas has increased, owing probably due to the larger volume of food being cooked at home under the lockdown conditions. Although at least a marginal increase of kerosene demand was expected following the LP gas demand increase from the residential sector, the kerosene demand followed the trend of transport fuels under pandemic conditions.

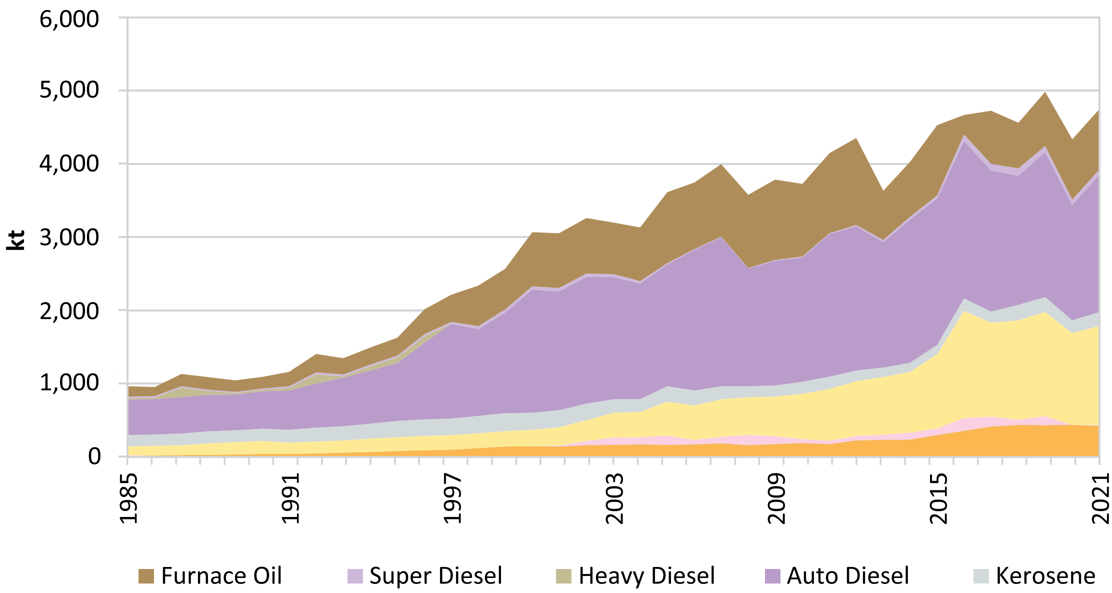


Figure 6.4 – Evolution in the Demand for Different Petroleum Products

6.2.2 Demand for Petroleum by District

Table 6.3 details the district-wise retail and consumer sales of petroleum products, of the CPC and LIOC in 2021. Figure 6.5 depicts the distribution of the petroleum demand by district in PJ.

Table 6.3 – Demand for Petroleum by District

District Sales (kl)	Petrol (90 Octane)	Auto diesel	Super diesel	Kerosene	Industrial kerosene	Petrol (95 Octane)	Fuel oil 1500 sec (HS)	Fuel oil 1500 sec (HS)	Fuel oil 1500 sec (Low)	Fuel oil 1500 sec (LS)	Fuel oil super	Chemical naphtha	LP gas	Avgas	Jet A1
Kandy	97,568	95,410	5,108	8,072	66	8,857.20	251	251	-	-	785	-	-	-	-
Matale	37,208	45,543	1,247	4,491	-	1,531.20	13	13	-	-	46	-	-	-	-
Nuwara Eliya	24,301	38,886	924	3,716	-	844.80	1,859	1,859	-	-	119	-	-	-	-
Batticaloa	31,089	36,755	660	8,401	-	792.00	-	-	-	-	-	-	-	-	-
Ampara	45,068	56,400	911	7,247	-	1,036.20	26	26	-	-	1,544	-	-	-	119
Trincomalee	31,958	56,506	607	12,491	-	429.00	264	264	-	-	1,307	-	-	270	449
Anuradhapura	74,705	101,904	2,191	7,762	20	2,976.60	13	13	-	-	-	-	-	-	581
Polonnaruwa	34,162	56,460	1,247	2,703	7	1,049.40	106	106	-	-	409	-	-	-	647
Jaffna	35,699	46,770	726	20,651	-	970.20	20,196	20,196	-	-	-	-	-	-	79
Mannar	7,448	12,665	284	8,039	-	145.20	-	-	-	-	-	-	-	-	-
Mulalativu	8,639	12,718	26	5,650	-	99.00	-	-	-	-	-	-	-	-	-
Vavuniya	14,428	41,606	554	4,115	-	359.33	-	-	-	-	-	-	-	-	13
Killinochchi	9,372	19,157	350	6,947	-	343.20	-	-	-	-	442	-	-	-	-
Kurunegala	144,441	187,001	5,894	11,296	7	7,887.00	1,300	1300	-	-	5,320	-	-	-	-
Puttalam	65,172	89,042	3,584	24,737	20	3,907.20	-	-	-	-	2,231	-	-	-	-
Ratnapura	69,452	84,619	2,858	6,329	1,663	3,742.20	-	-	-	-	92	-	-	-	-
Kegalle	53,576	52,160	1,894	5,141	86	3,075.60	-	-	-	-	1,360	-	-	-	-
Galle	77,948	80,125	2,977	10,115	172	5,425.20	-	-	-	-	1,716	-	-	-	13
Matara	50,528	77,125	1,973	7,993	-	2,831.40	-	-	-	-	211	-	-	-	-
Hambantota	46,784	76,386	1,934	7,085	-	1,735.80	-	-	-	-	-	-	-	-	53
Badulla	44,732	67,314	1,610	2,983	-	2,257.20	-	-	-	-	13	-	-	-	-
Moneragala	33,132	55,403	1,115	4,102	-	1,069.20	-	-	-	308	1,360	-	-	-	-
Colombo	279,005	424,725	28,321	18,823	-	65,854.80	-	-	108	30	72,796	15,407	16,707,115	308	177,325
Gampaha	230,503	305,437	16,355	24,671	-	27,786.00	-	-	-	134	124,361	-	-	30	103,430
Kalutara	96,030	100,802	5,016	12,345	-	8,877.00	-	-	-	-	1,102	-	-	134	1
Total	**1,642,947**	**2,220,917**	**88,368**	**235,903**	**2,039**	**153,881.93**	**24,029**	**24,029**	**108**	**472**	**215,214**	**15,407**	**16,707,115**	**742**	**282,709**

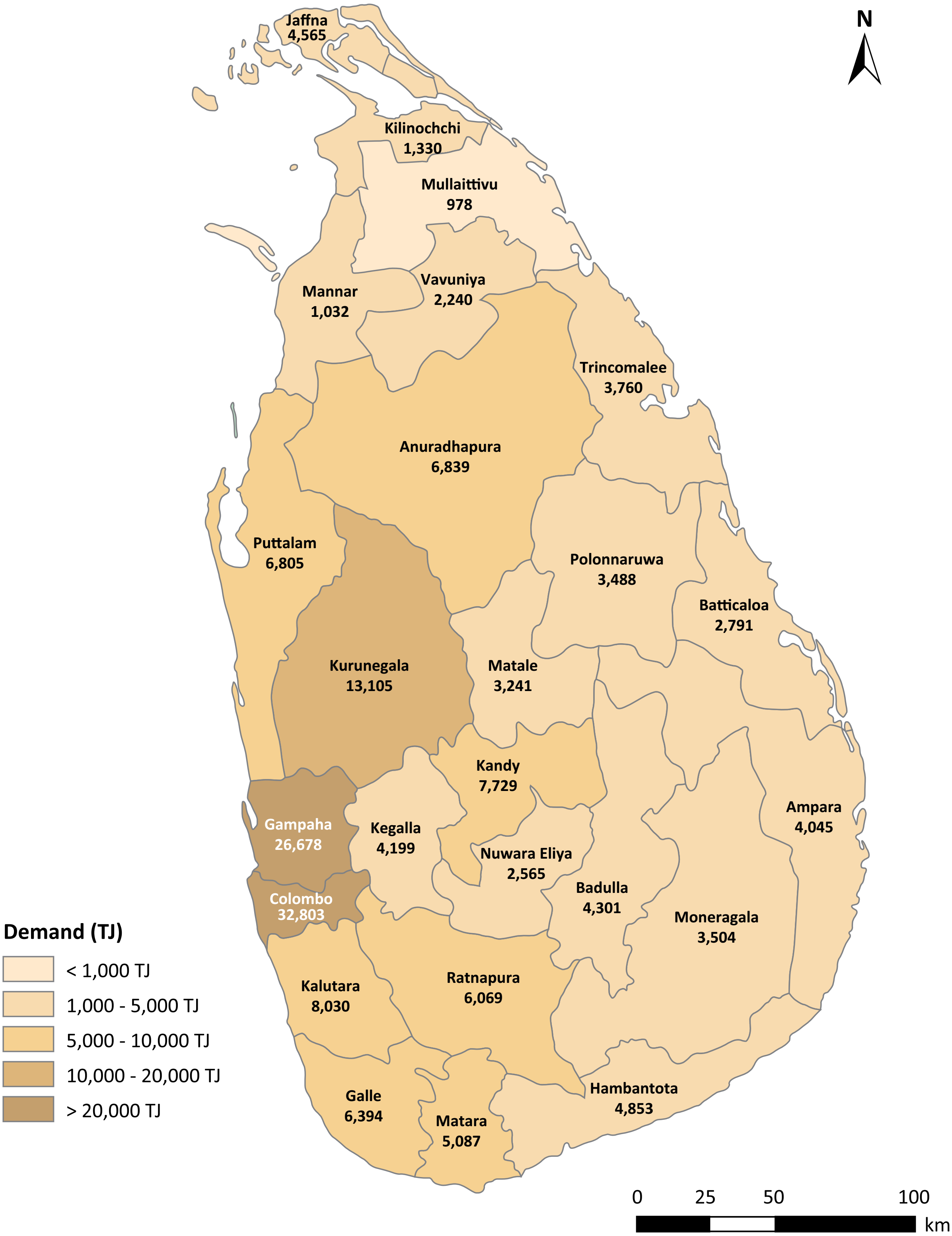


Figure 6.5 – Districtwise Demand for Petroleum (TJ) - 2021

The highest demand for petroleum fuels in 2021 was in the Colombo district, whereas the least demand was from the Mullaitivu district.

6.3 Coal

Coal is an energy resource used in industries and power generation. With the commissioning of two new coal power plants in 2014, the demand for coal was on the rise (Table 6.4).

Table 6.4 – Demand for Coal

Coal Consumption (kt)	2010	2015	2018	2019	2020	2021
Industries	86.6	86.6	75.0	87.6	79.3	80.1
Power Generation	1,880.0	1,880.0	2,009.1	2,208.9	2,349.3	2,301.3
Total Consumption	1,966.6	1,966.6	2,084.1	2,296.5	2,428.7	2,381.4
%						
Industries	4.4	4.4	3.6	3.8	3.3	3.4
Power Generation	95.6	95.6	96.4	96.2	96.7	96.6

6.4 Biomass

As the most significant primary energy supply source in the country, biomass has a widespread demand for both commercial and non-commercial applications. However, the informal nature of supply, mainly through users' own supply chains, has prevented accurate and comprehensive usage data being compiled for biomass. Therefore, estimation methods are used to develop reasonable information based on available data. Mid-year population data and LPG consumption are used to estimate household firewood consumption. Meanwhile, industrial biomass consumption is estimated based on the industrial production data and surveys. Most of the information on biomass presented in this report is based on estimates and sample surveys. The sample survey carried out in 2019 on the energy aspects of households will shed more light into the biomass energy supply and demand in the country. Table 6.5 summarises the total usage of sources biomass.

Table 6.5 – Demand for Biomass

kt	2010	2015	2018	2019	2020	2021
Firewood	3,788.5	4,532.7	4,895.8	5,012.0	5,191.2	5,343.0
Bagasse	137.8	196.4	203.0	199.5	200.1	141.5

Bagasse is the waste form of sugar cane, which is used in sugar factories for combined heat and power generation. By 2021, the bagasse production was 262.9 kt, generated from the Pelawatta and Sevanagala sugar factories. Charcoal is produced mainly from coconut shell and wood. A major portion of the production of coconut shell charcoal is exported as a non-energy product.

6.5 Sectoral Demand

6.5.1 Electricity Demand by Different End Use Categories

Based on the usage type, electricity consumers are separated into the following categories.

- Domestic
- Religious purpose
- Industrial
- Commercial
- Street Lighting

Amounts of electricity used by different customer categories are given in Table 6.6, which also includes off-grid electricity generation using conventional and non-conventional sources. Although the electrical energy demand of different end users is established using electricity sales data, individual power demand of different categories cannot be established due to the lack of a monitoring system or regular load research. Nevertheless, by analysing the typical load profiles of different user categories, it is visible that the domestic category is most influential in the morning and evening peaks and the consequent low load factor of the system.

Table 6.6 – Electricity Sales by End Use Category

GWh	2010	2015	2018	2019	2020	2021
Domestic	3,651.4	4,444.7	5,230.9	5,546.8	5,977.3	6,182.10
Religious	55.0	76.4	93.9	100.2	94.9	93.86
Industrial	3,148.1	3,880.1	4,597.9	4,716.2	4,485.1	5,153.23
Commercial	2,224.0	3,178.9	4,066.4	4,323.3	3,967.0	4,079.43
Streetlighting	130.0	160.7	130.6	131.4	131.2	120.20
Total	**9,208.5**	**11,740.9**	**14,119.6**	**14,818.0**	**14,655.5**	**15,628.81**
%						
Domestic	39.7	37.9	37.0	37.4	40.8	39.6
Religious	0.6	0.7	0.7	0.7	0.6	0.6
Industrial	34.2	33.0	32.6	31.8	30.6	33.0
Commercial	24.2	27.1	28.8	29.2	27.1	26.1
Streetlighting	1.4	1.4	0.9	0.9	0.9	0.8

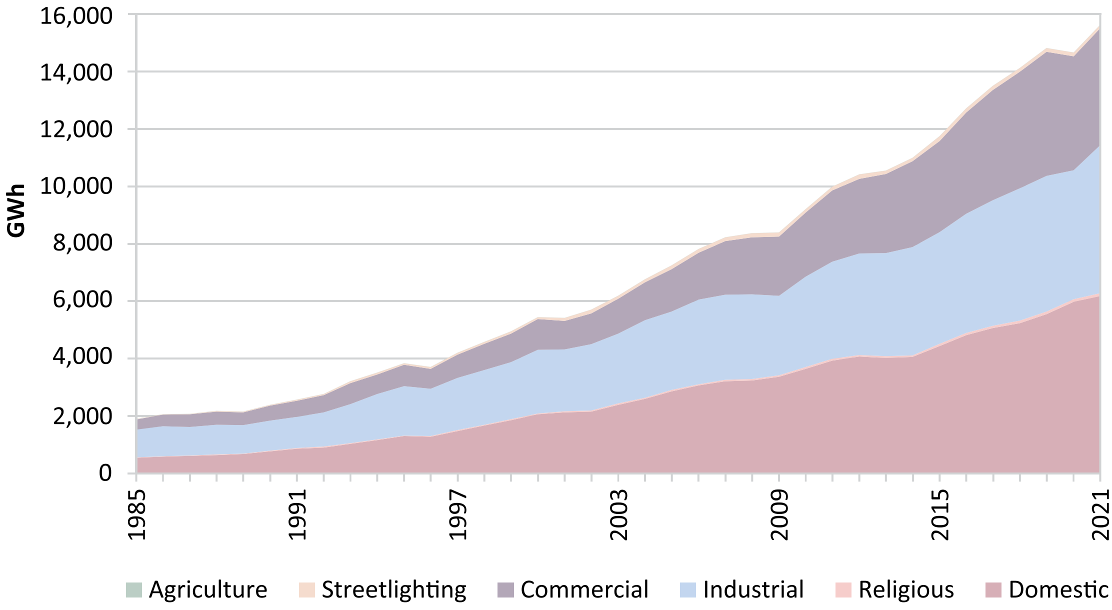


Figure 6.6 - Electricity Sales by Consumer Category

Table 6.6 indicates that the sales to the domestic and commercial customers have increased marginally, while the sales to the industrial customers have decreased, as expected under the pandemic conditions.

6.5.2 Petroleum Demand in Different Sectors

Petroleum has a wide range of applications as a convenient energy source. Transport, power generation, industrial thermal applications, domestic lighting and cooking are the most common uses of petroleum in Sri Lanka. In addition, due to the strategically important geographic location of Sri Lanka in terms of maritime and aviation movements, foreign bunkering and aviation fuel sales also create a demand for petroleum in the country. Petroleum demand to meet the non-domestic needs such as bunkering and aviation fuel is discussed separately in this report.

6.5.2.1 Transport Sector

Transport is the most important sector as far as petroleum is concerned. The majority of vehicles in Sri Lanka are powered by either diesel or gasoline. Both, road and rail transport are entirely fuelled by liquid petroleum fuels. In the distant past, rail transport was fuelled by coal, and today, only a single coal powered rail is operated as a tourist attraction. The Internal Combustion (IC) engines in all these vehicles intrinsically introduce considerable energy wastage in terms of conversion efficiency from petroleum energy to motive power. Use of electricity to at least energise the train transportation can be an efficient and economical alternative to burning petroleum fuels in the transport sector. Table 6.7 summarises the demand for fuels in the transport sector.

Table 6.7 – Transport Fuel Demand by Type

kt	2010	2015	2018	2019	2020	2021
Gasoline	616.5	1,009.0	1,358.7	1,421.5	1,250.6	1,353.6
Auto Diesel	1,433.8	1,815.1	1,568.4	1,606.5	1,388.5	1,658.4
Super Diesel	11.5	46.1	101.1	81.6	67.8	74.6

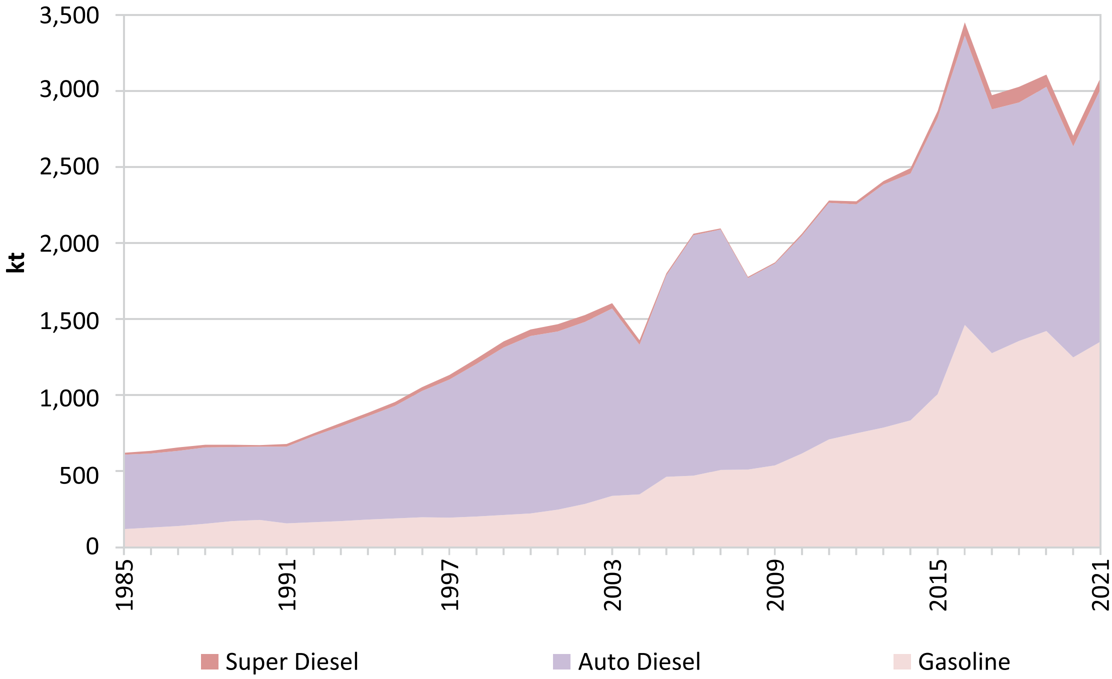


Figure 6.7 – Transport Demand by Fuel Type

Table 6.8 summarises the auto diesel demand in road transport and rail transport.

Table 6.8 – Auto Diesel Demand in Road and Rail Transport

kt	2010	2015	2018	2019	2020	2021
Road Transport	1,419.7	1,815.1	1,636.7	1,653.8	1,430.5	1,713.7
Rail Transport	26.2	38.4	32.8	34.2	25.8	19.3
Total	**1,445.9**	**1,853.5**	**1,669.5**	**1,688.1**	**1,456.3**	**1,733.0**
%						
Road Transport	98.2	97.9	98.0	98.0	98.2	98.9
Rail Transport	1.8	2.1	2.0	2.0	1.8	1.1

Only a marginal share of 1.1% of the total transport diesel demand is consumed by rail transport. The transport fuel mix is dominated by auto diesel. The demand for transport fuels has increased in 2021 compared with 2020. These reductions can be attributed to the travel restrictions which prevailed under the COVID-19 lockdowns.

Figure 6.8 gives a snapshot of the cumulative vehicle fleet. Motor cycles and three wheelers account for the highest number of registrations each year. The registration of motor cars too show an increasing trend.

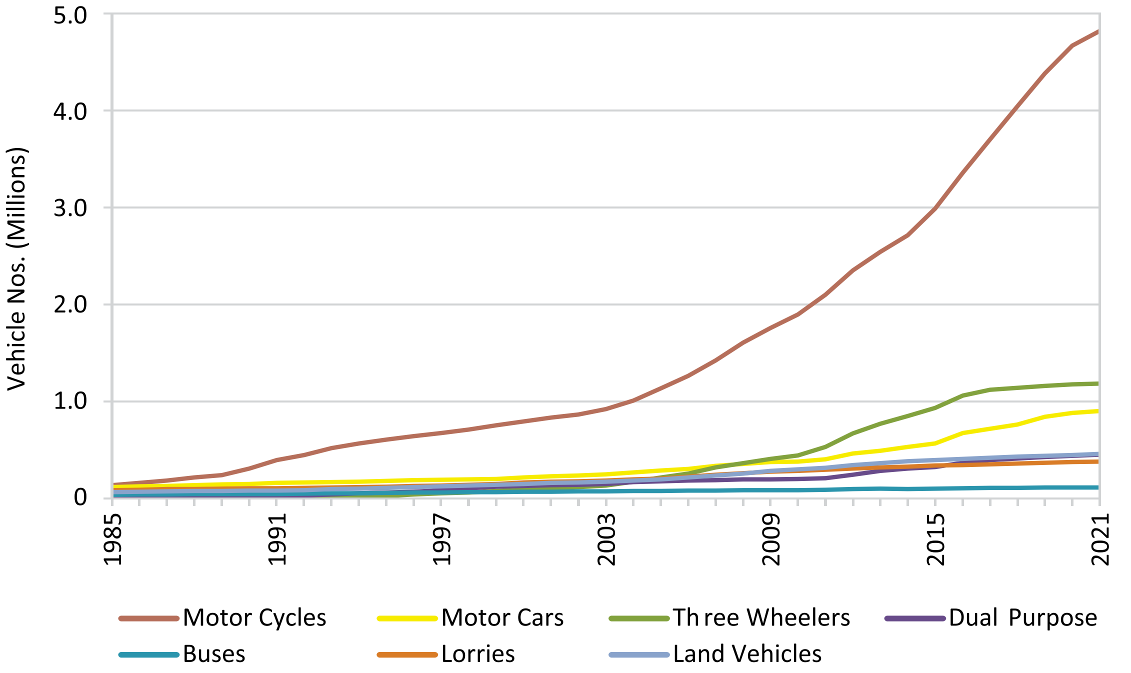


Figure 6.8 – Growth Pattern of Road Vehicle Fleet

The active vehicle fleet is reported from the Air Resource Management Centre (AirMAC) of the Ministry of Environment and Renewable Energy, using information from the Vehicle Emission Test (VET) programme (Figure 6.9).

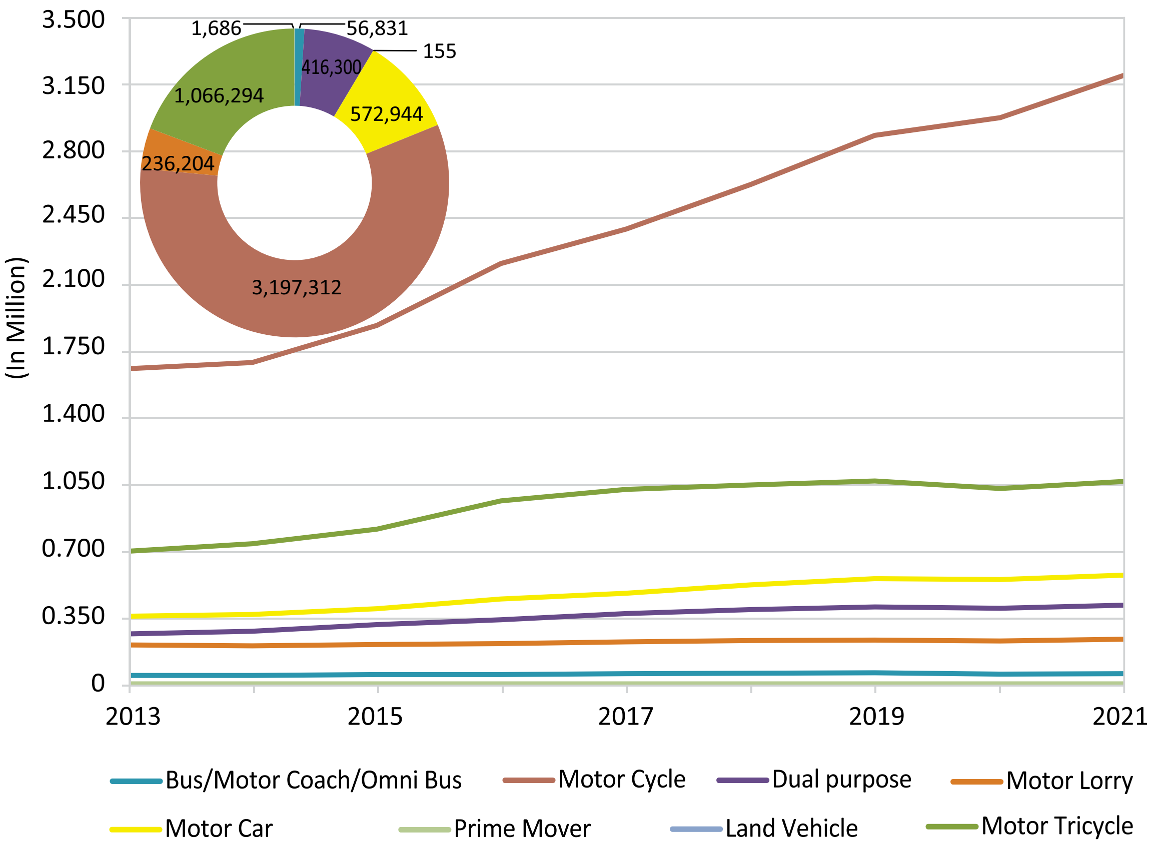


Figure 6.9 – Active Vehicle Fleet

Sri Lanka's active fleet in 2021 was 5,547,726 vehicles. It is characterised by an increased population of motor cycles (58%) and motor tricycles (19%). The share of public transport is very low (1%). Undoubtedly, this is a clear sign of worsening public transport services in the country, which must be arrested early, to avoid a severe transport crisis in the medium term.

6.5.2.2 Petroleum Usage in Other Sectors

Transport and power sector are the largest petroleum consuming sectors. Fuel consumption of the power sector by type, technologies and quantities has been detailed in Chapter 4, under energy conversions in thermal power plants.

Domestic sector petroleum consumption is limited to kerosene and LPG. However, with the increased use of LPG, especially in urban households for cooking purposes, the demand for petroleum by the domestic sector has also become significant. Industrial sector petroleum usage is mostly for thermal applications where diesel and fuel oil is used to fire industrial steam boilers and air heaters. LPG usage is also increasing in industrial thermal applications where the quality and control of heat generation is important for the industry operation. LPG fired kilns in the ceramic industry is one such example. The commercial sector including the service sector organisations such as hotels also contribute to the national petroleum demand, but to a lesser degree than the above-mentioned high-volume petroleum consumers.

Table 6.9 details LPG demand by sector. Although total LPG demand has increased over the years, in 2021, the demand has decreased. Sector wise, the demand in the household, commercial and other sectors has decreased, while it had marginally increased in the industries sector in 2021.

Table 6.9 – Demand for LPG by Sector

kt	2010	2015	2018	2019	2020	2021
Household, Commercial and Other	159.8	234.5	366.9	378.8	413.0	394.6
Industries	24.8	57.6	76.6	86.5	59.7	62.4
Transport	0.1	1.2	0.2	0.3	0.1	0.1
Total	**184.8**	**293.4**	**443.7**	**465.6**	**472.8**	**457.0**

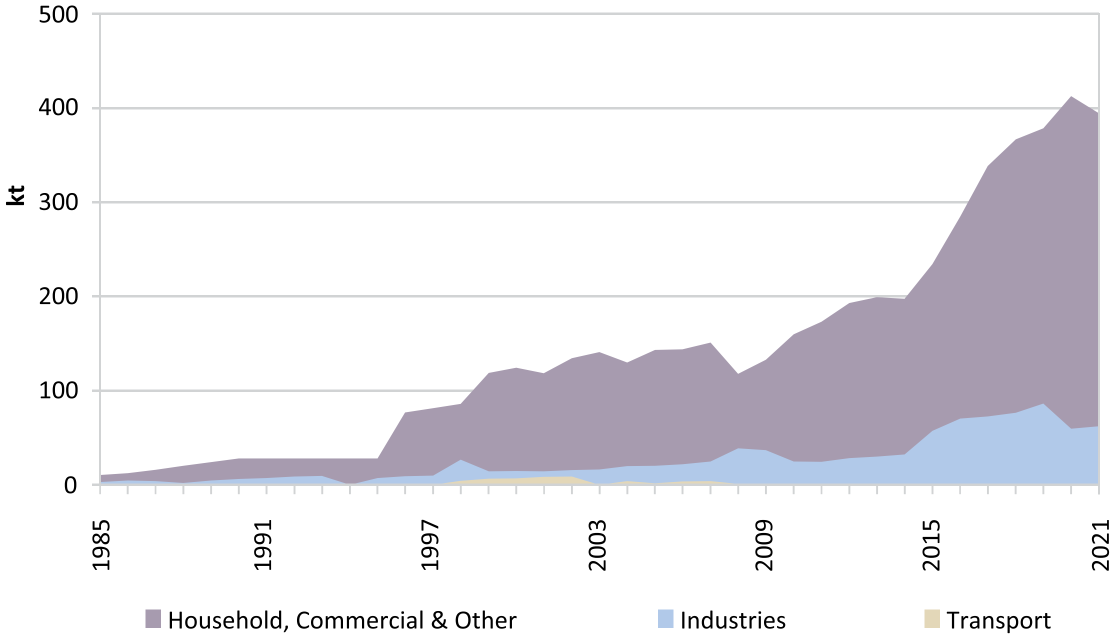


Figure 6.10 - LPG Demand by Sector

The domestic demand for LPG is increasing rapidly. This is often attributed to the improved per capita income levels. If the prices of LPG remain at low levels, many high temperature industries might switch back to LPG, to better control their processes.

Agriculture based petroleum demand in Sri Lanka is reported as considerably low, despite the fact that it is broadly an agricultural economy. This is also attributed to the difficulty in separating fuel dispersed for agricultural purposes and transport, as they are done through the same fuel station. Estate sector is one division which shows a fair usage of petroleum for drying purposes, but its energy consumption is accounted under industrial usage.

Kerosene used in fisheries is another substantial consumer category with regard to petroleum demand. Engine powered boats commonly used in the fishing industry are fuelled by either diesel or kerosene. It is therefore, important to understand that kerosene, which is a subsidised petroleum product in Sri Lanka, is not entirely used by the poorest segment of the society as envisaged in petroleum pricing policies. Table 6.10 summarises the kerosene consumption.

Table 6.10 – Demand for Kerosene by Sector

kt	2010	2015	2018	2019	2020	2021
Industrial	20.2	8.0	5.9	3.7	3.5	2.9
Household, Commercial and Other	-	122.2	203.6	202.4	173.2	102.1

Figure 6.11 indicates that the household kerosene consumption generally follows a declining trend, mainly owing to the deeper penetration of the national grid. Kerosene in the domestic sector is mainly used as a lighting fuel. Although a marginal increase in the residential use could have resulted from a population under a lockdown, the kerosene demand followed a sharp decline resembling the industry or the transport demand trend.

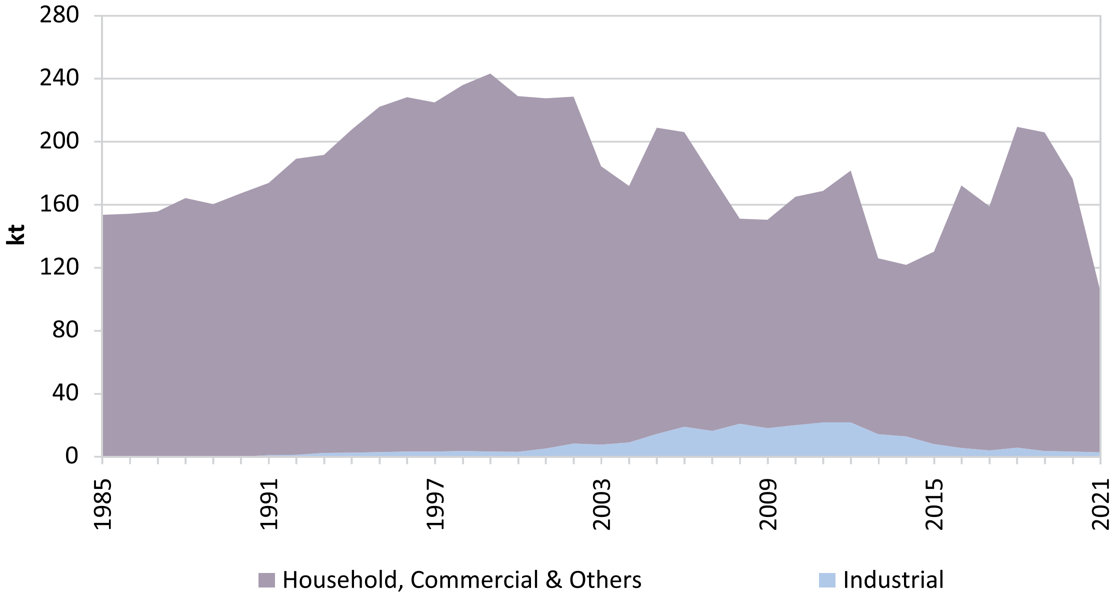


Figure 6.11 – Demand for Kerosene by Sector

In the early stages, the demand for kerosene has been only in the household and commercial sector. However, since the 2000s, the demand for kerosene in the industrial sector has gradually increased, but is in a decreasing trend at present.

6.5.2.3 Bunkering and Aviation Sales

Table 6.11 – Bunkering and Aviation Sales

kt	2010	2015	2018	2019	2020	2021
Domestic Bunkers						
Furnace Oil	22.1	40.1	67.0	61.2	38.8	52.4
Marine Lubricants	0.2	0.1	-	-	-	-
Sub total	28.5	40.2	67.0	61.2	38.8	52.4
Foreign Bunkers						
Marine Gas Oil	55.3	46.7	47.2	78.5	75.7	63.5
Furnace Oil	199.0	360.6	603.3	551.1	349.0	471.4
Marine Lubricants	1.8	0.9	-	-	-	-
Sub total	**256.1**	**408.1**	**650.5**	**629.6**	**424.7**	**534.9**
Domestic Aviation						
Jet A1	169.5	2.4	9.3	5.4	4.3	26.1
Avgas	0.2	0.1	-	0.2	0.2	0.1
Sub total	**169.7**	**2.6**	**9.3**	**5.6**	**4.4**	**26.2**
Foreign Aviation						
Avtur	111.0	370.5	501.4	473.4	186.7	222.4
Naphtha	26.7	-	-	-	-	-
Sub total	**137.7**	**370.5**	**501.4**	**473.4**	**186.7**	**222.4**

6.5.3 Coal Demand in Different Sectors

In the past, the total demand for coal had been in the transport sector or industries. But with the commissioning of coal power plants, there has been an increased demand for coal in power generation. In 2021, the demand for coal in power generation alone was 97%.

The total coal demand is given in Table 6.12.

Table 6.12 – Demand for Coal by Sector

kt	2010	2015	2018	2019	2020	2021
Industries	95.13	86.58	75.00	87.61	79.34	80.12
Power Generation	-	1,880.01	2,009.06	2,208.87	2,349.34	2,301.32
Total Consumption	**95.13**	**1,966.59**	**2,084.06**	**2,296.48**	**2,428.68**	**2,381.44**
%						
Industries	100.0	4.4	3.6	3.8	3.3	3.4
Power Generation	-	95.6	96.4	96.2	96.7	96.6

6.5.3.1 Coal Demand in Industries

The coal demand in industries declined marginally as given in Table 6.13.

Table 6.13 – Coal Demand in Industries

kt	2010	2015	2018	2019	2020	2021
Industries	95.1	86.6	75.0	87.6	79.3	80.1

6.5.3.2 Coal Demand in Power Generation

The demand for coal in the power generation in 2021 was 2,301.3 thousand tonnes.

6.5.4 Biomass Demand in Different Sectors

6.5.4.1 Biomass Demand in Industries

The demand bagasse has increased, whereas the demand for firewood has remained more or less the same.

Table 6.14 – Biomass Demand in Industries

kt	2010	2015	2018	2019	2020	2021
Firewood	3,788.5	4,532.7	4,895.8	5,012.0	5,191.2	5,343.0
Bagasse	137.8	196.4	203.0	199.5	200.1	141.5

6.5.4.2 Biomass Demand in Household, Commercial and Other Sector

Firewood is a main source of cooking fuel in many parts of the country. Table 6.14 gives the total firewood requirement in the household and commercial sector. Energy demand data from the residential and commercial sector were hitherto estimated using formulae derived a long time ago, which reflected the socioeconomic context of that era. With improved living standards and higher household income levels, however, these parameters have undergone a considerable change. In 2019, the SEA, in association with the Department of Census and Statistics conducted a survey on residential energy use involving a representative sample of more than 6,000 households. Using the preliminary results of this survey, the biomass usage estimates were calculated for the year 2019, and was found to be substantially lower than the previously estimated value. Using a reducing weighting factor, the past data on biomass demand from the year 2000 were recalculated and the respective data series was updated.

The total bagasse generated by the sugar plants was 141.5 kt in 2021, which was used in a captive generation plant for industrial purposes, amounting to a capacity of 3.8 MW generating 14,231.6 MWh.

Table 6.15 – Demand for Firewood in Household, Commercial and Other Sector

kt	2010	2015	2018	2019	2020	2021
Firewood	7,349.4	6,130.1	5,143.1	5,198.2	5,239.2	5,187.6

6.6 Total Energy Demand

Table 6.16 summarises the total energy demand by source.

Table 6.16 – Total Energy Demand by Energy Source

PJ	2010	2015	2018	2019	2020	2021
Biomass	179.6	173.0	163.1	165.8	169.3	169.9
Petroleum	126.0	158.1	170.0	174.3	154.8	177.9
Coal	2.5	2.3	2.0	2.3	2.1	2.1
Electricity	33.2	42.3	50.8	53.2	52.0	55.6
Total	**368.1**	**375.6**	**385.9**	**395.6**	**378.2**	**405.5**
%						
Biomass	48.8	46.0	42.3	41.9	44.8	41.9
Petroleum	34.2	42.1	44.1	44.1	40.9	43.9
Coal	0.7	0.6	0.5	0.6	0.6	0.5
Electricity	9.0	11.3	13.2	13.4	13.8	13.7

The petroleum demand figures presented are only in terms of final energy use and this does not include the fuels consumed in electricity generation. The share of biomass consumption in the total energy demand had decreased upto 41.9% in 2021, whereas the share of petroleum had increased to 43.9% in 2021.

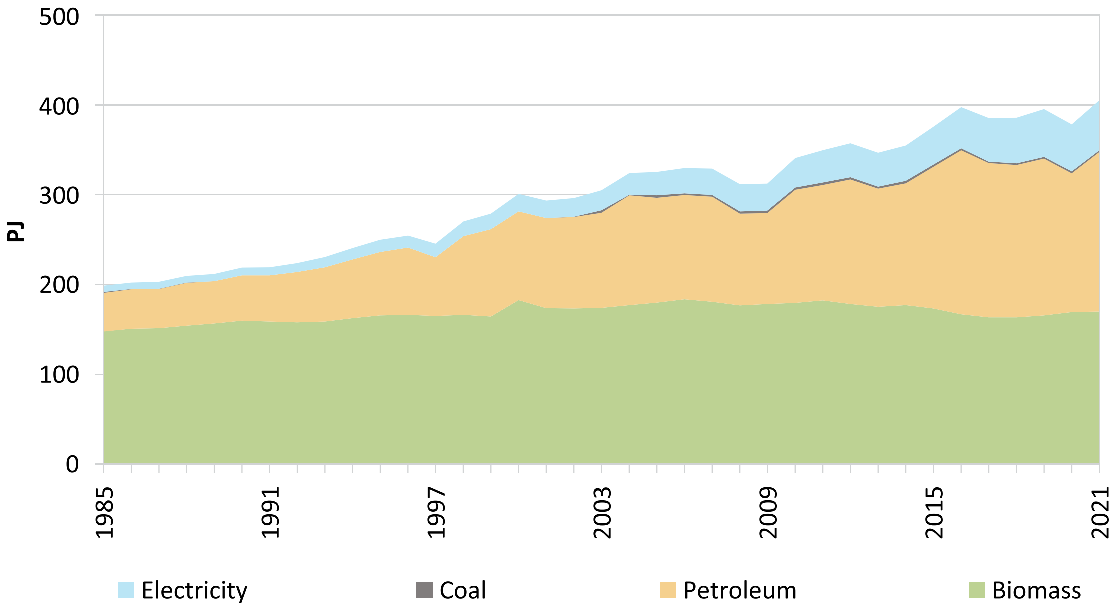


Figure 6.12 – Total Energy Demand by Energy Source

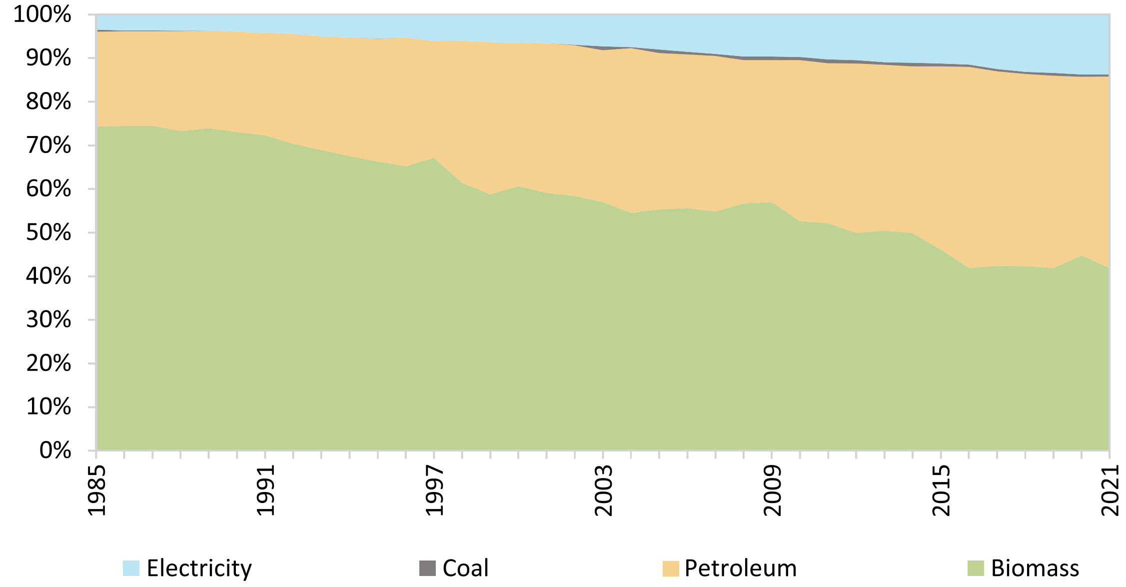


Figure 6.13 – Evolution of Energy Demand by Energy Source

As can be expected from any growing economy, the share of biomass in the energy demand portfolio was on a generally decreasing trend, while the share of electricity was on an increasing trend. Under the COVID-19 pandemic conditions in the country, these trends reversed in 2020. However it is expected that the long term trends will resume after the post pandemic recovery.

6.6.1 Total Industrial Energy Demand

Table 6.17 – Total Energy Demand of Industries by Energy Source

PJ	2010	2015	2018	2019	2020	2021
Biomass	62.7	75.5	81.3	83.1	85.9	87.4
Petroleum	10.2	14.6	9.0	9.3	7.6	13.2
Coal	2.5	2.3	2.0	2.3	2.1	2.1
Electricity	11.3	14.0	16.6	17.0	16.1	18.6
Total	**86.8**	**106.3**	**108.8**	**111.7**	**111.8**	**121.2**
%						
Biomass	72.3	71.0	74.7	74.4	76.9	72.1
Petroleum	11.8	13.7	8.2	8.3	6.8	10.9
Coal	2.9	2.1	1.8	2.1	1.9	1.7
Electricity	13.1	13.1	15.2	15.2	14.4	15.3

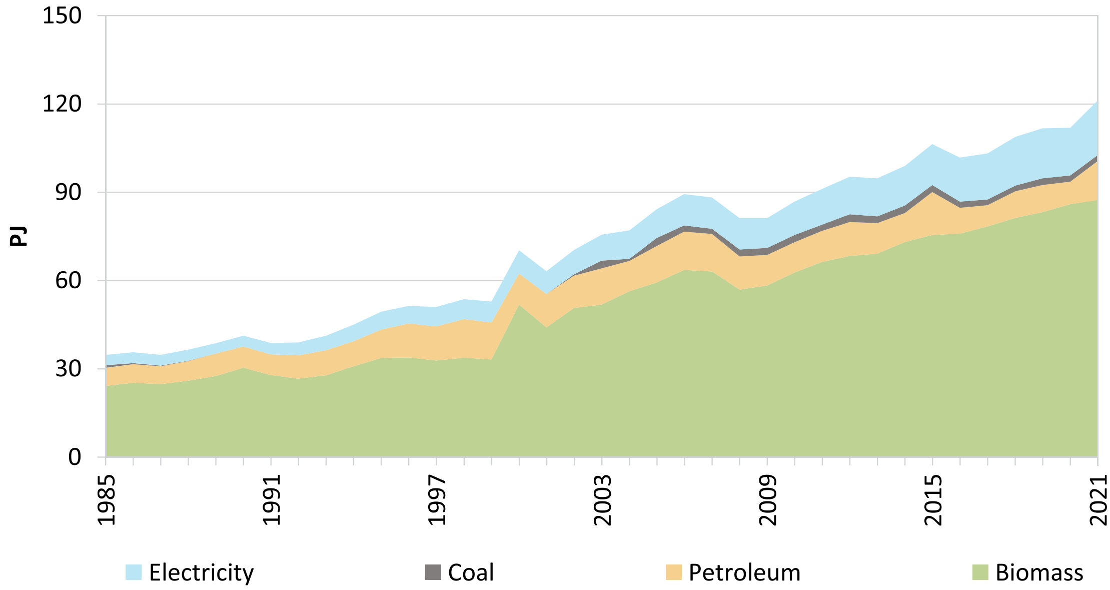


Figure 6.14 – Total Energy Demand of Industries by Energy Source

6.6.2 Total Transport Energy Demand

The transport demand declined sharply in 2020, owing to the mobility-restrictions imposed with the COVID-19 pandemic, but bounced back to the former levels in 2021.

The feasibility study of the Colombo Suburban Railway Project, to modernise and electrify the suburban railway network serving Colombo- Polgahawela, Colombo-Kalutara, Colombo- Avissawella and Colombo-Airport-Negombo, was completed. The project awaits funding for its implementation.

Electricity used in transport is not reported, and a survey of the available fleet is necessary to estimate the usage levels.

Table 6.18 – Total Transport Energy Demand by Energy Source

PJ	2010	2015	2018	2019	2020	2021
Petroleum	100.4	127.7	135.8	139.3	121.3	139.1

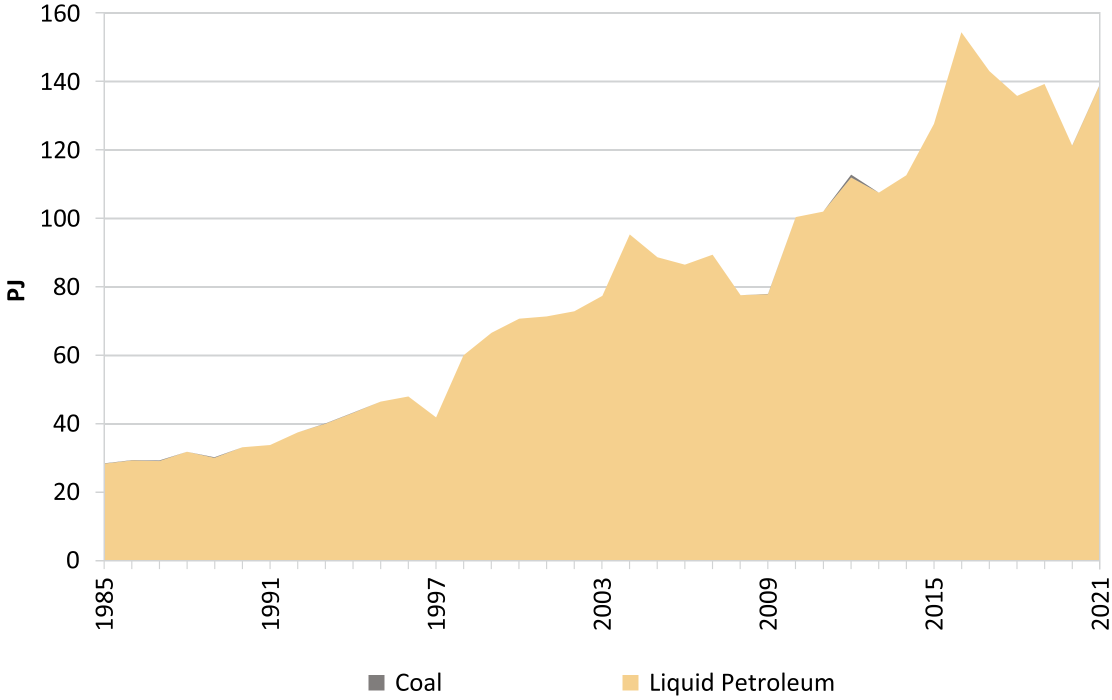


Figure 6.15 – Total Energy Demand of Transport by Energy Source

6.6.3 Total Energy Demand in Household, Commercial and Other Sectors

Table 6.19 – Total Energy Demand in Household, Commercial and Other Sectors by Energy Source

PJ	2010	2015	2018	2019	2020	2021
Biomass	143.8	97.5	81.8	82.7	83.4	82.5
Petroleum	14.9	15.8	25.2	25.7	25.9	22.0
Electricity	21.8	28.3	34.3	36.2	36.6	37.7
Total	**180.6**	**141.6**	**141.3**	**144.6**	**145.9**	**142.3**
%						
Biomass	79.6	68.9	57.9	57.2	57.1	58.0
Petroleum	8.3	11.1	17.9	17.8	17.8	15.5
Electricity	12.1	20.0	24.3	25.0	25.1	26.5

Biomass accounts for approximately 58.0% of the total household, commercial and other sector's energy demand. The share of biomass and petroleum indicate a marginal decrease, whereas electricity has shown a marginal increase. The share of electricity also shows an increase. The expansion of the electricity share could be attributed to the growth of households served by the grid and the tariff which remained unchanged since 2014.

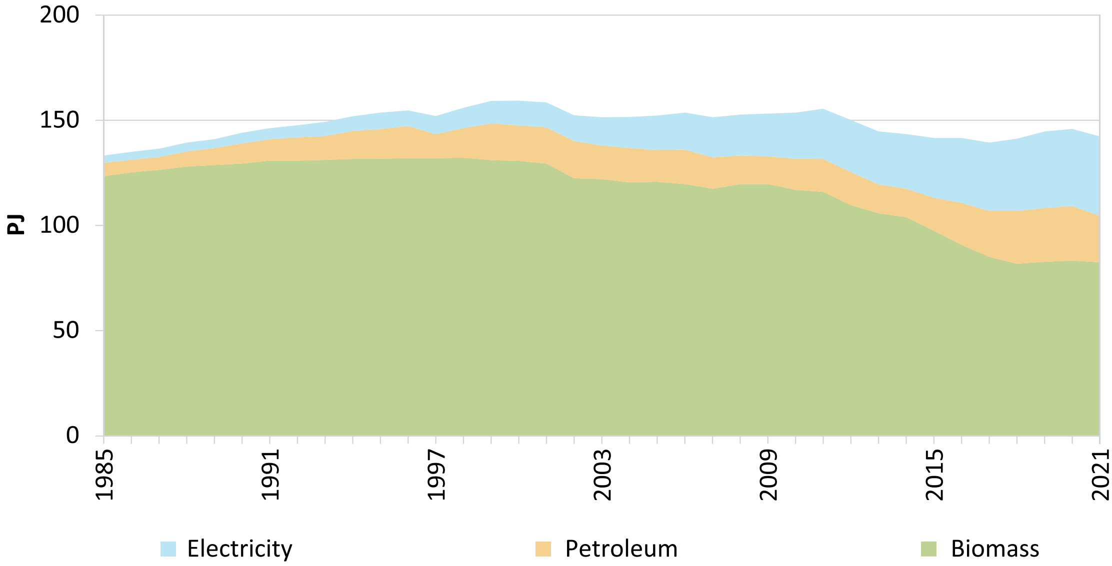


Figure 6.16 – Total Energy Demand of Household, Commercial and Other Sector by Energy Source

6.6.4 Total Energy Demand by Sector

Table 6.20 – Total Energy Demand by Sector

PJ	2010	2015	2018	2019	2020	2021
Industry	86.8	106.3	108.8	111.7	111.8	121.2
Transport	100.4	127.7	135.8	139.3	121.3	139.1
Household, Commercial & Others	153.7	141.6	141.3	144.6	145.9	142.3
Total	**367.7**	**375.6**	**385.9**	**395.6**	**379.0**	**402.6**
%						
Industry	23.6	28.3	28.2	28.2	29.5	30.1
Transport	27.3	34.0	35.2	35.2	32.0	34.6
Household, Commercial & Others	41.8	37.7	36.6	36.6	38.5	35.3

In 2021, households, commercial and other sectors accounted for the largest share of energy being 35.3%. The transport and industry sector accounted for 34.6% and 30.1%, respectively. The sectoral demands started to change back to the pre-pandemic shares, as a result of less stringent lockdown conditions imposed during 2021.

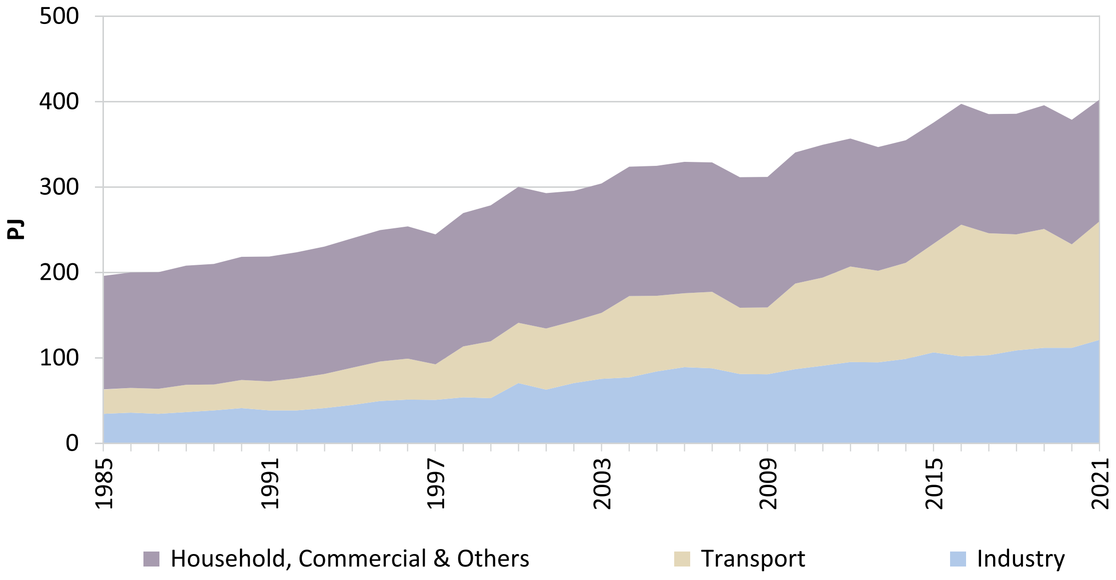


Figure 6.17 – Total Energy Demand by Sector

Figure 6.21 depicts the growth of energy demand in the three main Sectors.

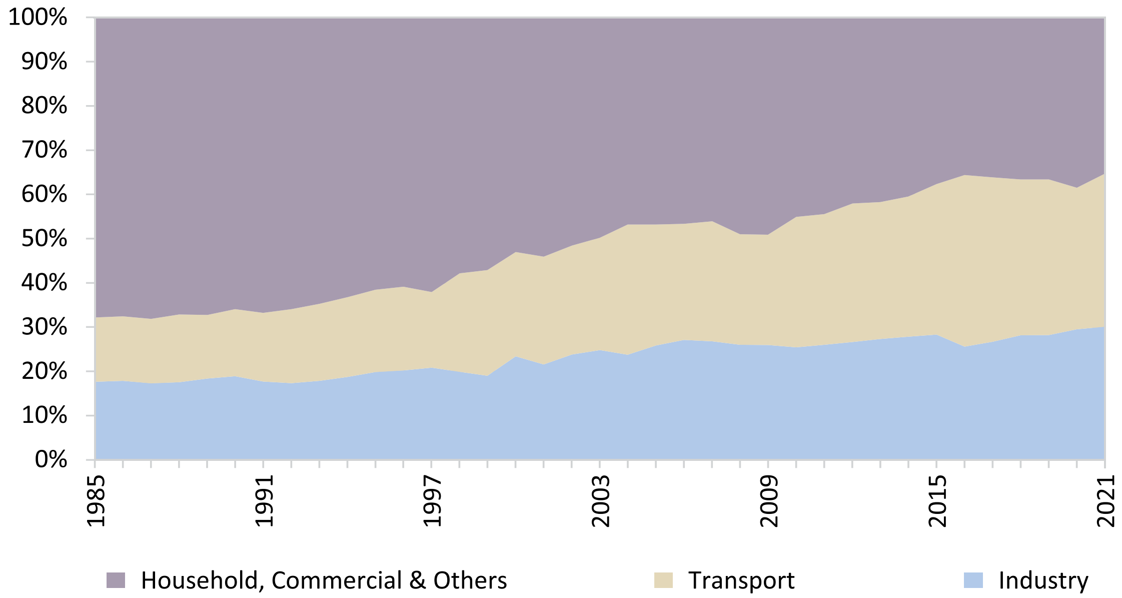


Figure 6.18 – Evolution of Total Energy Demand by Sector

Although the demand decreased in 2020 owing to the COVID-19 pandemic, the demand had gradually risen to its former levels by 2021.

7 Energy Balance

The performance of the entire energy sector is summarised in the National Energy Balance shown in the following pages, in original commodity units and in SI Units of PJ (Peta Joules). The Energy Balance illustrates the energy supply, energy conversion, losses and energy consumption (demand) within the year. Figure 7.1 gives the Energy Balance for 2021 in PJ. Relevant conversion factors are given in *Annex II*.

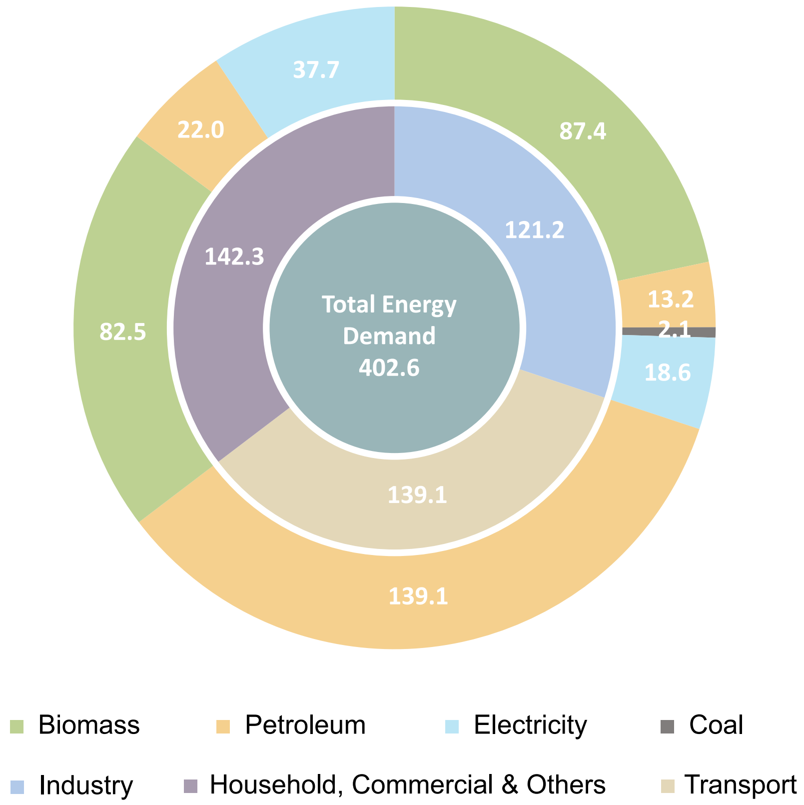


Figure 7.1 – Energy Balance 2021 (in PJ)

The total energy demand of the household, commercial and other sector was 142.3 PJ, out of which 82.5 PJ came from biomass, 22.0 PJ came from petroleum and 37.7 PJ came from electricity. The total energy demand in the industrial sector was 121.2 PJ. Biomass accounted for 87.4 PJ, petroleum for 13.2 PJ, coal for 2.1 PJ and electricity accounted for 18.6 PJ. In the transport sector, the total demand of 139.1 PJ was sourced by petroleum.

Table 7.1 – Sri Lanka Energy Balance: 2021 (in original units)

	Renewables (GWh)	Electricity (GWh)	LPG (kt)	Gasoline (kt)	Naptha (kt)	Av. Gas (kt)	Kerosene (kt)
Supply							
Primary Energy	9,120.6	-	-	-	-	-	-
Imports	-	-	422.0	1186.5	-	0.2	-
Direct Exports	-	-	-	-	(114.4)	-	-
Foreign Bunkers	-	-	-	-	-	-	-
Stock Change	-	-	18.4	36.5	19.6	(0.1)	(0.7)
Total Energy Supply	**9120.6**	**-**	**440.4**	**1,223.0**	**(94.8)**	**0.1**	**(0.7)**
Energy Conversion							
Petroleum Refinery	-	-	16.7	124.1	107.0	-	98.3
Conventional Hydro Power	(5,658.5)	5,658.5	-	-	-	-	-
Thermal Power Plants	-	8,829.8	-	-	(15.2)	-	-
Small Hydro Power	(1,568.1)	1,568.1	-	-	-	-	-
Wind Power	(653.3)	653.3	-	-	-	-	-
Biomass Power	(92.8)	92.8	-	-	-	-	-
Solar Power	(156.0)	156.0	-	-	-	-	-
Waste Heat	(70.0)	70.0	-	-	-	-	-
Net-metered Power Plants	(921.7)	921.7	-	-	-	-	-
Self Generation by Customers	-	-	-	-	-	-	-
Off-grid Conventional	-	-	-	-	-	-	-
Off-grid Non-Conventional	-	-	-	-	-	-	-
Charcoal Production	-	-	-	-	-	-	-
Own Use	-	(704.6)	-	-	-	-	-
Conversion Losses	-		-	-	-	-	-
Losses in T&D	-	(1,614.3)	-	-	-	-	-
Non Energy Use	-	-	-	-	-	-	-
Total Energy Conversion	**(9,120.6)**	**15,631.5**	**16.7**	**124.1**	**91.7**	**-**	**98.3**
Energy Use							
Agriculture	-	-	-	-	-	-	83.2
Industries	-	5,153.2	62.4	-	-	-	2.9
Road Transport	-	-	0.1	1,353.6	-	-	-
Rail Transport	-	-	-	-	-	-	-
Domestic Aviation	-	-	-	-	-	0.1	-
Household, Commercial & Other	-	10,475.6	394.6	-	-	-	102.1
Total Energy Use	**-**	**15,628.8**	**457.0**	**1,353.6**	**-**	**0.1**	**188.2**

Table 7.1 – Sri Lanka Energy Balance: 2021 (in original units)

Jet A1 (kt)	Diesel (kt)	Fuel Oil (FO 1500) (kt)	Residual Oil (kt)	Solvents (kt)	Coal (kt)	Baggase Agro Residues (kt)	Firewood (kt)	Charcoal (kt)	Crude Oil (kt)
-	-	-	-	-	-	262.9	10,530.6	-	-
178.1	1,779.7	359.3	-	-	2,543.6	-	-	-	1,130.2
-	-	(31.4)	-	-	-	-	-	-	-
(222.4)	(63.5)	(471.4)	-	-	-	-	-	-	-
4.3	77.3	(5.7)	138.9	(0.4)	127.0	30.8	-	-	212.8
(40.1)	**1,793.5**	**(149.2)**	**138.9**	**(0.4)**	**2,670.6**	**293.8**	**10,530.6**	**-**	**1,343.1**
130.6	370.6	359.0	-	3.0	-	-	-	-	(1,272.2)
-	-	-	-	-	-	-	-	-	-
-	(121.6)	(317.8)	(138.9)	-	(2,301.3)	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	(152.3)	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	(70.9)
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
130.6	**249.0**	**41.2**	**(138.9)**	**3.0**	**(2,301.3)**	**(152.3)**	**-**	**-**	**(1,343.1)**
-	-	-	-	-	-	-	-	-	-
-	114.5	127.3	-	-	80.1	141.5	5,343.0	-	-
-	1,713.7	-	-	-	-	-	-	-	-
-	19.3	-	-	-	-	-	-	-	-
26.1	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	5,187.6	-	-
26.1	**1,847.4**	**127.3**	**-**	**-**	**80.1**	**141.5**	**10,530.6**	**-**	**-**

Table 7.2 – Sri Lanka Energy Balance: 2021 (in Tera Joules)

	Renewables	Electricity	LPG	Gasoline	Naptha	Av. Gas	Kerosene	Jet A1
Supply								
Primary Energy	91,646.4	-	-	-	-	-	-	-
Imports	-	-	18,728.4	54,147.4	-	9.4	-	7,829.5
Direct Exports	-	-	-	-	(5,221.1)	-	-	-
Foreign Bunkers	-	-	-	-	-	-	-	(9,778.3)
Stock Change	-	-	816.0	1,666.0	894.2	(6.2)	(29.6)	188.1
Total Energy Supply	**91,646.4**	**-**	**19,544.4**	**55,813.5**	**(4,326.9)**	**3.1**	**(29.6)**	**(1,760.7)**
Energy Conversion								
Petroleum Refinery	-	-	738.9	5,663.1	4,881.1	-	4,320.7	5,740.1
Conventional Hydro Power	(56,858.3)	20,374.2	-	-	-	-	-	-
Thermal Power Plants	-	31,793.1	-	-	(695.1)	-	-	-
Small Hydro Power	(15,757.2)	5,646.3	-	-	-	-	-	-
Wind Power	(6,564.8)	2,352.4	-	-	-	-	-	-
Biomass Power	(932.9)	334.3	-	-	-	-	-	-
Solar Power	(1,567.8)	561.8	-	-	-	-	-	-
Waste Heat	-	-	-	-	-	-	-	-
Net-metered Power Plants	(9,261.9)	3,318.9						
Self Generation by Customers	-	-	-	-	-	-	-	-
Off-grid Conventional	-	-	-	-	-	-	-	-
Off-grid Non-Conventional	-	-	-	-	-	-	-	-
Charcoal Production	-	-	-	-	-	-	-	-
Own Use	-	(2,537.0)	-	-	-	-	-	-
Conversion Losses	-	-	-	-	-	-	-	-
Losses in T&D	-	(5,812.4)	-	-	-	-	-	-
Non Energy Use	-	-	-	-	-	-	-	-
Total Energy Conversion	**(90,942.9)**	**56,031.5**	**738.9**	**5,663.1**	**4,185.9**	**-**	**4,320.7**	**5,740.1**
Energy Use								
Agriculture	-	-	-	-	-	-	3,658.6	-
Industries	-	18,555.0	2,768.9	-	-	-	127.5	-
Road Transport	-	-	3.5	61,773.1	-	-	-	-
Rail Transport	-	-	-	-	-	-	-	-
Domestic Aviation	-	-	-	-	-	3.1	-	1,148.8
Household, Commercial & Other	-	37,718.9	17,510.9	-	-	-	4,487.9	-
Total Energy Use	**-**	**56,273.9**	**20,283.3**	**61,773.1**	**-**	**3.1**	**8,274.1**	**1,148.8**

Table 7.2 – Sri Lanka Energy Balance: 2021 (in Tera Joules)

Diesel	Fuel Oil (FO 1500)	Residual Oil	Solvents	Coal	Baggase Agro Residues	Firewood	Charcoal	Crude Oil	Total
-	-	-	-	-	4,403.3	167,539.6	-	-	263,589.3
78,239.6	14,742.5	-	-	67,091.7	-	-	-	48,740.4	289,528.9
-	(1,288.2)	-	-	-	-	-	-	-	(6,509.3)
(2,791.1)	(19,340.6)	-	-	-	-	-	-	-	(31,910.1)
3,396.8	(235.4)	5,699.6	(14.5)	3,349.8	516.6	-	-	9,178.3	25,419.7
78,845.4	**(6,121.7)**	**5,699.6**	**(14.5)**	**70,441.5**	**4,919.9**	**167,539.6**	**-**	**57,918.6**	**540,118.6**
16,291.8	14,730.9	-	113.2	-	-	-	-	(54,862.7)	(2,383.0)
-	-	-	-	-	-	-	-	-	(36,484.1)
(5,343.7)	(13,041.3)	(5,699.6)	-	(60,701.7)	-	-	-	-	(53,688.3)
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	(2,549.9)	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
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-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	(2,537.0)
-	-	-	-	-	-	-	-	(3,055.9)	(3,055.9)
-	-	-	-	-	-	-	-	-	(5,812.4)
-	-	-	-	-	-	-	-	-	-
10,948.1	**1,689.5**	**(5,699.6)**	**113.2**	**(60,701.7)**	**(2,549.9)**	**-**	**-**	**(57,918.6)**	**(103,960.7)**
-	-	-	-	-	-	-	-	-	3,658.6
5,031.5	5,222.6	-	-	2,113.2	2,369.9	85,006.3	-	-	121,194.9
75,334.8	-	-	-	-	-	-	-	-	137,111.4
849.9	-	-	-	-	-	-	-	-	849.9
-	-	-	-	-	-	-	-	-	1,151.9
-	-	-	-	-	-	82,533.3	-	-	142,251.1
81,216.2	**5,222.6**	**-**	**-**	**2,113.2**	**2,369.9**	**167,539.6**	**-**	**-**	**406,217.8**

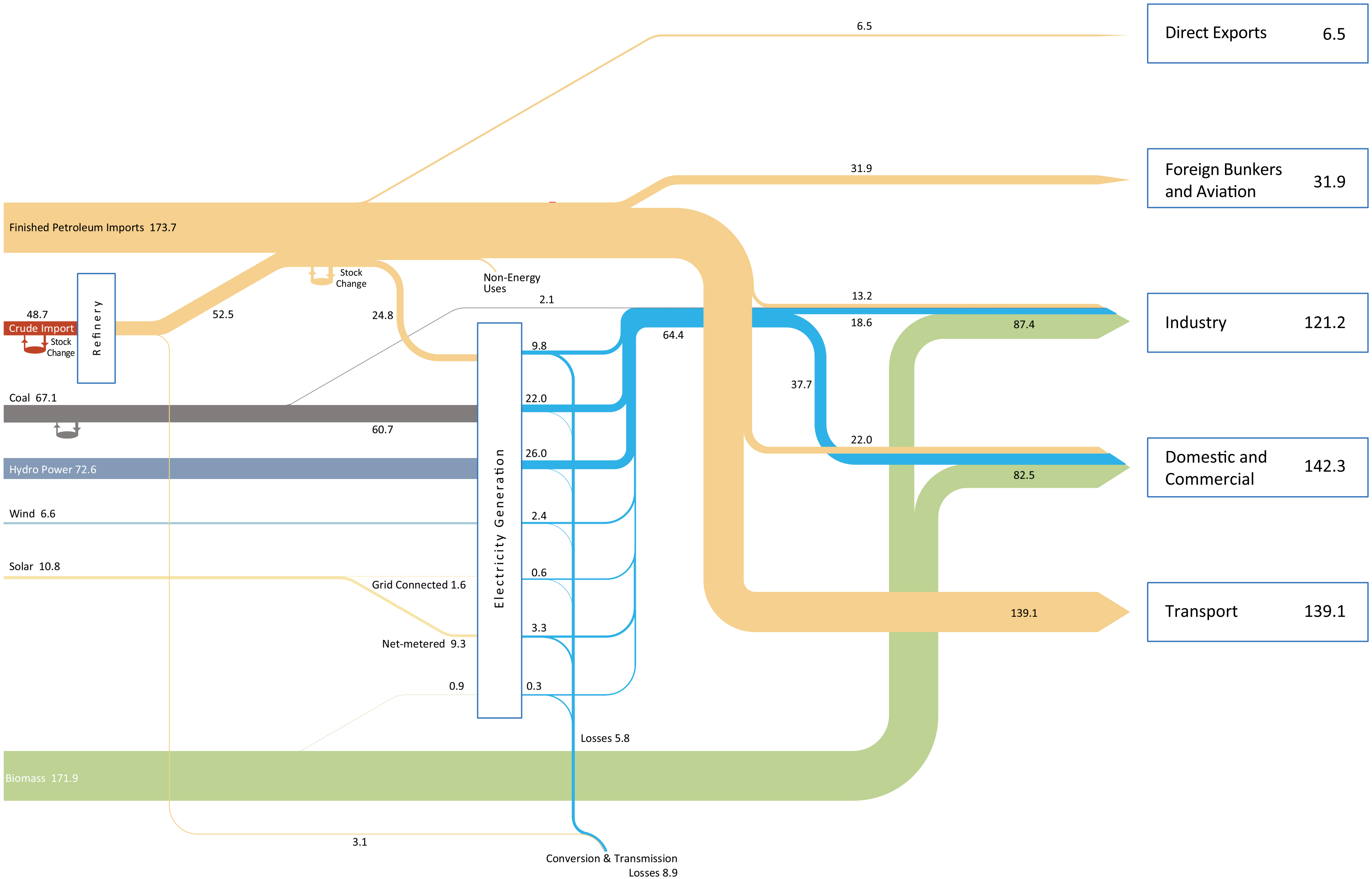

Figure 7.2 – Energy Flow Diagram - 2021 (PJ)

8 Energy and Economy

8.1 Electricity Sector Financial Performance

The year 2021 recorded poor financial performance for the CEB, and the return on assets (RoA) was negative for several consecutive years and stood at (1.7)%. The LECO recorded a better financial performance with an RoA of 16.0%. Table 8.1 summarises the financial performance of CEB and LECO.

Table 8.1 – Financial Performance of CEB and LECO

	2010	2015	2018	2019	2020	2021
CEB						
Net assets in Operation (LKRM)	378,207	616,154	747,049	781,869	819,086	852,877
Return on assets (%)	0.1	2.0	(2.7)	(7.4)	(5.7)	(1.7)
LECO						
Net assets in Operation (LKRM)	8,420	10,911	12,885	13,281	13,675	14,180.0
Return on assets (%)	(1.9)	4.5	6.6	13.9	7.5	16.0

8.2 Financial Performance of the Petroleum Sector

8.2.1 Impact on Macro Economy

The average crude oil price (Brent price) stood at USD 70.80 per barrel in 2021. The Brent price in 2020 was USD 43.35 per barrel, which rose by 63.3% in 2021. The net petroleum import bill was USD 4,067 million, a 32% increase from the USD 2,778 million in 2020. With the demand for petroleum increasing over the past years, expenditure on oil imports as a percentage of non petroleum exports stood at 29.7% in 2021. Table 8.2 shows the historic trends of the petroleum import costs.

Table 8.2 – Petroleum Import Costs and its Impact on the Macro Economy

million USD	2010	2015	2018	2019	2020	2021
Total Exports	8,626	10,546	11,890	11,940	10,047	12,499.0
Total Imports	13,451	18,935	22,233	19,937	16,055	20,637.0
Petroleum Imports	3,183	2,864	4,418	4,133	2,778	4,067.0
Petroleum Re-exports	263	374	622	521	374	506.0
Net Oil Imports	2,920	2,490	3,796	3,612	2,404	3,561.0
Non Petroleum Exports	8,363	10,172	11,268	11,419	9,673	11,993.0
Net Oil Imports as % of Non Petroleum Exports	34.9	24.5	33.7	31.6	24.9	29.7

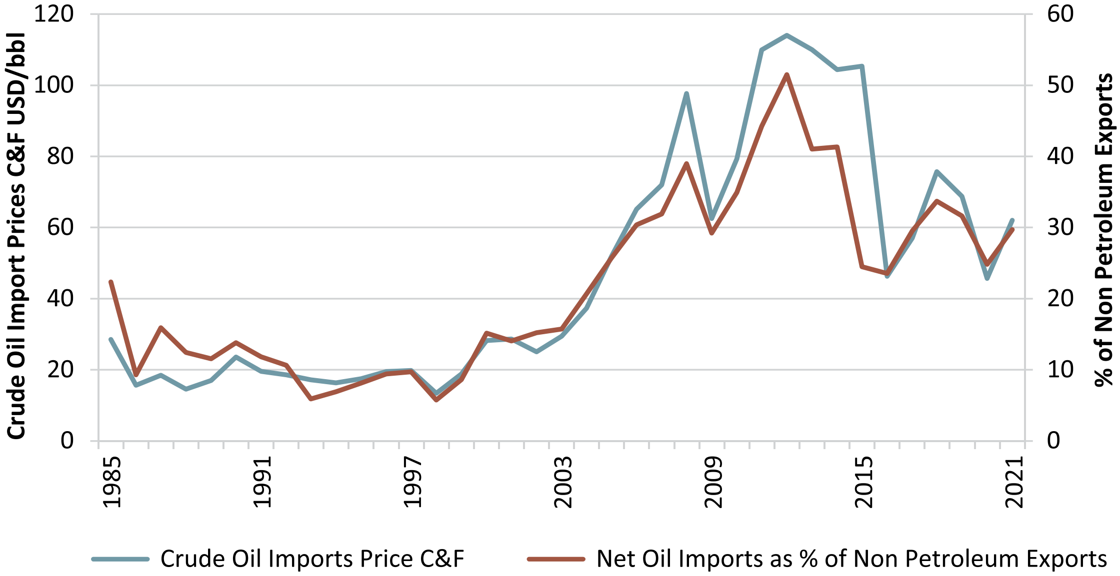

Figure 8.1 - Net Oil Imports as a Percentage of Exports

The impact of oil import bill on the national economy is clearly presented in the above graph, as the cost of net oil Imports as a percentage of all non-petroleum export earnings. This has two important points in history, first being in 1982, where it climbed to 44.8% and more recently in 2012 when it reached the highest ever value of 51.5%. This value for net oil imports as a percentage of non-petroleum exports climbed steadily over the consecutive years, declined in 2020, but rose to 29.7% by 2021.

8.2.2 Petroleum Sector Financial Performance

Ceylon Petroleum Corporation (CPC) dominates the petroleum sector of the country. However, the role of Lanka Indian Oil Company (LIOC) and the LP Gas companies also have a reasonable bearing on the overall sector performance. Several bunkering companies were also active in the petroleum sector. Table 8.3 presents financial performance details of the CPC and LIOC.

Table 8.3 – CPC and LIOC Financial Performance

LKR million	2010	2015	2018	2019	2020	2021
CPC						
Total Revenue	277,084	423,741	605,955	669,044	530,877	598,836
Total Cost	(304,007)	444,422	711,006	680,900	528,506	681,044
BTT/GST/VAT	20,222	37,761	16,761	15,731	8,740	9,079
Income Tax	-	634	22	-	-	-
Cost of Sales	-	-	579,617	626,599	454,880	588,823
Crude & Product Import Cost	(265,604)	337,119	-	-	-	-
Estimated other Cost	(18,181)	68,908	33,001	38,549	64,886	83,142
Profit/ Loss	**(26,923)**	**(20,681)**	**(106,163)**	**(11,856)**	**2,371**	**(82,208)**
LIOC *						
Total Revenue	51,423	68,728	91,608	78,227	68,268	81,126
Total Cost	(49,376)	69,114	92,245	76,521	68,709	78,713
VAT, ESC, Debit,Payee & other taxes	(998)	134	164	106	42	44
Income Taxes	(17)	286	6	8	(60)	371
Import Duty	-	-	-	-	-	-
Product Cost	-	65,986	88,830	73,344	66,244	75,575
Estimated other costs	-	2,709	3,246	3,063	2,484	2,722
Profit/ Loss	**1,032**	**(386)**	**(637)**	**1,706**	**(441)**	**2,412**

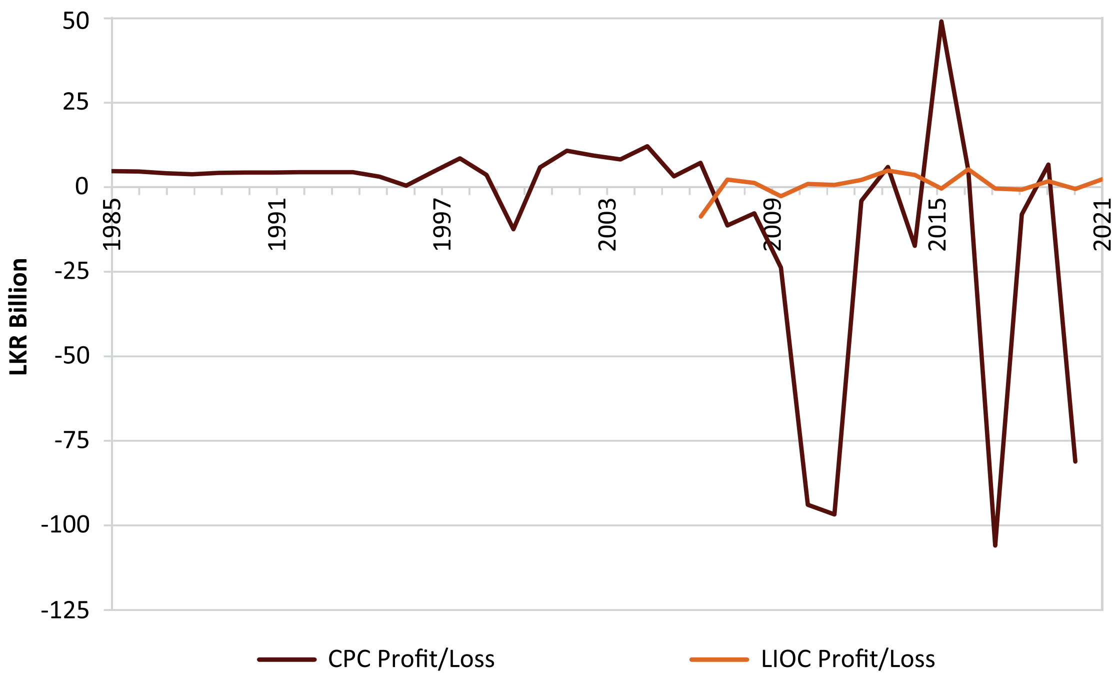

Figure 8.2 – Profit/Loss of CPC and LIOC

The rare window of opportunity which came in to being with the collapse of the global petroleum prices in 2020 closed and plunged the industry to the usual difficult position leading to a loss of more than LKR 80 billion in 2021.

8.3 Energy-Economy Indicators

Commercial energy (petroleum, electricity and coal) intensity is an indicator of a country's energy utilisation with respect to the national output (measured in terms of Gross Domestic Product-GDP). The commercial energy intensity decreased from 0.60 TJ/GDP million LKR in 2020 to 0.50 TJ/GDP million LKR in 2021. This is attributable to the much lower economic output of the country and the increased demand for energy services from the population confined to their homes.

Table 8.4 – Sri Lanka Energy Indices

	2010	2015	2018	2019	2020	2021
Electricity (TJ)	33,156.4	42,274.8	50,839.9	53,180.1	52,029.0	55,557.0
Petroleum (TJ)	125,958.2	171,363.1	170,011.6	174,347.4	154,818.4	177,921.2
Coal (TJ)	2,509.2	2,283.7	1,978.3	2,311.0	2,092.7	2,113.2
Total commercial energy (TJ)	**161,623.9**	**215,921.5**	**222,829.8**	**229,838.6**	**208,940.2**	**235,591.4**
GDP at 1982 factor cost prices (million LKR)	352,878	473,954	528,004	540,042	345,627	473,508
Commercial Energy Index	2.58	3.44	3.55	3.66	3.33	3.75
GDP Index (Index 1984=1.0)	3.38	4.54	5.06	5.17	3.31	4.54
Commercial Energy Intensity (TJ/LKR million)	**0.46**	**0.46**	**0.42**	**0.43**	**0.60**	**0.50**
Commercial Energy Intensity Index (1984=1.0)	0.76	0.71	0.70	0.71	1.01	0.83

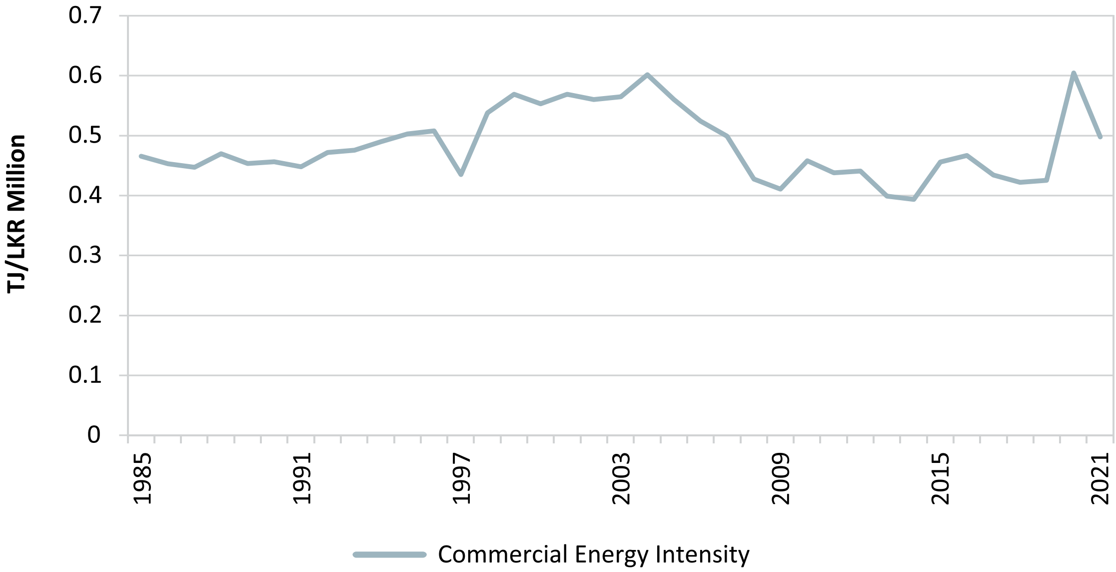

Figure 8.3 – Commercial Energy Intensity

9 Environmental Impacts

9.1 Grid Emission Factor

The 'Average Emission Factor (AEF)' is used mainly for reporting carbon footprint of electricity users. This emission factor is calculated by dividing the total emissions from the power sector from the total units of electricity used in the country in a given year. If the emission reductions due to any sustainable energy intervention are to be calculated, the appropriate emission factor would be the Grid Emission Factor (GEF).

Table 9.1 – Average Emission Factor

	2010	2015	2018	2019	2020	2021
Emission Factor (kg CO_2/kWh)	0.3158	0.4753	0.4694	0.5401	0.5229	0.4278

The SEA conducted a survey on the usage of electrical appliances in the domestic sector in collaboration with the Department of Census and Statistics in 2019, covering a representative sample of over 6,000 households. Cooking energy fuels were also assessed during this survey. Three cooking fuels were used, and based on this preliminary data, the emissions from cooking in the domestic and commercial sector were estimated, using IPCC emission factors. The results for 2021 are given in Table 9.2.

Table 9.2 – CO_2 Emissions from Cooking in the Domestic and Commercial Sector

Fuel (kt per annum)	2021
Fuel wood	2,096
LPG	321
Kerosene	5

The GEF indicates the amount of CO2 avoided, if a specific intervention is made either through the introduction of a renewable energy project to a grid or through the introduction of an energy saving project in the grid. The GEF also represents the quantity of CO2 emitted by a power system during a year. The GEF pivots on three factors, viz., Operating Margin, Build Margin and Combined Margin. 'Margin' refers to the happenings of renewable energy based power or an energy saving project.

The Grid Emission Factor for 2021 was calculated using the Methodological Tool 07 'Tool to calculate the emission factor for an electricity system' (Version 07.0).

9.1.1 Operating Margin

The Operating Margin (OM) is a concept which includes all power plants which can have reduced outputs due to a project. It specifically excludes 'low cost, must run' power plants, implying that with or without the project, such generation will continue. Table 9 3 gives the Simple Operating Margin (OM).

Table 9.3 – Operating Margin

	2018	2019	2020	2021
Emissions from Power Plants (t-CO_2)	2,529,709.6	3,552,816.2	2,960,912	1,908,744.7
Net Electricity Generation (GWh) excluding low-cost must run power plants	3,579.2	5,006.7	4,179.3	2,498.4
Operating margin CO_2 emission factor (kg-CO_2/kWh)				
Three-year generation based weighted average	0.7044	0.7084	0.7084	0.7208

9.1.2 Build Margin

The Build Margin (BM) is a concept which attempts to foretell the happenings of a generation system in future, during the crediting period of a project, considering the recent additions to a generation system.

Table 9.4 – Build Margin

	Unit	2018	2019	2020	2021
Emissions of power plants considered for the BM	tonnes of CO_2	3,508,911.2	4,266,621.5	4,111,940.3	3,922,524.3
Generation of power plants considered for the BM	GWh	4,208.8	5,101.3	5,381.3	5,863.0
Build margin emission factor	kg-CO_2/kWh	0.8337	0.8364	0.7641	0.6690

9.1.3 Combined Margin

The Combined Margin (CM) is a weighted average of OM and BM and is commonly known as the Grid Emission Factor (Table 9 5).

Table 9.5 – Combined Margin (kg-CO_2/kWh)

	2018	2019	2020	2021
For solar, wind Projects	0.7368	0.7404	0.7224	0.7079
All other Projects; 1st crediting period	0.7691	0.7724	0.7363	0.6949
All other Projects; 2nd - 3rd crediting period	0.8014	0.8044	0.7502	0.6820

The OM, BM and CM are required for the assessment of CO_2 emission reductions for projects claiming carbon credits under UNFCC guidelines. The GEF is indicated in Figure 9 1.

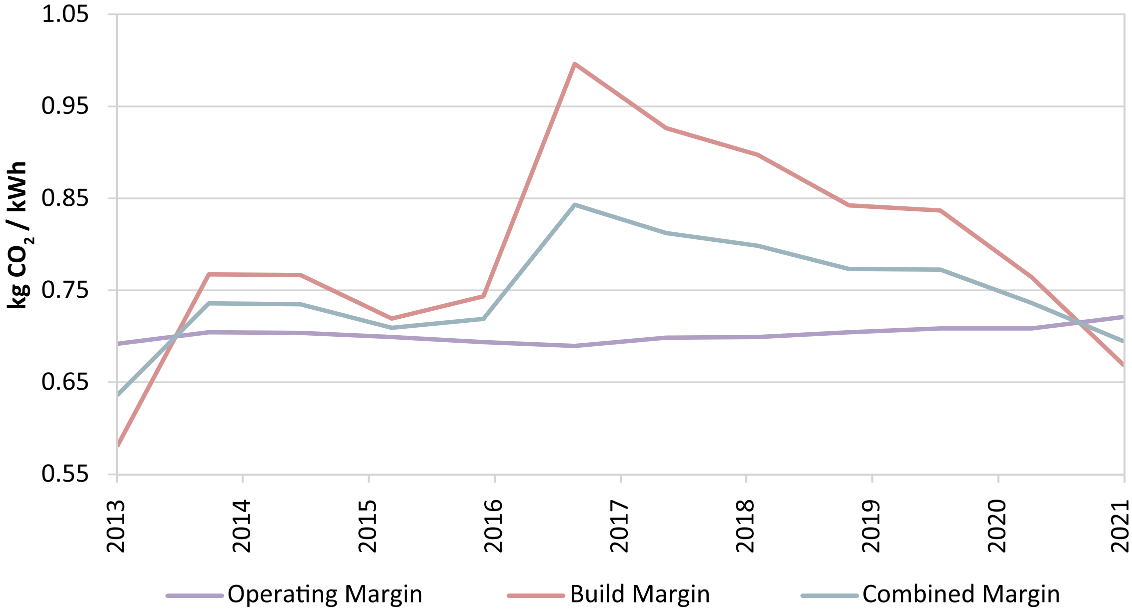

Figure 9.1 – Grid Emission Factors

The emission of CO_2 from power plants are depicted in Figure 9.2. The emission of CO_2 per kWh decreased in 2021 owing to increased hydro generation.

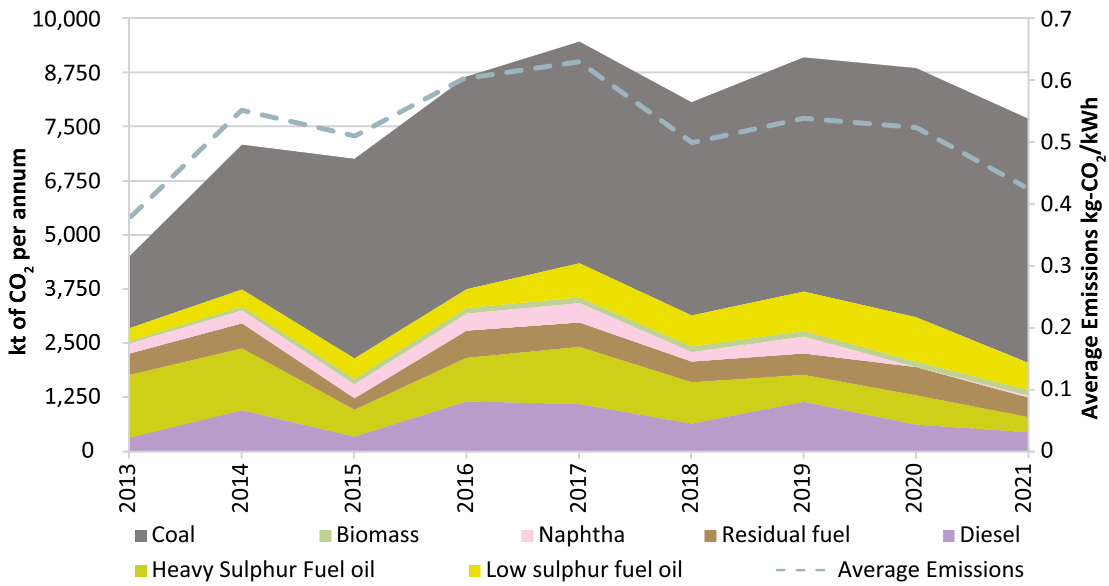

Figure 9.2 – Emissions from Power Plants by Type of Fuel

10 Energy Sector Performance and Future Outlook

Most of the problems which affected the global and national economy in 2020 continued in 2021 but with signs of improvement. Lockdowns which prevailed in 2020 were not that frequent until the end of third quarter, where a prolonged lockdown was reimposed due to a sudden breakout of the pandemic again. Electricity generation grew back ending three years of hovering around 16,000 GWh to reach 17,947 GWh in 2021. Similarly, demand for petroleum products grew by a margin of 9%. Reduced work days and travel restrictions, most of the energy sector development programmes failed to progress as expected in 2021. Due to these reasons and many other reasons, the implementation of the NEPS did not happen as expected at its publication in 2019.

10.1 Electricity

The electricity demand of the country was expanding in 2021, in line with the slow recovery of the economic activities. During the year, the electricity generation grew by 6% to 17,947 GWh, compared to the previous year, with increased share of hydropower generation. Water levels in reservoirs remained favourable, above 60% throughout the year owing to the heavy rainfall. This in turn contributed towards increasing the contribution of hydro power to the electricity generation. Accordingly, the total hydro power generation in 2021 was 7,226.6 GWh, which was an increase of 31%, compared to the corresponding 4,976.3 GWh of 2020. Corresponding to the increased hydro power generation, the component of the oil-based generation decreased. It was 4,306.4 GWh in 2020, which decreased by 59% to 2,716.2 GWh by 2021. Similarly, the generation from coal power too decreased from 6,364.9 GWh in 2020 to 6,110.9 GWh to 2021, which corresponded to a decrease of 4%.

The share of power generated by the CEB stood at 75% in 2021, while the balance was provided by IPPs, new renewable energy plants and micro power producers.

However, owing to the increased reliance on thermal-based power generation in the early months of 2021, the CEB experienced difficulties in meeting the corresponding electricity demand of the country. Therefore, the difficulties in fuel procurement caused by foreign exchange issues amidst soaring global prices of energy commodities took a heavy toll on the energy industry.

The overall own use and losses as a percentage of total power generation was maintained at 13.3% in 2021 despite the expansion of electricity supply to remote and rural areas.

Electricity sales increased by 6.2% to 15,628.8 GWh in 2021, owing primarily to the lower base induced by the reduced demand in 2020. The overall growth in sales was driven by demand from all user categories, except for religious and street lighting purposes. Electricity sales to the hotel sector, which accounts for 1.4% of total sales, increased notably by 13.7% in 2021, compared to the sharp decline of 29.2% observed in 2020. This could be attributed to the recovery in the tourism sector during the year.

The CEB faced difficulties in manual meter reading resulting in significant mismatches between electricity sales and electricity generation data. Accordingly, the CEB has taken initiatives to collect accurate and real-time energy data through remote disconnection and automatic reconnection facilities. Two such commercial scale smart metering projects were initiated in Dehiwala and Katunayake. Acceleration of such timely initiatives is imperative, as rapid implementation of smart metering technologies would ensure smooth billing and collection of dues in a prompt and efficient manner, thereby improving the cash flows of the CEB. Further, the increased reliance on hydropower generation, complemented by a low share of costly oil based electricity generation, helped improve the financial performance of the CEB during 2021. However, this was insufficient to offset losses incurred during the year as well as those from the past. As per unaudited provisional financial data, the CEB recorded a loss of LKR 22.0 billion in 2021, compared to a loss of LKR 69.2 billion reported in 2020. Further, the Government's decision to provide a grace period to settle electricity bills and to defer the disconnecting of services to unpaid consumers worsened the cash flow position of the CEB.

These developments in tandem, reiterate the urgent need to implement a cost reflective pricing mechanism for electricity tariffs and to undertake regular revisions especially considering that electricity tariffs have not been revised since 2014. Initiatives to increase the power generation capacity through expansion of renewable energy sources are also essential to overcome the crisis.

Activities related to the development of several power plants were in progress in 2021, with the aim of expanding energy generation to keep pace with the steady growth in electricity demand. Given the expected reliance on LNG as one of the main sources of electricity generation, as per the Long-Term Generation Expansion Plan for 2022-2041 (LTGEP), the Cabinet of Ministers granted approval for the construction of Sri Lanka's first LNG power plant at Kerawalapitiya. Accordingly, construction of the first 300 MW power plant commenced in March 2021 and is expected to be connected to the national grid in early 2024, while the second 300 MW plant was at the initial stages of construction and is expected to be completed in late 2024. Further, several transmission and distribution projects, including the Green Power Development and Energy Efficiency Improvement Project, Greater Colombo Transmission and Loss Reduction Project and Power System Reliability Strengthening Project, were underway to expand and strengthen the power transmission and distribution system in order to reduce system losses and to include more renewable energy while maintaining system reliability.

The construction work of the key hydropower projects, the Uma Oya (120 MW) and Broadlands (35 MW) projects continued well into 2021 and were expected to be commissioned in 2022. Construction work of the Moragolla, Gin Ganga, and Thalpitigala hydropower projects too continued in 2021, while these plants are expected to add a total capacity of 65 MW to the national grid in subsequent years.

10.1.1 New Renewable Energy Development

The NRE industry recorded a significant increase of 27.4% from 1,607.2 GWh in 2020 to 2,214.5 GWh to 2021, with the achievements of many milestones. This increase is predominantly attributed to the 100 MW Mannar wind power plant of the CEB, which generated 326 GWh in 2021. Further, in February 2021, Sri Lanka's first waste to energy power plant commenced operation, generating 70 GWh.

The CEB submitted its Long-Term Generation Expansion Plan for 2022-2041 (LTGEP) in October 2021 for the approval of the PUCSL, wherein the plan outlines that the share of renewable energy will be approximately 50% of the total electricity generation by 2030. However, the PUCSL requested the CEB to realign the LTGEP in accordance with the Government's target of achieving 70% in power generation by renewable energy by 2030. In a subsequent development front, in July 2021, the Cabinet of Ministers decided not to build any new coal power plants in the near future to ensure sustainable energy development and to reiterate its commitment to providing clean energy. The decision was in line with the commitment made under the United Nations Framework Convention on Climate Change to achieve carbon neutrality by 2050. Meanwhile, other monitoring and regulatory aspects of electricity, such as the development of a National Electrician Licensing Framework, inspections of renewable power plants, and training for electricians and technicians, were underway in 2021.

Further initiatives were taken to establish two 100 MW wind parks in two phases in Mannar, while development activities relating to wind plants located in the Pooneryn hybrid renewable energy park and Trincomalee were also in progress. The initial activities of the Siyambalanduwa solar power park (100 MW) and Pooneryn hybrid renewable energy park (150 MW) were also underway in 2021.

A loan agreement for USD 100 million was signed with India in June 2021 to install rooftop solar plants on government buildings and religious organisations, as well as for floating solar pilot projects. Accordingly, this project is expected to add an additional 120 MW of solar capacity to the grid. Sri Lanka also signed an agreement with the National Thermal Power Corporation (NTPC) of India in March 2022 to set up a solar power plant in Sampur, Trincomalee. The Sri Lanka Sustainable Energy Authority managed to secure USD 108 million funding for improving energy efficiency in buildings from the World Bank and the Green Climate Fund, targeting HVAC and lighting improvements in aging buildings.

In relation to solar energy, at the end of 2021, around 37,427 consumers had joined the Soorya Bala Sangramaya project and 516 MW were added to the national grid under this project.

10.2 Petroleum

Global crude oil prices rose sharply in 2021, supported by the steady recovery in global economic arena, albeit, sporadic declining trends were observed due to the resurgences of COVID-19. The average crude oil price (Brent price) stood at USD 70.80 per barrel in 2021. the Brent price in 2020 was USD 43.35 per barrel, which therefore indicated a rise by 63.3%, when it reached the Brent price in 2021.

The recovery in global crude oil prices that had begun in mid-2020 gained momentum and reached pre-pandemic levels by March 2021 before reaching a seven-fold increase in October 2021. In line with rising trends in global crude oil prices, the average price of crude oil imported by the CPC increased by 51.1% to USD 68.86 per barrel in 2021 compared to the average of USD 45.57 per barrel recorded in 2020.

The continuous escalation of global crude oil prices warranted the Government to increase the domestic retail prices of key petroleum products in 2021 after a break of over one and half years. Accordingly, domestic prices of the CPC products were revised upwards in June and December 2021. The LIOC also revised domestic retail prices of petroleum products in three rounds during 2021.

The revisions undertaken in March 2022 by both entities were historically high, however, they were a reflection of the sharp rise in global crude oil prices and the impact of the depreciation of the rupee. This phenomenon emphasises the need to urgently institutionalise a cost reflective pricing mechanism that improves transparency regarding pricing among all stakeholders, especially consumers. This in turn, would also contribute to the general acceptance of such revisions. Such a mechanism is also essential to ensure the financial viability of the CPC in the medium-term and thereby the safeguarding of macroeconomic and financial system stability, Transparency in relation to both pricing and procurement processes is a dire need for the viability and sustainability of the CPC.

The overall sales volumes of petroleum products in the domestic market declined by 7.7% during the year, driven by contractions in sales to the power sector.

Refinery output recorded an overall decline of 24.7% in 2021 due to multiple closures of the Sapugaskanda refinery. Subsequent to a closure from mid-February 2021 for the purpose of general maintenance, the refinery was closed again in November 2021 for three weeks due to the unavailability of crude oil for refinery operations. Hence, overall crude oil throughput declined by 24.5%, while the refinery output of key products such as diesel, petrol, fuel oil and naphtha contracted by 31.1%, 24.5%, 22.9% and 31.9%, respectively, during the period under review. These production gaps were compensated for by importing refined products, which rose by 15.2% in 2021.

Despite notable upward revisions to domestic petroleum prices, the financial performance of the CPC worsened further in 2021. As per unaudited provisional financial statements, the CPC incurred an operational loss of LKR 41.7 billion in 2021 compared to the operational profit of LKR 33.9 billion recorded in 2020. This reflected the impact of delayed and inadequate revision of prices in line with the sharp increase in global crude oil prices. Sales of petroleum products to the major sectors of transport and power generation yielded operational losses, while the aviation and industry sectors generated operational profits in 2021. The depreciation of the rupee against the US dollar resulted in a notable exchange rate variation loss of LKR 33.2 billion to the CPC in 2021. The borrowings of the CPC from the banking sector increased by LKR 123.5 billion to LKR. 505.3 billion in 2021.

Several infrastructure development projects aimed at improving the performance and productivity of the petroleum industry were carried out during the year, albeit at a slower pace. The detailed feasibility study for the establishment of a new refinery in Sapugaskanda as a Public-Private Partnership under a Built-Operate-Transfer model with a capacity of 100,000 barrels per day was completed by the CPC in 2021. Meanwhile, in order to improve the storage facilities available for petroleum products, two storage construction projects comprising total capacity of 93,000m3 in Kolonnawa were also under progress during the year. The CPC also commenced the development and upgrading of the Aviation Refueling Terminal as a part of the Bandaranaike International Airport (BIA) development project. In addition, the CPC continued to work in collaboration with the CEB to construct the pipeline conveying gas to the Kelanitissa power plant under the proposed Liquefied Natural Gas (LNG) power project

Annex I

Independent Power Producers (IPPs)

Starting from 1997, many IPPs entered the electricity market, supplying electricity to the national grid. CEB has separate power purchase agreements with these private sector companies.

1. Asia Power (Pvt) Ltd
2. Colombo Power (Pvt) Ltd
3. AES Kelanitissa (Pvt) Ltd
4. ACE Power Embilipitiya (Pvt) Ltd
5. Yughadhanavi (Pvt) Ltd

Small Power Producers

Many new small power producers came into existence as a result of the attractive tariffs offered by the CEB and the lending facilities provided by the RERED project. A total of 280 SPPs were operational by the end of 2021. CEB has signed Standardised Small Power Purchase Agreements (SPPAs) with these companies.

List of Small Power Producers

hydro | solar | biomass/dendro | wind | waste heat

	Name of Power Plant	Yr commissioned	Capacity (MW)	Generation (GWh)
1	Dick Oya	1996	0.96	2.3
2	Seetha Eliya	1996	0.07	0.4
3	Ritigaha Oya	1997	0.80	-
4	Rakwana Ganga	1999	0.76	2.8
5	Kolonna	1999	0.78	2.3
6	Ellapita Ella	1999	0.55	2.6
7	Carolina	1999	2.50	13.2
8	Weddamulla	1999	0.20	0.3
9	Delgoda	2000	2.65	13.8
10	Mandagal Oya	2000	1.28	4.9
11	Glassaugh	2000	2.53	-
12	Minuwnella	2001	0.64	2.4
13	Kabaragala	2001	1.50	1.7
14	Bambarabatu Oya	2001	3.20	15.7
15	Galatha Oya	2001	1.20	3.9
16	Hapugastenna I	2001	4.60	13.2
17	Belihuloya	2002	2.50	9.6
18	Watawala (Carolina II)	2002	1.30	4.1
19	Niriella	2002	3.00	8.1
20	Hapugastenna II	2002	2.30	12.4
21	Deyianwala	2002	1.50	4.7

List of Small Power Producers

hydro | solar | biomass/dendro | wind | waste heat

	Name of Power Plant	Yr commissioned	Capacity (MW)	Generation (GWh)
22	Hulu Ganga 1	2003	6.50	20.9
23	Ritigaha Oya -II	2003	0.80	3.8
24	Sanquhar	2003	1.60	5.7
25	Karawila Ganga	2004	0.75	3.5
26	Brunswic	2004	0.60	0.0
27	Sithagala	2004	0.80	3.3
28	Way Ganga	2004	8.93	29.3
29	Alupola	2004	2.52	8.2
30	Rathganga	2004	3.00	15.8
31	Waranagala	2004	9.90	50.5
32	Nakkawita	2004	1.01	1.6
33	Walakada	2004	4.21	22.2
34	Miyanawita Oya	2004	0.60	2.8
35	Atabage Oya	2004	2.20	7.4
36	Batalagala	2004	0.10	-
37	Hemingford	2005	0.18	0.3
38	Kotapola	2005	0.60	2.1
39	Wee Oya	2005	6.00	2.7
40	Radella	2005	0.20	0.5
41	Kumburuteniwela	2005	2.80	8.6
42	Asupini Ella	2005	4.00	15.9
43	Kalupahana	2005	0.80	-
44	Upper Korawaka	2005	1.50	-
45	Badalgama (Biomass)	2005	1.00	-
46	Delta Estate	2006	1.60	7.5
47	Gomala Oya	2006	0.80	4.6
48	Gurugoda Oya	2006	4.45	12.8
49	Coolbawan	2006	0.75	1.9
50	Henfold	2006	2.60	9.5
51	Dunsinane	2006	2.70	12.3
52	Nilambe oya	2006	0.75	1.9
53	Kolapathana	2006	1.10	2.6
54	Guruluwana	2006	2.00	10.4
55	Kuda Oya	2006	2.00	2.8
56	Labuwewa	2006	2.00	7.4
57	Forest Hill	2006	0.30	0.6
58	Batatota	2007	2.60	14.4
59	Kehelgamu oya	2007	3.00	11.8
60	Kotankanda	2007	0.15	0.6
61	Lower Neluwa	2007	1.45	6.3
62	Barcaple	2008	2.00	8.8
63	Kadawala 1	2008	4.85	13.0

List of Small Power Producers

hydro | solar | biomass/dendro | wind | waste heat

	Name of Power Plant	Yr commissioned	Capacity (MW)	Generation (GWh)
64	Blackwater	2008	1.65	4.2
65	Koswatta ganga	2008	2.00	6.0
66	Kadawala ii	2008	1.32	3.4
67	Loggal oya	2008	4.00	11.2
68	Manelwala	2008	2.40	9.5
69	Somerset	2008	0.80	3.8
70	Sheen	2008	0.56	2.6
71	Palmerston	2008	0.60	3.1
72	Giddawa	2008	2.00	10.5
73	Magal ganga	2008	9.93	53.4
74	Soranathota	2008	1.40	3.0
75	Tokyo	2008	10.00	0.4
76	Lower Atabage	2009	0.45	1.1
77	Halathura Ganga	2009	1.30	6.1
78	Nugedola	2009	0.50	1.5
79	Pathaha Oya	2009	1.00	3.0
80	Badulu Oya	2009	5.80	17.4
81	Amanawala	2009	1.00	5.4
82	Adavikanda	2009	6.50	24.7
83	Bogandana	2009	3.00	12.8
84	Gangaweraliya	2009	0.30	1.4
85	Watakella	2010	1.00	5.7
86	Ganthuna Udagama	2010	1.20	4.5
87	Aggra Oya	2010	1.50	4.7
88	Mampury I	2010	10.00	20.5
89	Seguwanthivu	2010	10.00	24.0
90	Vidatamunai	2010	10.00	24.1
91	Willpita	2010	0.85	0.2
92	Denawak Ganga	2011	1.40	7.9
93	Maduru Oya	2011	5.00	15.6
94	Laymasthota	2011	1.30	3.8
95	Kalupahana Oya (Pahala)	2011	1.00	3.2
96	Bowhill	2011	1.00	5.4
97	Kirkoswald	2011	4.00	21.2
98	Kiriwan Eliya	2011	4.65	21.2
99	Gnnoruwa - II	2011	0.50	0.5
100	Thiruppane	2011	0.12	0.0
101	Gnnoruwa - I	2011	0.74	0.7
102	Nirmalapura	2011	10.00	24.4
103	Watawala B	2012	0.44	2.3
104	Denawak Ganga MHP	2012	7.20	30.6
105	Waltrim	2012	2.00	8.3

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hydro | solar | biomass/dendro | wind | waste heat

	Name of Power Plant	Yr commissioned	Capacity (MW)	Generation (GWh)
106	Branford	2012	2.50	10.9
107	Upper Ritigaha Oya	2012	0.64	2.8
108	Koladeniya	2012	1.20	6.7
109	Upper Magalganga	2012	2.40	8.9
110	Kokawita MHP I	2012	1.00	4.0
111	Upper Hal Oya	2012	0.80	1.2
112	Kalugala Pitawala	2012	0.80	1.2
113	Bambarabotuwa MHP III	2012	4.00	14.8
114	Nandurana Oya	2012	0.35	1.1
115	Kaduruwan Dola Athuraliya	2012	0.02	0.0
116	Barcaple Phase II	2012	4.00	20.1
117	Bopekanda	2012	0.35	1.8
118	Falcon Valley	2012	2.40	6.0
119	Indurana	2012	0.06	0.0
120	Punagala	2012	3.00	11.7
121	Ambewala	2012	3.00	3.6
122	Madurankuliya	2012	10.00	27.4
123	Uppudaluwa	2012	10.00	13.0
124	Kalpitiya	2012	9.80	13.1
125	Green Energy	2013	0.25	1.5
126	Rakwana Ganga	2013	1.00	5.8
127	Wembiyagoda	2013	1.30	6.6
128	Pathanahenagama	2013	1.80	2.1
129	Wellawaya	2013	1.20	3.9
130	Lenadora	2013	1.40	7.4
131	Mulgama	2013	2.80	12.3
132	Rajjammana	2013	6.00	35.0
133	Kandadola	2013	0.18	0.9
134	Waverly	2013	1.20	2.8
135	Bambatuwa Oya	2013	3.00	9.6
136	Baharandah	2013	0.36	1.0
137	Gampola	2013	1.00	1.7
138	Gonagamuwa	2013	0.75	2.0
139	Kadurugaldora	2013	1.20	4.6
140	Werapitiya	2013	2.00	7.8
141	Madugeta	2013	2.50	11.0
142	Malpel	2013	0.01	0.0
143	Dunsinane cottage	2013	0.90	2.1
144	Mile Oya	2013	1.20	3.1
145	Maduru Oya 2	2013	2.00	5.5
146	Mul Oya	2013	3.00	5.5
147	Embilipitiya (Dendro)	2013	1.50	-

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	Name of Power Plant	Yr commissioned	Capacity (MW)	Generation (GWh)
148	Erumbukkudal	2013	4.80	6.1
149	Stellenberg	2014	1.00	3.7
150	Devituru	2014	1.20	5.6
151	Bulathwaththa	2014	3.80	6.5
152	Ranmudu Oya	2014	0.50	2.1
153	Monaraella MHP	2014	1.80	7.5
154	Lower Kotmale Oya MHP	2014	4.30	22.3
155	Gammaduwa MHP	2014	0.90	3.6
156	Ritigaha Oya MHP - I	2014	0.40	2.8
157	Ross Estate MHP	2014	4.55	23.5
158	Maa Oya MHP	2014	2.00	5.0
159	Maha Oya MHP	2014	3.00	10.2
160	Bowhill MHP	2014	0.60	1.5
161	Kudawa Lunugalahena	2014	0.05	0.2
162	Gawaragiriya MHP	2016	0.99	3.6
163	Samanalawewa MHP	2016	1.20	6.5
164	Upper Lemastota MHP	2016	1.00	3.0
165	Kurundu Oya Ella MHP	2016	4.65	14.9
166	Maskeli Oya MHP	2016	2.00	8.4
167	Hittaragewela MHP	2016	0.46	0.0
168	Ginigathhena Thiniyagala MHP	2016	0.80	1.7
169	Dolekanda MHP	2016	0.35	1.6
170	Gomale Oya	2016	1.40	3.7
171	Mawanana	2016	4.30	18.1
172	Ethamala Ella MHP	2016	2.00	12.5
173	Upper Waltrim MHP	2016	2.60	12.4
174	Urubokka MHP	2016	1.00	5.0
175	Ebbawala MHP	2016	4.00	11.0
176	Hulkiridola MHP	2016	0.75	2.2
177	Dambulu Oya MHP	2016	3.25	13.1
178	Saga (Baruthankanda)	2016	10.00	18.8
179	Solar One Ceylon Power	2016	10.00	20.4
180	Loluwagoda DPP	2016	4.00	19.8
181	Kiruwana Ganga MHP	2017	0.63	2.5
182	Ruhunu MHP	2017	0.35	1.4
183	Winsor Forest MHP	2017	0.40	1.8
184	Nahalwathura MHP	2017	0.40	2.7
185	Hapugahakumbura MHP	2017	1.60	5.4
186	Padiyapelella MHP	2017	3.50	18.0
187	Moragaha Oya MHP	2017	1.50	6.1
188	Campion MHP	2017	1.00	4.7
189	Demodara MHP	2017	1.60	7.9

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	Name of Power Plant	Yr commissioned	Capacity (MW)	Generation (GWh)
190	Berannawa MHP	2017	0.50	1.9
191	Loggal Oya DPP	2017	2.00	11.7
192	Iris (Baruthankanda) SPP	2017	10.00	18.9
193	Anorchi Lanka (Baruthankanda) SPP	2017	10.00	18.8
194	Nedunkulam SPP	2017	10.00	19.7
195	Udawela MHP	2018	1.40	3.6
196	Mossville Estate MHP	2018	0.90	4.1
197	Loggal Oya MHP - Phase I	2018	1.60	4.1
198	Bambarapana MHP	2018	2.50	11.1
199	Manakola MHP	2018	2.50	10.4
200	Moragahakanda Phase I	2018	10.00	15.6
201	Moragahakanda Phase II	2018	7.50	31.9
202	Muruten Ela MHP	2018	0.50	1.7
203	Moragahakanda Phase III	2018	7.50	37.6
204	Polgaswaththa MHP	2018	0.30	2.5
205	Maliyadda MHP	2018	0.90	1.3
206	Ankanda MHP	2018	6.50	34.3
207	Thannewatha MHP	2018	1.00	1.4
208	Ranwala Oya MHP	2018	0.70	4.1
209	Binathura Ela MHP	2018	0.70	2.3
210	Panamure DPP	2018	0.99	-
211	Kalawa Aragama DPP	2018	10.00	-
212	Loinorn MHP	2019	1.00	4.2
213	Koswathu Ganga MHP	2019	3.00	17.2
214	Elgin MHP	2019	2.40	10.0
215	Denipalle Oya MHP	2019	0.75	2.6
216	Deegalahinna Cascade II MHP	2019	0.55	0.9
217	Loggal Oya MHP	2019	1.35	3.4
218	Upper Hulu Ganga MHP	2019	1.90	6.8
219	Marukanda MHP	2019	1.80	7.1
220	Ganthuna MHP	2019	1.30	2.6
221	Kitulgala MHP	2019	1.00	4.5
222	Beramana MHP	2019	1.20	7.7
223	Dehiattakandiya DPP	2019	3.00	17.6
224	Vavuniya 2 SBSPII SPP	2019	1.00	1.8
225	Vavuniya 3 SBSPII SPP	2019	1.00	1.8
226	Beliatta 1 SBSPII SPP	2019	1.00	1.5
227	Embilipitiya 2 SBSPII SPP	2019	1.00	1.5
228	Embilipitiya 3 SBSPII SPP	2019	1.00	1.5
229	Pallekelle 1 SBSPII SPP	2019	1.00	1.6
230	Koskulana	2020	0.60	2.2

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	Name of Power Plant	Yr commissioned	Capacity (MW)	Generation (GWh)
231	Halgran Oya MHP	2020	2.00	3.3
232	Chunnakam I	2020	10.00	33.3
233	Chunnakam II	2020	10.00	35.7
234	Pannala I	2020	1.00	1.4
235	Mathugama I	2020	1.00	1.5
236	Anuradhapura 2	2020	1.00	1.4
237	Anuradhapura 3	2020	1.00	1.4
238	Panadura I SBSP II	2020	1.00	1.5
239	Vaunia I	2020	1.00	1.2
240	Embilipitiya I	2020	1.00	1.5
241	Maho 2 SBSP II	2020	1.00	2.2
242	Maho 3 SBSP II	2020	1.00	2.2
243	Ampara I SBSP II	2020	1.00	1.6
244	Mathugama I SBS II 90	2020	1.00	1.6
245	Mathugama I SBS II 91	2020	1.00	2.1
246	Ampara 2 SBSP II	2020	1.00	2.1
247	Mahiyanganaya 1	2020	1.00	2.1
248	Mahiyanganaya 2	2020	1.00	1.7
249	Mahiyanganaya 3	2020	1.00	1.5
250	Galle 2 SBS II 90	2020	1.00	1.5
251	Galle 3 SBS II 91	2020	1.00	1.5
252	Colombo Waste to Energy Waste (Municipal) PP	2020	10.00	70.0
253	Deduru Oya MHP	2021	2.00	5.5
254	Karapalagama MHP	2021	2.00	1.5
255	Madapitiya MHP	2021	0.60	0.8
256	Polonnaruwa 1 SBSPII SPP	2021	1.00	1.7
257	Horana 2 SBSPII SPP	2021	1.00	1.3
258	Horana 3 SBSPII SPP	2021	1.00	1.2
259	Mathugama 2 SBSII(90) SPP	2021	1.00	1.4
260	Anuradhapura 1 SBSPII SPP	2021	1.00	1.1
261	Kilinochchi 1 SBSPII SPP	2021	1.00	1.4
262	Kilinochchi 2 SBSPII SPP	2021	1.00	1.3
263	Kilinochchi 3 SBSPII SPP	2021	1.00	1.4
264	Mathugama I SBS II 90	2020	1.00	0.2
265	Mathugama I SBS II 91	2020	1.00	-
266	Ampara 2 SBSP II	2020	1.00	-
267	Mahiyanganaya 1	2020	1.00	-
268	Mahiyanganaya 2	2020	1.00	0.3
269	Mahiyanganaya 3	2020	1.00	0.3
270	Galle 2 SBS II 90	2020	1.00	-

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	Name of Power Plant	Yr commissioned	Capacity (MW)	Generation (GWh)
271	Galle 3 SBS II 91	2020	1.00	-
272	Valachchenai 2 SBSPII SPP	2021	1.00	-
273	Valachchenai 3 SBSPII SPP	2021	1.00	-
274	Monaragala 2 SBSPII SPP	2021	1.00	0.1
275	Monaragala 3 SBSPII SPP	2021	1.00	0.1
276	Galle 1 SBSII (90) SPP	2021	1.00	0.4
277	Beliatta 3 SBSII (90) SPP	2021	1.00	0.3
278	Maho 1 SBSII (90) SPP	2021	1.00	0.3
279	Beliatta 1 SBSII (90) SPP	2021	1.00	-
280	Anuradhapura 2 SBSII(90) SPP	2021	1.00	-
Total			**641.85**	**2,006.7**

Litro Gas Lanka Limited

Liquefied Petroleum Gas (LPG) industry was privatised in 1995, when Shell Gas purchased a stake in the previously Government-owned Gas Company, under a five-year concession. Over 1995-2000, Shell Gas purchased LPG available in the CPC refinery and also imported LPG, and marketed in Sri Lanka. The monopoly status ended in late 2000. The Company markets LPG to all customer segments, in all provinces of the country.

The full ownership of Shell Gas Lanka (Pvt) Ltd was handed over to the Government in November 2010, forming Litro Gas Lanka Limited (LGLL). Sri Lanka depends on imported LPG to bridge the growing gap between demand and the limited local production by Ceylon Petroleum Corporation’s (CPC) Refinery in Sapugaskanda. To meet this demand, the Government also took steps to purchase the Shell owned LPG Storage Terminal situated in Kerawalapitiya. The LPG Storage Terminal was re-named Litro Gas Terminal Lanka (Private) Limited (LGTLL). Litro Gas also owns a modernised LPG bottling plant situated in Mabima, Sapugaskanda which is one of the largest in the region and a fleet of modernised LPG tanker trucks.

LAUGFS Gas PLC

Established in the year 1995, LAUGFS Holdings is a Sri Lankan diversified business conglomerate covering most of the commercial spectrum of industries. LAUGFS Gas PLC is a subsidiary of Laugfs Holdings Limited. It plays a key role in the importation, storage filling, distribution and sale of Liquefied Petroleum Gas (LPG) for domestic, industrial and auto gas users. LAUGFS hold one of the state-of-art storage and filling facility at Mabima, with a storage capacity of 2,500 tonnes, equipped with a strong dealer network in the country.

Lanka Indian Oil Company (LIOC)

LIOC is a subsidiary of Indian Oil Company, which is owned by the government of India. It operates about 150 petrol & diesel stations in Sri Lanka, and has a very efficient lube marketing network. Its major facilities include an oil terminal at Trincomalee, Sri Lanka's largest petroleum storage facility and an 18,000 tonnes per annum capacity lubricants blending plant and state-of-the-art fuels and lubricants testing laboratory at Trincomalee.

Annex II

Conversion to Uniform Energy Units

For comparison, energy products expressed in their respective units used for ordinary transactions need to be converted to a common equivalent unit. Similar to most other countries, Sri Lanka used tonnes of oil equivalent (toe) as the common denominator for this purpose (1 toe = 10 GCal = 41868000 kJ). Sri Lanka is contemplating using Joules as the common unit in future. Shown below are the conversion factors used for converting each energy product to equivalent toe. After two more years, this publication will cease to report toe as the common energy denominator.

Conversion Factors and Calorific Values

Primary Energy	**toe/t**	**kJ/t**
Bagasse	0.40	16,747,200
Charcoal	0.65	27,214,200
Coal	0.70	29,307,600
Crude Oil	1.03	43,124,040
Fuel wood	0.38	15,909,840
Hydro electricity (thermal equivalent) (toe/GWh)	240.00	10,048,320,000

Products	**toe/t**	**kJ/t**
Aviation Gasoline	1.06	44,380,080
Aviation Turbine Fuel	1.05	43,961,400
Ethane	1.18	49,404,240
Fuel Oil	0.98	41,030,640
Gas Oil /Diesel Oil	1.05	43,961,400
Kerosene	1.05	43,961,400
LPG	1.06	44,380,080
Motor Gasoline (Petrol)	1.09	45,636,120
Naphtha	1.09	45,636,120
Refinery gas	1.15	48,148,200
Residual Oil	0.98	41,030,640
Solvent	0.89	37,262,520

Electricity	**kJ/kWh**
Electricity	3,600

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