MINISTRY OF ENERGY AND PUBLIC UTILITIES

ENERGY OBSERVATORY REPORT

2013

01/2015

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Disclaimer:

The purpose of this energy observatory report is to give an indication on the annual energy use in the country. This report has been compiled using data from the Central Electricity Board, National Transport Authority and Statistics Mauritius. Neither the Energy Efficiency Management Office, nor any of its employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information in this report.

1. INTRODUCTION

This is the fourth report of the Energy Observatory for Mauritius. The aim for setting up of the Energy Observatory, as one of the strategies of the Long Term Energy Strategy of the Ministry of Energy and Public Utilities in the field of Energy Efficiency, is to create a national database on energy usage in order to provide decisions makers with an instrument to monitor energy use and assist in energy management. Its main objective is to present data on energy use in the country with analysis of trends that have occurred.

The Energy Observatory report is provided on an annual basis and is posted on the website of the Energy Efficiency Management Office (EEMO) as an easily accessible source of information to all citizens and policy makers who want information about the energy situation in the country.

The EEMO wishes to acknowledge the cooperation and assistance of the organisations which have contributed for the development of the observatory report for Mauritius namely Statistics Mauritius, the Central Electricity Board and the National Transport Authority.

Note:
- *All data in this document refer to the Republic of Mauritius, unless otherwise specified and may be subject to revision in subsequent issues. The figures for Republic of Mauritius include those for the Island of Mauritius, Island of Rodrigues and Agalega.*
- *Rounding of error may be present on certain totals.*

2. KEY FIGURES

Surface area: 1864.8 km² (Island of Mauritius)

2040 km² (Republic of Mauritius)

Indicator	Unit	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total primary energy requirement	ktoe	1255.8	1293.2	1376.8	1381.8	1404.4	1346.9	1430.7	1426.9	1427.6	1454.8
Imported	*ktoe*	*980.1*	*1030.5*	*1122.1*	*1136.0*	*1140.9*	*1110.6*	*1189.0*	*1195.7*	*1205.3*	*1235.4*
Local	*ktoe*	*275.7*	*262.6*	*254.6*	*245.8*	*263.5*	*236.3*	*241.6*	*231.1*	*222.3*	*219.4*
Annual increase of total primary energy	%	2.7	3.0	6.5	0.4	1.6	-4.1	6.2	-0.3	0.1	1.9
Import Dependency	%	78.0	79.7	81.5	82.2	81.2	82.5	83.1	83.8	84.4	84.9
GDP in 2000 rupees	Rs M	141935	143996	150496	159338	168128	173247	180442	187919	193325	199512
Mid-year population	thousand	1,221	1,228	1,234	1,240	1,244	1,247	1,250	1,252	1,256	1,259
Energy intensity	toe per Rs 100000 GDP (in 2000 rupees)	0.88	0.90	0.91	0.87	0.84	0.78	0.79	0.76	0.74	0.73
Per capita primary energy requirement	toe	1.03	1.05	1.12	1.11	1.13	1.08	1.14	1.14	1.14	1.16

Data Source: Statistics Mauritius

All data in this document refer to the Republic of Mauritius, unless otherwise specified and may be subject to revision in subsequent issues.

3. SUMMARY TABLE 2013

	Fossil Fuels								Renewable Energy				Hydro	Solar		Wind	Electricity	Heat	TOTAL
	Coal	Petroleum products							Biomass										
-" Consumption in ktoe		Gasoline	Diesel	Aviation fuel	Kerosene	Fuel Oil	LPG	Used oils	Bagasse	Landfill Gas	Fuelwood	Charcoal		PV	Thermal		+ Prod	+ Prod	
+' Production and supply																	- Cons	- Cons	
Primary Energy and Supply																			
Local Production (LP)									201.7	1.7	7.3		8.2	0.2		0.3			219.4
Imported Resources	439.2	149.3	339.5	250.7	3.0	411.9	73.7												1667.2
R-exports and bunkering			-115.2	-120.5		-149.8													-385.6
Stocks (+ destocking; - stocking)	1.5	-6.6	-17.2	-9.5	-2.1	-13.5	1.2												-46.212
TOTAL Primary Energy (PE)	440.6	142.7	207.0	120.7	0.9	248.5	74.9	0.0	201.7	1.7	7.3	0.0	8.2	0.2	0.0	0.3	0.0	0.0	1454.8
% Energy independence (LP/PE)																			15.1
Secondary Energy																			
Coal input for electricity production	-423.6																104.4		-319.2
Fuel Oil and diesel input for electricity production			-1.3			-207.5											92.5		-116.3
Bagasse input for electricity production									-169.0								40.7		-128.3
Kerosene input for electricity production					-0.7												0.1		-0.5
Biogas input for electricity production										-1.7							1.7		0.0
Hydro input for electricity production													-8.2				8.2		0.0
PV input for electricity production PV														-0.2			0.2		0.0
Wind input for electricity production																-0.3	0.3		0.0
Electricity production own use																	-3.6		-3.6
Solar Thermal heat production																			0.0
Fuelwood to charcoal											-0.9	0.4							-0.5
TOTAL Secondary supply (SS)	-423.6	0.0	-1.3	0.0	-0.7	-207.5	0.0	0.0	-169.0	-1.7	-0.9	0.4	-8.2	-0.2	0.0	-0.3	244.5	0.0	-568.4
Energy Distribution																			
Final distribution (D=PE+SS)	17.1	142.7	205.7	120.7	0.2	41.0	74.9	0.0	32.7	0.0	6.4	0.4	0.0	0.0	0.0	0.0	244.5	0.0	886.4
Losses (L=(D+F))	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-15.8	0.0	-15.8
TOTAL final distribution (D+L)	17.1	142.7	205.7	120.7	0.2	41.0	74.9	0.0	32.7	0.0	6.4	0.4	0.0	0.0	0.0	0.0	228.7	0.0	870.6
																			870.6
Final Energy Consumption																			
Manufacturing	-17.1		-35.8			-37.6	-5.8		-32.7		-0.5						-82.8		-212.3
Commercial							-14.3					-0.4					-73.4		-88.1
Household					-0.2		-50.1				-5.9	-0.1					-67.1		-123.4
Transport		-142.7	-167.6	-120.7		-3.4	-4.4										0.0		-438.8
Agriculture			-2.3														-2.2		-4.5
Others							-0.3										-3.3		-3.5
TOTAL (F)	-17.1	-142.7	-205.7	-120.7	-0.2	-41.0	-74.9	0.0	-32.7	0.0	-6.4	-0.4	0.0	0.0	0.0	0.0	-228.7	0.0	-870.6

4. SUMMARY TABLE 2012

-' Consumption in ktoe
+' Production and supply

		Fossil Fuels							Renewable Energy											
	Coal	Petroleum products							Biomass				Hydro	Solar		Wind	Electricity	Heat	TOTAL
		Gasoline	Diesel	Aviation fuel	Kerosene	Fuel Oil	LPG	Used oils	Bagasse	Landfill Gas	Fuelwood	Charcoal		PV	Thermal		+Prod / -Cons	+Prod / -Cons	
Primary Energy and Supply																			
Local Production (LP)									206.5	1.5	7.5		6.4	0.1		0.3			222.3
Imported Resources	452.2	138.4	316.9	221.5	7.3	385.2	73.3												1594.9
R-exports and bunkering			-103.7	-114.7		-156.8													-375.2
Stocks (+ destocking; - stocking)	-33.8	-1.9	0.2	8.2	-3.5	17.1	-0.6												-14.4
TOTAL Primary Energy (PE)	418.4	136.6	213.4	115.0	3.8	245.4	72.7	0.0	206.5	1.5	7.5	0.0	6.4	0.1	0.0	0.3	0.0	0.0	1427.6
% Energy independence (LP/PE)																			15.6
Secondary Energy																			
Coal input for electricity production	-402.5																100.0		-302.5
Fuel Oil and diesel input for electricity production			-1.9			-204.5											90.9		-115.5
Bagasse input for electricity production									-172.4								40.5		-132.0
Kerosene input for electricity production					-3.6												0.9		-2.6
Biogas input for electricity production										-1.5							1.5		0.0
Hydro input for electricity production													-6.4				6.4		0.0
PV input for electricity production PV														-0.1			0.1		0.0
Wind input for electricity production																-0.3	0.3		0.0
Electricity production own use																	-3.7		-3.7
Solar Thermal heat production																			0.0
Fuelwood to charcoal											-0.9	0.4							-0.5
TOTAL Secondary supply (SS)	-402.5	0.0	-1.9	0.0	-3.6	-204.5	0.0	0.0	-172.4	-1.5	-0.9	0.4	-6.4	-0.1	0.0	-0.3	236.8	0.0	-556.8
Energy Distribution																			
Final distribution (D=PE+SS)	15.9	136.6	211.5	115.0	0.3	40.9	72.7	0.0	34.1	0.0	6.6	0.4	0.0	0.0	0.0	0.0	236.8	0.0	870.9
Losses (L=(D+F))	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-16.5	0.0	-16.5
TOTAL final distribution (D+L)	15.9	136.6	211.5	115.0	0.3	40.9	72.7	0.0	34.1	0.0	6.6	0.4	0.0	0.0	0.0	0.0	220.4	0.0	854.4
																			854.4
Final Energy Consumption																			
Manufacturing	-15.9		-41.7			-37.4	-5.9		-34.1		-0.5						-79.9		-215.5
Commercial							-12.9					-0.4					-70.4		-83.7
Household					-0.3		-49.0				-6.1	-0.1					-64.7		-120.1
Transport		-136.6	-167.4	-115.0		-3.5	-4.7										0.0		-427.3
Agriculture			-2.4														-2.1		-4.5
Others							-0.3										-3.1		-3.4
TOTAL (F)	-15.9	-136.6	-211.5	-115.0	-0.3	-40.9	-72.7	0.0	-34.1	0.0	-6.6	-0.4	0.0	0.0	0.0	0.0	-220.4	0.0	-854.4

5. PERCENTAGE GROWTH IN 2013 COMPARED TO 2012

	Coal	Fossil Fuels — Petroleum products							Renewable Energy — Biomass				Hydro	Solar		Wind	Electricity	Heat	TOTAL
		Gasoline	Diesel	Aviation fuel	Kerosene	Fuel Oil	LPG	Used oils	Bagasse	Landfill Gas	Fuelwood	Charcoal		PV	Thermal				
Primary Energy and Supply																			
Local Production (LP)									-2.3%		-2.9%		28.0%			0.9%			-1.3%
Imported Resources	-2.9%	7.8%	7.1%	13.2%	-59.6%	6.9%	0.5%												4.5%
TOTAL Primary Energy (PE)	10.3%	4.5%	-3.0%	5.0%	-77.0%	1.3%	3.0%		-2.3%		-2.9%		28.0%			0.9%			1.9%
Secondary Energy																			
Coal input for electricity production	5.2%																4.4%		5.5%
Fuel Oil and diesel input for electricity production			-31.6%			1.5%											1.8%		0.7%
Bagasse input for electricity production									-2.0%								0.5%		-2.8%
Kerosene input for electricity production					-81.2%												-84.5%		-80.1%
Biogas input for electricity production																			
Hydro input for electricity production													28.0%				28.0%		
PV input for electricity production PV																			
Wind input for electricity production																0.9%	0.9%		
Electricity production own use																	-2.8%		-2.8%
Solar Thermal heat production																			
Fuelwood to charcoal											0.0%	0.0%							0.1%
TOTAL Secondary supply (SS)	5.2%		-31.6%		-81.2%	1.5%			-2.0%		0.0%	0.0%	28.0%			0.9%	3.2%		2.1%
Final Energy Consumption																			
Manufacturing	7.4%		-14.2%			0.6%	-2.0%				-1.8%						3.5%		-1.5%
Commercial							11.5%					1.8%					4.1%		5.3%
Household					-16.9%		2.3%				-3.4%	-2.8%					3.7%		2.7%
Transport		4.5%	0.1%	5.0%		-4.1%	-6.8%												2.7%
Agriculture			-0.5%														1.7%		0.6%
Others							4.6%										5.2%		5.1%
TOTAL (F)	7.4%	4.5%	-2.7%	5.0%	-16.9%	0.2%	3.0%				-3.2%	0.9%					3.8%		1.9%

6. ENERGY PATTERN 2013

Renewables
219.4 ktoe

Wind	0.3 ktoe
Hydro	8.2 ktoe
Photovoltaic	0.2 ktoe
Bagasse	201.7 ktoe
Fuelwood	7.3 ktoe
Landfill gas	1.7 ktoe

Total Primary Energy Requirement 1454.8 ktoe

RE 219.4 ktoe
15.1 %

RE 49.5 ktoe

RE 39.1 ktoe

RE 10.4 ktoe

RE 169.9 ktoe

Re-Exports, Bunkering + Stock change -431.8 ktoe

Fossil 602.3 ktoe

73.7 ktoe	LPG	74.9 ktoe
149.3 ktoe	Gasoline	142.7 ktoe
250.7 ktoe	Aviation Fuel	120.7 ktoe
3.0 ktoe	Kerosene	0.9 ktoe
339.5 ktoe	Diesel	207.0 ktoe
411.9 ktoe	Fuel Oil	248.5 ktoe
439.2 ktoe	Coal	440.6 ktoe

Fossil fuel Imports

1667.2 ktoe

Fossil

1235.4 ktoe
84.9 %

Fossil 633.1 ktoe

Total Primary fuel input for transformation 803.0 ktoe

238.2 ktoe

Transformational losses -564.8 ktoe

237.7 ktoe

Own use -3.6 ktoe

244.5 ktoe

234.1 ktoe

0.4 ktoe

228.7 ktoe

Distribution losses -15.8 ktoe

Total final Energy Consumption 870.6 ktoe

641.8 ktoe

-129.5 ktoe	Manufacturing
-14.7 ktoe	Commercial
-56.2 ktoe	Household
-438.8 ktoe	Transport
-2.3 ktoe	Agriculture
-0.3 ktoe	Others

-82.8 ktoe	Manufacturing
-73.4 ktoe	Commercial
-67.1 ktoe	Household
0.0 ktoe	Transport
-2.2 ktoe	Agriculture
-3.3 ktoe	Others

7. TABLE OF ENERGY INDICATORS

Item	Indicators	Unit	2012	2013	% change
Primary Energy Consumption	Primary Energy Consumption	ktoe	1427.66	1454.84	1.90
	Share of local resources: local primary consumption/total primary consumption	%	15.57	15.08	-3.16
Energy intensity	Energy intensity per capita: Primary energy Consumption/capita	toe/capita	1.14	1.16	1.68
	Energy intensity per 100,000 (2000 Rupees): Primary Energy Consumption/GDP	toe/Rs	0.74	0.73	-1.26
Electricity Production	Total fossil fuel input for electricity production	ktoe	612.44	633.08	3.37
	Total renewable input for electricity production	ktoe	180.73	179.40	-0.74
	Total electricity production	GWh	2797.17	2885.30	3.15
	Penetration of renewable resources	%	20.26	20.58	1.57
Final electricity consumption per sector	Total electricity sold	GWh	2294.36	2384.10	3.91
	Domestic sector[1]	%	32.82	32.75	-0.21
	Commercial sector	%	35.68	35.74	0.15
	Industrial sector	%	29.96	30.00	0.13
	Electricity consumption per consumer (Domestic)	MWh/consumer	1.98	2.01	1.61
	Electricity consumption per consumer (Commercial)	MWh/consumer	21.24	21.74	2.31
	Electricity consumption per consumer (Industrial)	MWh/consumer	101.64	106.70	4.98
Final energy consumption in transport sector	Total energy consumption	ktoe	427.28	438.73	2.68
CO_2 Emissions	Total emissions	$ktCO_2$	3743.30	3835.50	2.46
	Energy sector	%	60.92	61.63	1.16
	Manufacturing sector	%	8.84	8.27	-6.40
	Transport sector	%	25.49	25.28	-0.82
	Residential sector	%	3.60	3.59	-0.27
	Others	%	1.16	1.24	6.74
	CO_2 emissions per capita	tCO_2/capita	2.98	3.05	2.24
	Grid emissions factor	gCO_2/kWh	1000	--------[2]	--------

Data Source: Statistics Mauritius

Table 7-1: Energy indicators 2012 - 2013

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[1] Domestic sector in this document includes CEB residential consumers, charitable and religious institutions.

[2] Grid emissions factor for 2013 is not available by the CEB at this stage.

8. ENERGY SUPPLY

8.1 Introduction

The energy supply of Mauritius is divided into:

- Imports of primary energy (*Fossil fuels: Fuel Oil, Liquefied Petroleum Gas, Gasoline, Diesel, Kerosene, Aviation fuel, Coal*)
- Production of primary energy (*Local resources: Bagasse, hydro, wind, landfill gas, fuelwood, photovoltaic*)
- Primary energy bunkering and re-exports
- Variation of stocks

These elements allow us to know the primary energy consumption of Mauritius.

8.2 Imports

The imports of energy sources in 2013 totalled 1667.2 ktoe as shown in Table 8.1

Fossil Energy Imports 2013	ktonne	ktoe
Coal	708.3	439.2
Gasoline	138.2	149.3
Diesel oil	336.1	339.5
Aviation fuel	241.1	250.7
kerosene	2.8	3.0
Fuel oil	429.1	411.9
Liquefied Petroleum Gas (LPG)	68.2	73.7
TOTAL		1667.2

Data Source: Statistics Mauritius

Table 8-1: Imports of energy sources

The distribution of the imports of energy sources are shown in Figure 8-1.
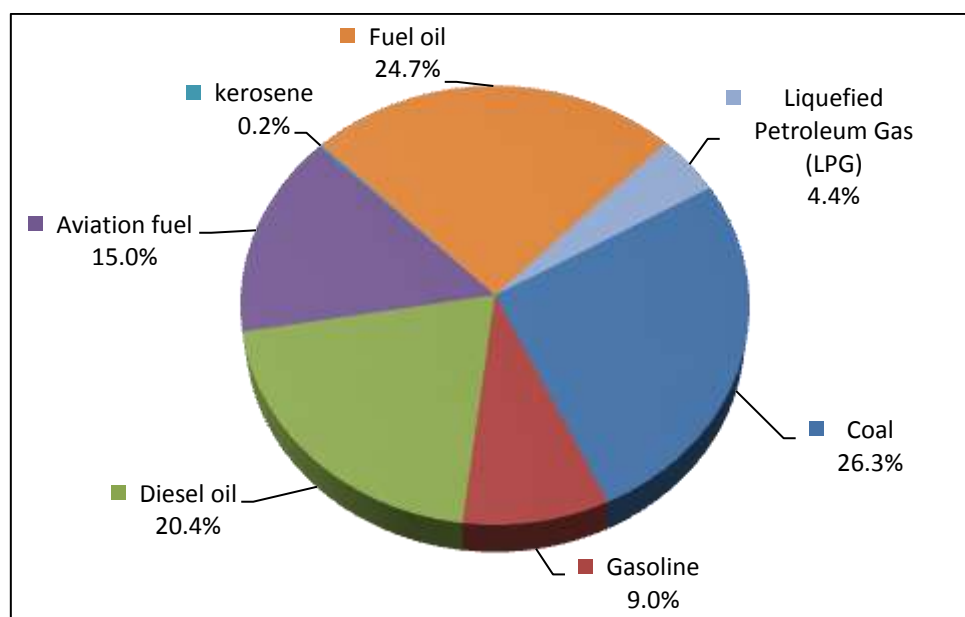
Data Source: Statistics Mauritius - Percentages refer to values in ktoe

Figure 8-1: Fossil energy imports 2013

Petroleum products are intended mostly for the sectors of transport, electricity generation, manufacturing, household, commercial and agriculture sectors, while coal is used primarily for power generation from thermal coal/bagasse power plants with a small fraction being used in the manufacturing sector. In the household sector, Liquefied Petroleum Gas (LPG) is used mainly as cooking and water heating fuel, to a lesser extent as fuel for vehicles. A minor level of kerosene is also used in the household sector for cooking.

Figure 8-2 shows the trend of fossil fuel imports over the period 2004 – 2013.
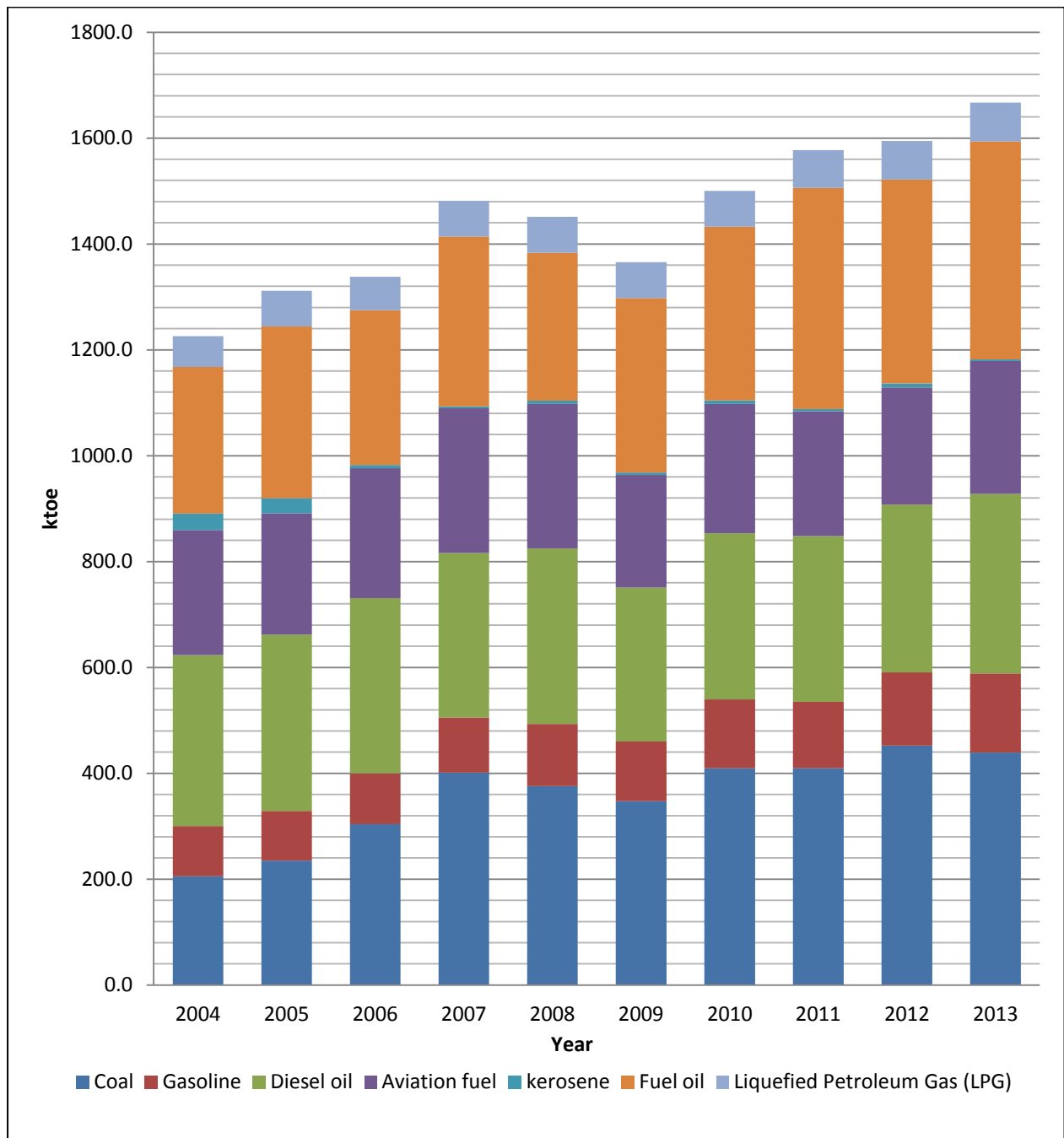
Data Source: Statistics Mauritius

Figure 8-2: Trend of fossil fuel imports

In 2013 imports of fossil fuels increased by 4.5% compared to 2012. The total import bill of energy sources for 2013 amounted to Rs. 34,915 M, representing an increase of 4.5% over 2012.
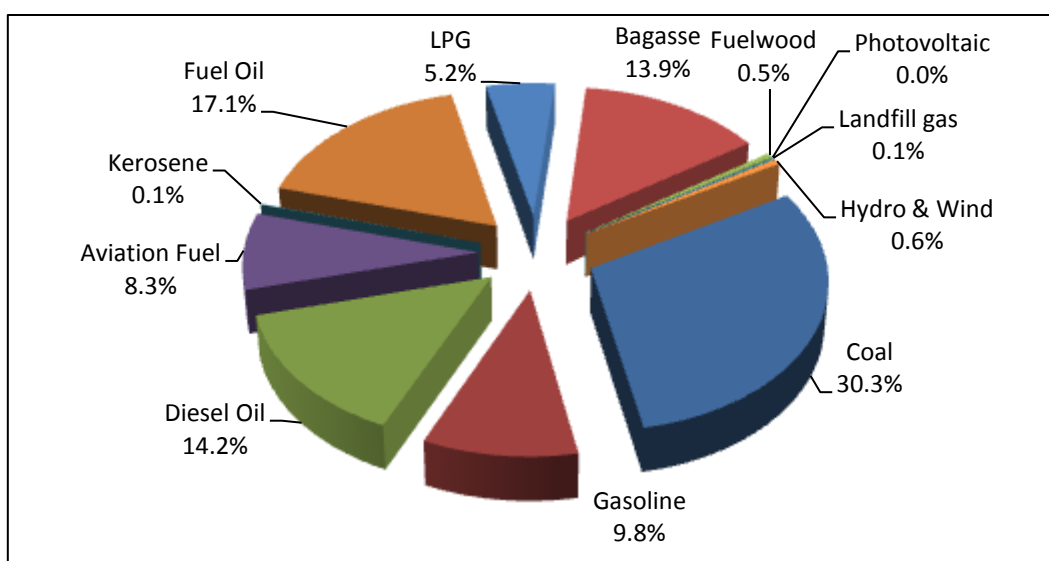
8.3   Primary energy requirement 2013

The primary energy requirements are met from imported sources and from local renewable sources as shown in Table 8-2.

Primary Energy Requirement (ktoe)		2012	2013	% change
Imported fuels	Coal	418.4	440.6	5.3 %
	Gasoline	136.6	142.7	4.5 %
	Diesel Oil	213.4	207.1	-3.0 %
	Aviation Fuel	115.0	120.7	5.0 %
	Kerosene	3.8	0.8	-78.3 %
	Fuel Oil	245.4	248.5	1.3 %
	LPG	72.7	74.9	3.1 %
	Sub Total	**1205.3**	**1235.4**	**2.5 %**
Local resources	Bagasse	206.5	201.7	-2.3 %
	Fuelwood	7.5	7.3	-2.9 %
	Photovoltaic	0.1	0.2	199.5 %
	Landfill gas	1.5	1.7	12.4 %
	Hydro & Wind	6.7	8.5	26.7 %
	Sub Total	**222.3**	**219.4**	**-1.3 %**
	TOTAL	**1427.7**	**1454.8**	**1.9 %**

Data Source: Statistics Mauritius

Table 8-2: Primary energy requirement 2012 - 2013

In 2013, primary energy requirement from fossil fuels amounted to 1235.4 ktoe representing an increase of 2.5% compared to 2012. Figure 8-3 shows the share of fuel source in the primary energy requirement for year 2013.

Data Source: Statistics Mauritius

Figure 8-3: Primary energy requirement (ktoe)

8.4 Production of Primary energy – Local Renewable Sources

Examples of renewable energy sources are wind, solar, geothermal, wave, tidal, hydro energy including energy derived from biomass, landfill gas, sewage gas and biogas. In Mauritius the main sources of renewable energy exploited are biomass (in the form of bagasse) and hydro.

Total local resources in 2013 amounted to 219.4 ktoe distributed as shown in Table 8-3.
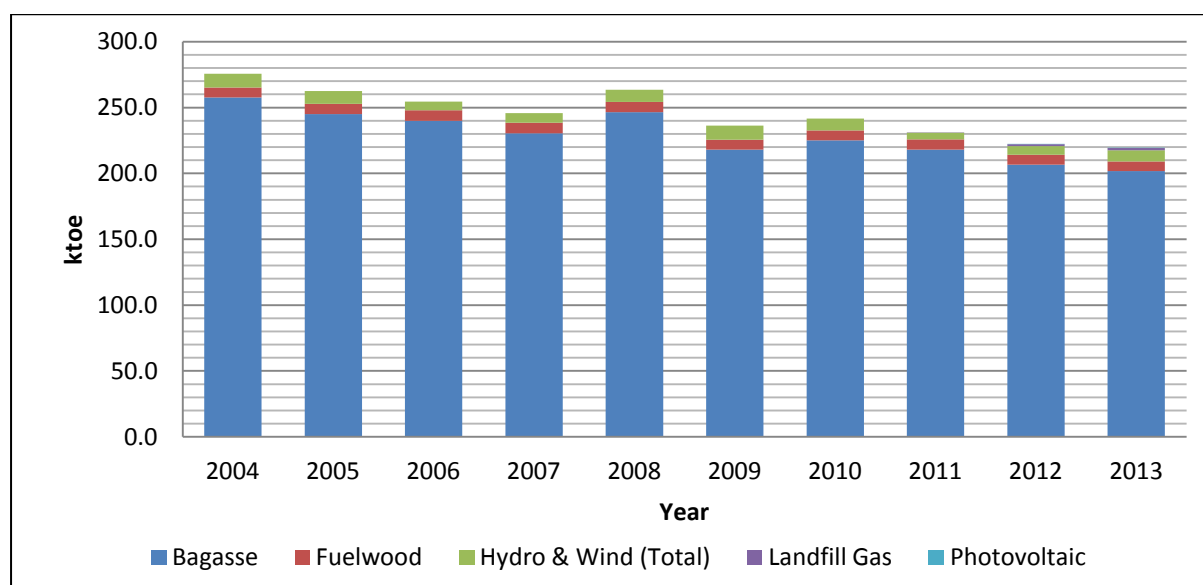
Local Resources	ktoe	
	2012	2013
Bagasse	206.5	201.7
Fuelwood	7.5	7.3
Photovoltaic	0.1	0.2
Landfill gas	1.5	1.7
Hydro & Wind	6.7	8.5
Total	**222.3**	**219.4**

Data Source: Statistics Mauritius

Table 8-3: Primary energy supply in 2013

In 2013, primary energy from local resources decreased by 1.3 %, compared to 2012. Bagasse is the main source of primary energy from local resources. Compared to 2012 we observe a reduction in primary energy obtained from bagasse. Primary energy obtained from photovoltaic has doubled due to the Small Scale Distributed Generation (SSDG) (http://ceb.intnet.mu/grid_code/project.asp) scheme implemented by the CEB which allows Small Independent Power Producers (SIPP) to feed excess electricity generated through PV plants installed on their premises to the CEB grid.

Figure 8-4 shows the trend of primary energy obtained from local resources from 2004 to 2013:

Data Source: Statistics Mauritius

Values for fuel wood are estimates.

Figure 8-4: Trend of Primary energy from Local Resources, 2004 - 2013

8.4.1 Hydroelectricity

There were ten hydro power plants in operation as at December 2013 across the Island of Mauritius, including the additional hydro power plant at Midlands Dam Reservoir with an effective capacity of 0.4 MW.
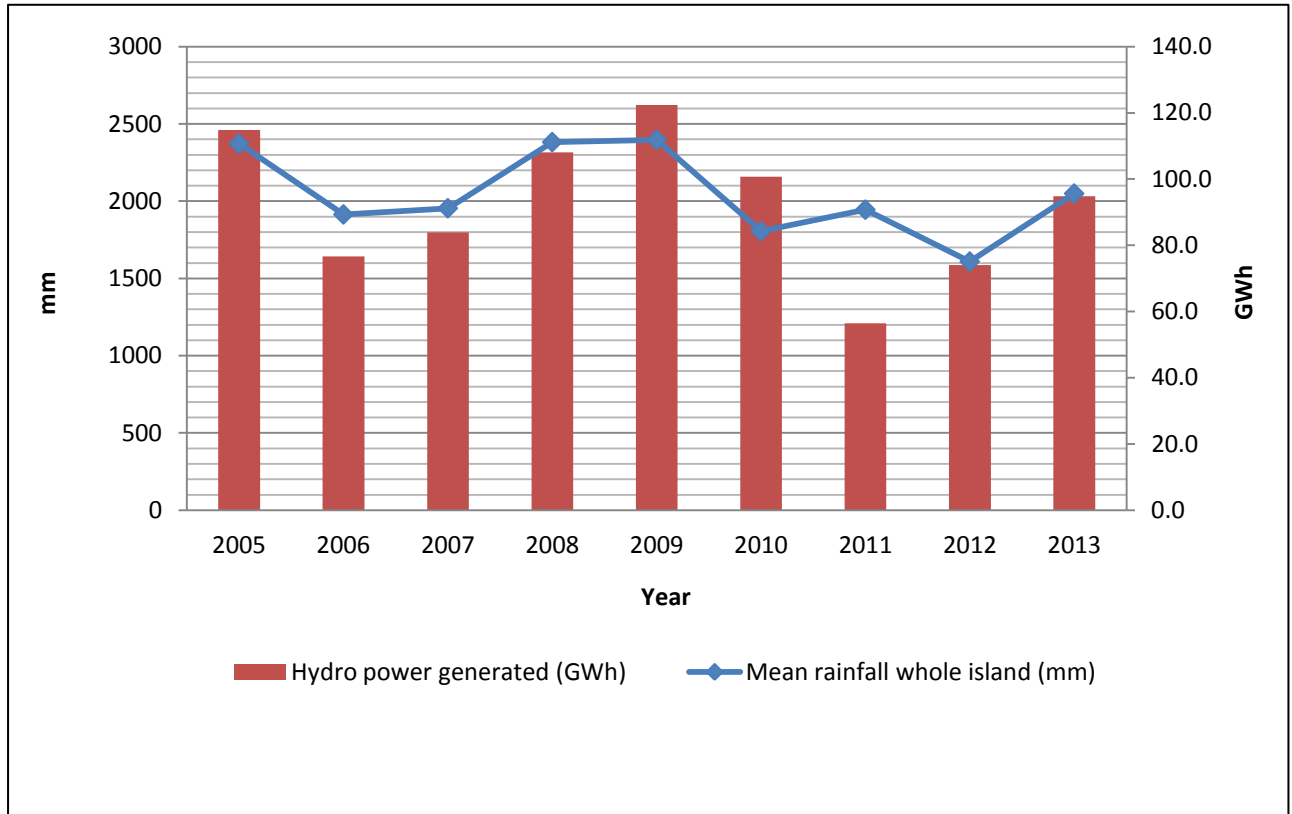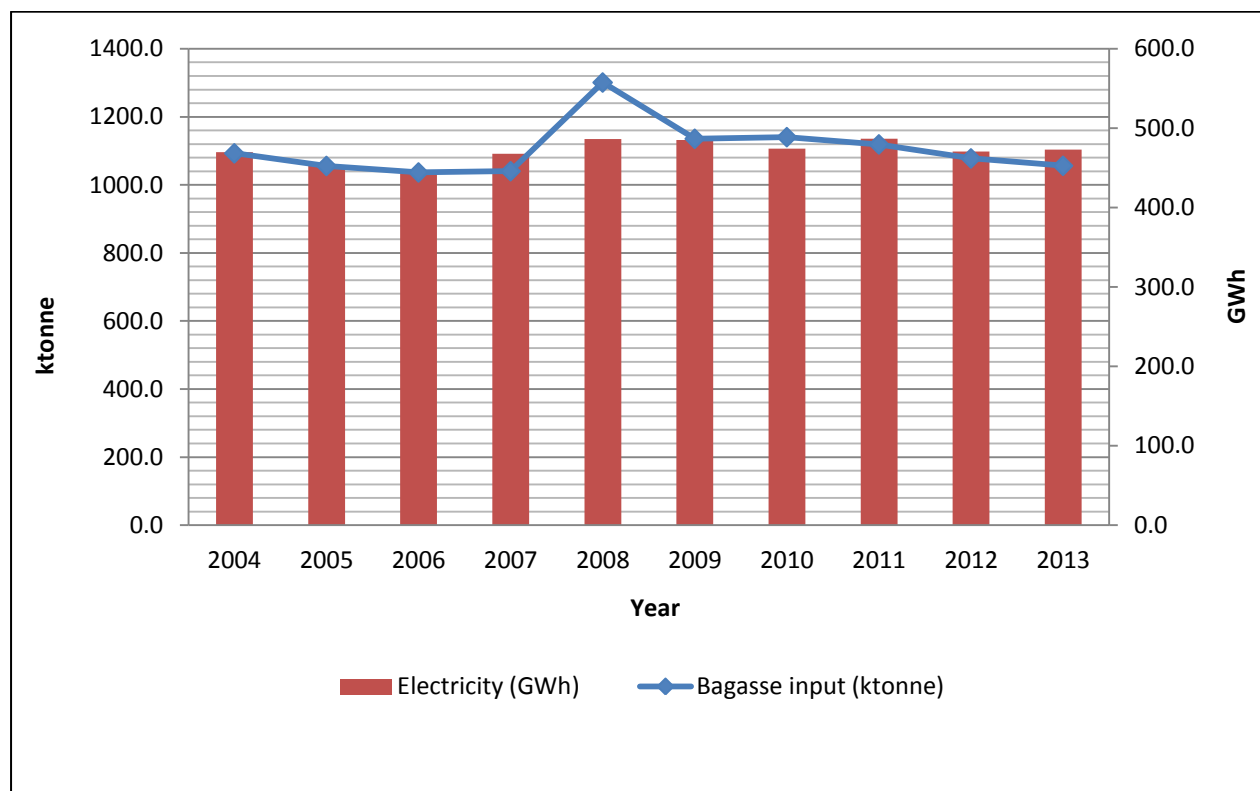

Data Source: Statistics Mauritius

Figure 8-5: Trend of hydro-electric generation, 2004 to 2013

Hydroelectric power generation accounted for 3.3% of electricity produced in 2013. Fluctuations in hydro electric power generation tend to follow the trend in annual rainfall levels as shown in figure 8-5 above. In 2011, the discrepancy between hydro electric power generation and rainfall level is attributed to the water shortage that affected the island of Mauritius where water, that otherwise, would have been used for hydro electric power generation had to be diverted for use in other sectors.

8.4.2 Bagasse

Bagasse is the fibrous residue of sugar cane used by sugar factories for heat production to meet their own requirements. Thermal power plants found mostly on sugar estates use the high pressure steam produced from bagasse to produce electricity.

Data Source: Statistics Mauritius

Figure 8-6: Trend of electricity generation from bagasse, 2004 to 2013

Figure 8-6 gives the bagasse input for electricity generation and the amount generated over the period 2004 to 2013. The decrease in the amount generated is due to a decrease in amount of bagasse available as a result of conversion of agricultural lands to residential and commercial areas.

Table 8-4 shows the ratio of electricity produced per tonne of bagasse over the period 2004 to 2013.

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Ratio electricity produced to bagasse input (MWh/tonne)	0.43	0.43	0.43	0.45	0.37	0.43	0.42	0.43	0.44	0.45

Table 8-4: Ratio of electricity produced per tonne of bagasse, 2004 - 2013

The ratio has been more or less stable in the range of 0.42 MWh/tonne to 0.45 MWh/tonne during the past decade. In 2013 the ratio of electricity produced per tonne of bagasse was 0.45. Also 16.4 % of electricity production was from bagasse representing a decrease of 0.4% compared to 2012.

8.4.3   Photovoltaics (PV)

Photovoltaic is a method of generating electrical power by converting solar radiation into direct current electricity using semiconductors.

In December 2010, the Central Electricity Board in collaboration with the Ministry of Energy and Public Utilities launched the Small Scale Distributed Generation (SSDG) scheme. A Grid Code developed for this scheme, allows Small Independent Power Producers (SIPP) to generate electricity through micro, mini or small PV, wind or hydro power plants installed on their premises. The initial scheme was limited to an installation capacity of 2 MW. This was subsequently increased to 3MW, with 2.8 MW for Mauritius and 200 kW for Rodrigues. The surplus electricity generated is sold to the CEB at a subsidised rate as defined by the Feed In Tariffs for a period of fifteen years. Thereafter, the tariff for selling the surplus electricity to the CEB would be the marginal electricity production cost of the CEB.

A Public, Educational, Charitable and Religious (PECR) Scheme was introduced with a limit of 2MW. The tariff applied under the scheme is that of the marginal cost of electricity production of the CEB.

8.4.4   Electricity from Wind energy

Wind energy comes from the movement of air across the atmosphere of the Earth. Wind power is the conversion of wind energy into a useful form of energy, such as using wind turbines to generate electricity, windmills for mechanical power, wind pumps for water pumping or sails to propel ships. 3.6 GWh of electricity was produced from wind energy in Rodrigues Island same as in 2012. Two large wind power projects are in the pipeline for Mauritius. This comprises a 29.4 MW plant by Consortium Suzlon-Padgreen Co Ltd and a 9MW plant by Eole Plaines des Roches Ltd for which Power Purchase Agreements were signed in August 2012 and July 2013 respectively.

8.4.5   Electricity from Landfill gas

Landfill gas is a gas, constituted of mostly methane, produced by the fermentation of organic waste in landfills in the absence of oxygen. 20.0 GWh of electricity was produced from Landfill gas in Mauritius in 2013, representing an increase of 12.4% compared to 2012.

8.4.6   Solar Thermal – Solar water heaters in Mauritius

Solar water heaters are mostly used on an individual basis with the latest technology in use being evacuated tubes that are more efficient that conventional flat plate water heater. Large scale installations are found in hotels and textile factories and are used to preheat water for boilers/ swimming pools.
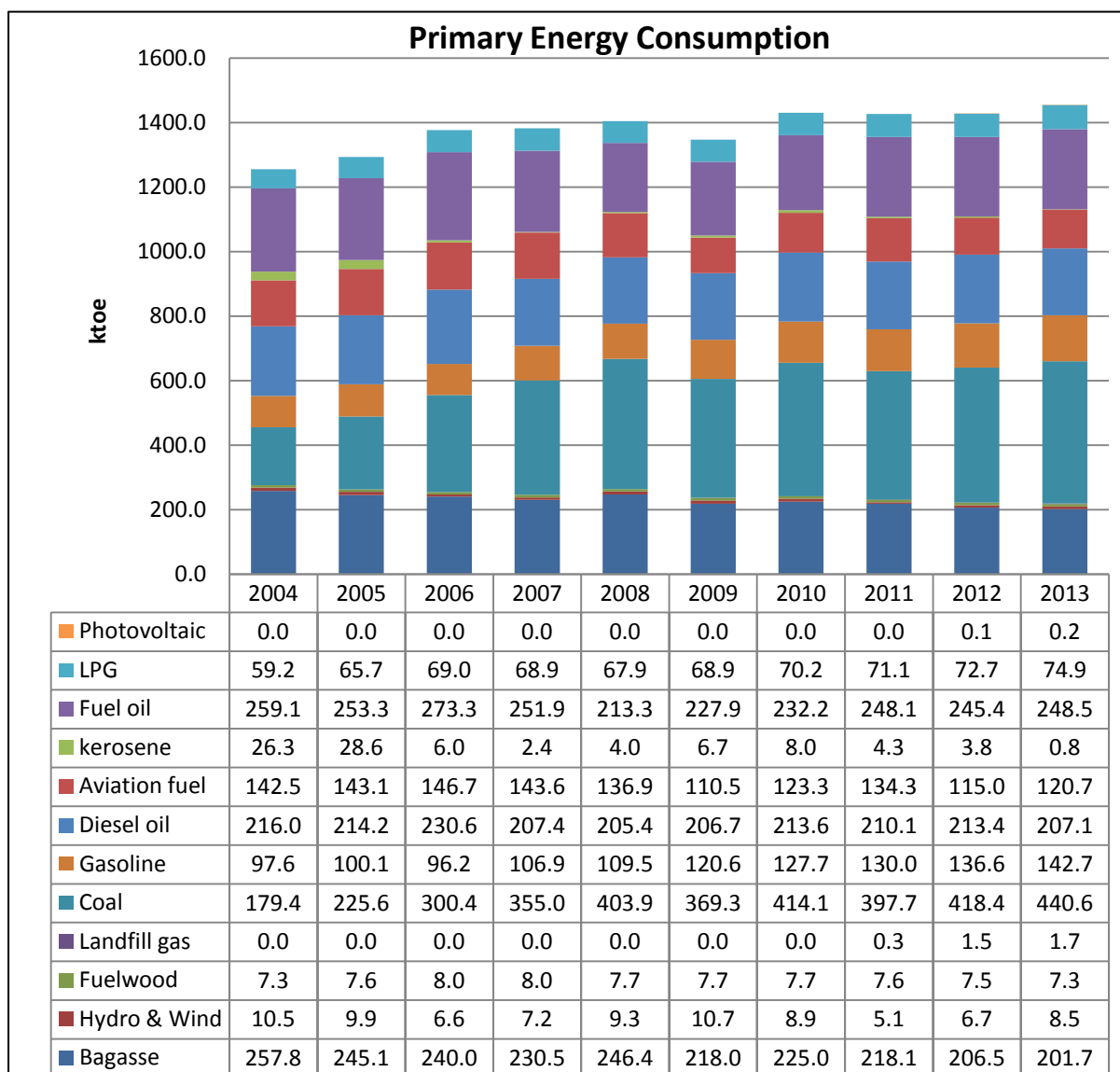
By the end of 2013, there were at least 76,742 solar water heaters installed, used mainly for the purpose of water heating for bathing. This figure has been calculated from the 41 842 SWH provided by the Housing National Census 2011, plus the 34 900 SWH subsidised during the MID Fund schemes 2 and 3. A few additional SWH may have also been installed since 2011 outside the MIDF, without subsidies

The solar energy captured by this estimated number of water heaters correspond to about **4.6 ktoe** under the assumption that the solar insolation of the island of Mauritius is around 660kWh/m^2/year and that the average solar factor and surface area of a solar water heater is 0.7 and 1.5 m^2 respectively. This would mean an avoided electricity consumption of approximately 8.7 GWh and an

avoided Liquefied Petroleum Gas (LPG) of approximately 3,530 Tonne. The installation of solar water heaters has therefore avoided the emission of about 17 ktCO$_2$.

8.5   Primary energy consumption

The evolution of primary energy consumption over the period 2004 to 2013 is shown in Figure 8-7.

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Photovoltaic	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
LPG	59.2	65.7	69.0	68.9	67.9	68.9	70.2	71.1	72.7	74.9
Fuel oil	259.1	253.3	273.3	251.9	213.3	227.9	232.2	248.1	245.4	248.5
kerosene	26.3	28.6	6.0	2.4	4.0	6.7	8.0	4.3	3.8	0.8
Aviation fuel	142.5	143.1	146.7	143.6	136.9	110.5	123.3	134.3	115.0	120.7
Diesel oil	216.0	214.2	230.6	207.4	205.4	206.7	213.6	210.1	213.4	207.1
Gasoline	97.6	100.1	96.2	106.9	109.5	120.6	127.7	130.0	136.6	142.7
Coal	179.4	225.6	300.4	355.0	403.9	369.3	414.1	397.7	418.4	440.6
Landfill gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.5	1.7
Fuelwood	7.3	7.6	8.0	8.0	7.7	7.7	7.7	7.6	7.5	7.3
Hydro & Wind	10.5	9.9	6.6	7.2	9.3	10.7	8.9	5.1	6.7	8.5
Bagasse	257.8	245.1	240.0	230.5	246.4	218.0	225.0	218.1	206.5	201.7

Data Source: Statistics Mauritius

Figure 8-7: Primary energy consumption

8.6   Petroleum products

The State Trading Corporation (STC) is responsible for the importation of all the country's requirements of petroleum products. These include the demands for the running of public transport, industrial and commercial activities, private motor vehicles, the needs of the Central Electricity Board in fuel oils for its power plants, the needs for aircraft refuelling at the SSR International Airport and the needs of bunker fuels for international shipping.

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Gasoline	87.7	86.8	88.9	96.4	108.5	104.4	120.6	116.7	128.2	138.2
Diesel oil	319.7	329.9	327.5	307.5	328.5	288.0	310.4	309.9	313.8	336.1
Aviation fuel	227.0	220.1	236.0	262.6	262.2	204.7	234.9	226.4	213.0	241.1
Kerosene	29.8	27.9	6.0	3.7	5.9	4.1	6.7	4.3	7.0	2.8
Fuel oil	288.8	337.5	304.4	333.9	291.0	343.7	341.5	434.8	401.2	429.1
Liquefied Petroleum Gas (LPG)	53.8	62.7	58.8	62.8	63.1	62.6	62.7	66.3	67.9	68.2
TOTAL (thousand tonnes)	**1006.9**	**1064.9**	**1021.5**	**1066.9**	**1059.2**	**1007.6**	**1076.7**	**1158.4**	**1131.1**	**1215.5**

Data Source: Statistics Mauritius

Table 8-5: Demand for petroleum products, 2004 - 2013

Table 8-5 shows the demand for petroleum products over the period 2004 to 2013. It may be noted that annual demand in Petroleum Products to meet domestic and international demand increased by 7.5% from 1,131,100 tonnes in 2012 to 1, 215,500 tonnes in 2013.

The local oil companies comprise:
(i)   Vivo (Mauritius) Ltd (Ex-Shell);
(ii)   Total Mauritius Ltd;
(iii) Engen (Mauritius) Ltd; and
(iv) Indian Oil (Mauritius) Ltd

The oil companies market, distribute and retail the products through their respective networks of about 137 filling stations across the country. Some also operate barges to carry out their bunker supply operations at sea.

8.7   Stock variation in 2013:

The variations in stock in 2013 are provided in the Table 8-6.

	2013							
	Import		Export		Consumption		Import-Export-Consumption	
	ktonne	ktoe	ktonne	ktoe	ktonne	ktoe	ktonne	ktoe
Coal	708.3	439.2			710.7	440.6	-2.4	-1.4
Gasoline	138.2	149.3			132.1	142.7	6.1	6.6
Diesel oil	336.1	339.5	114.1	115.2	205.0	207.1	17.0	17.2
Aviation Fuel	241.1	250.7	115.9	120.5	116.1	120.7	9.1	9.5
Kerosene	2.8	3.0			0.9	0.9	2.0	2.1
Fuel oil	429.1	411.9	156.1	149.8	258.9	248.5	14.1	13.6
LPG	68.2	73.7			69.3	74.9	-1.1	-1.2

Data Source: Statistics Mauritius
Note: A negative value indicates drawing from existing reserves.

Table 8-6: Variation in stock in 2013

8.8   Energy Import Dependency Rate

In 2013, the energy import dependency rate was **84.9 %**. The trend of the energy import dependency rate from 2004 to 2013 is shown in Table 8-8.

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Percentage (%)	78.0	79.7	81.5	82.2	81.2	82.5	83.1	83.8	84.4	84.9

Table 8-7: Energy Import dependency Rate, 2004 - 2013

9. ELECTRICITY PRODUCTION CAPACITY

The capacity of power plants connected to the grid in 2013 is shown in Table 9-1.

Type of power plant		Installed plant capacity (MW)	Total Installed plant capacity (MW)	Effective plant capacity (MW)	Total effective plant capacity (MW)
BAGASSE (during cane harvest)	Medine	12.5	12.5	12.5	12.5
	Union St Aubin				
COAL- BAGASSE	Alteo Energy Limited	36.7	226.3	33.0	194.5
	Terragen Limited	71.2		62.0	
	Consolidated energy limited	28.4		25.5	
	Omnicane	90.0		74.0	
COAL	Compagnie thermique du Sud	32.5	32.5	30.0	30.0
HYDRO	Champagne	30.0	60.74	28.0	56.30
	Ferney	10.0		10.0	
	Tamarind Falls	11.7		9.5	
	Le Val	4.0		4.0	
	Reduit	1.2		1.0	
	Cascade Cecile	1.0		1.0	
	Magenta	0.9		0.9	
	Midlands Dam	0.4		0.4	
	La Nicoliere	0.4		0.4	
	La Ferme	1.2		1.2	
LANDFILL GAS	Sotravic Ltd	3.3	3.3	3.0	3.0
KEROSENE	Nicolay	78.4	78.4	75.0	75.0
DIESEL & FUEL OIL	St Louis	100.9	348.5	72.6	313.6
	Fort Victoria	109.6		107.0	
	Fort George	138.0		134.0	
PHOTOVOLTAIC	SIPP	2.40	2.40	2.40	2.40
WIND	SIPP	0.01	0.01	0.01	0.01
WIND	Island of Rodrigues	1.28	1.28	1.28	1.28
DIESEL & FUEL OIL	Island of Rodrigues	12.3	12.3	11.4	11.4
PHOTOVOLTAIC	Island of Rodrigues (SIPP)	0.06	0.06	0.06	0.06
Total power available on grid (Island of Mauritius) (MW)		764.7	764.7	687.3	687.3
Total power available on grid		13.6	13.6	12.7	12.7

(Island of Rodrigues) (MW)					
Total (MW)		778.29	778.29	700.04	700.04

Data Sources: Statistics Mauritius

Table 9-1: Capacity of power plants in 2013

The trend of power plant capacity from 2008 to 2012 (Island of Mauritius) is shown in Figure 9-1.
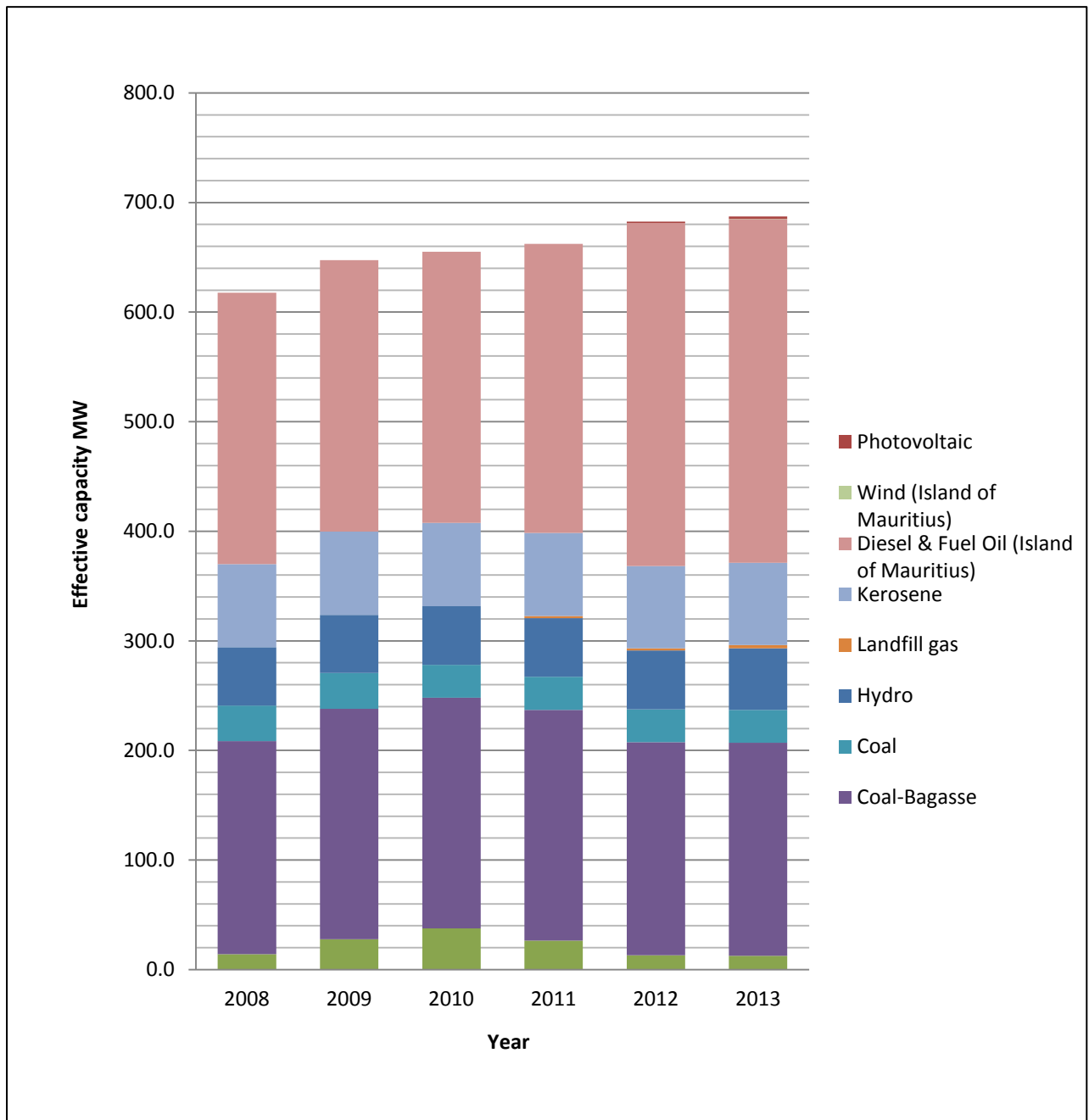
Data Source: Statistics Mauritius

Figure 9-1: Trend of effective power plant capacity, 2008 – 2013
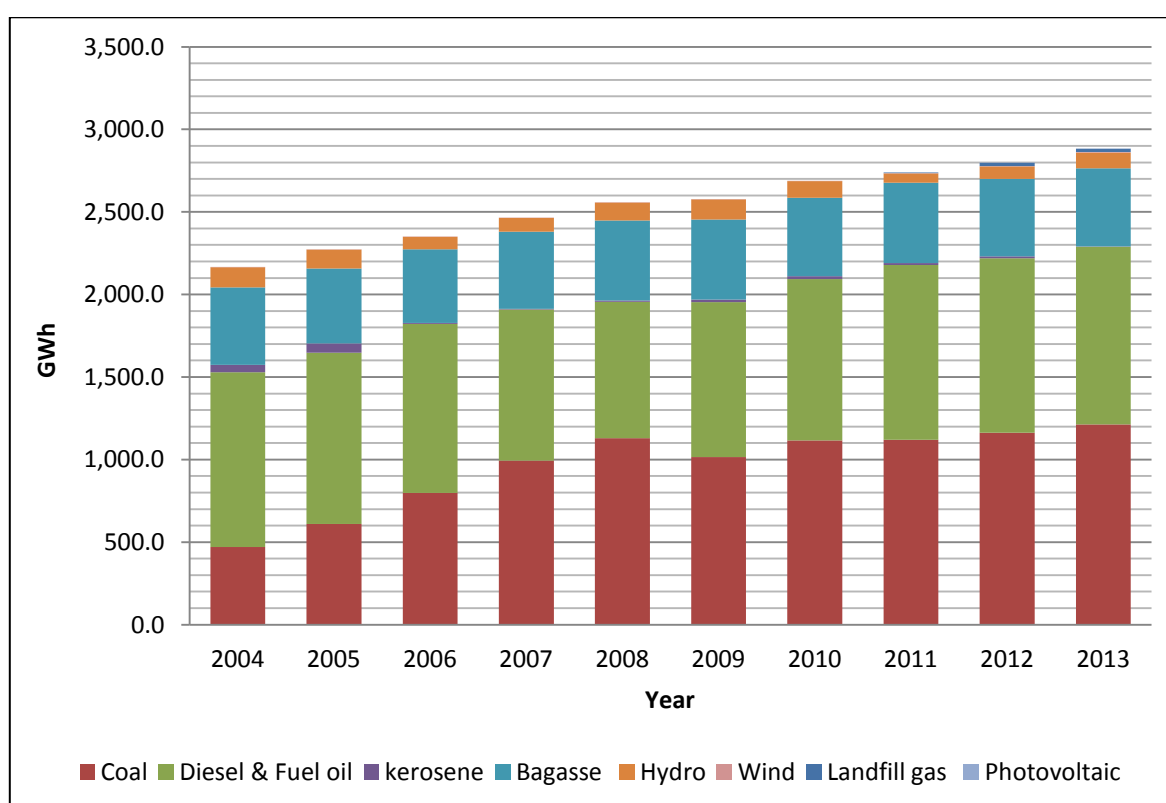
10. ELECTRICITY PRODUCTION

Overall conversion efficiencies of power plants in 2013 are given in Table 10-1.

2013	Fuel input	Electricity production		Overall conversion efficiency
	ktoe	*GWh*	*ktoe*	*%*
Coal	423.6	1213.6	104.4	24.6
Diesel & Fuel Oil	208.8	1076.1	92.5	44.3
kerosene	0.7	1.7	0.1	21.8
Bagasse	169.0	472.8	40.7	24.1
TOTAL	802.1	2764.2	237.7	29.6

Data Source: Statistics Mauritius

Table 10-1: Conversion efficiency of power plants

Figure 10-1 shows the trend of electricity production over the period 2004 to 2013.

Data Source: Statistics Mauritius

Figure 10-1: Trend of electricity production, 2004 - 2013

Total electricity production over the previous year increased by 3.2 % in 2013 compared to 2.2 % in 2012. It is worth noting that while electricity production from bagasse, which is the main renewable energy source, has decreased in 2013 compared to 2012, the share of electricity generated from renewable sources in 2013 was 20.6% which is more than the share of 20.3% in 2012. This can be

explained by an increase in electricity production from hydro power stations, land fill gas and photovoltaic sources.
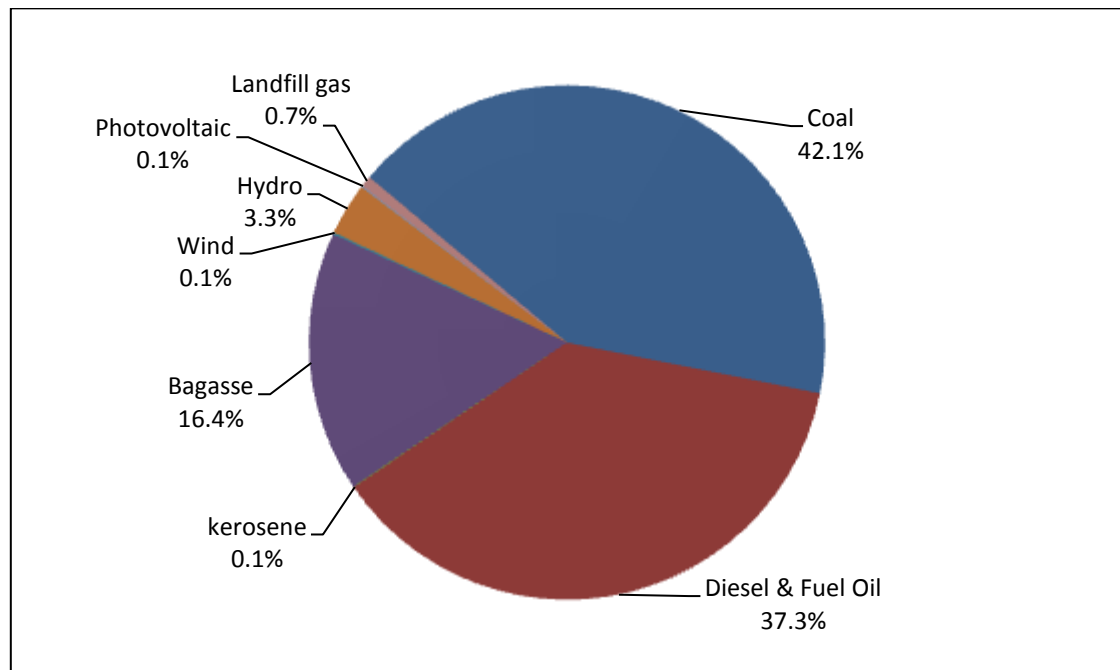
Figure 10-2: Share of electricity production by fuel type

As it can be noted from Figure 10-2 above, 79.4% of electricity production was derived from fossil sources and **20.6%** from renewable sources.

Figure 10-3 shows the monthly peak electricity demand for the years 2010 - 2013 (Island of Mauritius)
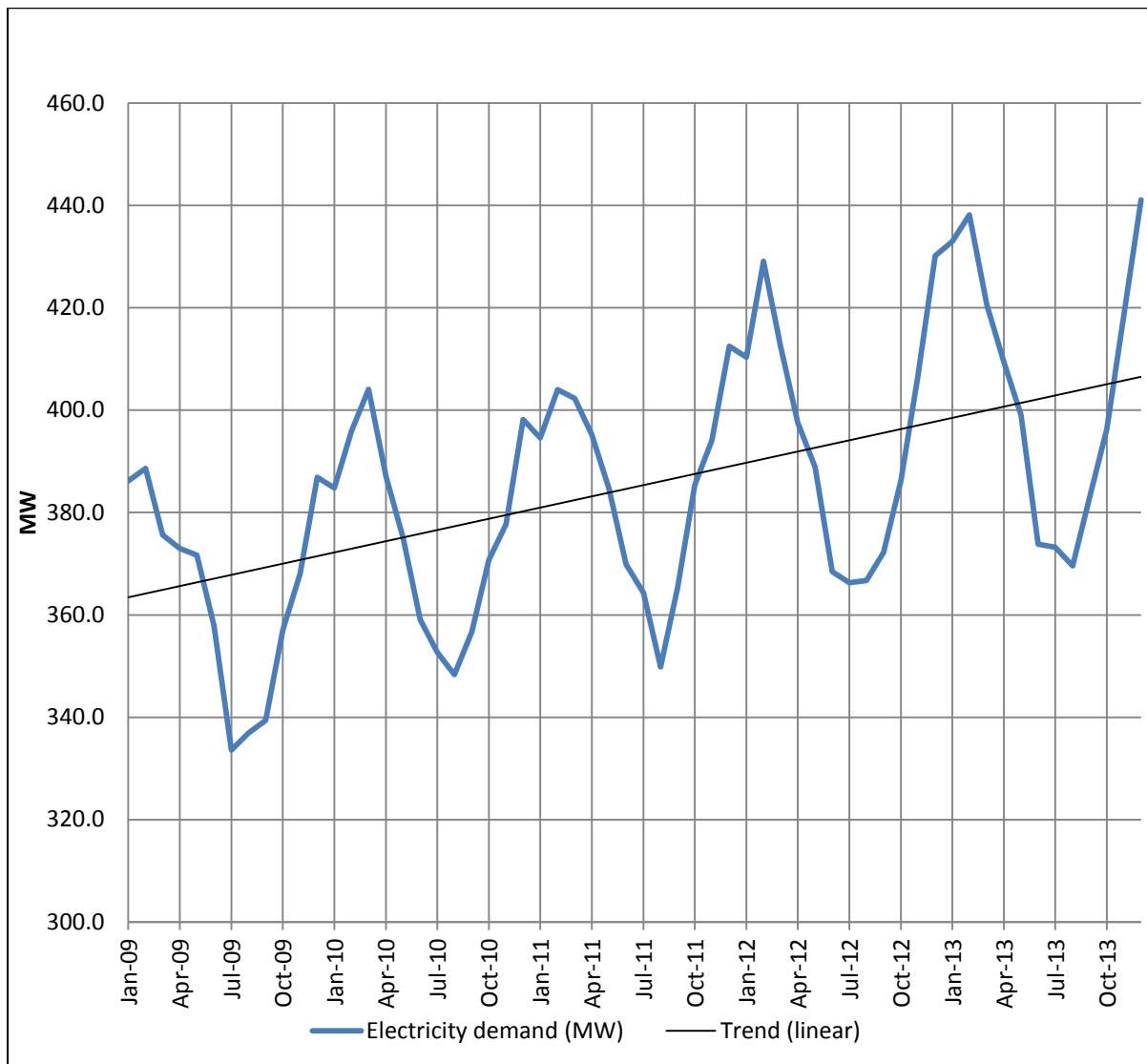

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	384.8	395.9	404.1	387.1	375.1	359.1	352.7	348.3	356.7	370.8	377.7	398.2
2011	394.6	404.0	402.3	395.2	384.7	369.9	364.3	349.8	365.4	385.4	394.1	412.5
2012	410.4	429.1	412.4	397.6	388.8	368.4	366.3	366.7	372.2	386.3	406.9	430.2
2013	433.0	438.2	420.6	409.4	399.1	373.8	373.2	369.6	383.1	396.3	418.7	441.1
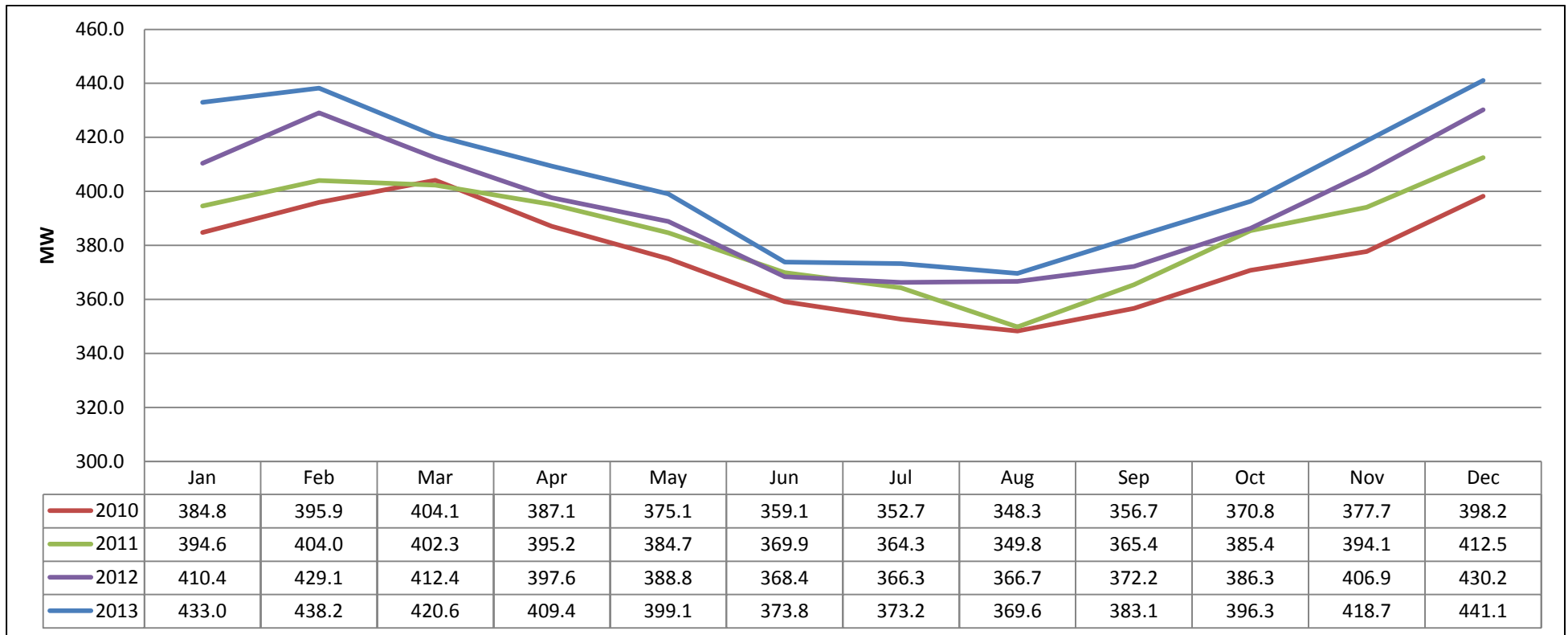
Data Source: Central Electricity Board

Figure 10-3: Peak electricity demand, 2010 - 2013

In 2012, peak power demand varied between 366.3 MW to 430.2 MW
In 2013, peak power demand varied between 369.6 MW to 441.1 MW

The peak power demand is observed to follow prevailing meteorological conditions, mainly temperature with peaks noted in the summer season, which implies additional power demand for air conditioning across the island. Electricity use for refrigeration also increases during the summer period.

Peak demand has consistently increased as shown by the demand trend over the period 2009 - 2013 (Island of Mauritius) in Figure 10-4.

Figure 10-4: Electricity demand (MW) trend, January 2009 to December 2013

Table 10-2 provides a summary of the electricity production over the period 2004 to 2013 (Island of Mauritius).

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Fossil (GWh)	1,573.0	1,704.0	1,827.4	1,912.5	1,962.5	1,968.5	2,111.4	2,189.7	2,230.3	2,291.4
Renewables (GWh)	592.3	568.2	522.7	552.2	594.8	608.9	577.3	548.9	566.8	593.9
Increase in Total Electricity Production (GWh)	83.7	106.9	78.0	114.6	92.5	20.2	111.3	49.9	58.6	88.1
Percentage increase overall (%)	4.0	4.9	3.4	4.9	3.8	0.8	4.3	1.9	2.1	3.2
Percentage of renewable (%)	27.4	25.0	22.2	22.4	23.3	23.6	21.5	20.0	20.3	20.6
Peak demand (MW) (Island of Mauritius)	332.6	353.1	367.3	367.6	378.1	388.6	404.1	412.5	430.2	441.1
Peak demand evolution (%)	2.7	6.2	4.0	0.1	2.9	2.8	4.0	2.1	4.3	2.5

Data Source: Statistics Mauritius

Table 10-2: Summary of electricity production, 2004 – 2013

11. FINAL ENERGY CONSUMPTION

11.1 General

Final energy consumption describes consumption of end users, excluding energy used for electricity generation and losses in the energy transfer matrix.
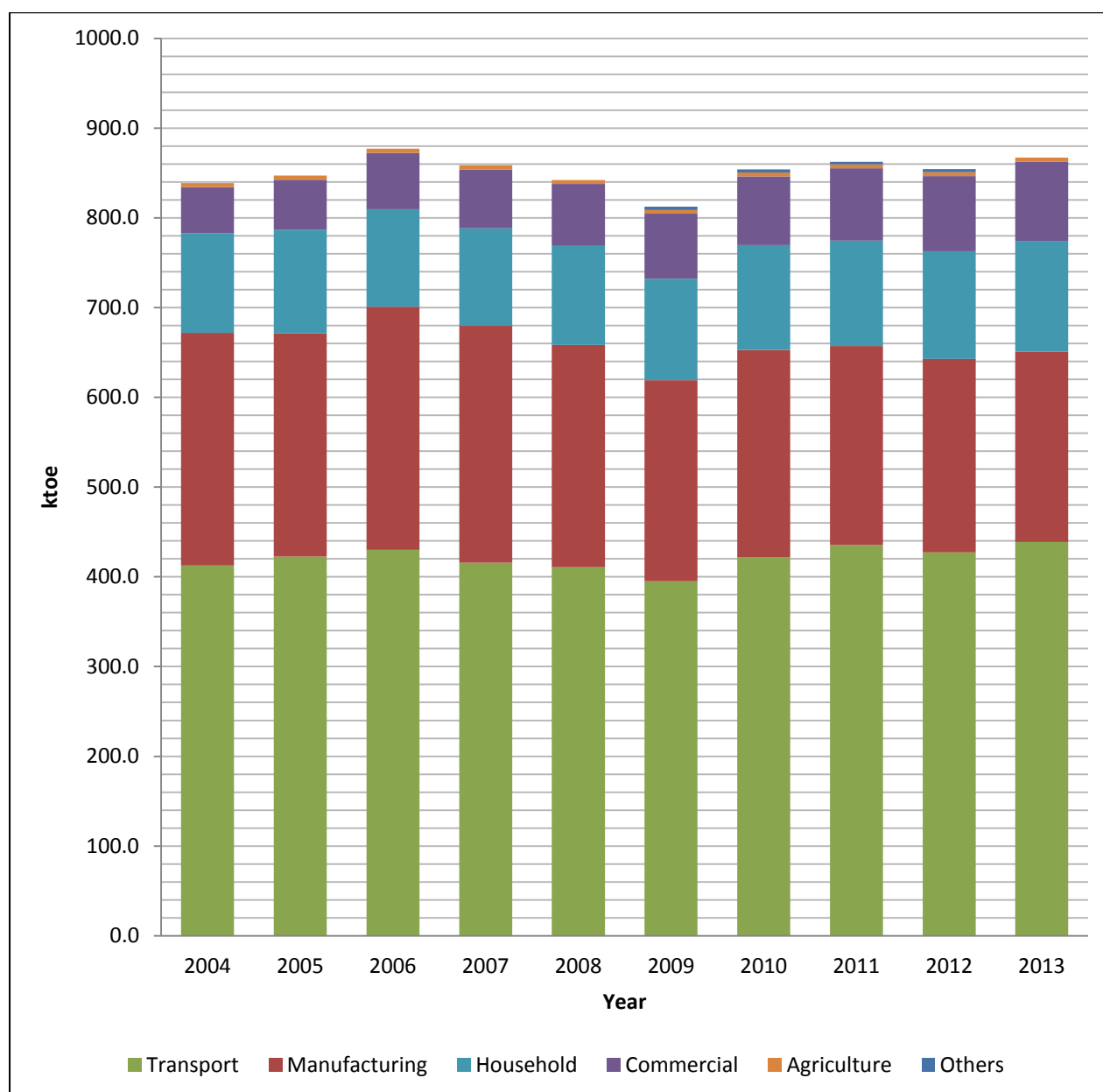
Data Source: Statistics Mauritius

Figure 11-1: Final energy consumption by sector, 2004 - 2013

Figure 11-1 shows the final energy consumption on a sector basis, for the period 2004 to 2013. It can be noted that the total final energy consumption in 2013 amounted to 867.0 ktoe, representing an increase of 1.5 % compared to 2012.

With the exception of the manufacturing sector, an increase in final energy consumption has been observed in all other sectors, with the highest increase (+ 5.3%) in 2013 as compared to 2012 for the commercial sector.

11.2 Final Energy consumption - Transport sector

Table 11-1 gives the fuel consumption in the sub-sectors of the transport sector, while Figure 11-2 shows the share of fuel use in each sub-sector and Figure 11-3 depicts the trend in consumption over the period 2004 – 2013.

Fuel consumption transport sector 2013	ktoe					
	Gasoline	Diesel	Aviation fuel (local aircraft)	LPG	Fuel Oil	Total
Land	139.2	166.5		4.4		310.1
Aviation			120.7			120.7
Sea	3.4	1.2			3.4	8.0
Total	**142.6**	**167.7**	**120.7**	**4.4**	**3.4**	**438.8**

Data Source: Statistics Mauritius

Table 11-1: Fuel consumption in the Transport sector in 2013
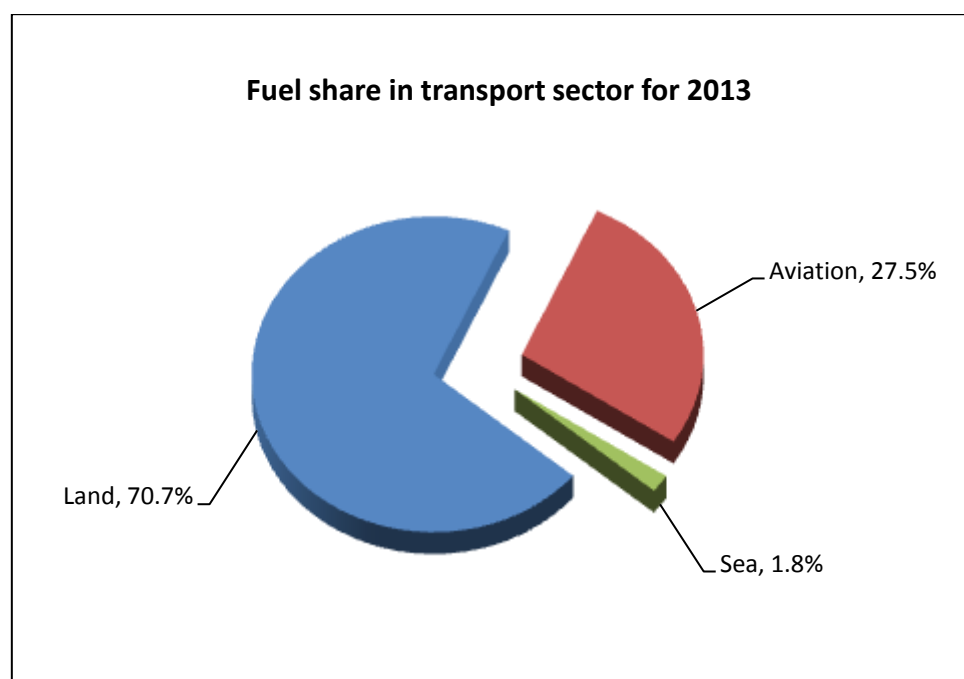
Data Source: Statistics Mauritius

Figure 11-2: Fuel consumption share in sub-sectors of the Transport sector in 2013

Trend of fuel consumption in the transport sector, 2004 to 2013
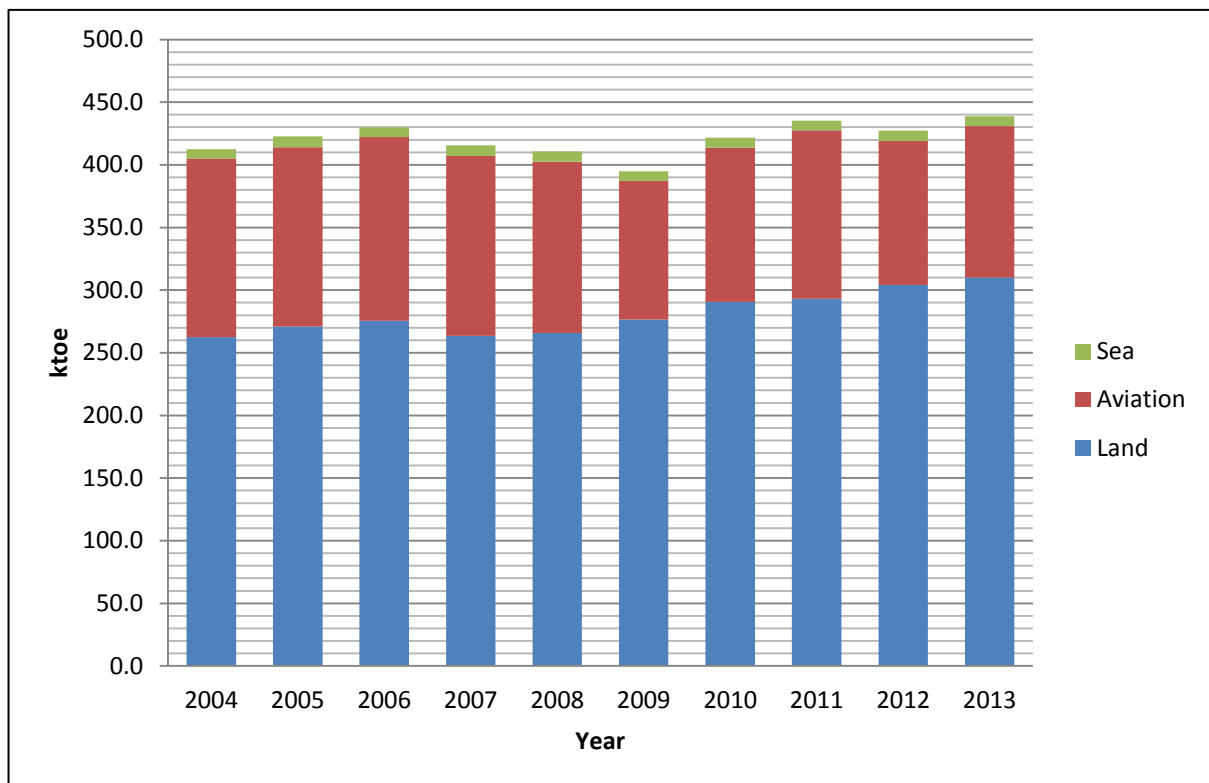
Data Source: Statistics Mauritius

Figure 11-3: Trend of Fuel Consumption in sub-sectors of Transport sector 2004 - 2013
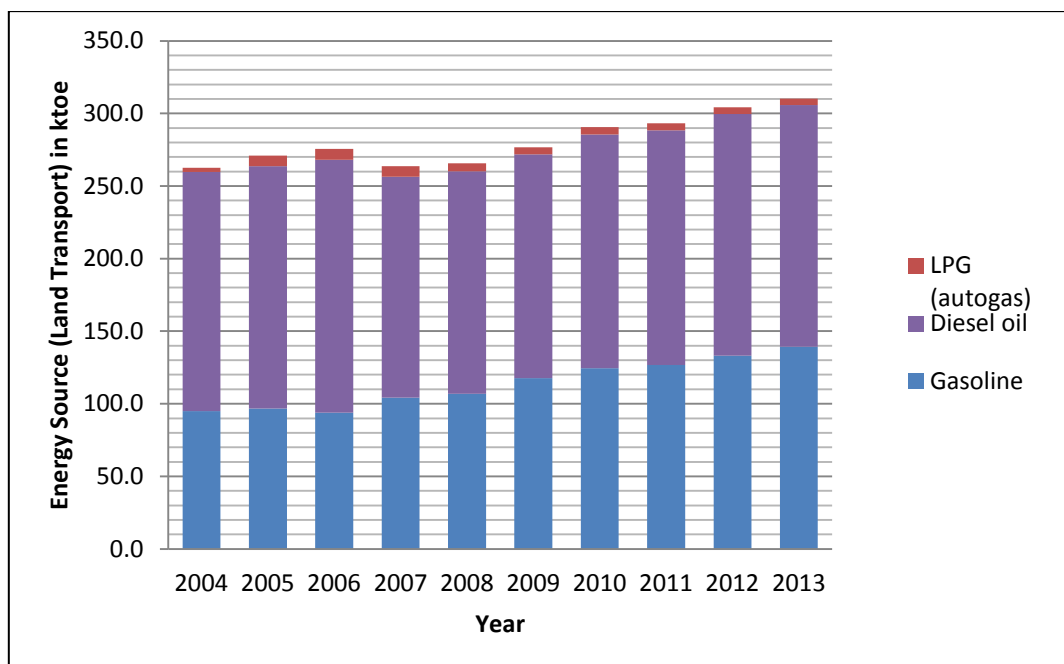
Data Source: Statistics Mauritius

Figure 11-4: Trend of Fuel Consumption in Road Transport, 2004 - 2013

The trend of fuel consumption in the road transport sector over the period 2004 to 2013 is shown in Figure 11-4. It may be noted that fuel consumption in road transport reached 310.1 ktoe in 2013; representing an increase of 1.9% over 2012.

Compared to 2012, it may be observed that in 2013:-

- Diesel consumption increased by 0.1%.
- Gasoline consumption increased by 4.5%.
- LPG (autogas) consumption has decreased by 6.6%

The decline in use of LPG (autogas) may be the result of the limited number of fuel stations selling the product, risk of compromising vehicle warranty when LPG (autogas) kits are installed and the difficulty in reprogramming electronic control units of new cars to work correctly with LPG (autogas).

Vehicle fleet

The fleet of powered vehicles for Mauritius comprised 441649 vehicles in 2013.

No.	2005	2006	2007	2008	2009	2010	2011	2012	2013
■ Gasoline	198900	208408	218416	230742	242085	255550	268532	283836	301554
■ Diesel	95531	99176	103334	107955	111970	116283	120236	125737	129000
■ Hybrid	0	0	0	0	43	161	315	703	1389
■ Electric	0	0	0	0	0	0	2	5	6
■ LPG	9300	10100	10600	10900	10600	10300	10000	9800	9700
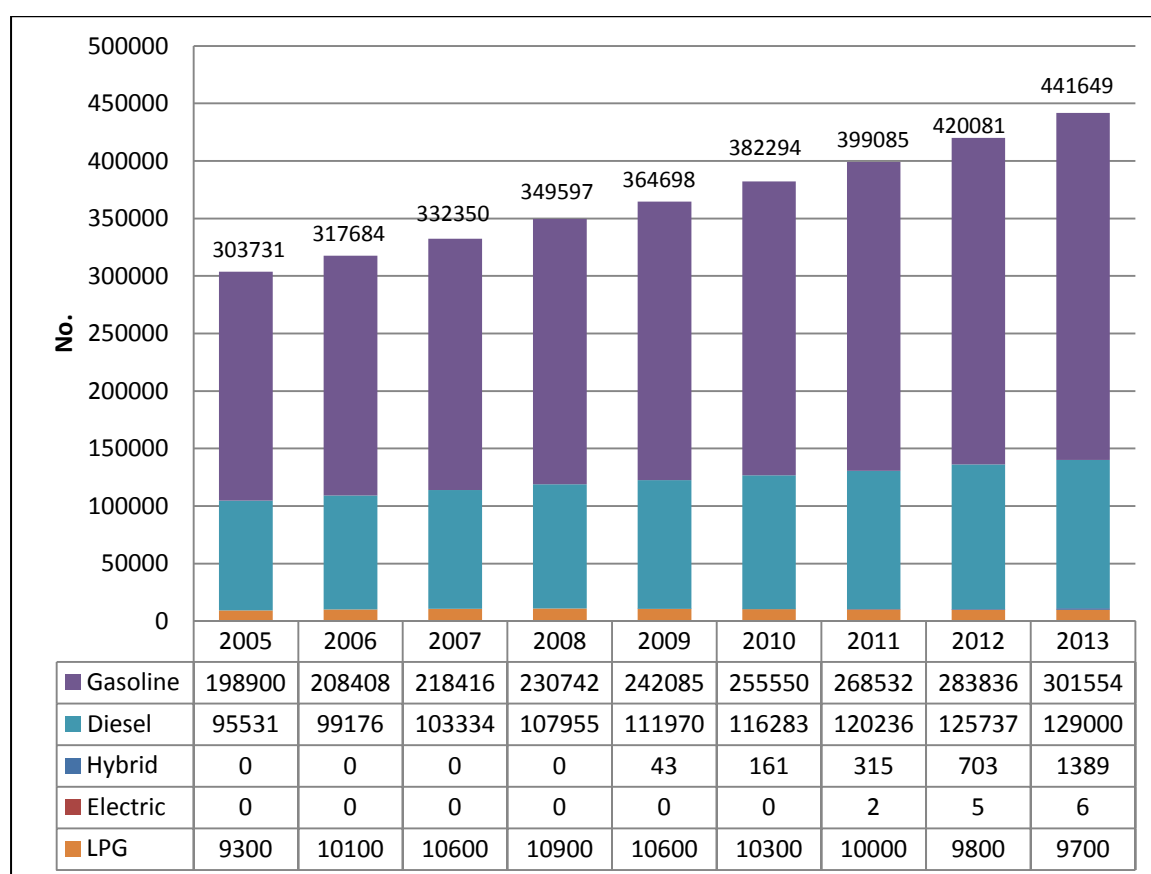
Data Source: NTA

Figure 11-5: Trend of vehicle fleet by type of fuel

We note from Figure 11-5 that in 2013 the number of hybrid powered vehicles increased to 1389 compared to 703 in 2012.

Engine capacity	2005	2006	2007	2008	2009	2010	2011	2012	2013	% growth in 2013 over 2012
Up to 1,000 c.c	1171	722	535	726	804	948	856	1634	1981	21.2
1,001 - 1,250 c.c	803	1224	1338	1580	1211	1060	1158	1582	2051	29.6
1,251 - 1,400 c.c	1135	879	1283	1801	1691	2205	2015	2691	3323	23.5
1,401 - 1,500 c.c	2926	2465	2033	2042	1835	2384	1771	1824	2531	38.8
1,501 - 2,000 c.c	1184	1945	2482	2858	2927	2105	2867	3557	3239	-8.9
2,001 - 2,250 c.c	141	100	72	338	32	9	20	30	50	66.7
2,251 - 2,500 c.c	57	59	91	169	155	196	166	58	45	-22.4
2,501 - 3,000 c.c	54	54	129	162	139	154	185	142	91	-35.9
Above 3,000 c.c	44	30	82	115	72	87	71	77	49	-36.4
Total	**7515**	**7478**	**8045**	**9791**	**8866**	**9148**	**9109**	**11595**	**13360**	**15.2**

Data Source: NTA

Table 11-2: New and second hand imported car registration

It may be noted from Table 11-2 that there has been a major increase of +15.2% in new car registrations in 2013 compared to 2012. We note that the main share of new cars registered is now in the engine capacity range below 1400cc.

Fuel economy and CO_2 emissions

Year	Average Fuel Consumption (l/100km)	Average CO_2 Emission (g/km)
2005	7	186
2013	6.6	169

Data Source: NTA

Table 11-3: Average fuel consumption and average CO_2 emissions for Light Duty Vehicles (LDVs) registered in 2005 and 2013

The above table shows data for Light Duty Vehicles (LDVs) for 2005 and 2013 in respect of CO2 emissions and fuel consumption.

In 2005, the average fuel consumption for LDVs in Mauritius was 7.0 l/100km with a corresponding CO2 emission of 186 g/km. The average fuel consumption in 2013 was 6.6 l/100km with a corresponding CO2 emission of 169 g/km. Therefore, it is observed that average fuel consumption of LDVs in Mauritius and subsequently the average CO_2 emissions have decreased over the years. This may be associated with improvement in engine technology resulting in more efficient vehicles.

11.3 Final energy consumption - Manufacturing sector

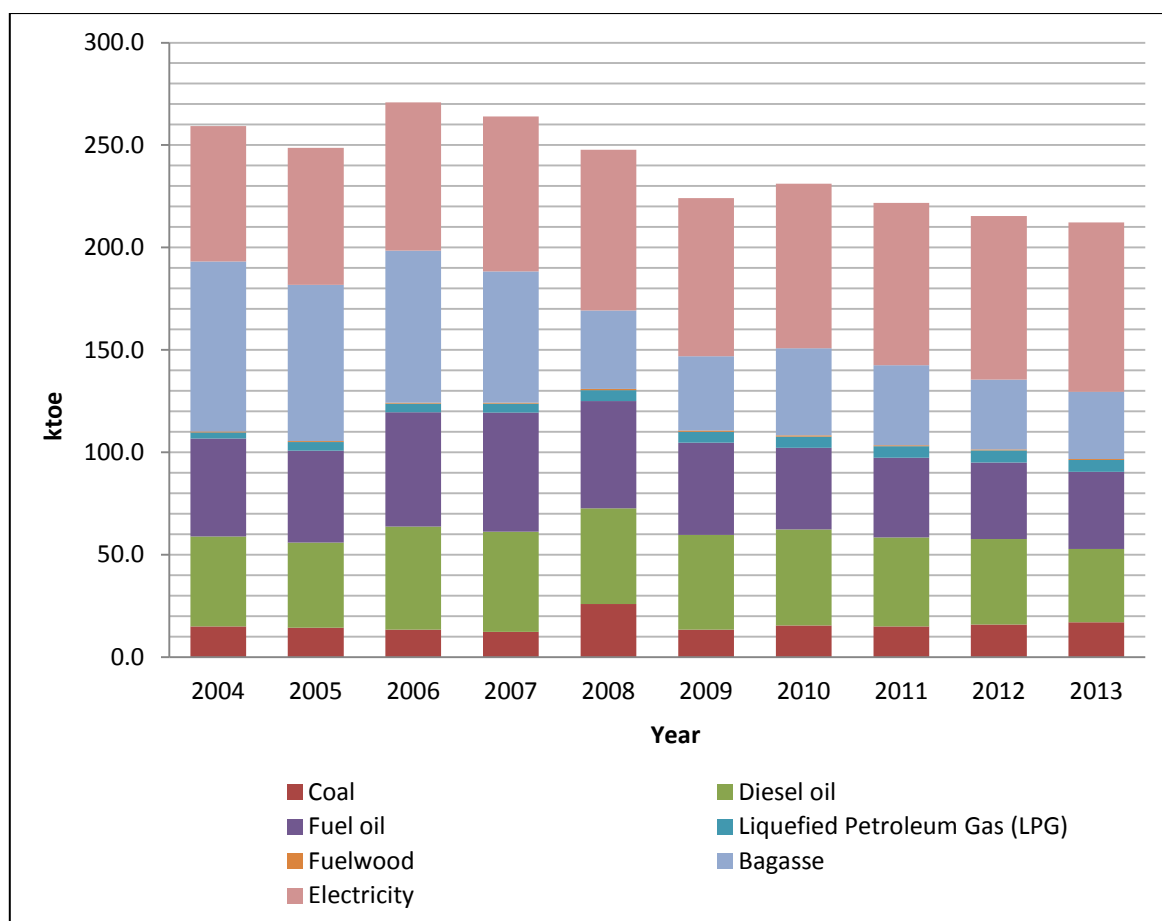| Energy Source	ktoe
	2013
Coal	17.1
Diesel oil	35.8
Fuel oil	37.6
Liquefied Petroleum Gas (LPG)	5.8
Fuelwood	0.5
Bagasse	32.7
Electricity	82.8
TOTAL	212.3

Table 11-4: Energy consumption in the Manufacturing sector in ktoe

Total energy consumption in the manufacturing sector amounted to 212.3 ktoe in 2013 which was 1.5% less than in 2012. Figure 11-7 shows the share of different energy sources used in the manufacturing sector in 2013, while Figure 11-8 provides the trend for the period 2004 to 2013.
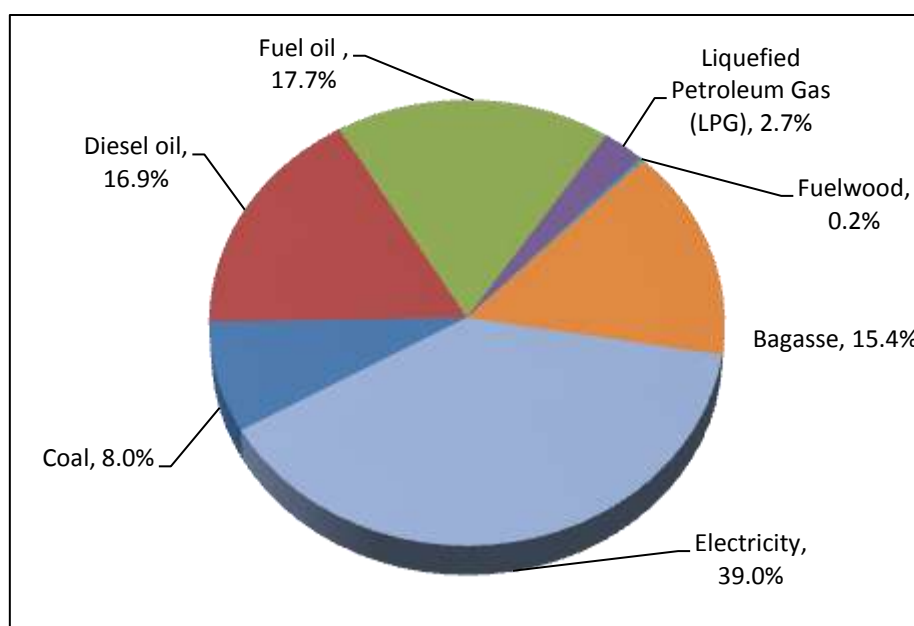
Data Source: Statistics Mauritius

Figure 11-6: Share of energy sources, Manufacturing Sector, 2013

Data Source: Statistics Mauritius

Figure 11-7: Trend of consumption of energy sources in the Manufacturing Sector, 2004 - 2013

11.4 Final energy consumption - Household sector

	ktoe
Energy Source	**2013**
Charcoal	0.1
Fuelwood	5.9
Liquefied Petroleum Gas (LPG)	50.1
Electricity	67.2
Kerosene	0.2
TOTAL	**123.5**

Table 11-5: Energy consumption in the Household sector in ktoe

Total energy consumption in the household sector amounted to 123.4 ktoe in 2013 representing a 2.7% growth over 2012. The share of energy sources in the Household sector in 2013 is given in Figure 11-9.
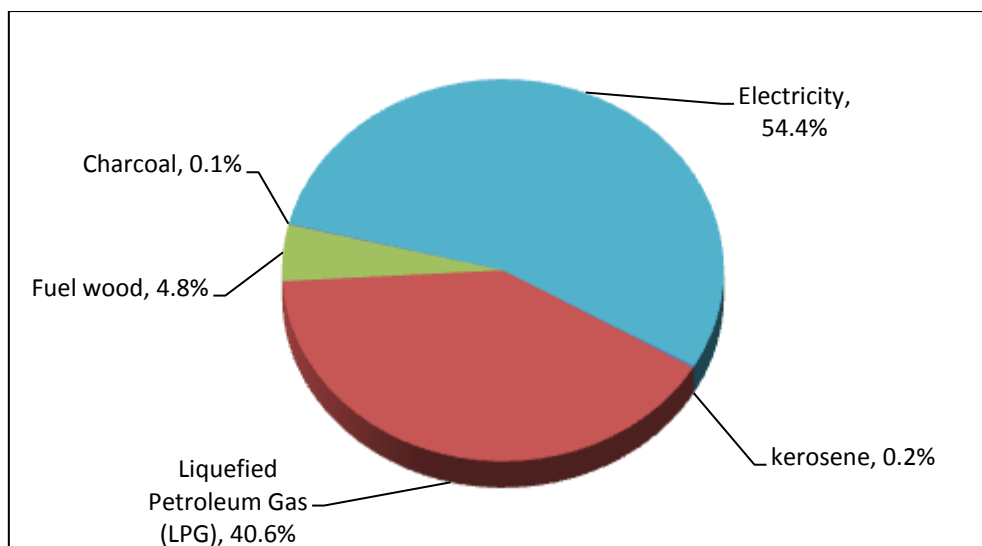
Data Source: Statistics Mauritius

Figure 11-8: Share of energy sources, Household sector, 2013

As can be seen from Figure 11-9, the main sources of energy for the household sector are LPG and electricity. LPG is used mostly for cooking and water heating. Fuel wood is still in use as cooking fuel albeit not very significant. Use of kerosene as fuel has nearly disappeared since the price increase in its retail price in 2005. In 2013 the consumption of electricity and LPG has both increased compared to 2012 by 3.7% and 2.3% respectively.

The trend of the use of each fuel over the period 2004 to 2013 is shown in Figure 11-10.
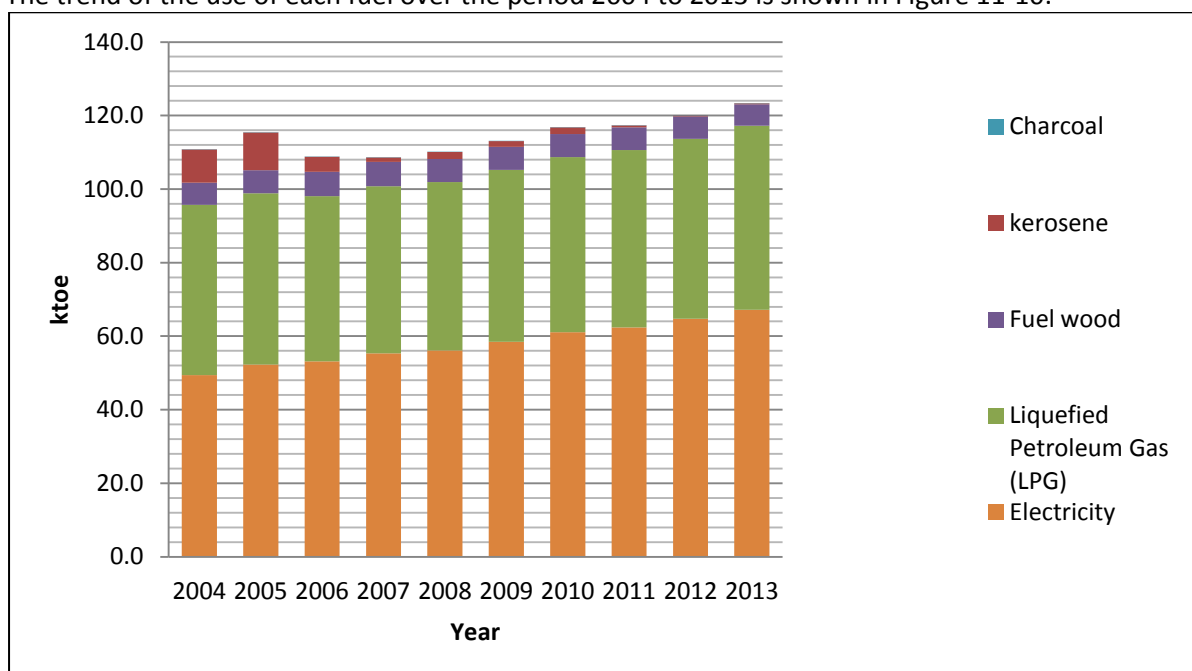
Data Source: Statistics Mauritius

Figure 11-9: Trend of fuel consumption in the Household sector, 2004 – 2013

11.5 Final energy consumption - Commercial sector

| Energy Source	ktoe
	2013
Charcoal	0.4
Liquefied Petroleum Gas (LPG)	14.3
Electricity	73.4
TOTAL	88.1

Table 11-6: Energy consumption in the Commercial sector in ktoe

Total energy consumption in the Commercial sector amounted to 88.1 ktoe in 2013 and the share of energy sources in 2013 is shown in Figure 11-11, while Figure 11-12 gives the trend of fuel consumption over the period 2004 - 2013.
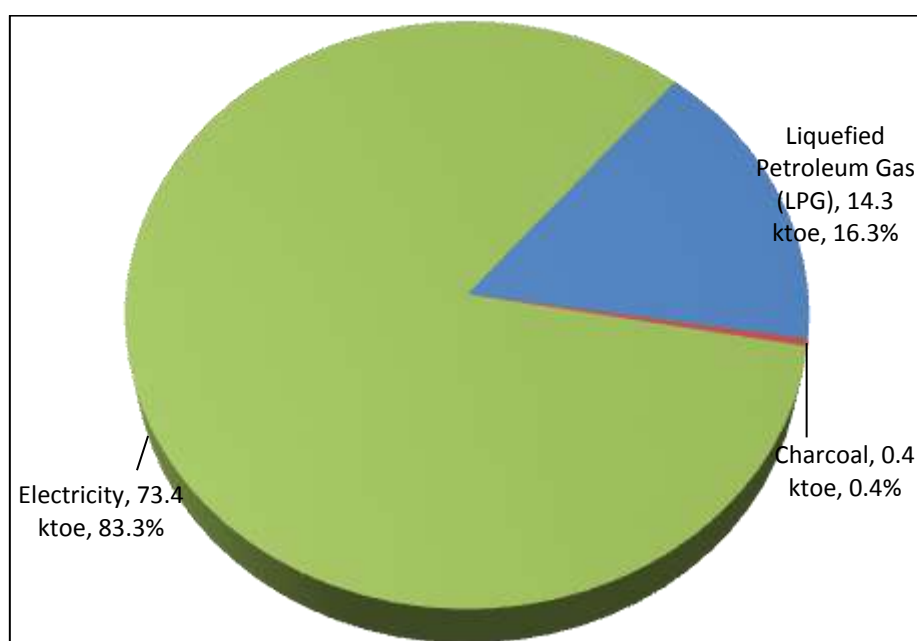
Data Source: Statistics Mauritius

Figure 11-11: Share of energy sources, Commercial Sector, 2013
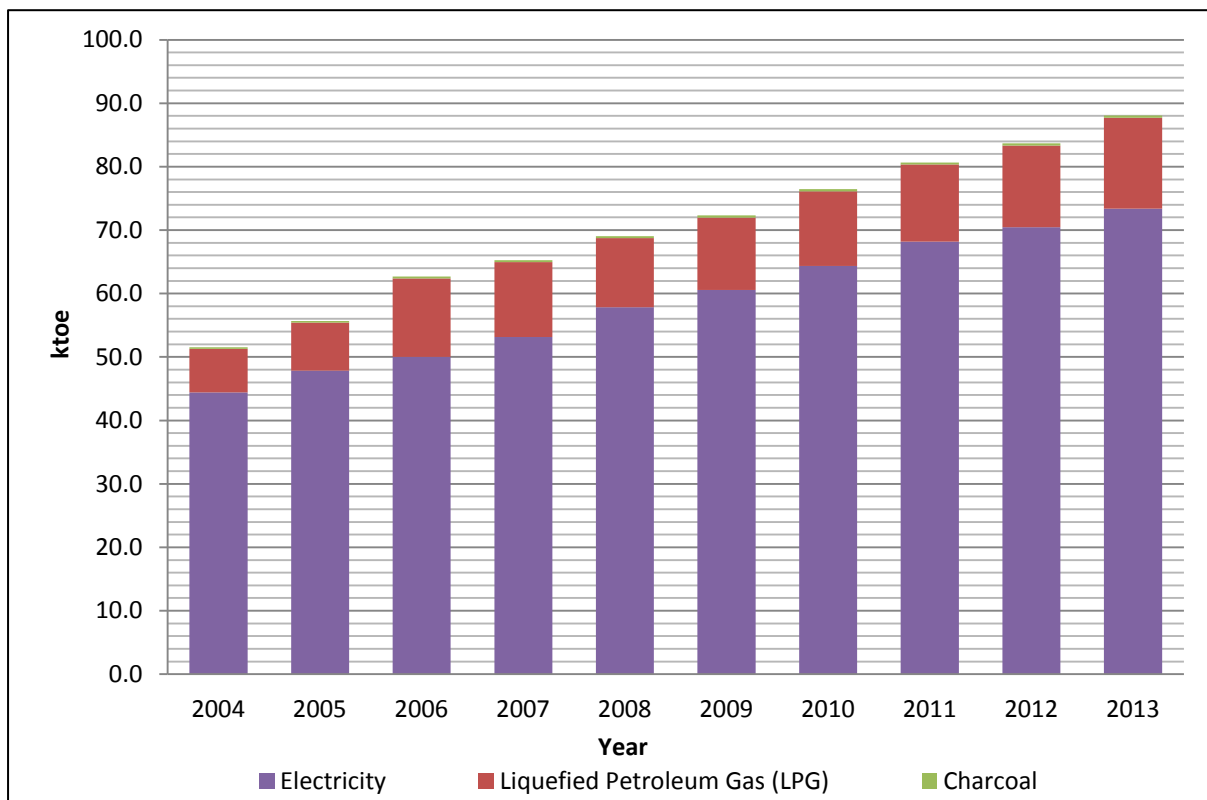
Data Source: Statistics Mauritius

Figure 11-12: Trend of fuel consumption in the Commercial sector, 2004 - 2013

In 2013, electricity consumption in the commercial sector increased by 4.2% compared to 2012, indicating continued expansion in the sector. The main areas of electricity use in the sector are refrigeration, air conditioning, decorative and security lighting.

11.6 Final energy consumption - Agriculture sector

| Energy Source	ktoe
	2013
Electricity	2.3
Diesel Oil	2.2
TOTAL	4.5

Table 11-7: Energy consumption in the Agriculture sector in ktoe

Total energy consumption in the agriculture sector amounted to 4.5 ktoe in 2013 and the share of energy sources in 2013 is shown in Figure 11-13, while Figure 11-14 gives the trend of fuel consumption over the period 2004 to 2013.
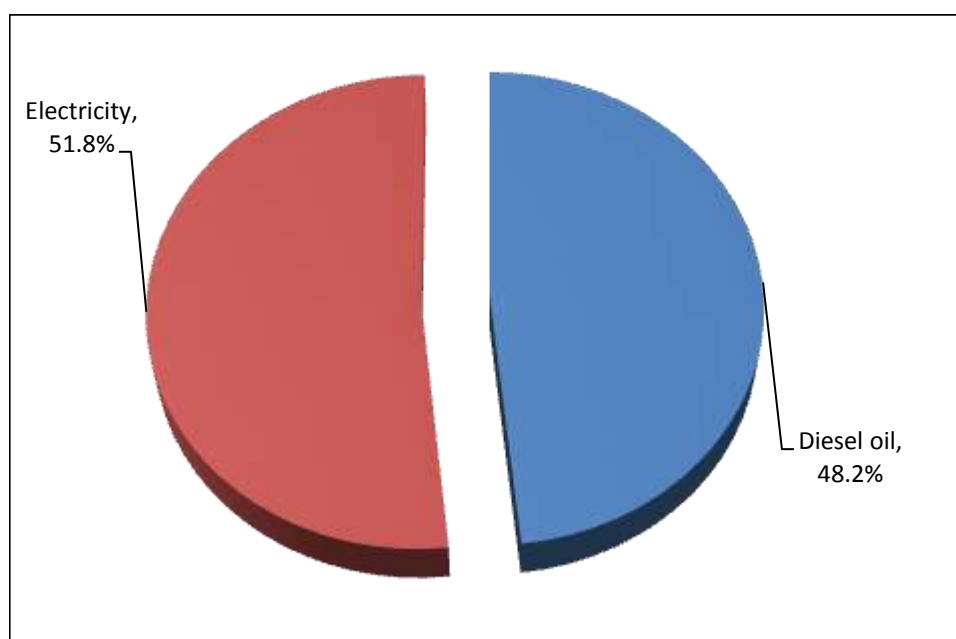
Data Source: Statistics Mauritius

Figure 11-13: Share of energy sources in Agriculture sector, 2013
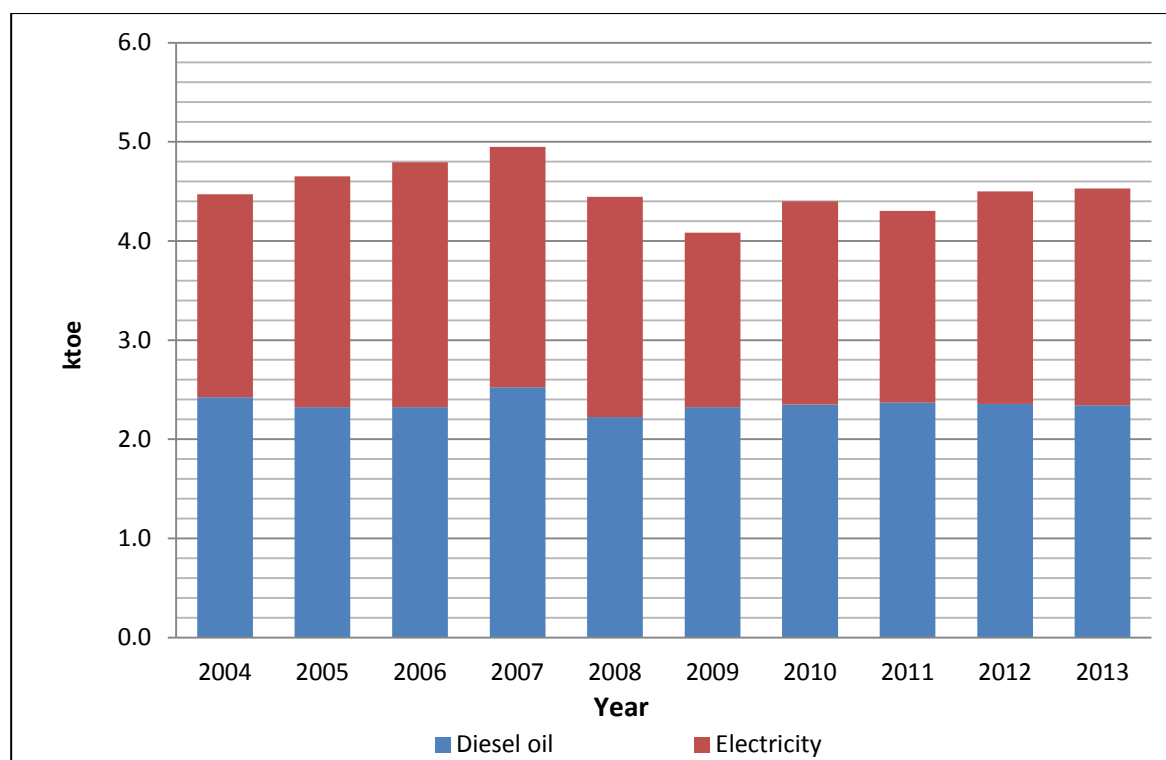
Data Source: Statistics Mauritius

Figure 11-14: Share of fuel consumption in the Agriculture sector, 2004 - 2013

It may be noted from Figure 11-13 that the fuel consumption in the sector is rather stable, in the range of 4.1 to 4.8 ktoe over the period 2004 to 2013.
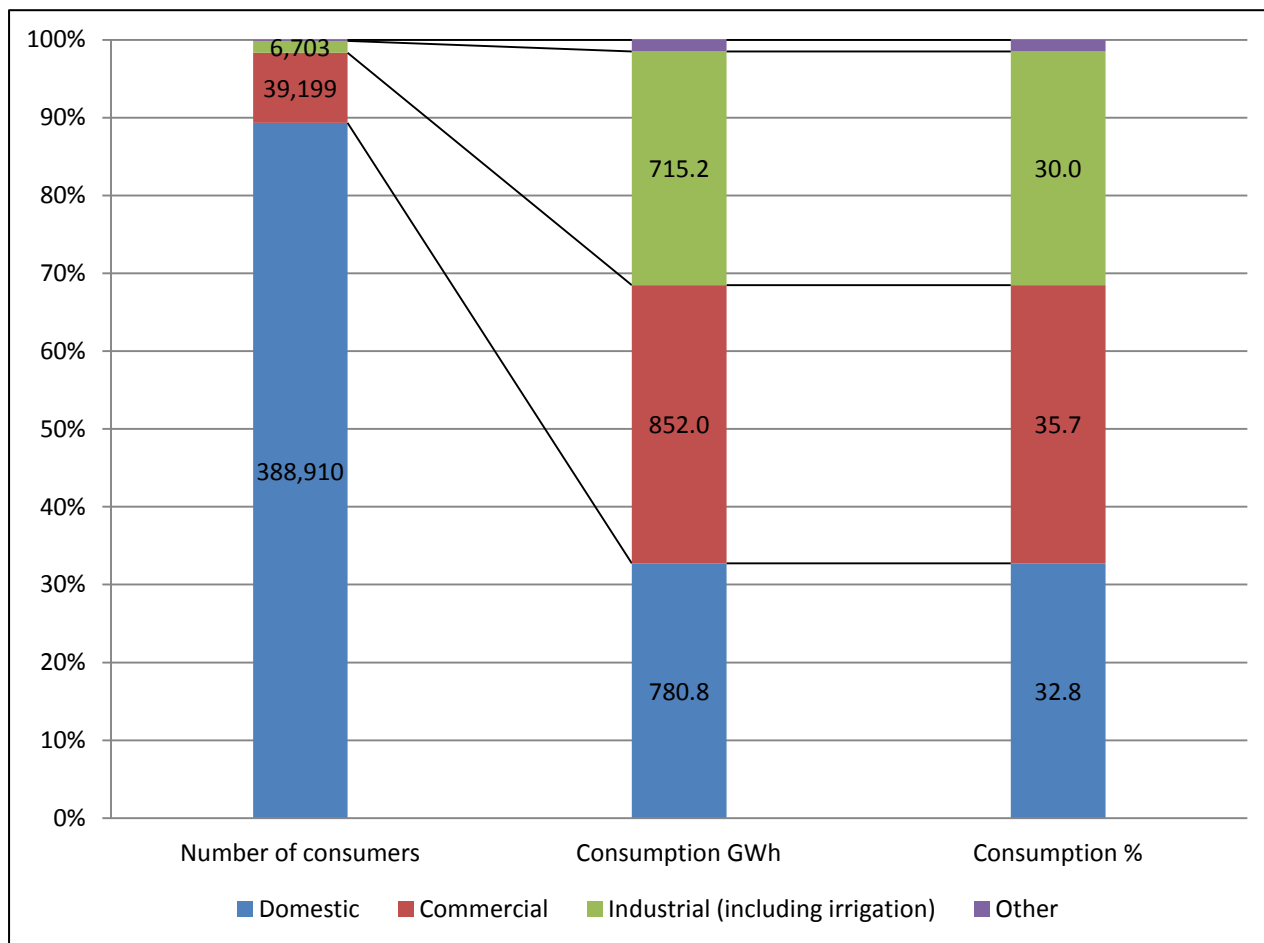
11.7 Electricity consumption

Type of tariff	Number of consumers		Consumption GWh		Consumption %	
	2012	**2013**	**2012**	**2013**	**2012**	**2013**
Domestic	381,096	388,910	753.0	780.8	32.8	32.8
Commercial	38,539	39,199	818.7	852.0	35.7	35.7
Industrial (including irrigation)	6,763	6,703	687.4	715.2	30.0	30.0
Other	507	588	35.3	36.1	1.5	1.5
Total	**426,905**	**435,400**	**2,294.4**	**2,384.1**	**100.000**	**100.000**

Data Source: Statistics Mauritius

Table 11-8: Electricity consumption, 2012 & 2013

As shown in Table 11-3 electricity sales for 2013 amounted to 2,384.1 GWh compared to 2, 294.4 GWh in 2012, that is an increase of 3.9 % in 2013 compared to 2012. Figure 11-15 gives details of the number of different category consumers, the electricity consumption in each category and the share of consumption of each for year 2013.

Figure 11-15: Electricity consumption of different category of consumers, 2013

An analysis of domestic electricity consumption is given in Table 11-4, which shows an increase from 1.90 MWh in 2009 to 2.01 MWh in 2013.

Domestic consumers	2009	2010	2011	2012	2013
Consumption (GWh)	680.1	710.7	725.3	753.0	780.8
Number of consumers	358359	364474	372315	381096	388910
Average consumption per consumer (MWh)	1.90	1.95	1.95	1.98	2.01
Growth rate %	2.0%	2.7%	-0.1%	1.4%	1.6%

Table 11-9: Analysis of domestic electricity consumption, 2013

11.8 Fossil Fuel consumption

2013	ktoe							
	Coal	Gasoline	Diesel	Aviation fuel	Kerosene	Fuel Oil	LPG	Total
Electricity production	423.6		1.3		0.7	207.5		633.1
Manufacturing	17.1		35.8			37.6	5.8	96.2
Commercial							14.3	14.3
Household					0.2		50.1	50.3
Transport		142.6	167.7	120.7		3.4	4.4	438.7
Agriculture			2.3					2.3
Others							0.3	0.3
Total	440.6	142.6	207.1	120.7	0.9	248.6	74.9	1235.3

Data Source: Statistics Mauritius

Table 11-10: Fossil fuel consumption by sector, 2013
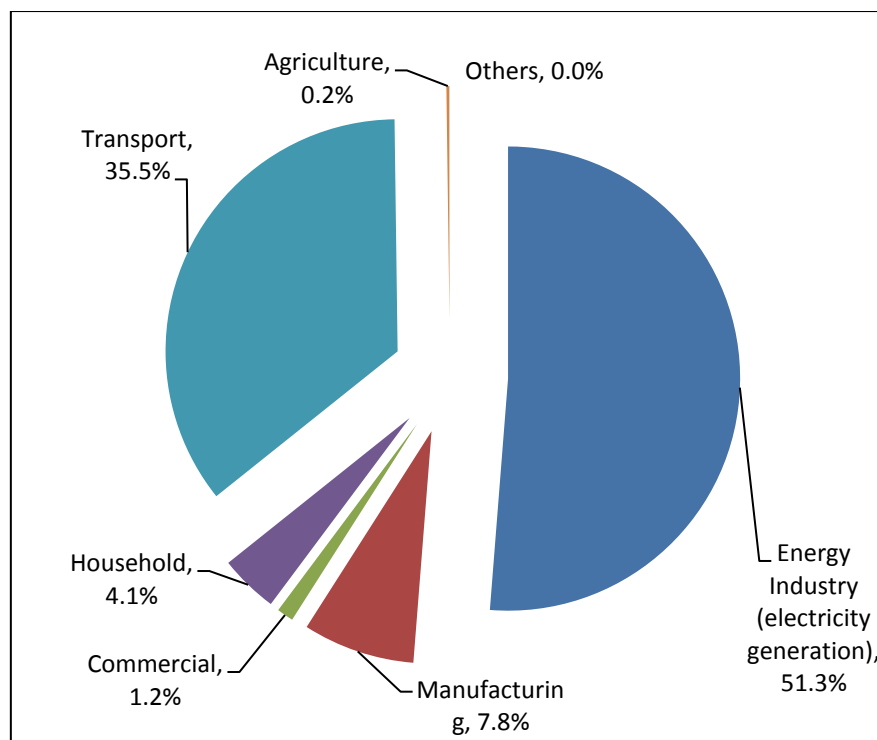
Data Source: Statistics Mauritius

Figure 11-16: Share of fossil fuel consumption by sector, 2013

12. CO_2 EMISSIONS DUE TO FOSSIL FUELS

12.1 Introduction

The green house gas (GHG) effect is a natural phenomenon that captures part of the energy emitted by the Sun to the Earth. GHGs have a role comparable to that of glass of a green house shed. The heat from the atmosphere depends on solar radiation (constant) and the amount of radiation trapped by greenhouse gases.

12.2 Greenhouse Gas Emissions

A greenhouse gas is a gas in an atmosphere that absorbs and emits radiation within the thermal infrared range. This process is the fundamental cause of the greenhouse effect. The primary greenhouse gases in the Earth's atmosphere are water vapour, carbon dioxide, methane, nitrous oxide, and ozone.

Emissions from human activities mainly concern the following six gases, covered by the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

Human activity since the industrial era has led, due to the consumption of fossil energy stocks, to the increase in carbon dioxide in the atmosphere, despite the uptake of a large portion of the emissions through various natural "sinks" involved in the carbon cycle. carbon dioxide (CO_2) emissions

produced by human activities come mainly from combustion of fossil fuels, principally coal, heavy fuel oil and its derivatives (gasoline, diesel, Liquefied Petroleum Gas (LPG) etc…), and natural gas.

12.3   Inventory of CO_2 from energy sources for Island of Mauritius in 2013

This report focuses only on CO_2 emissions (excluding other green house gases) during combustion of fossil fuels. The scope of emissions discussed concerns all CO_2 emissions due to fossil energy conversion in all sectors.
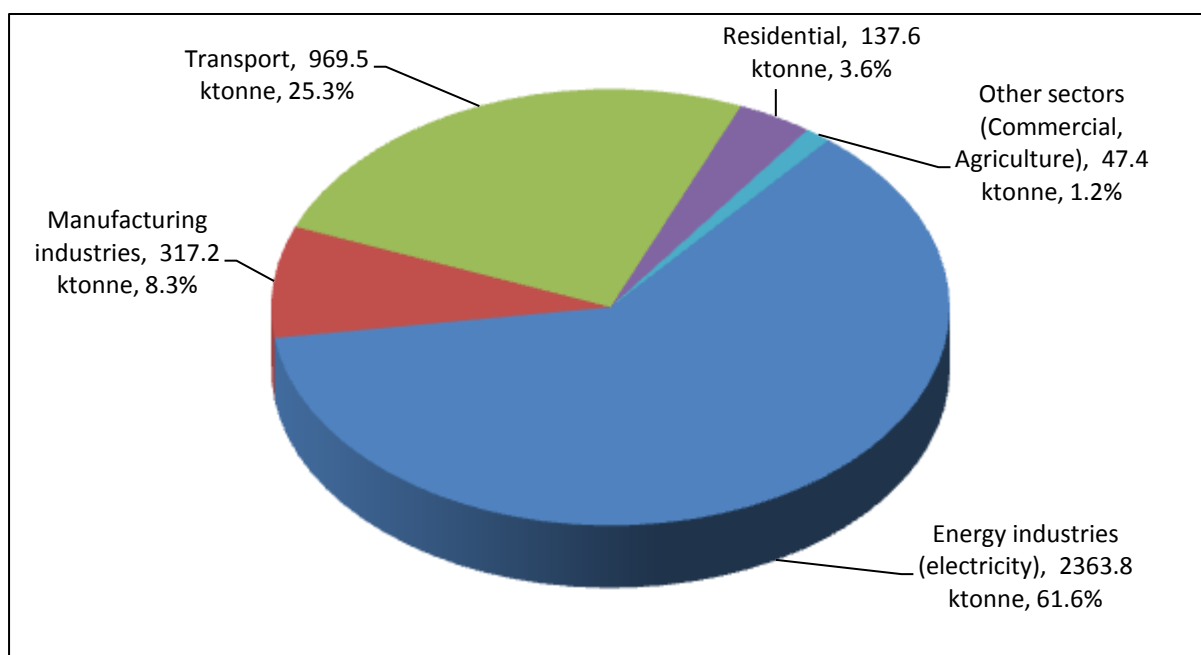
Data Source: Statistics Mauritius

Figure 12-1 : Sectoral carbon dioxide emissions from fossil fuel combustion, 2013

Figure 12-1 gives the share of carbon dioxide emission from fossil fuel combustion in each sector in 2013. It may be noted that the total CO_2 emissions in 2013 amounted at 3, 835, 500 tonnes.

12.4 CO_2 emissions for electricity generation

Total CO_2 emissions from electricity generation amounted to **2 363 800 tonnes**.

The average ratio of emissions per kWh consumed by all sources was 790.4 gCO_2/kWh. This represents a decrease of 3% compared to 2012, where the average ratio stood at 815.3 gCO_2/kWh, which can be attributed to the increased use of renewable energy (hydro power plants and solar PV) and reduced use of fossil fuels (kerosene and diesel) for electricity generation.

12.5 CO_2 emissions in the transport sector (inclusive of aviation)

In 2013 emissions have reached **969 500 tonnes** of CO_2 representing an increase of 1.6% compared to 2012.

Total CO_2 emissions: 3.05 tonnes per capita in 2013

GLOSSARY

Aviation fuel:
A kerosene type meeting the required properties for use in jet engines and aircraft-turbine engines.

Bagasse:
Cellulosic residue left after sugar is extracted from sugar cane.

Capacity:
The maximum power available from a power station at a point in time:
- *Installed capacity*: The nameplate capacity of the generator set.
- *Plant capacity*: The net capacity measured at the terminals of the stations, i.e., after deduction of the power absorbed by the auxiliary installations and the losses in the station transformers.
- *Effective capacity*: It is the plant capacity less any amount of derated capacity from the installed capacity.

Charcoal:
Comprises the solid residue obtained by the destructive distillation of wood in the absence of air.

CPP (Continuous Power Producers):
Entities which, in addition to their main activities, themselves produce (individually or in combination) electric energy intended, in whole or in part, to meet their own needs from bagasse only and the surplus for sale to the CEB only during the cane harvest period.

Coal:
Fossil fuel that has a high degree of coalification, with a gross calorific value over 24MJ/kg (5700 Kcal/kg) on an ash-free but moist basis.

Domestic Sector:
Domestic sector in this document includes CEB residential consumers, charitable and religious institutions.

Diesel Oil:
Consists primarily of medium oil distilling between 180^0C and 380^0C.

Electric energy dependence:
The ratio of electricity generation from fossil fuels and electricity generation total.

Electric dependency ratio:
Ratio between electricity production from fossil fuels and the total electricity production.

Energy:
Capacity for doing work or for producing heat. Producing heat is a common manifestation of 'doing work' as are producing light and motive force.

Energy intensity:

A measure of the energy efficiency of the economy of the country. Provides a measure of the efficiency with which energy is being used in production. A lower ratio usually reflects a more efficient use of energy.

Energy unit:
The International System of Units (SI unit) of energy is the Joule.

Final energy:
Energy that is supplied to consumers (electricity, petrol, diesel, natural gas, fuel oil, heating oil).

Final Energy Consumption:
Energy consumption by final user- i.e. energy which is not being used for transformation into other forms of energy. The consumption by sector is presented as follows:
Agriculture: Energy used for irrigation and by other agricultural equipments;
Commercial & distributive trade: Energy consumed by the business and commercial sector;
Residential: Consumption of energy by residential sector;
Manufacturing: Consumption in industry and construction; and
Transport: Includes consumption by land vehicles, ships and local aircrafts.

Fossils fuels:
Formed from the fossilized remains of dead plants and animals by exposure to heat and pressure in the Earth's crust over hundreds of millions of years.

Fuels:
Term used to describe energy sources that must be subjected to combustion in order to release the energy stored up inside them.

Fuel wood:
All forms of woody material.

Fuel Oils:
Heavy oils from the refining process of crude oil and used as fuel in power stations. It is also commonly used by ships and industrial large-scale heating boilers installations as a fuel in furnaces or boilers in the manufacturing sector.

Gasoline:
A mixture of relatively volatile hydrocarbons, which have been blended to form a fuel suitable for use in spark-ignition internal combustion engines.

Gross Domestic Product (GDP):
The aggregate money value of all goods and services produced within a country out of economic activity during a specified period, usually a year, before provision for the consumption of fixed capital.

Gigawatt hour (GWh):
Unit of electrical energy, equal to 3.6 terajoules (TJ).

Hybrid vehicle:
A vehicle that uses different types of energy for power. This vehicle has usually two types of engines: internal combustion engine and electric motor.

IPP (Independent Power Producers):
Entities which, in addition to their main activities, themselves produce(individually or in combination) electric energy intended, in whole or in part, to meet their own needs and for sale to the CEB throughout the year from bagasse during the cane harvest period and coal outside this period.

Kerosene (excl. Aviation fuel type):
A medium oil distilling between 150^0C and 300^0C and which is used in sectors other than aircraft transport.

Kilowatt (kW):
Unit of electrical power equal to 1 000 watts

Kilowatt hour (kWh):
Unit of electrical energy equal to one kilowatt (1 kW) of power expended for one hour (3 600 s) or 3 600 000 joules.

Liquefied petroleum Gas (LPG):
Consists mainly of propane or butane, derived from either petroleum refining process or extracted from petroleum streams. It is normally liquefied under pressure for transportation and storage. In Mauritius it is often used to power cooking stoves or gas water heaters and to fuel some types of vehicle.

Losses (transmission / distribution losses):
Comprise losses in transmission and distribution of electric energy and losses in transformers, which are *not* considered as integral parts of the power stations.

Own use (Station use and loss):
Included are consumption by station auxiliaries and losses in transformers, which are considered as integral parts of the power stations.

Peak demand:
Term used in energy demand management describing a period in which electrical power is expected to be provided for a sustained period at a significantly higher than the average supply level. Peak demand fluctuations may occur on daily, monthly seasonal and yearly cycles.

Petroleum products:
The primary source of petroleum products is crude oil. Petroleum or crude oil is a naturally occurring, flammable liquid found in rock formations in the Earth. Diesel oil, fuel oils, Gasoline, Kerosene and Liquefied petroleum gas(LPG) are among the major products derived from crude oil distillation.

Primary energy:
Primary energy designates energy from sources that involve only extraction or capture. Primary energy is not derived from any other forms of energy. By convention, sources of energy that occur naturally such as coal, fuel oil, fuel wood are termed primary energy.

Primary energy consumption:
The final energy consumption in which is included the losses and consumption of producers and transformers of energy.

Production:

Comprises gross production, i.e., the amount of electric energy produced, including that consumed by station auxiliaries and any losses in transformers that are considered integral parts of the power station.

Renewable energy or Renewables:

Natural resources that, after exploitation, can return to their previous stock levels by natural processes of growth or replenishment.

Secondary energy:

Designates energy from all sources of energy that results from transformation of primary sources. e.g. electricity from coal.

Solar Thermal:

Solar energy harnessed in the form of thermal energy

Thermal plants:

Comprises of conventional thermal plants of all types that require combustion of fuels to generate electricity. They include steam-operated generating plants and plants using internal combustion engines or gas turbines.

Thermal sources of electricity:

These include coal, oil and its derivatives and bagasse.

Tonne of oil equivalent (toe):

Amount of heat obtained by the perfect combustion one tonne of oil, defined as 41.868 gigajoules.

Watt (W):

The conventional unit to measure a rate of conversion of energy. One watt equals to 1Joule per second.

Energy conversion factors

	tonne	toe
Gasoline	1	1.08
Diesel Oil	1	1.01
Dual Purpose Kerosene (DPK)	1	1.04
Fuel Oil	1	0.96
Liquified Petroleum Gas (LPG)	1	1.08
Coal	1	0.62
Bagasse	1	0.16
Fuelwood	1	0.38
Charcoal	1	0.74

	GWh	ktoe
Hydro/Wind/Bagasse	1	0.086
Electricity	1	0.086

1 toe = 0.041868 terajoule (TJ) (net calorific value)

HOW TO READ SUMMARY TABLE

The summary table is presented at the beginning of document shows in a synthetic way the energy flows in Mauritius according to the activities and the types of energy:

- Energy activities: Primary production and supply, secondary production, distribution, final consumption
- Types of energy: coal, petroleum products, Biomass, Hydro, Solar, Wind, Electricity, Heat

The values shown are expressed in ktoe and the following convention has been used to differentiate the energy consumption: positive values indicate production while negative values indicate consumption.

	Coal	Gasolene	Diesel	Aviation fuel	Kerosene	HFO	LPG	Used oils	Bagasse	Biogas	Fuelwood	Charcoal	Hydro	PV	Thermal	Wind	Own use	Electricity +Prod -Cons	Heat +Prod -Cons	TOTAL
Primary Energy and Supply																				
Local Production (LP)								0.0	225.0	0.0	7.7		8.7	0.0	0.0	0.0				241.4
Imported Resources	409.6	144.7	313.5	244.2	7.0	327.8	68.3													1515.1
Re-exports and bunkering			-134.4	-119.6		-125.0														-359.0
Stocks (+destocking; - stocking)	4.5	-17.0	19.4	-1.4	1.0	22.9	1.9													26.3
TOTAL Primary Energy (PE)	414.1	127.7	213.5	123.3	8.0	225.7	70.2	0.0	225.0	0.0	7.7	0.0	8.7	0.0	0.0	0.0	0.0	0.0	0.0	1423.8
% Energy independence (LP/PE)																				17
Secondary Energy																				
Coal input for electricity production	-398.7																	89.4		-309.3
HFO and diesel input for electricity production			-1.9			-182.5												81.4		-183.0
Bagasse input for electricity and heat production									-182.5									47.3	0.0	-135.1
Kerosene input for electricity production					-6.2													1.6		-4.6
Biogas input for electricity production										0.0								0.0		0.0
Hydro input for electricity production													-8.7	0.0				8.7		0.0
PV input for electricity production PV																		0.0		0.0
Wind input for electricity production																0.0		0.0		0.0
Solar Thermal heat production																			0.0	0.0
Fuelwood to charcoal											-0.9	0.4								-0.5
TOTAL Secondary supply (SS)	-398.7	0.0	-1.9	0.0	-6.2	-182.5	0.0	0.0	-182.5	0.0	-0.9	0.4	-8.7	0.0	0.0	0.0		228.5	0.0	-552.5
Energy Distribution																				
TOTAL final distribution (D=PE+SS)	15.4	127.7	211.6	123.3	1.8	43.2	70.2	0.0	42.6	0.0	6.8	0.4	0.0	0.0	0.0	0.0	0.0	228.5	0.0	871.3
Losses (L=-(D+F))	0.0	0.0	-0.1	0.0	0.0	0.0	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.5	-17.1	0.0	-20.8
																				850.5
Final Energy Consumption																				
Manufacturing	-15.4		-47.0			-43.2	-5.5		-42.6		-0.5							-80.4		-234.6
Commercial							-11.0								-0.3			-64.3		-76.4
Household					-1.8		-47.6				-6.3	-0.1						-61.1		-116.9
Transport		-127.7	-162.2	-123.3			-5.0											0.0		-418.2
Agriculture			-2.3															-2.1		-4.4
TOTAL (F)	-15.4	-127.7	-211.5	-123.3	-1.8	-43.2	-69.9	0.0	-42.6	0.0	-6.8	-0.4	0.0	0.0	0.0	0.0	0.0	-207.9	0.0	-850.5

The table can be read in two ways:

- Reading horizontally:
  A line indicates flows specific to a specific activity for different types of energy shown in a column
  - For example, the line "Coal input for electricity production" indicates a production of electricity of 89.4 ktoe (+89.4at the intersection with the electricity column) from the combustion of 398.7 ktoe of coal (-398.7 at the intersection with the coal column); thus, generation of electricity from coal has a negative overall balance of 309.3 ktoe in the TOTAL column, indicating that it took more fossil energy to produce electrical energy.

- Reading vertically:
  A column indicates the flow of a particular type of energy for different activities
  - For example, the column "Diesel" indicates imports of 313.5 ktoe (+313,5at the intersection with the line imported resources), 114.4 ktoe for re-exports and bunkering (+114.4 at the inter section with the line "re-exports and bunkering"), with an addition of 14.4ktoefromstocksduring the year(+14.4at the intersection with the line "Stocks"), the use of 1.9ktoefor electricity production(-1.9 at the intersection with the line "Fuel Oil and diesel input for electricity production"), final consumption of 47.0 ktoe in the manufacturing sector, 162.2 ktoe in the transport sector and 2.3 ktoe in the agricultural sector(-47.0, -162.2and -2.3respectivelythe intersection with the lines "manufacturing", " transport" and "agriculture")

These background explanations allow you to combine both approaches and perform cross "vertical" and "horizontal" readings.