Maldives Energy Supply and Demand Survey

2010 – 2012

Maldives Energy Authority
Republic of Maldives

Maldives Energy Supply & Demand Survey 2010 - 2012

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List of Abbreviations

GJ	Giga Joules
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
J	Joules
KW	Kilo Watt
KWh	Kilo Watt Hour
LPG	Liquid Petroleum Gas
MWh	Mega Watt Hour
MWSC	Male' Water and Sewerage Company
SEC	Specific Electricity Consumption
tCO2	Tonnes of Carbondioxide
tCO2eq	Tonnes of Carbondioxide equivalent
TJ	Tera Joules
toe	Tonnes of Oil Equivalent

Executive Summary

The Energy Balance Report for the years 2010-2012 prepared for the Ministry of Environment and Energy provides an update to the existing Energy Balance prepared in the year 2010 prepared for years 2009 and 2008.

Energy supply of a country remains as one of the key drivers of economic development. The main purposes of its compilation include i) to enhance the relevance of energy statistics by providing comprehensive and reconciled information on energy situation in a country; ii) to provide comprehensive information on energy supply and demand in a country in order to understand energy security, the effective functioning of energy markets and other relevant policy goals and to formulate energy policies; iii) to ensure comparability between different years and between different countries; iv) to establish the basis for estimation of CO2 emissions; v) to provide an input for forecast modeling, etc.

The main components of this report include; Components of Energy Supply, Energy conversion, Component of Demand Side, Final Energy Balance and Energy indicators. Since the input data for the energy balance resides with various stakeholders and different end users, a careful methodology for obtaining the data was developed. Division of major energy sectors and the primary sources for obtaining the data for these sectors were identified. Data from the primary sources were analyzed and data from secondary and tertiary sources were used to fill the gaps in consultation with the Maldives Energy Authority. Data of energy supply or energy import was obtained from the Maldives Customs Service. Energy conversion and distribution data was collection from STO and Villa Gas and other private parties involved in the secondary distribution and conversion of fossil fuel. Demand side or end user data was based on the various use of the energy by the end users for different purposes such as domestic use. During all the stages of data gathering and compilation MEA was involved.

Components of Energy Supply

The main supply of energy includes Diesel, Petrol, Liquefied Petroleum Gas (LPG), Kerosene, Jet A1 fuel and solar energy. Diesel import with 84% in 2010, 80% in 2011 and 70% in 2012, is the most imported fuel type.

Due to several installations of solar PVs in Greater Male' Region and some areas in the Other Atolls, a huge increase in the solar energy production from 2011 to 2012 is observed. A significant increase in the import of jet A1 fuel is also observed in 2012 compared to 2011.

Energy Conversion

In Maldives the most significant energy conversion is from diesel energy to electricity. Nearly 100% of all electricity produced in Maldives in from diesel based systems. The

thermal conversion efficiency range from 33% to 38% in the Greater Male' Region. The thermal conversion efficiency of 38% observed in Male' Power house is an extremely good conversion rate for a diesel generator.

For the Other Atolls there are 189 power houses throughout the Maldives operated by different utility operators. The conversion rates from well-populated or development islands are considerably better than the rest.

All tourist resort islands have their own private electricity production. In the years 2010, 2011 and 2012 the total number of registered resorts was 98, 101 and 105 respectively. The average use of diesel for electricity production in this sector is 22.83 liters/bednight. The average conversion efficiency is 34%.

Maldives Water and Sewerage Company (MWSC), the largest operators of desalination plants in Maldives used 5492 toe in the year 2012 and 4.76 kWh of units were used to produce a cubic meter of water.

Energy used by fishing and canning sector shows these industries use 582 toe per year for their energy demands. 2157 toe was used in Thilafushi for energy production.

Components of Demand Side

Electrical energy is the main type of energy that has been utilized at the demand side. The growth of specific electricity consumption has been increasing for Greater Male Region and Other Atolls with a more rapid growth in the Other Atolls. In the Greater Male' Region there was a growth of 1% in 2011 and a growth of 6% in 2012 in electricity consumption. In the Other Atolls it was 18% in 2012 and 14% in 2012.

For the household sector use of electrical appliances and cooking are the most energy intensive activity. The use of LPG in Other Atolls is more than the use of LPG in Greater Male' Region and more energy is consumed by electrical appliances in both the regions compared to energy used for cooling and lighting.

In the tourism sector most energy is found to be used for cooling. On average 31.3 kWh per bed-night was found for this period.

Use of energy for the transport was determined by segregating the transport sector into three categories; transport for leisure and tourism, transport of passenger and cargo and land transport. Transport and leisure activities within the tourism sector is more energy intensive than the energy used for transport by the Greater Male' Region and Other Atolls.

Fisheries sector has been traditionally the main primary economic activity in the Maldives. It is also an extremely energy intensive economic activity involving transport and various manufacturing and industrial processes contributing to the energy consumption of the

sector. The data shows that there is a significant difference in energy consumption as well as activity between Greater Male' Region and Other Atolls. Majority of the fisheries activity occurs in the Other Atolls. However, when looking at the energy efficiency, the fishing in Greater Male' Region consumes twice as less energy than Other Atolls.

Emissions

Emissions from the energy consumption showed an increasing trend. An increasing trend of 75527 tCO2 per year was shown for the energy sector alone. By end of year 2012, 1,229,615.5 tCO2 was emitted by the energy usage. Among the main contributors, tourism sector shows to contribute the largest.

Final energy balance

The main primary energy supply in Maldives is still dependent on imported fossil fuel (99.9%). Bulk of this imported fuel is diesel and the main energy used for production of electricity and transport. Indigenously produced and supplied energy accounts for about 0.1% of the total energy supply.

Final Energy Consumption is based on demand of various sectors and uses. The major energy source in the demand side is electricity (38-40%) closely followed by diesel used for transport (28-31%) in various sectors. Tourism sector is the single most significant economic sector in terms of energy consumption. It accounts for 1/3 of the total energy consumption in Maldives.

1. Introduction

The importance of energy in modern society has led the countries to measure the energy flows that enter a country and how energy is used in the different sectors along the year. Like any other balance, the energy balance collects information on energy input and output. An overall energy balance is an accounting framework for the compilation and reconciliation of data on all energy entering, exiting and used within the national territory of a given country during a reference period. As such, the Maldives Energy Authority produces Energy Balances of Maldives to represent the energy flows. The first Energy Balance report was published in 2003 for the year 2002 and the second report was published in 2006 for the years 2003-2005. Another update of the balance was published in 2010 providing the Energy Balances for the years 2008 and 2009. Similarly, this report provides an update to the existing Energy Demand and Supply reports providing Energy Balances for the years 2010-2012.

With the objective of establishing Energy Statistics for the years 2010-2012, this report provides information on the following areas:

- National imports/export of energy (fuels)
- Energy production, transformation and distribution to various users.
- Energy use by various economic activities and sectors/sub-sectors.
- Technical and operational statistics of the plants and installations.
- Emissions related to the energy consumption
- Macro-economic and other social information related to supply and demand analysis
- Key indicators and country comparisons.

The establishment of Energy Balances also strengthens the capacity of the Energy Administration by adhering to the internationally recognized procedures for energy data handling and collection.

2. Need of an Energy Balance

The energy balance is a multipurpose tool. The main purposes of its compilation include:

- To enhance the relevance of energy statistics by providing comprehensive and reconciled information on energy situation in a country;
- To provide comprehensive information on energy supply and demand in a country in order to understand energy security, the effective functioning of energy markets and other relevant policy goals and to formulate energy policies;
- To serve as a quality tool to ensure the consistency and comparability of basic statistics;
- To ensure comparability between different years and between different countries;
- To establish the basis for estimation of CO2 emissions;
- To provide the basis for aggregated indicators (e.g. energy intensity etc…);
- To compute efficiencies of all the transformation processes occurring in the country;
- To allow calculation of relative shares of various products (including renewables vs non renewables) or sectors to the country total;
- To provide an input for forecast modelling and
- To provide a common framework for international comparisons.

Energy supply of a country remains as one of the key drivers of economic development. In 2012 alone, Maldives spent US$470 million on importing fossil fuels (Customs 2013) – a figure equivalent to around 23% of the GDP. Energy Balance is necessary to Maldives in numerous ways. The previous Energy Balances reports were used in formulating and implementing energy projects such as the Scaling up of Renewable Energy Project (SREP), formulation of energy policy, monitoring the development in the national energy consumption and development of renewable energy projects and to fulfill various international reporting obligations.

3. Methodology

The energy balance is a key tool which could be used in monitoring the growth of the energy sector. It could also be used as a planning tool for the power sector. Since the input data for the energy balance resides with various stakeholders and different end users, a careful methodology for obtaining the data was developed.

3.1 General approach on division of sectors

Three main key components of an energy balance are:

1. **The primary energy supply** – this represents the energy entering and leaving the country as well as changes to the bunkered stock to provide information on the supply of energy during the reference period.
2. **Conversion of energy** – considers how energy is transferred, transformed, used by the energy industries and distribution and transmission losses.
3. **The demand side** – the energy demand by the end users

The primary energy supply

The primary source of energy supplied in Maldives is from imported oil products. Maldives do not have other forms of energy supply coming from nuclear, hydro, biomass or any other supplies to mention a few. The only indigenous source of energy used is the solar energy.

Conversion of energy

Energy is converted for various use by different sectors. Energy is mainly converted to electricity by various industries in Maldives. During the energy balance calculations, transmission and distribution losses are included in the conversions. All the sectors which converts to energy to electricity are considered under the conversion.

The demand side or end user

The demand side is the use of the energy by end users or the energy consumption. The main categories used in the demand side are shown in in Table 1:

Table 1: Division of main energy conversion sectors.

Sector	Description
Households, residential use and public sector	The use of energy or electricity by households or for the residential use and by the public buildings
Manufacturing industry (desalination, fishing industry, cold storage and canning)	Use of energy by the desalination plants and by the fishing industry for operation of cold storage and fish processing plants
Tourism industry	Energy used for power production and distribution
Transport sector	Energy usage in land, sea and air transport

In previous energy balance reports, a significant difference is seen in the supply and demand geographically. This difference is especially seen in the Greater Male' Region. Therefore, a major geographic division is considered as Greater Male' Region and Other Atolls. Greater Male' Region consists of Male', HulhuMale', Villigili, Thilafushi and the newly reclaimed Gulheefalhu islands. The demand for these two areas are treated separately in the calculations.

A similar approach is made for the manufacturing industry. The industrial processes within the Greater Male' Region is separated to those in the atolls. Few industrial processes are carried out in the Other Atolls. Major industrial activities carried out in Maldives that are energy intensive and demanding are fish processing plants, desalination plants, cold storage and canning.

Tourism sector have the largest share of the energy of about 60% (MEE 2012). In total there are 105 resort islands and each island have their own power generation and desalinations systems.

Transport sector takes the next largest share in energy consumption. Land transport, domestic air transport and sea transport consumes a lot of energy, mainly Jet A1 and diesel fuel. For the energy balance, transport involved in passenger and cargo, fishing vessels, tourism leisure activities are dealt separately.

3.2 Data collection procedures and quality control

After identifying the main sectors, the primary sources for obtaining the data for these sectors were identified. Data from the primary sources were analyzed and data from secondary and tertiary sources were used to fill the gaps in consultation with the Maldives Energy Authority.

Data were obtained from the following sources and details of the data are given in the respective chapters.

- **Energy supply or energy import data**
  Since all forms of fuel are imported primary energy supply data is obtained from the Maldives Custom services Statistics Department. Fuel import data were obtained from 2012 until dating back to the last energy balance.

- **Energy conversion and distribution data**
  This data is essentially the data about the distribution of fuel carried by the main importers of the fossil fuel. This includes data collection from STO and Villa Gas as well as other private parties involved in the secondary distribution and conversion of fossil fuel. This set of data collection include data from the main power Utilities on their consumption of fossil fuel.

- **Demand side or end user data**
  The demand side is the use of the energy by end users or the final energy consumption. This data include different patterns of energy usage from different sectors and subsectors. One simple example would be an electricity bill which would be converted to energy use.

It is to be noted that the availability of data is not at the expected level especially on the energy conversion, distribution and on the demand side. The previous energy balances were followed and data gaps were determined. However, some of the data were much more readily available and reliable compared to the previous energy balances.

As for the quality control, the data obtained were checked for any anomalies such as insignificant peaks. Data entry were double checked to reduce the clerical errors and analysis results were checked and interpreted by the experts. Furthermore, initial findings were shared with MEA for them to better understand the underlying assumptions and calculations carried out in the process and to complement their suggestions for further refining of the results.

3.3 Data Analysis and underlying assumptions

The data analysis methodology used is similar to what was applied in the previous energy balances. However the following minor changes were used:

- Land transport is segregated to Greater Male' Region and Other Atolls.
- Change in the conversion factors to the latest IPCC and IEA figures.
- Change to a more informative data presentation.
- Comparisons of key indicators with previous energy balances.

In addition to this, the consumption of international aviation fuel was not considered in the energy balance. This assumption was made since the customs import data does not show the international aviation fuel consumed as being imported. However the data

of international aviation was collected from Maldives Airports Company Limited. Table below shows the amount of Jet fuel used in International Aviation.

Consultation with MEA was held to capture the latest updates in the sector to refine the assumptions to address data gaps. Every effort was made to utilize country specific conversion factors and assumption where data is sufficiently available. In case of unavailability, either the standards utilized in previous studies or figures prescribed by IEA or IPCC were used.

Data from the respective stakeholders including the suppliers, power producers and some data from the consumers or the demand side were also obtained. For the final energy consumption, the input data is converted to tonnes of oil equivalent (toe) which is one of the standard units used by the International Energy Agency (IEA) in representing energy balances. One toe is equivalent to the energy of standard crude oil which is defined as 41.87 GJ or 11,630 kWh. The data collected and compiled are aggregated to provide annual energy balance data. The petroleum products are converted from their natural units using their calorific values or using a simple conversion factor for the respective fuel types. The conversion factors used are specified in Table 2 which is obtained from the 2006 IPCC guidelines for National GHG inventories.

Table 2: Tables of conversion factors

Types of fuel	tonne	Density	Energy Content		Emission Factor
		g/cm3	GJ/tonne	toe/tonne	tCO_2/toe
Diesel	1	0.84	43.33	1.035	3.06
Petrol	1	0.75	44.80	1.070	2.84
Kerosene	1	0.8	44.75	1.069	2.92
Jet A1	1	0.8	44.59	1.065	2.92
LPG	1	0.54	47.31	1.130	2.57

The best available datasets were obtained for the year 2011. Since monthly records of 2011 were available, 2011 was used as a baseline data for the quality control of the datasets of the other years. Some of the datasets provided by the atolls were found to be unreliable during the quality control.

There are many factors which contribute to increase in energy demand such as increase in industrialization, globalization, increasing wealth in emerging markets etc… One of the assumptions made here is that in Maldives, the energy demand is highly linked to the increase in population to improve the living standards and there is less number of increase in industrialization compared to increase in population. This being a reasonable assumption, this was used in the quality control of the data.

Population projection data was provided by the DNP and this projection data with the 2006 population census data was used to estimate the populations for Greater Male'

Region and Other Atolls for the respective three years. Table 3 shows the socio-economic indicators used.

Table 3: Socio-economic indicators

Description	2010	2011	2012
Population (including Expats)	393,578	406,359	419,998
Population (excluding Expats)	319,738	325,135	330,652
Population in Greater Male'	110,897	112,769	114,682
Population in Other Atolls	208,841	212,366	215,970
GDP basic (million MVR)	27,317	31,584	32,469
GDP (PPP) conversion	10.30	10.84	11.12
GDP (PPP) (million USD)	2,652.78	2,912.78	2,919.38
GDP/capita (PPP)	8,296.73	8,958.67	8,829.17

The detailed demand side data of sample households from two islands in Other Atolls were used to form a baseline for demand side. Th. Electricity usage per household from these islands were used as a ratio to approximate the demand side usage of other islands. For the extrapolation additional information from the HIES 2009 data from DNP were used to supplement.

3.4 Uncertainties and Validation

It is to be noted that in any given area of interest for this study exhibits data gaps. These gaps were bridged by use of assumptions and approximations were made based on a previous year or based on the baseline. In addition to improve the reliability of data available data was same data was obtained from various sources and compared for consistencies to avoid error as much as possible. To further validate these assumptions and approximations proxy data like population, economic and expenditure information were used. Information available in previous energy balance was used to further verify the end results. Random data was collected on the field to verify some of the assumptions used especially in for transport sector and demand side electricity sector.

However given the dynamic situation politically and economically the country was in during the years in question, it was difficult to take into account the situation had on the energy use patterns in the Maldives.

4. Components of energy supply

This chapter outlines what was used in the main supply of energy and describes the use of those supplies in the country.

4.1 Diesel

Among the most imported fuel types, diesel carries the largest share. Diesel is mainly used for power generation and for transportation. Data for the import of all fuel types are well recorded by the Maldives Customs Service. Figure 1 shows the import and the consumption trend of diesel from 2010 to 2012. One notable feature is that the consumption levels in each year are similar to what is imported except for 2010 where consumption exceed the import amount. One of the reasons for this difference could be the consumption of stock left from 2009.

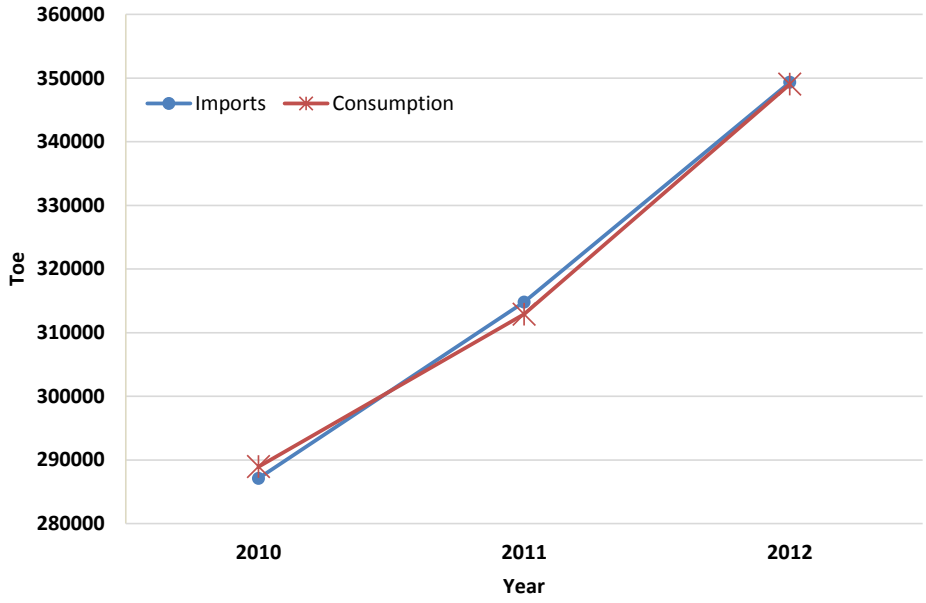


Figure 1: Diesel import and consumption trend from 2010 to 2012.

4.2 Petrol

Other than diesel, petrol carries the next largest share of imported fuel. Petrol is mainly used in transportation vehicles. Figure 2 shows the trend of import and consumption of petrol from 2010 to 2012. A similar trend of consumption and import usage is shown here.

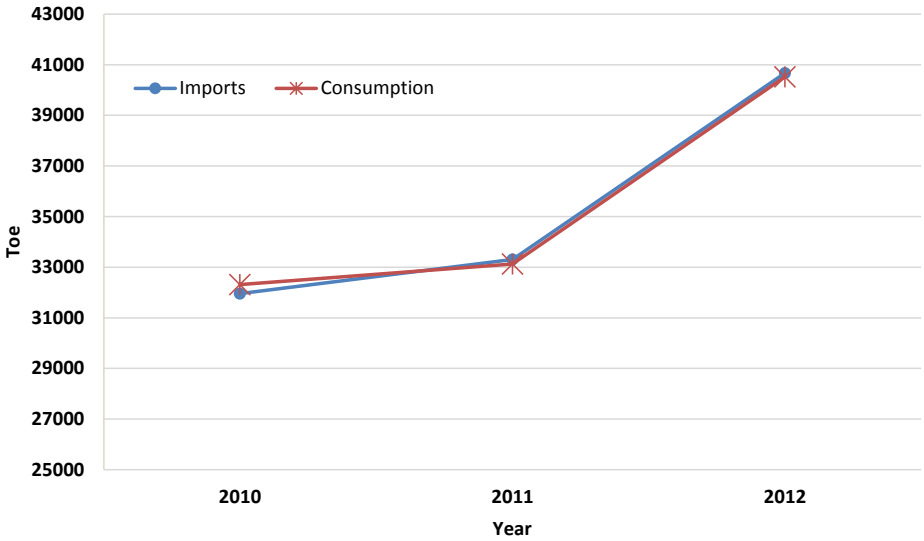


Figure 2: Import and consumption trend of petrol from 2010 to 2012.

4.3 Liquefied Petroleum Gas (LPG)

LPG primarily composes of propane and butane. LPG is most commonly used for cooking purposes in pressurized bottled containers in Maldives. Figure 3 shows the trend of the LPG import and consumption. In 2010, the consumption seems to be very less compared to imports. The import in 2011 seems to be less than that in 2010, probably due to leftover stock left from 2010. In 2012 the total import of LPG was considerably lower than its usage. However, the balance from 2010 and 2011 imports would have compensated for the deficit imports in 2012.

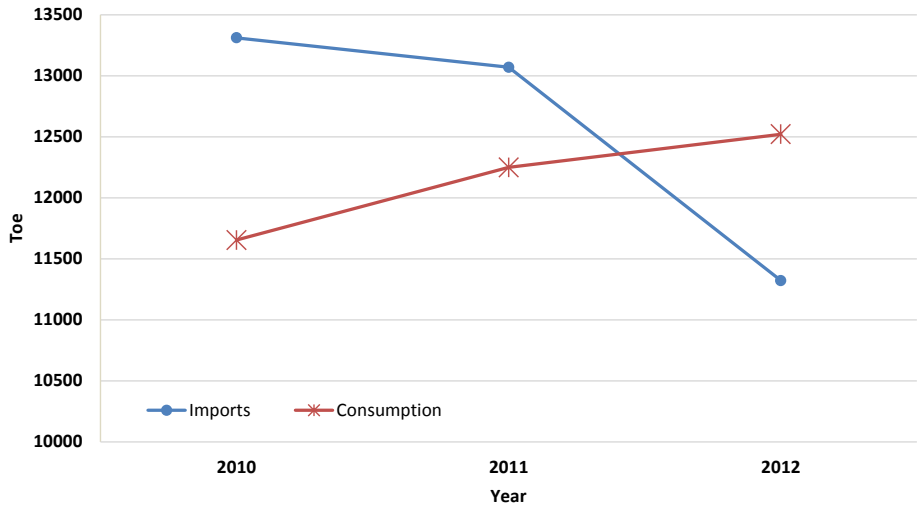


Figure 3: Import and consumption trend of LPG from 2010 to 2012.

4.4 Kerosene

Kerosene is used for heating and lighting purposes. Figure 4 shows the trend of kerosene imports and consumption.

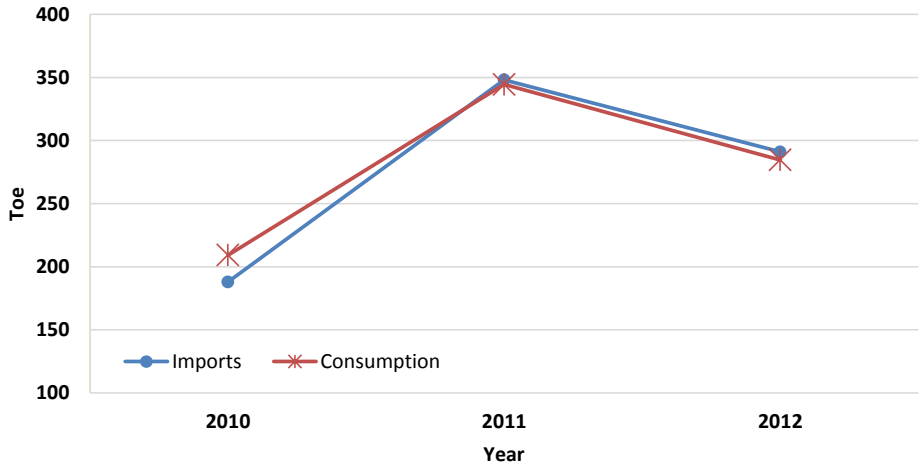


Figure 4: Import trend of kerosene from 2010 to 2012.

4.5 Jet A1 fuel

Aviation fuel is a specialized type of petroleum used in the aviation industry. Jet A1 fuel is the most imported in Maldives. A significant amount is re-exported for fuelling the international aircrafts. Figure 5 shows the import and consumption trends of jet A1. A significant increase in the import of jet A1 fuel is observed in 2012 compared to 2011. This is because in 2012 there was an increase in the amount of domestic airports. However, in 2012 there is only a slight increase in the consumption when compared to 2011.

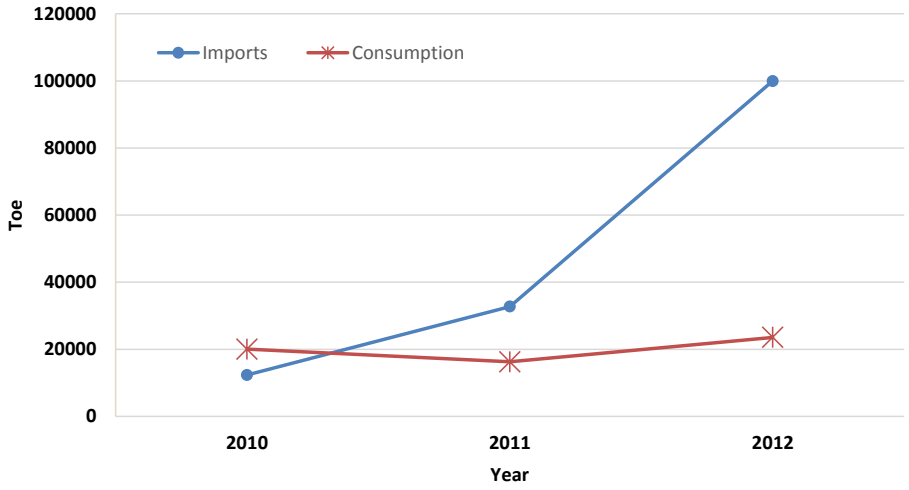


Figure 5: Import and consumption trend of Jet A1 from 2010 to 2012.

4.6 Solar energy

Use of solar energy in Maldives is growing due to its popularity and due to drop of its market prices. Solar power is used in resorts for heating purposes. Solar PV systems are now increasingly used to feed the electricity grids in some islands including the capital Male'. Figure 6 shows the increase in total energy produced over the time period. From 2010 government gave a special interest to promote low carbon technologies. As an incentive to introduce these technologies, the government introduced a tax exemption on the import of renewable energy appliances. In addition to this, with the reduction of the price of solar PVs, there was more import and hence more installation of solar PVs. The increase in production from 2011 to 2012 is due to several installations of solar PVs in Greater Male' Region and some areas in the Other Atolls.

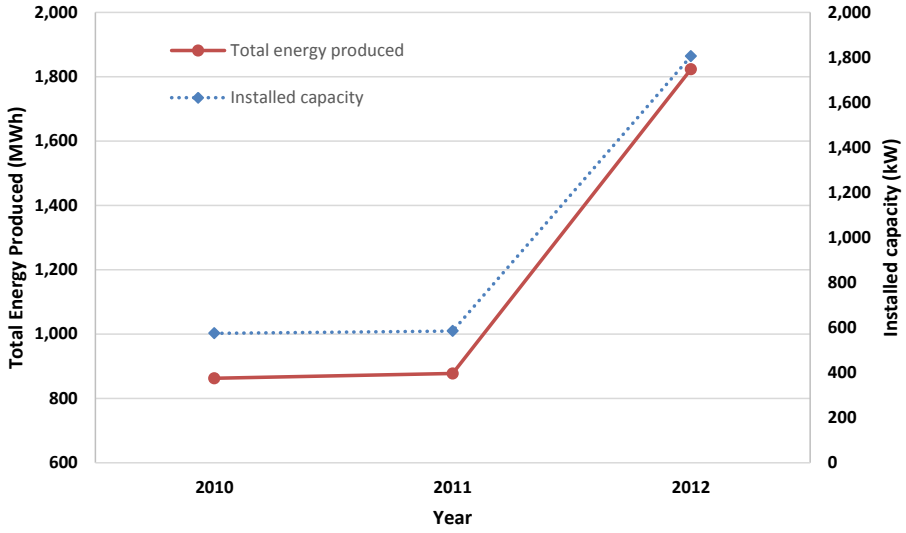


Figure 6: Trend of total energy produced by solar PV.

4.7 Other Energy Sources

Other energy sources used in Maldives are wind and biomass. However, currently there are no wind masts or biomass plants in operation. In addition, insignificant amount of charcoal is also imported for use such as barbecues. Due to non-operation, insignificant use and due to unavailability of data, these sources are not accounted for in this energy balance.

5. Energy Conversion

In Maldives the most significant energy conversion is from diesel energy to electricity. Nearly 100% of all electricity produced in Maldives in from diesel based systems. The generation and distribution of the electrical systems are decentralized with each separate island operating a self-sustaining diesel power generation and distribution system. This creates a wide range of generation size, demand and efficiency of electrical systems. For the ease of assessment, the supply of electricity has been divided into following segments

- Greater Male' Region
- Other Atolls
- Power production in tourist resorts
- Electricity production in industries (auto-producers)

Based on known conversion efficiency of a number of production units in the Maldives, it was possible to establish a satisfactory relation between the expected production efficiency and the total production. The assumption that the efficiency is relative to the total electricity production is reasonable from the following point of view:

- An increase in production requires a larger production unit which increase efficiency
- The right size of the generator sets are used with respect to the load
- An increasing production requires the existing unit run for more hours at higher loads increasing the efficiency

The conversion efficiency (y) has been modelled (see Figure 7) based on the analysis to be

$$y = 0.0144\ln(x) + 0.1908$$

where (x) is the electricity production, and the minimum efficiency is set at 19%.

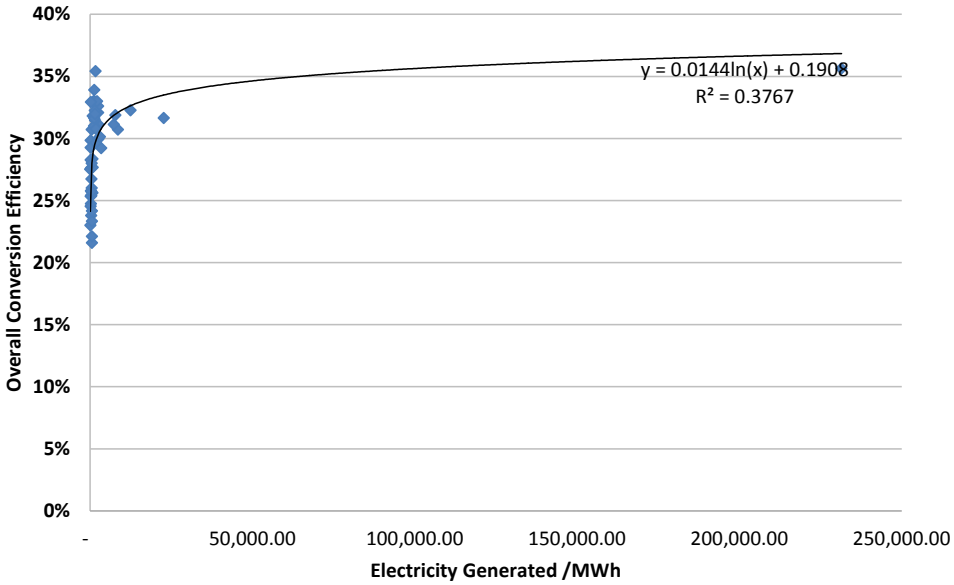


Figure 7: Relationship between conversion efficiency and electricity generation.

5.1 Greater Male' Region

The Greater Male' Region consists of Male', HulhuMale', Villigili, Thilafushi and the newly reclaimed Gulheefalhu islands. Electric utility service is provided by STELCO for this region. However there are few independent power producers that generate to meet their electrical demands in the industrial zones of HulhuMale' and Thilafushi. Also the desalination plant operated by MWSC produces electricity to meet the energy demand for desalination. These cases will be discussed under electricity production in industries.

Table 4: Conversion and distribution loss in Greater Male' Region

	2010	2011	2012
Diesel Consumed	53,670.86	57,962.21	61,817.26
Conversion Efficiency	38%	38%	38%
Average Distribution loss	7%	7%	7%
Electricity Produced	18,930.68	20,423.43	21,495.42

Table 4 provides an overall picture of thermal energy conversion and distribution losses in Greater Male' Region. The 4 power houses in the region have a thermal conversion efficiency ranging from 33% to 38% (see Appendix A) and a distribution loss ranging from 5% to 13% (see Appendix). The thermal conversion efficiency of 38% observed in Male' Power house is an extremely good conversion rate for a diesel generator. Main factors contributing to this is considerably larger systems that run on full loads and regular maintenance.

5.2 Other Atolls

Other Atolls is a collective name of all islands outside Greater Male' Region. There are 189 power houses throughout the Maldives operated by different utility operators. As of the end of 2013, STELCO operates 28 power stations in 26 islands while FENAKA operates 146 power stations in 145 islands. There are 16 power stations operated in 16 islands by island councils and 3 power stations operated in 2 islands by private parties. All of STELCO and some of FENAKA operated power houses have well documented information on its operation. Whereas privately operated and/or island council operated powerhouses do not have enough information of past three years to determine the state of the power houses.

In order to establish an overview of needs for investment in the power sector, MEE undertook a survey on electricity production and diesel consumption covering all islands and data of 3 months were collected. Similarly, as part of data collection for the Second National Communication, MEE has collected data for a full year covering monthly data for islands operated by state owned utility where it was available. Number of other data was collected by MEA on various occasions for their assessment of tariff structures. Thus, data from these sources has been cross referenced to complete the data gaps to produce the best possible result. The complete data set for the islands is provided in Appendix A. The overall conversion efficiency is given in the Table 5 below.

Table 5: Conversion efficiency in Other Atolls.

	2010	2011	2012
Diesel Consumed	35,526.85	48,814.28	57,687.18
Overall Conversion Efficiency	33%	31%	30%
Electricity Consumed	11,877.40	14,970.74	17,583.97

The conversion rates from well-populated or development islands are considerably better compared to other islands. The Table 6 below illustrates the difference in conversion efficiencies between administrative centers of the atolls and others.

Table 6: Comparison of overall efficiency with greater Male' and other regions.

	Thermal Conversion	Technical Loss	Overall system efficiency
Greater Male''	38%	7%	35%
Capital islands	35%	10%	31%
Others	NA	NA	22% - 39%

5.3 Power production in tourist resorts

All tourist resort islands have their own private electricity production. Detailed data covering all these islands are not available. A data questionnaire was issued to produce a reliable basis for analysis of the resort consumption. In the years 2010, 2011 and 2012 the total number of registered resorts were 98, 101 and 105 respectively.

Based on the analysis of the data obtained, it can be summarized that the average use of diesel for electricity production is 22.83 liters/bednight as shown in Table 7.

Table 7: Electricity production for the resorts.

	2010	2011	2012
Diesel Consumed per bed night litres	22.83	22.83	22.83
Diesel Consumed	120,944.90	124,647.29	129,583.82
Conversion Efficiency	34%	34%	34%
Electricity Produced per bednight kWh	78.08	78.08	78.08
Total Electricity Produced / toe	40,920.50	42,173.17	43,843.40

The average conversion efficiency of 34% is based on information from selected resorts, and site visit experience with the level of maintenance and operation of the diesel generator sets.

5.4 Power production in industries

A thorough mapping of power production in industries and manufacturing has not yet been carried out. In the industries, electricity is produced for specific needs and for smaller amounts. The known electricity producers are:

- Maldives Sewage and Water Company (MSWC) to make desalinated water
- Fish canning and freezing companies
- Captive electricity systems in Thilafushi and HulhuMale' used for industrial purposes

5.4.1 Desalination

Maldives Water and Sewerage Company (MWSC) is a public company with government as the major shareholder. They are largest operators of desalination plants in Maldives. Upon request, they have provided the details of the energy consumption at their facilities around the country. Table 8 shows the overall usage of energy for desalination in Maldives.

Table 8: Energy use for desalination by MWSC.

	2010	2011	2012
Diesel Consumed (toe)	4,308.67	4,328.14	5,492.09
Greater Male' Region(toe)	3,677.94	3,921.81	4,369.86
Other Atolls (toe)	630.73	406.34	1,122.23
Conversion efficiency	35%	37%	36%
Electricity Produced (toe)	1,521.93	1,582.12	1,956.15
Greater Male' Region (toe)	1312.34	1415.28	1631.23
Other Atolls (toe)	209.59	166.84	324.92
RE power produced (toe)	0	0	3.08
Greater Male' Region (toe)	0	0	1.73
Other Atolls (toe)	0	0	1.36
Water Produced (m3)	3,784,000	4,247,000	4,790,000
Specific Power consumption (kWh/m3)	4.68	4.33	4.76

5.4.2 Fishing and canning industries

Some freezing/cooling storage facilities have its power generation units. Since no data has been collected after 2002, the figures shown in Table 9 are from 2002 assuming that the consumptions are the same as in 2002.

Table 9: Energy used by the fishing and canning industry.

		Fish canning	Freezing plant	Freezing plant	Total
Diesel consumption (ton/day)	ton/day	7.5	4.5	4.5	16.5
Days of production per year		365	365	365	365
Diesel consumption (ton/year)	ton/year	2738	1643	1643	6023
Annual diesel consumption	toe/year	2833	1700	1700	6233
Efficiency in electricity production		0.28	0.28	0.28	
Electricity production	toe/year	793	476	476	1745
Efficiency in steam production		0.5			
Steam use	toe/year	1417			1417

5.4.3 Other Industries

Other industries, mostly includes storage and other minor industrial activities in Thilafushi. This has not been assessed in the previous energy balances. For this energy balance, there was a great difficulty in obtaining data for power generation and consumption. However, a study conducted in 2009 suggested that Thilafushi has a total captive capacity of 4MW. Assuming that these systems would operate 13 hours a day for 365 days yearly power consumption could be estimated.

Table 10: Estimation of power consumption for Thilafushi.

	2010	2011	2012
Estimated Diesel consumption (toe)	5,244	5,768	6,345
Assumed Conversion efficiency	34%	34%	34%
Estimated Electricity Produced (toe)	1,783	1,961	2,157

6. Component of Demand Side

This chapter describes how energy is used by the demand sector.

6.1 Households, Commerce and Public Sector

Electric energy is the main type of energy that has been utilized at the demand side. Table 11 and Table 12 shows the specific electricity consumption in Greater Male' Region and Other Atolls respectively.

Table 11: Demand side energy consumption in Greater Male' Region.

Greater Male' Region	2010	2011	2012
Estimated Population	110,897	112,769	114,682
Estimated Electricity Consumption (MWh)	292,823.60	295,510.71	313,107.52
Specific Electricity Consumption (kWh/Capita)	2,640.51	2,620.50	2,730.22
Growth rate of SEC		6.09%	4.13%

Table 12: Demand side energy consumption in Other Atolls.

Other Atolls	2010	2011	2012
Estimated Population	208,841	212,366	215,970
Estimated Electricity Consumption (MWh)	161,240.96	196,719.40	228,985.92
Specific Electricity Consumption (kWh/Capita)	772.07	926.32	1,060.27
Growth rate of SEC		23.16%	16.33%

Specific electricity consumption is a proxy indicator for living standards and urbanization. The growth of specific electricity consumption has been increasing in Greater Male' Region and Other Atolls and it is more rapid in the Other Atolls. This may be because of the fast rate of urbanization in the Other Atolls. Greater Male' Region is already very saturated in terms of urbanization. Looking back historically in the last ten years, specific electricity consumption grew more than 4 times while in Greater Male' Region it has more than doubled as illustrated in Table 13 below.

Table 13: Growth of electricity consumption.

	Specific Electricity		Annual Growth %
	2002	2012	
Greater Male' Region	1,131.00	2,345.29	11%
Other Atolls	234.00	964.40	31%
Maldives	460.00	1,443.34	21%

Break down of electricity consumption in household, commercial and public sector was obtained through the records from STELCO and FENAKA that give accurate information on the usage for these sectors.

A breakdown of the uses of electricity can be identified using different surveys and audits on appliances and its uses that MEE has conducted in the past two years. Data was obtained from an audit conducted in Thinadhoo by the Climate Change Trust Fund (CCTF) project and audits on electrical/electronic appliances under POPs (Persistent Organic Pollutants) reporting. Comparative data is also available in Household income and economic survey (HIES) conducted by Department of National Planning in 2009.

For the household sector cooking is one of the most energy intensive activity. Based on imported data it is assumed that primary fuel used in household for cooking is LPG. The distribution of LPG between Greater Male' Region and Other Atolls has been established using the expenditure data from HIES 2009. Since it was an extensive survey conducted, it had detail information of expenditure on gas (LPG) in Greater Male' and the Other Atolls.

Table 14 to Table 19 shows the use of energy by the residential, commercial public and government sectors in the Greater Male' Region and the Other Atolls for the years 2011 – 2012.

Table 14: Use of energy by residential, commercial, public and government in Greater Male' Region in 2010.

Greater Male' Region - 2010			Population:	110,897
	Electricity (toe)	LPG (toe)	Total (toe)	Energy Per capita (kWh/capita)
Residential				
Cooling	3,063		3,063	321
Lighting	1,597		1,597	167
Appliances	4,837		4,837	507
Cooking	526	2,325	2,852	299
Other	40		40	4
Commercial	9,419		9,419	988
Public and Government	2,767		2,767	290

Table 15: Use of energy by residential, commercial, public and government in Other Atolls in 2010.

Other Atolls - 2010			Population:	208,841
	Electricity (toe)	LPG (toe)	Total (toe)	Energy Per capita (kWh/capita)
Residential				
Cooling	1,859		1,859	103
Lighting	2,055		2,055	114
Appliances	2,343		2,343	131
Cooking	60	6,063	6,122	341
Other	103		103	6
Commercial	1,443		1,443	80
Public and Government	4,014		4,014	224

Table 16: Use of energy by residential, commercial, public and government in Greater Male' Region in 2011

Greater Male' Region - 2011			Population:	112,769
	Electricity (toe)	LPG (toe)	Total (toe)	Energy Per capita (kWh/capita)
Residential				
Cooling	3,057		3,057	315
Lighting	1,594		1,594	164
Appliances	4,827		4,827	498
Cooking	525	2,418	2,944	304
Other	40		40	4
Commercial	9,581		9,581	988
Public and Government	2,761		2,761	285

Table 17: Use of energy by residential, commercial, public and government in Other Atolls in 2011.

Other Atolls - 2011			Population:	212,366
	Electricity (toe)	LPG (toe)	Total (toe)	Energy Per capita (kWh/capita)
Residential				
Cooling	2,343		2,343	128
Lighting	2,591		2,591	142
Appliances	2,954		2,954	162
Cooking	75	6,305	6,380	349
Other	130		130	7
Commercial	1,819		1,819	100
Public and Government	5,060		5,060	277

Table 18: Use of energy by residential, commercial, public and government in Greater Male' Region in 2012.

Greater Male' Region - 2012			Population:	114,682
	Electricity (toe)	LPG (toe)	Total (toe)	Energy Per capita (kWh/capita)
Residential				
Cooling	3,217		3,217	326
Lighting	1,677		1,677	170
Appliances	5,080		5,080	515
Cooking	553	2,515	3,068	311
Other	42		42	4
Commercial	9,581		9,581	972
Public and Government	2,761		2,761	280

Table 19: Use of energy by residential, commercial, public and government in Other Atolls in 2012.

Other Atolls - 2012			Population:	215,970
	Electricity (toe)	LPG (toe)	Total (toe)	Energy Per capita (kWh/capita)
Residential				
Cooling	2,751		2,751	148
Lighting	3,043		3,043	164
Appliances	3,469		3,469	187
Cooking	89	6,557	6,646	358
Other	152		152	8
Commercial	2,137		2,137	115
Public and Government	5,943		5,943	320

It could be seen that the use of LPG in Other Atolls is more than the use of LPG in Greater Male' Region. There is a consistent rise of use of LPG in these two regions. In addition, more energy is consumed by electrical appliances in both the regions compared to energy used for cooling and lighting.

6.2 Resorts

As consumption of energy in tourist resorts is significant, a separate investigation was carried out for this sector. Figure 8 shows the growth in tourist resort in the period of 2010 to 2012.

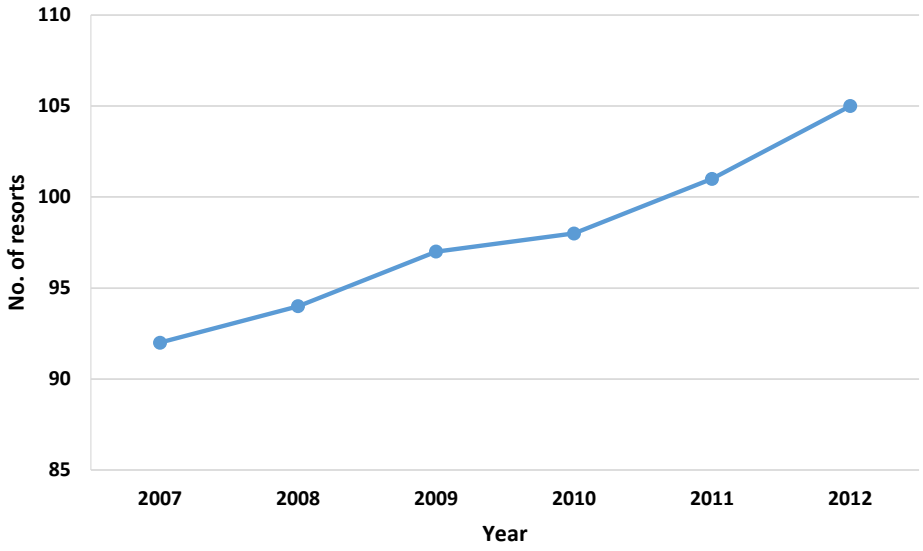


Figure 8: Growth trend of no. of resorts.

The end use of energy in the resorts is based on the data identified in the survey conducted in 20 resorts by Becitizen in 2009 to develop the carbon audit for the government. Due to the unavailability of data, it is assumed the specific energy consumptions has not changed for the period of 2010-2012. Table 20 to Table 22 shows the use of energy by the resorts.

Table 20: Use of energy by the resorts in 2010.

Resorts - 2010				Bed-nights	5,986,342.0
	Electricity (toe)	**LPG (toe)**	**Heat (toe)**	**Total (toe)**	**Energy Per bed-night (kWh/bed-night)**
Cooling	16,368.2			16,368.2	31.8
Lighting	4,092.1			4,092.1	7.9
Appliances	5,319.7			5,319.7	10.3
Cooking	2,046.0	3,493.2		5,539.2	10.8
Desalination	4,092.1			4,092.1	7.9
Water Heating			231.6	231.6	0.5
Others	9,002.5			9,002.5	17.5

Table 21: Use of energy by the resorts in 2011.

Resorts - 2011				Bed-nights	6,529,200.0
	Electricity (toe)	LPG (toe)	Heat (toe)	Total (toe)	Energy Per bed-night (kWh/bed-night)
Cooling	16,869.3			16,869.3	30.0
Lighting	4,217.3			4,217.3	7.5
Appliances	5,482.5			5,482.5	9.8
Cooking	2,108.7	3,810.0		5,918.7	10.5
Desalination	4,217.3			4,217.3	7.5
Water Heating			252.6	252.6	0.5
Others	9,278.1			9,278.1	16.5

Table 22: Use of energy by the resorts in 2012.

Resorts - 2012				Bed-nights	6,450,794.0
	Electricity (toe)	LPG (toe)	Heat (toe)	Total (toe)	Energy Per bed-night (kWh/bed-night)
Cooling	17,537.4			17,537.4	31.6
Lighting	4,384.3			4,384.3	7.9
Appliances	5,699.6			5,699.6	10.3
Cooking	2,192.2	3,764.2		5,956.4	10.7
Desalination	4,384.3			4,384.3	7.9
Water Heating			249.6	249.6	0.5
Others	9,645.5			9,645.5	17.4

6.3 Transport sector

Transport sector for the purpose of energy balance study has been segregated into following categories

- Transport for leisure and tourism
- Transport of passengers and cargo
- Land transport

The aviation sector is not discussed here as it consumed only for aviation purposes and is discussed on the supply side of aviation fuel.

6.3.1 Transport for Leisure and Tourism

This sub topic covers all energy uses in the transport mainly in tourism sector and for their leisure activities. The sector is divided in to three end use transports types. They are

- Energy used in transfer of tourists to and from airports
- Energy used in excursions and water sports
- Energy used in Safari

The information on the end use of transport modes are taken from a survey conducted in resorts by BeCitizen in 2009 and co-related with the registered vessel for tourism purposes and safari. The Table 23, Table 24 and Table 25 below gives an outline of the energy used in the above 3 sub categories.

Table 23: Energy usage in tourist transfers.

Year	Type of vessel	No.of Registered Vessels	% of active vessels	No.of Active vessels	Engine efficiency (l/km)	Total distance travelled (km)	Total Petrol Consumption (litres)	Total Petrol Consumption (toe)
2010	Speed boats	1,379	60%	827	65	210	11,294,010	9,064
2011	Speed boats	1,458	60%	875	65	210	11,941,839	9,584
2012	Speed boats	1,519	60%	911	65	210	12,440,610	9,984

Table 24: Energy used for excursions and water sports.

Year	No of resorts	Consumption / resort (litres)		Total Consumption (toe)	
		Diesel	Petrol	Diesel	Petrol
2010	98	108.7	22.9	11,024.5	2,396.6
2011	101	108.7	22.9	11,361.9	2,469.9
2012	105	108.7	22.9	11,811.9	2,567.7

Table 25: Energy consumed by safari boats.

Year	Safari bed-nights	Energy Consumption/ bed night			Total energy Consumption (toe)		
		diesel (litres)	LPG (kg)	Petrol (litres)	diesel	LPG	petrol
2010	156753	15.87	0.20	1.06	2163.0	35.1	133.1
2011	170622	15.87	0.20	1.06	2354.4	38.3	144.9
2012	133588	15.87	0.20	1.06	1843.4	30.0	113.4

6.3.2 Transport for Passenger and Cargo

This sub topic covers transport of passengers and cargo between habitat islands. In this assessment data of registered vessels was attained from Statistical year book for the period of 2010-2012. The energy balance was produced using the same assumption model in the energy balance of 2003-2005. Table 26 depicts use of energy in this sector.

Table 26: Energy usage for transport of passengers and cargo.

	Type of vessel	Registered Vessels	% of Active Vessels	Active vessels	Fuel consumption (l/hr)	Annual Hours of operation	Diesel Consumed (toe)	Petrol Consumed (toe)
2010							**20,233.49**	**3,021.23**
Passenger	Dhoni	1320	0.6	792	39	625	16,782.46	
	Speed boats	394	0.7	275.8	65	210		3,021.23
Cargo	Dhoni	172	0.5	86	39	500	1,457.87	
	Bahtheli	147	0.5	73.5	27	375	646.95	
	Barge	123	0.5	61.5	57	375	1,142.79	
	Other	39	0.5	19.5	32	375	203.42	
2011							**20,939.77**	**3,197.60**
Passenger	Dhoni	1363	0.6	817.8	39	625	17,329.16	
	Speed boats	417	0.7	291.9	65	210		3,197.60
Cargo	Dhoni	179	0.5	89.5	39	500	1,517.20	
	Bahtheli	155	0.5	77.5	27	375	682.15	
	Barge	130	0.5	65	57	375	1,207.83	
	Other	39	0.5	19.5	32	375	203.42	
2012							**21,658.76**	**3,327.96**
Passenger	Dhoni	1407	0.6	844.2	39	625	17,888.57	
	Speed boats	434	0.7	303.8	65	210		3,327.96
Cargo	Dhoni	186	0.5	93	39	500	1,576.53	
	Bahtheli	163	0.5	81.5	27	375	717.36	
	Barge	137	0.5	68.5	57	375	1,272.87	
	Other	39	0.5	19.5	32	375	203.42	

6.3.3 Land Transport

This sub topic covers land transport both in Greater Male' Region and Other Atolls. Data on registered vehicles for both the regions were available in statistical yearbook published by Department of National Planning. Assumption on mileage and engine efficiency is taken from the latest energy balance. Table 27 shows the energy usage by the land transport in Greater Male' Region. Table 28 provides that for the Other Atolls.

Table 27: Energy usage by land transport for Greater Male' Region

Type of Vehicle	Registered Vehicles	Petrol	Diesel	km/day	km/yr	petrol km/l	diesel km/l	petrol (toe)	diesel (toe)
2010								**12,312.2**	**2,104.7**
Car	2,534	100%		25	9,125	12	14	1,546.3	0.0
Motor Cycle	30,960	100%		15	5,475	15	20	9,068.6	0.0
Lorrie Trucks tractors	846	5%	95%	40	14,600	5	8	99.1	1,275.2
Van Buses	625	75%	25%	40	14,600	5	8	1,098.4	247.9
Jeep and Pick ups	1,327	45%	55%	20	7,300	7	10	499.8	463.2
Other Vehicles	597	0%	100%	5	1,825	6	8	0.0	118.4
2011								**12,784.5**	**2,185.3**
Car	2,524	100%		25	9,125	12	14	1,540.2	0.0
Motor Cycle	32,780	100%		15	5,475	15	20	9,601.7	0.0
Lorrie Trucks tractors	827	5%	95%	40	14,600	5	8	96.9	1,246.6
Van Buses	494	75%	25%	40	14,600	5	8	868.2	196.0
Jeep and Pick ups	1,799	45%	55%	20	7,300	7	10	677.5	628.0
Other Vehicles	579	0%	100%	5	1,825	6	8	0.0	114.8
2012								**14,092.9**	**2,283.9**
Car	2,670	100%		25	9,125	12	14	1,629.3	0.0
Motor Cycle	36,199	100%		15	5,475	15	20	10,603.1	0.0
Lorrie Trucks tractors	899	5%	95%	40	14,600	5	8	105.3	1,355.1
Van Buses	665	75%	25%	40	14,600	5	8	1,168.7	263.8
Jeep and Pick ups	1,557	45%	55%	20	7,300	7	10	586.4	543.5
Other Vehicles	613	0%	100%	5	1,825	6	8	0.0	121.6

Table 28: Land Transport for Other Atolls

Type of Vehicle	Registered Vehicles	Petrol	Diesel	km/day	km/yr	Petrol km/l	Diesel km/l	Petrol (toe)	Diesel (toe)
2010								**3,949.1**	**1,176.1**
Car	814	100%		25	9,125.0	12.0	14.0	496.7	0.0
Motor Cycle	7,900	100%		15	5,475.0	15.0	20.0	2,314.0	0.0
Lorrie Trucks tractors	436	5%	95%	40	14,600.0	5.0	8.0	51.1	657.2
Van Buses	459	75%	25%	40	14,600.0	5.0	8.0	806.7	182.1
Jeep and Pick ups	745	45%	55%	20	7,300.0	7.0	10.0	280.6	260.1
Other Vehicles	387	0%	100%	5	1,825.0	6.0	8.0	0.0	76.8
2011								**4,601.1**	**1,661.5**
Car	981	100%		25	9,125.0	12.0	14.0	598.6	0.0
Motor Cycle	9,791	100%		15	5,475.0	15.0	20.0	2,867.9	0.0
Lorrie Trucks tractors	827	5%	95%	40	14,600.0	5.0	8.0	96.9	1,246.6
Van Buses	494	75%	25%	40	14,600.0	5.0	8.0	868.2	196.0
Jeep and Pick ups	450	45%	55%	20	7,300.0	7.0	10.0	169.5	157.1
Other Vehicles	312	0%	100%	5	1,825.0	6.0	8.0	0.0	61.9
2012								**4,912.9**	**1,304.7**
Car	1,038	100%		25	9,125.0	12.0	14.0	633.4	0.0
Motor Cycle	10,210	100%		15	5,475.0	15.0	20.0	2,990.6	0.0
Lorrie Trucks tractors	484	5%	95%	40	14,600.0	5.0	8.0	56.7	729.5
Van Buses	544	75%	25%	40	14,600.0	5.0	8.0	956.1	215.8
Jeep and Pick ups	733	45%	55%	20	7,300.0	7.0	10.0	276.0	255.9
Other Vehicles	522	0%	100%	5	1,825.0	6.0	8.0	0.0	103.5

There is stark difference in terms transport fuel usage between Greater Male' Region and Other Atolls. This can be attributed to the better standard of roads and saturated economic activities in the Greater Male' Region. However it is noted that the rate at which transport increase in Other Atolls would continue to be at a higher rate than in Greater Male' Region as the scope of development in Other Atolls is much greater.

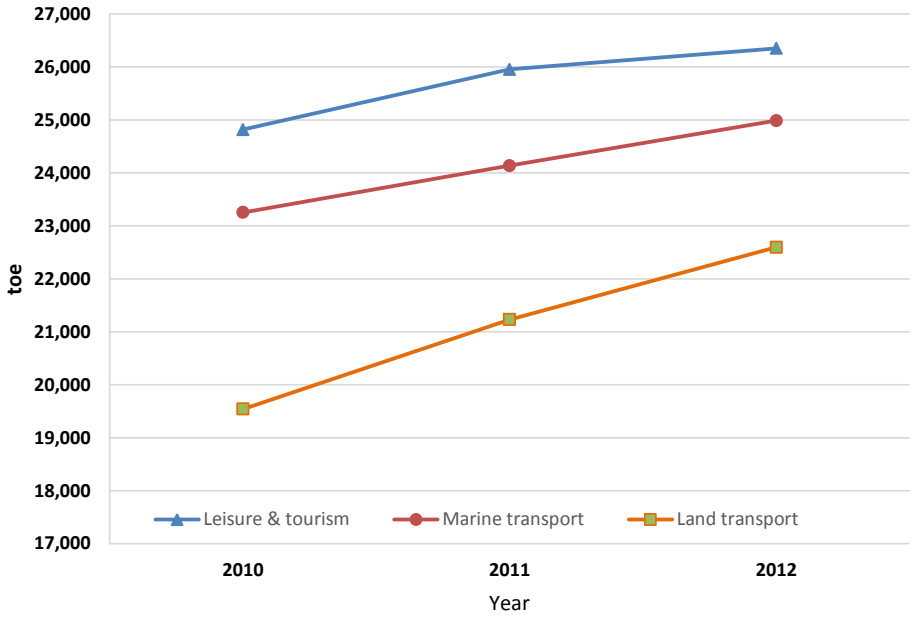


Figure 9: Summary of the energy consumption by the transport sector.

Figure 9 shows a summary of the energy consumption in the transport sector. A bulk of the energy is consumed by the tourism activity and the least is by the land transport.

6.4 Fisheries

Fisheries sector has been traditionally the main primary economic activity in the Maldives. It is also an extremely energy intensive economic activity involving transport and various manufacturing and industrial processes contributing to the energy consumption of the sector. A breakdown of the energy use in the sector can be assessed using the assumption used previously and number of fishing trips taken in the period of 2010-2012. Segregation of sector activities in Greater Male' Region and Other Atolls can be made as activity data provided in national statistics is given geographically.

Table 29: Energy consumption by the fishing vessels.

	2010	2011	2012
Number of fishing trips	152,193	137,784	139,622
Greater Male' Region	16,517	14,271	12,180
Other Atolls	135,676	123,512	127,442
Amount of fish catch (tonnes)	122,175.14	120,836.03	119,866.19
Greater Male' Region	20,514.00	21,900.43	20,231.72
Other Atolls	101,661.13	98,935.60	99,634.47
Assumed diesel used for transport per trip (litres/trip)	204.00		
Assumed LPG used for cooking per trip (kg/trip)	4.00		
Assumed Kerosene used for cooking per trip (litres/trip)	2.00		
Total of diesel used (toe)	26,990.48	24,435.08	24,761.09
Greater Male' Region	2,929.19	2,530.91	2,160.05
Other Atolls	24,061.29	21,904.17	22,601.04
Total LPG used (toe)	371.47	336.30	340.78
Greater Male' Region	40.31	34.83	29.73
Other Atolls	331.15	301.46	311.05
Total of Kerosene used (toe)	260.27	235.63	238.77
Greater Male' Region	28.25	24.41	20.83
Other Atolls	232.02	211.22	217.94
Total Energy Consumed	**27,622.22**	**25,007.01**	**25,340.65**
Energy Consumed per ton of fish catch	0.23	0.21	0.21
Greater Male' Region	0.15	0.12	0.11
Other Atolls	0.24	0.23	0.23

As the table above suggest there is a significant difference in energy consumption as well as activity between Greater Male' Region and Other Atolls. Majority of the fisheries activity occurs in the Other Atolls. However when looking at the energy efficiency the fishing in Greater Male' Region consumes twice as less energy than Other Atolls. There are number of contributing factors for this:

- Considerably higher and more concentrated demand for local consumption of fish products
- Readily available market place with ease of access
- Easier access to main loading ships and ports for industrial processing of fisheries products
- Ease of access to repair and maintenance of vessels

These factors leads to more predictable fisheries market in comparison. In Other Atolls fisherman would have to travel further to reach the buyers of the product. Smaller and distributed demand makes the fisheries industry less reliable in Other Atolls in comparison.

7. Final Energy Balance

This chapter provides the final energy balance considering the above chapters on supply, conversion and demand side. The final energy balance has been derived for the period of 2010-2012.

2010

Energy consumption 2010	Diesel toe	Petrol toe	LPG toe	Kerosene toe	Jet A1 toe	Electrical toe	Heat toe	Total toe
Total produced						74.1	231.6	
Total Imports	287,107.4	31,956.4	13,311.3	188.0	12,318.1			344,881.1
Total Re-exports								0.0
Change in Bunkering	-1,822.3	-353.5	1,023.0	-21.3	-7,692.0			-8,866.0
Primary Energy Consumption	288,929.7	32,309.9	12,288.3	209.2	20,010.1	74.1	231.6	354,052.9
Conversions								0.0
Greater Male'	-53,670.9					20,468.0		-33,202.9
Other atolls	-35,526.9					11,877.4		-23,649.5
- Industry, manuf., commercial	-120,944.9					40,920.5		-80,024.4
- Desalination (MWSC)	-4,308.7					1,521.9		-2,786.7
Airport	-4,240.0					1,615.0		-2,625.0
Other industries	-11,477.0					3,528.0	1,417.0	-6,532.1
Final Energy Consumption	58,761.4	32,309.9	12,288.3	209.2	20,010.1	80,004.9	1,648.6	205,232.4
Stat diff	-5,590.9	1,365.0	0.5	-51.0	0.3	0.0	0.0	-4,276.1
Total domestic consumption	**64,352.2**	**30,944.9**	**12,287.8**	**260.3**	**20,009.8**	**80,004.9**	**1,648.6**	209,508.5
Greater Male'								
- Households			2,325.4			10,064.1		12,389.4
- Government and public buildings						2,767.5		2,767.5
- Industry, manuf., commercial						9,419.4		9,419.4
- Desalination (MWSC)						1,312.3		1,312.3
- Fishing boats	2,929.2		40.3	28.2				2,997.7
Other atolls								
- Residential buildings			6,062.6			6,419.9		12,482.5
- Public buildings						4,014.3		4,014.3
- Commerce and industry						1,475.5		1,475.5
- Cold stores & canning						1,745.0	1,417.0	3,162.0
- Desalination						209.6		209.6
- Fishing boats	24,061.3		331.2	232.0				24,624.5

Energy consumption 2010	Diesel toe	Petrol toe	LPG toe	Kerosene toe	Jet A1 toe	Electrical toe	Heat toe	Total toe
Resorts (excluding transport)			3,528.4			40,962.4	231.6	44,722.4
Hulhule airport	660.0	69.0				1,615.0		2,344.0
Domestic air transport					20,009.8			20,009.8
Sea transport, Atolls	20,233.5	3,021.2						23,254.7
Sea transport, tourist & leisure	13,187.5	11,593.4						24,780.9
Atoll Vehicles	1,176.0	3,949.0						5,125.0
Male' Vehicles	2,104.8	12,312.2						14,417.0

2011

Energy consumption 2011	Diesel toe	Petrol toe	LPG toe	Kerosene toe	Jet A1 toe	Electrical toe	Heat toe	Total toe
Total produced						84.4	252.6	
Total Imports	314,794.3	33,301.0	13,069.5	348.1	32,704.0			394,216.9
Total Re-exports								0.0
Change in Bunkering	1,909.1	177.0		3.6	16,465.0			18,554.7
Primary Energy Consumption	312,885.2	33,124.0	13,069.5	344.5	16,239.0	84.4	252.6	375,999.3
Conversions								0.0
Greater Male'	-57,962.2					20,423.4		-37,538.8
Other atolls	-48,814.3					14,970.7		-33,843.5
Resorts	-124,647.3					42,173.2		-82,474.1
Desalination	-4,328.1					1,582.1		-2,746.0
Airports	-4,235.2					1,609.4		-2,625.8
Other industries	-12,001.4					3,706.3	1,417.0	-6,878.2
Final Energy Consumption	60,896.6	33,124.0	13,069.5	344.5	16,239.0	84,549.5	1,669.6	209,892.9
Stat diff	-2,701.3	273.4	161.5	108.9	0.0	0.0	0.0	-2,157.5
Total domestic consumption	**63,598.0**	**32,850.6**	**12,908.0**	**235.6**	**16,239.0**	**84,549.5**	**1,669.6**	212,050.4
Greater Male'								0.0
- Households			2,418.4			10,042.1		12,460.5
- Government and public buildings						2,761.5		2,761.5
- Industry, manuf., commercial						9,581.1		9,581.1
- Desalination (MWSC)						1,415.3		1,415.3
- Fishing boats	2,530.9		34.8	24.4				2,590.2
								0.0
Other atolls								0.0
- Residential buildings			6,305.1			8,091.9		14,397.0
- Public buildings						5,059.7		5,059.7

- Commerce and industry						1,851.4		1,851.4
- Cold stores & canning						1,745.0	1,417.0	3,162.0
- Desalination						166.8		166.8
- Fishing boats	21,904.2		301.5	211.2				22,416.9
								0.0
Resorts (excluding transport)			3,848.2			42,225.4	252.6	46,326.3
								0.0
Hulhule airport	660.0	69.0				1,609.4		2,338.4
Domestic air transport					16,239.0			16,239.0
Sea transport, Atolls	20,939.8	3,197.6						24,137.4
Sea transport, tourist & leisure	13,716.3	12,198.4						25,914.8
Atoll Vehicles	1,661.4	4,601.4						6,262.7
Male' Vehicles	2,185.4	12,784.2						14,969.6

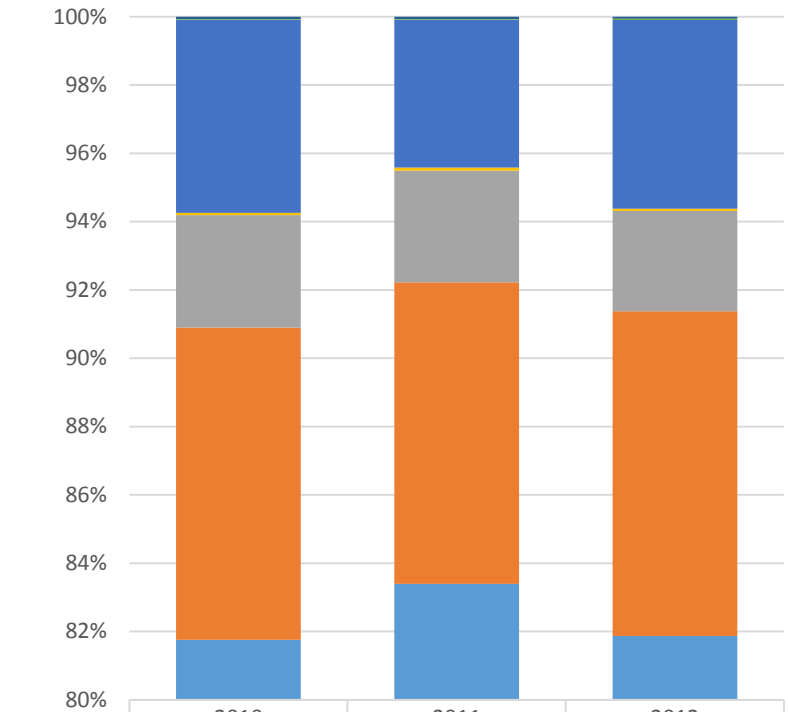
2012

Energy consumption 2012	Diesel toe	Petrol toe	LPG toe	Kerosene toe	Jet A1 toe	Electrical toe	Heat toe	Total toe
Total Produced						156.8	249.6	
Total Imports	349,317.6	40,669.8	11,321.4	291.0	99,968.2			501,568.0
Total Re-exports								0.0
Change in Bunkering	280.0	150.8	-1,800.0	6.4	76,416.0			75,053.2
Primary Energy Consumption	349,037.6	40,519.0	13,121.4	284.6	23,552.2	156.8	249.6	426,921.1
Conversions								0.0
Greater Male'	-61,817.3					21,427.9		-40,389.4
Other atolls	-57,879.2					17,584.0		-40,295.2
Resorts	-129,583.8					43,843.4		-85,740.4
- Desalination	-5,492.1					1,956.1		-3,535.9
Airports	-4,311.4					1,638.4		-2,673.1
Other industries	-12,578.3					3,902.4	1,417.0	-7,258.9
Final Energy Consumption	77,375.4	40,519.0	13,121.4	284.6	23,552.2	90,509.0	1,666.6	247,028.2
Stat diff	13,051.6	5,451.2	-86.0	45.9	0.1	0.0	0.0	18,462.8
Total domestic consumption	**64,323.8**	**35,067.8**	**13,207.4**	**238.8**	**23,552.1**	**90,509.0**	**1,666.6**	228,565.4
Greater Male'								0.0
- Households			2,515.1			10,569.2		13,084.4
- Government and public buildings						2,906.4		2,906.4
- Industry,								

manuf., commercial					10,177.2		10,177.2
- Desalination (MWSC)					1,631.2		1,631.2
- Fishing boats	2,160.0		29.7	20.8			2,210.6
							0.0
Other atolls							0.0
- Residential buildings			6,557.3		9,504.4		16,061.7
- Public buildings					5,943.0		5,943.0
- Commerce and industry					2,136.7		
- Cold stores & canning					1,780.3	1,417.0	3,197.3
- Desalination					324.9		324.9
- Fishing boats	22,601.0		311.1	217.9			23,130.0
							0.0
Resorts (excluding transport)			3,794.2		43,897.3	249.6	47,941.1
							0.0
Hulhule airport	660.0	69.0			1,638.4		2,367.4
Domestic air transport				23,552.1			23,552.1
Sea transport, Atolls	21,658.8	3,328.0					24,986.7
Sea transport, tourist & leisure	13,655.3	12,665.1					26,320.4
Atoll Vehicles	1,304.8	4,913.0					6,217.8
Male' Vehicles	2,283.9	14,092.7					16,376.6

7.1 Total Primary Energy Supply (TPES)

As apparent in the tables above the main primary energy supply in Maldives is still dependent on imported fossil fuel (99.9%). Bulk of this imported fuel is diesel (82% - 83%). Diesel is the main energy used for production of electricity and transport. Indigenously produced and supplied energy accounts for about 0.1% of the total energy supply. Figure 10 shows the TPES for 2010-2012.

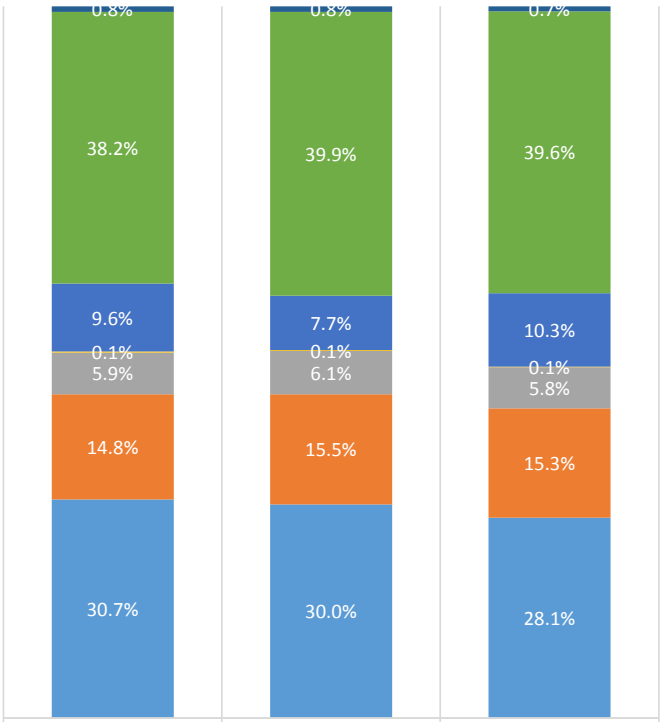


	2010	2011	2012
Solar	0.07%	0.07%	0.06%
Electrical	0.02%	0.02%	0.04%
Jet A1	5.66%	4.33%	5.52%
Kerosene	0.06%	0.09%	0.07%
LPG	3.30%	3.26%	2.94%
Petrol	9.14%	8.83%	9.50%
Diesel	81.72%	83.37%	81.85%

Figure 10: Total primary energy supply (TPES) for 2010-2012.

7.2 Final Energy Consumption

Final Energy Consumption is based on demand of various sectors and uses. The major energy source in the demand side is electricity (38-40%). This is closely followed by diesel used for transport (28-31%) in various sectors. Tourism sector is the single most significant economic sector in terms of energy consumption. It accounts for 1/3 of the total energy consumption in Maldives. Figure 11 shows the final energy consumption for 2010-2012.



	2010	2011	2012
Heat	0.8%	0.8%	0.7%
Electrical	38.2%	39.9%	39.6%
Jet A1	9.6%	7.7%	10.3%
Kerosene	0.1%	0.1%	0.1%
LPG	5.9%	6.1%	5.8%
Petrol	14.8%	15.5%	15.3%
Diesel	30.7%	30.0%	28.1%

Figure 11: Final energy consumption for 2010-2012.

In addition, the energy balance of 2012 offers a different set of statistical difference (>5%) in comparison to 2011 and 2010. This may be because of unusual circumstance the country was in after 7-8 February 2012. A number of long-drawn out protests took place with many people traveling to and from Male' in greater numbers. This might have altered/increased the activity pattern for energy consumption. This has not been considered as there is not enough data to ration this increase in activity.

8. Emissions

Green House Gas emissions from energy use are one of the main contributors to climate change. Maldives is a country striving for low carbon development and energy use is their main contributor to its emissions (>80%). Taking this into account and countries obligations for international reporting, emissions from fuel combustion is calculated and presented in tables below. The conversions and emission factors have been derived from reference values in IPCC 2006 guidelines on energy emissions.

Table 30: Emissions of 2010 from energy consumption (tCO2).

Energy Source	Diesel	Petrol	LPG	Kerosene	Jet A1	Electrical	**Total**
Emission Factors	3.1	2.8	2.6	2.9	2.9	8.8	
Greater Male'							
- Households	0.0	0.0	5,970.0	0.0	0.0	88,480.2	**94,450.2**
- Government and public buildings	0.0	0.0	0.0	0.0	0.0	24,331.0	**24,331.0**
- Industry, manuf., commercial	0.0	0.0	0.0	0.0	0.0	82,812.7	**82,812.7**
- Desalination (MWSC)	0.0	0.0	0.0	0.0	0.0	11,537.7	**11,537.7**
- Fishing boats	8,951.4	0.0	103.5	82.6	0.0	0.0	**9,137.5**
Other atolls							
- Residential buildings	0.0	0.0	15,564.8	0.0	0.0	56,441.8	**72,006.6**
- Public buildings	0.0	0.0	0.0	0.0	0.0	35,292.2	**35,292.2**
- Commerce and industry	0.0	0.0	0.0	0.0	0.0	12,972.0	**12,972.0**
- Cold stores & canning	0.0	0.0	0.0	0.0	0.0	15,341.5	**15,341.5**
- Manufacturing	0.0	0.0	0.0	0.0	0.0	1,842.6	**1,842.6**
- Fishing boats	73,529.8	0.0	850.2	678.6	0.0	0.0	**75,058.6**
Resorts (excluding transport)	0.0	0.0	9,058.6	0.0	0.0	360,129.3	**369,187.8**
Hulhule airport	2,016.9	195.7	0.0	0.0	0.0	14,198.6	**16,411.3**
Domestic air transport	0.0	0.0	0.0	0.0	58,436.2	0.0	**58,436.2**
Sea transport, Atolls	61,832.2	8,570.3	0.0	0.0	0.0	0.0	**70,402.5**
Sea transport, tourist & leisure	40,300.1	32,886.8	0.0	0.0	0.0	0.0	**73,186.9**
Atoll Vehicles	3,593.8	11,202.2	0.0	0.0	0.0	0.0	**14,796.0**
Male' Vehicles	6,432.1	34,926.0	0.0	0.0	0.0	0.0	**41,358.0**
Total	**196,656.3**	**87,781.0**	**31,547.1**	**761.3**	**58,436.2**	**703,379.6**	**1,078,561.4**

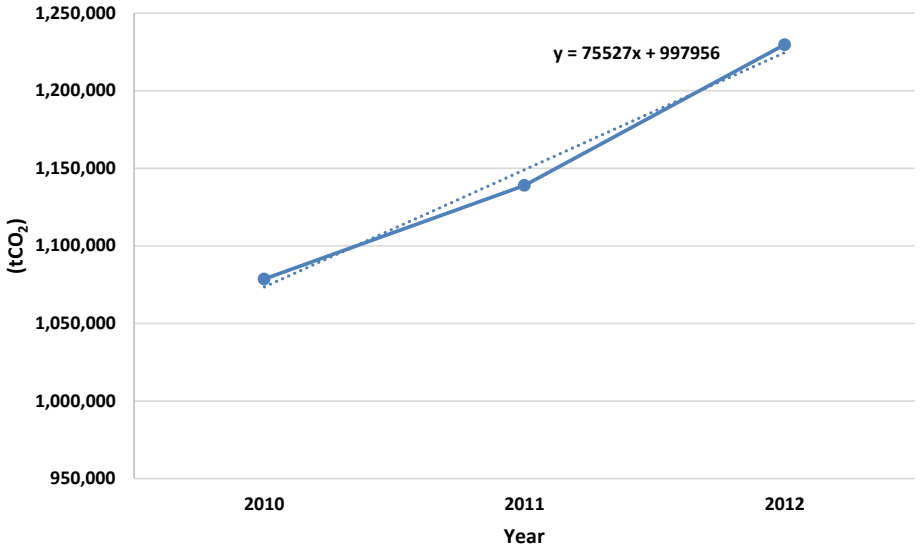
Table 31: Emissions for 2011 from energy consumption (tCO2).

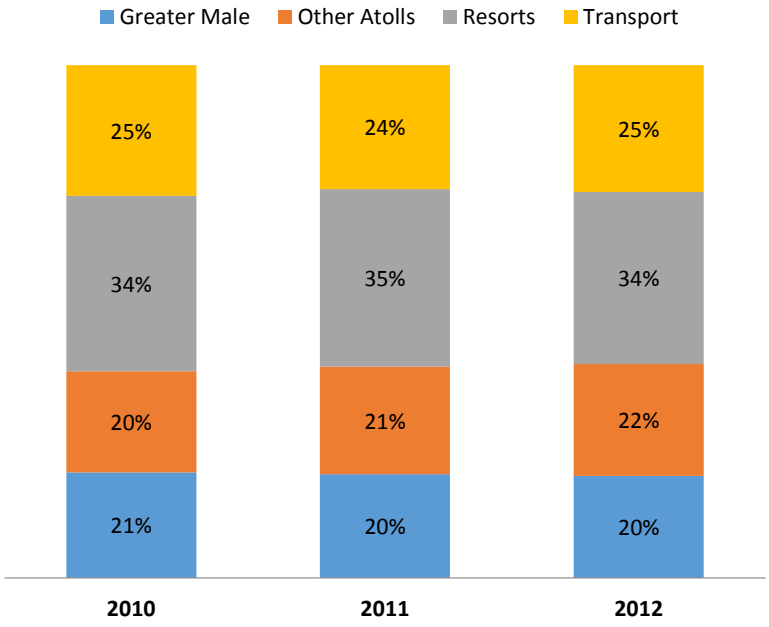
Energy Source	Diesel	Petrol	LPG	Kerosene	Jet A1	Electrical	**Total**
Emission Factors	3.1	2.8	2.6	2.9	2.9	9.1	
Greater Male'							**0.0**
- Households	0.0	0.0	6,208.8	0.0	0.0	91,461.9	**97,670.8**
- Government and public buildings	0.0	0.0	0.0	0.0	0.0	25,150.9	**25,150.9**
- Industry, manuf., commercial	0.0	0.0	0.0	0.0	0.0	87,262.6	**87,262.6**
- Desalination (MWSC)	0.0	0.0	0.0	0.0	0.0	12,890.1	**12,890.1**
- Fishing boats	7,734.3	0.0	89.4	71.4	0.0	0.0	**7,895.1**
Other atolls							
- Residential buildings	0.0	0.0	16,187.4	0.0	0.0	73,699.4	**89,886.8**
- Public buildings	0.0	0.0	0.0	0.0	0.0	46,083.1	**46,083.1**
- Commerce and industry	0.0	0.0	0.0	0.0	0.0	16,861.8	**16,861.8**
- Cold stores & canning	0.0	0.0	0.0	0.0	0.0	15,893.1	**15,893.1**
- Manufacturing	0.0	0.0	0.0	0.0	0.0	1,519.5	**1,519.5**
- Fishing boats	66,937.7	0.0	774.0	617.8	0.0	0.0	**68,329.5**
Resorts (excluding transport)	0.0	0.0	9,879.8	0.0	0.0	384,580.5	**394,460.3**
Hulhule airport	2,016.9	195.7	0.0	0.0	0.0	14,657.8	**16,870.5**
Domestic air transport	0.0	0.0	0.0	0.0	47,424.2	0.0	**47,424.2**
Sea transport, Atolls	63,990.6	9,070.6	0.0	0.0	0.0	0.0	**73,061.2**
Sea transport, tourist & leisure	41,916.3	34,603.1	0.0	0.0	0.0	0.0	**76,519.4**
Atoll Vehicles	5,077.0	13,052.7	0.0	0.0	0.0	0.0	**18,129.7**
Male' Vehicles	6,678.5	36,264.9	0.0	0.0	0.0	0.0	**42,943.3**
Total	**194,351.3**	**93,186.9**	**33,139.5**	**689.2**	**47,424.2**	**770,060.8**	**1,138,851.9**

Table 32: Emissions for 2012 from energy consumption (tCO2).

Energy Source	Diesel	Petrol	LPG	Kerosene	Jet A1	Electrical	**Total**
Emission Factors	3.1	2.8	2.6	2.9	2.9	9.2	
Greater Male'							
- Households	0.0	0.0	6,457.2	0.0	0.0	96,945.1	**103,402.3**
- Government and public buildings	0.0	0.0	0.0	0.0	0.0	26,658.7	**26,658.7**
- Industry, manuf., commercial	0.0	0.0	0.0	0.0	0.0	93,348.7	**93,348.7**
- Desalination (MWSC)	0.0	0.0	0.0	0.0	0.0	14,962.3	**14,962.3**
- Fishing boats	6,601.0	0.0	76.3	60.9	0.0	0.0	**6,738.2**
Other atolls							
- Residential buildings	0.0	0.0	16,834.9	0.0	0.0	87,177.8	**104,012.7**
- Public buildings	0.0	0.0	0.0	0.0	0.0	54,511.0	**54,511.0**
- Commerce and industry	0.0	0.0	0.0	0.0	0.0	19,598.2	**19,598.2**
- Cold stores & canning	0.0	0.0	0.0	0.0	0.0	16,329.8	**16,329.8**
- Manufacturing	0.0	0.0	0.0	0.0	0.0	2,980.3	**2,980.3**
- Fishing boats	69,067.3	0.0	798.6	637.5	0.0	0.0	**70,503.4**
Resorts (excluding transport)	0.0	0.0	9,741.1	0.0	0.0	402,642.6	**412,383.6**
Hulhule airport	2,016.9	195.7	0.0	0.0	0.0	15,027.6	**17,240.2**
Domestic air transport	0.0	0.0	0.0	0.0	68,781.3	0.0	**68,781.3**
Sea transport, Atolls	66,187.8	9,440.4	0.0	0.0	0.0	0.0	**75,628.1**
Sea transport, tourist & leisure	41,729.7	35,926.8	0.0	0.0	0.0	0.0	**77,656.5**
Atoll Vehicles	3,987.3	13,936.8	0.0	0.0	0.0	0.0	**17,924.1**
Male' Vehicles	6,979.4	39,976.7	0.0	0.0	0.0	0.0	**46,956.1**
Total	**196,569.4**	**99,476.4**	**33,908.1**	**698.4**	**68,781.3**	**830,182.0**	**1,229,615.5**

Table 30 to Table 32 shows the emissions from energy consumption for the period of 2010-2012. During this period the emission from energy use had been increasing at a rate of about 6-8% per year as shown in Figure 12. This gives an increasing trend of 75,527 tCO2 per year by energy sector alone. This rate is more or less consistent with the business as usual (BAU) scenario of Maldives Carbon Audit of 2009. As shown in the Figure 13 below, geographically resorts are the biggest contributor to the emissions.





Low carbon development has been high on political agenda since December 2009 with the announcement of carbon neutral goal. However as the data in this report suggests, a practical effort for reducing emissions activities started in 2012. These practical activities of emission reduction have been focused on intermittent sources like solar PV. There have been no installments done to cater base energy demand with a low carbon fuel source.

9. Energy Indicators

Indicators are useful for monitoring the progress of specific goals. It plays an important role in measuring a country's state of development by monitoring the progress or lack of progress towards sustainability. The choice of energy fuels, delivery and use of energy services have an impact on the social, economic and environment. Thus, the energy indicators play an important role in measuring and assessing the current and future effects of energy use on social, economic and environmental aspects of a country.

The same value for a given energy indicator might not mean the same thing for two different countries. Therefore this report provides information on the key indicators for the consumption of energy in the Maldives as well as a comparison with other countries.

9.1 Maldives Indicators

The Table 33 shows the key energy indicators for the Maldives. The selection of these indicators is based on the previous reports. These indicators are used to compare with other countries as well.

Table 33: Key indicators for Maldives.

Selected indicators	2010	2011	2012
Population	319738	325135	330652
Total Primary Energy Supply	354,052.93	375,999.34	426,921.11
Fisheries	30,784	28,169	28,538
Tourism	69,503	72,241	74,261.5
TPES/Capita	1.11	1.16	1.29
TPES/1000 GDP$	0.13	0.13	0.15
CO2emissions (tCO2eq)	1,078,561.45	1,138,851.89	1,229,615.52
tCO2eq/capita	3.35	3.47	3.69
kgCO2eq/GDP$ (PPP)	0.50	0.48	0.53
tCO2eq/TPES	3.02	3.00	2.86
Electricity Consumption (MWh)	930,457.21	983,311.22	1,052,619.15

As shown in table 33 the electricity consumption in the Maldives has an increase of 5.38% in 2011 and a 6.58% in 2012. As highlighted in Chapter 6 the electricity consumption has been increasing in Greater Male' Region and Other Atolls as well. This could be relating to the increase in the living standards and fast rate of urbanization in the Other Atolls.

The TPES when compared with tourism and fisheries Sector, it shows a reduction in 2011 and slight increase in 2012 in the fisheries sector. However, there was an increase of 3.79% in 2011 and a 0.027% in 2012 in the tourism sector.

By the end of 2012, the CO2 emissions is approximately 1.22 million tCO2eq from the energy sector. This emission has been increasing at a rate of about 3-6% per year from 2010-2012.

9.2 Comparison of Indicators with other countries

As shown in Figure 14 the CO2 emissions/capita for Maldives is much higher when compared to the South Asia Region average (SAR avg) and a very slight difference when compared to the SIDS average. These are calculated based on 2011 data for all the countries except for obtaining the SIDS average where 2009 figures are used.

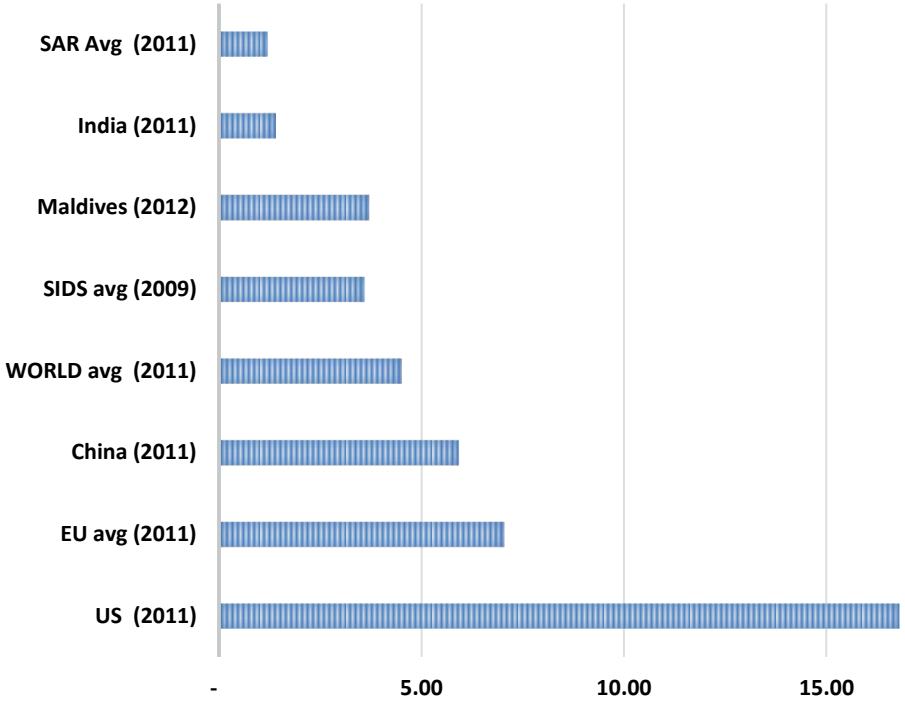


Figure 14: Comparison of emissions per capita.

The indicators can help to integrate energy into socioeconomic programmes, to increase the share of renewable energy options by developing targeting more programmes and projects to this area, etc.

10. Conclusions

The Energy Balance Report for the years 2010-2012 prepared for the Maldives Energy Authority provides an update to the existing Energy Balance prepared in the year 2010 prepared for years 2009 and 2008.

Input data were obtained from different sources including the Maldives Energy Authority, Maldives Customs Services, STO and Villa Gas. In addition some of the data were obtained through surveys and where data were not available, secondary data were used. Data were screened for quality control before being used for the calculations. The methodology adopted was similar to what was used in the previous energy balances as the energy balance is a simple relationship between imports, conversions and energy use.

It was found that diesel is the most imported fuel type contributing to about 80% of the fuel being imported. The analysis shows that the power generation with the Greater Male' Region is relatively efficient where in the Other Atolls the well-populated and developing islands too have good efficiencies. Tourist resorts use 22.83 liters/bednight of diesel for electricity production. The Maldives Water and Sewerage Company (MWSC) used 4.76 kWh of units to produce a cubic meter of water in the year 2012. Energy used by fishing and canning sector shows these industries use 582 toe per year for their energy demands. 2157 toe was used in Thilafushi for energy production.

A growth of 6% in 2012 in electricity demand for the Greater Male' Region was obtained where in the Other Atolls it was a 14% increase in 2012. More LPG used by the Other Atolls compared to Greater Male' Region. Most of the energy is used by the electrical appliances rather than energy used for cooling and lighting. Transport and leisure activities within the tourism sector is more energy intensive than the energy used for transport by the Greater Male' Region and Other Atolls. A significant difference in energy consumption as well as activity between Greater Male' Region and Other Atolls in the fisheries sector was found. Majority of the fisheries activity occurs in the Other Atolls. However, the fishing vessels in Greater Male' Region is shown to be more efficient than those used in the Other Atolls. Emissions from the energy consumption showed an increasing trend of 75527 tCO2 per year. By end of year 2012, a 1,229,615.5 tCO2 was emitted by the energy usage.

11. Recommendations on next energy balance

Energy balances are used as a fundamental tool for energy planning, for demand side management, for market development etc… It is an important tool for assessing the energy flow within the country. From the preparation of this energy balance, several difficulties were encountered and following recommendations are made so as to improve the formulation of future energy balances.

- A mechanism needs to be established within MEA, MEE or the Transport Authority to obtain the yearly statistics of usage of fuel by the aviation sector.
- A mechanism to obtain the data by powerhouses on their fuel usage, generated power and billed units.
- Reliable data from the tourism sector, especially on their power generation and energy usage on other activities.
- Energy usage data for the domestic purposes in the Greater Male' Region and the Other Atolls needs to be collected at least as sample energy audits.
- MEA and MEE should work with Ministry of Fisheries and Agriculture to keep track of energy use in fisheries and other small industries as MFA are responsible to provide energy subsidies for fisheries
- MEA and MEE should work with transport authority to collect information on fuel economy of the existing transportation technology in operation in the country.

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Appendix A – Electricity Consumption in Greater Male' & Other Atolls

2010

Atoll	Island Name	Diesel Consumed	Thermal Conversion efficiency	Total electricity Generated	Technical Losses	Total electricity consumed	Overall system efficiency
	Male'	56,015,591	38%	217,330,899	7%	201,419,216	36%
	Villingili	1,961,644	38%	7,549,260	9%	6,887,743	35%
	HulhuMale'	3,052,239	35%	10,825,575	11%	9,683,690	31%
	Thilafushi	708,555	33%	2,336,894	7%	2,173,134	30%
Ha.	Baarah	135,707	NA	NA	NA	458,703	33%
Ha.	Dhidhoo	574,535	NA	NA	NA	1,941,987	33%
Ha.	Filladhoo	73,426	NA	NA	NA	248,187	33%
Ha.	Hoarafushi	394,025	NA	NA	NA	1,331,844	33%
Ha.	Ihavandhoo	283,668	NA	NA	NA	958,826	33%
Ha.	Kelaa	182,078	NA	NA	NA	615,442	33%
Ha.	Molhadhoo	23,986	NA	NA	NA	81,075	33%
Ha.	Thuraakunu	63,584	NA	NA	NA	214,921	33%
H.dh.	Finey	48,676	NA	NA	NA	164,529	33%
H.dh.	Hanimaadhoo	435,742	NA	NA	NA	1,472,854	33%
H.dh.	Kulhudhuffushi	2,028,358	NA	NA	NA	6,856,061	33%
H.dh.	Kunburudhoo	17,046	NA	NA	NA	57,616	33%
H.dh.	Makunudhoo	188,247	NA	NA	NA	636,295	33%
H.dh.	Nolhivaram	160,306	NA	NA	NA	541,850	33%
Sh.	Feevah	93,288	NA	NA	NA	315,324	33%
Sh.	Milandhoo	313,567	NA	NA	NA	1,059,890	33%
Sh.	Narudhoo	31,103	NA	NA	NA	105,133	33%
Sh.	Kanditheem	228,302	NA	NA	NA	771,684	33%
B.	Dhonfanu	49,842	NA	NA	NA	168,470	33%
B.	Eydhafushi	624,308	NA	NA	NA	2,110,226	33%
B.	Hithaadhoo	125,297	NA	NA	NA	423,517	33%
B.	Kamadhoo	71,992	NA	NA	NA	243,340	33%
B.	Kendhoo	126,470	NA	NA	NA	427,481	33%
B.	Kihaadhoo	46,304	NA	NA	NA	156,514	33%
B.	Maalhos	76,865	NA	NA	NA	259,811	33%
Lh.	Hinnavaru	583,405	NA	NA	NA	1,971,968	33%
Lh.	Maafilaafushi	21,278	NA	NA	NA	71,922	33%
Lh.	Naifaru	788,945	NA	NA	NA	2,666,715	33%
Lh.	Olhuvelifushi	68,631	NA	NA	NA	231,981	33%
N.	Fodhdhoo	31,242	NA	NA	NA	105,602	33%
N.	Holhudhoo	285,140	NA	NA	NA	963,802	33%
N.	Kendhikolhudhoo	198,102	NA	NA	NA	669,605	33%
N.	Kudafari	74,078	NA	NA	NA	250,392	33%
N.	Landhoo	87,930	NA	NA	NA	297,214	33%

Atoll	Island Name	Diesel Consumed	Thermal Conversion efficiency	Total electricity Generated	Technical Losses	Total electricity consumed	Overall system efficiency
N.	Lhohi	72,687	NA	NA	NA	245,688	33%
N.	Maalhendhoo	97,587	NA	NA	NA	329,855	33%
N.	Magoodhoo	28,036	NA	NA	NA	94,766	33%
N.	Manadhoo	279,538	NA	NA	NA	944,867	33%
N.	Miladhoo	122,715	NA	NA	NA	414,789	33%
N.	Velidhoo	411,862	NA	NA	NA	1,392,136	33%
R.	Angolhitheem	43,758	NA	NA	NA	147,907	33%
R.	Hulhudhuffaaru	173,455	NA	NA	NA	586,296	33%
R.	Inguraidhoo	49,703	NA	NA	NA	168,000	33%
R.	Kinolhas	42,771	NA	NA	NA	144,570	33%
R.	Maduvvaree	85,361	NA	NA	NA	288,528	33%
Dh.	Kudahuvadhoo	612,956	NA	NA	NA	2,071,854	33%
Th.	Buruni	121,400	NA	NA	NA	410,344	33%
Th.	Kandoodhoo	69,637	NA	NA	NA	235,381	33%
Th.	Gaadhiffushi	28,959	NA	NA	NA	97,886	33%
Th.	Madifushi	129,076	NA	NA	NA	436,290	33%
Th.	Vilufushi	286,307	NA	NA	NA	967,746	33%
G.A.	Villingilli	738,259	NA	NA	NA	2,495,391	33%
G.Dh.	Gadhoo	369,151	NA	NA	NA	1,247,769	33%
G.A.	Gemanafushi	162,995	NA	NA	NA	550,941	33%
G.A.	Dhevvadhoo	87,515	NA	NA	NA	295,810	33%
G.Dh.	Faresmathoda	163,890	NA	NA	NA	553,966	33%
G.Dh.	Fiyoree	106,044	NA	NA	NA	358,438	33%
G.A.	Kanduhulhudhoo	82,508	NA	NA	NA	278,887	33%
G.Dh.	Hoadedhoo	134,307	NA	NA	NA	453,973	33%
G.A.	Kolamaafushi	212,264	NA	NA	NA	717,474	33%
G.A.	Vaadhoo	124,281	NA	NA	NA	420,083	33%
G.A.	Maamendhoo	168,475	NA	NA	NA	569,464	33%
G.A.	Nilandhoo	95,716	NA	NA	NA	323,529	33%
G.Dh.	Kondey	38,671	NA	NA	NA	130,711	33%
G.Dh.	Nadella	95,750	NA	NA	NA	323,645	33%
G.Dh.	Dhaandhoo	211,495	NA	NA	NA	714,875	33%
G.Dh.	Madaveli	164,550	NA	NA	NA	556,196	33%
G.Dh.	Rathafandhoo	96,975	NA	NA	NA	327,787	33%
G.Dh.	Thinadhoo	1,443,380	NA	NA	NA	4,878,773	33%

2011

Atoll	Island Name	Diesel Consumed	Thermal Conversion efficiency	Total electricity Generated	Technical Losses	Total electricity consumed	Overall system efficiency
	Male'	60,085,576	38%	231,445,147	6%	216,420,073	36%
	Villingili	2,407,983	35%	8,549,790	13%	7,476,528	31%
	HulhuMale'	3,454,183	36%	12,493,598	10%	11,270,491	32%
	Thilafushi	726,667	34%	2,489,249	5%	2,357,370	32%
Gn	Fuvahmulah	2,059,437	35%	7,272,822	11%	6,482,471	31%
S	Hulhumeedhoo	746,209	34%	2,534,360	7%	2,347,881	31%
S	CPS	6,163,031	36%	22,693,476	13%	19,721,497	32%
N	Velidhoo	475,611	35%	1,683,860	-1%	1,703,443	35%
N	Kendikulhudhoo	255,518	NA	NA	NA	732,117	28%
N	Lhohi	110,212	NA	NA	NA	275,673	25%
N	Landhoo	123,945	NA	NA	NA	488,711	39%
N	Holhudhoo	323,907	36%	1,165,017	7%	1,081,688	33%
N	Magoodhoo	47,364	NA	NA	NA	110,129	23%
R	Angolhitheemu	72,496	26%	190,902	3%	185,756	25%
R	Hulhudhuffaru	221,611	26%	591,612	18%	483,663	22%
R	Inguraidhoo	137,441	NA	NA	NA	330,540	24%
R	Innamaadhoo	139,303	27%	376,356	0%	376,355	27%
R	Kinolhas	67,478	28%	193,243	13%	167,338	25%
R	Maduvvari	235,685	NA	NA	NA	555,937	23%
R	Rasmaadhoo	106,848	NA	NA	NA	278,538	26%
B	Eydhafushi	721,712	35%	2,544,360	14%	2,185,349	30%
B	Kendhoo	166,822	31%	518,065	0%	518,038	31%
B	Kihaadhoo	58,397	29%	174,069	-1%	176,214	30%
B	Maalhos	104,510	31%	327,562	11%	291,788	28%
Lh	Hinnavaru	713,230	33%	2,395,416	10%	2,160,475	30%
Lh	Naifaru	1,022,110	33%	3,384,848	11%	3,019,562	29%
Dh	Kudahuvadhoo	728,288	34%	2,506,958	4%	2,399,602	33%
Dh	Hulhudheli	11,950	NA	NA	NA	33,250	28%
M	Veyvah	49,654	NA	NA	NA	146,863	29%
Ha	Baarah	225,228	NA	NA	NA	550,174	24%
Ha	Dhidhoo	643,128	33%	2,163,694	1%	2,145,528	33%
Ha	Filladhoo	108,470	29%	314,339	11%	278,484	25%
Ha	Hoarafushi	437,193	34%	1,489,827	7%	1,390,553	31%
Ha	Ihavandhoo	339,162	34%	1,163,259	9%	1,062,682	31%
Ha	Kela	231,980	34%	794,942	6%	745,883	32%
Ha	Thuraakunu	119,346	26%	312,816	2%	305,951	25%
Hdh	Finey	72,880	NA	NA	NA	208,212	28%
Hdh	Hanimaadhoo	545,344	32%	1,769,658	8%	1,634,571	30%
Hdh	Kulhudhuffushi	2,358,092	33%	7,766,938	2%	7,600,205	32%
Hdh	Makunudhoo	289,671	25%	741,910	-1%	749,762	26%

Atoll	Island Name	Diesel Consumed	Thermal Conversion efficiency	Total electricity Generated	Technical Losses	Total electricity consumed	Overall system efficiency
Hdh	Nolhivaram	190,731	28%	538,797	21%	426,239	22%
Sh	Feevah	67,294	NA	NA	NA	223,998	33%
Sh	Milandhoo	370,894	33%	1,253,000	5%	1,185,922	32%
Sh	Lhaimagu	127,484	36%	464,040	28%	335,196	26%
Sh	Kanditheem	269,781	30%	826,371	9%	754,594	28%
Sh	Maaungoodhoo	164,935	NA	NA	NA	428,795	26%
K	Kaashidhoo	358,454	35%	1,259,845	2%	1,228,921	34%
K	Thulusdhoo	421,110	34%	1,461,700	6%	1,372,461	32%
K	Himmafushi	556,008	32%	1,777,923	3%	1,730,262	31%
K	Maafushi	886,149	33%	2,995,144	10%	2,699,046	30%
K	Guraidhoo	436,526	34%	1,482,830	5%	1,411,348	32%
AA	Ukulhas	178,604	28%	512,576	1%	505,512	28%

2012

Atoll	Island Name	Diesel Consumed	Thermal Conversion efficiency	Total electricity Generated	Technical Losses	Total electricity consumed	Overall system efficiency
K	Male’	63,357,132				224,562,324	35%
K	Vilin'gili	2,551,404				8,543,892	33%
K	HulhuMale’	4,298,508				14,060,280	32%
K	Thilafushi	846,468				2,739,900	32%
K	GulhiFalhu	55,392				85,332	15%
HA	Thuraakunu	131,724				331,532	25%
HA	Uligan	88,326				258,900	29%
HA	Molhadhoo	50,400				132,000	26%
HA	Ihavandhoo	438,000				1,524,168	34%
HA	Kelaa	288,000				1,012,236	35%
HA	Vashafaru	104,160				261,120	25%
HA	Dhidhdhoo	769,320				2,545,512	33%
HA	Filladhoo	144,000				330,528	23%
HA	Maarandhoo	118,320				292,674	24%
HA	Utheemu	136,524				430,032	31%
HA	Baarah	264,000				705,804	26%
HDh	Hanimaadhoo	606,156				1,860,360	30%
HDh	Naivaadhoo	107,580				325,896	30%
HDh	Nolhivaranfaru	234,000				720,000	30%
HDh	Nellaidhoo	171,420				541,860	31%
HDh	Nolhivaran	283,200				780,000	27%
HDh	Kurin'bi	112,800				339,048	30%
HDh	Kulhudhuffushi	3,074,616				9,047,400	29%

Atoll	Island Name	Diesel Consumed	Thermal Conversion efficiency	Total electricity Generated	Technical Losses	Total electricity consumed	Overall system efficiency
HDh	Kumundhoo	166,296				510,408	30%
HDh	Neykurendhoo	180,000				523,872	29%
HDh	Vaikaradhoo	184,044				513,648	28%
HDh	Makunudhoo	295,980				836,904	28%
Sh	Bileiyfahi	91,836				249,564	27%
Sh	Narudhoo	72,000				189,842	26%
Sh	Komandoo	350,220				1,016,844	29%
Sh	Maaun'goodhoo	188,424				490,560	26%
Sh	Milandhoo	424,488				1,190,388	28%
N	Hen'badhoo	118,800				347,403	29%
N	Ken'dhikulhudhoo	320,544				929,052	29%
N	Kudafari	133,128				400,320	30%
N	Landhoo	176,508				697,680	39%
N	Manadhoo	468,000				1,340,244	28%
N	Holhudhoo	432,000				1,440,000	33%
N	Fodhdhoo	674,748				1,426,788	21%
N	Velidhoo	587,436				1,796,040	30%
R	Alifushi	437,160				1,245,600	28%
R	Vaadhoo	85,200				187,920	22%
R	Rasgetheemu	120,000				466,314	38%
R	An'golhitheemu	91,368				274,728	30%
R	Hulhudhuffaaru	270,000				816,000	30%
R	Dhuvaafaru	627,540				1,901,880	30%
R	Maakurathu	165,600				394,260	24%
R	Rasmaadhoo	152,400				321,600	21%
R	Innamaadhoo	169,200				415,512	24%
R	Maduvvari	396,384				816,852	20%
R	In'guraidhoo	312,000				808,236	26%
R	Fainu	70,200				186,000	26%
R	Kinolhas	79,200				156,000	19%
B	Kudarikilu	103,488				244,656	23%
B	Kamadhoo	126,660				385,920	30%
B	Kihaadhoo	75,732				194,952	25%
B	Dhonfan	82,536				183,000	22%
B	Dharavandhoo	282,000				688,668	24%
B	Maalhos	132,000				360,000	27%
B	Eydafushi	864,000				2,541,840	29%
B	Thulhaadhoo	337,500				1,276,296	37%
B	Hithaadhoo	184,524				498,648	27%
B	Fehendhoo	36,000				82,800	23%
B	Goidhoo	155,280				624,000	40%
K	Kaashidhoo	379,500				1,326,972	35%
K	Gaafaru	251,544				696,480	27%
K	Dhiffushi	203,256				626,664	30%

Atoll	Island Name	Diesel Consumed	Thermal Conversion efficiency	Total electricity Generated	Technical Losses	Total electricity consumed	Overall system efficiency
K	Thulusdhoo	440,136				1,454,496	33%
K	Hinmafushi	508,416				1,709,244	33%
K	Gulhi	171,840				523,344	30%
K	Maafushi	939,348				2,987,100	31%
K	Guraidhoo	490,908				1,534,668	31%
AA	Ukulhas	183,012				587,004	32%
AA	Mathiveri	163,200				428,400	26%
AA	Bodufolhudhoo	129,756				379,308	29%
AA	Feridhoo	118,476				275,148	23%
AA	Maalhos	110,604				281,112	25%
AA	Himandhoo	163,764				367,440	22%
ADh	Omadhoo	156,552				441,912	28%
ADh	Kun'burudhoo	88,968				252,528	28%
ADh	Dhigurah	137,580				375,960	27%
ADh	Didhdhoo	33,600				81,276	24%
ADh	Fenfushi	185,652				515,916	27%
V	Fulidhoo	140,832				412,800	29%
V	Thinadhoo	44,736				123,000	27%
V	Keyodhoo	113,952				412,056	36%
V	Rakeedhoo	58,236				122,904	21%
M	Mulah	324,000				970,800	30%
M	Muli	324,000				946,416	29%
M	Naalaafushi	81,168				241,860	29%
M	Diggaru	261,000				954,156	36%
M	Maduvvari	91,140				234,504	25%
F	Bileiydhoo	201,600				504,360	25%
Dh	Meedhoo	343,980				906,840	26%
Dh	Ban'didhoo	152,400				451,044	29%
Dh	Rin'budhoo	69,360				216,600	31%
Dh	Hulhudheli	157,968				491,952	31%
Dh	Maaen'boodhoo	144,552				390,060	27%
Dh	Kudahuvadhoo	799,428				2,299,500	28%
Th	Buruni	226,587				334,160	15%
Th	Vilufushi	312,000				842,392	27%
Th	Madifushi	192,000				605,160	31%
Th	Dhiyamigili	148,800				276,528	18%
Th	Guraidhoo	378,000				1,067,664	28%
Th	Kan'doodhoo	119,040				366,096	30%
Th	Vandhoo	72,000				160,188	22%
Th	Hirilandhoo	246,396				879,120	35%
Th	Gaadhiffushi	74,040				178,423	24%
Th	Thimarafushi	421,920				1,224,000	29%
Th	Kin'bidhoo	222,000				472,512	21%
L	Maabaidhoo	167,820				476,424	28%

Atoll	Island Name	Diesel Consumed	Thermal Conversion efficiency	Total electricity Generated	Technical Losses	Total electricity consumed	Overall system efficiency
L	Maavah	348,000				1,052,868	30%
L	Fonadhoo	720,000				2,424,345	33%
GA	Kolamaafushi	294,000				900,000	30%
GA	Vilin'gili	996,540				3,411,240	34%
GA	Maamendhoo	278,280				867,708	31%
GA	Dhevvadhoo	174,588				463,140	26%
GA	Kon'dey	70,200				170,640	24%
GA	Gemanafushi	267,100				919,152	34%
GA	Kan'duhulhudhoo	129,960				351,600	27%
GDh	Thinadhoo	1,800,000				5,165,856	28%
GDh	Madavli	286,310				612,264	21%
GDh	Rathafandhoo	172,200				477,300	27%
GDh	Fiyoaree	213,660				718,452	33%
Gn	Fuvahmulah	2,438,100				8,830,092	36%
S	Hithadhoo	6,674,255				23,483,244	35%
S	Hulumeedhoo	873,084				2,944,752	33%

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