Madagascar

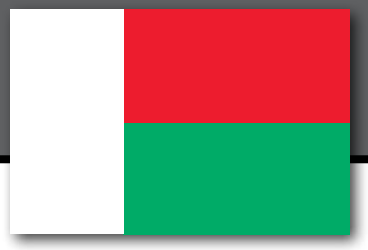
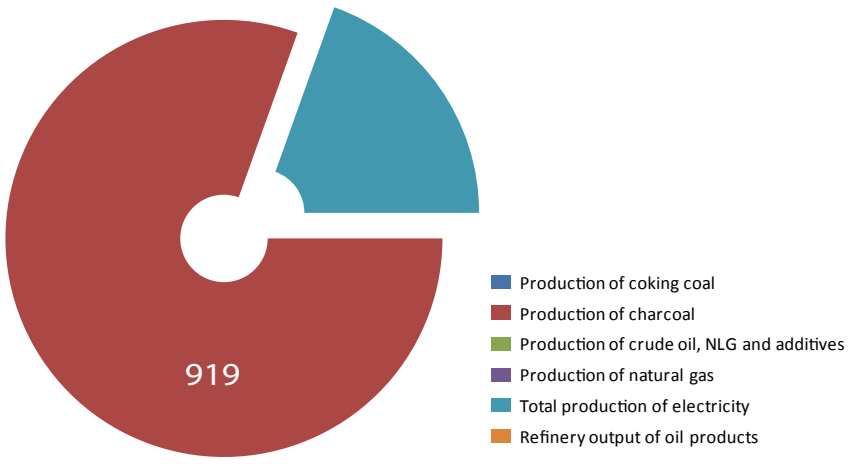


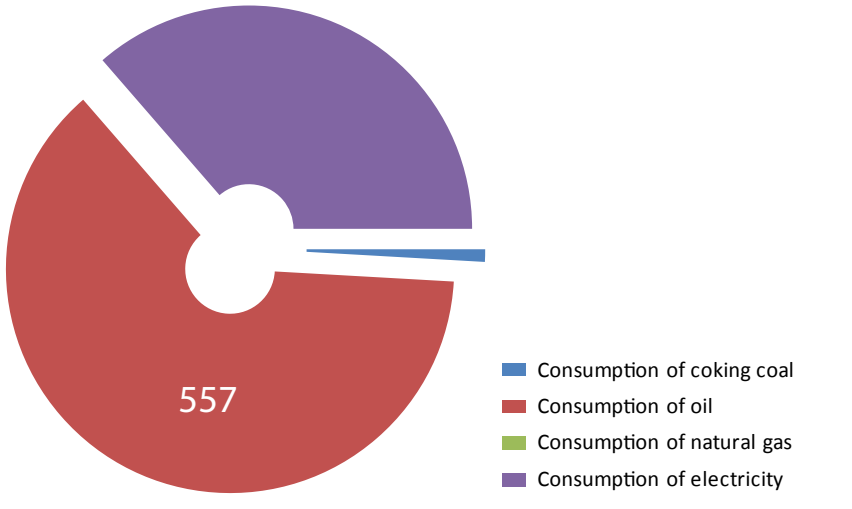
Figure 1: Energy profile of Madagascar

Figure 2: Total energy production, (ktoe)



Source: (AFREC, 2015)

Figure 3: Total energy consumption, (ktoe)



Source: (AFREC, 2015)

Energy Consumption and Production

Madagascar's population in 2013 was 22.92 million (Table 1) (World Bank, 2015). Electricity produced in 2015 was 223 ktoe of which 61.8 per cent came from fossil fuels and 36.3 per cent from hydro sources (Table 2). Final consumption of electricity in the same year was 323 ktoe (AFREC, 2015). Key energy statistics are highlighted in Figures 2 and 3.

Table 1: Madagascar's key indicators

Key indicators	Amount
Population (million)	22.92
GDP (billion 2005 USD)	6.21
CO_2 emission (Mt of CO_2)	2.44

Source: (World Bank, 2015)

Energy Resources

Biomass

The rural areas predominantly use firewood and charcoal as fuel sources. However, this has impacts on indoor air quality and the health of residents. In 2015 charcoal production amounted to 919 ktoe (AFREC, 2015). There is potential for energy from biofuels using agricultural waste from the sugar sector. Jatropha is also being cultivated for its oil which is used variously in the biofuels industry.

Hydropower

Only 1.9 per cent of Madagascar's hydroelectric power potential has currently been used (REEEP, 2012). In 2015, the country currently produced a total of 223 ktoe of electricity out of which 81 ktoe is from hydropower (AFREC, 2015).

Oil and natural gas

Madagascar imported 735 ktoe of oil products in 2015. In 2010, 41 ktoe of electricity was produced from fossil fuels increasing to 138 ktoe in 2015 (AFREC, 2015). Paraffin is used by 85 per cent of the population in the countryside for lighting (REEEP, 2012).

Wind

This island has several areas considered suitable for wind energy generation. Average wind speeds measured at 80 m range from above 7.5 m/s in the north and south; and above 5.5 m/s in the east and west. In 2015, 4 ktoe of electricity was generated from solar and wind (AFREC, 2015). Most of this is being used to extend rural electrification (REEEP, 2012).

Table 2: Total energy statistics (ktoe)

Category	2000	2005	2010	2015 P
Production of coking coal	8	0	0	0
Production of charcoal	244	333	453	919
Production of crude oil, NLG and additives	-	-	-	-
Production of natural gas	-	-	-	-
Production of electricity from biofuels and waste	0	0	0	0
Production of electricity from fossil fuels	21	29	41	138
Production of nuclear electricity	-	-	-	-
Production of hydro electricity	46	56	61	81
Production of geothermal electricity	-	-	-	-
Production of electricity from solar, wind, Etc.	0	0	1	4
Total production of electricity	67	85	103	223
Refinery output of oil products	400	403	0	0
Final Consumption of coking coal	6	6	6	8
Final consumption of oil	469	839	615	557
Final consumption of natural gas	-	-	-	-
Final consumption of electricity	53	64	73	323
Consumption of oil in industry	82	91	91	43
Consumption of natural gas in industry	-	-	-	-
Consumption of electricity in industry	24	27	22	21
Consumption of coking coal in industry	9	6	6	6
Consumption of oil in transport	344	349	349	438
Consumption of electricity in transport	-	-	-	-
Net imports of coking coal	1	9	8	8
Net imports of crude oil, NGL, Etc.	363	375	0	0
Net imports of oil product	270	449	608	735
Net imports of natural gas	-	-	-	-
Net imports of electricity	-	-	-	-

(AFREC, 2015)

- : Data not applicable
0 : Data not available
(P): Projected

Geothermal

Hot springs and dormant volcanoes are some of the indications that geothermal energy potential may exist. It is thought to be a medium-temperature geothermal system with about 350 MW of energy (REEEP, 2012).

Solar

Solar insolation in Madagascar has been measured at 5.5 kWh/m^2/day (REEEP, 2012). The sector is quite developed and it is used to power a variety of items from public buildings to rural electrification including solar cooking and lighting (REEEP, 2012).

Planting firewood trees, Madagascar

Tracking progress towards sustainable energy for all (SE4All)

Madagascar has a low electrification rate, averaging 15.4 per cent nationally, 8.1 per cent in rural areas and 60.7 per cent in urban areas in 2012 (World Bank, 2015); (World Bank, 2016). Access to non-solid fuels in 2012 was 2 per cent in both rural and urban areas and also at the national level (Table 3 and Figure 4) (World Bank, 2015).

Madagascar's energy intensity increased at a compound annual growth rate (CAGR) of 0.89 over the 20 years between 1990 and 2010; and at 0.76 CAGR from 2010 to 2012. Between 2010 and 2012, the Madagascar economy's energy intensity (the ratio of the quantity of energy consumption per unit of economic output) increased from 6.3 MJ to 6.4 MJ per US dollar (2005 dollars at PPP) (World Bank, 2015).

The share of renewable energy in total final energy consumption (TFEC) decreased from 86.4 to 78.4 per cent between 1990 and 2012. Traditional biofuels form the biggest share of renewable sources at 43.7 per cent of TFEC in 2012, followed by modern solid biofuels at 33.1 per cent and hydro at 1.5 per cent (World Bank, 2015). Renewable sources contributed 30.3 per cent of the share of electricity capacity in 2012 (World Bank, 2015).

Table 3: Madagascar's progress towards achieving SDG7 – Ensure access to affordable, reliable, sustainable and modern energy for all

Target	Indicators	Year					
		1990	2000	2010	2012	2000-2010	2011-2015
7.1 By 2030, ensure universal access to affordable, reliable and modern energy services	7.1.1 Per cent of population with access to electricity	9	11	14	15.4		
	7.1.2 per cent of population with primary reliance on non-solid fuels	2	2	2	2		
7.2 By 2030, increase substantially the share of renewable energy in the global energy mix	7.2.1 Renewable energy share in the total final energy consumption	86.4	78.5	82.8	78.4		
7.3 By 2030, Double the rate of improvement of energy efficiency	7.3.1 GDP per unit of energy use (constant 2011 PPP $ per kg of oil equivalent)						
	Level of primary energy intensity(MJ/$2005 PPP)	5.3		6.3	6.4	6.46	6.42

Sources: (World Bank, 2015); (World Bank, 2016)

Figure 4: SDG indicators

Percentage of population with access to electricity	Access to non-solid fuel (% of population)	GDP per unit of energy use (PPP $ per kg of oil equivalent) 2013	Renewable energy consumption (% of total final energy consumption), 2006-2011, 2012
15.4%	2.0%	NA	78.85%

Intended Nationally Determined Contributions (INDC) within the framework of the Paris climate Agreement

Madagascar aims to reduce its greenhouse gas emissions by about 30 $MtCO_2$ compared to the Business-as-Usual scenario (ROM, 2015). Actions to accomplish this are articulated in its INDC. Those related to energy are listed in Table 4.

Table 4: Madagascar's key aspects/key mitigation measures to meet its energy Intended Nationally Determined Contributions (INDCs)

INDC
*Facilitate access to energy by strengthening existing systems and by promoting renewable and alternative energies;
*Rehabilitate energy producing network and plant stations;
*Reinforce renewable energy (hydraulic and solar) from the current level of 35 per cent to 79 per cent);
*Improve energy efficiency;
*Develop rural electrification programme;
*Disseminate improved stoves (by 2030: 50 per cent of households adopting improved stoves).

Source: (MEM, 2015)

Table 5: Madagascar's institutional and legal framework

Basic Elements	Response
Presence of an Enabling Institutional Framework for sustainable energy development and services (Max 5 institutions) most critical ones	• Ministry of Energy • Agency for the Development of Rural Electrification (ADER)
Presence of a Functional Energy Regulator	Board of Electricity Regulation (ORE) 2004
Ownership of sectoral resources and markets (Electricity/ power market; liquid fuels and gas market)	JIRAMA (Jiro sy Rano Malagasy – Malgache Power and Water)
Level of participation in regional energy infrastructure (Power Pools) and institutional arrangements	Belongs to SADC but not to the SAPP
Environment for Private Sector Participation	
Whether the Power Utility(ies) is/are vertically integrated or there is unbundling (list the Companies)	
Where oil and gas production exists, whether upstream services and operations are privatized or state-owned, or a mixture (extent) e.g., licensed private exploration and development companies)	Office Malgache des Hydrocarbures (OMH) (Malagasy Hydrocarbons Board)
Extent to which Downstream services and operations are privatized or state-owned, or a mixture (extent)	
Presence of Functional (Feed in Tariffs) FIT systems	No
Presence Functional IPPs and their contribution	Association des Opérateurs Professionnels en Electrification de Madagascar (AOPEM) Hydelec Madagascar S.A. ENELEC Madagascar Électricité de Madagascar (EDM)
Legal, Policy and Strategy Frameworks	
Current enabling policies (including: RE; EE; private sector participation; & PPPs facilitation) (list 5 max) most critical ones	National Electricity Fund (FNE) 2002 No specific renewable energy policy
Current enabling laws/pieces of legislation (including: RE; EE; private sector participation; & PPPs facilitation) – including electricity/grid codes & oil codes (5 max or yes/no) most critical ones	Law No. 98-032 on energy in 1999

This table was compiled with material from (REEEP, 2012)

Institutional and Legal Framework

The Ministry of Energy is in charge of the energy sector. The energy regulator is the *Office pour la Regulation de l'Electrification* (ORE), which was created in 2004. The JIRAMA (*Jiro sy Rano Malagasy* – Malgache Power and Water) is in charge of generation, transmission and distribution of electricity (Table 5). On a regional level, Madagascar is a member of the Southern Africa Development Corporation, but not yet a member of the Southern Africa Power Pool (SAPP). The legal framework is provided by the Law No. 98-032 on energy of 1999. A policy and national energy strategy is being developed with plans to reform the electricity sector.

Diesel and gas stocked in barrels. Gas is brought to the island in barrels, Madagascar