



Figure 1: Energy profile of Morocco



Figure 2: Total energy production, (ktoe)

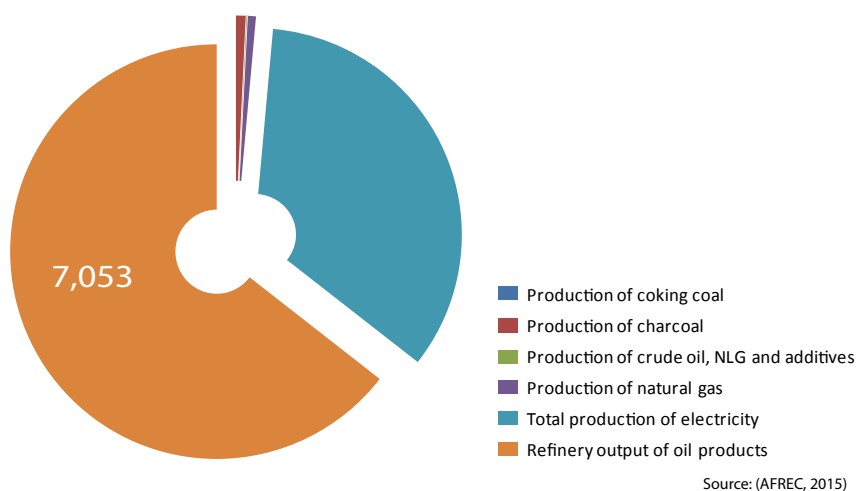
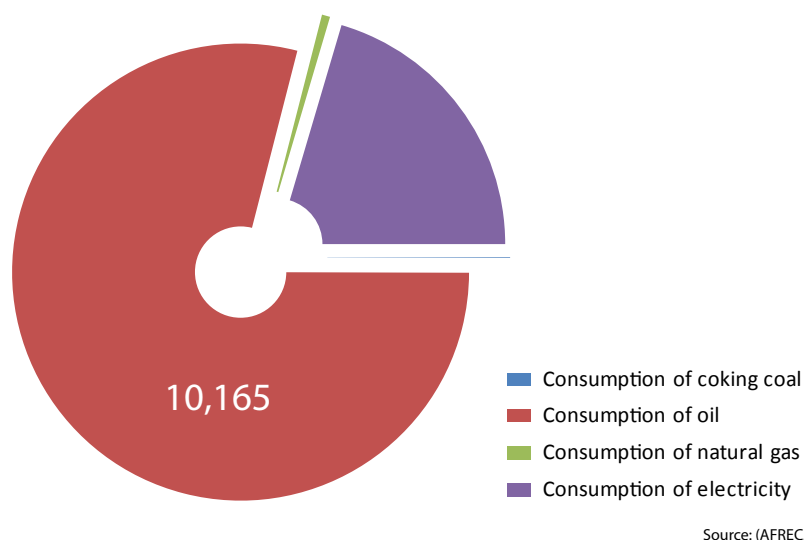


Figure 3: Total energy consumption, (ktoe)



Energy Consumption and Production

Morocco had a population of 33.01 million in 2013 (Table 1). In 2015, total electricity production was 3,733 ktoe, with 86.1 per cent from fossil fuels, 8.09 per cent from hydro and 5.7 per cent from solar and wind. Final electricity consumption was 2,630 ktoe (AFREC, 2015) as shown in Table 2. Between 2000 and 2015, Morocco's consumption of electricity almost doubled. This is likely partly due to a focus on energy-intensive sectors, such as construction and chemicals, among others. Figures 2 and 3 show the key energy statistics.

Table 1: Morocco's key indicators

Key indicators	Amount
Population (million)	33.01
GDP (billion 2005 USD)	84.97
CO ₂ emission (Mt of CO ₂)	50.34

Source: (World Bank, 2015)

Energy Resources

Biomass

It is primarily in Morocco's rural areas where traditional biomass is still used for cooking and other domestic purposes. The annual consumption of wood is estimated at 30,000 ha while land under forest is about 9 million ha (REEEP, 2014). Production of charcoal increased from 78 to 82 ktoe between 2010 and 2015 respectively (AFREC, 2015). There is research ongoing into biogas from landfill waste and the use of biomass to replace oil in thermal generators.

Hydropower

Generation of electricity from hydro-sources increased by 2.3 per cent to 302 ktoe between 2010 and 2015 (AFREC, 2015). Hydro-electricity has been the main source of the available renewable energy options to the electricity grid making up 8 per cent of total electricity generated in 2015. However, the contribution of hydro-electricity to the grid has been fluctuating. For instance in 2005 hydro contributed 6 per cent of total electricity generated increasing to 14.5 per cent 2010 (AFREC, 2015). This could partly be the influence of climate change. Future developments are looking at micro-hydro power (plants generating between 5 and 100 kW of electricity).

Oil and natural gas

Morocco produced only 6 ktoe of crude oil in 2015, yet net imports of crude oil were 6,705 ktoe, net imports of oil product was 6,275 ktoe and net imports of natural gas was 1,086 ktoe in the same year (AFREC, 2015). The share of oil in electricity generation was 86.1 per cent in 2015 highlighting how central oil is to the Moroccan economy. Shale oil deposits by 2011 were estimated at over 53 billion barrels (WEC, 2013), with the most important deposits at Timahdit in the Middle Atlas Mountains and Tarfaya in the southwest. The government aims to develop this resource so as to reduce its over-dependence on oil and gas from other Arab countries.

Table 2: Total energy statistics (ktoe)

Category	2000	2005	2010	2015,P
Production of coking coal	35	7	0	0
Production of charcoal	11	12	78	82
Production of crude oil, NLG and additives	12	7	9	6
Production of natural gas	42	43	49	69
Production of electricity from biofuels and waste	0	0	0	0
Production of electricity from fossil fuels	1,150	1,807	1,681	3,216
Production of nuclear electricity	-	-	-	-
Production of hydro electricity	62	123	295	302
Production of geothermal electricity	-	-	-	-
Production of electricity from solar, wind, Etc.	6	18	57	215
Total production of electricity	1,217	1,947	2,032	3,733
Refinery output of oil products	6,600	6,790	6,596	7,053
Final Consumption of coking coal	409	466	12	6
Final consumption of oil	5,716	7,176	9,549	10,165
Final consumption of natural gas	42	43	50	74
Final consumption of electricity	1,348	1,668	2,145	2,630
Consumption of oil in industry	977	1,139	1,104	996
Consumption of natural gas in industry	42	429	49	79
Consumption of electricity in industry	520	615	775	1,014
Consumption of coking coal in industry	409	466	12	6
Consumption of oil in transport	2,568	3,201	4,275	4,459
Consumption of electricity in transport	18	25	24	28
Net imports of coking coal	2,024	3,449	2,157	3,191
Net imports of crude oil, NGL, Etc.	6,400	6,514	5,737	6,705
Net imports of oil product	33	1,627	6,341	6,275
Net imports of natural gas	0	0	583	1,086
Net imports of electricity	200	69	339	422

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

(AFREC, 2015)

Peat

There is 10 km² of peatland (WEC, 2013).

Coal

The proven recoverable reserves of coal by the end of 2011 was 82 million tonnes (WEC, 2013).

Wind

Wind energy is a growth industry in Morocco as the resource potential is high, estimated at 25,000 MW (REEEP, 2014). The north and southwestern coasts of Africa are considered most attractive regions for wind energy generation (WEC, 2013). By the end of 2013, there was 487 MW of installed wind energy (GWEC, Various years) and the government is planning to augment this to 2,000 MW by 2020 (OECD/IEA, 2014). This additional capacity will be installed using a variety of financing options (GWEC, 2009).

Nuclear

Morocco is interested in utilizing nuclear energy to diversify energy supply. The National Centre for Energy Sciences and Nuclear Technologies (CNESTEN) was established over 30 years ago to drive research in that area (OECD/IEA, 2014).

Geothermal

According to AFREC (2015), by 2015 geothermal energy was not part of Morocco's energy mix. However, there are hot natural springs in the northeast. These visible features of geothermal activity may be an indicator of potential energy that could be tapped (REEEP, 2014).

Solar

Morocco has ample resources for solar energy generation with irradiation appraised at over 2,300 kWh/m²/yr (REEEP, 2014). The government is investing heavily in developing its solar potential with a target of having installed capacity from solar of 2 GW by 2020 (OECD/IEA, 2014). The institutional framework for solar includes the Moroccan Agency for Solar Energy set up in 2010 and the Institute for Research into Renewable and Solar Energies established in 2011 and they are already having an impact. For instance, production of electricity from solar and wind increased almost four-fold between 2010 and 2015 to 215 ktoe (AFREC, 2015). There are solar plants at Ain Beni Mathar (20 MW) and 160 MW at Ouarzazate (OECD/IEA, 2014).

Table 3: Installed wind power capacity in Morocco, (MW)

	End 2007	End 2008	End 2009	End 2010	End 2011	End 2012	End 2013
Morocco	124	134	253	286	291	291	487
Africa	539	635	866	1 065	1 033	1 165	1 602

Source: (GWEC, Various years)

Tracking progress towards sustainable energy for all (SE4All)

By 2012, the whole of Morocco had access to electricity (Table 4 and Figure 4) (World Bank, 2016). National access to non-solid fuels in 2012 was 97.10 per cent. Disaggregated by location, it was 85 per cent in rural areas and 100 per cent in urban areas (World Bank, 2015).

Morocco's energy intensity increased at a compound annual growth rate (CAGR) of 0.42 per cent over the 20 years between 1990 and 2010 and at 1.48 per cent CAGR from 2010 to 2012. Between 2010 and 2012, the Moroccan economy's energy intensity (the ratio of the quantity of energy consumption per unit of economic output) increased from 3.4 MJ to 3.5 MJ per US dollar (2005 dollars at PPP) (World Bank, 2015).

Morocco's success at increasing access to electricity lies in pursuing an off-grid renewable energy electrification model at village scale (Benkhadra, 2011). This project which started in 1995 is being led by the government utility ONEE in collaboration with PPPs and so far, 1.9 million households have electricity (OECD/IEA, 2014). The share of renewable energy in total final energy consumption (TFEC) decreased from 91.6 to 83.54 per cent between 1990 and 2012. In 2012, modern biofuels formed the biggest share of renewable sources at 5.2 per cent, followed by traditional solid biofuels at 4.6 per cent of TFEC, hydro at 1.0 per cent and wind 0.5 per cent (World Bank, 2015). Renewable sources contributed 25.9 per cent of the share of electricity capacity and 8.6 per cent of the electricity generated in 2012 (World Bank, 2015).

Table 4: Morocco'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	49	71	99	100		
	7.1.2 Per cent of population with primary reliance on non-solid fuels	81	91	96	97		
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	8.5	6.7	7.2	11.3		
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)				12.74 (2013)		
	Level of primary energy intensity (MJ/\$2005 PPP)	3.1		3.4	3.5	3.49	3.51

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

Figure 4: SDG indicators

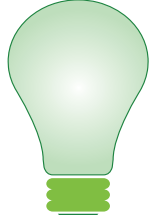



Percentage of population with access to electricity	Access to non-solid fuel (% of population)	GDP per unit of energy use (PPP \$ per kg of oil equivalent) 2013	Renewable energy consumption (% of total final energy consumption), 2006-2011, 2012
100% 	97.1% 	13.17 	11.34% 

Table 5: Morocco's key aspects/key mitigation measures to meet its energy Intended Nationally Determined Contributions (INDCs)

INDC
*Reach over 50 per cent of installed electricity production capacity from renewable sources by 2025.
*Reduce energy consumption by 15 per cent by 2030.
*Substantially reduce fossil fuel subsidies, building on reforms already undertaken in recent years.
*Substantially increase the use of natural gas, through infrastructure projects allowing liquefied natural gas (LNG) imports.
*Provide 42 per cent of the installed electrical power from renewable sources, of which 14 per cent is from solar energy, 14 per cent is from wind energy and 14 per cent is from hydraulic energy by 2020.
*Achieve 12 per cent energy savings by 2020 and 15 per cent by 2030, based on current trends.
*Reduce energy consumption in buildings, industry and transport by 12 per cent by 2020 and 15 per cent by 2030. The breakdown of expected savings per sector is 48 per cent for industry, 23 per cent for transport, 19 per cent for residential and 10 per cent for services.
*Install an additional capacity of 3,900 MW of combined-cycle technology running on imported natural gas by 2030.
*Supply major industries with imported and re-gasified natural gas through pipelines.

Source: (MEM, 2015)

Table 6: Morocco'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	<ul style="list-style-type: none"> • Ministry of Energy, Mining, Water and Environment (MEMEE) • Agency for the Development of Renewable Energy and Energy Efficiency • Moroccan Agency for Solar Energy • Office of Hydrocarbons and Mining (ONHYM)
Presence of a Functional Energy Regulator	National Authority for Electricity Regulation
Ownership of sectoral resources and markets (Electricity/ power market; liquid fuels and gas market)	
Level of participation in regional energy infrastructure (Power Pools) and institutional arrangements	
Environment for Private Sector Participation	
Whether the Power Utility(ies) is/are vertically integrated or there is unbundling (list the Companies)	ONEE (Office National de l'Electricité et de l'Eau Potable)
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)	
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	<ul style="list-style-type: none"> • Jorf Lasfar Electric Company JLEC (coal power plant with 6 units of 350 MW capacity each) • Energie Electrique de Tahadart (400 MW NGCC power plant) • Compagnie Eolienne du Detroit (Wind park)
Legal, Policy and Strategy Frameworks	
Current enabling policies (including: RE; EE; private sector participation; & PPPs facilitation) (list 5 max) most critical ones	National Energy Strategy 2009 Energy Development Fund 2009
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	<ul style="list-style-type: none"> • Law No.13-09 Renewable Energy Law • Law No.16-09 creating the National Agency for the Promotion of Renewable Energy and Energy Conservation (ADEREE) • Law No. 57-09 creating the Moroccan Agency for Solar Energy (MASEN) • Bill No. 48-15 on regulation of the electricity sector adopted in September 2015 • Law No.47-09 relating to energy efficiency • Draft law on Public-Private Partnerships (PPPs) • Law No. 16-08, 40-09 and 54-14 dealing with the Office National de l'Eau et de l'Eau Potable (ONEE)

This table was compiled with material from (REEEP, 2014) and (OECD/IEA, 2014)

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

Morocco's vision is to make the country more resilient to climate change while making the transition to a low carbon economy. Many of the activities to achieve this vision will be undertaken by transforming the energy sector. The main targets are to reduce dependence on energy imports while meeting the internal growing demand for energy. By June 2015, the government had stated its energy-related Intended Nationally Determined Contributions (INDC). These are highlighted in Table 5.

Institutional and Legal Framework

The Ministry of Energy, Mining, Water and Environment (MEMEE) is in charge of the energy sector (Table 6). A bill to approve an energy regulator was passed in September 2015. The ONEE (*Office National de l'Electricité et de l'Eau Potable*) is the sole generator, transmitter and distributor of electric energy. On a regional level, the country is a member of Maghreb Electricity Committee (COMELEC) Power Pool. The legal framework is provided by Law N° 16-08, 40-09 and 54-14 dealing with the ONEE.

The National Energy Strategy 2009 is the main sector policy. The challenges of this policy are the

high-energy import dependency that negatively affects the country's balance of trade and the energy bill, which makes up 12 per cent of GDP (Zejli, 2015). Over 91 per cent of energy supplied comes from abroad (OECD/IEA, 2014). Addressing these issues through investing in more renewables will help to reduce GHG emissions in the energy sector.