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Trajectories (**MENA-SELECT**)

Background Paper: Country Fact Sheet Morocco

Energy and Development at a glance 2016

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SUMMARY

Reliable energy supply is vitally important to meet the growing electricity demand and hence to sustain the socio-economic progress of Morocco. With the kingdom's electricity consumption projected to double by 2025 and to increase more than five times by 2050, substantial investments in additional power generation capacities are required. Faced by the dual challenge of importing 96% of its energy supplies as fossil fuels from abroad, and being highly vulnerable to the effects of climate change, Morocco has, therefore, explicitly set low-carbon and climate change resilient development as its strategic development priority.

As a consequence, a myriad of national strategies, plans and programmes have been initiated to achieve poverty-reducing sustainable development whilst taking steps to preserve the environment. Additionally, the kingdom put in place a new National Energy Strategy aiming to reach a share of 52% of installed power capacities from renewable energy by 2030.

Since the planning of new power generation capacities is intrinsically interlinked with societal implications and thus with the operationalization of Morocco's development priority, this paper aims to illustrate the Moroccan energy-development context. From a development policy perspective the following questions are addressed in this paper:

- \ What defines Morocco's development background and its challenges in regard to socio-economic, socio-political and environmental aspects (Chapter 1)?
- \ What characterizes Morocco's present and future energy system, and which challenges in sustainable energy planning still persist (Chapter 2)?
- \ How does Morocco's policy framework address low-carbon development, energy security and participatory governance (Chapter 3)?
- \ Which recommendations can be given to Moroccan policy-makers to close remaining policy gaps and foster the continuation of the country's move towards low-carbon prosperity (Chapter 5)?

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ABBREVIATIONS

ADEME	French Environment and Energy Management Agency
ADEREE	National Agency for Renewable Energies and Energy Efficiency
AFD	Agence Française de Développement
ANRE	National Authority for Electricity Regulation
BAU	Business-As-Usual
BTI	Bertelsmann Transformation Index
CCGT	Combined Cycle Gas Turbine
CDER	Centre for the Development of Renewable Energy
CED	Compagnie Écolienne du Détroit
CNEDD	National Charter for Environment and Sustainable Development
CNESTEN	National Centre for Energy Science and Nuclear Techniques
CSP	Concentrating Solar Power
EBRD	European Bank for Reconstruction and Development
EIB	European Investment Bank
FDE	Energy Development Fund
FDI	Foreign Direct Investment
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
Gg	Giga grams
GHG	Greenhouse Gas Emissions
GIP	National Green Investment Plan
GoM	Government of Morocco
HDI	Human Development Index
ICCPR	International Covenant on Civil and Political Rights
ICPC	Central Authority for Corruption Prevention
IEA	International Energy Agency
IFI	International Financial Institutions
INDC	Intended Nationally Determined Contribution
INDH	National Initiative for Human Development
IPP	Independent Power Producers
IRESEN	Institute for Research into Solar and New Energies
JLEC	Jorf Lasfar Energy Company
KfW	Kreditanstalt für Wiederaufbau

LNG	National Liquefied Natural Gas Plan
LULUCF	Land Use, Land Use Change and Forestry
MAD	Moroccan Dirham
MANE	National Strategy for Improvement of the Environment
MASEN-	Moroccan Agency for Solar Energy
MCDA	Multi-Criteria Decision Analysis
MEMEE	Ministry of Energy, Mines, Water and the Environment
MENA	Middle East and North Africa
MII	National Innovation Initiative
MorSEFF	Morocco Sustainable Energy Financing Facility
MT	Metric Tons
Mtoe	Million Tons of Oil Equivalent
NES	National Energy Strategy
Noor	Moroccan Solar Plan
NSP	National Liquid Sanitation and Wastewater Treatment Program
NSSD	National Strategy for Sustainable Development
OECD	Organization for Economic Co-operation and Development
ONE	Office Nationale de l'Electricité
ONEE	National Agency for Electricity and Water
ONHYM	National Office of Hydrocarbons and mines
PAI	Industrial Acceleration Plan
PAN-LCD	National Action Plan for the Fight Against Desertification
PCD	Communal Development Plan
PDNDD	National Master Plan for Solid and Hazardous Waste
PERG	Program of Rural Electrification
PMV	Plan Maroc Vert (Green Morocco Plan for Agriculture)
PJD	Justice and Development Party
PNAP	National Priority Action Plan
PNE	National Water Plan
PNEI	National Industrial Emergence Pact
PNRC	National Plan Against Global Warming
PPA	Power Purchase Agreements
PV	Photovoltaics
R&D	Research and Development
RE	Renewable Energy
RNDM	National Program for Solid Waste

SIE	State-funded Energy Investment Company
SNPE	National Strategy for Environmental Protection
SNE	National Water Strategy
TFC	Total Final Consumption
TPES	Total Primary Energy Supply
TWh	Terawatt per hour
UNCED	United Nations Conference on Environment and Development
UNECA	United Nations Economic Commission for Africa
VHV/HV	Very high / high Voltage

1. THE DEVELOPMENT BACKGROUND: ECONOMY, POLITICS AND ENVIRONMENT

1.1 Socio-economic background

In an increasingly unstable international economic environment the Moroccan economy remains resilient. It was able to resist the last world economic crisis and the economic depression marked by the political instability of the Arab Spring. Defined as a *Lower Middle Income Country* and being the sixth largest economy in Africa with a current GDP of around MAD 1,112 billion (Trading Economics, 2015), Morocco has performed strongly over the past decade. With an average GDP growth between 2-5% in the last five years and a lower volatility than in the previous two decades and in most of the other MENA countries the country is positioning itself as an economic hub between the markets of the European Union and the African continent (World Bank, 2015a; Trading Economics, 2015) (see fig. 1).

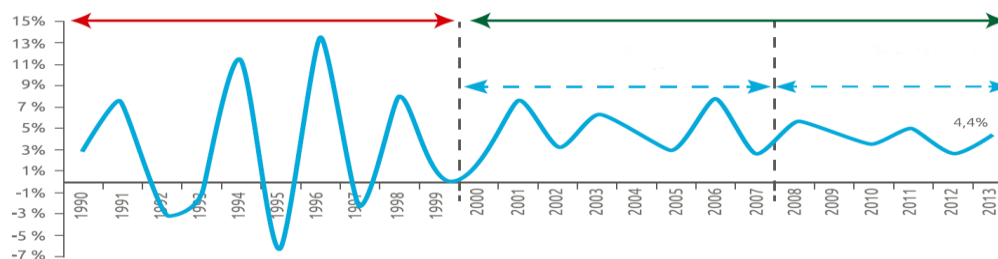


Figure 1: Growth rates in Morocco 1990-2014 (MEMEE, 2016a, p. 50).

As a result of stable annual economic growth rates and boosted shared prosperity, the kingdom has significantly improved its human development status. Since 2000, per capita incomes have doubled (in *Power Purchase Parity*), extreme poverty practically been eradicated and illiteracy substantially decreased. Compared to 1980 the *Human Development Index (HDI)* value of Morocco has gone from 0.351 to 0.617 in 2014, earning the country the 130th position in the annual *HDI* ranking (UNDP, 2014; WBG, 2015, p. 91).

In regards to GDP by sector, the Moroccan economy is currently shifting toward a new growth model based on increasing shares of higher value-added industries and services (Coface Group MENA Economist, 2015, p. 9). While the service sector accounted for 55.3% of the country's GDP in 2012, strong growth and *Foreign Direct Investment (FDI)* inflows in the manufacturing industries (in particular the automotive and aerospace industries) led to a contribution of 30.3% by the secondary sector (Mansour and Castel, 2014) (see fig. 2).

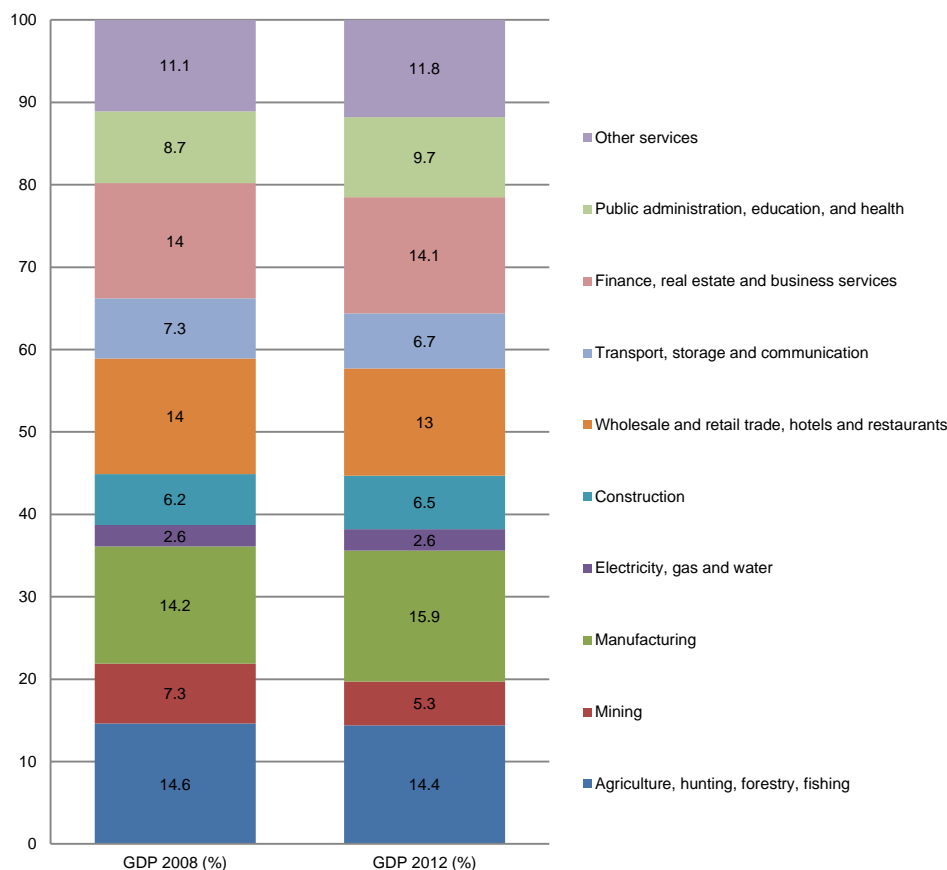


Figure 2: Morocco's GDP by sector in 2008 and 2012 (Authors' illustration based on Mansour and Castel, 2014).

Although the share of the agricultural sector in total added value is gradually shrinking, agriculture remains one of the most important pillars of the Moroccan economy, accounting for 14.4% of GDP and employing over 40% of the Moroccan population in 2012 (Ghanem, 2015, p. 8). In rural areas, the livelihoods of as much as 80% of the working population depend on agricultural activities, either directly or indirectly and employment opportunities for the youth in rural areas outside of agriculture remain very limited (UNECA, 2015, p. 19; Ghanem, 2015, p. 8).

1.1.1 Socio-economic challenges

Notwithstanding its recent progress Morocco still faces considerable socio-economic challenges. According to reports provided by the *United Nations Economic Commission for Africa (UNECA)*, *International Financial Institutions (IFIs)* and rating agencies, these challenges encompass the following areas:

- \ *Population growth:* Although annual population growth rates are anticipated to decline in the mid-long term, the Moroccan population is expected to reach over 40 million by 2040. Especially the urban areas will be affected by high growth rates and rural migration flows (MEMEE, 2016a, p. 94).

- \ *Unemployment rates among the youth and women:* Despite stable economic growth rates, the national unemployment rate remains at high levels (9.9% in 2014). Moreover, analysis of the unemployed labour force reveals three main features: it is an urban rather than a rural phenomenon, with four out of five unemployed people living in urban areas (80.9%); it affects the youth (people aged 15-24) more, especially in urban areas (20.1%); and the unemployment rate among university graduates is more than double the national average (22.5%) (UNECA, 2015, p. 10-12).
- \ *Lack of competitiveness and absorptive capacities in non-primary sectors:* New industry policies especially in the automotive (200 companies, 85,000 employees) and aeronautic (100 companies, 100,000 employees) industries, with two industrial clusters in Casablanca and Tangier now producing vehicles and components for the world market, have contributed to stable growth rates in the industry sector. Nevertheless the Moroccan economy still remains orientated toward non-tradable and labour-intensive activities (Mansour and Castel, 2014, p. 4-13). Low innovation resources (R&D), skill mismatches and high informality rates among small and medium size firms are considered significant barriers to raising the absorptive capacities of domestic industries and improving the productivity and competitiveness of the Moroccan labour force (Cafos, 2015, p. 16). As a result, the lack of human capital and slow technical progress are altogether limiting the country's ability to benefit from knowledge and technology transfer and slowing its move towards a high-added value economy (World Bank, 2014, p. 2-10; Moody's Investor Service, 2015).
- \ *Trade deficit:* The *Government of Morocco (GoM)* has taken significant efforts to strengthen the macro-economic base through structural reforms and actively encouraging foreign investment and trade (Arieff, 2013, p. 9). Yet, the country's trade balance remains structurally in deficit with the recorded deficit of MAD 9,053 million accounting for 6% of GDP in 2015 (Trading Economics, 2015). This is because the economic value of its main imported products, such as fossil energy, machinery, electrical equipment, vehicles and electricity still outweighs the value of its main exports, such as electric components, textiles, agricultural products (e.g., fruits, vegetables and fish), and phosphates (KPMG, 2015, p. 3).
- \ *Regional disparities:* Poverty rates have decreased substantially over the last decade in Morocco. Yet, the country is still marked by high levels of geographic inequality (Mansour and Castel, 2014, p. 11). Most of the rural areas, in particular in the mountainous regions, have significantly higher poverty rates than the national average. Besides the distribution of poverty rates, these regional disparities are also reflected by the percentage of the population having access to safe water, which is 98% in urban areas, but only 62.7% in rural areas (AfDB, 2015), or the percentage of the population having ac-

cess to improved sanitation facilities (84% in urban areas versus 66% in rural areas in 2014) (World Bank, 2015b).

- \ *Gender inequalities:* While Morocco has made progress towards gender equality due to a number of legal reforms, inequalities between men and women are still visible in the country. Especially in rural areas, women are affected more from the absence of basic infrastructures, have significantly lower employment rates than men (25% women, 73% men), and account for only 30% of the labour force working in administration (UNECA, 2015, p. 12).

1.2 Socio-political background

Morocco is a constitutional monarchy and consists of 12 administrative regions (MEMEE, 2016a, p. 42). King Mohammed VI, who succeeded his father King Hassan II in 1999, rolled out a number of reform proposals in March 2011, which culminated in a constitutional revision in July 2011. He chairs the *Council of State*, approves and dismisses government ministers on the basis of suggestions by the prime minister, has the ability to dissolve the parliament, can call elections, and exercises certain powers via decree (Arieff, 2013, p. 3). The King is also the head of the army and, as a direct descendant of the Prophet Mohammed, the chief religious leader (Ernst and Young, 2011, p. 6). The constitutional reform grants some new powers to the parliament and to the prime minister. The King also appoints the prime minister, who is the head of the government and who is assisted by the *Council of Ministers*, after being elected. The parliament consists of two chambers: the *Chamber of Counsellors* (the upper house, *Majlis al-Mustasharin*) with 270 seats, whose members are indirectly elected for nine years, and the *Chamber of Representatives* (the lower house, *Majlis al-Nuwab /Assemblée des Représentants*) with 395 seats, whose members are directly elected for five years (Arieff, 2013, p. 3). After the 2011 elections, the moderate Islamist *Justice and Development Party (PJD)* won the most seats, and its leader, Abdelilah Benkirane, became the new prime minister.

1.2.1 Socio-political challenges

Notwithstanding that the *GoM* has made progress in pursuing good governance reforms, fighting corruption and strengthening democratic participation as well as decentralization, Morocco still faces substantial socio-political challenges. According to reports provided by civil society organisation and scientific publications, these challenges encompass the following areas:

- \ *Good governance and social justice:* As of 2014, the quality of governance and democracy in Morocco is rated as “very limited” (4.52 out of 10) in the *Bertelsmann Transformation Index (BTI)*. Moreover, political participation and rule of law receive low ratings (3.5 and 3.8, respectively) (BTI, 2014a).

- \ *Corruption*: Despite efforts made by the *GoM* to enhance the institutional framework for corruption prevention, particularly through the establishment of the *Central Authority for Corruption Prevention (ICPC)*, the *Corruption Perception Index 2014* of *Transparency International* still rates Morocco rather low (39 out of 100) (*Transparency International*, 2014).
- \ *Decentralization and participation of the civil society*: Although significantly less strong, Morocco nevertheless had its share of civil unrest following the uprisings of the Arab Spring in 2011. Motivated by persistently high unemployment rates and social inequalities, the movements in Morocco were accompanied by the necessity to meet societal aspirations through greater participation in decision-making and empowerment (Ben-Meir, 2015, p. 1-34). In response, King Mohammed VI agreed to certain political, judicial, social and economic reforms, e.g., the promotion of human rights, women's equality, and Berber (Amazigh) cultural rights as well as an encouragement of decentralization. However, implementation of these frameworks under the new *National Constitution* adopted in 2011 remains challenging, especially in regards to decentralizing to the municipal level and enhancing human service delivery based on civil society participation (Ben-Meir, 2015, p. 1-34; AMDH, 2014; ARI, 2014).

1.3 Socio-environmental background

Morocco's principle geographic features are dominated by its large sea front, 512 km of coastline towards the Mediterranean Sea and 2,934 km towards the Atlantic; its high altitude mountainous areas, e.g., the Rif, the Middle-, High- and Anti Atlas; and its large extension in latitude (MEMEE, 2016a, p. 37). These features result in great spatial-temporal temperature and precipitation variations with strong impacts on the country's water resources, plant canopy, and agricultural production: Sub-humid Mediterranean climate and high agricultural productivity on the North coast and the interior mountains, semi-arid continental climate and moderate to high agricultural productivity in inland areas, and arid desert climate with very low to low agricultural productivity in the South (MoE, 2015, p. 2; IAEA, 2013, p. 2; MEMEE, 2016a, p. 36-40).

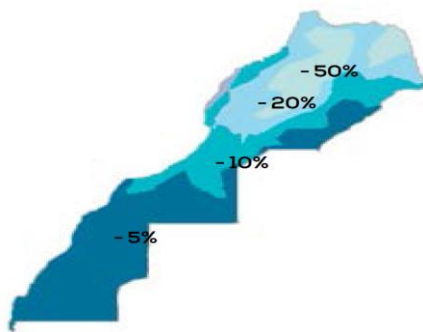
The annual water availability per capita in Morocco is around 700-867 m³ which puts the country into the "water scarce" category (MEMEE, 2016a, p. 129; World Bank, 2015c). Yet, due to significant spatial variations of the annual precipitation patterns, Southern areas in Morocco are endowed with significantly less water resources (<100 mm/year) than Northern parts (>800mm/year) and some coastal areas have less available freshwater resources than central provinces (MEMEE, 2016a, p. 40; World Bank, 2015c; UNESCO, 2012, p. 799). The total land area of the country is about 71 million hectares (ha) of which 8% (5.8 million ha) are forests; 13% (9.2 million ha) are agricultural lands; and about 65% (46 million ha) are pastures, rangelands, and deserts. However, despite its rela-

tively high biodiversity, Morocco can be characterized by an overall lack of productive arable land (Dahan et al., 2012, p. 1).

1.3.1 Socio-environmental challenges

The environment in Morocco is subject to strong pressure due to demographic growth, urbanization and economic development. Furthermore, and despite being responsible for less than 0.2% of global GHG emissions, and with its annual per capital emissions of 3 tons being four times lower than the average industrialized country (Schinke, 2015, p. 2), the kingdom is severely affected by climate change impacts. Slow-onset and sudden-onset climate change impacts are already leading to displacement and migration of people across the country. According to Tangermann and Chazalnoel (2016) this trend is expected to intensify in the future due to increasing environmental challenges. Based on the *3rd Environmental Rapport of Morocco* (MoE, 2015), the country's most pressing environmental challenges are as follows:

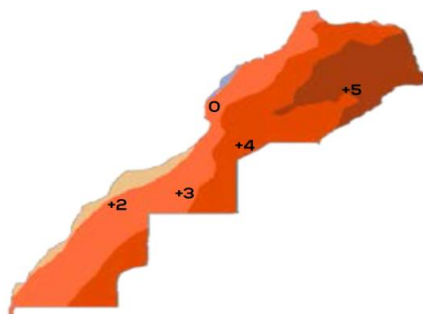
- \ *Decreasing and more erratic precipitation:* Future climate trends for Morocco point towards decreasing annual precipitation between 5 and 50% until end of this century (based on the baseline period 1961-2000), with the strongest reductions projected to occur during winter months and in the North-East (MoE, 2015, p. 19; Schilling et al., 2012, p. 14) (see fig. 3). Consecutive



droughts, extreme rainfall events, reduced biodiversity, decreasing high altitude snow-cover and water-borne diseases are among the projected consequences (Sow et al., 2015).

Figure 3: Projected precipitation changes in Morocco until 2070-2099 (MoE, 2015, p. 19).

- \ *Increasing temperatures:* Climate models suggest a temperature rise of up to 5°C for Morocco by 2100 (based on the baseline period 1961-2000), with significantly high increases projected for the North-East (MoE, 2015, p. 19; Schilling et al., 2012, p. 14) (see fig. 4). Forest fires, deforestation, vector-



borne diseases and higher evapotranspiration rates are among the projected consequences (Sow et al., 2015).

Figure 4: Projected temperature changes in Morocco until 2070-2099 (MoE, 2015, p. 19).

- \ *Solid hazardous waste:* The generation of solid waste is one of the major environmental challenges of Morocco. Of the 6.9 million metric tons (MT) of solid waste generated across the country in 2014, 1.6 MT was considered industrial waste of which 290,000 MT was hazardous (MoE, 2015, p. 120; GIZ, 2014, p. 7). All but 8% of this waste was disposed of in uncontrolled municipal landfills and dumpsites without prior treatment, thus resulting in serious consequences for public health and the environment (MoE, 2015, p. 120; GIZ, 2014, p. 26).
- \ *Soil degradation:* As most of the country's soils are fragile, soil degradation due to desertification and erosion is a serious challenge in Morocco (MoE, 2015, p. 65). Only 27% of the country's soils are considered to be of low sensitivity to degradation whereas the rest is characterized by high fragility (MoE, 2015, p. 66). Urbanization, intensive irrigation schemes and climate change impacts are expected to further contribute to the degradation of arable soil layers due to overexploitation of lands as well as water and wind erosion (MoE, 2015, p. 67-75; Dahan et al., 2012, p. 10).
- \ *Air pollution:* Untreated gaseous emissions (e.g., SO₂, NO_x) stemming from industrial activities, heavy traffic and electricity generation have led to high levels of air pollution in Morocco - particularly causing severe health impacts in the major agglomeration and industrialized zones along the coastal areas (MoE, 2015, p. 78-86).
- \ *Decreasing water quantities and quality:* Since the 1950s the available water resources in Morocco have decreased by 20% which almost halved the annual water availability per capita from 1.500 m³ to 700-867 m³ in the same period (MoE, 2015, p. 47; World Bank, 2015c; MEMEE, 2016a, p. 129). Paired with insufficient recharge capacities of groundwater tables and the silting up of water reservoirs, higher temperature and less precipitation in times of climate change will further reduce the availability of already scarce water resources. As a consequences water availability is projected to reach 500 m³ per capita by 2050 and 280 m³ by 2080 (MEMEE, 2016a, p. 129). The change in rainfall has already affected water levels in many reservoirs across Morocco (MEMEE, 2016a, p. 126-127). For example, the annual capacity of the Mansour Eddahbi reservoir next to Ouarzazate has been reduced by more than 50% - from 583 million m³ to 250 million m³ - over the last 25 years (MASEN, Personal Interview, 2014) due to reduced rainfall, high evaporation losses, poor farming practices, increasing water demands, and reservoir silting. Even worse: future scenarios developed within the GLOWA-IMPETUS project - that included assumptions about climate change, anticipated socio-economic development, and environmental degradation - simulate a significant reduction of the reservoir's water capacity for the next decades (see fig. 5). The worst-case scenario calculates that the Mansour Eddahbi reservoir could become inoperable between 2030 and 2042 and thus would no longer

be able to supply enough water for drinking and agricultural demands in the Ouarzazate area (Diekkrüger et al., 2012, p. 10).

This decrease in rainfalls and reservoir waters, in turn, implies a reduction in yields which means declining incomes for a huge part of the Moroccan population depending on agricultural activities. For example, a reduction of 20% in average precipitation could result in a decrease of total income from pastoralism by 15–37% in Morocco (Freier, 2012).

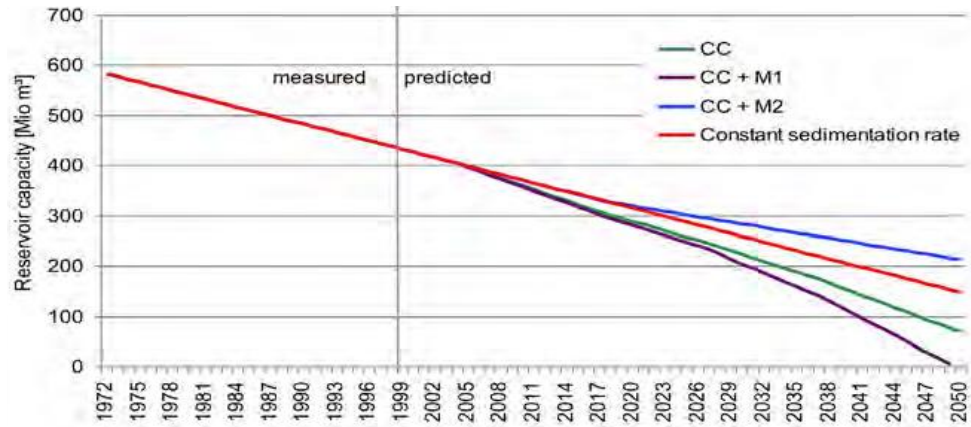
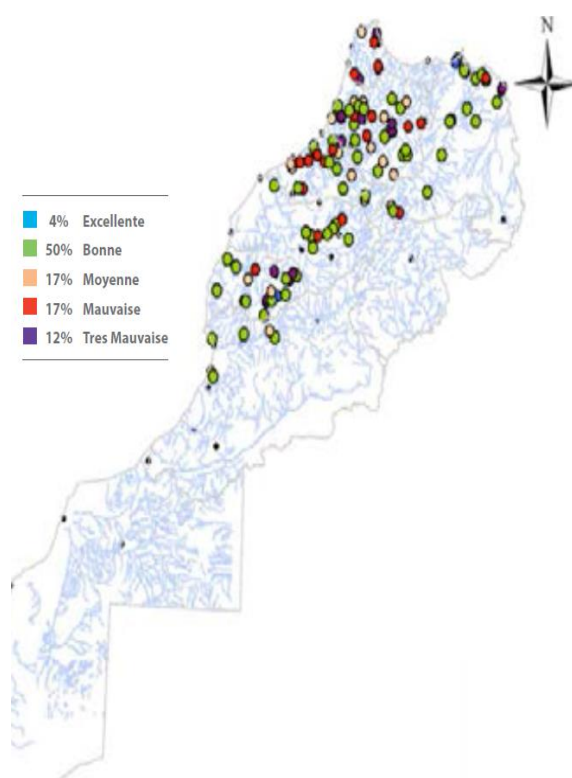


Figure 5: Simulated development of the capacity of the Mansour Eddahbi reservoir (Diekkrüger et al., 2010, p. 12).



Additionally, the majority of water bodies are of poor quality due to high salinity and pollution stemming from industrial or municipal discharges. In fact, 98% of industrial wastewater is directly discharged into the sea, causing substantial environmental harm and health impacts especially around Safi, El Jadida, Casablanca, Mohammedia, Tangier and Nador (MoE, 2015, p. 93) (see fig. 6).

Figure 6: Quality of surface water in 2011/12 (MoE, 2015, p. 59).

2. THE ENERGY BACKGROUND: PRESENT STATUS AND FUTURE PROJECTIONS

2.1 The present energy supply and demand in Morocco

Morocco's *Total Primary Energy Supply (TPES)* has grown considerably due to the country's rapid economic growth within the last decades: while TPES was about 7.6 million tonnes of oil equivalents (Mtoe) in 1990 and about 11 Mtoe in 2000, TPES reached 18.8 Mtoe in 2012. Today, the country's energy mix is dominated by oil (67.6% of TPES), followed by coal (16.1% of TPES), biofuels and waste (7.4% of TPES), and natural gas (5.7% of TPES). Electricity imports (2.2% of TPES) and renewable energy (RE), such as hydropower (0.7% of TPES) and wind (0.3% of TPES), only contribute marginal to the TPES (IEA, 2014, p. 17) (see fig. 7).

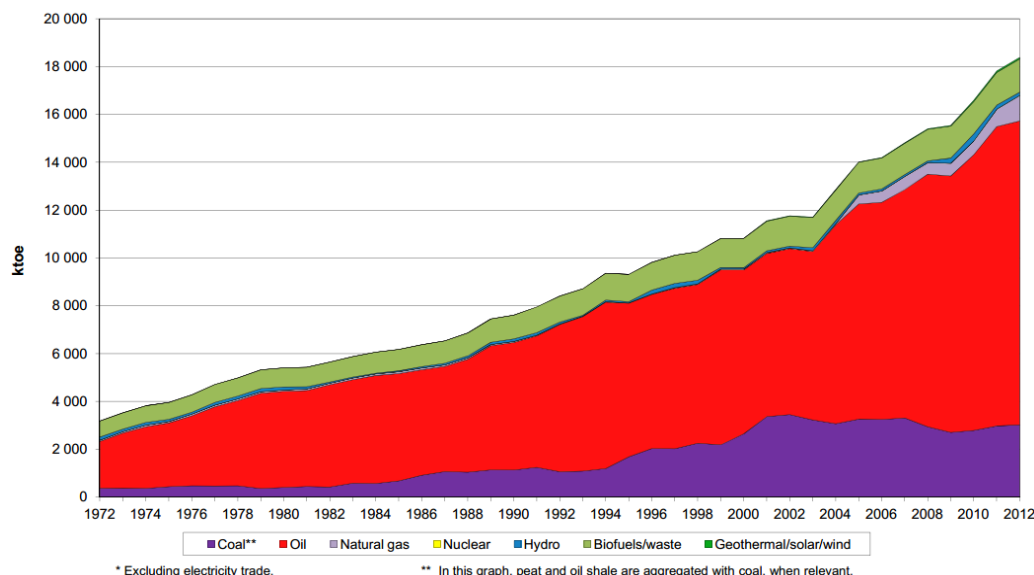


Figure 7: Total primary energy supply in Morocco from 1972 to 2012 (IEA, 2015a).

Morocco's *Total Final Consumption (TFC)* was 14.3 Mtoe in 2012 (IEA, 2015a) and increased drastically since the 1970's (around 3 Mtoe in 1973). In recent years, TFC has even grown with a faster rate than in earlier decades, increasing by 60% from 2002 to 2012. The largest consumer of energy in Morocco is the transport sector (33.2%), followed by the industry (26%), and the residential and commercial sectors (20.4%) (see fig. 8). In 2012, oil products accounted for by far the largest share to satisfy the TFC (73.4%), followed by electricity (16.5%) and biofuels and waste (9.4%) (IEA, 2014, p. 19).

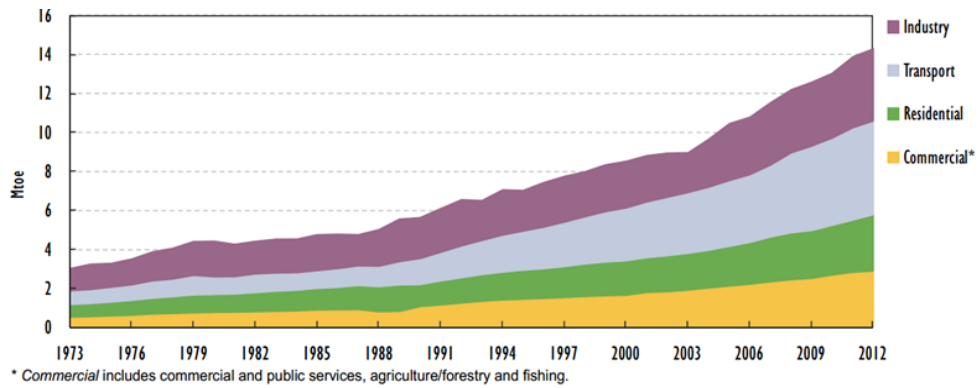


Figure 8: Total Final Consumption in Morocco by sector from 1973 to 2012 (IEA, 2014, p. 19).

The increasing energy consumption is mirrored in the country's total CO₂ emissions, which have risen at 4.2% per year between 1994-2012 and have passed the 100,000 Giga grams (Gg) mark in 2012 (MEMEE, 2016a, p. 90).

2.2 The present electricity generation and demand in Morocco

Morocco's electricity generation grew by 6-7% per year between 2002 and 2012 to satisfy the demand. The country's total installed power generation capacity of 7,994 MW generated 28 TWh of electricity in 2014 (ONEE, 2015). The main sources for electricity generation (in TWh) are fossil fuels: coal (57%), gas (20%), and oil (9%) totalling in 86% (ONEE, 2016, p. 4) (see fig. 9).

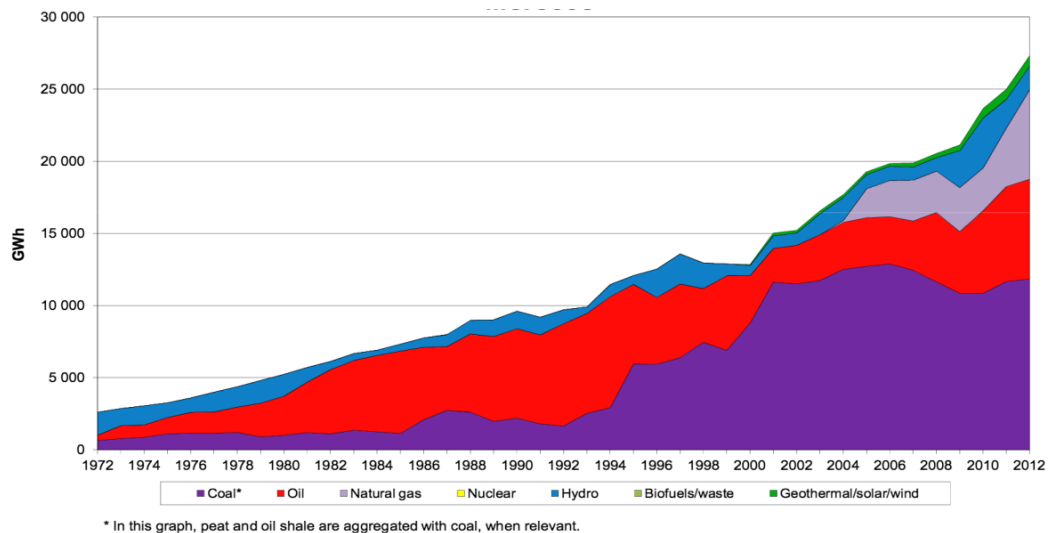


Figure 9: Electricity generation by fuel in Morocco from 1972 to 2012 (IEA, 2015).

Moreover, hydropower accounted on average for 7% of the national electricity generation in 2014 - despite significant inter-annual variations. In the same year, wind contributed 7%, while the share of solar power was negligible (ONEE, 2016, p. 22). However, being a net importer of energy, Morocco also imports electricity from abroad (mostly Spain (1,400 MW) and sometimes Algeria

(1,200-1,500 MW) in case of mutual assistance. These electricity imports accounted for an additional 6 TWh in 2014 (MEMEE, 2015b, p. 4; ONEE, 2015; ONEE, 2016, p. 4) (see fig. 10).

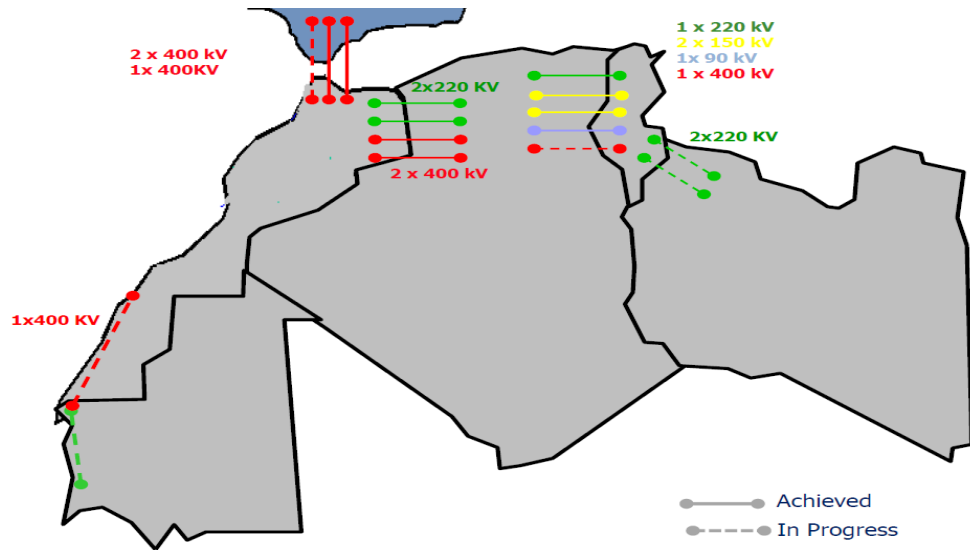


Figure 10: Regional electricity interconnections in Morocco (ONEE, 2016, p. 6).

As electricity demand goes hand in hand with economic development, Morocco's current electricity demand grows strongly with an average rate of 6.5% per year (ONEE, 2016, p. 7). Consequently, electricity demand more than doubled from 16 TWh in 2002 to 34 TWh in 2014 (ONEE, 2016, p. 7). The industry sector is the biggest consumer of electricity in Morocco (43.6%), followed by the residential sector (32.8%) and the commercial sector including agriculture (22.4%), while the transport sector accounts only for 1.2% of the electricity demand (see fig. 11).

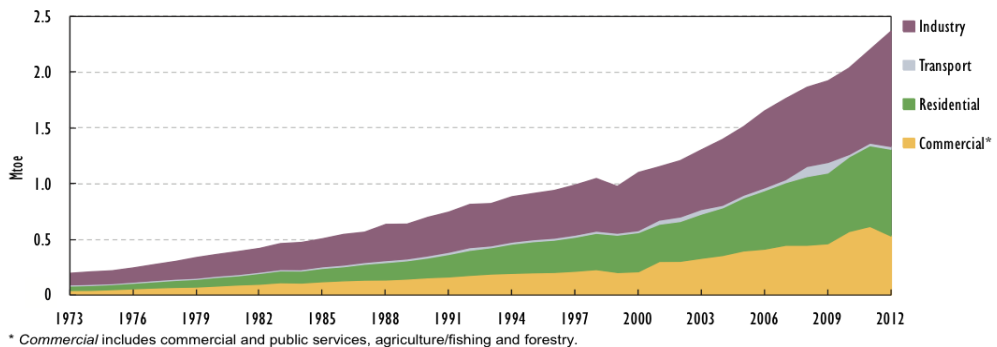


Figure 11: Electricity demand by sector in Morocco from 1973 to 2012 (IEA, 2014, p. 56).

As a result of economic growth and industrial development as well as new lifestyles, the increasing electricity demand has been followed by a shift in Morocco's load curve since the beginning of the 21st century. Whereas the load curve of 2000 was characterized by a single peak, today's load curve has a double peak and has shifted from a winter peak to a summer peak due to increasing air cooling demands (ONEE, 2016, p. 9) (see fig. 12).

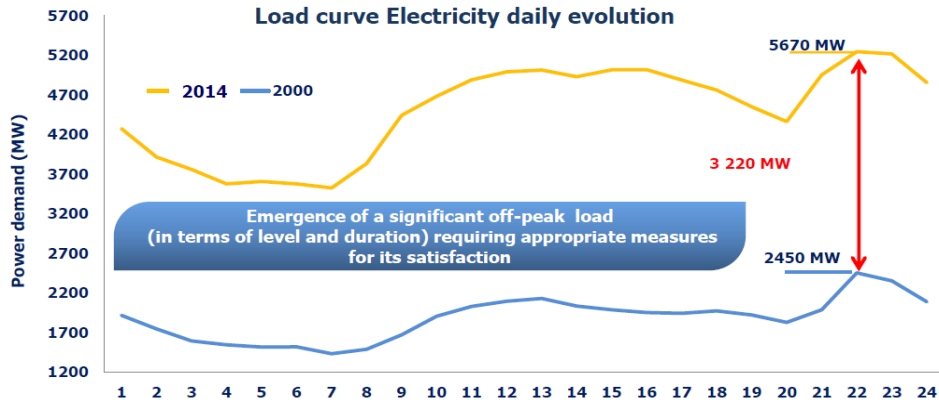


Figure 12: Load curve in Morocco for the years 2000 / 2014 (ONEE, 2016, p. 9).

Remarkable success has been achieved in the field of rural electrification. While only 18% of the Moroccan population had access to electricity in 1995, around 12 million citizens have been provided access to electricity over the last 20 years through the Program of Rural Electrification (PERG). As a result, Morocco's electrification rate of today is close to 100% (ONEE, 2016, p. 8).

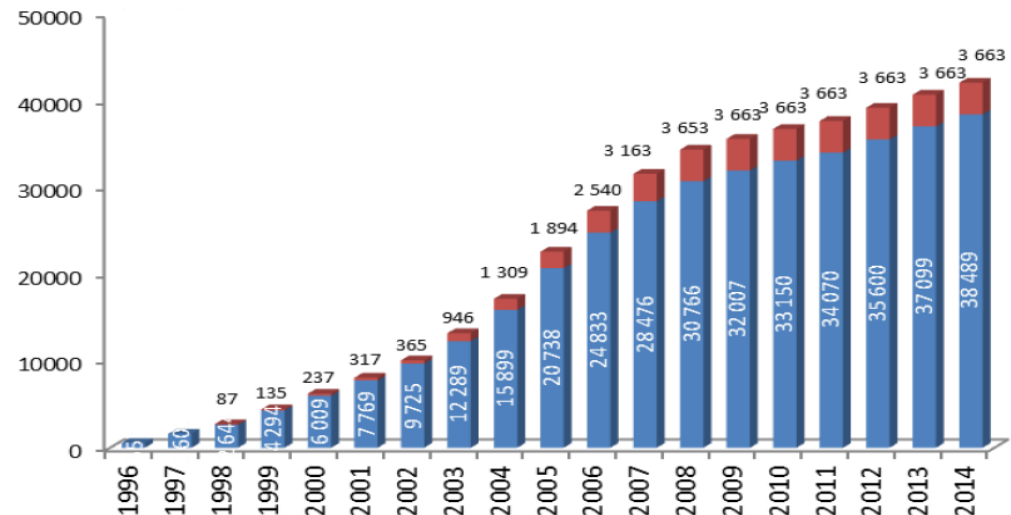


Figure 13: Connection of villages to the grid (blue) or to decentralized PV installations and mini grids (ONEE, 2016, p. 8).

Moreover, it is noteworthy that of the 40,000 villages that have been provided access to electricity through PERG, around 3,600 villages profited from decentralized PV installations and mini grids - especially in remote areas. The increasing electrification rates have also led to a constant growth of annual per capita electricity consumption (5% annual growth) (see fig. 13). Yet with 885 kWh/year the annual consumption is still around 10 times smaller than in OECD countries (8,300 kWh) (ONEE, 2016, p. 7).

2.3 The future energy and electricity system of Morocco

Morocco's energy plans to move beyond its high dependence on foreign energy imports stand at a critical crossroads: efforts in valorising its abundant solar and wind resources coincide with high interests to unlock its domestic unconventional fossil potential through the extraction of oil shales as well as plans to move towards nuclear power.

With regard to RE sources, Morocco has huge potential and favourable conditions – especially for wind and solar energy (IISD, 2014, p. 9). Due to its long coastline with high wind speeds (up to 11 m/s), the total wind power potential is estimated to be about 25 GW or 7,936 TWh/year. The country's annual sunshine duration varies between 2,700 h in the North and up to 3,500 h in the South with intensive average solar radiation of more than 5 kWh/m² (Kousksou et al., 2015, p. 52) (see fig. 14).

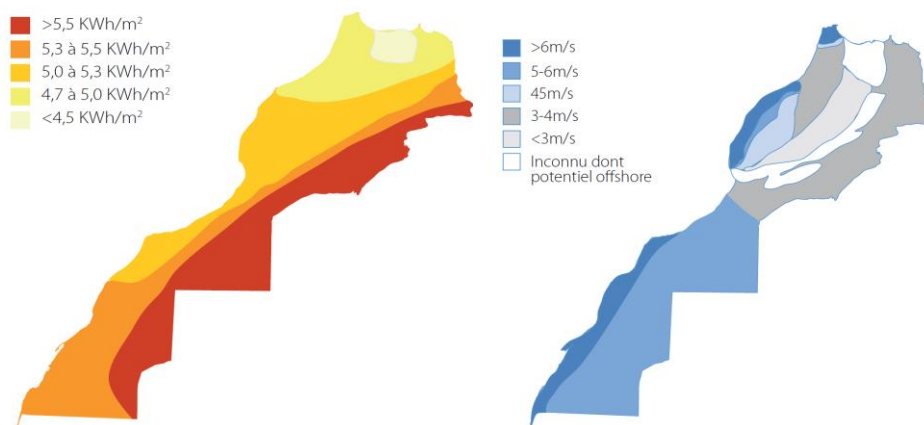


Figure 14: Morocco's solar and wind potential (MEMEE, 2012, p. 44-45).

Given these favourable conditions, even with conservative assumptions, the potential of *Concentrating Solar Power (CSP)* generation alone sums-up to 20,000 TWh/year (DLR, 2005, p. 56; Trieb et al., 2012, p. 349). Concerning hydropower, Morocco has also some potential estimated to be about 5 TWh/year. Moreover, bioenergy has great potential in Morocco because of the huge generation of agricultural, animal, and municipal waste. Total solid bioenergy potential is about 12.6 TWh/year and biogas as well as biofuel potential about 13 TWh/year (Kousksou et al., 2015, p. 53).

In spite of its great RE potential Morocco is currently turning its attention to domestic unconventional fossil fuel deposits and progressively exploring the extraction of oil shale both on- and offshore. In fact, Morocco is considered to possess significant reserves and resources of oil shale that would outstrip other members of the *Gulf Cooperation Council (GCC)*, if counted by the IEA as oil. Assessments provided by the *National Office of Hydrocarbons and Mines (ONHYM)* in Morocco estimate the country's oil shale resources to be more than 50 billion barrels, a level which ranks the country also amongst the world leaders in re-

spect of in-place oil shale (ONHYM, 2010; WEC, 2010, p. 101 and 116). As a consequence of this potential, the kingdom has not only started drilling for oil and gas in its territory but also began implementing new legal frameworks to attract developers and build corresponding infrastructures, such as terminals, pipelines and power plants. Exploration contracts with major companies, such as Shell, BP, Chevron, Total and Petrobras have been signed and an increasing number of other international corporations are now eyeing the unconventional potential in Morocco (WEC, 2010, p. 116).

Furthermore, the kingdom is making constant progress in its nuclear infrastructure development. Building on its experience with an already existing 2 MW research reactor, the *GoM* has not only established a network of institutions to examine the feasibility of nuclear power and build up human capital for its operation, but also announced its plans to build a 1,300 MW nuclear power plant near Sidi Boulbra. While However, Morocco has yet to issue a tender for constructing this plant.

Projections about the future energy needs of Morocco are scarce. However, several sources rely on estimations given by *Morocco's Ministry of Energy, Mines, Water and the Environment (MEMEE)*. According to MEMEE, future primary energy demand could reach 26 Mtoe in 2020 and 43 Mtoe in 2030 (with a range between 36.6 and 54.5 Mtoe). This means that primary energy demand would more than triple in the next 15 years (Ouattassi, 2012; Barkouch, 2014).

The electricity sector in Morocco is experiencing a phase of rapid changes and will probably witness important transformations in the near future. Different projections have been made with regard to Morocco's future electricity consumption. Based on linear exploration of historical data, e.g., the current electricity demand growth rate, future electricity consumption would be about 40 TWh/y by 2020 and 80 TWh/y by 2050 (for comparison: electricity consumption in 2014 was about 34 TWh/y) (MEMEE, 2014b, p. 5; ONEE; 2016, p. 4; Trieb et al., 2015, p. 98).

Yet, according to MEMEE, national consumption would be even higher: 49 TWh/y by 2020 and 65 TWh/y by 2025, which means that the electricity consumption of Morocco would almost double in the next 10 years (MEMEE, 2014b, p. 5). However, a model developed by Trieb et al. (2015) even predicts higher consumption: 50 TWh/y by 2020 and up to 170 TWh/y by 2050 (Trieb et al., 2015, p. 98) (see fig. 15).

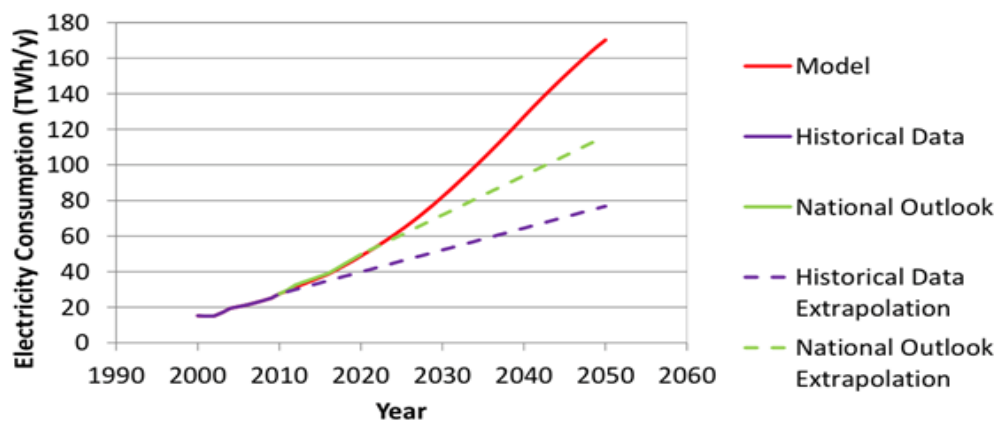


Figure 15: Electricity consumption forecasts (Trieb et al., 2015).

If this prediction holds true, it means that Morocco's electricity consumption would increase more than five times in the next 35 years, while per capita electricity consumption would still be comparably low to other North African countries (4.1 MWh/cap/y in 2050).

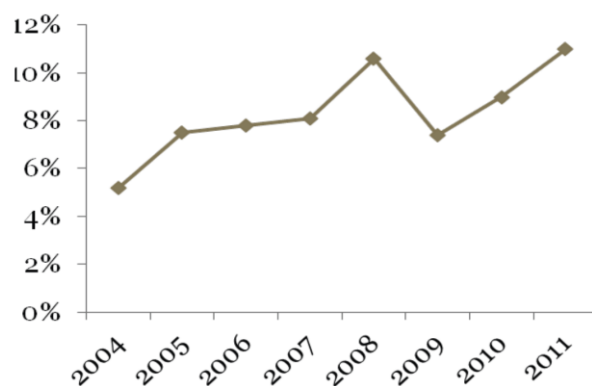
2.4 Energy challenges

Apart from enforcing an enabling investment and institutional environment the energy/electricity system in Morocco is characterized by four additional challenges.

- \ *Increasing CO₂ emissions:* Despite the country's efforts to base its electricity system on high shares of RE, its national energy consumption is still highly dominated by fossil energy carriers. As a consequence total CO₂ emissions are anticipated to closely follow the rising energy demands and increase substantially in the mid-long term. Both, per capita and total emissions are expected to more than double by 2040 and reach 6.35 tons CO₂-Eq/capita and 260,000 Gg respectively under Business-as-usual (BAU) (MEMEE, 2016a, p. 98).
- \ *Electricity system stability:* Morocco is in urgent need of new electricity infrastructure. With the electricity consumption projected to increase substantially in the next decades (see chapter 2.3), meeting this growing demand will require substantial investments in additional power generation capacity, transmission and distribution infrastructure as well as storage. In agreement with the projections developed by Trieb et al. (2015), installed capacity would have to reach between 14.4 and 15 GW by 2020 (see also Chapter 3 for more details) and 93 GW by 2050 in order to fulfil the respective demands of 40-50 TWh/y by 2020 and 170 TWh/y by 2050 (MEMEE, 2014b, p. 5; MEMEE, 2014b, p. 6; MEMEE, 2015c, p. 14; MEMEE, 2015d, p. 3; Trieb et al., 2015, p. 98). Moreover, the integration of large amounts of intermittent RE capacities (utility PV and onshore wind) with different load types will create challenges for maintaining grid stability, power balancing and reliability of supply. While these challenges can be minimal at low penetration lev-

els, they will increase significantly the more fluctuant REs are connected to the grid. As a result of this dual challenge - the need for new electricity capacities and the integration of intermittent RE - Morocco, will have to develop different measures for improving the flexibility of the power system and balance the increasing electricity demands with secure and stable supplies in the future, e.g. through additional interconnections as planned with Portugal (1,000 MW), Spain (700 MW) or Mauritania (MEMEE, 2015a, p. 4).

- \ *Electricity prices and subsidies:* Electricity prices in Morocco are not uniform. They are differentiated by voltage and consumer category. For households, the more electricity consumed, the higher the rate, not taking into account the socio-economic situation of the household. There is also a prepaid system available exclusively for the rural population where the rate is between MAD 1.07/kWh and MAD 1.391/kWh (IEA, 2014, p. 55). For the industry, rates are in general lower and differentiated into four categories: off-peak, regular, peak hours, and super-peak hours to encourage large consumers to reduce their electricity use during peak hours. However, while subsidies for gasoline, diesel and kerosene were almost eliminated since 2007 (IISD, 2014, p. 9), electricity prices in Morocco do not represent the real costs as they are below average costs of production and transmission. This “hidden subsidy” for the final consumer is estimated to be at around MAD 0.30/kWh and creates a significant financial burden on the national budget - which was estimated at 5.1% of GDP in 2011 (Bridle et al., 2014). Yet, efforts to bring the electricity price closer to the cost of production will also continue (IEA, 2014, p. 55).
- \ *Energy import dependence:* Unlike some of its neighbours in the region, Morocco is highly dependent on imported hydrocarbon energy. With very limited domestic energy sources over 96% of its net energy supplies comes from abroad: oil largely from Saudi Arabia, gas almost exclusively from Algeria, and coal from Russia and South Africa (IEA, 2014; Amegroud, 2015, p. 3). These energy imports negatively affect Morocco's trade balance and have created an annual fiscal burden of MAD 90-100 billion or 11.50 % of GDP in



2012 (IEA, 2014, p. 23; IEA, 2015b; IMF, 2014, p. 18) (see fig. 16). Moreover the high dependence on foreign energy makes Morocco's economy and political stability vulnerable to global price fluctuations.

Figure 16: Change in energy bill as in % of GDP (MoE, 2013, p. 4).

3. THE POLICY BACKGROUND: GREEN GROWTH, ENERGY POLICY AND PARTICIPATORY GOVERNANCE

3.1 From sustainable development to green growth

Sustainable development has been a national objective of Morocco's policy framework since the *United Nations Conference on Environment and Development (UNCED)* in 1992. While the kingdom's approach to sustainable development was mainly related to environmental protection at the beginning, the rise and resilience of the Moroccan economy, especially during the difficult international context of the world economic crisis as well as the Arab Spring, can be explained - to a large degree - by structural reforms towards a more integrated vision of sustainable development that started after the millennium. As a consecutive step of this integrated vision, King Mohammed VI explicitly set *Green Growth* as the country's new strategic development priority, stating that there is a "[...] need to foster the sustainable development process, in which the ecological question is central [...] at the base of green growth" in his 2010 *Throne Speech* (UNEP, 2012, p. 1).

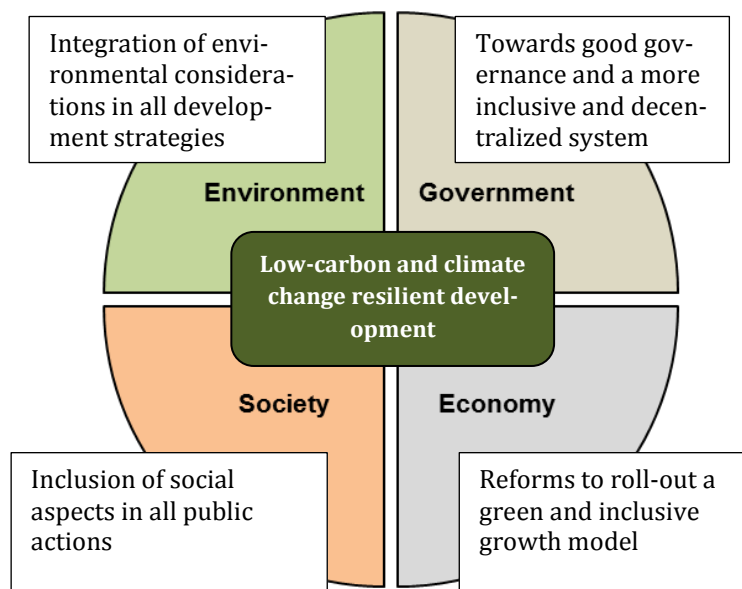


Figure 17: Morocco's vision towards sustainable development (Authors' illustration based on MEMEE, 2014a, p. 18).

In this context Morocco's overall vision towards sustainable development is defined as "reaching a low-carbon and climate change resilient development" (MEMEE, 2014a, p. 18) that encompasses all sustainability dimensions (see fig. 17). The operationalization of this vision follows a hierarchical structure.

At the top stands the newly-adopted *National Constitution* of 2011 (Constitute Project, 2012), wherein

- \ Article 31 explicitly recognizes the right to have access "to a healthy environment and sustainable development", and
- \ Article 35 compels the state to work towards ensuring "lasting human development [...] and the preservation of the national natural resources and of the rights of the future generations".

The next level is marked by the *National Charter for Environment and Sustainable Development* (CNEDD, 2009) and its corresponding *Framework Law 99-12* (2014) which explicitly consider all sectors and address all responsible authorities in order to mainstream sustainable development in Morocco. Building on these two documents the implementation level follows. The first level of implementation is characterized by rather comprehensive, national strategies and initiatives that aim at achieving poverty-reducing sustainable development, whilst taking steps to preserve the environment:

- \ *The National Strategy for Improvement of the Environment* (MANE, 2010)
- \ *The National Strategy for Environmental Protection* (SNPE, 2010))
- \ *The National Strategy for Sustainable Development* (NSSD, 2010)
- \ *The National Initiative for Human Development* (INDH, 2005 and 2011)

The second level of implementation is characterized by several rather specific, sector-based strategies, plans and programmes to which Morocco has committed major public investments in order to address and overcome the multiple development challenges outlined in Chapter 1 (hereafter in chronological order):

- \ *The National Action Plan for the Fight Against Desertification* (PAN-LCD, 2001), which aims to protect the soil against erosion and degradation from desertification;
- \ *The Azur Plan* (2001), which aims to establish modern seaside resorts along the Moroccan coast of the Mediterranean Sea and the Atlantic.
- \ *The National Program for the Protection of Air Quality* (2005) with different laws to reduce and manage the concentration of gaseous emissions;
- \ *The National Liquid Sanitation and Wastewater Treatment Program* (NSP, 2005), which aims at the improvement of wastewater treatment and the country-wide connection to sanitation facilities;

- \ The *Green Morocco Plan for Agriculture (Plan Maroc Vert, PMV, 2008)*, which aims to modernize the national agricultural sector in order to increase its competitiveness;
- \ The *Halieutis Strategy for the Fishing Sector (2009)*, which aims to develop new dynamics for fisheries;
- \ The *National Industrial Emergence Pact (PNEI, 2009)* and the *New Industrial Strategy (2014)*, which aim to build a modern, productive and competitive industry in high-added value sectors;
- \ The *National Water Strategy (SNE, 2009/10)* and the *National Water Plan (PNE, 2014)*, which aim to preserve domestic water resources from pollution, overuse and climate change;
- \ The *National Plan Against Global Warming (PNRC, 2009)* and Morocco's *Intended Nationally Determined Contribution (INDC, 2015)*, which aim to increase efforts in climate change mitigation and adaptation (see also the box below);
- \ The *National Plan Against Global Warming (PNRC, 2009)* and Morocco's *Intended Nationally Determined Contribution (INDC, 2015)*, which aim to increase efforts in climate change mitigation and adaptation (see also the box below);
- \ The *National Energy Strategy (NES, 2009/2015)* - including the *Moroccan Solar Plan (Noor, 2009)* and the *Moroccan Integrated Wind Energy Program (2010)* - which aims to strengthen the security of supply, energy availability and its widespread accessibility at reasonable costs (see also Chapter 3.2);
- \ The *National Master Plan for Solid and Hazardous Waste (PDNDD, 2010/2012)* and the *National Program for Solid Waste (PNDM, 2008)*, which aim to improve the mitigation, collection, treatment, and recycling of waste;

Morocco's INDC as submitted to the UNFCCC in 2015

The Moroccan INDC encompasses two economy-wide targets covering CO₂, CH₄, and N₂O: One unconditional target and another based on support provided by richer countries.

\Unconditional target: By investing around US \$10 billion into greening its economy, Morocco will cut its greenhouse gas (GHG) emissions including land use, land use change and forestry (LULUCF) unconditionally by 13% below the Business as Usual (BAU) scenario by 2030 from 2010 levels;

\Conditional target: If Morocco receives US \$35 billion by 2030 for financial, technical and capacity-building support through climate finance mechanisms, the country would increase its target to 32% below BAU by 2030 from 2010 (Schinke, 2015; MEMEE, 2015a, p. 1);

For a comprehensive list of suggested mitigation actions see MEMEE, 2016a, p. 100-104.

- \ The *National Innovation Initiative (MII, 2013)*, which aims to foster a technology-producing economy through skill development, innovation and R&D;
- \ The *Industrial Acceleration Plan (PAI, 2014)*, which aims to increase the share of industry in the national GDP to 23% until 2020 by fostering industry linkages and creating jobs especially for young people;
- \ The *National Green Investment Plan (GIP, 2015)*, which aims to promote green investment and encourage companies to initiate sustainable projects;

By implementing these strategies, programmes and plans, Morocco aims - on the one hand - at pursuing its economic diversification, which consists both in consolidating its traditional sectors and building up a high value-added industrial fabric in export orientated sectors. On the other hand, the kingdom aims at mainstreaming environmental considerations into all existing economic sectors and creating new industrial prospects, employment opportunities and competencies to support the transition to a low-carbon economy. According to a study by MEMEE in 2012, the different national strategies and sectoral programmes implemented since 2005 could create more than 120,000 green jobs by 2020 (MEMEE, 2012, p. 42).

3.2 Morocco's National Energy Strategy

Morocco adopted its *National Energy Strategy (NES)* with corresponding targets for 2020 in 2009 and renewed it prior to the 21st climate negotiations in Paris end of 2015 with targets until 2030 (MEMEE, 2015a; MEMEE, 2015d, p. 3). Facing the three principal challenges of modern energy policy - security of supply, affordability and sustainability - the *NES* is centered on four main goals (OBG, 2013, p. 141; MEMEE, 2012, p. 44; IEA, 2014, p. 22):

1. Securing energy supply, especially by reducing the dependence on imported energy carriers through the development of domestic RE sources (from 96% in 2015 to 82% by 2030 (MEMEE, 2016b)), regional integration into Euro-Mediterranean and African markets, and the intensified exploitation of domestic oil and gas deposits (La nouvelle Tribune, 2016);
2. Curbing energy demand, especially by improving energy efficiency;
3. Generalizing energy access to all segments of the population at affordable and competitive prices;
4. Preserving the environment;

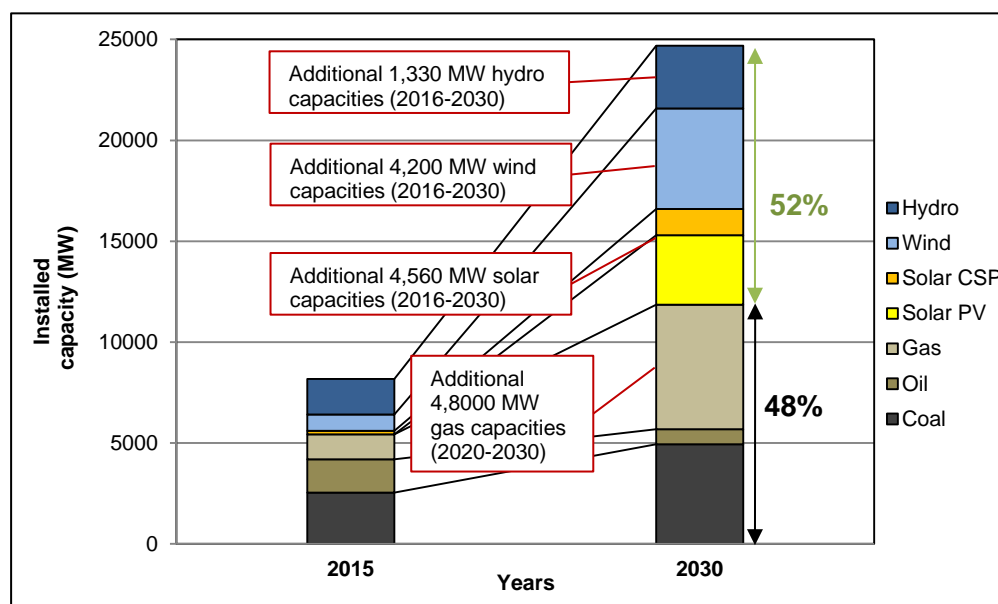
Based on these goals the *NES* and the related *National Priority Action Plan (PNAP, 2009/2015)* set the following targets:

- \ Electricity supply: Increase the total installed capacity of RE in the electricity sector to 42% by 2020 (which equals 30% RE in total electricity production)

and to 52% by 2030 (up from 34% in 2015) (MEMEE, 2015a, p. 1; MEMEE, 2015d, p. 3) (see fig. 18);

- \ Energy demand: Meet 10-12% of the country's primary energy demand by 2020 and 15-20% by 2030 with RE sources;
- \ Energy efficiency: Achieve 12% energy saving by 2020 and 15% by 2030 as well as to reduce GHG in the transport sector by 35%;

The targets of reaching 42% installed RE capacity by 2020 and 52% by 2030 respectively have been complemented by concrete numbers for envisioned power capacities (in MW). However, while the RE target for 2020 was accompanied by respective numbers of total MW to be achieved at the end of the target period, the RE target for 2030 only refers to MW numbers that will be added to the existing capacities of end of 2015 (see fig. 18).¹



	Years	Coal	Oil	Gas	Solar PV	Solar CSP	Wind	Hydro	Total capacity	Total RE capacity
Installed capacity (MW)	2015	2,545	1,652	1,230	0	180	797	1,770	8,174	2,747
	2030	4,937	741	6,172	3,440	1,300	4,997	3,100	24,687	12,837

Figure 18: Total and assumed installed capacity in Morocco for 2015 and 2030 (Authors' estimates¹, based on ONEE, 2015 (plus 180 MW CSP capacities); MEMEE, 2015a; MEMEE, 2015c; MEMEE, 2015d, p. 3; MEMEE, 2016c, p. 9).

¹ As the NES did not provide specific numbers on the amount of the total installed capacities anticipated to be reached by 2030, but instead referred to relative numbers - namely the envisioned additional capacities to be reached over the period 2016-2030 - the authors have recalculated the official RE targets for 2030 published in the NES in order to get estimates for the envisioned total installed capacities of all technologies by 2030. However, these estimates need to be interpreted with caution because a) the numbers of installed capacities in 2015 differ between ONEE and MEMEE, and b) a recalculation of the envisioned future percentage share for the technologies (as provided by MEMEE for 2030) into MW installed capacities entails significant uncertainties.

Based on the information provided by *ONEE* and *MEMEE* for the renewed *NES* the total power capacities required to address the country's increasing electricity demand (see also Chapter 2.2 and 2.4) are estimated to increase from Based on the information provided by *ONEE* and *MEMEE* for the renewed *NES* the total power capacities required to address the country's increasing electricity demand (see also Chapter 2.2 and 2.4) are estimated to increase from 8174 MW² end of 2015 to reach 15,000 MW by 2020, 20,000 MW by 2025, and eventually around 25,000 MW in 2030 (see table of fig. 18). The shares of the different technologies are envisioned to change accordingly: with gas (25%), coal (20%), wind (20%) and solar (20%) projected to contribute the largest to the country's power capacities, followed by hydro-electric (12%) and oil (3%) (see fig. 18 and 19) (MEMEE, 2014b, p. 6; MEMEE, 2015c, p. 14; MEMEE, 2015d, p. 3).

These sums translate into the following numbers and different shares for the respective power technologies (see fig. 19 and also Annex II for more details):

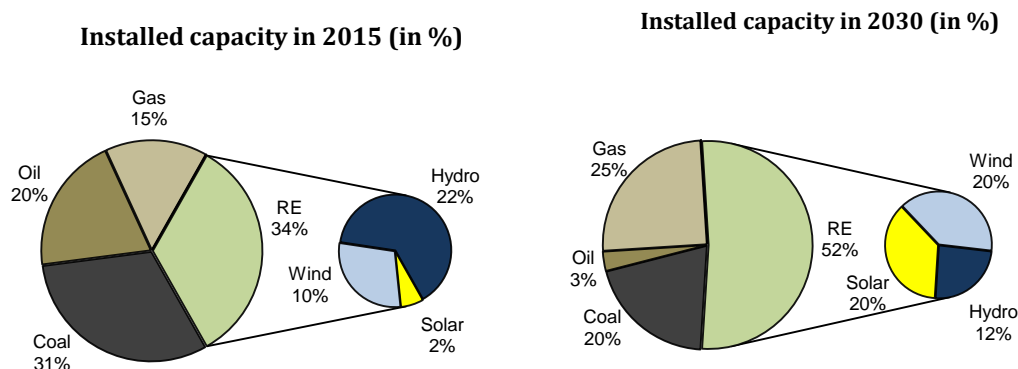


Figure 19: Shares of installed capacity in Morocco for the years 2015 and 2030 (Authors' calculations, based on *ONEE*, 2015 (for 2014); *MEMEE*, 2015a; *MEMEE*, 2015c; *MEMEE*, 2015d, p. 3; *ONEE*, 2016, p. 20; *Maroc.ma*, 2016).

\ Renewable energy: A major plank in Morocco's *NES* is the progressive rollout of RE technologies through the *Moroccan Integrated Wind Program*, the *Moroccan Solar Plan* as well as a continuation of the country's hydro-electric plans started under King Hassan II in the 1970s. Altogether Morocco aims to substantially increase its installed utility-scale solar, wind and hydropower capacities from the existing 2,747 MW end of 2015 to reach 6,000 MW by 2020 (*MEMEE*, 2016a, p. 114) and roughly 13,000 MW or 52 % of all installed capacities by 2030 (additional 10,100 MW from 2016 to 2030) (*MEMEE*, 2015a, p. 1; *MEMEE*, 2015d, p. 3) (for more details see also Chapter

² Note that this number is based on the latest official data provided by *ONEE* for end of 2014 but includes 180 MW CSP capacities of Ait Beni Methar and Noor I in Ouarzazate. (<http://www.one.org.ma/FR/pages/interne.asp?esp=2&id1=4&id2=53&t2=1>). Yet, the number differs from the power plant inventory of all known power plants currently being in operation in Morocco provided in Annex II. The difference can be explained by the fact that *ONEE* data encompasses multiple small scale projects below an installed capacity of 10 MW, whereas the power plant inventory only considers capacities above 10 MW. Both numbers, however, do not include the capacities of independent producers.

3.2.1). The costs for achieving this are estimated at US \$32 billion (MEMEE, 2015a, p. 1).

- \ Coal: 1,706 MW new supercritical coal-fired power capacities fuelled by imported hard-coal are planned to be added to the existing 2,545 MW (1,386 MW in Safi and 320 MW in Jerada,) totalling in around 4,251 MW by 2020 (MEMEE, 2016c). According to *MEMEE* the share of coal in the 2030 electricity mix will be 20%. Thus, additional coal capacities of around 800 MW (possibly in Nador) would become operable beyond 2020 eventually totalling in around 5,000 MW (Authors' estimates based on MEMEE, 2015d, p. 3; ONEE, 2016, p. 20).
- \ Natural gas: According to the *National Liquefied Natural Gas (LNG, 2014) Plan* of 2014 around 3,900 MW of new gas fired combined cycle power capacities (CCGT) - mostly based on (LNG) imports (2,400 MW) - will be added to the existing 1,230 MW by 2025. Between 2020 and 2030 4,800 MW additional gas capacities are estimated to become operational reaching around 6,100 MW³ in total or 25% of all installed capacities by 2030 (Authors' estimates based on MEMEE, 2014b, p. 7; MEMEE, 2015d, p. 3 and 5; ONEE, 2016, p. 20).
- \ Oil: 72 MW of new oil-fired capacities are planned to be connected to the grid and added to the existing 1,652 MW⁴ (in Tiznit or Laayoune) by 2020. Additional 16.5 MW are planned for Dakhla. Yet, the GoM aims to transform oil-fired power plants into gas plants in order to decrease its installed amount of oil capacities significantly to around 740 MW in order to eventually reach 3% of all installed capacities by 2030 (Authors' estimates based on IEA, 2014, p. 60; MEMEE, 2015d, p. 3; ONEE, 2016, p. 20).
- \ Nuclear: Although still undecided, 1,300 MW of installed nuclear capacities could become reality beyond 2030.

Figure 24 in the Annex illustrates the geographic distribution of Morocco's power plant inventory as it is either already in operation, under construction or planned to be developed in the near future.

3.2.1 Morocco's Solar Plan and Wind Program

While hydro-electric power capacity has been a crucial element of the kingdom's energy system for many decades and is expected to increase from 1,770 MW end of 2015 (ONEE, 2015) to 2,000 MW by 2020 and up to 3,100 MW (additional 1,330 MW from 2016-2030) by 2030 (MEMEE, 2015d, p. 3), two ambitious programmes were developed to boost Morocco's solar and wind development (IEA, 2014, p. 24 and 68).

³ The 300 MW OCGT plant in Mohammedia will be transformed into 450 MW CCGT.

⁴ The 300 MW oil-fired power plant in Kenitra will be transformed into 450 MW CCGT.

- \ The *Moroccan Solar Plan (Noor)* aiming to increase the installed solar power capacity (PV and CSP) of 180 MW end of 2015 to 2,000 MW by 2020 and to around 4,800 MW (authors' estimate) or 20% of all installed capacities by 2030 (additional 4,560 MW from 2016 to 2030) (MEMEE, 2015a, p. 2; MEMEE, 2015d, p. 3; ONEE, 2016, p. 20). In light of this plan, multiple large- and medium-scale solar projects will be installed at different sites until 2020 (see Annex):
- Two mixed CSP/PV solar complexes in Ouarzazate (510 MW CSP and 70 MW PV), and Midelt (ca. 320 MW CSP and ca. 80 MW PV) contributing around 980 MW (potentially one more in Tata with 320 MW CSP and 80 MW PV) ;
 - Two PV projects in Boujdour (80 MW PV) and Laayoune (20 MW PV) contributing around 100 MW;
 - Three regional PV complexes - with singular projects in the range of 10-30 MW - in the central provinces (100 MW PV Noor Tafilalt, 200 MW PV Noor Atlas and 100 MW Noor Argana) contributing the remaining 400 MW by 2020;
 - Private PV projects with a planned installed capacity of 470 MW (ONEE; 2016, p. 16);

Based on these project plans, solar CSP capacities are envisioned to increase from 180 MW in 2015 to around 1,300 MW by 2030 (authors' estimates), while solar PV capacities will increase from zero today to 3,440 MW until 2030 (MEMEE; 2015a, p. 4; MEMEE, 2015d, p. 5; ONEE; 2016, p. 16).

- \ The *Moroccan Integrated Wind Program* aiming to increase the country's installed wind power capacity of 797 MW in 2015 to 2,000 MW by 2020 and up to 5,000 MW (authors' estimate) or 20% of all installed capacities by 2030 (additional 4,200 MW from 2016 to 2030) (MEMEE, 2015d, p. 3). The next projects to be commissioned to reach the 2000 MW target by 2020 entail tenders for five project regions (for more details see Annex II) (ONEE, 2016, p. 14):
- 220 MW in the region of Akhfenir;
 - 500 MW in the regions of Tiskrad/Tanger and Koudia;
 - 200 MW in the region of Jbel Lahdid/Essaouira;
 - 100 MW in the region of Boujdour;
 - 300 MW in the regions of Taza and Midelt;

However, Morocco has not simply prioritized its renewable ambition out of concern for the climate or for energy security reasons, but rather as a "green stimulus" to achieve multiple development objectives. Embedded within national development plans, such as the National Green Investment Plan, the PNEI and



Figure 20: The MASEN approach of integrated solar projects (MASEN, Personal Interview, 2014).

the PAI, the production of green electrons is envisioned to yield long-lasting dividends in terms of economic growth, job creation and skill development, through integrated solar and wind development projects along the RE value chain (see for example fig. 20).

3.2.2 Regulatory framework regarding the electricity sector

Morocco does not have a single law that describes the different functions, bodies, or the market structure within the country in regard to electricity. Over the past two decades, many different decrees and laws have been issued that shape the current structure of Morocco's electricity sector (EBRB, 2013, p. 13; see fig. 22). In general, increasing steps towards liberalisation of electricity and towards the use and support of RE within Morocco's legal framework can be recognized. Legislation has been in place since 1994 to allow for the national power monopoly (*Office National de l'Electricité, ONE*) to enter into *Power Purchase Agreements (PPAs)* with *Independent Power Producers (IPPs)* or privately owned power producers for capacities up to 10 MW (Amegroud, 2015, p. 7; Trieb et al, 2015, p. 103). Governed by decree law 2-94-503, the first step towards an opening of the electricity market was facilitated in order to offer electricity at internationally competitive prices (GTZ, 2009, p. 202). Law 54-05 (*Loi sur la Gestion Délégée*) promulgated in 2006 allowed private entities to manage public services (e.g., electricity, water, and urban transport), if the state or local authorities decide to grant them the right to do so (Linklaters, 2013, p. 2).

Another step towards the liberalization of the electricity sector came with law 16-08 in 2008, which increased the self-production threshold from 10 MW to 50 MW and, therefore, amends decree law 1-63-226 that granted ONE a monopoly for production above 10 MW. The law also granted access to the transmission network for RE based power production facilities and was primarily initiated in order to support wind energy (NRF, 2012; IEA, 2014, p. 67). In 2010, law 13-09 was promulgated ("renewable energy law") that sets out the legislative framework for the promotion of REs. The law removed the power ceiling for RE based facilities and further liberalised the RE sector. Any producer of electricity based on RE – private or public - has now the right to be connected to the medium, high, and very high voltage national electricity grid, while the exact conditions for the connection to the medium grid stated in law 13-09 are rather unclear (WFC, 2015). The law sets out also a power generation scheme based on the capacity of the RE power plant (see fig. 21). However, the law also determines that the supply of

electricity has to be undertaken through the national grid with the exception of electricity generated for export or due to formal agreements with ONE (NRF, 2012; Links-later, 2013; IEA, 2014, p. 74; Amegroud, 2015, p. 8). In the same year, law 16-09 and 57-09 provided the legal basis for different governing bodies in charge of implementing these regulatory reforms in the field of RE technologies (see Chapter 3.2.3).

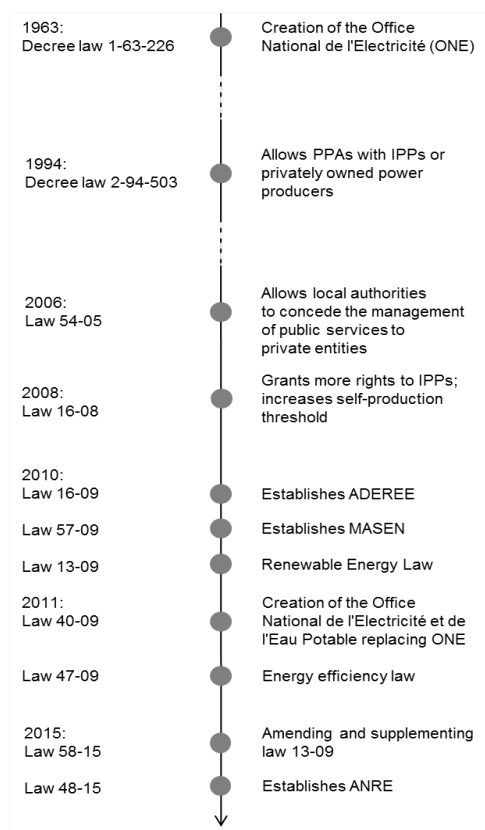


Figure 21: Important electricity regulations in Morocco (own depiction).

In 2015, law 13-09 was amended by law 58-15. This new law introduces a net metering scheme for solar and wind power plants connected to the high/very high-voltage grid, and later, also for the middle and low-voltage level as well, allowing RE producers to sell surplus electricity to the grid (but no more than 20% of their annual production and only for the high/very high-voltage grid). While this amendment should be seen as a move towards greater liberalisation of the RE sector, exact terms and conditions for opening the low voltage-grid are yet to be elaborated (MEMEE, 2015b). Lastly, and also in 2015, law 48-15 aiming at the regulation of the electricity sector was introduced. The law will establish the new independent regulatory institution ANRE (Autorité Nationale de Régulation de l'Électricité) (see below) (Garcia, 2015).

3.2.3 Institutional framework in the electricity sector

In the electricity sector of Morocco, the most important actors are the following:

MEMEE - *The Ministry of Mines, Energy, Water and Environment*: The Ministry and its three departments (the Mining Development department, the Fuels and Energy department, and the Electricity and Renewable Energies department) is in charge of designing and implementing government policies with regard to energy, mines, and geology, and oversees companies and public institutions under its jurisdiction (IEA, 2014, p. 72; Reegle, 2015). The primary tasks of the Ministry: managing and developing energy and mining assets, developing access to energy and organising the operations of the energy markets, diversifying energy resources, developing RE, improving energy efficiency, and ensuring the security of energy supply. The Ministry is responsible for Morocco's New Energy Strategy and for its facilitation, preparation and follow-up. MEMEE's Electricity and Re-

newable Energies department is responsible for electricity sector policies in consultation with the Ministry of Interior that oversees the performance of public enterprises responsible for the distribution of water and electricity in urban areas (Amegroud, 2015, p. 6). However, the department consults with other important agencies in the sector, such as ONEE, MASEN, and ADEREE (EBRD, 2013, p. 13). MEMEE also has the oversight of ONEE, and, as there is currently no such entity in place, it also has the role of an energy regulator. However, parts of energy and electricity related responsibilities are also overseen by other ministries: for example, the energy efficiency policy is developed in co-ordination with the Ministry of Economics and Finance, the Ministry of General Affairs, and the Ministry of Interior, while energy efficiency programmes are chaired by MEMEE and the other ministries. Electricity and fuel prices are regulated by the Minister for General Affairs and Governance, the Minister of the Economy, and the Minister of Energy (IEA, 2014). A number of different institutions (state-owned companies, agencies, and research institutes) were set-up in the past to support MEMEE in its work:

ONEE - The National Agency for Electricity and Water (Office National de l'Electricité et de l'Eau Potable): Created in 2011 out of the merging of ONE (Office Nationale de l'Electricité, until 2011 responsible for electricity) and ONEP (Office National de l'Eau Potable, until 2011 responsible for drinking water), the state-owned operator is the sole buyer of electricity and under administrative and technical control of MEMEE. ONEE owns a large share of generation capacities, the whole transmission network, and the greatest share of the distribution network (Amegroud, 2015, p. 6; IEA, 2014, p. 44). The national agency is also responsible for all tasks related to the transmission network (construction, operation, and maintenance). It also is responsible for the planning and development of transmission network in coherence with expected demands (EBRD, 2013, p. 14). Further ONEE oversees the implementation of Morocco's Integrated Wind Program (Trieb et al., 2015, p. 104).

ADEREE - The National Agency for Renewable Energies and Energy Efficiency (Agence Nationale pour le Développement des Energies Renouvelables et de l'Efficacité Energétique): The national Agency is the successor of the Centre for the Development of Renewable Energy (CDER) and was created in 2010. ADEREE develops national, regional, and sectoral plans with regard to REs and energy efficiency. It also realizes and coordinates RE and energy efficiency programmes and projects. ADEREE gives advice to other authorities with regard to site selection for projects as well (Reegle, 2015). In order to fulfil its tasks to promote REs and energy efficiency and to benefit from European experiences, a co-operation with the French Environment and Energy Management Agency (ADEME) is currently being developed (IEA, 2014, p. 44). However, it has been mentioned that ADEREE is more invested into its RE responsibilities than into its energy efficiency related responsibilities (IEA, 2014, p. 48).

MASEN – The *Moroccan Agency for Solar Energy*: Following an instruction of King Mohammed VI in December 2015, the state-owned company was given a central role in piloting the implementation of the Moroccan RE programme - in symbiosis with ONEE. It has three main tasks (NRF, 2012): a) Developing solar and other RE power projects, b) Contributing to the development of national expertise, and c) Proposing regional and national plans on solar and other RE technologies. Therefore, MASEN conceptualizes RE power projects, such as the 580-MW solar complex near the city of Ouarzazate (NOOR₀ solar complex), promotes projects towards domestic and foreign investor, but also develops technical and economic feasibility studies (Reegle, 2015).

IRESEN - The Institute for Research into Solar and New Energies (Institut de Recherche en Energie Solaire et Energies Nouvelles): Created in 2011, IRESEN co-ordinates research and development (R&D) activities in Morocco and co-operates with international partners from France, Germany, and Spain. While the research institute works under the patronage of MEMEE, it also works together with other Ministries, such as the Ministry of Higher Education, Training, and Scientific Research and the Ministry of Industry, Trade, and New Technologies (IEA, 2014, p. 75). IRESEN's primary mission is to define research areas as well as implement, finance, and manage R&D projects. Universities and research centres, but also the industry, are at the heart of IRESEN's co-operation and co-ordination efforts (IEA, 2014, p. 75).

CNESTEN – The National Centre for Energy Sciences and Nuclear Techniques (Centre National de l'Energie des Sciences et Techniques Nucléaires): The national centre is a scientific and technological complex that was founded in 1986. Its mission is primarily dedicated to the promotion, research, and use of nuclear energy (EUROSUNMED, 2015). CNESTEN developed a research reactor with 2 MW of capacity that was commissioned in 2009.

SIE - The state-funded *Energy Investment Company (Société D'Investissement Energétique)*: SIE is a national interest company that was created in 2009 in order to finance green growth. It manages MAD 1 billion in total assets provided by the Energy Development Fund (FDE) where one-quarter is dedicated to energy efficiency and three-quarters to REs (IEA, 2014, p. 44). According to its own mission statement, the company facilitates and develops projects in the energy sector with the support of partner investors, developers, and private industry (SIE, 2015).

MorSEFF - *Morocco Sustainable Energy Financing Facility (Ligne Marocaine de Financement de l'Energie Durable)*: MORSEFF is a special EUR 80 million fund set up in 2015 by EBRD, AFD, KfW and EIB. It aims to support Morocco's private sector for RE by on-lending credits to eligible private sector sub-borrowers for sustainable energy investments. Apart from international banks also local Moroccan

banks (BMCE Bank, Maghrebail, ATW Bank, Crédit Agricole) participate in offering credits under MorSEFF.

FDE - *Energy Development Fund (Fonds de développement de l'énergie)*: The FDE was created in 2009 by his Majesty King Mohammed VI to support the NES and is endowed with US \$1 billion from grants by the Kingdom of Saudi Arabia, the United Arab Emirates, and the Hassan II Fund (IEA, 2014, p. 32).

ANRE - *National Authority for Electricity Regulation (Autorité Nationale de Régulation de l'Électricité)*: The newly established regulatory institution, which is independent from any energy operator, will define tariffs and conditions for the access to the networks and interconnections for all actors involved in the electricity market (Garcia, 2015).

3.2.4 Market structure of the electricity sector

The national utility ONEE has a dominant role in Morocco's electricity market as it operates throughout the whole value chain (generation, transmission and distribution). There exist several possibilities to generate electricity in the Moroccan market: a) electricity directly generated by ONEE, b) IPPs selling electricity directly to ONEE with individually negotiated PPAs, c) self-production, and d) IPPs selling RE based electricity to large consumers via PPAs (DII, 2014) (see fig. 22).

ONEE is the sole buyer of all electricity in Morocco and generates a significant amount of electricity (29%). Another important part of electricity is generated by IPPs (50%) whereas the *Jorf Lasfar Energy Company (JLEC)* with its 2,100 MW of coal based power plants, the *Electrical Energy Company of Tahaddart* with a 384 MW of combined cycle power plant, and the *Compagnie Écolienne du Détroit (CED)* with a 50 MW of wind power plant are the most significant ones (ONEE, 2016, p. 10). ONEE also is in charge of all electricity imports through interconnections (18%). Private industrial producers made up less than 2% of electricity generated in 2014. These producers, mostly within the mining sector, can install generation capacities based on REs not exceeding 50 MW mainly for their own use ("self-production"), while they are charged MAD 0.08 per kWh for using the grid. However, producers of RE-based electricity up to 50 MW can also sell directly to industrial users if both (producers and users) are connected to the Very high/high voltage (VHV/HV) grid, while medium and low-voltage (MV/LV) producers (mainly PV in the residential and commercial sectors) currently do not have the right to use the grid. The distribution of electricity is facilitated either directly through ONEE or in one of two other ways: a) through local authorities under the control of the Ministry of Interior in seven cities or b) through private companies in four cities (IEA, 2014, p. 54) (see fig. 22).

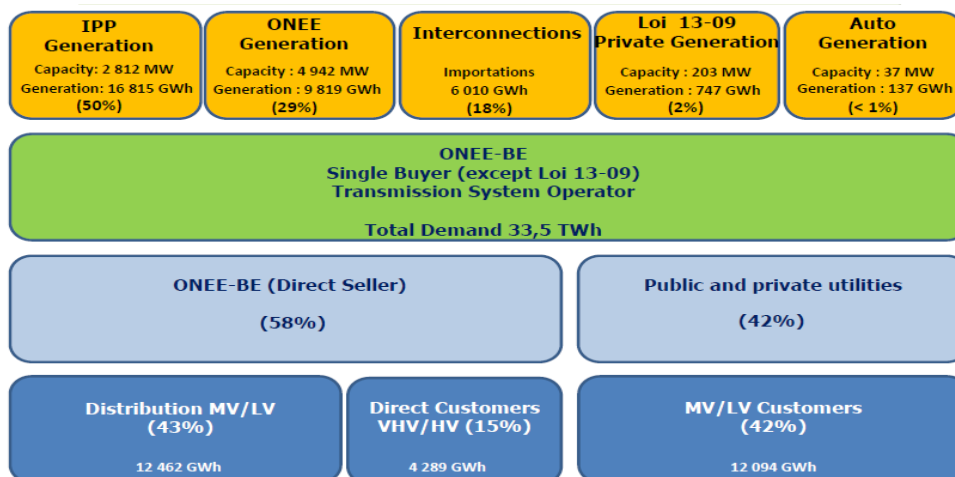


Figure 22: Market structure of the Moroccan electricity sector end of 2014 (ONEE, 2016, p. 3).

For wind and solar projects, the main tool for implementation is tendering. Private wind project developers enter a 20-year PPA with ONEE after winning the tendering process whereas also financial support from international donors is common. Private solar project developers are responsible for the implementation of the project in association with MASEN: After winning the tendering process the private project developer enters a PPA with MASEN for 25 years at a fixed tariff. In a second step, MASEN sells the electricity to ONEE, while the difference between the fixed tariff and the electricity price is covered by the FDE. Morocco designates land directly for the installation of wind and solar projects above 2 MW (“priority zones”). The land is bought by ONEE’s *Division de la Gestion du Patrimoine et des Affaires Immobilières* and granted directly to wind developers and to MASEN for solar projects (DII, 2014; Trieb et al., 2015, p. 100).

3.3 Legislative conditions for participatory governance in the electricity sector

In response to the demands of the Arab Spring in 2011, Morocco has made substantial efforts in strengthening democracy and rebalancing powers towards an inclusive development model based on a more open and decentralized system of governance. As stated in the preamble of the *National Constitution* of 2011, the kingdom is pursuing the process of consolidating and reinforcing the "principles of participation, pluralism and good governance" in its legislative framework in order to construct a state of democracy and the rule of law (Constitute Project, 2012, p. 3).

In the context of any infrastructure development at the local level and with the aim to give local communities more control over their own affairs this "participatory approach" is also reflected in Article 36 of the *Charter on Communal Development* and implemented through the *Communal Development Plan (PCD)* (MoI 2015a, p. 24; MoI, 2015b). Yet, despite King Mohammed VI has emphasized that

"citizens are the engine for and ultimate objective of all initiatives" (Ben-Meir, 2015, p. 20), balancing political power and democratic demands in light of existing socio-economic and political shortcomings remains a challenge for the GoM (Arieff, 2013, p. 5; AMDH, 2014). Nevertheless, important aspects required for ensuring procedural and distributive justice in developing utility-scale power projects in Morocco are already enshrined in different national documents and international documents that Morocco has ratified.

Right to information: According to the *National Constitution* the right to information is protected by Article 27 stating that "the citizens [feminine] and citizens [masculine] have the right of access to information under the law of Morocco". The disclosure of information by every authority that is concerned with the application and enforcement of the law, such as public administrations, public enterprises, local authorities, or every public or private enterprise entrusted with the management of a public service, is therefore a right guaranteed by the state to all citizens (Constitute Project, 2012, p. 10). Also, law No. 99-12 of the CNEDD protects the rights to adequate information related to the environment and sustainable development. Moreover, Morocco ratified the *International Covenant on Civil and Political Rights (ICCPR)* in 1979, agreeing that "everyone shall have the right to freedom of expressions, which includes freedom to seek, receive and impart information and ideas of all kinds" (Article 19). Additionally, Morocco signed the UNCED in 1992, where it is stated that "each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes" (Article 10). Lastly, Morocco ratified the *UN Convention Against Corruption* in 2007, which places a clear obligation on Member States to facilitate the right of access to information held by public bodies (Article 10).

Right to participation: Within the "framework of participative democracy" Article 12 of the *National Constitution* guarantees the right to participate in public affairs to associations of civil society and non-governmental organizations by allowing them to exercise their activities in all freedom, within respect for the law (Constitute Project, 2012, p. 7). Further, Article 136 "assures the participation of the population concerned in the management of their affairs and favors their contribution to a lasting human development" (Constitute Project, 2012, p. 35). Additionally, Article 139 of the constitution allows citizens to participate in "the enactment and the application of programs of development" (Constitute Project, 2012, p. 35). Also, law No. 99-12 of the CNEDD entitles civil society associations and individual citizens to proactively participate in planning and implementing public policies, strategies, and programmes that are related to the environment and sustainable development. Lastly, Morocco signed the UNCED in 1992, where it is stated that "environmental issues are best handled with participation of all concerned citizens at the relevant level" (Article 10).

Right to accountability: According to Article 118 of the *National Constitution* "access to justice is guaranteed to every person for the defense of their rights and of their interests protected by the law" (Constitute Project, 2012, p. 30). Further, Article 120 states that "every person has the right to an equitable process and to a judgment rendered in a reasonable time" (Constitute Project, 2012, p. 31). Also, law No. 99-12 of the CNEDD states that any person or institution is to be held accountable for any actions that may damage the environment and natural resources. At the international level and by ratifying the ICCPR Morocco is obliged to ensure the right to access fair judicial procedures and dispute resolution. Lastly, with the ratification of the UNCED in 1992, Morocco committed to guarantee "effective access to judicial and administrative proceedings, including redress and remedy" (Article 10).

4. CONCLUSIONS

Achieving sustainable development has been a national objective of Morocco's policy framework for more than two decades. Since the early 1990s the kingdom has made great progress in addressing a myriad of socio-economic, socio-political and environmental challenges at the national and local level. While its approach to sustainable development was mainly related to environmental protection at the beginning, the GoM explicitly set low-carbon and climate change resilient development as its strategic development priority after the millennium. As a result, numerous sectoral strategies, plans and programmes have been initiated over the last decade in order to achieve poverty-reducing sustainable development whilst taking steps to preserve the environment. Additionally, Morocco put in place its *NES* aiming to reach a share of 52% of installed power capacities from RE sources by 2030.

Although considered a role model for RE policy-making and despite the Moroccan context being favourable for establishing a low-carbon economy, room for improvement yet remains. Even greater leaps forward towards a low-carbon development pathway could be achieved if existing sectoral development policies were to be aligned closely with the RE policy framework towards an integrated *Low-Carbon Development Strategy* based on high shares of RE.

Figure 23 illustrates how the MCA-criteria set applied in the MENA SELECT project is reflected in Morocco's sustainable development challenges and its national policy framework.

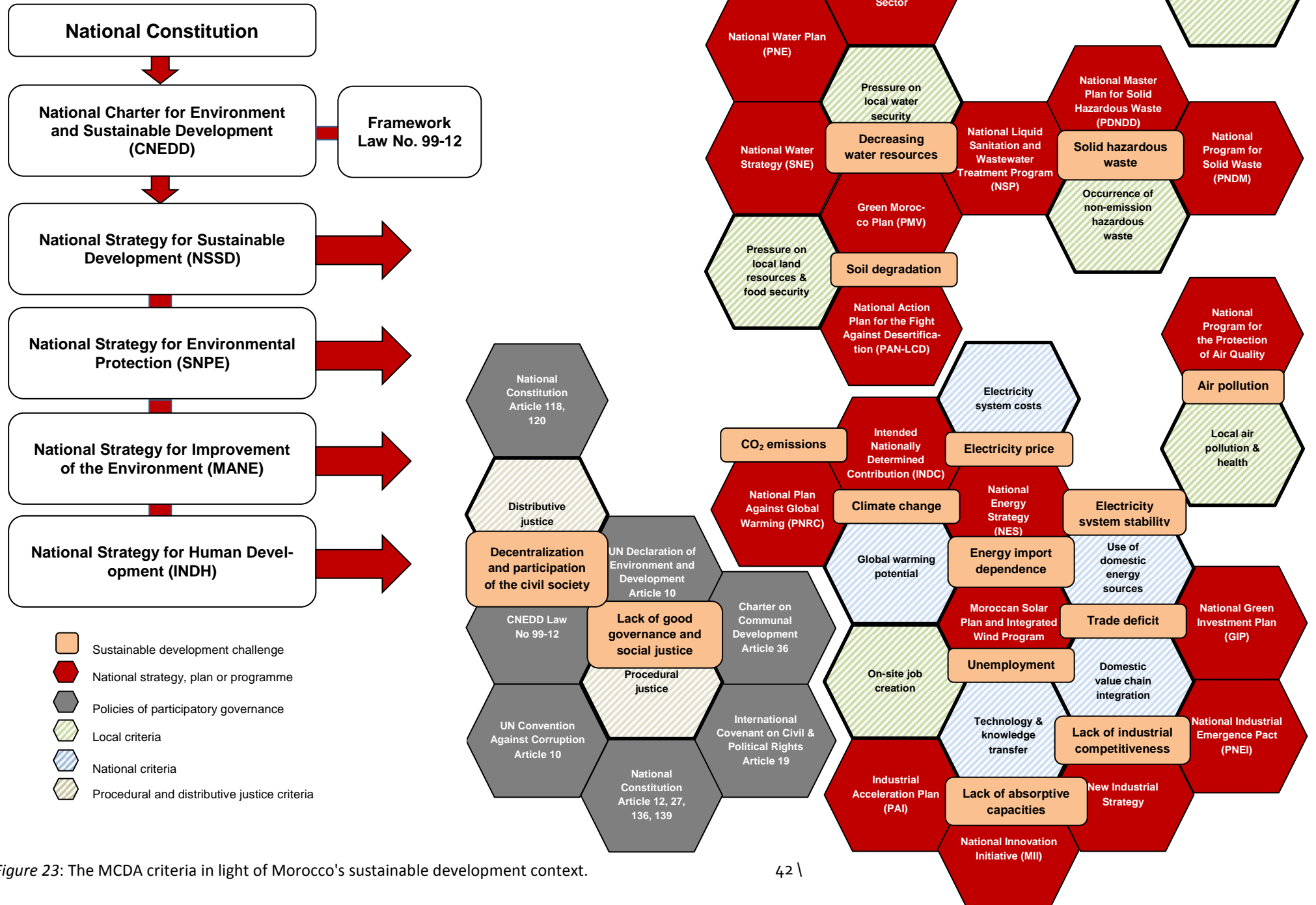


Figure 23: The MCDA criteria in light of Morocco's sustainable development context.

5. RECOMMENDATIONS

Morocco's recent progress towards low-carbon development is commendable. Nevertheless important challenges still need to be addressed in order to unlock the full development potential of a sustainable electricity system. From a development policy perspective these hurdles do not relate to equally important questions of system stability or cost efficiency, but rather to RE policy-making. Accordingly, the following recommendations are provided to shed light on different political aspects that should be improved in order to arrive at an integrated and coherent *Low-Carbon Development Strategy* based on high shares of RE.

1. **Improve institutional set-up and policy coherence:** Energy and development policies in Morocco are often designed and implemented in absence of a clear framework defining the responsibilities of involved actors and without sufficient consideration of their interrelationship. As a result of sectoral fragmentation and silo approaches at the governmental level, substantial inefficiencies are undermining national progress and hampering urgent decisions. By recognizing the multiple interlinkages between energy and development challenges, political actions can only be efficient and effective if developed in integrated and coherent ways. For bridging the existing sectoral divides and harmonizing the often non-convergent interests at the institutional and policy level two recommendations are given to the GoM:
 - i. Improve the sectoral interplay between and within relevant governmental institutions to jointly work on RE by promoting transparency and collaboration as well as minimizing institutional fragmentation (especially between institutions dealing with energy, education, industry and employment, such as e.g., *MEMEE*, *MoE*, *MoI*, *ONEE*, *MASEN* and *ADEREE*);
 - ii. Create an integrated energy and development policy framework (including a framework for private finance in RE) by removing inconsistencies, providing clarity (particularly on a) the status of the self-consumer, and b) the role of the low-voltage grid), as well as accompanying energy policies with affirmative development initiatives geared towards the country's overall development objectives;
2. **Extend efforts to achieve sustainable growth through RE policy-making:** As it can neither be assumed that positive returns will occur automatically from the deployment of RE technologies as investments pour in, Morocco will need to extend its efforts of integrating its RE ambition into an overarching green growth policy. In order to avoid a new form of import dependency that would substitute fossil fuel dependency with reliance on imports of RE technologies two recommendations are given to the GoM:

- i. Apply lessons learned from the automotive and aeronautic industries to the RE sector by coupling national industrial policies to RE policy-making for boosting the productivity of domestic industries and allowing them to become internationally competitive in international markets;
 - ii. Explicitly consider existing areas of expertise and "learning by doing" effects in project tenders by mandating project bidders and developers to promote job creation, domestic supply chains and rural uplift through ambitious, yet realistic, *Local Content Requirements (LCRs)*⁵ and mechanisms of horizontal technology transfer;
3. **Phase out fossil subsidies in the power sector:** Although Morocco has carried out an extensive set of energy subsidy reforms, which adjusts domestic prices for gasoline, diesel, and industrial fuel oil to release the increasing fiscal pressure on the state's budget national electricity prices still do not reflect actual costs. This creates major obstacles to the development of a competitive electricity market and hampers efforts to incentivize customers to be more energy efficient⁶. For unlocking the full potential of centralized and decentralized RE technologies to contribute to electricity generation two recommendations are given to the GoM:
- i. Adopt a cost-based approach to gradually replace electricity subsidies and set electricity tariffs for residual and industrial consumers that match production with sale prices in order to encourage higher penetration of RE into the grid (including medium and low voltage) as well as the take-off of energy efficiency practices amongst consumers;
 - ii. Accompany the phase out of electricity subsidies with improvements in social services, such as health, education and infrastructure, that are targeting poor households in particular;
4. **Increase absorptive capacities and R&D in RE deployment:** The objective of creating sustainable employment along the value chain of RE technologies can only be achieved if the absorptive capacities of the labour market match with industry needs. Despite Morocco having invested heavily on facilitating technological education and training, the domestic labour market is still characterized by a significant mismatch between the skill development currently offered by universities and vocational training institutions and the competencies required for high added-value jobs in RE deployment. In order

⁵ Contrary to support schemes with *LCRs*, procurement tenders that contain *LCRs* will hardly be disciplined by WTO law and are therefore regularly applied to RE tenders (see IRENA, 2015, p. 33-37).

⁶ The 20-20 tariff in Morocco, for example, awards households that reduce electricity consumption by 20% compared to the same month in the previous year with an additional 20% of the value of the saved consumption. At the end of 2011, the impact of this incentive resulted in total electricity savings of 1.77 TWh. The bonuses are granted through the Energy Development Fund (RCREEE, 2015, p. 34).

to match national curriculums to RE market requirements and build up a knowledge base that is able to absorb foreign expertise and technologies two recommendations are given to the GoM:

- i. Establish a market orientated research framework by linking vocational training and university programmes (especially in science, engineering and technical studies) with activities of the RE-industry, for example through joint education-industry clusters (R&D platforms) or partnerships (joint lectures, internships etc.);
- ii. Increase the role of universities and its researchers of transferring international knowledge to the domestic labour market by fostering exchange programmes with the international scientific community;

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ANNEX

Country facts at a glance

General information		Rankings	
Subregion	North Africa	Human Development Index (HDI)⁷	129 / 187 (2013)
Official language	Arabic, Amazigh	Gender Inequality Index (GII)⁸	92 / 152 (2013)
Currency	Moroccan Dirham (MAD 10 =(USD 1,04)	Corruption Perception Index (CPI)⁹	80 / 175 (2014)
Capital city	Rabat	Bertelsmann Transformation Index (BTI)¹⁰	96 / 129 (2014)
Form of state	Constitutional monarchy	Education For All Development Index (EDI)¹¹	94 / 120 (2010)
Demographic indicators		Education and employment	
Population (millions):¹²	34.378 (2015)	Literacy rate adults¹³	67% (2011)
Child (0-14 years)	27.2% (2015)	Literacy rate youth¹⁴	81,5% (2009-2013)
Adult (15-59 years)	63.1% (2015)	Male	89% (2009-2013)
Aged (60+ years)	9.6% (2015)	Female	74% (2009-2013)
Senior (80+)	1.1% (2015)	Net enrolment in secondary school:¹⁵	54.77% (2012)
Urban population¹⁶	60% (2014)	Male	58.81% (2012)
Expected population:¹⁷		Female	53.04% (2012)
In 2030 (millions)	39.787	Unemployment rate:¹⁸	9.2% (2013)
In 2050 (millions)	43.696	Youth unemployment:¹⁹	18.5% (2013)
Urban population in 2050²⁰	74%	Male	16.9% (2013)
Total fertility rate²¹	2.56 (2010-2015)	Female	19% (2013)

⁷ UNDP, 2015

⁸ Ibid.

⁹ Transparency international, 2014

¹⁰ BTI, 2014a

¹¹ UNESCO, 2012

¹² UN, 2015

¹³ World Bank, 2015d

¹⁴ UNICEF, 2015

¹⁵ UNESCO, 2015

¹⁶ UN, 2014

¹⁷ UN, 2015

¹⁸ World Bank, 2015f

¹⁹ World Bank, 2015g

²⁰ UN, 2014

²¹ UN, 2015

Power plant inventory Morocco (2016)

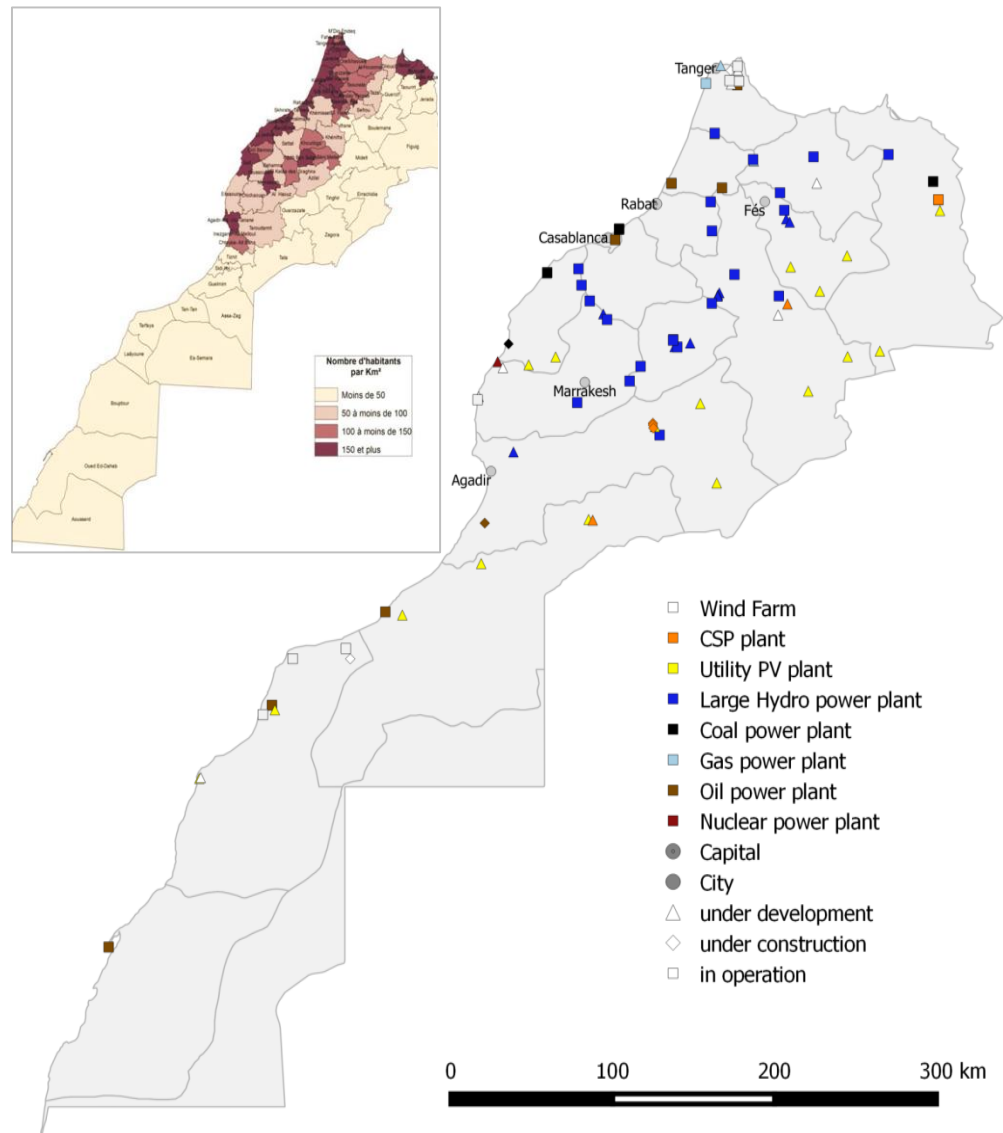


Figure 24: Power plant inventory of Morocco (operational, developed and planned) and population density (based on Annex II) (MEMEE, 2016a, p. 47).

	Power plant	Technology	Installed capacity (MW)	Location (Province)	Status
PV	Noor Argana Boumalen	Solar PV	n.d	Boumalen	Under development
	Noor Argana Errahmana	Solar PV	n.d	Errahmana	Under development
	Noor Argana Tensift	Solar PV	n.d	Marrakesh	Under development
	Noor Atlas Ain Beni Mathar	Solar PV	n.d	Ain Beni Metthar	Under development
	Noor Atlas Bouanane	Solar PV	n.d	Bouanane	Under development
	Noor Atlas Boudnib	Solar PV	n.d	Boudnib	Under development
	Noor Atlas Bouizakame	Solar PV	n.d	BouiZakrane	Under development
	Noor Atlas Enjil	Solar PV	n.d	Enjil	Under development
	Noor Atlas Outat El Haj	Solar PV	n.d	Outat El Haj	Under development
	Noor Atlas Tantan	Solar PV	n.d	Tantan	Under development
	Noor Atlas Tata	Solar PV	n.d	Tata	Under development
	Noor Tafilalet - Erfut	Solar PV	25	Errachedia	Under construction
	Noor Tafilalet - Missouri	Solar PV	25	Missour	Under construction
	Noor Tafilalet - Zagora	Solar PV	25	Zagora	Under construction
	NoorO IV	Solar PV	70	Ouarzazate	Under development
	NoorB	Solar PV	80	Boujdour	Under development
NoorL	Solar PV	20	Laayoune	Under development	
CSP	NoorO I	Solar CSP	160	Ouarzazate	Operational
	NoorO II	Solar CSP	200	Ouarzazate	Under construction
	NoorO III	Solar CSP	150	Ouarzazate	Under construction
	NoorM	Solar CSP and Solar PV	400	Midelt	Under development
	NoorT	Solar CSP and Solar PV	400	Tata	Under development
	Ain Beni Methar	Solar CSP and gas	20	Ain Beni Metthar	Operational
Wind	Akhefnir 1	Wind energy	100	Tan-Tan	Operational
	Akhefnir 2	Wind energy	100	Tan-Tan	Under construction
	Boujdour	Wind energy	100	Boujdour	Under development
	Amogdul	Wind energy	60	Essaouira	Operational
	Fouma Alouad	Wind energy	50	Laayoune	Operational
	Jbel Alhadid	Wind energy	200	Essaouira	Under development
	Khalladi	Wind energy	120	Tanger	Under construction
	Koudia Baida	Wind energy	300	Tetouan	Under development
	Lafarge	Wind energy	32	Tetouan	Operational
	Midelt	Wind energy	100	Midelt	Under development
	Tanger I	Wind energy	140	Tanger	Operational
	Tanger II	Wind energy	150	Tanger	Under development
	Ynna Bio Power	Wind energy	20	Essaouira	Operational
	Tarfaya	Wind energy	301	Tarfaya	Operational
	Taza	Wind energy	200	Taza	Under development
	Eolien Essaouira	Wind energy	50	Essaouira	Under development
	Tiskrad	Wind energy	300	Laayoune	Under development
	Haouma	Wind energy	50	Tanger	Operational
A. Torres	Wind energy	50	Tetouan	Operational	

Hydro	Afourer	Hydropower	94	Azilal	Operational
	Ahmed El Hansali	Hydropower	92	Kasbat Tadla	Operational
	Al Massira	Hydropower	128	Settat	Operational
	Allal El Fassi	Hydropower	240	Sefrou	Operational
	Al wahda	Hydropower	240	Ouezzane	Operational
	Bine el Ouidane	Hydropower	135	Beni Mellal	Operational
	Boutferda	Hydropower	12	Beni Mellal	Under development
	Tillouguite I	Hydropower	12	Azilal	Under development
	Tillouguite II	Hydropower	12	Azilal	Under development
	El Menzel	Hydropower	125	Sefrou	Under development
	Hassan I	Hydropower	67.2	Demnate	Operational
	Hassan II	Hydropower	11.7	Midelt	Operational
	Idriss I	Hydropower	40	Taounate	Operational
	Mdez El Menzel	Hydropower	170	Khmessiat	Under development
	Mohammed V	Hydropower	23	Zaio	Operational
	Ouljet Essoultane	Hydropower	19	Khemissat	Operational
	Step Abdelmoumen	Hydropower (Pumping station)	350	Taroudant	Under development
	Step Afourer	Hydropower (Pumping station)	464	Afourer	Operational
	Tanafnit-El Borj	Hydropower	40	Khenifra	Operational
	Mansour Dahbi	Hydropower	10	Ouarzazate	Operational
	Daourat	Hydropower	17	Settat	Operational
	Lalla TAKERKOUST	Hydropower	12	Marrakesh	Operational
	El Kansara	Hydropower	14	Sidi Slimane	Operational
	Imfout	Hydropower	32	El Jadida	Operational
	Moulay Youssef	Hydropower	24	Fes	Operational
	Oued El Makhazine	Hydropower	36	Kenitra	Operational
	Imezedilfane	Hydropower	63	Khenifra	Under development
	Taskdert	Hydropower	38	Khenifra	Under development
	Tajemout	Hydropower	28	Fes	Under development
	Mechra Sfa	Hydropower	30	Nador	Under development
Tarmast	Hydropower	14	Azilal	Under development	
Asfalou	Hydropower	20	Taounate	Operational	
Sidi Said Maachou	Hydropower	20.8	El Jadida	Operational	
Nuclear	Sidi Boulbra	Nuclear	900 - 1300	Dar el Mguemda	Under development
Coal	Moahamadia - coal	Coal	300	Mohammadia	Operational
	Safi	Coal	1386	Safi	Under construction
	Jerrada	Coal	318	Jerrada	165 MW Operational and an extension plan to have a total of 318 by 12/2017
	Jorf Lasfar	Coal	350	El Jadida	Operational
	Jorf Lasfar	Coal	350	El Jadida	Operational
	Jorf Lasfar	Coal	350	El Jadida	Operational
	Jorf Lasfar	Coal	350	El Jadida	Operational
	Jorf Lasfar 1	Coal	350	El Jadida	Operational
Jorf Lasfar 2	Coal	350	El Jadida	Operational	

Gas	Mohammadia	Fuel/Gas	300	Mohammadia	Operational
	Mohammadia CCGT (this project is the transformation of the existing OCGT plant -300MW- above mentioned in CCGT)	CCGT	450	Mohammadia	Under development
	Kenitra GT (this project is the transformation of the existing fuel-based thermal power plant -300MW- mentioned in CCGT)	CCGT	450	Kenitra	Under development
	Jorf Lasfar CCGT	CCGT	1200	El Jadida	Under development
	Dhar Doum	CCGT	1200	Tanger	Under development
	Oued El Makhazine CCGT	CCGT	1200	Kenitra	Under development
	Al Wahda CCGT	CCGT	1200	Ouezzane	Under development
	Tahaddart CCGT	CCGT	600	Tanger	Under development
	Tahaddart	CCGT	384	Tangier	Operational
	Ain Beni Methar	INCC	450	Ain Beni Metthar	Operational
Oil	Kenitra	Fuel	300	Kenitra	Operational
	Tiznit	Fuel	72	Tiznit	Under construction
	Dakhla (will be upgraded to 20 MW until 2016)	Fuel	16	Dakhla	Operational
	Tantan	Fuel	100	Tantan	Operational
	Laayoune	Fuel (Heavy Oil)	150	Laayoune	Operational
	Mohammadia	Fuel (Distilate Oil; heavy oil)	300	Mohammadia	Operational
	Sidi Kacem	Fuel (Distilate Oil)	16	Sidi Kacem	Operational
	Tanger	Fuel (heavy oil)	40	Tanger	Operational
	Tetouan	Fuel (heavy oil; natural gas)	105	Tetouan	Operational
Tit Mellil	Fuel (heavy oil and gasoil)	102	Casablanca	Operational	

Figure 25: Power plant inventory of Morocco as of 2015.

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