Rabat renewable energy growth

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Morocco"s energy strategy has been developed in response to climate change, specifically that caused by the activities of the energy sector. Indeed, it is based on the mobilization of Morocco"s own national resources, the rise of renewables in the energy mix, and the introduction of energy efficiency as a national priority. Its implementation will enable the establishment of a diversified energy mix and will be optimized around specific technology choices, both reliable and competitive.

This strategy, which has the major objectives of ensuring security of supply and widespread energy price-optimized access; mobilization of domestic energy resources, mainly the significant potential for renewable energy (RE) in the country; the promotion of energy efficiency [1]; and the integration of Morocco into the regional energy system in compliance with environmental preservation, places the development of RE at the top of its priorities [2].

Furthermore, Morocco has experienced considerable growth in electricity demand. Energy consumption has risen at an average annual rate of 6.5% from 2002 to 2015 [3, 4] due to economic growth, the rise in population, and the increase in per capita energy consumption. This increase in consumption was also due to consistent investments in electrification projects, which allowed the country to reach a 99.5% electricity access rate in 2015 (which is impressive growth considering that the rural electrification level was only at 18% in 1995) [5].

During the 21st session of the Conference of the Parties (COP21), Morocco announced a new goal to increase the capacity of renewables to 52% (20% solar, 20% wind, 12% hydro) by 2030 [6]. This will make Morocco the first African country to aim to reach more than 50% electricity generation from RE in a continent where access to any energy is a big issue [7]. These goals are attainable because the country has high potential in wind and solar resources and is an important player in the Euro-Mediterranean energy hub, including all regional projects facilitating synergy as Project MedGrid, of which the Morocco is a member [3].

This paper describes the organization of the Moroccan energy sector, which is based on a green strategy with RE. Potential impacts of this strategy are discussed on the basis of a regulatory framework. We also discuss opportunities and barriers for this green strategy in relation to the international context based on the findings from past and ongoing studies and conferences organized regarding the Moroccan energy experience. Finally, we suggest additional measures that integrate large-scale projects and regulation improvements that involve a real transition from a regulated market to a full free market and that takes account of the barriers related to existing independent power producers (IPP) facilities.

The primary energy supply in Morocco has been rising steadily and reached 17,283 ktons of oil equivalent ("TOE") in 2015 [8]. The country is clearly dependent on fossil fuels, as petroleum products account for 41% of the primary energy supply, crude oil for 31%, coal and peat for 17%, and gas for 4%. The primary energy

supply has increased significantly in the past. Morocco is highly dependent on imports of energy sources; in 2015, the dependency was about 94.5%. Morocco experienced a significant increase in demand for primary energy as it has increased by 0.36 TOE per capita in 2002 to 0.56 TOE in 2015 [9].

In 2015, the total energy consumption was 18.4 million TOE out of which petroleum products stood for 60% of energy consumption and coal 22% [10]. This trend was also observed on electricity, where the rate was 7% in 2013 with a total energy demand of 32 Twh in the end of 2015 reflecting an energy bill of US$12.3 billion [11].

Due to demographic and economic growth, electricity demand grew at an average annual rate of 6.6% in 2015, leading to an energy consumption of 34,413 GWh at the end of 2015 [11]. In 2015, the amount of electricity produced totaled 29,914.2 GWh. Renewable sources generated 13.4% of the energy, while 49% came from coal, 16.6% from natural gas, and 6% from oil [9].

Morocco has an overall vision towards sustainable development. After adopting a National Energy Strategy (NES) with corresponding targets in 2009 of reaching 42% installed RE capacity by 2020, Morocco renewed the strategy in 2015 with a 52% target for 2030 [12]. Thus, Morocco has prioritized the development of renewables in addition of other sources as natural gas.

The electricity sector is structured around a national utility, the National Agency for Electricity and Water/Electricity Branch (ONEE), which is placed under the administrative and technical control of the Ministry of Energy, Mines, Water, and the Environment. The ministry also supervises the following institutions:

ADEREE - The National Agency for the Development of Renewable Energy and Energy Efficiency was established in 2010. ADEREE has replaced the Centre for Renewable Energy Development and aims to develop and promote RE and energy efficiency [15] In 2016, ADEREE was transformed into AMEE, the Moroccan agency for Energy Efficiency, with the goal of focusing only on energy efficiency [16]. This transformation is very important to the agency, as energy efficiency in Morocco is still in progress, and the work done before in this field was insufficient regarding the huge potential of reducing overall energy consumption in Morocco [17].

EIS - The Energy Investment Corporation was created in June 2009 to boost the development of RE projects [18] The company has a national interest capital of MAD 1 billion [19]. With the new update of Moroccan institutions and their roles, the new role of this company is still undefined, and it still works only in small and medium projects, such as street lighting (use of PV panel system).

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