Promotion of renewable energy in some MENA region countries

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Abstract. In recent years Middle East and North African (MENA) countries, are showing efforts about the integration of renewable electricity into their power markets. Indeed, installations were already achieved and renewable energy programs were launched. The Algerian program remains one of the most ambitious with its installation capacity up to 22GW of power generating to be installed by 2030. More than 60% of the total capacity is planned to be solar photovoltaic (PV). Like Algeria, Morocco has integrated development project with a target to develop by 2020 a 2000 MW capacity of electricity production from solar energy. The Tunisian government has launched its first phase of the renewable power generation program, with an objective to install 1,000 MW of renewable power capacity over the 2017-2020 periods, where 650 MW of the total capacity is planned to be solar and 350 MW wind. One of the leading Arab country in wind energy, these recent years is Egypt, with its more than 700 megawatt of operational power generation plants and has launched significant projects development in solar energy. Regarding Jordan, the government has taken different steps in this field of energy with a Strategy plan 2007-2020, by implementing a large scale of projects on renewable energy sources, with an objective to cover 10% of the country’s energy supply, from renewable sources by the year 2020. Concerning Lebanon, the country is looking to attain an integration of 12% by 2020.

1. Introduction
The MENA region heavily dependents on non-renewable, fossil energy sources. High population growth and energy-intensive consumption in the region will cause energy needs to surge by 6 to 7% per year in the future, if consumption patterns stay the same. The energy needs are estimated to double by the year 2020 [1].

In order to face the increasing demand for energy, many countries in the MENA region started to move smoothly the energy mix; this will lead to the reduction of greenhouse gas emission. The subsidization of fossil energy sources in the region is putting a tremendous strain on government budgets. The subsidization regime is not contributing to socially just support for the weakest private households.

Nowadays, renewable energy plays a great role, is being as a potential means of industrial diversification, new value-chain and employment activities, technology transfer, and improved environmental paths. Even though wind has become the largest renewable energy source after hydro, solar power generation has seen higher growth in recent years, through photovoltaic (PV), eventually due to the price drop. Like PV, we saw a commissioning of large concentrating solar power (CSP) plants in Algeria, Egypt, Iran, and Morocco. Furthermore, solar water heating (SWH) systems are also a key element in the deployment of renewables in the region.
2. Situation in MENA countries
Please follow these instructions as carefully as possible so all articles within a conference have the same style to the title page. This paragraph follows a section title so it should not be indented.

2.1. Case of Algeria
The availability of large amount of solar potential in Algeria means it would be possible to consider solar energy as a potential source of energy for different applications as individual modules or solar photovoltaic systems.

In 2011, the Algerian government has launched an ambitious programme dedicated for renewable energies plans to produce 22,000 MW of electricity from renewable sources, including solar and wind, for the local market, with more than 10,000 MW export for the next 20 years. This corresponds to 40% of global electricity production by 2030 and double the current capacity of the national park of electricity; this programme was updated recently, where the capacity of the photovoltaic solar plant was increased to 13,575 MW.

The total capacities for different considered technologies are given in table 1 [2].

| Technology       | Capacity  |
|------------------|-----------|
| Photovoltaics    | 13575 MW  |
| Wind             | 5010 MW   |
| Thermal          | 2000 MW   |
| Biomass          | 1000 MW   |
| Cogeneration     | 400 MW    |
| Geothermal       | 15 MW     |

2.2. Installed capacity.
Different installations were achieved so far, recently a call tender was released for the installation of 4 000 MW of PV, below are given some examples of installed plants, SKTM (Shariket Kahraba wa Taket Moutadjadida) are responsible for these projects:

• 23 PV plants were installed across the country representing a capacity of more than 343 MW.

• Pilot PV plan of 1.1 MW was installed in the region of Ghardaia

• Wind farm of 10 MW in the region of Tindouf.

• A hybrid solar-gas plan with a capacity of 150 MW with 25 MW solar in the region of Hassi R’mel. Concentration solar collector is provided by parabolic trough.

Energy Efficiency Policy. In February 2015, the Algerian government announced a new national programme on energy efficiency (EE) for the years 2015 to 2030. The EE programme mainly targets three sectors: the building sector, transport and industry [3].

In the building sector, more than 30 million toe are supposed to be saved by 2030. This will be achieved through innovative technologies and thermal insulation of constructions. In addition, economic lamps and solar water heaters will contribute. In the transport sector, the target is to save more than 15 million toe. The government aims to use fuels, which are widely available and least polluting, like LNG and natural gas, in order to reduce the use of gasoline. The industry sector is supposed to contribute 34 million toe by 2030.
2.3. Case of Morocco
Morocco is one of the leading potential markets for renewable energy across the MENA region. The country is targeting sufficient renewable energy to account for 42% of its energy generation mix by 2020. In 2009, the government has planned to develop 2,000MW of solar capacity across five sites. It also plans to bring online 2,000MW of wind capacity by 2020 [4]. Morocco has a potential to export renewable energy to southern Europe.

2.3.1. Wind. Some large projects are in the pipeline, including GDF Suez and Nareva Holding’s 300MW Tarfaya wind farm, which started construction in June 2013, and Nareva Holding’s 50MW Haouma and 50MW Foum El Oued wind farms, which are due to begin construction imminently.

2.3.2. Solar. Solar energy in Morocco was playing a minor role in the Moroccan energy mix, mostly in the rural electrification programme, where photovoltaic (PV) power was used to supply isolated villages. There have been substantial changes in this field since the government’s solar power plan, entitled the Moroccan Solar Power Programme, was launched back in 2009. The programme has an objective to increase installed capacity in terms of CSP and PV generation to at least 2,000 MW by 2020. In 2015, two sites, located in Midelt and Tata, were added to the original five. The development of these two sites has been carried forward, which will allow Morocco to exceed the 2,000 MW mark by 2020.

Table 2, shows the seven sites where major projects have been carried out or are scheduled for installation.

| Site/power plant | Power in MW | Technology         |
|------------------|-------------|--------------------|
| Ouarzazate       | Total: 580  |                    |
| NOOR I           | 160         | CSP                |
| NOOR II          | 200         | CSP                |
| NOOR III         | 150         | CSP (solar tower)  |
| NOOR IV          | 70          | PV                 |

2.4. Case of Tunisia
Tunisia is an energy-dependent country with modest oil and gas reserves. Around 97 percent of the total energy comes from natural gas and oil, while renewables contribute at a level of 3% of the energy mix. The installed electricity capacity at the end of 2015 was 5,695 MW, which is expected to sharply increase to 7,500 MW by 2021 to meet the increasing power demands. Meanwhile, Tunisia is building additional conventional power plants and developing its solar and wind capacities to withstand its economic growth [5].

2.4.1. Wind. Tunisia holds an important wind resource; In fact, wind power represents the leading source of renewable energy in Tunisia. Since 2008, wind energy is considered a principal the energy transition of Tunisia with a growth of the production up to 245 MW of power installed in 2016. Two main wind farms have been implemented until now: Sidi-Daoud and Bizerte.

2.4.2. Solar. Back in 2005, the government has launched a Solar Program called PROSOL, is a joint initiative of UNEP, Tunisian National Agency for Energy Conservation, state-utility STEG and
Italian Ministry for Environment, Land and Sea. The program has an objective to encourage the enlargement of the solar energy sector via financial and fiscal support. PROSOL includes a loan mechanism for domestic customers to purchase Solar Water Heaters and a capital cost subsidy provided by the Tunisian government of 20% of system costs. The major benefits of PROSOL are:

- More than 50,000 Tunisian families get their hot water from the sun based on loans
- Generation of employment opportunities in the form of technology suppliers and installation companies.
- Reduced dependence on imported energy carriers
- Reduction of GHGs emissions.

The Tunisian Solar Plan includes 40 projects with an objective to promote solar thermal and photovoltaic energies, wind energy, as well as energy efficiency measures. Besides, the plan includes the ELMED project; a 400KV submarine cable interconnecting Tunisia and Italy.

The first large scale solar power plant of a 10MW capacity, co-financed by KfW and NIF (Neighbourhood Investment Facility) and implemented by STEG, is due 2018 in Tozeur. Concerning CSP technology, the government has launched a program called “TuNur”. The program is considered as Tunisia's most ambitious renewable energy project yet. The project includes of a 2,250 MW solar CSP plant in Sahara desert and a 2 GW HVDC (High-Voltage Direct Current) submarine cable from Tunisia to Italy. The project itself will generate 2.5GW of electricity on 100km2 of desert in South West Tunisia by 2018.

2.5. Case of Egypt

Egypt holds a rich renewable resources, which could be an interesting solution in Egypt. As a matter in fact, the government has given an importance to the use of renewable in order to meet the increasing demand in energy supplies. PV and wind technologies are the main options for electricity generation mix in Egypt. Among different renewable energy technologies, unfortunately, other options such as solar water heaters, biogas and biomass technologies are not yet given enough attention, except for some donor-funded activities and efforts of NGOs that try to build some momentum on pilot and local scales, but not yet under a national deployment program [6].

The renewable equipment market is potentially worth billions of dollars. By the year 2022, the Egyptian government has an intention to reach 20 percent of generated electricity from renewable sources (Wind 12 %, Hydropower 5.8 %, and Solar 2.2 %). The solar energy plan has an objective to set up 3.5 GW by 2027 including 2.8 GW of PV and 700 MW of CSP. Besides, there is plan to produce 7.2 GW (12 percent of generated electricity) from wind by 2022, where private sector will be involved (67 % of the plan). Over the next three to five years the Ministry of Electricity and Renewable Energy has an aim to increase 51.3 GW to current installed capacity.

In June 2014, the total installed capacity reached about 32 GW (28.8 thermal, 2.8 hydro & 0.55 wind).

2.5.1. Wind. Egypt holds a huge wind potential along the Suez Gulf with an average wind speed of 10.5 m/sec. The Government has an objective to reach 12 % of the generated electricity (6.8 GW) through generated wind energy by 2022.

Since 2001, a series of large-scale wind farms have been implemented with total capacity of 550 MW in cooperation with Germany (KFW), Denmark (DANIDA), Spain, and Japan (JICA). Implementation of the Spanish project in Jebel El Ziet took place in 2013, which clarifies the huge increase in Egypt imports for renewables, which were mainly wind powered generators imported from Spain.

2.5.2. Solar. In 2011, the first Solar Thermal Power Plant at Kuraymat was established, with a total installed capacity of 140MW where, 20MW are based on parabolic trough technology integrated with combined cycle power plant using natural gas. A 10 MW power plant also has been operating in Siwa since March 2015.

2.6. Case of Jordan
Jordan started the promotion of renewable energy since early 1970s. The first wind power pilot project was installed back in 1988. In recent years, the government gave a great importance to the generation of power from renewable with many initiatives. By 2020, the renewable energy integration should attain 10% [7].

2.6.1. Wind. Jordan holds an important wind energy potential. Actually, the government has prepared an ambitious program in wind energy development, where about 1200MW of wind turbines are to be installed by the year 2020.

2.6.2. Solar. Concerning solar energy potential in Jordan, the resource is great, where solar radiation ranges between 5 and 7KWh/m2. Concerning the total installed capacity, it still to be improved, where only 1 MW of solar installation is available (photovoltaic kits including water pumping in rural and remote villages). Meanwhile, the good news is that 15% of all households are equipped with solar water heating systems. A goal the increase the number up to 30% in the future (by 2020). Concentrated Solar Power (CSP), has its share in the program, in fact the government is aiming to set up the first (CSP) demonstration project in the short to medium term. In addition, a solar desalination plant is planned to be installed. Therefore, the global capacity will be 600MW (CSP, PV and hybrid power plants) by 2020 [8].

2.6.3. Biomass. A great amount of waste is available in Jordan, where the equivalent annual power production is estimated at 698.1 GW h. (about 5 % of the consumed electricity). Many projects dealing with waste are in operation across the country. Now, concerning, the goal of the production, which the government is planning to produce by 2020 is about 50 MW [9].

2.7. Case of Lebanon
Lebanon remains one of the rare countries where the electrification rate is at 100%, but suffers from frequent daily power blackouts. Knowing that there are no identified fossil fuel resources currently available. The development of renewable energies in the country could be an interesting alternative. Despite all the efforts being made to promote Renewable Energies in Lebanon, these forms of energy are struggling to take their place in the energy market, and they account for as little as 2% [10]. However, the government has an objective to attain an integration of 12 % from renewable in the energy mix by the year 2020.

2.7.1. Wind. A wind map was updated in 2011, confirmed the existence of an interesting potential. Few installations that exist are of low power (particular instillations). However the government aims to reach a total of 100 MW of installed capacity.

2.7.2. Solar. For solar energy the production potential is very interesting, Lebanon is a country fortunate enough to have a very high amount of sunny hours, even during winter days, with a daily Average solar insolation of 4.8 kWh/m² [11]. But if we can talk about a market that is growing pretty well for the individual solar water heater; other solar technologies including solar thermal collective or photovoltaic can not really take off, despite some projects in this area. Several reasons are behind this fact, the most important in our opinion is the absence of a clear and coherent policy for the energy sector in Lebanon. Furthermore, the government has a plan to develop PV installations up to 10 MW of capacity by 2020.

3. Conclusion
The availability of sustainable resource in the region must exploited by all the countries in the region for the establishment of a clean and productive economy. This will allow, for sure, having investments less costly and reducing the harmful effects of greenhouse gas emissions on the environment. However, the MENA region, renewable energy technologies can be considered as an economic solution for the supply of their rapidly expanding domestic energy markets. It can also be seen as a
source of good quality jobs including local hiring, training and transfer of knowledge. Governments also have the choice to promote renewable energy via a different set of measures known as ‘fiscal and regulatory incentives’, they may help achieve renewable targets in the short- and medium-term.

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