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PROMOTION OF RENEWABLE ENERGY IN MOROCCO¹

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Abstract. The article analyses the problems of renewable and fossil based energy consumption. Particular emphasis is put on the promotion of renewable energy technologies. Morocco implements the energy efficiency programmes in the parallel with the Wind promotion plan and Morocco Solar Plan, which is one of the largest projects in the world. The authors of the article focus on the obstacles and barriers of implementing renewable energy promotion plan in Morocco. The investigation shows that Morocco faces with a lack of financing sources and risk implementing small projects, social-economic problems, a lack of transparency and lobbyism. Even public apathy or the acceptance of RE in the community might be a challenge.

Keywords: renewable energy, fossil resources, Morocco, promotion systems, sustainability

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1. Introduction

Energy sector represents a fundamental economic sector, as its efficiency strongly affects competitiveness of the entire national economy, particularly as regards industry (Jankauskas et al. 2014). At this moment, fossil fuel based technologies predominate across most countries. However, the perspectives and energy development trends in developed countries suggest that renewable energy technologies are rapidly growing. This tendency is significant as the consumption of fossil resources leads to economic and environmental problems (Klevas et al. 2013). Natural resources run out much faster than it is expected. Even more, burning fossil resources raise the level of CO₂, which is recognised as exerting a negative impact on the environment and causes the greenhouse effect (Sarkis, Tamarkin 2008). Thus, this resulted to search for alternative energy sources. Another important determinant, to choose alternative energy sources instead fossil ones, is energetically security, which is extremely significant for countries that do not have natural resources. For that reason, the promotion of renewable energy (RE) has become one of the most important national goals to ensure sustainable development of the energy sector and the country's energy independence. The consumption of RE sources is equally important for reducing environmental pollution or climate change mitigation, and for the country's economic development, which promotes creation of new jobs, encourages innovation, and research development. However, the competitiveness of RE decreased as the prices of oil has dropped off. On the other hand, weighted average costs of electricity from biomass for power, geothermal, hydropower and onshore wind are all now in the range, or even span a lower range, than estimated fossil fuel-fired electricity generation costs (IRENA 2015). The aim of this article is to analyse promotion system of renewable energy sources in Morocco.

2. Global Consumption of Renewable Energy Sources

As the world embarks on the transition to a truly sustainable energy future, the world's renewable resources and technologies increasingly offer the promise of cleaner, healthier and economically and technically feasible power solutions and sustainable energy access for all (IRENA 2015). Historically, the choice of energy has been based on economics and domestic conditions. The society has been driven to choose inexpensive energy (Marano, Rizzoni 2008). However, nowadays, the technical superiorities of energy systems may fail to describe for instance renewable energy systems or its technology properly. Still, the primary RE system investment decision-making criteria are economic. These criteria are focused on the RE system and its support ancillary infrastructure technical superiorities, such as efficiency and cost, which is reasonable in the context of generous financial support schemes (Azzopardi 2014).

As the global population and global economy are on increase, so is the global energy consumption. In the period of 2004 to 2008, the global population increased by 5%, consequently total energy generation and annual emission of CO₂ increased by approximately 10 % per year (International Energy Agency 2006, 2010). Despite the global financial crisis, G20 states reported a decrease in energy consumption of 1.1 % only in 2009, which increased by 5 % in 2010 (Enerdata 2011), while CO₂ emission increased by 5.8 % due to energy generation. According to the estimates of the International Energy Agency (2015), in case the current trend continue, in the 2030 the global energy demand might increase by approximately 60 % while the emission of carbon dioxide might increase by 62 %. International Energy Agency (2015) has warned that if urgent measures are not taken for reducing greenhouse gas, earth's temperature might rise by 3.5 Co by the end of the century. In order to decrease the volume of greenhouse gas, some researchers (Boharb et al. 2016; Utlu, Parali 2013; Siitonen et al. 2010) suggest to improving efficiency of energy consumption in industry and buildings. However, it is a quite challenge as the industrial sector accounts for 30–70 % of the total global energy consumption and is certainly responsible for a great part of the global greenhouse emissions.

For example, the industrial sector is responsible for 21 % of energy consumption in Morocco (Boharb et al. 2016). In addition, Morocco is the only North African country without any fossil energy reserves. Thus, it imports almost all of needed primary energy (Hanger et al. 2016).

The global leaders in accord that the above trends conflict with the objectives of sustainable development, therefore as early as in 2002, the global leaders came to an agreement at the World Summit on Sustainable Development to have the share of the renewable energy increased substantially in the global context. The European Union (EU) places particular emphasis on the renewable energy and increase of energy efficiency. In 2008, the renewable energy source was accounted for only as little as 10.3 % in the total EU energy balance. Thus, the European Parliament made a decision that very same year to cut the CO₂ pollution until 2020 by 20 % across the EU, to increase the efficiency of energy use by the same rate and to obtain up to 20 % of energy from the renewable energy sources. Meanwhile, in 2014 the share of renewables in electricity production in the EU amounted to 30 % (Enerdata 2015).

Global investment into the renewable energy has demonstrated a steep growth over the last few years. Europe dedicates most funding to the development of the on combating climate change and development of a competitive and safe energy has become a key funding source for the RE projects. Over the last few years, the date of loans extended by the EIB for the development of the renewable energy sources has increased by several times and totalled €6.2 billion in 2010, while the share of the renewable energy in the total portfolio of energy investment grew up three times in the period of 2006 to 2010, i.e. an increase from 10 % to 30 %.

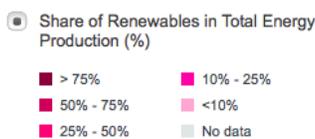
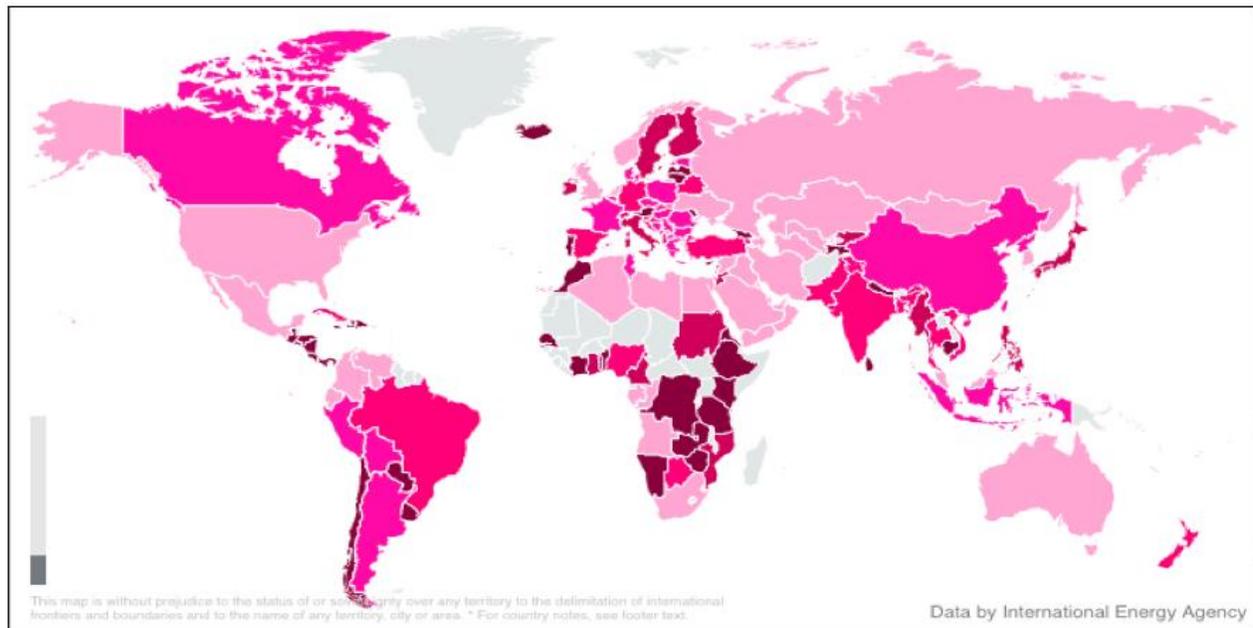


Fig. 1. Share of Renewables in Total Energy Production (%)
 Source: IEA Atlas

The loans are largely dedicated to the development of wind and solar energy generation. Given the intention of the EU Member States to accomplish the tasks set, the coming decade would clearly require more funding for the development of the renewable energy sources, while the efficient use of the same funding might bring a tangible impact on the development of the region and the wellbeing of the public. The Member States must first of all estimate the benefit created by the same investment and to channel the same investment to those technologies that generate most benefits. Assessment of the added value in the sector of the renewable energy is not a simple task, as it concerns not the energy generation alone, and instead covers a much wider field, including protection of the environment, sustainable development, creation of jobs, and impact on the economic development. Direct added value represents a single component of the value, however given that this component is the easiest to measure, it usually predominates over any other values.

Furthermore, the approach taken on the environmental requirements and sustainable development has undergone a material change. Consequently, standard assessment methods of costs and benefits demonstrate limited adjustment to the dynamic factors in the energy sector and possible changes that might come in the future.

3. Moroccan Policy and Regulation on Renewable Energy Promotion

All countries are using different policies for promoting research, development, demonstration, deployment and commercialization of renewable sources of energy. Development of RETs in a country depends on its renewable energy readiness (RE-Readiness) that indicates the gaps and strengths of their development (UNEP 2012). Currently, a wide range of strategies is implemented in different countries to increase the share of electricity (RES-E), from renewable energy sources (Haas *et al.* 2011).

In general, the policies promoting renewable energy might include:

- regulatory policies (feed-in-tariffs, quotas or portfolio standards, priority grid access, building mandates, and biofuel blending requirements)
- fiscal incentives, (tax policies and direct government payments such as rebates and grants)
- public finance mechanisms (includes mechanisms such as loans and guarantees)
- climate-led policies (include carbon pricing mechanisms, cap and trade, emission targets, and others) (Table 1).

Table 1. Fundamental types of regulatory instruments (Haas *et al.* 2011)

		Price-driven	Quantity-driven
Regulatory	Investment focused	Investment subsidies Tax credits Loan interests/ Soft loans	Tendering system for investment grant
	Generation based	Fixed (feed) in tariffs Fixed premium system	Tendering system for long-term contracts Tradable green certificate system
Voluntary	Investment focused	Shareholders programmes Contribution programmes	
	Generation based	Green tariffs	

Source: Haas *et al.* 2011

First signs of promoting renewable energy, Moroccan government showed in 2006 by issuing the Decree 1-06-15, which placed under obligation public institutions to employ competitive calls for tender in the award of projects. This Law applied to municipalities that may wish to contract with wind farms or other sources of electricity from renewable energy (Norton Rose Fullbright 2012).

In 2008, the Law 16-08 increased the ceiling for self-generation by industrial sites from 10MW to 50MW. The Law was conceived principally to support wind power, but also applied equally to other technologies. This Law adopted the 1963 Decree, which created ONE (Office National de l'Electricite et de l'Eau Potable) and attributed to ONE a monopoly of production above 10 MW.

In 2009, renewable energies represented 4% of the Moroccan energy mix (without biomass) and produced 10% of the total electricity demand. The same year Moroccan government introduced law 13-09 on renewable energy with the target to increase these shares from 4% to 10% and from 10% to 20% of electricity production by 2012. The law 13-09 partially opened electricity market to competition for the production and commercialization of electrical energy from renewable energy sources for customers. The law 13-09 did not put a limit on the installed capacity per project or per type of energy, and provides a legal framework for clean energy export. In the same year, National Energy Strategy was adopted and set energy efficiency as a national priority.

Law 16-09, voted in 2009, was introduced for the establishment of ADEREE (Agence Nationale pour le Developpement). The agency is currently finalizing the regulatory framework on energy efficiency in passive building. After working on technical aspects of this type of buildings, the agency is currently working on its regulatory framework together with the Moroccan Energy Ministry.

For implementing Moroccan Solar Plan MASEN (Moroccan Agency for Solar Energy) was established by the Law 57-09. SIE (Société d'Investissements Energétiques), reference investor in the energy strategy of Morocco, was founded in February 2010 in accordance with the guidelines of the national energy strategy aimed at the diversification of resources, promotion of renewable energy and energy efficiency (Moroccan Ministry of Energy, Mines, Water and Environment 2016). The new legislative framework for the renewable energy sector offered the possibility to private operators to develop electricity generation projects from renewable sources and to sell electricity to a consumer of their choice with a guaranteed right of access to the national power grids within the limit of available technical capacity of networks. For ensuring proper functioning of the free market for electricity generated from renewable sources and regulation of the access of self-producers to the national electricity transmission grid, in 2012 new Law 48-15 was introduced.

Although, National Energy Strategy was adopted in 2009, the implementation of energy efficiency programmes has started since 2008 (Arce et al. 2012). Energy efficiency programmes are implemented in the parallel with the development of renewable energy forms a major part of Morocco's energy strategy. Morocco's energy strategy aims to save 12 % in 2020 and 15 % in 2030 of total energy consumption. Moroccan government expects 42 % of its total energy mix to come from solar, wind and hydroelectric sources by 2020. At this moment, Morocco implements six energy efficiency programmes and Solar and Wind energy programmes. Moroccan Solar Plan is one of the world's largest solar energy projects and it is estimated that it will cost €7,8 billion. Moroccan energy efficiency projects, Solar and Wind programmes are supported and funded by the African Development Bank (AfDB), the World Bank (WB), and the European Investment Bank (EIB).

Among the others, the DESERTEC concept is one of the major projects developing in Morocco. The aim of the project is to build concentrating Solar-Thermal Power (CSP) plants and export renewable energy from MENA to European countries. DESERTEC involves the development of a trans-national super grid that integrates all types of renewable energies:

- CSP in desert regions;
- wind power in coastal areas;
- hydro power in mountainous regions;
- photovoltaics in sunny areas;
- biomass and geothermal power where geographic conditions are favourable (Norton Rose Fulbright 2012).

Morocco's energy efficiency plan includes a solar water heater programme (PROMASOL), which aims to increase supply to reduce equipment costs, improve the quality of solar-powered equipment and related services, and ensure the large-scale adoption of solar water heaters. PROMASOL is a United Nations funded initiative.

The energy efficiency programme GMT + 1 started in 2008, which aim is during the summer to improve the power reserve margin during peak hours. The decree No. 21 781-13-2 set the period of this schedule which runs from April to October each year with the exception of the month of Ramadan. National Programme of low consumption lamps reduced 3.3 % of energy consumption. The other programme aims to upgrade energy efficiency in 15000 mosques. The programme has double objectives: awareness of energy efficiency techniques to citizens and reducing the energy consumption of mosques. The first phase of this project has started in 2015. In the field of public lighting energy efficiency, some measures and actions were initiated to install equipment to achieve energy savings (LED lamps, stabilizers, and etc.). As the results of first project in public lightening, the public lightening installations in the cities were renovated, the network and widespread public to the entire urban territory was extended, lower energy costs reduced Communal budget; the preventive and corrective maintenance were established. The first phase of Regionalization program "Jiha-Tinou" was implemented in Agadir, Oujda and Chefchaouen during the period of 2012 – 2014. As a part of Regionalization program "Jiha-Tinou", the project "Green Cities" (2015–2017) aims to strengthen the methodological and technical skills needed for sustainable urban development in the cities of Morocco. Agadir, Beni Mellal, Benslimane, Chefchaouen, Oujda, Ouarzazate, Rabat, Marrakech and Tetouan participate in this programme.

Eco-neighborhood Project in Ouarzazate aims to integrate energy efficiency and renewable energy measures at the time of renovation of the infrastructure. In Ouarzazate, it is a planned to build 500MW solar plant, which will be among the largest CSP plants in the world. The project is financed from the World Bank's Clean Technology fund and the International Bank for Reconstruction and Development, and other funds. Ain Beni Mathar project is a part of DESERTEC, it is planed to build a 470 MW hybrid solar-gas plant. The African Development Bank is financing two-thirds of the cost of the plant, approximately €187.85 million.

Since 2010 Moroccan government implements Integrated Wind Energy Project, with an estimated investment €3.2 billion, aims to increase the share of wind power in the national energy balance to 14 per cent by 2020, to reduce by 1.5 million tonnes of fuel a year, corresponding to €648 million and prevent the emission of 5.6 million tonnes of CO₂ per year.

4. Obstacles of Implementing Renewable Energy Promotion Plan

Although, Moroccan government has started to implement policy and regulation on RE promotion; however, still some barriers for developing renewable energy in Morocco exist. Hanger et al. (2016) as a primary barrier identify a lack of financing and risks of the project implementation for both private and public investment. Especially this is a problem for the small-scale projects. Moreover, foreign companies do not tend to invest in this area, as it looks too risky. Both foreign and local private companies prefer investing in high profitability projects and require to return in short time of period rather than in long-term, which is more common for project of renewable energy sources. Thus, most of financial support comes from the international funds and the government. The World Energy Council (2015) sees short termism one of the major economic and financial limiting factors.

Due to the fact that fossil fuels are more subsidized than renewable energy sources, it becomes even more difficult to encourage local and foreign companies to invest in RE. In this way, renewable energy sources lose their competitiveness. Competition in cost-driven markets increases when market penetration is large. However, Moroccan energy market is occupied by large monopolies, which expecting higher profits, use fossil fuel that is

much cheaper than to install renewable energy technologies. The World Energy Council (2015) emphasizes that Morocco faces with a shortage of businesses, entrepreneurs and trained workers and specialized industries, which would be able to promote and expand the market of renewable energy.

Moroccan government introduced various national programmes regarding promoting renewable energy. Particular attention is paid to Agadir, Marrakesh, and Quarzazate. However, World Energy Council (2015) notices that there are some ambiguities in strategy, it is not clear how decisions are made. According to Mahia et al. (2014) research, the social–political instability in the country and/or region is one of top five policy related barriers. Historically, statutory framework and institutional infrastructure were one of the weakest links in developing renewable energy sources and the enhancement of energy efficiency.

Even more, the reduction of lobbyism and corruption are two other challenges Morocco faces with (Global Competitiveness Report 2015–2016). Lobbyism serves in favour of large monopolies, which use fossil fuel. Thus, there is a lack of transparency and clearness over the management of the energy sector. The transparency in implementing policies regarding renewable resources would increase if the society would receive more information about new national programmes, availability of funding for the RE projects. Due to the lack of information, local investors do not recognize benefits and challenges of using renewable energy. Even more, key stakeholders do not how RE technology works. World Energy Council (2015) distinguishes cultural and behavioural barriers. The organization notices the public apathy to support renewable energy. In addition, the Moroccan society is inflexible to accept many changes. This might be explained as the consequence of illiteracy and lack of knowledge and understanding of added value of RE technology. Wolsink (2007) and Wüstenhagen et al. (2007) state that acceptance of RE in society is determined by various factors such as expected costs and benefits, social, economic and environmental risks, trust and perceived fairness, distance to the proposed power plant and the regulatory context. Meanwhile Hanger et al. (2016) find that the community of Ouarzazate, seemed to be overwhelmingly in favour of the project: 91% being completely in favour or in favour.

Thus, in Morocco case information takes one of major parts in introducing renewable energy technologies. Furthermore, technical problems might occur as well. For example, the renewable energy has only been incorporated in the electricity sector while cross-sectorial system between heating/cooling and transport does not exist. There are unsolved issues with integrating renewable power on to the transmission grid system. Such issues may be successfully addressed by investment to reinforce the transmission grid. More problems might arise for large-scale project whereas there is not enough highly qualified staff that could operate RE facilities.

Conclusions

Although the fossil based energy still dominates in most of the countries, renewable energy sources become more and more important for reducing environmental pollution or climate change mitigation, and for the country's economic development. Even prices of RE and fossil based energy are nearly equal.

However, the development of RE technologies in a country depends on its renewable energy readiness that indicates the gaps and strengths of their development. For that reason, nearly every country implements policies promoting renewable energy. Usually, the regulatory policies, fiscal incentives, public finance mechanisms, and climate-led policies are included.

Morocco, in the parallel with Wind and Solar plan, implements Energy efficiency programmes. Additionally, the project “Green Cities” (2015–2017) aims to strengthen the methodological and technical skills needed for sustainable urban development in Agadir, Beni Mellal, Benslimane, Chefchaouen, Oujda, Ouarzazate, Rabat, Marrakech, and Tetouan. Morocco government introduced National Energy Strategy in 2008 and established several agencies, which are responsible for implementing various projects. However, Morocco faces with some

barriers and obstacles in implementing National Energy Strategy. One of the most significant barriers is a lack of financing sources and risk implementing small projects. A lack of transparency and lobbyism more serve for monopolies, which are using fossil based energy, shortage of qualified labour force might delay to implement RE projects. Even, the acceptance of RE in the community might be one of the challenges.

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