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Prospective analysis for a long-term optimal energy mix planning in Algeria: Towards high electricity generation security in 2062

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ABSTRACT

Issues relating to the potential collapse of oil prices and possible consequences which are rising for all oil producing countries including OPEC countries (in which Algeria is a member). Since February 2011, a national renewable energy (RE) program was launched by the president of Algeria to make RE a major source of production for electrical energy which is a fundamental concept for sustainable development. A prospective analysis will be used to contribute in making a decision for such process. This article addresses the issue that explains the current and future energy scenarios in Algeria with the aim of investigating opportunities and possibilities for enhancing the presence of renewable energy resources in Algeria's Energy mix. This prospective is particularly suitable to the treatment of long-term technological energy issues in Algeria from an explicit representation of economic characteristics (represented by indicators: GDP, population and unemployment), and energetics (expressed by the aggregate of energy production, of total and final consumption) during the period 1962–2012. The developed approach can enrich the discussion of possible consequences of futures energy in the country. We focused on the consumer sectors of energy (Industrial, Transport and Household sector) and strategies to increase the contribution of renewable in the energy supply, in order to respond efficiently to national expectations as part of their energy and economic objectives. It should be noted that the present study offers three energy scenarios in Algeria from mid to long term. We suggest that the scenario " Trended Non Energetic Efficiency (EE) " could be a reference in the 10 coming years. Moreover, " Trended of EE " and " voluntarism of EE " are considered as transition scenarios in case that Algeria desires to improve its energy system on the horizon of 2062, a year taken as a reference to the 100 year jubilee of independence.

1. Introduction

Since many years, energy is returned to be the major concern of public opinion and governments. Energy challenges are inevitably a global nature and we cannot consider an autarkic energy policy that does not take into account the balance between supply demands in today's world. However, these challenges are differentiated by energy source and by major region.

Exploring the future is not new in the energy sector. By 1860 W.S. Jevons had prolonged the growth of English extraction of coal until the 20th century to assess the risk of British industry. Half a century later, H. S. Fleming had expected a consumption of 1.5% of energy in the United States. Later on, short and long term prospective calculations have multiplied, used and encouraged by all industrialized countries and the United Nations at that time [1]. The increase in global energy demand, depletion of fossil fuels and global warming, all these factors led some countries to make a short, medium and long term prospective studies and possible measures interested in mastering the energy conservation and sustainable development. Such researches have been achieved by many authors in different countries; as an example some researches in the EU and other African countries that they share similarities with our studies like: [2] who made Markal modeling for long term energy planning in the French context [2]. His study found that nuclear generation reaches more than 49% of total production with 34% of thermal generation in 2050. [3] were interested to do a Strategic Study of the energy mix for electricity generation in Tunisia [3]. Major scenarios had been found by doing this study that they are exposed to the purpose of covering the Tunisian electricity demand

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which will almost be tripled by 2030. In 2013, the Ministry of Energy and Mines in Morocco made a prospective study of the energy demand by 2030 [4]. The study shows that the development of renewable energy had an impact on dispense in the exterior (around 96% at present) resulting in a heavy energy bill of around 63.7 billion dirhams, either a puncture in GDP of around 8.3%. Algeria like other countries did some studies by: [5] made a review on the renewable energy development in Algeria: Current perspective, energy scenario and sustainability issues. In his studies, he clarified that the ambition of Algeria is to generate at least 40% electricity from RE by 2030. [6] Had also made a prospective study of the final energy demand for Algeria in 2030 which he estimated annual growth rate of 4% for the energy demands in Algeria in the horizon by 2030. A number of other researches deals with the same subject have been done and are detailed in their papers [7–11].

In view of current climate change, rapid transition towards a sustainable energy future is needed. One year after the adoption of the historic Paris Agreement, the international community now has to convert the pledges made into concrete climate action. In order to meet the target of limiting global temperature rise to well below 2 °C, the decarbonization of the global energy sector is critical and of key importance. Accelerating and scaling-up the deployment of RE will be a crucial key to realize the aims and ambitions of the Paris climate change agreement. At the current time, the energy sector accounts for more than two thirds of global greenhouse gas emissions, which puts it at the center of international climate protection efforts. As global climate change poses one of humanity's greatest challenges today. In this context, some researches have been achieved by many authors in different countries; as an example we find some studies are focused on China: [12] were studying the decomposition of factors affecting energy-related carbon emissions in Guangdong province [12], they provided a reference for relevant administrative departments in the government of Guangdong province to develop policies for energy conservation and emission reduction as well as to promote development of low-carbon economy. (Jiang W., Liu J., Liu X.; China 2016) they have studied the impact of carbon quota allocation mechanism on emissions trading: an agent-based simulation [13], they obtain that the scheme with a small extent quota decrease in a comprehensive allocation mechanism can minimize the unit carbon emission cost. [14] were interested to do a forecasting the allocative efficiency of carbon emission allowance financial assets in China at the provincial level in 2020 [14], they tried to examine the allocated efficiency of carbon emission reduction and non-fossil energy consumption by employing a zero sum gains data envelopment analysis (ZSG-DEA) model. (Zeng S., Chen J; China 2016) have made a forecasting of the allocation ratio of carbon emission allowance currency for 2020 and 2030 in China [15]. They propose a new method that divides low-carbon economy development processes into two separate periods: from 2020 to 2029 and from 2030 to 2050. The results obtained can help boost China's economic development and help the country reach its energy conservation and emissions reduction goals.

Algeria is trying to identify innovative ways to realize a swift transformation towards a low-carbon energy industry. As global climate change nowadays and poses one of the biggest challenges to humanity, Algeria is providing an important program in its RE policy to show at first-hand how clean energies can play their part in transforming economies, the future of humanity and how a fast transition towards a sustainable energy future can be realized under the Paris Agreement. Moreover, Algeria strongly believes in international networks and local action in order to be successful in climate protection. All levels of government communicate and cooperate to tackle this immense challenge.

North Africa is endowed with abundant, but largely unexploited, renewable energy resources. A few years ago, the announcement of the ‘Desertec’ concept which is the idea of tapping the region's wind and solar potential for European electricity supply, triggered a number of studies on how North Africa could realize a higher renewable power export potential. However, it paid for the subject of renewable integration into the existing domestic power systems to satisfy local demand. Algerian RE program outlines a number of key innovation and technical issues that focuses on strategies such as electrification and improved integration of renewables into grids. These issues are not only important to the development of the country itself but also ensuring that we can maximize the potentials of renewable energy and its impact on climate change of the worldwide [16].

Algeria as many African countries faces difficulties to develop a global comprehensive energy policy especially with the other African countries. Countries in the Organization of African Unity (OAU) are bound by the convention of the African commission of energy (AFREC) in which it headquarter is situated in Algiers. It aim at making major agreements include the development of the use of energy, cooperation in the energetic field, the promotion of research, and encouraging the development of transferring the technology in the energy sector. AFREC is attributed to various functions including the elaboration of policies, strategies and development plan of energy, exploitation and the use of sources of renewable energy, the implementation of mechanisms for the exploitation and the utilization of energy resources of the continent, all of these are made in the respect of standards and common procedures [17]. Such organization shows how the energy sector is in the 21st Century concerns for safeguarding even the integrity of the country.

Algeria participates in other programs such as The Mediterranean Program for Renewable Energy (MEDREP) whose two main objectives are: to provide sustainable energy services particularly to rural populations and to contribute to the mitigation of climate changes by increasing the presence of RE of all the energies in the region. This program is realized by the Mediterranean Center for RE (MEDREC) in Tunisia [18].

The prospective of electrical energy production in Algeria revolves around a referenced scenario that provides a coherent picture of the long term evolution of the Algerian energy system. Based on a number of assumptions related to the demographic and economic context (GDP, Population...) Algeria is already involved in efforts imposed by sustainable development by putting the means to ensure that future generations aspire a decent standard of living which could be compromised by the gradual disappearance of the fossil. Knowing that the world is going through a financial crisis and Algeria is situated in a promising area, this can make it the target for many technological developed countries so as to avoid any controversial situations, So in one hand, we have to raise the awareness in the society to have a responsible behavior on the one hand, and make political and financial measures to ensure an energy security for Algeria on the other hand, taking into consideration that the country is projected as a future producer of electrical energy from renewable sources.

It is now widely known that Algeria is characterized by an important and a diverse natural gas wealth, these resources are considered among the well-known in the world, while the underground is abundant with oil and other giant resources (phosphate, zinc, iron, gold, uranium, tungsten, kaolin....). Despite all the resistance and skepticism, the idea that had been put into practice is to believe in the future of Algeria outside the hydrocarbons. Now, it is only a question of introducing timidly a portion of production of renewable energy in the national energy mix, but it is also a matter of structuring a production based on renewable energy in Algeria that makes our country in the future an exporter of electricity from solar and wind power. In this perspective we must react if we want to implement the potential of current and emerging technologies, as well as reducing the dependence on fossil fuel, with consequences that will flow from supply energy and economic security; it is important to create the future energy rent and the energy of today to finance tomorrow's energy.