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Decision-making strategy for cogeneration power systems integration in the Lebanese electricity grid

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Abstract

Cogeneration and trigeneration systems can contribute to the reduction of primary energy consumption and greenhouse gas emissions in residential and tertiary sectors, by reducing fossil fuels demand and grid losses with respect to conventional systems. The cogeneration systems are characterized by a very high energy efficiency (80 to 90%) as well as a less polluting aspect compared to the conventional energy production. The integration of these systems into the energy network must simultaneously take into account their economic and environmental challenges. Moreover, the electricity distribution service can motivate the users of these systems by buying their residual electrical and thermal products. In this case, the "smart-grid" is the interface that manages the client-network interaction.

In this paper, we will find the best cogeneration power that had to be integrated in the Lebanese electricity grid using a new decision-making technique.

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1. Introduction:

Lebanon is a country located on the Mediterranean Sea, having an area of 10452 km² and a coastline of 220Km. Its population is estimated at 4 million. It is known by its tourist sites and its moderate climate. It is characterized by its academic and educational level. He was able to have a good reputation in the fields of science and engineering

thanks to Lebanese abroad. Despite all this, Lebanon is among the few countries in the world without electricity 24/24, and suffering from a large energy deficit. The latter causes economic, social and environmental issues.

The electricity and energy sector in Lebanon is very important. In fact, energy demand is always higher than supply. The electricity sector is monopolized by Electricity of Lebanon (EDL, a public institution that controls more than 90% of this sector), it is still the victim of political and social conflicts. The latter can stop the administrative and governmental operation. Development decisions can only be made when the majority of politicians agree. So, it is impossible to separate the administrative directorates from political intervention in Lebanon. This means that the latter will not be able to have electricity 24 hours a day unless the decision makers are in global agreement.

The integration of cogeneration systems (CS) and renewable energy systems into the Lebanese electricity grid (LEG) can serve and save the electricity and energy sector in Lebanon. These systems can be installed by the users of the network by a grant from the Ministry of Energy and Water in Lebanon. The purpose of this subsidy is to use clean, non-polluting energy, or energy conservation systems that are less polluting. Knowing that the Lebanese government set a goal that by 2020, the percentage of electricity production through renewable energy systems should reach 12% to obtain a comprehensive and in-depth idea of the effect of the integration of such systems and their constraints,

In this paper, we will find a solution for the energy deficit in Lebanon by integrating cogeneration systems and renewable energy sources to the Lebanese electricity grid. This solution is validated by the decision-making strategy used in [1-3] in order to install the needed CS and ER sources.

2. Electricity in Lebanon: The Present

Between 1992 and 2002, there was a Power Sector Master Plan. The purpose of this plan was to rehabilitate transmission and distribution networks and to expand productive capacity. In fact, this plan was not effective, given that production never reached the load demand [4]. Since then, no significant improvements network has been made to the. There were several plans and several projects to save the area, but political obstacles hindered their implementation.

2.1. Power plants in Lebanon

The power plants in Lebanon are divided into two categories: thermal and hydroelectric (or hydraulic).

The seven thermal power stations of the EDL are:

- Three steam turbine plants (Zouk, Jiyeh and Al Hreasha).
- Two CCGT plants (Deir-Ammar and Zahrani).
- Two OCGT plants (Baalbek and Tire).

The total installed capacity of these plants is 2038 MW, but their current capacity does not reach 1700 MW knowing that the peak demand is 2500 MW [5,10].

3. Reform Strategy

A strategy that can be implemented is the decentralization of the electricity sector in Lebanon. This decentralization will be applied in such a way that municipalities in Lebanon invest in electricity generation projects. This can be from renewable energy systems or cogeneration systems because there is no need for big investments in installing these systems with their infrastructure. Municipalities will be able to link their generators to the Lebanese electricity grid. This will create decentralized production, and municipalities will be able to assist the EDL in controlling losses and assaults. And most importantly, this project does not need complex legislation. It will take less time than the rehabilitation of thermal power plants. Moreover, from an economic point of view, the government will not have to make large investments, and most municipalities will be able to pay for the investments because they will be affordable for them. The integration of cogeneration and renewable energy systems will have a very good chance. This will reduce pollution, and at the same time diversify the nature of the energies used. This will lead to using these energies throughout the year.

This strategy will be very efficient in Lebanon because it is independent of political conflicts, and it is very logical from a production-demand perspective. In fact, there will be a decentralization of billing and invoice collection, so that the EDL will save and at the same time it will have an electrical management role and not all the roles it had

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