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Importance of Adopting V2G Technology in Morocco

Ayoub Abida, Redouane Majdoul and Mourad Zegrari

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Ayoub ABIDA, Radouane MAJDOUL, Mourad ZEGRARI

Université Hassan II de Casablanca,
Ecole nationale supérieure d'arts et métiers de Casablanca
Laboratory: Complex cyber physical systems (LCCPS)
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Abstract. Considering the harmful effects of CO2 emissions and huge coasts of fossil fuels and geopolitical challenges, countries around the world established policies to adopt renewable energy sources, and to set up new laws the decarbonize their ecosystems of industry, transportation, residential, and other services In this work we present the energetic landscape in Morocco, and renewable energy sources, and some new strategies lunched by our country to achieve those goals, and we reveals the electric mobility actual and future status, and we calculate an estimated potential of energy that can be stored in Electric vehicle and hybrid electric vehicle batteries, for using it again when grid is on a critical situation and look for support from energy storage units.

Keywords: Renewable energy source, Electric Vehicle, Hybrid Electric Vehicle.

Abbreviations:

EV: Electric Vehicle

HEV: Hybrid Electric Vehicle

RES: Renewable Energy Sources

Introduction

Morocco and other countries are moving towards green energy sources to face those challenges and increase their independence on fossil fuels and international providers**.** Starting from the large part occupied by road transportation in CO2 emissions, and coasts generated, our country adopted many strategies to reduce those effects, by encouraging all

stakeholders of the road mobility ecosystem to move towards the electric mobility, by the exemption of EV/HEV owners from taxes, and by the participation of the government in these strategies by replacing its vehicle fleet by EV/HEV,

1 Energetic landscape in Morocco

1.1 Thermal generation

Thermal electricity generation is the pillar solution for electricity generation in the country. Thermal generation plants are the dominant solution in the electricity generation Moroccan landscape. This technology was the first to establish by Morocco in the 20 th century to generate electricity demand of the consumers. These plants rely on fossil fuels such as coal, natural gaz, fuel, which are transferred into heat energy. This heat energy is used to boil water in a very high temperature degree which give birth to a very high-pressure steam. The steam with high pressure leads to the rotation of a steam turbine connected to an electrical generator with a high rotation speed. In the framework of the SNDD (Stratégie nationale de developpement durable) (National strategy for sustainable development), The country is moving towards renewable energy sources faster than its moving towards thermal plants. But considering the advantages of thermal plants such as efficiency, availability, and controllability makes it irreplaceable at least in these coming years.

1.2 Interconnection:

Considering the modecity of Moroccan energy generation plants, and the high-power demand of electricity during the peak hours, the kingdom find itself obliged to import its electricity needs from its connection lines connected to Algeria, Spain. Aiming to more secure its electrical grid, Morocco is studying a new connection sub-marine with the United Kingdom and also with Portugal. Interconnection lines stay an effective solution to secure the national grid against tiredness so that against blackouts. But in other side, considering the cost of electricity, Moroccan treasury suffer from, because it finds itself in commercial balance incapability especially comparing with Spain, and geopolitical challenges makes this source of energy in the second class of Moroccan energy policy.

1.3 Renewable energy sources:

As we cited above, thermal plants and interconnection stay a good solution in one hand, but in other hand, considering CO2 emissions of fossil fuels, cost, and political challenges, Morocco find itself obliged to think about an electricity source that solve those problems, and aiming to be more independent from fossil fuels, and more independent from other provider countries. This solution can only be renewable sources which are primary sources that produce no CO2 emissions, and work at very lower

cost because it uses natural sources which are free. Currently Morroco succed to install o total capacity of 3950 MW of renewable energy plants. [1]

1.4 Solar plants

As the most popular renewable energy source, solar energy is the most used in energy generation mode, Morocco is one of the pioneer countries which used solar plants for energy generation on high scale and by big capacities to produce electricity and inject the produced in the national grid. Currently, Morocco has the two solar generation technologies, CSP (concentrated solar power) and PV (Photovoltaic), and each one has its advantages and drawbacks, for that Morocco rely more on PV technology for electricity generation. There are many years that Morocco began to inaugurate solar plants to produce electricity to support conventional plants. The kingdom is in progress of construction and also in planification for construction of new solar plants. Currently morocco has a total installed capacity of 750 MW [2].

1.5 Wind energy

As one of the first renewable energy sources used by human kind in leading mills. Wind energy is a renewable energy source which constitute the backbone of the RES landscape in Morocco, because of its high capacity of installation, and energy efficiency, despite of tis difficulty of installation and risks on humans and birds, it stays very benefic and useful if we deal with it in an aware manner which respect all the stakeholders. According to the Ministry of Energy Transition and Sustainable Development, Morocco has currently a total installed capacity of wind energy of 1430 MW [3]. Other plants are under construction, and others are in planification phase. The total capacity of wind energy plants will reach 4000 MW [4]in 2030.

1.6 Energy storage

RES are paramount for Moroccan energy system currently, and its importance will increase the coming decades considering financial crisis and geopolitical challenges. RES will be a lifejacket for Morocco against those coming challenges. But the drawbacks of RES are its intermittent character, and uncontrollability of produced energy because of the uncontrollability of meteo conditions (Sun, Wind). In Morocco, peak hours are the period between 18h00 and 22h00, at this period, the consumption of electrical energy increase at his maximum, which create a real problem on production capacity of generation plants. The peaks period of RES is at the mid-day for solar energy, that means during the normal hours, and for wind energy plants, its maximum production is during the night and especially during off-peak hours. This intermittent character, lead to renewable energy losses, because of the difference between peak hours of production and demand. To solve this problem, it clear that the energy pro-

duced from RES during their peak production hours should be stored and use it during peak hours' demand, when the grid really need support from energy storage plants. In this part we will present briefly the storage capacity in Morocco and technologies used in energy storage plants. Table 1, and figure 1 represents Moroccan energy sources current status, and 2030 predictions [5].

Table 1. Moroccan energy sources current status, and 2030 predictions

Year	2015	2019	2030
Thermal	5446	7070	12000
Wind	800	1455	4000
Solar	160	711	4000
Hydro	1770	1770	3000
Interconnection	3100	3100	5100
Storage Capacity	464	974	2224

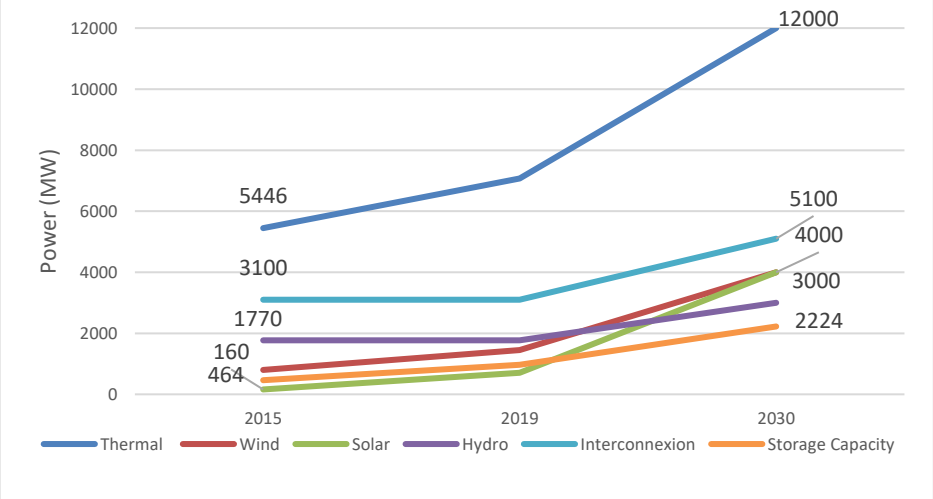

Fig. 1. Moroccan energy sources current status, and 2030 predictions

Analyzing this data which reveals the power and ancillary services status of 2015 and 2019, and predicted situations for 2030. It is clear from the curves of ancillary services in 2030, and comparing the storage capacity with the total power to be installed from RES, we find that RES total capacity is very high, the fact that leads to the incapability of this storage plants to accept all the surplus that comes from RES plants, which means that Moroccan electrical grid will lose an important quantity of energy because of the modecity of storage plants compared to RES plants. Considering RES (Solar, Wind, Hydraulic), the total capacity will reach 11 000 MW by 2030, but the

total installed capacity of storage energy plants will reach just 2 224 MW. That's means that the storage capacity at maximum will cover just 21 % of the energy produced by RES.

2 Moroccan EV/HEV fleet landscape

2.1 Moroccan efforts towards electric/hybrid mobility

In 2020, around the world, road transportation accounted for 23% of total CO2 emissions, which is a huge value considering its dangerous effects. For Morocco,23,23% of total CO2 emissions is due to road transportation, which is a harmful danger for environment and society, especially because the majority of Moroccans are concentrated in big cities.

In COP 21 in Paris, like other countries going towards energy efficiency and renewable energy sources, morocco, committed to set up strategies to reduce greenhouse gas emissions by 42% by 2030, committing to encourage all the participants and stakeholders to achieve energy saving of 48% in the industry, 23% in transportation sector, 19% in the residential sector, 10% in the service sector, and reduce the CO2 emissions in the transportation sector by 9,5% (50 million Tons). Moroccan government is currently moving fast towards this goal, by replacing 30% of its fleet (35 400 Vehicles) with EV/HEV, by 2030. To encourage private entities to move towards EV/HEV, since 2017, government exempted EV/HEV owners from taxes on their vehicles. Figure 2 [6] represents Moroccan EV/HEV current status, and 2030 predictions

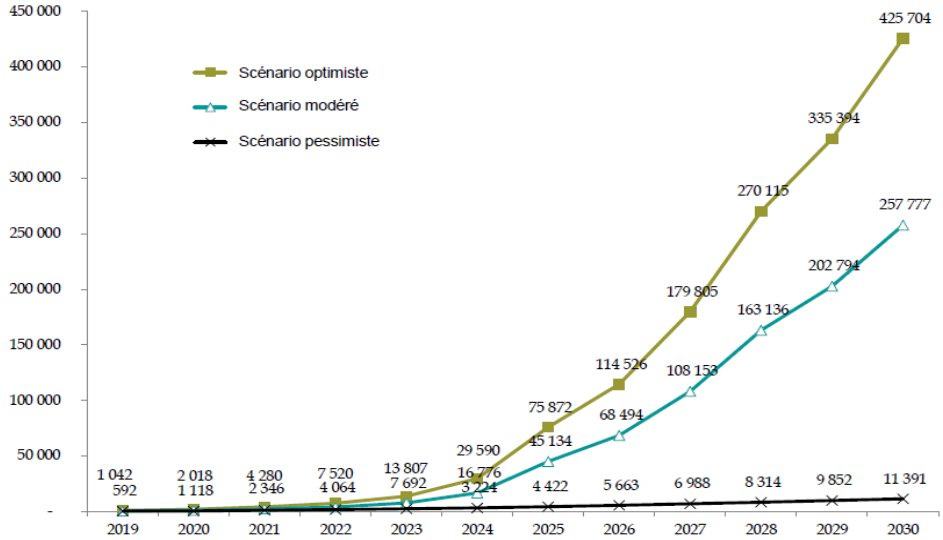

Fig. 2. Moroccan EV/HEV current status, and 2030 predictions

2.2 The potential of EV/HEV to support Moroccan electrical grid

V2G technology is a concept, and technologies that allow the EV/HEV to charge their batteries from the grid, and selling power back to the electrical grid when is needed, making a mobile energy storage unit. Figure 3 represents the architecture of V2G technology. And figure 4 represents chargers in Morocco inaugurate by IRISEN with charging power of 20 kW.

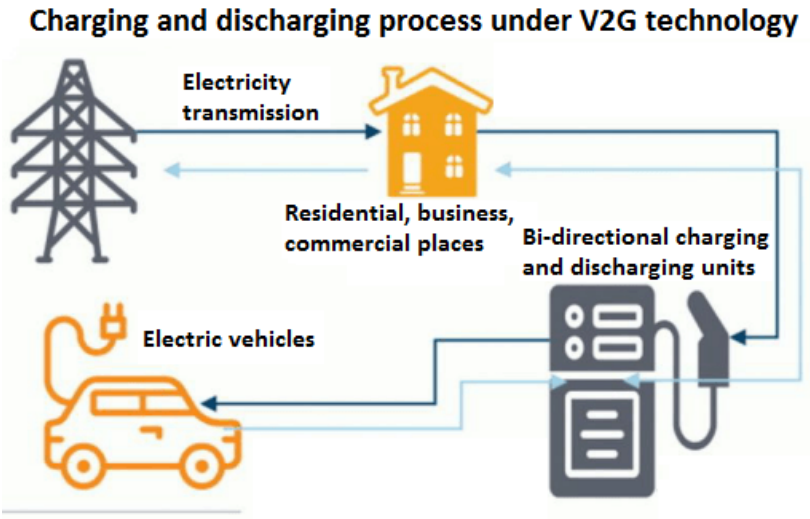

Fig. 3. A**rchitecture of V2G technology**

Fig. 4. Chargers in Morocco inaugurate by IRISEN, charging power of 20 kW

In Morocco, assuming in general that EV/HEV having a 20 kW as power of charging and discharging, and a total energy storage capacity of 50 kWh, we found that at 2030, considering the normal scenario with 257 777 EV, Morocco will have a storage capacity of 5.15 GW, and assuming that electrical grid will not absorb totally the

energy stored in the battery vehicle, Moroccan grid will have a support of more than 6.5 GWh considering 50% of energy stored (25 kWh). Another thing which is very encouraging is that cars are moving on the road just 5% of their total lifecycles. It is clear that Morocco will have a high EV/HEV penetration at 2030, which will be a huge charge for the grid, so to benefit from this problem, we suggest to adopt V2G technology to make this challenge a revenue for the state and for the EV/HEV owners.

Conclusion and perspectives

Ton concludes, this work is an overview of Moroccan ancillary services, and goals targeted by Moroccan government in order to set up system of renewable energy sources and a fleet of EV/HEV, and we presented the necessity of the adoption of V2G technology on Morocco to face the coming challenges, considering the problem of power call of the EV/HEV fleet, Moroccan grid will face a problem of incapacity, so it is important to manage the charging and the discharging those vehicles. For that Morocco has to set up strategies to predict the energy exchange between the electrical grid and EVs, for that we propose to present in the next work the methodologies and algorithms used in predicting the EVs charging times and energy consumption to avoid the incapability of the grid.

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