Electric Energy Value Chain In Morocco

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Abstract: The electricity sector plays a crucial role in the economic and social development of our country. Today, access to this energy is a fundamental right. Electricity has gradually become a necessity in our daily lives. In addition, the electricity sector is the workhorse of our national economy, in which the country is exploiting all its efforts to get out of its dependence on the outside world. These, are all the arguments that favor an option to promote and develop renewable energy. The electric value chain consists of the following links: production, transport, distribution.

Index Terms: Value chain, Electrical energy, Analysis, Cost of electricity, Production, Transport, Distribution

1. INTRODUCTION
All human activities, including those that contribute to economic and social development, rely on energy. Indeed, the development of a society results in the increasing satisfaction of a certain number of needs: food, education, housing, recreation, health, transportation, etc. All these activities require, to varying degrees, the use of final energy in different forms (fuels, electricity, etc.). Therefore, access to modern energy services is essential for economic and social development. In this respect, the global energy context is rapidly changing under the influence of a number of factors, including demand trends, industrial development and technological developments. Indeed, given economic development and population growth, the world is experiencing a sharp increase in energy needs. This energy demand is mostly covered by the use of fossil fuels. According to the latest report prepared by the Renewable Energy Policy Network for the 21st Century, global final energy consumption is dominated by fossil energy sources like oil, natural gas and coal, at nearly 78.3% in 2013. Morocco, which is no exception, relies heavily on imports of fossil fuels to meet its energy needs, with respective proportions of 95% and 80%. In fact, in 2014, energy consumption stood at 19 million TEP against 10.5 million TEP in 2002. An increase of 80%. Nowadays, electricity has become a staple and represents a major challenge in our societies. This can be translated, among other things, by an analysis of the value chain of electrical energy in order to study the current state of the Moroccan power sector. As an effect, a value chain is an analytical tool that allows to detail the different stages of the supply of raw material to the final consumption. According to Mr. Porter (1986), the value chain is "the firm in activity relevant to the strategy plan". Thus, this concept is taken up in industrial economy, defined by J-M. Chevalier (2000), "as an organizational sequence which, starting from the initial value of raw materials (or intangible products such as knowledge), adds value during different stages of transformation, manufacture, transport, storage, made available to eventually lead to the sale of a product". In the case of electricity, the value chain assumes a linear progression from production to consumption.

The literature review has revealed numerous articles and studies over the years. Among the research carried out, an analysis of the restructuring of energy value chains in Europe (Benoît ESNAULT, 2002) indicates that deregulation and the new economy have brought the electricity market into a new and more competitive era, offering new strategic opportunities. The new information technologies have made it possible to reduce transaction costs and make it possible to use electricity networks by a large number of operators, facilitating dispatching and counting. Our goal is to conduct a meticulous study of the internal environment in order to highlight the strengths and weaknesses of electrical energy in Morocco. We will introduce the value chain to identify the sources of competitive advantages available to this sector.

2. METHODOLOGY
We studied the electricity sector market in Morocco through an analysis that interprets several documents, articles and reports belonging to different organizations. A value chain has been developed to present the main characteristics of the Moroccan energy context.

3. RESULT
3.1 Electricity Sector Organization
Currently electricity generation is largely provided by the National Electricity Board (ONEE) representing 50.1% of the electricity produced in 2013 - generates the bulk of the country's electricity, manages the transmission network and has the status of sole purchaser of injected electricity - and this done by three main private generators:

- Jorf Lasfar Electric Company- JELEC-, consisting of coal plants and represents 36.6% of the electricity produced
- Tahaddart Electric Energy with natural gas - EET- with a percentage of 9.8% of the electricity produced
- And Detroit-CED-Wind Company - representing 0.6% of the electricity produced

The remainder of the production is provided on one hand by the third party producers who are mainly industrialists representing 0.4% of local production in 2013, in particular chemistry, which produce electricity from exothermal chemical reactions brought into play during their normal industrial activity. These include: MOROCCO PHOSPHORUS, MAROC CHEMISTRY, PHOSBOURAA, CMCP, SCP, SAMIR CELLULOSE OF MOROCCO COSUMAR and other industries including some other national sugar mills. On the other hand, by fuel plants that produces 16.6% of the country's energy by running on fuel. In addition all these auto producers are connected to the ONEE network. Despite all the efforts made
by the ONEE and private investors to develop local production capacity, the national supply does not allow to sustain high demand, which makes the import of electricity from Spain and Algeria a vital necessity. Morocco completes with imports to meet the country’s energy needs. In addition, another group of operators is involved in the Moroccan electricity sector, which is the municipal and intercommuned authorities, 12 of which are responsible for distribution in the major cities of the Kingdom.

2.2 Determinants of Electricity Cost

The electric value chain consists of the following links: production, transport, distribution

a) The production of electricity

Today electricity production is partially open to the private sector, however the storage of electricity in large industrial quantities is not yet achieved. These two dealers who are already installed bear a large part of the risks related to the fluctuation of the price of raw materials when buying bulk of their electricity. For this reason Morocco needs to revisit its regulatory framework in order to find the proper balance between regulation -tar selling sales to end customers, wholesale electricity sales prices, and the market mechanism.

At the end of 2015, the total installed capacity of the office’s electricity generating capacity was 8158.5 MW against 7994 MW in 2014, of which 33% is from a renewable source. This production is provided by thermal power plants, hydro, gas turbines and diesel plants. In addition, ONEE’s generating fleet, which plays an important role in meeting demand at peak hours, consists of 24 hydroelectric plants, 5 steam power plants, 7 gas turbines, several diesel plants and one wind farm.

b) The transport

The electricity transport market has been a monopoly of the ONEE since 1963. It is a mesh network with an interconnection between the means of production. It includes very high voltage lines (400KV, 225 KV, 150KV), high voltage lines (60KV) and medium voltage lines (20KV, 22KV, 30KV and 55KV). At the end of 2015 the total of the transport lines THT and HT reached 24508 Km including the realization of 3753 km in the period between 2009 and 2014. In addition, the national transport network is interconnected with the Spanish and Algerian power grids. Today Morocco has become an energy crossroads between the two shores of the Mediterranean.

c) The distribution

The distribution of electrical energy is insured either by municipal or intercommuned authorities under the supervision of the Minister of the Interior for the major urban centers. They are:

- Seven communal distribution boards in El Jadid (RADEEU), Fes (RADEEF), Kenitra (RAK), Marrakech (RADEEMA), Meknes (RADEM), Larache (RADEEL) and Safi (RADES)
- Four private concessionaires in Casablanca (LYDEC), Rabat (REDAL), Tangier and Tetouan (AMENDIS), either directly by ONEE, which covers all the other cities with a market share of 44% and almost all rural areas through the Global Rural Electrification Program (PERG).
- Cost of production in 2013

According to the report of the court of auditors, it appears that the price of KWh produced from special and standard fuel is three times higher than coal and twice than of natural gas. Indeed the KWh produced by the special and standard fuel costs respectively 2.06DH and 1.57 DH against 0.69 DH for the product from coal. With the high demand for electrical energy and the risk of electricity interruption (deballasting), these two kinds of fuel became necessary because of its use by the ONEE as fuel for the operation of its gas turbine. As a result, the fuel consumption of ONEE continues to grow, recording 304,017 in 2013. The graph below shows the evolution of the amount of fuel consumed by ONEE.

Graph 1: The Evolution of the Amount of Fuel Consumed by ONEE.

According to the graph, we see an increase in the ONEE fuel standard between 2008 and 2013, thus we notice the appearance of the special fuel at the beginning of 2009 and which is progressing significantly, year after year. On the other hand, the amount of fuel consumed by ONEE has decreased. This can be explained by the increase in the production of hydro-based electricity due to the exceptional rainfall and dam retention levels and wind growth. In addition, fuel oil was a highly subsidized product between 2009 and 2013. Average subsidy rate increased from 41% to 176%. The evolution of the ONEE fuel compensation charge is as follows:

Graph 2: The Evolution of the ONEE Fuel Compensation Charge

From mid 2008 to August 2014, the ONEE-BE bought electricity at fixed prices, the unit subsidy therefore varied with the prices of oil imported in Morocco. According to the Clearing Fund statistics, the ONEE special fuel compensation bill was DH 7.7 billion and the standard fuel oil bill was DH 16.1 billion. In July 2014, the government decided to abolish the subsidy for fuel oil N°2 and special fuel oil purchased by ONEE-BE. This resulted in an increase of 0.14DH/Kwh in the production of fuel oil electricity. The withdrawal of the fuel subsidy, as calculated at the end of 2013, would impact sales prices up to 0.19DH / Kwh. However, reductions in subsidies have a positive impact on the fund and give more economic
opportunities to renewable energies. As a result, a new 2013-2020 equipment plan focused on coal and renewable energies was established to cope with the evolution of electricity demand over the next few years and the financial burden of the fuel that rose between the 2013 and 2016 before declining from 2017 after the entry into service of new plants.

2.3 Price of electricity sold:
Today, ONEE, the leading producer, transmission and distribution of electricity in Morocco experienced an unbalanced financial situation that results in:
- A net deficit of 2.3 billion dirhams and, in the absence of any reform, will reach 7 billion dirhams in 2017;
- A debt of Dirham 56.9 billion, in addition to an internal pension fund commitment of Dirham 17.95 billion;
- A negative net cash flow of 4.8 billion dirhams, which will reach, in the absence of any reform, 38 billion dirhams in 2017.
This is mainly due to the sharp increase in demand for electricity. In 2015 electricity sales reached 29831 GWh, an increase of 1.9% compared to 2014. On the other hand, the rise in input costs leads to an explosion in cost while the selling price remains stable. Indeed electricity is sold at a loss, ONEE lost 0.36 for each KWh or 28% of cost. To cope with the financial deficit recorded in the accounts of the Office, improve the treasury situation and guarantee the availability of electrical energy. A new tariff and billing system for electric power distribution services comes into effect. Following the signing of a program contract between ONEE and the State over a period of 2014 and 2017, a new tariff schedule was launched by the ONEE to reduce electricity consumption. It's about a
- Rate increase allocated from 1 August 2014 over the duration of the program contract in order to ensure the necessary balance between the cost price and the selling price of these products.
- Application of selective pricing beyond social tranches for low voltage customers with consumption exceeding 150KWh/month.
- Creation of two new consumption units (between 101 and 150KWh and between 301 and 500KWh).
The electricity sales rates applied to customers connected to ONEE’s distribution network are set by order of the Minister delegate to the Head of Government in charge of General Affairs and Governance. However, the electricity prices distributed in the cities of Rabat, Tangier, Casablanca and Tetouan (distribution in delegated management) are fixed contractually. The official electricity rates depend on the voltage used, the amount consumed and the period of consumption.
  a) Sales prices for electrical energy supplied by ONEE to customers
The graphs below show the evolution of the base rates for selling electrical energy to very high voltage (225 KV) and high voltage (60KV) and medium voltage (22KV and 5.5 KV) distributors between 2014 and 2017:

Firstly, we note that the annual rate of change of the basic rates of sale of very high voltage is identical to that of high voltage and medium voltage. The graphs show us that a new "peak hour" consumption fee has been created from 1 January 2016. This occurrence led to a decrease during the year 2016 of 10.45% for peak hours and 3.77% for off-peak hours. However, as of January 1, 2017 the rates of THT, HT and MT saw an increase of 6.19% for peak hour consumption, 4.26% for peak hours and 2.72% for off-peak hours.
  b) Tariffs for selling electrical energy to consumer customers
For customers connected to a first class network Low voltage electricity rates have not changed since 2009, when they increased by more than 10% over the 2014-2017 period, due to the sharp increase in the prices of different fuels used for electricity generation. The following graph illustrates the

In the low voltage, six tranche of consumption are fixed against four previously, two new slices have been created: 101 to 150KWh and 301 to 500KWh. According to the graph we note that the price increase under the program contract will only affect households consuming more than 100KWh/month the price remains 0.9010DH/KWh during the 2014-2017 period. According to the government, modest revenues will escape this increase, 4.1 million subscribers. Consumption ranges from 101 to 150KWh and from 151 to 200KWh increased from 0.9689 DH/KWh to 1.0732 DH/KWh. For the range from 201 to 300KWh, this is the case of 600,000 subscribers; the price reached 1.1676 DH/KWh in 2017 against 1.0541 DH/KWh in 2014. In addition, those whose consumption is between 301 and 500KWh (300,000 subscribers), the tariff amounts to 1.3810DH/KWh compared with 1.2474 DH/KWh in 2014. The 100,000 subscribers of more than 500 KWh, the price of KWh was 1.4407 in 2014 and reached 1.5958DH/KWh. Low voltage increased electricity prices by 10% over the period 2014 to 2017.

For customers connected to a second category network: Since 1997, the public authorities have reduced the cost of industrial electricity by 34% over a period of four years in order to contribute to the competitiveness of Moroccan companies. However, the sharp increase in the electricity prices of the different fuels used for the production of electricity has increased the costs of the ONEE. This graph below shows the evolution of ONEE’s basic tariffs in very high voltage, general high voltage between 2014 and 2017.

According to the graph, we find that in the case of the general tariff THT, HT, The power charge increased by 31.5%. When at the kilowatt hour rate in “peak hours” knows an increase of 4.8% over 4 years, 6.07 for the option “full hours” and 23.63% for the rate “hollow hours”. Clients connected to a third category network include customers of THT,HT powered from

Graph6: the evolution of ONEE’s low-voltage domestic tariffs between 2014 and 2017

Graph7: the evolution of the basic ONEE tariffs in general medium voltage

Graph8: the evolution of ONEE’s basic tariffs in very high voltage, general high voltage
60 to 225 KV. These are direct accounts customers operating in the mining, cement and other industrial sectors. The rates of THT, HT in a general tariff, an optional THT, HT tariff and an optional THT, HT "super tip" tariff.

4. CONCLUSION AND DISCUSSION

We can conclude that the new tariffs established by the program contract come with a VAT rate of 14%. They are differentiated by voltage and consumption category. The tariffs also include tariff options per time band, as defined by the said stop correspond to the GMT hourly system. In the event of a transition to GMT+1, these hourly shifts will have to be modified accordingly. In addition, customers connected to a third category network. Those linked to ONEE by an exchange contract, the price per kilowatt hour is 1.1164 DH in 2017, an increase of 14.43%. As for the rate applied to customers Very high voltage, High voltage, the fixed premium is 494.09 DH/KVA per year. To avoid peak consumption in peak hours, between 17 and 10 pm in winter and 18 to 23 pm in summer, a consumption charge has been established based on hourly shifts. In this respect, the rate was set at 1.3645 DH/KWh in peak hours, 0.9736 DH/KWH in full hours and 0.7131 in off-peak hours. The THT, HT rate includes a charge of power billed according to the power subscribed annually. It also includes a charge for exceeding the subscribed power. In the case of the optional THT,HT tariff, the very short use was created. This option is for companies whose average annual power usage does not exceed 1000 hours. It is the most expensive in peak hours. Indeed, the price of the kilowatt hour is 1.8638 against 1.6066 for the short use, 1.2183 for the average and 0.7648 for the very long use. A "super-peak" tariff has been introduced to encourage large industrial companies to reduce their consumption during peak hours. It is two hours over five hours (18 to 20h in winter and 19 to 21h in summer). Regarding the average voltage, the optional tariffs have been replaced by the general average tariff. A green tariff for agricultural use has been established for the regional offices of agricultural development for their consumption relating to the pumping of water and irrigation both the organisms and the state companies for their consumption relating to the activities of production plant and animal. The new pricing also affects customers connected to the first category network. Low voltage electricity sales rates are progressive on the basis of monthly consumption. 0.9010 for a range of 0 to 100KWh, 1.0732 for customers with a consumption of 101 to 150 KWh and 151 to 200 kWh, 1.1676 for 201 to 300KWh, 1.3817 for 301 to 500KWh and 1.5959 KWh for a consumption that exceeds 500KWh. Thus, the ONEE proposes a price based on the subscribed power. In the case of the optional THT,HT "super tip" tariff. For professional BT subscribers, there are 9 types of contracts (in rural, urban and bi-hour) with 19 KWh rates.

Faced with the complexity of the tariffs presented above, the two graphs below show the essential through the average prices of electricity sold by ONEE to the different customers in Morocco. The average price of the electricity mix was calculated taking into account the different contributions of each.

Graph 9: Moyenne des prix de l'électricité fournie par ONEE aux clients distributeurs:

Graph 10: Moyenne des prix de l'électricité fournie par ONEE aux clients consommateurs

The prices of KWh are the same in the ONEE-BE zones of action and municipal authorities but slightly higher in the areas granted to the private sector. To maintain the growth of the country and ensure its development, Morocco must face the problem of supply and energy adequacy. Indeed, optimization of consumption is necessary to balance the electricity market. To achieve this, the ONEE has launched a number of awareness-raising measures aimed at industrial enterprises to encourage them to shift their consumption outside the country's peak consumption. Thus the equipment of the public lighting of the country allowed significant gains. In addition, efforts have been made for residential consumers such as, for example, the "15 minutes eco" encouraging households to use only one light bulb between 21h30 and 21h45.

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