

NUCLEAR POWER AS AN ALTERNATIVE SOLUTION TO ENERGY ISSUES IN EGYPT

A.E.A. Soliman, B.Sc.
Supervisor E.A. Efimova

Abstract: This article discusses the energy problems in Egypt, evaluates the possibilities of nuclear power as an alternative and potential source of power, and introduces to the reader the nuclear power project in Egypt which will be funded by Russia.

Keywords: Energy, Power generation, Nuclear power, Environment

Overview of the Energy sector in Egypt:

Egypt is a country with relatively high potential of natural resources: oil, natural gas, coal, wind and solar energy. Egypt has the 3rd largest natural gas reserve in Arica which estimated to 72.8 trillion cubic feet. And has the 6th largest oil reserve in the African continent with approximately 3.3 billion barrels. Egypt is by far the largest consumer of oil and gas in the continent. Egypt's consumption is estimated to be 22% and 37% of the total continent consumption of oil and natural gas, respectively. Egypt has always been relying on two major sources to produce electricity: oil and natural gas which to produce around 90% of the total capacity of electricity in Egypt. In 1990s, Egypt was a major oil producer and net oil exporter and has become net oil importer around 2009/2010. Egypt has the largest refinery in Africa at nominal 840000 barrels per day. But in 2017, the production output of this refinery has dropped to 508000 barrels per day. The hydropower in Egypt has been exploited, and its share in the total energy production is limited to 3.3%. The renewable energies (like wind power and solar energy) have not increased to a significant extent, and still have a minor role in the production of power in Egypt. The total final power consumption has dramatically increased from 40.66 MTOE in the year of 2000 to 86.75 MTOE in the year of 2013. the

power generation reserve capacity has declined from 20% in the early 2000s to 10% by the 2010s. The constant increased demand for electricity is one of the main issues in the energy sector that Egypt due to urbanization and the construction of new cities and residential compounds, industrialization and the construction of new industrial plants as well as the Dynamic growth of population [1,2].

Table 1. Production and consumption of energy sources [5].

Power Source	2010	2011	2012	2013	2014	2015	2016	2017	2018	Growth Rate in 2018
Overall Energy Consumption	78.4	79.7	83.8	83.2	83	85.3	89.9	92.6	94.5	2.10%
Oil Consumption	37.4	34.8	36.5	36.9	39.5	41.1	42.1	39.2	36.7	-6.40%
Natural Gas Consumption	37.3	41.1	43.5	42.6	39.7	39.6	42.4	48.1	51.2	6.50%
Coal Consumption	0.5	0.4	0.4	0.4	0.4	1.1	1.7	1.6	2.8	68.70%
Hydropower Consumption	2.9	2.9	2.9	3	3.1	3.1	3.1	3	3.1	0.60%
Renewable Consumption	0.3	0.4	0.4	0.4	0.3	0.4	0.6	0.6	0.8	28.10%

Nuclear power as a reliable source of power:

Nuclear power has proved that it is a very reliable source of electricity. There is no debate over the efficiency of nuclear power as one of the best sources of power generation. But the controversy is about nuclear health and environmental risks, as well as nuclear disasters. Nuclear power could sustainable energy if it will be used with optimum safety standards; from uranium mining, design of reactors to handling nuclear waste. Nuclear accidents are tremendously dangerous, that is why the safety is regarded as the most important factor in a nuclear power plant. And as with every source of energy, nuclear power has advantages and disadvantages. Some of the advantages of nuclear power are: It is a Reliable source of energy as one gram of uranium produces about 8000 times more electricity than one gram of coal. It has the highest power capacity available; the maximum production capacity of power sources as follows; 92.5% for nuclear power, 56% for natural gas, 52.7% for coal, 38% for hydropower, 34.7% for wind

power and 27.2% for solar power. Nuclear power is relatively cheap source of energy in the long-term. Nuclear power has no carbon dioxide emissions [3].

Table 2. Average Power Plant Operation, maintenance and fuel Expenses for Major U.S. Investor-Owned Electric Utilities, (*Mills per Kilowatt-hour “kWh”)

*A mill is a billing unit equal to 1/1000 of the U.S. dollars [4]

Year	Nuclear power plant	Fossil fuel plant (steam turbine)	Hydro-electric plant	Solar Photovoltaic / Wind turbine
2016	25.36	36.08	10.98	30.19
2017	24.38	35.41	10.29	31.76
2018	23.86	35.86	10.65	32.43

Nuclear power in Egypt:

Egypt’s need of a nuclear power plant has reached its peak nuclear power is due to the needof an alternative source of energy to compensate the decline in the fossil fuels production, and the constant increased demand for more power supplies. In 2015, Egypt has signed an initial agreement contract with Russia for the construction of the Nuclear Power Plant (NPP). Then, in 2017, Egypt and Russia have signed a construction contract of the NPP. The official name of the NPP will be “El Dabaa Nuclear power plant”. The site location of the NPP will be in El Dabaa in North coast, Egypt. The construction is planned to start in 2020. The project will cost \$28.75 billion. Russia will fund 85% of the total project’s cost which is estimated to be \$25 billion, and the other 15% will be funded by private investors. Russia will lend Egypt the loan over a period of 13 years, from 2016 to 2028, with an interest rate of 3%. In 2029, Egypt should repay the loan in 4 installments over a period of 22 years. By 2029, Egypt should gain an estimated revenue of \$17 billion. This project is an EPC project where the Russian state-owned company Rosatom will be fully responsible of the engineering, procurement and construction of the nuclear power plant, as well as nuclear fuel supply (NFS)

throughout the plant's entire lifetime, spent nuclear fuel (SNFT) and also responsible for the commissioning, operation and the maintenance. Rosatom will build four nuclear reactors type (VVER-1200) with an overall production capacity of 4800 megawatts. The cooling source of the NPP will be the Mediterranean Sea. The type of the power cycle will be "cogeneration", which mean the NPP will produce electricity and heat simultaneously. This NPP will provide Egypt with 50% of Egypt's total capacity of electricity. This project will create 50000 job opportunities. The environmental factor plays a very important role in this project. The reactors will have high safety standards, taking into accounts new safety methods developed after 2011 Fukushima disaster in Japan. This reactor will be able to withstand earthquakes up to 9 degree on a Richter scale, as well as a crash of 400 tons airplane. The reactors will have with a "core catcher" to contain the molten reactor core to minimize the risk of nuclear disaster [6,7].

Conclusion:

Renewable energies are very promising source of power. But currently, they are not a reliable enough and expensive to be the main source of power generation. That is why Nuclear power could be an alternative solution to the energy crisis in Egypt. it also could be sustainable and environment-friendly if it will be used with the highest standards of safety and with extreme caution. Nuclear power plays an important role in broad technological and scientific applications, and has a good long-term value-cost ratio, which means it will contribute to the economy.

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ELECTRICITY COSTS IN COLOMBIA

A.M. Alvarez Camargo
Supervisor E.A. Efimova

Electric current is the movement of electrons in large quantities. Electrons are tiny particles that are in constant motion in all the material things we know. Voltage is the force that pushes these electrons in a desired direction. Electric energy is the movement of electrons with a certain force. This energy is used to operate devices that produce heat (stove, iron), light (bulbs) or movement (blender, vacuum cleaner and motors in general). This electrical energy is measured according to the work it does during a certain time. Its unit of measurement is