

Effects Of Population Growth On Electricity Consumption In Egypt For The Period 2004-2020

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Abstract: Many countries in the world have witnessed significant increases in population, and Egypt is one of these countries that has witnessed high population growth, which has led to an increase in demand for and consumption of electric energy because it is involved in all areas of human life.

Accordingly, the research aims to know the most important effects that the population growth in Egypt has on the total electricity consumption and the per capita share of it, and its impact on the various uses of electricity. To reach the desired goal of the research, it was relied on the descriptive analytical method in analyzing the evolution of the indicators under study depending on the data available on this topic.

The researchers have concluded that the growth of the population size has contributed to raising the level of consumption in all areas of electrical energy use, taking into account the impact of other factors, in some years that may have caused a reduction in electricity consumption in various sectors, such as the economic reforms in the energy sector that Egypt followed and the pandemic. corona. **Keywords-**

Population Growth, Electricity Consumption.

I. INTRODUCTION

As one of the most important pillars of infrastructure and the mainstay of social and economic development projects and plans, electric power is the foundation of contemporary development in its social and economic aspects .

In addition, the number of people in the world who have been living in the world has increased by the number of people who have been living in the world since the end of the world, the number of people who have been living in the world has increased by the number of people who have been living in the world has increased by the number of people

As for Egypt, the increase in the population during the study period has contributed to increasing the electricity consumption in its multiplier forms

Based on the above, we will know the most important implications of population growth on electricity consumption in Egypt for the time being

II. Research Methodology

The importance of research:

The importance of research comes from the fact that electricity is the backbone of the national economy and is reflected in its clear role in all economic sectors and its impact on development. Consequently, meeting the increasing demand for it resulting from the increase in population and urbanization resulting from migration and displacement is a " real " challenge for the state, therefore it must be They must meet it by developing and implementing plans and strategies to meet the growing demand and consumption of electricity.

Research objectives:

1- analyzing the development of population growth in Egypt during the study period and its impact on total electricity consumption and average per capita share.

2-explain the effects of the growth in the size of the population in Egypt on the consumption of electricity in various fields.

3-to know the effect of the growth in population size on the number of subscribers to the electric grid in Egypt.

Search problem:

The problem is posed by the following question: Did the increase in population and the acceleration of its growth rates in Egypt have positive repercussions on the demand for electricity for multiple uses?

Research hypothesis:

The increase in population size and the rise in population rates in Egypt positively reflected on electricity consumption in Egypt during the period 2004-2020.

Research Methodology: In order to achieve the objectives of the research, the descriptive analytical approach has been used to analyze the evolution of the indicators under consideration through the data available on the subject.

III.Part Two: Theoretical background and hypothesis development

First, population growth is a theoretical framework

The concept of population growth and its importance:-

The study of population growth is one of the main pillars of population studies that are of widespread interest to researchers, as it is an important subject that affects the dynamics of the population

Society resulting from population growth or decline through life activities such as births that represent the factor of increase in society while deaths represent the factor of decrease in society, as well as migration whose effect is determined by its trends (Tishodar, 2015, p. 42).

Population growth, in its simplest sense, means the difference between birth rate and mortality rate, which represents the natural rate of increase.

Population growth is defined as the rate at which the population increases in the middle of a given year due to natural increase and net migration and is expressed as a proportion of the indigenous population. Some have known it as the change in the population of a given country over a certain period of time.

It is also defined as the difference in the size and number of the population of a society over a given period of time, represented either by the trend of increasing numbers due to births and emigration, or by the decline resulting from deaths and emigration (Halabi, 2006, p. 34).

The change in population groups in a specific period has been known to some people, and the quantitative estimate of this change is reflected as a change in population per unit of time.

Others defined it as the change in the size of the population, either by the increase or decrease resulting from births, deaths, and emigration (Fatima al-Zahraa, 2019, p. 474).

The importance of studying population growth is highlighted in the following:

- 1- This will give a realistic picture of the characteristics of the population, the trends of growth, the birth rate and the death rate, which makes it an important source of planning.
- 2- Study population changes related to fertility, births, deaths and migration and their relation to gender variables (male and female) and age and determine the appropriate methods and orientations for all these changes so as not to lead to demographic imbalance.
- 3- The study of population growth is of great importance in being one of the main inputs to economic and social planning, on which labor market planning and educational planning depend, thus contributing to determining the population of economic activity age and to estimating the society's potential of human resources from the productive labor force.
- 4- identify the possibility of population attraction and expulsion and define human settlement policies.
- 5- This is the first time that the government has been able to do so.
- 6- This will help to make estimates of the need for the community in terms of health and environmental services in the infrastructure sector.
- 7- Population growth helps reveal the possibility of environmental, economic and social problems in certain areas of society, such as environmental pollution, congestion, unemployment and urban encroachment on agricultural areas.

Thus, it gives early warning to decision makers or planners to prepare preventive policies and measures to avoid problems. It should be noted that estimating the population rate over long periods of time greatly reduces its usefulness because the variables of growth, whether natural growth or migration, change rapidly in relation to changes in economic, political and social circumstances surrounding the future of the State (.Mowlana ,2001).

Effects of population growth:

Humanity is in conflict with the forces of demographic changes, the most prominent of which is the rapid population growth in some developing economies and the attendant urbanization and international migration, and it has many effects and repercussions

It can be mentioned as follows: (Demographic window 2005)

A- Economic effects :-

- Savings, investment and income

Age distribution of the population, at a certain stage, the impact may be positive or negative depending on the growth of the working age population and the growth of the population meaning, in other words, the higher size of the aging population relative to the working age population will lead to a higher proportion The negative impact of the financial implications (remittances and services for the elderly), economic growth and poverty reduction, as the level of savings decreases as a result of higher numbers of dependants

When the volume of saving in the society is weak, the volume of investment will decrease, thus weakening the ability of the society to carry out investment projects, thus hindering the economic development process, and vice versa in the event of a rise in the population of working age and low rates Support, this will increase saving, investment and the potential for growth of per capita income (Merghani, 2021).

Population growth and capital formation

The increase in the population growth rate leads to a decline in per capita income, which aggravates the problem of capital formation, as it can be said that the little the financial material and the abundant labor element, the lower the capital ratio for each worker and thus his income decreases.

- Population and income distribution

Population growth has an adverse relationship with equity in income distribution, since this relationship is based on two basic assumptions:

Rapid population growth and the associated rapid growth in the labor force will cause yield declines for scarce elements, especially land and capital, adversely affecting wages in overall output, thereby worsening the overall distribution of income.

Population growth and the associated high dependant-force ratio reduce savings and impede investment in education and physical capital. This effect is negative for poor families with higher fertility and a higher average family number than for better families, resulting in greater income inequality The families (Ajamiya, 1984, p. 346-348).

- Impact of population growth on consumption

The accelerating population growth in any society will inevitably lead to an increase in the demand for consumer goods (essential and luxury) and for services, putting pressure on society's development process and on available resources, forcing many countries to resort to imports or meet growing demand for them (Naim, 1999, p. 142-143).

B- Social effects :-

Unemployment:

Population growth is a social cause of unemployment, as high-rate population growth leads to higher labor force growth, which leads to the need to create new jobs, i.e. the expected relationship between population growth and unemployment is a direct one (on, 2013, p. 112).

- Population and social services:

The rapid population growth in developing countries, their low income, the deficit of most of their budgets, and the multiplicity of their fields of expenditure have made it difficult to meet the increasing requirements of their population in the health, education and public services sectors. We also note the expenditure in providing adequate housing in these countries (Igen, 2003, 44).

The increase in the population may directly put pressure on the educational, health and housing services needed to meet the needs of these populations, resulting in overcrowding of schools with large numbers of students and the inability to provide educational needs due to the decrease in the amount of government expenditure per student as the population increases In the case of education services, the higher population will lead to increased demand for health services, which may be inaccessible due to the lack of adequate health structures to accommodate the growing population and its concentration in urban areas rather than rural areas, or because of their high costs Health sector spending in many developing countries is only a fraction of what is required to provide health services and cope with population growth leading to higher mortality (Fatima, 2017).

One of the problems created by population growth is the growing need to provide shelter, as the housing crisis is one of the most important challenges facing both developed and developing countries and societies, and the problem is most prominent

(Developing countries) as a result of population increases due to natural increase and migration that have led to inequality between the number of housing and the need for it, there is a direct relationship between population growth and demand for housing (Triki, 2014, p. 63)

The **first** is the lack of housing units in place that do not cope with the increase in population, and the second is the existence of housing that is inadequate for housing as a result of the deterioration of services and infrastructure in residential areas. This crisis is exacerbated by the inability of some governments to adopt proper housing policies to solve this crisis, which was reflected in the emergence of a clear housing deficit, high rates of family size, high rates of overcrowding in distance, and the emergence of random settlements and overtaking of agricultural land (Nashour, 2012, p. 239-243)

C- Environmental impacts:

It is natural for the increase in population to be accompanied by an increase in the demand for environmental resources, and to maintain the balance between population and resources, individuals have

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tended to raise agricultural productivity for fear of disrupting the balance of food security, and with the rapid increase in population and the attendant consequences of the agricultural and industrial revolution, which has depleted non-renewable environmental resources (Oil, metals, groundwater) The deterioration of the surrounding environment has resulted in pollution of water, air and soil. In addition, the increase in rural-urban migration in many developing countries has led to an increase in population density, overcrowding in large cities, unplanned random housing and lack of sanitary conditions (Abu Dya, Hatog, 2009, p. 283). The growth of the population has contributed to the depletion of natural resources, environmental pollution, and the physical encroachment on agricultural land, which is the natural result of the increase in the world population, the use and consumption of resources, and the release of more industrial and human waste, which has adversely affected water quality

Second: The consumption of electric power in a theoretical approach

This is the first time that you have been working on a new generation of new technologies

In the early years of the early years of the early years of the year, the government has been able to provide a new and more efficient service to the public, and to provide a more efficient and effective service to the public And wind energy or energy stored in a substance such as conventional fuel

This is a list of the most common types of energy in nature, which can be generated in a variety of ways, including kinetic, photovoltaic, and the two cases of daily life, whether domestic, industrial or commercial, and the energy stored in charged particles in the atom, which generates an electric field surrounding it. (Al-Waffe Al-Tayeb, 2021, p. 465). As employment expanded, people's lives improved, electricity was easy to use, and it was one of the most flexible sources of energy in use, and a link between the national income rate and the rate of increase in consumption had been established Electricity the annual per capita consumption of electricity is a criterion by which countries progress, development and progress, as well as an indicator of their prosperity, are determined It should be noted that electric power is a secondary source derived from primary power sources in other words, it is renewable energy that is released by connectors that operate the engines of all devices, and that it results in moving the magnetic field, which creates a voltage difference at the ends of the conductor (Khairallah, 1990, p. 79)

The importance of electricity and the fields of use:

The importance of the study lies in the important role that electric power plays as one of the main sources of energy and a component of economic progress because of its many uses in many fields.

There are many areas in which electric power is used:

1- **the household sector:** This sector has an important role on the consumption rates, as it takes the largest share of electricity consumption due to technological and economic progress and development, which is accompanied by an increase in population growth, which has led to an increase in demand for electricity by this sector The sector through the operation of various electrical appliances such as lighting equipment and appliances used for Heating and cooling houses (Al-Majali, 2018, p. 2-3).

- **Industrial sector:** Energy is of great importance in this sector, as it operates engines, machines, computers, Heating and cooling in the plant and industrial buildings, in order to carry out production, manufacturing, and using electricity in operating machines in producing goods and services to a great extent, but in the current age, the importance increased because of the high rate of industrial activities The industrial sector's consumption rate of electricity has increased at high rates in the operation of its equipment and machinery in many industries, such as the metal industry and the wood industry, and is very strong. (the importance of electricity, 2022).

Agricultural sector: The field study showed that electricity use in agriculture has had several economic effects, including the expansion of irrigation machines, which have reduced the cost of irrigation schemes and enhanced productivity through the use of pumps Water, demand for electricity for use in plant crop production and animal production has increased

The health and education services sector :-

In addition, the state-of-the-art equipment used in surgical operations, detection of modern equipment used in surgical operations, detection of diseases, operation of radiators, sonar, etc. in addition to the validity of medicines related to the preservation of refrigerators and which operate on electricity This means that if there is no electricity, then electricity is essential to the hospital infrastructure.

Electricity is of great importance in school and university educational activities, as electricity is the one that operates modern technological equipment such as televisions, computers and other machines used in the infrastructure of schools, institutes, universities and all educational buildings, and therefore the process is greatly affected in the absence of electricity It is a major source of improvement in the education situation and the modern and comprehensive education system.

- Water sector, transport and transportation:

Electricity has supported the water sector in its collection, storage, home pumping and technology, as water purification plants depend mainly on electricity use and are then supplied with electric current-based devices.

In addition to the fact that it is not possible to use electricity, it is not possible to use electricity, but also to use electricity, and therefore to operate cars, which are considered to be essential for electricity and electric circuits, the vehicles are not supplied with power or gasoline, but instead they are used to generate electricity, and therefore the operation of the cars is considered essential. In addition, the company has been able to provide a new service to the public and private sectors of the country.

6-Commercial and tourist sectors:

The commercial sector is heavily dependent on electric power, as it is the basis of commercial services that supply consumers of different industries with their needs and has also contributed to the opening up of new trade in the current era; E-commerce, making it easier to communicate with remote geographies through the use of mobile phones and the Internet, which are mainly electricity-dependent.

Electricity use in the commercial sector includes Heating and cooling, lighting of buildings and commercial spaces, and electricity is used in companies and malls throughout the cities to operate computers, faxes, photocopiers, printing machines, elevators and electrical drawers. It has contributed to the development of the tourism sector, the lighting of archaeological and tourist sites and the play of recreational games that depend on electricity, and this has provided support" for the tourism sector.

(Dawson ,27-12-2015)

III. Analysis of the development in population growth and its implications for electricity consumption in Egypt for the period 2004-2020:**The effects of population growth on total electricity consumption and the average per capita electricity consumption during the study period (2004-2020):**

Population growth is linked to a complex and interlinked relationship and is one of the " major determinants of this type of consumption," as increasing population size and population movements through migration from rural to urban areas contribute to growing demand for and increased consumption of electricity.

In order to find out the impact of the increase in Egypt's population on electricity consumption during the course of the study, you can follow the table and figure 1, as it is noted that the population increased from 74172073 persons in 2004 to 102334403 persons in 2020 with a growth rate ranging from 1.80% - 2.30%), which increased electricity consumption from (79,737) C. and . In 2004, it reached 148,517 And W.O. , with a growth rate ranging from 1.90% to 8.21%, if we take into account the average annual population growth over the period 2004-2020, we find that it rises to about 2.007%. When compared to the annual average electricity consumption for the same period, it was 5.366%, meaning that the increase in electricity consumption was twice the increase in population growth over the same period (& Jahanzaib, M. (2018) is a result of the multiple uses of electricity in various economic activities by the population

As for the limited period between 2017 and 2020, the population growth rate has declined for reasons already mentioned," despite the increase in the population, this has been reflected in the decline in the growth rates of electricity consumption to negative proportions in most of the years mentioned. When comparing the average annual growth rate of the population during the above period, it is noted that it reached about 2% against an average annual growth rate of (-5.18%) for total electricity consumption, which resulted in the lifting of energy subsidies and successive increases in electricity prices, and consequently the increase in population did not have a noticeable effect in that period (Fuinhas .2016). We conclude that, despite the positive relationship between people and electricity consumption, it may be affected by other factors that can contribute to the reduction of consumption, such as income, prices and policies adopted in countries regarding programs in the electric power sector

Table 1. Population growth and electricity consumption in Egypt during the period 2004-2020

Annual growth of average per capita electricity consumption (6)	Average share Per capita electricity consumption(. K.and O) (5)	Annual growth in consumption % (4)	Total electricity consumption Million (C. WOH) (3)	Annual population growth % (2)	Population size Persons (1)	Year
	1350		79,737	1.80	74172073	2004
7.41	1450	7.58	85,781	1.80	75523576	2005
0.00	1450	8.21	92,828	1.80	76873670	2006
8.62	1575	6.44	98,812	1.80	78232124	2007
6.67	1680	7.87	106,595	1.80	79636081	2008

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2.38	1720	4.80	111,714	1.90	81134789	2009
3.60	1782	6.43	118,903	2.00	82761244	2010
-11.34	1580	6.60	126,758	2.10	84529251	2011
20.89	1910	5.68	133,969	2.20	86422240	2012
2.09	1950	4.69	140,257	2.30	88404652	2013
0.00	1950	1.90	142,935	2.30	90424668	2014
0.82	1966	2.10	145,946	2.20	92442549	2015
3.71	2039	7.45	156,828	2.10	94447071	2016
-0.05	2038	-3.70	151,023	2.10	96442590	2017
-1.08	2016	4.36	157,610	2.00	98423602	2018
0.20	2020	3.61	151,908	2.00	100388076	2019
0.20	2024	2.23	148,517	1.90	102334403	2020

Source

Column (1, 2) of World Bank data.

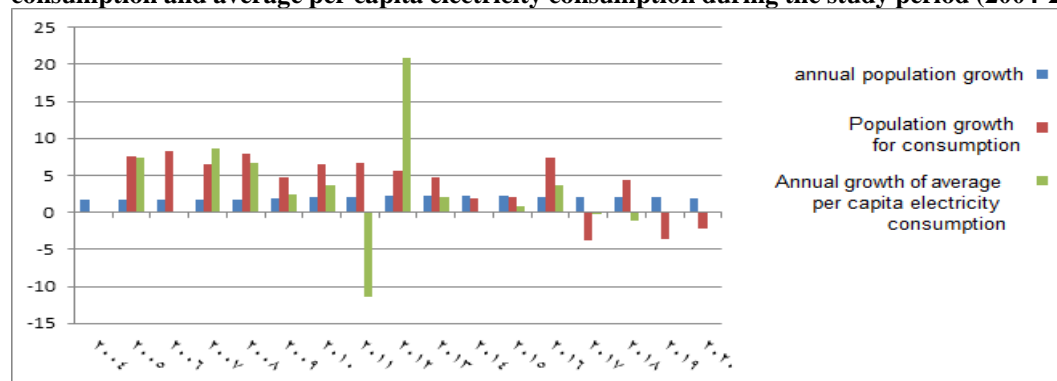
Column (3) Data from the Arab Electricity Union, Statistical Bulletin, except 2019/2020 based on the data of the holding Company for Electricity.

Column (4) the researcher worked on the basis of the data of the Arab Electricity Union, Statistical Bulletin, and the holding Company for Electricity for 2019|2020

The annual growth rate of the average per capita income is applied in accordance with the following equation:

Current year —previous year /previous year x100

Figure 1 Comparison of the population growth rate with annual growth rates, total electricity consumption and average per capita electricity consumption during the study period (2004-2020):



Source: Researcher's work based on table data (1)

B - implications of population growth on electricity consumption in different fields:

It is essential for operating various electrical appliances in homes, is used in the industrial sector to operate various machinery, equipment and devices, and has contributed to the production of goods in a better and better manner. In addition to being used in the commercial and other sectors, these sectors have opened up the horizons where they have contributed

(Fuinhas.2016 To facilitate the operation of these sectors and to open the prospects for their growth and development (

This can be seen in the figures listed in Table 2, which shows the effects of the growth in the population size in Egypt on electricity consumption in various fields during the period 2004-2020. The increase in the size of the population led to an increase in the consumption of the household sector, followed by the industrial sector and other uses in addition to the commercial sector. This increase in consumption resulted from the increase in the demand for electricity. In the year 2016, the domestic consumption increased from (29807) to (94,447071) J.W. (2004) to (73,361) C.. Q, in 2016, at a growth rate of 7.58%-7.45%, when compared with the average annual growth of the population for the period 2004-2016, it reached about 1.80% against 3.71% for the average annual growth of electricity consumption in the household sector. The period (2017-2020) ranged from rising to falling due to other factors such as prices and the lifting of subsidies on the energy sector, with the industrial sector second, reflecting the increase in population over the period (2004-2018) from (74,172073). The population in 2004 reached (98,423602) in 2018 increased electricity consumption in the industrial sector from 28,388 W.C. in 2004 (43,623) GWOH in 2018; When comparing the average annual population growth during the above-mentioned period, we find that it reached 2.00% against 1.08% for the average electricity consumption in the industrial sector, which indicates that the increase in population has contributed, whereas consumption has witnessed a decrease" during 2019-2020". This is due to the Corona pandemic and the

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suspension of most economic activities in the world, including Egypt, while the impact of the increase in population size on the volume of electricity consumption is noticeable.

The commercial sector is reflected in the increase in the volume of consumption in the amount of one million (4,8861) GWh in 2004 to reach 19.179 million. GG. W . In 2019|2020, the volume of electricity consumption has decreased in spite of the increase in population size, which is the result of the Corona pandemic, which has contributed to many economic activities, especially those of the commercial sector. The same situation applies to the rest of the Egyptian national economy (Balaidi, p. 160).

In conclusion, the growth of population size has contributed to raising the level of consumption in all fields of electricity use, taking into account the impact of other factors, in some years that have reduced electricity consumption in different sectors, such as the economic reforms in the energy sector followed by Egypt and the Corona pandemic.

Table (2) relationship between population size and consumption by use in Egypt during the period 2004-2020

Other (C.and .h) (6)	Industrial (C.and .h) (5)	Commercial (C. and O) (4)	My home (c and c) (3)	(2) Annual population growth rate of %	Population size Persons (1)	Years
16,706	28,388	4,836	29,807	1.80	74172073	2004
22,175	30,284	2,127	31,195	1.80	75523576	2005
23,975	32,701	2,375	33,777	1.80	76873670	2006
25,222	34,569	2,573	36,448	1.80	78232124	2007
26,419	37,045	2,860	40,271	1.80	79636081	2008
21,876	37,273	8,754	43,811	1.90	81134789	2009
22,882	38,916	9,674	47,431	2.00	82761244	2010
31,239	40,702	3,447	51,370	2.10	84529251	2011
24,491	42,098	10,716	56,664	2.20	86422240	2012
26,008	39,887	14,605	59,787	2.30	88404652	2013
26,261	37,320	17,392	61,962	2.30	90424668	2014
24,308	38,242	18,850	64,546	2.20	92442549	2015
32,447	38,310	12,710	73,361	2.10	94447071	2016
26,833	41,479	18,585	64,126	2.10	96442590	2017
27,999	43,623	19,179	66,809	2.00	98423602	2018
124,372	20,692	18,562	60,115	2.00	10038807	2019
122,443	19,957	17,380	61,542	1.90	10233440	2020

Source: From the work of the researcher based on the Arab Electricity Union's data, Statistical Bulletin, multi-year, multi-page, except for year 2019|2020 column (1, 2, 3, 4) Data from the holding Company for Electricity

The impact of population growth on the number of participants in the electric grid in Egypt:

The increase in population size leads to an increase in the number of subscribers to the electric grid, as can be seen in Table 3, which shows that Egypt's population increased from 74,17073 persons in 2004 to 102,233,403 persons in 2020 with a growth rate ranging from 1.80%- The number of subscribers increased from 19,991 million in 2004 to 37.120 million in 2020 at rates ranging from 1.90% to 5.82%, which indicates the positive impact on population growth on the number of subscribers. The higher growth rate of the number of subscribers in the electricity grid indicates that it has increased twice the rate of population growth during the study period. The average annual population growth rate during the entire study period was about 2,005%, compared with (3.71%) the average number of participants during the above-mentioned period, which indicates that the population has a positive effect on the number of subscribers in the electric network, especially for the home sector (peppers, 2022).

Table (3) the development in population size and its implications on the number of subscribers in the electricity network in Egypt during the period 2004-2020:

Subscriber growth rate % (4)	Number of network subscribers 1 million subscribers (3)	Annual growth of % (2)	Population size Persons (1)	Years
	19,991	1.80	74172073	2004
3.87	20,765	1.80	75523576	2005
3.68	21,530	1.80	76873670	2006
4.74	22,552	1.80	78232124	2007
5.45	23,782	1.80	79636081	2008
3.83	24,693	1.90	81134789	2009

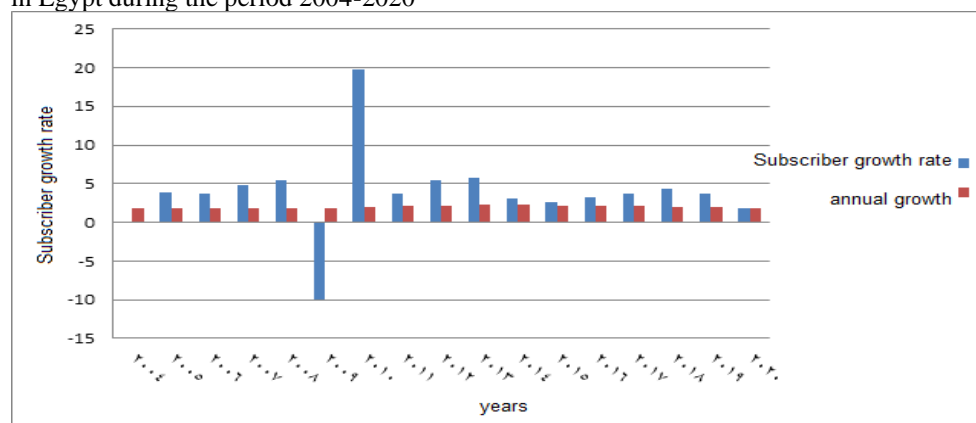
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3.89	25,656	2.00	82761244	2010
3.71	26,610	2.10	84529251	2011
5.46	28,065	2.20	86422240	2012
5.82	29,700	2.30	88404652	2013
3.03	30,600	2.30	90424668	2014
2.68	31,420	2.20	92442549	2015
3.21	32,430	2.10	94447071	2016
3.78	33,658	2.10	96442590	2017
4.28	35,100	2.00	98423602	2018
3.77	36,426	2.00	100388076	2019
1.90	37,120	1.90	102334403	2020

Source: The researcher worked on the data of the World Bank and the Arab Electricity Union, a multi-year multi-page statistical bulletin.

Column (1, 2) World Bank statements

Figure 2: Evolution in population size and its implications for the number of subscribers to the electricity grid in Egypt during the period 2004-2020



Source: The researcher works based on the data of the table (3)

Conclusions:

The increases in the annual population growth rates have contributed to its double increase in the annual growth rates of electricity consumption in some years of study.

2. Despite the positive relationship between population and electricity consumption, it may be affected by other factors that can contribute to the reduction of consumption, such as income, prices and policies adopted by countries on programs in the electricity sector.

3- the growth of the population size in Egypt has contributed to raising the level of consumption in all fields of electricity use, taking into account the impact of other factors, in some years that have reduced electricity consumption in different sectors, such as the economic reforms in the energy sector followed by Egypt and the Corona pandemic.

4-the increase in the size of the population in Egypt has led to an increase in the number of subscribers to the electric grid at rates that are more than twice the size of the increase in the population growth rate.

Recommendations:

1-Egypt is one of the countries that suffer from increases in population size and population growth, as it is considered one of the top countries in the Arab countries and the world, so it is necessary to regulate population numbers in terms of spreading birth control culture through relying on modern scientific or medical means.

The need to establish appropriate investment policies toward the energy sector that will help meet the growing demand for electricity by the population for many uses.

3- adjusting electricity usage according to economic activity (commercial, industrial, population, service) to facilitate the process of monitoring consumption.

4. Work to adopt policies that encourage the use of renewable energies in electricity generation.

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