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Title:
Improvement of energy efficiency in Tlemcen(case of SONELGAZ TLEMCEN)

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DECLARATION

ABDELKADER BENMILOUD, hereby declare that this thesis represents my personal work, realized to the best of my knowledge. I also declare that all information, material and results from other works presented here, have been fully cited and referenced in accordance with the academic rules and ethics.

Signatures

Supervisor**: Dr Fouad BOUKLI HACENE**

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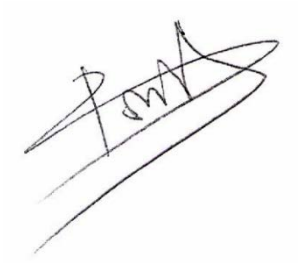

Student:

31/07/2018

Dedicaces

This modest work is only the fruit of a relentlessness and a will that grew more and more. This much-desired goal could not be achieved without the presence of all those who helped, supported and encouraged me in the most difficult moments; for that I dedicate this memoir:

To my dear mother **Amaria**, to my dear father **Mahi**, who brought me help and always pushed me forward. For all their sacrifices, their anxiety, I will always be grateful to them.

To my dear brother **Amine.**

To my dear **Siham** sisters.

And especially **Fatima bourzig**

To all members of the family.

To my promoter Mr**. FOUAD BOUKLI HACENE** who helped me a lot.

To my promoter Mr. **FOUAD MALIKI**

To our dear director Mr. **ABDELLATIF ZERGA**

To all my friends .

To all of you I dedicate this modest work.

Resume:

In a context of increasing population, scarcity of energy resources and increasing energy needs in electricity, energy efficiency is an essential way to guarantee the security of energy supply by reducing fossil energy consumption. and greenhouse gas emissions.

The objective of the study is to carry out a diagnosis on the state of energy consumption in the wilaya of Tlemcen proving the feasibility of the introduction of energy efficiency in order to contribute to the generalization of good practices in the architectural design of habitat and behavior of the actors.

The study will adopt a participatory approach that aims to bring together the efforts of all, municipal institutions, building owners, developers, building managers, and the population.

KEYWORDS

Energy consumption, sustainable development, energy efficiency

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CHAPTER 01
General Introduction

CHAPTER 1: GENERAL INTRODUCTION

1.1 Background:

The surge of energy consumption in the world in recent decades is an indisputable fact. This growth has created new challenges :

- Climate change linked to the increase in greenhouse gases generated largely by the emission of CO2 gas due to increasing energy production.
- The increasing pressure on available resources, which calls into question the guarantee of a right of access to energy at a reasonable price, but also the security of supply for importing states and a sustainable management of resources primary for exporting countries.

For these structural reasons, several countries have opted for public policies aimed at controlling the expenditure and energy management of their states through energy efficiency measures as a first step, then towards a possible energetic transition towards sustainable energy with less impact on the environment. The current global economic model is out of breath, it is based on two false assumptions namely primary energy sources available in abundance and at a lower cost and the lack of impact of their uses on health and the environment.

It is now clear that conventional energy resources, after years of waste and mismanagement, are becoming increasingly scarce and running out over time.

Faced with this energy crisis due to the increasing explosion of energy consumption and in order to cope with the climatic changes caused by two centuries of intense industrialization, governments and legislators have undertaken a series of texts and laws aimed at mastering energy consumptionenergy at first, then the development of alternative energies that are more respectful of the environment, and to ensure a viable economic model over time.

This crisis makes it possible to build a strong and lasting energy model in a competitive economy.

With a population of 40 million inhabitants in 2015, Algerian energy consumption internally reached 58 million equivalent tons, it was 17 million (toe) in 2005 for 33 million [1].

It has been multiplied by four in the spaceduring this 10 years. It should, according to the forecasts of the energy sector and if the rate of consumption continues, double by 2030, or even triple by 2040. [2]

Algeria is the 4th largest energy consumer in Africa with the equivalent of just over one tonne of oil equivalent (1.15 toe) per capita per year, behind South Africa (2.8 toe) Libya (2.18Tep) and Gabon (1.25Tep). [3]

The national economy consumes twice the energy to create the same unit of added value (according to the national agency APRUE).Energy subsidies in Algeria absorb 30% of the state budget and 11% of its GDP. They amount to about 1500 to 2400 billion dinars (about 10 to 20 billion dollars), according to the World Bank.[3]

Failure to recover all its debts as soon as possible, the company SONELGAZ near bankruptcy and cessation of payment, according to its director Mohamed ARKAB, who announced a total of 75 billion dinars unpaid [4]. This situation is the result of the current financial crisis, and that in the absence of support from the state, the management of these debts, become inextricable, it has a direct impact on the group is even compromises its projects, emphasizing that "almost half of these unpaid, or 30 billion dinars, are held with public companies, 32 billion DA are unpaid households, and 3 billion power losses.

For renewable energies, it has been reported that 500 MW of renewable energies are already on the grid and that production of 4,000 MW is in preparation with significant local integration. It is only through a significant change in energy policy that Algeria will be able to build an adequate environment to produce 30 to 40% of its energy from renewable sources by 2030[5]. However, with an average annual sunshine estimated at 2,000 hours and a territory composed of 86% Saharan desert, the solar power of Algeria is estimated at about 1700 KWh / m² / year in the north of the country and 2,650 KWh / m² / year in the south. This corresponds to an electrical capacity eight times higher than the country's natural gas reserves [6].

1.2 Problem statement :

Faced with substantial growth in domestic domestic consumption of energy products (gas, electricity, fuels), the decline in domestic production of oil and gas and the decline in hydrocarbon exports, Algeria's energy future is creating worries. This model of energy consumption is unsustainable, we are heading straight for an inability to maintain a rate of export of hydrocarbons likely to finance our economic development. For this purpose we must review our energy strategy in our case the strategy of SONELGAZ.

1.3 Objective:

Our approach is based on an analysis of Tlemcen's willpower energy consumption data and proposed appropriate solutions in the context of energy efficiency in order to reduce consumption at the local level and then to generalize it at the national level.

The objective of this study is to reduce the bill of energy consumption of the wilaya of Tlemcen by the approach of the efficiency and the energy performances which will have a positive impact on the company SONELGAZ and on the economy of the country. Faced with this situation and given the reconfiguration of the national energy context, important questions about future energy changes arise:

- How to meet the energy demand of the population?
- What energy model for SONELGAZ?
- What impacts would concrete energy subsidies have?
- What can be done to rationalize internal energy consumption?
- What is the share of renewable energy?

Our brief master thesis consists of four chapters. The first chapter focuses on the general introduction, the objectives as well as the position of the problem of this study. The second chapter is devoted to bibliographic research on energy resources and efficiency. In the third chapter the study area is presented. The results will be discussed in this chapter. The final chapter addresses recommendations for implementing a national energy efficiency policy.

1.4 Justification of the study:

Our work is part of the study for improving the energy efficiency of the Wilaya de Tlemcen. This department has experienced a vertiginous increase in energy consumption in recent years, which has created enormous problems for the electrical production company "SONALGAZ".

1.5 Constraints and obstacles:

We found a lot of difficulty for data collection due to buracracy and the lack of database, these problems we cost a lot of time

CHAPTER 02

Literature review

CHAPTER 02: LITÉRATURE REVIEW

2.1 Introduction:

The whole world is facing an increase in energy consumption in a way that has been increasing for this last decades. This increase fundamentally calls into question the economic model that is dependent on its development for a colossal amount of energy that jeopardizes the way in which its resources are managed and the question of security of energy supply (A reformuler).

Energy efficiency has confirmed its weight at the strategic level, it is an essential step for sustainable development.

Being aware of this problematic, Algeria through its sustainable program accentuates the need for involvement of all parties concerned in order to achieve real results achieved by large-scale projects, thus exploiting the huge savings potential of energy.Energy efficiency plays an important role in the national energy context, characterized by strong growth in consumption, led in particular by the domestic sector with the construction of new housing, the construction of public utility infrastructure and the revival of energy efficiency industry.

The Government's adoption of the National Energy Efficiency Agenda to 2030 reaffirms the latter as a priority. This new dynamic must serve differentissuessuchas:

- Environmental:curbing global warming
- Social: to allow equal access to energy
- Politics: to remove the risk of energy dependence of France against producing countries
- Economic: limiting the impact of energy prices on the production and operating costs of companies.

2.2 Definitions:

2.2.1 Primary energy:

All energy consumption designed to meet the various needs of man comes from forms of primary energy that are either exhaustible (fossil fuels such as coal, oil, natural gas, but also uranium) renewable (hydropower, wind, marine, geothermal, solar and biomass[7].

2.2.2 Secondary energy:

These primary energies are transformed into secondary energies. This transformation of one energy into another is always done with a loss of energy, so that the transformation of a primary energy into secondary energy "consumes primary energy » [7].

2.2.3 Final energy:

The so-called "final energy" is that which is used to satisfy the needs of man. The satisfaction of needs can be direct, if the energy is consumed by a human being during a domestic use (to heat, work on his computer, to move by car), or indirect if it is used in the production of goods or services intended for human consumption [7].

2.2.4Energy efficiency

Energy efficiency is a dimensionless number, which is the ratio between what can be usefully recovered from the machine over what has been spent to make it work.

This notion is very often confused with performance, which is the ratio between the actual efficiency of the machine and the maximum theoretical efficiency that can be expected from it. Increasing energy efficiency helps to reduce energy consumption, at the same level of service, and reduces the ecological, economic and social costs of energy production and consumption. One of the main objectives in achieving energy efficiency is to improve energy efficiency [8].

Energy efficiency is one of the pillars of the new United Nations Sustainable Development Goals. Indeed building buildings and cities in terms of energy control is of paramount importance in sustainable development [8].

2.3 The evolution of the world's population:

The world's population is the number of humans living on Earth at any given moment. It is estimated at 7.55 billion as of July 1/2017 according to the United Nations, whereas it was estimated at $ 7 billion as at October 31/2011, at $ 6.1 billion in 2000, between $ 1.55 and 1.76 billion in 1900 and 600 to 679 million inhabitants around 1700[1]. This increase in the population, however, tends to slow down with a more or less significant global drop in the fertility rate.

The annual rate of population growth of the world population is 1.2%. In 2014, about 54% of the world's population lives in urban areas[9].

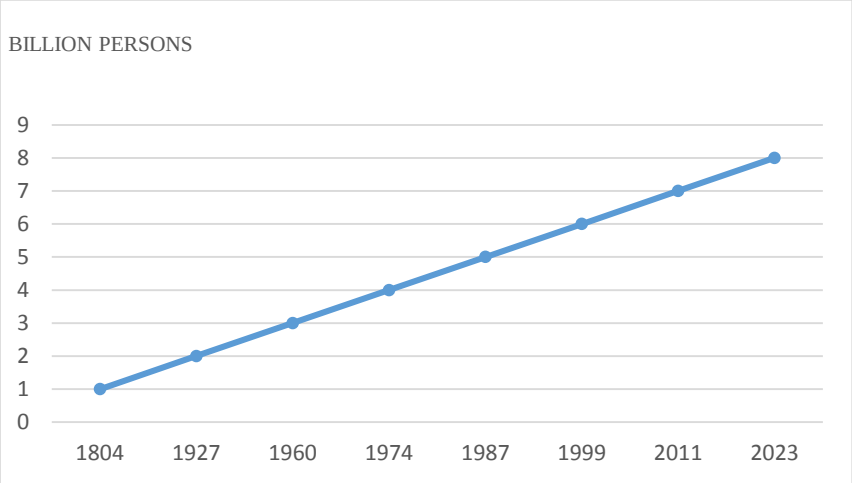


Figure 1: Evolution of the world population [9].

2.4 Energysources:

Energy sources fallis divided into two large segments. The first supply the so-called fossil energies whereas the second supply the so-called renewable energies.

2.4.1 Fossil energy "non-renewable":

It refers to the energy produced from compounds derived from the sedimentary decomposition of organic matter [11], ie mainly composed of carbon. It encompasses:

- Oil: The exploitation of this source of fossil energy is one of the pillars of the contemporary industrial economy.
- Natural gas is a primary energy, considered to be the cleanest fossil fuel of our time.

- Coal: World coal production is 3.5 billion tonnesplus 900 million tonnes of lignit 50% of the coal produced is used for electricity generation.

It is estimated today that oil and natural gas stocks will be exhausted in about fifty years. But the search for new hydrocarbon deposits constantly pushes these limits

2.4.2 Renewable energy:

The energies are said to be renewable insofar as they are able to renew themselves rather quickly. These energies are sometimes considered inexhaustible on the scale of time (human scale)[12]. There are severaltypes:

- Hydropower: This is a clean energy.
- It accounts for about 19% of the world's electricity, which is one of the most used energy sources in the world.
- Solar energy, can be photovoltaic or thermal.
- Biomass energy: It comes from the fermentation of organic matter. It produces gas and electricity or heat thanks to forestry, agricultural waste or household waste.
- Geothermal energy: It is energy from the earth's heat to produce heat and electricity.
- Nuclear energy is considered clean energy since it does not release greenhouse gases. It represents 17% of global energy consumption.
- Wind energy, known as wind energy, is most often used in Europe. Wind turbines are located in windy areas or in huge fields, in small groups or at sea.
- Turbine energy works the same way as wind turbines except that it is the ocean currents that drive the turbines and not the wind. This same system isalsousedwith the tides.
- The air heater is an energy that uses the ambient air from the outside to heat the inside of the fireplaces.

2.5 Peak oil:

In 1938, the famous geologist King Hubert proposed the concept of peak oil, defined as the extraction of half of conventional recoverable oil reserves. After that, oil production declines and can not cope with the growing demand as the population continues to growincease[13].

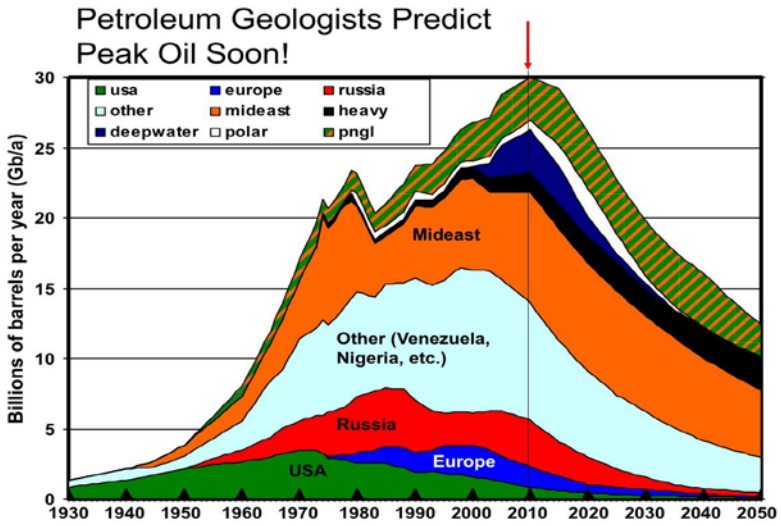


Figure 2: World oil reserves[14]

At the time of Hubbert, most conventional oil reserves had already been discovered. Hubberta went on to predict that US production would peak in 1969 and appear to be capping in 1970[14].

World reserves were expected to peak around 2010 (Figure 2.2). However, about 20 years ago, the industry really jumped on technologies to find oil and extract it[14].

2.6 Global energy production:

World energy production (primary energy) is 13.8 billion toe in 2015 against 6.2 billion toe in 1973.

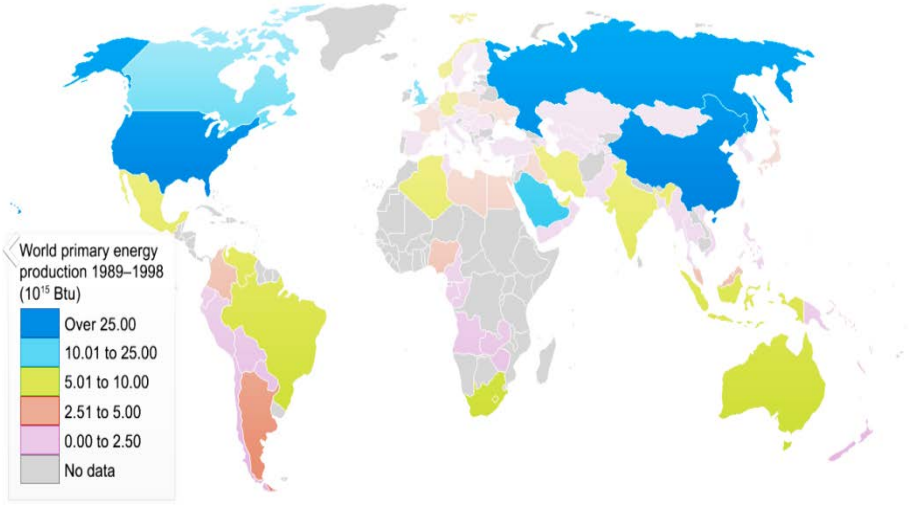


Figure 3: Map of the distribution of energy production in the world between 1989 and 1998[15].

Figure 3 shows that the increase in global energy production in 2015 is significant compared to the year 1973 due to the increase in population.

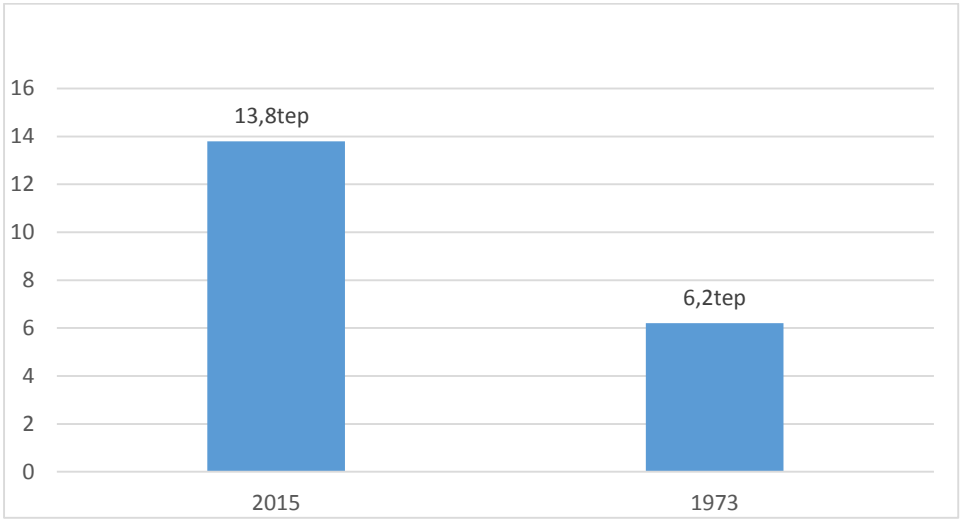


Figure 4: World energy production in 1973 and 2015[16]

Figure 4 shows the distribution of the global sources of energy production. Fossil fuels accounted for 81.7% of this production. The rest of energy production came from nuclear and renewable energies.

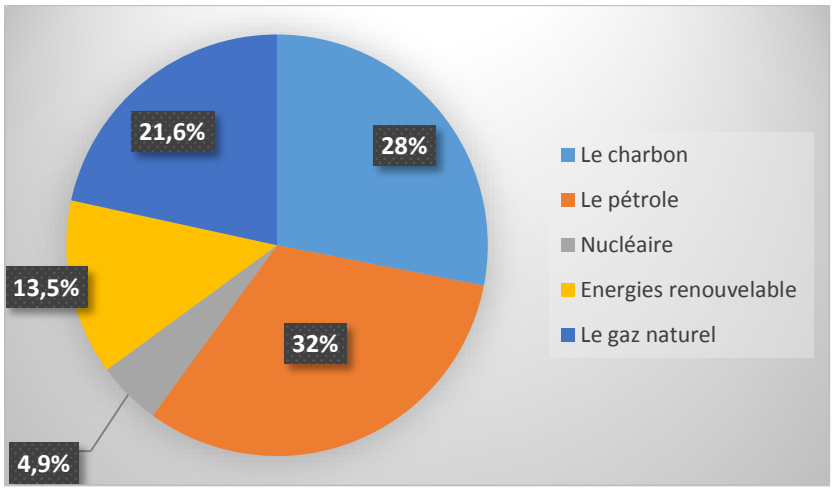


Figure 5: Rates of global energy sources[16]

A more recent study shows the evolution of the share of renewable energies in global energy production. Table 1 shows the comparison of the change in global marketed energy production by source of energy for the two years 2007 and 2017[16].

The share of renewable energy is growing sharply which explains the global energy mix policy.

Table1: Change in Marketed Global Energy Production by Source of Energy 2007-2017[16]

Energy	Production in 2007	Production in 2017	Variation 2007/17	Production 2017 Mtep	Part in 2017
Oil	82,33 Mbbl/j	92,65 Mbbl/j	+12,5 %	4 387	32,5 %
Coal	6 688 Mt	7 727 Mt	+15,5 %	3 767	27,9 %
Natural gas	2 941 Gm^3	3 680 Gm^3	+25 %	3 165	23,4 %
Hydraulic	3 080 TWh	4 060 TWh	+32 %	919	6,8 %
Nuclear	2 747 TWh	2 636 TWh	-4 %	596	4,4 %
Wind energy	171 TWh	1 123 TWh	+558 %	254	1,9 %
Solar-PV	7,9 TWh	443 TWh	+5507%	100	0,7 %
geothermal, Bio-mass, etc	294 TWh	586 TWh	+99 %	133	1,0 %
Bio fuels	702 kbblep/j[n 2]	1 577 kbblep/j	+125 %	84	0,6 %
Total Energy primary	11 588 Mtep	13 511 Mtep	+16,6 %	13 511	100 %

This statistic includes renewable energies used for electricity generation.

Around the world, the conjunction of the instability of the fossil fuel markets the conjunction of the instability of fossil fuel markets and the need to protect the environment and reduce greenhouse gas emissions require a revision of energy strategies. Renewable energies have essential assets to take the first place in the energy packages of the countrie.

At the end of 2015, renewable energies reach more than 19.3% of global energy capacity. They provide 24.5% of global electricity by the end of 2016.

For the first time in the industrial era, worldwide installed renewable capacity in 2016 exceeded conventional new facilities (fossil and nuclear). Global investments in renewable energy amounted to $ 39 billion in 2004. By the end of 2016, $ 242 billion was invested in these industries [16].

2.7 Global energy consumption:

Between 1973 and 2012, world energy consumption almost doubled (+ 92%).

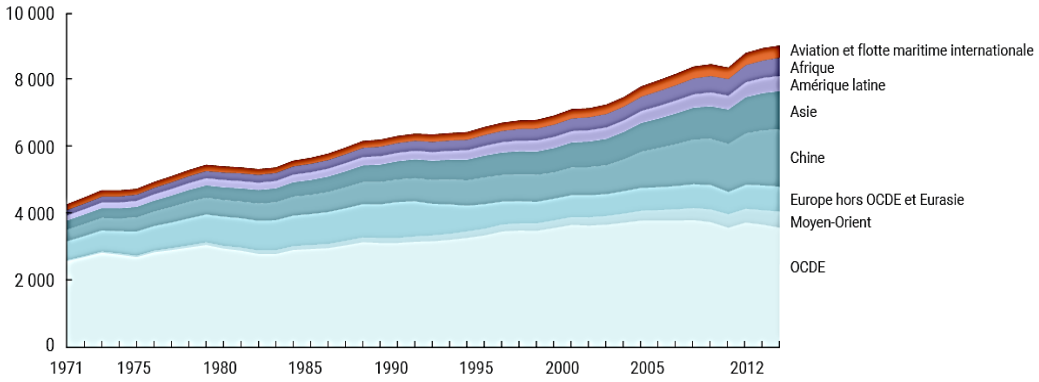


Figure 6: Evolution of energy consumption by region[16]

This development is the combination of the stagnation of past 10 years consumption of formerly industrialized countries, represented by the group of OECD countries, and new economies that are growing rapidly. China saw its energy consumption more than triple from 1990 to 2008. Its share of world consumption doubled from

7.5% to 16.4%[16]. Per capita consumption in China is now equal to per capita consumption in the world.

Africa's consumption increased by 50% from 1990 to 2008, but it remained marginal in world consumption (about 5.7% for more than 15% of the world's population)[16].

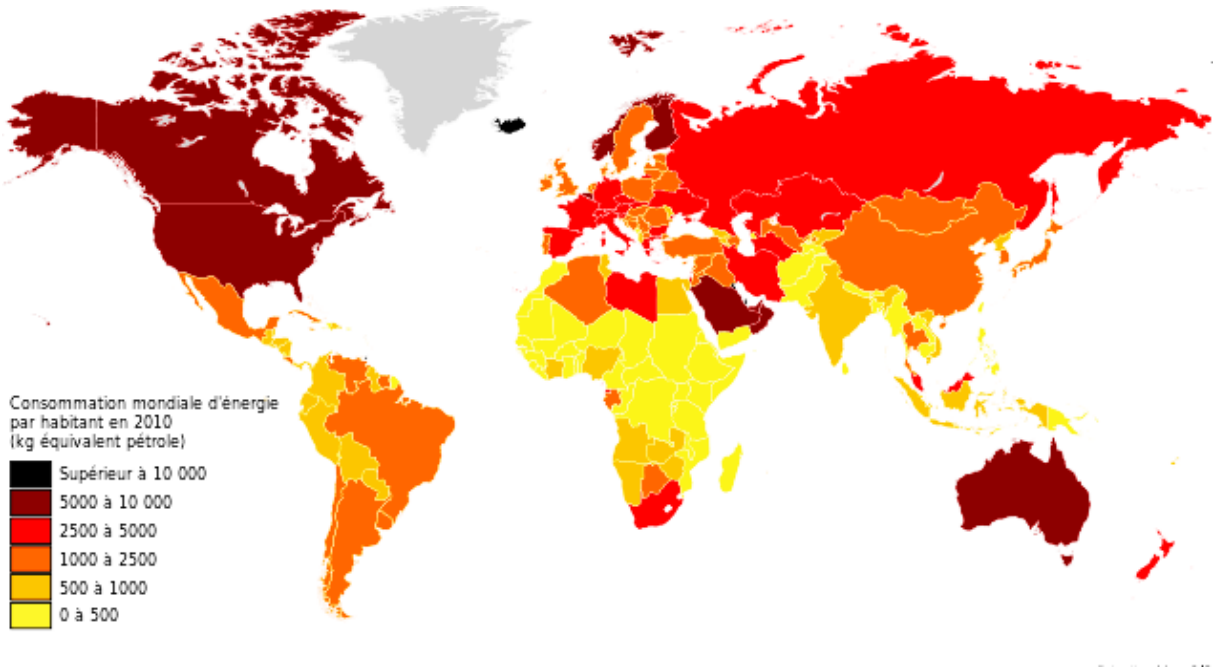


Figure 7: World Energy Consumption during 2010[15]

The global energy consumption per capita for the year 2012 is shown in Figure 7 We note that it varies from one country to another according to the way society consumes.

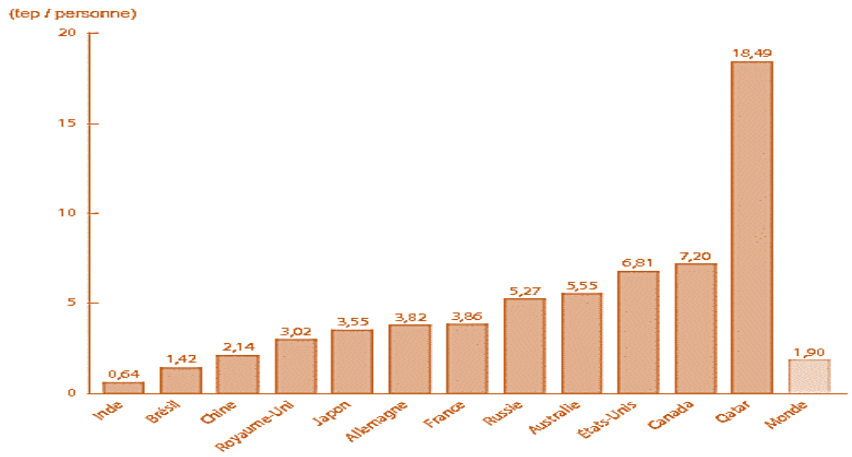


Figure 8: Energy consumption per person in 2012[16]

2. 8 Energy situation in Algeria:

2.8.1 Evolution of the Algerian population:

There has been a rapid increase in the Algerian population since independence. The figure 9 represents the evolution of the population from 1950 to 2030 where the number will exceed fifty million in habitants[17].

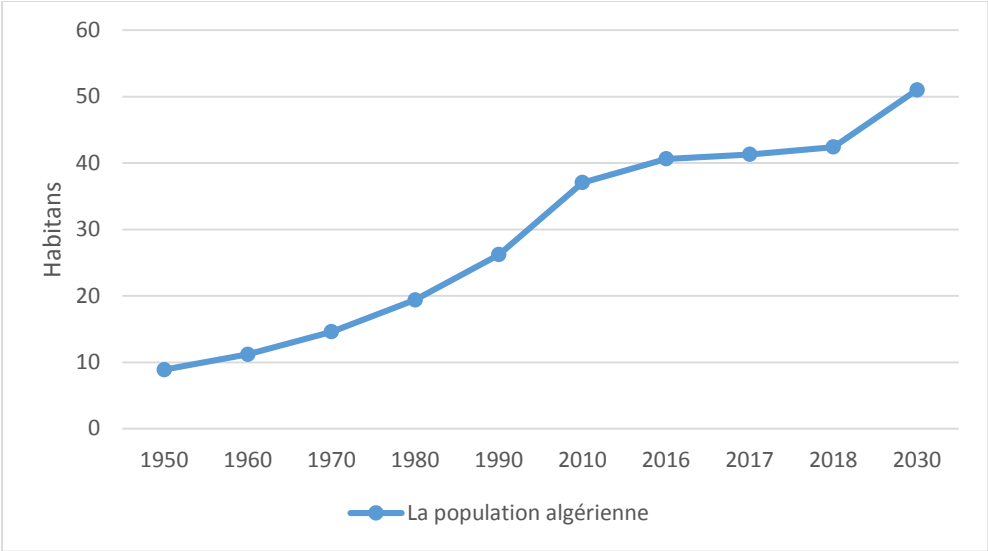


Figure 9: Evolution of the Algerian population [17]

2.8.2 Evolution of the price of a barrel of Algerian oil:

The average price per barrel of Algerian oil went from $ 112 in June 2014 to $ 45 in 2016 to $ 53.97 in 2017 and the current price fluctuates between $ 77 / $ 79[18]. The figure 10 shows the evolution of the price per barrel of Algerian oil between 2014 and 2018.

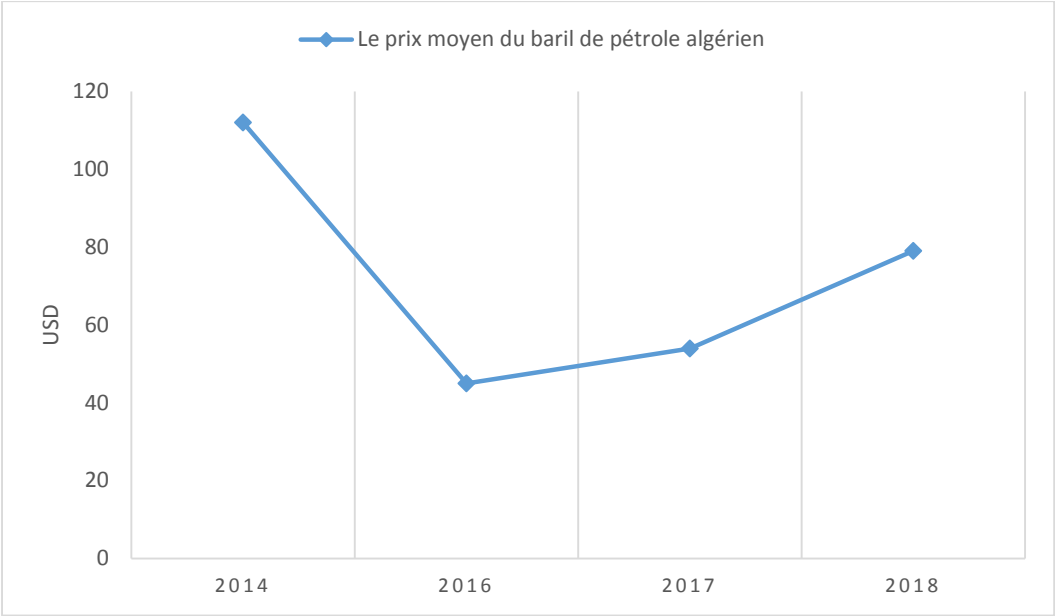


Figure 10: Evolution of the price of a barrel of Algerian oil. [18]

2.9Evolution of foreign exchange reserves of Algeria:

Algeria's foreign exchange reserves have fallen drastically since 2013. Figure 11 shows the evolution of Algerian foreign exchange reserves from 2010 to 2017[19].

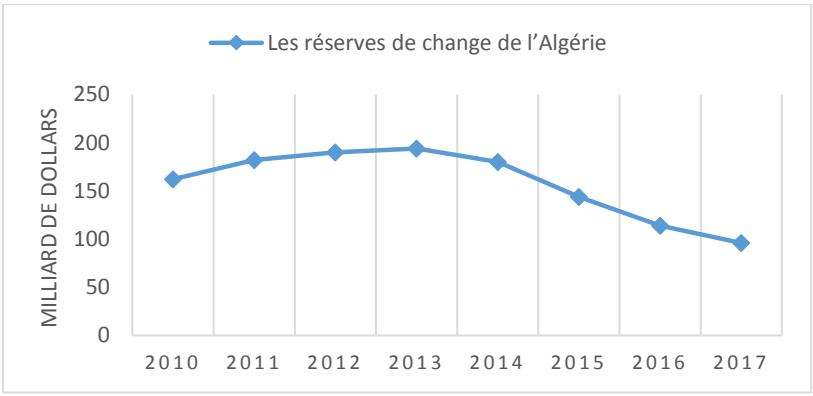


Figure 11: Evolution of Algerian foreign exchange reserves from 2010 to 2017[19]

2.10Energy consumption in Algeria:

The energy consumption in 2005 has as its exclusive source primary energy sources (Gas and oil). Algeria remains heavily dependent on petroleum products, which represent almost half of the global energy base. The finding is reversed as electricity generation relies almost entirely on gas-fired generation, in which case the latter becomes the dominant source[20]. The figures 12 and 13 respectively represent the

distribution of final consumption by type of energy in Algeria in the year-2005 and 2012

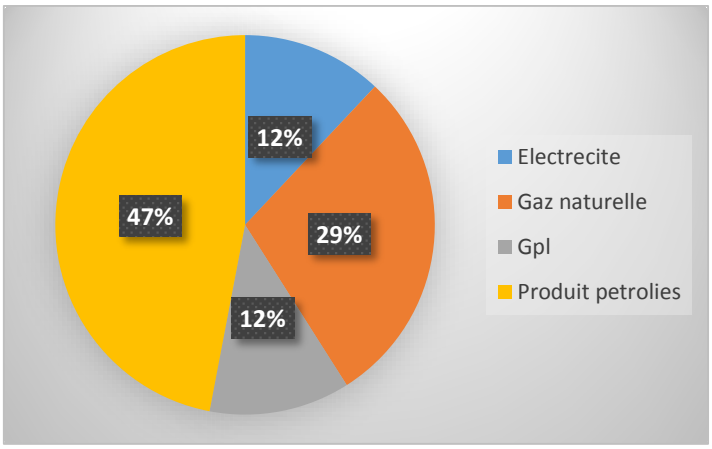


Figure 12: Distribution of final consumption by energy type in Algeria-2005[20].

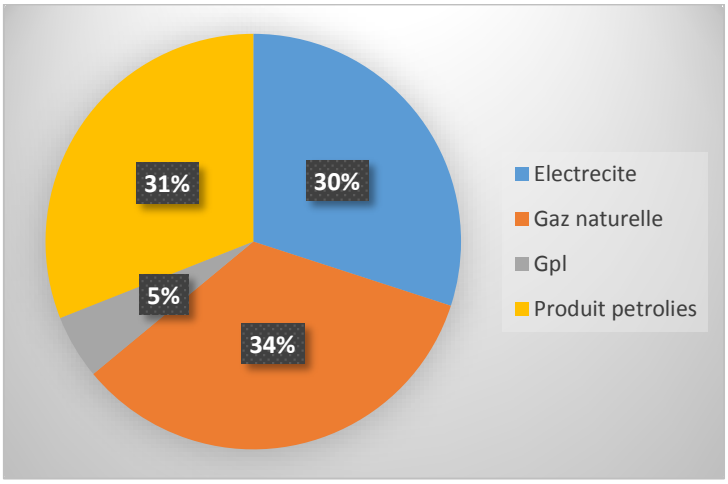


Figure 13: Distribution of final consumption by energy type in Algeria-2010[20].

In the year 2010, the final consumption by type of energy shows that: petroleum products are in net declines from 47% to 31%, electricity has increased from 12% to 30%, gas stabilizes more at least by winning five highlights.

Figures 14 and 15 respectively represent the distribution of final consumption by sector of activity in Algeria in the year 2005 and the year 2010.

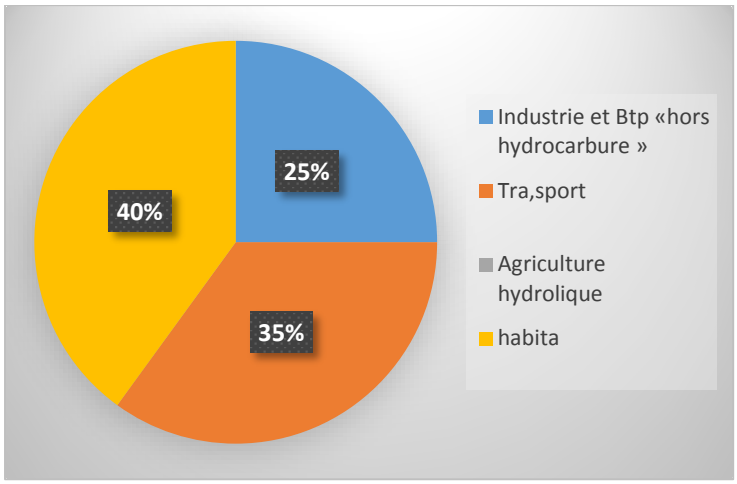


Figure 14: Distribution of final consumption by sector of activity in Algeria-2005[20].

In 2005, the household and other sector, is the sector that includes the residential-tertiary sector with the agriculture sector, is the most energy-seeking sector with 40%, the industry has a 25% share and transportation 35%.

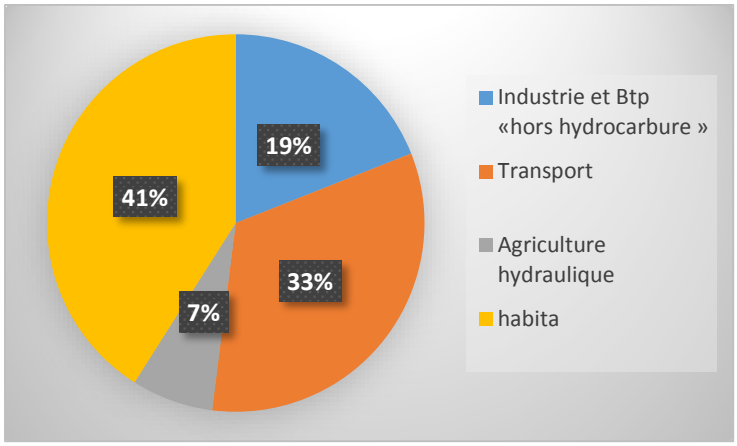


Figure 15: Breakdown of final consumption by business sector in Algeria-2010[20].

In 2010, the residential-tertiary sector is the one that needs the most energy with no less than 41%, followed by the transport sector with 33%, then comes the sector of industry and agriculture with 19 respectively. % and 7%.

These statistics indicate that it is urgent to rebalance consumption through a policy of reducing consumption and / or readjustment through energy efficiency in the building sector.

Compared to the year 2005, in 2010 the residential-tertiary sector remains the most energy-intensive, especially since the consumption of the agricultural sector is accounted for separately from the residential-tertiary sector.

2.11 Conclusion:

Energy management is a major issue of economic development that goes hand in hand with sustainable development. For all countries beyond their differences (climate, economy, politics, needs, lifestyle) they all face the problem of the scarcity of energy resources. This scarcity leads to a great challenge, that of knowing how to manage effectively is above all reasonably these same resources in order to respond in the most adequate way to the increasing energy thirst of their populations.. The residential sector being the most consumer, this is all the more true for the Algerian energy model, with in addition a sustained growth because of the increased demand on the number of new housing, built without taking into consideration the problematic of the energy and the rate of household equipment energy-seeking devices that continues to grow.

Energy efficiency has confirmed its weight at the strategic level, it is an essential step for sustainable development.

Being aware of this problematic, Algeria through its sustainable program accentuates the need for involvement of all parties concerned in order to achieve real results achieved by large-scale projects, thus exploiting the huge savings potential ofenergy.

It is now necessary to take all measures to reduce energy consumption by adopting a model of energy management and rationalization.

Chapter 03

Case Study: Energy Efficiency of Tlemcen Area

CHAPTER 03: CASE STUDY: ENERGY EFFICIENCY OF TLEMCEN AREA

3.1 Introduction:

In this chapter, the study area will be presented on all the following sections:

- Area,
- Demography
- Energy consumption.

3.2 Presentation of the Wilaya of study:

3.2.1 Geographical situation:

The Wilaya is located on the northwest coast of the country and has a seafront of 120 km. It is limited by:

- The Mediterranean Sea in the North;

- The wilaya of AinTémouchent to the East;

- Thewilaya of SidiBel Abbes in the East-South-East;

- The wilaya of Naama in South;

- Morocco in the West.

Figure 16: Map of Algeria[21].

The region covers an area of 9,018 km². The chief town of the stady area is located 432 km west of the capital, Algiers[21].

3.2.2 Daïra and Number of communes:

According to the last territorial organization of the country, the Wilaya of Tlemcen currently includes 20 Daïras and 53 Communes illustrated in figure 17[10].

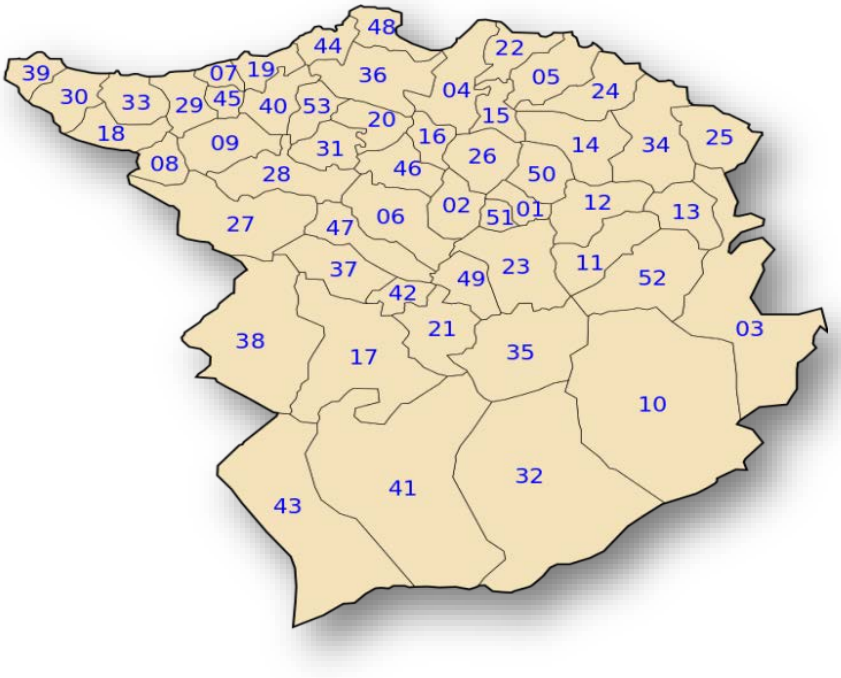


Figure 17: Map of Tlemcenwilaya[10].

The Table 2 presents the name of the dairas with their areas,we have 19 daira and 53 municipaliti .

Table2: Daïras of the Willaya de Tlemcen[10].

N°	Name of the daïra	Number of municipalities	Area (km^2)
1	TLEMCEN	**1**	40
2	MANSOURAH	**4**	346
3	CHETOUANE	**3**	408
4	OULED EL MIMOUN	**3**	456
5	AIN TALLOUT	**2**	510
6	BENSEKRANE	**2**	359
7	REMCHI	**5**	574
8	HENNAYA	**3**	241
9	GHAZAOUET	**4**	177
10	NEDROMA	**2**	205,5
11	FILLAOUCENE	**3**	224
12	BENI BOUSSAID	**2**	428
13	SEBRA	**2**	331
14	SEBDOU	**3**	1 772
15	SIDI DJILLALI	**2**	1 400
16	BENI SNOUS	**3**	555
17	BAB EL ASSA	**3**	237
18	MARSAT BEN M'HIDI	**3**	156
19	HONAINE	**2**	137

3.3 Materials and working method:

Our method of study is based on a collection of the different data which are necessary for our analysis (demography, electricity consumption and recipes), we contacted several local and regional administrations among these entities: the direction of sonelgazTlemcen, regional office statistics of ORAN the ONS ORAN, National Agency of Intermediation and Land Regulation of Tlemcen "ANIREF",

the national agency of the development of the investment of Tlemcen ANDI and the direction of the urbanism of Tlemcen.

We proceed by classification of data by sector of activity we set up histograms of the evolution of the consumption of electricity which will allow us to make proposals of scenarios for 2030. in the last place we will write the new policy energetic that will be compatible with the current situation.

3.4 Population and activities:

The total population of the wilaya is 824 053 inhabitants, a density of 91 inhabitants per Km². Figure 18 shows the evolution of the population of the Tlemcen urban group from 1966 to 2008[22].

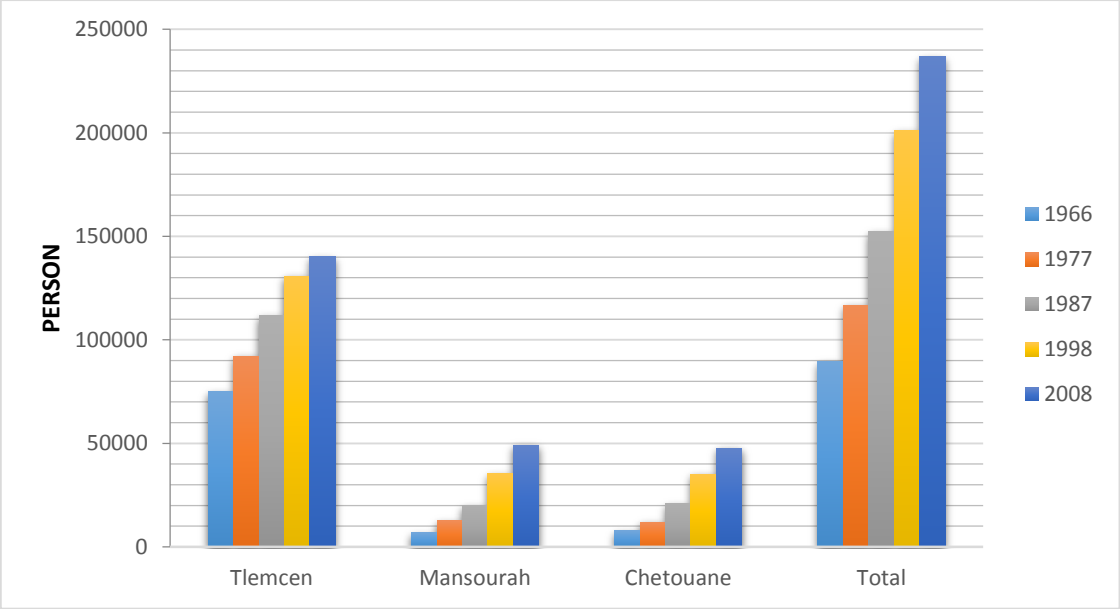


Figure 18: Evolution of the population of Grand Tlemcen (1977-2008) [22].

It can be seen that the municipality of Tlemcen confirms its territorial weight. It represents 29% of the potential of the global population and 42% of the economic potential of the wilaya of Tlemcen in 2008, with a density of 2205Hab / km2.

We calculate the growth rate of the population of Great Tlemcen as follows:

$$\text{Population growth rate} = \left(\frac{Current\ population}{Previous\ population}\right)$$

Years	1966	1977	1988	1998	2008
Populations of the great Tlemcen	89597	116762	152370	201135	236908

The average rate gives us:

$$\frac{\frac{116762}{89597}+\frac{152370}{116762}+\frac{201135}{152370}+\frac{236908}{201135}}{4}=\mathbf{1,27}$$

So the population growth rate of Tlemcen large urban population is 1.27 every 10 years and the growth rate of the global population is 1.56. Figure 19 shows the types of activities of the population in 2010 in the wilaya of Tlemcen.

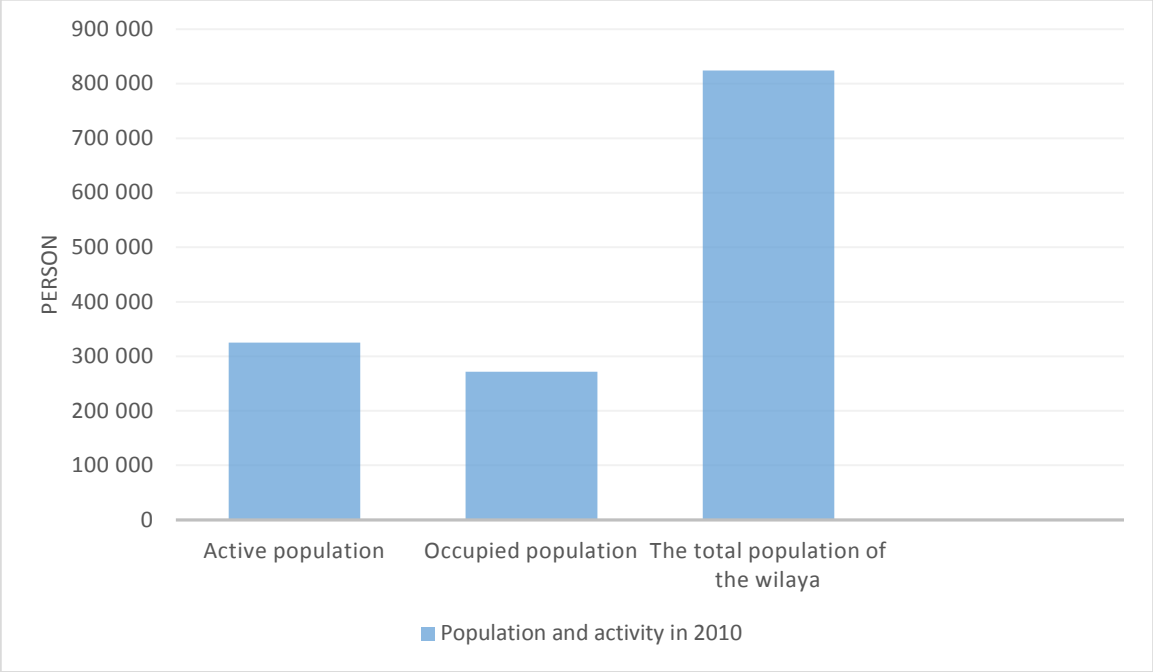


Figure 19: Types of activities of the population in 2010 in Tlemcenwilaya[10].

The Figure 20 shows the distribution of the active population by sector of activity in 2010

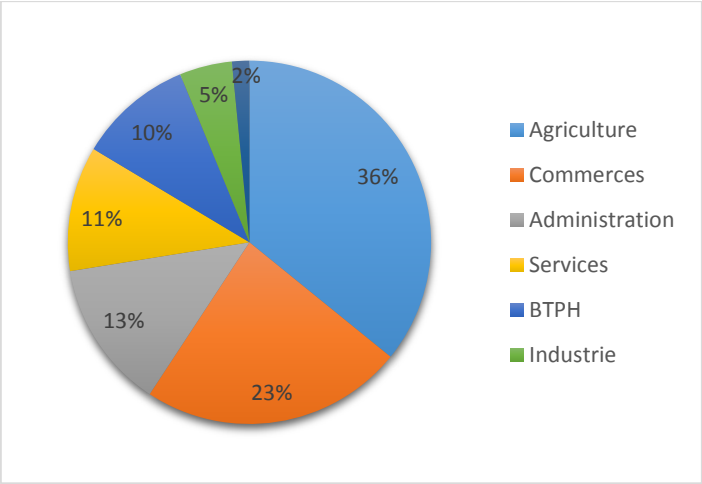


Figure 20: Labor Force by Business Line in 2010[10].

3.5 Overall Electricity Consumptions in the Province of Tlemcen:

Energy consumption in the Wilaya de Tlemcenis managed by SONALGAZ. The Table 3 shows the length of electricity distribution networks in the Tlemcenwilaya.

Tableau 3: Length of distribution networks:	
Length of networks Electricity	5 544 KM

The energy consumption in electricity in the wilaya of Tlemcen during the year 2004 is represented in figures 21.

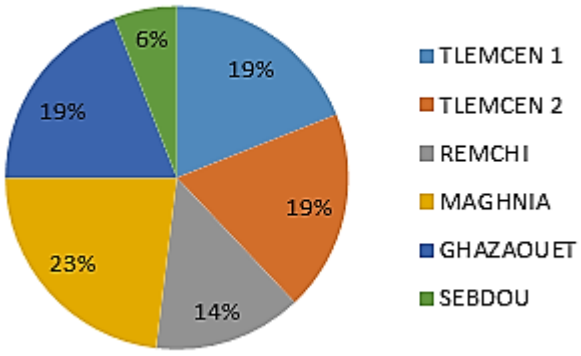


Figure 21: Electricity consumption SONELGAZ from Tlemcen 2004[23].

For the year 2004 in terms of electricity consumption, the large urban Tlemcen occupies the first position with a total of 38% (Tlemcen 1: 19%, Tlemcen 2: 19%). The city of Maghniais ranked second with 23%. Then; the city of Ghazaouetis

found with 19% followed by the city of Remchi with 14%. In last position we find the city of SEBDOU with a consumption rate of 6%.

For 2005, electricity consumption is reported in Figure 22. We can see that Tlemcen's big city is still in first place with a total of 27% (Tlemcen 1: 13%, Tlemcen 2: 14%), followed by the city of MAGHNIA with 23%, the city of REMCHI with 19% then in fourth and fifth place respectively come the cities of GHAZAOUET and NEDROMA with 7%. Finally the cities of SEBDOU, CHETOUANE and OULADMOUN have the same rate of consumption 6% followed by the city of BAB EL ASSA with only 4%.

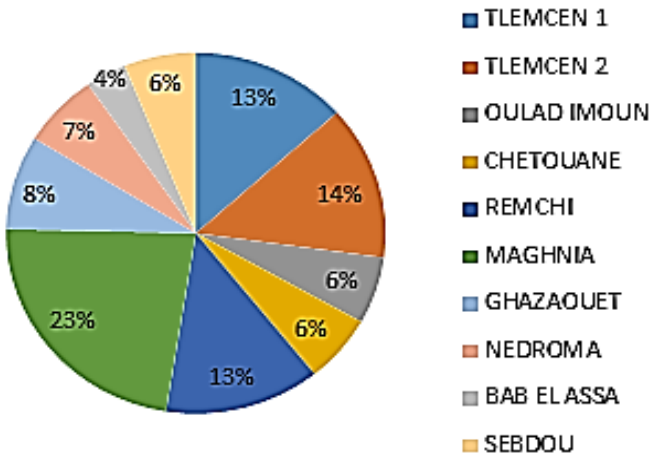


Figure 22: Electricity consumption by SONALGAZ Tlemcen 2005[23].

For the years 2010, 2015 and 2018 in terms of electricity consumption we have the same ranking as the year 2005 with different rates. The collected data are reported in Figures 23; 24 and 25.

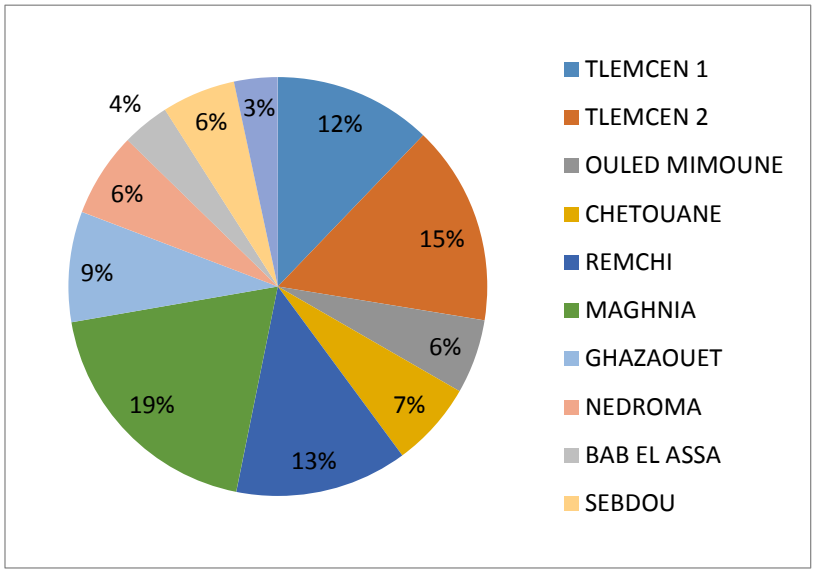


Figure 23: Tlemcen electricity consumption in 2010[23].

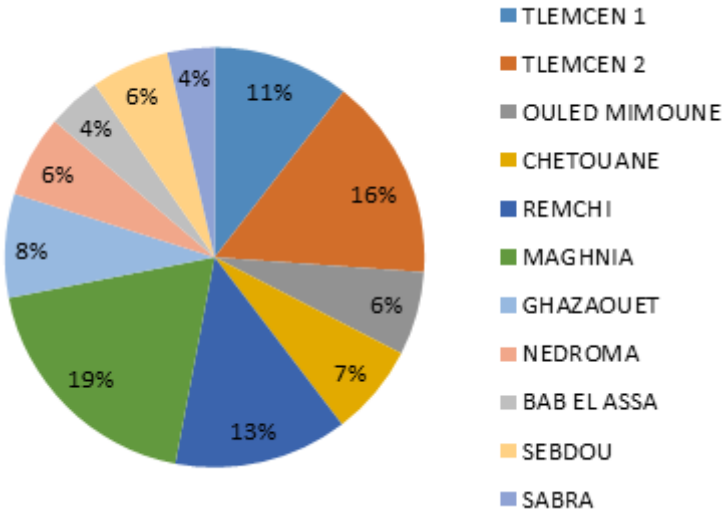


Figure 24: Electricity consumption of Tlemcen 2015[23].

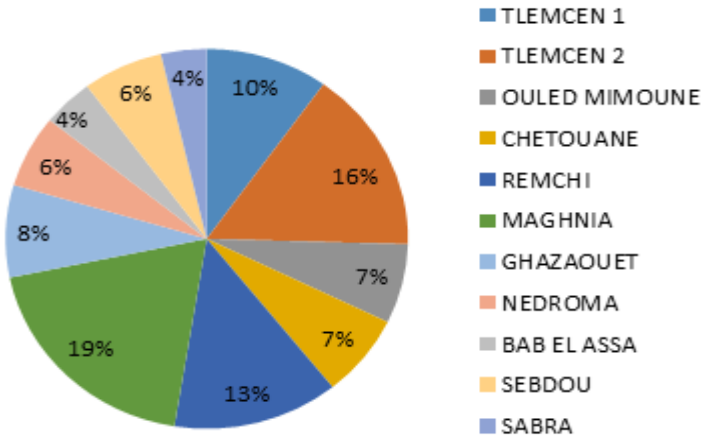


Figure 25: Electricity consumption of Tlemcen in 2017[23].

3.6 Evolution of electricity consumption by sector of activity:

In Algeria there are two types of public services:

The productive service which concerns the public companies which manage their budgets in an independent way like: «SONELGAZ, NAFTAL, ADE (Algerian of waters), URBAT, SEROR, ...»

Non-productive services which concern the public administrations "daïra, commune, school, ..." which depend on the budget of the state. The latter is allocated each year to the request is to the needs of the services concerned. Table 4 shows the evolution of electricity consumption by sector of activity:

Tableau 4: Evolution of electricity consumption of companies and public services from 2014 to 2016[23].

Distribution Sector	2014	2015	2016
TLEMCEN I	10 902 247 KWh	11 434 122 KWh	10 853 817 KWh
TLEMCEN II	12 254 725 KWh	13 423 295 KWh	13 273 094 KWh
OULED EL MIMOUN	8 518 069 KWh	9 856 827 KWh	9 479 198 KWh
GHAZAOUET	8 672 954 KWh	9 553 195 KWh	10 061 315 KWh
MAGHNIA	12 022 098 KWh	13 414 161 KWh	13 981 440 KWh
REMCHI	12 687 443 KWh	14 481 476 KWh	14 125 119 KWh
SEBDOU	12 865 760 KWh	14 702 130 KWh	14 282 061 KWh
CHETOUANE	5 686 747 KWh	6 593 944 KWh	6 320 562 KWh
NEDROMA	7 868 448 KWh	8 424 650 KWh	8 568 168 KWh
BAB EL ASSA	5 421 064 KWh	6 957 933 KWh	7 013 868 KWh
SEBRA	4 592 560 KWh	5 100 034 KWh	5 417 338 KWh

3.7 Results and Discussion:

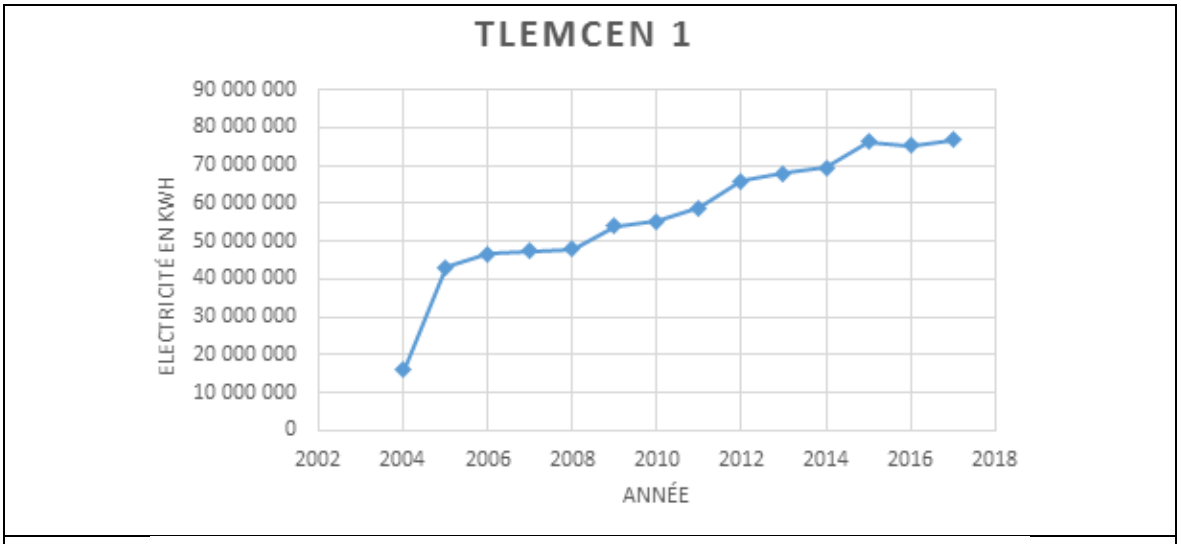
3.7.1 Analysis of electricity consumption in the study area:

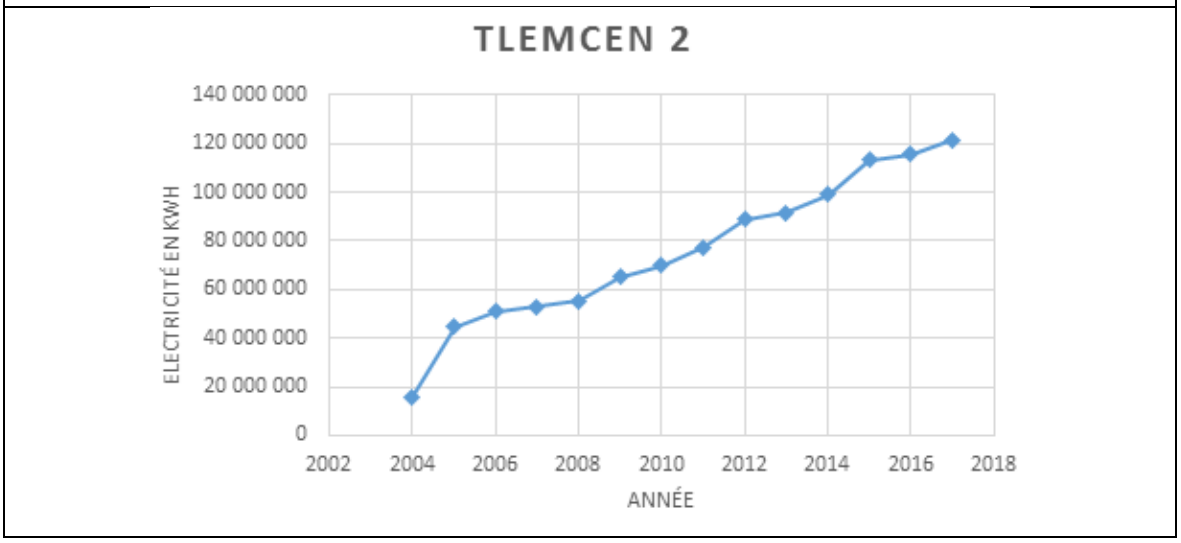
Figure 26 shows the temporal evolution of the electricity consumption of the Tlemcen urban group formed by "TLEMCEN-1; TLEMCEN-2 and CHETOUENE "; during the period from 2004 to 2017. It can be seen that consumption for the three poles increases in an ascending and continuous way with different energy

consumptions depending on the specificities of each region. This growth can be explained by several factors:

- ✓ The demographic growth
- ✓ The increasing needs of the population in energy consumption
- ✓ The urban differential development in the three poles
- ✓ Increase investment projects in all sectors.

The year 2004 represents the lowest electricity consumption and the year 2017 represents the highest consumption.





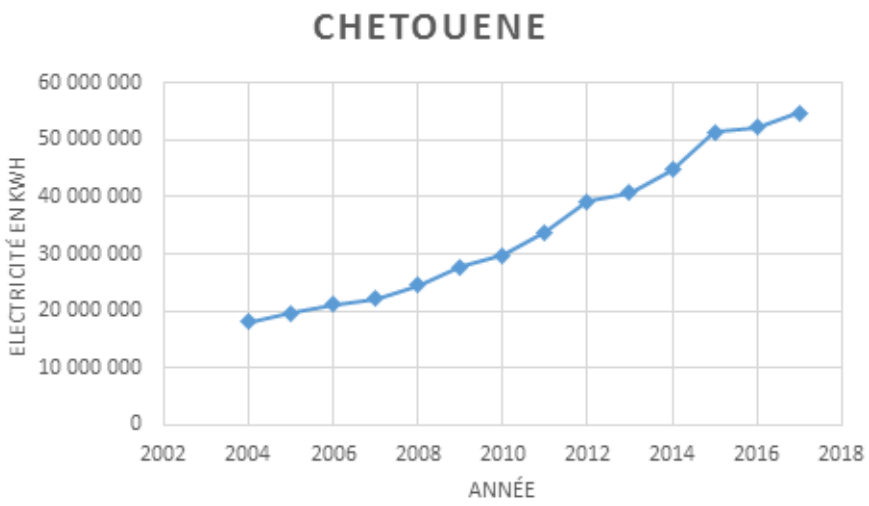


Figure 26: Evolution of the Electricity Consumption of the Tlemcen Urban Group from 2004 to 2017

In this study we find that the same phenomenon occurs in other regions of the wilaya. Indeed figures 27, 28, 29, 30 and 31 respectively illustrate the growth of energy consumption in electricity of the regions of REMCHI, MAGHNIA, GHAZAOUAT, SEBDOU and BAB EL-ASSA.

What characterizes our study is that the rate of change of growth is specific for each city. This difference is mainly due to the number of people and energy needs.

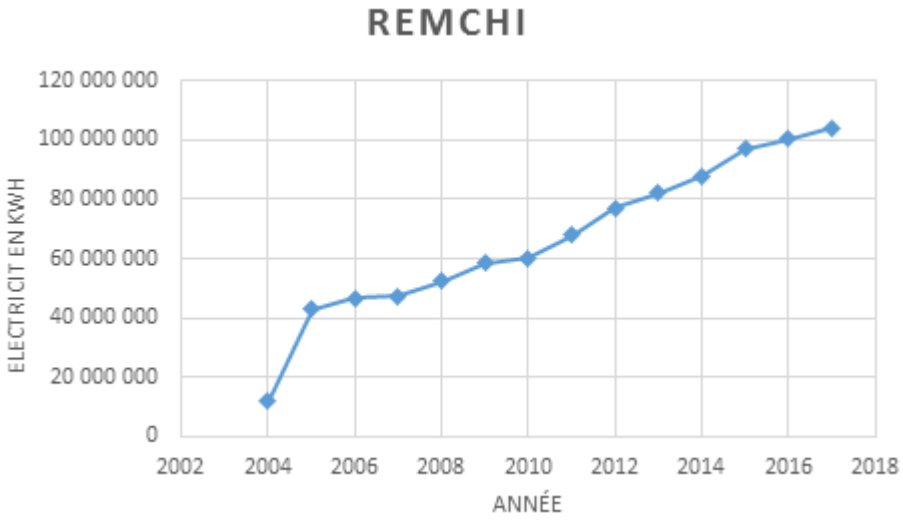


Figure 27: Evolution of Electricity Consumption

From REMCHI from 2004 to 2017

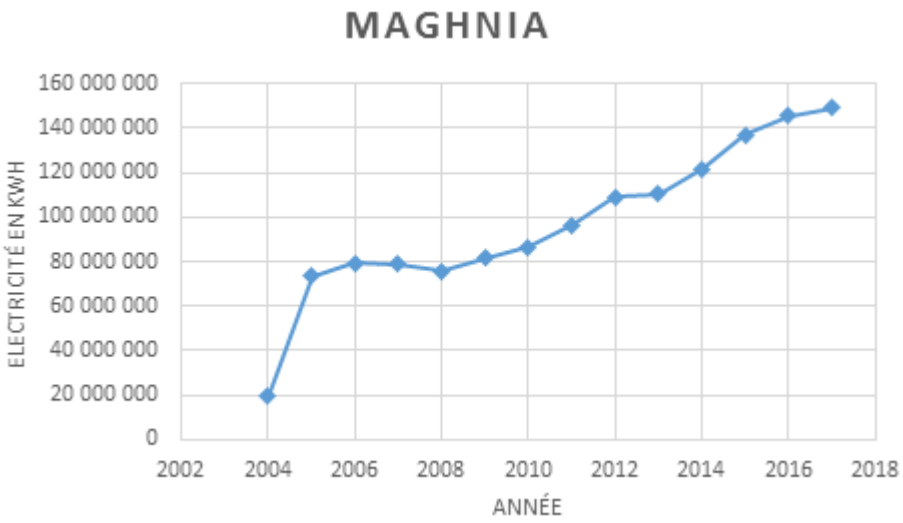


Figure 28: Evolution of Electricity Consumption From MAGHNIA from 2004 to 2017

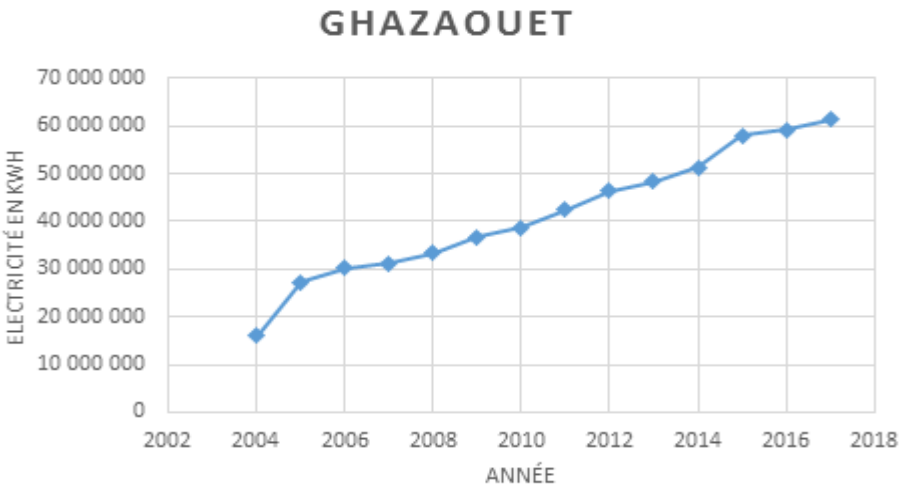


Figure 29: Evolution of Electricity Consumption From GHAZAOUET from 2004 to 2017

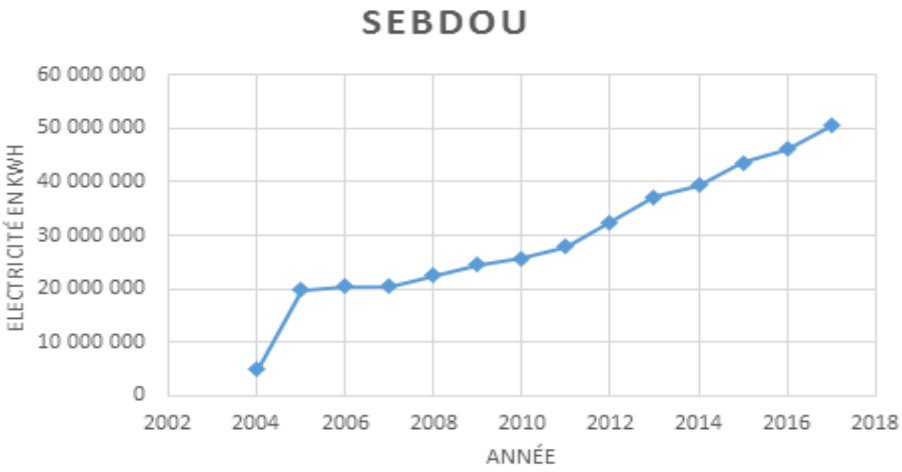


Figure 30: Evolution of Electricity Consumption

From SEBDOU from 2004 to 2017

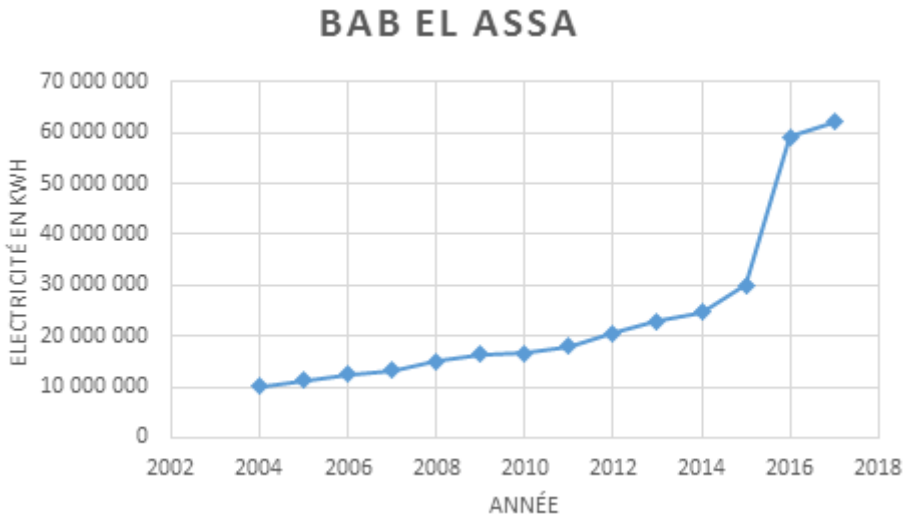


Figure 31: Evolution of Electricity Consumption

From BAB EL ASSA from 2004 to 2017

3.7.2 Analysis of changes in electricity consumption revenues from 2004 to 2017:

Figure 32 shows the evolution of dinar revenues from the electricity consumption of the Tlemcen urban group formed by "TLEMCEN-1; TLEMCEN-2 and CHETOUENE "; during the period of 2004 up to2017. It is noted that the revenues of the city of CHETOUANE are the lowest.

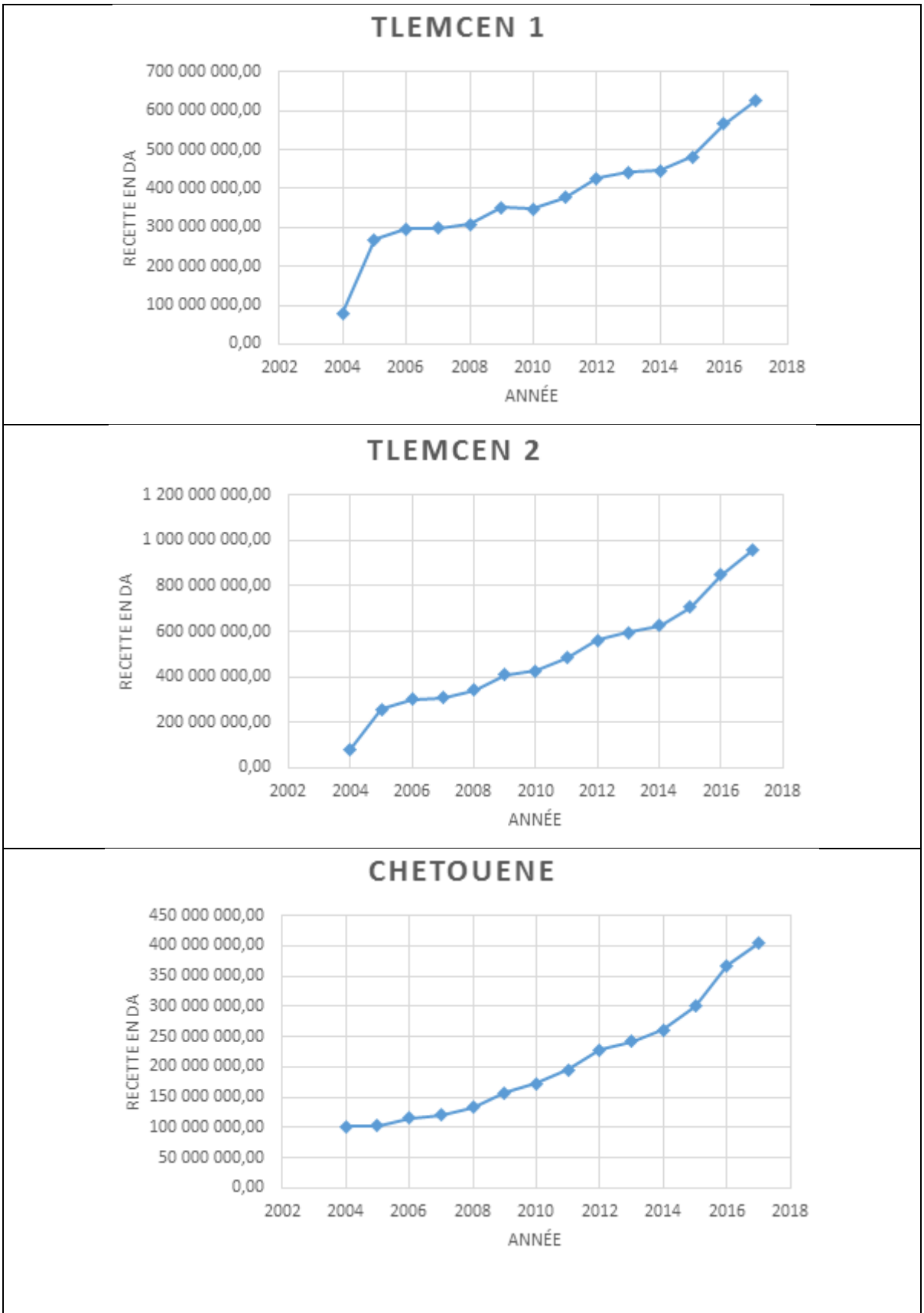


Figure 32: Evolution of the collected revenues of electricity consumption of the urban group of Tlemcen during the period from 2004 to 2017.

We note that the pace of growth of energy consumption in electricity in other regions of the wilaya of Tlemcen is the same. For this purpose, figures 33, 34, 35, 36 and 37 respectively represent the evolution of the revenue collected from electricity consumption during the period from 2004 to 2017 in the regions of REMCHI, MAGHNIA, GHAZAOUAT, SEBDOU and BAB EL-ASSA.

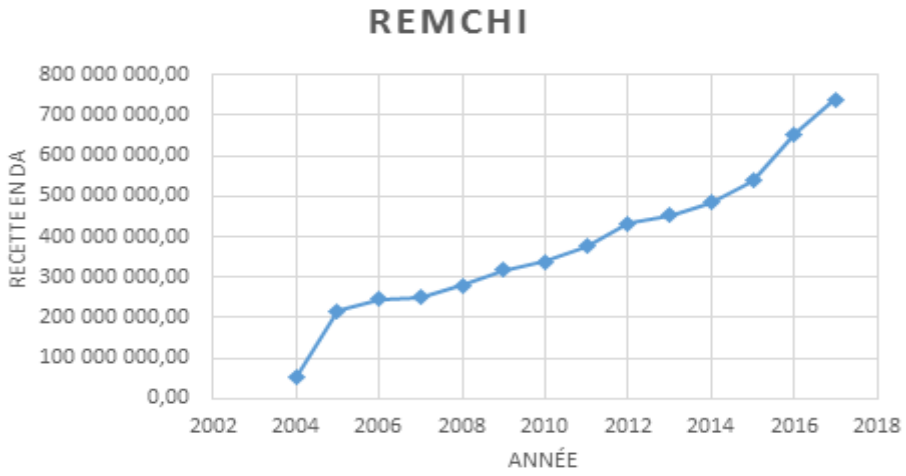


Figure 33: Evolution of consumption of revenue collected at REMCHI from 2004 to 2017

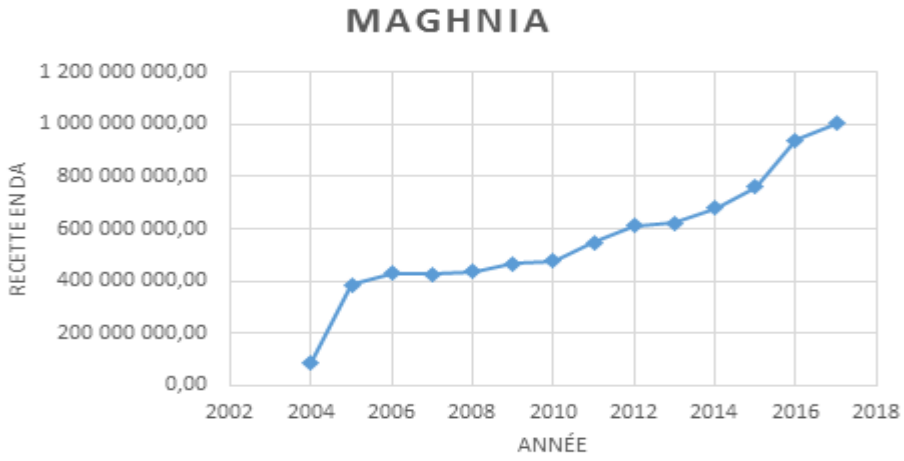


Figure 34: Evolution of consumption of revenues collected at MAGHNIA from 2004 to 2017

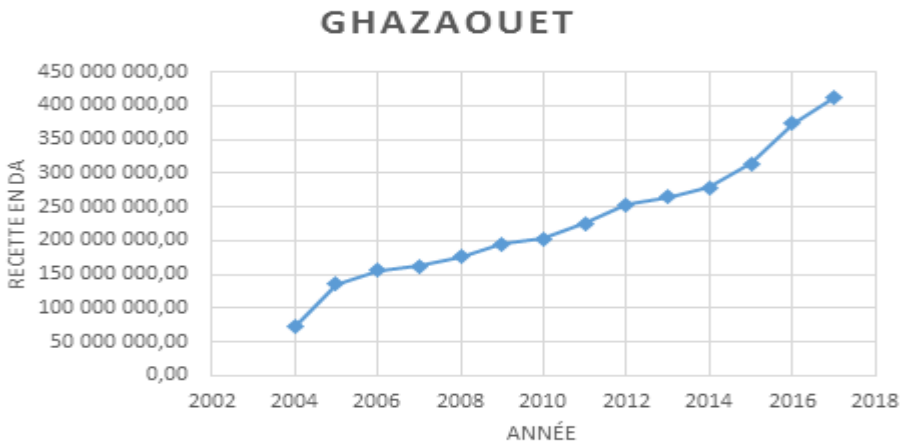


Figure 35: evolution of the consumption of the collected receipts with GHAZEOUET from 2004 to 2017

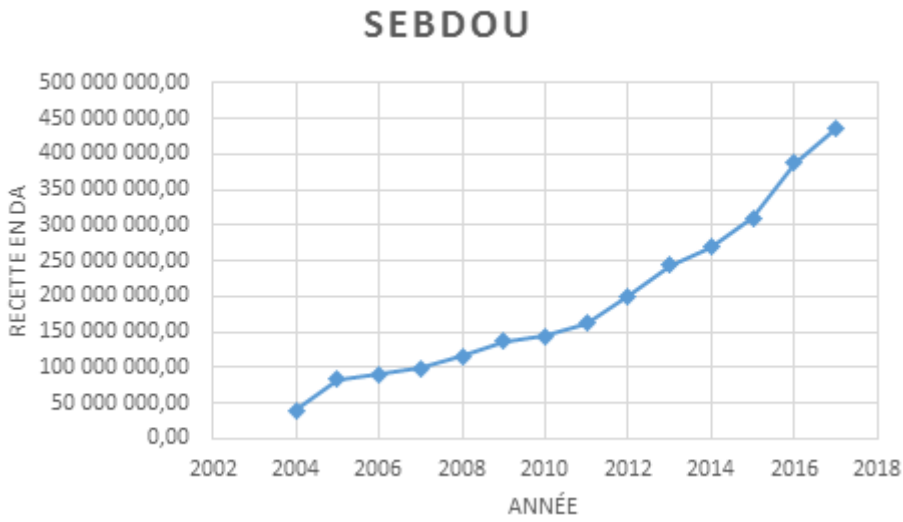


Figure 36: Evolution of consumption of revenue collected at SEBDOU from 2004 to 2017

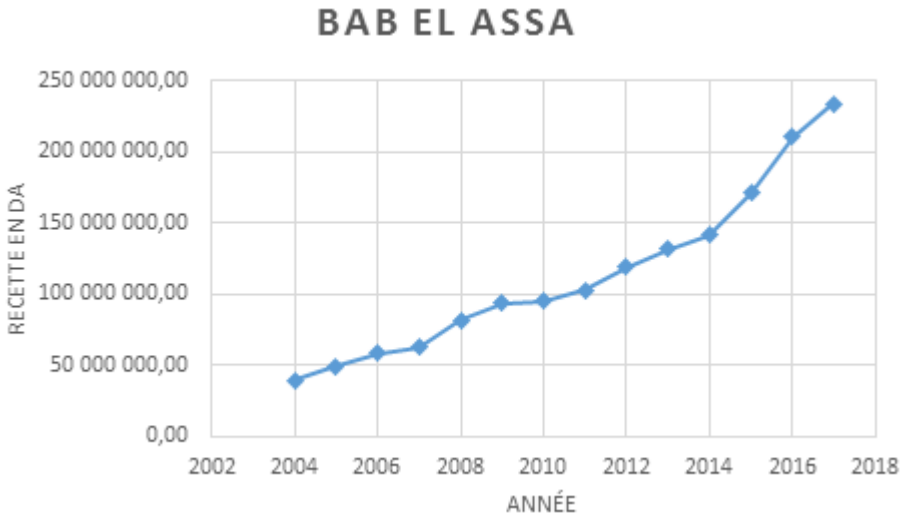


Figure 37: change in consumption of revenue collected at BAB EL-ASSA from 2004 to 2017

3.7.3 Analysis of consumption by sector of activity:

Electricity consumption saw growth from 2014 to 2015 and then a slight decrease from 2015 to 2016 due to the sharp drop in oil prices which pushed the Algerian government declared the state of emergency and reduce all unnecessary expenses, This period the former Prime Minister ABDELMALK SELLAL named by "TAKACHOF" or he asked all the Algerian people to reduce these expenses.

As noted above, the company that manages consumer energy bills is named SONELGAZ. The latter faces a big problem with its customers who do not pay their electricity bills. This is the reason why SONELGAZ is facing a financial crisis.

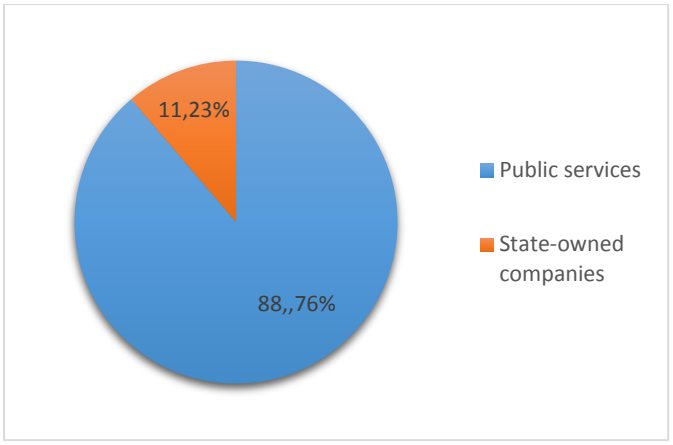


Figure 38: 2014 Business and Utility Electricity Consumption [23]

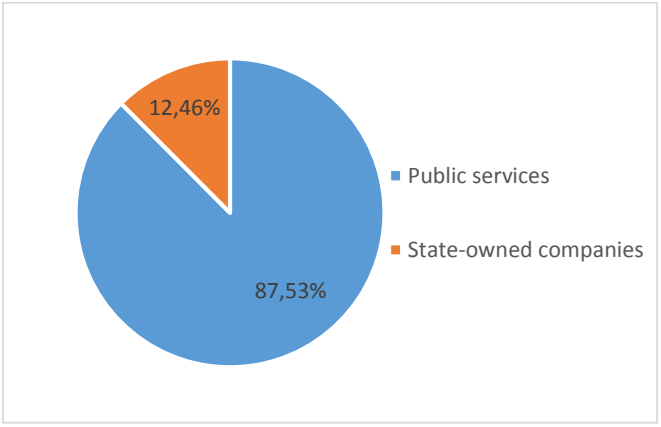


Figure 39: 2016 business and utility electricity consumption[23]

We note that the weight of energy consumption of utilities represents 88.76% of the total electricity consumption for the year 2014 and 87.53% for the 2016. The public companies represent only 11, 23%, 12, 46% for 2014 and 2016 in succession.

According to our study in situ, we confirm the statement of the director of SONELGAZ "Mohamed Arkab", One of the major problems that pushes "SONELGAZ" to bankruptcy is the unpaid bills of public institutions that s'

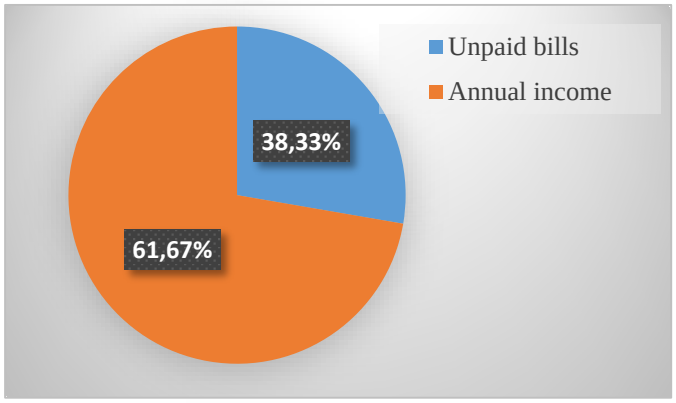


Figure 40: Annual revenue of LA SONELGAZ[23]

amounted to DA 499,850,551 in 2016 represents 38.33% of global revenues.

SONELGAZ is obliged to supply the public sector of the wilaya despite unpaid bills. To solve this problem, the solution is to make these public institutions energy independent. For this purpose the majority of public buildings operate during the day, require only natural sunshine. The use of photovoltaic panels is a very good solution to reduce power consumption.

3.8 Estimated electricity consumption by 2030:

Our goal is to make an estimated study and to propose scenarios of evolution of the population and the energy consumption in electricity by 2030.

3.8.1 Scenario of demographic change:

- Estimation of the Tlemcen population by 2030:

The energy consumption of the population has increased because of the enormous population growth. With a population of 824 053 inhabitants in 2017 and a growth

rate of 1.59 every 10 years the population of Tlemcen will reach 2 150 064 inhabitants in 2030:

The table ... shows the population estimate up to 2030

Tableau 5: Estimated evolution of the future population of 2030

years	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
populations	495269	524094	554597	586875	621032	657177	695425
years	**2015**	**2016**	**2017**	**2027**	**2028**	**2029**	**2030**
populations	735899	778730	824 053	1310244	2 083 288	2 116 413	2 150 064

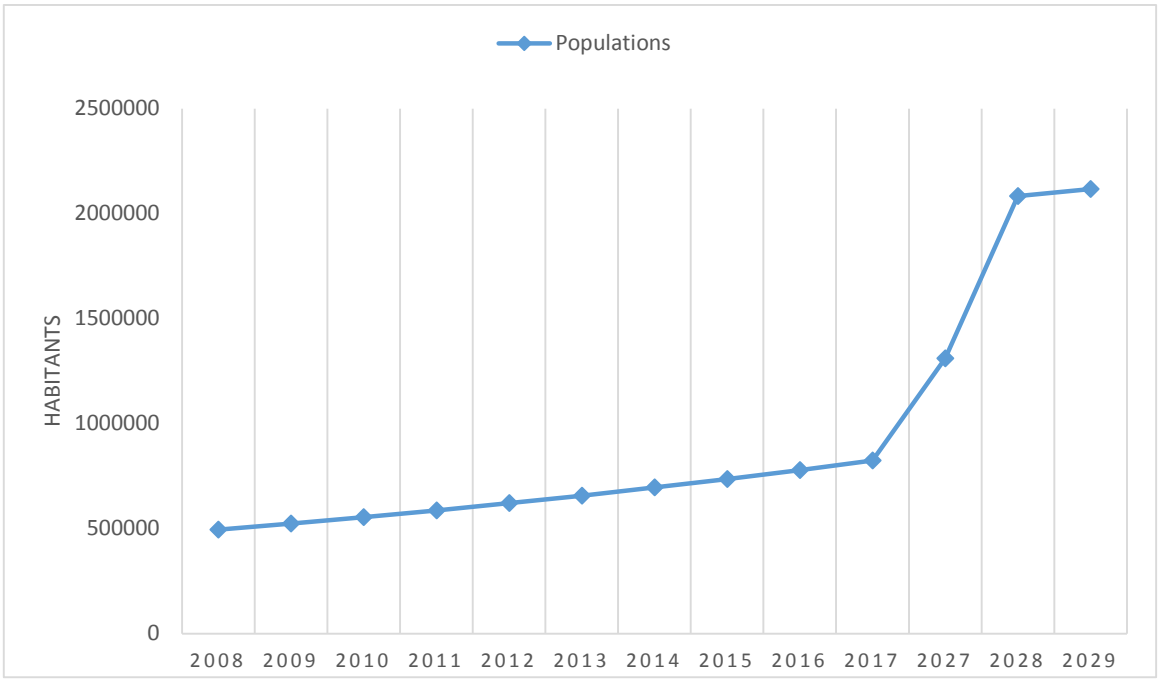


Figure 41: Estimated evolution of the future population of 2030

Another parameter is behind the demographic growth it is the middle class which has undergone a great evolution following the improvement of the standard of living, This middle class is the main consumer since it represents the majority of the population and one notices at this class a phenomenon of "anarchic consumption".

The mode of energy consumption of the population has changed drastically because of the new habits adopted by the population, today we find in each house: (2 to 3 TV, machine has washed, refrigerator, air conditioner, ...) all these appliances consumes a lot of energy if they are misused.

The problem that has been detected in this category is the lack of awareness that drives households to consume more and more and anarchically.

The lack of consciousness is the number one enemy of efficiency since the use of equipment that consumes the minimum energy is not enough to reduce its consumption bill must be appropriate behavior to manage at best power consumption and increase energy performance. For this it takes more Awareness.

Our approach is to do:

• Several information campaigns to raise consumers' awareness of energy savings

• Proposals of consulting services to save more energy.

• Proposals for student and student training on energy efficiency

• "Energy Labeling" that allows consumers to make a greener choice.

• Launch of research and development programs on energy efficiencies »

• Energy audit, annual assessment used to take corrective measures from one year to the next.

3.8.2 Scenario of changes in electricity consumption:

Taking into account the evolution of electricity consumption in the table6:

Tableau 6: Rate of change in consumption from 2014 to 2016[23]

years	2014	2016	Evolution rate
Total consumption	1 198 416 538 KWh	1 351 447 175 KWh	1,12

We obtain the estimate of the rate of evolution of the electricity consumption by 2030 represents in the figure 42.

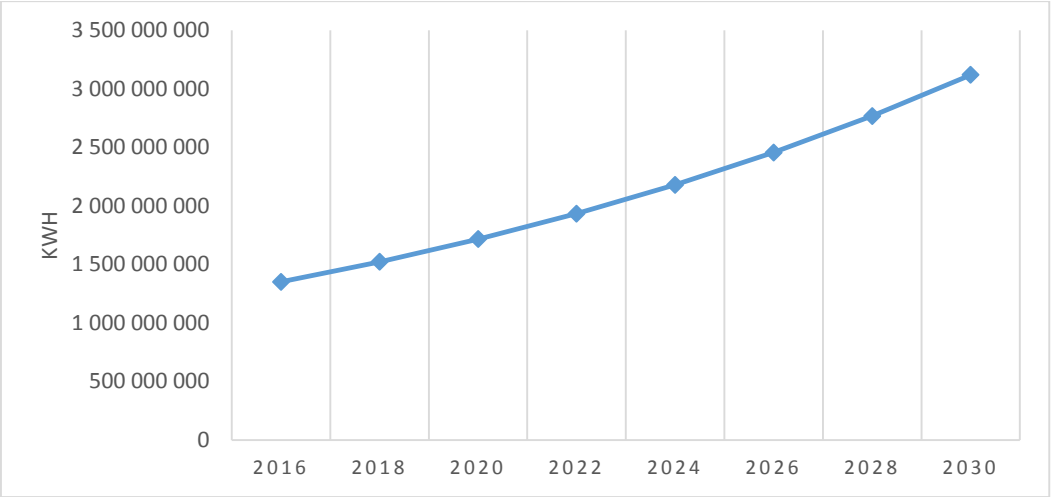


Figure 42: Estimated Future 2030 Electricity Consumption

3.8.3 Scenario of the evolution of the receipts:

The prognostic study of the evolution of energy consumption up to 2030 according to the government's program requires a rational policy on energy efficiency. The approach to follow is to estimate the cost of consumption according to the evolution of the population in 2030. The table 7 Presents the scenario of evolution of the energy consumption during the period 2014 until 2030

Tableau 7: Estimation of the cost of consumption of the future population in 2030

Years	Electricity cost with current conditions	Electricity cost with PV installation for public administrations
2014	4 793 666 152 DA	4 355 966 834 DA
2016	5 405 788 700 DA	4 833 763 885 DA
2018	6 096 075 643DA	5 363 969 513 DA
2020	6 870 277 249 DA	5 954 006 159 DA
2022	7 742 802 460 DA	6 608 946 837 DA
2024	8 726 138 373 DA	7 335 930 989 DA
2026	9 834 357 946 DA	8 142 883 397 DA
2028	11 083 321 405 DA	9 038 600 571 DA
2030	12 490 903 223 DA	10 032 846 634 DA

Case 01:

The first case is to leave things as they are and the result will be catastrophic since the company Sonelgaz will go bankrupt because of the uncollected revenue that will be more and more huge.

Case 02:

In this case we propose photovoltaic panels installations for administrative buildings. This operation gives autonomy of energy consumption to reduce the commitments towards the company sonelgaz

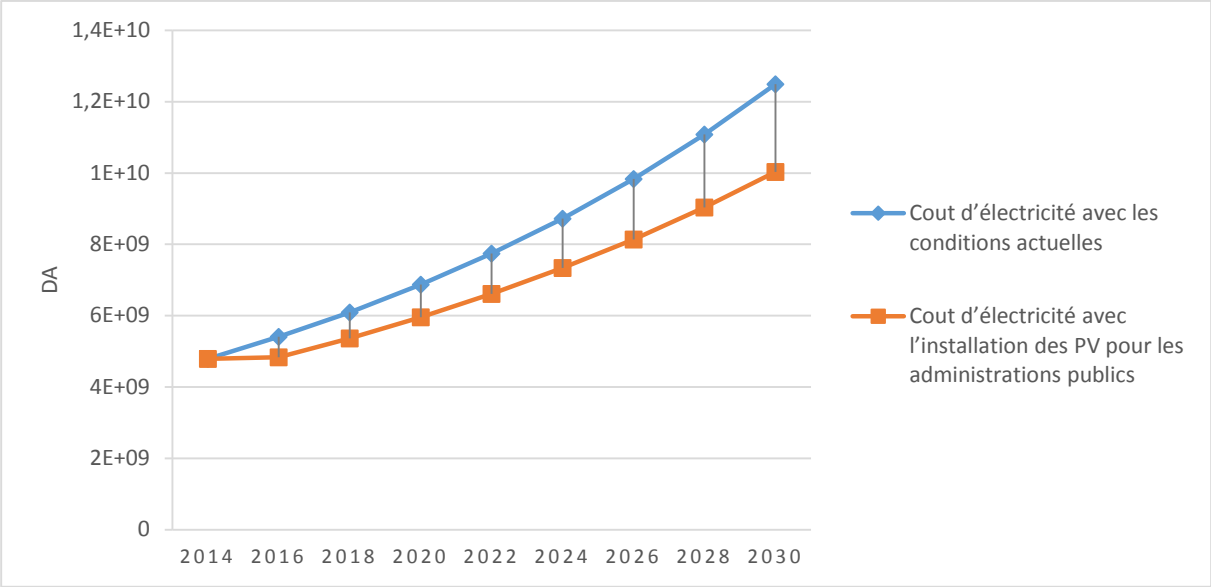


Figure 43: Different Scenarios for the Electricity Cost

The figure shows the reduction in energy consumption costs of Sonelgaz using the second scenario. The gap between the two scenarios diverges as we evolve over time.

3.8.4 Scenario of the energy price subsidy policy:

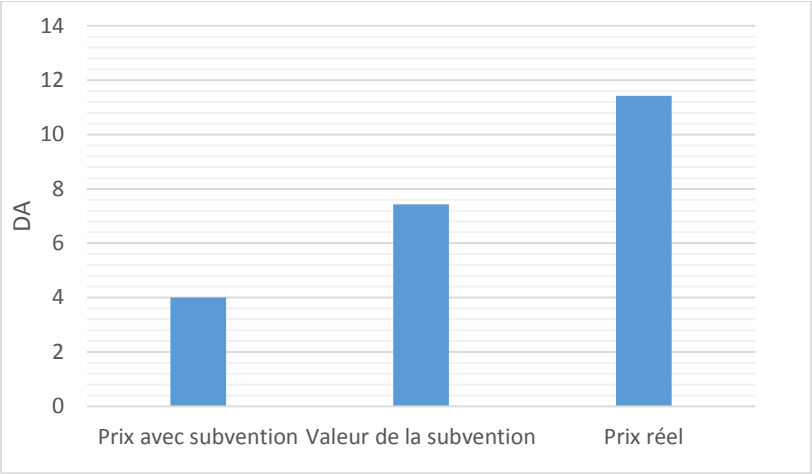


Figure 44: Electricity cost in Algeria[23]

Algeria uses the energy price subsidy as a tool for developing the industry and helping the population, which is normal for a developing country.

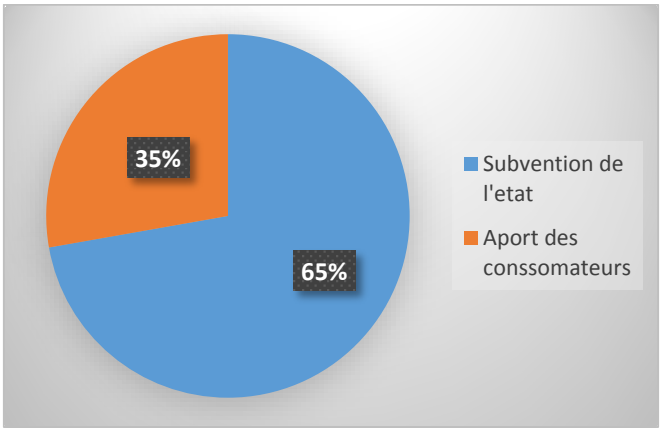


Figure 45: The real cost of electricity in Algeria[23]

The Algerian government subsidizes 65% of the price of electricity to ensure the comfort of its people, the price of electricity in Algeria is one of the lowest prices in the world and for this reason the Algerian population consumed more and more.

The value of the electricity subsidy for the wilaya of Tlemcen amounts to 10,241,952,440,57 DA in 2017 which represents 0,3% of the hydrocarbons revenues.

3.8.5 Scenario of the rate revision:

According to our study if the existing tariffs remained fixed one will never be able to satisfy the demand of the wilaya in electricity, it is for this reason that one must review these tariffs on the rise.

A tariff review program will be applied to reduce the share of the electricity price subsidy so that large consumers pay more for electricity.

The subsidy survey program will be phased in gradually to avoid changing the habits of the population. This operation requires a period of 5 years over 20 quarters until reaching the real price of electricity of 11.43DA / KWh. In this case, the increase in consumption rates will be 0.4DA so that the consumer does not feel the heaviness of the new charges.

Condition of the policy implementation:

- The quarterly option was chosen because customers receive their electricity bills every 3 months.
- The choice of 5 years for the implementation of this policy corresponds to the duration of governance in Algeria.

Tableau 8: Electricity Rate Revision Program

Years	Quarter	Electricity price
2019	First trimester	4,40DA
	2nd quarter	4,80DA
	3rd quarter	5,20DA
	4th quarter	5,60DA
2020	5th quarter	6,00DA
	6th quarter	6,40DA
	7th quarter	6,80DA
	8th quarter	7,20DA
2021	9th quarter	7,60DA
	10th quarter	8,00DA
	11th quarter	8,40DA
	12th quarter	8,80DA
2022	13th quarter	9,20DA
	14th quarter	9,60DA
	15th quarter	10,00DA
	16th quarter	10,40DA
2023	17th quarter	10,80DA
	18th quarter	11,20DA
	19th quarter	11,43DA
	20th quarter	11,43DA

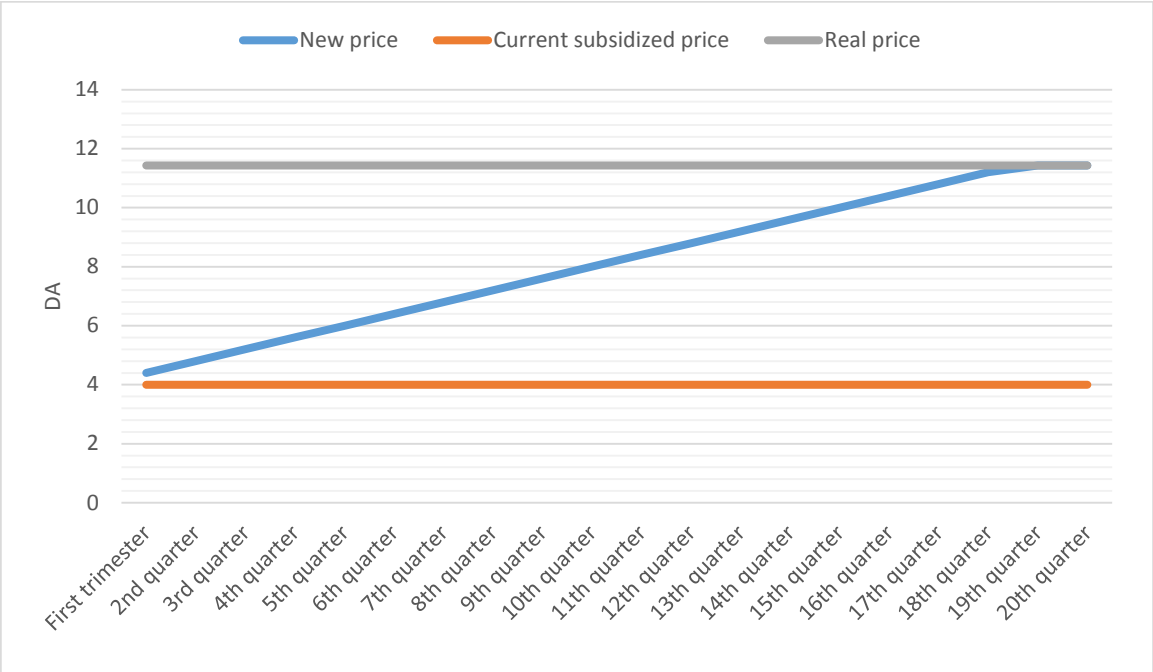


Figure 46: Different scenario of electricity price revision

1st case:

The first case is to directly raise the subsidy on the pricing of electricity, in this case the results will be catastrophic since we will create a direct shock for the consumer who will respond with events that will destabilize the country's security.

2nd case:

The second case is to let the prices as they are, in this case the economy of the country will suffer until waiting for a critical threshold or the state will be unable to provide electricity to all consumers.

3rd case:

The third case is the price revision gradually decreasing the subsidy until the real price, in this case we will avoid the sudden shock of the first case since the increase will be 0.4DA every three months.

3.9 Conclusion:

These prospective studies are thus intended to shed light on thepublic decision, while the choices to be made involveconsiderable resources. Investments to be madeinare of great financial and technical importance.Oil and gas will be there for many yearsin our country, even following the most pessimistic scenarios.

Resources are considerable, but nothing can guaranteewill be exploited quickly enough to cope with the level ofexpected demand in the different scenarios.In addition, the uncertaintiessources of supply necessary to meet thegrowing demand, as well as the cost of producing this oil andon its consumer price, are very high.

To ensure that energy supplies are availablesufficient, government action is needed to reduce theconsumption by encouraging businesses, households andmotorists to change their mode of consumption in order to improveenergy efficiency, by setting up financial incentivessee even appropriate regulatory frameworks; for example theremoval of local price subsidies could greatlycontribute to the reduction of domestic consumption.

At present, oil and gas are two sources of energyvital to the economy of our country, future prosperity depends onHydrocarbons sector: ensuring suppliessufficient energy to meet growing demand,with reasonable prices, remains the major challenge for our country.

Today the Algerian economy is totally dependent onoil and gas, but there is still time to borrow a newtrajectory, developing alternative energies.

CHAPTER 04

Energy efficiency policy and recommendations

CHAPTER 04: ENERGY EFFICIENCY POLICY AND RECOMMENDATIONS

4.1 Introduction:

In this chapter we will propose a new energy policy with recommendations to be adopted in order to solve the energy consumption failures at the scale of the study area and to extrapolate to the national scale.

This approach is part of a global managerial approach to energy efficiency to ensure energy security.

4.2 Energy policy:

Energy policy is the policy adopted by an entity with regard to energy management. It is fundamental for all countries involved in energy efficiency, as the energy development strategies and their articulation require the appropriation of energy planning methods, based on a good knowledge of energy efficiency. the situation (reliable and sustainable information system) [16].

The operations to be carried out as part of this activity will all be related to methodological aspects related to energy planning. The objectives of this activity are:

• Develop in the countries an adapted understanding of the processes (globalization, quest for sustainable development, etc.) at the base of the changes in the energy sector so that it can anticipate and control its evolution.

• Contribute to strengthening countries' skills and capacities for developing national energy policies that enable the sector to play its role in the economic and social development process while respecting the environment.

The energy efficiency policies put in place are combinations of programs and instruments classified into a few broad categories:

- Research
- Innovation and demonstration
- Information

- Promotion
- Education and formation
- Regulations
- Labels
- Voluntary agreements
- Dissemination of methods and techniques
- Decision aids
- Economic and financial incentives

The energy efficiency policy is based on two essential conditions:

- ❖ The first is the need for a strong political will to develop energy efficiency in all sectors. In addition to producers and sellers of energy who occupy very strong positions on the economic level and have an undeniable influence on the political decision-makers. Energy efficiency, because it is dispersed across all sectors of activity, it needs constant political support, at the highest level.

- ❖ The second concerns the prices of energy products to the consumer. Energy prices must reflect the costs of sound energy system management and gradually incorporate the cost of externalities (including environmental damage). If prices of energy products to the consumer remain artificially low, energy efficiency efforts may be in vain.

4.3 Energy efficiency policy currently adopted in Algeria:

The means of supervision of the national policy of energy efficiency were defined in the framework of the law n ° 99-09 of July 28, 1999 relating to the control of the energy [1].

Thus the instruments provided are:

1. The Agency for the Promotion and Rationalization of the Use of Energy, (APRUE);

2. The National Fund for Energy Management (FNME);

3. The Intersectorial Committee for Energy Management (CIME);

4. The National Energy Efficiency Program.

5. The law on energy management reflects the efforts of the public authorities, particularly at the legislative and regulatory levels.

6. The aim is to strengthen this system through the implementation of the regulations, including:

- ✓ Thermal regulation in new buildings
- ✓ The energy audit of the large consumer establishment
- ✓ Energy efficiency classification of household appliances
- ✓ How to organize and exercise energy efficiency control
- ✓ Energy labeling.

7. The financing of actions included in the National Energy Efficiency Program is mainly supported by the resources of the National Energy Efficiency Fund (FNME). This one is powered by:

- ✓ State subsidies
- ✓ The product of the national energy consumption tax
- ✓ The product of the tax on energy appliances
- ✓ The product of the fines provided for under the law on the control of energy
- ✓ The proceeds of repayments of unpaid loans granted as part of energy management
- ✓ Any other resources or contributions.

4.4 Our Energy Policy Action Plan:

4.4.1 Legal and Institutional Frameworks:

The missions of the legal and institutional framework are the adaptation of the laws and regulations allowing the industry to deploy its activities. In the sense that

reforms will be implemented for a logic of sustainable development, with the aim in particular:

- ✓ Optimal exploitation of the potential of natural resources
- ✓ Increase and diversification of state revenues
- ✓ Improving the availability and quality of energy products and services
- ✓ Strengthening Algeria's position abroad, as a reliable supplier country.

4.4.2 Energy Policy:

The aim of the energy policy is to supervise and promote all energy activities: electricity, natural gas distribution, renewable energies and energy efficiency. One of the missions of the energy sector is to provide the entire population and throughout the national territory, energy in the best conditions of cost and quality and continuity of service. It takes a lot of effort in terms of investment for the development of production and transmission and distribution capacities, as well as the reinforcement of infrastructures and electricity and gas networks.

This policy contributes to the preservation of exhaustible natural resources and the protection of the environment and health.

a) The energy transition:

Improve energy efficiency because how can we program two (02) million homes according to the old building standards demanding high energy consumption while modern techniques save 40 to 50% of consumption

Review the subsidy policy that should target energy products, referring to a new energy pricing policy.

The creation of a National Clearing House, that any grant will have to have the approval of the Parliament for more transparency, Chamber having to realize an equalization system, segmenting the activities in order to encourage structuring sectors and taking into account the income by layers social policies, involving a new wage policy.

The development of renewable energy to combine the thermal and photovoltaic whose global cost of production has decreased by more than 50% and it will be more in the future. However, with more than 3,000 hours of sunshine a year, Algeria has all it takes to develop the use of solar energy, or almost. The sun alone is not enough. It takes technology and equipment to turn this gift of heaven into electrical energy.

Large-scale production would substantially reduce costs while supporting downstream a multitude of SMIs and SMEs, strengthening the industrial fabric from clean energy (green industries).

Promoting renewable energies by creating an unveiling fund fueled by hydrocarbon revenues

In mid-July 2011, Algeria received the hybrid power plant in HassiR'mel, with a total capacity of 150 MW, including 30 MW from the combination of gas and solar. This experience is interesting. The combination of 20% conventional gas and 80% solar is an effective choice to reduce costs and master technology[24].

Incentives are provided by a voluntarist policy through the granting of subsidies to cover the additional costs it induces on the national electricity system and the creation of funds to ensure the financing of these projects and to grant unpaid loans and guarantees. for borrowing from banks and financial institutions.

Algeria intends to build its first nuclear power plant in 2025 to cope with a galloping demand for electricity, where according to the 19 May 2013 of the Minister of Energy and Mines, the Institute of Nuclear Engineering, created recently, to form engineers and technicians in partnership, who will be responsible for operating this plant. Algeria's proved reserves of uranium are around 29,000 tonnes, enough to run two nuclear power plants with a capacity of 1,000 megawatts each for a period of 60 years, according to data from the Ministry of Energy[1]..

The option of oil / shale gas (third global reservoir according to international studies) introduced in the new hydrocarbons law of 2013. In Algeria, to avoid

positions decided for and against, a wide national debate is needed, because can not minimize the risk of groundwater pollution in the South of the country.

As Algeria is a semi-arid country, the water problem is a strategic issue at the Mediterranean and African level, must be arbitrated for the consumption of fresh water, a billion cubic meters of gas requiring 1 million meters cubes of fresh water and be considered the costs of drilling several hundred medium wells for one billion cubic meters of gas. Not to mention the short life of these deposits and the necessary agreement with riparian countries sharing these water tables.

COPE21 and COP22 is climate action that can not be conceived within the framework of a Nation, will involve wide consultation with the Maghreb countries and Africa. In general, for the Maghreb, including Algeria, water resources are vulnerable to climate variations.

In the Maghreb region, the negative effects will affect the production of vegetables whose yields would decrease by 10 to 30% and a decline of wheat to nearly 40%. Thus, climate change could lead to a real migration crisis, blue gold, an unresolved 21st century issue that can cause global wars.

The transition can be defined as the transition from a human civilization built on a predominantly fossil, polluting, abundant, and cheap energy to a civilization where energy is renewable, rare, expensive, and less polluting, with the aim of replacing at the end of stock energies (oil, coal, gas, uranium) by the flux energies (wind, solar).

b) The law of the energy transition:

Through this law, several sectors will have to contribute to the energy efficiency effort, including building. In fact, it represents the majority of energy consumption and greenhouse gas emissions each year.

The objective is therefore triple in this sector:

• Fight against fuel poverty

• Improve the quality of life of households

• Strengthen the energy performance of buildings

Several measures must be taken to restart the energy renovation work. The law sets a goal of energy renovation of all homes that are not in line with the latter, aiming to reduce energy poverty by 2030.

To achieve this a set of financial arrangements for individuals has been launched:

• The "energy check" to help renovate low-income households

• Guarantee funds to access microcredit and carry out the work

• The development of specific energy saving certificates

• The reinforcement of regional public third-party finance companies to allow funds to be advanced to individuals who wish to undertake work to improve the energy efficiency of their homes.

Households will also have more information, both on their housing with the creation of a digital logbook for monitoring and maintenance of housing, but also on their consumption through smart meters of electricity and gas. In addition to these tools, territorial energy renovation platforms will be set up to advise consumers on financing, certified craftsmen, energy diagnostics and the planning of works to be carried out.

Measures for the energy performance of buildings. Heavy renovations (roofing, façade renovation, surface extension, conversion of attics) will now have to comply with energy performance requirements.

Public buildings (State, public institutions or local authorities) will be positive energy and high environmental performance whenever possible, and will promote the use of natural materials.

To help achieve these goals, the government has embarked on a major program to simplify planning rules and plans to showcase exemplary operations.

Finally, measures will be taken into consideration on renewable energies such as:

• Single authorization for the commissioning of wind, hydroelectric, biogas and electricity or biomethane production facilities from biogas

• The exemption of bioenergy from domestic consumption taxes, which are now only subject to fossil fuels

• Promotion of renewable energies in the building

• Encouraging crowdfunding of renewable energy projects

• A carbon tax paid on all CO2 emissions.

Their share will have to reach 50% of the energy consumption in 2030.

For Algeria, the energy transition must lead to a sustainable national energy system and will in fact constitute an economic transition

c) State support for electricity developments:

The policy of support to the populations of the South, a reduction in the bill of consumption of electricity will be adopted for the south and TAX exemptions on the purchase and use of renewable energy generating equipment for others :

1- South: Adrar, Laghouat, Biskra, Bechar, Tamanrasset, Ouargla, Illizi, Tindouf, El Oued, Ghardaia.

Two levels of support have been identified:

• 60% discount for low-voltage households and farmers

• 20% discount for low and medium voltage subscribers engaged in economic activities outside agriculture

• Exemption of the T.V.A for the purchase of Equipment generating renewable energies.

2- Highlands: Djelfa, El Bayadh and Naama.

• For the three HautsPlateauxwilayas: 5% discount for low and medium voltage subscribers

• Exemption of the T.V.A for the purchase of Equipment generating renewable energies.

3-North:

• Exemption of the T.V.A for the purchase of Equipment generating renewable energies.

d) Prospects for development of electricity and gas infrastructures:

1- For electricity:

Changes in electricity consumption are generally analyzed from the point of view of security of supply, it is a question of guaranteeing continuity of supply even at the peaks of consumption. These variations thus cover important issues in terms of sizing the electricity network and the electricity generation fleet.

Advanced electricity consumption results in significant power requirements which in turn require heavy and costly investments for the development of electricity generation infrastructure and the transmission and distribution network, which must be permanently dimensioned to support extreme needs.

To make all the energy-independent state establishments install installations of renewable energy generations that will be allowed thanks to the energy transition plans.

The implementation strategy of this program consists in the implementation of a series of industrial projects in partnership based on the valorization of local resources. Above all, it aims to develop a national industry responsible for supplying equipment for the electrical energy sector.

2- For gas:

The domestic natural gas supply market is based on a gas transportation capacity adapted to the needs of customers.

The major stake to which the development of the network must respond is to provide the national gas market with the necessary and sufficient capacities, in economic conditions compatible with the quality of service expected by the users of the network.

Also, the development of new transmission capacities and the rehabilitation of structures in operation are a major focus of the strategy of the gas transmission system operator, as part of its mission to satisfy the national gas supply.

The development of gas distribution infrastructure to improve people's access to natural gas and ensure a regional socio-economic balance of the country.

4.4.3 Renewable Energies and Energy Efficiency:

A- Renewable energies:

A program to develop the national potential for renewable energy and energy efficiency must be adopted by the government.

The technological evolution and lowering of the costs of certain electricity production chains such as the photovoltaic and wind power sectors, are the first reason to invest in the field of renewable energies.

Thus, a proactive updated program will be adopted to increase energy production capacity.

The development of renewable energies within the framework of this program, concerns the sectors of the wind turbine, solar photovoltaic, solar thermal (CSP), cogeneration, biomass and geothermal

This program, which aims for a renewable share of nearly 40% in the electricity generation balance sheet by 2030, plans to mobilize all the necessary resources by calling on private and public, national and international investments. As a result, it will save a large volume of natural gas.

An incentive mechanism based on purchase tariffs guaranteed by a regulation will be set up to allow national and international private and public investors to participate in the implementation of this program.

B- Energy efficiency:

Implementing energy efficiency helps achieve more efficient and optimal energy use in residential, transportation and industry. A significant program has been

launched in this direction and the realization of which will allow significant energy savings. This program, which affects several sectors of activity, consists of:

a) Building Sector:

1. Thermal insulation requirement in the specifications of new housing, Thermal bridge insulation is mandatory to reduce heat loss and ensure very good energy efficiency.

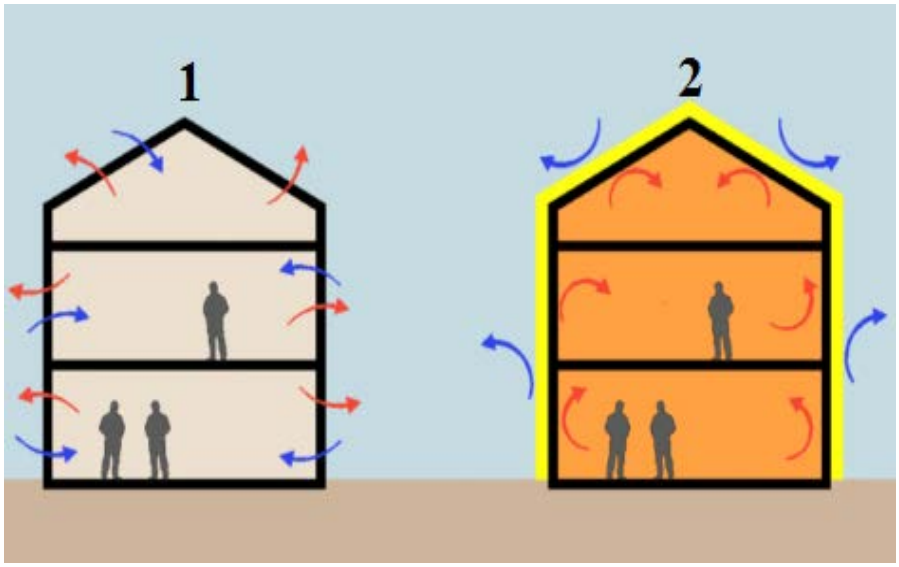


Figure 47: Heat transfer with and are insulation[25]

The inhabitants of house 1 consume more energy for winter heating and air conditioning for the summer unlike house 2 which has thermal insulation.

The main thermal bridges to treat:

- ✓ Junctions with the roof.
- ✓ Junctions with joinery.
- ✓ Junctions with intermediate and low floors.
- ✓ The pouters.

2. Requirement to install solar water heaters in the specifications of new housing

4. Ventilation :

The purpose of the ventilation is to evacuate moisture, water vapor and pollution related to the occupation of the buildings, which guarantees the hygiene of the

premises and the health of the occupants. Losses related to air renewal can represent between 15 and 20% of total losses of a home.

The ventilation ensures a renewal of hygienic air, Good ventilation is essential for:

a. Fight against visible or non-visible pollution:

- ✓ Various emanations (glue, varnish, paint, chipboard and other materials, interior perfumes, chemicals)
- ✓ CO2 (breathing, cooking, candles)
- ✓ Mites, microbes
- ✓ Plants, animals
- ✓ Odors, fumes, tobacco
- ✓ Mold, moisture
- ✓ Dust

b) Evacuate the moisture in the form of water vapor contained in the ambient air and a good air quality and a healthy habitat

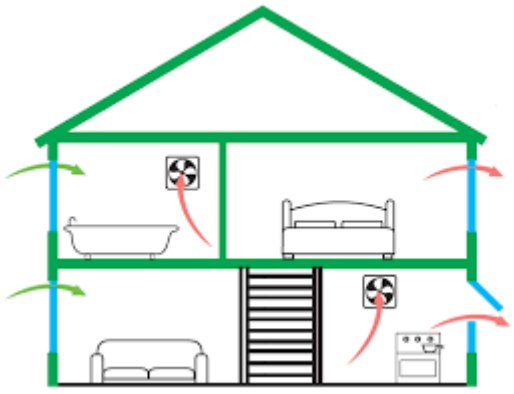


Figure 48: Air circulation in a ventilated house[30]

For ventilation to be effective, it is essential that the insulation and airtightness of the walls be perfect. Since the walls are not airtight, ventilating with a powerful system can prove to be very counterproductive in terms of air renewal and heating savings.

Heat recovery provided via a heat pump on the extracted air.

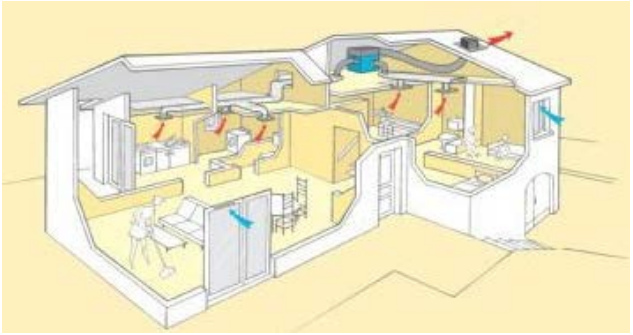


Figure 49: Ventilation Technique[30]

To avoid condensation, the appearance of traces of moisture, mold or saltpetre on the frame, it is imperative to evacuate the water vapor produced by the activity inside buildings (showers, cooking, and washing, drying ...).

3. Distribution of low consumption lamps

4. Promote Positive Energy Buildings: Any building with a very low level of energy consumption.

5. Promote Sustainable Construction: The construction of houses with natural materials.

6. Using architecture that respects follows the philosophy of energy efficiency:

In terms of orientation and architecture, the work of the designer must consist of combining the best contributions of the winter sun and sun protection in summer and mid-season:

- ✓ Rooms occupied permanently during the day should preferably be oriented to the south.
- ✓ The rooms will be rather south and east, enjoying the sunrise. They will keep their freshness at the end of the day.
- ✓ Make sure to limit solar gain in the kitchen on south-west windows, which often cause overheating.
- ✓ A greenhouse or veranda placed to the south allows, while bringing heat in winter, to create an intermediate space between the inside and the outside.

Orientation of the house: The sun is often sought after in the winter when we try to protect it during the summer

The orientation parameters are decisive and linked to the destination of the places:

- ✓ Light needs.
- ✓ The use of solar rays to heat.
- ✓ The need to protect oneself from the sun against overheating.
- ✓ The presence of cold prevailing winds of the winter (one thus decreases the consumption of heating).

7. Natural lighting:

The importance of natural lighting is essential because it allows a significant reduction in energy consumption

- ✓ Lighting through windows: It guarantees the necessary visual contact with the outside and presents little risk of water infiltration by driving rain.
- ✓ Ceiling lighting: It is much more efficient than window lighting, even in overcast conditions. The light comes indeed from the central part of the sky, more luminous.

8. Substitution of public lighting lamps with high-pressure sodium lamps

9. Install presence detectors with relays in corridors, garages, toilets

10. Paint light colored walls and ceilings: They reflect better light and avoid artificial lighting

11. Awareness campaign:

To tackle the behavioral aspect, an awareness campaign is an avenue to consider. It will allow you to:

- ✓ Clarify the concept of energy efficiency
- ✓ Change attitudes or behaviors regarding the use of energy at work, at home or on the road
- ✓ Reduce the energy costs of your organization
- ✓ Contribute to the reduction of greenhouse gas emissions
- ✓ Understand the link between the task and energy consumption

- ✓ Challenge and encourage the adoption of work methods that save energy
- ✓ Demonstrate that your organization is managing the assets entrusted to it in an informed manner
- ✓ Create a dynamic conducive to the emergence of new sources of energy saving.

12. The use of energy efficiency awareness messages:

- ✓ Lift: use the stairs instead
- ✓ Hot water: be sure to close the faucets between uses, because a tap that leaks at a rate of one drop per second will waste approximately 25 liters of water per day, or more than 9,000 liters per day year
- ✓ Lights: Turn off the switch when leaving a room, turn off the lights near the workstation before leaving for a meeting or for the evening
- ✓ Heating and air conditioning: in summer, close the curtains or blinds during the day to facilitate air conditioning (this avoids the warming of the room by the sun's rays); in winter, close curtains or blinds in the evening to facilitate heating (this cuts cold air from windows)
- ✓ Computer: Turn off the computer screen since, even in standby mode, it consumes energy
- ✓ Cell Phone Battery Charger and External Notebook Power Adapter: Unplug them when they are not in use because they consume power even if they are not connected to the device they are powering or that the latter is fully charged.

13. Informed and advised the population about the importance of energy:

There is no miracle recipe for changing behavior. In addition, by following the tips that follow, you will have more chances of success!

- ✓ Be patient: change is long!
- ✓ Opt for continuity and repeat the messages, often and in various forms: nothing better than to hit the nail!
- ✓ Encourage good moves and make them known: the very principle of candy.

- ✓ Inform the staff of the news; everyone loves primeurs.
- ✓ Listen to what employees have to offer: lots of heads are better than one.
- ✓ Look for voluntary membership of staff: forced labor, no thanks!
- ✓ Preach by example: no more "Do what I say, not what I do"!
- ✓ Use humor and creativity: it's better to be original than moralistic.
- ✓ Reward efforts: a game, participation prizes ... our child's hearts are never far away.
- ✓ No matter what awareness tools you plan to develop, it is advisable to follow the following tips to increase the chances of success of your campaign:
- ✓ Present the campaign to the appropriate manager and obtain permission to proceed;
- ✓ also get support from sustainability leaders, the communications team and other interested people and make sure they are actively involved
- ✓ find out about other awareness campaigns that are ongoing or upcoming, since one message should not overshadow the other;
- ✓ also find out about ongoing or upcoming sustainability and energy efficiency measures: this could help you improve your campaign.
- ✓ seize the opportunity to explain to an employee that the mere fact of not closing the door unbalances the entire ventilation system and leads to undue expense;
- ✓ train staff when adding equipment or modifications to existing systems;
- ✓ pass on to colleagues the knowledge gained at a conference or conference on energy
- ✓ find creative ways to reward energy-saving initiatives
- ✓ add a message about saving energy in the e-mail signature of the sender in emails

There is no magic recipe for changing the way people use energy or to achieve meaningful results for your organization. Remember that the success of awareness is very much about repetition and continuity.

14. Energy audits in the tertiary sector.

15. Obligation to use Smart Meters

b. Industry Sector:

1. Execution of energy audits in the industrial sector

2. Gold Tax Exemption for the purchase of Renewable Energy Generating Equipment

3. Exemption of 10 years from the various taxes of any investment exercising in the sector of renewable energies.

4. Strengthening the capacities of industrialists in the field of energy efficiency and energy management, Accompanying measures for industrialists

5. Financial support for industrialists for the implementation of energy efficiency projects

6. Technical accompaniment by setting up a body of auditors

7. Strengthening the capacities of industrialists by multiplying cooperation programs

8. Establishment of energy efficiency standards for equipment

9. Information and awareness of industry.

10. Energy performance diagnosis

11. Measurement campaign

12. Advice on the choice of energy used

13. Control of customer invoices

14. Simulation optimization study by simulation

15. Measurement and Verification Plan (PM & V)

16. Global energy balance

17. The use of energy consumption measuring apparatus

18. Energy compensation systems

19. Power regulators

20. Production and industrial use of heat (boilers, heat exchangers, industrial refrigeration)

21. Obligation to use the ISO 9001[26] quality management standard

22. Obligation to use the ISO 14001[26] environmental management standard.

23. Obligation to comply with the ISO 50001 standard which refers to the implementation of energy management systems. This International Standard is based on elements common to all ISO management system standards, which ensures a high level of compatibility, in particular with ISO 9001 and ISO 14001.

The objectives of ISO 50001[26]:

- ✓ Optimize energy security
- ✓ Reduce risks
- ✓ Improve environmental performance
- ✓ Reduce costs (save energy
- ✓ Increase energy efficiency

24. Using light catchers:

The use of light catches in the industry is the best solution to reduce the electricity consumption used for lighting during the day.

Figure 50: Light catcher[27]

c) Transport Sector:

1. Vignette exemption for LPG and electric vehicles;

2. Tax Exemption Gold for the purchase of hybrid and electric vehicles.

3. Energy audits in the transport sector.

4. Increasing public transit infrastructure for environmental, growth and employment purposes

5. Promote the use of public transport and clean transportation for travel

6. Favor, to the detriment of road transport, clean transport for the transport of goods,

7. Promoting river, sea and rail transport to the detriment of trucking

8. The promotion of safety in all modes of transport

9. Accessibility of persons with disabilities to public transportation

10. Ecological bus acquisition for public transport

Figure 51: Ecological Bus[28]

11. Create special routes for cyclists

Figure 52: Road for cyclist[28]

12. Introductions of trams in major cities: Public transport reduces traffic and thus pollution in cities.

Figure 53: Tramway[28]

4.5 Conclusion:

In this chapter we present the current energy policy of Algeria which allowed us to propose complementary solutions.The tools used by the Algerian state are no longer effective because of the scarce fossil resources and the negative environmental impact of this unconventional resource.

Energy efficiency is the strong point of our policy, since it has confirmed its weight at the strategic level; it is an essential passage for sustainable development.The financing of the investment in clean and renewable energies must do so thanks to the income from hydrocarbons since to ensure a stable energy transition.

We have also proposed a public awareness program to reduce the consumption bill for households and entrepreneurship, our strategy is to involve the citizen to achieve maximum energy efficiency.

General conclusion:

This work is part of the energy efficiency policy to ensure a sufficient supply of electricity locally and nationally for energy needs in the future.

Algeria, and more generally the whole world, are facing unprecedented challenges stemming from the scarcity of energy resources, population growth, rising energy prices, accelerating the phenomenon of energy poverty and the need to fight against climate change and, therefore, to reduce greenhouse gas emissions.

Faced with these problems, energy efficiency is an important tool that will improve energy security by reducing primary energy consumption and an essential lever in the energy transition. It will help reduce greenhouse gas emissions in a cost-effective way as part of sustainable development.

The present work has made it possible to evaluate the energy growth according to the growth of the population and to target the energy consuming sectors in the wilaya of Tlemcen. Two major constraints were raised in this study. Unpaid bills from unproductive sectors and state subsidy.

Based on the actual data, forecast scenarios up to 2030 on the evolution of population growth and electricity consumption have been established.

The Algerian state has developed a national institutional, financial and incentive program on energy efficiency. Since 1995, he has conducted reflections on energy consumption in the field of energy management. It could put an end to the significant growth in energy demand by engaging in activities that encourage energy efficiency

The main interest of this work is to contribute to a better understanding of energy consumption control processes in the wilaya of Tlemcen, by analyzing the capacity of a managerial intervention to produce changes in this process implemented by

actors in a complex system. Our challenge is to understand the control of energy consumption and to raise awareness among managers and decision-makers; critical aspects related to the process of energy control, and what would be the recommendations to be transmitted to the different actors to draw the reliability and the efficiency of this operation.

To this end, we recommend urgent measures to overcome these problems of excessive energy consumption by developing a reliable energy efficiency policy. We propose some solutions:

- ✓ Efforts by public authorities to facilitate behavioral changes with regard to energy: awareness-raising, monitoring of the integrated implementation of the regulatory mechanisms for energy management, standards and labeling, strengthening of industrial capacities and techniques, tariff and tax incentives, innovative financing mechanisms
- ✓ Ethical values acting on the global society (researchers, technicians, directors, suppliers, industrialists, households, etc.). These actors must have an ecological sensitivity, whereas the latter correlates with certain number of practices; technological development or renewal and continuous training of actors; leads to a process of reorientation of behavior vis-à-vis the sustainable and efficient consumption of energy

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