Journal of ENVIRONMENTAL Treatment Techniques

J. Environ. Treat. Tech.
ISSN: 2309-1185

Journal weblink: http://www.jett.dormaj.com

Energy Consumption Policy, GHG Emissions and Climate Change Impact in Algeria

Abdelkarim Mellah, Youcef Abdelhafid, Ahmed Benmalek

Centre de recherche scientifique et technique sur les régions arides, CRSTRA, Biskra.

Received: 25/04/2019 Accepted: 11/06/2019 Published: 01/12/2019

Abstract

In recent years, the phenomenon of climate change has become very remarkable in Algeria, given its recorded effects on the temperature and precipitation. Algeria is among the top 50 countries at high risk of climate change, with a vulnerability index of 7.63%, because of its geographical position and climatic characteristics. This climate change leads to major risks in Algeria such as the displacement of sub-Saharan diseases like malaria, typhoid, and viral hepatitis, etc..., phenomenon of colored waters on the coast, drought on wide ranges, coastal erosion is also very marked, which may cause flood risks threatening in some regions. In this work, we present an analysis of GHG emissions as the main culprit in the phenomenon of climate change in Algeria compared to other countries. We analysis as well the national strategy to reduce GHG emissions and its plans of mitigation, adaptation, and the implementation of the program of renewable energies development and energy efficiency, whose offer a great potential for GHG mitigation. The analyses of data of temperature and rainfall from 2009 to 2018 show a clear tendency towards decreasing rainfall and increasing average temperatures in north and south of Algeria.

Keywords: CO_2 emissions, climate change, renewable energy, economic growth, Algeria.

1 Introduction

The industrial development taking place in the world, which started early in the last century at the beginning of the industrial revolution, led to a strong spread of factories, urbanisms, and a large number of used cars in the world, which are considered as important sources of emissions of greenhouse gases, in reason of the considerable volume of fuel which it consumes globally. Vehicular pollution in only India is estimated to have increased eight times through the last two decades. This source alone is estimated to contribute about 70 per cent to the total air pollution. The U.S., China, Russia, Japan and India are the first countries in contribution to world carbon emissions [3]. Global carbon emissions is predicted to increase in the coming years due to the fast pace of urbanization, change from non-commercial to commercial fuels, increased vehicular usage and continued use of older and more inefficient coal-fired and fuel power-plants [4].

Therefore, the temperatures have been going up around the world for many decades, which produces the shift in worldwide weather phenomena associated with an increase in global average temperatures. This has been termed climate change [1]. Authoritative temperature registration started in 1850. The earth became now hotter one degree Celsius than it was in the period between 1850 and 1900. This period is commonly referred to as the "pre-industrial" average [2]. Global warming primarily caused by increases in “greenhouse” gases such as Carbon Dioxide (CO_2), Nitrous oxide (NOX), Sulphur dioxide (SO2), Hydrogen etc.,. A warming planet thus leads to global climate changes which can adversely affect weather in different ways; it has ever had remarkable effects on the earth. Glaciers have retract, ice on rivers and lakes is breaking up earlier, plant and animal areas have disappeared and trees are flowering sooner [3].

Geographically, Algeria belongs to the hot-hyper-arid lands, where its large part belongs to the Mediterranean basin [6]. It is considered as a hot spot, highly vulnerable to global climate change and should therefore be protected [7]. Thence, the query of climate change is became more and more important and a new big challenge [5]. Therefore, Algeria is participated to several global events and it is a member of most international organizations in the context of struggling to reduce climate change and environment prevents. Algeria, ratified in April 1993, the United Nations Framework Convention on Climate Change (UNFCCC), and the Kyoto Protocol in 2005, and totally supports their commitments regarding to the stabilizing emissions of greenhouse gases to prohibit anthropogenic interference with the climate system. It has presented its willingness to take part in the international effort against climate change and its potential impacts on water resources, natural ecosystems and the sustainability of economic development

Corresponding author: Abdelkarim Mellah, Centre de recherche scientifique et technique sur les régions arides, CRSTRA, Biskra.e-mail: karim.epa2008@hotmail.fr.

[5].

In the present work we highlighted the impact of the climate change on the temperature and the precipitation in Algeria. The aspects of this research are also being studied particularly the Algerian government policy, and their ways of adaptation and mitigation of GHG emissions. We as well present the nationals plans of reduce energy consumption in order to minimize GHG emissions without restrictive or menacing the economic growth of the country.

2 Each country's share of CO_2 emissions

The world's countries emit vastly different amounts of heat-trapping gases into the atmosphere. The Figure 1 shows data compiled by the International Energy Agency (IEA), which estimates carbon dioxide emissions from the combustion of coal, natural gas, oil and other fuels, including industrial waste and non-renewable municipal waste for the most CO_2 emitted countries in 2017 [8]. The population list of the 13 countries that emitted the most carbon dioxide in 2017 is presented in the Table 1:

Table 1: Population list of 13 countries contributing highest CO_2 [9]

Countries	Population
China	1418844155
US	328526823
India	1365161306
Algeria	42514256
Russia	143911107
Japan	126934043
Germany	82406902
Iran	82624355
Saudi Arabia	33991991
South Africa	57900691
Egypt	100726281
South Korea	51296416
Canada	37199710

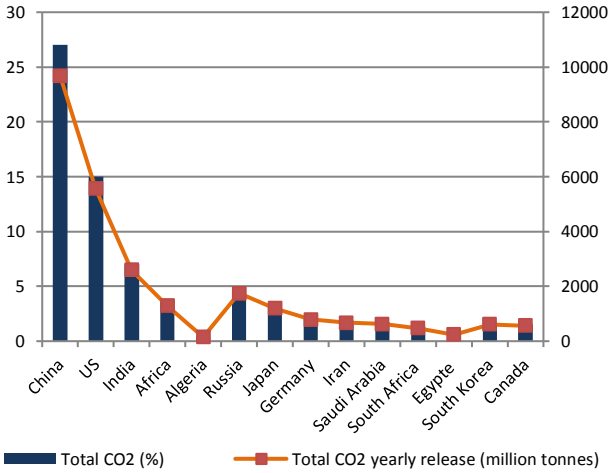

Figure 1: Country's share of CO_2 Emissions [8]

The largest carbon emitters in the world are classified in the first by China with 9680 Mt CO_2 (million tons of CO_2), which is equivalent of 27% of CO_2 globally emitted, followed by USA with 5561 Mt CO_2 equivalent of 15%, European Union with 28 countries with 9%, India by 2597 Mt CO_2 equivalent of 7%. Only these four countries account 59% of the world issue. Africa (1295 Mt CO_2) represents only 3.6% of the world emission in 2017 (Figure 1). Global carbon dioxide emissions in Algeria has been increasing in the last years, in which reached a value of 147 Mt CO_2 in 2017 against 143 Mt CO_2 in 2016, an increase of 2.8%. In terms of per capita emissions, the report records 3.8 tonnes of CO_2 per person per year in 2017 compared with 3.7 tonnes of CO_2 per person per year in 2016. Algeria ranks 33rd in the world, third in Africa after South Africa with 476 Mt CO_2) and Egypt with 237 Mt CO_2, 6th in the MENA region, but represents only 0.41% of the world emission in 2017 against 0.36% in 2016.

3 Evolution of CO_2 and GHG in Algeria

3.1 Evolution of CO_2

The CO_2 measured by the Global Atmosphere Watch (GAW) in station of Assekrem in Tamanrasset in the extreme south of Algeria (altitude: 2710 m) has been growing in the period of 1960 to 2020 (projection) as shown in the Figure 2. Actually Algeria is classified as one of the most important CO_2 emitters among African and developing countries [5]. The quantity of CO_2 emitted in 2018 was reaching 161000 Mt CO_2, in which Algeria was being 34th in the fossil fuel emissions world ranking of countries [10]. CO_2 was growing steadily from 360 ppm in 1995 to 385 ppm in 2008, showing an annual increase of about 2 ppm / year, and it measures today no less than 392 ppm [5].

Nevertheless, Algeria is facing to a very complicated task; the first is to meet the targets set in its INDC [12] and the second to improve its economy [13]. Algerian economy is characterized by its high dependence on fossil fuel exports. According to the CIA World Factbook, Algeria is classified the sixth largest gas exporter in the world, and oil formed more than 97% of all Algeria exports in 2013 [14]. This economy is characterized by a poorly diversified production as well [15].

In addition, Algeria's total final consumption (TFC) has been steadily increasing in recent years in reason of industrialization and modernization of its economic sectors. Therefore, this high consumption has been leading up to increase of consumed energy resulted principally from oil and gas, which consequently increases the CO_2 emissions [16],[17]. In 2013, the energy consumption was reached a value of 38,543 ktoe higher than 31,500 ktoe registered in 2010 [17], which indicate an increase of 22% in just three years. Taking a closer look at various sectors, the residential sector (including agriculture) consumes the most energy with 43%, followed by the transport sector with 36% and the industry sector by 21% as shown in the Table 2.

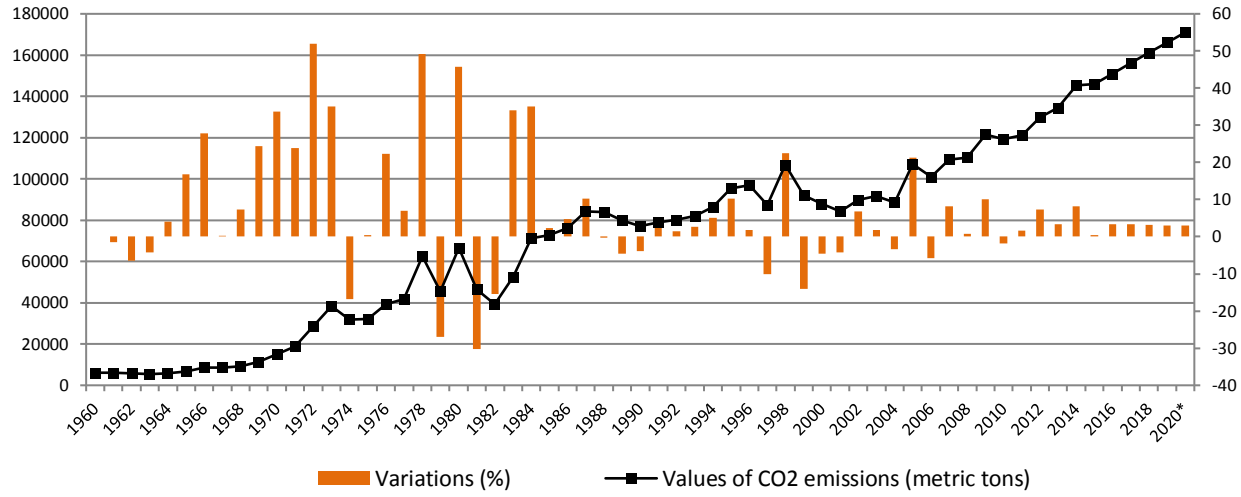

Figure 2: CO_2 emissions in Algeria in the period 1960–2020 [11]

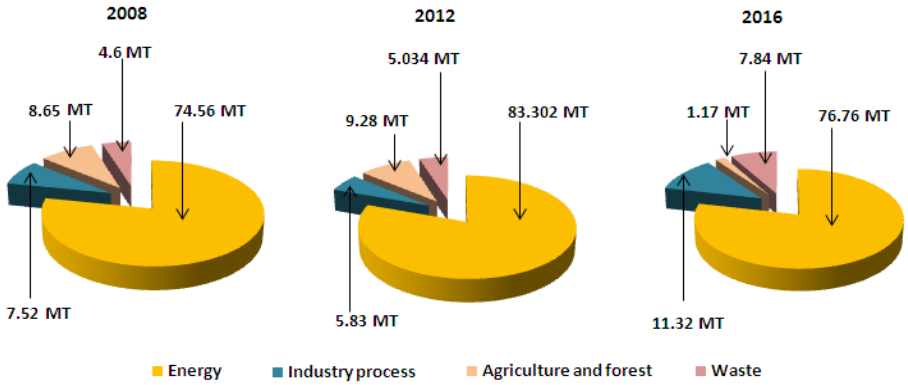

Figure 3: Quantity of CO_2 emitted by sectors in Algeria in 2008, 2012 and 2016 [18]

Given its importance, many studies have examined the relationship between energy consumption and CO_2 emission in Algeria. For example, Kerbachi and co-workers studied climate change in Algeria: vulnerability and strategy of mitigation and adaptation. They reported the high quantity of CO_2 emitted from different economic sectors in Algeria, and its relationship with the energy consumption [5]. Pablo-romero and co-workers had tested the validity of the EKC (Environmental Kuznets Curve) hypothesis throughout the period from 1970 to 2010 in their study about CO_2 emissions and economic growth in Algeria. They reported as well that the estimated coefficients for energy use and electricity consumption are both positive and significant, indicating that an increase in energy use and electricity consumption in per capita terms increase CO_2 emissions [13]. Amri (2017) has examined the relation between CO_2 emissions, income, non-renewable, and renewable energy consumption in Algeria during the period extending from 1980 to 2011. He reported the particular attention to the validity of environmental Kuznets curve (EKC) hypothesis. He also indicates in his study that the autoregressive distributed lag (ARDL) with break point method outcome demonstrates the positive effect of non-renewable type of energy on CO_2 emissions consumption [19]. Rahli and co-workers were as well studied the impact of CO_2 emission on output in Algeria [20].

Table 2: Energy consumption (ktoe) by sectors in Algeria in 2012 and 2013 [18]

Sector	2012	2013	Change in %
Industry	7,939	8,229	+3.7
Transport	13,371	13,889	+3.9
Residential	15,068	16,425	+9.0
Total	36,377	38,543	+6.0

3.2 Evolution of GHG

Total greenhouse gas (GHG) emissions in Algeria have seen a rise between the period of 2001 and 2012 as shown in the Figure 5. In 1970, The GHG registered in Algeria was 34,603.825 Kt E-CO_2. The GHG has being increasing since 1970 to reach 129334,834 Kt E-CO_2 in 2001 and continuing to growth, in which reached a high value of 176,471.227 kt E-CO_2 in 2012. Because of Algerian government efforts, GHG decreased to 144537,06 Kt E-CO_2 in 2014, to increase again for reaching

155,948,78 Kt E-CO_2 in 2015, and stable almost at this value in 2016 [21].

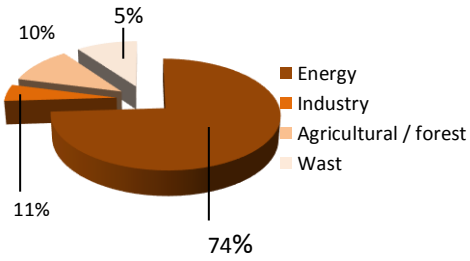

Figure 4: Quantity of CO_2 emitted by sectors in Algeria expressed as percentage [18].

Algeria is party of United Nations Framework Convention on Climate Change (UNFCCC). It is required to provide two national inventories of emissions and removals of greenhouse gases due to human activities for the years 1994 and 2000 [22]. The inventories provide estimates about selected anthropogenic GHG for the sectors of energy; industrial processes and product use; agriculture, forestry, and other land use (AFOLU); and waste. Algeria belongs to developed countries, which it should annually report calendar-year estimates for all sources and sinks of the six greenhouse gases specified by the UNFCCC (carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), perfluorocarbons (PFCs), and hydrofluorocarbons (HFCs)) going back to 1990. Algeria inventories, along with elaborated documentation of the process and data sources used to assess emissions and removals, are submitted electronically in a standard format to facilitate data analysis and comparison [23].

In except of the industry sector, whose activities are steadily declining, the GHG emissions has been increasing in all other sectors, and continue to growth in reason of the intense consumption of energy [24]. In fact, the industry sector contributes to GDP at 7% in 2005 and 4.8% in 2012 [25]. The evolution of GHG emissions presents an annual average growth of 2.2% [24]. This growth rate seems to be in line with the increase of the average annual consumption of energy during the period of 2001–2016 [24].

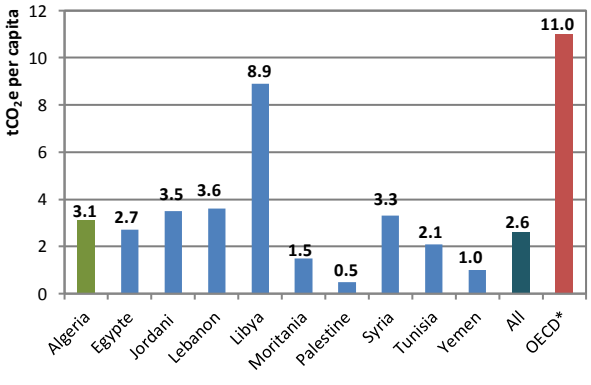

Figure 6: Energy sector CO_2 emissions per capita [22]

As illustrated in Figure 6, Energy sector GHG emissions per capita in Algeria is around 3.1 tCO_2e per capita, which is far below the OECD average of 11 tCO_2e per capita, and it is a bit high than 2.7 tCO_2e per capita of Egypt emissions, and very low compared to 8.9 tCO_2e per capita of Libya. Libya has by far the highest emissions per capita due primarily to the high level of primary energy consumption per capita (more the 3 toe/capita). For Yemen and Palestine the ratio is very low because of the low primary energy consumption. In addition, the import of all electricity in Palestine leads to reduce the emissions. For the other countries, the figures are close with small variation due to the differences of fuel mix.

Algerian government announced a new national program on energy efficiency (EE) for the period from 2015 to 2030 in February 2015. The EE program comes in order to evaluate and regulate the use of energy mainly targets three sectors: the building sector, transport and industry. The national consumption of energy (gas, oil, and electricity) increased from 30.1 Mtoe in 2000 to 48.2 Mtoe in 2012, an average annual growth rate about 3.8% and currently a consumption of 1.4 toe/capita. Therefore, this program controls the usage of energy in the long term and aims to develop the use of clean energy. In the building sector, more than 30 Mtoe are supposed to be saved by 2030. This will be achieved through innovative technologies and thermal insulation of constructions. Also, economic lamps and solar water heaters will contribute. In the transport sector, the target is to save more than 15 Mtoe. The government aims to use fuels which are widely available and least polluting, like LNG and natural gas, in order to reduce the use of gasoline. The industry sector is supposed to contribute by 34 Mtoe by 2030 [26].

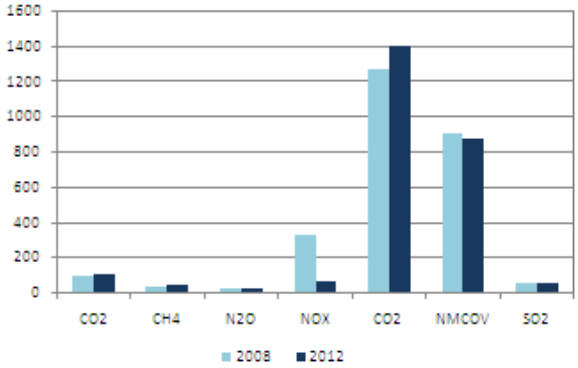

Figure 7: Total of GHG emissions by sectors of energy, industry process, agriculture/forest, and waste [41]

4 Renewable energy

To decrease its CO_2 emissions Algeria oriented its efforts to develop the clean energy by releasing a new national strategy essentially based on mitigation, adaptation, and institutional strengthening to integrate climate change at all levels and in all sectors. In the context of sustainable development, it has been established the Algerian law on energy management 99-09 of July 28, 1999, who reflects a fundamental goal of national energy policy, namely the rational management of energy demand

[27]. The Algerian law N° 04-09 of august 14, 2004 on the promotion of renewable energies, has confirmed the environmental concern by establishing modalities for promotion of renewable energies [28].

Algeria started to exploit its high potential of using solar energy. Although of solar power plants which has been established so far, but it is not enough compared to the increasing demand of energy. According to the MENA renewable status report 2013 by REN21 the installed capacity of Photovoltaic's (PV) was 7.1 MW in 2010 and 25 MW in 2012 of Concentrated Solar Power (CSP) [29].

Algeria has been launching an ambitious green momentum program to develop renewable energies starting from 2011 until 2030. The program consists to generate about 22 000 MW of power generating capacity from renewable sources during the period mentioned above, in which 12 000 MW will be provided for domestic electricity demand and 10 000 MW destined for export [30]. This program look forward to provide domestic consumption by 40 % of the electricity produced from renewable energy sources by 2030. This is besides the wind energy, which considered as a relatively low potential source of energy. Several solar photovoltaic projects has been launching, where the government seeking to reach an 800 MWp by the end of 2020. Other projects with an annual capacity of 200 MWp will be achieved over the 2021-2030 period [31, 32].

5 Impact of heat waves and the climate change

5.1 Impact in the world

The high temperature recorded in Ouargla (South Algeria) in July 2018 is compared also to temperature records in the same month in other cities countries belong to different continents, considering that July 2018 featured by its unusual high temperature in the world Figure 8.

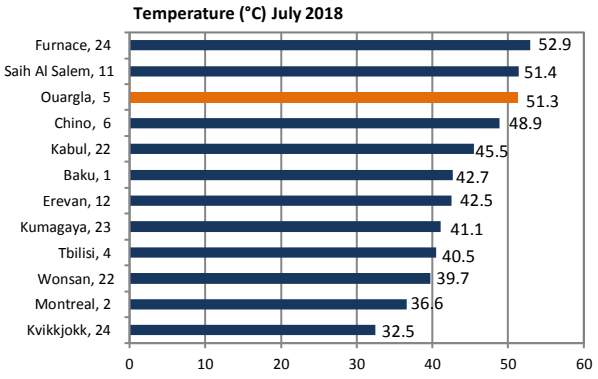

Figure 8: Temperature records for the month of July 2018 in the world

July 2018 was historically hot not only in Algeria, but in Europe and throughout the Northern Hemisphere. According to the international network World Weather Attribution (WWA), this heat wave bears the imprint of climate change, including a series of world records. Several records have been registered around the world, 41.1 °C in Kumagaya, Northwest of Tokyo, 51.3 °C at Ouargla, Algeria, 48.9 °C in Chino, Los Angeles, 36.6 °C in Montreal, 42.7 °C in Baku, Azerbaijan, 40.5 °C in Tbilisi, Georgia, 32.5 °C in Kvikkjokk, Sweden, near the Arctic Circle. 52.9 °C in Furnace Greek 2013, California (USA) against 54 °C recorded in June 2013. 42.5°C in Erevan, Armenia. 45.5 °C in Kabul, Afghanistan, 39.7 °C in Wonsan, North Korea, 51.4°C in Saih Al Salem, E.A.U, 42.6 °C in Qurayyat, Oman.

The reached heat records during the month of July 2018 are caused by exceptional temperatures. These extremes cause droughts, fires and high electricity consumption around the world. High heat waves in recent years have caused considerable material and human losses. In California, Yosemite Park has declared its largest evacuation order in 30 years as the Ferguson fire continues to ravage this iconic American landmark. In Japan, 22,000 people were hospitalized because of the sweltering heat, and a total of 57,534 cases of heat exhaustion and heatstroke were reported between April 30 and July 29, including 125 who died from heat-related causes, according to data from the Fire and Disaster Management Agency [33]. A big Part of the UK have been continuing to experience a heat wave in July 2018, as temperatures reached 30 °C, The highest recording was in Cavendish, Suffolk, at 31.4 °C. The Heat-health watch alert: level 3 was set up for much of east and south-east England according to the United Kingdom's national weather service [34]. Rivers and streams have dried up in England, which obliged the Environment Agency to rescued thousands of fish, and the crops were completely smashed according to The National Farmers' Union (NFU).

5.2 Impact in Algeria

In order to study the impact of climate change on the temperature and the precipitation in Algeria, we highlighted the study of two cities belonging to two different climate regions. The first is the capital Algiers, characterized by its Mediterranean climate and the second is Biskra city, which characterized by its desert-like climate.

The compared temperatures of July 2017 are illustrated in the Figure 9. We noted throughout the curves that the Saharan regions such as Timimoun, Ghardaia, and Ouargla are featured by their high temperatures during the month of July 2017, compared to the northern regions such as Algiers, Oran, Tipaza, and Setif. The temperature in Timimoun is ranged between 35 and 40 in the 20 first days, and it is raised to more than 45 °C in the 10 last days in this month, followed by Ouargla and then Ghardaia. The temperature in Algiers and Oran, whose are subject to the Mediterranean climate were also experienced unprecedented rises in July 2017 and sometimes exceeded 35 °C. They are exposed to unmatched heat waves in the heat seasons often lead to cases of illness, which imposes intervention, as well as its environmental impact on climate change and vegetation. Setif is Algerian interior city had as well experienced the same heat waves during the summer 2017. The Figure 9 exposes the variation of the temperature during the month of July, which shows that temperature is generally more than the temperature recorded in Algiers.

The Figure 10 shows the variation of temperature during July 2018, 2017, 2014, and 2013 in Biskra. Biskra is belonging to arid regions, which characterized by its hot

summer. However, the last years the temperature in this city was beyond the limits. According to the curves Biskra had experienced a high temperature in July 2018 and the first 10 days of July 2014 compared to the temperature in the same month of other years, but the difference in temperature is unstable at convergent values during the month or followed the same form in his fluctuations. It is noticeable as well that the temperature recorded in each July of different years are varying between 35 °C and 45 °C, and sometime reached a values near to 50 °C.

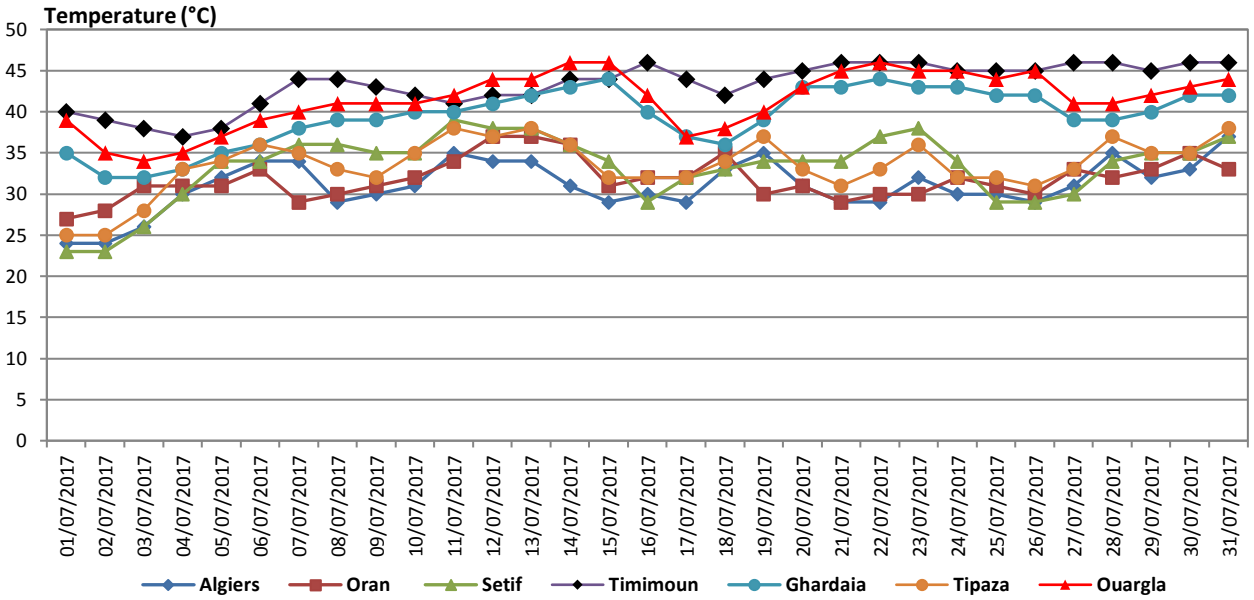

Figure 9: Temperature variation in some different climate regions in Algeria during July 2018–2017–2014–2013.

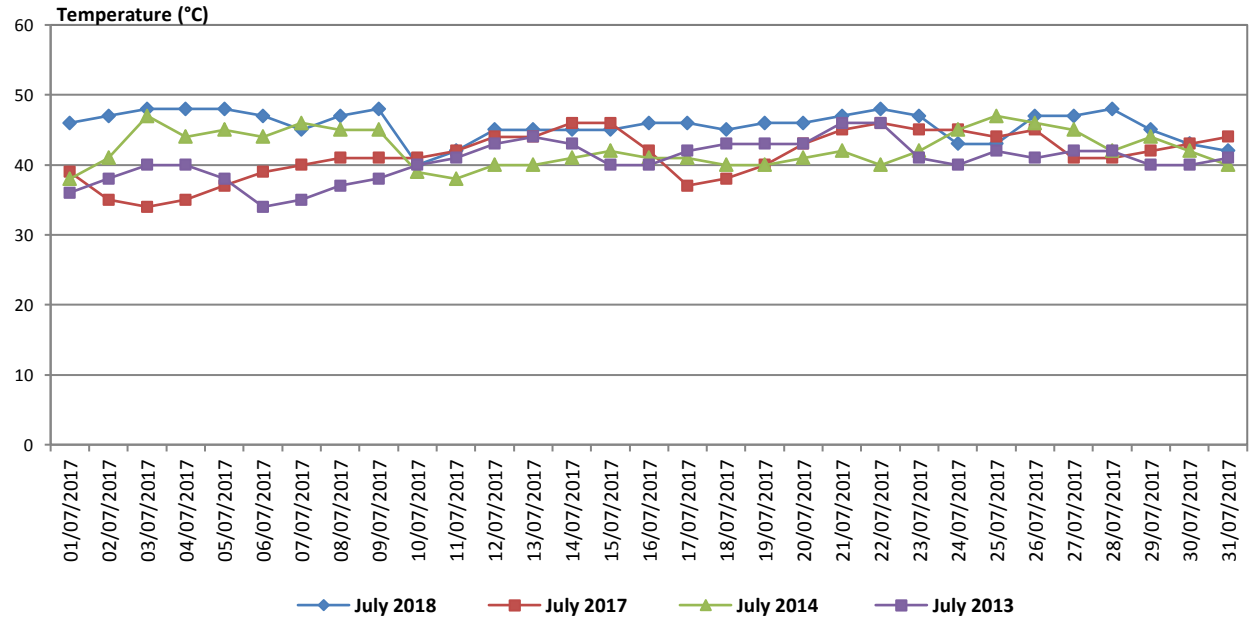

Figure 10: Biskra temperature variation during July 2018–2017–2014–2013.

The variation of the precipitation recorded by Dar El-Beida station at Algiers in 2017 and 2018 are presented in the figure 11, 12. The compared illustration curves showed the fluctuations of the precipitation during the years, whose indicate a less precipitation in 2017, where the metropolitan area passed a dry year, in except rains that fell in January, which reached 250 mm and that fell in November and December, who are estimated by 131 mm in each month. Unlike the year 2017, it is mostly noted that 2018 saw an equal distribution of precipitation during all months of the year. According to the thresholds in millimeters of arid, very arid, humid and very humid years indicated in the

Table 3, 2017 and 2018 with cumul total of 665 mm, and 625 mm, respectively, are classified under the normal years (597,8 < x< 689.9).

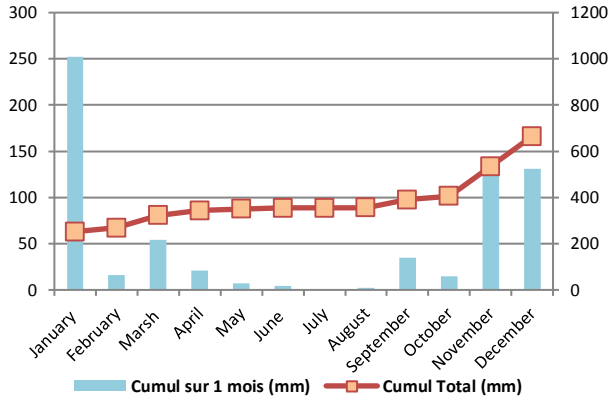

Figure 11: precipitation recorded by Dar El-Beida station at Algiers in 2017 [34]

The variation of the precipitation registered by Biskra station in 2017 and 2018 are presented in Figure 13, 14. The compared illustration curves showed the fluctuations of the precipitation through those years, whose indicate a very less precipitation in 2017. Rainfall did not exceed a threshold of 13 mm in Biskra in 2017, which recorded in April, about 10 mm in September and October, and between 0–4 mm in the rest months. In 2018, the rainfall saw its high record in May with 49 mm, followed by 26.9 mm in October, 17 mm in September, 10 mm in Marsh and 7 mm in February, while the rainfall recorded in the rest months in 2018 were all close to 0. The cumul total registered in Biskra in 2017 was 45 mm, and 112.9 mm, both of those quantities were exceeding the specified value 39 mm of humid years mentioned in the table 3, which indicate a change in climate in that region. The rainfall fluctuations knew also a disorder between all months in the year, for example, the high quantity of rainfall was registered in April 2017, unlike 2018 where the high quantity of rainfall was registered in May

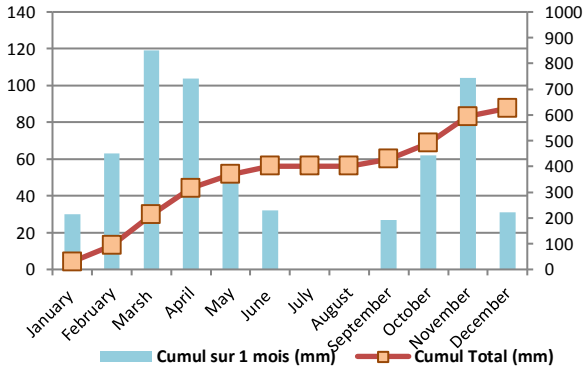

Figure 12: Precipitation recorded by Dar El-Beida station at Algiers in 2018 [35]

These fluctuations in temperature and precipitation require new and in-depth studies, because what we have collected as a previous climate archive of Algeria is no longer as useful as the previous last years.

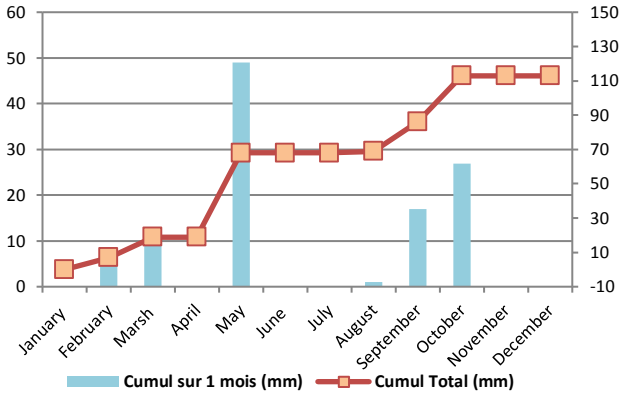

Figure 13: Precipitation recorded by Biskra station in 2018 [35]

We have to find new methods and collect new data that correspond to regional and global environmental changes to meet the challenges ahead. Actually, the national strategy against climate change is essentially based on mitigation, adaptation, and institutional strengthening to integrate climate change at all levels and in all sectors. The implementation of the program of renewable energies development and energy efficiency offers a great potential for CO_2 mitigation [38]. Algeria is particularly vulnerable to the multiform effects of climate change, with its yearly average rainfall having declined by more than 30% over the past decades. Moreover, land characteristics, mainly desert areas, reduce the possibilities of carbon capture [13].

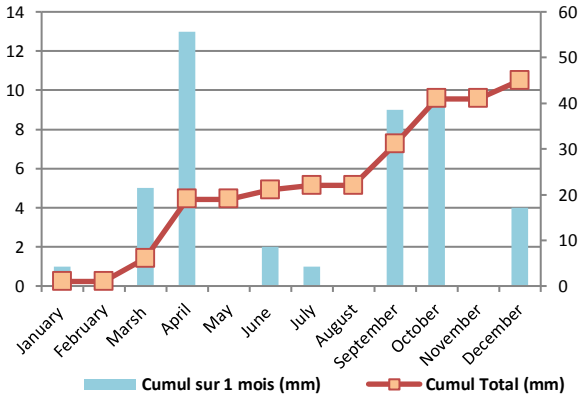

Figure 14: Precipitation recorded by Biskra station in 2017 [35]

According to the report of the United Nations University for Environment and Human Security (UNU-EHS) revealed in 2014, Algeria is among the top 50 countries at high risk of climate change, with an index of 7.63% vulnerability Figure 15 [39]. This index is calculated based on natural factors, such as earthquakes, floods and drought, on the country's predisposition to be affected by a disaster, the capacities to cope, and finally, the adaptation strategy. Climate change will have a negative impact in the Mediterranean, considered as one of the 25 hotspots in the world. In a nutshell, the temperature is set to increase from 1.4 to 5.8 degrees in 2040. Algeria is classified as a very vulnerable country to social and economic consequences.

Global warming consequences are increasingly visible and alarming in Algeria, which are observed on dry seasons, and much less rainfall, soil degradation and coastal erosion [40]. The results are terrible where more than 13 million hectares (ha) are affected by erosion, including 4 million in a serious way. Algeria loses nearly 400,000 ha annually because of this phenomenon. The most affected regions are Sidi Bel Abbes, Mascara, Mostaganem and Chliff, recalling as well the harmful impact of erosion on agriculture and the volumes of water that can be mobilized [40]. In addition, since the 1970s, Algeria has suffered a recurring drought with a rainfall decrease of about 10% over the last 20 years, leading to a disruption of the agricultural calendar and a drop in cereal yields of up to 50 % [40]. In addition, global warming is causing extreme weather events in Algeria, citing as examples the floods that have hit parts of the country since 1971 [41].

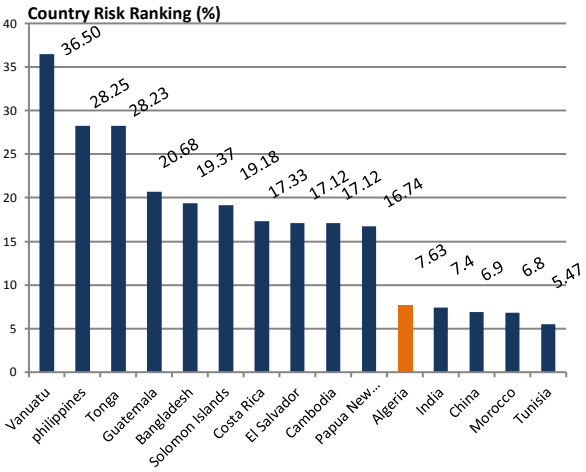

Figure 15: Index of vulnerability

Vanuatu: long form Republic of Vanuatu, is a state of Oceania located in Melanesia, in the South-West Pacific Ocean, in Coral Sea.
Tonga: a state of Polynesia in the Pacific Ocean)

In Algeria, the health dangers linked to global warming have been particularly focused on the risk of displacement of sub-Saharan diseases to the North such as malaria and the development of water-borne diseases such as typhoid, viral hepatitis, etc... The phenomenon of colored waters on the Algerian coast is more and more recurrent in recent years, is also directly related to climate change. This phenomenon is due to the proliferation of certain marine species, sometimes toxic, coming from the Indian Ocean and living in very different climatic conditions from those of the Mediterranean [40]. Coastal erosion is also very marked in Algeria, which may cause flood risks threatening the regions such as Sidi Fredj and Zeralda west of Algiers.

To avoid such a scenario, Algeria undertook, under the Cop 21 agreement in Paris, to reduce greenhouse gas emissions by 7% by 2030. Algeria wants to go further, it aims to reduce 23% of its GHG emissions if its actions in this direction are supported financially and accompanied by a technology transfer from developed countries. This national effort to reduce greenhouse gases is part of an updated renewable energy development programmed in 2015. The natural gas, by its specificity the least polluting of fossil fuels, will be privileged in the world consumption of energy with the horizons 2030-2040 and is a main element of the energy mix of Algeria to these deadlines [42]. In the objective of the energy control and efficiency, Algeria has tackled the program of equipping 5,000 dwellings annually with thermal insulation (energy savings of 40%), and the plan also aims to convert vehicles to GPL. First, the conversion of 100,000 vehicles to GPL fuel in 2018, 500,000 vehicles by 2021 and 1 million vehicles by 2030 [43].

Recently, several reports have studied the vulnerability and the impact of climate change in Algeria. Kerbachi and co-workers studied vulnerability of Algeria against climate change and the government strategy of CO_2 mitigation and adaptation, who's reported the high vulnerability of Algeria to climate change by their analysis of climate data from 1931 to 1990 in northern of Algeria [5]. Aidaoui and co-workers are studied the impact of climate change on durum wheat cropping, the most strategic commodity in the food system and in the national economy of Algeria [44]. Climate change Assessment in Algeria from 1951 to 2098 using the Köppen–Geiger climate classification scheme study by Zeroual 2019 [45].

Table 3: Thresholds in millimeters of arid, very arid, humid and very humid years [36, 37]

	Very arid years	Arid years	Normal years	Humid years	Very humid years
Dar El-Beida	501,3	597,8	597,8 < x< 689.9	689.9	802.4
Biskra	-	39	10	39	-

6 Conclusion

The Algerian authorities have started to be conscientious concerning their environmental problems. The consequences of global warming are increasingly visible and alarming in Algeria, which are observed on dry seasons, and much less rainfall, soil degradation and coastal erosion. This is confirming by our study about temperature and rainfall in some regions belonging to north and south of Algeria. Summer 2018 was historically hot in Algeria in which Ouargla has been classified among the most regions experienced a high temperature in the world in July 2018. The regions of Biskra was witnessed a hot season in 2018 in which the temperature was exceeded a 45 °C along of July 2018 compared to July 2013, 2014, and 2017.

The northern regions of Algeria are also vulnerable to a hard drought in reason of hot temperature and low rainfall. The temperature in Algiers and Oran, whose are subject to the Mediterranean climate were also experienced

unprecedented rises in July 2017 and sometimes exceeded 35 °C. The variation of the precipitation recorded by Dar El-Beida (Algiers) and Biskra stations in 2017 and 2018 showed fluctuations of the precipitation between years and during months in the same year. Algiers regions were passed a dry year in 2017 characterized by a less precipitation, in except of 250 mm in January. In Biskra, we noticed a disturbance in rainfall confirmed by the records between 2017 and 2018 which clearly show an impact of climate change on this vulnerable region. Changes and irregularity in precipitation amounts may cause a flooding and many other risks in Biskra.

To avoid such a scenario, Algeria undertook, under several international protect environment agreements. Algeria was one of the developing countries that signed the COP21, in which the Algerian INDC pledged to curb carbon emissions by at least 7% by 2030. Thanks to the new Algerian strategies to reduce GHG emissions, a total GHG emission has experienced a downward trend in the last few years. Algeria wants to go further to reduce about 23% of its GHG emissions if its actions will be supported financially and accompanied by a technology transfer from developed countries.

The natural gas, by its specificity the least polluting of fossil fuels, will be privileged in Algeria with the horizons 2030-2040. In the objective of the energy control and efficiency, Algeria aims to save 40% of energy by equipping 5,000 dwellings annually with thermal insulation. First, the conversion of 100,000 vehicles to GPL fuel in 2018, 500,000 vehicles by 2021 and 1 million vehicles by 2030.

In order to control its national consumption of energy (gas, oil, and electricity), the Algerian government announced a new national program on energy efficiency (EE) for the years 2015 to 2030 in February 2015. This program controls the usage of energy in the long term and aims to develop the use of clean energy. Algeria aims to generate about 22 000 MW of power generating capacity from renewable sources during 2011–2030 and look forward to provide domestic consumption by 40 % of the electricity produced from renewable energy sources by 2030.

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