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The Impact Of Renewable Energies Production On Algeria's GDP And Its Position In Africa And The Word- An Econometric Study For The Period (2006-2019)

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Abstract

This study aims to highlight the impact of the renewable energies' production on the World domestic gross production and in Africa and Algeria. To determine the Algeria' position relative to Africa and the World for the period 2006-2019. The study assumed that Algeria occupied a weak position internationally and a strong one in Africa. It concluded that the hypothesis was not proven, as the study did not record a clear impact of the production of renewable energies in Algeria during the period 2006-2019 on the domestic gross production, and it occupied a very weak position for the World and for Africa, while a positive and strong impact was found in the World, and a positive and weak effect Africa.

Keywords: Renewable energy; Domestic Gross Production (DGP); Africa; Algeria.

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1. INTRODUCTION

The World's economies tend to adopt the green economy and replace the use of the depleted and polluting energies of the environment with those that are renewable and clean, in order to reduce the continuous environmental deterioration and its negative effects on the globe and human life. All countries of the World have headed towards inventorying the potential of renewable energies and trying to exploit them to meet their energy needs, as some countries have achieved superiority in some areas of using renewable energies according to their geographical location, human, technological, financial and material capabilities. Given the critical importance of the availability of energy and its direct relationship to the economic growth of countries, attention has been paid in this research paper to the extent to which the economies of countries around the World benefit from their exploitation of these renewable and clean energies.

1.1. The research main problem:

- What is the impact of the production of renewable energies on the Domestic gross production of Algeria in the period for 2006-2019? And what is its position from this impact on the World and Africa?

To study the main problem, it was divided into sub-questions as follows:

- What are the capacities and actual exploitation of the World' countries, Africa and Algeria of renewable energies?
- What is the impact of the production of renewable energies in the World on its domestic gross production in the period for 2006-2019?
- What is the impact of the production of renewable energies in African on its domestic gross production in the period for 2006-2019?

- What is the impact of the production of renewable energies in Algeria on its domestic gross production in the period for 2006-2019?
- What is the impact of the production of renewable energies in Algeria on its domestic gross production in the period for 2006-2019?
- What is the position occupied by Algeria in the impact of its production of renewable energies on its domestic gross production compared to the World and Africa in the period for 2006-2019?

1.2. The research' main hypothesis:

- The production of renewable energies has a positive and strong impact on its domestic gross production in the period for 2006-2019. Algeria occupies a lagging position for the World as a whole, and a good position for Africa.

1.3. The sub-hypotheses:

- The countries of the World, Africa and Algeria have actual capacities and productions of renewable energies.
- The World's production of renewable energies has a positive impact on its domestic gross production in the period for 2006-2019.
- The Africa's production of renewable energies has a positive impact on its domestic gross production in the period for 2006-2019.
- The Algeria's production of renewable energies has a positive impact on its domestic gross production in the period for 2006-2019.
- Algeria occupies a lagging position position in the impact of renewable energies production for the World as a whole, and a good position for Africa in the period for 2006-2019.

1.4. Research' objectives:

- Researching the available capabilities and the actual production of clean renewable energies by the World, Africa and Algeria in an attempt to succeed in replacing them with the depleted and polluting energy resources.
- Determining the role played by these renewable energies in achieving global economic growth in Africa and Algeria, and the extent of their ability to have a positive and strong impact on the domestic gross production as one of the indicators of this desired economic growth, as an incentive to continue investing in its fields.

1.5. Research' importance:

- The urgent need to shift the production of renewable energies and to replace them with depleted and harmful energies, as they represent one of the pillars of sustainable development policies and strategies adopted by the whole World.
- The need to find ways and methods that make the production of renewable energies a source of raising the African and Algerian domestic gross production, so that countries are encouraged to invest in them and to adhere to the principles and policies of sustainable development.
- Highlighting Algeria's position in its production of renewable energies compared to the World and Africa, to try to find strategies and policies that help it advance this sector and exploit its natural and human potential with higher efficiency and greater efficiency.

1.6. Research' method:

A standard study was based on the impact of the production of renewable energies on the total national income during the period from 2006 to 2019, for the World as a whole, Africa and Algeria.

1.7. Literature of the review:

- Janet L. Sawin et al, (2016), « Renewable energy and Sustainable development: Accounting for Impacts on the Path to 100% RE". The study addressed the problem of political, economic, security and environmental causes and effects of adopting renewable energies policies, and the following results were reached: Adopting the investment and exploitation of renewable energies for political, security, economic and environmental reasons; From the economic benefits: lower costs (especially solar and wind energy), lower indirect costs of fossil fuels such as health, sustainable environment and economic growth, creating new job opportunities, improving the trade balance and reducing price fluctuations, speed in meeting the increasing medicine on energy, reducing poverty in the global south, promoting rural development, preserving domestic energy revenues, increasing fee revenues.
- Nicole Vandaele, Wendell Porter, (2015), « Renewable Energy in Developing and Developed Nations: Outlooks to 2040". This study dealt with the problem of switching to an infrastructure for electricity generation based on renewable energy. It explores the current and future state of energy business in the United States and the developing countries of Kenya, Morocco and South Africa. The research establishes a framework that can be applied to any country to determine the capacity facilities required annually up to 2040 in order to generate nearly 100% of electricity using renewable sources. This framework was applied to the four countries studied; showing how their potential for renewable technologies and

energy efficiency measures can transform their energy sectors into more sustainable and diversified resource bases for electricity generation.

2. Capacities and productions of renewable energies in the World, Africa and Algeria.

The countries of the World count their capacities to invest in renewable energies during each year, with the aim of defining their investment strategies in renewable energies, and maximizing their exploitation. Table (1) presents statistics of World's, Africa's and Algeria's capacities, and compares them with what was actually produced in the period from 2006 to 2019. And the following has been noted:

- Concerning the World' capacities and production of renewable energies:
  - A continuous increase and doubling value of the World' capacities of renewable energies, from (1,031,494MW) in 2006 to (2,542,035 MW) in 2019. An estimated increase was achieved 1,510,541 (MW).
  - A continuous increase and doubling value of the World' production of renewable energies, from (949.563MW) in 2006 to (1.934.292MW) in 2019. An estimated increase was achieved (984.729MW).
  - A decrease in the percentage of production of the available World' capabilities from 92% in 2006 to 76% in 2019, i.e. a decrease in the rate by an amount (16%).
- Concerning the Africa' capacities and production of renewable energies:
  - A continuous increase and doubling value of Africa' capacities of renewable energies, from (26318 MW) in 2006 to (51278MW) in 2019. An estimated increase was achieved +26507(MW).

- A continuous increase and doubling value of the Africa' production of renewable energies, from (26.318MW) in 2006 to (47613MW) in 2019. An estimated increase was achieved (21.295MW).
- The full use of the available renewable energies in production, from 2006 to 2016, then decreased in 2017 to 95% and reached 93% in 2019, i.e. a decrease in the rate by an amount (7%).

- Concerning the Algeria' capacities and production of renewable energies:
  - A continuous increase and doubling value of Africa' capacities of renewable energies, from (251 MW) in 2006 to (686MW) in 2019. An estimated increase was achieved 453 (MW).
  - A continuous increase and doubling value of Africa' production of renewable energies, from (61.4 MW) in 2006 to (234MW) in 2019. An estimated increase was achieved 172.6 +(MW).
  - An increase in the rate of exploitation of the available Algerian capacities from 24% in 2006 to 42% in 2009, then decreased in 2010 to 21 (MW), meaning a decrease in the exploitation rate was achieved by an estimated (21%), Then it achieve a noticeable increase in the years (2011, 2012) by (52, 63 MW), respectively, Then it fell again in 2013 by half (30 MW) and continued to decline until 2016 by (18 MW), then it rose again to (34 MW) in 2019.

Table (2) represents the percentage of Algerian capacities and production from the world and Africa for the period 2006-2019. And the following has been noted:

- Regarding the capacities of renewable energies in the period 2006-2019:
  - The contribution of the Africa' capacities of renewable energies in the World did not exceed 2.41%, and Algeria's contribution did not exceed 0.032% of the global capacities of renewable energies. In addition, the contribution of

the Algerian renewable energies capacities in the Africa did not exceed 1.7%, which it reached in 2016, and then decreased to 1.3% in 2019.

- Regarding the production of renewable energies in the period 2006-2019:
  - The contribution of the Africa to the production of global renewable energies did not exceed 2.77%, which it reached in 2009 and then decreased to 2.46% in 2019. Also, the contribution of Algeria' production did not exceed 0.50% of the production of Africa in 2019, which is a small percentage.

3. Renewable energies produced in the World, Africa and Algeria

Countries of the world exploit their geographical location, their natural characteristics, and their human, material, technological and financial capabilities to produce renewable energies and replace them with depleted and polluting energy resources. Table (3) lists the types of renewable energies produced in the world, in Africa and in Algeria (2018). And the following has been noted:

- Regarding the World' production of renewable energies:

The world depends on the production of renewable energies in order: hydroelectric and hydroelectric energy of both kinds, with 64.22% of the total energy produced,

and it ranks first in the world's renewable energy sources, then comes second for all kinds of wind energy by 14.39%, then solar energy of all kinds by 8.583%, ranking third. Then bioenergy types by 9.5%, and the rest is shared by other types, i.e. 3.307% of the World production of renewable energies.

- Regarding Africa' production of renewable energies:

Africa depends on the production of renewable energies according to the order: hydroelectricity and hydroelectricity of both kinds, with 75.43% of the total energy

produced, and it is considered the first source of renewable energy in Africa, wind energy of all kinds comes in second place by 5.69%, except for marine winds that do not produce them. In the third place is renewable municipal waste with a rate of 8.31%, Solar energy of all kinds by 4.96%, geothermal energy by 1.43%, accumulation by pumping by 1.39%, and the rest is shared by other types, i.e. 2.79% of Africa's production of renewable energies.

- Regarding Algeria' production of renewable energies:

Algeria produces only six types of renewable energies out of 18 types in the world, and 17 types in Africa, as it depends on (hydroelectricity, hydroelectricity (including mixed plants), wind, onshore wind, solar and concentrated solar energy). It relies on solar energy in the first place with a capacity of 507(GW), then comes in second place hydroelectric power, 117(GW) and wind energy in third place with a capacity of 10(GW).

4. Measuring the impact of renewable energies production on gross domestic production in the World, Africa and Algeria during the period (2006-2019).

The gross domestic production is affected by the size and nature of production carried out by countries, and it will be important to study the impact of the production of renewable energies in the world, Africa and Algeria on it. And to measure this effect, we will go through several stages as follows:

4.1. Determine the study variables.

The gross domestic product (GDP) was adopted as the dependent variable, and the independent variable represented in the production of renewable energies in GW/H, as these two variables were chosen on the basis of previous studies, the availability of

statistics, its importance and status for the economy and its reality in the world at the present time.

Where each variable is represented by the following symbol:

$\boldsymbol{Y3_t}$ $Y3_t$: (Dependent variable) gross national income.

$\boldsymbol{X3_t}$ $X3_t$: (Independent variable) Renewable energies production.

4.2. Estimating regression model

The simple regression model in this research is written as follows:

$$Y3_t = \hat{a}_0 + \hat{a}_1 X3_t + \varepsilon_t$$

4.2.1. Estimation of the World' model

To estimate the regression parameters, we use the least squares method (MCO), and by using and entering data into the Eviews10 program, the following estimate shown in Table (4) was obtained based on Appendix (1). Therefore, the estimated (World) regression model is given by the following relationship:

$$\boldsymbol{Y_t = 5.0008 + 1.48.X3_t + \varepsilon_t}$$

ε_t4.2.2. Estimation of the Africa' model

The following estimation is shown in Table (5). Therefore, the estimated (Africa) regression model is given by the following relationship:

$$\boldsymbol{Y_t = 3.0445 - 2.26.X2_t + \varepsilon_t}$$

Before evaluating the validity of the model and the equation, we note through table (5) that the value of DW is very weak, which indicates the existence of a self-correlation, and the model is not significant as a whole because the probability of F is not significant, Therefore, these problems must first be eliminated by the most common and well-known method, which is the cochrone-orcutt method, by adding ma(1), i.e. auto regression with one deceleration in table (6).

4.2.3. Estimation of the Algeria' model

Table (7) shows the estimation (Algeria' model). Therefore, the estimated (Algeria) regression model is given by the following relationship:

$$Y_t \boldsymbol{Y_t} = \mathbf{0.151806} + \mathbf{4.52}.\boldsymbol{X1_t} + \boldsymbol{\varepsilon_t}$$

From table (7): the value of DW is very weak, which indicates the existence of a self-correlation, and the probability of F is not significant, so there can be asymmetry instability problem. Therefore, these problems must first be eliminated by the most common and well-known method, which is the cochrone-orcutt method, by adding ma(1), i.e. auto regression with one deceleration. Thus, the new estimate appears in Table (8).

4.3. Statistical evaluation of (World, Africa and Algeria) models

4.3.1. Student's test for significance of model parameters (aˆ, bˆ):

- **Parameter significance test $\widehat{\boldsymbol{a}}_{\boldsymbol{0}}$**: To test the following hypothesis:

$$\begin{cases} H_0 : \widehat{\boldsymbol{a}}_{\boldsymbol{0}} = 0 \\ H_1 : \widehat{\boldsymbol{a}}_{\boldsymbol{0}} \neq 0 \end{cases}$$

If we have a $\left|\mathbf{t}_{\widehat{\boldsymbol{a}}_{\boldsymbol{0}}}\right| > \boldsymbol{t}_{\boldsymbol{n-2}}^{\boldsymbol{1-\propto/2}}$, the hypothesis H_0 is carried out at the significance level of α = 5%, and vice versa. So:

- **($\widehat{a_0}$) for the World**: is not significant (not economically significant) at α=5% significance level. See prob in table (4).
- **($\widehat{a_0}$) for Africa**: is significant (economically significant) at α=5% significance level. See prob in table (6).
- **($\widehat{a_0}$) for Algeria**: is significant (economically significant) at α=5% significance level. See prob in table (8).

- Parameter significance test $\widehat{a_0}$: To test the following hypothesis:

$$\begin{cases} H_0: \widehat{a_1} = 0 \\ H_1: \widehat{a_1} \neq 0 \end{cases}$$

If we have a $\left|t_{\hat{a}_0}\right| > t_{n-2}^{1-\propto/2}$, the hypothesis H_0 is carried out at the significance level of α = 5%, and vice versa. So:

- **($\widehat{a_1}$) of the World:** is significant (economically significant) at α=5% significance level. See prob in table (4). Accordingly, the production of renewable energies in the **World positively and significantly** affects the world's gross domestic product.
- **($\widehat{a_1}$) of Africa:** is not significant (not economically significant) at α=5% significance level. See prob in table(6). Accordingly, the production of renewable energies in the Africa **positively but it has not significantly** affects the world's gross domestic product.
- **($\widehat{a_1}$) of Algeria:** is not significant (not economically significant) at α=5% significance level. See prob in table (8). Accordingly, the production of renewable energies in the Africa **positively but it has not significantly** affects the world's gross domestic product.

3.4.2. Fisher's test:

It is a test of the overall significance of the model, where we test the following hypothesis:

$$\begin{cases} \boldsymbol{H_0}: \widehat{\boldsymbol{a_\iota}} = \mathbf{0} \\ \boldsymbol{H_1}: \exists \widehat{\boldsymbol{a_\iota}} \neq \mathbf{0} \end{cases}$$

- **Fisher's test of the World:** The model has total significance at the level α = 5%. See Prob(F-statistic) in table (4)
- **Fisher's test of Africa:** The model has no overall significance at the level of α = 5%. See Prob(F-statistic) in table (6)
- **Fisher's test of Algeria:** The model has total significance at the level α = 5%. See Prob(F-statistic) in table (8)

3.4.3. Determination coefficient$(\mathbf{R^2})$: Represents the proportion of the independent variable's representation in the dependent variable.

- $(\boldsymbol{R^2})$ of the World: $\boldsymbol{R^2 = 0.8938}$. See table (4).
- $(\boldsymbol{R^2})$Africa: : $\boldsymbol{R^2 = 0.6405}$. See table (6).
- $(\boldsymbol{R^2})$of Algeria: : $\boldsymbol{R^2 = 0.4401}$ See table (8).

4.4. Standard evaluation of (World, Africa and Algeria) models.

4.4.1. Durbin-Watson test: It allows examining the autocorrelation of first-order errors.

- **D-W test of the World = 1.7539** .See table (4). It is a good value, indicating the absence of autocorrelation, compared to the previous value of this model.
- **D-W test of Africa = 0.5573**. See table (6). It is a good value, indicating the absence of autocorrelation, compared to the previous value of this model.

- **D-W test of Algeria= 1.5512**: See table (8). It is a good value, indicating the absence of autocorrelation, compared to the previous value of this model.

4.4.2. Model quality testing:

In order to be able to trust the regression result of the previous standard model, and its explanatory ability of the relationships that combine its variables, it is necessary to test the availability of the conditions of the ordinary least squares method. Tables (9), (10), (11) show the quality tests of the models (the world, Africa and Algeria).

- **Quality testing of the World**: So the conditions of the least squares method are validated and this indicates the quality, accuracy and unbiased of the estimated coefficients, and from it we will pass to the stage of economic evaluation of the model.
- **Quality testing of Africa**: Table (10) shows that the probability value of the Jarque-Bera test equals 0.12, which is greater than 5%, and thus this indicates that the residuals in the model follow the pattern of the normal distribution, which is a good and desirable trait, and also the probabilities of the ARCH test are greater than 5%, and therefore this is considered an indication However, the model does not suffer from the problem of variance. The conditions of the least squares method are validated and this indicates the quality, accuracy and unbiased of the estimated coefficients, and from it we will pass to the stage of economic evaluation of the model.
- **Quality testing of Algeria**: Table (11) shows that the probability value of the Jarque-Bera test equals 0.68, which is greater than 5%, and thus this indicates that the residuals in the model follow the pattern of the normal distribution, which is a good and desirable trait, and also the probabilities of the ARCH test are greater than 5%, and therefore this is considered an indication

However, the model does not suffer from the problem of variance. The conditions of the least squares method are not met, because the model is not significant in addition to the lack of significance of the independent variable, and this indicates the lack of quality and accuracy of the estimated coefficients and their bias.

4.5. Economic evaluation of (World, Africa and Algeria)' models.

From table (4) an estimated regression model can be written as:

4.5.1. Economic evaluation of World' model

$$Y_t \boldsymbol{Y_t = 5.0008 + 1.48.X3_t + \varepsilon_t}$$

- Through the estimated model, we notice that $\hat{c} = +5.0008$ and this constant variable is interpreted as follows: If there are no explanatory variables, this means that the GDP will be 5.0008.
- We notice that $\widehat{a_2} = +1.48$. it is means that whenever the production of renewable energies in the world increases by one unit, the gross domestic product increases by 1.48 units. It is in agreement with the economic theory, meaning that the increase of renewable energies would lead to an increase in sustainable development in general, one of which is the gross domestic product. And there is a positive direct relationship between the production of renewable energies and the national income in the world.

4.5.2. Economic evaluation of Africa' model

$$\mathbf{Y_t = 2.84 + 2.44\ X2_t + \varepsilon_t}$$

- Through the estimated model, we notice that $\hat{c} = +2.84$ and this constant variable is interpreted as follows: If there are no explanatory variables, this means that the GDP will be 2.84.
- We notice that $\widehat{a_2} = +2.44$. it is means that whenever the production of renewable energies in the world increases by one unit, the gross domestic product increases by 2. 44 units. it is in agreement with the economic theory, meaning that the increase of renewable energies would lead to an increase in sustainable development in general, one of which is the gross domestic product. That is, there is an insignificant direct relationship between the production of renewable energies and the total national income in Africa, and this can be explained by the weak capabilities and modern technology to exploit renewable energies in Africa, which results in a weak contribution to the gross domestic production.

4.5.3. Economic evaluation of Algeria' model

The Algeria' model is rejected and therefore not pass to the stage of economic evaluation.

5. Conclusion

The whole world is trying to shift to the exploitation of renewable energy sources to avoid environmental, economic and social problems. Through this study, many of the following were concluded:

5.1. The hypothesis test results

- The main hypothesis has not been proven, as no statistical significance has been shown for the impact of the exploitation of renewable energies on the gross domestic production in Algeria for the period 2006-2019. This made it not achieve any place in this influence, whether at the world or African level.

- Proving the first sub-hypothesis: Countries of the world, Africa and Algeria have actual potentials and uses of renewable energies.
- Proving the second sub-hypothesis: the exploitation of renewable energies in the world has a positive impact on the gross domestic production in the period 2006-2019.
- Proving the third sub-hypothesis: the exploitation of renewable energies in the African continent has a positive impact on the gross domestic production of Africa in the period 2006-2019. But it is a relatively weak effect.
- The fourth sub-hypothesis has not been proven: that the exploitation of renewable energies in Algeria has a positive impact on the gross domestic production in the period 2006-2019.
- The fifth sub-hypothesis has not been proven: Algeria occupies a lagging position for the world as a whole, and a good position for Africa in the impact of renewable energies production on the gross domestic production for the period 2006-2019.

5.2. Study results

- The world is currently moving towards the production of renewable energies, exploiting from 92% to 76% of its potential, and the African continent from 100% to 95% of its energy potential, but Algeria suffers from the small size of its renewable energy potential and from the exploitation of percentages weak ones, ranging from 18% to 63%, and in 2019 it decreased to 34%.
- The world exploits 18 types of renewable energies, and Africa exploits 17 of them, while Algeria relies on only 6 types represented mainly in solar, hydroelectric and wind energy, and it has no other types.
- The exploitation of renewable energies in Algeria did not achieve any clear and tangible impact on the gross domestic production during the period from 2006-

2019, while there was a positive and strong relationship in the world, and a positive and weak relationship in the continent of Africa.

- Algeria suffers from a weak position, whether in terms of its capacities of renewable energies, or in its production compared to the world or the African continent during the period 2006-2019.

5.3. Study suggestions:

- Algeria's diversification of natural resources to obtain renewable energies, and the exploitation of 12 species that it does not have. And to increase its capabilities and exploit the resources currently available to it.
- Directing investment towards green investments that are active in the production of renewable energies, to achieve their economic benefits, which positively affects the gross domestic production.
- Encouraging research and development in the fields of renewable energies, in terms of their production and exploitation as an alternative to fossil energy.

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Table (1): Renewable energies production rates in the World, Africa and Algeria from the available capacities for the period 2006-2019.

years	The World			Africa			Algeria		
	Cap (MW)	Prod (MW)	%	Cap (MW)	Prod (MW)	%	Cap (MW)	Prod (MW)	%
2006	1031494	949563	**92**	26318	26318	**100**	251	61.4	**24**
2007	1 089692	984653	**90**	26764	26764	**100**	251	63.6	**25**
2008	1160732	1039858	**89**	28366	28366	**100**	232	79.5	**34**
2009	1240683	1071672	**86**	29708	29708	**100**	230	96	**42**
2010	1330478	1163993	**87**	31625	31625	**100**	230	49	**21**
2011	1439401	1222690	**85**	32706	32706	**100**	255	134	**52**
2012	1559802	1320412	**85**	33078	33078	**100**	255	161	**63**
2013	1679758	1.398824	**83**	34970	34970	**100**	266	80	**30**
2014	1808213	1477583	**81**	36341	36341	**100**	537	108	**20**
2015	1964655	1532341	**78**	38323	38323	**100**	482	91	**19**
2016	2014645	1637180	**81**	38570	38570	**100**	663	120	**18**
2017	2186145	1728500	**79**	43485	41482	**95**	686	176	**26**
2018	2.359753	1834012	**78**	48816	44720	**92**	686	217	**32**
2019	2542035	1934292	**76**	51278	47613	**93**	686	234	**34**

Sources: Prepared by researchers based on:

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Table(2): The percentage of Algeria' capacities and production to the World and Africa for the period 2006-2019.

Years	Capacities			Production		
	% of Africa fom the World	% of Algeria fom Africa	% of Algeria fom the World	% of Africa fom the World	% of Algeria fom Africa	% of Algeria fom the World
2006	2.4	1.0	0.024	2.7	0.23	0.006
2007	2.3	1.0	0.023	2.71	0.24	0.006
2008	2.22	0.9	0.020	2.73	0.28	0.008
2009	2.25	0.8	0.018	2.77	0.32	0.009
2010	2.17	0.8	0.017	2.72	0.15	0.004
2011	2.41	0.8	0.018	2.67	0.40	0.01
2012	1.97	0.8	0.016	2.50	0.49	0.01
2013	1.90	0.8	0.016	2.50	0.23	0.006
2014	1.91	1.5	0.029	2.46	0.29	0.007
2015	1.85	1.3	0.024	2.50	0.23	0.006
2016	1.88	1.7	0.032	2.35	0.31	0.007

2017	1.99	1.5	0.031	2.40	0.24	0.010
2018	2.07	1.4	0.029	2.44	0.48	0.011
2019	2.01	1.3	0.027	2.46	0.50	0.012

Sources: Prepared by researchers based on:
Report of IRENA, (2020), Renewable capacity statistics 2020, International Renewable Energy Agency (IRENA), Abu Dhabi, p5. www.irena.org
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Table (3): Renewable energies produced in the world, Africa and Algeria in 2018 (GWh).

Year		**The World**		**Africa**		**Algeria**
	Renewable energies	Prod (**GWH**)	%	Prod (**GWH**)	%	Prod (**GWH**)
1	Hydropower	4.267.085	32.56	134.043	38.41	117
2	Renewable hydropower (including mixed plants)	4.149.216	31.66	129.204	37.02	117o
3	Pure pumped storage	117.869	0.90	4.839	1.39	//
4	Marine energy	1.002	0.008	1	0.0002	//
5	Wind energy	622.408	4.75	5.770	1.65	10
6	Onshore wind energy	1.194.718	9.12	14.117	4.04	160e
7	Offshore wind energy	68.196	0.52	//	//	//
8	Solar energy	562.033	4.29	8.677	2.48	507
9	Solar photovoltaic	549.833	4.20	6.082	1.74	//
10	Concentrated solar power	12.200	0.093	2.595	0.74	133e
11	Bioenergy	522.552	3.88	3.233	0.93	//
12	Solid biofuels and renewable waste	426.830	3.26	3.128	0.90	//
13	Renewable municipal waste	62.148	0.47	29.014	8.31	//
14	Bagasse	55.355	0.42	3.032	0.87	//
15	Other solid biofuels	309.214	2.36	96	0.027	//
16	Liquid biofuels	5.729	0.043	3	0.0008	//
17	Biogas	88.378	0.67	102	0.029	//
18	Geothermal energy	88.408	0.67	5.005	1.43	//
	Sum	13.103.174	100	348.941	100	

Sources: Prepared by researchers based on:
Report of IRENA, (2020), "Renewable capacity statistics 2020', International Renewable Energy Agency (IRENA), Abu Dhabi, p5. www.irena.org

Table (4): Estimating the World' model

Variable	coefficient	prob	R2	F-statistic	Prob (F-statistic)	DW
C	5.0008	0.6122	0.893	42.1099	0.001296	1.7539
X3	1.48	0.0013				

Source: Prepared by researchers based on the outputs of the EVIEWS10 program.

Table (5): Estimating the Africa' model

Variable	coefficient	prob	R2	F-statistic	Prob(F-statistic)	DW
C	3.0445	0.0000	0.10	0.000117	0.9915	0.3339
X2	-2.26	0.9915				

Source: Prepared by researchers based on the outputs of the EVIEWS10 program.

Table (6): Auto regression with one deceleration (Africa)

Variable	coefficient	prob	R2	F-statistic	Prob (F-statistic)	DW
C	3.0445	0.0000	0.6405	5.9413	0.013578	0.5573
X1	2.44	0.1448				

Source: Prepared by researchers based on the outputs of the EVIEWS10 program.

Table (7): Estimating Algeria' model

Variable	coefficient	prob	R2	F-statistic	Prob(F-statistic)	DW
C	0.151608	0.0000	0.10	1.382713	0.262442	0.673981
X1	4.52	0.2624				

Source: Prepared by researchers based on the outputs of the EVIEWS10 program.

Table (8): Auto regression with one deceleration (Algeria)

Variable	coefficient	prob	R2	F-statistic	Prob (F-statistic)	DW
C	0.153725	0.0000	0.440148	2.620626	0.108467	1.551200
X1	3.74E-05	0.4930				

Source: Prepared by researchers based on the outputs of the EVIEWS10 program.

Table (9): Quality tests of the World' model

	Hypotheses	Calculated value	The decision
Normal distribution test	Normal distribution of residuals: H0 Abnormal residual distribution: H1	J-B=0.5293 Prob **(j-b=00.767)>0.05**	We accept the null hypothesis, the residual series of the model is normally distributed
residual autocorrelation test	No autocorrelation:H0 Autocorrelation:H1	Prob **(0.4148)>0.05**	We accept the null hypothesis, there is no autocorrelation
Variation instability test	No variance instability:H0 Variance instability H1	Prob (ch-square) = **0.1324> 0.05**	We accept the null hypothesis, absence of variance instability

Source: Prepared by researchers based on the outputs of the EVIEWS10 program.

Table (10): Quality tests of the Africa' model

	Residual autocorrelation test			Normal distribution test		
	F	**prob**	**Variance stability**	**JB**	**prob**	**Normal distribution**
Model	0.438	0.521	Yes	4.14	0.12	Yes

Source: Prepared by researchers based on the outputs of the EVIEWS10 program.

Table (11): Quality tests of the Algeria' model

	Residual autocorrelation test			Normal distribution test		
	F	**prob**	**Variance stability**	**JB**	**prob**	**Normal distribution**
Model	0.051	0.82	Yes	0.761	0.68	Yes

Source: Prepared by researchers based on the outputs of the EVIEWS10 program.