Analysis of the relationship between the transition to renewable energies and sustainable development using simple linear regression: A case study of Algeria

Bouazza Elamine ZEMRI

Laboratory POLDEVA
University of Tlemcen, Algeria
zemribouazzaelamine01@gmail.com

Dr. Sidi Mohamed KHETIB

Laboratory POLDEVA
University of Tlemcen, Algeria
khetib.s@yahoo.com

Received: 01/10/2022 *Accepted*: 14/12/2022 *Published*: 31/12/2022

Abstract:
This study aimed to investigate and analyse the impact of the transition to the use of renewable energies on the dimensions of sustainable development (economic, environmental, social) in Algeria during the period 2000-2019. The data were submitted to linear regression analysis through structural equation modelling using SPSS software v.25.0 .
The results show that the transition to renewable energy use has significantly impacted the economic dimension of sustainable development, as represented by Gross Domestic Product per capita (GDP/capita). In addition, the results demonstrate a significant correlation between the use of renewable energy and the environmental dimension of sustainable development represented by the Emissions of Carbon Dioxide (CO_2). However, the study concluded that there was no significant correlation between renewable energy consumption and the social dimension of sustainable development represented by the Human Development Index (HDI).
Key Words: Renewable energies; Sustainable development; Simple linear regression; Algeria.

JEL Classification : Q56, C25.

* Corresponding author: Zemri Bouazza Elamine (*zemribouazzaelamine01@gmail.com*)

Introduction

Given the current context, with phenomena such as climate change. The trend toward renewable energies and the achievement of sustainable development goals become a necessity, not an option. The implementation of renewable energy can improve the economic and social welfare of people throughout the world and can achieve sustainable development goals, which allows them to achieve profitability, increase energy supply, and reduce costs and time. For that purpose, the Algerian government is working to define strategies to incorporate renewable energy into its energy market by developing several types of research and technologies. These efforts have enabled the Algerian state to increase the use of renewable energy through a series of official Plans and programs.

In light of this statement, this paper aims to understand the interrelationship between the transition to renewable energy and various aspects of sustainable development in Algerian from 2000-2019 to rationalize future decisions on the matter. We used the variable of Gross Domestic Product per capita (GDP/capita) as the indicator of economic dimensions of sustainable development, the Human Development Index (HDI) representing social dimensions of sustainable development, and the environmental dimension of sustainable development represented by the Emissions of Carbon Dioxide (CO_2).

Problematic study: Through the previous submission, the problems of the study are reflected in the following fundamental question:

What is the relationship between the transition of use renewable energies and the dimensions of sustainable development in Algeria during the period 2000-2019?

Research hypotheses: To answer the fundamental question we based our study on three hypotheses, they are:

- Hypothesis 1 (H_1): The relationship between the transition to the use of renewable energy and the economic dimension of sustainable development is represented by the Gross Domestic Product per capita (GDP/capita).
- Hypothesis 2 (H_2): The relationship between the transition to the use of renewable energy and the environmental dimension of sustainable development is represented by the percentage of Carbon Dioxide Emissions (CO_2).
- Hypothesis 3 (H_3): The relationship between the transition to the use of renewable energy and the social dimension of sustainable development is represented by the Human Development Index (HDI).

Research aims: In light of this statement, the objective of this paper is to:

- determine the link between the transition to renewable energy use and the dimensions of sustainable development to streamline future decisions in this domain.
- Knowing Algeria's strategy in the field of renewable energies and its ability to achieve sustainable development.

Research importance: The importance of the study is shedding light on renewable energy because of its position in parallel with the path that various countries have come to follow and is based on adopting policies and strategies that work to

encourage this kind of energy. In addition to the urgent need for Algeria to catch up with developed countries, as well as the need to find optimal ways to exploit this sector, considering the decline and fluctuation that characterize the non-renewable energies, and the pursuit of achieving sustainable development.

Research Methodology: To answer the research problem, we used the descriptive approach to present various general concepts of renewable energy and sustainable development. The research included a period of 20 years (2000-2019) to study renewable energies and sustainable development, as well as the historical path of the experiences of Algeria and the analysis of its different paths for the same period. The study utilized data collected by worldbank.org and Office National des Statistiques (ONS), We use simple regression models in analyzing the data and determining the relationship between the study variables .

This paper is divided into 5 sections: introduction, literature review, data and methodology, result and discussion, conclusion and recommendations.

I. Literature Review

1. Renewable Energy Concept

1.1. Definition of Renewable Energy:

Since February 2013, the International Renewable Energy Agency (IRENA) legal definition has been approved by 107 countries: renewable energy includes all forms of energy sustainably produced from renewable sources, including bioenergy, geothermal energy, hydropower, ocean energy, solar energy and wind energy (Simonyan & Solntsev, 2010). Renewable energy is energy gotten from natural resources that renew themselves in less than a human lifetime without draining the planet's resources.

These resources such as sunlight, wind, rain, tides, waves, biomass, and thermal energy stored in the earth’s crust have the benefit of being available in one form or another nearly everywhere (Rahman et al., 2022). They are almost endless and more important, they cause little climate or environmental damage. Here are some common types of renewable energy: solar energy; wind energy; Geothermal energy; Hydroelectric power; sea energy; Bioenergy.

1.2. Importance of Renewable Energy:

Given the definition of this renewable energy, it becomes clearer why renewable energy is an important choice for reducing mitigation of climate change and allows sustainability in the long term. Renewable energy has many benefits, including, but not limited to offering a freely available source of energy generation. Along with the growing sector, there is also a surge of job creation to develop and install the renewable energy solutions of tomorrow (Asif & Muneer,2007).

Renewable Energy offers greater energy access in developing nations and can reduce energy bills too (Usman & Radulescu, 2022). The largest benefits of renewable energy are that much green and clean energy. Renewable Energy is not an end in itself, but rather a necessary starting point for achieving the goals of all three pillars of sustainable development. In addition, Renewable energy has the potential to provide a ready supply of power without using natural resources. There is also a

reduced risk of environmental problems such as fuel spills and emissions issues.

2. Sustainable Development Concept

2.1. Definition of sustainable development:

Climate change has become one of humanity's most significant challenges in recent years. for that, Sustainable development has attracted much attention in the academic, governance, planning, and development intervention space (Abbass et al., 2022). A wide range of government and non-government bodies seem to have embraced it as an appropriate development paradigm. Almost all paradigms proponents and proponents agree that it is possible to overcome the challenges facing humanity today such as climate change, ozone layer degradation, water scarcity, deprivation, and inequality by upholding the principles and principles of sustainable development, deprivation and poverty.

In September 2015, the United Nations achieved an international agreement for its 2030 Agenda on Sustainable Development. The agenda identifies 17 Goals and 169 targets to address several economic, environmental, and social concerns facing the world today (Ahmed & Karim, 2022). Although many definitions, the most commonly used definition of sustainable development is that proposed by the Brundtland Commission (Cerin, 2006; Dernbach J. C., 1998; Dernbach J. C., 2003; Stoddart, 2011) (Al-Qudah et al., 2022). However, the definition touches on the importance of intergenerational equity. This resource-saving concept for future generations is one of the key features that distinguish sustainable development policy from traditional environmental policy, which also seeks to internalize the externalities of environmental degradation (Yermolenko, Volodymyr, et al.,2022).

The general objective goal of sustainable development (SD) is the long-term stability of the economy and environment; This can only be achieved by integrating and considering economic, environmental, and social concerns throughout the decision-making process. The definition of sustainable development that is used by the UN is Development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Verma, 2019).

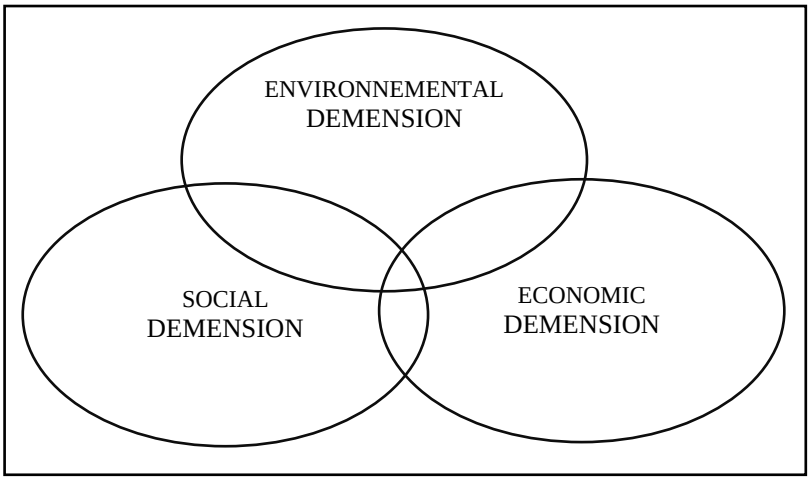
2.2. The dimensions of sustainable development:

Sustainable development is based on a long-term approach that takes into account the inextricable nature of the environmental, social, and economic dimensions of development activities.

(Fig.1) indicates the three dimensions of sustainable development (Environmental, Social, Economic) which:

- Environmental responsibility: the ability to use natural resources without undermining the equilibrium and integrity of ecosystems, reducing the burden on the environment.
- Economic efficiency: efficiency of economic and technological activities, fostering investment and productivity, economic growth, economic output potential.
- Human development: Equal opportunities for people, including well-being, quality of life and sustainable human development, should liberate individual capabilities and meet human needs to eradicate poverty and quality of life.

Fig.1: « the three dimensions of sustainable development»



Source: Prepared by the researchers

2.3. Importance of sustainable development:

The main principle of sustainable development is the integration of social, economic and environmental, problems into all aspects of decision-making. All other principles in the SD framework have built-in decision-making at their core (Emas, 2015). This firmly anchored concept of integration distinguishes sustainability from other forms of politics. Sustainable Development Goals preserve environmental integrity to ensure the health and safety of human communities and life-sustaining ecosystems. Make sure social equality enables the full fulfilment of all men and women, community development and respect for diversity. Create an innovative and prosperous economy that is ecologically and socially responsible.

It can be said that sustainable development: Is a development based on the integration of economic development and social affairs, taking into account the protection of the surrounding environment, in addition to a serious treatment of the needs of society at present without compromising the well-being and quality of life for future generations.

2.4. Characteristics of sustainable development:

- Continuity: It is what is required to invest and generate high income, part of which we can invest to carry out renewal, and replacement of resources.
- Regulating the use of natural resources: It means renewable and non-renewable resources, which guarantee the rights of future generations.
- Achieving environmental balance: Preserving the environment in a way that guarantees the renewal of natural life is the criterion for sustainable development, with the production of renewable resources, and the legal and fair use of non-renewable resources.

3. Algerian's renewable energy strategy

Algeria is the largest county in Africa and the 10th largest in the world. It has an area of 2,381,741 km^2 and an estimated population of 42.2 million people, with an average of 17.71 inhabitants/km^2. It is located in the north of Africa with a 1644 km long coastline, The Southern part of the country consists of a significant portion

of the Sahara Desert. This region is hot year around. Algeria intended to be an important player in electricity production from the photovoltaic and wind by cogeneration, geothermal, and eventually thermal solar, under its renewable energy program (Bouznit et al., 2022).

These energy sectors will drive a sustainable economic development model (Himri et al., 2022). According to the forecast government programs in 2030, 37% of the installed capacity of electricity generation for come from will be renewable energy. Algeria considers solar energy, which is widespread in the region as an opportunity and lever for economic and social development, especially through the formation of industries that create wealth and jobs. In addition, several wind agricultural projects and the implementation of experimental, geothermal, and cogeneration projects were launched (Bouraiou et al., 2020). The multi-annual program for the development of renewable energy adopted by the Government in February 2020, sets an objective of 15,000 MW by 2035. This program takes into account the current potential of the national electricity distribution organization 1,000 MW of electricity from renewable sources is planned to be generated annually, as the first objective of the energy transition and renewable energy sector.

The other priority of the energy transition and renewable energy sector is the project to hybridize power plants in the south of the country that operates from conventional sources, including diesel, with solar photovoltaic production.

II. Data and Methodology

We will try to determine the relationship between the transition to the use of renewable energies and sustainable development in its three dimensions (the economic dimension, the social dimension, and the environmental dimension) in Algeria during the period 2000 to 2019. By formulating the simple regression equations as follows:

$Y = \beta_0 + \beta_1 X_{it} + \varepsilon_{it,}$ where Y is the dependent variable used to express the energy consumption. X are the independent variables used to express the dimension of sustainable development (economic, environment, human development), and t = 2000, 2001, . . ., 2019 represent the analyzed years. β_0 are the control variables. β_1 is parameter and "Ɛ" is the error term.

- The equation of renewable energies and the economic dimension of sustainable development:

$$GDP_t = \beta_0 + \beta_1 CER_t + \varepsilon_t \dots \dots \dots \dots \dots \dots \text{ Eqn (1)}$$

Where: (GDP/capita) denotes the Gross Domestic Product per capita, and CER represents Energy Consumption (the percentage of renewable energy consumption of the total energy).

Notes: Per capita Gross Domestic Product (GDP) is calculated by dividing a country's GDP by its population. It is a value that distributes the economic output of a country to the number of people.

- The equation of renewable energy and the environment dimension of sustainable development:

$$CO_{2t} = \beta_0 + \beta_1 CER_t + \varepsilon_t \dots \dots \dots \dots \dots \dots \text{ Eqn (2)}$$

Where: CO_2 shows the Carbon Dioxide emissions (Total CO_2 emissions) and CER represents Energy Consumption (the percentage of renewable energy consumption of the total energy).

Notes: Carbon dioxide (CO_2) emissions are caused by the combustion of fossil fuels (coal, oil, and natural gas) and the production of cement. These emissions include carbon dioxide produced by the combustion of gases as well as the consumption of solid, liquid, and gaseous fuels.

- The equation of renewable energy and Human Development dimension of sustainable development:

$$HDI_t = \beta_0 + \beta_1 CER_t + \varepsilon_t \dots \dots \dots \dots \dots \dots \text{ Eqn (3)}$$

Where: HDI mentions the Human Development Index, and CER represents energy consumption (percentage of renewable energy consumption of the total energy).

Notes: The level of human development index.

1. Test the normality distribution of variables

1.1. The Kolmogorov-Smirnov test:

Before validating the study's main hypothesis and its sub-hypotheses, it is necessary to conduct some tests on the study's data as follows: The Kolmogorov-Smirnov test was used to check whether study data was distributed as Normal Distribution or not.

Table 1: « Results of Normality Test, Kolmogorov-Smirnov Test »

One-Sample Kolmogorov-Smirnov Test					
		CER	***CO2***	***GDP***	***HDI***
N		**20**	**20**	**20**	**20**
Normal Parameters [a, b]	Mean	,156220	,738162	1,265396	,681100
	Std. Deviation	,0692337	,2310213	,3155465	,0559869
Most Extreme Differences	Absolute	,168	,187	,143	,104
	Positive	,126	,187	,143	,104
	Negative	-,168	-,137	-,121	-,098
Test Statistics		,168	,187	,143	,104
Asymp. Sig. (2-tailed)		**,085[c]**	**,026 [c]**	**,200[c, d]**	**,200[c, d]**

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors significance Correction.
d. This is the lower bound of true significance.

Source: Done on SPSS v.25.0

Based on the normality test in (Table 1) by using Kolmogorov-Smirnov, the result was the data of the independent variable (CER) is normally distributed, because the value of (Sig > 0.05), while the data of the dependent variables (HDI,

GDP per capita) are normally distributed because (Sig > 0.05). As for the dependent variable represented in the percentage of carbon dioxide emissions (Co_2) They are not normally distributed because (Sig< 0,05).

2. Hypothesis test:

Hypothesis 1 (H1): The relationship between the transition to the use of renewable energy and the economic dimension of sustainable development is represented by the gross domestic product per capita (GDP/capita).

From the results in (Table 2), it is clear that the value (Sig) = 0.041 < 0.05), and therefore we reject the null hypothesis that: There is no statistically significant relationship between the transition to the use of renewable energies (CER) and the gross domestic product per capita (GDP/capita), and therefore accepting the alternative hypothesis that states that there is A statistically significant relationship between the transition to the use of renewable energies (CER) and the gross domestic product per capita (GDP/capita), meaning that the transition to the use of renewable energies has an impact on the gross domestic product.

Table 2: « Results of the statistical analysis of the impact of the transition to the use of renewable energies (CER) on (GDP/capita) »

ANOVA[a]					
Model	**Sum of Squares**	**ddl**	**Mean Square**	**F**	**Sig.**
1 Regression	,404	1	,404	4,790	,041[b]
Residual	1,962	18	,085		
Total	2,366	19			
a. Predictors: (Constant), CER b. Dependent Variable: GDP/capita					

Source: Done on SPSS v.25.0

Notes: denote that we accept the alternative hypothesis (significance) at the level of 5%

Table 3: « Results of the statistical analysis of the impact of the transition to the use of renewable energies (CER) on the variable (GDP/capita), the expected variable »

Model		**unstandardized coefficients**		**standardized coefficients**	**t**	**Sig.**
		B	**Ecart standard**	Bêta		
1	(Constant)	1,002	,091		11,234	,000
	CER	-1,771	,587	-,554	-3,165	,004

Source: Done on SPSS v.25.0

The following (Table 3) shows the predictive variables (CER) that contribute to predicting the value of the output. The gross domestic product per capita (GDP/capita) where the Sig value is less than the significance level (α = 0.05), indicates the coefficients of the variable using renewable energies.

Hypothesis 2 (H2): The relationship between the transition to the use of renewable energies and the environmental dimension of sustainable development is represented by the percentage of carbon dioxide emissions.

From the results of (Table 4) , the value of (Sig = 0.004 < 0.05), thus rejecting the null hypothesis which states that there is no statistically significant relationship between the transition to the use of renewable energies (CER) and the rate of carbon dioxide emissions (CO_2), and we accept the alternative hypothesis Which claims that there is a statistically significant relationship between the transition to the use of non-renewable energies (CER) and the emission of carbon dioxide (CO_2), meaning that the transition to the use of renewable energies has an impact on the rate of carbon dioxide emission (CO_2).

Table 4: « Results of the statistical analysis of the impact of the transition to the use of renewable energies (CER) on the variable (CO_2) »

ANOVA[a]					
Model	**Sum of Squares**	**ddl**	**Mean Square**	**F**	**Sig.**
1 Regression	,349	1	,348	9,987	,004[b]
Residual	,798	18	,038		
Total	1,147	19			
a. Predictors: (Constant), CER b. Dependent Variable: CO2					

Source: Done on SPSS v.25.0

Notes: denote that we accept the alternative hypothesis (significance) at the level of 5%

The following (Table 5) shows the predictive variables (CER) that contribute to predicting the value of the CER ratio. The emission of Carbon Dioxide (CO_2), where the Sig value is less than the significance level ($\alpha = 0.05$), indicates the finance of the coefficients of the variable of using renewable energies. Therefore, improvements in renewable energy and government interest in encouraging renewable energy to help the environment and has contributed to a reduction in greenhouse gas emissions from the energy industry.

Hypothesis 3 (H3): The relationship between the transition to the use of renewable energies and the social dimension of sustainable development is represented by: The Human Development Index (HDI).

Table 5: « Results of the statistical analysis of the impact of the transition to the use of renewable energies (CER) on the variable (CO_2), the expected» variable »

Model		**unstandardized coefficients**		**standardized coefficients**	**t**	**Sig.**
		B	**Ecart standard**	**Bêta**		
1	(Constant)	1,572	,141		11,044	,000
	CER	-1,917	,877	-,414	-2,175	,040

Source: Done on SPSS v.25.0

On the other hand, the following (Table 6), the value of (Sig= 0.181 > 0.05), thus accepting the null hypothesis states that there is no statistically significant relationship between the transition to the use of renewable energies (CER) and the Human Development Index (HDI), meaning that the transition in renewable energy and government interest in promoting renewable energy during the study period in Algeria had no discernible impact on the improvement of living conditions or the abolition of poverty.

Table 6: « Results of the statistical analysis of the impact of the transition to the use of renewable energies (CER) on (HDI) »

ANOVA[a]						
Model		Sum of Squares	ddl	Mean Square	F	Sig.
1	Regression	,006	1	,006	1,905	,181[b]
	Residual	,075	18	,005		
	Total	,0747	19			
a. Predictors: (Constant), CER b. Dependent Variable: HDI						

Source: Done on SPSS v.25.0

Notes: denote that we accept the alternative hypothesis (significance) at the level of 5%

The following (Table 7) shows the predictive variables (CER) that contribute to predicting the value of the index. Human Development Index (HDI), where the Sig value is more than the significance level (α = 0.05), indicates the insignificance of the coefficients of the variable using renewable energies.

Table 7: « Results of the statistical analysis of the impact of the transition to the use of renewable energies (CER) on (HDI), the expected»

Model		unstandardized coefficients		standardized coefficients	t	Sig.
		B	Ecart standard	Bêta		
1	(Constant)	,698	,029		25,851	,000
	CER	-,237	,175	-,287	-1,480	,040

Source: Done on SPSS v.25.0

III. Result and Discussion

1. Result:

Table 8: « A summary of the results obtained»

Hypothesis		the decision
H_{11}	There is no statistically significant relationship between the use of renewable energies and the (GDP/capita) at the significance level (α =0.05)	**Rejected**
H_{12}	There is a statistically significant relationship between the use of renewable energies and (GDP/capita) at the significance level (α =0.05)	**Accepted**
H_{21}	There is no statistically significant relationship between the use of renewable energies and the percentage of carbon dioxide (CO_2) emissions at the significance level (α =0.05)	**Rejected**
H_{22}	There is a statistically significant relationship between the use of renewable energies and the percentage of Carbon dioxide (CO_2) emissions the significance level (α =0.05)	**Accepted**
H_{31}	There is no statistically significant relationship between the use of renewable energies and the sustainable development index (HDI) at the significance level (α =0.05)	**Accepted**
H_{32}	There is a statistically significant relationship between the use of renewable energies and the sustainable development index (HDI) at the significance level (α =0.05)	**Rejected**

Source: Prepared by the authors

2. Discussion:

The research results confirm the initial hypothesis There is a statistically significant relationship between the use of renewable energies and (GDP/capita) at the significance level (α=0.05), According to the results above, the GDP per capita in Algeria state is influenced positively by the production of renewable energy. at the same time being negatively influenced by the education expenses in GDP and the HDI index. The negative influence is explained by the fact that in Algerian, the HDI level are not so high in comparison with the developed western economies from Europe.In addition, there is a statistically significant relationship between the use of renewable energies and the percentage of Carbon dioxide (CO_2) emissions the significance level (α =0.05). The control variables confirm that renewable energies positively influenced on the CO_2, as stated by the literature.

Conclusion

In conclusion, renewable energy as a necessary variable to achieve the dimensions of sustainable development requires adapting the current economic system to new energy models. In this paper, we specifically sought to detect the impact of using renewable energy on the global domestic product (GDP/capita), the emissions of carbon dioxide (CO_2), and the human development index (HDI) sever the last 20 years in Algeria. This study treated and diagnosed Algeria's experience in the transition to the use of energies renewables to achieve sustainable development, by presenting the main programs that Algeria is trying to implement in the sector and the role of the latter in achieving sustainability in its three dimensions, our study draws the following conclusions:

- There is a statistically significant relationship between the shift to the exploitation of renewable energies in Algeria and the achievement of sustainability in its economic dimension.
- There is a statistically significant relationship between the shift to exploiting renewable energies and achieving sustainability in its dimension environmental.
- There is no statistically significant relationship between the transition to the exploitation of renewable energies and the social dimension of Sustainability.
- The lack of attention to environmental considerations in economic policies is one of the important reasons for the slowdown in sustainable development processes.

Achieving truly sustainable development in all of its dimensions is extremely challenging, especially at this time. Currently, in light of economic development and rising energy demand. This is because many technologies continue to rely on traditional energy. Nevertheless, Algeria has enormous potential in the field of renewable energies with all its sources, but despite the shift to this energy alternative, its exploitation and use remain very little compared to other countries that do not have the same ingredients as Algeria, and therefore the exploitation of renewable energies in Algeria remains not up to the level of aspirations to achieve sustainable development, despite the state's apparent intention for a green energy transformation, and this is evidenced through the structuring of institutions and the preparation of programs, policies and strategies adopted in this regard.

Many opportunities can be achieved development sustainability in Algeria but, the issue is: are we going to take this opportunity to make changes?

Recommendations:

In light of the study results, we came to several recommendations as follows:

- Transforming political desire into tangible goals for the development of renewable energies, particularly photovoltaic solar energy, particularly in agriculture, and the nature and vastness of Algeria.
- The current levels of economic development in Algeria are not sustainable, a key focus must be the impact economic growth has had on the environment in a particular human activity that has caused an uptick in greenhouse gases such as methane CO_2, which in turn have caused the atmosphere to retain heat.

- Create a strategy for the development of renewable energies and create appropriate financing mechanisms to support clean energies within the energy mix adopted in the development process.

References:

- Abbass, K., Qasim, M. Z., Song, H., Murshed, M., Mahmood, H., & Younis, I. (2022). A review of the global climate change impacts, adaptation, and sustainable mitigation measures. *Environmental Science and Pollution Research*, 1-21.
- Ahmed, S. B., & Karim, M. R. (2022). Analyzing the role of collaboration and partnerships in implementing sustainable development goals in Bangladesh. *Journal of Community Positive Practices*(2), 39-55.
- Asif, M., & Muneer, T. (2007). Energy supply, its demand and security issues for developed and emerging economies. *Renewable and sustainable energy reviews*, 11(7), 1388-1413.
- Al-Qudah, A. A., Al-Okaily, M., & Alqudah, H. (2022). The relationship between social entrepreneurship and sustainable development from economic growth perspective: 15 'RCEP'countries. *Journal of Sustainable Finance & Investment*, 12(1), 44-61.
- Bouraiou, A., Necaibia, A., Boutasseta, N., Mekhilef, S., Dabou, R., Ziane, A., Sahouane, N., Attoui, I., Mostefaoui, M., & Touaba, O. (2020). Status of renewable energy potential and utilization in Algeria. *Journal of Cleaner Production*, 246, 119011.
- Bouznit, M., Elaguab, M., Selt, M. M., Himrane, M., & Aïssaoui, R. (2022). Climate Change and Agricultural Production in Algeria. In Climate Change in the Mediterranean and Middle Eastern Region (pp. 249-268). *Springer*.
- Emas, R. (2015). The concept of sustainable development: definition and defining principles. Brief for GSDR, 2015, 10.13140.
- Himri, Y., Rehman, S., Mostafaeipour, A., Himri, S., Mellit, A., Merzouk, M., & Merzouk, N. K. (2022). Overview of the Role of Energy Resources in Algeria's Energy Transition. Energies, 15(13), 4731.
- Makhloufi, S., Khennas, S., Bouchaib, S., & Arab, A. H. (2022). Multi-objective cuckoo search algorithm for optimized pathways for 75% renewable electricity mix by 2050 in Algeria. *Renewable Energy*, 185, 1410-1424.
- Rahman, A., Farrok, O., & Haque, M. M. (2022). Environmental impact of renewable energy source based electrical power plants: Solar, wind, hydroelectric, biomass, geothermal, tidal, ocean, and osmotic. *Renewable and Sustainable Energy Reviews*, 161, 112279.
- Simonyan, A., & Solntsev, A. (2010). The International renewable energy agency (IRENA). *Международное право*, 43(3), 61a-61a.
- Usman, M., & Radulescu, M. (2022). Examining the role of nuclear and renewable energy in reducing carbon footprint: Does the role of technological

innovation create some difference? *Science of The Total Environment*, 841, 156662.

- Verma, A. K. (2019). Sustainable development and environmental ethics. *International Journal on Environmental Sciences*, 10(1), 1-5.
- Yermolenko, V., Hafurova, O., Deineha, M., Novak, T., & Shovkun, Y. (2022). legal aspects of the use of renewable energy sources and the implementation of the concept of "green economy" in ukraine in the context of sustainable development strategy. in systems, decision and control in energy iii. *springer*, 373-386.