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The role of environmental accounting in the transition to renewable energies for achieving sustainable development in Algeria

دور المحاسبة البيئية في التوجه نحو الطاقات المتجددة لتحقيق التنمية المستدامة في الجزائر

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Abstract:

This research paper aims to clarify the relationship between adopting the green accounting philosophy and the orientation towards the choice of renewable energies as an approach to achieve both energy security and sustainable development in Algeria. The research assumes that activating and integrating the environmental dimension within the activity of institutions has a major impact in adopting alternative energies to the fossil, depleted energies that threaten environmental security.

The choice of renewable energy, rather than being strategy for achieving energy security, also it is considered less polluting and is part of the concept of sustainable development.

Accordingly, this paper attempts to answer the following problem: To what extent can green accounting contribute to achieving sustainable development?

Keywords: Green accounting; Renewable energies; Sustainable development; Energy security; Potential of renewable energy in Algeria.

JEL Classification Codes: K32 , M41, O13, Q2.

ملخص:

تهدف هذه الورقة البحثية إلى توضيح العلاقة بين تبني فلسفة المحاسبة الخضراء و التوجه نحو خيار الطاقات المتجددة كمقاربة لتحقيق كل من الأمن الطاقوي و التنمية المستدامة بالجزائر، إذ يفترض البحث أن لتفعيل و دمج البعد البيئي ضمن نشاط المؤسسات أثر كبير في تبني طاقات بديلة عن الطاقات الأحفورية الناضبة المهددة للأمن البيئي، فخيار الطاقات المتجددة، عدا كونه إستراتيجية لتحقيق الأمن الطاقوي، يعتبر أقل تلويثا للبيئة و هو ما يدخل ضمن مفهوم التنمية المستدامة. و عليه، تحاول هذه الورقة الإجابة عن الإشكالية التالية: إلى أي مدى يمكن للمحاسبة الخضراء أن تساهم في تحقيق التنمية المستدامة ؟

كلمات مفتاحية: المحاسبة الخضراء؛ الطاقات المتجددة؛ التنمية المستدامة؛ الأمن الطاقوي؛ البرنامج الطاقوي في الجزائر.

تصنيفات JEL : K32، M41، O13، Q2.

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INTRODUCTION:

A mid of the economic and technological developments that the world is witnessing, the demand for energy resources is increasing, which is the main driver of economic activity, whether in terms of consumption or production in terms of funding sources.

However, this request encountered many problems, most notably the problem of depletion of fossil energy and the problem of environmental pollution, which led to the emergence of a new concept of the economy, which is known as the environmental economy or the green economy, which aims to achieve sustainable development.

In this context, the concept of green accounting has developed, considering that accounting is the most important measurement and disclosure tool, with the aim to evaluate and measure the costs of damage caused by industrial pollution.

From here we pose the following problem:

To what extent can green accounting contribute to achieving sustainable development?

This question includes the following sub-questions:

- What is the role of green accounting in the trend towards adopting new energies?
- What is the role of renewable energy in sustainable development?
- What is the relationship between energy transformation and energy security?

To address the research problem, the present study is divided into three principal axes. The first ax is based on the conceptual framework which consists of the concept of green accounting, renewable energies, energy security, and sustainable development. The second contained the contribution of green accounting to achieving both energy security and sustainable development, while the third ax concerned the reality of the transition energy in Algeria under the renewable energy program.

1- Conceptual framework:

1-1 Green accounting

Green accounting, or what is also known as environmental accounting, is a new concept of accounting that has developed with the emergence and exacerbation of environmental problems, as it became necessary to measure the costs of damages and treat pollution resulting from industrial activity to reduce its damages and achieve sustainable development

1-1-1 Green accounting definition

Environmental accounting is the accounting that looks at how the environment in terms of costs and benefits affects the financial accounting system (El Serafy, 2013, p. 23).

It is also known as an extended accounting system for the traditional accounting system, based on the analysis of the results and negatives of cost occurrence to determine and specify the impact of the environmental costs caused by the unit (Caraiani & others, 2015, p. 4).

Environment accounting is defined as a system for producing information on the environmental performance of an organization, which benefits its stakeholders in making decisions. It is considered a satisfactory response to the needs of the stakeholders in the institution for information with an environmental dimension on the one hand, and a response to the effects of legislation on the activity of the institution on the other hand (Rabiei, 2012, p. 60).

From the previous definitions, it can be said that green accounting is accounting for the waste and environmental damage resulting from the activity of industrial establishments through their estimation, measurement, and inclusion within the costs borne by both the establishments and the state to reduce pollution and limit the depletion of natural revolutions under the principle of "who pollutes Pay".

1-1-2 Environmental Accounting Objectives

The application of green accounting allows achieving many goals, including(Mansouri & Judi Mohammed, 2008, p. 28):

- Demonstrate the benefits achieved, for example, those resulting from converting solid waste into usable materials and selling them instead of throwing them away;
- Accurate monitoring of the flows of energy, water, materials, and waste; This allows the preparation of correct reports on environmental waste and emissions;
- Show what can be saved in costs by reducing losses and damages of environmental pollution along with financial information;
- Inclusion of the elements of environmental costs within the variables of the decision-making process;
- Measuring and disclosing the efficiency of the facility within the framework of environmental protection, which facilitates the process of its controlling;
- Correcting performance indicators by including environmental costs to avoid inflating results...

1-2 Renewable energy

1-2-1 Definition, sources, and characteristics

Renewable energy is defined as that energy derived from natural resources that are constantly renewed (inexhaustible)(Sneideman & Twamley, 2016, p. 5), which is fundamentally different from traditional energy that is subject to depletion, such as oil, coal, and natural gas. It is also called clean energy because it can be generated without emissions. harmful to the environment(Ferroukhi, 2018, p. 3).

According to Graddock, the renewable energy sources are: solar energy; Wind Energy; Hydropower; biomass energy; Geothermal energy...(Craddock, 2008, p. 13)

The most important renewable energy characteristics can be reported as follows(Bin Jadid, 2016, p. 9):

- Being clean energy that allows maintaining the general health of the individual and the environment;
- It is considered local, natural, and inexhaustible energy;
- Suitable for the potential of developing countries...

1-2-2 Motives for moving towards renewable anergies

The motives for adopting the renewable energy policy can be summarized as follows(Bensfat & Ziane, 2018, p. 7):

- Concern about climate change: Renewable energy contributes to securing energy reserves without emitting greenhouse gases, of which fossil fuels are the most important causes.

- The cost of renewable energy: due to the increasing interest in the issue of renewable energy and the development of its production technology, the costs of generating some of it have decreased, making it suitable, especially for developing countries.
- Energy security: Fossil energy is the most widely used energy, but it is non-renewable energy that is subject to demise. Otherwise, its prices have declined, especially oil and gas, which is the most important source of financial resources for many countries, for example, Algeria, matter Which prompted the adoption of new energies that would achieve energy security by meeting energy needs instead of those traditional energies(Craddock, 2008).

1-3 Energy secrurity

1-3-1 Definition

The concept of energy security is a modern in the energy literature. It varies according to the nature of the countries, producing or consuming them, and according to the existing relations between them(Gheorghe & Muresan, 2011, p. 10). It appeared in 1973 when oil was used as a weapon against the countries supporting Israel, which made the world wake up to the nightmare of the absence of oil, which prompted importing countries to intensify efforts and research on exploring alternatives to secure their energy needs; Even the countries exporting it realized that their economic security, which depends on oil revenues, would not be achieved by selling a depleted commodity.

In general, to achieve energy security, energy sources must be diversified and not depend on only one source so that energy supplies are available at all times and in multiple forms, in sufficient quantities, and at reasonable prices(Albrecht, 2009, p. 43).

1-3-2 Energy secrutity strategies

To ensure energy security, energy transition must be achieved, moving towards renewable energies as a solution to energy crises (price deterioration, environmental pollution, depletion of energies...), in other words, passing from the traditional energy system to the energy mix that is based mainly on renewable resources(Albrecht, 2009, p. 239).

The most important requirements of the energy transition policy focus on moving towards alternatives to fossil energy, through(Abdel-Razzaq & Haswaoui, 2015, p. 7):

- Encouraging scientific and technological research in the field of renewable energies;
- Financing renewable energy projects with the involvement of the private sector;
- Opening markets for renewable energies products to enable them to compete with traditional energies;
- Concluding international partnership contracts to develop renewable energies...(Abdel-Razzaq & Haswaoui, 2015, p. 7‑8).

1-4 Sustainable development

1-4-1 Definition and characteristics

Sustainable development is the process that works to meet the needs of the present without compromising the capabilities of future generations to meet their needs, in other words, it is the maintenance and sustainability of environmental resources and their management to ensure their continuity for the welfare of subsequent generations(Marten, 2010, p. 9). It has a set of characteristics defined by the United Nations Conference, held in 1992 in Rio de Janeiro, as follows(Mamoud, 2018, p. 12):

- Continuity: in the sense that it is long-term development, permanent, present and future, to meet the needs of generations over the ages;
- Justice: It takes into account the right of subsequent generations to natural resources by calling them not to deplete or pollute these resources and to coordinate policies for their use to achieve integrated development;
- Comprehensiveness: sustainable development is considered comprehensive development and shared responsibility among all sectors of the state to rationalize the exploitation of resources, whether renewable or non-renewable.

1-4-2 Sustaible development dimensions

Sustainable development is based on three basic dimensions represented in the economic dimension, the environmental dimension, and the social dimension, no dimension is less important than the other, because only and an agreement between these dimensions ensures the sustainability of resources for subsequent generations(Baracchini, 2007, p. 3).
The dimensions of sustainable development can be summarized in the following table:

Table (1): the dimensions of sustainable development

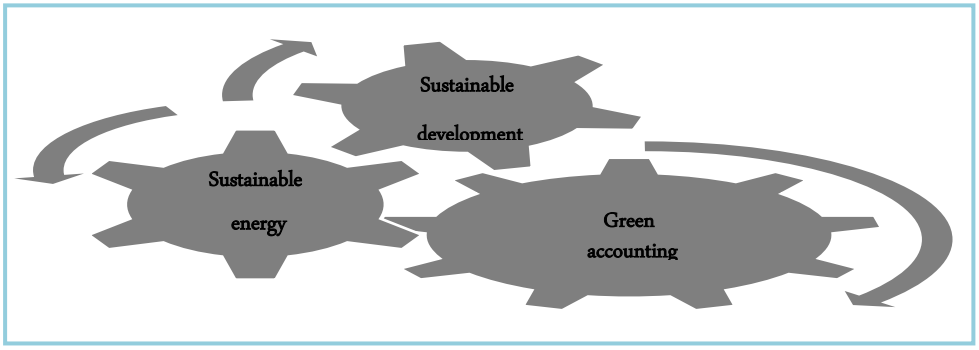
Economic impact	Social impact	Environment impact
• Achieving economic justice • basic needs Satisfaction • Increasing the welfare of the community • Reducing income inequality	• reduce the gap between the North and the South • Cultural diversification • Development of the health and education sectors • Investing in human capital • Reducing unemployment	• Optimum utilization of natural resources •Biodiversity • Ecosystems • Natural resources Protection • water Protection

Source: Prepared by the researchers based on :(Al-Aib, 2011, p. 25; Bourbain, 2018, p. 74)

2- The contribution of green accounting to achieving both energy security and sustainable development:

The relationship between green accounting, energy security, and sustainable development can be illustrated as follows:

Fig (1): The relationship between green accounting, energy security, and sustainable development



Source: prepared by the searchers

2-1 The role of green accounting in the trend towards adopting renewable

In the context of the growing interest in environmental problems, which is one of the dimensions of sustainable development, the philosophy of the green economy was adopted,

from which several branches emerged, the most important of which is green accounting because of the important information it provides in the decision-making process.

Where this type of accounting was concerned with identifying all environmental costs (measurement of environmental damage) and charging the institution the source of pollution by compensating the damages resulting from its activity, which prompted many from establishments to reconsider the way they operate to mitigate environmental damage and thus reduce environmental costs.

In this context, we pose the problem of shale gas, this gas-rich in ethane, preferred in the petrochemical industry, which was considered a lifeline from the economic crisis caused by the deterioration of the oil price. According to the statements of many natural disaster experts, the process of liberating shale gas causes great damage to the environment at the site of the completion of the project, and also leads to the pollution of the underground water with toxic arsenic and radioactive uranium used in the extraction of shale gas, which threatens the safety of the citizen and the homeland and by measuring the extent of the damage caused from exploiting this energy source, he preferred the choice to abandon it in favor of other energies that are less polluting and harmful to the environment, such as solar energy and wind energy as an alternative to depleted energies and as a new source of economic income until the development of techniques for extracting it without compromising the environment, which would contribute to achieving sustainable development.

2-2 The role of renewable energy in achieving sustainable development

The use of renewable energies has a positive impact on improving living conditions in parallel with preserving natural resources from depletion, in line with the goals of sustainable development.

The positive repercussions of using renewable energies on the three dimensions of sustainable development can be summarized as follows:

Table (2): The role of renewable energy in achieving sustainable development

Economic impact	Social impact	Environment impact
• Achieving a permanent source of financing instead of fossil energy, whose price has decreased; • Providing real opportunities for permanent work by investing in renewable energy technologies; • Enabling the countryside to obtain a source of renewable energy, which stimulates economic activity.	• poverty alleviation; • health safety; • Expanding the electricity distribution process • Saving energy, especially in isolated areas, reduces the phenomenon of rural exodus.	• rationalizing the use of environmental resources; • Combating global warming by reducing greenhouse gas emissions; • Maintaining the ability of the ecosystem to digest the waste resulting from energy activities.

Source: Prepared by the researchers based on: (Bensfat & Ziane, 2018, p. 8,9)

The establishment of the Ministry of Environment and Renewable Energies in 2017 embodied the relationship between renewable energies and the environmental dimension, which naturally helps to preserve the latter and thus ensures sustainable development.

3- The reality of the energy transition in Algeria under the renewable energy program:

Algeria has adopted a program for the development of renewable energies, and it revolved around establishing a capacity of about 22,000 MW during the period 2011-2030, 12,000 MW directed to cover the national electricity demand, and the rest is directed to export. The program included five axes:

- Renewable Energy Development Program;
- Energy Efficiency and Energy Economy Development Program;
- Industrial capabilities to be developed to accompany the program;
- Research and development;
- Legal and regulatory framework and motivating procedure

Solar and wind energy have had the lion's share of interest compared to other renewable energies, due to Algeria's potential and qualifications to invest in them.
The energy program's endeavors to produce solar thermal, photovoltaic, and wind energy, to achieve energy security, can be summarized in the following table:

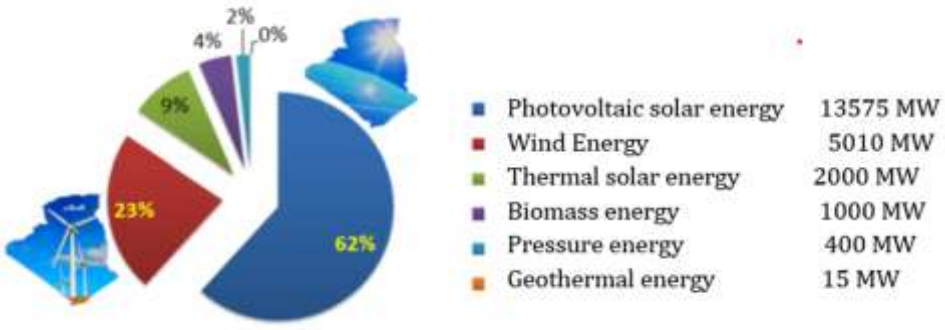
Table (3): Solar thermal, photovoltaic, and wind energy production stages

Energy type	2020-2011		2030-2021	
photovoltaic solar energy	Completing projects worth	800 MW	Completing projects worth	200 MW
Thermal solar energy	2011-2015		2021-2023	
	Completing two projects with storage	150MW for each one	Completing projects worth	500 MW
	Completion of a mixed gas-solar plant project in Hassi R'Mel	150 MW of which 25 MW is from solar energy		
	2016-2020		2024-2030	
	Completion of four stations with storage	1200 MW	Completing projects worth	600 MW
Wind Energy	2011-2013		2016-2030	
	first wind farm establishment in Adrar	10 MW	Completing projects worth	1700 MW
	2014-2015			
	Completion of two wind farms	20MW each		

Source:(Madahi & Guashy, 2018, p. 19)

The following figure shows the forecasts for the production of each renewable energy in the horizons of 2030:

Fig (2): Algerian renewable energy program 22000 MW



Source: (Ardjoun, 2016, p. 2)

3-1 The legal and legislative framework for renewable energies in Algeria

Among the legal texts related to sustainable development are the following:

- Law No. 99-09 of 15 Rabi' al-Thani 1420/28 July 1999 relating to energy control;
- Law No. 02-01 of February 22, 1423/05 February 2002 relating to electricity and the public distribution of gas;
- Executive Decree No. 03-10 of Jumada El Oula 19 1424/19 July 2003 relating to the protection of the environment within the framework of sustainable development;
- Executive project No. 04-149 of Rabi' Al-Awwal 29, 1425/19 May 2004, which specifies the modalities of preparing the national program for energy control;
- Law No. 04-09 of Jumada al-Thani 1425/ 14 August 2004 relating to renewable energies and sustainable development;
- Executive Decree No. 11-33 of Safar 22, 1432/January 27, 2011 establishing the Algerian Institute of Renewable Energies;
- Executive Decree No. 15-69 of Rabi' Al-Thani 21 1436/February 11, 2015, specifying the modalities of proving the certificate of origin of renewable energy;
- Executive Decree No. 17-98 of Jumada Al-Oula 29, 1438/February 26, 2017, specifying the procedures for demand and supply for the production of renewable energies.

3-2 The potential of renewable energy in Algeria

Below we will try to present the reality of some renewable energy resources in Algeria.

3-2-1 Solar energy in Algeria:

Algeria enjoys very important solar radiation due to the vastness of its geographical area and the period of exposure to solar lighting, more than 3000 solar hours annually, and it is the most important in the Mediterranean basin(Ben Arous, 2015).

The following table shows the solar capacity in Algeria:

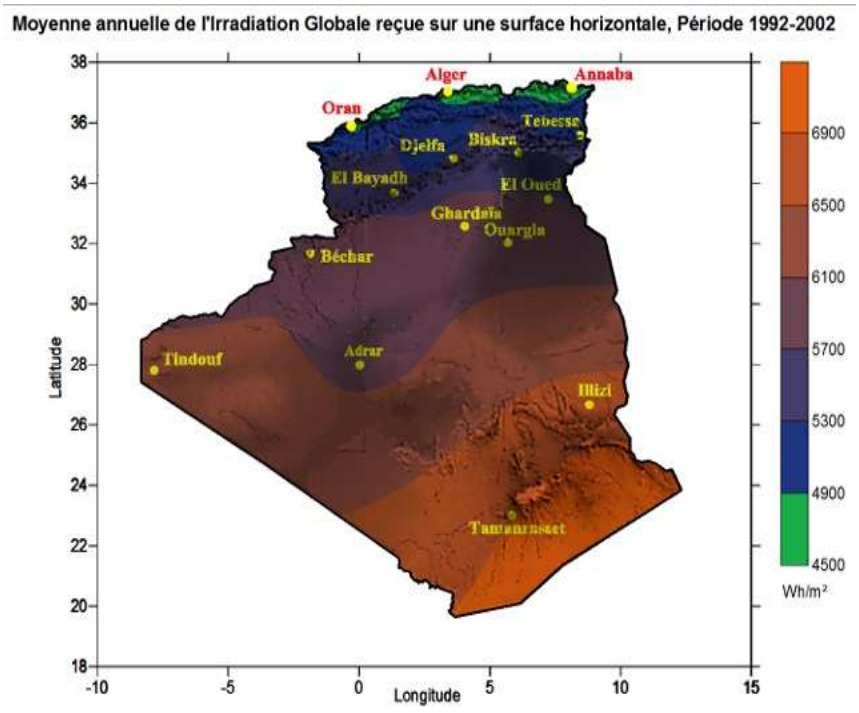
Table (4): Solar Capacity in Algeria

Datas	Coastal area	High plateaus	Sahara
Area (%)	4	10	86
Average Sunshine Hours/Year	2650	3000	3500
The average annual collected energy in kilowatt-hours/m2	1700	1900	2650

Source: (Mansour, 2018, p. 141)

The degrees of solar radiation can also be illustrated in the following figure:

Figure (3): Annual average in degrees of solar radiation in Algeria



Source: (Ghodbane & Boumeddane, 2015, p. 12)

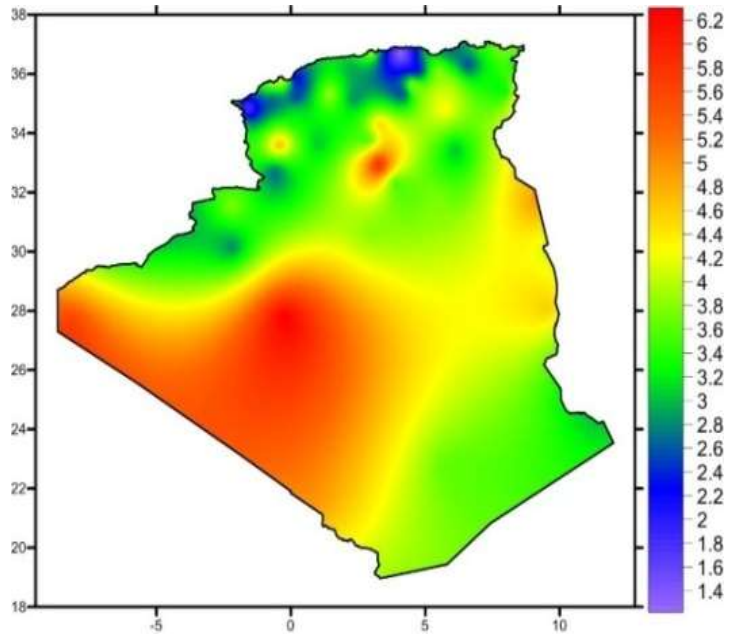
3-2-2 Wind Energy

According to the Renewable Energies Development Center (CDER), wind energy represents the second axis of renewable energies development after solar energy, and as a result of climatic diversity in Algeria, the wind resource changes from one region to another:

- The North region, which is distinguished by a coast extending over 1200 km and a very high rate of wind speed;
- The southern region is also distinguished by the high wind speed that exceeds 6 m/s in the Adrar region.

The average wind speed in Algeria ranges from 2 to 4 m/s, which is suitable energy for pumping water, especially in the high plains. The following figure shows the wind fields in Algeria:

Figure (4): Wind fields map in Algeria



Source: (BOUDIA, 2013, p. 122)

3-2-3 The most important achievements of the energy program in Algeria:

The most important achievements of investment in renewable energies have been crystallized in(Snousi & Saida, 2018):

- The completion of the world's largest solar and gas tower within the framework of the Algerian-German partnership in Tipaza, with a capacity of 7 megawatts;
- Electrification of 18 villages in southern Algeria with solar energy;
- Construction of the first hybrid solar/gas plant in Hassi R'Mel (an Algerian-Spanish partnership) ABENER NEAL, with an estimated capacity of 150 MW;
- The project of renewable energies in the new city of Boughzoul for the realization of a hybrid (solar-air) plant that aims to reach 10% of the national energy program for renewable energy by 2030;
- The Renewable Energies Development Center “CDER”, which operated the first 10-kilowatt voltage lighting station, which was connected to the Sonelgaz distribution network;
- Rouiba factory for the production of solar panels, with an estimated capacity of 120 megawatts per year;
- Batna factory for the production of solar panels "AURES SOLAIRE" with a capacity of 25 megawatts per year;
- Highway lighting project (east-west);
- Completing 10 solar energy plants with a capacity of 10 kilowatts per station.

Conclusion:

Through studies and research related to the subject of green accounting, it is clear that there is a development and interest by private bodies in Algeria, which is evident in the emergence of the concept of environmental control and environmental auditing, as it appears

through the adoption of the standards of the environmental standard ISO 14000 and the commitment to contribute to the global effort to reduce carbon dioxide emissions, which was credited with turning away from polluted energies and replacing them with less harmful ones to the environment.

It was also found that to achieve sustainable development in its three dimensions (environmental, social, and economic), it is necessary to adopt a policy of energy transformation, which would achieve energy security, especially for Arab countries threatened by fluctuation and decline in oil and oil prices.

Algeria enjoys the significant potential of clean energies, which enables it to achieve energy security in the long term. However, the renewable energy sector knows a slow movement in the field of investment, which made production expectations fall from 22,000 megawatts to 12000 and then to 6000 megawatts within the horizons of 2027, i.e. a construction rate of 60 A stations with a capacity of 50 megawatts per station, which is an unattainable rate according to the current circumstances, such as the fiscal deficit imposed by the Sonelgaz Corporation, and to achieve its energy security by:

- ✓ Rationalization of the energy consumption process;
- ✓ Encouraging partnership between the public and private sectors in the field of renewable energies;
- ✓ encouragement of foreign investment;
- ✓ Encouraging scientific research in the energy field.

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