

Energy Transition and Sustainable Development in Algeria: The Challenges of Green Economy

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Abstract: The study examines the energy transition towards a green economy in Algeria, exploring its challenges and opportunities. The analysis is based on in-depth research methods, investigating technical and financial obstacles such as lack of infrastructure and funding. However, Algeria boasts significant solar and wind energy potential, conducive to sustainable growth and job creation. The energy transition mitigates greenhouse gas emissions, preserving the environment and ensuring energy security. The study underscores the need for substantial investments in infrastructure, emphasizing the importance of public-private partnerships and innovative financing mechanisms to overcome budgetary constraints. Strengthening technological capacities and promoting policies conducive to the green economy are crucial for a successful transition in Algeria.

Keywords: Energy transition; green economy; sustainable development.

1. Introduction

Green economy is a concept that encompasses a sustainable and environmentally friendly economic model. It aims to reduce the environmental impact of human activities and promote the efficient use of natural resources while fostering economic growth and social well-being. Thus, transitioning to a green economy offers numerous advantages such as reducing greenhouse gas emissions, preserving ecosystems, creating green jobs, and stimulating technological innovation. Several studies have been conducted to analyze the economic, social, and environmental aspects of the green economy. For example, research conducted by Hsu et al. (Hsu, 2018) has shown that adopting green economy-friendly policies can stimulate economic growth while reducing carbon emissions. This study also highlights the importance of technological innovation in supporting the transition to a green economy. Another study by Fizaine and Court (Fizaine, 2015) examined the impacts of the green economy on employment.

Furthermore, research conducted by UN Environment and the International Labour Organization (Organization, 2018) identified the necessary policies and measures to promote the transition to a green economy. This study emphasizes the importance of an integrated approach that involves collaboration between governments, businesses, and civil society to implement effective and green economy-friendly policies.

Algeria faces a major issue regarding green economy and energy transition. As country rich in oil and gas resources, Algeria heavily relies on these fossil fuels for its economy and

revenues. However, this excessive dependence poses significant challenges on economic, environmental, and social fronts. The need to promote the green economy and achieve an energy transition in Algeria stems from several key issues. Firstly, the intensive use of fossil fuels leads to high greenhouse gas emissions, contributing to climate change and its detrimental consequences. By adopting an approach focused on renewable energies and energy efficiency, Algeria can reduce its carbon footprint and contribute to mitigating the effects of climate change.

Moreover, excessive dependence on non-renewable energy resources makes the Algerian economy vulnerable to fluctuations in global hydrocarbon prices. Diversifying the energy mix by incorporating more renewable energies would reduce this vulnerability and stimulate long-term economic growth. Additionally, the transition to a green economy in Algeria presents opportunities for creating sustainable jobs and promoting technological innovation. By investing in renewable energy sectors, energy efficiency, waste management, and sustainable agriculture, Algeria can generate new employment prospects, enhance economic competitiveness, and improve the social well-being of its population.

1.1. Research problem

The issue of the green economy and energy transition in Algeria is crucial for the country's future. It is essential to implement concrete policies and measures to diversify the energy mix, promote renewable energies, and foster sustainable economic growth. This transition will allow Algeria to reduce its carbon footprint, strengthen its economic resilience, and create a more sustainable future for future generations. Thus, the purpose of this contribution is to address the following issue: What are the challenges and opportunities of the energy transition towards a green economy in Algeria? This issue aims to explore the different dimensions of energy transition and the green economy in Algeria, focusing on the specific challenges the country faces and the opportunities it can seize for a successful transition. To facilitate the understanding of our issue, we have formulated three sub-questions that derive from the central question, namely:

- What is the extent of Algeria's dependence on fossil fuels, and what are the economic, environmental, and social consequences associated with this dependence?
- What are the objectives and government policies regarding energy transition and the green economy in Algeria?
- What opportunities are offered by Algeria's natural resources and geographical conditions to develop renewable energies and promote a green economy?

The objectives of our research stem from the crucial issues related to green economy and energy transition in Algeria. Firstly, we aim to analyze the extent of Algeria's dependence on fossil fuels, evaluating the economic, environmental, and social consequences of this dependence. Next, we delve into the government's objectives and policies regarding energy transition and green economy.

To achieve these objectives, we have formulated three fundamental hypotheses: firstly, we assume that the energy transition towards a green economy in Algeria faces technical and technological challenges, notably the lack of appropriate infrastructure and renewable energy production capacities. Secondly, we consider financial and budgetary constraints as a major challenge for this transition, particularly in terms of financing renewable energy projects and energy efficiency. Thirdly, we firmly believe that the transition to a green economy in Algeria offers significant opportunities for economic development and sectoral diversification, especially in the fields of renewable energies and energy efficiency. Our research aims to shed light on these complex aspects and provide practical solutions to guide Algeria towards a more sustainable and resilient future.

2. The Aspects of green economy

The concept of the green economy has gained significant global attention in recent years, especially during the 2012 United Nations Conference on Sustainable Development. It serves as a tool to address crises and has sparked a surge in published literature by international organizations, governments, think tanks, experts, and NGOs. Governments recognized the green economy as an inclusive approach fostering economic growth, employment, and poverty reduction while preserving ecosystems. The term encompasses sectors (like energy), topics (such as pollution), principles (like the polluter pays principle), and policies (such as economic instruments).

It also denotes strategies like integrating environmental policies into economic structures. Resource efficiency is closely linked, essential for the green economy's transition, requiring balancing ecosystem functions and reducing resource use's environmental impact. Regardless of the approach, the green economy emphasizes integrating economic and environmental policies, promoting economic growth while safeguarding natural assets. This integration involves various measures, from economic instruments like taxes and subsidies to regulatory policies and standards.

2.1. Definition of the green economy

There are several different definitions of the green economy that emphasize different aspects. A more formal definition can be considered as a "system of economic activities related to the production, distribution, and consumption of goods and services that result in long-term improvements in human well-being, without exposing future generations to significant environmental or ecological risks." This implies decoupling resource use and environmental impacts from economic growth and is characterized by a substantial increase in investments in green sectors supported by enabling policy reforms.

The United Nations Environment Programme (United Nations Environment Programme (Programme, 2011) defines the green economy as "an economy that results in improved human well-being and social equity while significantly reducing environmental risks and ecological scarcities." This definition emphasizes the promotion of sustainable development and social justice, an economy that improves human well-being and social equity while significantly reducing environmental risks and ecological scarcities. In practical terms, in a green economy, revenue growth and job creation come from public and private investments that lead to better resource use, reduced carbon emissions, waste and pollution, and the prevention of biodiversity loss and ecosystem degradation.

The European Commission (Commission, A Resource-efficient Europe - Flagship initiative under the Europe 2020 Strategy, 2010) defines the green economy as "an economy that enables economic growth while ensuring sustainable use of resources, environmental protection, and preservation of biodiversity and natural capital." This definition emphasizes the preservation of biodiversity and natural capital. The green economy is based on renewable energy (including hydropower, biofuels, and biomass); energy efficiency; mobility (air quality, emissions, and noise); industry (emissions and waste); innovation; environmental impact assessment and strategic impact assessment; governance (including institutional arrangements and multilateral environmental agreements) and environmental performance reviews; corporate social responsibility (CSR); and mining. The OECD (OECD, Towards a Green Economy., 2011-a) defines the green economy as "an economy that aims to address environmental problems and support sustainable development by using natural resources efficiently and sustainably, reducing environmental impacts, and promoting economic growth." This definition emphasizes resource efficiency and the compatibility between economic growth and environmental protection.

2.2. Objectives and principles of the green economy

The green economy is a concept that aims to integrate the economic, environmental, and social aspects of sustainable development. The objectives and principles of the green economy can vary across countries and organizations.

2.2.1. Objectives of the green economy

The green economy seeks to maintain the balance of natural capital. This means that its objective is to use only resources that the Earth is capable of replenishing. It is therefore about not consuming more than what natural ecosystems can provide. Furthermore, the green economy pursues a goal of social justice by ensuring that natural resources are distributed equitably among different populations and generations. Another objective of the green economy is to promote more responsible modes of production in line with the principles of industrial ecology. In summary, the green economy aims to:

Transition to sustainable growth: The objective of the green economy is to promote economic growth that is compatible with environmental protection and long-term sustainability (Elkington, 1997).

Efficient use of resources: The green economy aims to promote efficient and sustainable use of natural resources by reducing waste, encouraging recycling, and promoting energy efficiency (STAHEL, 2010).

2.2.2. Principles of the green economy

The green economy can be considered a set of principles, objectives, and actions, which generally include (United Nations Environment Programme (Programme, 2011) and (OECD, Towards a Green Economy., 2011-a):

- **Circular economy:** The green economy promotes the adoption of a circular economy model, where resources are used efficiently, waste is minimized, and materials are recycled and reused as much as possible (McDonough, 2002).
- **Renewable energy:** The green economy encourages the use and development of renewable energies such as solar, wind, hydropower, and geothermal energy to reduce greenhouse gas emissions and dependence on fossil fuels (Jacobson, 2010).
- **Environmental and biodiversity protection:** The green economy emphasizes the preservation and restoration of the environment, the protection of ecosystems, and the conservation of biodiversity (Daily, 1997).
- **Social responsibility and sustainable governance:** The green economy encourages the consideration of social and environmental issues in business practices and promotes sustainable and transparent governance (Elkington, 1997).

2.3. Green economy, sustainable development, and food security: what interaction?

The green economy, sustainable development, and food security are closely interconnected and interact in complex ways. The green economy aims to promote sustainable economic growth by reducing negative environmental impacts and encouraging efficient use of natural resources (Programme, 2011). Sustainable development seeks to meet present needs without compromising the ability of future generations to meet their own needs (De Schutter, 2014). Food security concerns the physical, economic, and social access to sufficient, safe, and nutritious food for all (FAO, 2014).

The interaction between these three concepts is crucial for creating a sustainable food system. To achieve this goal, it is essential to implement sustainable agricultural practices, preserve natural resources, and promote resilience to climate change (FAO, 2014). Sustainable agriculture, based on methods such as agroecology, agroforestry, and organic farming, allows for maintaining agricultural productivity while minimizing environmental

impacts (FAO, 2014). Responsible management of natural resources, including water, land, and forests, is essential for preserving biodiversity and maintaining the availability of resources necessary for food production (Programme, 2011). Furthermore, adaptation to climate change is necessary to enhance the resilience of food systems in the face of climate disruptions (FAO, 2014).

Indeed, the green economy and sustainable development are often used interchangeably with a common objective of preserving environmental resources for future generations. Thus, the transition to a green economy is widely recognized as an urgent task to overcome the disconnect between economic goals and environmental concerns. Furthermore, placing the green economy at the center of debates acknowledges the delay of the economy in implementing sustainable development and encourages economic decision-makers to modify their resource usage (Aubertin, 2012).

3. Challenges of energy transition in the green economy in Algeria

In Algeria, energy transition poses significant challenges for developing a green economy. The country, abundant in natural resources like natural gas and solar energy, has the potential for a low-carbon, sustainable economy. Diversifying the energy mix from heavy reliance on hydrocarbons, especially natural gas, is critical, reducing economic vulnerability tied to oil price fluctuations. Transitioning to renewables like solar, wind, and biomass can mitigate this dependence (ONS, 2019). Energy efficiency is pivotal due to rising demand; policies encouraging energy-efficient technologies in residential, industrial, and transportation sectors are essential (DGE, 2015). Creating green jobs in clean energy sectors and sustainable practices is vital, fostering income generation and sustainable economic growth (ONS, 2019). Establishing a robust regulatory framework is crucial, emphasizing policies, incentives, and coordination between public and private sectors to drive investments in renewables (DGE, 2015). According to Professor Chitour, a strategic transition involves embracing solar, wind, geothermal, and unconventional gases, emphasizing training and technological advancements (Chitour, 2021). This aligns with Algeria's National Energy Transition Program of 2020, highlighting the necessity of diversified energy sources for enhanced energy efficiency and development.

3.1. Existing energy deposits

Algeria has vast energy resources, particularly in the field of hydrocarbons. The country is one of the leading producers and exporters of oil and natural gas in Africa. The main energy deposits in Algeria are:

3.1.1. Oil deposits

Algeria has several oil deposits located in different regions of the country. The main oil deposits include the Hassi Messaoud deposit, which is one of the largest and produces a significant amount of crude oil. Other notable deposits include Rourhoud II, Berkine, Tin Fouye Tabankort, and Ourhoud (Algeria).

3.1.2. Natural gas deposits

Algeria is also rich in natural gas, with significant gas deposits distributed across different areas of the country. The main natural gas deposits include the Hassi R'Mel deposit, which is the largest natural gas deposit in Algeria, as well as the Rhourde Nouss, Tiguentourine, and In Salah deposits (National Agency for the Valorization of Hydrocarbon Resources - ALNAFT).

3.1.3. Solar energy deposits

Algeria benefits from abundant sunlight and high solar potential. The country has developed several large-scale solar projects, including the Hassi R'Mel solar complex and the Ghardaïa solar complex. These installations harness solar energy for electricity production. In terms of sunlight, Algeria has an average annual capacity of around 2000 hours, with an

average sunlight of 6.57 kWh/m²/day. It possesses a significant solar deposit with a volume of 37,000 trillion cubic meters, surpassing its natural gas deposit by eight times. (Ministry of Energy and Mines of Algeria).

3.1.4. Wind energy deposits

Algeria also has significant wind energy potential, particularly in coastal and mountainous regions. Wind projects are being developed to harness this renewable resource, such as the Kabertene wind farm in Adrar (Algeria).

3.2. Government action plan and challenges of energy transition

Since 2019, the Algerian government has made energy transition a priority in its action plan to ensure sustainable development of the national economy while ensuring environmental protection. This shift to a green economy, as dictated by the declaration of green growth signed in 2009 by 34 countries, is dependent on energy transition, which represents energy, economic, technological, environmental, and sustainable development challenges (OECD, Towards a Green Economy., 2011-a).

3.2.1. Government action plan

The green economy aims to reconcile energy and environmental issues by protecting the environment while meeting energy needs. Algeria's efforts, crystallized in the five-year plan (2015-2019), make the green economy a pivot for development and technological progress. Renewable energy financing has always been planned in government actions, and a national energy conservation plan was launched for the period 2006-2010.

Through the Ministry of Energy Transition and Renewable Energy, the government is opting for a new national energy model by 2030. According to this model, energy supply and demand management will ensure energy transition by considering constraints and involving all sectors, including housing, industry, transportation, and agriculture. In addition, the transition law depends on this model by setting quantifiable objectives with future choices. The challenges of the transition are identified and announced as follows:

Mitigating climate change and meeting domestic energy demand without resorting to energy imports, whether primary or final; Ensuring energy independence and reducing greenhouse gas emissions by 7 to 22%; Ensuring energy security and moving away from dependence on rent.

Indeed, the major challenge is dependence on hydrocarbons because, in addition to the dominance of a rent-based economy, this non-renewable resource cannot meet the increasing energy demand. In this context, Algeria places energy transition within a comprehensive ecological transition logic to make the energy system more sustainable and provide clean energy for future generations. Thus, all sectors of the economy are involved, particularly the industrial and agricultural sectors, by transitioning from fossil fuels to renewable energy and improving production and consumption systems.

By 2030-2050, the ministry responsible for energy transition to combat climate change (a global trend) and ensure Algeria's energy security sets quantifiable objectives for all relevant sectors and mechanisms that will facilitate the transition to the energy mix through the expected energy transition law. As for climate change, much remains to be done. Efforts to combat desertification, drought, erosion, and other phenomena relevant to the priorities of the green economy remain insufficient. In 2021, Algeria experienced a significant number of forest fires, leading to degradation of the forest ecosystem.

3.2.2. Objectives of energy transition in Algeria

Diversification of the energy mix: Algeria heavily relies on hydrocarbons for its energy consumption. Energy transition aims to diversify the energy mix by integrating more renewable energy sources such as solar, wind, and hydroelectric power. This would reduce dependence on fossil fuels and promote more sustainable use of energy resources (Center for

Renewable Energy Development - CDER).

Increased energy efficiency: Improving energy efficiency is a key aspect of energy transition. Algeria seeks to implement policies and measures to reduce energy consumption per unit of production or use, particularly in the industrial, building, and transportation sectors (National Agency for the Promotion and Rationalization of Energy Use - APRUE).

Infrastructure development: Energy transition requires the development of adequate infrastructure to support the production and distribution of renewable energy. This includes the establishment of solar parks, wind farms, smart grids, and energy storage systems (Ministry of Energy and Mines of Algeria).

Creation of green jobs: Energy transition provides opportunities for job creation in the renewable energy, energy efficiency, waste management, and environmental preservation sectors. Algeria aims to stimulate sustainable employment and foster the emergence of a green economy (Organization, 2018).

3.3. Algerian energy transition strategy

The Algerian energy transition strategy aims to diversify the energy mix, promote renewable energy, improve energy efficiency, and reduce greenhouse gas emissions. Through the diversification of the energy mix, Algeria seeks to reduce its excessive dependence on hydrocarbons by developing renewable energies, including solar, wind, and hydropower. This diversification will ensure sustainable energy supply and reduce greenhouse gas emissions. The strategy for promoting renewable energies emphasizes the development of renewable energy sources. Programs are in place to encourage investment in solar and wind energy projects, including through tenders and financial incentives. The goal is to increase the share of renewable energy in the country's overall energy mix.

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Energy efficiency is a key aspect of energy transition in Algeria. Measures are being taken to promote rational energy use and reduce energy consumption in key sectors such as industry, buildings, and transportation. Policies and incentives are being implemented to encourage the adoption of energy-efficient technologies. Finally, the energy transition strategy aims to reduce greenhouse gas emissions in Algeria. Measures are being taken to improve industrial practices, promote the development of clean transportation, and encourage sustainable lifestyles. This will contribute to mitigating the effects of climate change and improving air quality.

3.3.1. A Renewable mix target for 2030

In anticipation of the tangential decline in export quantities, Algeria plans to produce 27% of clean energy by 2035. The solar energy potential is estimated at 1500 kWh/m²/year in the north and 3500 kWh/m²/year in the south of the country. Additionally, there is significant wind potential in the Adrar region, as already mentioned. Geothermal energy has a potential of around 282 sources, while hydroelectricity has a functional potential of 130 MW and a potential at rest of 160 MW. Regarding biogas energy, household waste is expected to provide 1 billion m³/year. Finally, the objective for wood energy in the energy model by 2030 is 1% with a total capacity of 1,200,000 m³/year, considering that the current production is 117,000 m³/year. Achieving the 2030 energy model will increase the share of renewable energies, mainly solar, in the electricity mix to a rate between 30% and 40% by 2030, thereby reinforcing the country's role as a reliable energy supplier.

A long-term plan for renewable energy and energy efficiency has been adopted with the objective of implementing 22,000 MW, including 27 photovoltaic power plants, 27 hybrid power plants, 6 solar thermal plants, and 7 wind farms. These 22,000 MW will be divided into 12,000 MW to meet national demand and 10,000 MW that could be exported if long-term purchase guarantees and external financing were secured.

A strategy that is difficult to achieve, according to the Minister of Energy himself, considering the chosen deadline and the current rate, which does not exceed 2% of the

national energy mix, as well as the failure of the DESERTEC project. Chems-Eddine Chitour states, "The plan to develop 22,000 MW of renewable energy projected by 2030 is practically impossible to achieve because the construction pace of these plants, the pace of solar implementation, does not allow for a minimum construction of 1,500 MW per year" (CHITOUR, 2016). The realization of this objective also requires commitment not only from the government but also from all sectors of society, who are expected to adhere to and implement the recommended measures in the program.

3.3.2. Implementation of the energy transition program: ongoing actions

The energy model is a key element in the government's efforts to ensure an energy transition. Several programs are being implemented:

- The energy sobriety and efficiency program.
- The national program for the development of renewable energy.
- The national green hydrogen plan.
- The development of a new energy model by 2030.
- Support measures to strengthen energy transition actions.

Launching the energy transition program requires an investment of over \$62 billion (ATTAR, 2018) a significant amount added to the already substantial investment in the oil industry, estimated at \$171 billion by 2030 (APS, 2018). In addition to these colossal amounts, the Algerian government must also finance the more costly economic transition during the same period.

The various recovery plans have not resulted in an average growth rate exceeding 3% and have generated few productive jobs (only 14% in industry). Even over the long period from 1964 to 2011, Algeria's GDP per capita multiplied by only 1.93. Compared to other countries, this growth can be considered relatively modest (Bouyacoub, 2012). This low growth is likely to continue if the factors causing it persist, such as institutional weakness, rent-seeking, the weight of the informal sector, corruption, and the limitations of non-oil growth (APS, 2018).

3.4. Energy transition and ecological transition: what is the relationship?

The energy transition and ecological transition are two closely linked processes in Algeria, sharing common objectives of promoting sustainable development and mitigating negative environmental impacts.

3.4.1. Energy transition as a lever for ecological transition

Energy transition in Algeria plays a crucial role in the country's ecological transition. By diversifying the energy mix and promoting renewable energy sources, it contributes to reducing greenhouse gas emissions and mitigating the effects of climate change. Energy transition also promotes more efficient use of natural resources and reduces dependence on fossil fuels, aligning with goals of environmental preservation and biodiversity protection (Center for the Development of Renewable Energies (CDER)).

3.4.2. Environmental preservation and sustainable development

Energy transition in Algeria is closely linked to environmental preservation and sustainable development. By investing in renewable energies and adopting eco-friendly practices, Algeria can reduce its carbon footprint and minimize negative environmental impacts associated with energy resource exploitation. This promotes the conservation of natural ecosystems, the preservation of water resources, and the protection of biodiversity (Ministry of Environment and Renewable Energies of Algeria).

3.4.3. Integration of ecological issues into energy policies

Energy transition in Algeria is supported by policies and regulations aimed at integrating ecological issues. Algerian authorities are establishing legislative frameworks to promote

renewable energies, encourage energy efficiency, and protect the environment. These policies foster a holistic approach that integrates ecological considerations into the planning and implementation of energy policies (National Agency for the Promotion and Rationalization of Energy Use (APRUE)). Like other countries, Algeria needs green growth to improve the well-being of its population, reduce environmental risks, and ensure sustainable development.

In this context, the installation of solar water heaters in buildings, the use of less polluting fuels such as LPG in transportation, and the transition to a decarbonized industry will facilitate the energy transition and, consequently, promote the ecological transition. In this perspective, the national green hydrogen plan is part of a strategic vision and requires the establishment of a program for electricity production from photovoltaic solar sources. This plan holds strategic importance as it ambitiously aims to accelerate the energy and ecological transition by developing a green hydrogen sector (with technological mastery) to substitute natural gas, and even to use it in various sectors of the economy (Ministry of Energy Transition and Renewable Energy, 2021).

3.4.4. Environmental sustainability indicators in Algeria

Environmental sustainability indicators in Algeria are essential tools for assessing progress in environmental protection and promoting sustainable development. These indicators provide quantitative and qualitative data on various environmental aspects such as air quality, waste management, energy consumption, biodiversity, and natural resource management.

To measure air quality, indicators such as concentrations of air pollutants like sulfur dioxide (SO₂), fine particles (PM_{2.5}), and nitrogen oxides (NO_x) are used. They are evaluated using air quality monitoring stations distributed throughout the country.

Regarding waste management, the key indicator is the recycling rate. This measures the amount of waste recycled relative to the total amount of waste generated. Initiatives such as selective collection and sorting centers are implemented to improve this rate.

Energy consumption is another important indicator of environmental sustainability. The rate of renewable energy utilization is closely monitored. In Algeria, efforts are being made to increase the share of renewable energy in the energy mix, notably through solar and wind projects.

Biodiversity is also considered in environmental sustainability indicators. The number of threatened species and the area of protected areas are measures used to assess biodiversity conservation in Algeria.

Lastly, natural resource management is evaluated through indicators such as water consumption per capita and the efficiency of natural resource use. These indicators aim to promote more sustainable and responsible use of resources in Algeria (Ministry of Water Resources and Environment, Algeria).

These indicators allow for the assessment of performance in environmental sustainability and guide the country's policies and actions towards more sustainable development. It is crucial to continue monitoring these indicators and regularly updating them to ensure that progress in environmental sustainability is sustained in the long term.

4. Conclusion

The energy transition towards a green economy in Algeria presents both significant challenges and opportunities. In terms of challenges, it is essential to overcome technical and technological obstacles, such as the lack of suitable infrastructure and renewable energy production capacity. Additionally, financial and budgetary constraints pose a major challenge for financing renewable energy and energy efficiency projects. However, the energy transition also offers significant opportunities for economic development and sector

diversification.

Algeria has considerable potential in terms of renewable resources, particularly solar and wind energy, which can drive economic growth and create sustainable jobs. Furthermore, the energy transition contributes to reducing greenhouse gas emissions, preserving the environment, and ensuring long-term energy security. To address these challenges and seize these opportunities, it is crucial to strengthen technological capacities, mobilize adequate financing, and adopt ambitious policies in favor of the green economy. The energy transition towards a green economy in Algeria is thus a crucial step to ensure a sustainable and prosperous future. After analyzing the challenges of this transition, we can confirm our initial hypotheses.

The energy transition towards a green economy in Algeria faces technical and technological challenges, such as the lack of suitable infrastructure and renewable energy production capacity. This hypothesis is confirmed as the energy transition requires significant investments in infrastructure and renewable energy production capacity. Algeria must tackle the challenge of developing appropriate facilities and networks to fully harness the potential of renewable energy sources, such as solar and wind energy. This requires strengthening technological capacities and implementing incentives to encourage the adoption of green technologies.

Financial and budgetary constraints pose a major challenge for energy transition in Algeria, particularly in terms of financing renewable energy and energy efficiency projects. This hypothesis is confirmed as the energy transition requires substantial investments. Financial and budgetary constraints can limit Algeria's ability to fully finance renewable energy and energy efficiency projects. However, it is important to note that public-private partnerships, international funds, and innovative financing mechanisms can be mobilized to alleviate these constraints and stimulate investments in the green energy sector.

The transition to a green economy in Algeria offers opportunities for economic development and sector diversification, particularly in the renewable energy and energy efficiency sectors. This hypothesis is validated as the transition to a green economy opens prospects for economic development and sector diversification in Algeria. Exploiting renewable resources and promoting energy efficiency can stimulate economic growth, create new sustainable jobs, and enhance competitiveness. Finally, energy transition and sustainable development in Algeria present significant challenges related to technical, financial, and budgetary aspects. However, they also offer tremendous opportunities for economic development and sector diversification, particularly in the renewable energy and energy efficiency fields. To overcome these challenges and seize these opportunities, it is essential to strengthen technological capacities, mobilize appropriate financing, and adopt ambitious policies in favor of the green economy in Algeria.

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