

## Fostering Renewable Energies Investments as a Driver of Green Growth: case study of Algeria

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### Abstract :

Energy is the engine of economic growth and development, however, environmental damages caused by traditional sources of energy have led the world economies to shift to cleaner and renewable sources of energy, this study aims to review renewable energy investments and explore the strategies and policies to foster renewable energies investments and their role in achieving green growth, for this purpose we used the descriptive and analytical methods. We conclude that renewable energy is one of the most important drivers of green growth and that promoting investments in that field requires their integration in a large, comprehensive, and consistent policy in order to attract investors.

### Mots clés:

Mot clé.1: énergie-renouvelable

Mot clé.2: croissance-verte

Mot clé.3: investissement

Mot clé.4: Algérie

Codes de classification JEL: Q42, Q56.

### Résumé :

L'énergie est le moteur de la croissance économique et du développement, cependant, les dommages environnementaux causés par les sources d'énergie traditionnelles ont conduit les économies mondiales à passer à des sources d'énergie plus propres et renouvelables, cette étude vise à examiner les investissements dans les énergies renouvelables et à explorer les stratégies et politiques pour favoriser les investissements dans ce secteur, et leur rôle dans la croissance verte, pour cela nous avons utilisé les méthodes descriptives et analytiques. Nous concluons que les énergies renouvelables sont l'un des moteurs les plus importants de la croissance verte et que la promotion des investissements dans ce domaine nécessite leur intégration dans une politique large, globale et cohérente afin d'attirer les investisseurs.

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## **1- The introduction :**

In many parts of the planet, fossil fuels continue to have harmful consequences. High levels of air, water, and soil pollution, as well as a reliance on imported fuels, are among them. Air pollution currently causes 7 million premature deaths per year. The world has 840 million people who do not have access to electricity and 2.6 billion who do not have access to clean cooking fuels (IRENA, 2020).

Green growth has become a dominant policy response to climate change and environmental degradation. According to green growth theory, continued economic development is consistent with the climate of our planet because technological progress and replacement would enable us to fully decouple GDP growth from resource use and carbon emissions.

Energy drives human progress, it is inextricably connected to humanity's history and development. The connection between energy access and growth is well-known today; however, for billions of poor people, lack of access to energy has a profound effect on their ability to bridge the development divide. The relevance of energy in the global scenario has constantly risen and the interconnections with the environment and the society have become increasingly evident. Renewable energy production has gained momentum in the global energy market in recent years, and it is rapidly being hailed as the "power of the future." Because of the environmental damages caused by traditional energy sources. In this article we attempt to explore the problematic of fostering renewable energies investments by addressing the following research question : *How to foster the investments in renewable energies in order to achieve green growth ?*

## **2- Theoretical framework of renewable energies and green growth :**

As a response to the preoccupying environmental damages resulting from the irrepressible race for economic growth, the notion of green growth has emerged as a central theme at the Rio+ 20 Conference on Sustainable Development in 2012. It is based on the assumption that absolute decoupling of GDP growth from resource use and carbon emissions is possible (Hickel & Kallis, 2020). Subsequently renewable energies and energy efficiency development appear as one of the most important challenges for realizing green growth by the transition from polluting sources of energy toward clean and renewable energy.

### **2.1- Renewable energy definition :**

There are many definitions for renewable energy, the international energy agency IEA defines renewable energy as : "energy from sources that are naturally replenishing but flow-limited; renewable resources are

virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time.” (Coburn & Farhar, 2004)

“Renewable energy can be defined as energy flows which are continuously replenished by natural processes. This is in distinction to fossil and nuclear fuels and oil, which consist of energy stocks, of which only finite quantities are available, rather than flows.” (Hersh, 2006)

“Renewable energy is energy that is derived from a supply that is constantly and naturally replenished over a relatively short time. Hence, any discussion of renewable energy is ultimately reduced to a discussion of renewable resources as they are derived from geophysical processes: sunlight, wind, falling water, sustainable biomass, wave motion, tides, and geothermic.” (*Renewable Energy - an Overview | ScienceDirect Topics*, n.d.)

To sum up, renewable is the energy that is produced from sources that are naturally and regularly replenished.

## **2.2- Sources of renewable energy :**

Renewable energy can be derived from numerous sources, namely:

- Solar energy: Solar energy systems use radiation from the sun to produce heat and electricity. There are two main methods by which solar energy may be used to generate electricity: photovoltaic solar power and concentrated solar thermal power. (Crossley, 2019)
- Biomass energy : Biomass energy is produced from non-fossilized plant materials. Wood and wood waste are the largest sources of biomass energy in the United States, followed by biofuels and municipal solid waste. (*Renewable Energy Explained - Types and Usage - U.S. Energy Information Administration (EIA)*, n.d.) any plant matter used directly as fuel or converted into other forms before combustion. Included are wood, vegetal waste (Crossley, 2019)
- Wind energy : Wind energy is the second fastest growing form of renewable energy and onshore wind is one of the most cost-competitive renewable energy technologies (Crossley, 2019) The wind turbines use blades to collect the wind's kinetic energy and transform it to electricity. The blades are connected to a drive shaft that turns an electric generator, which produces electricity.
- Hydropower : Hydropower is electricity produced from flowing water. There are two general types of hydropower : (1) Conventional hydropower that uses water in dams or flowing in streams and rivers to spin a turbine and generate electricity, and (2) Pumped storage systems use and generate electricity by moving water between two

reservoirs at different elevations (*Renewable Energy Explained - Types and Usage - U.S. Energy Information Administration (EIA)*, n.d.)

- Geothermal energy : Geothermal energy is heat that comes from the earth's hot interior or near the surface. The near constant temperature of the earth near the earth's surface is used in geothermal heat pumps for heating and cooling buildings. (*Renewable Energy Explained - Types and Usage - U.S. Energy Information Administration (EIA)*, n.d.)

With continuous scientific and technological advancements in wind, solar, and other renewable energy production and utilization, Europe, Asia Pacific and North America have become the three major producing regions of new energy (Zou et al., 2016).

### **2.3- Green growth definition :**

The World Bank defines green growth as : “economic growth that is efficient in its use of natural resources, clean in that it minimizes pollution and environmental impacts, and resilient in that it accounts for natural hazards and the role of environmental management and natural capital in preventing physical disasters.” (Hickel & Kallis, 2020).

The United Nations Environment Program “UNEP” that is responsible for coordinating responses to environmental issues within the United Nations system provides the following description to the concept of green growth : “it is a key concept for framing the challenges we face in making the transition to a more resource efficient economy is decoupling. As global economic growth bumps into planetary boundaries, decoupling the creation of economic value from natural resource use and environmental impacts becomes more urgent”(Hickel & Kallis, 2020).

In several ways, renewable energy production is one of the most crucial drivers of green growth. Empirical studies show that environmental-related technologies positively contribute to green growth. The findings also confirm that renewable energy promotes green growth, but non-renewable energy is detrimental to green growth. (Danish & Ulucak, 2020).

## **3- Green energies’ investments in the world :**

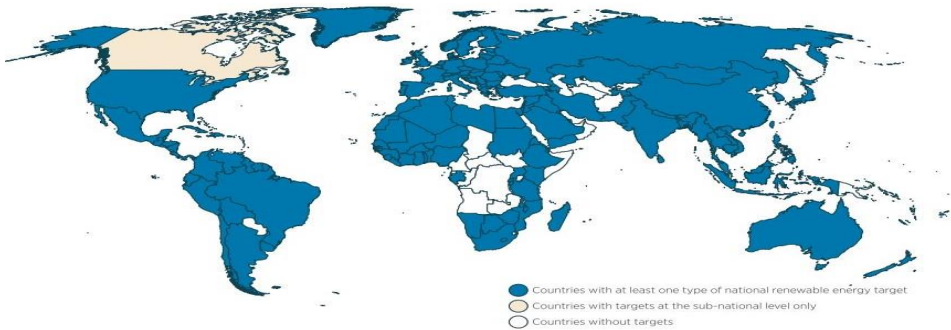
### **3.1- World renewable energy targets :**

Regarding climate change mitigation, COP 21 conference of the parties was one of the most important steps as it was the first time since 1948 (UN declaration of human rights) that nearly all countries agree on a common declaration , the fact that it has allowed countries to determine their own contribution by proposing their own plan to reduce GHG emissions was determinant to obtain that wide agreement. (Balibar, 2017). And one of its most important goals is keeping global temperature rises below 2 degrees

Celsius above pre-industrial levels, and pursuing attempts to keep temperature rises to 1.5 degrees Celsius above pre-industrial levels.(United Nations, 2015)

In the decade leading up to 2030, governments and businesses around the world have committed to installing 826 gigawatts of new non-hydro renewable power capacity, at a likely cost of around \$1 trillion. Nevertheless, those commitments fall far short of what would be needed to limit world temperature increases to less than 2 degrees Celsius. They also seem modest as compared to the \$2.7 trillion spent from 2010 to 2019, according to the Global Trends survey. (UNEP, 2020)

Figure N<sup>o</sup>1 : Global map of national renewable energy targets of all types, 2015

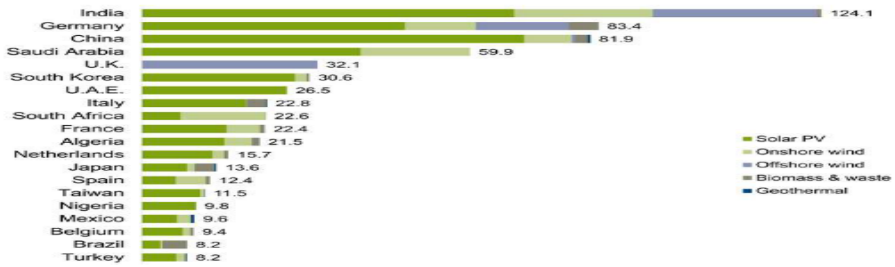


Source: (IRENA, 2015)

Renewable energy goals have taken many different forms since their inception in the 1970s. In the majority of cases, renewable energy targets are not accompanied by a binding obligation. They often are either embedded within sectoral plans, such as Integrated Resource Plans or energy sector master plans (e.g. South Africa, Brazil), or in National Renewable Energy Action Plans (e.g. in the European Union and now in the Economic Community of West African States region), or they are part of national development plans (e.g. China, India). As a result of this considerable diversity in target types, it can be difficult to define precisely what constitutes a renewable energy target.(IRENA, 2015).

However targets setting is critical because they send an important signal to stakeholders. As they have spread around the world, renewable energy targets have played a significant role in informing investment decisions. When backed by supportive policy and investment frameworks, they can provide long-term visibility to industry, a critical ingredient in stimulating deployment at scale. Renewable energy targets contribute to developing a clearer vision for the development of the sector and enable stakeholders to allocate resources more effectively. (IRENA, 2015)

Figure N<sup>0</sup> 2 : renewable power additions required to meet government targets with deadlines between 2020 and 2030



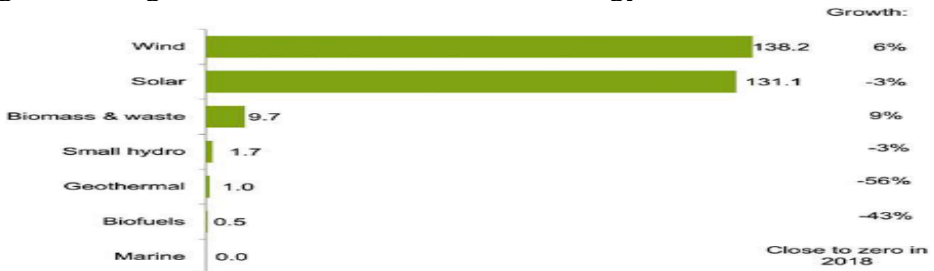
Source: (UNEP, 2020)

Governments have set higher goals for solar than for any other non-hydro renewable energy technology. This reflects the fact that three countries (China, India and Germany) would need to build a further 70GW, 68GW and 48GW respectively by 2030 or earlier, in order to meet their ambitious solar targets. While the U.K., India and Germany would need to build 32GW, 30GW and 17GW respectively, to meet their offshore wind targets (UNEP, 2020)

These low-carbon power generation goals come from a total of 87 governments, covering both high-income countries and emerging economies that were early adopters of green energy 10-20 years ago. Some of the above are long-time supporters of renewable energy (UNEP, 2020).

**3.2- Global investment in renewable energy status :**

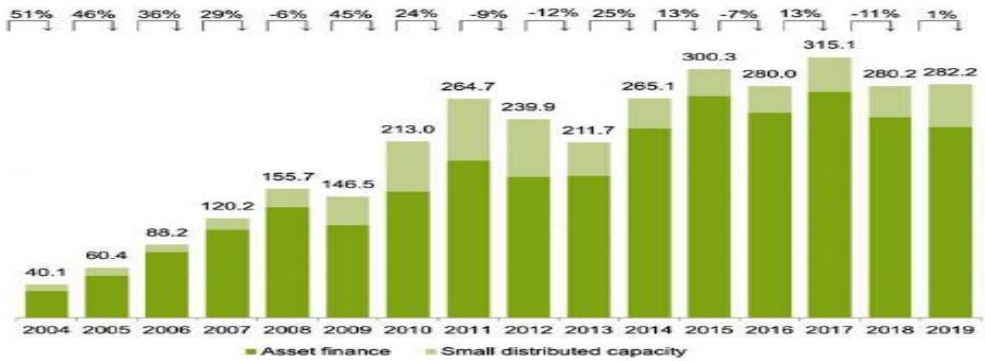
Figure N<sup>0</sup> 3 : global investment in renewable energy



Source : (UNEP, 2020)

The figure 9 shows that the wind and solar energy investments outpace largely other sources, two of the key reasons for that are the further rise in activity in offshore wind, both off the coasts of Europe and in the sea off mainland China and Taiwan. And the downward trend in costs per megawatt for solar photovoltaics. In fact the levelized cost of electricity of PV has known the most important decrease of 83% from 2009 to 2019. although those costs vary depending on countries resources and local policies and labour and finance costs (UNEP, 2020)

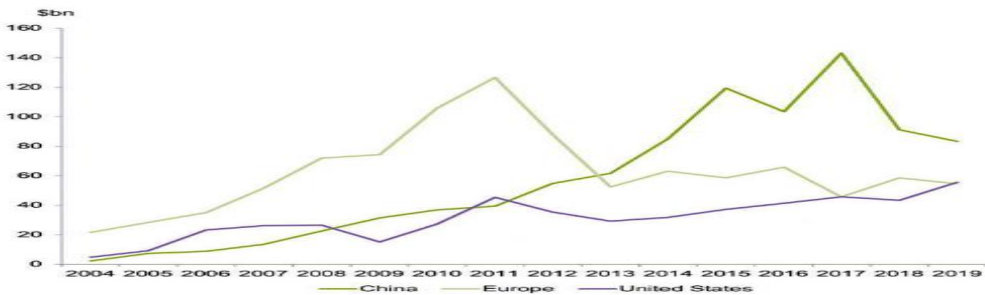
Figure N<sup>o</sup> 4 : global renewable energy capacity investment 2004-2019.  
Source : (UNEP, 2020)



The figure shows that global renewable capacity investment is knowing a relatively steady growth, but the level of additional investments needed to set the world on a more climate-friendly path above current plans and policies is USD 15 trillion by 2050 –a sizable amount, but one that has fallen by more than 40% since the previous study, thanks to rapidly dropping renewable energy prices and opportunities to electrify transportation and other end-uses. Overall, energy system expenditure will need to hit USD 110 trillion by 2050, or roughly 2% of average annual gross domestic product (GDP) over that time span. (International Renewable Energy Agency, 2019)

The world invested \$282.2 billion in new renewable energy capacity (excluding large hydro) in 2019. This was a mere 1% higher than the total for the previous year, and it was 10% below the record figure of \$315.1 billion set in 2017.(UNEP, 2020)

Figure N<sup>o</sup> 5 : renewable energy capacity investment in the US, Europe and China.

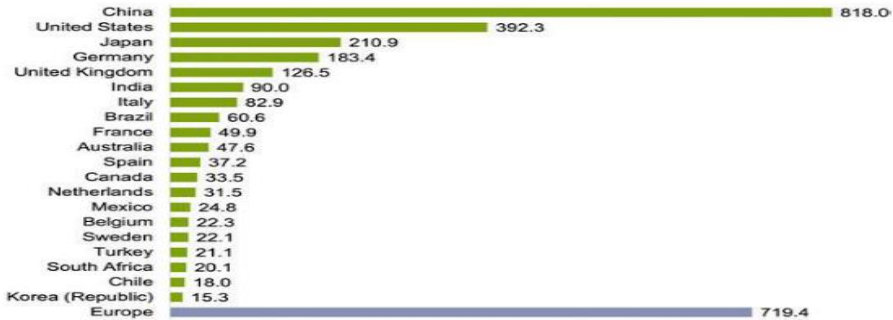


Source : (UNEP, 2020)

Developed economies were the first to embrace renewable energy technologies like wind, solar, and biomass, but once prices dropped close to parity with fossil fuel substitutes, emerging economies took up the baton..

They have usually been looking expand capacity generation to meet rising electricity demand, while for many developed countries it has been more about replacing existing coal, gas or nuclear generation(UNEP, 2020)

**Figure N<sup>o</sup> 6** : renewable energy capacity investment 2010-2019, top 20 markets.



Source : (UNEP, 2020)

The figure shows that china the US and Japan –the most criticized countries for not making enough efforts to decarbonize their economies, are paradoxically the ones that invested the most in RE capacity from 2010 to 2019 (UNEP, 2020).

China is ahead of investments in renewable energy capacity, as it is promoting renewable energy through different incentive policies, such as the subsidy to feed-in tariffs of renewable energies, the tax deduction for both renewable energy generators and users, as well as the priority natural resource supply for renewable energy infrastructure installation, have been designed to promote clean energy production and stimulate the demand for clean energy suppliers to have more opportunities. (Sun et al., 2020)

The EU is always a leader in promoting renewable energy globally. Each EU country is in charge of promoting and managing its own renewable energy sources, and energy mix activities. The EU launched the 2020 Climate and Energy Package that aimed to initiated a 20% increase in energy generated from RES, a 20% cut of greenhouse gas (GHG) emission, and a 20% increase in energy efficiency Paving the path of the 2030 Agenda for Sustainable Development, (Ilham et al., 2019) The United Kingdom plans to run 50% of clean energy by 2030 to realize the target of zero-emission at the end of 2050 through a cost-effective path (Sun et al., 2020)

The US government is responsible for formulating energy policy that benefits all multilayered stakeholders, both at the federal and state levels. Its appointed government and autonomous agencies, such as the Department of Energy, Energy Information Administration (EIA), Environmental Protection Agency, and US Geological Survey, are recognized as a



noteworthy country in RE investment and installed power (Ilham et al., 2019)

Many technological and economic factors affect the selection of a suitable energy policy, including geographic location, meteorological conditions, overall capital cost of energy system, and end-use applications (Liu, 2017). Ultimately, The policies introduced, the pace at which they are implemented, and the amount of money invested will all play a role in mitigating the climate threat. Anything less would hinder the transformative decarbonization of societies.(IRENA, 2020)

Renewable energy sources face significant entry barriers, which are mostly caused by market failures. Such as : initial investment; inelastic demand; restrictive practices; and Research & Development. enhancing the economic rationale of using renewables. Policymakers should promote measures on the demand side (Afonso et al., 2017).

In the case of developing countries, the most significant impediment to further renewable energy growth is the private sector's inability to invest due to high costs and delayed capital returns. In this report, it was proposed that government assistance and assured purchases of produced electricity could help to alleviate the problems to some degree (Balakrishnan et al., 2020)

Whereas for Gulf Countries “GCC” The largest and most significant impediment to the widespread adoption of renewable energy is the government's high subsidies for electricity and fuel prices. However, financial market deterioration in 2008 and its effects, which resulted in the Arab Spring events and were felt regionally and internationally. Each of these factors has drew the attention of decision-makers to renewable energy. (S. Al-Maamary et al., 2017)

#### **4- Renewable energy investments : case of Algeria**

The study of Singh and al (2016) proved that renewable energy production is associated with a positive and statistically significant impact on economic growth in both developed and developing countries. Moreover, it has also shown that the impact of renewable energy production has a greater effect on economic growth in developing economies than in developed economies (Singh et al., 2019).

The pollution of the environment in Algeria has a negative impact on GDP and growth as it costed 5.8% of GDP between 2001 and 2011, and 4.2% of GDP between 2014 and 2021. The losses of GDP related to the deterioration of the air quality have been estimated to 0.863% between 2013 and 2014. The air quality impacts negatively GDP through health damages, wealth and quality of life decline and agricultural productivity damages. While the losses due to poor energy management and resource use inefficiency are estimated to 0.3% of GDP (2021, حبيلي). Therefore,

developing renewable energies is necessary to foster growth in a green and sustainable way.

#### 4.1- Algeria's renewable energy potential :

Algeria has numerous advantages for renewable energy systems utilization due to its suitable climatic conditions and its geographical location. Solar energy being the most advantageous source as its received average energy is estimated at 6250kWh/m<sup>2</sup>/year with a Solar daily energy density of 7.26 kWh/m<sup>2</sup> in Sahara, 5.21 in high plains and 4.66 in coastal area (Bouraiou et al., 2020), and 3000 hours of sunshine duration per year in the Sahara which is the highest level of sunshine duration in the world (بختي & بهياني, 2018).

On the other hand, wind energy is characterized by large variability, 78% of Algeria's surface is characterized by velocities higher than 3 m/s with about 40% of these speeds exceeding 5 m/s. but there variations from one place to another important. Wind energy is more favorable in the south (Bouraiou et al., 2020).

In the case of hydropower, the total installed power estimated capacity is 270 MW, low benefit due to the lack of exploitation, (Bouraiou et al., 2020) water capacity is estimated at lower than 25billion m<sup>3</sup> (عكريف et al., 2021).

geochemical and geophysical data has made possible the identification of more than two hundred sites for Geothermal energy, represented by hot springs that have been inventoried in the northern part of the country. About one-third of them have temperatures above 45°C (Bouraiou et al., 2020).

With a rate of 3.7 MTOE coming from trees and 1.33 MTOE per year through agricultural and urban wastes, biomass, on the other hand, is a very promising source of energy for Algeria (Bouraiou et al., 2020).

#### 4.2- Renewable energy investments in Algeria :

The Algerian government implemented a renewable energy and efficiency growth policy in 2011 and updated it in 2015. These energy sectors will be the engines of long-term economic growth, propelling a new economic growth paradigm. (Bouraiou et al., 2020)

The following are the most relevant clean energy laws and regulations: (محمود & محمد عيسى, 2017)

Law No. 99-09, 28<sup>th</sup> July, 1999, pertaining to energy control : It aims to define the conditions for the national policy for energy control and the means for its implementation and development, as well as the rationalization of energy consumption and the development of renewable energies

Law No. 02-01, 5<sup>th</sup> February, 2002, pertaining to electricity and public distribution of gas, providing for open competition in electricity production.

Law No. 04-09, 14<sup>th</sup> August, 2004, pertaining to promotion of renewable energies in the context of sustainable development.

Regarding the financing of renewable energies projects, many procedures have been set to promote its production and development and to encourage the investment in all its branches : (محمود & محمد عيسى, 2017)

- The foundation of a national fund for renewable energies according to the 2010 Financial law that is funded by 1% of the oil revenues in order to finance Res projects.
- Financial, fiscal and customs incentives, investment freedom and legal protection against nationalization for renewable energy projects, provided by the order 01-03, 20<sup>th</sup> august 2003.
- Reducing customs rights and the value added tax for the importation of raw material and components semi-finished products related to renewable energy production.

In addition, several organizations and institutions have been founded to foster the deployment, development strategies and policies for the renewable energy, as to name : the national center for the development of renewable energies CDER, the renewable energy research unity in Saharan region URERMS, the research unity in renewable energies URAER, the unity for development of solar equipment UDES, the Silicium technologies development unity UDTS, the research in renewable energy equipment unity of the university of Tlemcen URMER.(موساوي & موساوي, 2015)

Many renewable energy projects have been realized, or are currently in realization, to list a few :(موساوي & موساوي, 2015)

- The solar field of 169440Twh per year.
- Establishing a joint company between Sonatrach, Sonelgaz, and Sim group related to Neo-energy Algeria “NEAL” the development of renewable energy industry in Algeria.
- The cooperation between an Algerian and a Spanish society for the realization in 2011 of a hybrid electricity production from natural gas and solar energy in Hassi Rmel.
- In addition, many cooperation with foreign countries especially European, have been established about the promotion of renewable energies and the protection of the environment.
- Sonelgaz provided 1000 families from southern Algerian villages with solar electricity by providing them with the appropriate equipment.
- Two wind farms in Adrar and Khenchla, of a capacity of 30megawatt respectively in 2013 and 2014(بختي & بهياني, 2018)
- One of the most promising renewable energy projects in cooperation with Germany namely Desertec has been suspended because of a disagreement between the two parts.

- Factory of photovoltaic plates that was supposed to start working in 2011 has also been suspended because of numerous obstacles despite the high financial and efforts deployed for its achievement. It was supposed to create 200 thousand jobs.

#### **4.3- The obstacles and barriers that constrain renewable energy capacity investments in Algeria:**

One of the reasons that make investors avoid renewable energies is the high investment costs for renewable energies projects and the inefficient financing mechanisms (2015, موساوي & موساوي). The private banking sector is severely constrained by current regulations and framework, Algerian businesses could were not able to obtain loans outside of the country until 2015. In addition the law 51-49% severely constrains Foreign Direct Investments; this differentiated treatment of Foreign Direct Investment (FDI) constitutes with the exchange control system and the character non-exportable Algerian dinar a significant barrier to attract foreign investors. High cost of borrowing (loans and equity) and capital (loans) and lack of access to capital and financial institutions, and the lack of diversity of incentive mechanisms and support for the promotion of renewable energy investment (Bouraiou et al., 2020) are all important barriers to renewable energies investments, especially considering the importance of FDI in economic growth as an increase in the inflow of FDI has a positive effect on economic growth in Algeria, in fact FDI has a positive impact both on GDP and Export (Ilyes & Abdellah, 2020).

Besides, from an institutional, political and legal perspective, the absence of a stable and effective trajectory of Renewable energy policies, lack of regulation and incentives or missing application, absence (or insufficiency) of rights reduction mechanisms customs of VAT on the import of renewable energy components and equipment (Bouraiou et al., 2020) represent important constrains to REs development.

Regarding capacitation, knowledge and renewable energy education, there is a weak support infrastructures for Renewable energy technologies and an insufficient university-level training and education in renewable energy practitioners to meet the demands of the national renewable energy program in the renewable energy sector, in addition the number of experts in the field of renewable energy is limited, and that is due to the fact that the study of renewable energy is focused only in the post-graduate Master program and PhD thesis and there is a weak coordination between universities, research centers and industrial sector. (Bouraiou et al., 2020)

Renewable energy goals' feasibility is determined not only by their design but also by how well they are integrated into the larger policy context. Effective goals include political engagement, support from key stakeholders,

and institutional capability. (IRENA, 2015) Feed-in tariffs (which entails offering small-scale energy producers, such as solar or wind energy, a higher-than-market price for what they supply to the grid.) tend to be the most effective policy mechanism in promoting renewable capacity at affordable rates, incorporating investment-based, operational support, and consumer-facing policies in a multi-faceted approach to renewable promotion. (Sarti, 2018)

Demand-pull policies have been also highly effective compared to other form of policy interference in promoting innovation in renewable energy technologies, and policies designed to address only one technology are often more effective than multi-technology policies in fostering innovation (Pitelis et al., 2020).

### **5- Conclusion:**

The transition to sustainable energy systems is one of our global economy's most pressing problems, as well as an opportunity to reconsider our energy structures based on finite resources and centralized systems. Within this challenge, renewable energies play a critical role.

Although the renewable energy sector has known an extensive growth during the last decade and it is expected to grow even more, and despite the progress made in the last decades, barriers still exist to promote sustainable energy solutions; actions are needed in all the areas ranging from technology development to policies and regulations, from improved business models to governance structures. And setting effective strategies to foster investment in renewable energies remains an important challenge to many countries.

The study concluded the following:

- Renewable energy is one of the most important drivers of green growth, and non-renewable ones appear to have a detrimental effect on it.
- Most countries have set renewable energy targets and integrated its implementation into their national strategies after the COP 21. But the most relevant cases of renewable energy integration are China, some European countries, and USA.
- Renewable energy still face important entry barriers caused mainly by market failures.
- The selection of a suitable energy policy depends on many technological and economic factors to cite a few ; geographical location, meteorological conditions, the overall capital cost of energy systems.

- Algeria clearly possesses a promising potential in terms of renewable energy sources, but the implementation national renewable energy program 2030 still faces some barriers;
- Renewable energy program feasibility relies on its integration into a larger comprehensive and consistent policy, comprising the financial system, the education and demand pull policies to promote innovation in renewable energy technologies.

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