Renewable Energies and Sustainable Development

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Abstract
Renewable energies are at the heart of global energy transition strategies aimed at reducing greenhouse gas emissions and promoting sustainable development. This literature review explores the main aspects of renewables energies provide a solid basis for future developments in this crucial area.

Keywords: Energy transition, Global warming, Renewable energy, Economic growth.

Introduction

Since the Kyoto Protocol, the energy issue has become an integral part of all economic and political debates. Following the oil crises (1973, 1979), the energy issue has become a pressing one in both developed and developing countries. After years of strong growth known as the "thirty glorious years", developed economies were faced with a rise in the price of crude oil, the main source of fossil fuels. Economic growth thus came up against a shortage of raw materials, as evoked by the Meadows Report of the Club of Rome experts as early as 1972.

Some economists opposed this fatalistic vision of limited growth. Solow (1974) emphasized technical progress and the substitution of production factors. If oil is expensive, the industrialist will be led to substitute it with a less costly factor of production. And thanks to innovation, the technical combination of factors of production will not have to suffer from the scarcity of raw materials. Despite a few dissenting voices (Georgescu-Roegen, 1971, 1976; René Passet, 1979). Following the work of Hotelling (1931), the debate focused on the relationship between the cost of extraction and the depletion of the deposit. Market structure (competition, monopoly, oligopoly) thus has consequences for natural resource prices and the life of the deposit (Diemer, 1999). Environmental economics introduces the notion of externality to internalize the external effects (pollution, waste, etc.) of firms' industrial activity via a pigouvian tax or pollution rights markets.

Indeed, global warming due to greenhouse gas emissions and energy dependency are one of humanity's most topical issues. The international and local press is constantly talking about it; energy, a fundamental pillar of economic, political and social development, remains one of the main challenges facing them as the planet changes. Renewable energies have also entered a virtuous circle of technological progress and cost reduction, making them increasingly competitive with fossil fuels, which partly explains this renewed interest. This augurs well for major development potential in the years to come.

Reports from the African Development Bank (2015), point to a very high potential for energy sources (fossil and renewable) in Africa. Indeed, fossil fuels account for 10% of oil reserves, 7.9% of gas reserves and 4% of coal reserves (Favennec, 2015). Yet the ratio of energy consumption to this potential remains very low (20%) of overall world production. Renewable energies, meanwhile, account for around 3.2% of overall energy consumption in Africa (AFDB, 2015). Moreover, this consumption is poorly distributed between North and South. On the other hand, most of this consumption is made up of electricity generated from hydropower. These include solar thermal or photovoltaic energy (with sunshine levels of between 1,500 and 1,900 kWh/m2), wind power (29% of global resources), biomass or agrofuels (first- and second-generation), hydropower (a potential of 400,000 Gwh, of which less than 2% is exploited) and geothermal energy (a potential of 9,000 MW, of which only 13% is exploited in the Rift Valley), which could be adapted to supply national and regional grids to make up for the continent's energy deficits. This low level of consumption is limited by the level of investment. According to the Agence de l'Environnement et de la Maitrise de l'Energie(AEME) shows that in 2012, 70% of people in sub-Saharan Africa had new access to electricity via renewable energies (hydropower, geothermal and solar photovoltaic), thanks in particular to the extension of existing networks (IEA, 2017).

In September 2015, the United Nations adopted 17 Sustainable Development Goals. Among these goals is a mobilizing one, ranked 13ème which states: **"take urgent action to combat climate change and its impacts".** In this feverish context, green energies have a place of choice, because of their operating characteristics (low installation costs, less pollution), they raise hopes of reconciling technological progress and human development. This hope is particularly important in the world's energy-poor regions. Goal 7 of the Millennium Development Goals (MDGs), "**Ensure access to reliable, sustainable and affordable energy services for all",** could be met by the use of abusive natural resources. According to these goals, renewable energies will contribute to improving social life, education, economic growth through poverty reduction, strengthening the agricultural sector that can enable food security (Schwerhoff and Sy, 2017) and environmental protection. These green energies are an endowment of nature with a more accessible and sustainable capacity providing economic, social, environmentally balanced development.

When it comes to access, Africa's regions show marked disparities. In North Africa, the electrification rate is close to 100%, while Sub-Saharan African countries barely reach 15%, in Rural Areas (AFDB, 2015). This low energy consumption may be the cause or consequence of low economic development in Sub-Saharan Africa. Indeed, some individuals in these regions still live on less than 1.5 Dollars a day despite the increase in the average level of growth (4; 5% of GDP). This is why lifting Sub-Saharan Africa out of energy poverty is seen as an overriding goal by 2050 (Favenec, 2015).

In its 2017 report, the International Renewable Energy Agency (Irena), which has more than 145 member states, explains that the "rapid" decline in renewable energy production costs between 2010 and 2017 is linked to several factors. These include: improved manufacturing processes; continuous technological innovation; increasingly competitive supply chains; greater competition between product suppliers; and increasingly experienced international project developers competing. Irena also cites the existence of a favorable regulatory and institutional framework, strong local engineering, incentive tax regimes, low project development costs and excellent resources. All these factors have helped to level out the Levelised cost of electricity (LCOE) of renewable energy projects around the world. Irena has also published its Renewable Power Generation Costs in 2017 report, to raise awareness of the "true cost of renewable energy". The data presented in the report is drawn from Irena's Renewable Cost Database, which contains details of nearly 15,000 power generation projects worldwide.

It's a fact that Africa faces a contrasting reality. On the one hand, the continent holds significant reserves of energy resources, both of fossil and renewable origin, but on the other, it faces numerous energy challenges. Although abundant, these resources are unevenly distributed, under-exploited, exported in raw form, or wasted during extraction or transport. As a result, the supply available to populations remains insufficient, in a continent characterized by high economic and demographic growth, which will only accentuate its energy demand.

What's more, Africa has the lowest electrification rate among developing countries. It was estimated at 52% in 2016, compared with 89% for developing countries in Asia and 97% for Central and South America. Although positive developments have been made - indeed 26 million Africans have gained access to electricity every year since 2012, progress remains uneven among regions. Indeed, while the rate of access to electricity in North Africa has reached 100%, it remains limited to 43% in sub-Saharan Africa, where 588 million people still have no access to electricity. Average electricity consumption per capita is 335 kWh per year (171 kWh excluding South Africa and North Africa), around 1/7th of the average level in China.

In economic literature, several researchers have examined the link between energy consumption and economic growth around the world. Unfortunately, most of these studies have focused on developed countries. Indeed, from a theoretical point of view, this work can be grouped according to two main currents of thought in economics (i.e. the classics and the neoclassics). The classics, such as A Smith and Ricardo, only marginally evoked the notion of energy in their work, by addressing the concept of the machine. According to them, the use of machines increases the productivity of economic agents. The neoclassicals were the first to introduce energy as a factor of production in the production function in the 19th century. This function was called KLEM (Capital, Labor, Energy and Non-Energy Materials).

Following this work, other researchers such as Pacerbois (1978), Hamilton (1983), Darmstadter et al (1997), Ferguson et al (2000), and Babusiaux (2001), highlighted the importance of energy in the production process, establishing a link between energy consumption and wealth creation. This link will be explored further at the beginning of the 21st century with the analysis of Lee and Chang (2008).

Added to this are a number of economic theories that reconcile renewable energies and sustainable development. Here are some of the key theories and factors in this process: the green growth approach (Solow,1992; Romer, 1955; Stern, 2006; Stigitz, 2014; Daly, 1996; Dasgupta, 2001; Costanza, 1997; Nordhaus, 2013), it emphasizes the need to develop an economy that is ecologically sustainable and socially equitable; In other words, they suggest integrating environmental factors into economic analysis; Next, the theories of technological innovation (Schumpeter, 1911; Nelson and Winter, 1982; Acemoglu and Robinson, 2012), which emphasize the importance of technological innovation in the development process; fiscal incentive theory (Cheung, 1973; Williamson, 1985; Laffont and Tirole, 1993), which assumes that appropriate economic incentives are needed to encourage renewable energies; and finally, externalities theory (Pigou, 1920; Coase, 1960; Demsetz, 1967), which describes the positive or negative effects of an economic activity on third parties that are not taken into account by the market.

What's more, in empirical terms, a great deal of work has been done on the relationship between energy consumption and economic growth in general. However, these studies differ in terms of method, data and results. In terms of methodology, most work uses time series or panel data econometrics. Some of these analyses use widely-used traditional econometric techniques such as panel data econometrics, ordinary least squares, double ordinary least squares (Pereira et al., 2019; Wang et al., 2018; Bélaïd and Youssef, 2017). Others, on the other hand, use fairly recent methods such as Structural VAR, the panel VEC model, the dynamic panel or the ARDL model in panel data (Cherni et al., 2017; Wesseh, and Lin, 2016).

They can therefore be divided into two main groups, depending on the results obtained. The first group consists of work establishing a unidirectional relationship between energy consumption and economic growth. It is carried by researchers such as Kraft and Kraft (1978), Abosedra and Baghestani (1991), Jumbe (2004), Narayan and Smyth (2005), Esseghir Asma and Haouaoui Leila (2011). The second group consists of works using bivariate or multivariate methods to highlight a bidirectional relationship between energy consumption and economic growth or wealth creation. Here, we find authors such as Ebohon (1996), Glauser and Lia (1997), Yang (2000), Shiu and Lam (2004), Moritomo and Hope (2004), Wolde-Rufael 2004), Yoo (2005), Yemane Wolde-Rufael (2006), Kane Chérif Sidy (2009) and Apergis and Payne (2009). They put forward four hypotheses on the link between energy consumption and economic growth: the growth hypothesis, the conservation hypothesis, the neutrality hypothesis and the feedback hypothesis. Their overall assumption is that low energy consumption is a symptom of poverty and an obstacle to economic development.

According to the Global Status Report on renewable energies published in 2014, renewable energies account for 19% of total global energy production, and global investment in clean renewable energies exceeded that in non-renewable energies at the end of 2013, reaching 214.4 billion USD, with global production capacity exceeding 1,560 gigawatts (GW). Fossil fuels: hydrocarbons and coal provide 86% of the energy used. The remainder is provided by nuclear and renewable energies. To what extent can renewable energies contribute to sustainable development? How can we integrate the externalities generated by the development of alternative energy markets?

In short, the aim of this research is to assess the economic impact of renewable energies and analyze their role in the energy transition towards a sustainable energy system.

Secondary objectives are derived from this general objective. These include :

- ✓ Analyze the production costs and prices of renewable energies compared with conventional energy sources, and assess their competitiveness on energy markets.
- ✓ Examine the economic and social implications of access to renewable energy in developing countries, with a focus on reducing inequalities and improving living conditions.

In order to answer these questions, this research work is based on three main hypotheses:

H1: increased use of renewable energies will reduce the negative environmental impacts associated with fossil fuels.
H2: renewable energies will become increasingly competitive with fossil fuels
H3: Diversifying the energy mix helps meet energy needs while limiting environmental impact.
In this work, we support the hypothesis that the energy transition is essential to achieving sustainable development.

The topic of renewable energies and sustainable development is highly relevant and continues to gain in importance as environmental challenges and concerns about climate change intensify.
Firstly, renewable energies play a crucial role in reducing greenhouse gas emissions and ensuring the transition to a low-carbon economy.

Secondly, renewable energies offer an alternative to traditional energy sources, such as oil and gas, which are subject to fluctuations. It also solves geopolitical problems linked to access to natural resources (hydroelectric dams).

Thirdly, investment in renewable energies generates employment opportunities, and fosters technological innovation and development. They improve air quality and people's health.

Finally, RE offers an opportunity for energy access in landlocked regions that are not connected to traditional electricity grids.

Section l. Conceptual framework and literature review on renewable energies
The literature on RE and sustainable development will be organized as follows: first, we'll look at the key elements. Next, we present the body of theories. Finally, we outline the empirical work that has been carried out on this study.

1.1. Conceptual framework
This section is devoted to defining our concepts of renewable energies and sustainable development.

1.1.2. Definitions

Renewable energies can be defined as any useful form of energy from a renewable source, whose current use does not limit its future availability. There are various types of renewable energy, producing mechanical energy, thermal energy and/or electricity.

IEA (2020), Renewable or green energies include hydropower, geothermal, solar, wind, biomass and biofuels. These energy sources are renewable, meaning that they renew themselves naturally and sustainably over time.

According to ADEME (2021), "renewable energies are energies derived from natural sources that are inexhaustible on a human scale, such as the sun, wind, water, the heat of the earth or biomass".

The best-known definition of **sustainable development,** taken from the Bruntland Report (1987), is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

In the past, development was synonymous with industrialization, economic growth, consumption levels and urbanization. A developed state was one that produced, consumed and built more and more, regardless of the social and environmental costs involved. From the 1980s onwards, the end of the "trente glorieuses", the onset of globalization, the rise of global environmental problems (the greenhouse effect, global warming, the hole in the ozone layer, etc.) and the stagnation of underdeveloped countries forced development experts to revise this inadequate concept and think about equitable sustainable development. Today, sustainable development has become one of the major concerns of public opinion, and of political, economic and social players. Without sustainable practices, economic growth can lead to excessive degradation of natural and human resources. Public authorities are therefore called upon to reconcile short- and medium-term economic imperatives with long-term ecological challenges, with a view to achieving sustainable development accepted by all stakeholders. Moreover, the energy sector is seen as an inseparable element of development. Consequently, the promotion of sustainable energies can bring about structural changes, particularly at the socio-economic level and in terms of the reduction of polluting agents (such as CO2). For example, the Johannesburg Summit on Sustainable Development, in contrast to the Rio Summit (Agenda 21) and the Millennium Summit (Millennium Development Goals - MDGs), explicitly recognizes the key role of energy in building sustainable human development. Its close links with all activities that contribute to economic and social development, its impact on the current and future ecological balance, and the role it is now recognized as playing in the achievement of the MDGs, all give concrete expression to this role.

Is the current energy system sustainable?

An energy system is said to be sustainable if it is compatible with the objectives of equitable economic and social development in space and time, and long-term ecological balance. From this point of view, the current global energy system is not sustainable:

- Intra-generational and spatial equity is not assured, as the system is characterized by unequal access to energy services in terms of quantity and quality, both worldwide and within a single

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country. A third of the world's inhabitants have no access at all to modern forms of energy, and rely exclusively on biomass to meet their energy needs. Millions of men and women are thus limited in the choices and opportunities open to them.

● Economic growth is hardly feasible for countries that are so energy-scarce and so heavily dependent on biomass (80-90% for many countries in sub-Saharan Africa)11. The productivity of a large part of their workforce is compromised. Supply risks and price fluctuations are disruptive to economic growth, which needs to be sustained to achieve economic and social development objectives.

● Nor is intergenerational equity, equity between present and future generations, guaranteed at the rate at which energy resources, particularly fossil fuels, are being exploited. Current reserves are estimated to last 50 years at this rate of exploitation. In the not-too-distant future, there is likely to be considerable pressure on quantities and prices.

Impact on the environment

Solar energy

● Passive and active solar heating techniques have little impact on the environment other than visual. Photovoltaic modules operate silently and produce no greenhouse gas emissions. The environmental impact will be limited mainly to that of the building they equip, and will depend on the surrounding environment; in this respect, local planning regulations apply in the same way as for new construction or the modification of an existing building. It's worth noting that the use of solar thermal equipment contributes to a reduction in dioxide emissions. In fact, one m² of collectors replacing an oil-fired water heater avoids the emission of 350 kg of CO_2/year. 1 Wind turbine A wind turbine occupies only a small area (around 1 to 2%) of the land on which it is located. If the land is used for agriculture or livestock farming, 98-99% of the area can be farmed at the base of the tower. The problem of visual impact is often considered to be the most important environmental problem associated with wind turbines. However, this is a highly subjective issue, and can depend on a variety of factors, not least the landscape around the turbines. Well-prepared siting will help resolve these difficulties and improve public acceptance. A preliminary assessment of the visual impact, by means of a photomontage for example, gives an idea of the future appearance of the installation. As for the noise level generated by the turbines, studies have shown that at a distance of 350 m from a wind farm, the noise is only slightly higher than in a quiet room. Technological improvements have also made machines quieter. In fact, some micro-turbines are even discreet enough to be installed close to dwellings without any perceptible nuisance.

Hydropower

● The environmental impact of large hydroelectric schemes can be particularly significant. This is not generally the case for small power plants, although the issue does merit careful consideration. While hydroelectric installations are not polluting per se, a number of specific factors need to be taken into account, such as the impact on the landscape, visual impact, noise and the effects of water detour on fish (habitats, populations, migrations) and wildlife in general. Altering the flow regime of a watercourse can have consequences for downstream habitats, and variations in reservoir levels can also have an impact. 3. Biomass A careful study of the ecosystem is necessary before embarking on an energy crop project, particularly in the case of intensive monoculture. This type of operation is vulnerable to disease and may require the use of pesticides, which can have a negative impact on biodiversity. So it's best to diversify crops and exclude the use of pesticides or artificial fertilizers. Care should also be taken to preserve soil fertility and, if necessary, avoid removing forest residues from sites that need this nutrient input. Fuel transport can be a problem where the power plant is located some distance from the biomass source. Particular attention needs to be paid to the hydrological consequences of capturing the water needed to grow crops. Landscape and visibility are also criteria to be taken into account when new crops are planted in this location. Biomass combustion generates carbon dioxide emissions. The advantage over fossil fuels is that these emissions are equivalent to the amount of carbon dioxide captured by the biomass during its growth. In this respect, growing and burning biomass is carbon-neutral. It should be noted that bioenergy sources are less polluting than coal or oil, since they emit virtually no sulfur into the atmosphere.

Bioenergy

● Bioenergy is a major source of renewable energy. It is generated by converting solid, liquid and gaseous products derived from biomass. Globally, its contribution to final energy demand across all sectors stood at 10% in 2017 five times that of wind and solar photovoltaics combined. In Africa, bioenergy dominates the energy mix6. It accounted for almost 49% of primary energy demand in 2017, outstripping the share of oil (22%) and gas (15%) by a wide margin. The only exceptions are South Africa and the countries of North Africa, where energy demand is dominated by oil. The use of traditional biomass7 predominates in Africa, where it is burned directly, either for cooking and lighting in the residential sector or, to a lesser extent, in the industrial sector. This has harmful consequences, not only for people's health, but also for the environment. The main source of traditional biomass on the African continent is fuel wood or firewood, with a total forest stock estimated at 130 billion tonnes in 2010, spread across Central Africa and parts of Southern Africa. But the amount available each year without risk of deforestation is much smaller. Agricultural residues also represent an important part of the available traditional biomass resources.

Geothermal energy

● This is the energy that comes from the earth's heat. It can provide heating, cooling and power generation from high-temperature hydrothermal resources, low- and medium-temperature aquifer systems and hot rock resources. In 2017, global geothermal energy production amounted to 84.8 TWh, while cumulative installed capacity reached 14 GW. In Africa, geothermal technologies represent only a small fraction of the electricity supply, but can be an attractive option. Electricity generation from geothermal energy grew strongly over the period 2000-2016, recording an average annual rate of 17%. Sufficient geothermal resources exist and are concentrated in East Africa's Rift Valley, with a total potential estimated at between 10 GW and 15 GW. The cost of production is competitive with fossil fuels, and geothermal energy is not characterized by the variability problems associated with some renewable energies.

Socio-economic impact of renewable energies

Economic development: The exploitation of renewable energies can contribute to regional development by injecting rural areas with a valuable and sustainable source of income.

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Opening up local communities and improving quality of life: As with other aspects of development, renewable energy projects can help improve living standards and act as a catalyst for other local projects.

Creating jobs and fighting unemployment: Renewable energies are an important source of employment, as their use will automatically lead to the development of new economic activities in the various economic sectors (primary, secondary, tertiary), and will enable existing industries to expand and new ones to be created.

1.1.3. The main sources of renewable energy

Two ways of approaching the energy question. From an environmental or political point of view, it's a question of thinking about alternatives to oil (biofuels, solar energy, wind power, water power, etc.), but also of laying the foundations for what is now known as "sustainable development". In its pre-report (October 2007), the Commission pour la Libération de la croissance économique, chaired by Jacques Attali, states: "From an economic and financial point of view, energy (and its price) depends on the price of crude oil. As oil is the dominant source of energy, and its price reflects the balance between supply and demand at world level, it is important to follow the evolution of commodity markets.

1.2. Literature review

The literature on the relationship between renewable energy and sustainable development will be organized as follows: first, we present the body of theory on the link between RE and sustainable development. Secondly, we present the empirical work that has been carried out on this study.

1.2.1. Review of theoretical literature

It is well known that climate change is mainly due to carbon dioxide (CO2) emissions from conventional energy. According to the United Nations Department of Economic and Social Affairs (UN/DESA, 2009), energy is essential for economic development, and RE is essential for a future without climate change. Thus, a rapid conversion from fossil fuel use to RE is no longer a choice, but an urgent matter for achieving climate stability. Indeed, there is a consensus among scientists that the use of RE is necessary to mitigate climate change. There are a multitude of theories reconciling renewable energies and sustainable development.

1.2.2. The green economy approach

It emphasizes the need to develop an economy that is ecologically sustainable and socially equitable; in other words, they suggest integrating environmental factors into economic analysis. According to this perspective, investment in RE can create new employment opportunities, improve energy efficiency and open up new markets, contributing to sustainable development. It aims to promote the use of renewable energies and reduce dependence on fossil fuels. It proposes solutions to reduce the environmental impact of economic activity and promote sustainable development. It promotes the use of RE such as solar, wind, hydro and geothermal energy, energy efficiency, waste reduction and recycling, protection of biodiversity, enhancement of ecosystem services (Stahel, 1976; Markandya and Pearce, 1988), and proposes to rethink the traditional linear economic model of take, make, throw and replace with a circular model based on the reuse, recycling and regeneration of resources.

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Mathews (2014) considers that the use of RE is necessary to reduce CO2 emissions. Dincer (2000) claims that there is a profound link between the use of RE and sustainable development. In fact, RE is one of the most effective solutions to current environmental problems.

Solow (1980) challenges traditional approaches to measuring economic growth that do not take account of environmental degradation. He stresses the importance of integrating natural resources into economic models.

Some economists argue that the green economy does not sufficiently challenge the economic model based on continuous growth. Growth, even if it is green, always leads to increased use of natural resources, which can ultimately be unsustainable.

Also, green initiatives, such as RE development, may simply displace problems and in some cases exacerbate socio-economic inequalities. For example, the adoption of green technologies can exclude low-income populations who lack the means to adapt. In some cases, it may serve as a marketing strategy rather than a genuine commitment to sustainability.

What's more, it's difficult to accurately quantify environmental costs when making economic decisions.

1.2.3. Theories of technological innovation (Schumpeter, 1911; Nelson and Winter, 1982; Acemoglu and Robinson, 2012)

Schumpeter (1911), in his book "**The Theory of Economic Development**", introduced the concept of "**creative destruction"** to describe the role of technological innovations in the development process.

Romer (1990) develops the theory of endogenous growth, based on the role of technical progress in long-term growth and development.

Acemoglu and Robinson (2012), shows how the quality of political and economic institutions influences innovation and economic development.

But this theory is not exempt from criticism: technological innovation presents a deterministic vision of technical progress, assuming that technologies develop in a linear and ineluctable fashion. The neglect of the social, political and cultural factors that encourage the adoption and diffusion of technologies.

In addition, neglect of user behavior, the environment and the institutional and regulatory context can slow down the adoption and diffusion of technology.

1.2.4. Economic incentive theory (Cheung, 1973; Williamson, 1985; Laffont and Tirole, 1993)

They explore the role of economic incentives in coordinating economic activities and solving collective action problems.

Oliver Eaton Williamson, born September 27, 1932, is an American economist who has published several influential works on the economics of organizations and contracts. His book

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"**The Economic Institutions of Capitalism**", published in 1985, examines how economic incentives influence the structure and performance of organizations.

On the other hand, tax incentives are not always an effective way of stimulating economic activity. Targeted tax cuts can distort the market.

Darwal (2013) and hem (2015), question the effectiveness of climate policies and tax incentives for renewable energies. They also explore the economic implications of these resources.

Incentives can have a significant cost on public finances. Also, the complexity and opacity of the real benefits of these incentives.

1.2.5. Externalities (Pigou, 1920; Coase, 1960; Demsetz, 1967)
Pigou (1920), describes the positive or negative effects of an economic activity on third parties that are not taken into account by the market.

Coase (1960), for his part, developed the theory of property rights and showed how stakeholders can negotiate externality problems between themselves.

On the other hand, Posner (1972) believes that government intervention to correct externalities can be inefficient and lead to unforeseen consequences.

Cheng (1973), argues that external costs and benefits are actually market phenomena that can be internalized through voluntary negotiations between the parties concerned.

Bradley (2008), criticizes renewable energy support policies. He argues that these policies are inefficient and costly, and prevent the market from functioning properly.

Section ll. Empirical review

Over the last few decades, the relationship between renewable energy consumption and sustainable development has become a recurring issue in the debate on economic and social development policies, and also environmental protection. At present, many researchers in this field are questioning the direction of causality between the two. Thus, knowledge of the causal relationship between economic variables can provide important elements for the implementation of appropriate economic policies (Bourbonnais 2003). The first notions of integration, cointegration and causality date back to the work of pioneers such as Kraft and Kraft (1978), Sims (1972), Sims (1980), Granger et al. (1981), and (1983), and Granger and Weiss (1983). Following on from these works, we can cite those of Granger and Engle (1987) and Johansen (1991). Empirical results from these studies are sometimes very mixed, even contradictory, as they reflect divergent hypotheses (Jumbe 2004, Ghali and El-Saka, (2004). The result is often a unidirectional or bidirectional causal relationship, and in some cases a noted total absence of causality (neutrality hypothesis). As a result, there is as yet no consensus in the research field on this issue.

2.1. Studies that establish a unidirectional relationship between energy consumption and economic growth

Ocal and Aslan (2013) apply the empirical tests of the ARDL approach and Toda-Yamamoto causality tests to the case of Turkey. The results of this study confirm the conservation hypothesis and suggest that renewable energy consumption has a negative impact on economic growth. The authors indicate that there is a unidirectional causality from economic growth to renewable energy consumption.

Tsangyao Chang et al (2015) used the panel method with a heterogeneous model and causality in the sense of Granger to study the relationship between renewable energy and economic development for the case of the 7 (G7) countries over the study period 1990- 2011. They found that there was a unidirectional relationship from renewable energy consumption to GDP.

Alper and Oguz (2016) examined the relationship between renewable energies and economic development using the ARDL method and the asymmetric causality of (A. HATEMI-J, 2012) for the case of 8 European countries. They employed these econometric techniques over the study period 1990-2009 and the variables were renewable fuel and waste energy, real GDP, gross fixed capital formation and labor. They found no causal relationship for Cyprus, Estonia, Hungary, Poland and Slovenia. However, they did find unidirectional causality from GDP to the renewable energy variable for the case of the Czech Republic, and unidirectional causality from the renewable energy variable to GDP for the case of Bulgaria.

Armeanu et al (2017) conducted a study to test the hypothesis that renewable energies can help achieve sustainable economic development. This study was based on the case of 28 European countries, and the authors used the panel cointegration method and causality in the Granger sense over the period from 2003 to 2014. The study variables were GDP per capita, renewable energy production and its forms (hydroelectric, wind, geothermal...), energy dependency (countries dependent on energy imports), greenhouse gas emissions, nitrogen gas emissions, R&D spending and labor force. They concluded that there was a positive influence of renewable energies on economic development, and also found that there was a unidirectional relationship from GDP to renewable energy production.

Omri et al (2015) examined the relationship between nuclear energy consumption, GDP and renewable energy consumption for the case of 17 developed and emerging countries. They employed the dynamic simultaneous equations method over the period 1990-2011. They concluded that there was bidirectional causality between GDP and renewable energy consumption for the case of Belgium, Bulgaria, Canada, France, Pakistan and the USA. However, for the panel as a whole, they found that there was a unidirectional relationship running from GDP to renewable energy consumption.

Furthermore, Maji et al, (2019) study the impact of renewable energy on economic growth in West African countries using the Dynamic Ordinary Least Squares (DOLS) method applied to a panel of15 West African countries between 1995 and 2014. The results indicate that the use of renewable energy can slow economic growth by reducing productivity when sources that are highly polluting when burned, impure, and inefficient, such as wood biomass, are used. In contrast, the authors recommend the use of clean energy sources such as solar, wind and hydroelectric power, which have no adverse effects on human health and the environment, and are less common in West Africa. More recently, Rahman and Velayutham (2020) examine the relationship between renewable and non-renewable energy consumption and economic growth in five South Asian countries between 1990 and 2014. Rahman and Velayutham apply the tests of Pedroni (1999, 2004) and Kao (1999) to analyze long-term cointegration and the causality test on panel data proposed by Dumitrescue-Hurlin (2012). These authors determine the long-term equilibrium relationship using both FMOLS and DOLS estimation techniques. They conclude that renewable energy consumption, non-renewable energy consumption and fixed capital formation have a positive impact on economic growth. A 1% increase in renewable energy consumption, non-renewable energy consumption and capital formation implies an increase in economic growth of 0.66%, 0.10% and 0.58%, respectively. They find a unidirectional causal relationship from economic growth to renewable energy consumption. Thus, the conservation hypothesis is verified for South Asian countries.

Chama et al (2021) analyzed the relationship between renewable energies and economic growth in Morocco over the period 1990-2017. Using the ARDL model approach to Granger causality testing. The results suggest a strong co-integration between our variables and confirm the neutrality hypothesis for the Moroccan case. Our results also confirm the role of economic growth and trade openness in the deployment of renewable energies.

Houcine and naceur (2019) examine energy substitution and its effects on economic growth in Tunisia. To do so, the VAR method and Granger causality test are used to study the dynamic relationship between non-renewable electricity generation, renewable electricity generation and Tunisian economic growth for the period 1992-2016. The results suggest that the development of renewable energies favors the Tunisian economy by enhancing economic growth compatible with the environment and social well-being, and even ensuring sustainable development.

2.2. Works using bivariate or multivariate methods to highlight a bidirectional relationship between energy consumption and economic growth

In the same context, Apergis and Payne (2010), using variables such as capital formation, GDP, labor and renewable energy consumption, showed that there is a bidirectional relationship between economic growth and renewable energy consumption in certain countries. They reported the same result for OECD countries in 2010. Sadorsky (2009), Menyah and Wolde Rufael (2010) and Menegaki (2011) have also studied the relationship between economic growth and renewable energy consumption.

In the same year and using the same econometric approach, Apergis and Payne carried out two studies examining the relationship between renewable energy consumption and economic growth. The first (2010b) concerns a panel of twenty OECD countries between 1985-2005, while the second (2010c) examines the case of a panel of 13 Eurasian countries over the period 1992-2007.In both studies, the authors find bidirectional causality between renewable energy consumption (REC) and economic growth in the short and long term (feedback hypothesis).

Lund (1999) has shown that subsidizing renewable energy will increase the number of jobs in Denmark5. In contrast, classical and neoclassical economists do not consider the "energy" variable in the production function. They base their theory of production on two variables: "Labor" and "Capital". These theorists consider Labor and Capital to be the source of wealth. They neglected the "Energy" variable in their production function. The question of energy took its place in the production function with the development of the industrial sector. Thus, the emergence of the intelligent economy with production systems based on increased energy consumption.

Apergis & Danuletiu (2014) examined the relationship between renewable energy consumption and economic growth for 80 countries, using Canning and Pedroni's long-term causality test. Both authors showed the existence of positive long-term causality between renewable energy and real GDP for the whole sample as well as for the different regions. The interdependence between renewable energy consumption and economic growth indicates that renewable energies are not only important for environmental quality, but also for economic growth.

In the same vein, (Behname, 2012) examined the long-term and also short-term causal relationship between renewable energy consumption and economic growth in Western European countries for the period 1995-2010. The Pedroni test used revealed a long-term relationship between the two variables. It follows that there is a long- and short-term bidirectional relationship between economic growth and renewable energy consumption. Another study, by (Lekana, 2019), confirms some of the previous results. This work looked at CEMAC countries for the period 1990 and 2015 and used three panel data error correction models (MG PMG and DFE) and two causality approaches (Engel and Granger causality and Dumitrescu and Hurlin causality). The results showed that renewable energy consumption has a positive long-term effect, but a negative short-term effect on economic growth in these countries.

Apergis and Payne (2012) use the same estimation technique to study the relationship between renewable energy consumption, non-renewable energy consumption and economic growth in a sample of 80 countries between 1990 and 2007, concluding that there is a short- and long-term bidirectional causal relationship between renewable energy consumption, non-renewable energy consumption and economic growth, and between renewable and non-renewable energy consumption, indicating substitutability between the two energy sources.

Using the Toda-Yamamoto method and bootstrap-corrected causality, Yildrim et al (2012) studied the relationship between renewable energy and GDP for the USA. The study period was from 1949 to 2010, and the variables were gross fixed capital formation, real GDP and renewable energy consumption (biomass, hydroelectric, wood waste and geothermal). They eventually found that there was a single bidirectional causality between the consumption of wood waste (biomass) and GDP, and that there was no causal relationship between the other energy drifts.

More recently, (Saidi & Omri, 2020) examined the effectiveness of renewable energies in promoting economic growth and reducing CO_2 emissions in the case of 15 countries, using Ordinary Least Squares (OLS) and Vector Error Correction Model (VECM) estimation techniques. The results confirm the presence of a bidirectional causal relationship between economic growth and renewable energies in the short and long term. On the other hand, (Chen et

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al., 2019) explored the relationships between carbon dioxide emissions, economic growth, renewable and non-renewable energy consumption in three regions of China for the period 1995-2012. One of the main findings of this work is the existence of bidirectional causal relationships in the long term between renewable energies, CO2 emissions and economic growth in all regions.

Al-mulali et al (2013) studied the impact of renewable energy consumption on GDP growth for countries classified into three income classes (high-income, middle-income and low-income). They used the FMOLS procedure over the period 1980-2009, and the study variables were electricity consumption from renewable sources and GDP. They demonstrated that 79% of the data, especially for high-income countries, had a positive bidirectional causality in the long term. On the other hand, they did not find a causal relationship for the 19% of these countries. However, for the remainder, there was a unidirectional relationship from GDP to renewable electricity consumption.

Amri (2017a) studied the economic development factor (GDP), renewable energy consumption, capital stock, labor and trade factor for the case of 72 developed and emerging countries over the study period 1990-2012. He employed the two-stage generalized method of moment and eventually found that there was a bidirectional relationship between income or GDP and renewable energy consumption.

Kahia et al (2017) examined the case of MENA or net oil-importing countries with the cointegration panel model over the period 1980-2012. The study variables were real GDP, renewable and non-renewable energy use, gross fixed capital formation and labor. They concluded that there was bidirectional causality between renewable energy use and economic development.

Rafindadi and Ozturk (2017) researched the relationship between renewable energy consumption and economic development for the case of Germany. The method used was ARDL and VECM (the error correction vector) and structural break in the unit root test. They used these techniques over the period from Q1 1970 to Q4 2013 and on the variables GDP per capita, renewable energy consumption per capita, real capital per capita and labor force per capita. They found that in the long term, using the ARDL method, a 1% increase in renewable energy consumption will increase economic development by 0.2194%. They also had the same positive results with the VECM method, but with different coefficients. Also, the causality result was the same (positive), so they concluded for the existence of a bidirectional relationship between GDP and renewable energy consumption.

Jebli and Slim (2015) investigated the relationship between renewable and non-renewable electricity and international trade for 69 countries. They used the panel cointegration method and causality in the Granger sense on the variables of GDP, total renewable and non-renewable electrical energy, export and import, capital stock (gross fixed capital formation) and labor, the period of study was 1980 to 2010. They observed that there was no causal relationship between GDP and renewable electricity consumption in the short term. However, there was bidirectional causality between these two variables in the long term.

Tugcu et al (2012) investigated the causality between renewable and non-renewable energy and economic development for the G7 countries over the study period 1980-2009. The variables were real GDP, gross fixed capital formation, labor force, total number of full-time and part-time students enrolled in public and private higher education, number of patents filed with a European office, renewable and non-renewable energy consumption. They used the panel cointegration procedure and causality in the sense of Granger. They eventually found that there was no causality between renewable energy consumption and economic development in the case of France, Italy, Canada and the USA. However, they did find bidirectional causality (retroactive hypothesis) in the case of England and Japan. Also, for the panel as a whole, they observed that there was a two-way causal relationship between the variables of GDP, renewable and non-renewable energy consumption.

Aïssa et al (2014) explored the relationship between renewable energy consumption, trade and economic output for 11 African countries over the period 1980 to 2008. They used the panel cointegration method for the variables GDP, renewable energy consumption (electricity consumption from renewable sources), export and import, capital stock (gross fixed capital formation) and labor. In the short term, they concluded that there was no causality between these variables.

Inglesi-Lotz (2016) studied renewable energy consumption and economic development for the case of 34 OECD countries over the period from 1990 to 2010. The study variables were GDP, GDP per capita, total renewable energy consumption, the share of renewables in total energy consumption, gross capital formation, labor and research and development expenditure. The author used the Cobb-Douglas production model and found that there was a long-term equilibrium relationship between these variables. Also, she found that a 1% increase in renewable energy consumption will increase GDP by 0.105% and GDP per capita by 0.1%. However, a 1% increase in the share of renewable energies in total energy consumption will increase GDP by 0.089% and GDP per capita by 0.09%.

Bhattacharya et al (2016) conducted a study on the contribution of renewable energies in the economic development process for the case of 38 countries over the period 1991-2012. They used panel cointegration (FMOLS and DOLS) and heterogeneous causality on the variables of GDP, gross fixed capital formation, labor, renewable and non-renewable energy consumption. In the long term, they concluded that renewable energies must be included in the energy production cycle to secure the sustainable development factor and the stability of economic development. Also, they made the causality between the GDP variable and renewable energies and found that there was a positive relationship for the case of Austria, Bulgaria, Canada, Chile, China, Czech Republic, Denmark, Finland, France, Germany, Greece, Italy, Kenya, South Korea, Morocco, Netherlands, Norway, Peru, Poland, Portugal, Romania, Spain and Great Britain. However, in the case of India, Ukraine and the USA, they found a negative relationship between GDP and renewable energy consumption.

Kahia et al (2016) studied the influence of renewable and non-renewable energies on economic development for the case of two groups of MENA countries over the study period 1980-2012. The first group was made up of 13 countries and the second group of 5 countries that use renewables in their energy production cycle. They used the FMOLS (panel cointegration) method, causality in the Granger sense and the pair-wise correlation model on the variables of GDP, consumption of renewable and non-renewable electrical energy, gross fixed capital formation and labor. They observed that there was a cointegration relationship for both groups of MENA countries. In the long term, they found that for both groups together (the entire panel), a 1% increase in renewable energy consumption will increase GDP by 0.058%. Furthermore, they observed that there is a bidirectional causality between GDP and renewable energies for the case of the second group (5 MENA countries).

Fethi (2017b) examined the relationship between renewable and non-renewable energies and GDP for the case of Algeria over the period from 1980 to 2012. He used the ARDL method and causality in the Granger sense for the variables of GDP, capital stock, population, total renewable and non-renewable electric energy consumption. He found no relationship between renewable energies and economic development in Algeria. These results confirm that the country has not yet reached the renewable energy threshold that would enable it to contribute to a positive improvement in GDP. However, renewable energy consumption was almost non-existent (0.10%) in 2013.

Elissaoui (2021) To assess the relationship between renewable energy (RE) and non-renewable energy (NRE) consumption and economic growth between 1990 and 2015 for a sample of 5 emerging economies, we use the Panel Co-integration method to evaluate the long-term impact. The overall estimate for a panel of 5 countries using both the FMOLS and DOLS methods indicates positive and significant results.

Summary table of empirical work

	Studies that establish a unidirectional relationship between energy consumption and economic growth			
Author(s) and Year of Publication	Methodology	Field of study	Study period	Results
Tsangyao Chang et al (2015)	heterogeneous model and causality in the sense of Granger	7 G7 countries	1990- 2011 .	They found that there was a unidirectional relationship from renewable energy consumption to GDP.
Alper and Oguz (2016)	ARDL method and asymmetrical causality (A. HATEMI-J, 2012)	8 European countries	1990-2009	real GDP, gross fixed capital formation and labor.

Armeanu et al (2017)	the panel cointegration method and causality in the Granger sense	280 European countries	2003-2014	positive influence of renewable energies on economic development, and also found that there was a unidirectional relationship from GDP to renewable energy production.
	Studies using bivariate or multivariate methods to highlight a bidirectional relationship between energy consumption and economic growth			
Kahia et al (2016)	A multivariate panel framework and Granger and panel causality tests.	MENA	1980 à 2012	confirms the existence of a two-way causality between the use of renewable energy and short- and long-term economic growth -proves the substitutability and interdependence between these two types of energy sources
Bhattacharya et al.(2016)	Panel cointegration method (FMOLS and DOLS)	38 countries	1991 and 2012	term between economic growth and traditional and energy-related inputs, - renewable energy consumption has a significant positive impact on economic output of 57%.
Inglesi-Lotz (2016)	the Cobb-Douglas production model	34 OECD countries	1990-2010	it found that a 1% increase in renewable energy consumption will increase GDP by 0.105% and GDP per capita by 0.1%. However, a 1% increase in the share of renewable energies in total energy consumption will increase GDP by 0.089% and GDP per capita by 0.09%.
Menegaki, AN, Tiwari, AK, 2017	Multivariate panel	American countries	1990 à 2013	different implications between GDP growth and growth - well-being, sustainable energy - Energy-saving measures will curb growth of both types, conventional and sustainable.

Conclusion

From this literature review, it appears that the results of theoretical and empirical work on the relationship between RE and sustainable development diverge. On a theoretical level, this work can be grouped according to two main currents of thought in economics (i.e. the classics and the neoclassics). The classics, such as A Smith and Ricardo, make only marginal reference to the notion of energy in their work, addressing the concept of the machine. According to them, the use of machines increases the productivity of economic agents. The neoclassicals were the first to introduce energy as a factor of production in the production function. This function is called KLEM (Capital, Labor, Energy and Non-Energy Materials).

Following this work, other researchers such as Pacerbois (1978), Hamilton (1983), Darmstadter et al (1997), Ferguson et al (2000), and Babusiaux (2001), highlighted the importance of energy in the production process, establishing a link between energy consumption and wealth creation. This link will be explored further at the beginning of the 21st century with the analysis of Lee and Chang (2008).

Added to this are a number of economic theories that reconcile renewable energies and sustainable development. Here are some of the key theories and factors in this process: the green growth approach (Solow,1992; Romer, 1955; Stern, 2006; Stigitz, 2014; Daly, 1996; Dasgupta, 2001; Costanza, 1997; Nordhaus, 2013), it emphasizes the need to develop an economy that is ecologically sustainable and socially equitable; In other words, they suggest integrating environmental factors into economic analysis; Next, the theories of technological innovation (Schumpeter, 1911; Nelson and Winter, 1982; Acemoglu and Robinson, 2012), which emphasize the importance of technological innovation in the development process; fiscal incentive theory (Cheung, 1973; Williamson, 1985; Laffont and Tirole, 1993), which assumes that appropriate economic incentives are needed to encourage renewable energies; and finally, externalities theory (Pigou, 1920; Coase, 1960; Demsetz, 1967), which describes the positive or negative effects of an economic activity on third parties that are not taken into account by the market.

Empirically speaking, a great deal of work has been done on the relationship between energy consumption and overall economic growth. However, these studies differ in terms of method, data and results. In terms of methodology, most work uses time series or panel data econometrics. Some of these analyses use widely-used traditional econometric techniques such as panel data econometrics, ordinary least squares, double ordinary least squares (Pereira et al., 2019; Wang et al., 2018; Bélaïd and Youssef, 2017). Others, on the other hand, use fairly recent methods such as Structural VAR, the panel VEC model, the dynamic panel or the ARDL model in panel data (Cherni et al., 2017; Wesseh, and Lin, 2016).

They can therefore be divided into two main groups, depending on the results obtained. The first group consists of work establishing a unidirectional relationship between energy consumption and economic growth. It is carried by researchers such as Kraft and Kraft (1978), Abosedra and Baghestani (1991), Jumbe (2004), Narayan and Smyth (2005), Esseghir Asma and Haouaoui Leila (2011). The second group consists of works using bivariate or multivariate methods to highlight a bidirectional relationship between energy consumption and economic growth or wealth creation. Here, we find authors such as Ebohon (1996), Glauser and Lia (1997), Yang

(2000), Shiu and Lam (2004), Moritomo and Hope (2004), Wolde-Rufael 2004), Yoo (2005), Yemane Wolde-Rufael (2006), Kane Chérif Sidy (2009) and Apergis and Payne (2009). They put forward four hypotheses on the link between energy consumption and economic growth: the growth hypothesis, the conservation hypothesis, the neutrality hypothesis and the feedback hypothesis. Their overall assumption is that low energy consumption is a symptom of poverty and an obstacle to economic development.

Bibliography

International Energy Agency (IEA), "Renewable Energy: Medium-Term Market", Report 2020

Aneja, R., Banday, U. J., Hasnat, T., &Koçoglu, M. (2017), "Renewable and Non renewableEnergyConsum ption and Economic Growth: Empirical Evidence from Panel Error Correction Model. Jindal Journal of Business Research, 6(1), 76-85. Apergis, N., & Payne, J. E. (2010). Renewable energy consumption and economic growth: Evidence from a panel of OECD countries. Energy Policy, 38(1), 656-660.

Asiedu, B. A., Hassan, A. A., &Bein, M. A. (2020). Renewable energy, non-renewable energy, and economic growth: evidence from 26 European countries. Environmental Science and Pollution Research.

Asif, M., Bashir, S., & Khan, S. (2021). Impact of non-renewable and renewable energy consumption on economic growth: evidence from income and regional groups of countries. Environmental Science and Pollution Research, 28(29), 38764- 38773.

African Development Bank, Sustainable Energy fund for Africa (SEFA), Annual Report 2015.

Bhattacharya, M., Awaworyi Churchill, S., &Paramati, S. R. (2017), "The dynamic impact of renewable energy and institutions on economic output and CO2 emissions across regions", RenewableEnergy, 111, 157-167.

Bhattacharya, M., Paramati, S. R., Ozturk, I., &Bhattacharya, S. (2016). The effect of renewable energy consumption on economic growth: Evidence from top 38 countries. AppliedEnergy, 162, 733-741

CHIEN Taichen and Jin-Li HU (2007), "Renewable Energy and Macroeconomic Efficiency of OECD and non OECD Economies", Energy Policy, vol.35(7), pp.3606-3615, July, DOI : 10.1016/j.enpol.2006.12.033.

CHIEN Taichen and Jin-Li HU (2008), "Renewable Energy: An Efficient Mechanism to Improve GDP", Energy Policy, vol.36(8), pp.3045-3052, August, DOI : 10.1016/j.enpol.2008.04.012

D.S. Armeanu, G. Vintila, S. C. Gherghina, (March 17, 2017), Does Renewable Energy Drive Sustainable Economic Growth? Multivariate Panel Data Evidence for EU-28 Countries, Energies, 10 (3). http://www.mdpi.com/1996-1073/10/3/381

DALY Herman E. (1990) "Toward Some Operational Principles of Sustainable Development", Ecological Economics, vol.2(1), pp.l-6, April, DOI : 10.1016/0921-8009(90)90010-R.

DALY Herman E. (1992), "Steady-State Economics: Second Edition with New Essays", 2nd ed. London: Earthscan, 297 pages.

Favennec J-P. (2015). Energy in Africa to 2050. Agence Française de Développement and African Development Bank.

Fethi Amri, (March 2017a), Intercourse across economic growth, trade and renewable energy consumption in developing and developed countries, 69, 527-534.energy consumption in developing and developed countries, 69, 527-534. https://doi.org/10.1016/j.rser.2016.11.230

M. Bhattacharya, S.R. Paramati, I. Ozturk, S. Bhattacharya, (January 15, 2016), "The effect of renewable energy consumption on economic growth: Evidence from top 38 countries, Applied Energy," 162, 733-741. https://doi.org/10.1016/j.apenergy.2015.10.104

MARKANDYA Anil and David PEARCE (1988), "Natural Environments and the Social Rate of Discount", Project Appraisal, vol.3(1), March, pp.2-12, DOI : 10.1080/02688867.1988.9726647

Montassar Kahia, Mohamed Safouane Ben Aissa, Charefeddine Lanouar, (May 2017), Renewable and non-renewable energy use-economic growth nexus: The case of MENA Net Oil Importing Countries, Renewable and Sustainable Energy Reviews, 71, 127-140. https://doi.org/10.1016/j.rser.2017.01.01

Nordhaus w (2013), "The Climate Casino. Risk, Uncertainly, and Economics for a Warming World".

Roula Inglesi-Lotz, (January 2016), "The impact of renewable energy consumption to economic growth: A panel data application", Energy Economics, 53, 58-63.

SOLOW Robert M. (1974), "Intergenerational Equity and Exhaustible Resources", Review of Economic Studies, vol.41(5), pp.29-45, DOI : 10.2307/2296370.

Tsangyao Chang, Rangan Gupta, Roula Inglesi-Lotz, Beatrice Simo-Kengne, Devon Smithers, Amy Trembling, (December 2015), "Renewable energy and growth: Evidence from heterogeneous panel of G7 countries using Granger causality, Renewable and Sustainable Energy Reviews, 52, 1405-1412.