

The energy transition and the challenges of its embodiment in the African Economies**- AN ANALYTICAL READING OF THE ADOPTED PHILOSOPHY APPROACH -****BOUFABA OUIDED**

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Reçu le : 23/04/2023

Accepté le : 29/06/2023

Publié le : 30/06/2023

Abstract:

This research paper aims to provide an academic and scientific knowledge about the concept of energy transition, and its philosophy and definition. Through an analytical reading, in the language of economic analysis, reviewed the determinants of the general framework for the concept of energy transition as a point of convergence for the interests of the peoples of the globe. And how did the various economies deal with this multi-dimensional concept and the philosophy of the approach it adopted?

Through the historical and descriptive analytical approach and a deep survey of the literature on the subject, the study concluded that although the institutions of the international community agreed on the concept of the energy transition and defined the determinants of its general framework, they left the choice regarding defining the type of renewable source that depends on it. This opened the way for competition and the search for the largest possible number of sources, according to the geographical environment and the human resource of any economy. On the other hand, the African oil economics approach remains highly ambiguous in light of the difficulty of replacing oil, the weak competition of its economic environment, and the rate of human resource innovation in this field

Keywords: the sustainable energy transition, the renewable sources, the African oil economics, the millennium goals, the trade-off criteria

Jel Classification Codes : O13 ; Q42 ; Q54.

ملخص:

تهدف هذه الورقة البحثية إلى توفير معرفة أكاديمية وعلمية حول مفهوم انتقال الطاقة وفلسفتها وتعريفها. ومن خلال قراءة تحليلية بلغة التحليل الاقتصادي استعرضت محددات الإطار العام لمفهوم الانتقال الطاقوي باعتباره نقطة تلاقي مصلحة شعوب الكرة الأرضية. وكيف تعاملت مختلف الاقتصاديات مع هذا المفهوم متعدد الأبعاد وفلسفة المنهج الذي اعتمدته.

ومن خلال المنهج التاريخي والوصفي التحليلي ومسح عميق لأدبيات الموضوع توصلت الدراسة إلى أن مؤسسات المجتمع الدولي وإن اتفقت في مفهوم الانتقال الطاقوي وعرفت محددات إطاره العام، إلا أنها تركت الخيار فيما يخص تعريف نوعية المصدر المتجدد المعتمد عليه. وهو ما فتح مجالاً للمنافسة والبحث عن أكبر عدد ممكن من المصادر وفق ما توجد به البيئة الجغرافية والموارد البشري لأي اقتصاد. في مقابل ذلك، يبقى منهج اقتصاديات النفط الإفريقية ذو درجة عالية من الغموض في ظل صعوبة إحلال النفط وضعف منافسة البيئة الاقتصادية بها ومعدل ابتكار المورد البشري بها في هذا المجال!

الكلمات المفتاح: انتقال طاقي مستدام ؛ مصادر متجددة ؛ اقتصاديات نفطية إفريقية ؛ أهداف الألفية ؛ معايير المفاضلة..

تصنيف JEL: Q54 ; Q42 ; O13

I. Introduction:

Since the environmental problem was raised during the United Nations first conference concerning the dangerous consequences of the massive exploitation of oil-the engine of the industrial revolution-The meetings of the international community institutions did not hesitate to follow it emphasizing the importance of addressing it and the necessity of accelerating the implementation of programs to confront it. Moreover, since it is the basis for the launch of people's well-being and the sustainability of their development, the international community has agreed to work hard to find an appropriate sustainable development formula that combines the growth and the continuity of the economic activity on one hand, and considering the environmental constraint on the other hand. The most important challenge to this structure was to work on modifying the sources of energy production until changing it. The work began with a mixture of energy that combines the traditional fossil energies with new and clean energy sources such as water, wind, and others, preparing for the energy transition. The features of this work emerged in defining the consumption share of each energy source separately, on the one hand. On the other hand, the growing shares of renewable energy resources. However, the fossil sources, led by oil, gas and coal, still cover 84.3% of the global consumption and they will generate 36.4 billion tons of carbon dioxide carried by the environment in 2021.

As energy is a product that is shared in consumption among people all over the world, it has been defined as an independent goal among the global goals adopted by all the states members of the United Nations, through which they call for action to end poverty, protect the planet, and ensure that all people enjoy peace and prosperity by 2030. The eighth goal, entitled "Clean energy with reasonable prices", which is closely related to the thirteenth goal entitled "Climate Action" (United Nations, 2022). Varieties of sources of clean and renewable energy have quickly emerged. Its prevalence indicators increased with the beginning of the 2000s (Erna, 2021), it spread with it, the persistent call for the need to work more seriously to embody the energy transformation that refers to the transition from a system of energy production and consumption based on a traditional non-renewable energy to a clean and sustainable energy source (C.GARRETT, 2022).

After the beginning of 2022, and despite the pressure that the economies were exposed to as a result of the closures resulting from the "Covid 19" pandemic, international and local efforts are still continuing in the field of developing a clean energy and generalizing its use, with impressive results, but it remains modest compared to the extent of the damage and the necessity of transition (Gazprom-energy, 2022). The greatest example of this is the "Olympic Games 2021" in Japan, which was a model of a micro-society, whose consumption depends entirely on renewable energy on the one hand, and the adoption of rational production and the consumption methods that are not wasted by the natural resources on the other hand. And in the face of this brilliant success, the German chancellor stated that she would reconsider the quality of the renewable energy source chosen because it is the biggest supporter of solar energy, while Japan has adopted a hydrogenation technology to generate a clean energy (O.Kouche, 2021).

The development of this proposition and the multiplicity of its dimensions and its overlap crystallized the problem of this research paper, which specializes in the study and the analysis of the path of the energy transition as one of the challenges of the millennium and a more threatening to the fate of human life on this universe. In light of an international agreement on the call for embodiment, how were those steps? Especially at the level of the African oil economies, as they are the largest economies linked to the largest polluting energy resource on one hand, and how it programmed its strategy and outlined the axes of its general policies to embody this transformation as a part within the international community on the other hand. This thesis resulted regarding the results of **previous studies** whose content has been surveyed, the most important of them are:

01. **"The energy transition facing the time of the climate clock »** (P.C.Perthuis & B.Solier, 2018): The study included the presentation of several economic ideas covering the development of the economic proposal for the energy transition process. Moreover, in a political economy manner, the study dealt with the forms of transition that humanity had already experienced, the multi-dimensional developments taking place in the energy market, and its consequences on the need for a sustainable energy transition.
02. **"The clean electricity bets and the reality of petroleum economics from that"** (Amani.l&Boufafa.W, 2019): This research paper aimed to provide a reading of a set of institutional and financial factors affecting the clean electricity market, which are at the same time the bets of the transition process to a sustainable energy model.

This resulted in emphasizing the difficulty of a rapid replacement of clean energy and the necessity of only a gradual transition.

03. **“Pathways for sustainable energy transition”** (Bin , Rui, & others, 2019): This study reviewed the most important latest research on Sustainable Energy Systems, their results and innovative methods. By following up on the data of successful experiments in this. The study concluded that it is necessary to formulate innovative and strong strategies in the field of governance, administration and education, especially as a means of strengthening the transition process at all levels. The study indirectly showed how the chosen model should be in accordance with the special data of the relevant economy on the one hand and the economic, technical and environmental transition constraints on the other.
04. **“Just Energy Transition: Learning from the Past for a More Just and Sustainable Hydrogen Transition in West Africa”** (Löhr & other, 2022): This study presented a literature review on the process of transition to alternative energy sources of various types with a preference for the hydrogen source. It sought to identify relevant conflict factors that could influence the outcome of Transition Projects by examining the case of Nigeria and Mali. The study concluded that the relationship between the technical and social aspects of the transition process should be considered together because of their crucial overlap in this. Especially since European countries are struggling to get an African partnership to help achieve a green future.

The study is based on **two hypotheses**:

- ↳ **The first hypothesis:** The existence of a unified international agreement on a set of determinants of the energy transition, whether it is scientific, technical or practical. Even if this hypothesis includes two parts, they are related and cannot be separated or studied separately, because the determinants require the definition of the factors affecting the phenomenon under study and the study of their overlap and arrangement
- ↳ **The second hypothesis:** which is complementary to the first one, and defining the field of case study was as follows: The African oil economics are working hard according to an independent approach to achieving the global energy transition.

This **research paper aims** to provide an academic and a practical knowledge about the concept of energy transition, the philosophy of its definition and the embodiment within the official discourse of the international community institutions and analyze its path to study the extent to which its requirements are compatible with the African environment, so that it becomes a reference base when formulating its general policy on the one hand, and defining the axes of the executive programs formulated in this context on the other hand. Thus, its **importance** emerges as more serving the decision-makers in the African countries that suffer from the curse of an abundance of the energy resource on the one hand; On the other hand, it seeks to prove its presence within the international programs. This requires knowledge and a deep sophistication to take the appropriate decision and compare its data. Accordingly, a historical and a descriptive **method**, as well as a descriptive analytical method, was relied upon to formulate the body of this research paper, where it is reinforced by analyzing and collecting **data** from reports of international organizations. Moreover, this is included in the presentation of the following parts:

- 📁 **Part One:** The international framework for the energy transition and the mechanisms for its embodiment: this part discusses the concept of energy transition with multiple dimensions and how it was adopted internationally. It also reviews experiences and models embodied in the energy transition. At the end, it summarizes a number of challenges, as the ways to confront them are still under study and development.
- 📁 **Part Two:** The efforts of the African economies to achieve the energy transition: it presents the extent of the strong link of the African economies to the oil resource and the difficulty of achieving a separation from it in the short and medium term. Then, it presents a summary of a number of efforts and programs adopted in embodiment for local and international participation in achieving the energy transition. To analyze, in conclusion, the reality of the philosophy of the approach followed to embody the energy transition in Africa,

considering a number of internationally unresolved challenges, so, how will these developing economies deal with them?

II. The energy transition in the light of the international community efforts and the mechanisms for its embodiment:

From the date of Meadows, report issuance in 1972 to the second decade of the new millennium. The problem of the impact of energy on the environment has known several developments and studies. It soon gained a general acceptance for its treatment and embodiment. This was represented in the various types of the renewable sources that have been developed and implemented. Nevertheless, the term energy transition and the strategy to achieve it are still ambiguous. And this will be presented and studied in this part.

2.1 The energy transition -its concept and its multiple dimensions: the energy transition is defined as the set of processes and procedures in the current model of energy production, distribution and consumption to make it more environmentally friendly (**P.C.Perthuis & B.Solier, 2018, p. 03**). The goal is to shift from an energy system based on fossil energies to a system based on renewable energies that do not pollute the environment and do not waste its resources. Historically, the human life has witnessed several turning points of the energy transformation, considering the source of production based on it: It is the human and animal physical energy to convert muscular effort into energy to exploit thermal energy through burning humans and biomass to square the energy field fossil sources and its history. It was the greatest energy model that mankind has exploited whether in terms of the size or the duration of its exploitation, until the matter of abandoning it and replacing it became beyond hope and attainability. Despite the growing number of voices calling for the necessity of this, due to the fluctuation it left, and the change at the environmental level. The energy transition remains a major challenge and a priority in the 21st century. It is not limited to the structural change of the mode of production and consumption only, but also to a change in all aspects of the human life. It is a social and behavioral transmission; it takes place according to two simultaneous levels (**IRENA, 2022**):

- Working on weighting the energy consumption, towards green energy gradually from a “traditional/green” energy mix to a “green/green” mixture.
- Because the transition process requires a period of time that is difficult to know. The human individual is required to rationalize his energy consumption in order to preserve our resources and to avoid wasting them. And this is what the official authorities are trying to work on.

It should be noted and recalled here that this transition path requires a re-examination of the scientific process for choosing a sustainable energy alternative (**Amani.l&Boufafa.W, 2019, p. 05**), where a reading in the solid literature indicates that the process is based on a tight and deep weighting between the economic efficiency, the environmental dimension and the energy security... How is that?

- ❖ **The economic efficiency:** the exploitation of the least amount of the natural resource at the lowest possible cost. The research here is based on the selection of the resources that are abundant and practically easy to extract, and which provides the largest energy return that can compensate for what has been agreed materially and financially.
- ❖ **The environmental aspect:** the exploitation of the traditional energy sources has had devastating effects on the environment, whether it is related to climate change or the ecological balance. There is 3.7 million tons of carbon dioxide emitted by the coal industry in the United States of America alone! For example, the explosion of the Deep-water Horizon platform in the Gulf of Mexico in 2010 covered 68,000 square miles of sea surface and the resulting leak killed nearly one million shore and marine seabirds, 5,000 marine mammals, and 1,000 sea turtles.
- ❖ **The energy security:** relates to providing the usable energy supplies at the point of a final consumption, it is a continuous supply without any threat of cessation or interruption (**A.AUSRINE, 2018**). This term has been widely used, what made it implicitly included in the previous criteria. In front of these criteria, the demands for rapid action to materialize the energy transition are increasing, and the challenges associated with renewable energy and the path to achieving them are increasing. Where we find:
 - a. The high initial cost of installing renewable energy kits: the cost is an important factor influencing the adoption and embodiment of clean, renewable energy sources. Both solar and wind energies are the cheapest renewable sources, but they are significantly higher than the cost of installing a traditional energy system. The cost of installing large solar energy systems is about \$2000 per kilowatt, which is

- equivalent to a very small residence and a small unit area of a factory. This increases the inclinations to fossil energy (**forbes, 2022**).
- b. The energetic mix and the requirements for the flexibility of the distribution network: on one hand, the multiplicity of the renewable energy sources and the problem of storing them, and the natural conditions that govern them to ensure the continuity in the supply, and the distribution on the other hand. This leads to the necessity to plan in order to secure a continuous supply, especially at the level of seasonal gaps (low wind, sunset, increased energy needs) through low-carbon economic solutions. This will create major economic, technological and political challenges.
 - c. The fate of traditional infrastructure and the possibility of re-exploiting it: the current energy production infrastructure is compatible with the fossil energy sources. It is unable to deal with renewable energy sources under exploitation and development. It requires a large capital and a greater technical effort to repair it; however, it will not include most of the stages, which requires the creation of a parallel infrastructure that covers the production stage, pending the adaptation of the distribution stage.
 - d. The strong presence of traditional energy market structuring: the time dimension that separates between the stages of extracting, producing, marketing, distributing, and consuming fossil energy source gave way to "the Wall Street" financiers by developing a special structure for the energy markets that combines the spot market and the long-term market in order to manage the total operational and financial risks (**W.BOUFAFA, 2017**). This combination became a principle and a pivotal determinant in the movement of energy pricing on one hand, and the movement of money markets on the other. Since the clean sources of the renewable energy excluding the element of scarcity, the fate of this combination is most questionable. Does the capitalist thought accept that free?
 - e. The lack of awareness and support policies: the lack of knowledge and awareness of the renewable energy technology makes people hesitating to use it. In addition, the fossil energy exploitation plants are often the source of livelihood for the region's population. It is estimated that more than half of the world's population uses the traditional energy sources that pollute the nature and negatively affect their health. In the absence of the supportive policies and encouraging motives, the pressure increases over the duration of the energy transition.
 - f. The energy transition and the public health: the air quality raises major health problems. The problem of addressing it has taken a major focus and a fundamental space within the programs, and work of the World Health Organization (**Neira.P.maria, 2020**). The household air pollution causes more than 3.3 million deaths annually, especially in low-income areas' level... till when?

Despite the multiplicity of the determinants, and the growing pressures between the need for achieving the transition and the difficulty of reconciling the many challenges, the renewable energy has known a global adoption for its embodiment... So how will the paths to embody this be globally?

2.2Experiences of global efforts to achieve the energy transition: soon, peoples of the globe expressed, in the official discourse of their officials, the need for a rapid action in embodying the "proper energy transition" and the change of the traditional energy sources to clean sustainable sources. There was a diverse mix of sources accompanied by a diverse mix of usage. The body of the following paragraph reviews a comprehensive summary of this, so we find:

 **A diversified mix of the renewable energy sources**: the scientific research has contributed to the definition of a significant variety of clean energy sources that are derived from the use of the renewable natural resources. The scientific research has contributed to defining a significant variety of clean energy sources that are derived from the use of the renewable natural resources. Each of them has production advantages and drawbacks that will affect the comparing criteria on one hand, and the selection criteria on the other. And we find:

- **The sun**: it represents the best source because it provides a natural pressure for the fusion of two nuclei, so a great energy yield is obtained from this interaction. The process is called "the nuclear fusion". As for the panels (cells), they consist of semiconductor materials (mostly silicon) that receive the sunlight and start moving in an expulsion system to form an electric field. The electrons are released from the semiconductor material or the silicon to accumulate in a form

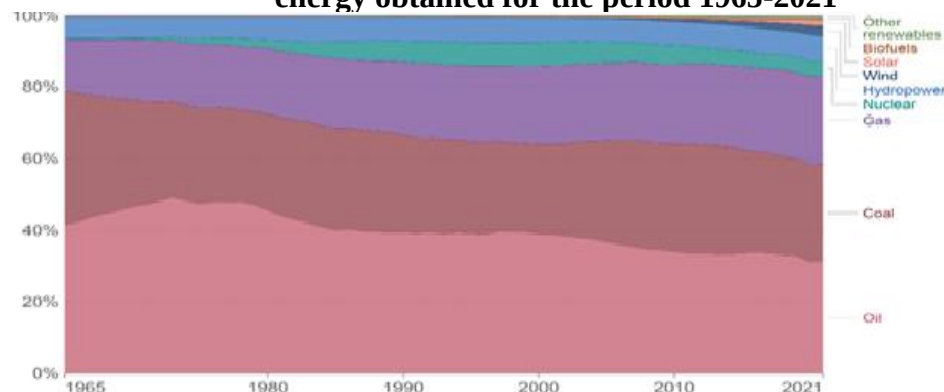
of electrical energy. What is wrong with this source is that it requires large areas, there are countries that do not enjoy radiation for only a very few hours. As for the nuclear fusion, the researchers are trying to embody the solar interaction on Earth. Because it neither emits carbon dioxide nor faces the problem of storage, there is no nuclear waste that requires storage and protection for a very long time, but it requires high radiation protection techniques.

- **The wind:** it is considered as the most promising clean energy after the solar energy, it is highly competitive with the rest of the proposed renewable sources due to its low cost (**electrobrahim, 2022**). As for the drawbacks, the public opinion blames the annoying sounds generated during production. To ensure more efficient production, placing the turbines in the middle of the seas is what achieves that. This creates significant operational risks on one hand, and other environmental bets that must be managed on the other hand.
- **The water:** the method of generating electricity depends on the Kinetic energy. The production efficiency increases with the increase in the volume of the flow, Because of the scarcity of the potable water that the globe is witnessing; this source is not very reliable as a permanent alternative, but only within the transitional mix.
- **The hydrogen:** the electricity is produced in this case through a chemical reaction between the hydrogen and the oxygen. In contrast to the process of dismantling water, a hydrogen fuel cell achieves the reaction between a hydrogen atom and oxygen so an electric current is produced and water is formed. At the beginning, this technology requires some traditional energy to produce the electricity that the cell needs to ensure the reaction, to later re-exploit the resulting water in order to produce the new cell of electricity without resorting to the traditional energy (**ifpenergiesnouvelles, 2022**).

In front of this diverse assortment of clean renewable sources. There have been considerable efforts to exploit and employ it; the renewable energy has seen a multiplicity and a diverse presence.

📖 **The variety and the diversity in the areas of use:** the renewable energy contributes to improving the well-being of the societies and the saving lives. Therefore, we find it present in various forms of our daily life, even if the rates of its presence vary. The treatment was carried out according to a number of indicators, where we find that according to the rate of distribution of the energy consumption, we record a slight, regular, and a gradual rise - Figure 01-, with regard to the energy consumption from clean sources or in the decline in oil consumption, which decreased from 63% to 17%, while the consumption of both of natural gas and nuclear energy increased from 28% to 46%. However, oil still holds the lead, after the gas and coal.

Fig.1. the distribution of energy consumption according to the sources of energy obtained for the period 1965-2021



Source: the Statistical Database of the International Renewable Energy Agency.

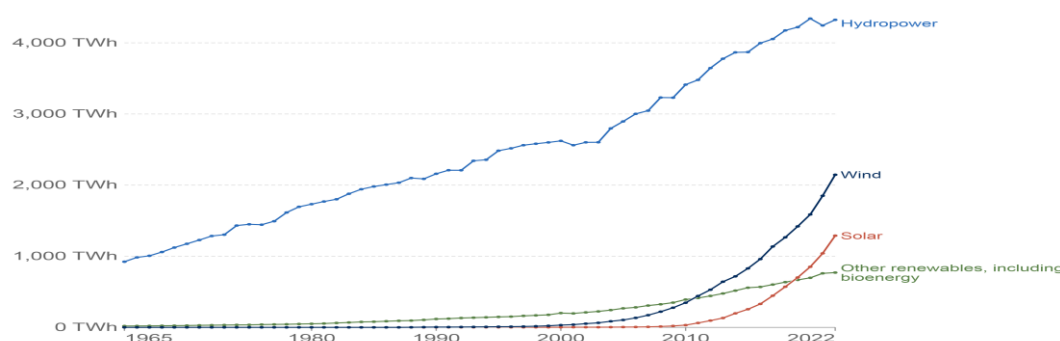
In spite of multiple sources, the traditional sources still have the lion's share in the production of electricity i.e. the fuel of the human life today, where we find: 63.16% of them come from the fossil fuels and 17.33% from the nuclear source, which is equivalent to 19.51% of the renewable sources.

At the same time, the use of renewable sources for clean energy generation have grown faster. At the forefront of the water source, then the wind, then the sun, and the rest of the other clean sources,-Figure 02-.

Hydropower is the backbone of low-carbon electricity generation, providing almost half of it worldwide today. Hydropower's contribution is 55% higher than unclears and larger than that of all other renewables combined, including wind, solar PV, bioenergy and geothermal. In 2020, hydropower supplied 17% of global electricity generation, the third-largest source after coal and natural gas. Over the last 20 years, hydropower's total capacity rose 70% globally, but its share of total generation stayed stable due to the growth of wind, solar PV, coal and natural gas.

China is the largest producer of hydroelectricity. Other top producers of hydropower around the world include the United States, Brazil, Canada, India, and Russia. But Hydropower can also cause environmental and social problems. Reservoirs change drastically the landscape and rivers they are built on. Dams and reservoirs can reduce river flows, raise water temperature, degrade water quality and cause sediment to build up. This has negative impacts on fish, birds and other wildlife.

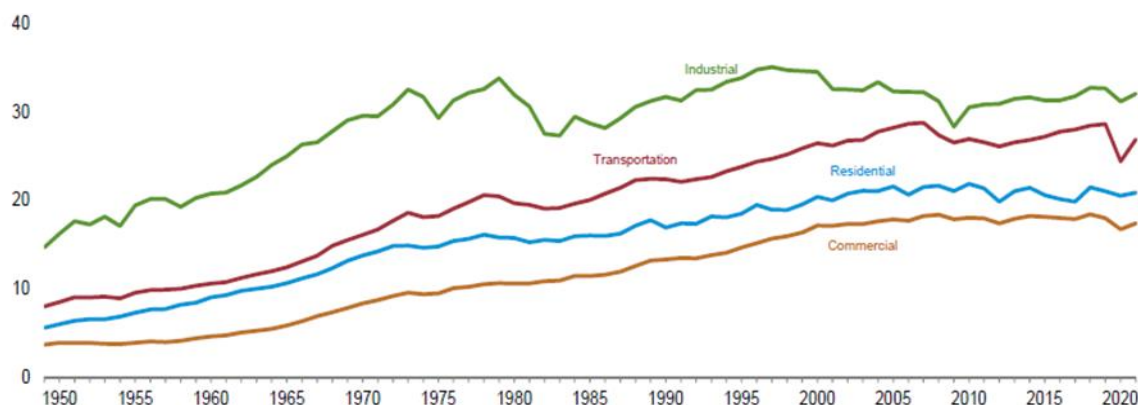
Fig.2. the distribution of energy production according to the sources of access for the period 1965-2022



Source: the Statistical Database of the International Renewable Energy Agency.

To deepen the picture about the energy consumption by sectors of the economic activities, we find that the industrial sector takes the lead since the second half of the last century to this day - Figure - 03 -:

Fig.3. the distribution of energy consumption by the sector of economic activity for the period 1950-2020



Source: the Statistical Database of the International Renewable Energy Agency.

However, in light of the international efforts to embody the energy transition, attentions are directed to the transportation sector, which is very reliable, for example, the Norwegian economy. Despite its presence in the list of the oil-exporting economies, we find that it relies on the hydroelectric power by 95%.

This allowed 40% of the motor vehicles on its lands to operate with this energy; this has received a great consumer demand against the background of tax and insurance motives

accompanying its consumption. The efforts are also continuing to establish the charging centers for the battery of the electric cars at many close points. The Norwegian society is also considered as the European population integrating with the clean energy (euronews, 2022).

The transportation sector is classified one of the most polluting sectors and the human activities for the environment and for consuming traditional resources. The transportation sector is expected to consume approximately 61% of the total primary energy consumed globally by 2035.

Oil is still the main source of transportation, despite the innovation of alternative sources and environmentally friendly consumption technology. Worldwide, petroleum and other liquid fuels are the dominant source of transportation energy, although their share of total transportation energy declines over the 2016 projection period, from 96% in 2012 to 88% in 2040.

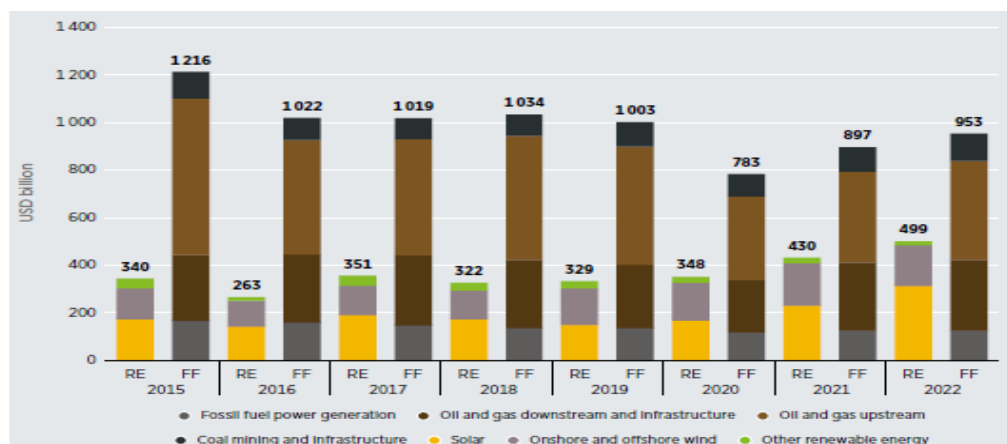
World transportation sector liquid fuels consumption grows by 36 quadrillion Btu in the reference case projection, with diesel (including biodiesel). Motor gasoline remains the largest transportation fuel, but its share of total transportation energy consumption declines from 39% in 2012 to 33% in 2040. From 2012 to 2040 the total transportation market share of diesel fuel (including biodiesel), which is the second-largest transportation fuel, declines from 36% to 33% and the jet fuel share increases from 12% to 14% in 2040.

Today, in rapidly growing places such as India, China, Africa and Southeast Asia, billions of people have expectations for a better life, as well as new aspirations for mobility and transportation efficiency. In addition, mega projects such as China's "One Belt, One Road" project will connect more than half of the world's population and about a quarter of goods and services that move around the world through sea and road links. Although there is, a long-term vision focused on the sustainable development as an important factor in the future of mobility. However, transportation is not included as one of the 17 Sustainable Development Goals. This is largely because the transportation sector does not speak with one voice to influence this global process. A number of transportation components have been included in the different sustainable development goals for instance the road safety, and the carbon emissions, etc.

Over the past two years, the international community has made several commitments related to transportation. For example, transportation constitutes a major element of the general policy of the work program agreed upon by the landlocked developing countries and their development through linking them with other countries. The international community also adopted the New Urban Agenda at the Third International Conference held in Quito, the capital of Ecuador, which highlighted the importance and inevitability of improving the sustainability of transport systems to alleviate the burdens of a rapid urbanization.

The last observation that we make about the global consumption of energy from clean sources in particular, is the leadership of advanced economies in consumption and production. This is due to the volume of investments allocated for this. Figure-05-

Fig.5: Annual investment in renewable energy vs. fossil fuels, 2015-2022



Source: The statistical Database of the International Renewable Energy Agency

Note: FF = fossil fuel; RE = renewable energy.

Considering the figure above, it can be noted that:

- Fossil fuel investments had declined in 2020 (down 22% from the USD 1 trillion invested in 2019) mainly due to the impacts of the COVID-19 pandemic on global energy markets

- Nevertheless, 2021 saw fossil fuel investments bounce back up 15% to USD 897 billion and preliminary data for 2022 suggest they might have almost returned to their pre-pandemic levels (+6%), reaching USD 953 billion.

These efforts are described as gigantic and successful because they gradually moved into source, a sector, and a field of consumption. This allowed it to achieve effective management and its embodiment in the field. The Norwegian economy is heading towards recording 95% of its consumption from water energy; the transportation sector is covered by 42% of environmentally friendly cars. As for the Japanese economy, which has a scarce and difficult geographical structure, it has developed hydrogen technology to obtain a clean electric energy with great returns. It abandoned the nuclear model and the 2021 Olympics was an example of applying an environmentally friendly human life model by all the standards other than the Corona pandemic - however, there were a considerable control and precautionary measures.

Despite these numbers and the efforts to achieve, the reality is still very modest. Meeting the requirements of the Paris Agreement alone requires action at a rate six times faster than what is currently in place. By 2050, the renewable energy should make up two-thirds of the world's total energy (IREA, 2019). These facts reflect the depth of the time dimension in the transition, but it is not impossible... So does the transition process face other obstacles and challenges?

2.3 The obstacles and challenges facing the energy transition process globally: as a major platform for the international cooperation in the field of renewable energy, The International Renewable Energy Agency presents an annual compendium on the global prospects to spread the use of the renewable energy and its replacement use. Despite the state of the economic stagnation that the international community has experienced, we cannot neglect the important and the urgent need to take accelerated steps to keep up the Millennium goals within the appropriate economic stimulus options. Considering the efforts of the achieved experiences and the programmed planning scenarios, there are still a number of obstacles and challenges facing the process of energy transition globally, namely:

- ❧ **In terms of concept:** various academic studies and official reports did not specify a final and a unified definition of a clean and a sustainable energy source. It is rather a balance and a weighting between the economic efficiency, the environmental dimension, and the energy security. At this point, it is difficult to differentiate between the environmental dimension and the rest of the dimensions, because the planet Earth is the place of life for everyone. Although, this scenario is far from being proposed in time, but it is possible to realize it. The selection criteria gives weight to the energy yield and cost, but the environmental dimensions of the tools and equipment of the renewable energy sources have been neglected, which did not take the full place to study its consequences. In other words, the solar source may be the best yield and the most cost, but the waste of its solar cells may have good consequences on the environment. Which makes us wonder, whether it is currently being addressed during the transition stages, by defining the best alternative sources or drawing the attention of decision-makers to the necessity of defining this problem within the axes of their plans for the transition, hoping that the scientific research will provide the final definition in that.
- ❧ **The replacement period, the fate, and the movement of the industrial growth:** the industry faces a double challenge in terms of sustainable development and its objectives. It is required to practice more environmentally friendly production methods, and adopting "green growth" technologies. In light of the reluctance of the major industrialized economies governments, to adopt agreements, to reduce the carbon emissions, the problem of the energy transition is apprehensive about the time required for the replacement on one hand, and the cost of that replacement on the other hand. The industrial sector outperforms in the traditional energy consumption.
- ❧ **The economic disparity level:** although it is considered as a goal within the Millennium Development Goals, the problem of disparity between the economies of the international community is still taking an upward curve. Through the tenth goal entitled to reduce disparity, we find that 10% of the world's population makes up to 40% of the total global income, whereas the poorest 10% earn only between 2% and 7% of total global income. At the level of most of the developing countries, including oil, the inequality rates increased by 11% if the population growth rates were taken into account. These levels of inequality, which are widening require adopting intact policies to empower the lowest income groups and to promote the economic integration for all.

✎ **The financialization of the traditional energy markets and their fate in the capitalist thought:** in conjunction with the spread of the digital bubble, at the beginning of the third millennium, the number of the financial investors has not ceased to be increasingly present at the level of the raw materials markets. A wide variety of financial instruments have been developed for these basic commodities, which have become a major topic of trade in larger financial spaces. The raw materials market is witnessing a new division based on the nature of the carried out transactions, where we find real markets in which inspection and delivery take place, and financial markets that are dealt with at large rates that may exceed the real ones. In front of this "Mali Wall Street" invasion of the raw materials market led by oil, the horizon indicates neither the possibility of canceling it nor even stopping dealing with it. So how is it versus clean energy?

✎ **The scientific research and its financing:** The health crisis caused by the COVID-19 pandemic has confirmed the role of the scientific expertise in protecting us and improving our life level. In addition, the ability of science to produce knowledge in relation to available resources, the energy, the universe, life and society is increasing. It represents an essential task for it, and it will be closely and increasingly intertwined with the technology. It will also give it the opportunity to play an important role in the development of the public policies in fields such as health, energy, transportation, defense, etc. It is, therefore, useful to assess the role of the scientific expertise that plays in the political decision-making and the democratic debate on energy issues...

From the above, the selection criteria and the formulation of the most appropriate energy model are revealed. Which was, according to the capabilities and the resources of the economy and although the international community agreed on the need to move .However, a unified final framework for all is not yet known. The decision, rather, remained an individual one, which requires the fulfillment of the standards only, unless life developments raise new determinants. So how is the case with the African oil-producing countries in particular?

III. The efforts of the African economies to achieve the energy transition:

3.1 The depth of developmental link with the oil resource: the African economies do not succeed in getting rid of the features of underdevelopment despite the vastness of the area, and the diversity of its objects and components. Despite their political independence, most of them suffer from (J.Gasqian, 2013, p. 245):

- a) **The Dutch disease:** this concept has been associated with the hydrocarbon-exporting economies as an expression of the severe decline of the economic sectors in general as a result of the boom in petroleum exports. In fact, it means all the economies which were satisfied with exporting their natural resources in a way that affected - and affects - some activities that are considered important for the growth such as: education, industry, government policies, ...etc. It refers to the contraction of productive sector due to the expansion of the exploitation of these resources as the proceeds from export process leads to an increase in the exchange rate of the national currency, which leads in return to the rise in prices of its produced goods. Thus, it weakens its competitiveness at the international market level. On the other hand, the price of imports from abroad decreases, this leads gradually to the demise of the local production activity, and the consequences of that lies in the rise in unemployment rates and others.

And through a survey of summarized statistics of the development of the general and the economic situation, especially for these economies, contradictions of dependence on the export of these natural resources emerge.

Despite the positive growth recorded by the growth rate of gross national product for most of natural resource economies, which ranged between 1.7% to 3.6% during the period between 1964-2019, the reason for this is primarily due to the increase in the volume of its exports of natural resources due to an increase in the global demand for them on one hand, and the increase in their prices on the other hand. However, these revenues were not invested in boosting the development movement. The unemployment rates remained high and the individual welfare indicators were low. The inflation caused by the increased wages has absorbed the value of this money. The indicators of the educational level also remained low, especially that its share of the state budget

did not exceed 10%. Despite the decline in illiteracy levels, the rates of emigration of highly skilled workers increased, it exceeded 16.7% during the period between 1990 and 2019. Despite the general situation in most of the economies of natural resources, however, that does not cancel out the significant disparity in the efforts aimed at disengaging the economy and activating the path of growth and development. The economies of African continent maintain their lowest levels. It is also difficult to collect accurate and comprehensive data on the situation there. The economies of Asia and the Pacific region record a large rate of dispersion among the statistics of urbanized countries and the rural countries such as India, Pakistan, Vietnam and Yemen. However, this phenomenon is not inevitable if the process is accompanied by the development of comprehensive and strict measures in order to control this rent in a manner that serves the development needs of the host country. On the other side, we find that the natural resources sector is an isolated sector with weak links with other sectors, as:

- In terms of the capital ownership and management of its proceeds: the state supervises ownership of the sector as well as the allocation of revenues generated from it under the principle of national sovereignty. However, it exaggerates spending, during the years of recovery brought about, by high prices on huge unproductive projects, which leads to the absorption of a large mass of public funds. It could have financed productive activities that would help it to improve the growth indicators later, and face the financial deficit when revenues fell. Therefore, the international organizations (based on theoretical and experimental studies) often recommend using these revenues, especially the unexpected part, to expand and deepen horizontal and vertical links with other sectors of the economy.
- As for exploitation: the mission is entrusted to foreign companies that did not invest and are not interested in investing huge profits that they earn from their activities.
- b) **Neglecting the agricultural sector:** despite being the first economic sector and the origin of human activity, it has been neglected as its share declined at the expense of the activities related to the natural resource, whether extractive, commercial or service and it does not exceed 15% of the gross domestic product. The situation does not differ with the difference of the natural resource. The countries' producing agricultural products such as cotton, cocoa or coffee, the agricultural activity stops at this material and depends on the proceeds of its sale to meet the needs of the various remaining goods. Despite the intensive efforts that were launched at the beginning of the seventies to take care of the agricultural sector and work on developing it so as to activate its contribution to achieve the development. The conflict remained between the agriculture directed to exports and the living agriculture. The volume of general expenditure on the agricultural research remained low; it does not exceed 5%, although the yield of lands of these areas indicates good figures, as it reaches 43.4% for cereals, 84.8% for oil crops, and 50.4% for the agricultural products with an industrial orientation. Peoples of these countries consider the farmer or the worker in the agricultural sector as a second-class citizen, in addition to his adoption of the traditional agricultural techniques. And if the developed techniques are found, they need financial support that exceeds the capacity of the farmer. Despite the lack of the arable lands, the climate change experienced by some developing countries, especially the African ones, has worsened the situation, for example: drought in Niger, Ethiopia and Somalia. Since investing in this field requires significant materials and financial capabilities, the results can only be fulfilled only in the medium and the long term, "carelessness" and "irresponsibility" have become widespread among these countries' peoples in everything related to this activity, which was limited to foreign investors or to the state itself.
- c) **A consumable market:** With the absence of a local production base and the decline in the agricultural production, African economies in general represent consumable markets that developed countries are rushing to access them and work to acquire the largest share there. With the low level of these economies' competitiveness, the cost of most of the imported consumable products became less expensive than those produced locally. So, its food bill rose.

- d) **The failure and the bankruptcy of the economic policies:** by gaining its political independence, the institutional legacy and the national resources were managed by elite that did not have a political orientation with a long, or at least medium term dimension. Most of them applied the ideas of the socialist current to a capitalist structure with exaggerated goals (There was no compatibility between the volume of the national spending and investments with the real need of the country) this left a vortex of problems that were exacerbated because of the mismanagement. This has also led to a rise in the debt ratios that it could not pay. It resorted to foreign financial institutions and international organizations to lend; it required it to correct its economy according to a set of conditions and rules dictated to it in order to benefit from new loans or to reschedule its bad debts. It opened up to the global economy with a very fragile economic and institutional structure, which worsened the situation.

Despite the fact that the African environment is rich in nature and poor in humankind, most of the continent's economies are witnessing a multi-dimensional renaissance movement that included the need to activate the continent's international presence by adopting the Millennium Development Goals and devoting efforts to achieve them... How was that?

3.2 The experiences of the African economies in the path of energy transition: the Kenyan capital, Nairobi, was chosen as the world's capital for the environment during the first meeting of the first United Nations Environment Assembly, the international community strongly supported the African reality in order to achieve the Millennium Development Goals in the field of energy climate. There were a number of initiatives that varied between “the national” ones, by which we mean the commitment of the state within its general policy and between “the regional” that includes concerted efforts of the economies according to its location. We summarize the most important of them as follows (abdullah Al-Shamali & others, 2019):

At the national initiatives' level: We list below the most important experiences recorded by the African economies in the field of sending investments to establish clean power plants. Where we find:

- ✎ **The Kingdom of Morocco:** It is considered the leading African country in the use of solar renewable energy through its establishment of the generation station in the "Wazazart" region. The station contains more than one million solar cells and an investment volume of nine billion dollars. It aims to cover half of the country's energy needs by 2040.
- ✎ **Cameroon:** launched the "LOOM" project, which is related to the completion of a power plant using the hydropower of the "Sanaga" river. It is expected to generate 6000 megawatts of clean electricity, after regulating the flow of river water to ensure the best use.
- ✎ **The Democratic Republic of the Congo:** The government has allocated the "Anga" site for the construction of hydro-generating station by exploiting the roaring Congo River. Although the estimates indicate an amount of 100,000 megawatts, only 2.5 percent of this potential is being exploited.

At the regional initiatives level: in this context, the African continent can be divided into four regions, where every region witnessed a number of efforts to create a good energy transition path and accelerate its pace. So we find:

- ✎ **The region of the North African countries:** it includes the economies of: Algeria, Libya, the Kingdom of Morocco, Tunisia, Mauritania, the Western Sahara, Egypt and the Northern Sudan. The general policy of these countries has set goals at the national level in cooperation with the League of the Arab States, which constituted a regional center for an efficient renewable energy. The strategy of this policy extends to 2030 and aims to achieve a clean energy production share of 12.4%. That was done by writing a plan that includes 17 programs: 11 of them at the national level, and 06 at the regional level.
- ✎ **The region of the West African countries:** It was in July 2013 that a common policy among the economies of this region for clean energy was defined. It includes Benin,

Burkina Faso, Ivory Coast, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo and Cape Verde. It aimed to realize a contribution rate of solar energy from 35% in 2020 to 48% in 2030, and from 10% to 19% for the hydropower. Plans and programs were put with the European support and partnerships in line with the regional goals announced by the countries of the region, as well as the development goals. They also emphasized on efficiency and the market development for these sources.

- ✦ **The region of the East African countries:** the countries of this region consist of: Djibouti, Ethiopia, Somalia and Eritrea, in addition to Sudan, Kenya and Tanzania created the "East African Center of Excellence for the Renewable Energy and its Efficiency." it aims at the same time, to facilitate the procedures for creating the renewable energy markets and investments in this field. All Member States defined their national and regional goals that by 2021 there was no regional, a national plan, or even an agreement on a single goal.
- ✦ **The region of the Central African countries:** Eleven ministers for the economies of this region, including: Angola, Burundi, Chad, the Central African Republic, the Democratic Republic of the Congo, Rwanda, Sao Tome and Principe, the Gabon, Equatorial Guinea, Cameroon and the Congo, had met and decided to establish a research and development center, and to appoint a specialist to supervise the embodiment of a road map in order to achieve the energy transition. It started from excluding water source, because the region is geographically scarce and it aims to achieve 77 percent as an energy mix until the end of 2021.

As for the **South African region:** The level is advanced there compared to the rest of the economies of the continent, we find that it adopted a strategy to achieve the energy efficiency and it formulated the plan for action in July 2017. Its regional objectives included increasing the share of the renewable energy in the electricity mix in the region to 33% in 2020 and 39% in 2030.

3.3The bases for establishing the transition path and the efforts made to achieve it:

the energy system based on renewable sources can help to solve many social, economic, health and environmental challenges in the African continent. The energy transition has become essential for a secure climate future and to fulfill the benefits of the sustainable development. However, only about 48% of the population of the sub-Saharan Africa has access to electricity, with this access in 2019. Despite the huge capacities of the continent in the field of wind, sun, water and heat. Especially that the falling costs of the renewable sources are on an increasingly growing path

- ❖ According to SPG, a website specialized in energy, 40% of the new global gas discoveries in the past decade were in Africa especially Senegal, Mauritania, Mozambique and Tanzania, where 17 countries produce gas in addition to having seven net exporters and seven importers, according to the African Energy Commission. However, more than 45% of Africa's natural gas production is exported. While the gas's contribution to the energy balance is "little".
- ❖ The solar energy is the largest renewable resource that contributes to spreading a clean energy and achieving the energy transition. It has contributed by adding about 26 giga watts over the past decade.
- ❖ The average annual investment in renewable energy has grown tenfold, from less than \$0.5 billion in the period 2000-2009 to \$05 billion in the period 2010-2020.
- ❖ In contrast, 2% of the global investments in renewable energy in the past two decades were made in the African continent, with significant regional variations. This path created only 3% of new jobs.
- ❖ The renewable energy distribution mechanisms through autonomous systems and small grids are steadily contributing in expanding the access to clean electricity and strengthening the supply chains locally and regionally, which is absent on the approved African paths' level.
- ❖ The hydropower represents the largest share of the total global renewable energy generation capacity of 1230 GW. However, the renewable energy statistics of the year 2022 from the International Renewable Energy Agency show that the solar and the wind energies continue to dominate the new generation capacity. The two technologies together

contributed approximately with 88% of the share of all the new renewable capacities. This enhances the source options for the African continent.

- ❖ The African countries must contribute in different ways to the efforts to reduce the emissions at the international level. This transition to a clean energy means less dependence on the fossil fuels. Although the continent's oil consumption is estimated at only 9% and only 3% of the oil is used in the transportation sector, it is supposed to be the most polluting sector in the continent.
- ❖ The African continent is extraordinarily diverse; the features of the failure of the unilateral approach to advance its energy future are being confirmed day after day. Therefore, careful, comprehensive, and additional efforts must be made to build modern, resilient, and sustainable energy systems all over it. Those efforts avoid it being stuck in conventional or other undesirable systems. This increases the burden on it and limits the economic prospects that are hoped to be reached.
- ❖ In light of the numerous and overlapping data on the energy transition path, the Ukrainian-Russian war "provoked a significant surge in oil prices since its beginning, as it is the second largest exporter of crude in the world. Brent crude hit \$139 a barrel on Monday before falling back, but it remains very high. What is interesting and disturbing here is to which extent are the economies stable on their path to the energy transition? Such situation provides the African economies with an opportunity to earn additional revenue streams to enhance the status of their impotent treasury, due to the delay in their development project and the global economic stagnation of the Corona pandemic.
- ❖ In parallel, the custodian European continent is exploiting this situation as an inheritance over the majority of the African oil economies to consolidate new economic relations by which it saves its precarious situation regarding the energy supply. Are there rationality and sanity in taking advantage of the opportunity?

IV - CONCLUSION:

By looking at recent reports and data issued by the International Renewable Energy Agency, we find that those reports insist on the continued achievement of the renewable energy for growth and gaining momentum despite the degree of the global uncertainty left by the "Covid-19" pandemic. By summarizing the set of data and the analysis, we find that there is a unified international agreement on the set of determinants of the energy transition. The processes were framed in a series of stages, starting with the selection of the energy source and then replacing it, in order to spread relying on it in various aspects of the human life. There are stages and only one stage is agreed upon at the international level. However, with regard to the first stage, which is the basis, the choice was left to the decision makers, which is the focus of its general policy. Thus, the choice differs from one country to another, and the international agreement on this has not been achieved. This confirms the validity of the first hypothesis in its first part about the compatibility of the stages, while there is no unified final chapter at the level of its second part related to the type of source. The same case is true with regard to the second hypothesis. The analytical study confirms the existence of a diligence from the part of the African oil economies to abandon the polluted traditional energy sources under the leadership of oil. Despite its fateful place within its development project, but this diligence is not part of an independent approach that comes from the data of its environment and the volume of its resources, as much as it is a partnership and an import of experiences, which speeds up the process in the short term, but it takes a long time to achieve.

By the end of 2021, the global renewable energy generation capacity reached 3,064 GW. This led to an increase in renewable energy stocks by 9.1%. The energy transition is expected to create jobs that exceed those achieved by the traditional sources. However, this requires:

- An overall policy package that combines the pursuit of climate and environmental goals on one hand, and to achieve the economic development, job creation, social justice and welfare for society as a whole on the other hand.
- A great coordination at the regional level and a greater international cooperation through a strong, honorable and transparent institutional structure, especially at the North-South relations level.

These requirements may pose a new form of economic dependence to the African economies in light of the weak institutional structure they possess, especially with regard to innovation and research, because they are the winning card for achieving a flexible and a sustainable transition. It is the problematic that the international community has not yet decided its details. So what is the case with the economies of the black continent, which the proposed solutions for the advancement of its situation are still betting on the possibility of achieving the energy transition to a qualitative leap? It gives it options to exploit its capacities. It can produce hydrogen from the natural gas, choose innovative carbon capture, storage, and use the technologies in order to exploit its natural resources in an environmentally friendly manner.

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