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International Energy Transition: A Review of its Status on Several Continents

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ABSTRACT

Many of the more developed countries and other members of the United Nations organization are already working hard on energy transition issues, which is nothing more than the independence of fossil energy sources and the technological foray into clean energy sources. This independence is generally achieved by replacing conventional energy sources with alternative renewable sources, and because of this, it is also necessary to adapt or replace systems using these conventional sources with systems using alternative sources. In the United States of America, they have set to work seeking to reduce dependence on oil and increasing the production of natural gas and biofuel, which will save eighteen hundred barrels of oil. In England, decarbonization and energy efficiency increase plans are carried out that proposes an 80% reduction in emissions. Likewise, efforts are made in the European Union to increase energy efficiency and renewable energy, as well as CO_2 capture and nuclear energy generation, as well as cost reductions of all renewable energies of up to 53%. For its part, China represents almost half of the world's investment in renewable energy in something they call the energy revolution, despite the fact that it has also been a major importer of oil. In Latin America, Brazil is aiming at decarbonization by designing adequate mechanisms and policies for sustained development in the use of renewable energy sources, in addition to increasing the use of solar electric power generation sources, among others. In this paper, you can find the efforts made and projections on energy transition in some countries.

Keywords: Energy Transition, Consumption Reduction, Energy Efficiency, Decarbonization, Renewable Sources
JEL Classifications: L78, L90, O31, Q20

1. INTRODUCTION

Currently, in all countries, alternatives to energy and fuel supply are hastily sought, this diligent and impetuous search is what creates a state of transition, where all the energy obtaining systems are put to the test to be replaced or updated by others who are more efficient friendly to the environment. Also, stronger motivation is the fact that fossil fuels are part of the non-renewable energy group. That is, it is a limited resource and has a time of availability; therefore, having sensitive systems dependent on the existence of this resource. It is something you want to avoid (Ramkumar et al., 2020) (Wei et al., 2020). The energy transition is also driven by the need to better satisfy the energy consumption sectors in non-interconnected or remote areas where it is difficult to supply from the electricity grid, so renewable energy is a very viable option for these points (Batinge et al., 2019). Another important aspect is that along with the energy transition transitions are generated in various aspects of a region, these aspects are strongly influenced by the energy transition which can improve the quality of life of a country, change the forms of production and labor productivity (Lee and Yang, 2019).

The world has been exploiting fossil energy reserves such as coal and oil for decades, and at the same time, there are also decades of scientific knowledge developed to use this energy in the industry (O' Sullivan et al., 2003, da Hora, et al., 2019). The state of oil reserves disagrees, and those who are producing oil conveniently say that the existing reserves are sufficient for decades, and those who disagree with this say that the peak of oil production will begin to decline. The truth is in the way the reports are analyzed, and what happens is that the oil reserves that can maintain the commercial prices of the exploitation, that is, in which the oil maintains relations in cost of exploitation and cost of sales similar to the current ones are few. After these reserves, there is more oil, but at a higher cost of exploitation (Owen et al., 2010).

However, the scientific communities and governments of the world have realized that this widespread use of these energies has brought bad consequences, and not only that, but it has increased concern, knowing that the reserves may not have the capacity to satisfy the forecasts of growing demand (Alekkett, 2007). 51% of the oil fields in the world are in production decline, and 15% have stopped producing already. And 80% of the major oil fields are beginning the decline. The rate at which oil reserves decrease after the peak of production is estimated at 4.5-6.7% (Robelius, 2007) (CERA, 2008).

The energy transition is something that has to take place in the countries, whether the oil reserves last for decades or not, since this can make better use of non-renewable resources since obtaining energy would not focus on this point. If not, it is supported by multiple renewable sources. The energy transition is an issue that has been generated in cities, but it is something that involves not only cities but rural areas (Nuamann and Rudolph, 2020) (Ramesh and Saini, 2020), which play an important role in the generation of change, since these are the ones that generate perhaps the greatest amount of resources, the raw materials for the generation of Biogas and seeing the land space as a resource (Rehman and Saini, 2010) (Poggi et al., 2018).

Rural areas are one of the most benefited areas since many times they use mostly inefficient energy systems and non-renewable energies, in addition to the fact that due to their remoteness these areas do not have easy access to energy sources (Murphy, 2001) (Cloke et al., 2017). Furthermore, in many cases, these areas are the source of raw material resources for the generation of renewable energies such as the production of biogas and bioethanol (Roubíki and Mazancová, 2020) (Zhang et al, 2020) (Mostafaeipour et al., 2020).

In this rural context that is closely related to urban development, it is also affected by natural disasters that apparently only affect the areas affected by the disaster; they also have repercussions in other associated chains, for example, a drought can affect the electricity generation of A country and in turn affects the generation of Biogas since the raw material can be produced using plant or animal resources (Weng et al., 2020) (Birkmann et al., 2010).

The energy transition can become a risky political and business challenge that today is driven more than ever by the strong changes in the energy system that have occurred since the last half-century (Miller et al., 2013).

The most specific factors that drive the energy transition are technological innovation, and the climate change policies that they create are creating a path for the proper development of new energy sources. There are various definitions of the energy transition, which are generated by the diversification of fuel sources, governments, supply networks, and trade (Bazilian et al., 2013). Hirsh and Jones characterize the energy transition as the change of primary fuel, or the predominant technology and Araujo says that the energy transition is developed by the change in the scheme of how energy is used, including details associated with the type of fuel, access, the supply, the reliability and the final use of this energy (Hirsh and Jones, 2014) (Araújo, 2014).

Over time, the energy transition has become a subject of study as an interdisciplinary investigation. For this, some organizations have developed energy indicators that seek to keep track of the performance of energy systems at the global, national, and local levels. Some of these may be the World Bank (The World Bank, 2020), The International Energy Agency (AIE for its acronym in English) (IEA, 2020), The International Renewable Energy Agency (IRENA for its acronym in English) (International Renewable Energy Agency, 2020).

However, these energy indicators do not take into account the complex interactions involved, such as political, social, and environmental aspects. Some other indicators take into account this type of interaction and allow government systems worldwide to be able to make decisions on the subject more assertively. Some of these indices link to access to energy and human development as an energy development index (EDI for its acronym in English) (Organisation for Economic Cooperation and Development, 2020), the Multidimensional Energy Poverty Index (MEPI for its acronym in English) (Nussbaumer et al., 2012), The Sustainable Energy Development Index (SEDI for its acronym in English) (Iddrisu and Bhattacharyya, 2015), And the World Energy Council's Energy Trilemma Index, among others, which provides a concept linked by three aspects such as energy security, energy equity and environmental sustainability (World Energy Council, 2020) (Vera and Langlois, 2007).

2. ENERGY TRANSITION AND PROJECTIONS ON VARIOUS CONTINENTS

The objective of the energy transition, among other aspects is climate change, to promote this energy transition towards a distributed energy model, with low environmental impact and greater affordability and diversity, it requires investment, it acts in the long term, and this is due. This is to change the existing diversity of the current energy system. The economy reflects the impact given by the tendency to invest in renewable technologies and the investments made in R&D results given by the diligent search for compliance with carbon reduction goals and government support. This results in a decrease in the costs of renewable energy production technologies. This is demonstrated by the annual amount of installed solar energy equipment, which increased from 31GW in 2012 to 39GW in 2013. Wind energy has also increased in this period by 40% of its total capacity (Frankfurt School of Finance and Management gGmbH 2018; UNEP Collaborating Centre for Climate and Sustainable Energy Finance, 2018).

2.1. European Union

The European Union has uneven progress in terms of renewable energy, and this is due to the differences in the interests of the different members of the EU, which leads to different foreign energy policy strategies. This creates a classification between the EU: Countries that focus on renewable energy and see it as an industrial opportunity and the way to mitigate dependence on fossil fuels, sometimes imported and those that see the energy transition as something expensive and unstable as to replace fossil fuels. The EU proposes that by 2030 a deployment of renewable energies has been reached in such a way that it will allow 32% dependence on the total energy basket. This approach was made in the European Parliament, in which they agreed among other things the participation of renewable energy should increase from 1.3 to 1.1 percentage points in energy used for heating, renewable energy should also have a participation in fuels of 14% supported by mandatory fuel suppliers (Council of the European Union, 2018).

In the European Union, scenarios are presented in which an increase in energy efficiency is observed, motivated by the foreseeable increase in fossil fuels. Although fossil fuels continue to dominate the market today, green fuels such as biofuels, electricity, or fuel gases have increased. This is reflected in the low participation in the energy basket of gasoline, which is around 26% to 11%. Trends in the EU show an increase in the service sector from 75% to 78% by 2050, and an increase in prices of crude oil up to 27%, gas up to 24%, and coal prices growing up to 33%.

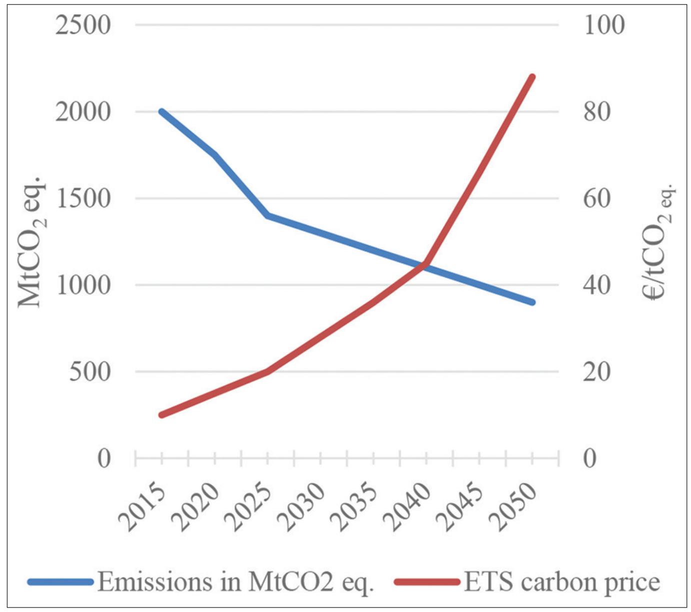
Greenhouse gas emissions have decreased by 1.74% annually since 2013. According to EU policies, the emissions trading system (ETS) is a key policy with which the EU seeks to reduce emissions. Emissions, this covers around 45% of Greenhouse Gas (GHG) emissions, which sets a limit on the total amount of GHG emitted. In 2020 ETS emissions drop by 21% compared to 2005. The graph shows how CO_2 emissions have decreased as the price of ETS increases due to low policies. Carbon and the decrease in the supply of emission rights that decreases linearly over time. This decrease is also appreciated due to the fact that a price reduction is foreseen in renewable energy technologies such as offshore wind energy with a 37% reduction, geothermal energy with a 38% reduction and direct use of solar energy or solar energy passive with a reduction of 53%. Figure 1 shows that a 50% reduction in CO2 emissions is forecast for 2050 (European Commission, 2016).

In the transportation sector, reduction trends are expected to remain constant by 2021 for the fleet of vehicles established for 95gCO2 / Km automobiles and for 147gCO2 / Km vans. Although continuous reductions in emissions are expected after 2021 due to the penetration of new vehicles running on alternative fuels, for its part, the EU expects a gradual reduction of hydrophilic carbon gases (HFC for its initials in English) up to 65% by 2030. With the current scenario, a 60% reduction in fluorinated greenhouse gases is expected from 2015 to 2030 (European Commission, 2013).

Regarding renewable energy, an increase in the participation of renewable energies in the country's energy basket in the electricity sector is expected up to 50% and, as a minimum goal of 35%, in the heating and cooling sector up to 27%. In general, the participation of renewable energy sources is expected to be 29% as a goal by 2050 (European Commission, 2016).

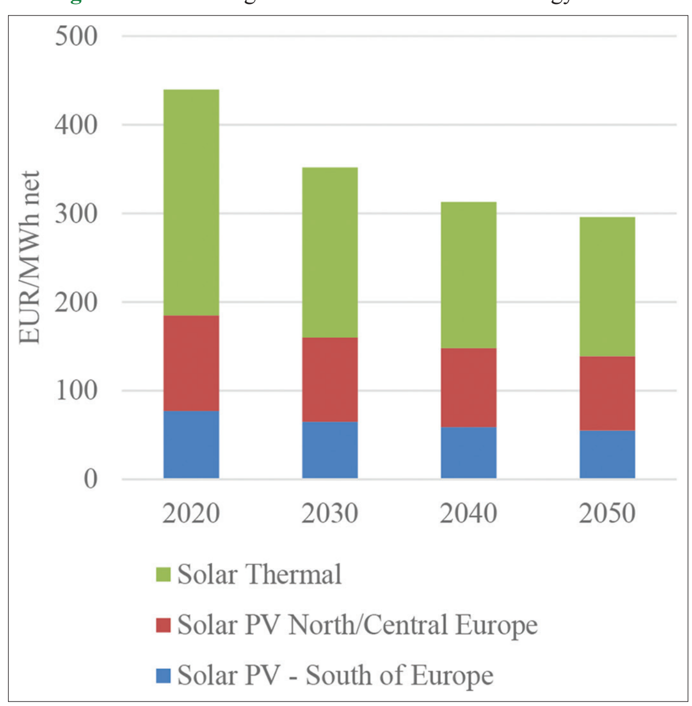
Figure 2 shows the decrease in solar energy costs due to technological and economic improvements that exceed expectations and decrease costs in the short term. However, they create a base that does not go beyond abnormally low costs between 2040 and 2050, decreasing its rate of decrease. In general, a 38% decrease in thermal solar energy is expected, 22%

Figure 1: Relationship between ETS emissions and ETS carbon price



Source of data: Prepared by the authors based on data from (European Commission, 2013)

Figure 2: Decreasing trends in the cost of solar energy in 2050



Source of data: Prepared by the authors based on data from (European Commission, 2013) in photovoltaic solar energy in the northern and central regions of Europe, and 28% in photovoltaic solar energy in the southern region of Europe.

The European Parliament and the European Council implemented political agreements that aim at a new regulatory framework with an energy efficiency of 32.5% by 2030 (European Enviroment Agency, 2020). In 2011, a route was created that seeks to have a competitive low-carbon economy as a goal, towards the year 2050, where it is proposed to reduce domestic emissions by 80% to 95%. It also shows the way in which the European consumer sectors which are responsible for generating emissions in greater or lesser measures can make the energy transition in the coming decades (European Commission, 2011). In 2015, a document was created by the European Parliament that seeks to create a strategy for resilient energy with climate change policies that establish routes to follow for the security of energy supply, the internal energy market, efficiency energy, greenhouse gases and research and innovation (European Commission, 2015). In 2018, legislation for a reliable government on energy union was created, adhering to the goals proposed in accordance with the 2015 Paris Agreement on climate change (European Union, 2018).

2.2. United States of America

In the United States of America, there is an energy system strongly dependent on non-renewable energy sources, mainly imported oil, which is why it increasingly seeks to reduce their economic dependence. The energy basket of any country plays a vital role in the development of any country, allowing industries to develop at speeds that are intrinsically influenced by the strength of the country's energy basket and its policies (Elshurafa et al., 2019).

In 2017, the United States spent $ 1.1 trillion on energy, which is approximately 5.8% of the gross domestic product (GDP). The environmental impacts that this supposes are great since 89% of the energy used comes from non-renewable resources such as oil, natural gas, coal. And only 11% comes from renewable energy (U.S. Energy Information Administration, 2019).

Increasing energy efficiency is also a problem, according to Marco Sonnberger, that mentions the rebound effect on increasing efficiency, and describes them as an increase in energy consumption due to direct or indirect causes (International Risk Governance Council, 2013).

The United States has a market in which non-renewable energies are strongly rooted in the family basket, and this creates a future scenario in which the participation of renewable energies remains low, in the Annual Energy Outlook a high oil and natural gas production, which allows for greater production at lower prices, on the renewable energy side represent a cost reduction of 40%, which leads to a greater increase in the development of this by 2050 (U.S. Energy Information Administration, 2020).

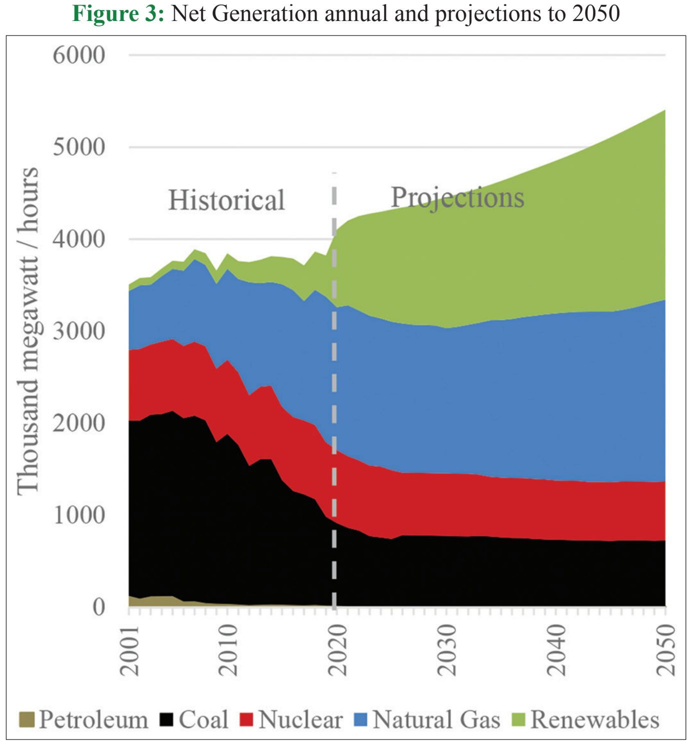
About the projections raised U.S. Energy Information Administration to reveal in the case of natural gas that from 2000 to 2020 it has had a growth of 75% and it is forecast that by 2050 it will have a growth of 31% more than this year, in the case of coal It registered a decrease of 71% and it is expected that it will continue to decrease until it stabilized by 2050 with a 23% reduction of the current one, although crude oil had a decrease from 2000 to 2010, by 2020 it finally had an increase of 100%, it is expected according to projections that by 2050 it has increased only 4%. For its part, renewable energies have had constant growth from 2000 to 2020, with an average growth rate of 5.6% per year, and it is expected to continue increasing in the same way until 2050 (U.S. Energy Information Administration, 2020).

As Figure 3 shows, renewable energy has a considerable growth forecast, going from having participated in the energy basket from 10.1% in 2019 to 38.16% of total electricity generation by 2050 with participation strong of wind and solar energy expected to grow 33% and 46% of total renewable energy by 2050 as shown in Figure 4. On the other hand, natural gas that had participation in 2019 of 41% of the total, and it is forecast that in 2050 it will have a 36% participation. Likewise, the energy produced by nuclear and coal sources decreases gradually until reaching the participation of 11.8% and 13.3% of the total electricity generation by 2050.

The trilemma index tries to weigh the countries by linking not only their evolution in terms of energy efficiency and low carbon in their energy basket but also human development as an energy development index. In the case of the United States, it is in a rank number 15, with a trilemma score of 77.5 and an AAB balance grade (World Energy Council, 2020).

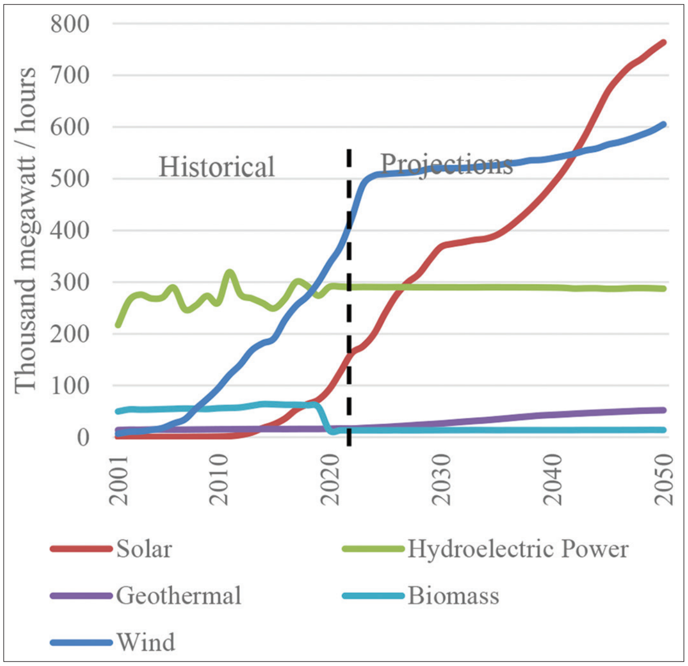
Generally, when talking about energy transition, one thinks about the technologies necessary to achieve it, how it affects the industry and environmental issues, but one does not think about politics. In the literature on policy issues, renewable energy continues

Figure 3: Net Generation annual and projections to 2050



Source of data: Prepared by the authors based on data from (U.S. Energy Information Administration, 2020)

Figure 4: Renewable energy by fuel and projections to 2050



Source of data: Prepared by the authors based on data from (U.S. Energy Information Administration, 2020).

to be a poorly studied topic, however, in the existing literature, it is emphasized that policy change arises through windows of opportunity, which are, for example, the oil crisis (Carley, 2011) (Nohrstedt, 2008).

The United States has been one of the first leaders in wind energy and in principle, some political mechanisms supported these investments such as the public utilities regulatory policy act (PURPA for its acronym in English) and the business energy tax credits in the 1978 National Energy Act Some of the political mechanisms to incentivize renewable energy sources have occurred over time, and mainly wind energy has been the source that has made the most of it, The renewable electricity production tax credit (PTC for its acronym in English) is A tax credit that provides a tax per kilowatt-hour of electricity generated using resources that meet the requirement. This credit expires in 2020, and this support is available to projects that qualify before this date for 10 years (Congressional Research Service, 2020). The Energy Policy Act of 1992 was also a Bill developed to increase the use of clean energy and improve energy efficiency (Federal Trade Commission, 1992).

The renewable portfolio standard (RPS for its acronym in English), or renewable electricity standard (RES for its acronym in English), is a statewide regulatory policy that requires states' electricity supply companies to increase the percentage of producing energy from renewable energies or unconventional sources, almost always wind, solar, biomass, biofuels and geothermal energy, competing with each other motivated by cost reductions and increased efficiencies (American Wind Energy Association, 2020).

The federal Investment Tax Credit (ITC for its acronym in English) is a federal mechanism that has strongly promoted the development of solar energy in the United States and has made solar energy have an average annual growth of 52%. This credit has one of the most important incentives available on solar energy for both residential homeowners and commercial and gives 30% of the federal investment tax credit (Energy Efficiency and Renewable Energy, 2020).

The Zero Emission Vehicle (ZEV for its acronym in English) program, which is run by The California Air Resources Board (CARB for its acronym in English), is a state regulation created in California which requires automakers to They sell zero-emission vehicles in California and ten other states. For 2018, the goal was that sales of ZEV or mixes of ZEV and hybrids should be 4.5%, and by 2025 the goal is for them to be 22%. Also, this program provides decrees for special credit for these vehicles (Energy Efficiency and Renewable Energy, 2013).

2.3. China

Climate change that affects all the nations of the world makes everyone focus on thinking about ways to mitigate its effects. China is one of the countries that seriously needs to think about this since according to IQAir China it is classified in the rank 11 with 110 $\mu g/m^3$ of air pollution on average (IQ Air, 2020) (Chen et al., 2020). China's rapid development requires measures that ensure sustainable development, and this includes the effects of pollution and the use of non-renewable or fossil energy. The most significant growth in the whole world is that of China, which grows 5.5% annually, and its industrial sector has a final energy consumption higher than that of other energy consumption sectors, consumes around 37% of energy in all the world. China's industrial sector is one of the most intensive sectors, and in 2000 it consumed around 60% of the country's total energy use (Abdelasis et al., 2011).

Some studies show that China has great potential to reduce emissions by implementing renewable energy such as bioenergy, and it is estimated that the reductions could be 1,652.73-5859.56 Mt CO_2 displacing fossil fuels during the period from 2020 to 2050 (Kang et al., 2020).

Due to the rapid growth of the country's economy, urbanization and industrialization also do so at the same rate, as does its population. One of the sectors that makes a great contribution to greenhouse gas emissions is the transport sector (Zeng et al., 2016). The so-called "Energy Revolution" that started with President Hu Jintao in 2012 and was followed by President Xi Jinping, driven by the need to improve air quality and reduce dependence on fossil fuels (International Energy Agency, 2017).

The Chinese government already sets goals to reduce the environmental impact of its energy consumption, the government's plan for 2025 is to place more emphasis on renewable technologies and their end-use, such as electric vehicles and energy efficiency in the industries (NDRC, 2020). They propose that by 2030 they must reach the maximum peak of emissions to begin a decline and that CO_2 emissions are 60% per unit of GDP. Also, by 2030, non-fossil electricity generation should be 50% of the total generation, natural gas should occupy only 15%. So by 2050, renewable energy or clean energy must have a participation of more than 50% of total energy (Chen et al., 2019).

2.4. Brazil

Brazil is one of the countries with the highest share of renewable energy in its primary energy supply, which is 42% of total energy. In the country, changes have arisen from the year 2000 onwards that have led to a progressive improvement in energy consumption in the country, approximately 40% of investments in the electricity sector have been made in renewable energy. This change has consistently bet on the production of hydroelectric energy, which is one of the most mature in the country and represented 62% of electricity generation in 2020. Increasing investment has also been made in projects such as solar energy and wind, increasing investments by 35% in 2016 on the subject. Until 2020, the share of wind and solar energy in primary energy production is 58% and 1.7%, respectively. Also, the use of biofuels such as ethanol is widely used, being able to make government-permitted ethane-gasoline blends of up to 27.5% ethanol, and there is the possibility of using up to 100% ethanol in vehicles. Brazil also has great potential for the production of Biogas, which is estimated to be up to 40 million cubic meters per day (Felca et al., 2018). For this reason, the government has started to manage alternative energy auctions that propose that by 2021 a Biogas production plant with capacity for 21MW should be carried out (Wills and Westin, 2019).

Some of the policies implemented in Brazil are: Program for the Incentive of Alternative Energy Sources (PROINFA for its acronym in English) created through law 10438 of April 2020, which gives rise to the creation of the program. This program expects in its first stage to produce 3,300 MW of renewable energy. In stage 2, it is proposed that once the 3,300 MW of renewable energy production has been reached, an annual increase of 10% of the total production of renewable energy produced that year should be increased (International Energy Agency, 2015).

The National Alcohol Program (ProAlcool), created in 1975 thanks to the oil crisis, increased the production of ethanol produced with sugar cane for use as fuel in road transport. This increased ethanol production from 0.9 trillion liters to 27.8 trillion liters, also boosting the use of vehicles that can use 100% ethane and vehicles that can use both ethanol and mixtures of this as gasoline (Pearson and Turner, 2014). The goal for Brazil by 2050 is to depend 100% on renewable energy in a better scenario, and in its base scenario, the participation of renewable energy including hydroelectric would be 80% of total energy production, with 52% of hydroelectric energy, 14% of wind energy, 5.4% of photovoltaic solar energy and 10% of the energy obtained from biomass, among others (Wills and Westin, 2019).

3. TRENDS FOR THE ENERGY TRANSITION

In general, the energy transition that takes more force every day, and the countries in the world are in favor of this. The most common trends are those of progressive changes and independence from fossil fuels, but in some cases, not the total breakdown of fossil fuels, that is, it is expected that they will continue to be used in a very small percentage.

On the contrary, the important burden and responsibility for energy supply are seen in the most mature renewable energies, which are the ones that have made the most progress so far, such as photovoltaic, solar thermal, wind power onshore and offshore. Hydropower controversially included as renewable energy also has a large percentage in the generation of electrical energy. According to data from the International Energy Agency, hydropower is one of the most important sources of electricity generation with renewable energy worldwide, which has had a constant growth. In 2000, 2.7 MGWh (millions of giga-Watt hours were generated), and in 2017 4.2 MGWh were generated. That is, it had a 161% growth, while electricity generation by wind energy began to have a noticeable increase from 2000 to 2004. Wind power generation in 2004 was 84437 GWh, and in 2017, it was 1.1 GWh, which means that its growth was 1335% in just 13 years. Finally, the electrical generation resulting from photovoltaic solar energy had a notable growth from 2010 onwards, when it was 32,222 GWh, and for 2017 it was 443,554 GWh, that is to say, it grew by 1,376% in just 7 years.

For its part, the replacement of fossil fuels for the transport sector, the trend is mostly to use biogas as a replacement for current fuels, the use of electric battery cars are also contemplated but as a less viable and more remote option. And another option is the use of hydrogen fuel cells as one of the options least considered by governments at a general level. Biogas not only seen as a fairly mature technology for use in vehicles but also for use in power generation turbines. Advances in the use of biogas are quite notable, in the European Union the electricity generation obtained through biogas and waste is 6,310 GWh, being the highest of the four continents analyzed, followed by the United States with 1,305 GWh, Asia, and Brazil with 2053 GWh and 1027 GWh respectively.

As a final look, one of the renewable energy technologies that are starting to grow at a slow pace is the use of hydrogen, and this promises to be the key complement to other renewable technologies. According to the IEA, the capacity of the installed hydrogen electrolyzers by 2020 should be 20 MWe for hydrogen-based on synthetic fuels, 38 MWe for industrial applications, and 70 MWe for use in vehicles. 6MWe is also contemplated for electrical storage and 6 MWe for mixing in the gas network.

However, to date worldwide, oil consumption has been maintained at a not so accelerated but steady rate in the transport sector, which consumed 2.7 million ktoe for 2017, the industrial sector consumed 314,977 ktoe, the residential sector 214757 ktoe, the commercial sector 84658 ktoe, the agriculture or forestry sector 107022 ktoe, these within the sectors that consumed the most. Being one of the most consumed derived products such as Gas/Diesel and motor gasoline with approximately 1.2 Mktoe and 1 Mktoe. One of the countries that have the most oil production among those mentioned in the document is the United States, with a production in 2017 of 540 683 ktoe, followed by China and Brazil with 191,506 ktoe and

133,314 ktoe respectively and the European Union with 64,943 ktoe (IEA, 2020).

4. CONCLUSIONS

Globally, efforts on climate change and energy transition are taking place, and the goals for 2050 are promising. However, it is a long way to meet the goals.

In Brazil, currently, more than 50% of the energy basket is led by fossil fuels. In 2017, the total primary energy supply, according to the IEA, was 110,721 ktoe, with the transportation sector being one of the sectors that consumed the most oil 65428 toes. The other part of the energy basket is largely occupied by hydroelectric generation, which generated 370,906 GWh in 2017. Contrasting with the sizes of the country and its dependence mainly on oil and hydroelectric energy, which, although it is a renewable source, makes other sources of renewables have small participation, in addition to their usefulness, they are not sufficient for the stated goals to be met.

In the United States, the policies implemented are good. However, their political conformation slows down the advance to the new laws on energy transition. In addition to having an industry strongly dependent on fossil fuels and oil production, this is why its forecasts for 2050 do not describe a scenario without the presence of fossil fuels or non-renewable energy. This can be seen in the total CO_2 emissions, which are used as indicators of the energy transition. For the year 2017, the emissions were 4896 Mt of CO_2, which are only 11% <10 years ago.

In the European Union, the issue that slows down progress in energy transition issues is the different approaches of the countries that make it up. Since not everyone is betting on renewable energy technologies. Less than half of 40% of the countries that make up the European Union are below 20% of use in renewable energy, and only three countries are above 40% in the use of renewable energy of final gross consumption.

Another important contribution is that technological progress is good, and helps greatly to increase the reliability and viability of the use of renewable energy, however, not all responsibility can be left to this, but also the policies that are created to support The change or transition of fossil fuels to a context of renewable and low carbon are necessary, on the contrary, there would be no more motivation for technological development than the simple fact but not less important than that of climate change.

REFERENCES

Abdelasis, E., Saidur, R., Mekhilef, S. (2011), A review on energy saving strategies in industrial sector. Renewable and Sustainable Energy Reviews, 15(1), 150-168.

Alekkett, K. (2007), Peak Oil and the Evolving Strategies of Oil Importing and Exporting Countries: Facing the Hard Truth about an Import Decline for the OECD Countries. Paris, France: OECD Publishing. p17.

American Wind Energy Association. (2020), American Wind Energy Association. Avialable from: https://www.awea.org/policy-and-issues/electricity-policy/rps. [Last accessed on 2020 Jun 10].

Araújo, K. (2014), The emerging field of energy transitions: Progress, challenges, and opportunities. Energy Research and Social Science, 1, 112-121.

Batinge, B., Musango, J., Brent, A. (2019), Sustainable energy transition framework for unmet electricity markets. Energy Policy, 129, 1090-1099.

Bazilian, M., Sovacool, B., Miller, M. (2013), Linking energy independence to energy security. International Association for Energy Economics, 2013, 17-21.

Birkmann, J., Buckle, P., Jaeger, J., Pelling, M., Setiadi, N., Garschagen, M., Kropp, J. (2010), Extreme events and disasters: A window of opportunity for change? Analysis of organizational, institutional and political changes, formal and informal responses after mega-disasters. Natural Hazards, 55, 637-655.

Carley, S. (2011), The era of state energy policy innovation: A review of policy instruments. RPR Review of Policy Research, 28(3), 265-294.

CERA. (2008), No Evidence of Precipitous Fall on Horizon for World Oil Production: Global 4.5% Decline Rate Means No Near-term Peak: CERA/IHS Study. Available from: https://www.businesswire.com/news/home/20080117005242/en/Evidence-Precipitous-Fall-Horizon-World-Oil-Production. [Last accessed on 2020 May 17].

Chen, C., Xue, B., Cai, G., Thomas, H., Stückrad, S. (2019), Comparing the energy transitions in Germany and China: Synergies and recommendations. Energy Reports, 5, 1249-1260.

Chen, J., Wang, B., Huang, S., Song, M. (2020), The influence of increased population density in China on air pollution. Science of The Total Environment, 735, 139456.

Cloke, J., Mohr, A., Brown, E. (2017), Imagining renewable energy: Towards a social energy systems approach to community renewable energy projects in the Global South. Energy Research and Social Science, 31, 263-272.

Congressional Research Service. (2020), The Renewable Electricity Production Tax Credit: In Brief. CRS Report. Avialable from: https://www.fas.org/sgp/crs/misc/R43453.pdf. [Last accessed on 2020 Jun 10].

Council of the European Union. (2018), European Council. Retrieved from Renewable Energy: Council Confirms Deal Reached with the European Parliament. Avialable from: https://www.consilium.europa.eu/en/press/press-releases/2018/06/27/renewable-energy-council-confirms-deal-reached-with-the-european-parliament. [Last accesed on 2020 Jun 08].

da Hora, M., Asrilhant, B., Accioly, R., Schaeffer, R., Szklo, A., Hawkes, A. (2019), Decision making to book oil reserves for different Brazilian fiscal agreements using dependence structure. Energy Strategy Reviews, 26, 100377.

Elshurafa, A., Farag, H., Hobbs, D. (2019), Blind spots in energy transition policy: Case studies from Germany and USA. Energy Reports, 5, 20-28.

Energy Efficiency and Renewable Energy. (2013), Fact #771: March 18, 2013 California Zero-emission Vehicle Mandate is Now in Effect. Avialable from: https://www.energy.gov/eere/vehicles/fact-771-march-18-2013-california-zero-emission-vehicle-mandate-now-effect. [Last accessed on 2020 Jun 10].

Energy Efficiency and Renewable Energy. (2020), Residential and Commercial ITC Factsheets. Avialable from: https://www.energy.gov/eere/solar/downloads/residential-and-commercial-itc-factsheets. [Last accessed on 2020 Jun 10].

European Commission. (2011), A Roadmap for Moving to a Competitive Low Carbon Economy in 2050. Brussels. COM(2011) 112 Final. Avialable from: https://www.eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0112:FIN:EN:PDF. [Last accessed on 2020 Jun 10].

European Commission. (2013), EU Energy, Transport and GHG Emissions Trends 2050, Reference Scenario 2013. Avialable from: https://www.ec.europa.eu/transport/sites/transport/files/media/publications/doc/trends-to-2050-update-2013.pdf. [Last accessed on 2020 Jun 10].

European Commission. (2015), A Framework Strategy for a Resilient Energy Union with a Forward-looking Climate Change Policy. Brussels. Available from: https://www.eur-lex.europa.eu/resource.html?uri=cellar:1bd46c90-bdd4-11e4-bbe1-01aa75ed71a1.0001.03/DOC_1&format=PDF. [Last accessed on 2020 Jun 10].

European Commission. (2016), EU Reference Scenario 2016. Energy, Transport and GHG Emissions Trends to 2050. Avialable from: https://www.ec.europa.eu/energy/sites/ener/files/documents/20160713%20draft_publication_REF2016_v13.pdf. [Last accessed on 2020 Jun 10].

European Enviroment Agency. (2020), European Enviroment Agency. Final Energy Consumption by Sector and Fuel in Europe. Avialable from: https://www.eea.europa.eu/data-and-maps/indicators/final-energy-consumption-by-sector-10/assessment. [Last acessed on 2020 Jun 08].

European Union. (2018), Regulation (Eu) 2018/1999 of the European Parliament and of the Council of 11 December 2018. Avialable from: https://www.eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0001.01.ENG&toc=OJ:L:2018:328:FULL. [Last accessed on 2020 Jun 08].

Federal Trade Commission. (1992), Federal Trade Commission. Avialable from: https://www.ftc.gov/es/enforcement/statutes/energy-policy-act-1992. [Last accessed on 2020 Jun 10].

Felca, A., Barros, R., Filho, G.T., dos Santos, I., Ribeiro, E. (2018), Analysis of biogas produced by the anaerobic digestion of sludge generated at wastewater treatment plants in the South of Minas Gerais, Brazil as a potential energy source. Sustainable Cities and Society, 41, 139-153.

Frankfurt School of Finance and Management gGmbH 2018; UNEP Collaborating Centre for Climate and Sustainable Energy Finance. (2018), Global Trends in Renewable Energy Investment. Germany: Frankfurt School of Finance and Management. p1-86.

Hirsh, R., Jones, C. (2014), History's contributions to energy research and policy. Energy Research and Social Science, 1, 106-111.

Iddrisu, I., Bhattacharyya, S. (2015), Sustainable energy development index: A multi-dimensional indicator for measuring sustainable energy development. Renewable and Sustainable Energy Reviews, 50, 513-530.

IEA. (2020), International Energy Agency. Data and Statistics IEA. Avialable from: https://www.iea.org/data-and-statistics?country=WORLD&fuel=Energy%20supply & indicator =Coal%20production%20by%20type. [Last accesed on 2020 Jun 05].

International Energy Agency. (2015), Programme of Incentives for Alternative Electricity Sources-programa de Incentivo a Fontes Alternativas de Energia Elétrica-PROINFA. Availabel from: https://www.iea.org/policies/4019-programme-of-incentives-for-alternative-electricity-sources-programa-de-incentivo-a-fontes-alternativas-de-energia-eletrica-proinfa?country=Brazil%2CCanada&type=Obligation%20schemes. [Last accessed on 2020 Jun 10].

International Energy Agency. (2017), Renewables 2017 Analysis and Forecasts to 2022. Avialable from: https://www.oecd-ilibrary.org/energy/renewables-2017_re_mar-2017-en. [Last accessed on 2020 Jun 15].

International Renewable Energy Agency. (2020), Avialable from: http://www.resourceirena.irena.org/gateway/dashboard. [Last accesed on 2020 Jun 05].

International Risk Governance Council. (2013), The Rebound Effect: Implications of Consumer Behaviour for Robust Energy Policies. Lausanne. Avialable from: https://www.researchgate.net/publication/275207115_The_Rebound_Effect_Implications_of_Consumer_Behaviour_for_Robust_Energy_Policies. [Last accessed on 2020 Jun 06].

IQ Air. (2020), Air Quality in China. Avialable from: https://www.iqair.com/china. [Last accessed on 2020 Jun 18].

Kang, Y., Yang, Q., Bartocci, P., Wei, H., Liu, S., Zhujuan, W., Cheen, H. (2020), Bioenergy in China: Evaluation of domestic biomass resources and the associated greenhouse gas mitigation potentials. Renewable and Sustainable Energy Reviews, 127, 109842.

Lee, J., Yang, J. (2019), Global energy transitions and political systems. Renewable and Sustainable Energy Reviews, 115, 109370.

Miller, C., Iles, A., Jones, C. (2013), The social dimensions of energy transitions. Science as Culture, 22(2), 135-148.

Mostafaeipour, A., Sedaghat, A., Hedayatpour, M., Jahangiri, M. (2020), Location planning for production of bioethanol fuel from agricultural residues in the south of Caspian Sea. Environmental Development, 33, 100500.

Murphy, J. (2001), Making the energy transition in rural East Africa: Is leapfrogging an alternative? Technological Forecasting and Social Change, 68(2), 173-193.

NDRC. (2020), National Development and Reform Commission (NDRC). People's Republic of China. Avialable from: https://www.en.ndrc.gov.cn/newsrelease_8232. [Last accessed on 2020 Jun 16].

Nohrstedt, D. (2008), The politics of crisis policymaking: Chernobyl and Swedish nuclear energy policy. PSJ Policy Studies Journal, 36(2), 257-278.

Nuamann, M., Rudolph, D. (2020), Conceptualizing rural energy transitions: Energizing rural studies, ruralizing energy research. Journal of Rural Studies, 73, 97-104.

Nussbaumer, P., Bazilian, M., Modi, V. (2012), Measuring energy poverty: Focusing on what matters. Renewable and Sustainable Energy Reviews, 16(1), 231-243.

O'Sullivan, A., Sheffrin, S., Perez, S. (2003), Economics: Principles, Applications and Tools. New Jersey, USA: Prentice Hall.

Organisation for Economic Cooperation and Development. (2020), OECD iLibrary. Avialable from: https://www.oecd-ilibrary.org/energy/world-energy-outlook-2019_caf32f3b-en. [Last accesed on 2020 Jun 05].

Owen, N., Inderwildi, O., King, D. (2010), The status of conventional world oil reserves-hype or cause for concern? Energy Policy, 28(8), 4743-4749.

Pearson, R., Turner, J. (2014), Improving the use of liquid biofuels in internal combustion engines. In: Advances in Biorefineries. United Kingdom: Woodhead Publishing. p389-440.

Poggi, F., Firminio, A., Amado, M. (2018), Planning renewable energy in rural areas: Impacts on occupation and land use. Energy, 155, 630-640.

Ramesh, M., Saini, R. (2020), Dispatch strategies based performance analysis of a hybrid renewable energy system for a remote rural area in India. Journal of Cleaner Production, 259, 120697.

Ramkumar, M., Santosh, M., Mathew, M., Menier, D., Nagarajan, R., Sautter, B. (2020), Hydrocarbon reserves of the South China Sea: Implications for regional energy security. Energy Geoscience, 1(1-2), 1-7.

Rehman, I., Kar, A., Raven, R., Singh, D., Tiwari, J., Jha, R., Mirza, A. (2010), Rural energy transitions in developing countries: A case of the Uttam Urja initiative in India. Environmental Science and Policy, 13(4), 303-311.

Robelius, F. (2007), Giant Oil Fields-the Highway to Oil: Gint Oil Fields and their Importance for Future Oil Production. Sweden: Uppsala University, Teknisk-naturvetenskapliga Vetenskapsomradet.

Roubíki, H., Mazancová, J. (2020), Suitability of small-scale biogas systems based on livestock manure for the rural areas of Sumatra. Environmental Development, 33, 100505.

The World Bank. (2020), The World Bank IBRD IDA. Avialable from: http://www.datatopics.worldbank.org/world-development-indicators. [Last accesed on 2020 Jun 05].

U.S. Energy Information Administration. (2019), U.S. States Profile and Energy Estimates. Technical Notes and Documentation-complete; 2017. Avialable from: https://www.eia.gov/state/seds/seds-technical-notes-complete.php?sid=US#Prices%20and%20Expenditures. [Last accessed on 2020 Jun 05].

U.S. Energy Information Administration. (2020), Annual Energy Outlook 2020 with Projections to 2050. Washington, DC: Office of Energy Analysis U.S. Department of Energy. Avialable from: https://www.eia.gov/outlooks/aeo/pdf/AEO2020%20Full%20Report.pdf. [Last accessed on 2020 Jun 07].

U.S. Energy Information Administration. (2020), Annual Energy Outlook 2020, Table: Table 8. Electricity Supply, Disposition, Prices, and Emissions. Electricity Supply, Disposition, Prices, and Emissions. Avialable from: https://www.eia.gov. [Last accessed on 2020 Jun 10].

U.S. Energy Information Administration. (2020), U.S. Energy Information Administration (EIA), Short-term Energy Outlook. EIA, AEO2020 National Energy Modeling System. Avialable from: https://www.eia.gov. [Last accessed on 2020 Jun 10].

Vera, I., Langlois, L. (2007), Energy indicators for sustainable development. Energy, 32(6), 875-882.

Wei, W., Stefanie, L., Matthias, K., Tobia, L. (2020), Landscape matters: Insights from the impact of mega-droughts on Colombia's energy transition. Environmental Innovation and Societal Transitions, 36, 1-16.

Weng, W., Becker, L.S., Lüdeke, M., Lakes, T. (2020), Landscape matters: Insights from the impact of mega-droughts on Colombia's energy transition. Environmental Innovation and Societal Transitions, 36, 1-16.

Wills, W., Westin, F. (2019), Climate Transparency Policy Paper: Energy Transition in Brazil. Centro Clima; Climate Transparency. Available from: https://www.climate-transparency.org/wp-content/uploads/2019/04/Brazilian-Policy-Paper-En.pdf. [Last accessed on 2020 Jun 15].

World Energy Council. (2020), Trilema World Energy Council. Avialable from: https://www.trilemma.worldenergy.org. [Last accesed on 2020 Jun 05].

World Energy Council. (2020), World Energy Council. Avialable from: https://www.trilemma.worldenergy.org/#!/country-profile?country=United%20States&year=2019. [Last accessed on 2020 Jun 10].

Zeng, Y., Tan, X., Gu, B., Wang, Y., Xu, B. (2016), Greenhouse gas emissions of motor vehicles in Chinese cities and the implication for China's mitigation targets. Applied Energy, 184, 1016-1025.

Zhang, D., Zheng, Y., Wu, J., Li, B., Li, J. (2020), Annual energy characteristics and thermodynamic evaluation of combined heating, power and biogas system in cold rural area of Northwest China. Energy, 192, 116522.