



THE NEED FOR A RADICAL CHANGE IN THE WAY ENERGY IS USED FOR THE TRANSITION TO RENEWABLE ENERGY

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ABSTRACT: *THE TRANSITION TO RENEWABLE ENERGY IS A COMPLEX CHALLENGE AND REQUIRES A RADICAL CHANGE IN THE WAY SOCIETY THINKS, DESIGNS AND USES ENERGY. TODAY, SOCIETY RELIES HEAVILY ON FOSSIL RESOURCES, WHICH HAVE BEEN EXPLOITED IN AN INTENSIVE AND UNSUSTAINABLE WAY, GENERATING PROBLEMS RELATED TO CLIMATE CHANGE, AIR AND WATER POLLUTION, AND OTHER NEGATIVE ENVIRONMENTAL IMPACTS.*

THE TRANSITION TO RENEWABLE ENERGY IS NOT ONLY ABOUT REPLACING ENERGY SOURCES, BUT ALSO ABOUT CHANGING OUR MINDSET, HOW WE DESIGN AND BUILD ENERGY INFRASTRUCTURE, AND HOW WE USE ENERGY. THIS INVOLVES THE DEVELOPMENT OF NEW TECHNOLOGIES AND METHODS OF ENERGY PRODUCTION AND STORAGE, BUT ALSO A CHANGE IN INDIVIDUAL AND COLLECTIVE BEHAVIOR.

THUS, WE MUST THINK OF ENERGY NOT ONLY AS A RESOURCE THAT MUST BE EXPLOITED TO THE MAXIMUM, BUT ALSO AS A LIMITED RESOURCE THAT MUST BE USED RESPONSIBLY. WE NEED TO THINK IN TERMS OF ENERGY EFFICIENCY, REDUCING ENERGY CONSUMPTION AND USING RENEWABLE ENERGY WHEN POSSIBLE.

FINALLY, THE TRANSITION TO RENEWABLE ENERGY IS NOT ONLY A TECHNICAL CHALLENGE, BUT ALSO A CULTURAL AND SOCIAL CHALLENGE. WE NEED TO CHANGE OUR WAY OF THINKING AND BEHAVING IN ORDER TO MAKE THIS TRANSITION IN AN EFFECTIVE AND SUSTAINABLE WAY

KEY WORDS: *RENEWABLE ENERGY, LIMITED RESOURCES, GREEN TECHNOLOGIES, STRATEGY.*

1. INTRODUCTION

By using limited and polluting resources, such as fossil fuels, humanity will reach their depletion and unintended consequences, such as climate change and environmental degradation.

The transition to renewable energy must be accompanied by a change in public policies and significant investment in renewable energy infrastructure. This includes stimulating innovation and research in renewable energy, promoting green technologies and sustainable business models.

Georgescu Roegen's statement "Energy can be converted into all other needs of life" refers to the fact that Energy is a fundamental and essential resource to satisfy all human needs. For example, energy is needed to produce and transport food, to produce household items, to



maintain thermal comfort and lighting in homes, for transport and communication, to produce goods and services in all sectors of the economy, etc. (Georgescu-Roegen, 1996)

This concept is related to the idea of entropy, which is defined as the measure of disorder and unavailable energy in a system (Georgescu-Roegen Nicholas, 1971). In a closed system, entropy always increases and energy decays into less useful and available forms. For this reason, it is important to find sustainable sources of energy and use it as efficiently as possible to minimize entropy and resource degradation.

Therefore, energy is a key factor in the economy and development, and its efficient use can contribute to building a more sustainable and equitable society.

There is enough energy on Earth to support our long-term energy needs. Indeed, ocean water is a huge reservoir of thermal energy, which can be exploited through the use of heat pumps or geothermal power plants. But to be able to exploit this energy, appropriate technologies and infrastructure are needed, which can be a major challenge. Also, overexploitation of these resources can lead to climate change and other ecological problems. Therefore, we must be careful in the use of our resources and have a sustainable and balanced approach to energy production and consumption.

In an economic system, an increase in energy efficiency will lead to a decrease in energy costs and an increase in profits. In this way, energy efficiency can contribute to improving economic efficiency. However, the reverse is not true - an increase in economic efficiency will not automatically lead to an increase in energy efficiency.

Thus, Georgescu Roegen underlines the importance of energy efficiency in a sustainable economy and suggests that steps should be taken to improve it, such as investing in more energy efficient technologies and processes.

Fossil fuel reserves are finite, and it is estimated that at the current rate of use, we will exhaust these resources within the next decades or, at most, centuries. At the same time, the solar energy that reaches Earth every day is immense, far exceeding our energy needs. For example, the Sun burns about 600 million tons of hydrogen per second, producing an enormous amount of energy, and the Earth receives enough solar energy in one hour to meet the energy needs of the entire planet for an entire year (Georgescu-Roegen, 1996). So it is clear that solar energy has huge potential and is one of the main sources of renewable energy in our sustainable energy future.

There are several reasons why solar energy, hydro energy and nuclear energy are not yet fully exploited economically despite their potential. Here are some explanations:

1. High initial costs: Compared to fossil fuels, the plants and equipment required to produce and store renewable energy are more expensive. These high initial costs can be an impediment to the adoption of these technologies by companies and governments (Duncan, 2006).

2. Dependence on subsidies: Renewable energy still requires significant financial support from governments and other organizations to be competitive in the energy market. Subsidies are needed to cover the high initial costs and to make renewable energies more affordable and attractive to consumers.

3. Technological limitations: Even though solar energy and hydro energy have great potential, there are technological limits to the ability to use them efficiently and reliably. For example, solar panels cannot produce energy consistently during the night or during adverse weather conditions such as cloudy or rainy days.



4. Energy storage issues: Renewable energy can be produced in varying amounts depending on weather conditions and other factors. This can lead to energy storage problems, which can make renewable energy not as convenient and affordable as energy produced from fossil fuels.

5. Political and economic interests: The fossil fuel industry has strong interests in maintaining the status quo, which can cause the transition to renewable energies to be slowed or blocked through political lobbying or disinformation campaigns. There are also some economic interests that are linked to the development of new technologies and equipment for the production and storage of renewable energy, which may make the adoption of these technologies slower than it would otherwise be.

Uranium-235 and thorium-232 are two elements that can be used as nuclear fuel to produce electricity through nuclear fission. The process of fission involves the splitting of a nucleus of uranium-235 or thorium-232 into smaller nuclei, thereby releasing large amounts of energy in the form of heat, which can be used to generate electricity (Georgescu-Roegen, 1996).

Uranium-238, on the other hand, cannot be directly used as nuclear fuel for the production of electricity through fission. Instead, it can be converted into plutonium-239 by neutron irradiation in a nuclear reactor. Plutonium-239 can then be used as nuclear fuel to produce electricity through fission.

It is important to note that the energy obtained through nuclear fission is not considered inexhaustible, as nuclear fuel (uranium-235, thorium-232 or plutonium-239) can be depleted over time. In addition, nuclear power also carries risks associated with the security, management and storage of radioactive waste, which must be considered when evaluating energy options.

2.ECONOMIC THEORIES FOR THE TRANSITION TO A SUSTAINABLE CIVILIZATION

Choosing an economic theory, science or approach to design and implement economic policies that contribute to the transition to a sustainable civilization is a complex issue and depends on several factors, including the socio-economic, cultural and political context. In general, there are some principles and criteria that can be taken into account when making this choice:

1. Sustainability: an economic theory or approach must be consistent with the principles of sustainable development and promote an economy based on renewable and circular resources.

2. Equity: economic policy must consider and promote the equitable distribution of resources and benefits in society.

3. Efficiency: economic policy must be efficient in the use of resources and maximize production and social welfare.

4. Flexibility: economic policy must be flexible and adaptable to socio-economic changes and the evolution of the global context.

5. Public participation: the decision-making process should involve public participation and take into account the views and needs of different social groups.

Furthermore, it is important to recognize that there is no single economic theory or approach that can answer all socio-economic challenges. The solution is usually a combination of theories and approaches that are tailored to the specific context and economic policy



objectives. It is also important to bear in mind that the transition to a sustainable civilization requires efforts and contributions from all socio-economic actors and sectors, including government, the private sector, civil society and citizens.

There are several economic theories and approaches that are relevant to the transition to a sustainable civilization, such as:

1. Circular economy: This approach focuses on the efficient use of resources and the promotion of recycling and reuse of materials. This involves adopting policies that encourage sustainable and recyclable product design, increasing the use of renewable energy and developing less polluting transport systems.

2. Green economy: This approach focuses on reducing greenhouse gas emissions and promoting the development of clean technologies. This involves the adoption of policies that promote investment in renewable energies, electric transport and the reduction of energy consumption in general.

3. Social and Solidarity Economy: This approach focuses on reducing social inequalities and promoting sustainable and community-based economic development. This involves adopting policies that promote the social and solidarity economy, as well as supporting local and community initiatives.

4. Earth economy: This approach focuses on the relationship between the economy and the environment and on the integration of sustainable development principles into economic policies. This involves adopting policies that take environmental and natural resource impacts into account in economic decisions.

5. Bioeconomic theory is a relatively new approach in economics that attempts to integrate economic principles with those of ecology and biological systems (Costanza, 2015).. This approach can help identify how economic decisions can impact the environment and on natural resources, which can lead to more effective and sustainable policies.

The choice of an economic theory or approach must take into account the specific context and economic policy objectives. For example, if the goal is to reduce greenhouse gas emissions, the green economy may be the most appropriate approach. Conversely, if the objective is to reduce social inequalities, the social and solidarity economy may be a more appropriate approach. The bioeconomic approach integrates ecological principles with economic ones, which can lead to a better understanding of how economies interact with the environment and other biological systems.

It is important to keep these aspects in mind and to analyze and evaluate the different options according to the specific context.

3.ECONOMIC THEORIES ADDRESSING SUSTAINABLE ENERGY ISSUES

There are several economic theories that address issues related to sustainable energy. However, an appropriate theoretical framework can be found in ecological economics and energy economics.

Ecological economics is a branch of economics that examines the interaction between the economy and the environment. It addresses the issue of sustainable development, that is, economic development that takes into account the protection of the environment and the use of resources in a sustainable way. In this context, sustainable energy is a central concern. In ecological economics, economic development and environmental protection are considered to be interdependent, and renewable energies and energy efficiency are important tools for sustainable development.



Energy economics, on the other hand, focuses on the study of the interaction between the economy and energy, including the production, distribution, and consumption of energy. It addresses issues such as the development of clean energy technologies, as well as how government policies and regulations can be used to promote sustainable energy use.

In general, economic theory on sustainable energy should focus on creating an economic framework that promotes sustainable development through the use of renewable energy and energy efficiency, as well as creating policies and regulations that support this development. This framework should also consider the costs and benefits of using renewable energy and find ways to promote a gradual transition to its use.

Nicolas Georgescu-Roegen's theory

"Perpetuum mobile of the third level" is a theory proposed by the Romanian economist and physicist Nicolas Georgescu-Roegen in his book "The Entropy Law and the Economic Process" (1971). This is an extension of the concept of perpetuum mobile, which refers to a theoretical machine that can produce energy without receiving energy from another source.

In Georgescu-Roegen's theory, level three perpetuum mobile refers to a theoretical hypothesis of a society that could function perpetually and sustainably without consuming or producing entropy. In this scenario, resources would be used in a way that would minimize entropy, which would allow society to continue to function without facing resource depletion or environmental destruction.

Although this theory is extremely attractive, there is still no practical solution to achieve a level three perpetuum mobile. Understanding entropy and the limits of natural resources remain a key issue for scientists, governments and societies to address as they move towards a more sustainable world.

4. ENERGY MODELS

4.1. The energy model proposed by Nicolas Georgescu-Roegen

Nicolas Georgescu-Roegen proposed an energy model that starts from two fundamental principles: The first principle of thermodynamics, which states that energy cannot be created or destroyed, but only transformed from one form to another, and the second principle of thermodynamics, which states that any transformation of energy leads to an increase in the entropy of the system (Georgescu-Roegen, 1971). Starting from these principles, Georgescu-Roegen argued that energy is a limited good and that, ultimately, the entire economy is based on a finite amount of energy.

The energy model proposed by Georgescu-Roegen (2009) involves a reassessment of the way the world economy is structured, emphasizing the need to move from models based on fossil fuels to models based on renewable energy sources such as solar and wind energy. In addition, he proposes a series of measures to reduce the use of energy and optimize its use in the economy, so that we can achieve a sustainable economy and sustainable development.

4.2. Mario Gianpietro's energy model

Mario Giampietro is an Italian economist specializing in industrial ecology and social ecology. In his research, he developed an energy model called "Multi-Level Integrated Analysis of Societal and Ecosystem Metabolism" (MuSIASEM), which takes into account the social, economic and ecological aspects of resource and energy use.

MuSIASEM is an energetic and metabolic analysis method that attempts to integrate multiple levels of analysis into a single model (Giampietro, 2019). This includes the individual



level, the economic level, the social level and the ecological level. In this way, the model can be used to assess the economic and social impact of resource and energy use.

MuSIASEM uses a multi-agent approach and models energy and material flows in a complex system, taking into account all the interactions between the different components of the system. In this way, it can be used to assess the impact of economic and political decisions on resource and energy use.

One of the main objectives of the MuSIASEM model is to show that there is no one-size-fits-all solution to energy and environmental problems, but that solutions must be adapted to the specific needs and characteristics of different regions and communities. The model also focuses on evaluating the notion of "sustainable development" and incorporating the principles of social equity and equal distribution of resources into economic and energy analysis.

The energy model proposed by Georgescu-Roegen and the one proposed by Mario Giampietro have many common aspects, but also some important differences.

Both models are based on the idea that energy is a fundamental factor for the human economy, and the inefficient use of energy can lead to the depletion of natural resources and environmental degradation.

However, there are significant differences between the two models.

The energy model proposed by Georgescu-Roegen is based on the idea that energy is an essential factor in economic and social development and that there is a limit to the energy resources available on the planet. He argues that the economy must be built around this reality and be oriented towards energy efficiency and the use of renewable resources, at the expense of non-renewable ones (Georgescu-Roegen, 2009).

On the other hand, the energy model proposed by Mario Giampietro focuses on the idea of social metabolism, that is, how energy is used within social and economic systems. He suggests that there must be harmony between the natural cycles of energy and the cycles of production and consumption in the economy. This model focuses in particular on the idea of energy efficiency and technological change, encouraging the use of renewable energy sources and promoting sustainable practices in energy production and consumption.

In general, the two models share a common goal of creating a more sustainable and energy-efficient economy, but they focus on different aspects of energy and environmental issues. Georgescu-Roegen's model focuses more on the limits of available resources and the importance of using renewables, while Giampietro's model focuses more on the sustainable use of energy within social and economic systems.

It can be said that Giampietro's (2019) model is an embodiment of Georgescu Roegen's more general model. This is because Giampietro was largely inspired by the ideas of Georgescu Roegen and developed an empirical approach to the energy problem. Giampietro's model aims to provide a holistic and interdisciplinary approach to energy and sustainability issues, considering the complexity and interconnections between different aspects of the global energy system. Therefore, Giampietro's model can be considered a practical and concrete application of Georgescu Roegen's more general theory in the field of energy and sustainability.

4.3. Gunter Pauli's model of blue energy and renewable energy

Gunter Pauli's (2017) model of blue energy and renewable energy is known as "The Blue Economy". This model focuses on using renewable resources available in nature to create innovative and sustainable solutions to economic and environmental problems.

In the Blue Economy model, blue energy represents energy produced from marine sources such as wave energy, tidal energy, ocean thermal energy and salinity energy. These



energy sources are renewable and have the potential to be used to produce electricity and heat without emitting carbon dioxide emissions (Pauli, 2017).

On the other hand, renewable energy refers to energy sources that are renewable, such as solar energy, wind energy, and hydroelectric energy. These energy sources are also used in the Blue Economy model to create sustainable and innovative solutions to economic and environmental problems.

The Blue Economy model argues that the efficient use of these renewable and blue energy sources can lead to the creation of a sustainable economic cycle, where energy and resources are used responsibly and consistently without harming the environment or human health.

In addition, this model encourages the use of local resources and the creation of short supply chains to reduce costs and increase energy efficiency. Therefore, the Blue Economy model can be a promising solution for creating sustainable and innovative economies that provide solutions to the world's economic and ecological problems.

5. GENERATION OF AN EU STRATEGY ON ENERGY INDEPENDENCE AND THE TRANSITION TO RENEWABLE ENERGY

The EU strategy on energy independence and the transition to renewable energy could be structured as follows:

1. Improving energy efficiency: The EU should develop an integrated approach to improving energy efficiency in all sectors of the economy, including construction, transport and industry. This can be achieved through the use of smart technologies, energy-efficient buildings, electric transport and other innovative solutions.

2. Development of renewable energy: The EU should invest in the development of renewable energy sources such as solar, wind, hydro and geothermal. To do this, the EU should allocate more funds for research and development and provide subsidies and tax incentives for investments in renewable energy.

3. Promoting green energy throughout the EU: The EU should promote renewable energies in all member countries. This can be achieved by creating common policies and funding programs that encourage the use of renewable energy sources in all member countries.

4. Encouraging innovation in energy technology: The EU should support research and development in the field of energy technology, especially in renewable energy. This can be achieved by providing subsidies and tax incentives for companies that invest in the development of energy technology (Mazzucato, 2021).

5. Improving energy infrastructure: The EU should improve energy infrastructure to facilitate the transition to renewable energy. This could include upgrading electricity distribution networks, developing smart grids and encouraging the use of electric vehicles by developing a network of charging stations (Seba, 2020).

6. International cooperation: The EU should cooperate with other countries and international organizations to promote the transition to renewable energy globally. This can be achieved by creating international partnerships for research and development, exchange of knowledge and technologies, and collaboration within international climate change agreements.

These are just some of the strategies the EU could adopt to promote energy independence and the transition to renewable energy.



There are several insights from economic theories that could be taken into account to rethink the REPowerEU plan and harmonize this strategy with various economic theories.

1. The neoclassical perspective: According to the neoclassical theory, the market should be the main mechanism by which the transition to renewable energy is ensured. Therefore, a market-based approach, such as the implementation of fiscal policies and market mechanisms, could be used to encourage investment in renewable energy sources. In addition, the development of energy storage technologies and smart grids could play an important role in encouraging the transition to renewable energy.

2. The bioeconomic perspective: This theory suggests that the economy should be seen as a biological system, where resources are finite and cycles of materials and energy are essential. (Costanza, 2015). Therefore, an approach based on material and energy cycles could be used to ensure the transition to a renewable energy. This would involve using renewable resources efficiently, reducing energy losses in production processes and encouraging recycling.

3. The institutional perspective: This theory suggests that institutions and rules play an important role in shaping economic behavior. In this regard, the government could play an important role in encouraging the transition to renewable energy through appropriate policy and regulation. These could include tax policies, subsidies for renewable energy and regulations on greenhouse gas emissions.

In conclusion, an approach based on a combination of these theoretical perspectives could be used to rethink the REPowerEU plan and encourage the transition to renewable energy efficiently and sustainably.

6. CONCLUSIONS

Solving the renewable energy problem can be achieved by applying an integrated and ambitious plan that includes both public policies and investments in clean technologies. Such a plan could include the following measures:

1. The adoption of a favorable legislative framework for the development of renewable energy, which promotes investments and innovations in this field.
2. Implementation of support policies for the development of renewable energy infrastructure, including smart energy distribution and storage networks.
3. Promotion of advanced renewable energy production technologies, as well as research and development in this field.
4. Stimulation of private investments and public-private partnerships in the field of renewable energy.
5. Raising awareness and educating citizens about the benefits and importance of renewable energy, as well as promoting a sustainable lifestyle.

The REPowerEU plan can be an opportunity for the European Union to improve its production and consumption of renewable energy. This plan can be approached from multiple theoretical perspectives, such as economic, behavioral, entrepreneurial or complexity. An interdisciplinary and integrated approach can ensure the sustainable success of the plan.

It is important to understand that the transition to renewable energy requires a radical change in the way society thinks, designs and uses energy. Close collaboration between EU Member States and between the production, transport and consumption sectors is also needed to ensure a coherent and integrated plan.



Action research methodology can be a valuable tool in the development and implementation of renewable energy production and consumption programs. This methodology involves the active involvement of those affected by the proposed change, such as local communities and businesses, and encourages them to take responsibility for the implementation of the plan.

Finally, the implementation of the REPowerEU plan can contribute to reducing greenhouse gas emissions, increasing energy security and sustainable economic development in the EU. However, it is important to recognize that the transition to renewable energy will not be easy and will require significant efforts from all parties involved.



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