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Renewable Energy and Energy Efficiency: evidence from Tecnalia company

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Abstract:

This study aims to determine the existing synergy among renewable energies and energy efficiency, by identifying their advantages and benefits, to do that evidence is taken from Tecnalia company which is considered as a pioneer and leading company in the field of renewable energies and energy efficiency .

The results of the study reveal that: First, Tecnalia company can help organizations to save more energy and achieve the energy efficiency, by providing some innovative products. Second, Tecnalia provides for organization the service to use and adopt the renewable energy sources. Third, Tecnalia provides some efficient renewable products. Finally, energy efficiency and Renewable energy are working in synergy to reach global energy decarbonization. When pursued together, they result in higher shares of renewable energy, a faster reduction in energy intensity, and lower energy system costs. This also brings environmental and social benefits, such as less air pollution. Moreover, all countries can benefit from the important synergies between renewable energies and energy efficiency. Specific technologies enable energy efficiency and renewable energies in the energy and end-use sectors.

Keywords: *energy efficiency; renewable energy; synergy; Tecnalia.*

Jel Classification Codes : *Q4 ; Q2.*

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1. Introduction :

Energy is one of the most important basic pillars on which a person's life is based, especially at the present time, where all the means that he uses to meet his various needs of transportation, communication, heating and others have become dependent on energy for their operation and for this reason the topic of energy is no longer a matter that is only concerned with academics, researchers, specialists and decision-makers Economic and political only, but it transcended those frameworks to become everyone's interest, regardless of their employment and social positions. What has led to the expansion of interest in the issue of energy in this way is that we as individuals have become concerned with the future of energy resources in our regions in particular and in the world in general. Energy no longer affects our daily well-being and the way we conduct our affairs. Rather, it takes on a more comprehensive importance related to the crucial issues of societies such as environmental pollution as a result of the various gases caused by the fossil energy resources and the risks they cause to the health and safety of humanity in all countries of the world.

The leading countries in renewable energy were previously confined to the industrialized West, the same countries that were most affected by the oil crises of the 1970s. Since that time, Western interest in the field of renewable energy has grown, especially in industrialized countries such as the United States and Germany. As these countries have developed modern techniques and methods and depend on advanced technology to enable the exploitation of renewable energies and replace them with fossil energy, which is characterized by its depletion and disappearance with the passage of time, and the latter can be obtained from the earth's crust, unlike renewable energies that depend on permanent sources such as solar energy, water and wind etc. But leadership in this field has now moved to other geographical areas outside the industrialized West, and successful experiences have emerged for many Western and Arab countries, which can be used to promote this type of energy and achieve economic, social and environmental development alike.

In light of the above, this research paper came to shed light on a pioneering experience in the field of renewable energy and energy efficiency in order to extract lessons from this experience and to try to highlight the most important technologies that it uses in this field and to demonstrate the contribution of these energy sources to achieving economic development and supporting programs to protect the environment from destructive energy elements, pollution, and various epidemics that would threaten the security and safety of humanity and earth.

Achieving the objective for renewables depends on also achieving the efficiency objective. Similarly, increasing the share of renewables results in faster improvement of energy efficiency improvement rate, accordingly the main problematic of this research can be formulated as follows: *To what extent can renewable energies and efficient energy contribute to enhancing and achieving advanced practical performance?* To answer this main question, it will be divided into the following sub questions:

1. Two what extent does a synergy exist between renewable energy and energy efficiency?
2. what are the most important lessons that can be learned from the experience of Tecnalia in the field of utilizing renewable energies and energy efficiency?
3. How can Algeria benefit from this experience?

Accordingly, the following of the paper is organized as follows: section one clarifies the conceptual framework for renewable energies by presenting its definition, sources, and

characteristics. Section two explains the existing synergy between renewable energy and energy efficiency, this section defines the energy efficiency concept and presents the benefits of both renewable energies and energy efficiency moreover, it provides the methods for improving energy efficiency. Section three deals with the case of Tecnalia company as a successful experience in the field of renewable energies and energy efficiency, by introducing this company and presenting its innovations in the field of renewable and energy efficiency. Finally, the last section concludes the research.

1.1 Study objectives

The study seeks to achieve the following objectives:

- To give some insights about the renewable energies and identify the energy efficiency;
- To understand the synergy between renewable energies and energy efficiency;
- To get lessons from the experience of Tecnalia company in the field of renewables, energy efficiency and energy transition.
- To determine how can Algeria benefit from the experience of Tecnalia company

1.2 Study Approach

The Descriptive method is used to clarify the characteristics and the nature of renewable energies and energy efficiency in Tecnalia company, and the case study is applied in order to answer the research questions with maximum breadth.

1.3 study hypotheses

1. **H1:** There is a synergy between renewable energy and energy efficiency.
2. **H2:** Many lessons can be learned from the experience of Tecnalia in the field of utilizing renewable energies and energy efficiency.
3. **H3:** Algeria can benefit from the experience of Tecnalia company.

1.4 Literature Review

The assessment of energy savings attributable to policies, in order to assess the impact of policies, is a crucial topic in energy efficiency policy analysis (Boonekamp, 2006). Some models are proposed for evaluating the energy efficiency, (Bertoldia & Mosconi, 2020) offer an econometric model for evaluating the energy savings brought about by measures promoting energy efficiency in the European union Member States between 1990 and 2013. In a dynamic panel model for 29 European nations, and they propose an explicit measurement of energy policy intensity based on the MURE database. According to our findings, Europe's energy usage in 2013 would have been around 12% higher if energy efficiency policies hadn't been in place. Another work of (Dhakouani, Znouda, & Bouden, 2019) show how improved integration of renewable energies could result from a planned reduction in power system reliability without affecting energy access. As a result, we have connected the peak clipping as scheduled outages energy efficiency action to the aspect of power system reliability. The cost-based long-term optimization model Open-Source energy Modeling SYStem (OSeMOSYS), which is used for energy planning, has taken this element into account. The Tunisian power system has then been subjected to upgraded OSeMOSYS utilizing two scenarios that reflect the penetration of renewable energy sources. According to simulation results, the penetration of renewable energy sources is high, and the dependability of the power system as a result of energy efficiency measures is declining.

Increasing energy efficiency while retaining productivity in manufacturing systems requires integrating energy efficiency as a fundamental factor in production management. Due to their ignorance of the connection between productivity and energy efficiency, decision-makers continue to face a great difficulty as a result of this integration. As a result, related energy-saving potential is still underutilized. (Wena, Caoa, Honb, Chena, & Li, 2021) in order to encourage the systematic integration of energy efficiency into production management, in their paper introduces the novel Energy Value Mapping (EVM) method. Three phases in succession make up the method: Lean energy analysis using production-oriented energy performance indicators to highlight energy inefficiencies and indicate improvement directions; Energy loss modeling to reveal the coupling relation between Energy losses and productivity variables; Improvement strategies determination to improve Energy Efficiency While Considering Traditional decision-making in production. The efficacy and applicability of the method have also been proved through an industrial case study of a die-casting factory, highlighting its enormous potential for locating, visualizing, quantifying, analyzing, and reducing energy losses connected to production and operations management. The findings demonstrated that by increasing time and energy consumption by 5.0 percent and 4.8 percent, respectively, the overall energy demand of the production chain could be reduced by 6.17 percent.

Many literatures dealt with the renewable energies and energy efficiency separately, but just few of them studied the linkage or the synergy between the energy and the energy efficiency, that is why in this research we try to fill this gap, by investigating the synergy between energy and energy efficiency.

2. The conceptual framework for renewable energies

Renewable energies are considered one of the most important sources of energy that can be relied upon, as an alternative to fossil energies due to the privileges they offer to the countries that use them, and on top of these privileges comes the environmental drive to reduce the gases emitted, especially carbon dioxide. Its sources.

2.1 Renewable energies definition

Renewable energies mean “those energies that re-exist in nature automatically and periodically, meaning that they are energy derived from natural resources that are renewed or that cannot be depleted. Renewable energy is also defined as energy that is generated from an inexhaustible natural source that is available everywhere on the ground surface and can be easily transformed (OPEC, 2007, p. 112).

It can be said that renewable and sustainable energy is energy generated from natural sources such as sunlight, wind, water, rain and heat of the Earth's interior, in addition to the energy of biomass. Renewable energies are eternal and environmentally friendly, unlike non-renewable energies.

2.2 Renewable energy sources

There are many sources for renewable energies, the most important of them are presented as follows:

First: wind energy (wind energy): The wind is moving air and thus it possesses kinetic energy that can be converted into regular rotational turbine energy using wind turbines. These rotating turbines can be used to raise water, grind grains and generate electrical energy (Wakaa, 2019, p. 117). Wind turbines have been used for decades to pump water, grind grains and cut wood, but their use has

begun to decrease since the discovery of traditional (fossil) energy sources and the spread of electrical networks. The energy is generated from moving large panels fixed in high places by the action of the air, and the electric energy is produced from the wind by motors or (turbines) with three rotating arms carried on a pole that convert the kinetic energy of the wind into electrical energy, so when the wind passes over the arms it creates an air impulse. A dynamic that causes it to spin, and this rotation drives the turbine, producing electrical energy.

Second: Solar energy: Solar energy is one of the clean, renewable energies that are inexhaustible as long as the sun is present, and all the energy sources on the earth have first originated from solar energy, and this energy can be converted directly or indirectly into heat, cold, electricity and motive power. And the sun's rays are electromagnetic rays and their visible spectrum is 49% and invisible, ultraviolet rays constitute 2% and infrared rays 49% (Ferouhat, 2012, p. 150)

The use of the sun's thermal energy has been known for thousands of years in hot regions, as it was used in heating water and in drying some crops to save them from damage. At the present time, research and experiments are based on trying to exploit the energy of the sun in the production of electrical energy, heating and air conditioning, smelting metals, etc., and solar energy varies according to its temperature and its distance from the earth, and it also reaches the ground with light or radiation, in the clear day and when the sun is Vertical, it is an abundant source. The solar energy is an abundant source. If it could be collected and exploited, its radiation energy reaches the surface of the earth at a rate of 1 kilowatt / m. It should be noted that solar energy is the strongest candidate to replace petroleum after.

Photovoltaic panels, which convert sunlight into electricity, are also expected to be successful. Solar thermal energy which is considered a relatively new and promising technology to a large extent, as its resources are many and its effects on the environment are limited, and it provides the countries most exposed to the sun in the world an opportunity similar to those currently provided by wind farms in European seas with the most vulnerable shores to wind, and among the most promising areas: the southwestern states The United, African and European countries bordering the Mediterranean are one of the land to generate between 100 and 120 gigawatt per hour.

Third: Geothermal energy: The principle of geothermal heat is to extract energy in the soil for use in the form of heating or electricity, as the heat rises mainly from the surface of the earth towards its interior, and the temperature rise changes according to the depth, and this heat is produced mainly by radioactivity This heat is not obtained unless the geological components of the Earth's interior contain pores and permeability and contain. Also, on water reservoir layers (aquifers with water or water vapor) (Muschet, 2000, p. 17).

Fourth: Hydropower energy: There are several types of water energy sources that can be classified as follows (Wakaa, 2019, p. 117):

- Hydropower production from large stations, and this is mostly done by building huge dams in the course of large rivers and it is the largest source of energy production;
- Hydroelectric production from small stations, which are dams that produce a single unit of up to 100 kilowatts, and the China is a leading country in the world producing this type of energy;
- Hydropower resulting from the movement of water and rivers, without the use of dams. Small stations are placed in the course of rivers to move them and provide cooling for them.
- The energy of the ocean and seas water that is produced from the kinetic waves and currents in force in the stations and seas, as well as the tides, and the difference in temperature between the surfaces and depths of the stations.

- Osmotic energy, which is the result of the difference in salinity between rivers and seas
- Cellular fuel energy, which is the production of hydrogen from water by way of water analysis, and it is one of the important and modern topics as hydrogen has begun to replace traditional fuels in many uses.

Fifth: Biomass energy: Biomass means what is collected from waste, such as dead trees, tree branches and leaves, crop residues, wood pieces, etc. Waste recycling is intended to be reused to produce other products of lower quality than the original product, while it is intended to reuse, for example the reuse of plastic bottles for mineral water after sterilization (Khayyat, 2012, p. 12).

2.3 Characteristics of renewable energy

Renewable energies are characterized by several characteristics, the most important of which are presented as follows:

- It plays an important role in a person's life and contributes to meeting a high percentage of his energy requirements, which are long-term sources because they are mainly related to the sun and the energy they give.
- Renewable energy is not a ready-made storage that we use from it whenever we want it. And energy sources are not available or disappear in a way outside the ability of humans to control it or to determine the available amounts of it, such as the sun and the intensity of radiation.
- The use of renewable energy sources requires the use of many devices of large areas and sizes. Indeed, this is one of the reasons for the high initial cost of renewable energy devices, which is at the same time one of the obstacles to their rapid spread.
- Various forms of energy are available in renewable energy sources, which requires the use of appropriate technology for each form of energy.

More characteristics of renewable energies are presented in the following table:

Table (1): Important Characteristics of renewable energies

	Options	Status	Capacity
Small hydro	Low to high head turbines and dams. Run of river.	Virtually all are commercial.	Factor Intermittent to base load.
Wind	Horizontal and vertical axis wind turbines. Wind Pumps.	Commercial. New designs under development.	Variable, 20 to 40%.
Solar	Photovoltaic. Active thermal (low to high temp for heat or electricity). Passive thermal.	Most commercial. Some under development or refinement.	W/o storage: <25%, intermittent W/thermal storage: 40 to 60%, intermediate.
Geothermal	Cycles: Dry steam, Flash, and Binary	Commercial. Exploration and drilling improvements underway.	High, base load.
Bioenergy	Combustion. Fermentation. Digestion. Gasification and Liquefication.	Many commercial. More under development or refinement.	Wood plants average 95+%. Intermediate, peaking.

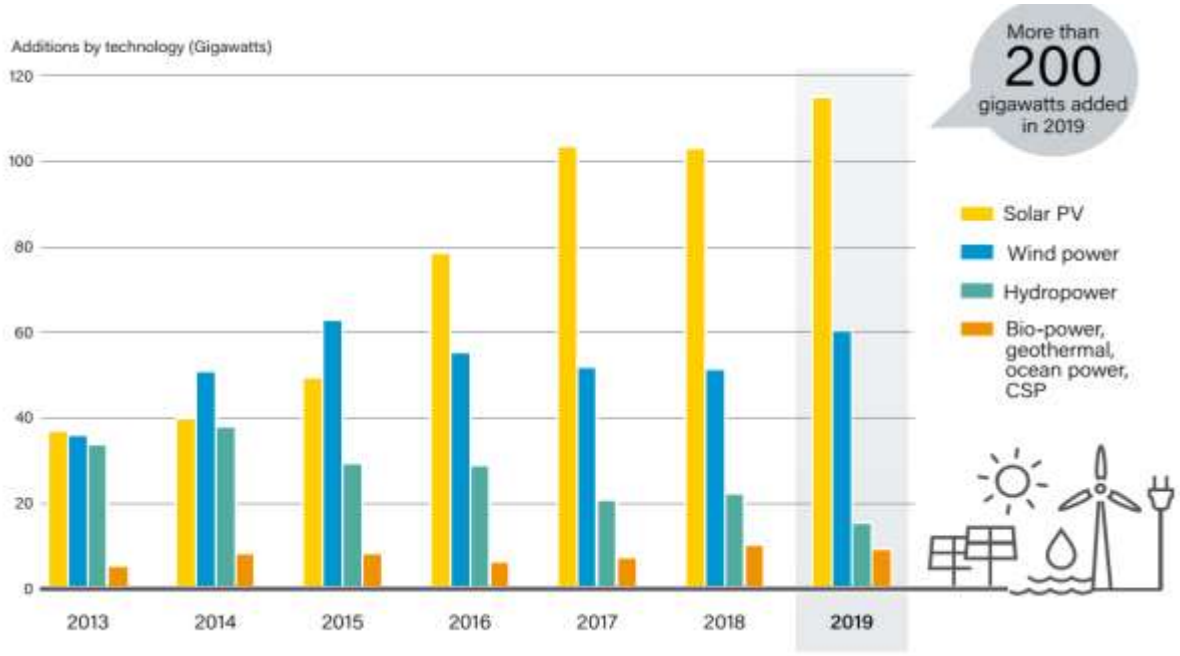
Source: Armstrong, A. J., & Hamrin, J. (2016). Trends in Energy Policy, Deregulation, Energy Markets and Technology. U.S: United States Export Council for Renewable Energy.

All five renewable energy sectors offer technologies which are proven and are available in the marketplace. All can be purchased today in forms that are reliable and cost-competitive (Armstrong & Hamrin, 2016, p. 15).

· "Capacity Factor" summarizes the output patterns.
- Geothermal and most biomass plants provide baseload energy.
- Most hydro and some biomass plants are highly dispatchable, offering a range of options from baseload to peaking.
- Run-of-river hydro is intermittent, but variations in its output tend to be slow and predictable.
- Solar ranges from intermittent to intermediate, depending on how well it matches the pattern of energy usage.
- Wind is intermittent, but studies have found that most grids can add an intermittent source up to 15% of their capacity without requiring any compensatory action. Higher shares from intermittent sources are usually easy to accommodate.

From figure 1 it can be concluded that more than 200 GW of new renewable power generating capacity was installed in 2019, raising the global total to 2,588 GW by year's end. Installations were well above 2018 levels, maintaining the more than 8% average growth rate of installed renewable power capacity over the previous five years: (RN21, 2021, p. 46)

Figure (1): Annual Additions of Renewable Power Capacity, by Technology and Total, 2013-2019



Source: RN21. (2021). RENEWABLES 2020 GLOBAL STATUS REPORT. Retrieved January 27, 2021, from https://www.ren21.net/wp-content/uploads/2019/05/gsr_2020_full_report_ en.pdf.

3. Synergy Between Renewable Energy and Energy Efficiency

Renewable energy and energy efficiency works in synergy. When chased together, they can lead to faster energy intensity and lower energy costs. Improved efficiency may reduce overall energy demand, allowing the share of renewable energy in the energy mix to grow faster. Renewable energy "energy efficiency" synergy studies how this synergy affects the value of the energy system and technology, further effects on air pollution ևւ avoids adverse effects on pollutants' health.

Moreover, due to the growing environmental concerns regarding fossil fuel generation & security of supply of energy there has been increasing focus upon the development of cleaner renewable energy technologies. Renewable energies can provide cleaner energy but due to

economic pressures on module prices this has caused massive losses to module producers and continues to cause many bankruptcies in the field. Additionally, the cost to complete technology development and commercialization is high and funding possibilities have become rare. This leads to a sincere need to rethink about the energy efficiency concept.

3.1 Energy efficiency definition

Energy efficiency simply means using less energy to perform the same task – that is, eliminating energy waste (EESI, 2020).

Another definition of (Cleary & Palmer, 2020) considers that energy efficiency refers to using less energy to provide an energy service. For example, energy-efficient LED light bulbs are able to produce the same amount of light as incandescent light bulbs by using 75 to 80 percent less electricity. Since energy production typically creates pollution and greenhouse gases, improving the energy efficiency of certain technologies has the potential to significantly reduce energy consumption and consequently reduce emissions from the energy sector.

Accordingly, we can simply define the energy efficiency as the process of reducing the used energy to perform or accomplish the same task. And it is the most cost-effective mean of reducing the energy intensity of the economy and achieving low carbon future.

3.2 Benefits of Renewable Energy and Energy Efficiency synergy

Some of the most important benefits of renewable energy and energy efficiency synergy are provided in the following:

Electricity system benefits: Energy efficiency and renewable energy initiatives—in combination with demand response measures—can help protect electricity producers and consumers from the costs of adding new capacity to the system and from energy supply disruptions, volatile energy prices, and other reliability and security risks.

Emissions and health benefits: Fossil fuel-based electricity generation is a source of air pollution that poses risks to human health, including respiratory illness from fine-particle pollution and ground-level ozone. The burning of fossil fuels for electricity is also the largest source of greenhouse gas (GHG) emissions from human activities in the United States, contributing to global climate change (EPA, 2018, p. 7).

Improving energy efficiency and increasing the use of renewable energy can reduce fossil fuel-based generation and its associated adverse health and environmental consequences. (IRENA, 2017) argue that global energy-related CO2 emissions could be reduced by 70% by 2050 and renewable energy sources could account for about half of these cuts, with a 45% increase in energy and electricity efficiency increases. But to maximize these synergies, it is necessary to better understand the current potential at the national, sectoral and technological levels. Power generation from many types of renewable energy sources is 100% efficient in international energy statistics, while fossil power plants are only 25-85% efficient. Although the competitive cost of technologies varies from country to country, the joint deployment of renewable energies and energy efficiency technologies always results in total savings.

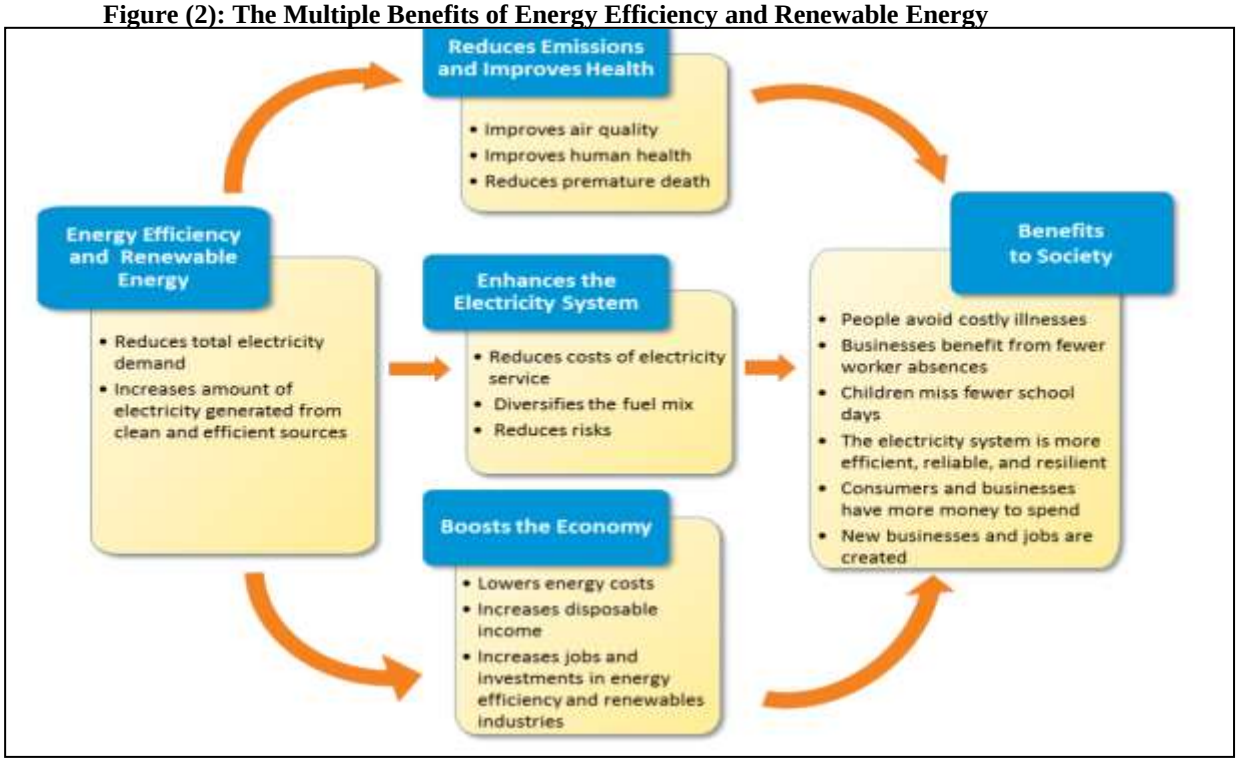
Economic and social benefits: Many of the electricity system, emissions, and health benefits yield overall economic benefits to the state. These benefits include savings in energy and fuel costs for

consumers, businesses, and the government; new jobs in, profits for, and tax revenue from companies that support or use energy efficiency and renewable energy, such as construction, manufacturing, and services; and higher productivity from employee and students taking fewer sick days (EPA, 2018, p. 7).

Moreover, the real environmental and social benefits can be achieved through the integration of renewable energy and energy efficiency. Reducing air pollution - the real killer - is one thing. Another recent study shows that, for example, about 13,000 people living in Iraq's environmental and social workers are one. “Looking in detail at China, Germany, India, Japan, Japan, and the United States” — the world’s five largest energy users —, the implement some policies to promote renewable and energy efficient development (IRENA, 2017).

The benefits of energy efficiency and renewable energy are summarized in the following shape:

Figure (2): The Multiple Benefits of Energy Efficiency and Renewable Energy



Source: EPA. (2018). Quantifying the Multiple Benefits of Energy Efficiency and Renewable Energy. US: U.S. Environmental Protection Agency. P 7.

3.3 Methods for Improving Energy Efficiency

- Energy technologies turn energy sources into energy services such as lighting, mobility and heat. Some energy is lost during the conversion of any energy. The energy efficiency of the technology improves when it loses less energy during conversion. There are several technologies and design features available to improve energy efficiency in buildings and transport areas.
- There are a range of energy-efficient devices, appliances, and other equipment available for many electricity end-uses that offer the same service using less energy, either through improvements in efficiency of appliances (such as stoves, air conditioners, and refrigerators), or through the use of technologies that consume less fuel (such as hybrid or electric vehicles relative to

gasoline cars). Other measures can also be taken to reduce energy consumption, such as improving the insulation of buildings (EESI, 2020).

- Moreover, the following tips can be followed to save energy:
  - Use halogen incandescent bulbs, compact fluorescent lights (CFLs), since the CFLs CFLs produce the same light output and warm colors as incandescent bulbs and are very energy-efficient. Their use up to 75 percent less energy and last up to 10 times longer than traditional incandescent light bulbs (NRC, 2014);
  - Using smart power trips;
  - Installing a programable or smart thermostat;
  - Purchasing energy efficient appliances;
  - Reducing water heating expenses;
  - Installing energy efficient windows;
  - Upgrading heating, ventilation and air conditioning (HVAC) system, and streamline your energy bill.

4 Implementation of renewables and energy efficiency and in Tecnalia company

In this section the authors will shed light on a leading research and development company, to see the role of this company in energy transition, energy efficiency and renewable energies:

4.1 Introducing Tecnalia company

TECNALIA is a leading Research and Technological Development Company in Europe, whose mission is to transform technology into GDP to improve people's quality of life, by creating business opportunities for companies, being member of BRTA (Basque Research and Technology Alliance). It works with an increasingly strategic business relationship model based on trust, collaboration, and a shared technological approach, whereby its main scopes of action are: digital transformation, advanced manufacturing, energy transition, sustainable mobility, health, and the urban ecosystem. This company is the first private Spanish organization since 2011 in contracting, participation, and leadership in the European Commission's Horizon 2020 programme and is ranked second in European patent applications.

4.2 Scopes of Tecnalia Actions

TECNALIA company develops solutions for a competitive generation of renewable energy and for CO2-free mobility. Its experience in smart networks, energy storage (including hydrogen), digital technologies, energy efficiency, and advanced materials supports their own deployment. It also supports the industry decarbonization, and the planning/design of energy-efficient, sustainable, comfortable, and resilient urban environments. The worldwide goal of this company it to achieve climate neutrality by 2050 via the in-depth decarbonization of energy with 100 % renewable electric system. The main scopes covered by Tecnalia company are presented as follows (Tecnalia, ENERGY TRANSITION, 2020):

Renewable Energy: innovates in renewable energy systems and components, solar, photovoltaic, wind (offshore and onshore), and biomass, developing and integrating technologies for their design, manufacturing, and operation, while optimizing them in terms of costs, sizing and performance.

Smart Grids: develops systems to enable a smart network, on the one hand, using tools and applications for planning, operating and controlling and, on the other hand, through models and

algorithms to manage the flexibility of demand, storage, and distributed generation. Moreover, it contributes to increase the integration of renewables, providing network flexibility, security of supply, defense against attacks, and reduction of network operating and maintenance costs. Moreover, we offer services for conformity assessment, diagnosis, and commissioning of electrical equipment in the network.

Co2-Free Mobility: provides decarbonized mobility solutions through electrification, integration of applications (the electric vehicle as distributed storage) and hydrogen-based solutions.

Circular Economy: collaborates with administrations in:

The development of their energy strategy and planning, by integrating economic and social dimensions, Assessment of vulnerability and adaptation to climate change, in each region, Environmental quality and comfort management. It also offers climate services, impact assessment, and decarbonization roadmaps, as well as advice on circular economy strategies.

Energy Transition Materials: develops and characterizes materials for:

- Power generation under extreme conditions
- Bio-based products
- Electrochemical storage
- Energy conversion processes based on hydrogen or synthetic fuels.

Industry Decarbonization: supports industry decarbonization by combining technologies from:

- Energy efficiency, use of residual heat and electrification
- Production, transport, and storage of low-carbon H2.
- Bio-refinery. Resulting Bio-products.
- Waste Recovery, bio-products and circular solutions.

Building/City Energy: works on technological solutions to achieve positive energy buildings, neighbourhoods, and cities through technologies for:

Energy Efficiency

- Integration of renewables in construction and city systems.
- Heat electrification.
- Integration of energy uses at district levels.

Digital Energy: puts the smart in systems and processes related to power generation, distribution, and supply. Thus, driving new digital solutions for:

- Asset maintenance and operation.
- Smart energy efficiency systems.
- Artificial intelligence in the Oil & Gas and Chemical Industries.
- Cybersecurity
- Data analysis for environmental assessment and climate-energy prediction.

Data Hub: Shared ownership and data governance.

Health: Tecnalia fosters the development of customized products and services in the prevention, diagnosis, treatment and rehabilitation stages. During these stages, we consider the main variables that affect people's health: genetics, nutrition, the physical and social environment

The following figure illustrates the scopes covered by Tecnalia company (Tecnalia, annual report Fundación Tecnalia research & innovation, 2019, p. 20):

Figure (3): Tecnalia actions' scopes

Source: (Tecnalia, annual report Fundación Tecnalia research & innovation, 2019, p. 20)

4.3 The efficiency areas in industry

The main efficiency services provided to companies and instituations by Tecnalia company are illustrated in the following:

4.3.1 Energy planning and energy efficiency

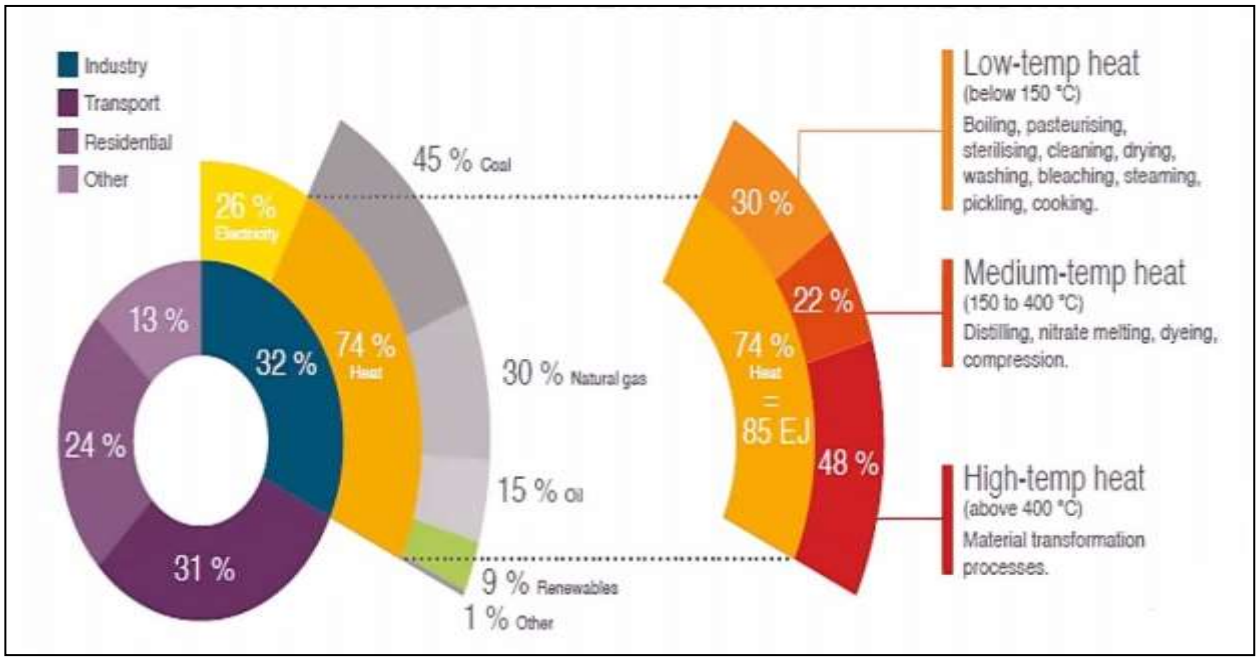
- Integrated energy planning for urban and regional decarbonization;
- Design and integration technologies for NZEB (Near Zero Energy Buildings) and NZED (Near Zero Energy Districts);
- Analysis of the potential deployment of energy technologies including Electrical Vehicle;
- Energy strategies assessment and energy policies definition;

- Multicriteria impact assessment of energy technologies and systems (LCA, LCC, SLCA);
- Thermal systems design, development and validation: solar systems for buildings and urban environment; hybrid systems (photovoltaic-thermal-thermodynamic); heat pumps, heat recovery, biomass combustion, UTAs; control strategies; ORC/HP hybridization forheat valorization in boats, industrial cooling with natural coolants.

4.3.2 Thermal Heat Demand

The thermal heat demand is presented in the following figure, from which it can be seen that the industry has the high demand by about 32% (26 electricity and 74% heat, from 74% heat 30% are low-temp heat, 22% are medium-temp heat and 48% are high-temp heat), followed by the transport services by 31% then the residential by 24% and finally the other sectors by 13%.

Figure (4): Enormous Global Heat Demand in Industry



Source: Tecnalia. (2019). Annual report Fundación Tecnalia research & innovation Retrieved January 27, 2021, from annual report Fundación Tecnalia research & innovation:https: //cms.tecnalia.com/uploads/2020/11/TECNALIA_INFORME_ANUAL _2019_EN.pdf.

4.3.3 Energy Efficiency products

Accordingly, the main products provided by Tecnalia in this field are presented as follows:

Efficient active Thermal systems

Tecnalia company provides modeling, simulation, design and testing of complex thermal systems and components, depending on the following technologies:

- Residual heat recovery which is done through using high temperature heat pumps and heat transformers (absorption);
- Thermal and thermochemical storage;
- Hybridization with renewable energies;

- Solar thermal medium temperature;

Heat transformer: Industrial heat recovery by adiabatic heat transformation, the concept of this method depends on recovering residuals from a process by means of temperature transformation to be able to reused in the same or other heat intensive industrial process, this method enables for achieving 50 % of heat recovery.

High temperature heat pump: High temperature heat pump for industrial uses permits for the revalorizations of medium temperature waste steams to generate high temperature heat.

ARTIC : ARTIC represents an energy efficient air conditioning system, air conditioning system with liquid desiccants for independent control of humidity and temperature. Installed prototype achieves saving of up to 30%.

NAIA 4: NAIA 4 helps for understanding the energy consumption of the industrial processes and carrying out an effective management that provides important economic savings.

Next24-energy: Next24-energy is a platform which offers a dynamic optimization of energy consumption in building, it can guarantee a total saving of 15% in the building energy consumption. By applying a calculation algorithm based on machine learning techniques and optimization. So, that the system learns the behavior of the building and the HVAC system from the historical logs.

HANDLE: HANDLE is a hybrid solar system for simultaneous electricity and hot water generation, hybrid collection of the generation of photovoltaic and electricity and it is connected to a heat pump that maximize the solar energy generation within limited space.

SOLAR FACE: SOLAR FACE enables for energy generation composites, proprietary technology for structural components manufacturing with embedded system for construction, urban furniture, electric vehicles, infrastructure, low power devices and space applications.

SUNSET: SUNSET is an advanced PV inverter with energy storage, it can reduce the electricity bill up to 10% due to its ability to generate and consume matching algorithms taking into account the current electricity tariffs, consumption and weather forecasts.

AGRICOLAT: Is a low cost-anti reflective (AR) and ANTI SOILING (AS) coating for the PV modules, it gains of transmission over standard glass resulting in a considerable improvement in the PV module efficiency an electricity generation. This method enables for:

- 2 % increase in the energy production
- 5% less maintenance cost.
- Low electricity costs reduction up to 3%.
- 100 MW solar plant saving over lifespan.

GRAPHESAL: GRAPHESAL is a CDI water desalination with low energy consumption using graphing electrodes, novel hybrid material based on three-dimensional reduced Graphene Oxide which show very good results on electro sorption capacity. From its advantages it allows for:

- 50 to 70 % less energy consumption (reduction in $(Co_2$emmissions);
- 99% salt removal (eliminates all types of ions);
- 90%water recovery;
- 50%reduction of operation and management costs;

- 50% reduction of investment costs.

4.4 Renewable energy innovations in Tecnalia

From the advanced products and services provided by Tecnalia company we can distinguish the following:

Photovoltaic solar energy: new concepts of PV farms (bifacial, floating PV, agro-PV): design and evaluation, component development and prototyping.
- Analysis, design and simulation of new conversion topologies, modulation techniques and control strategies for large PV converters.
- Analysis, design and simulation of control strategies for energy storage systems in order to provide services to large PV farms.
- Development of failure detection and diagnosis tools for large farms and predictive maintenance
- Economic profitability and life cycle assessment in large PV farms.
- Component and systems characterization and reliability studies: monitoring, indoor and outdoor tests.

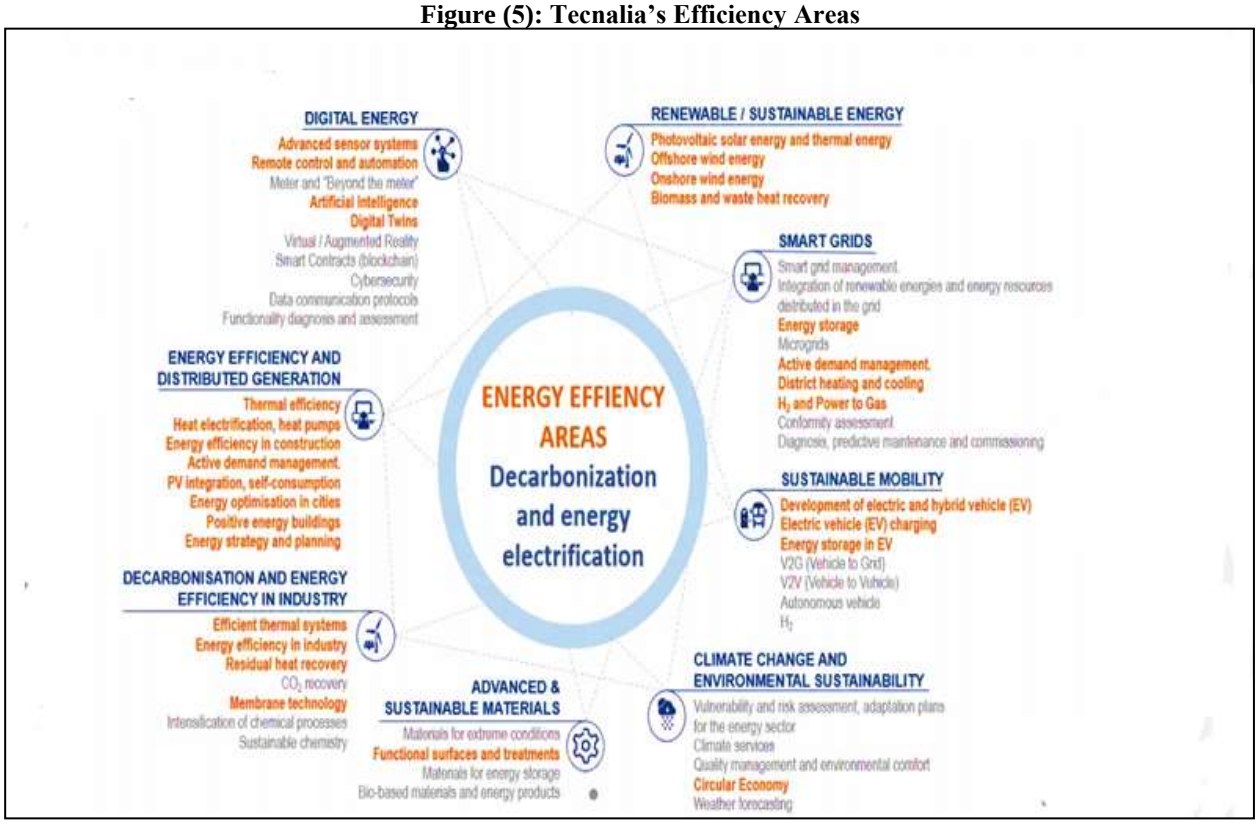
Offshore renewable energy

- Component testing for offshore applications in real conditions
- Development of digital twins of offshore products and components offshore for life
- extension, operation, maintenance and redesign.
- Offshore structures and systems design and optimization, including mooring, umbilical cable, offshore operations and electrical
- layout.
- Generation, modelling and assessment of innovating concepts to reduce costs in renewables and distributed energy integration

- Power grid interconnection impact modelling, simulation and assessment of the renewables and distributed generation, handling environments of power grids simulation as PSS/E y DigSilent PowerFactory;
- Algorithms development for voltage and frequency control in power grids with high penetration of renewable and distributed generation, using decentralized control strategies as Web-of-Cells concept;
- Power converter prototypes design and development for several applications related with power grid: Interconnection to the distributed generation power grid and storage, and/or service provision for quality supply.
- HVDC offshore plants interconnection, working with MMC topologies and also with diode hybrid converter.

Figure 5 gives more details about Tecnalia's efficiency products and renewable energies:

Figure (5): Tecnalia's Efficiency Areas



Source: Tecnalia. (2019). Annual report Fundación Tecnalia research & innovation Retrieved January 27, 2021, from annual report Fundación Tecnalia research & innovation:https: //cms.tecnalia.com/uploads/2020/11/TECNALIA_INFORME_ANUAL _2019_EN.pdf

From the preceding analyses we can see that Tecnalia company provides many products and services in the field of renewable energies and energy efficiency, and accordingly it can be concluded that this hypothesis H2: Many lessons can be learned from the experience of Tecnalia in the field of utilizing renewable energies and energy efficiency is accepted.

4.5 Synergy between renewable energies and energy efficiency in Tecnalia company

NanoPhoSolar aims to develop nanophosphor down converting material which will be incorporated into coatings and polymer films for integration into new solar modules and retrofit of existing solar modules. Through creating down-converter materials significantly increase the solar cell efficiency and lifetime of conventional technologies (e.g., silicon based, CIGS and CdTe) as well as emerging technologies such as dye sensitized solar cells. The NanoPhoSolar project will overcome the limitations relating to efficiency and performance range of solar cells by developing nanophosphor down converting materials which are capable of absorbing UV and short wavelength visible light and re-emitting in the more useful longer wavelength visible spectrum. In effect the solar cell will be able to harvest more of the energy from the sunlight and thus increase the cell efficiency. In addition, the solar module will experience less of the damaging sections of light (high energy UV rays), through the down conversion to visible light, thus increasing module lifetime (EuropeanCommission, 2017).

By doing this, the PV system created will offer greatly improved photovoltaic performance due to capture of a larger proportion of the incident visible spectrum. This will lead to significant economic and societal benefits to consumers and manufacturers. by providing manufacturers with

more efficient solar modules and providing installers of solar modules with a means to increase the efficiency of existing installed systems.

From the above it can be concluded that the following hypothesis H1: There is a synergy between renewable energy and energy efficiency is accepted.

4.6 lessons Algeria can learn from the Tecnalia experience

The future vision of activating the exploitation of renewable energy takes into account the positive results that it will achieve and the opportunities that it will provide for Algeria through achieving the societal well-being of the Algerian citizen, through the provision of energy supply and the areas of its uses that will raise the standard of living of thousands, especially in isolated villages and remote areas.

In this context, Algeria can depend on many products provided by Tecnalia company in order to benefit from renewable energy products like: the NanoPhoSolar, photovoltaic solar energy, offshore renewable energy, HANDLE that maximizes the solar energy generation within limited space, and SOLAR FACE which enables for energy generation composites and SUNSET which can realize a reduction of the electricity bill up to 10%. Moreover, to ensure the efficiency of some energic products Algeria can adopt the technology provided by Tecnalia company in this field like Efficient active Thermal systems, Heat transformer that enables for achieving 50 % of heat recovery, High temperature heat pump that helps for the revalorizations of medium temperature waste steams to generate high temperature heat; ARTIC that permits saving of up to 30%, NAIA 4 which is an effective management tool that provides important economic savings and Next24-energy which offers a dynamic optimization of energy consumption in building, it can guarantee a total saving of 15% in the building energy consumption. This will lead to significant economic and societal benefits to consumers and manufacturers. According to the preceding, it can be concluded that this hypothesis: H3: Algeria can benefit from the experience of Tecnalia company is accepted

Therefore, the renewable energies sector would absorb a significant percentage of the labor force, which would absorb a percentage of unemployment at all levels, whether with regard to tires, university graduates with specialization, workers at lower levels, or even the administrative staff to run such projects. Which would achieve acceptance and satisfaction by the circles and groups of Algerian society, which is what leads to the economic stability and social cohesion in Algeria. Algeria's reliance on renewable energies will ensure its position as a producer and exporter of energy, by increasing its revenues and financial incomes from energy markets in the distant future, as these revenues are major and important and a fundamental role in ensuring its economic security and financing the development process and the development of energy projects. In the same context, it will ensure that oil and gas reserves are maintained for a longer period for future generations.

5. Conclusions

This paper aims to identify the existing synergy among renewable energies and energy efficiency, and demonstrate their advantages, evidence is taken from Tecnalia company which is considered as a pioneer and leading company in the field of renewable energies and energy efficiency. The results of the study reveal that:

First, Tecnalia company can help organizations to save more energy and achieve the energy efficiency, by providing some innovative products presented in this paper like:

- Heat transformer that enables for achieving 50 % of heat recovery;
- High temperature heat pump that permits for the revalorizations of medium temperature waste steams to generate high temperature heat;
- ARTIC achieves saving of up to 30%, NAIA 4 which is an effective management tool that provides important economic savings;
- Next24-energy which offers a dynamic optimization of energy consumption in building, it can guarantee a total saving of 15% in the building energy consumption;
- HANDLE that maximizes the solar energy generation within limited space,
- SOLAR FACE which enables for energy generation composites;
- SUNSET which can realize a reduction of the electricity bill up to 10%,
- AGRICOLAT which enables for: 2 % increase in the energy production, 5% less maintenance cost, Low electricity costs reduction up to 3% and 100 MW solar plant saving over lifespan;
- GRAPHESAL from its advantages it allows for: 50 to 70 % less energy consumption, 99% salt removal (eliminates all types of ions); 90%water recovery; 50%reduction of operation and management costs; 50% reduction of investment costs.

Second, Tecnalia provides for organization the service to use and adopt the renewable energy sources for example: Photovoltaic solar energy Photovoltaic solar energy, Offshore renewable energy and Renewables and distributed energy integration…

Third, energy efficiency and Renewable energy are working in synergy to reach global energy decarbonization. When pursued together, they result in higher shares of renewable energy, a faster reduction in energy intensity, and lower energy system costs. This also brings environmental and social benefits, such as less air pollution.

Fourth, Tecnalia provides some renewable and at the same time energy efficient products that lead to significant economic and societal benefits to consumers and manufacturers. by providing manufacturers with more efficient products and providing installers with a means to increase the efficiency of existing installed systems.

Fifth, it can be concluded that Algeria can benefit from the important synergies between renewable energies and energy efficiency. Specific technologies enable energy efficiency and renewable energies in the energy and end-use sectors. In terms of end use, the electrification of services such as passenger transportation and kitchen heating results in higher efficiency, allowing for greater use of renewable energies. On the supply side, the shift to renewable energy, in turn, tends to reduce the demand for primary energy. Moreover, the Algerian authorities can take advantage from Tecnalia's experience and create a similar company or research center, to help Algerian companies and individuals to increase the traditional energies efficiency and to use and

invest in renewable energies field, Companies and individuals also can benefit from renewables and energy efficiency though:

- Using renewable energy systems;
- Using renewable heat pumps;
- Using efficient dishwasher;
- Using LED lights;
- Developing a zero-energy building.

Finally, we recommend that all parties in Algeria have to participate in the adoption of renewable energies and energy efficiency, and this can be done by the support of Universities that should organize seminars and conferences about the energy efficiency and renewable energies, and send their recommendations to the concerned ministry to enhance the awareness of both individuals and authorities about the subject.

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