Rimak International Journal of Humanities and Social Sciences

ISSN: 2717- 8293

Suheir Ibrahim HACHIM[1]

RENEWABLE ENERGY ECONOMICS AND ITS IMPACT ON THE PROTECTION OF ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

http://dx.doi.org/10.47832/2717-8293.1-3.15

Research Article

Received: 18/11/2020
Accepted: 19/12/2020
Published: 01/01/2021

This article has been scanned by **iThenticat**
No plagiarism detected

Abstract:

A progression of different variables, for example, constraint of fossil fuel assets, negative effects on environment. Fossil directly or indirectly costs energies, political question and their consequences for providing feasible energy are among the reasons which have made numerous government officials, energy and environment specialists move toward the advancement of a cutting edge structure. This is to secure supply of energy, environment assurance and productivity change of energy frameworks. In addition, environmental degradation and the unsustainability of the use of natural resources will lead to increased difficulties for governments and the international community in addressing development challenges, and because the world population is expected to reach (9.7) billion people by the year 2050, in the midst of a situation that is also diminishing. Sources of energy, water and food in the world.

Subsequently, most nations have started to understand that the requirement for manageability in energy creation and utilization is altogether crucial. Thusly, following the advance of manageability is basic. with the increasing global awareness of environmental issues, and the realization Everyone that it is necessary to preserve the planet and to take into account the environmental aspects in the use of conventional energy of all kinds, such as natural gas, coal or petroleum, as it is the main cause of pollution of the elements of the environment, as well as classifying traditional energy among the depleted resources that cannot be compensated. Therefore, many countries have paid attention to providing an alternative component of energy, which is renewable energy, which varies to different sources, from solar energy, wind energy, biomass energy, and other renewable energy sources, and the extent of its contribution to supplying the world with alternative energy and its ability to continue to flow, And also the extent of its potential in

[1] Dr. , AL. Mustafa University College, Iraq, suheir57@gmail.com, https://orcid.org/0000-0002-9619-1854

achieving sustainable development, achieving prosperity in society, and the future of the world.
The point of this paper is to introduce an arrangement of markers for internationally, in view of the Helio International Sustainable Energy Watch (SEW) markers, that demonstrates to track advance toward maintainability in the energy area.. The goal of present work is to highlight key difficulties about the improvement of renewable energy and strategy system prerequisites for accomplishments of maintainable energy in World.
Key words: Sustainable, Environment, Renewable Energy Economics.

Introduction

The historical backdrop of modern human progress is a past filled with transitions of energy. In less created, agrarian economies, individuals' fundamental requirement for sustenance calories is given through basic types of horticulture, which is basically a technique for catching sun powered energy for human utilization and necessities. Sun oriented energy put away in kindling or different biomass energy meets other essential requirements for heating the home and cooking. As economies create and turn out to be more intricate, energy needs increment significantly. Truly, as provisions of kindling and different biomass energy demonstrated lacking to bolster developing economies in swung to hydropower (likewise a type of put away sun oriented energy), then to coal amid the nineteenth century, and afterward to oil and regular gas amid the twentieth century. In the 1950s atomic power was brought into the energy blend. Every phase of financial advancement has been joined by a trademark energy move starting with one noteworthy fuel source then onto the next.

Today, fossil fills coal, oil and regular gas are by a wide margin the overwhelming energy source in mechanical economies, and the fundamental wellspring of energy generation development in creating economies. Be that as it may, the twenty-first century is as of now observing the begin of the following incredible move in energy sources far from fossil fills towards renewable energy sources. This move is roused by many components, including worries about natural effects (especially environmental change), confines on fossil fuel supplies, costs, and innovative change. Society will in the end embrace renewable energy, since fossil energizes are constrained in supply and just made over geologic time. Consequently the question is not whether society will move to renewable energy, but rather when [1].

The lifetime reserves of Fossil fuel might be reached out by new advancements for extraction, however the need to minimize the harming impacts of environmental change is a more prompt issue than fossil fuel consumption. In the event that the most exceedingly terrible effects of rising temperatures and atmosphere adjustment are to be maintained a strategic distance from, society needs to change to renewable energy sources while much fossil carbon is still securely covered in the world's hull. Since such an extensive amount the capital stock and foundation of advanced financial frameworks depend on fossil-fuel energy utilize, any move far from fossil-fuel reliance will include enormous rebuilding and new venture. Some scientific studies indicate that, until 2050, renewable energy can cover the global need for energy and electricity. How will that happen? What is the impact of the

renewable energy system on job opportunities and environmental protection?

These questions are being answered by a team of international scientists at the (Lappeenranta University of Technology) in Finland, and for the first time the study of the Finnish University in cooperation with the (Energy Watch Group) was presented at the Climate Conference (Planet 23) held on November 7, 2017 in Bonn. German.

Professor Breyer says, "The elimination of carbon-emitting substances in the production of electricity is feasible until the year 2050, and this matter is no longer a question of its viability in terms of technology or its economic effectiveness, but rather an issue of the availability of political will or not," due to the considerably low costs. In the long run, solar panels and battery storage will become the most important sources of energy supply. The Finnish team proceeds from the fact that the size of solar panels in global electricity production will increase from 37% in 2030, to 69% in 2050, and thus it will secure more than a quarter of the global need for electricity.

In order to secure the supply of energy around the clock, there is a need for tanks for this purpose. The Finnish team's approach indicated that the need for electricity in 2050 will be covered by 31% through energy storage tanks.

And the authors of the study proceed from the fact that the world population until 2050 will increase to about 9.7 billion. Compared to today, the world will consume twice as much electricity and energy. And the trend of renewable energies and their storage, will also bring with it benefits for the economy and consumers, as compared with today, the costs of electricity production will decrease by about 25%.

While private markets will assume a basic part in this procedure, significant changes in government strategies are important to encourage the move. The extensive monetary ramifications of this legitimize an uncommon concentrate on renewable energy use as a focal financial and ecological issue.

The global shift to environmentally friendly renewable energies will also affect the labor market. It is noteworthy that there are currently 19 million people working in the world in the electricity sector, half of them in the coal extraction and production sector. In the midst of the transition to environmentally friendly renewable energies, many lost their jobs. However, on the other hand, the trend for alternative energies, according to calculations compared to today, provided poor job opportunities, especially in the field of solar energy, battery technology and wind energy.

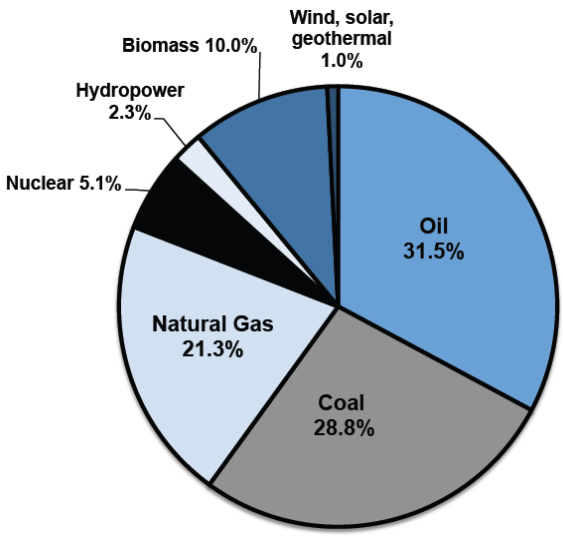

Figure 1: Global Energy Consumption

In one sense, renewable energy is boundless, as provisions are consistently recharged through regular procedures. The every day supply of sun powered energy is hypothetically adequate to meet all human energy requirements for a whole year. In any case, sun powered energy and other renewable energy sources are constrained as in their accessibility fluctuates crosswise over space and time. A few areas of the world are especially appropriate for wind as well as sun powered energy. For instance, the sun based energy, potential is most astounding and parts of Australia and South America. A portion of the best locales for wind energy incorporate Northern Europe, the southern tip of South America, and the Great Lakes area of the United States. Geothermal energy is plenteous in nations, for example, Iceland and the Philippines. Each world district has some renewable energy assets, however accessibility and cost of utilizing these fluctuate. Most renewable energy is at last sunlight based energy. The sun's energy can be utilized specifically for warmth or power. Hydropower originates from falling water, which happens on the grounds that sun powered energy dissipates water at low rises that later rains on high heights. The sun additionally makes twist through differential warming of the world's surface. Biomass energy originates from plant matter, created in photosynthesis driven by the sun. Consequently biomass, wind, and hydropower are simply auxiliary wellsprings of sun oriented energy. Non-sun based renewable energy sources, incorporate geothermal energy, which originates from the world's center, in some mix of energy left from the starting point and proceeded with rot of atomic materials. Tidal energy is another non-sun oriented renewable energy source, being driven by the moon. Despite the fact that atomic power from splitting is not renewable, there is an incredible level headed discussion about whether atomic power ought to be a piece of the post-fossil-fuel energy blend [2].

Sustainable energy for all:

The accessibility of satisfactory, reasonable and solid vitality administrations is basic for mitigating destitution, enhancing human welfare, raising expectations for everyday comforts and eventually to achieve practical improvement. As worldwide advancement challenges keep on being attempted, it is progressively perceived that arrangement of sufficient vitality

administrations has a multiplier impact on wellbeing, instruction, transport, broadcast communications, and water accessibility and sanitation. Therefore, vitality is a vital component for accomplishing the Millennium Development Goals. Securing "sustainable energy for all" includes the improvement of frameworks that bolster the ideal utilization of vitality assets in an impartial and socially strong way while limiting ecological effects. Incorporated national and territorial frameworks for vitality supply, productive transmission and circulation frameworks and also request programs that underscore vitality effectiveness are vital for supportable vitality frameworks.

Universal energy access is essentially related to access to modern energy fuels that can replace traditional biomass consumption for cooking, heating and lighting. It also relates to access to electricity. Traditional biomass is solid biomass used in an unsustainable manner and includes fuelwood, agricultural waste and animal dung. It usually represents the only available or affordable fuel to the poor in many developing regions. Worldwide about 2.7 billion people depend on traditional biomass for cooking of which 83 per cent live in rural areas. Modern or commercial biomass is produced in a sustainable way and can be used for electricity generation, heat production and transportation.

Environmental Protection and Climate Change:

Environmental change could obstruct countries' capacities to accomplish supportable advancement pathways. It is "likely" that environmental change can moderate the pace of advance toward reasonable improvement either straightforwardly through expanded introduction to unfavorable effects or in a roundabout way through disintegration of the ability to adjust. Throughout the following half-century, environmental change could hamper the acknowledgment of the Millennium Development Goals. Environmental change will collaborate at all scales with different patterns in worldwide ecological and normal asset issues, including water, soil and air contamination, wellbeing perils, fiasco hazard, and deforestation. Their joined effects might be exacerbated in future unless there are incorporated relief and adjustment measures. On the opposite side, relief of environmental change can make cooperative energies and maintain a strategic distance from clashes with different measurements of supportable advancement. For instance, enhancing vitality productivity and creating renewable energies can enhance vitality security and decrease neighborhood contamination. Lessening deforestation will profit biodiversity, and afforestation can reestablish debased land, oversee water overflow and advantage country economies, in the event that it doesn't contend with sustenance creation.

Wetlands are perplexing environments and include an extensive variety of inland, beach front and marine living spaces. They share the qualities of both wet and dry situations and show enormous assorted qualities in light of their beginning, land area, hydrological administrations and substrate elements. They incorporate surge fields, swamps, bogs, fishponds, tidal bogs normal and man-made wetlands. Among the most profitable life bolster, wetlands have colossal financial and natural significance for humankind. They are critical to the survival of common biodiversity. They give appropriate territories to jeopardized and uncommon types of feathered creatures and creatures, endemic plants, bugs other than managing transient winged animals. India has an abundance of wetland environments

circulated in various geological districts. India is additionally a signatory to the Ramsar Convention on Wetlands and the Convention of Biological Diversity; Apart from government direction, advancement of better observing strategies is expected to expand the learning of the physical and natural attributes of every wetland asset, and to pick up, from this information, a superior comprehension of wetland elements and their controlling procedures. India being one of the mega different countries of the world ought to endeavor to save the environmental character of these biological systems alongside the biodiversity of the widely varied vegetation related with these environments.

Capital Intensity

Contrasted with fossil energizes, most renewable energy sources require extensive capital speculations. At the point when smoldering a fossil fuel like characteristic gas to produce power, a substantial bit of the aggregate power cost is from acquiring gas, and these gas buys are spread out over a drawn out stretch of time. For a gas-terminated plant with a 50-year lifetime, $1 of gas acquired in year 50, reduced at a 5% rate, would represent only $0.09 in present esteem at the season of plant development. Furthermore, no cash must be obtained to fund the buy of gas for future years of power generation.

Table 1: Capital Cost of Renewable and Non-Renewable Electricity Sources

	Nominal Capacity (MW)	Capital Cost ($/kW)	Assumed Capacity Factor	Capital $ Expected1 kW
Natural gas: combined cycle	620	917$	90%	1,019$
Coal: advanced pulverized fuel	650	3,246$	90%	3,607$
Nuclear: dual unit	2,234	5,530$	90%	6,144$
Wind: onshore	100	2,213$	25%	8,852$
Biomass combined cycle	20	8,180$	90%	9,089$
Wind: offshore	400	6, 230$	35%	17,800$
Solar: photovoltaic	150	3,873$	20%	19,365$
Solar: thermal electric	100	5,067$	20%	25,335$

Renewable sun powered and wind energy sources have low working costs once creating offices are worked, there is minimal extra cost for delivering energy every year. While this is a working preferred standpoint over fossil powers, it comes at the cost of higher capital use. Building a renewable energy plant is like building a fossil energy plant in addition to purchasing all the fuel that the fossil plant will use over its lifetime. Couple of mortgage holders would buy a gas heater and in the meantime buy every one of the gas the heater would use over its life. However by their inclination, this is what is normal for most renewable energy sources [3]. The high capital cost

of most renewable energy sources implies that renewable power cost is delicate to loan costs. High loan fees make renewable sources essentially less appealing when contrasted with fossil energizes, while low financing costs make renewables more alluring. Changing loan fees successfully changes the cost of renewable energy, since financing costs decide the cost of acquiring for starting capital speculation.

Sustainable Development

Customarily, manageability has been encircled in the three-column show: Economy, Ecology and Society are altogether thought to be interconnected and pertinent for maintainability (BMU, 1998). The three-column demonstrate expressly recognizes the including way of the supportability idea and permits a schematic arrangement of maintainability issues. The goes for activity to advance the coordination of the three parts of SD monetary improvement, social advancement and ecological insurance—as associated and commonly strengthening columns. This view subscribes to an understanding where a specific arrangement of activities (e.g., substitution of fossil powers with RE sources) can satisfy every one of the three advancement objectives at the same time. The three-column show has been censured for weakening a solid standardizing idea with obscure classification and supplanting the need to secure characteristic capital with a methodological thought of transsectoral mix.

Inside another reasonable structure, SD can be situated along a continuum between the two ideal models of powerless maintainability and solid manageability. The two ideal models contrast in suppositions about the substitutability of regular and human-made capital. Powerless maintainability has been named the substitutability worldview and depends on the possibility that exclusive the total load of capital should be saved regular capital can be substituted with man-made capital without trading off future prosperity. All things considered, it can be deciphered as an augmentation of neoclassical welfare financial aspects [4]. For instance, one can contend that non-renewable assets, for example, fossil fills, can be substituted, for instance, by renewable assets and innovative advance as incited by market costs. Feeble supportability additionally infers that natural debasement can be made up for with man-made capital, for example, more hardware, transport framework, training and data innovation.

Though powerless supportability expect that the monetary framework adaptable adjusts to changing accessibility of types of capital, solid manageability begins from an environmental point of view with the expectation of proposing guardrails for financial pathways. Solid maintainability can be seen as the non-substitutability worldview, in view of the conviction that normal capital can't be substituted, either for creation purposes or for natural arrangement of managing, supporting and social administrations. For instance, restricted sinks, for example, the climate's ability to retain GHG outflows might be better caught by applying the requirements of the solid supportability idea. In one essential translation, the physical load of particular non-substitutable assets must be safeguarded.

Guardrails for staying inside the limits of maintainability are frequently advocated or roused by nonlinearities, discontinuities, non-smoothness and non-convexities. As a normal correspond, common researchers caution of and portray particular tipping focuses, basic edges at which a minor bother

can subjectively change the state or advancement of Earth frameworks. The prudent standard contends for keeping a protected separation from guardrails, putting the weight of evidence for the non-hurtful character of characteristic capital lessening on those making a move. RE can add to the advancement objectives of the three-column demonstrate and can be evaluated as far as both feeble and solid manageability. Utilization of non-RE sources, for example, fossil energizes and uranium, decreases regular capital specifically. RE, conversely, manages normal capital the length of its asset utilize does not lessen the potential for future reap [5].

Interactions between sustainable development and renewable energies

The relationship amongst Renewable Energy and Sustainability be seen as a chain of importance of objectives and limitations that include both worldwide and provincial or neighborhood contemplations. In reliable with the decision of the AR4, a beginning stage is that alleviation of hazardous anthropogenic environmental change will be one in number main impetus behind expanded utilization of RE advances around the world. To the degree that environmental change adjustment levels (e.g., a most extreme of 550 ppm CO2eq air GHG fixation or a greatest of 2°C temperature increment as for the pre-mechanical worldwide normal) are acknowledged, there is a verifiable affirmation of a solid maintainability standard, as talked about. RE is anticipated to assume a focal part in most GHG relief techniques, which must be in fact possible and financially proficient so that any cost weights are minimized [6].

Information about mechanical capacities and models for ideal alleviation pathways are along these lines critical. In any case, energy innovations, monetary expenses and advantages, and energy approaches, as portrayed in different parts of this report, rely on upon the social orders and regular habitat inside which they are inserted. Spatial and social varieties are along these lines another vital calculate intelligently tending to SD. Manageability difficulties and arrangements significantly rely on upon geographic setting (e.g., sunlight based radiation), financial conditions, imbalances inside and crosswise over social orders, divided foundations, and existing framework, additionally on a fluctuating standardizing comprehension of the undertone of supportability. Investigators along these lines require a separation of examination and arrangement systems as indicated by geographic areas and particular spots and a pluralism of epistemological and regularizing viewpoints of maintainability. These perspectives underline the need to survey both the social and ecological effects of RE innovations to guarantee that RE sending stays adjusted to general SD objectives. Some of these vital provisos are tended to in this part, similar to the degree to which RE advances may have their own particular ecological effect and diminish common capital, for instance, by upstream GHG discharges, wrecking woods, restricting area that can't be utilized generally and expending water. Assessing these effects from the points of view of the powerless and solid maintainability ideal models explains potential tradeoffs amongst decarbonization and other manageability objectives.

Environmental Externalities

In one sense, renewable energy is boundless, as provisions are constantly recharged through regular procedures. The day by day supply of sun based energy is hypothetically adequate to meet all human energy requirements for

a whole year. Yet, sunlight based energy and other renewable energy sources are constrained as in their accessibility differs crosswise over space and time. A few districts of the world are especially appropriate for wind and additionally sun powered energy. For instance, sun oriented energy potential is most astounding and parts of Australia and South America. A portion of the best locales for wind energy incorporate Northern Europe, the southern tip of South America, and the Great Lakes area of the United States. Geothermal energy is rich in nations, for example, Iceland and the Philippines. Each world locale has some renewable energy assets, however accessibility and cost of utilizing these shift. Most renewable energy is at last sun based energy. The sun's energy can be utilized straightforwardly for warmth or power. Hydropower originates from falling water, which happens on the grounds that sun based energy vanishes water at low rises that later rains on high rises. The sun likewise makes twist through differential warming of the world's surface. Biomass energy originates from plant matter, delivered in photosynthesis driven by the sun. Along these lines biomass, wind, and hydropower are simply auxiliary wellsprings of sun oriented energy. Non-sunlight based renewable energy sources incorporate geothermal energy, which originates from the world's center, in some mix of energy left from the inception and proceeded with rot of atomic materials. Tidal energy is another non-sun powered renewable energy source, being driven by the moon. In spite of the fact that atomic power from splitting is not renewable, there is awesome civil argument about whether atomic power ought to be a piece of the post-fossil-fuel energy blend [7].

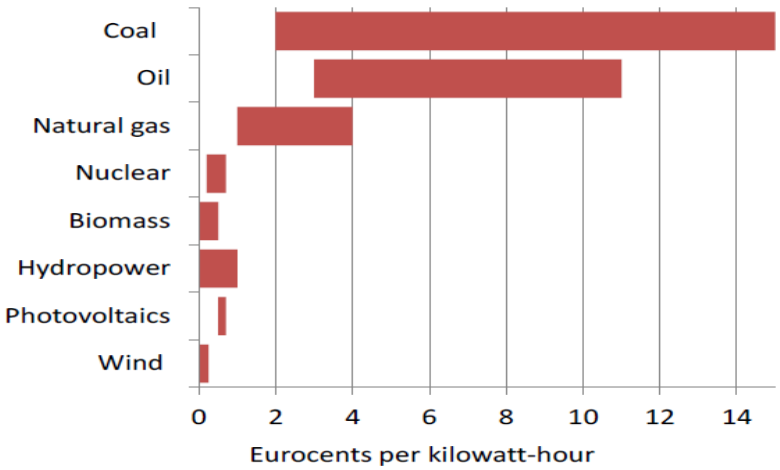

Figure 2: Externality Cost of Various Electricity Generating Methods

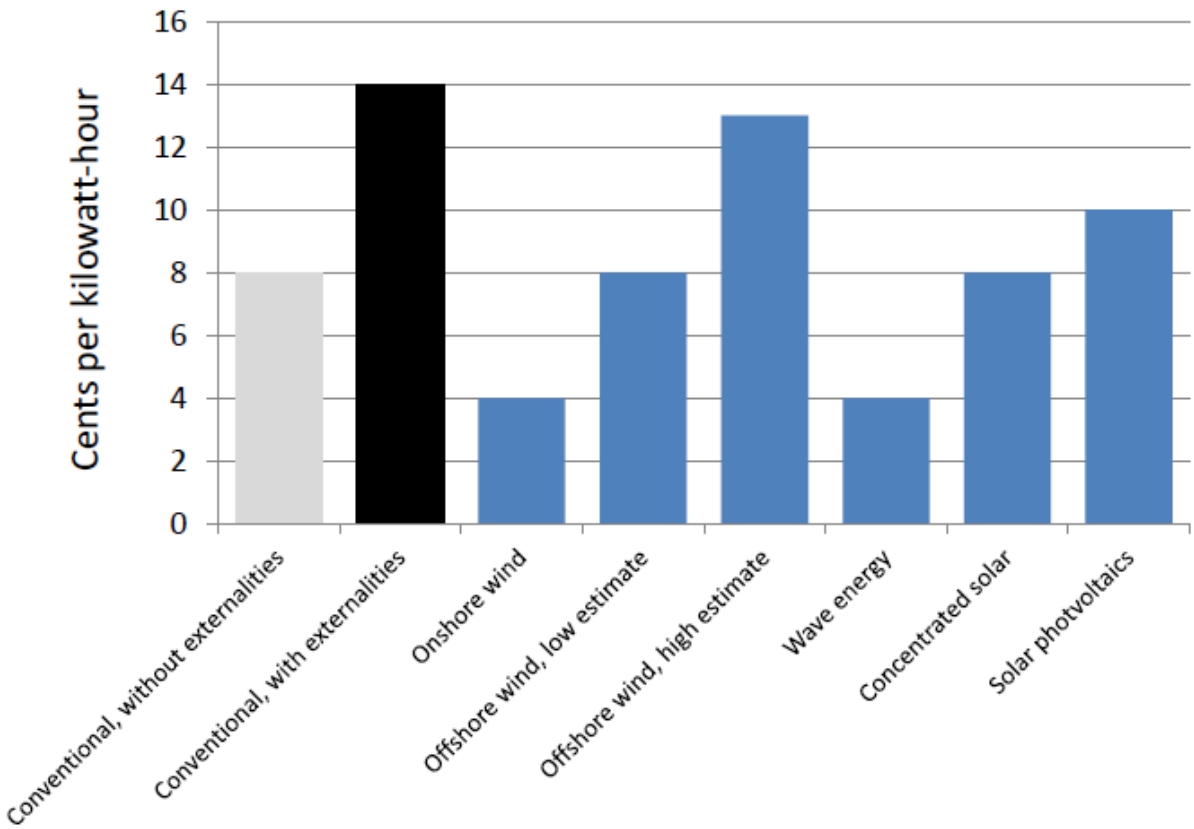

Figure 3: Cost of Electricity Generating Approaches, 2020

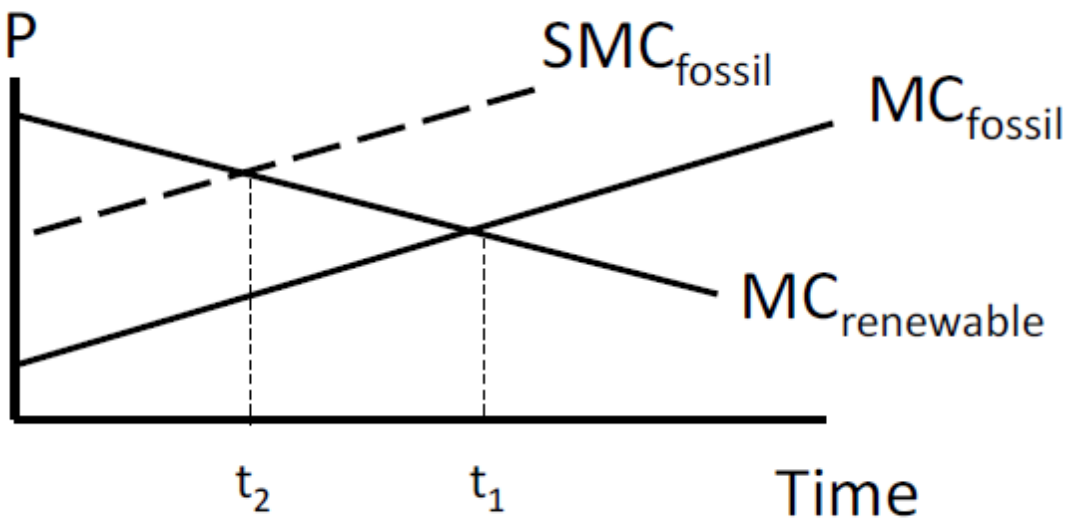

Figure 4: Renewable energy transition dynamics

Declining Renewable Energy Costs

In the meantime fossil fuel costs rise, new innovation will probably decrease renewable energy costs, as demonstrated by the descending slanting value way for renewable energy. At time t1, the supply ways for fossil fills and renewable energy cross and expenses are equivalent. After time t1 renewable energy will be less costly than fossil powers, and market powers will then

achieve the renewable move with practically zero help. Where this has as of now happened, renewables are common. For instance, in Iceland geothermal high temp water is less costly than coal or oil for warming structures, and most structures are currently warmed with geothermal water. While there are examples of overcoming adversity for renewable energy innovation, the planning of upgrades required for renewables to uproot fossil powers is indeterminate. For instance, better approaches to deliver sunlight based photovoltaic boards are bringing down board creation cost, yet despite everything we have expenses of day by day and regular discontinuity. Cellulosic ethanol innovation permits ethanol generation from switchgrass instead of corn, however arrive accessibility still places requirements on switchgrass creation. Better innovation can bring down renewable energy expenses to some degree, yet can't change major attributes of energy sources [8].

This is especially evident at the edge: while huge scale hydropower and biomass can possibly convey energy close current costs for fossil fills, amounts of these energy sources are extremely restricted contrasted with current use, and are not expandable in numerous areas. Sunlight based PV and seaward wind might be the main renewable sources sufficiently inexhaustible to dislodge fossil fills. While expenses of these innovations are declining, they are diminishing at a diminishing rate [9].

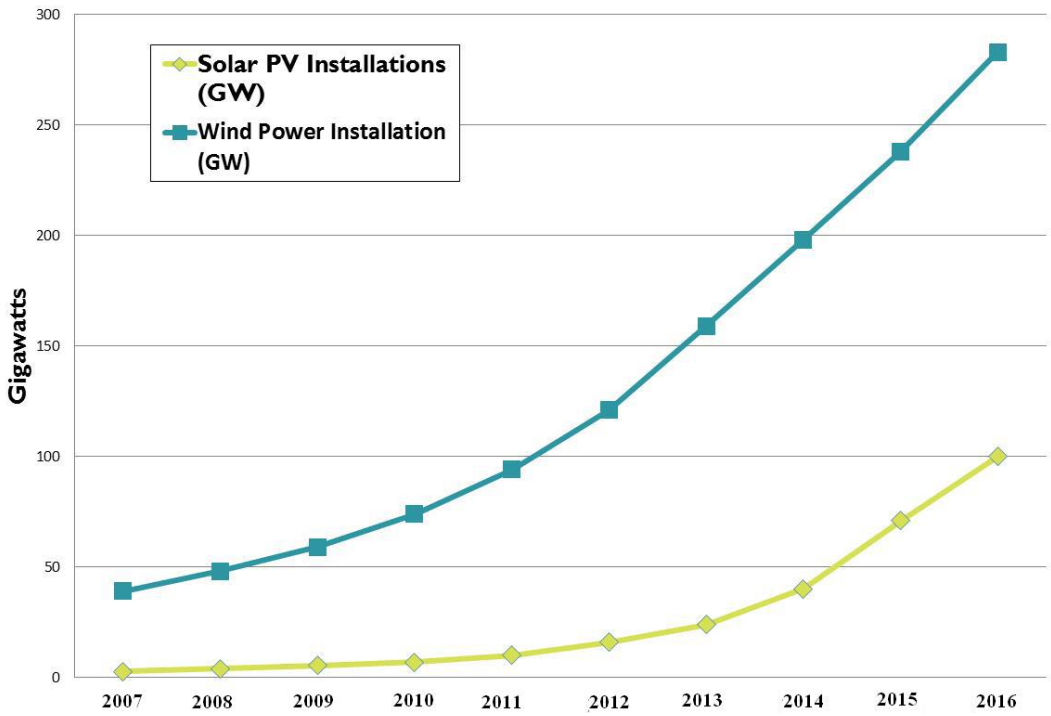

Figure 5: Level of solar and wind energy

Policy Framework Requirements for Renewable Energy

Improvement: Although World has rich stores of oil and gas, it ought not just depend on these assets and ought to take approaches to create elective wellsprings of energy [10]. By considering, World has extraordinary potential in renewable energies furthermore its plan towards realizing the costs of energy transporters and with the assistance of planning an adaptable and

element structure and evacuating the current deterrents, it is important to examine the frameworks, strategies and authoritative structures in the field of renewable energies in the nation to quicken their improvement [11]. As specified before, there were a few hindrances for improvement of renewable energies in World. In this area a few strategies to determine the issue are recommended.

Social acknowledgment of renewable energy for development and improvement of this energy is vital. The administration must do a considerable measure of push to expand open attention to the banquet and preferences of these energy sources [12].

Conclusion

World has an extraordinary potential as far as renewable energies. The advancement of renewable energy assumes a focal part in development gets ready for the regulation of a feasible arrangement idea. The creators create eight markers to take after energy supportability in World. As of now World's energy framework is a long way from maintainable. While World's entrance to power pointer is almost practical.through the study of this research was to identify the various renewable and alternative energy sources. And also to renewable energy is not one type, and it includes many forms that can solve each other and in the case of the availability of potential conditions such as and presence technology underlying the substitution and also bear the cost of this replacement.

Renewable energies are considered one of the most important alternatives available to achieve sustainable economic development, as their supplies constitute a fundamental factor in boosting production and achieving stability and growth in the event of their traditional counterpart depletion, thus providing permanent job opportunities and contributing to improving living standards and reducing poverty across the world.

Many countries have pushed an acceleration of the transition towards the economics of renewable energies through a set of strategies aimed at achieving economic gains, social stability and environmental balance, through the mechanism of rationalizing the consumption of depleted energies, valuing them and working to replace them with alternative energy sources. This matter has proven its economic success due to the availability of these resources locally, and the possibility of their contribution to empowering the poor by ensuring the security of energy supplies and preserving natural resources for future generations.

The new international initiative for the 2030 Sustainable Development Agenda was issued, with a comprehensive consensus at the United Nations Development Summit at the end of 2015, to represent the most comprehensive, integrated and the most widely accepted and adopted global plan among the countries of the world (2016, SDGs) and includes seventeen (17) goals in which energy occupies the goal position Seventh (7) when it became known as the Sustainable Development Goals (SDGs: Sustainable Development Goals).

The seventh goal of the development goals means achieving sustainable development of energy by enabling everyone to facilitate the easy connection of modern energy in a documented and sustainable manner based on three targets and a set of goals and tracking indicators. It is noted that the arrival of a sustainable energy strategy according to the seventh goal is linked to According to the following table 2 :

1- Providing universal access to modern energy services.
2- Significant increase in the contribution of renewable energy to the national energy mix.
3- Improving energy efficiency.

Table 2 : The seventh sustainable energy goal, with a set of targets and indicators

Seventh aim: Enabling everyone to have affordable, reliable and sustainable access to modern energy by 2030	
Indicators	Targets
The percentage of the population connected to the electric power grid	Ensuring universal access to modern energy services in an affordable and reliable manner
Proportion of population dependent on modern fuel (unconventional fuel)	
Per capita share of electric energy (rural and urban)	
Availability of modern transportation (average annual distance traveled per person yearly)	
Modern energy services in the rural area (rural share of total final energy)	
Percentage of renewable energy contribution to final consumption	Achieving a significant increase in the share of renewable energy in the energy mix
The share of renewable energy in power plants	
Availability of regulatory legislation to encourage the role of renewable energy	
The rate of improvement of primary energy density	Working to improve and upgrade energy efficiency
The ratio of final energy to primary energy	
The rate of improvement in the efficiency of power plants	
The rate of improvement in energy efficiency of consumer sectors	

Reference:

Amer, M. and T.U. Daim, 2011. Selection of renewable energy technologies for a developing county: A case of Pakistan. Energy for Sustainable Development, 15: 420-435. EIA, 2009. International energy outlook. DOE/EIA- 0484(2009), energy information administration. U.S. Department of Energy.

Assefa, G. and B. Frostell, 2007. Frostell. Social sustainability and social acceptance in technology assessment: a case study of energy technologies. Technology in society, 29: 63-78.

Gorji, M., M. Hatami, A. Hasanpour and D.D. Ganji, 2012. Nonlinear Thermal Analysis of Solar Air Heater for the Purpose of Energy Saving. Iranica Journal of Energy & Environment, 3: 361-369.

Hepbasli, A. and Z., 2011. Alsuhaibani. Exergetic and exergoeconomic aspects of wind energy systems in achieving sustainable development. Renewable and Sustainable Energy Reviews, 15: 2810-2825.

Hepbasli, A., 2008. A key review on exergetic analysis and assessment of renewable energy resources for a sustainable future. Renewable and Sustainable Energy Reviews, 12: 593-661.

Hepbasli, A., 2010. A review on energetic, exergetic and exergoeconomic aspects of geothermal district heating systems (GDHSs). Energy Conversion and Management, 51: 2041-2061.

Jefferson, M., 2006. Sustainable energy development: performance and prospects. Renewable Energy, 31: 571-582.

Karakosta, C. and D. Askounis, 2010. Developing countries' energy needs and priorities under a ustainable development perspective : A linguistic decision support approach. Energy for Sustainable Development, 14: 330-338.

Khoiyangbam, R.S., 2011. Environmental Implications of Biomethanation in Conventional Biogas Plants. Iranica Journal of Energy & Environment, 2: 181-187.

Musango, J.K. and A.C. Brent, 2011. A conceptual framework for energy technology sustainability assessment. Energy for Sustainable Development, 15: 84-91.

WCED-World Commission on Environment and Development, 1987. Report of the World Commission on Environment and Development: Our Common Future. Oxford, UK: Oxford University Press.

Winkler, H., 2007. Energy policies for sustainable development in South Africa. Energy for Sustainable Development, 11: 26-34.