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An Overview of the Adverse Effects of Renewable Energy Sources

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Abstract: Growing human population requires an increase in energy production that will satisfy the daily needs and demands. Conventional energy sources are finite, and as such they are exhaustible which implies that, man requires an alternative sources of energy that are inexhaustible and clean. Renewable or alternative energy source is a term used for any energy source that is an alternative to fossil fuel i.e. electricity or heat generated from solar, hydro, wind, geothermal, biomass or biogas energy. These energy sources are considered to be clean. Despite the fact that renewable energy sources are assumed to be clean, they pose a significant risk to the environment and well-being of the populace. Pending on the source and the technique use for harnessing, these energies may affect the environment at different stage of their life cycle. The effects ranges from exploitation and processing of the raw materials, to the construction of the plant, to its operation and finally to demolishing when the need arise. In addition, the energy input and output is also an interesting matter to be considered when dealing with renewable energy. Other issues of land clearing, biodiversity and habitat loss, emission of some greenhouse gases in terms of hydro power and biomass, use of toxic chemicals in construction of photovoltaic panels, the amount of energy consumed during the construction and west generated need to be considered as well. This paper aimed to review and highlight the adverse effects associated with harnessing and processing of renewable energy sources.
Keywords: Renewable, Energy, Solar, Biomass, Power, Impact

I. INTRODUCTION

Energy is a key factor in determining the economic development of any country. Almost all human activities require an unlimited supply of energy for efficiently and effectively carrying out daily processes. Nowadays, the technologies in the world are becoming digital and automated. Artificial Intelligence is taking over the modern industrial and domestic activities, as it provides vast array of activities in a short period of time. Agricultural, industrial, social, economic, health and all other activities requires energy in different forms. These energy requirements force man to exploit many resources in the search of energy that will provide for basic needs and miscellaneous. Conventional methods through which energy is generated or major source of energy is fossil fuel. Several environmental problems are related to the use and burning of fossil fuel for energy. Studies have shown that fossil fuel consumption in almost all human activities has led to many undesirable phenomena like climate change and global warming [1]. Conventional energy sources are finite, and as such, there is need for alternative energy source that not only pose less risk to the environment but also long lasting.

Vezmar et al., [2] reported that, unlike conventional energy sources which require millions of years for formation, renewable energy sources cannot be exhausted as they are constantly been supplied by nature. Renewable energy source accounts for only 14% of the total world of energy [3]. These sources of energy are clean and inexhaustible [4]. Climate change is one of the major problems related to conventional energy sources. The increasing concentration of greenhouse gasses, such as methane, carbon dioxide, CFC, halogens, Nitrogen Oxide, Ozone and Peroxy acetylnitrate (PAN) in the atmosphere as a result of burning fossil fuel is acting to trap heat radiation/infrared radiation from earth surface, which result in rising the Earth temperature [3]. The alternative renewable energy sources are assume to reduce the effects of greenhouse gases and climate change. Despite the fact that renewable energy sources termed as clean and inexhaustible, they may pose a significant effect to the environment in one way or another. Pending on the source, these energies may affect the environment adversely as well. This review focused on the adverse effects of renewable energy sources.

II. SOLAR ENERGY

Sun is the ultimate source of energy for the whole universe. It emits energy at a rate of 3.86×10^{26} Watts at any moment, of which approximately 1.74×10^{17} Watts is intercepted by the Earth [5]. There is vast scope employed to utilize available solar energy for thermal applications such as cooking, water heating, crop drying, and electricity generation through thermal solar plant or photovoltaic effect. It also provides energy for producers (green plant) to conduct primary production.

The Sun regulates the world climatic condition and many other physical processes on Earth (either directly or indirectly). Studies have shown that generation of electricity from sunlight directly through photovoltaic and indirectly through concentrating solar power using solar thermal processes, over the last decade has been growing exponentially globally [6]. Energy from the Sun is considered to be clean and inexhaustible as it is infinite. According to Theocharis et al., [7] solar energy provides important environmental advantages in comparison to the conventional energy sources like fossil fuel that directly increase the amount of greenhouse gases in the atmosphere, thus contributing to the sustainable development of human activities. Solar energy technologies are assume to reduce the emission of greenhouse gases, prevention of toxic gas emission, reduction of required transmission line of the electricity grids [8]. However, solar energy as all other processes involves some adverse and detrimental effects on the environment and well-being of the human populace and other organisms in the environment. These effects may come in many ways including construction processes where high amount of energy is consumed in the production of photovoltaic cells and the facility itself, to operation where by large surface area is cleared to mount solar panels, for maintenance of the facility and its decommissioning when it is no longer required [1].

Solar energy can be exploited in many ways as stated by some scholars such as according to Vezmar et al., [2], solar energy is most commonly exploited in three ways, which are as follows;

1) Solar Thermal Power Plants (For electricity and heat),
2) Solar thermal Systems (For thermal energy) and
3) Photovoltaic systems (For electricity generation).

Some researchers such as Hernandez et al., [6] and Mahmud [9] categorized solar energy technologies broadly into two categories, namely the photovoltaic (PV) cells as well as the concentrating solar power (CSP). Photovoltaic cells convert sunlight into electric current, whereas CSP uses reflective surfaces to focus sunlight into a beam to heat a working fluid in a receiver.

A. Solar Thermal Power

Solar thermal electricity power system is a device which utilizes the radiation coming from the Sun for generation of electricity through the solar thermal conversion [3]. Principally, the solar radiation collected is converted to electricity through the use of an equipment (i.e. a thermoelectric generator (TEG), also called a Seebeck generator, which is a device in a solid form that change differential temperature into electricity through a thermoelectric effect [10]. Historically, there are several types of the Seeback collectors including the; compound parabolic, evacuated tube, flat-plate, parabolic dish, parabolic trough and heliostat field collectors [11]. So many equipment and facilities are required for this process. Moreover, solar thermal power plants uses water, which when heated produces steam that turns a turbine to produce electricity [2]. There are numerous ways to do that. Some utilize mirrors that are curved which follows the Sun's movement and concentrate the sun radiation towards pipes that are filled with water or other forms of liquids. Other designs make use of flat rotating mirrors that are long in nature. These rotating mirrors are less expensive [9]. The ability of solar thermal energy generation to absorb all wavelengths on the electromagnetic spectrum is one of the main significance. This results in an efficiency of above 90% in reflecting solar power. However the efficiency of such generation in regards to electricity production is between 30-40% [9].

B. Solar Thermal System

In this form of solar radiation exploitation, the radiation is used directly for heating (cooking) or for preparation of hot water. The process is environmental friendly as the energy from the Sun can directly be utilize for cooking and crop drying, which was found to be effective [3]. The process requires less facilities and it can be promising option capable of being one of the leading energy for cooking [12].

C. Solar Photovoltaic (PV) System

The word "photovoltaic" consists of two words: photo, a Greek word for light, and voltaic, which defines the measurement value by which the activity of the electric field is expressed, that is the difference of potentials [13].
This is the direct conversion of solar radiation to electricity using photovoltaic cell. Solar photovoltaic modules, which are a result of combination of photovoltaic cells to increase their power, are highly reliable, durable and low noise devices to produce electricity. The Sun is the only resource that is required for the operation of PV systems and its energy is almost inexhaustible. A typical photovoltaic cell efficiency is about 15%, which means it can convert 1/6 of solar energy into electricity.

Considering the energy consumed in the production of photovoltaic cells, the electricity produce tends to be less, though, they produce several tens of times less carbon dioxide per unit in relation to the energy sourced from fossil fuel technologies [13].

A complete photovoltaic system comprises usually of photovoltaic units, inverters, batteries, charging controllers, load controllers, circuit breakers and wiring [9]. Many technologies were developed to produce electricity using solar photovoltaic. Mahmud [9] mentioned that the main technology in commercial consumption is crystalline silicon. Other research are currently in process to produce solar cells that are more effective.

D. Principle

A silicon cells comprises of two layers structured adjacent to one another. The first layer is created from a silicon doped with small quantity of phosphorus. When the phosphorus atom exchange places with silicon atom, there is a transfusion of an extra electron to the crystal lattice. N-type silicon are those silicon in which the negatively charged electrons are free to move. P-type silicon on the other hand becomes charged positively from tiny particles of boron, another element with one less electron in its outer shell than silicon. In such circumstances, there is the formation of a hole due to the insufficient number of electrons to complete the required number of covalent bonds. Hence the electrons moves freely to account for this deficiency. These holes behaves just like free particles that are positively charged. The creation of a p-n junction occurs when a p-type and an n-type material are joined together. The attraction between electrons and holes is always strong and it is created by the interface. This makes the p-type region negatively charged while n-type region positively charged, thus creating an electrical field. As soon as sunlight strike the crystalline silicon, electrons found in the crystal lattice are then released [9].

The energy in photovoltaic system is stored in batteries which are not 100% efficient. This implies some of the energy is lost as heat. Several types of batteries exist for this purpose which includes; Lead-acid battery and alkaline battery [9].

E. Adverse Effects of Solar Energy

Solar energy is assumed to be the safest form of renewable energy resources and it is considered to be the best energy for future. The source of solar energy is Sun, which is the primary source of energy for the universe. However, variety of problems are associated with solar energy production and utilization. These effects can happen all through the life span of solar energy plants on varying magnitudes [6]. The impacts could be direct, indirect, or related to energy budget and efficiency, impacts on the loss of biodiversity, water uses and consumption, dusts and soils, air quality and human health, corridors of transmission, land-use and changes in land-cover.

1) *Energy budget and efficiency*: Manufacturing of Photovoltaic modules requires large amount of energy. Studies have shown that the power plants producing PV modules uses large amount of energy and facilities that requires high amount of energy. This is one of the negative impact of solar photovoltaic system [2]. Sherwani et al., [14] reported that further development and improvement in efficiency of solar cells, amount of materials used in the solar cell and the system design for maximum use of recycled materials will reduce the energy requirement and greenhouse gas emission. Cells made from crystal silicon (Si), are made of a thinly sliced piece (wafer), a crystal of silicon (monocrystalline) or a whole block of silicon crystals (multicrystalline), their efficiency ranges between 12% and 19% and high amount of energy is required to construct the PV cells [13]. This material is found abundantly in the environment. Reports have shown that expected life span of a PV cells is 15-30 years, with the outputs degrading over the years. On average solar energy or amount of Sunlight inclusive of all the electromagnetic spectrum is about 1KW/m^2 peak, (for most of the period where the Sun is at its peak) not early hours or late at night. Careful examination has shown that about 90% of solar power is during the Sun's peak for averages between 8AM and 4PM, varying on the locality, distance from the equator as well as seasonal timings. The amount of energy produced by a 1m^2 solar cells is between 140-170W peak [9]. The period of energy depreciation of photovoltaic cells is the time period that must pass using a photovoltaic system to return the energy that has been invested in the construction of all parts of the system, as well as the energy required for the breakdown after the lifetime of a PV system. Of course, the energy depreciation time is different for different locations at which the system is located, thus it is a lot shorter on locations with a large amount of irradiated solar energy, up to 10 or more times shorter than its lifetime. When compared with conventional energy sources, the efficiency of solar energy is very low [13].
2) *Visual impact:* Visual intrusion is highly dependent on the type of the scheme and the surroundings of the PV systems. It is obvious that, if we apply a PV system near an area of natural beauty, the visual impact would be significantly high.

3) *Air quality and health:* Though, in the operational stage, solar energy does not emit harmful and toxic substances into the environment, the construction stage, transportation, maintenance, and decommissioning stage discharges harmful and toxic substances into the environment. Such emissions and discharge, pose a significant health risk to human population surrounding the area. Silica particles can be released in the mining and refining stage of the raw materials which if small enough, may be inhaled and cause the lung disease Silicosis [1]. Silicon panel production can include; F, Cl, NO_3, Isopropanol, SO_2, N_2O, CO_2, Silica particles, acids, and solvents which are considered to pose acute or chronic hazards to health [1]. Construction of solar power on a large scale just like any other big industry, can affect the quality of air, It can also be detrimental to the health of employees and the general public (TEEIC). Such hazards include the release of soil-borne pathogens in clearing processes [15], increases in air particulate matter as dust [16], decreases in visibility for drivers on nearby roads and the contamination of water reservoirs [17]. For example, soil degradation in arid areas of North and South America, which are targeted places for solar plants. This assists in transmitting a fungus causing valley-fever called Coccidioides immitis, in humans [18]. Increased aeolian transport resulting from soil disturbances would subsequently induce contaminant concentrations in air-borne dust within locations which have surface soils with trace amount of radioactive contaminants such as radio nucleotides, and harmful chemicals like agrochemical residues [19]. In most cases, PV cells are not recycled during decommissioning phases. This results to contaminations from corrosion of toxic elements such as cadmium, silica dust and arsenic from the cells, which can be detrimental to human health [20]. In other cases, inappropriate handling of damaged cells can be exposed, posing hazardous consequences to the public and environment [20]. For example, long time exposure to silica dust can lead to silicosis, a disease of the lungs, which can be fatal in severe cases [21]. Additionally, when spillage of chemicals such as coolants or heat and transfer fluids, or dust suppressants occurs, it can results to surface, ground and deep water pollution [17].
4) *Water Use and Consumption:* Water is one of the raw materials required for silicon cell production. The fabrication of silicon solar cells requires large volumes of high purity water for silicon wafer cleaning. Solar photovoltaic (PV) requires water for cleaning panels and thermal generation. Its consumption rate is 0 to 33 gallons/MWh with a median value of 26 gallons/MWh [22]. Concentrating Solar Power (CSP) systems also require water for cooling towers ranging from 600 and 650 gallons of water per MWh [23]. Recent analysis in both dry cooled CSP and PV installations shows that dust control for utility scale solar energy is the dominant (60-99%) factor of total water consumption within the southwestern US. Solar energy consumes large amount of water as a result of wet cooling, about $3.07m^3$/MWh. This is much more that both natural gas and coal consumptions in total [24]. All the water used during the extraction of raw materials for the production of solar panels, to the water use for cleaning and other activities are released back into the environment and may pose a risk to the environmental quality.
5) *Habitats and biodiversity loss*: Extraction of natural resources such as quartz, silicon carbide, glass and aluminum habitats of many living organisms are destroyed through mining processes. Large area of natural environment is required to install panels for utility scale solar energy which pose a devastating effect on the biodiversity of that particular environment. In some cases, large infrastructures for solar energy may fragment habitats and protrudes as a linear barriers to the movement pattern of certain wild life species. Although some highly mobile or wide-ranging animals may be capable of circumventing these infrastructure, others are mostly surmountable to increasing risk of gene flow disruption between populations on either sides of the infrastructures [6].
6) *Impact on natural resources and carbon foot-print:* Solar cells have some negative impacts on the environment during their production phase like many other systems. The energy needed for the production of solar energy systems is still produced in conventional methods today. Some toxic chemical substances used during the production phase are produced as a by-product. Especially, the solar cell batteries pose a threat on natural resources by having a short lifespan and containing heavy metals such as cadmium [1]. Fossil fuels are used for raw materials extraction and for transporting those materials to manufacturing plants. Energy from electrical grid is also used for processing and making the materials, which may also add in carbon footprint [1].
7) *Land use:* Vast surface areas are cleared for the purpose of installation of solar panels. Solar cells (photovoltaic) have miscellaneous impacts on the natural ecosystem. These impacts are related to some specific factors like the area and the topography of land may cover sensitive ecosystems and biodiversity installation of solar panels may damage it. The application of the solar cells in cultivable land can cause possible harm on the land's productive areas. Large-scale utilization of the land also affects thermal balance of the area by absorbing more energy by the Earth than otherwise would be reflected by the surface back to space [1]. A serious solar power application needs to utilize square kilometers of desert area. Thermal balance of this land space can certainly be effected by such an application. Also, additional heat might destroy a few species living in this kind of harsh environment [1].

8) *Effects of the waste generated from cells and batteries:* Solar cells do not emit any pollutants during their operations. But solar cell modules contain some toxic substances, and there is a potential risk of releasing these chemicals to the environment during a fire or when decommissioning [1]. Several toxic chemicals are used during the construction of the solar panels. These toxic substances can be released back into the environment in form of waste. Most of the products used are persistent and a pose a significant risk to the living organisms in the environment.

Other adverse effects of solar energy include soil erosion. This may be as a result of deforestation or cutting down of trees to create a space for mounting solar panels or to extract raw materials for the production of the panels. For the installation of USSE infrastructures, extensive land scape modification are in most cases required. Such modifications include; vegetation removal, land grading, soil compaction, the construction of access roads and activities that increase soil loss by wind and water [25].

III. HYDROELECTRIC POWER

Hydropower is a renewable energy source based on the natural water cycle and one of the most reliable renewable power generation technology available [26]. To generate hydro electricity, water must be in motion (kinetic energy). During the process running water turns the blades in a turbine, the form of energy is changed from kinetic energy to mechanical energy. Then into another form of energy (electricity) [27].

In the generation of hydroelectric energy, reservoirs are required where they serve much like a battery, storing water that can be released when needed to generate power [27].

Therefore, reservoirs has to be constructed and it may pose the greatest environmental impacts both at construction and at operation stages, such as air pollution, deforestation, loss of land, forest resources and property, muck dumping, litter problem, ambient noise pollution and aquatic pollution (siltation) [28].

Large reservoirs flood the riparian ecosystem which when prolonged causes the release of carbon dioxide and methane through the dead and decay of vegetation that would be covered by water from the floods. These negative impacts have mainly been reflected in both biotic and abiotic environment. But the degree of impact is largely dependent upon the nature and extent of activities on different components of the environment [28].

A. Adverse Effect of Hydroelectric Power on the Environment

1) *.Air pollution:* During construction of hydropower projects and related activities considerable amount of ambient air pollution increases due to ongoing construction activities. Activities such as drilling, blasting, quarrying, dam construction, excavation, transportation of construction materials and road construction in the project region lead to increase in air pollutants. These air pollutants remain in the form of suspended particulates matter [28]. These dust particles not only affect human beings but also pollutes premises and lays a coat on living vegetation, and reduces visibility [29]. Also large quantity of dust is transported from one place to other. As a result, human survival becomes difficult due to many respiratory problems in human beings.
2) *Deforestation*: Deforestation through tree felling is one of the major adverse impacts during construction of hydropower projects. The past studies dealing with the environmental impact assessment of hydropower projects at global levels indicate that development of water related projects have great adverse impacts on the environment mainly on fauna and flora. It results in increased deforestation within the vicinity of hydropower projects [30]. Sanjeev [28] explains that most of these hydropower projects are located in the mountain areas and submergence of forest areas become inevitable. The direct adverse impacts can be observed on the natural vegetation that are close to the dam sites. Deforestation mainly during construction period increases due to construction of reservoir, movement of Earth rock, dumping of overused or unused materials, movement of heavy machines like cranes, crushers, bulldozers and levelling machinery, widening of roads, piling of construction materials and erection of temporary sheds. Illegal and unscientific dumping of muck in the valley together has caused damage to many deodar trees (*Cedrus deodara*) and other species [28].
3) *Muck dumping and litter problem:* The construction activities involved during execution of hydroelectric projects were mainly construction of dams, head race tunnels, surge shafts, spillways, diversion tunnels, de-silting chambers, pressure shafts, powerhouses, tailrace tunnels etc., which together generate huge amount of muck. Muck dumping is one of the major problems during construction period. Its indiscriminate dumping on the steep slopes has accelerated the rate of erosion on slopes and silt depositions in dams and reservoirs. During monsoon season, the muck disposal sites increasingly become prone to slides which cause floods along the river sides [28].

4) *Ambient noise pollution:* Noise pollution is one of the important indicators to assess environmental impacts of a project. The maximum noise pollution is generated during construction phase of the projects. Noise intensity remains high during heavy blasting for tunneling, digging rock strata, constructing roads, mixing sand and cement for concreting roads and tunnels with the help of cranes and other heavy machineries [28]. These machines are also capable of disturbing the Earth crust thereby resulting in ground vibrations [31].
5) *Impact on health:* ecological changes and social disruption resulting from dam construction have adverse health impacts on local communities and downstream users. Among the resettled communities, access to basic amenities including drinking water and health services determine health conditions [31]. Reservoirs usually provide a favourable environment for several vector-borne diseases, the most common of these diseases is schistosomiasis [32], affecting over 200 million people worldwide. In addition to those affected about 500-600 million people are exposed to the infection [33]. The installation of new power lines, in addition to disturbing habitat, may pose collision hazards for birds and bats and electrocution hazards for large raptors [31].
6) *Siltation*: Dam constructed on rivers carrying heavy silt charge get silted with consequent effects on the aquatic lives. Certain chemical pollutants bind to sediment as it washes across the land during rainstorms. These sediments can rapidly change the water quality. The sediments may carry some chemicals along that are often dangerous to plants and animals. If the processes continue the ability of dam to meet it purpose will be low since it would not be able to support life, water supply, recreation or other aesthetic purposes [34].
7) *Greenhouse gas emission*: Greenhouse gas (GHG) emissions including carbon dioxide (CO_2) and methane (CH_4) from hydropower reservoirs have been increasingly concerned recently [35]. Jacobson and Archer [35] estimated the carbon emissions of 176 Tg CO_2/year and 4.4 Tg CH_4/year from global hydroelectric reservoirs. Methane is produced at the bottom of dam from the degradation of plants, organic matters (plankton, algae, etc), while the carbon dioxide is produced during decay of the organic matter in and around the reservoirs. These gases are then released from the surface of the dam, at turbines and spillways ranging over tens of kilometers downstream.

IV. WIND ENERGY

Wind is available for conversion to useful energy in nearly every corner of the globe with the exception of heavily forested areas of the Amazon, Congo and Southeast Asia. Moreover, these wind resources are enormous, the estimated 250 trillion watts of global wind power is 20 times greater than total global power consumption and they appear in settings as diverse as arid desert and the urban canyons of major metropolitan cities [36]. Despite the global availability of wind resources, wind energy technology has thus far had only a modest impact on power generation worldwide. Only 4 countries currently generate more than 10 percent of their electricity from wind, all of them in Europe [37]. There are local instances of high wind energy penetration in the U.S. in states such as Iowa and South Dakota; nonetheless, only 4 percent of electricity generated in the U.S. is derived from the wind [37]. Perhaps most poignant is the example of developing countries such as Somalia and Malawi, which have excellent wind resources and yet still suffer some of the lowest household electrification rates in the world [38].

A. Life Cycle Assessment (LCA)

Life cycle assessment (LCA) is a process of evaluating the environmental impacts of manufactured goods ranging from, extraction, production, distribution, uses, recycling to end life of the products. [39]. Life cycle assessment researches for wind have been carried out to examine several aspects. In a recent past, modernised turbines were investigated for an offshore project [40]. Lenzen and Wachsmann [41] stated that the finding recognised in literature review concentrated on transportation of wind turbine components from where it was manufactured to a particular park site in the analysis. However, the vehicle used in the transportation of materials mostly used fossil fuels which results to emission of air pollutants more importantly carbon which is primarily greenhouse gas and to leading to greenhouse effect. For detailed investigation, the reader can refer to previous findings that thoroughly investigated various LCA analysis of wind energy structures. [42].

B. Wind Turbine Operation and Maintenance

Regarding the maintenance of the turbine a conservative estimate include that half of the gearboxes are to be renewed after 10 years. Additionally, change of oil, lubrication of gear and generator are to be included. Twice in every year, technician must go to the farm for carrying out surveillance of turbine and cables. Therefore, fuels used during transportation should also be taken into account [43].

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C. Dismantling and Recycling

The end of life period of a material is very vital point of the life cycle assessment (LCA). The degree of recycling for a manufactured products are adopted from prior literatures [43]. The recycling rates of copper, iron, aluminium, steel are 90% while non-recycle waste moved to a landfill. Concrete is completely non-recyclable. The recycling location supposed to be 50 km away from Wind Grounds.

D. Adverse Effects of Wind Energy

Wind energy pose numerous drastic environmental issues right from the beginning; it involves clearing of some economic and medicinal trees as well as destruction of habitats for biodiversity, operation leads to noise pollution, visual effects and disruption of birds activities, and dismantling; most components of wind farms are steel, iron and aluminium which can accumulate in soils when corroded.

Previous findings have focused on several environmental impacts. Various researches give emphasis on emission of greenhouse gases [44]. Ardente et al., [44] conducted a comparative studies of the solids wastes, water and air emissions for an Italian wind farm with other source of energy generation. Schleisner [45] studied the emissions and energy needed for the manufacturing of the materials for Danish onshore and offshore wind farms. Tremeac and Meunier [46] investigated four different damages on resources, ecosystem quality, human health and climate change resulting from 14 big (4.5 MW) and small (250 KW) wind turbine. Procedure dependence was examined for the same research by using various impact assessment procedures, but the results observed was significantly dissimilar. Maritinez et al., [47] and [48] carried out two researches with same wind turbine by adopting different procedures. One applied the Eco-indicator 99 technique, which focused on 11 different impact factors, meanwhile the other used the CML technique, which focused on ten impacts, normalised as equivalent emissions [48]. However, some common negative effects of wind energy include:

1) *Impacts on wildlife:* The impacts can be divided into direct and indirect impacts. The direct impact of wind turbine, include the rate of death from collision with energy plant, whereas the indirect impacts involve destruction of environment and force migration for wildlife animals. Even though, the adverse effect of wind turbine is slightly disastrous when compared with other source of energy generation [49].
2) *Noise impact:* The most precarious environmental impact of wind turbine is the noise pollution. Noise produced by a wind turbine can be categorized into mechanical and aerodynamic types. Mechanical noise is occurred when moving components such as gear box, electrical generator and bearings. Normal wear and tear, poor component designs or lack of preventative maintenance may also be consider as an aspects contributing to the rate of mechanical noise produced [50]. Meanwhile, aerodynamic noise is produced as a result of movement of air over the blades of a turbine. The noise produced rise significantly with the speed of the rotor. For blade noise, lower blade tip speed leads to lesser noise levels. The main concern is the interaction of wind turbine blades with atmospheric turbulence, which leads to a characteristic whooshing sound [51].
3) *Visual impact:* Visual impact assessment was conducted by Ian [52] to assess the adverse effect of wind turbine. Jacob [53] described that the visual impact differs, depending on the wind energy technology such as colour or contrast, size, distance from the residences, shadow flickering, the time when the turbine is moving or stationary and local turbine history.
4) *Repowering technologies for aging wind farms:* Global expenditures for the operation and maintenance of wind farms are expected to reach $13 billion annually within this decade [54]. Much of this cost is associated with the need to repower aging wind farms, either to increase power production or to satisfy new environmental regulations related to noise production and impacts on migratory birds and bats. Despite huge amount of money spend for the maintenance of wind plant. Fox News [55] reported that, even today, the best commercially available VAWTs (Vertical-axis wind turbine) suffers structural and electrical failure within months if not weeks after initial commissioning.
5) *Demand for land:* Wind resource development may not be the most profitable use of the land. Land which is required for wind turbine installation must exceed all other alternative use. However finding such areas only suitable for wind turbine tends be difficult, thereby enforcing the utilization of land best suitable for other purposes to electricity generation [56].

V. BIOMASS ENERGY

Biomass power, derived from the burning of plant matter, raises more serious environmental issues than any other renewable resource except hydropower. Combustion of biomass and biomass-derived fuels produces air pollution; beyond this, there are concerns about the impacts of using land to grow energy crops. How serious these impacts are will depend on how carefully the resource is managed. The picture is further complicated because there is no single biomass technology, but rather a wide variety of production and conversion methods, each with different environmental impacts [57]. The burden such a massive plantation would cause on soil moisture, through uptake as well as evapotranspiration of precious water, has not been estimated but would obviously be quite great. There would be other impacts of a large magnitude such as impact on soil productivity, microclimate, and wildlife. Some of these impacts would be disastrous to the ecology of the region [57].

Organic matter, particularly cellulosic or lignocellulose matter is available on a renewable or recurring basis, including dedicated energy crops, trees, wood, wood residues, plants and associated residues, agricultural food and feed crop residues, plant fiber, aquatic plants, animal wastes, specific industrial waste, the paper component of municipal solid waste, other waste materials, etc. All of them being well known as biomass [58].

A. Adverse Effects of Biomass Energy

Biomass energy is one of the renewable energy sources that supplies large amount of energy to many individuals and communities through burning of the organic matter. This energy source comes with many negative effects which are as follows:

1) *Effects on water quantity and quality*: The effects of bioenergy production on water quantity are mainly through the water consumption of bioenergy crops and conversion of land use. For example, the wide expansion in corn ethanol production is because serial corn production demands more quantity of water in compared with other serials crops such as (soya beans, wheat, etc,), due to high water consumption across all the growing stages of the crops. Conversion of native land or grassland to perennial grasses (such as miscanthus and switch grass), can be impacted directly on the hydrological process in the area which includes water yield, surface water runoff, at regional scale, soil water storage or reservoirs among others. Similarly, result was also concluded by Wu and Liu (2020), and forecasted that the land use conversion pattern for the bioenergy crops production limits water resources potentials at watershed scale. Like coal and nuclear plants, biomass plants may disrupt water sources. The volume of water consumed by biomass plants equates to 20000 and 50000 gallons per megawatt –hour, hence, these water is released back into the sources at a higher temperature, thus disrupting the local ecosystem. The runoff nutrients from bioenergy crops distorts and affect local water resources as well. Also the cultivation of bioenergy crops in a low seasonal rainfall areas leads to high competitive pressure on local water supply.
2) *Effects on soil degradation*: Soil organic carbon (SOC) is an essential indicator of soil quality and nutrients, and high contents (SOC) leads to soil water retention capacity, structure and nutrients contents for productivity. Bioenergy production influences SOC with three major pathways i.e. residue removal, tillage and land use change. AA In wider perspectives, harvesting bye product from returned deed plants to cropland directly affect and leads to SOC loss due to reduced carbon input (Hoekman et al 2018). Nonetheless soil erosion, a very common but severe problem as a result of exposure of bare soils due to biomass removal that previously covers the soils is also a major point of concern in bioenergy production. This is because erosion decrease the quality of soil, hence reduce the productivity of both agricultural and natural ecosystems.
3) *Effects due to deforestation and farming practices*: Biomass requires bioenergy crops production at a large phase. Grasses and some uneatable, high-cellulose crops are the most frequent varieties affected. These pose similar environmental impact with food crops in the aspects of pest control, watering and erosion. The clearance of forest for bioenergy crop production accelerate greenhouse gasses; 25 to 30 percent annual release are due to deforestation.
4) *Effects on air quality:* Despite that biomass is clean alternative sources of energy than harmful fossil fuels, the energy still generate harmful substances back to the atmospheric environment as its combusted. The exhaust emitted to atmospheric environment differs depending on the feedstock compositions of the bioenergy plants, but pollutants such as nitrogen oxides, carbon monoxide, Sulphur dioxide, and particulate matter are the same in impact to environment. To mitigates or reduce the harmful effects the use of cleaner sources of biomass, gasification techniques and electrostatic extractors or precipitators can help reduced the effects to the environment. The waste transporting from forestry and industry to processing plant of biomass takes reasonable carbon footprint from petroleum in use for the transportation. The release of greenhouse gases may be a secondary environmental impact from biomass energy generation, but it's important nonetheless [57]
5) *Economic impacts:* Evaluation of the costs and the expected revenue is paramount parameters to take into consideration in any proposed project. Bioenergy projects is geared toward energy produced in a cost-effective way in compared to other conventional methods of energy production. In some instances, bioenergy production is undertaken other available energy production options, that are more profitable in short time due to decline in feed stocks as well as social and environmental importance that accelerate government supports. . In some cases, the generation of bioenergy mostly when on a small scale has incurred more cost than benefits, especially when economically compared [57].

VI. CONCLUSION

In summary, renewable energy sources tend to be cleaner than the conventional or nonrenewable energy sources. However, there are some adverse effects of these green energy sources, especially if not properly utilized as outlined above.

Therefore, measures had to be taken to enhance these renewable energy sources so as to anticipate overexploitation and mitigate their adverse effects. This would be so as to make the renewable energy sources more environmentally friendly and more efficient.

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