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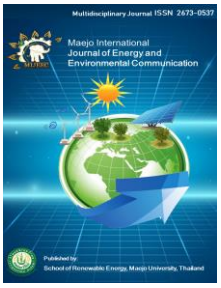

ARTICLE

The renewable energy sources for electricity generation: Short review

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ABSTRACT

It is critical to increase the value of life in rural areas by developing power from renewable sources or expanding the grid. The extension of the national grid or off-grid systems depends on location, geography, population, distance from grid point, and land size. Since grid connections are not always available or feasible, off-grid rural electrification systems using renewable energy sources (RES) have become unavoidable. An alternative to costly grid extensions in remote areas of the world is a hybrid combination of renewable energy technologies. This review paper discusses renewable energy sources that can generate electricity for residential and commercial.

1. Introduction

Energy that comes from sources that can replace themselves in a relatively short amount of time is referred to as renewable energy. Clean energy is energy that does not generate a lot of greenhouse gases or other pollutants, and renewable energy sources provide this type of energy for the most part. Because of this, many scientists and policy experts support the use of renewable energy sources rather than conventional fossil fuels (Chuanchai & Ramaraj, 2018). The challenge is to acquire the necessary technologies, infrastructure, and political support to successfully complete this shift. The five renewable energy sources highlighted in this map series are the five largest worldwide (Ramaraj & Dussadee, 2015a). Hydroelectric energy is by far the most prevalent, accounting for 83% of the world's electricity generation from renewable sources. This is most likely because the requisite technology to generate electricity by harnessing the flow of water has been around the longest, dating back to the early 20th century.

Since the beginning of the Industrial Revolution, fossil fuels have grown to predominate in the energy portfolios of most nations around the world. This has significant repercussions for the environment across the world as well as for the health of people. Burning fossil fuels for energy purposes is responsible for around 75 % of the world's total greenhouse gas emissions (Khammee et al., 2021a). Also, the burning of fossil fuels results in massive levels of pollution in the air around us, which is a hazard for human health that is responsible for at least 5 million premature deaths each year. It is imperative that the globe swiftly transition toward low-carbon sources of energy, such as nuclear and renewable technologies, in order to cut CO_2 emissions and local air pollution.

Wind energy is the next largest, at just over 7% of the

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electricity generated from renewable sources, followed by biowaste and biomass energy (7%), geothermal energy (2%), and solar, tidal, and wave energy (less than 1%). Modern life relies heavily on energy, and it is a form of life. There are two broad categories of sources of energy: renewable and nonrenewable (Chuanchai & Ramaraj, 2018). The former is derived from natural sources, and the latter is derived from non-natural sources but formed over time under various conditions (Dutsadee et al., 2014). Using conventional energy sources such as natural gas, gasoline, natural coal, and crude oil has several disadvantages, including limited supply, high fuel prices, high generation costs, and increased emissions (Mondal et al., 2010). Coal, petroleum, natural gas, and nuclear fuels are all nonrenewable energy sources that have a finite supply and may run out at any time (Bala et al., 2018). Solar, water (hydro), biomass, and wind naturally replenish resources (Huang et al., 2020). Therefore, it would become challenging to invest in large-scale energy-related operations without ensuring the long-term viability to avoid environmental disasters and reduce costs (Mondal et al., 2010; Hybat et al., 2019).

2. Renewable Energy

The literature has a significant amount of coverage on renewable energy technology, but it is abundantly obvious that many obstacles still need to be overcome (Behera et al., 2021). The purpose of the review that was carried out as part of this study was to map the issues that variable renewable energy poses by describing the relevant technological solutions that may be used to solve these challenges (Khammee et al., 2021a). The approach that was taken for this paper was to conduct an analysis of the data that was taken from the relevant literature. This was done to compile and map the list of technology solutions and challenges based on their interrelationships, as well as to locate any inconsistencies and categorize the difficulties that are associated with variable renewable energy (Khammee et al., 2021b). The purpose of this strategy is to differentiate the observable symptoms, such as performance qualities that fluctuate (Ramaraj & Dussadee, 2015a). In addition, this analysis has been supplemented with information from several different experts so that the results would be strengthened and more accurate (Unpaprom et al., 2021). The results on problems, as well as their connections to technological solutions, are also explored here (Ramaraj & Dussadee, 2015b). In the following part, the pertinent consequences for policymakers and companies will be outlined. Over the last few decades, global energy consumption has increased significantly. Increased demand for electricity necessitates a greater reliance on renewable energy sources (RES). Renewable energy sources, in comparison to conventional fuels, are virtually limitless. They must first be processed and transformed before they can be used effectively. The technological capabilities of the conversion mechanism are critical when it comes to renewable energy generation capacity (Mondal et al., 2010). Global fossil-fuel reserves, the International Energy Agency (IEA) projects, will decline by 16% by 2035, as demand for renewable energy (RE) triples between 2008 and 2035 (IEA 2014; Raza et al., 2020).

2.1. Solar (PV) Energy

Solar radiation is converted to electricity via the photovoltaic effect, discovered in 1839 by Becquerel. Solar radiation to electricity via the photovoltaic effect, found in 1839 by Becquerel. This phenomenon occurs in semiconductors, which have two energy bands, one of which allows electrons (valence good) and one of which does not (valence terrible). Silicon is the most frequently used semiconductor material in the semiconductor industry (Sampaio et al., 2017). Silicon is the world's second most plentiful element. Solar energy is a limitless resource and one of the most promising green energy sources for large-scale power generation. Solar Energy Systems (SES) are a tried-and-true method of providing essential energy to people who live in areas where grid extension is complex (Abu Saim et al., 2021). Libya is a country that has significant solar and wind energy potential. Annual sunshine hours average 3500, with 7.1 kilowatts per square meter per day horizontal solar radiation in the north and around 8.1 kilowatts per square meter per day horizontal solar radiation in the south. Since the mid-1970s, Libya has been utilizing this technology, and numerous devices of varying sizes and configurations have been developed (Almaktar et al., 2021).

2.3. Wind Energy

Electricity generated by harnessing the movement of air currents in the form of wind turbines is called "wind power." In 2018, it had a global potential of more than 600 gigawatts, making it an appealing and affordable energy source (Moria et al., 2020). Modern wind turbines were introduced in 1973, with the primary goal of increasing aerodynamic efficiency and reliability, which resulted in lower costs per kilowatt-hour produced (Khan et al., 2018). When it comes to wind flow, measuring instruments are required to characterize and collect precise data on prevailing wind direction, velocity, air pressure, ambient temperature, and relative humidity at a given location (Nunez-Quispe et al., 2020). In 2018, 53.9 GW of wind power capacity was added to the 599 GW of installed wind power globally. Several scenarios and proposals from countries around the world indicated that wind penetration could easily reach 40% by 2050. 74000 Tw/yr will not be achieved, but 40000 Tw/yr is expected to be the low point (Darwish et al.,

2020). In the winter, Libya experiences strong atmospheric winds, while the north-eastern trade winds come from the north in the summer. Ghibli winds are also a consideration. In addition to the dry, hot winds that blow throughout the year, Libya is also subjected to rains. Previous surveys show that in Benina, Sirt, Dinah, Sabha, and Tolmetha, wind energy is highly likely to be used as a source of power generation and connected to the national grid. Other regions, such as Ajdabia and Sorman, are better served by wind energy for water pumping and other purposes (Mohamed et al., 2008; Abohedma et al., 2010; Yahya et al., 2020).

2.3. Hydropower Energy

Hydro energy, or hydropower, generates electricity by converting falling or flowing water into electrical power. Hydro energy plants are classified into two types: (1) A sizeable hydroelectric plant with a capacity greater than 10MW and a reservoir. They provide power continuously while also adjusting their output to balance the electrical demand. (2) Small hydropower plants with a capacity of less than 10 MW are less flexible in response to demand or load fluctuations due to their reliance on a water resource. Its technologies are already available and within reach (Mondal et al., 2010). Hydraulic power has numerous advantages, including low operating and maintenance costs, zero waste or greenhouse gas emissions, high efficiency (between 60–80 %), and long life. Hydropower systems have some disadvantages, are including their inability to be built close to their intended use locations due to their high initial costs and lengthy construction times; seasonal variations in water flow patterns; the effects of climate change on water supply; and their high initial costs and long construction times (Hatata et al., 2019). Annual rainfall in northern Libya varies between 100 and 600 millimetres. Precipitation is most significant along the coast, while the interior receives as little as 10 millimetres. Only 5% of Libya's total land area receives more than 100 millimetres of precipitation per year. Certain regions of Libya's land are entirely devoid of water. According to some sources, the total volume of water available in 2012 was 3890 mm^3 (3650 mm^3 groundwater, 170 mm^3 surface water, and 70 mm^3 desalinated water). Gross water withdrawals were estimated at 5830 mm^3 in 2012. 4850 mm^3 were used for agriculture (83%), 700 mm^3 for domestic use (12%), and 280 mm^3 for industrial use (5 %) (Brika, 2018).

2.4. Biomass energy

Biomass (bioenergy) electricity generation is possible via a variety of technologies and feedstocks, ranging from low-cost, mature options such as combustion of agricultural and forestry residues (traditional biomass) to more expensive (Homdoung et al., 2020), less mature modern biomass energy options such as methane, biological fuel oil, fuel ethanol, and other biofuels (Almaktar et al., 2021). Biomass is expected to play a critical role in meeting future energy demands (Ramaraj & Unpaprom, 2016). Additionally, it is a significant source of electricity in some developed countries, though most of it is uneconomic (Cunningham et al., 2017). Bioenergy will continue to be the fastest-growing source of clean energy in the near future, specifically between 2018 and 2023 (Wang et al., 2020). Solid biofuels accounted for 84 GW of installed biomass energy worldwide in 2018, followed by biogas (18 GW), recycled urban waste (12.63 GW), and liquid biofuels (3.24 GW). In 2017, biomass-based energy sources generated 500 terawatt-hours of electricity (Almaktar et al., 2021). Biomass can be used in three ways: to generate heat and energy, to convert it to gaseous fuels such as methane, hydrogen, and carbon monoxide, or to convert it to a liquid fuel (Cunningham et al., 2017). Gasification and direct combustion are the most frequently used technologies for converting biomass to electrical energy (Ramaraj et al., 2016). Gasification is the process by which biomass is converted to a low-calorie gas used as fuel in power plants. This technology generates energy more efficiently than a steam turbine. Biogas is composed of approximately 30%–60% carbon dioxide (CO_2), 40%–70% methane (CH_4), and 1%–5% other gases that are produced in bio-digesters from poultry droppings, animal dung, and waste from other biomass products (Mondal et al., 2010). In Libya, solid waste has the most significant potential as a source of biomass (Abdelnaser et al., 2011). Libya generates approximately 3.2 million tons of municipal solid waste per year. Where organic matter comprises 59% of the total. Benghazi generates about 750 t of solid waste per day, with biodegradable materials containing between 28% and 30% of the total (Almaktar et al., 2021). According to a qualitative analysis conducted in Misrata, Libya's third-largest city, the city generates 0.155 Mt of MSW annually, with organics accounting for the majority (56%), followed by plastics (26.5%) and paper (15%) (Badi et al., 2016).

2.5. Hybrid Power Generation System

A hybrid renewable energy system (HRES) is created when two types of renewable energy are combined to provide safe and cost-effective electricity to remote areas. Wind and solar, wind and fuel cells, solar and fuel cells, and many more can be combined to create a hybrid power generation system. Numerous models and approaches for designing hybrid wind-PV systems have been proposed in the last two decades. It's now possible to do this with a wide range of consumer-level applications (Mehrjerdi, 2020). Energy production can be increased with the help of the use of hybrid power generation systems, while CO_2 emissions can be reduced at the same time (Alkarrami et al., 2016; Yasmeen et al., 2019). By combining various energy sources, a hybrid system can supply power in different load demand situations while being highly efficient, environmentally sustainable, and economically

viable (Obi et al., 2021). Hybrid photovoltaic (PV) systems that are cost-effective and reliable can now be found in rural areas of the United States. Disturbance from the primary grid. Due to the abundance of natural resources in most regions of the world, wind and solar energy have gained much attention (Thiaux et al., 2019). Mercedes studied a hybrid wind/photovoltaic renewable energy system considering this fact. However, one of the drawbacks of renewable energy systems is that their generation and consumption schedules are inconsistent (Mehrjerdi, 2020). Advanced solar-based HRES claims that remote areas can provide low-cost, renewable energy by optimizing modules to meet all load requirements while minimizing investment and maintenance costs (Alkarrami et al., 2016; Assaf et al., 2019).

2.6. Rural Electrification Through Grid Electricity Options

Photovoltaic (PV) systems have been compared to other decentralized energy sources such as wind/diesel hybrid systems or small diesel generators in most previous rural electrification studies (Mahapatra et al., 2012). It was considered when calculating the energy demand and HRES source. COE of 0.163 $/kWh and 0% unmet demand were achieved using HOMER and GA in all four HRES configurations (Suresh et al., 2020). Compared to the HOMER, the GA-based system emits less CO_2. Pathak and Khatod determined the IRES sizes for various renewable energy systems in India using the HOMMER software (Pathak et al., 2018) In India, researchers used the HOMMER software to figure out the ideal IRES size for a particular renewable energy system combination, along with the corresponding NPC and COE. Seven unconnected villages in Gujarat's Lim Kheda taluka and Dahod district will be investigated for remote rural electrification. According to Scenario-COE, it was 0.069 cents per kilowatt-hour, surplus energy accounted for 0.65 % of total power, and the NPC was $ 141414. The energy cost was 0.078 dollars per kilowatt-hour, and the surplus energy was 3.91 %. The NPC costs $ 159747 in Scenario-IV.

3. Conclusion

The primary purpose of this paper is to present a systematic review of renewable energy sources as sources of sustainable energy that are used to generate electricity because it has low cost, low-capacity shortage, and low emissions. A hybrid combination of renewable energy technology provides an alternative to costly grid extensions in distant places of the world. This review paper looks at renewable energy sources that can be used to generate power for both household and commercial purposes.

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