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An overview of Renewable Energy Utilization and Developments: Challenges and Opportunities Worldwide

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Abstract:
Renewable energy sources (RES) have become highly in demand due to the high increase in fuel prices (petrol and diesel), which has also significantly contributed to the high cost of maintenance of conventional power plants and the negative environmental impact of conventional power plants. Due to its eco-friendly and economic nature, RES has caught the minds of engineers, and it has been deployed in several developed countries to improve their economic growth and mitigate the instability of power supply. This paper provides an in-depth, comprehensive review of various renewable energy generation sources with a detailed explanation of the advantages and disadvantages, as well as the availability and capability of producing clean and sustainable power. Furthermore, the study reviews the integration of storage systems on the off-grid as a strategy to improve the sustainability of the power supply. The contribution of this paper is to review state of the art in different renewable energy sources. Results showed that renewable energy sources are usable and efficient, incorporated into microgrid systems, and accompanied by an energy storage system for suitability.

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Introduction

In recent years, the interest in renewable energy sources in power generation in rural areas started to increase, meanwhile, the prices of oil and gas increased with high maintenance costs. Several researchers have conducted studies to find out the importance of this technology.

The objectives of this paper are to review the renewable energy sources in different countries and define the advantages and disadvantages of each one. The first section discusses the different types of renewable energy sources and the deployments worldwide, while in second section an overview of the energy storage systems, and finally gives a brief overview of the micro-grid system. The Source of this overview is google scholar, 180 papers were screened and, 72 irrelevant papers were removed, ending conducting this overview with 108 papers in total. There are many types of renewable energy sources are available in rural areas, each type produces energy based on the location and the availability, where sunlight is the most used source around the globe. For heating and cooking purposes biomass is mostly used in rural areas. In the following figure (1), shows the types of renewable energy sources involved and are discussed in the following section.

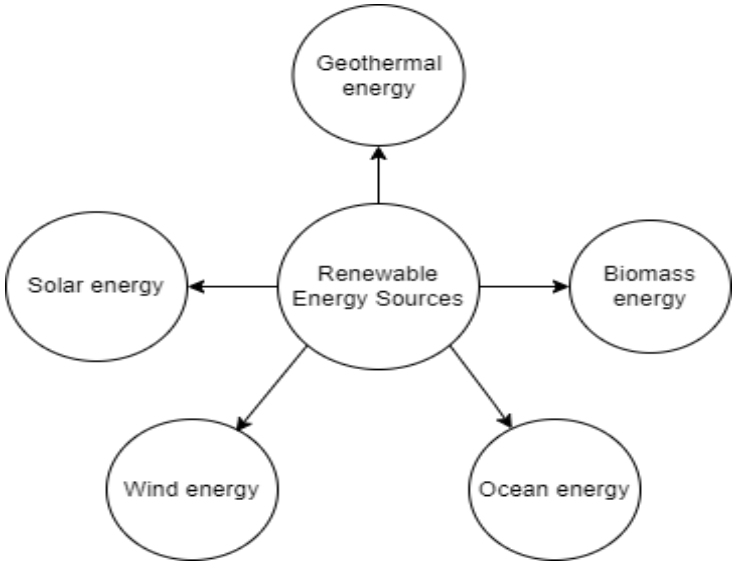

Figure 1 Types of renewable energy resources

Solar energy

Solar energy is free non-end energy produced by the Sunlight and is considered economical and eco-friendly. This energy is used to meet the demand for power during the year, easily obtained from direct Sunlight. Furthermore, free of pollution and harmless to the environment, considering solar power among the best choices to follow up with the future energy demand and adopted and become more common in rural areas as an alternative power [2].

Solar energy is used in heat, the literature review of [3]on solar energy based on heat and power plants explained Denmark's possibility of generating heat and building power plants depends on solar only and solar hybrid. The results showed that it is very economical and eco-friendly for the environment to implement this system to decrease the fuel cost consumed in power generation. Furthermore, the study compared various solar thermal power plants and PV modules based on their semi-conductor materials and concluded that the initial cost of CSP power generation plants and maintenance costs is higher than PV plants [4].

Moreover, PV systems are suitable for small power generation with higher output, while CSP plants have better economic returns and less CO2 emission. For instance, in the Gulf Cooperation Council (GCC) region, solar power can perform very well due to high solar radiation. However, some challenges and barriers slow renewable energy development, such as policy development and limited applications for integrating renewable energy in buildings. Nevertheless, installing solar PV on the rooftop of the buildings can improve and lessen the CO2 emissions in the area [5].
The progress of solar power energy worldwide is considered a solution to rapid electricity demand. However, according to [6] the obstacles that prevent the use of this technology, such as low solar cell ability and efficiencies and economic hindrances several technical issues harming the improvements of renewable energy recourses their study highlighted concerns of developed and underdeveloped countries where CSP projects have benefits and are suitable in specific locations where clouds and haze are frequent. Although the decrease in solar cell prices in recent years. Generating electricity using solar power in rural areas continues to be expensive. In a study conducted

in Poland households in rural areas depends on fossil fuel to generate electricity, which leads to air pollution and GHG emissions.
The government of Poland and the European Union subsides the projects for thermal solar panels to lessen air pollution results showed a decrease in monthly savings and suggested that the new rural houses include solar panels and the rural residents who invested in the solar panels and accepted the subsidy have more savings, encouraging the other farmers to invest in the solar panels [7].

A study on Solar Energy in Urban Planning analysed 34 international case studies in 10 countries, focused on addressing the challenges and barriers to implementing active and passive solar systems in those locations, and by evaluating the solar energy strategy and solar energy production, taking into account the solar irradiation and the period of daylight divided into three categories existing urban areas, new urban areas, solar landscapes. Results showed that in existing and new urban areas, the duration of Sunlight and proactivity depends on the size of the area, development, and usefulness of conducting a comprehensive study on the area to check the solar accessibility and availability in the area during daylight [8].
According to [9] a photo-electrochemical(PEC) study for solar energy, which represents the new technology of assimilation of the PEC system for solar water, the results showed no material available for a cheaper and low-cost photoanode.
Renewable energy sources, especially solar energy, have an essential role in implementing the 2030 agenda and Sustainable Development Goals (SDGs) in Africa [10]. In rural China, a study conducted about the deployment of solar energy in remote areas showed that Renewable energy is growing and significantly linked
with the rural household economy, especially solar energy benefits economic growth and helps to improve the quality of rural residents [11].
A review of solar energy capacity around the globe stated that Solar Energy is the prime critical source of energy. There was massive adoption of solar energy in Asia, 56.58% in 2018. Where the Caribbean has the lowest capacity with 0.36%, policymakers should consider improving the implementation of solar energy to improve the situation more, especially in African countries such as Egypt, Morocco, and Algeria, where renewable energy has a bright future due to its functionality, reliability, and affordability [12].
In another study [13] Compared rural Central Asian regions with urban areas and examined the vital of renewable energy, especially solar, for development, the results proved that rural areas are isolated from the principal power utilities since the growth and improvements are linked to electricity availability.
The households have lower incomes and recommended that governments provide subsidies and contribute by installing renewable energy as an alternative in rural areas. Targeting net-zero emission by 2050 in many countries [14].
A comprehensive review conducted on solar energy in the united states of America addressed the solar industry and prices and challenges, results showed concentrated solar power projects of photovoltaic, solar heating, and cooling.
The total solar capacity installed in the U.S. is 108.7 GWde as of 2021, making it the second solar producer globally. For example, 31 GW of solar installed in California alone represents 33% of U.S overall installation. Triple times of Texas. While in a study conducted by [15], reviewed the assimilation of solar energy in greenhouses showed that PV is more suitable to produce electricity and heat due to its availability and capability, making it a good candidate for agriculture in rural areas and remote locations.

In the study [16] to overcome the challenges of solar energy irradiation. Prediction and availability using an in-depth survey. Advanced techniques found out that solar production depends on the proper parameters inputs. A review of the challenges of solar energy harvesting (SEH) techniques of self-power PV application in rural areas showed that the current system is costly, with intricate structures expensive to afford in remote areas. Moreover, the technical challenges such as dust disposition and maintenance. Therefore, the study suggests exploring and introducing new materials to overcome dust removal[2].

Wind energy
Wind energy is a clean and reliable energy source. Furthermore, as an alternative to conventional energy, the advantages of wind power are low operating costs and availability as an endless free source. The paper investigated the importance of developing wind energy and technologies associated with wind energy applications. The outcome showed that wind power must be promoted, especially in rural areas, as wind power is a natural and clean energy source with high availability around the globe[3].
For example, in Brazil's electricity problem in 2001, projects were created and implemented using renewable energy sources as an alternative for conventional resources wind energy despite projects success but disadvantages of wind negative impact on the environment. The study suggested that wind power has to be relocated away from physical humans and territories[4].

A review was conducted about wind resource assessment and compared the literature review of wind energy, results showed that wind energy plays a vital role in renewable energy as a power source. Moreover, the effort to develop this energy should continue[5].
As wind energy has many advantages, such as reliability and efficiency, wind energy infrastructure requires investment. However, the study carried out in Turkey about the wind farm and integrating it into the existing system showed that the ability of wind power to cover the future increased power demand which is suitable for smart grids[6].
The research on current urban wind energy challenges found that further research on establishing reliable wind power and controlling noise emissions is needed[7].
Study about Wind energy challenges and obstacles in South Korea. The research outcome pointed out that the country is suitable for adopting renewable energy, but considering the variable wind speed may lead to instability, more studies about the wind hourly and annual predictions have to be done. Furthermore, the infrastructure of transmission systems needs upgrades to fit the renewable energy capacity [8].
An empirical analysis on wind energy development in the united states found that wind power development in the united states depends on political and policy maker's issues. Aside from that, many states can produce and add more wind power[9].

In India, wind energy generates about 302GW at 100m and 102 GW at 80m of electricity. However, results showed many barriers denying the improvements of the wind energy in the country, including technical and Financial, Environmental, and Socioeconomic barriers, and can improve those barriers by updating the prices and policies implementations[10].
In Saudi Arabia, crude oil is the primary source, producing carbon dioxide emissions. As results of the review study showed the potential use of renewable energy sources, specifically wind energy, for clean electricity generation in rural and remote areas.
Moreover, many locations are suitable for wind power generation on a massive scale, adding more energy to the system to meet the 2030 target, which produces 20% renewable energy[11].
Kenya is one of the top African countries that utilize large wind energy farms to generate clean electricity. Therefore, a study about renewable energy showed that the policies and government support are vital for improving renewable energy use in the country.
Moreover, it recommended conducting more feasibility studies to allocate the need and improvement of electricity in remote areas[12].

An empirical review on the current development of community-based wind energy focused on remote areas. The results showed community acceptance, encouraged more investments in renewable energy, and suggested that more studies in developing and implementing wind energy should continue because these outcomes aid policymakers and decision-making to support the use of renewable energy[13].
A study about the level of wind energy development in Nigeria. Moreover, it evaluated the advancements of wind energy farms around the country and their usefulness in rural areas. Recommendations that research in wind energy and its applications and development should continue. Furthermore, in some parts of the country, small wind turbines can be used as a water pumping system. While in other parts, deploying large-scale wind turbines is applicable[14]. An analytical review[15] on the challenges and opportunities of wind farms in rural and urban areas concluded that additional studies in analyzing and mapping for the wind energy farms are essential. However, as wind energy is reliable, power can be utilized in remote and urban areas with adjustments.
Review of integration challenges of wind energy and proposed solutions and methodologies addressed by [16] including socioeconomic, environmental, and other technical issues.
Another study on Community Acceptance of Wind Energy Developments in different countries in Europe endorsed that wind power plays a vital role in eliminating emissions in society. Moreover, using a wind energy-based community increases the positive environmental impacts, increasing community acceptance and supporting wind energy development in the area[17].
In Tunisia, a comprehensive review on challenges facing wind energy development. The potential of using wind energy in the area showed a prosperous future for using wind energy 30 meters above the ground for harvesting wind energy. The real challenge is the finical issues to invest in this project.
A certain amount of investment is required, Government should regulate the policies and enhance community acceptance for wind energy in the remote areas[18].
An overview of the adoption of wind energy and challenges in different countries around the globe, Asia, America, and Europe concluded that rural areas of Africa should embrace and apply wind energy and, most importantly, encourage community acceptance[19].
A review of current methods utilized for harvesting electricity from wind energy and selection of guidelines for proper use, the conclusion of this study each method of choosing a particular wind turbine depends on the location and wind speed and considering parameters such as environmental impact and dangerous for the community[20].

Wind energy is used for water desalination in the coastal area or rural areas, According to [21] presents the current state of using wind energy in Desalination Systems and challenges denying the improvement for sustainable freshwater. Results pointed out that instability of wind speed and power fluctuations are the main reasons behind this system's improvement. The advancement of wind farms in the United Kingdom, where plans to reach 22GW to154GW by 2030, faces some challenges for offshore wind farms.
Therefore, a review [22] to address those issues and concerns. Ended by offshore development depends on many factors, such as maintenance and investments. Although some inherited problems, Artificial intelligence is used for automated decision-making.
Another term of wind energy is Airborne wind energy (AWE) in a study of acceptance and knowledge about AWE in the community[23].
Hence, it reviewed the impact, emissions, and safety. Results. It is concluded that comprehensive and empirical research addresses the AWE for the community and facilitates the improvement and deployment of this renewable energy in rural communities.

Geothermal energy

The use of Geothermal energy started at the beginning of 1900, Earth's internal heat produces it. This energy is considered very old with renewed and considerable power amount. [24]. Geothermal energy is reliable and sustainable. a review of geothermal energy, a worldwide application for direct use, presented in [25].
Among the earliest countries, China started using geothermal energy in direct utilization. As a result, the expected existing geothermal energy 3.06 * 1018 kWh/yr. Represents 7.9% of the world. Moreover, geothermal power generation's low cost and sustainability make it suitable in many parts of China[26].
As energy is essential for development increase, the public's awareness is vital in a case study[27] of geothermal development in Iceland and Japan applied Hoftsede's cultural theory framework to evaluate the public understanding. The results showed that culture impacts the development of geothermal energy in the two countries.
In study presented by [28] Supercritical geothermal systems are considered for the high temperature uses and located below the brittle-ductile transition zone in the crus. Therefore, more policies and producers have to announce to secure this energy as it is a very danger and that cannot be solved by one country alone. According to [29], in the country of Pakistan development of Geothermal energy resources.
Most used are the Shallow geothermal energy and Direct-utilization of Geothermal energy, where the geothermal energy can be applied in remote areas and industrial. Which has the potential to decrease the fossil fuel consumption in the country.

In turkey, the target is to produce 30% of the energy demand by 2023, but the target reached before the set date, which make the country suitable for deploying more power plants of Geothermal energy[30].
Geothermal energy showed lesser environmental impacts place it on the top of renewable energy sources and the straightforward uses in heat in industry and remote areas household where the efficiency relies on the location, in[31] a complete review direct heat applications and Power plant technology.
Therefore, according to [32]presenting an overview of geothermal resources in Poland and the various uses for heat and energy production, the results showed that geothermal energy improvements help people control and secure their electricity needs with zero impact on the environment.
The study of [33] reviewed 18 important enhanced geothermal system (EGS) locations in around the globe, including (the European Union, Japan, Australia, South Korea, and the USA).
Results concluded that site characteristics and type of types of equipment and setting. A huge potential of 85% and EGS power generation assumed to be 70GWe by 2050.

In research by [34] a worldwide review on direct uses of geothermal energy, the finding showed the development in most countries is slow, another issue is the high investment costs of starting geothermal projects.
And finally geothermal energy used in heat pumps, going deep underground to extract and bring energy to the surface requires expensive equipment and materials beyond the reach of a single family.

Hydropower

Hydropower energy is a vital energy source harvested from the water during the moving from high to low positions, while this water is moving and with the gravity this movement turn on the turbines to generate electricity, around the globe there are many projects to generate electricity using hydropower stairgates.
For instance, using Dam projects with reservoirs, and run of river. In a survey conducted by [35] on China installing small hydropower instead of depending on fuel, results found that using hydropower helps improve the economy of the rural areas and develop the society's understanding of clean energy and protect the environment.

Moreover, in a summary of assessment for micro hydropower plants model in China, for 50 years, chines hydropower development plan, Results showed that the hydropower energy protects the ecological environment and improves the economic and social developments[36].
Another study addressed the development of hydropower energy in the country over 100 years' study showed that China long and short-term (2030, 2050) development plan implies that hydropower energy development is rapidly increasing in the country. Moreover, by 2050, hydropower will play a vital role in economic growth, especially in remote area[37].

In Colombia, an analysis [38] on the potential of developing small hydropower projects installed in rivers to produce clean power results showed that the generated power can be utilized in the lighting of streets on highways and water irrigation and waste management and helps to reduce the an emission about 536,284 CO2 annual tons. In addition, the Hindu Kush Himalayan region, an investigation about the current state of hydropower generation and the obstacles and challenges slowing the improvement of hydropower, the study identified some economic and social challenges and overcame those issues more energy programs and energy trade should be promoted[39]. In India, a study b [40] showed that small hydropower energy could help overcome the country's energy outage for three decades by utilizing renewable energy, including hydropower in rural areas. Another study conducted in Brazil[41] about the relationship between economic growth and gas emissions reduction is exceptionally significant, and the construction of hydropower power plants is essential for energy security in the Amazon region. Another study considered installing the hydropower plants in the Amazon found a substantial negative direct and indirect impact on the environments where the damage of the freshwater occurred due to the utilization of the hydropower[42].
A study conducted [43]about the importance of hydropower and renewable energy in rural areas and off-grid applications found that deploying hydropower in remote areas should be considered, especially the efficiency of the hydropower proved and employed commercially. In Afghanistan, research about clean energy development by deploying hydropower technology in the rivers and water flow showed that the country has massive potential for implementing hydropower renewable energy projects[44].
In a review focused on hydropower in Malaysia in rural electrification, the results identified 149 suitable locations for small hydropower and expected to produce 500MW, and recommended some improvements in financial and institutional including technical aspects[45].
Moreover, a study evaluated the challenges of large and small-scale hydropower in Malaysia. Furthermore, proposed strategies for improvements, since this energy is a leading contributor, finalized that the country can expand the hydropower and require more training about hydropower installation and conducting more research about choosing suitable turbine size to fit the location[46].
In a study about small-scale rural communities and renewable energy and development in Wales UK and economic growth, hydropower in remote areas increases the community benefits and economic situation[47].
In Europe, small hydropower is considered an option for rural and remote areas, and this technology represents the future of suitable clean energy[48].

Where a review of the development of hydropower in Romania, which started in 1884, showed the development of this energy gives an advantage for the country for sustainable clean energy resources[49].
On the other hand, an assessment evaluated over 3600 articles and policies to identify the issues and problems slowing the small hydropower deployments. Recommended that there is a lack of introducing the small hydropower for social and more studies are needed to explore the environmental and cumulative impacts and consider improvements of environment laws and policies[50].
Moreover, analysis[51] for environmental pollution and economic growth in relationship with the hydropower energy consumption in G7 countries, using Markov Switching-Vector Autoregressive (MS-VAR) and MS-Grange methods to evaluate the impact of hydropower on economic growth and developments of remote areas, showed that in some regimes the hydropower affects the environment. However, in contrast, it helps improve the economic growth of the rural areas in other regimes.
For instance, in Napel, a proposed model for micro hydropower plants. Showed the ability to produce a significant amount of clean energy suitable for rural areas and recommended that policymakers consider improving the policy to suit the deployment[52].
In sub-Saharan Africa, research on hydropower improvements showed that although the SSA has many suitable locations for installing hydropower, only a few countries could use hydropower energy to generate electricity. Moreover, more extensive research must be done to explore its challenges[53].
A short review comparing hydropower uses instead of fossil fuels showed more benefits for utilizing hydropower, such as producing electricity without polluting the water or the air. However, one drawback is that hydropower requires massive deforestation in certain areas[54]. In a review of the challenges and status of hydropower in Kenya, one major challenge is the installation of hydropower. Small-scale hydropower has made a significant contribution to electrification attempts.[55].

In Mekong the use of hydropower shows very high potential. Therefore, the regime signed the 1995 Mekong Agreement to use this clean energy substitute for fossil fuel. Between the countries since the rivers and water flow in the entire regime[56].

In Cameroon, hydropower shows the capability to cover the internal electric power demand. Therefore, the potential of hydropower in the country is very high, with a positive impact on the environment[57].
In South Asian countries, the challenge is providing and covering the increased electricity demand with lower carbon emissions to the environment. Therefore, hydropower energy is a suitable candidate to replace fossil fuel where it has a positive impact on the environment cost and social, hydropower still affordable and cheap compared with other power sources[58] The ecological impacts of the hydropower types for small run-of-river dam-toe, diversion weir, and pondage schemes are presented in[59].
In order to select a suitable location for the hydropower plant considering the (environmental flow, hydro-technical infrastructure status of surface water body) presented in[60].
In a study about Myanmar's hydropower development, the country has the probability of utilizing this energy. Nevertheless, connecting the hydropower to the grid adds more cost due to the weak government support[61].
Small hydropower has the potential to solve the rural area electricity problem in any country[62].

Ocean energy
Ocean energy is free and clean energy harvested using different techniques. A review of the current state of this energy pointed out that there are six types of ocean energy namely ocean wave, tidal current, tidal range, ocean thermal energy, ocean current, and salinity gradient[63]. Different techniques are used to harvest the energy for each type, as the ocean offers a considerable amount of clean energy. Among those techniques, Wave and Tidal energy devices are the most advanced ocean energy technology[64].
Another review of ocean energy's enormous potential production added the marine energy to the exited types and the possible way to extract the marine energy to overcome the challenges such as cost and environmental impacts[65].
In a study about the existing tidal harvesting system proposed new devices to overcome the environmental and cost reduction challenges[66].
The integration of wave energy devices with the marine facilities helps improve the breakwater and wave energy aside from stand-alone wave energy and reduces the maintenance and installation cost. Although these improvements, more challenges are still facing, such as finding a suitable location for installation for the breakwater, other parameters tidal range, and direction of the incoming waves[67].
The Tidal power can generate 1-10MW/KM in about 4-12 m range and assimilation of ocean energy to the utility grid is still a big issue[68].

In a study about the current development of ocean energy conversion in the united states, the results showed that ocean energy is valuable, and the country has a suitable location to develop ocean energy[69].
In the European regime study about the economic, social, and environmental barriers addressed, results showed that utilizing ocean energy in the EU regime has a bright future, despite some drawbacks, such as adjusting policies to attract the investors. Moreover, the main advantage of this source is predictable[70].
An evaluation of the wave energy harvesting techniques and challenges presented in [71]the study identified the major unsolved issues such as the operation and maintenance costs, lifecycle cost, and wave farm optimization.
Another advantage of ocean energy is applying it in desalination. A study that investigated in promoting the use of ocean energy in desalination results shows that the ability to solve the fresh and drinkable water shortage in rural areas and coastal areas[72].

The fundamental of ocean energy around the globe about installed capacities, technologies and devices is discussed in[73] , the study compared the IEA was 530MW and EIA 2730 MW reports in 2014, concluding that many countries aim to use this energy in the future.
Proposed study for utilization the wave energy in remote areas, and proposed techno-economic model for operating the facilities that depend on oil and gas to generate electricity and reduce the CO2 emissions, and analyzed Norwegian Continental Shelf(NCS), results showed that using the wave energy has the advantage to reduce the pollution and CO2 emissions[74]. Another way to boost the efficiency of the energy harvested from wave energy is using the triboelectric nanogenerator(TENG), which converters the wave energy to electrical energy. However, the disadvantages of the cost of materials and the harsh connection between the sea and the triboelectric Nano-generator[75].
The strategies of selecting the suitable location for Wave Energy Farm (WEF) and choosing the appropriate Wave Energy Converter (WEC) for maximum efficiency of energy production is discussed in[76].
In conclusion ocean energy useful and can be utilized for producing clean energy for rural and remote areas.

Biomass energy

Biomass generates electricity from the crops and trees, considered one of the most promising renewable energy that secures sustainable energy supply, On the one hand, it is a suitable candidate for replacing fossil fuels, but it can affect the environment, water, and food security[77].

Biomass energy is the primary source for cooking, heating, and nowadays applied in various applications, and as renewable energy, 10%-14% is the contribution among other renewable energies[78].

To develop biomass energy planting new plants and microbe for more yield help in increase the energy production in available land or water. In Turkey, as the country is considered one of the most agricultural areas, various agricultural debris such as crop residues and grain dust, including fruit trees, make Turkey depend on biomass to supply its energy demand. Therefore, biomass is one of the most secured energy sources utilized for heating and fuel for vehicles.

Moreover, prices fluctuations in petroleum and natural gas cannot affect its price. [79]. Hence, the different sources of biomass utilized to generate the electricity discussed in[80].

In tropical forests Malaysian lands cover about 76%, including the agriculture fields. Therefore, biomass is applicable in the country, especially the government programs to reduce waste by producing energy for heating and cooking. On the other hand, significant barriers still deny the improvement of the biomass in the country, such as lack of information and financial issues and the high cost of using the biomass for producing electricity compared with fossil fuel[81]. The economic growth of short-run and long-run in relationship with biomass energy for ten developing and emerging countries are discussed in[82], and results showed a significant link between the biomass energy consumption and economic growth in 9 countries out of 10. Moreover, the biomass uses and its impacts on land, and the side effect on food security, including environmental issues and concerns, are discussed in[78].

In India the biomass has a bright future to meet the demand. The advantage is that the resources are available to utilize energy, such as bio-waste and biomass recycling, including dry wood. Moreover, the biomass gasifier plant has a lower and best environmental impact. However, the coal power plants drawbacks labor may end with injuries, illness, and high maintenance costs [83].

In the US, biomass utilization increases the GDP per capita by converting it to liquid, gas, and sold, making it suitable for transportation fuel uses, electricity generation, and heating. Therefore, promoting biomass needs extra steps such as reducing biomass costs and subsidies and supporting investments in research and development[84].

Biomass burning in China harms the country in several ways, like air pollution and health issues, especially indoor smoking, cooking, and heating, resulting in health problems[85].

The biomass energy deployment growing over Europe, in Croatia research showed that various residues utilized in biomass production abandoned, promoting biomass especially many lands to use without distributing the food production[86].

Pakistan is suffering from electricity outages due to rapidly increasing power demand. Biomass energy is a suitable candidate to cover this demand where it can be used in transportation and covering remote location demand. In addition, the country has the potential for more biodiesel projects[87].

Another study in Africa that biomass energy has great potential to produce a massive amount of energy come up with the increasing demand, enhancement of agricultural sector production, and more robust policies, especially in Nigeria where crops vast lands and massive forests available[88].

Strategies to Improve renewable energy standalone

In order to improve the efficiency of the renewable energy sources, and to lower the costs and enhance the capacity of stand-alone systems in rural areas, attaching the source with energy storage system can make the energy reliable and sustainable. In following sections, a brief overview on different types energy storage system and Micro-grid system.

Energy storage systems (ESSs)

The energy storage systems widely used in the various applications and utilizations of ESSs are extensive and suitable for rural areas depending on the energy source used and locations[89].

The energy storage systems help to increase the electricity in the rural areas, various types of energy storage methods and the characteristics with comparisons includes the field of applications reviewed in[90].

The operation fundamentals of various storage systems presented in[91]. While in [92] three critical types of energy storage systems(pumped hydroelectricity storage, batteries and fuel cells) are discussed.

The flywheel Energy Storage system(FESS) operating mechanism and FESS structures and their applications discussed in[93]. The pros and cons of the energy storage systems in micro-grid applications are discussed in[94]. The thermal energy storage (TES) and aspects presented in[95]. Moreover, evaluation based on their capacities

and the future impacts on power system discussed in[96]. Furthermore, the life cycle costs of the electricity storage systems, including initial costs, operational costs, maintenance, and replacements cost addressed in[97].

Micro-Grid system

According to [98] foremost addressed the concept of the micro-grid and describe it as one system with multiple power resources united as one source to supply the demanded electricity from the consumer, furthermore distribution strategies and the explanations of the renewable energy resources such as micro-turbines, PV panels. And fuel cells and energy storage systems (ESSs) including the dynamic of the controlling scheme of the micro-grid and the mechanism of operating as one unity and controlled by insider controller called micro-source controller which made it easier to stable the voltage and current was first promoted in [99].

these cluster of loads and units of disturbed generation (DG) and ESSs preforming as one system to provide the electricity, this unity is connected at one point by using point of common coupling (PCC) there were many attempts around the world to develop the micro-grid farther by investing in research, development and demonstration (RD&D) [100].

The capability to minimise the total cost of the generated electricity by developing micro-grid system and replacing the diesel generators in Remote Community of Bella Coola ,Canada was successfully installed and tested which had to provide the community with clean and sustainable power supply to cover their daily power needs [101].

Moreover according to the researchers [102] explained the increase demand of alternative energy resources such as wind turbine and PV from the international communities to cover the highly increasing demand of sustainable and clean energy drove towards developing the micro-grid system and investing in its distributed power generation system (DPGS) this system is consist of controlling system schemes used to improve the reliability and efficiency of the micro-grid system, the pollution that occurs by using the traditional power sources such as fossil fuel to generate the electricity. The micro-grid system has been an attractive research field for many years, especially in the recent past, the distributed generation (DG) infrastructure development is internationally adopted [99], [103]–[105].

The rapid development of the micro-grid/Mini-grid system and multiple investments in renewable energy systems around the globe explains the positive impact of the micro-grid on the energy sector, especially in rural areas this can be highlighted as follows [106]–[108].

Finally according to the findings of [1] considered goals for energy sources are affordability, dependability, and renewability in order to achieve a cost-effective system, reduced power losses, and a hybrid renewable system. Therefore, incorporating renewable energy sources into microgrid systems improved electricity efficiency.

Results and discussion

Renewable energy generation and micro-grid sources produce lower pollution than the traditional grid system, which uses fuel and coal. The micro-grid works as a contingency power supply to support the national grid during load shedding.

and minimize the blackout of the entire system by the ability to work in islanded mode and cover the load demand during peak hours. This means the ability of connected the stand-alone system in near future to the grid.

From the economic side, the micro-grid lowers the cost of generating energy by using renewable energy recourses, cutting the high cost of installing the transmission lines, and minimizing the line losses since the generation units and lines are installed near the consumer. Working in grid-connected and islanded mode ensures an untreatable power supply. Furthermore, the load is always covered under different conditions, from either the utility grid or the micro-grid.

The increase energy efficiency, as a result of using the combined heat and power in the micro sources side by installing it closer to the load.

Uniqueness the micro-grid is a unique small system and a straightforward system consisting of micro sources and loads not as complex as the large grid.

Controllability: Unlike the large grid, it can be controlled easily during the maintenance and adding or removing micro sources.

Interactivity: The micro-grid can assist the primary grid to improve the power quality and supply the load demand in peak hours.

Conclusion

This study found a way to improve the lives of suburban residents by reviewing the available resources, highlighting the side effects of renewable energy sources on health and the climate, and discussing the benefits and drawbacks of each renewable energy source, as these resources exist in nature and can be used to produce clean and affordable electricity. In addition, several nations have shown significant potential for renewable energy sources to meet their rising energy demand and provide electricity to rural locations. In addition, merging the

various storage systems and installing micro-grid systems in rural regions would be a good option for reserving and storing power for lengthy periods as opposed to direct applications. In addition to reducing CO2 emissions in the region, using various renewable energy sources for energy production would help conserve the environment and improve the living circumstances of individuals who reside in remote areas far from the national utility grid. This would help increase economic development by supplying rural communities with the energy they need to support agriculture. However, more policy modifications are required, decision-makers must strengthen their judgments to entice investors, and the government should plan and give training on the use of installed renewable energy facilities to the local populations.

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Conflict of Interest

The authors declare no conflict of interest.

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