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REVIEW OF HYBRID RENEWABLE ENERGY SYSTEMS BASED ON WIND AND SOLAR ENERGY: MODELING, DESIGN AND OPTIMIZATION

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Abstract
This paper explores the technical challenges of wind energy systems hybridized with solar module systems and suggests possible solutions resulting from the integration of processes in off-grid and grid-connected modes. A general introduction to wind energy is discussed, including how to harvest wind energy, as well as recent advances and developments in wind energy. Particular attention was paid to issues related to wind and photovoltaic (Wind-PV) systems.

Key words: renewable energy, wind, solar, hybrid energy, optimization, modeling, simulation, techno-economic .

According to recent studies, approximately 78-80% of the world's commercial energy comes from fossil fuels such as oil, coal and natural gas. These high carbon sources have negative effects on our environment such as heat, dryness, air and rain. With this in mind, most countries in the world have focused on low-carbon energy. Renewable energy is abundant natural resources that can be used without compromising future energy needs. Unlike fossil fuels, which are depleted over time. Renewable energy sources such as wind, solar, biomass, wave and tidal are many sources of clean energy. Recently, renewable energy technology has witnessed a number of improvements as the cost of generating electricity has been decreasing [1].

Although renewable energy is seen as a new technology for generating electricity, the obstacle associated with renewable energy is the stochastic and unpredictable weather behavior. Its availability varies by location. Therefore, renewable energy needs to be supplemented with other sources such as batteries. Due to the intermittent nature of renewable energy, a single renewable energy source remains problematic in terms of energy efficiency and operating costs. Based on the aforementioned drawbacks, two or more renewable energies are being combined to create a hybrid renewable energy system (HRES). The main purpose of this is to improve electricity generation, minimize costs, reduce the negative impacts associated with burning fossil fuels, and improve overall system efficiency.

Recently, more attention has been paid to the integrated renewable energy system, because the hybrid system can be effectively used to provide high efficiency and reliable electricity to end users, unlike a single renewable source. HERS can be used in standalone or networked modes. A stand-alone system must be large enough to handle

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the load. In grid-connected mode, the storage can be small and the missing power can be obtained from the grid. It should be noted that in grid-connected mode there should be electronic power controllers for load distribution, voltage, harmonic and frequency control. Thus, the operational model of HERS is classified into an island mode in which the generated electricity is consumed locally and a grid-connected mode in which the renewable energy source is connected to the grid [2].

Interestingly, among renewable energy sources, wind power is the fastest growing in terms of global annual and cumulative installed capacity. Wind energy is available almost everywhere. But the wind speed varies depending on the area. Unlike other renewable sources, wind energy can work both day and night.

The sun is the cleanest and most renewable source of energy available on earth. Solar energy can be defined as radiant light and heat from the sun and is harnessed by humans through technology.

The amount of energy received from the sun depends on radiation, and scientists define radiation in two ways: energy in the form of waves (electromagnetic waves) or energy in the form of particles (photons). The wavelength range of electromagnetic radiation from the sun is from 0.1 nm to 104 m. However, 95% of the solar energy reaches the Earth only at distances of 0.3-2.4 μm [3]. Photons travel through space at a speed of 3.0×10^8 m/s, and each photon carries a different amount of energy, measured in electron volts. Photovoltaic (PV) is derived from two words: photo, meaning light, and voltaic, or volt, meaning a unit of electrical potential. A solar module or solar cell, also called a semiconductor, converts sunlight into direct current (DC) electricity. A solar cell is typically a thin wafer consisting of an ultra-thin layer of phosphorus-doped (N-type) silicon on top of a thicker boron-doped (P-type silicon). A pn junction is formed by doping and an electric field is generated near the top surface of the element. When sunlight carrying photons falls on a PV cell, a current is generated as the photons cause electrons to flow from the n to the junction. A typical silicon cell produces about 0.5 ~ 0.6 V under short-circuit conditions, regardless of size. The current produced is proportional to the intensity of sunlight falling on the surface, as well as the efficiency and size of the element. A photovoltaic cell is usually connected in a series or parallel circuit to produce the required amount of current. A series of solar panels is called a solar array, which is a ready-to-install unit for generating electricity. The performance of solar modules and arrays is mainly evaluated by the maximum power output (w) tested under standard test conditions (STC). Standard test conditions are defined as cell (module) operating temperature of 25°C (77°F) and solar irradiance of 1000 W/m ^{2}.

Macro grid

A physical structure in which electricity is produced using different generators to power the load using electrical conductors and cables, overhead or underground transmission and distribution networks, usually using different equipment for transmission and distribution. Figure 1 shows the power of a three-phase network coming from a generating station through a step-up transformer connected to three-phase

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transmission lines and connected to a step-down transformer that distributes the power to various consumer loads as explained by Diaf et al. [2]. The network in Figure 1 is a three-phase AC network for alternating current (AC) loads. Describes several implemented networks that exist and are classified as micro- and large-scale networks connected to various conventional and renewable energy generators.

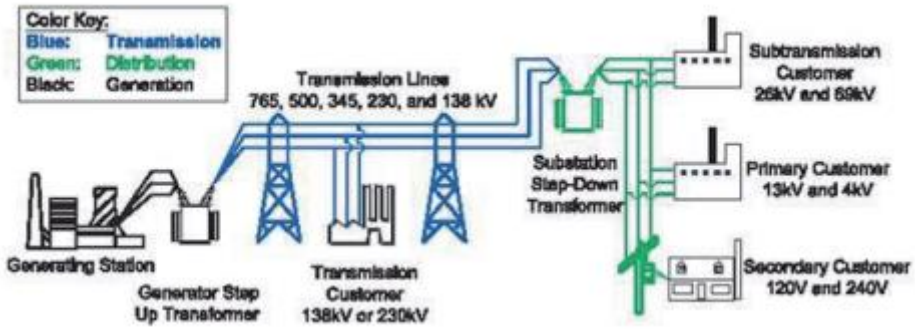

Figure 1. Several power networks (transmission and distribution).

Micro grid- A microgrid is a network designed for the integration of distributed energy resources, operations management, power quality issues, and energy management infrastructure to ensure the load and stability of the energy supply. It is the smallest facility commonly used in the network with a variety of generators that use three-phase-four-wire power from Ultra Low Voltage to single-phase three-wire or two-wire power configurations to supply electricity to consumer loads. In addition, the microgrid is considered as a group of distributed resources (rer) and loads that make up the electrical network. It includes a low-voltage power distribution network (DER), an energy storage system (ESS) and/or micro-resources such as photovoltaics, fuel cells, wind turbines, etc. A microgrid can have controlled energy sources such as biomass, hydropower, fossil fuels, or uncontrolled energy sources such as solar and wind, or it can be River flow dependent on daily, monthly, and annual rainfall. Solar and wind microgrids are very difficult to operate, which involves measuring parameters such as solar radiation or insolation, photovoltaic cell voltage, photovoltaic cell current, ambient temperature, wind speed, and the nature of the AC load for annual evaluation. . Conversely, renewable energy storage losses, average output of the energy converter, and peak period parameters are used to estimate microgrid capacity [3].

Various sources (DGs)- A single source of electricity supply to the consumer, local load, is either conventional fossil fuel generation such as oil, coal, etc., or renewable energy sources such as solar, wind, hydro, biomass, geothermal, etc. Gasoline generators commonly and frequently used in different production strategies or rural areas are classified as power sources of small different electric generators. The integration of various energy sources for real-time power system operation, control, power management is obvious, the micro grid has the same distribution structure as the macro grid, except that it is smaller in size, in a small grid, and has low power consumption.

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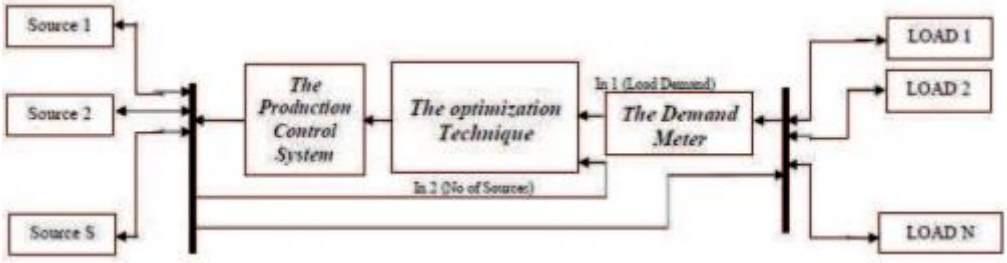
Hybrid energy system

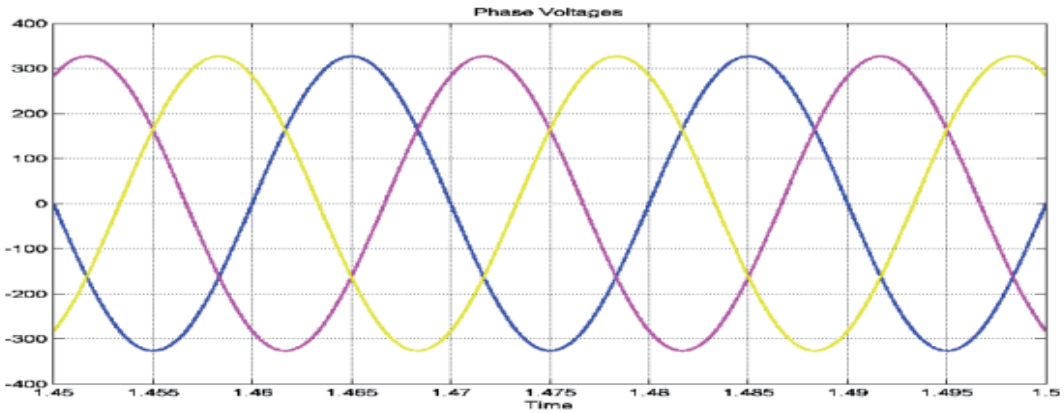
Hybrid energy system is an engineering project of hybridization or pairing of power source components, for example, the organization of different energy sources for parallel (equivalent) operation is very common in energy. Thus, hybridization is defined as crossing pairs of agents to work together to achieve a goal. Thus, hybridization consists of manually or automatically synchronizing the sources or components of two or more electrical generators to supply electricity to the grid, thus forming a hybrid energy system. In general, a hybrid renewable energy system (HRES) is an extension that uses a variety of mixed resources as hybrid or full hybrid renewable energy to supply the electricity supply system.



A hybrid scheme for optimization, management and production of electricity from renewable sources.

In addition, modern advanced generators; an electronic logic power controller optimized to improve wind farm performance for effective energy delivery and integration of grid requirements [4]. Thus, power electronic logic controllers, hybrid SP, hybrid SSD and hybrid RAR technologies are therefore applied to the solar photovoltaic power system to improve the reliability of the power supply.

However, the approaches here consider optimization not only in terms of costs, but also in terms of power supply reliability. Therefore, the long-term operation of hreps is economically preferable, because the costs are reduced, there are no replacement costs, reinvestment, refueling costs, maintenance costs, costs of the possibility of power loss, and the environment -non-quantified costs for environmental degradation indicate the use of diesel generator only as economic parameters. energy supply. these hybrid reps have much greater value variables than energy system performance.



Three-phase output voltage waveforms of the hybrid system.

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