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# ENERGY DEVICES BASED ON RENEWABLE ENERGY TYPES

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## ABSTRACT

In this paper, essential statistics demonstrating the increasing role of renewable energy generation are firstly discussed. A state of the art review section covers fundamentals of wind turbines and PV systems. Included are schematic diagrams illustrating the main components and system topologies and the fundamental and increasing role of power electronics as an enabler for renewable energy integration, and for the future power system and smart grid.
Recent examples of research and development, including new devices and system installations for utility power plants, as well for as residential and commercial applications are provided. Fuel cells, solar thermal, wave generators, and energy storage systems are also briefly presented and illustrated. Challenges and future trends for 2025 are summarized in a table for on-shore and off-shore wind energy, solar power, including photovoltaic and concentering, wave energy, fuel cells, and storage with batteries and hydrogen, respectively. Recommended further readings on topics of electric power engineering for renewable energy are included in a final section.

**Keywords:** renewable, energy electric, power, system smart, grid wind, power wind, generator solar, power photovoltaic, array PV, cellful cells hydrogen wave, energy power, converters power, electronics2025, trends10-year predictions.

## INTRODUCTION

Renewable energy means energy that is sustainable - something that cannot dry out or endlessly like the sun. When you hear the term "alternative energy", it usually also refers to renewable energy sources. This means alternative energy sources to the most commonly used unsustainable sources such as coal.
Renewable, or regenerative, "green" energy - energy from energy resources that are renewable or inexhaustible on a human scale. The basic principle of using renewable energy is to extract it from processes constantly occurring in the environment or renewable organic resources and provide it for technical use.
Renewable energy sources have been important for humans since the beginning of civilization. For centuries and in many ways, biomass has been used for heating, cooking, steam raising, and power generation and hydropower and wind energy, for movement and later for electricity production. Renewable energy sources generally depend on energy flows through the Earth's ecosystem from the insolation of the sun and the geothermal energy of the Earth. One can distinguish:

- Biomass energy (plant growth driven by solar radiation).
- Wind energy (moving air masses driven by solar energy).
- Direct use of solar energy (as for heating and electricity production).
- Hydropower.

-Marine energy (such as wave energy, marine current energy, and energy from tidal barrages).
-Geothermal energy (from heat stored in rock by the natural heat flow of the Earth).

If applied in a modern way, renewable energy sources (or renewables) are considered highly responsive to overall energy policy guidelines and environmental, social, and economic goals:

-Diversifying energy carriers for the production of heat, fuels, and electricity.
-Improving access to clean energy sources.
-Balancing the use of fossil fuels, saving them for other applications and for future generations.
-Increasing the flexibility of power systems as electricity demand changes.
-Reducing pollution and emissions from conventional energy systems.
-Reducing dependency and minimizing spending on imported fuels.

Proper operation and maintenance of renewable energy devices is of paramount importance. Furthermore, many renewables technologies are suited to small off-grid applications, good for rural, remote areas, where energy is often crucial in human development. At the same time, such small energy systems can contribute to the local economy and create local jobs. The natural energy flows through the Earth's ecosystem are immense, and the theoretical potential of what they can produce for human needs exceed current energy consumption by many times. For example, solar power plants on 1 percent of the world's desert area would generate the world's entire electricity demand today.

Renewable energy is obtained from natural resources such as sunlight, water flows, wind, tides and geothermal heat, which are renewable (replenished naturally), as well as from biofuels: wood, vegetable oil, ethanol.

Renewable energy sources (RES) applies to those energy sources reserves of which are replenished in a natural way, primarily due to the Earths flow of energy from solar radiation, and in the foreseeable future are practically inexhaustible. This is, first of all, solar energy itself, and also its derivatives: wind energy, energy of plant biomass, energy of water flows, etc. Renewable energy sources include also geothermal heat coming to the surface of the Earth from its depths, low-potential heat of the environment, which can be used, for example measures using heat pumps, as well as some energy sources associated with life human (thermal "waste" of housing, organic industrial and agricultural waste, household waste, etc.). The energy potential of most of the RES listed above on a global scale and individual countries are many times higher than the current level energy consumption, and therefore they can be considered emerge as a possible source of energy production.

The known scenarios for the development of mankind suggest the need for widespread development of renewable energy sources already in the coming decades, as due to the inevitable reduction in production and increase in the cost of oil, gas and coal, and for environmental reasons ($CO_2$ emissions and other harmful effects of traditional energy on the environment). The use of renewable energy sources, as a rule, does not have a serious

negative impact on the environment, for the most part they are environmentally friendly and universally available sources of energy.

The fusion of the Sun is the source of most renewable energy, with the exception of geothermal and ebb and flow energy. Astronomers estimate that the Sun's remaining lifespan is about five billion years, so on a human scale, renewable energy from the Sun is not threatened with depletion.

Sunlight is one of the richest and most readily available energy resources on our planet. The amount of solar energy that reaches the Earth's surface in one hour exceeds the planet's total energy needs in a year. While this sounds like an ideal renewable energy source, the amount of solar power we can use varies depending on the time of day and season of the year, as well as geographic location. In the UK, solar energy is becoming an increasingly popular way to supplement energy consumption. PV cells, or solar cells, are semiconductor devices that convert solar energy directly into DC electric energy. In the 1950s, PV cells were initially used for space applications to power satellites, but in the 1970s, they began also to be used for terrestrial applications [7, 8]. Today, PV cells are used to provide power in a wide variety of applications, including grid-connected systems (e.g., utility scale and residential), remote buildings, outdoor traffic-related equipment, and satellites. Linear Fresnel Reflector -this kind of technology approaches the parabolic trough collectors but uses an array of flat or slightly curved mirrors to collect the sun rays onto a fixed receiver mounted on a linear tower

Wind is an abundant source of clean energy. Wind farms are becoming more commonplace in the UK as wind energy makes an ever-growing contribution to the national grid. In order to select an electrical generator for small wind energy power application, it is necessary to study and define a wide set of variables such as voltage, frequency, speed, output power, slip factor (for induction machines), required source of reactive power, and field excitation along with other to harness electricity from wind power, turbines are used to power generators, which then supply electricity to the national grid. Despite the fact that there are residential or □off-grid□ power generation systems, not all facilities are suitable for the installation of a domestic wind turbine. Find out more about wind energy on our wind energy page. In order to understand the characteristics of wind energy conversion and how a turbine works, it is possible to make a simplified assumption that the wind approaches the turbine with constant velocity, with homogeneous properties (such as temperature, density), and without turbulence. A gearbox is used to match the rotational speed of the turbine to the generator. Although the rotational speed of a small wind turbine can be very high, a larger turbine is usually designed to have a slow rotational speed. A wind turbine operates with much higher wind speeds. The normal cut-in wind speed is 4.5 m/s and the cutout wind speed is approximately 30 m/s. A water turbine operates at a

much lower water speed; thus, the rotational speed of a water turbine is much lower than the rotational speed of a wind turbine. With a gearbox, it is possible to use a high-speed generator to match the rotational speed of the blades, so a much smaller size of the generator (often off the shelf) can be used. Unfortunately, a gearbox requires regular maintenance, so it is often the cause of generators downtime and consequently the loss of productive hours.

As a renewable energy source, hydropower is one of the most commercially developed. By building a dam or barrier, a large reservoir can be used to create a controlled flow of water that will drive a turbine that generates electricity. This energy source can often be more reliable than solar or wind power (especially if it is tidal rather than riverine) and also allows electricity to be stored for use when demand peaks. Like wind power, hydropower may be more viable as a commercial energy source in certain situations (depending on the type and compared to other energy sources), but to a very large extent depending on the type of property it can be used for residential, autonomous' generation. WEC devices extract energy contained within ocean surface waves and convert it into useful electrical power. To date, there are more than 100 prototypes of various WEC systems. These devices are typically divided into point absorbers, terminators, attenuators, an oscillating water column (OWC), and overtopping designs. The first three are often categorized as oscillating types of WEC designs and consist of one body or multiple bodies that are designed to directly convert wave energy into electrical power from the wave-induced relative translation motion and/or rotational motion between the body and a reference frame (e.g., seabed or another body) through the use of a linear or rotary PTOS. The overtopping devices and OWCs generate energy through the use of hydro turbines and air turbines, respectively. Illustrations of the various types of WEC devices and illustrates the mechanisms through which the devices extract energy.

Technologies that extract energy from ocean, tidal, and river currents are collectively called CECs. Tidal currents are generally driven by the Earth's rotation, the relative positions of the moon and the sun to the Earth, and local bathymetry, and they consist of multiple constituents with varying periods. In most places, the dominant constituent is the principal lunar semidiurnal, which has a period of 12 h and 25.2 min. The term ocean current refers to the wind-driven surface ocean current. The Gulf Stream (in the North Atlantic Ocean) and Kuroshio (in the North Pacific Ocean) are the two largest ocean currents.

Today, these technologies are significantly more mature than WECs because their designs draw on decades of research and development experience from the wind energy and shipbuilding industries. Accordingly, most CECs currently under development resemble wind turbines that have been adapted to operate in the ocean environment and marine propellers that have been modified to harness energy.

This is another form of hydro energy that uses twice-daily tidal currents to drive turbine generators. Although tidal flow unlike some other hydro energy sources isn't constant, it is highly predictable and can therefore compensate for the periods when the tide current is low.

By harnessing the natural heat below the earth's surface, geothermal energy can be used to heat homes directly or to generate electricity. Although it harnesses a power directly below our feet, geothermal energy is of negligible importance in the UK compared to countries such as Iceland, where geothermal heat is much more freely available

This is the conversion of solid fuel made from plant materials into electricity. Although fundamentally, biomass involves burning organic materials to produce electricity, and nowadays this is a much cleaner, more energy-efficient process. By converting agricultural, industrial and domestic waste into solid, liquid and gas fuel, biomass generates power at a much lower economic and environmental cost

In a strictly physical sense, energy is not renewed, but is constantly withdrawn from the above sources. Of the solar energy arriving on Earth, only a very small part is transformed into other forms of energy, and most of it simply goes into space.

The use of continuous processes is contrasted with the extraction of fossil fuels such as coal, oil, natural gas or peat. In a broad sense, they are also renewable, but not by human standards, since their formation takes hundreds of millions of years, and their use is much faster.

This is a branch of energy specializing in converting the kinetic energy of air masses in the atmosphere into electrical, thermal and any other form of energy for use in the national economy. The transformation takes place with the help of a wind generator (for generating electricity), windmills (for generating mechanical energy) and many other types of units. Wind energy is a consequence of the activity of the sun, therefore it is classified as a renewable energy.

The power of the wind generator depends on the area swept out by the blades of the generator. For example, turbines with a capacity of 3 MW (V90) manufactured by the Danish company Vestas have a total height of 115 meters, a tower height of 70 meters and a blade diameter of 90 meters.

The most promising locations for wind power generation are coastal areas. Offshore wind farms are being built in the sea, at a distance of 10-12 kilometers from the coast (and sometimes even further). Wind turbine towers are installed on foundations made of piles driven to a depth of 30 meters.

Wind generators consume virtually no fossil fuels. The operation of a 1 MW wind turbine over 20 years of operation saves about 29 thousand tons of coal or 92 thousand barrels of oil.

In the future, it is planned to use wind energy not through wind generators, but in a more unconventional way. In the city of Masdar (UAE), it is planned to build a power plant operating on a piezoelectric effect. It will be a forest of polymer trunks covered with piezoelectric plates. These 55-meter barrels will bend in the wind and generate current.\

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Solar water heaters for household use and kitchens. Solar distillers for seawater or brackish water desalination. Photovoltaic systems to generate electricity for use in outdoor lighting, lighting, air conditioning, computers, cell phones, pumps, TV, radio and transport vehicles. Under the current situation of the park, the arrangements grid-connected and stand-alone were taken into account.

The wind power systems for generating electricity and its use as in the photovoltaic systems. Anaerobic digester for digestion of manure to produce biogas that would be used in heating and lighting. A transition to renewables-based energy systems would have to rely largely on successful development and diffusion of renewable energy technologies that become increasingly competitive through cost reductions resulting from technological and

organizational development and on the political will to internalize environmental costs and other externalities that permanently increase fossil fuel prices. Different technologies vary widely in their technological maturity, commercial status, integration aspects, and so on. Policies aimed at accelerating renewable energy must be sensitive to these differences. As renewable energy activities grow and ever more extensive funding is required, many countries are moving away from methods that let taxpayers carry the burden of promoting renewables, towards economic and regulatory methods that let energy consumers carry the burden.

## REFERENCES

1) Lasseter, R.H., Paigi, P., Micro grid: A conceptual solution, Power Electronics Specialists Conference, 2004 (PESC 04), Vol. 6, pp. 4285□4290, Aachen, Germany, June 2004.
2) Zhao, B., Song, Q., Liu, W., Xiao, Y., Next-generation multi-functional modular intelligent UPS system for smart grid, IEEE Transactions on Industrial Electronics, 60(9), 3602-3618, September 2013.
3) Graditi, G., Apicella, A., Augugliaro, A., Dusonchet, L., Favuzza, S., Riva Sanseverino, E., Technical and economic aspects on integrated PV-UPS systems, 19th European Photovoltaic Solar Energy Conference, pp. 2572-2575, Paris, France, June 2004.
4) Lahyani, A., Venet, P., Guermazi, A., Troudi, A., Battery/super capacitors combination in uninterruptible power supply (UPS), IEEE Transactions on Power Electronics, 28(4), 1509-1522, April 2013.
5) Nguyen, M.Y., Yoon, Y.T., A comparison of micro grid topologies considering both market operations and reliability, Electric Power Components and Systems, 42(6), 585-594, 2014.
6) Kwasinski, A., Power electronic interfaces for ultra-available DC micro-grids, Power Electronics for Distributed Generation Systems (PEDG), 2010, pp. 58□65, Hefei, Anhui, Peoples Republic of China June 2010.
7) Li, Z., Yuan, Y., Li, F., Evaluating the reliability of islanded micro grid in an emergency mode, 45th International Universities Power Engineering Conference (UPEC) 2010, pp. 1-5, Cardiff, U.K., August 2010.
8) Burgio, A., Menniti, D., Pinnarelli, A., Sorrentino, N., Reliability studies of a PV-WG hybrid system in presence of multi-micro storage systems, IEEE Bucharest Power Tech 2009, pp. 1-5, Bucharest, Romania, June 2009.
9) Salomonsson, D., Soder, L., Sannino, A., Protection of low-voltage DC micro grids, IEEE Transactions on Power Delivery, 24(3), 1045-1053, July 2009.
10) Li, H., Zhang, W., Xu, D., High-reliability long-backup-time super UPS with multiple energy sources, Energy Conversion Congress and Exposition (ECCE), 2013 IEEE, pp. 4926-4933, Denver, CO, September 15-19, 2013.
11) Zhu, Y., Xu, B., Chen, L., Dong, D., Lin, P., Xu, D., Multi-functional bidirectional AC/DC T-type 3-level converter for super UPS, IEEE PEAC 2014, pp. 390-395, Shanghai, China, November 5-8, 2014.
12) Zhou, J., Li, H., Zhou, Z., Xu, D., Control strategy of Li-ion battery module in super UPS, IEEE PEAC 2014, pp. 1236□1241, Shanghai, China, November 5-8, 2014.