Renewable energy

Introduction

Renewable energy sources are those that are naturally available and replenished. Renewable energy sources include solar, wind, hydro (water), geothermal, Tidal power or ocean wave energy, and biomass.Non-renewable energy sources, such as the combustion of fossil fuels, rely on a limited supply that can be considered non-renewable since they are replenished slowly (or not at all). Because of their finite supply, non-renewable energy sources can become more difficult and costly to extract as their supplies decrease. In addition, recovery of fossil fuels can eventually be damaging to the environment, such as in the case of oil drilling and /or mining.

Use of renewable energy sources reduces dependence on fossil fuels, diversifies energy resources, and reduces the emission of greenhouse gases and other pollutants associated with fossil fuels. While there are many benefits to the use of renewable energy sources, many renewable technologies currently remain prohibitively expensive compared to non-renewable fuels, at least as they are valued within the economic markets of today. In order for such energy sources to gain more widespread use, technologies must be advanced such that the cost of renewable energy sources becomes competitive with conventional energy sources. Widespread adoption of renewable energy sources will also benefit from economic markets that place a true cost of using non-renewable energy sources (such as environmental damage or cleanup required) on the user and not on society as a whole.

Current usage of renewable energy

In 2004, renewable energy sources (renewables) constituted 13.1% of the world's primary energy supply.79.4% of total renewables came from combustible material, mostly biomass. Hydropower was the second most important renewable energy source, contributing to 16.7% of total renewables. Renewable energy sources are becoming increasingly important in the world's electricity supply as well. In 2004, renewables contributed to 18% of global electricity, the third largest source after coal and natural gas. Almost 90% of renewable electricity comes from hydropower plants.

During the period from 1971 to 2004, the total primary energy supply increased by 2.2% per year, with comparable growth (2.3% per year) in renewables. The largest increases in energy supply were from wind (48.1% per year) and solar (28.1% per year) power.

Renewable energy sources

Solar

Solar power, or solar energy, uses energy from the sun directly, such as heating and lighting homes and offices, or indirectly, such as the conversion of sunlight to electricity. The four main solar technologies are solar heating, solar lighting, concentrating solar power (CSP), and photovoltaics. Other forms of renewable energy, such as wind, hydropower or biomass, can actually be traced back to solar energy, but these are typically thought of as separate energy sources due to the means by which they are collected and used.

Solar heating (water or air)

Solar heat can be utilized to produce hot water or to warm buildings via a hot air or water system. In solar water-heating systems, heat from the sun is absorbed by a solar collector and transferred to the water directly, or via a working fluid. In most cases, a solar water-heating

system is used along with a conventional gas or electric water-heating system to ensure a sufficient supply of hot water to the building.In the United States, this technology is most commonly used to heat water for swimming pools.

Solar lighting
Hybrid solar lighting (HSL) systems use light more efficiently that simply lighting a building using windows. In prototype systems, sunlight is collected in rooftop concentrators that are able to separate the light into the visible and infrared (heat) portions. The visible light is distributed throughout the building using fiber optic based lighting fixtures. The remaining heat is converted to electricity using thermo-photovoltaic cells, and distributed throughout the building.

Concentrating solar power
Concentrating solar power (CSP) plants use mirrors to focus the sun's energy and convert it to heat. Theheat is then directed through a conventional generator to produce electricity. CSP systems can range in size from small (10 kW; to power a small village) to large (up to 100 MW; for use in utility grids). Because CSP systems can only use direct-beam sunlight, the amount of power generated depends on the amount of direct sunlight at the site. This makes CSP systems a good option for power generation in the southwestern United States and other sunny regions in the world.

Photovoltaics
Photovoltaics (PV) take advantage of the photoelectric effect to convert the energy in sunlight to electricity. PV technology is used around the world, in large cities and remote areas. Applications range from street lights and highway signs to lighting for homes, businesses, and recreational areas. PV systems generally require unobstructed exposure to sunlight for most of the day. Unlike CSP systems, which can only use direct sunlight, many PV systems can also utilize energy from diffuse sunlight. In some areas of the United States, homeowners can use excess electricity produced by their PV system to offset their electricity bill.

Wind
Wind results from temperature differences that arise when the sun heats different parcels of air at different rates. Warmer air rises and colder air sinks, leading to wind. This occurs both locally, such as the air movement around a low or high pressure region, and globally such as the tradewinds. Thus wind is actually an indirect form of solar energy. Anything that moves contains kinetic energy, and air is no exception. When air moves due to wind, the kinetic energy can be captured and converted to mechanical energy.

Mechanical energy
The farm windmill is the most commonly recognized example of using wind to utilize mechanical energy directly. The energy obtained in this manner is traditionally used to pump water, grind grain, or saw wood. A sailboat is also an example of using wind energy to obtain mechanical energy; in this case the energy needed to push the boat across a body of water.

Electricity
To produce electricity, the mechanical energy captured in a Wind turbines are used to turn generators and thus convert wind energy into electricity. The blades, or rotors, of wind turbines convert the wind's energy into rotational energy, which is subsequently converted to electrical

energy. Turbines have increased in size over the past few decades, with today's utility-scale turbines typically producing approximately 1.5 MW, although larger scale turbines are now being brought to market which exceed 3 MW. This energy is collected and transferred to traditional power grids where it is then transferred to consumers. In the U.S., wind energy will produce over 1% of the total electrical power consumed in 2008. This does not sound like much, but actually represents a tremendous increase. The U.S. led the world in installation of new wind power capacity in 2005 and 2006; during the decade from 1997 to 2007 the installed wind power capacity increased approximately six-fold in the U.S. According to the Department of Energy funded studies, wind energy has the potential to supply as much as 20% of the United States' electricity. (For example, see "20% Wind Energy by 2030 - Increasing Wind Energy's Contribution to U.S. Electric Supply" [www1.eere.energy.gov/windandhydro/pdfs/41869.pdf], U.S. Dept. of Energy, Energy Efficiency and Renewable Energy).

Hydropower

Hydropower, sometimes called hydraulic power, is the energy contained in moving water. It is possible to collect this energy and convert it to a useful form. The watermill is one of the oldest examples of the use of hydropower.

Oceans

Useful energy can be obtained from both ocean tides and ocean wave action. Tidal power is utilized in areas where the water is trapped in a bay or estuary. As the water flows in and out of the bay or estuary, it moves turbines that are used to harness the energy of the moving water. Energy can also be obtained when surface waves move air within large concrete structures that is coupled to generators. In addition to tidal and wave power, the heat energy stored in the ocean can be converted to electricity, in a process called ocean thermal energy conversion (OTEC).

Rivers

Just as the energy in moving air can be captured by wind turbines, the energy of moving water in rivers can be captured by turbines and generators. The resulting electrical energy can then be sent to the electrical utility grid. Impoundment facilities are the most common types of hydroelectric systems. In such facilities, river water is trapped in a reservoir behind a dam. When the water is released from the reservoir, it flows past turbines that capture energy and convert it to electricity.

Geothermal

Unlike other sources of renewable energy, geothermal energy does not originate in the sun, but rather in the heat of the Earth's core. The most common example of this natural heat is seen in hot springs. The Earth's heat can be captured by drilling into hot water or steam reservoirs or geothermal reservoirs located near the Earth's surface.

Geothermal energy is captured and used in various ways. It can be used directly, such as when hot water is used for heating buildings or water, or indirectly such as in power plants that use high temperature (200 C or hotter) water or steam to generate electricity. The use of geothermal heat pumps is also widely done, but that is not really a direct use of a renewable energy source. Geothermal heat pumps in essence just use the earth's crust as a heat source (for heating mode) or a heat sink for cooling purposes.

Biomass

Biomass energy is the use of the energy contained within the organic matter in plants. Biomass energy is actually the "original" renewable energy source for humans. Today, wood is the largest source of biomass energy, although other sources, such as grassy plants, agricultural residue, and municipal and industrial organic waste, are increasingly used. Gases released by decomposition from landfills, the major component of which is methane, are also a biomass energy source.
Biofuels, biopower, and bioproducts are gaining in popularity as replacements for fossil fuels as fuels, power sources, and products, respectively. Biofuels result from the conversion of biomass into liquid fuels, which are then burned for energy. Biopower, on the other hand, refers to the direct combustion of biomass for energy. Bioproducts are biomass-based plastics that replace traditional petroleum-based plastics.

Further Reading

- Learning about renewable energy, National Renewable Energy Laboratory (NREL)
- Renewable energy, International Energy Agency (IEA)
- Solar frequently asked questions, US Department of Energy (DOE)
- Wind web tutorial, American Wind Energy Association (AWEA)
- Exploring ways to use ocean energy, US Department of Energy (DOE)
- Hydropower basics, US Department of Energy (DOE)
- Geothermal technologies information, US Department of Energy (DOE)

Source:
http://www.eoearth.org/view/article/51cbeec87896bb431f69a33a/?topic=51cbfc78f702fc2ba8129e5f