What are the different types of renewable energy?

June 12 2015, by Matt Williams

The Gemasolar solar power plant, situated near Seville in Spain. Credit: Torresol Energy

Renewable energy is becoming an increasingly important issue in today's world. In addition to the rising cost of fossil fuels and the threat of

Climate Change, there has also been positive developments in this field which include improvements in efficiency as well as diminishing prices.

All of this has increased the demand for alternative energy and accelerated the transition towards cleaner, more sustainable methods of electrical power. However, it is important to note that are many kinds – biomass, solar, wind, tidal, and geothermal power – and that each has its own share of advantages and drawbacks.

Biomass:

The most widely used form of renewable energy is biomass. Biomass simply refers to the use of organic materials and converting them into other forms of energy that can be used. Although some forms of biomass have been used for centuries – such as burning wood – other, newer methods, are focused on methods that don't produce carbon dioxide.

For example, there are clean burning biofuels that are alternatives to oil and gas. Unlike fossil fuels, which are produced by geological processes, a biofuel is produced through biological processes – such as agriculture and anaerobic digestion. Common fuels associated with this process are bioethanol, which is created by fermenting carbohydrates derived from sugar or starch crops (such as corn, sugarcane, or sweet sorghum) to create alcohol.

Another common biofuel is known as biodiesel, which is produced from oils or fats using a process known as transesterification – where acid molecules are exchanged for alcohol with the help of a catalyst. These types of fuels are popular alternatives to gasoline, and can be burned in vehicles that have been converted to run on them.

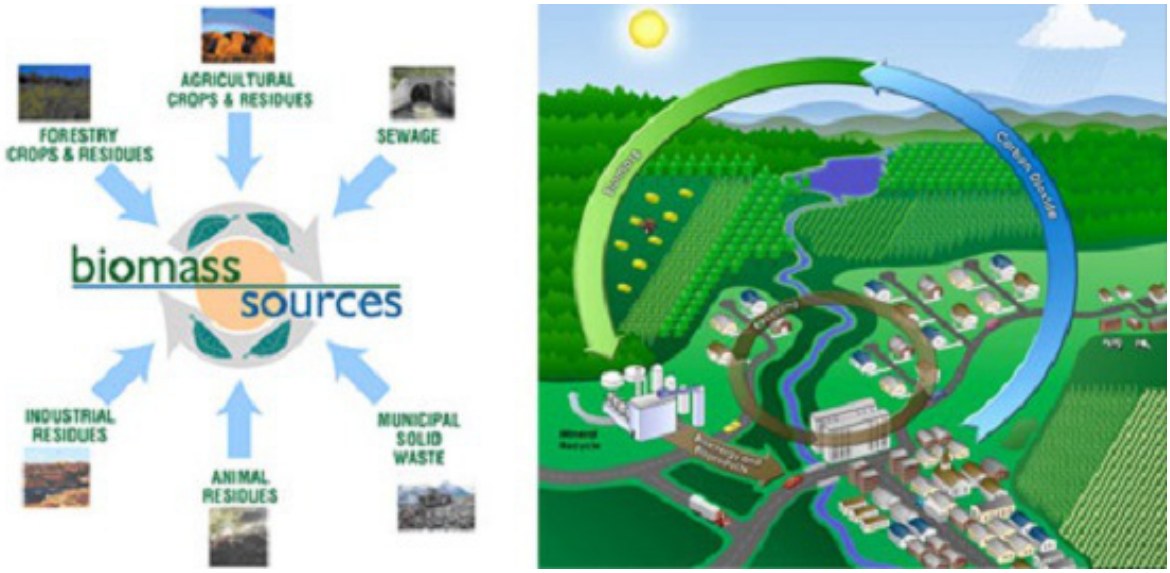
Solar:

Solar power (aka. photovoltaics) is one of the most popular, and fastest-growing, sources of alternative energy. Here, the process involves solar cells (usually made from slices of crystalline silicon) that rely on the photovoltaic (PV) effect to absorb photons and convert them into electrons. Meanwhile, solar-thermal power (another form of solar power) relies on mirrors or lenses to concentrate a large area of sunlight, or solar thermal energy (STE), onto a small area (i.e. a solar cell).

Initially, photovoltaic power was only used for small to medium-sized operations, ranging from solar powered devices (like calculators) to household arrays. However, ever since the 1980s, commercial concentrated solar power plants have become much more common. Not only are they a relatively inexpensive source of energy where grid power is inconvenient, too expensive, or just plain unavailable; increases in solar cell efficiency and dropping prices are making solar power competitive with conventional sources of power (i.e. fossil fuels and coal).

Today, solar power is also being increasingly used in grid-connected situations as a way to feed low-carbon energy into the grid. By 2050, the International Energy Agency anticipates that solar power – including STE and PV operations – will constitute over 25% of the market, making it the world's largest source of electricity (with most installations being deployed in China and India).

Wind Power:



Biomass – which involves converting organic materials into energy – can come from a variety of sources. Credit: ecoble.com

Wind power has been used for thousands of years to push sails, power windmills, or to generate pressure for water pumps. Harnessing the wind to generate electricity has been the subject of research since the late 19th century. However, it was only with major efforts to find alternative sources of power in the 20th century that wind power has become the focal point of considerable research and development.

Compared to other forms of renewable energy, wind power is considered very reliable and steady, as wind is consistent from year to year and does not diminish during peak hours of demand. Initially, the construction of wind farms was a costly venture. But thanks to recent improvements, wind power has begun to set peak prices in wholesale energy markets worldwide and cut into the revenues and profits of the fossil fuel industry.

According to a report issued this past March by the Department of Energy, the growth of wind power in the United States could lead to even more highly skilled jobs in many categories. Titled "Wind Vision: A New Era for Wind Power in the United States", the document indicates that by 2050, the industry could account for as much as 35% of the US' electrical production.

In addition, last year, the Global Wind Energy Council and Greenpeace International came together to publish a report titled "Global Wind Energy Outlook 2014". This report stated that worldwide, wind power could provide as much as 25 to 30% of global electricity by 2050. At the time of the report's writing, commercial installations in more than 90 countries had a total capacity of 318 gigawatts (GW), providing about 3% of global supply.

Tidal Power:

Similar to wind power, tidal power is considered to be a potential source of renewable energy because tides are steady and predictable. Much like windmills, tide mills have been used since the days of Ancient Rome and the Middle Ages. Incoming water was stored in large ponds, and as the tides went out, they turned waterwheels that generated mechanical power to mill grain.

It was only in the 19th century that the process of using falling water and spinning turbines to create electricity was introduced in the U.S. and Europe. And it has only been since the 20th that these sorts of operations have been retooled for construction along coastlines and not just rivers.

Traditionally, tidal power has suffered from relatively high cost and limited availability of sites with sufficiently high tidal ranges or flow velocities. However, many recent technological developments and improvements, both in design and turbine technology, indicate that the

total availability of tidal power may be much higher than previously assumed, and that economic and environmental costs may be brought down to competitive levels.

The world's first large-scale tidal power plant is the Rance Tidal Power Station in France, which became operational in 1966. And in Orkney, Scotland, the world's first marine energy test facility – the European Marine Energy Center (EMEC) – was established in 2003 to start the development of the wave and tidal energy industry in the UK.

The Ivanpah Solar Power Facility in California, showing its three towers delivering concentrated solar power. Credit: Wikipedia commons/Sbharris

In 2015, the world's first grid-connected wave-power station (CETO,

named after the Greek goddess of the sea) went online off the coast of Western Australia. Developed by Carnegie Wave Energy, this power station operates under water and uses undersea buoys to pump a series of seabed -anchored pumps, which in turn generates electricity.

Geothermal:

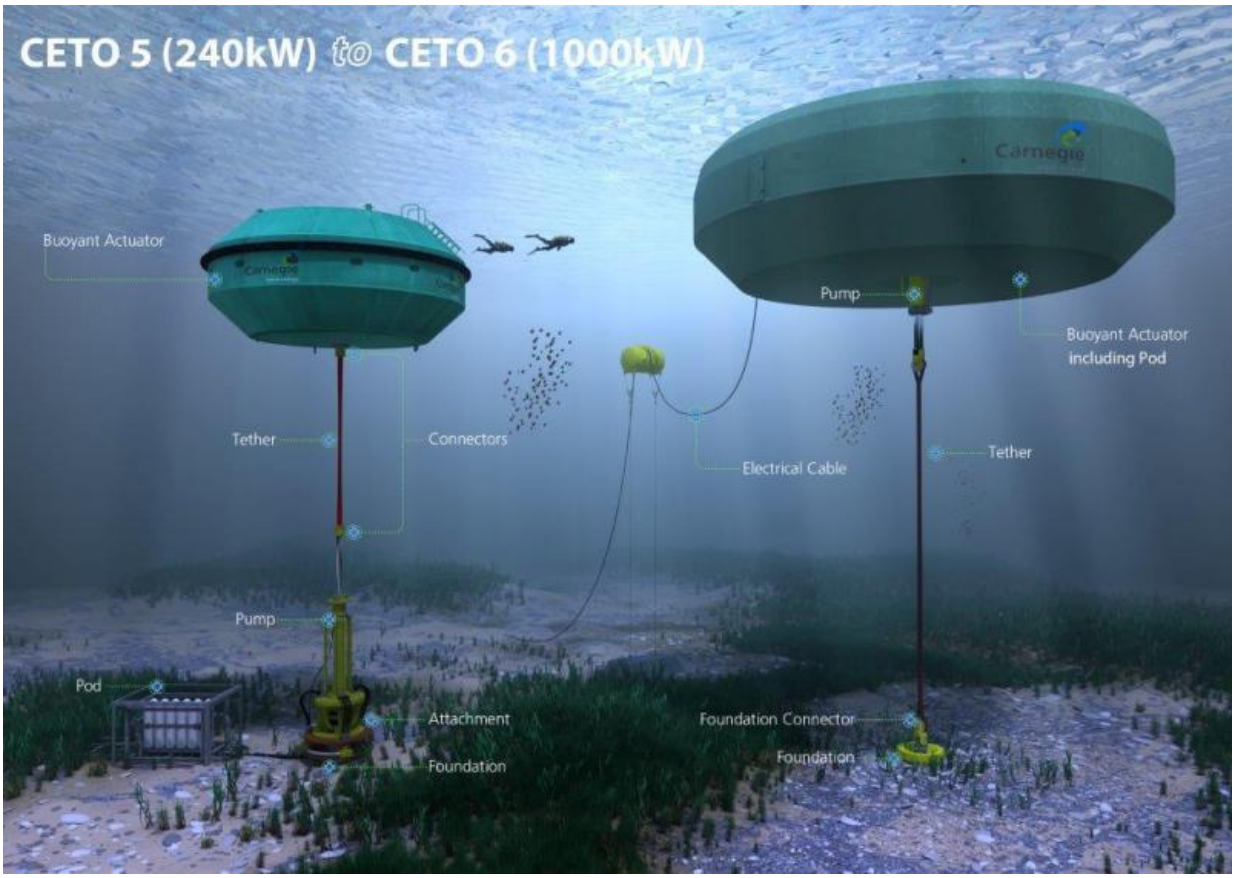
Geothermal electricity is another form of alternative energy that is considered to be sustainable and reliable. In this case, heat energy is derived from the Earth – usually from magma conduits, hot springs or hydrothermal circulation – to spin turbines or heat buildings. It is considered reliable because the Earth contains 1031 joules worth of heat energy, which naturally flows to the surface by conduction at a rate of 44.2 terawatts (TW) – more than double humanity's current energy consumption.

One drawback is the fact that this energy is diffuse, and can only be cheaply harnessed in certain locations. However, in certain areas of the world, such as Iceland, Indonesia, and other regions with high levels of geothermal activity, it is an easily accessible and cost-effective way of reducing dependence on fossil fuels and coal to generate electricity. Countries generating more than 15 percent of their electricity from geothermal sources include El Salvador, Kenya, the Philippines, Iceland and Costa Rica.

In Denmark, wind power accounts for 28% of the country's electrical production, and is now cheaper than coal power. Credit: denmark.dk

As of 2015, worldwide geothermal power capacity amounts to 12.8 gigawatts (GW), which is expected to grow to 14.5 to 17.6 GW by 2020. What's more, the Geothermal Energy Association (GEA) estimates that only 6.5 percent of total global potential has been tapped so far, while the IPCC reported geothermal power potential to be in the range of 35 GW to 2 TW.

Issues with Adoption:



Artist' concept of a series of the Carnegie Wave Energy's tidal system, where buoys anchored to the sea floor and use swells to move a series of pumps. Credit: Carnegie Wave Energy

One problem with many forms of renewable energy is that they depend on circumstances of nature – wind, water supply, and sufficient sunlight – which can impose limitations. Another issue has been the relative expense of many forms of alternate energy compared to traditional sources such as oil and natural gas. Until very recently, running coal-fired or oil-powered plants was cheaper than investing millions in the construction of large solar, wind, tidal or geothermal operations.

However, ongoing improvements made in the production of solar cells,

wind turbines, and other equipment – not to mention improvements made in the amount of energy produced – has resulted in many forms of alternative energy becoming competitive with other methods. All over the world, nations and communities are stepping up to accelerate the transition towards cleaner, more sustainable, and more self-sufficient methods.

The Krafla a geothermal power station located in Iceland. Credit: Wikipedia Commons/Ásgeir Eggertsson

Source: Universe Today

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