



Alternative Energy Technology Laboratory 2000

CES Solar Technology Station
CES Wind Technology Station
CES Fuel Cell Technology Station
CES Geothermal Technology Station
CES Control Electronics Technology Station
CES Synchronization to the Power Grid Technology Station

Why is Alternative Energy Technology important?

- Less dependence on conventional carbon-based fuels
- Saves the environment
- Reduces pollutants greenhouse gas emissions
- Saves money

CES Solar Technology Station:

With rising cause of electric lighting people are finding different alternatives for electrical current. Solar energy is one such alternative which can fulfill the domestic requirements of electricity. Following are some of the advantages of solar energy.

Compare to other forms of electricity solar energy is cheaper. Generating electricity from solar energy is actually free. You need to install solar panels only once and utilize the electricity generated for several years.

The maintenance costs of solar panels are negligible. You need to set up the system only once and it runs on itself for years. The function of solar panels is to absorb the energy from the sunlight and convert it into direct current like in batteries. This stored power can be utilized for any purpose.

If electricity is generated by fuels it produces carbon dioxide pollution as by product. Electricity generated by solar energy does not cause any such pollution. Solar energy panels are environmental friendly and produce no pollution while generating electricity.

Solar energy is renewable as sun is available daily and we do not have to pay taxes for utilizing the solar power.

Solar energy panels do not occupy lot of space for installation. When compared to wind turbines, installing solar energy panels is lot simpler and causes no disturbance.

Solar energy panels do not make any noise while working. They do their job of absorbing solar energy and converting to electricity silently. So your neighbors will have no reason to complain about you using solar energy.

For domestic purposes solar energy is an ideal source for electricity for the reasons stated above.

Solar energy panels are also safe when compared to normal electricity.

CES Wind Technology Station:

Since ancient times, people have harnessed the winds energy. Over 5,000 years ago, the ancient Egyptians used wind to sail ships on the Nile River. Later, people built windmills to grind wheat and other grains. The earliest known windmills were in Persia (Iran). These early windmills looked like large paddle wheels. Centuries later, the people of Holland improved the basic design of the windmill. They gave it propeller-type blades, still made with sails. Holland is famous for its windmills.

American colonists used windmills to grind wheat and corn, to pump water, and to cut wood at sawmills. As late as the 1920s, Americans used small windmills to generate electricity in rural areas without electric service. When power lines began to transport electricity to rural areas in the 1930s, local windmills were used less and less, though they can still be seen on some Western ranches.

The oil shortages of the 1970s changed the energy picture for the country and the world. It created an interest in alternative energy sources, paving the way for the re-entry of the windmill to generate electricity. In the early 1980s wind energy really took off in California, partly because of state policies that encouraged renewable energy sources. Support for wind development has since spread to other states, but California still produces more than twice as much wind energy as any other state.

Like old fashioned windmills, today's wind machines use blades to collect the wind's kinetic energy. Windmills work because they slow down the speed of the wind. The wind flows over the airfoil shaped blades causing lift, like the effect on airplane wings, causing them to turn. The blades are connected to a drive shaft that turns an electric generator to produce electricity.

With the new wind machines, there is still the problem of what to do when the wind isn't blowing. At those times, other types of power plants must be used to make electricity.

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CES Fuel Cell Technology Station:

A fuel cell is a device that generates electricity by a chemical reaction. Every fuel cell has two electrodes, one positive and one negative, called, respectively, the anode and cathode. The reactions that produce electricity take place at the electrodes.

Every fuel cell also has an electrolyte, which carries electrically charged particles from one electrode to the other, and a catalyst, which speeds the reactions at the electrodes.

Hydrogen is the basic fuel, but fuel cells also require oxygen. One great appeal of fuel cells is that they generate electricity with very little pollution-much of the hydrogen and oxygen used in generating electricity ultimately combine to form a harmless byproduct, namely water.

One detail of terminology: a single fuel cell generates a tiny amount of direct current (DC) electricity. In practice, many fuel cells are usually assembled into a stack. Cell or stack, the principles are the same.

CES Geothermal Technology Station:

Your own backyard has the potential to be your source of heating and cooling comfort. Now you can get safe, reliable, energy efficient heating and cooling from one piece of equipment. Geothermal energy represents the leading edge of heating and cooling technology. It moves heat energy to and from the earth to heat and cool your indoor environment. And compared to ordinary systems, geothermal technology can save you 30% to 60% on your monthly energy bills. Geothermal is the safest, cleanest, most reliable space conditioning system you can buy.

Geothermal energy is an unlimited resource. The lot surrounding a suburban home or other building contains a vast reservoir of low temperature thermal energy, typically 10 times that required over an entire heating season. This resource is constantly resupplied by the sun, the surrounding earth, and heat rejected while cooling during the summer. The universal definition of geothermal is "...pertaining to the heat of the earth." By using the earth to provide up to 50% of a building's total heating and cooling needs, GHP systems are truly geothermal energy made practical.

CES Control Electronics Technology Station:

The Electricity-Electronics technology station and the Digital System Station are easily operated self-contained stations where all components are protected against damage.

CES Synchronizing to the Power Grid Station:

A grid-tie inverter, or a (GTI) is an electrical device that allows solar power users to complement their grid power with solar power. It works by regulating the amount of voltage and current that is received from the direct current solar panels (or other D.C. energy source) and converting this into alternating current. The main difference between a standard electrical inverter and a grid-tie inverter is that the latter also ensures that the power supplied will be in phase with the grid power. This allows individuals with surplus power (wind, solar, etc) to sell the power back to the utility. This is sometimes called "spinning the meter backwards" as that is what literally happens.

Inverter for grid connected PV

On the AC side, these inverters must supply electricity in sinusoidal form, synchronized to the grid frequency, and limit feed in voltage to no higher than the grid voltage including disconnecting from the grid if the grid voltage is turned off.

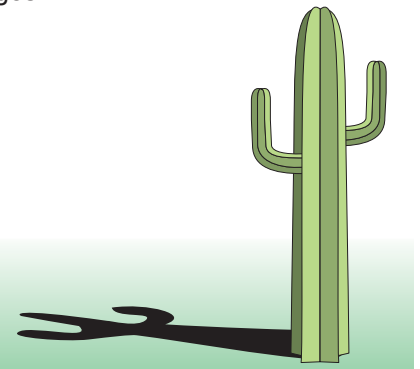
On the DC side, the power output of a module varies as a function of the voltage in a way that power generation can be optimized by varying the system voltage to find the 'maximum power point'. Most inverters therefore incorporate 'maximum power point tracking'.

The inverters are designed to connect to one or more strings.

For safety reasons a circuit breaker is provided both on the AC and DC side to enable maintenance. The AC output usually goes through an electricity meter into the public grid.

The meter must be able to run in both directions.

Installations will require, "rate of change of frequency" (ROCOF), vector shift, and a voltage monitor with disconnection of all phases to prevent power being fed back during power outages.



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