

# Electricity: How it powers our modern lives

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Electricity drives our modern lifestyle. It always surprises me how few people understand where electricity comes from and how it is generated.

There are two fundamental ways to generate electricity. One of these, photovoltaic cells, is still in its infancy. It converts sunlight directly into electricity when photons from the sun jar electrons loose in a semiconductor, such as silicon, creating an electrical current.

Efficiency of that conversion is creeping upward suggesting that someday every rooftop will become an electrical generating station. Only a tiny fraction of our electricity is currently produced by photovoltaic cells.

The primary generation method requires that a magnet be mechanically spun inside a wire coil. When this occurs, electrons in the wire are set into motion creating an electrical current.

Almost all of our electricity is generated this way. Numerous ingenious techniques for spinning magnets have been developed by a lot of clever people.

Fossil fuel and nuclear power plants boil water into steam and force the steam to turn the blades of a turbine with its attached magnet. Water flowing under a dam spins a turbine.

Geothermal plants use natural pressurized steam from within the planet to turn the blades. Wind, wave, tidal, and ocean current turbines extract natural energy to turn the magnet.

It's all electricity but which is best? Let's

look at electrical space heating. The goal is to bring air temperature up to 20°-22° C.

Using coal-fired electricity, this requires that coal be extracted from the ground, often causing immediate long term environmental destruction. It is then transported, usually by rail, to a power plant where thousands of tons of it are burned daily at up to 1500° C so that it can heat water to 375° C where it flashes to high-pressure steam.

The steam is blasted into a turbine, generating the electricity that flows across the wires to your heating unit where air is heated to 20°-22° C.

In addition to being able to watch American Idol in the warmth of our living rooms, society is left with tons of toxic coal ash, air and water pollution, a degraded landscape, and an acidifying ocean.

The countryside is shrouded with a toxic dusting of lethal chemicals, primarily

mercury, that were released with the carbon dioxide that results from burning carbon: more than 3½ tons of CO2 for every ton of carbon burned.

The world burns more than 6.1 billion metric tons of coal each year. After blowing steam through a turbine, once, at ~35% thermodynamic efficiency, most heat is released into the atmosphere through cooling towers at the power plant.

Although nuclear fuel avoids much of the water and air pollution, it leaves behind a lethal waste that needs to be closely guarded and monitored for the next million years. Few offer their backyards as storage sites. These are caveman approaches to generating electricity.

One might be led to conclude that electric heating is bad and should be banned.

Not so! Think about that cold January wind that pelted Brevard for most of

last month. That cold wind can turn a wind turbine, converting wind energy directly into electricity to heat your electric heater with only a fraction of the waste and virtually none of the environmental degradation.

Deniers scream that wind power will kill birds and bats. How many more birds and bats are killed by air pollution from coal-fired plants? or from flying into smokestacks?

The body count in wind farms is well documented because these critters fall where they get bonked. No body counts are made of air pollution-related deaths because air pollution kills anywhere that birds and bats breathe.

The death toll is probably at least an order of magnitude higher than that in the wind farms. We also know that in the southeastern United States, which has the worst regional air pollution in the country, there are more than 20,000 premature human deaths each year that are directly related to air pollution.

Naysayers and deniers claim that wind power is not economic—even though it is the fastest growing sector of our energy palette. I ask, “What the hell is so economic about heating water to 375° C so that air can be heated to 22° C?”

On top of that, who pays for the environmental cleanup? We do, through cleverly hidden subsidies to the nuclear and fossil fuel power industries, in our tax bill.

If our electric bills reflected the true cost of using nuclear or coal-fired electricity, we would be screaming at Congress to lower our taxes by developing the renewable energy field as fast as possible.

There is nothing requiring us to use up all of our fossil fuels before converting to renewable energy. No one doubts that this conversion will happen.

Fossil fuels are not renewable, except over geologic time. Thomas L. Friedman is fond of quoting a Saudi Arabian oil minister who said, “The Stone Age didn't end because we ran out of stones.”

