

Going Solar

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Since 2008, solar generating capacity in the U.S. has increased by 1200%, and the Johnson household has been one to add to these. Last spring we had solar panels installed on the roof of our house. Since then, sunny days have more meaning than before. There are 50 panels with a nominal total generating capacity of 12.5 kW. They are supposed to supply three quarters of our total electrical needs for the year.

The panels belong to the company that installed them. That means that we had no financial outlay to buy them, and we buy electricity from the panel owner as well as from our previous electrical supplier utility. Power from the panels costs us less than from the power company because there is no distribution fee associated with the solar electricity, and the rate of power cost from the panels is guaranteed for 20 years. That means that, over time, our self-generated electrical power should become comparatively cheaper and cheaper compared to that from the electric utility.

When we generate power in excess of our use, the extra power goes into the grid, and we are then assisting the power company to supply electricity to all of you. When we use more than we generate, we buy from the grid. This does not make us independent of the grid. When electrical service from the grid is interrupted, say during a severe storm, we do not continue to have electric to our house because the solar panel controls shut down the output from the panels; to keep them live would pose an electrical hazard to linemen working to restore service.

The first full month after we installed the panels, our new digital electric meter registered a net electrical use from the power company of negative 1000 kWh. The company sent a meter reader man to our house to check that it was correct. It was. So far, each succeeding summer month has added to the total electrical power deficit. We will likely make up for this shortfall in the winter, when temperatures are colder, sunlight is shorter and weaker, and electrical heating kicks in, but, for now, we are very well pleased.

There is one additional benefit to having solar panels located on the roof of our house. The panels are mounted on standoffs so that they do not rest directly on the roof. That means that they intercept solar radiant energy and cooling air can flow between the panels and the roof. This should reduce the amount of heat coming into the house through the roof. In the summer, this is a considerable benefit. Additionally, solar deterioration of roof shingles should be diminished under the panels.

All this has me thinking about alternative energy sources. They all sound so appealing, but I wonder about the consequences of using them. "There is no such thing as a free lunch", so alternative energy sources must have some downsides; all technologies do. The first consideration is possible reaction from electric power companies. If too many solar panels or wind generators are installed, and more electric power is generated in this way, then electric companies may have a difficult time providing economical base load to their customers during times when local alternative power generation cannot meet demand. Electrical power suppliers are either destined to have to make a drastic change in their means of generation, or they may

choose to try to limit the amount of alternative power that can be generated in their supply region.

Looking at the larger picture, world power consumption is about 20 TeraWatts, giving an annual energy use of about 175×10^3 TWh, increasing by more than 2% per year. Fossil fuel is burned to supply 86% this power, and this causes more than 30 billion metric tonnes of CO_2 to be added to the atmosphere each year. As we know, this causes an unsustainable condition trapping heat in the atmosphere and contributing to apparent climate changes.

It is not likely that human power consumption will decrease any time soon. So, the search is on for practical alternative power sources. Solar energy is one of these, with an estimated annual potential of 440×10^3 TWh, enough to supply twice the annual energy needs of the world if we could capture it all. What would be the downside of converting to solar? Installing panels on roofs makes dual use of the roof area, but installing panels on open land significantly reduces the possibility to use the land for other purposes, including raising food.

Wind power has been estimated as being able to produce 180×10^3 TWh annually. High altitude wind may have 16×10^6 TWh of potential. This sounds good, but extracting energy from the wind will most likely cause turbulence, and could have profound climate effects of its own.

Hydrogen is a possible energy source to replace fossil fuels. Some auto manufacturers are readying cars powered by hydrogen to sell in the years to come. Burning hydrogen has the advantage that the only product of combustion is water vapor instead of carbon dioxide. Burning hydrogen produces more than four times the amount of energy as burning an equal mass of carbon (142 MJ/kg vs. 33 MJ/kg). But wait! Commercial quantities of hydrogen must be formed through electrolysis of water, requiring additional energy use, and water vapor is a more potent greenhouse gas than is carbon dioxide, contributing 36-70% of the Earth's greenhouse warming, compared to 9-26% for carbon dioxide, so adding large quantities of water vapor to the atmosphere may make climate change even worse than it is.

There are other alternative energy sources under consideration: geothermal (1.4×10^6 TWh potential), biomass (77×10^3 TWh), hydro-generation (14×10^3 TWh), and the ocean (280 TWh). Each of these has some advantages and some disadvantages. The challenge for the future will be to harness the energy we need without compromising our ability to live sustainably on this planet. But, then again, producing systems and processes within limitations is what engineering is all about.

All this came from installing a few solar panels. We may never produce enough energy in the forms that we need it without some costs that must be overcome, but, with some ingenuity and awareness, I have no doubt that we will make significant progress. We just need the sun to keep shining on my roof.