# The Painfully Slow Emergence Of Green Energy

*By Michael Richarme*

**Green, or renewable, energy sources – biothermal, solar, wind, and others – are emerging, but too slowly to, as yet, make a noticeable impact on U.S. energy use. And therein lies a major problem facing our economy – what if green energy sources aren't ready to fill the gap when the gasoline runs out, or when the traditional electric power plants run out of fuel?**

We're not talking about rising costs for traditional energy sources. It won't simply be a matter of gasoline costs rising to $20 per gallon, or even $200 per gallon. There just won't be any gasoline available. It took nature millions of years to manufacture the petroleum from which gasoline is derived, and most Americans don't have enough patience to wait that long for another batch to brew. The same holds true for coal and natural gas, the primary fuels used in traditional electric plants.

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How did we get into this situation? Let's take a look at current energy-use patterns. According to Department of Energy statistics, gasoline is the major source of transportation fuels, with over 126 billion gallons consumed in 2001. In addition, 37.5 billion gallons of diesel fuel were consumed. This is in strong contrast to the 366 million gallons of alternative transportation fuels that were consumed during 2001, including liquefied petroleum gasses, compressed natural gas, liquefied natural gas, methanol, ethanol, and electricity. Another 4 billion gallons of oxygenates, such as methyl tertiary butyl ether and ethanol, were consumed as well, but these are typically considered replacement or additive fuels to gasoline rather than renewable alternative fuels.

Total fuel consumption has risen over the last 10 years from 134 billion gallons to 164 billion gallons, a 24% increase, while the consumption of alternative fuels has risen by 59% over the same period. Clearly, alternative fuels are making progress, but the gap is still enormous and not closing rapidly enough.

Electricity is the second major type of energy consumed. There are three major electricity grids serving the United States and Canada, although as we saw with the brownouts in California last summer, even these massive grids can fall short of demand at times. With about 1,000 power companies currently generating most of the electricity consumed in the United States

and Canada, it is anticipated that the overall generating capacity will grow about 20% in the next 10 years.

Over 51% of electricity is currently generated by coal-burning power plants, with another 20% coming from nuclear power plants and another 16% coming from natural-gas power plants. The remaining 13% is primarily hydroelectric, with a small amount of expensive petroleum-burning power plants. Green energy is currently the source of less than 3% of the total electricity generated in the United States and Canada.

So what are the alternatives, the "green energy" sources? Four main sources of green energy can be used to generate electricity: biomass, geothermal and hydroelectric, solar, and wind turbines. In addition, an exciting new technology called fuel cells, though not typically classified as green energy, has a significant potential for reducing our reliance on traditional power plants.

Biomass is feedstocks or trash. When burned or gasified (converted to combustible gasses), biomass produces energy. A trash dump is a great source of methane gas, produced by the decaying trash and giving trash dumps that unforgettable aroma. A pipe called a methane collector is inserted down into the trash to collect the methane gas for use as fuel. Another method of biomass energy production is burning feedstocks, such as the parts of the grain crops that are not harvested and used for food. The feedstocks can also be gasified, but this effort tends to require a fairly large gasifier plant.

Geothermal and hydroelectric energy uses water power, such as dams, tides, and thermal vents, to generate electricity. This source of power is geographically dependent, and may have an impact on the surrounding area. For example, damming a river may cause relocation of people upstream, and can also be detrimental to wildlife habitats. Geothermal and hydroelectric projects tend to have fairly high visibility, resulting in involvement from numerous local, state, and federal government entities, as well as environmental protection groups. Well-known examples of successful projects include Hoover Dam, which powers Las Vegas, parts of California, and parts of Arizona with its 17 main turbines, and the Lower Colorado River Authority in Texas, with six major dams on the Colorado River providing power to over one million Texans through 10 electric co-ops and 33 cities.

A third major source of green energy is solar. It is a myth that solar energy is only available to people in the far southern states; in fact, solar energy is available to about 70% of the United States. Solar has evolved from early technologies that simply heated hot water for the shower and laundry to photovoltaic technology that converts solar energy directly to electricity. Current conversion efficiency is only about 16% with cadmium-telluride (CdTe) thin film, far short of necessary efficiencies for large-scale utilization. A major research effort to increase solar conversion efficiency is under way at the Department of Energy's National Renewable Energy Laboratory (NREL) outside Boulder, Colorado.

Wind turbines are the fourth major source of green energy, and are the most promising technology from a current cost perspective. Over 90% of near-term construction in green-energy power plants involves wind turbines. Federal policy targets 5% of the total U.S. electric output to come from wind sources by 2020, up from less than 0.1% today.

The largest project under construction is at Wallula, Washington, with 396 turbines generating enough power to serve about 60,000 homes. However, the entire state of California has more than 13,000 wind turbines that produce less energy than one natural gas power plant, so there is still significant work to be done to make wind power more efficient.

Another technology that shows promise is fuel cells, though this technology is not typically classified as green energy. Many fuel-cell technologies are under development. The most promising is the proton exchange membrane (PEM), which has no moving parts and uses the physics of atomic structures to convert fuels such as natural gas directly to electricity. This technology has

much lower emissions than diesel generators, producing less than 1 part per million of nitrogen oxide (compared to over 300 parts per million for a diesel generator), and is projected at about 40% energy efficiency over the next few years.

Fuel-cell systems are already being tested that will produce 5 to 10kWh of energy, enough to provide most or all of the electricity requirements of a single-family dwelling. Units in the near future will be capable of producing 15 to 30kWh of energy, enough for larger homes or homes with teenagers. Fuel cells will look a lot like air conditioning units outside the home and will take up about as much space. Costs for these larger units will run from $15,000-30,000, but will allow a home to generate all of its own electricity, possibly even selling excess electricity back to the electric company. Fuel cells have tremendous potential in automobiles as well, providing a more effective green energy solution than liquefied gas or electric-powered cars.

Initial fuel-cell development is being funded by companies like Detroit Edison and General Electric, who are investors in Plug Power, a manufacturer of fuel cells. Other fuel-cell manufacturers include Honeywell, Ballard Power Systems, and Avista Labs.

So if green energy is so promising, what is the holdup? Why isn't it being utilized throughout the United States on a large scale? The primary reason is cost. Though billions of dollars have been invested in technology research, and the federal government spends about $400 million per year in this area, most of the technologies described above are not as cost-efficient as the traditional burning of fossil fuels and gasses. A typical homeowner, paying $0.07 per kWh for electricity, would have an average electric bill of about $116 per month. Wind turbines could provide the same electricity for about $0.09 per kWh, or a monthly electric bill of about $149. By contrast, existing solar technology would require a cost of $0.28 per kWh or a monthly bill of almost $464. Fuel cells are still being developed, but currently would run about $0.14 per kWh for a monthly equivalent bill of $232.

In studies conducted across the United States, a small core group of environmentally conscious consumers (approximately 5% to 10% of the population) is willing to pay more to support green-energy deployment. The large bulk of the U.S. population, however, is not. Cost economies for green-energy must improve dramatically before widespread acceptance of green energy is forthcoming.

The good news is that cost economies are expected to improve. The same $0.07 per kWh from traditional sources, if held constant over the next 20 years, would be competing against wind turbine costs of $0.08 per kWh and solar power at $0.14 per kWh. The cost of fuel cells, if amortized over a 20-year life span, would be the same $0.07 per kWh as traditional electricity.

That places the incremental cost of green energy well within range of most consumers.

Electric companies are taking note of these trends. Austin Energy and Seattle City Light are two municipally-run electric companies that are among the most aggressive in their efforts to deploy green energy generation and to educate their consumer base. Austin Energy is a major participant in West Texas wind farms, solar-power deployment, and hydroelectric utilization. Seattle City

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Light has a large consumer support staff that helps its customers reduce electricity consumption through energy consumption awareness and appliance efficiency. As mentioned earlier, Detroit Edison is one of the major investors in fuel-cell research, continuing a pattern of electric generation companies attempting to reduce its generation costs. As long as this economic incentive continues, spurred by deregulation activities, investigation of green energy sources and further innovation will also continue.

Retail electricity deregulation has also brought new entrants into the market. Green Mountain Energy is generating energy through wind turbines and other renewable sources, and is marketing itself as an environmentally friendly alternative source of residential electricity. Though its prices are not as low as other traditional competitors, it is receiving a lot of interest in states where its service is offered.

The bad news is that all of this activity in the green-energy arena is painfully slow. At the rate it is progressing, it will be the next century before significant increases are made in the percentage of energy produced by green-energy sources. It is unlikely that the petroleum remaining in the ground is adequate to sustain the U.S. economy for that length of time, and even natural gas supplies are expected to be measurably depleted in the same time frame. It's almost like saving for your child's college education at the rate of a dollar per day, then wondering after 18 years why you only have $6,500 in the bank. It may seem like a lot when you are doing it, but the final results fall far short of what is needed.

**The need for green-energy sources is extremely critical, yet it is a problem that is quiet, unobtrusive, and thus not the recipient of widespread media attention. It is also the type of problem that takes a long time to develop, and solutions to the problem will take a long time to implement. We need to develop a sense of urgency about the emergence of green-energy sources, and take appropriate, coordinated action to develop and deploy these sources. Green energy needs to be a national priority before it becomes a national emergency.**

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