TRENDS AND OBSERVATIONS

Powering our future

BY RAUNO PERTTU

A friend called to tell me about companies that are turning discarded plastic drink bottles into synthetic fleece. Most plastic is made from petroleum and she had learned the amount of plastic used in the conversion of recycled bottles into clothing is equal to about 500,000 barrels of oil per year. At first glance, that sounded like a substantial number.

First, that large-sounding number of 500,000 barrels of oil needs to be put into its own perspective. The half million barrels of oil for plastic fleece is less than 0.0017 percent, or one 60,000th of the total world consumption, which is about 30 billion barrels per year. The US consumes about a quarter of the world's oil, or somewhat more than 7.5 billion barrels per year.

After review, I expanded the question of energy conservation to all of the world's plastic drink bottle production. I then added all those plastic bags used around the world. The total oil consumption numbers for all that plastic got much higher. According to an article in businessshrink.biz entitled "America's dirty little oil secret: Plastic Bottles and Bags", the total world consumption of oil to make plastic bottles and bags is between 147.4 and 207.4 million barrels per year. As huge as those numbers sound, the new much larger number is still only about a hundred fiftieth (less than two days) of the world's annual oil production. For an even larger perspective, according to Simon Usborne's May 15, 2007 article "Grow your own plastic" on the online BNET business network, about four percent of petroleum is converted into plastic. Another four percent is consumed in the manufacture of plastic, so about eight percent of world petroleum production is used in the manufacture of plastics.

Sadly, because the total energy consumed in gathering, cleaning and recycling this plastic is significant, it may be that recycling this plastic doesn't actually result in any significant energy savings. To me, this means that the more important reason for restricting the use of plastic bottles and bags and for recycling them is that they are a major bulk problem in landfills and create numerous aesthetic and environmental problems when thrown away.

In summary, while the ongoing efforts of many groups to reduce the use of plastic bottles and bags are important from many environmental aspects, these efforts won't significantly alter the world's energy consumption. In some ways, focusing on these types of issues as ways to save energy can actually distract us from addressing potentially more important issues impacting our future energy consumption.

To clarify, we need to look at a breakdown of U.S. primary energy consumption by source and sector, which was compiled by the Department of Energy's (DOE) Energy Information Administration in its Annual Energy Review 2007. The DOE lumps energy sources into five categories: petroleum (39.8%), natural gas (23.6%), coal (22.8%), renewable energy (6.8%), and nuclear electric power (8.4%). It sorts energy consumption into four sectors: transportation (29.0%), industrial (21.4%), residential and commercial (10.6%), and energy used for the production of electric power (40.6%).

The review reveals some important numbers. The largest source of energy, petroleum, provides almost all (96%) of our transportation energy—mostly gas and diesel for our cars and trucks. Petroleum also provides almost half (44%) of the energy used by industry. The other large source of industrial energy is natural gas (37%). Natural gas also provides 75 percent of our primary residential and commercial energy because electricity is not considered a primary energy resource. While coal accounts for only 22.8 percent of our energy consumption, it is the source of 51 percent of our electric power generation. Virtually all of our use of nuclear power is for electric power, wherein it accounts for 21 percent of our electricity. Fossil fuels and nuclear power together account for 95 percent of our electric power. Renewable energy accounts for only nine percent of our energy consumption in the four sections. The DOE's list of renewable energy includes hydropower, geothermal, wind, solar thermal and photovoltaic, wood and wood derived fuels, geothermal, and "Other Biomass."

Hydropower, at 6.4 percent of electric production, is the largest source of renewable power. Biomass, which includes wood-derived fuels, waste, and biofuels, provides 2.5 percent of our energy needs. Burning of wood products accounts for slightly more than a third of power generation within the biomass category. As of 2007, wind provided 0.32 percent of our energy needs and solar provided 0.08 percent. Last year, the DOE estimates the U.S. figure for wind power jumped to more than one percent, and could climb to as high as 20 percent of our power supply by 2030. I remember similar lofty growth forecasts for geothermal power many years ago. While the optimistic geothermal forecasts never materialized, some European countries are actually deriving up to several percent of their power from wind turbines today.

These numbers are not static, nor are they a statement of future desired energy sources or of priorities. They merely reflect the realities of a starting point to the often repeated goal heard from politicians of "energy independence". These numbers clearly state that we can't just stop using fossil fuels and ignore nuclear power in our future power needs without an abrupt collapse of modern society. Until we have truly electric cars, wind and solar power can't replace gasoline and diesel fuels in transportation, and therefore won't reduce our dependence on petroleum.

It's easy to say, "Let's replace our old energy sources with renewable sources", but actually accomplishing that task won't be nearly as easy as saying it. Any major shift to renewable energy will be very expensive and complex, and will take time. In today's economy, the front-end capital requirements and almost certain rise in energy costs that will accompany the shift to renewable energy have increased importance.

A substantial replacement of fossil fuels by renewable energy may ease existing problems, but will also create a whole new set of problems. I will touch on only a few.

Wind power is expensive and is currently economically dependent on government subsidies. At the point wind power becomes a significant contributor to our electric needs, wind turbines and their associated infrastructure and power collection systems will be a very visible part of our landscape. They will also create their own environmental impact challenges. Because wind is fickle, our need to have a dependable power supply will mean that we will need some sort of method to store power from times when the wind blows to when it doesn't or we will need backup generators.

Although new wind turbine designs are trying to address the problem, the experience of many countries has been that wind power is actually available (meaning enough wind blows) less than 20 percent of the time. New turbine designs to account for lower wind velocities can only partly improve the situation because low wind velocities have less available energy. Because wind power can't be counted on when needed, conventional power plants are typically kept running as backups at nearly the same levels as if the wind power didn't exist. Wind power therefore currently doesn't have the desired effect of replacing conventional power plants. Other hurdles, including major and expensive necessary modifications to the nation's power grid to accommodate wind generators, are too lengthy to discuss herein. In summary, it will not be fast and easy, nor will it be inexpensive to make wind power a major player in electric generation.

On smaller scales and for heating purposes, solar energy has a sunny future. However, large-scale solar power faces problems similar to those that challenge making wind power a major contributor to our energy needs.

Utilizing biomass to create energy for our needs is an indirect way of using solar energy. Plants convert sunlight and soil nutrients into biomass which can then be used as burnable fuel. Biomass is a less efficient energy source than coal or oil, but it is replaceable and doesn't result in nearly the same carbon dioxide generation as fossil fuels because it recycles the carbon from living plants over a short time span. Unlike wind and solar power generation, biomass can be used as base load power because it doesn't depend on weather or daylight.

However, biomass opponents already question the sources and potential pollution aspects of biofuels. They worry about the damage to soils and to the environment from growing crops for biomass fuels and are concerned about the water and fertilizers needed to make the plants grow. Perhaps a greater hurdle can be the lack of available large tracts of land needed to grow large quantities of biofuels. Other potential biofuels sources, such as algae, could bypass this problem. Further, the economics of growing, transporting and utilizing biomass as a significant fuel for power generation can be challenging. Despite these obstacles, power generation from biomass will continue to grow in importance in the future.

In getting back to the problem behind the solutions, it is clear that there will be no practical short-term fix to our energy dilemma. Most of the easy solutions that we hear offered will make only minor differences in the overall problem. This doesn't mean that they are not worthwhile to enact, especially because many, such as reduction in the use of plastic bottles and bags, improve our environment in other ways.

However, any serious changes to our pattern of energy consumption will involve large expenditures, higher energy costs and improved technologies. To be successful, the long-term goal of a major contribution from renewable energy will also need a clear plan of our goals and how we intend to accomplish them.

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