The Impact of Renewable Wind and Solar Energy Services on US Oil Imports and Transport Systems

James Powell and Gordon Danby
February 17, 2010

Renewable wind and solar power sources hold promise as a way to reduce dependence on fossil fueled power generation, eliminating the contribution to global warming from their greenhouse gas emissions. However, because virtually all fossil fueled power generation comes from coal and natural gas fuels, electric generation from wind and solar will have very little impact on US consumption of oil, and our need for oil imports.

Oil is only a minor contributor to electric energy generation in America. 70% of US oil consumption goes for our autos, trucks and airplanes. Electric energy from wind and solar can only displace oil from the Mideast if there is a massive shift away from oil fueled transport to electrically powered transport. So far, the US is pinning its hopes on electric autos and high speed trains. Both have major limitations. Electric autos have short driving distances. The Chevy Volt driving distance is only 40 miles with a 400 pound battery pack, and it takes 8 hours to charge. For longer distance trips, or if a charging site is not available, the Volt switches to a small internal combustion engine. While some reductions in transport oil consumption will be possible using the Volt, it is doubtful that it will have a major impact.

The picture is even bleaker for steel wheel High Speed Rail (HSR) trains. They can only carry passengers, are very expensive to ride, and must be heavily subsidized. As an example, consider the Long Island Railroad. The LIRR is a commuter rail system, and much cheaper to construct and operate than HSR. Yet, its riders pay about 30 cents per passenger mile, with an actual cost of 90 cents per passenger mile, 3 times greater than the fare cost. European HSR passengers pay 50 cents per passenger mile, and their systems are all subsidized. Today, per capita, Americans drive 10,000 miles per year, fly 2000 miles, and travel 30 miles on Amtrak. Even if HSR traffic were to increase 10 fold over Amtrak, it would still be just a drop in the bucket for US transport needs.

US oil fueled transport systems will soon face a crisis of even scarcer and more expensive oil. Not the longer term "Peak Oil Crisis", which has caused much concern, and which will happen, but the much nearer term "Oil Competition Crisis", which has not yet been recognized. Today, the per capita American consumption is 25 barrels of oil per year, corresponding to a total annual consumption of 25% of the World's total oil production. The average per capita consumption for the other 6.3 Billion people in the World is only 3.75 barrels per year. If it increases from 3.75 to 4.5 barrels per person per year, only a slight increase of 20%, there would be no oil for the US. We soon will face a situation where more solvent countries will outbid us for oil, decreasing the US amount and severely hurting our economy which depends critically on cheap oil for our transport.

World oil production has plateaued at about 85 to 90 million barrels per day. It will not go up appreciably, because we consume much more oil than we discover – 10 barrels consumed for every 4 barrels discovered. What will rise rapidly and steeply is the demand for oil from countries like China and India as they rapidly industrialize. China now buys more cars per year than the US and its highway traffic is increasing 15% annually.

The oil situation brings up a major moral issue if the World continues to rely on oil fueled transport. To bring up living standards in poorer countries, they will need to consume more oil for transport. This will reduce America's transport oil consumption, lowering our living standards. GDP correlates with oil consumption; the higher the GDP per capita, the more oil consumed per capita.

The World could increase oil production by converting coal to oil and processing tar sands and oil shale to synfuels, but at a terrible environmental price, due to the additional carbon dioxide generated in the synfuel process. Today, the US alone releases over 2 billion tons of carbon dioxide per year from the tailpipes of our autos, trucks, and airplanes. This is almost 10% of world total carbon dioxide emissions. Going to synfuels would double US CO_2 transport emissions to 20% of today's World total. As the rest of the World converted to synfuels and increased their transport CO_2 emissions, within 20 years, total World transport emissions would reach today's 25 billion tons of CO_2 from all sources – industry, power plants, home heating, and transport – with no hope of ever reducing them by 80%, the current World goal. There is no way that one can capture CO_2 from transport vehicles and sequester it.

Competition for the plateaued World oil production will rapidly drive up the price of oil, and rapidly drive down America's share. Today, the high unemployment in the US is wrecking peoples' lives, their living standards, and their hopes for a better future. As oil prices escalate, unemployment will further increase, it will cost much more to get to work, and the price of goods will climb, due to much higher transport cost.

Unless we can meet this oncoming challenge to our oil fueled transport systems, the US economy and its citizens face a very bleak future.

In our view, and the view of our colleagues working on Maglev transport, we must find a better, cheaper, faster, non-oil way to move people and goods in America. We believe that our advanced 2nd generation Maglev-2000 system is that way, because it does not burn oil, is very energy efficient, and can carry passengers, highway trucks, and personal autos with their passengers at much higher speeds and much lower cost than by highway. Between cities, the Maglev vehicles can travel at 300 mph on elevated guideways alongside the Interstate Highways. Inside a metropolitan area, the Maglev-2000 vehicles would transition to levitated travel above existing RR tracks in urban and suburban areas. The existing RR trackage can be adapted for Maglev use by laying down thin panels of aluminum loops on the cross-ties. The cost of adaptation is very low, only 4 million dollars per 2-way mile (1/10th the cost of High Speed Rail), there is no disruption of existing infrastructure, and conventional trains can still use the RR tracks with appropriate scheduling.

Our colleagues find it very hard to understand why the US resists implementing Maglev. Japan has built their 1st generation passenger Maglev system based on our original inventions. It is very successful, but too expensive and revenue limited for implementation in the US. Our new 2nd generation Maglev-2000 system reflects significant engineering improvements on the 1st generation system, and is much cheaper and more capable. Once demonstrated and certified at a government facility, it can be privately financed, and will not need government financing and subsidies for construction and operations.

Yet with all its advantages, development of an American Maglev system is fiercely resisted by the government and private industry. One can only conclude that the same forces are at work that killed Senator Moynihan's Maglev Initiative 20 years ago. We were their co-chairmen of his Maglev Task Force that put together reports detailing the advantages of Maglev for the US. Senator Moynihan was a strong champion for Maglev and succeeded in having the Senate pass a 750 million dollar R&D program in 1990 for development of a US Maglev system. If it had passed the House of Representatives, the US, today, would now have a 25,000 mile long National Maglev Network to transport passengers,, highway trucks, personal autos, and freight at high speed, with high energy efficiency and very low cost. Our oil import problem would be much less, and it would have created millions of steady, well paid American jobs with Billions of dollars in exports.

Sadly, Senator Moynihan's bill died in the House when the Chairman of the Transportation Subcommittee, from Detroit, refused to hold hearings on the Bill. Over the past 20 years we have continued to experience strong resistance to developing a U.S. Maglev System from a variety of industries, administrations, and members of Congress.

Unless the US acts soon, 2nd generation Maglev-2000 will probably be developed in another country like China or India, and we will end up buying it from abroad. One container ship, sailing into a US port, can carry 20 miles of prefabricated Maglev-2000 guideway beams, ready to be trucked to a construction site, there to be quickly and cheaply erected on pre-poured concrete footings by conventional cranes. The number of US workers needed to erect the guideway will be very small.

Maglev will also be important as a way to economically store electric energy from renewable wind and solar power sources. The February 13th Phys.org web site has a report on Norway's plans to build the World's largest and most powerful wind turbine. The off-shore unit will generate 10 megawatts (e) and be 533 feet tall. It will cost 400 million Kroner (67 million dollars), corresponding to a unit cost of $6700 per kilowatt. Since the wind blows only about 30% of the time, the average capacity will be only 3 Megawatts, for a real installed cost of about $20,000 per Kilowatt, on a continuous basis. New nuclear plants run about $7,000 per Kilowatt, and coal-fired plants about $2000 to $3000 per Kilowatt. Moreover, the power output from wind turbines does not always match demand – e.g., if the wind is blowing at night, when demand is low, some form of inexpensive energy storage will be required to match output to demand.

It is not yet clear that the cost of wind power can be made low enough to displace coal and nuclear plants on a large scale. The cost of energy storage will play a major role in determining the economic practicality of wind and solar power. To help make wind power more economic, we have investigated the possibility of Maglev providing a very low cost way – about 2 cents per KWH – of storing large amounts of electrical energy with very high electrical output/input efficiency, about 95% [pumped Hydro returns only 60% of its input energy back to the grid.]. It does this by efficiently moving heavy concrete blocks by Maglev between a lower and higher elevation, much as pumped hydro does with water and turbines & pumps.

Dr. James Powell and fellow scientist, Dr. Gordon Danby are the holders of the first patent for superconducting Maglev awarded in 1968, as well as many recent patents on their 2nd generation advanced maglev system. Powell and Danby are the recipients of the 2000 Benjamin Franklin Medal in Engineering for their invention of superconducting Maglev.