Vaclav Smil's “Energy Myths and Realities” - A review

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Vaclav Smil, professor of Environment and Environmental Geography at the University of Manitoba in Winnipeg, has written a new book called “Energy Myths and Realities.” In the book, he looks at a number of things he considers myths:

1. The future belongs to electric cars
2. Nuclear electricity will be too cheap too meter
3. Soft-energy illusions (local generation, etc.)
4. Running out: Peak oil and its meaning
5. Sequestration of carbon dioxide
6. Liquid fuels from plants
7. Electricity from wind
8. The pace of energy transitions

Smil is well-respected in the world of energy, so I think it is also worthwhile looking at what he has to say. I think that it is even worthwhile looking at what he has to say about peak oil, because it may give us some insights as to where our thinking needs to be refined, or better explained, if it is to be understood by the “mainstream”.

I might note that Smil is not entirely in disagreement with peak oil. He says,

It is fairly probable that its [conventional crude oil’s] extraction will peak within the next two decades, and it is inevitable that its share of the world’s primary energy supply will continue to decline.

A major point he makes in the peak oil section is that he is not convinced that peak oil will have a terrible impact, even if the decline does occur in the near future—something that quite a number of Oil Drum readers would agree with.

Let’s look at a few things Vaclav Smil has to say:

Electric Cars

Smil points out that electric cars have been around a long time and are still expensive compared to internal combustion cars. But his major concern seems to be that the amount of additional electricity required would be more than could reasonably be added within a short time frame. And, given the limitations of renewables, there would probably need to be a big ramp-up in fossil fuel use, to accommodate the additional cars.

According to Smil:

An electric car whose size would correspond to today's typical American vehicle (a composite of passenger cars, SUVs, vans, and light trucks) would translate to 3 MWh of electricity consumption.

In 2010, the United States had about 245 million passenger cars, SUVs, vans, and light trucks; hence, an all-electric fleet would call for a theoretical minimum of 750 TWh/year. . . The charging and recharging cycle of Li-ion batteries is about 85% efficient, and about 10% must be subtracted for self-discharge losses; consequently, the actual need to be close to 4 MWh/car, or about 980 TWh of electricity per year. This is a very conservative calculation, as the overall demand of a midsize electric vehicle would be more likely around 300 Wh/km or 6MW/year.

But even this conservative total would be equivalent to 25% of US electricity generation in 2008, and the country's utilities needed fifteen years (1993-2008) to add this amount of new production. As this power for electric cars would have to come on top of the demand growth by households, services, and industries, it would be exceedingly optimistic to expect such an increment could be in place in less than twenty years.

He later goes to explain how much fuel would be needed for all this.

The average source-to-outlet efficiency of U. S. electricity generation is about 40 percent, and adding 10 percent for internal power plant consumption and transmission losses, this means that 11 MWh (nearly 40 GJ) of primary energy would be needed to generate electricity for a car with an average annual consumption of about 4 MWh.

This would translate to 2 MJ for every kilometer of travel, a performance equivalent to about 38 mpg (9.25L/100 km)—a rate much lower than that offered by scores of new pure gasoline-engine car models, and inferior to advanced hybrid designs or to DiesOtto designs. . .

He explains that there would be no CO2 savings in all of this, unless renewable sources were used for all of the additional energy required. He also notes that a European report by the European Federation for Transport and Environment called How to Avoid an Electric Shock offers analogical conclusions. A complete change to electric cars in the EU would increase European electricity consumption by 15%, and would not lower CO2.

Wind Power

Smil's conclusion regarding wind is

Conversion of wind's kinetic energy by large turbines by large turbines can become an important contributor to the overall electricity supply, but, except for relatively small regions, it cannot become the single largest source, even less so the dominant mode of generation.

One of the limits he sees on wind power is the quantity of roads needed to service all of the wind power sites. He says:

But even when assuming a large average turbine size of 2—3 MW, the access roads (which are required to carry heavy loads, as the total weight of foundations, tower, and turbine is more than 300 tons per unit) needed to build roughly 2 million turbines and new transmission lines to conduct their electricity would make a vastly larger land claim than the footprint of the towers; and a considerable energy demand would be created by keeping these roads, often in steep terrain, protected against erosion and open during inclement weather for servicing access.

He also sees **wind intermittency** as a limiting factor. He says that many studies have shown that these variations do not cause any unmanageable problems as long as the total power installed in wind turbines is no more than about 10% of the system's overall output.

He quotes P. A. Ostergaard, in the 2008 *Energy* article "Geographic Aggregation and Wind Power Output Variance in Denmark," saying:

Drawing on the Danish experience, he finds, predictably, that demand and wind variations in different areas help even out fluctuations and reduce imbalances in systems with high reliance on wind power, and that exploiting these variations allows for reductions in reserve capacity in other modes of electricity generation. But, no less predictably, he also finds limits to what can be done: The average requirement for the reserve thermal capacity may drop, "but the same is not generally the case with the maximum required condensing mode capacity. . . . There will simply be times with wind production in neither of the interconnected areas."

He is also concerned about the high installation rates that would be required to reach high penetrations, and the fact that at this point we cannot be certain of average life spans of wind turbines and of their need for maintenance and replacement requirements, particularly in harsh and offshore environments.

Peak Oil and Its Meaning

In the chapter "Running Out: Peak Oil and Its Meaning", Smil starts by looking at individual peak oil predictions that turned out not to be exactly correct. He argues that contrary to the assumptions of Richard Duncan in his Olduvai Gorge theory, average per capita energy consumption did not peak in 1978. Instead, based on BP data for all types of energy and UN population figures, world per capita energy consumption was 10% higher in 2008 than in 1978. He also says,

but even a lower rate would not signify anything catastrophic; because of steadily falling energy intensity—the energy consumption per unit of economic product—of the global economy, it could be a sign of progress for the world to use less energy.

It would seem to me that this is one area where there is considerable additional work that needs to be done. Is oil a limiting factor on all other forms of energy use, or will efficiency and other changes lead to higher GDP relative to energy use? There is probably room for a range of views on this subject.

Smil also points out that the predictions of M. King Hubbert, Andrew Flower, Collin Campbell, Kenneth Deffeyes and others were not exactly right, partly because the estimates of ultimately recoverable oil were not correct and partly because the deterministic approaches being used were too simple. Smil says:

The fundamental problem with the notion of predicting a peak for oil extraction is that it rests on three simple assumptions—that recoverable oil resources are known with a high level of confidence, that they are fixed, and that their recovery is subsumed by a symmetrical production curve—which happen not to be true. These three claims mix incontestable facts and sensible arguments with indefensible assumptions, and they caricature complex processes and ignore realities that do not fit preconceived conclusions. There is, obviously, a finite amount of liquid oil in the earth's crust, but estimates of this grand total remain uncertain.

He mentions Adam Brandt's 2007 article "Testing Hubbert" from *Energy Policy*. Smil says regarding Brandt's article, "the symmetrical model of oil extraction is just one of many possibilities, and we now have a rigorous quantitative proof that it is not either a dominant or a modal choice."

He also mentions R. Nehring's conclusion,

The task facing us now is not to continue to use an obsolete and irrelevant method [that is, Hubbert's model] but to develop further understanding of recovery growth.

Smil also has sections on untapped resources and non-conventional oil reserves.

The point of all of Smil's analysis is that the amount of oil available could very well be considerably more than what an analysis simply using a Hubbert curve would project. But I think an equally valid argument could be made in the other direction—the amount of oil that can actually be extracted may prove to be considerably less than what a Hubbert curve would project.

It seems to me that Hubbert curves are valuable as giving a first-order approximation to what may happen in the future. In that regard, Hubbert curves have been helpful in saying that the peak in conventional oil production is about now. Smil mostly agrees with this—he says that there is a high probability that conventional oil production will peak in the next 10 to 20 years.

But it seems to me that Smil is correct in saying that Hubbert curves really don't tell us precisely what lies ahead. Smil lays out the favorable scenario, where untapped resources, nonconventional oil reserves, and higher percentages of oil recovery act to increase the total amount of oil available to society. But Smil never looks at what the real limiting factor is. It seems to me that this limiting factor is declining energy return from the oil that is extracted, and the impact that this has on the world economy and the ability to do reinvestment. After a certain point, net energy obtained is so low that it is not possible to justify the ever-higher energy investment required to maintain production.

If net energy is the limiting factor, one would also expect that Hubbert curves are, as Smil says, not very helpful in predicting what is likely to happen in the future. In the case of net energy being the limiting factor, the result could well be that the downslope is more severe than a Hubbert curve would suggest.

Perhaps we do need to back away from Hubbert curve as a primary way of estimating what will happen in the future. While that approach was valuable as a rough approximation in the past, now that we are approaching the down slope, maybe we need to be looking at other approaches, to give a more refined understanding of what limits we are really up against, and how these can be expected to affect the entire process. More refined approaches are also likely to give us more credibility with the non-peak oil community, who see Hubbert curves as discredited, and see analyses of demand as important as analyses of supply.

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