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Beyond Peak Oil?

New Technologies to Sustain Transport Futures

Gioietta Kuo
Senior Fellow, American Center for International Policy Studies
Washington DC

In a recent interview, Dr. Fatih Birol, the chief economist at the International Energy Agency (IEA) in Paris, stated that the world is heading for a catastrophic energy crunch – an extreme shortage of supplies that can cripple a global economic recovery because most of the major oil fields in the world have passed their peak production.[i]

What is peak oil? This is the point when the maximum rate at which oil is extracted reaches a peak because of technical and geological constraints with global production going into decline from then on. Many governments have believed that peak oil will not occur until well into the 21st century, at least not until after 2030. But the shocking news today is that IEA believes we are heading for a much earlier oil shortage already beginning after 2010 because the demand is likely to exceed dwindling supplies. In fact the global production is likely to peak in 10 years, at least a decade earlier than most governments have estimated.

In a first detailed assessment of more than 800 oil fields in the world covering 3/4 of the global reserves, it has been found that most of the biggest oil fields have already peaked and that the rate of decline in oil production is now running at nearly twice the pace as calculated just two years ago.[ii] Because of chronic under-investment by oil producing countries, it is likely to result in an oil crunch within the next five years, which will jeopardize any hope of a strong recovery from the present global recession.

Just to illustrate how far demand is running ahead of supplies – even if demand remains steady, the world would have to find the equivalent of four Saudi Arabias to maintain supply and six Saudi Arabias to keep up with the expected increase in demand between now and 2030.[iii] This is a big challenge in terms of geology, investment, and geopolitics. In fact, IEA has concluded that the global energy system is at crossroads and that consumption of oil is “patently unsustainable.”

It is certain that the market power of the few oil producing countries will rise when the demand picks up because not enough is being done to build up new supplies of oil to compensate for the rapid decline in existing fields. This means we shall soon see a sharp rise in oil prices, as many experts in the oil field have predicted.

ALTERNATIVES TO PEAK OIL

So what is going to happen? There are no good solutions. Some are looking to the tar sands of Alberta Canada to extract oil. This is a dirty method needing a lot of electricity, water, and capital investment. In addition, it is devastating for the environment.

At present, the global transport sector accounts for approximately 24% of the total global CO_2 emission.[iv] As oil is peaking, some believe that the new generation of motor cars, including the electric car and the hybrid car – both presently on the market – may be the solution for the coming oil crunch. To some extent the new cars will reduce the demand for gasoline, but it is certainly not the complete solution.

Electric Car

As urbanization continues, the electric car is suitable for city travel where distances are short. This is powered by a heavy lithium ion battery and an electric motor. The advantage of an electric car is that it does not emit CO_2 at the tailpipe; hence does not pollute. To this extent, it is environmentally friendly. Another advantage is that it is more silent than a gasoline-powered car. An electric car has a range of about 100 miles, after which the battery has to be charged by plugging into a power outlet, which needs to be available and on 24 hours per day.

One must not forget, however, that the power of the electric car comes from the grid and that grid has to have a baseload even if renewable sources of energy feed into the grid. It is therefore still necessary that electricity be on 24 hours a day. Unless one phases out fossil fuel as the baseload and replaces it with nuclear power, the electric car is not totally environmentally friendly as some would let you believe.

Hybrid Car

The hybrid car combines parts of the electric car and gasoline car in an attempt to get the best of both.

A gasoline engine provides 100-200 Hp in order to handle acceleration. However, the hybrid uses the electric motor for acceleration, so the gasoline engine can be very small, perhaps 10-20 HP. The gasoline engine is useful for cruising, and for maximum efficiency, it is designed for only one speed.

When the car is in the city and needs acceleration, it uses the electric motor, and when it is cruising at constant speed, it uses the gasoline motor. When the car is decelerating or standing still, the batteries recharge because the motor is running. This sort of hybrid car is essentially an electric car with a built-in recharger for longer range.

Better mileage results from the more efficient 10 HP engine. Exactly how much saving in gasoline depends on how much the car is run in the city or in the open country. However, although the propulsion system is more efficient, it still depends on gasoline.

Then there is the possibility of second generation biofuel, using cellulosic plant materials to produce liquid fuel.

Biofuel

New technologies already exist in the form of ethanol from corn, but more exciting is the development of grassoline from cellulosic materials, which are plentiful and cheap.

It is true that most technologies are market driven, which in turn is determined by demand. However, there are pitfalls in rushing headlong into production with a certain technology without some cool headed long term analysis of the viability and basic contradictions that might exist in the route taken by the market. For example, the market may change or new technology may become available, so that the production just initiated becomes short lived, resulting in the inability to recover the capital put into the production.

A good example of just this phenomenon is the rush into first generation biofuel over the last several years, specifically, the world's rush into production of ethanol from corn and soya beans in the US and sugarcane in Brazil. The good intentions notwithstanding, there were unforeseen consequences. Given the sharp rise in oil prices, producing ethanol offered the prospect of a cheaper transport fuel. In the US, another driver was the Bush Administration's wish to be independent of foreign oil; thus farmers were given huge government subsidies to produce ethanol from corn. Presently there are 180 refineries processing corn into ethanol, consuming around 30 % of corn production in the US.[v] However, even if all the corn produced by US were processed into ethanol, it would satisfy only 20% of US transport needs.[vi]

Furthermore, the processing of foodstuffs – corn and soybeans in the US and sugarcane in Brazil – into ethanol for transport thus tied the world's energy market to the food market. As a consequence, grain prices on the world market shot up three times between mid-2006 and mid-2008, causing hardship and hunger for the poor people in countries that import US corn, including Mexico, China, India, and parts of Africa.[vii] It may be laudable that Brazil has become independent of foreign oil by using sugar-produced ethanol. However it has come about at the expense of cutting down Amazon forests to produce arable land to grow sugarcane, with consequences to the environment.

With the insatiable demand for food ever increasing as the world's population soars, the long-term sustainability of this model – energy from food – is difficult to envision. A second generation cellulosic biofuel consists of liquid fuel made from dozens of sources – the inedible parts of plants, for example, agricultural leftovers like wood, sawdust, corn stalk, and wheat straw. Then there are specially grown 'energy crops' – fast growing grasses like switchgrass – from which oil can be derived. In other words, "grassoline."

The advantages of this second generation biofuel are that the feed stocks are cheap (about $10 -$40 per barrel of oil energy equivalent), abundant, and independent of foreign sources. In addition, they do not interfere with food production. Most of these cellulosic materials can be salvaged from plant wastes. Energy crops can be grown on marginal lands that would not otherwise be used as farmland.

Annually 1.3 billion dry tons of cellulosic biomass can be harvested in the US without interfering with the food chain. Globally, there is enough cellulosic biomass with an energy content equivalent to between 34 to 160 billion barrels of oil a year, exceeding the world's annual consumption of 30 billion barrels of oil.[viii]

Now for the difficult part. While fermenting corn kernels is relatively easy, breaking down tough stalks of cellulose is more difficult. Nature has made cellulose the backbone of plants to support their vertical growth. It is rigid and very difficult to decompose. Cellulose is made up of thousands of glucose molecules strung together. To release the chemical energy inside these sugars, one must untangle the molecular knot that makes the cellulose beams.

Scientists are developing the technology to break down the interlocking molecules. Basically they consist of deconstructing the solid biomass into smaller molecules by heat, acids, or bases, in a way that will most likely be commercially competitive with petroleum.

One method, ammonia fiber expansion (AFEX), cooks cellulose at 100 degrees C with concentrated ammonia under pressure. Enzymes then convert the cellulose into sugar, which then turns to ethanol. AFEX has the potential to be very cheap – approximately $1 per gallon of equivalent gasoline energy content, which could mat it available for $2 per gallon at the pump.

OUTLOOK

Technology is progressing at a furious pace. A stimulus bill from US government signed this year provides $800 million funding for the biomass program as well as $6 billion loan guarantees for ‘leading edge biofuel projects.’ So a number of demonstration plants are already on line, and the first commercial bio-refinery projects will commence construction by Oct 2011. Even then, the technology will take 5 to 15 years to be on the market.

Gioietta Kuo *has 40 years of research experience in nuclear physics, plasma and thermonuclear physics, and astrophysics, focusing primarily on energy challenges. In addition, she holds two patents in computer tomography image reconstruction in medical physics. Her work experience includes Siemens Medical Systems, the Princeton University Plasma Physics Laboratory, the Culham Laboratory of the United Kingdom Atomic Energy Authority, and the French Atomic Energy Commission ("Commisariat d'Energie Atomique"), and she is presently a senior fellow at the American Center for International Policy Studies (www.amcips.org). The author of more than 70 papers in leading physics journals, she has also written 40 popular articles on climate change, energy, and population in various publications including China Daily, Guang Ming Daily, and World Environment. She is the author of Himalayan Odyssey, a memoir.*

POINTS FOR THE CLASSROOM *(send comments to forum@futuretakes.org)**:***

- *In what ways will improved efficiencies in transportation – and alternatives to oil – change the geostrategic interests of various oil importing and exporting nations and regions? Consider all pertinent factors – for example, relative environmental impact (and the consequences to various regions), linkages between the energy market and the food market, factors that can impact transportation needs and energy consumption, other economic factors, and demographics?*

- *Considering the same factors, do you envision biomass becoming the most attractive alternative to oil during the next decade? Why or why not?*

- *Also see Carolyn Stauffer's article, "Space: The Next Energy Frontier," this issue, and synopsis of Robert L. Olson's program "Beyond Oil? The Great Energy Transition," in the Winter 2004-2005 issue.*

[i] "Warning: Oil Supplies are Running Out Fast," *The Independent*, August 3, 2009, at http://www.independent.co.uk/news/science/warning-oil-supplies-are-running-out-fast-1766585.html, accessed May 1, 2010.
[ii] *Ibid*.
[iii] *Ibid*.
[iv] http://www.xing.com/net/gscm/scm-strategy-315471/global-transport-sector-responsible-for-24-co2-emissions-28707450/29423581/, accessed May 1, 2010.
[v] C. F. Rung and B. Senauer, "How Ethanol Fuels the Food Crisis," *Foreign Affairs*, May-June 2007.
[vi] *Ibid*.
[vii] *Ibid*.
[viii] G. W. Huber and B. E. Dale, "Grassoline at the Pump," *Scientific American*, July 2009, p. 52.