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Beyond Oil?

The Great Energy Transition

synopsis of the November 2004 WFS Washington DC Chapter dinner program presented by Robert L. Olson; summarized by Dave Stein

Energy transitions are a central factor in the evolution of civilization, noted Mr. Olson at the start of his presentation to the chapter at its November 2004 dinner program. For example, the invention of agriculture was essentially an innovation in capturing solar energy and storing it in caloric form. With agriculture came crop rotation systems, waterwheels, and windmills. A related development was animal husbandry, which enabled the supplementation of human muscle power with animal muscle power as an energy source. This was the first quantum leap in social evolution.

WAVING ALONG

This so-called first wave was followed by the second wave, the age of fossil fuels and industrialization, continued Olson. The coal-driven industrial revolution produced a revolution in productivity. As Buckminster Fuller said, it gave every individual a hundred "energy slaves." This period saw the perfection of the steam engine and the invention of machine tools, which make tools for mass production. Initially the dominant energy source, coal gave way to the oil age of the 20th century, which brought unprecedented mobility, both locally and across the globe.

Noting Kenneth Bolding's studies of economies as well as human progression from the hunter-gatherer age to the agricultural age and then to the industrial age, Olson posed the question, "What's next?" However, he was quick to point out that this is not just an academic question, since the long term prognosis for oil availability is bleak, belying the general downward trend in oil prices between 1996 and 1999. Said Olson, oil now provides 96% of the energy for mobility – even the attendees' automobile and Metro rail transportation to his presentation – and that the dinner served there was cooked with petroleum-generated power! However, this cannot continue indefinitely, and oil supply depletion will force the third wave, a shift to eternal sources of energy such as solar and wind power.

On the need for this transition, the pessimists and optimists cited by Olson were not far apart, in relative terms. For example, John F. Bookout, then-president of Shell USA, predicted that US oil production would peak in 1970. Others contend that oil discovery peaked in the 1960s, and while the oil from newly discovered fields adds approximately six billion barrels per year, the current consumption is 26 billion barrels annually, with China and India now becoming major consumers. A somewhat more optimistic prediction suggests that production of oil will peak in 2015 and in 2050 for all underground fossil fuels combined – oil, gas, coal, plus additional oil that is obtained from tar sand and shale via advanced processing techniques. Olson suggested that US oil production has already peaked, soon to be followed by peaks in European oil production and then in oil production from Russia. The most optimistic oil production forecasts cited were those by the US Department of Energy Information Administration and the International Energy Agency, which show a peak between 2025 and 2035. Still other forecasts placed the peak at 2004-2006, 2010, and 2015-2025. Said Olson, the differences among the most optimistic and the most pessimistic predictions are a mere tick in the second hand of history. Furthermore, there is the additional sobering thought is that perhaps some of the oil reserves in other parts of the world are not really there, since in Olson's view, at least one country is not telling us much.

THE CALL TO SCENARIO THINKING

On one point, according to Olson, nearly everyone agrees. Another great energy transition – beyond oil – must occur over the generations just ahead. Global oil demand will exceed global production of oil. Citing several book titles that suggest an eventual doomsday scenario – e.g., ***Power Down***, ***The End of Suburbia***, ***The End of Oil***, ***The Party's Over*** – Olson noted that in the recent US Presidential campaign, neither candidate really addressed the issue.

If the "peak oil" pessimists are right, the economic and social consequences are going to be colossal, perhaps with implications to civilization itself, and it is necessary to begin thinking about how to adapt, said Olson. Among other consequences would be an exacerbation of tensions between haves and have-nots. The challenge would be how to manage the decline, since production could drop by 50% within ten years after peak production. However, even if the optimists are right, there is little reprieve. There may be just enough time to make a smooth transition to a new energy regime, if we act now with urgency and foresight.

INTERSECTION – OIL AVAILABILITY AND CLIMATE CHANGE

Intersecting the oil peak problem is the issue of global warming. The global average temperature is rising. According to Olson, this climate change may make it impossible for half of all land in the US to support the plants and animals that live there now. Other parts of the world may be impacted even more. For example, the rising ocean may submerge half of Bangladesh. Even the ocean conveyor may shut down. Presently, the Gulf stream brings warm water alongside the European coast – but paradoxically, if enough ice melts, the resulting change in salinity may shut down the pump, thereby precipitating an ice age, at least in Europe. Any of these changes would have profound geostrategic implications for national security. Olson even noted that the US Navy is conducting a study of new port opportunities that may result from global warming.

Olson was quick to caveat that there are uncertainties regarding climate change forecasts similar to those in the oil availability forecasts. In addition, he stated the need to determine the extent to which global warming is a consequence of fossil fuel use.

THE OIL PARADIGM AND RESULTING CHALLENGES

As Olson explained, the dependence on oil has pervasive consequences. The concentration of oil supplies in the volatile Middle East drives national security interests, which in turn drives military costs. This is a region rife with growing anti-US sentiment, and the distribution network – terminals, ports, and pipelines – is vulnerable to terrorists. In turn, oil price volatility leads to price shocks.

To compound the problem, as Olson noted, oil is the biggest part of the trade deficit, which in turn weakens the dollar. Furthermore, the need to protect US strategic interests often results in support of corrupt regimes and concentration of wealth, which in turn leads to extremism – and this is before environmental impacts (above and beyond climate change) are considered. Additional challenges include tensions between the US and poorer nations and the prospect of an eventual conflict with China.

CALLING ALL FUTURISTS!

The problem is there is no single, clear "optimum solution" on the horizon for replacing oil and limiting greenhouse gas emissions. Instead, there are a lot of competing "partial solutions," and little effort is going into developing new energy solutions. One of the greatest contributions futurists can make is to call attention to the urgency of the Great Energy Transition and to help project and evaluate alternative transition paths into the energy future. As Olson suggested, this would include developing contingency plans for a "power down," just in case the pessimists are right. Wargames and scenarios can provide useful insights on how to maintain critical functions, protect the economy, and reduce hardships. The studies need to consider all possible ways forward including new energy sources, reduced need for transportation, increased efficiency of all energy-consuming technologies, and assistance to developing nations in making the necessary transitions.

Beyond that, futurists can help manage change. Drawing upon Margaret Mead's studies of societies that faced rapid change, in some cases from the stone age to the space age, Olson noted that the pace of change caused many cultures throughout history to disappear but that some survived and flourished nonetheless.

LOW HANGING FRUIT – A COOL IDEA!

A key point of Olson's presentation was his contention that energy efficiency improvements can have high payoff. He noted that in 1973, refrigerators used approximately 1800 kilowatt-hours of electricity per year, in contrast with new refrigerators today, which use only 500 kilowatt-hours per year. As more older refrigerators are replaced by new ones, the resulting savings in energy will be equivalent to the output of 40 power plants, each of 1,000 megawatt capacity, said Olson. A more comprehensive view notes that by 2000, improved energy efficiency was already providing 40% of all US energy needs. As Olson noted, this is equivalent to five times the domestic oil production, three times the total US oil imports, and 13 times the US imports from the Persian Gulf. However, he quickly followed that not too many people know this, since it doesn't draw attention to itself.

Olson also suggested that we have not yet picked all of the "low hanging fruit." For example, new US cars average 24 miles per gallon, a 25 year low. Relatively mundane technologies such as hybrid card, ultralight hybrids, advanced carbon composites, and advanced on-board computing systems can increase the miles per gallon substantially, perhaps to more than 100 mpg as some envision for cars of the future. It is believed that hydrogen fuel cell vehicles will be twice as efficient as internal combustion engines. Furthermore, the new advanced composites, although lighter, may be safer in crashes.

Similarly, improvements in commercial lighting will result in an additional equivalent savings, even if residential lighting is unchanged. This can be achieved with high efficiency fluorescent bulbs and high-efficiency ballast transformers. Saved oil is cheaper than produced oil, said Olson.

GETTING OFF THE MERRY-GO-ROUND

Even so, other sources of energy are needed, particularly in light of the fossil fuel "vicious circle" that Olson explained. Fossil fuels create carbon dioxide emissions, which result in a greenhouse effect.

The greenhouse effect, in turn, leads to global warming, which increases the demand for air conditioning and thus for energy – which in turn leads to the burning of more fossil fuels!

For alternative energy sources, Olson mentioned several possibilities ranging from "mild" to "wild" – from natural gas, clean coal, oil shale, and tar sand to hydrogen, and from hydroelectric, wind, geothermal, solar, and ocean tide power to biomass, cold fusion, and zero point energy. Among these possibilities, those that have already been proven are not without their own problems. For example, clean coal presents the challenge of sequestering the carbon dioxide. It may therefore be useful in a transitional sense, said Olson, but it is not good for the long term.

Another possibility is the pebble bed modular reactor. This reactor makes smaller nuclear plants possible, which in turn requires less of an upfront capital investment than is needed for traditional nuclear plants, which are no longer being built in the US anyway. The technology is encapsulation of the uranium into spheres the size of tennis balls. When these spherical capsules are brought together, they produce heat, but they never get sufficiently close to melt down. Furthermore, they are pre-sealed, and harder for terrorists to get to. However, they still require uranium enrichment, so there are still proliferation and protection issues involved.

USING IT OVER AND OVER AGAIN

Now turning to renewable energy sources, Olson emphasized their lower social, environmental, and health costs. They produce little or no greenhouse gas emissions, are less vulnerable to terrorist attacks, do not lend themselves to being weaponized, and avoid the fuel costs and the risks associated with fluctuations in fuel prices. Additionally, they are good for rural development, involve low transportation hazards, and are modular, thereby permitting modular investment in power plants and lines. Olson also noted that renewable energy sources provide more jobs per unit of capacity and that the total investment in these technologies in 2003 was more than $20 billion.

Regarding specific technologies, Olson noted that both wind energy and photovoltaic energy are possible. At the same time, biofuels have not seen as much growth as other areas. Referring to an article in the July-August 2003 issue of ***The Futurist***, Olson indicated that in his view, hydrogen technologies – ranging from photoelectrochemical based water splitting to biodisassemblers and genetically engineered bacteria and algae – are being over-hyped.

THINKING SMALL, ONCE AGAIN

Olson commented on the possible application of nanotechnologies to energy needs. One possibility is nano-rod solar cells made of conductive polymers with nanoscale semiconducting crystals. These crystals increase the surface area by a factor of more than 100. Additional applications include nanomaterial-based fuel cell membranes, advanced hydrogen absorbants, lightweight tanks for hydrogen storage, and even nanobatteries that store more electricity and have rapid recharge capability.

SO, STAY HOME!

Turning his attention to another frontier, Olson noted that advanced telecommunications, made possible by broadband technology, can reduce the need for travel and already has. At the same time, he proposed that maybe the full potential of advanced telecommunications has not been reached, because the energy pinch is not yet sufficiently painful.

Additional possibilities to reduce the need for travel include smart growth – sustainable cities (themselves concentrations of people) and higher population densities in the suburbs.

THE GREAT DEBATE OF THE ‘70s (during the early days of the WFS) – REPLAYED!

Looking back (and in a sense, ahead) to the great debate of the '70s, Olson characterized it as binary. During these early days of the World Future Society, the issues were continued growth vs. limits to growth, the super industrial society vs. “small is beautiful,” and the trickle-down economy vs. the community economy. Not surprisingly, one side favored large scale, complex, high technology whereas the other side favored small scale “appropriate technology.” This debate entailed twin risks, noted Olson – either that a collective loss of nerve might result if the prophets of doom held sway, or that overshoot and collapse might occur if the uncritical optimists prevailed.

Continuing, Olson suggested that an even bigger challenge might result from remaining in an obsolete polarization. He stressed the need for investment in the great transition, for reducing waste in consumption, and for cooperative global sustainable development and prosperity, coupled with social equity and harmony with nature.

Q&A (as best captured)

Q: To what extent have the more radical wings of environmental groups inhibited the move to a sustainable future?

A: The environmental movement has largely shifted away from confrontation. When the environmental groups started, there was substantial chemical pollution, and this led to confrontation, but now more of the environmentalists have a cooperative spirit.

Q: What is being looked at on the demand side? What do we consider a materially good life?

A: This was not looked at in the present study, but it is worth investigation. You (this WFS chapter) has a specific program coming up on redefining progress. In any event, the government is not likely to mandate anything. The change will come from the grassroots, perhaps with religious institutions playing a role. In fact, this question is part of the basis for the critique that we get from much of the Islamic world. From their perspective, we made the mistake of defining happiness in terms of material affluence and envy. It is possible that a future way of life will be more community centered.

Q: Can a shift to alternate energy, come as a result primarily of private sector investment, without assistance from government?

A: I don’t have an answer. The process is very capital intensive, but there exists a lot of capital. To make the shift happen, the market is essential.

Q: What about geothermal energy?

A: Geothermal energy makes sense in some places, such as Iceland.

Q: When you discussed energy efficiency, it was per unit of energy. However, we have a growing economy – for example, a growth in the number of refrigerators. Even with improved efficiency, how can we continue meeting the energy demand if the population is growing?

A: You are ultimately right. The total energy demand is the energy demand per person multiplied by the population, so everything contributes. At the same time, some demand is self-limiting. For example, there can be only so many refrigerators. If you reduce the energy needed to create a unit of GDP, then you can have economic growth concurrent with reduced energy consumption.

END OF PROGRAM

The participants said their good-byes and proceeded home, perhaps now more appreciative of the energy that brought them to the presentation and cooked their food. Perhaps the "far-out futurists" among them can find solace in data suggesting that in geological timeframes (10,000 to 50,000 years), the Earth is cooling!

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

- *How will a new or renewable abundant energy source change the geostrategic interests of the US and other industrialized nations?*
- *What will be the next living and working patterns after telecommuting, and how will they change the energy needs of industrialized nations?*
- *As the speaker stated, India and China are becoming major consumers of energy resources. What are the other geostrategic implications of growing middle classes?*
- *Special question for geophysicists and climatologists: If global warming results in a partial or complete shutdown of the thermohaline conveyor, paradoxically resulting in an ice age, will the net result be a rise or a fall in ocean levels?*