Our Energy Future and Nanotechnology

By
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Nanotechnology is fundamental over the next 50 years to providing sufficient energy for a growing world and to protecting the environment in which we live. There is an energy/environmental storm gathering and we must pay attention. Our children's' and our grandchildren's' lives are at stake if we mess up the energy/environment issue. Under all practical solutions nanotechnology will play a critical role in any successful outcome. Just as we claim that nanotechnology will change our entire economic structure and our lives over the next decades, so will world energy demand and supply. The two are intimately intertwined.

Detailed energy data, options, nanotechnology involvement and intelligent discussion are appearing regularly from responsible institutions. Some of the best energy information has just been mounted on the web. If you haven't considered investing in promising nanotech energy applications up to now, the following may change your mind.

A superb energy colloquium was held at MIT on May 3, 2006 discussing safe and productive energy supply (at reasonable economics) and environmental problems with possible solutions for the rest of the century. This colloquium was not heralded in the press … I'm sure most of you missed it … and yet it contained some of the wisest discussions about the world's energy future to date. MIT will be one of the premier US institutions providing insight, wisdom, advice and practical solutions to the world, our government and various industries on energy and environmental issues this century.

This illuminating forum can be heard on the web. "The MIT Energy Forum: Taking On The Challenge," (http://web.mit.edu/erc/forum/ and http://mitworld.mit.edu/series/91/) was chaired by MIT's President, Dr. Susan Hochfield, and involved many of Tech's world class faculty members. MIT has been fundamentally involved in energy generation since early in the 20th Century (e.g. power plant design, nuclear power generation and wind energy) and the early 21st century is no different.

MIT has had an institute-wide cross disciplinary major project underway for over two years examining world wide environmental and energy needs for this century, energy problems (including many economic and policy issues), all energy/environmental sub-sections and possible practical societal and economic solutions. This forum was an interim report of initial findings. All fundamental issues and options are discussed and are quite sobering. The panelist's findings and possibilities concern all of us and I strongly recommend that you listen to at least to the introduction session.

The early sessions explored the issues, problems and solutions arising from the worldwide energy supply side "production" perspective (i.e. oil, gas, atomic, biomass, and alternative energy sources). They specifically focused on oil issues … worldwide real reserves, possible shortages, price considerations and where we might find additional major supplies of crude. Interestingly only 40% of all provable oil reserves historically have been producible (liftable) reserves. 60% of discovered oil can't currently be lifted. 25% of these reserves cannot ever be produced, leaving 35% of existing provable oil reserves possibly available, subject to improved technological processes.

Nanotech is fundamental to increasing production from old wells. Assuming consensus projected world wide growth in developed and third world energy demand every increase in percent recovery extends available worldwide oil supplies 1.5 - 2 years. Increasing old well yield is one of the more productive research activities because producers know the oil is there. Some current nanotech developments for improving lifting percent include harder and more versatile drilling, platform and pipe line materials (stronger, lighter, more flexible and more impervious to heat and corrosion), better catalysts for processing lower quality crude, stronger impeller blades for oil pumping motors, and finer and more selective filters to minimize contamination and improve usable yields.

Most new oil reserves will be in places more expensive to explore and difficult to produce (e.g. deep seabed) than the current inventory of sources. Many large new reserves also will be in areas considered politically unstable and risky (e.g. off West African.) Many of the new reserves may require exquisite filtering, available only through newer nanotech based materials (aligned CNT and nanomagnetic filters) and stronger nanotech created materials that must function miles down into the ocean at extraordinary pressures and made to be productive. (I will discuss nanotech's role in increasing gas, nuclear, biomass and alternative sources and the consequent environmental effects in my next article.)

The afternoon sessions revolved around energy and environment demand or "need."

The issue that is usually minimized in discussion of global energy "need" solutions (or nanotechnology as applied to oil production or energy needs) is the co-need for scalability. Today's energy industry is huge and global. Ergo, all possible solutions to our future energy/environmental needs similarly have to be huge and global in scale. One example used to illustrate the need for scalable answers is dramatic. Talking about 30 large windmills in Nantucket Sound south of Cape Cod is one thing. It is a completely different issue to talk about millions of windmills (using nanotechnology) installed around the globe. The effect of millions of windmills on surface textures, wind patterns and local environments worldwide will be enormous. For nanotechnology energy related applications to succeed in helping to solve the energy/environmental dilemmas society is facing, every planned nanotechnology application has to be scalable to global dimension and non damaging … or it will fail.

Some additional energy facts further illustrate the energy/environmental problems we face.

The US represents ¼ of the world's energy consumption each a year. The US also in the process produces ¼ of the CO_2 emissions in the world each year. Today's per capita energy consumption in the US is 10 times that of India and China combined. However, the combined populations of India and China are about 9 times that of the US. The Chinese and Indian populations aspire to gain the same living standards we in the US have and they want it quickly. Increases in living standards equate to multiple increases in per capita energy consumption.

Query … what does it mean for future world energy supply requirements and to the world environment if these countries elevate their per capita energy consumption in fifty years to ½ or even ¼ of the US per capita consumption? Do the math. And don't forget that during that same time, the US per capita consumption will continue to grow as well. Do the math again but cap the amount of global warming allowed at 2^oC. See the energy and environmental problem we all face … especially what our children and our grandchildren will face? Did you calculate how many billions of tons of liquid CO_2 from energy production will have to be collected as a gas, liquefied, transported to a site, buried, etc. world wide?

Many of us forget that the energy issues that nanotechnology is beginning to find solutions for are global in scale, especially with environmental pollution in the developing countries not the highest element on the value chart, and that all the solutions derived from nanotechnology or with nanotechnology input, have to be scalable to global dimensions so that adopted solutions can have few negative consequences.

Last, three more facts to inspire your energy related nanotechnology investment curiosity.

In global terms, the world currently consumes (or generates with large inefficiency and losses) about 14 terawatts of electrical power. By 2100, the world will need to generate over 30 terawatts just to have minimally modern standards worldwide. Nanotech based efficient electrical transmission lines seem to have a bright future this century.

In the US, buildings consume 40% of all energy used. (50% in the UK). Moreover, 67% of all electricity is consumed by buildings. 31% of building energy consumption is devoted to lighting; 23% of building energy consumption goes to cooling and 22% of building energy consumption goes to heating. The Chinese are constructing 10,000,000 energy consuming new buildings a year. Anyone looking to invest in nanotech based building lighting, insulation and multifunctional wall panel systems need look no further for justification.

Last, In the US, 23% of all energy used is used in transportation. Worldwide, today's energy industry provides fuel for about 750 million vehicles. By 2050, most estimates put the number of vehicles used in the world at about 2 billion, or about three times today's worldwide inventory. From where does the energy to power two additional worldwide inventories of new cars come? Oil? Biofuel? Natural gas? Electricity? Atomic power? Renewable sources? Large energy storage banks? Note: Nanotech is critically involved in each of these energy sources … and transportation probably represents less than a ¼ of the demand for new energy over the next few decades.

Anyone for a few investment bets on nanotech energy application companies? We'll have more on nanotech, energy and the environment next month.

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