A Conversation with Professor William Moomaw, September 10th, 2009

(Notes by Mary Essary, who is solely responsible for their content. The content has been rearranged to be grouped by topic; comments by ME are in [].)

Professor Moomaw was just back from Europe, where he participated on the IPCC meeting regarding the report that is due in 2010. At this meeting he had a chance to learn about the efforts, progress, successes, future plans, and philosophies of countries all over the world as represented by his one hundred plus fellow panel members. At the BASEA forum on September 10th, he commented on this experience, what he learned, and his own thinking on the issue of addressing climate change.

He began by noting the change since he and his wife built their new zero-energy home two years ago: The lumber yard now carries the supplies that they had to specially order; the contractor, who had never worked on such a project before, is now "busier than ever", as are the plumbers and electricians who worked with him.

He also noted that the Tufts/BAC team is almost finished with their 2009 Solar Decathlon House entry, which will be packed up in a few weeks for its journey to Washington DC. There, too, has been much progress since the MIT team built its house in 2007 – the Tufts/BAC team was able to take an integrated design approach, creating a conversation from the beginning between the builders and the architects, as well as policy students and others. And, new CAD hardware is available that includes analysis of energy consumption.

The good news here and around the world is that progress is being made on sustainability, as well as growth of sustainable energy industries.

I. POLITICALLY: things are not as encouraging: The target for many is the United Nations Climate Change Conference, meeting in Copenhagen this December [http://en.cop15.dk].

U.S. Legislation: Many nations are looking to a commitment from the United States before agreeing to limitations; but the Waxman-Markey bill is out of the House, but not yet discussed in the Senate. At 1600 pages "it is about as complicated as the tax code", the result of compromises that accommodate a variety of special interests and viewpoints. In fact, Senators Kerry and Boxer have indicated that they will introduce an entirely new bill by the end of September – which may be an improvement, but will certainly prolong negotiations and reconciling the Senate and House versions of the bill.

He "doubt[s] that there will be a final piece of U.S. legislation before Copenhagen" – or even that it will be out of joint committee. There is a new "stick" available to bring people to the table: the Supreme Court has ruled that CO2 is a pollutant, giving the EPA authority to regulate emissions.

Re the IPCC report and Copenhagen: The chapters in the report are solar, wind, geo-thermal, hydro, storage, and biofuels.

[Later] The U.S. is out of synch with Copenhagen, due to Bush administration introducing a "parallel track" to Kyoto. However, he said that he is becoming convinced that we are negotiating the wrong treaty [the follow-up to Kyoto]. We are negotiating [a stick], i.e. a pollution control treaty, when what will work is [a carrot], i.e. an energy system and supply treaty. For example, India's position is that it will cap its carbon footprint per capita at no more than it is in the U.S. [India per capita consumption is currently about one-tenth that of the U.S.]

He believes that we should be negotiating a development plan, one that provides energy service for everyone at acceptable and comfortable levels, emphasizing mobility, renewable energy and efficiency.

But remember, we need to marry a financial budget with an energy budget: e.g. using solar panels with LEDs for light is affordable (one panel), using incandescent bubs instead (five panels) is not affordable.

We can regulate or we can set a market price – and motivating by price is a far more effective path (if it can be done). He believes that we don't need a carbon tax as much as we need to set a minimum price that reflects the true cost and puts renewable energy in the correct context. In Europe they have had this policy for decades – gasoline in Europe is about $8.00/gallon; the price is the result of taxation. The U.S. has some of the "cheapest" energy prices of any country that is economically developed. [In the beginning the EU countries taxed gasoline because of balance of trade; they wanted to have the bulk of the money generated by sales stay in the country. Now it is a matter of "monetizing the external costs", i.e. internalizing social and environmental costs.]

II. PROGRESS, LOCAL AND GLOBAL: Independently of federal legislation, states and cities are moving forward – more than 700 cities, and about 20 states now have emission reduction commitments.

- Norway and the Netherlands have committed to a 20% reduction by the year 2020;
- Japan has committed to a 25% reduction (over 1990 levels) by 2020.
- India, along with other countries is balking at firm commitments, but the thinking in China is shifting as it sees a growing world market in both PV and in wind.
- *A major breakthrough:* In 2008, Germany demonstrated that base-load could be completely supplied by renewable sources, using a distribution of various sources and technologies "cobbled together".

III. INVESTMENT/THE INDUSTRY: The REN21 report [http://www.ren21.net] stated that investment in renewable energy has grown to over $140 billion in 2008, exceeding that in coal and nuclear (at $110B) world-wide, plus $15B in energy efficiency.

- China is first in solar hot water; third in biofuels; and its wind power industry is doubling every year.
- In 2008, the United States finally overtook Germany in terms of total wind capacity – not such an accomplishment when one considers that Germany has the wind potential of the state of Pennsylvania.

- Germany now leads in PV, with 55% of world-wide PV installations – even though it is hardly the sunniest country in the world.
- The U.S. still lags behind, being committed to the illusion of "cheap energy"
- Germany: Exports more than any other country – including China! Not just the BMWs but a lot of manufacturing technology. Many years ago they decided clean technology was a business to encourage, government regulations required "scrubbers" for cleaning up industrial exhaust, and now they have the most advanced scrubbers in the world — they decided that "we're going to look ahead." And now they are reaping the benefits. The German Federal State of Schleswig-Holstein has a goal of being a net energy exporter from wind, etc.
- China: China does have coal, but the coal plants that they are building are significantly more efficient than those in operation in the U.S. – the U.S. has about 32% from its coal plants, with no technology changes since 1962. New Chinese plants run at 40-45% efficiency – [twenty five percent better than U.S. plants]. The expectation is that China will soon be number one in PV, and will overtake the U.S. in wind within the next few years.
- Denmark: Did not invest at all in R&D, but set long-term incentives for private investment. Vestas, the largest wind company in the world, is one of the results. Note that at one point, Vestas had supplied 60% of the operating wind turbines in the world — from a country that is smaller than Massachusetts.
- U.K.: The U.K. is one of the few countries that will meet the Kyoto targets without going outside the country for offsets, primarily due to the substitution of natural gas from the North Sea for coal. U.K. is emphasizing energy efficiency in buildings – definitely an attraction and added value for resale. A leader in pursuing ocean/wave and deep-ocean wind technology.
- Spain: Is becoming more and more active, in concentrating solar, in wind and in PV. They have very high goals for installations over the next ten years.
- Portugal: Although not as economically energetic as other European countries, Portugal is also beginning to develop its clean energy industries and usage.

IV. DEBATE: DISTRIBUTED VERSUS "MEGA" PROJECTS: Current thinking is divided in terms of strategy between distributed energy solutions versus "mega-scale" solutions, requiring a substantial investment in power transportation infrastructure. He noted that already in the U.S. 55% of our capital in providing electricity is not in the power plants themselves, but in the transmission of the electricity — i.e. in the wire and substations.

As noted earlier, in 2008 Germany demonstrated that base-load could be completely supplied by renewable sources, using a distribution of various sources and technologies "cobbled together" – it consisted of wind, solar, demand side management, storage and some gas generation. A "system" "only an engineer could love".

"Desert-Tech": Some Europeans, especially Germany, are pushing for fields of solar collectors in North Africa and Saudi Arabia, with the electricity to be piped into Italy and Spain, over/under the Mediterranean and Straits of Gibraltar respectively.

[Later] MIT says that it is a question of scale and speed, but they claim the answers lie in nuclear power and in carbon sequestration. But he doesn't know anyone who is able to build a nuclear power plant quickly – and building one 10MW plant a year each year for ten years generates a lot more energy in the interim. The "state of the art, fast-track" nuclear plant in Finland is, after two years, two years behind schedule, and 100 % over budget. [http://greeninc.blogs.nytimes.com/2009/09/02/more-delays-at-finnish-nuclear-plant].

Norway: In contrast, Norway is currently getting 99% of its electricity from hydropower (a balance for Danish winds). This is highly distributed, with only one big plant, and 640 plants in the 1-40MW range. These small dams are little, diversionary constructions with a low environmental impact. By avoiding the huge costs of dams and reservoirs, and making this investment early — in the 60s, 70s and 80s — electricity rates are 3 ½ to 4 ½ cents a KW-hr; the average household usage is about 23KW/yr (note – about twice as high as the U.S.!).

V. THE FUTURE — THE TECHNOLOGY CRYSTAL BALL:

- *BioFuels:* There are mixed feelings about biofuels: Brazil now claims that biofuel production only occupies 1% of the agricultural land, but a study showed that, beginning in 1975, it took 16 years (to 1991) for biofuel production in Brazil to be carbon neutral, in particular due to the land-clearing. Brazil also says that no more clearing is necessary
- *Transportation:* The big issue here is storage; most are looking to Toyota given its leadership, but Toyota is skeptical of all-electric vehicles. Asked about lithium/storage: Lithium is without a doubt the best material that we know for storage. It has the highest electro-chemical potential combined with a light weight. Much of it is in Bolivia, and it is true that Bolivia is not interested in being mined for raw materials; it wants to have manufacturing and economic benefit of added value. [Note: China also has a large amount of lithium, and some battery companies are manufacturing in China, e.g. A123.]
- *The Grid:* Our grid is basically unchanged from the 1920s, but R&D is less than the percent spent on dog food research. Requires a lot of policy as well as technology advances. We do need a smart grid; people have to be able to communicate with the grid (and vice versa). The grid needs to have access to slow energy usage at certain points, and individuals/companies have to be allowed to put excess energy back into the grid. Right now, MIT can move steam across the street from co-generation, but it can't move the electricity itself across the street! We do have to be careful of security with an updated and "smart" grid.
- *Hydrogen:* Iceland is a world leader in H_2 production; ample electricity generated from hydro and geo-thermal. The biggest Al smelter in the world is in Iceland for this reason. He suspects that hydrogen fuel cells will be a "fixed location" solution, and not a major infra-structure shift for passenger vehicles.
- *Wind:* There is much more wind than we thought – it is out further, and up higher than we have been monitoring, but there is a tremendous amount of potential there, yet unrealized.

- *Efficiency*, particularly in buildings: The U.K. and Germany are leaders here (when in Darmstadt, Germany in 1990s for a meeting, already a Passivhaus to visit). No country has a national policy. If we had a serious energy efficiency program for the built environment it would generate a tremendous number of non-exportable jobs, in addition to addressing a huge energy issue. In Japan, the replacement rate for buildings is 4% a year, compared to about 1% for the U.S., due to earthquake upgrades. The average building lasts about 25 years. [However, this still corresponds to what Paul Eldrenkamp from Byggmeister said last year — the typical U.S. building project has a lifetime of 25 years between new structures and major renovations.]
- *Geo-thermal:* The biggest potential and hardest to reach source is geo-thermal. Surface easy to access (and deplete), but deeper reserves are not being tapped.

CONCLUDING REMARKS: The important thing to remember is that we are NOT in any way limited by the natural flow of energy on this planet – there is solar, wind, hydro and geo-thermal power in abundance.

The best way to lobby is like the best sources for renewable energy – any way and all ways. We have to re-educate ourselves, our neighbors, and our representatives that cheap non-renewable energy is a false premise. And we have to pursue all solutions from upgrading efficiencies to newest technologies.

We need to make a dramatic switch in a dramatically short time – look at the examples from WWII – in a few years we had totally changed manufacturing systems. The manufacturing infrastructure is almost the same, e.g. wind blades and turbines versus planes and bombs: It is possible!!

[Thank you to Ambrose Spencer for reviewing these notes and for his comments.]