The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

C2C – the Emerging Energy Technologies Summit – day 2

Posted by Heading Out on February 11, 2007 - 1:27pm
Topic: Alternative energy
Tags: carbon sequestration, coal, nuclear, sustainable development [list all tags]

Well they sure are hospitable folks down here, they laid on Seattle weather here today for their Dean, who hails from those parts. Unfortunately Bill Mitchell, the first speaker in the session on Sustainable Development Communities was taken ill and could not make the meeting, so that the following two speakers were given extra time to fill in the gap. (I will forego the UCSB PR that was the intro to the day – but will cover a bit at the end, since it paid for my trip).

The responses to the evolving crisis in Energy Supply will have to be addressed in several ways, and the first session of the morning looked at the development of sustainable communities, in particular focusing on Chula Vista and the work of the National Energy Center for Sustainable Communities, itself part of the Global Energy Center and an affiliation of universities in addressing the issues of urban sustainability given

> In the United States, for example, 80% of the population lives in cities. Their buildings, transportation and urban infrastructure account for 80% of U.S. energy consumption, and 70% of that amount is determined by how and where Americans design their neighborhoods. Low-density development in the U.S. consumes 85% more energy, 70 times more water, 50 times more lumber and 40 times more land than higher-density development of the same square footage.

This being CA and the times being what they are, it was also stressed that urban areas are responsible for 75% of the GHG emissions. This was one of Doug Newman's opening comments as he talked about the goals that the Center and the Department of Energy have in setting up this effort to build what hopefully will become an international model of a sustainable community. It is important at the community level when one considers that power outages, which impact communities, cost $119 billion a year, and that energy costs are second only to labor in community expenses.
UPDATE Byron Washom's remarks have been corrected - my apologies for the error.

Building a sustainable community is, however, not just something that is done by universities unloading a set of new technologies onto the community. It requires community planning and the creation of public policy, and for those to be effective, they require that there must also be some economic, market and behavioral studies to give input in the formulation of those policies.

And so, recognizing that this could not be a piecemeal approach, three disparate communities within Chula Vista, (pdf) map here Village 2, the Eastern Urban Center and Village 9 were selected.

In essence the idea is to take the development plans in these communities, evaluate each using computer models to evaluate, inter alia, energy use, and to ensure that development ideas will work, and to then make recommendations. Out of the exercise it is anticipated that a plan of action will evolve and be refined, that will give two Reference Guides for the future of such communities. One will be a Guide for Development Professionals, and the other a Guide for State Agencies and Financial Entities.

The idea is also, once a baseline has been established, to model options and, after policy and feasibility reviews, to then identify 20 projects in which to install showcase technologies and then to create a national demonstration site for other communities. And I must apologize in that there was a video shown on the program at lunch, and I missed the reference and was too late to get one, but I believe that you can get a free copy here . (I hope so 'cos I just tried ordering one).

Larisa Dobriansky who first was involved with the program while at the Department of Energy, and unfortunately her laptop had a problem and so she read her speech – and I must apologize, but she talked too fast for me to get it all down, though it was largely about the same project as the previous speaker.

Looking at the anticipated growth in energy demand – something on the order of a four-fold multiplication – there will be many consequences, but these will fall disproportionately on transitional societies. And we have to find a better solution than the status quo, or it will get worse. Yet these solutions must fit within the existing infrastructure and provide for viable development. Sustainability must occur at all levels, and thus developing an energy smart community makes sense. It has been the energy insensitive developments of the past that have given us our reputation as profligate users, particularly in regard to our use of low density housing. But the blame must also go to an energy distribution system that by being centralized, and invisible, has become rigidified as it responded to the initial incentives and created barriers against evolution. The emphasis must change so that instead of having fuel use the first priority, that instead goes to the service provision first, and the actual fuel source last. This will allow the combination of functions (this is well illustrated in the video) and thereby major savings in energy. It will allow optimization of land use, and the creation of micro-grids that can be more responsive to fluctuating need and supply.

The next speaker was Ernst von Weizsacker , Dean of the School of Environmental Science and Management at UCSB, who noted that applications for admission to that school and the environmental program had tripled over the past nine months, in apparent recognition of the growing problem. Now I am going to have to step out of just straight reporting and, for reasons I will go into in more detail tomorrow, expand a little on what I think he said next.

He was talking about the talk that Dr James Hansen gave at UCSB last week on the impact of global warming, and I presume since the titles were the same it was likely close to this set of slides (pdf . What Dr Hansen had noted was the need for society to understand that it is too timid in speculation in regard to non-linear events. And as illustration of this he noted that about 800 years ago the ice pack over Labrador and Hudson Bay collapsed almost instantaneously creating a water level rise that showed, in coastal changes, of some 7 – 8 m. This was relatively rapid and his point (based on slides 23 and 24 in the above, which Dean von Weizsacker showed) is that those conditions, which can occur with unanticipated ferocity and speed, are occurring again over Greenland. (And I think that what he was referring to are what are known as an Heinrich event which is associated with Dansgaard-Oeschger conditions . The movement of the ice is exacerbated by the generation of freshwater flows within the ice, and below it, dropping the intra-structural friction and allowing sudden, and catastrophic movement. A condition, which is very similar to

what we have now. Sometime later in the day one of the audience noted that the conference announcement slide shows an aerial view of the campus, pointing out that with such a water level rise UCSB would likely be underwater, including the hall wherein we were sitting.

I tried to recreate the greater picture because I believe that the point was that we are expecting this crisis to unfold slowly and with plenty of warning. This breeds a lack of urgency in seeking solutions. (As another example, when we talk about oil peaking - the concern is somewhat ameliorated if we say that there will be a long plateau before the decline). But history suggests that this may not be the case, and rather that a disaster can unfold with speeds beyond that allowing unprepared remediation.

Thus, if we are looking at the effects of increased CO2 levels on global warming, when levels are soon expected to double, when the urgency in reducing emissions by 60-80% is lost, then we open the future to the possibility of disaster.

The Dean had been heavily involved in energy research in Germany before coming to UCSB and talked with pride of their wind efforts, until he put up the slide that showed, in reality, how little that program was contributing to Germany's overall energy supply. He then asked how many kWh it would take to carry a bucket of water weighing 20 lb from sea-level to the top of Mount Everest (answer at the bottom of the page) – after all this is academia and spot quizzes are still, I suppose, the norm. The point is that that power is still ridiculously cheap. He had written a book with Amory Lovins entitled Factor 4 showing a path to enhancing energy performance, reducing water and material consumption.

He noted that both he and Amory Lovins believe that there are many pathways to make dramatic reductions in the energy that we use. Passive house designs can reduce heating costs by 90%, refrigerator power can be dropped from 1,190 to 50 watts, with water use falling from 750 liters/kg to 1.5 liters in paper making. Modern Japanese practices lower the energy cost of making steel by a factor of 4. And it does not need to be new technology, while in Germany he looked at the transportation paths used in making strawberry yoghurt, and by only changing paths not the trucks themselves, found he could save significant energy.

There have been five technical waves of development in the past – we are now ripe for, and desperately need, the sixth wave. But to get it we have to change our mind set, and our level of complacency. We did not see great changes in labor productivity until the price of labor went up, and energy can be treated in much the same way.

In questions he noted that Santa Barbara has a plan to be carbon free by 33, but noted that this depends on many issues and that the scope for communities was limited. (Though it was interesting to wander around the student poster sessions at the break and see that UCSB has a group that is monitoring and improving the energy use in its research labs – ouch!).

There was then a panel discussion led by David Rohy and including Gary Barsley , Michal Moore , and Byron Washcom . They were asked first to define sustainability, David Rohy bemoaned the change in culture – for example who, today, repairs a toaster, or uses a solar clothes drier (a clothes line). And, to modest embarrassment of the speakers – who were using them, he pointed out the energy cost of bottled water. There are also the unintended consequences of change – the more energy efficient use of fluorescent lights has spread mercury, it takes four gallons of water to make a gallon of ethanol, and crime flourishes along public transportation routes. And when we start installing hydrogen filling stations can we anticipate the NIMBY attacks? It's the culture, stupid!

Gary Barsley saw the crisis as an opportunity for entrepreneurship with the students (and again – out in the courtyard was a poster by one of the student Engineers without Borders projects, where they are encouraging the growth and harvesting of Jatropha in Mali). With an ageing work force how does industry attract the "best and the brightest" – his answer was to provide a sustainable environment. He did object to plans for a local LNG port, he feels that installing one just delays the need to face the fact of energy depletion.

Michal Moore, with a Canadian perspective, asked if the object was to conserve or preserve ? Is the world a series of polaroid shots, where answers, once found, are installed and forgotten, or is it a movie, where the challenges are constantly reviewed and answers updated. He expressed concern about the 2-m dams holding the mining waste at the Athabasca Oil Sands, given that, should they fail, the silt will enter the Athabasca River, which will carry it up to the Arctic Sea, and the fish breeding grounds.

We must learn to ask the right questions, which might have led to butanol rather than corn ethanol (butanol might be better harvested from sugar beets – to answer a question I got asked at lunch). Alternately using porous brick with grass in the hollows would allow sidewalks that would allow rainfall to immediately percolate the ground instead of flooding into drains. We must create standards and enforce them, relying on volunteers does not work! And price can be a signal.

Byron Washom brought an interestingly different viewpoint to the discussion, since his early childhood had been passed on a small island, far from the mainland, where they had to subsist on a gallon of water a day, with power coming from a diesel he named after his sister (since he never knew when it would cooperate), and where he did not associate the word "fresh" with meat", but thought "freshfish" was one word. He noted that, in the coming crisis, it will be the poorer populations that will suffer earliest and worst, even though they have contributed least to the problem. Current demand for power in California is 60 GWe per year, but the growth of energy use in China exceeds 65 GWe a year, so that they are adding the equivalent of a Californian energy demand every year, using a set of technologies that will impose a 50-year mortgage that none of us can pay. It is thus important, not only that we create all the innovations that we can, but also that we make them available around the world.

From that point of view, the "sixth wave" of technical progress should be a disruptive wave, rather than one of logical progression. The energy business, because it has been heavily regulated for so long, is one of the slowest to adapt and needs that sort of action. He noted that when Prime Minister Blair introduced the initiative to work on global warming issues at the Gleneagles G-8 summit two years ago, he initially received a positive response for the governments attending. However, when the price of some $10-30 billion/year was presented those nations choked. He noted that this was not because of the reality of the message, but because of the price.

And yet the price need not be without return. In comments from the floor Dr. Alan Sweidler of CSU-San Diego pointed out that Tijuana has doubled its population without increasing water use, through an improvement in efficiency. Yet in Southern California they pay 32,000 kWh to move an acre-foot of water from the North to satisfy their demand. We have a culture that focuses on demand, with 80% of GDP based on consumer spending. And thus, yes, price can be a control. However, having come back from testifying before an Energy Committee in Congress he pointed out that there is zero, nada, zilch stomach for raising prices or taxes in this Congress.

To which Michal Moore retorted "the boomers are in power and are going to get run over by a very big train – and God Speed!" They are out of tune, out of date and should soon be out of office.

He talked about a Canadian solution, which is to start off with a minimal charge for the cost of energy/carbon generation. At this price no-one notices. But each year it is slowly increased. And gradually, over the years, it becomes significant – and creative folks start to find ways to use that cost to introduce change, and so, after 30-years, when the price has become severe, the culture has been changed.

However, it was also pointed out, that while it is great to be in vogue (and if I had suggested that Global Warming was not occurring I suspect I would have been held until men in white coats could be summoned to take me away, with the unanimous approval of all the audience), but the public are intolerant of the time that it takes for remediation. Thus, as the price becomes more evident, without visible solution, then the current popularity of the position will quickly fade into an adverse reaction.

There was then a break for lunch, while the video mentioned earlier was screened (it looked a bit science-fictiony but you should check it out for yourself, by getting a copy, since I only saw the end bit, and it is only 17 minutes long. Incidentally it was part of an international competition and placed second – Vancouver won).

After lunch Mike Corradini was the first of the speakers dealing with energy choices. The first session dealt with the nuclear option, with the background that, while the world population is growing, as is their energy demand, the majority of that growth is taking place in Asia, with rates of demand increase that exceed 8%. He noted that while the US is criticized for the share of energy that they use, as a percentage it has dropped from 50% of global use, some 50 years ago, to the present where it is about 22%. Yet it is the vital physical force that underpins the global system, and thus resources that provide that supply are critical.

In this regard he reviewed the amount of uranium that is available, as a function of supply, yet with cost a significant part of the choice. Nuclear power stations now run at more than 90% capacitance factor, and with costs of around 2.5 cents/kWh (coal is 4 cents/kWh) in part because the plants are older. But while in the short term improved energy production efficiency is the key, the question must be asked as to whether this should be driven by cost or by law.

He showed a slide with a rainbow ending in a Wisconsin nuclear plant, and noted the legend. Yet the last order for a plant in the US was in 1972, and it was completed in 1982, and the US still outproduces the combined nuclear power of France and Japan.

To meet demand, of the 104 plants in operation, 44 have been upgraded and approved for a 20-year plant operating extension; 34 have applied for such a permit, and 22 are in the process of getting one together. While recognizing that Chernobyl was a terrible design he noted that “there has not been a loss of life in the US due to commercial nuclear plants,” over teir life of operation to date. In the United States the constant vigilance to ensure that plants are upgraded with reliable replacement of components. All nuclear waste, to date, is securely stored and at 50,000 tons total would occupy a volume no greater than 2-3 times that of the hall in which the Conference was being held.

He reviewed the anticipated progress in nuclear plant design, and where new plants are likely to go in, but pointed out that nuclear is in competition with coal, and prices must be sufficiently realistic if the right choice is to be made. He considered nuclear use in providing process heat to supply other energy needs, the use of power stations to provide the process heat for Synfuel production, and also reviewed ways in which to minimize waste generation.

Two comments from the floor included one that nuclear costs should also include the costs incurred in mining and processing, and another that if the world is to see an increase in nuclear power then the populace should be convinced that it is needed.

Mujid Kazimi from MIT (the organizers found it very difficult to get industry spokespeople for this event) reviewed some of the Myths that have arisen about nuclear power. He further noted that while there has been no new permitting of nuclear plants, some plants had previously been permitted, but had then been mothballed, and one of these, in Tennessee, is going to come on line next year.

He felt that popular opinion is skewed against the reality of the situation, and re-emphasized the reliability of the nuclear stations. Further the power that they generate does not, in itself, have the military and geopolitical consequences that we are now seeing from the need for transportation fuels. He noted (in disabusing some of the myths) that nuclear power is not in decline, is not dangerous, is not too expensive, produces tolerable amounts of waste and does not lead to weapons proliferation.

The only real competition to future growth comes from coal power plants, and there are 100 of them on the nations drawing boards. Wind only works 30% of the time and it is nuclear that provides a great portion of the nations base load at an economic price. It is a technology that is, in relative terms, still new enough that it can be considerably improved, and there are lots of new ideas around of which he cited two, new fuel designs to give 50% more power per unit volume) and nanotechnology to solve some of the cooling problems and to up the power density.

A standard house consumes 2,400 kWh/year of energy which will generate 0.3 gms of fission products in 9 gm of uranium, wste is thus minimal relative to other energy producers. In 2004 the world used 0.07 million tons of uranium ore and so current reserves will last for several decades. Extraction and conversion costs run about $48/kg and $1/MWh is paid to the government for fuel disposal.

He discussed waste storage issues and gave a figure of 70 watts of heat per spent fuel assembly after a thousand years of storage. And while the debate over the fate of Yucca Mountain as a storage site is yet to be resolved there is really not hurry since the waste is currently safely stored (though expensive to the utilities storing it). There is a debate as to what should be done with plutonium, if it is burned in nuclear power plants (as in France) the storage life needed drops to a few hundred years.

He then talked about other possible uses for nuclear power, as an energy source for EOR for example, or in the oil sands, though if it were to be used to provide the energy for the oil shale development a higher-temperature reactor would need to be used to reach the temperatures needed for that process (at least as foreseen in the Shell method). It can provide base heat and hydrogen for refineries, and can be used to make synfuels and liquid fuels with a lower CO_2 impact from production. And by changing from steam to Helium or carbon dioxide in the plants, size can be reduced considerably.

He noted that, because of perceived (rather than real) risks, nuclear power plants must pay a premium of 4% to lending institutions over that charged to those building coal-fired plants, and if that disincentive were removed, he believes that nuclear power would be introduced more rapidly into use.

When asked about the risks of earthquakes to stored waste at sites such as Diablo Canyon, he discussed the design of the individual storage units, where the contents are not pressurized, so

that even in the unlikely case that the unit was breached, the contents would only slowly leak out.

The discussion then switched to coal, with Tim Appenzeller of National Geographic, who, as a journalist, had more of an outsiders view of the industry, that the stronger proponent oriented talks that were given on nuclear power. And yet such a need to sell the industry was un-necessary since, as his title noted :The Future is Black" which could be taken to mean that the future is coal, or that the problems that coal brings will darken our future prospects. And in fact his talk covered both aspects. In terms of greenhouse gases (GHG) oil and gas are mere pipsqueaks, relative to the amount of CO2 that is going to be injected into the air from the power plants that are coming. The volumes are likely to generate an atmosphere that will be equivalent to that which prevailed at the time of the Eocene., and the Arctic was sub-tropical. He noted the retreat of the glaciers, and that the rivers of clear water on the Greenland ice sheets were inducing massive instability. This is already giving problems, due to higher water levels in Bengal and the Maldives.

As a study of coal development he recommended "Coal – A Human History," by Barbara Freese (Amazon says it only has 3 left, since I just ordered one). In that book the introduction of coal to London is given as first happening in 1306, but the stench of the smog was such that the King banned its use, until the deforestation of England meant that there was no alternative, nor source to produce horse shoes. It did give England, and the world, the Industrial Revolution, but also the peas soup fogs of the 50's and early 60's.

And so coal is again the fuel of the future, demand is rising faster than for any other fuel, it is cheap and abundant. While Peak Oil and Peak natural gas are here, there is enough coal, at current use levels, to last 200 years (100 in China). Coal is no longer the old dirty fuel that it was once considered to be, and the discussion of factors such as acid rain have disappeared from the front pages of the world. Labor intensities of production have fallen dramatically, and safety (outside of China) records are growing. It can either be gasified or liquefied, with China now having their first CTL plant, set to produce 20,000 bd at a cost of around $30 a barrel. In Illinois there is a fertilizer plant that is set to turn coal into synthetic diesel (though running a Prius on the fuel would, due to the conversion process put more CO2 into the air than from running an SUV).

Which illustrates the fact that coal is often an invisible fuel. The house owner who flips a clean switch on a white wall does not see electricity as coming from coal, nor as a dirty. The Internet user that moves 10 meg of data is not aware that they are using the energy from 2 lb of coal to do so, and so the public is unaware of the situation.

Without that awareness there will be no change, a conventional light bulb uses the power from 500 lb of coal that could be saved by changing to alternate lighting, but only 1 house in 15 has converted to the newer bulbs. So power demand rises, and the climate gets warmer. And with China set to overtake the US in GHG production within two years, they are unlikely to change their power generation methods, and so, the argument goes, "why should we?"

Thus the hope is that solutions such as sequestration of the carbon dioxide be considered, and so he concluded by discussing the different options for CO2 capture from power plants, since we are burning our best fuel source in the worst way.

To answer that challenge, or to better explain the situation Sally Benson from Lawrence Berkeley then talked about what carbon sequestration (underground injection and storage of the gas) entailed. After reviewing the inevitability of coal, she talked about the steps that must be undertaken to achieve sequestration. Firstly the CO2 must be captured from the power plant.

This can be done, to differing degrees, before or after combustion (before entails a gasification phase – the IGCC power plants). A conventional fuel stack gas only contains 14% CO2 and this is thus difficult to capture, and amine solutions have proved to be the best at this. (They absorb the gas, and are pumped away and heated so that when the gas is then emitted and recaptured it is in a much purer form). The third way of dealing with the problem is to burn the coal in an oxygen environment (known as the the Oxyfuel process). There is apparently no current favorite for which technology will give the best results, IGCC had the lead, but conventional approaches are making a come-back.

Once the gas is captured it must be transported, and can then be pumped underground. There are three favored sites, as an aid in enhanced oil recovery , in deep saline formations, and in un-mineable coal seams.

With the gas (which must be buried deep enough that it liquefies and becomes supercritical) being lighter than water there is some concern to ensure that it remains trapped. The only major demonstration so far has been at the Sleipner oil field off Norway. However seismic surveys have proved that the site can be monitored and the security of the storage checked. The data suggests that the security is anticipated to be 99% over a period of 1,000 years. And there is the capacity to store more than a hundred years of production.

The final speaker in the session was Frank Alix who spoke about the benefits of using ammonia rather than amines for carbon capture. However, as he pointed out, the power stations are mandated to install "the best available technology," so he can't get a site for a full-scale test, since the first successful power station test will mandate that all stations would have to spend hundreds of millions of dollars making the conversions to the new system.

Both he and Sally recognized that sequestration would add significantly to the cost of burning the coal, or more relevantly to the consumer, to the price of electricity. And doubling the cost of a watt is not likely to be popular or accepted under the current situation. Thus while those who see the benefits are often supportive (such as NGO's) the public acceptance is likely to be much more difficult.

The final panel was under the supervision of Daniel Weiss and included Sanjoy Banerjee (who I had met at the reception the evening before), Bill Freudenburg a sociologist, and Tim Appenzeller. In that discussion the time scale of the proposed solutions, relative to the imminence of the problem did come up, but the discussion seemed to focus more on whether consumers would pay more for remediation, with the conclusion being NO. Tim asked "How does one get people to care about an abstract process?" and without pain at the pump or switch, it won't happen.

And on that slightly discouraging note, the conference was really over, though there was a PR presentation from USBC and a stunning presentation of some of the results of the work by Shuji Nakamura on the development of the blue/green LEDs and the power saving that can be achieved with the use of these devices.

And so we left, out into a wet evening, much better informed, and enlightened, yet with some discouragement at the prospects. Oh, and thanks Jim for your tolerence of my scribbling through all the presentations, I appreciated your comments on this site, but modesty forebade that I admit my identity.

(Quiz answer quarter of a kWh)