The Oil Drum: Europe
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Royal Society, Energy... for the future: DAY 1

Posted by Chris Vernon on April 15, 2006 - 12:57pm in The Oil Drum: Europe
Topic: Miscellaneous
Tags: energy [list all tags]

Here I will briefly summarise the papers from the first day of the Royal Society's recent conference. The speakers were:

Sir David King - Chief Scientific Advisor
Energy for a sustainable future

Professor Robert Socolow - Princeton Environmental Institute
Solving Climate Change

Sir Chris Llewellyn Smith FRS - UKAEA Culham Division
The path to fusion power

Dr Sue Ion OBE - British Nuclear Fuels
Nuclear energy - fission: plugging the gap until the potential of fusion is realised?

David Kerr - Institution of Civil Engineers
Marine energy - power from tides and waves

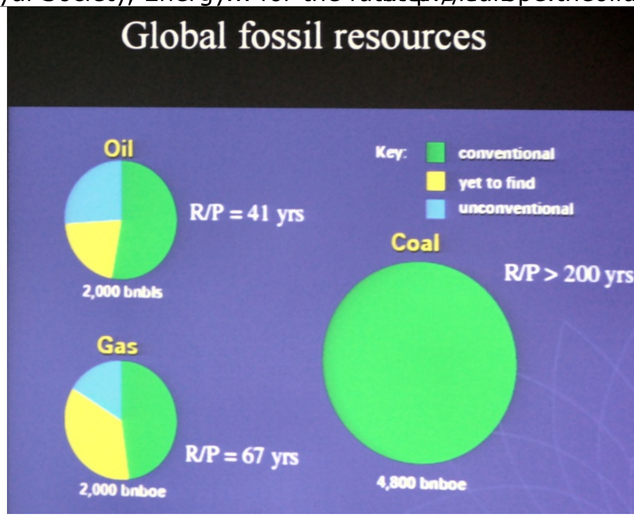
Professor Bill Leithead - University of Strathclyde
Wind energy

Professor Michael Gratzel - Ecole polytechnique federale de Lausanne
Photovoltaics

Christiane Egger - Landesenergiebeauftragter
Energy efficiency in buildings

Sir David King - Chief Scientific Advisor
Energy for a sustainable future

A very solid presentation on climate change, stressing that due to inertia of the global system further warming over the coming decades is inevitable. As a consequence millions of people will face hunger, drought, water shortages and flooding. All governments need to act now to manage the new risks to their people. King was totally clear that anthropogenic CO_2 emissions were chiefly responsibly. He did show one slide about fossil fuel resources:



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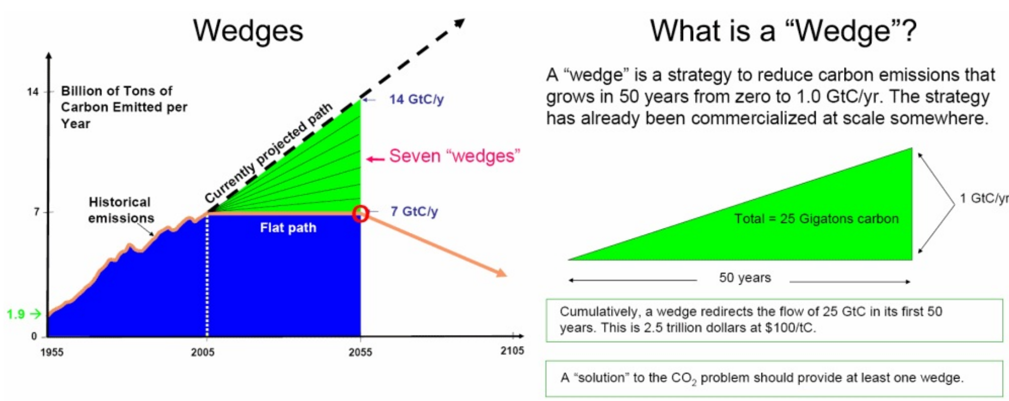
Combining those figures, of 2 trillion barrels remaining (1 trillion conventional and half a trillion both unconventional and yet to find) with an understanding of Hubbert's peak, expected low flow rates from unconventional and what we actually expect from 'yet to find' would suggest an earlier rather than later global oil peak.

These figures were presented to illustrate an abundance of fossil fuels.

Professor Robert Socolow - Princeton Environmental Institute
Solving Climate Change

Forgiving his comments on peak oil the rest of Socolow's presentation was a little more reasonable. He presented the stabilisation wedges framework for tackling climate change. The assumption is that doing nothing will result in a doubling in the rate of CO_2 emission by 2055 and the aim of stabilisation is to achieve the same emissions in 2055 as we have today. To achieve this seven wedges are needed, a wedge being the reduction of CO_2 emissions by 1 billion tons per year in 2055.



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He suggests such a goal is achievable since the current energy system is permeated with inefficiency, CO_2 emissions have only just begun to be priced and most of the 2055 stock of building, vehicles, factories and power plants - everywhere in the world - have not yet been built yet.

The last point is interesting. Our CO_2 emissions in 2055 will be determined by infrastructure we are yet to build, so knowing what we know now there really isn't any excuses for not significantly cutting CO_2 emissions by then.

Sir Chris Llewellyn Smith FRS - UKAEA Culham Division
The path to fusion power

Llewellyn gave an overview of the fusion process: Deuterium and tritium (heavy and very heavy hydrogen) are heated to a few thousand degrees which, through collisions, knock electrons from the atoms to produce plasma. When the nuclei of deuterium (proton and neutron) and the nuclei of tritium (proton and two neutrons) collide they are repelled due to the coulomb force. As you make the plasma hotter and hotter they move faster and faster and so get closer before they are repelled. As temperatures approach 100 million degrees they get close enough such that one grabs the other with the nuclear force - they fuse to make helium, a spare neutron and 17.6MeV.

This energy is in the form of kinetic energy, carried one fifth by the helium and four fifths by the neutron. The helium, due to it's electric charge, is contained by the magnetic field preventing the plasma from touching the walls and deposits its energy keeping the plasma hot. The neutron escapes since it is not charged and deposits its energy in the wall where it is used to generate electricity (thermally in the conventional way).

This heating of a large volume of gas to 100 million degrees can be routinely achieved. Projects to date just haven't been large enough for the resulting helium atoms to sustain the temperature. This is just a surface area to volume ratio problem and ITER should be large enough. Similarly suitable magnetic bottles to contain the plasma are now a reality, further work is on increasing the pressure to increase the number of fusion reactions per unit volume.

The remaining scientific challenge is the wall. The material has to withstand bombardment of several megawatts per square meter of 14MeV neutrons for several years. And the engineering challenge of systems integration.

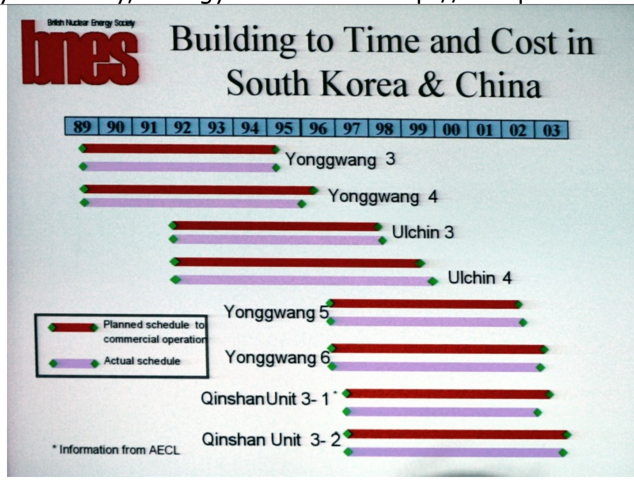
Regarding timings, ITER should be operational with 10 years and in parallel, the material testing facility (International Fusion Materials Irradiation Facility, IFMIF) to find suitable wall materials should, once agreement is reached be built within 10-12 years. The first prototype power stations can be designed in parallel and should be ready to be built after some 8-9 years of data and analysis from ITER. The demonstration power station will take about 8-9 years to build resulting in fully operational power station within 27-28 years from now and commercial power stations maybe 15 years later.

I did manage to have a quick world with Llewellyn after his presentation, I asked him about the long timescales for fusion power with respect to oil/gas depletion within that time scale. He said that he used to think a lot about Hubbert's peak but now believes high prices will make unconventional oil viable so doesn't consider it much of a problem. He does wish Fusion could become a reality faster though!

Dr Sue Ion OBE - British Nuclear Fuels
Nuclear energy - fission: plugging the gap until the potential of fusion is realised?

Ion's presentation made the case for nuclear build based on low CO_2 emissions and security of supply, highlighting the current situation that sees the decommission of much of the ageing UK fleet just as the rest of the world (China, India, Japan, South Korea, Finland and France) are building and as several other countries (US, South Africa, Indonesia and Poland) are making preparations to build.

This slide was shown to illustrate how it is now usual for nuclear power stations to be built to time and cost, with ~7 years being typical.



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She laboured the point that the UK nuclear past is an example of how not to operate a nuclear industry. The UK legacy is one of bespoke designs, eliminating the benefits of reuse, economy of scale, standard operation procedures and creating the decommissioning problems we now face. Future build would be of international designs off the shelf.

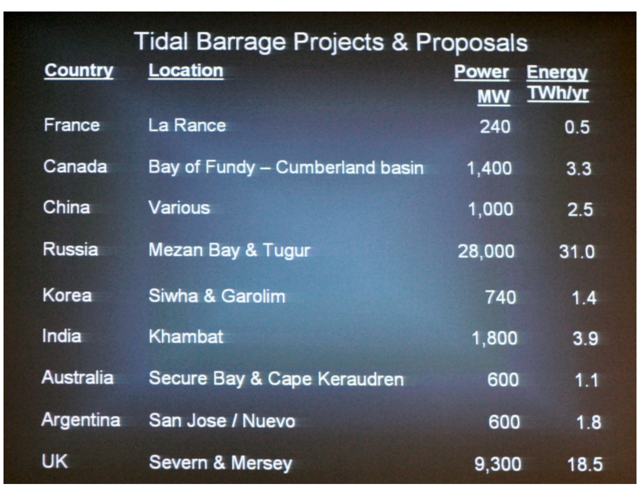
Uranium resource was mentioned in passing - 60 years for international fleet (including Chinese expansion). She was very 'hand waving' at this point so I'm not convinced she really meant to include all conceivable international expansion. She then concluded that fuel recycling would increase this to hundreds of years.

Ion also said that future designs could use process heat in the direct production of hydrogen to reduce CO2 in the transport sector.

David Kerr - Institution of Civil Engineers
Marine energy - power from tides and waves

Three areas, tidal barrage, tidal stream and wave power were covered. Recent reinvigoration of this area has been driven by the search of carbon free energy.

This slide shows the potential for tidal barrage systems, I believe La Rance in France is the only one actually built.


Tidal Barrage Projects & Proposals

Country	Location	Power MW	Energy TWh/yr
France	La Rance	240	0.5
Canada	Bay of Fundy – Cumberland basin	1,400	3.3
China	Various	1,000	2.5
Russia	Mezan Bay & Tugur	28,000	31.0
Korea	Siwha & Garolim	740	1.4
India	Khambat	1,800	3.9
Australia	Secure Bay & Cape Keraudren	600	1.1
Argentina	San Jose / Nuevo	600	1.8
UK	Severn & Mersey	9,300	18.5

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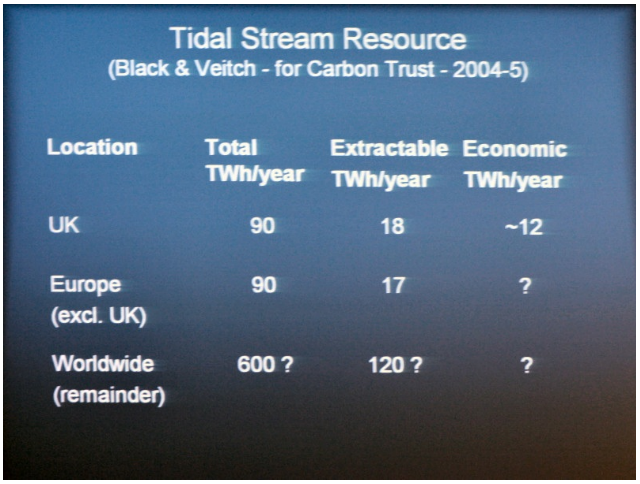
A total of some 64 TWh/y (cf global electricity consumption of 14,317 TWh 2001, link) so a half of one percent.

This slide shows the potential for tidal stream.



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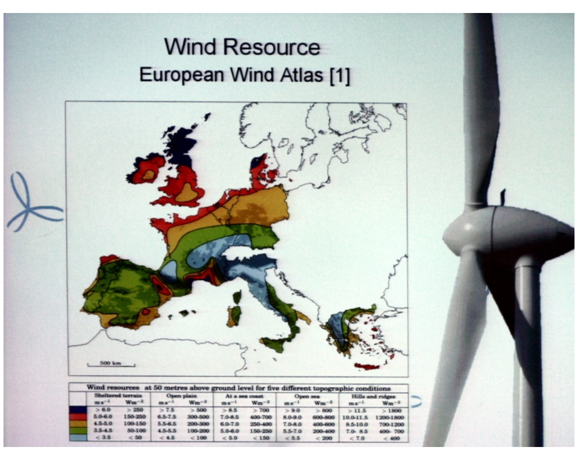
The difference between total and extractable reflects the fact that if more than about 20% of the energy is attempted to be extracted the flow changes, with the water finding an alternative route of least resistance. There's a larger degree of uncertainty surrounding this resource compared to barrages but it could be comparable.

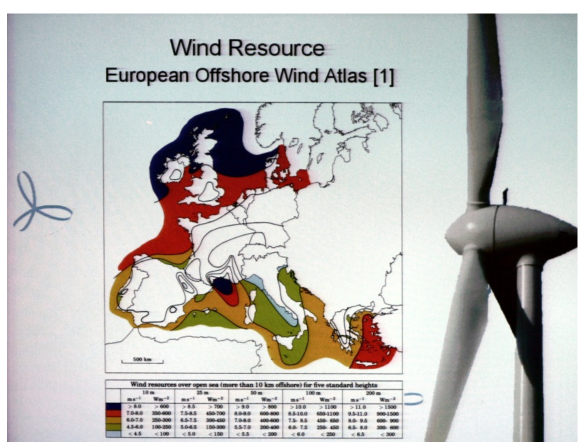
The UK wave resource alone has been estimated at ~50 TWh per year (with most of this offshore) - that's a lot, perhaps 15% of current UK electricity consumption. The history of wave power in the UK is not great, large R&D investment was made in the 70's and 80's but costs were expected to be high, 15-20 pence/kWh and government funding ceased. Nuclear was the fuel of choice during that period with the fleet of AGR power stations being built providing ~10GW.

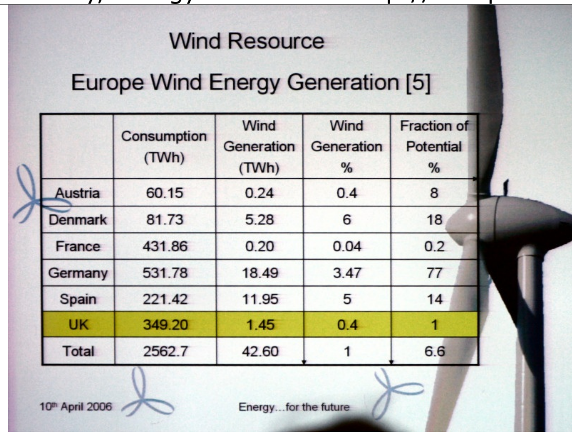
The biggest technical change for wave power is withstanding extreme seas. With wind power the storm winds are energetic but the forces on the structure only go up by a factor of two or three above maximum operational forces. With wave power it's a completely different story with forces an order of magnitude or more higher than you really want.

Professor Bill Leithead - University of Strathclyde
Wind energy

I will be brief here, I think we are all quite familiar with wind energy so I'll just highlight the embarrassing position the UK finds itself in regarding this resource.







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When viewed in combination these slides speak for themselves.

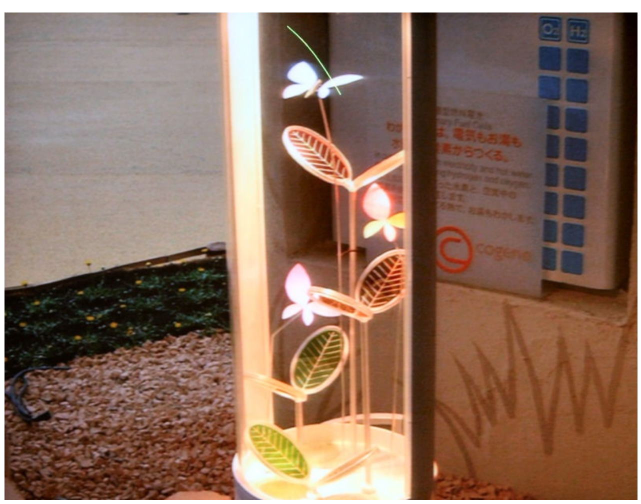
Professor Michael Gratzel - Ecole polytechnique federale de Lausanne
Photovoltaics

Gratzel outlined the situation regarding photovltatics in the predictable way. 100 thousand times more energy reaches the Earth in the form of solar radiation than our current rate of energy consumption. This in itself is a difficult point to make but I assume he is only talking about presently metered energy consumption and not the energy use to dry clothes on the washing line for example or the energy we would have to use to heat the planet from near absolute zero in absence of the sun!

The problem however is the cost. At between $0.25-0.65/kWh (best systems at well chosen sites) energy from photovoltaics is just too expensive. In order to become competitive price would need to fall to $0.05/kWh.

Apparently Shell told Gratzel that “we really need to get away from those dull modules... we need more beauty in photovoltiacs”. Gratzel went on to discuss his translucent dye based photovoltatics, available in multiple colours which could be used in windows. Such panels could be 7% efficient and apparently relatively cheap though I don’t recall him mentioning a price compared to silicon.

This photovoltaic tree was his party piece; the butterflies flap their wings in the sun using the green and red translucent panel.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I can't help thinking that the aesthetics of photovoltaics shouldn't be Shell's top propriety!

Christiane Egger - Landesenergiebeauftragter
Energy efficiency in buildings

Christiane Egger gave the only presentation of the conference focusing on reducing demand. She works for the energy agency, a regional government body in Upper Austria. Her patch covers 12,000 km2 and has a population of 1.38 million people.

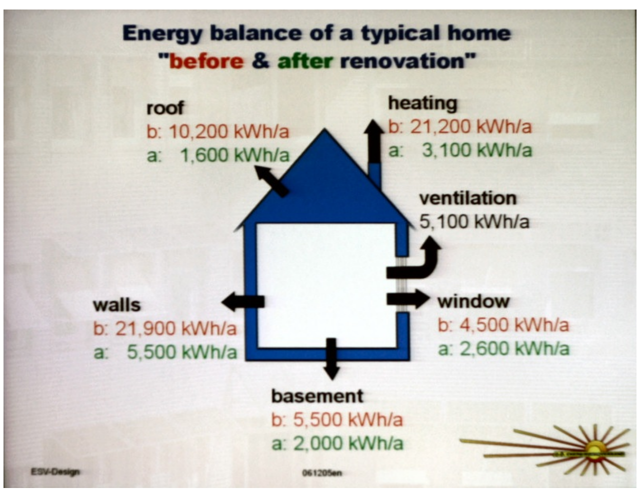
In the mid-nineties sustainable energy became a key government policy and an Energy Action Plan was made to increase the share of renewables to 30% by 2000. This was met with half bio-mass (wood), half hydro and about 2% solar. CO2 is an important driver but also jobs, 15,000 good long term jobs have been created in the sustainable energy field.

Target 1% energy efficiency improvement (1.5% in the public sector) per year.

She did stress that markets can't deliver the required change to our energy systems and said that looking back over the last 100 years nearly all major changes to our energy systems have been policy driven, not market driven.

The difficulty with efficiency is that it's invisible. Whereas a new power station might need three captains of industry, two politicians and three bankers to make it happen, efficiency requires billions of decisions by millions of energy consumers. The biggest problem is that these consumers don't know about energy efficient buildings or appliances. The labelling problem.

This slide shows the improvements possible against a typical 1960's-`70's house (the bulk of houses in Western Europe).



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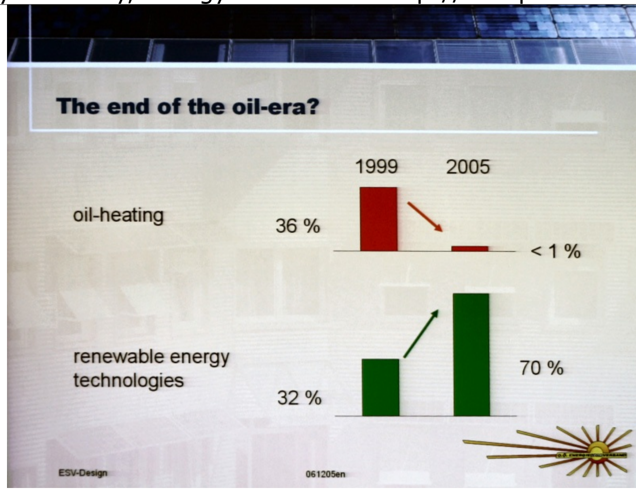
50,000 buildings have been audited and a single figure assigned kWh/m2. Old traditional buildings are 150 kWh/m2 but from 1994 this figure has fallen from 110 kWh/m2 to 50 kWh/m2 for new buildings.

This slide shows the new building heating systems installed - oil heating just isn't being installed any more and 70% of new systems are renewable energy.



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