

## ENERGY MANAGEMENT GROUP NEWSLETTER

### Introduction

Welcome to the Summer edition of our newsletter. As ever, if you wish to contribute any material to the newsletter or have any comments on its content please contact the group secretary, Patricia Thornley ([patricia.thornley@physics.org](mailto:patricia.thornley@physics.org)). The next edition of the newsletter will be published in early September and the deadline for contributions is end of August.

### Bursaries

Group members can apply for bursaries of up to about £250 to contribute towards the cost of attending energy related seminars or conferences. To apply for a bursary please contact Patricia Thornley ([patricia.thornley@physics.org](mailto:patricia.thornley@physics.org)), detailing the event you wish to attend, costs for which you are seeking support and reason for application (e.g. priority may be given to those not in employment or for whom travel costs are a particular obstacle for certain events).

### Energy Management Group Events 2004

The following events are being organised for EMG members this year:

**15 September – Visit to UKAEA Fusion at Culham (morning)** – note that numbers will be strictly limited for this event and, while it is free to EMG members, advance registration is essential-the visit is open exclusively to EMG members until the end of June : – contact Peter Gill ([gill.pf@virgin.net](mailto:gill.pf@virgin.net)). Any spare places will be open to any IOP members until the end of July, then any others can apply.

Note it may be possible to organise transport for this depending on the number of people attending from particular locations.

**18 October – Climate Change and the Role of the Sun** – evening lecture by Professor Haigh of Imperial College, to be held in Manchester (UMIST) at 6.30 pm

**November 17th – One day seminar at IoP HQ to include group AGM – date to be confirmed** – note if there are any particular subject areas that members would like covered at this please let Patricia Thornley know as soon as possible . The provisional title is “ Energy demand-spiralling out of control? “

## Other forthcoming events

### Energy Institute events:

June 8<sup>th</sup> Aberdeen branch ASCO marine base visit - contact Denis Pinto.

June 10<sup>th</sup> W.Midlands and mid Wales branch - lunch and presentation on biodiesel.  
Contact Mike Ward.

June 11<sup>th</sup> S.West,S.Wales & Channel Islands –annual CRE lunchtime lecture. Contact Dr John Whitehead.

July 7<sup>th</sup> Energy Institute-Frank Whittle lecture by Roy Fowkes.Contact Laura Viscione

Sept.21<sup>st</sup> Energy Institute-Towards Zero Carbon,Sustainability in Practice.

Contact Katie Crabb.

## Other energy events

June 7-10<sup>th</sup> Resource 04-exhibition of low carbon & renewable technologies for buildings . Building Research Establishment,Watford.

[www.resource04.com/programme.html](http://www.resource04.com/programme.html)

June 9-11<sup>th</sup> Global Carbon Market Fair & Conference. Cologne,Germany organized by World Bank,IETA & Koelnesse.

[www.carbonexpo.com](http://www.carbonexpo.com)

1<sup>st</sup> July CIWEM Presidential Conference-Science & the Environment.

[www.ciwem.com](http://www.ciwem.com)

7<sup>th</sup> July Climate Change Mitigation & the Law(Newzeye) .Hamilton House ,London.

Contact Joanne Ferris 020-8969-1008

## **Policy and Consultations**

The all party Commons Environment Audit Committee have recently said that the growth in air travel and road transport will make it impossible for the UK to meet the Government target of reducing CO2 emissions from fossil fuels by 60% by 2050-maximum CO2 cuts will be 35%.

## **Other Energy News**

### **Renewable Energy in the Community**

Held on 30<sup>th</sup> March 2004 at ImechE London . Summary follows-full report on website.

When will the use of renewables increase ? Farming communities could use wind turbines and heat pumps to achieve independence from the Grid. Grants need to be increased to promote more use. Jackie Carpenter from Energy 21 Trust (renewables group) emphasized that more reliance on renewables would provide more local jobs as well. This would help environmental problems caused by CO2 emissions. Currently there is a low take-up of technology-UK has the lowest renewable energy use in Europe. Local opposition to wind farms and biomass projects is not helping and there needs to be more public acceptance of the contribution of renewables .Planning permission is another problem area –the public is not yet persuaded that renewables are the answer !

### **Conference Report on the 5<sup>th</sup> British-German Environment forum, Berlin, 5-6<sup>th</sup> February 2004.**

This report can be downloaded from :  
<http://www.agf.org.uk/pubs/publications.shtml>

## Meeting Report

Future of Fission Power –Evolution or Revolution held at IOP 26/4/04

By Richard Mayson & David Weaver.

See <http://policy.iop.org/Policy/HE/index.html>

## REPORT ON THE INAUGURAL INTERNATIONAL ENERGY SYMPOSIUM

Of THE ADAM SMITH INSTITUTE. 15 MARCH 2004. Westminster, London.

Organised by the Energy Policy Unit of the ASI.

### Report by Terri Jackson

In the preamble to this important event the director of the Energy Policy Unit at the ASI Chris Lambert notes “ in keeping with the ASI general free market vision of choice, competition and small government we support the liberalised structure of the UK markets but keep an open mind concerning the need for longer term policy guarantees that will incentivise City investment for large scale new build projects”

The forward work programme of the Energy Policy Unit is designed to provide an independent political forum for the discussion of a range of emerging energy issues between the different stakeholder groups.( Future work will include UK trends in enhanced oil recovery, clean coal technology, LPG, monetarising the externalities of electricity production across the G8 countries and the economics for nuclear new build.)

The first session included government perspectives by Joan McNaughton, Director General of the Energy Group at the DTI, Simon Skillings Head of strategy at Powergen UK and Professor Ian Fells Chair of NaREC. Ms McNaughton went through the aims of the energy white paper and agreed that energy cannot be left completely to the market alone but should operate within the confines of the energy white paper. She acknowledged the necessity for security of supply and emphasised the timing in investment in gas infrastructure was vital as was gas and electricity interconnectors. (Apparently the 1200 MW Norwegian interconnector has been turned down and the proposed Dutch interconnector is only at the planning stage). Simon Skilling did not so much look to the future but was interested in the present and wanted to know if the market was going to deliver certainty to enable companies to invest. In this respect he said it was important to consider three important factors: 1) commodity risk management, 2) policy certainty, 3) products and services that promote customer loyalty in competitive retail markets. Professor Fells was concerned about the intermittency of wind power(in Denmark last year the wind did not blow on 50 days). He noted the figures for generation costs in the new Royal Academy of Engineering report which were 2.2p/kwh for gas, 2.3p/kwh for nuclear, 3.7p/kwh for onshore wind and 5.5p/kwh for offshore wind. However

adding the necessary back up capacity to allow for windless days means the wind figures rise by 1.7p/kwh giving onshore wind 5.2p/kwh and offshore wind 7.2p/kwh. Professor Fells also noted that to give a true analysis for wind it is necessary to include the impact of load factor.

The second session included presentations from Giles Chichester MEP and **Professor John Gittus** risk analyst and Fellow of the Royal Academy of Engineering. Mr Chichester emphasised that security of supply rests in diversity and that the UK should not be dependent on one fuel for more than 25% of supply. He also gave figures for generation costs which were very close to those given by the Royal Academy of Engineering.

Professor Gittus the next speaker was Director of the UK Atomic Energy Authority programme for the water reactor programme, and was Regents Professor at the University of California in Los Angeles. He has DSc degrees from Stockholm and London universities. He specialises in risk analysis to nuclear installations from terrorists and political and insurance risks. His presentation was literally electrifying! With present government energy policy he gave figures for risk from insurance data which estimated that the probability of a blackout by 2024 was far greater in the UK than any other G8 nation. By blackout is meant a 70% loss of electrical power, not lasting for hours but for weeks! The UK will be the least self sufficient in fuels of all the G8 nations. He also noted that political risk indices were such that under President Putin the market perceives political risk is rising in Russia. There is a growing risk of the reliability of gas supplies from Russia. Professor Gittus emphasised that these were not his figures but were insurance risk data and market based. He also noted that Gazprom the Russian state gas company stopped supplying gas to Turkey on 18 February 2004. Russia has also stopped supplies to Belarus and Poland and the Ukraine and Georgia have also been cut off.

The third speaker in this session was Dr Andrei Konoplyanik the Deputy Secretary General of the Energy Charter Secretariat and formerly a minister in the Russian government with responsible for energy. He went through the various supply routes for Russian gas to Europe and of course the prices. He also considered development trends in the European gas market. I managed to get a question to Dr Konoplyanik asking him to tell the audience what proportion of Russian gas reserves were earmarked for China bearing in mind that Russia recently signed an agreement with China to supply oil to China through a new pipeline, and also how much is to be used for internal consumption in Russia. My assessment of his reply was that he completely avoided a direct answer to my question.

After a sumptuous lunch the next session was about energy technologies and strategy and the first speaker was Ms Anneli Nikula the Corporate Advisor of Tellisuuden Voima Oy in Finland and spoke on public perceptions in Finland regarding nuclear new build. She emphasised that public perception in Finland was in favour of the further development of nuclear power and the public regarded the new nuclear plant which was given Finnish parliament backing as essential for Finland to maintain its independence in energy matters. A deep waste repository will also be constructed in Finland. Ms Nikula was followed by Professor James Lovelock who talked about the need to redefine green, thinking here about the green nature of nuclear. He had some searching things to say about where the present green lobby was heading. The final speaker in this session was Michel Poireau Head of Energy Policy and strategy at the EC Commission. He was concerned with public understanding of energy technology, acceptability and conflict of values, and the influence of individual attitudes on energy demand. He said that public support and understanding were critical for the energy agenda. He mentioned the Eurobarometer Survey which surveyed public perceptions in energy in all sixteen Euro states.

There then followed in the final session two keynote addresses by John Ritch the Director General of the World Nuclear Association and Jimmy Glotfelty the Director of the US office of Electricity Transmission and distribution. Mr Ritch emphasised that nuclear power was essential for future world economic development

and sustainable development and he noted that the world demand for energy would double over the next fifty years. The present 440 nuclear reactors in the world accounted for one sixth of world electricity generation. Nuclear power does not emit CO<sub>2</sub> and he noted that both China and India which at present were large CO<sub>2</sub> emitters were both committed to a large expansion of the nuclear element. Also the hydrogen economy of the future needed clean electricity supplied by nuclear power. Mr Ritch also noted that present UK energy policies were going to destroy UK independence.

DTI energy Jimmy Glotfelty discussed the US power black out last year and said it was a consequence of a lack of attention to the electricity transmission system. Fifty million were affected with no power. There was a failure to invest in the transmission system. He also said that the US cannot meet rising demand by using gas plants alone and it was for this reason that the US was expanding its nuclear power plant building programme. While renewables could play a part they will also not be able to meet demand for electricity. Both speakers said that President Bush was committed to further expansion of nuclear electricity for the US.

This concluded the symposium and the delegates were well satisfied with the depth of discussions. The audience was around one hundred and included six members of the House of Lords, the shadow spokesperson on energy, the various energy institutions, the team, the EC Commission and a wide spread of energy experts. Possibly the best energy seminar I have ever attended.

Terri Jackson

## Committee on Radioactive Waste Management

Between July and November 2003 this independent committee was set up by DEFRA. It is not an expert group, but more a societal group. Only few members are technically oriented. Its core function is to ensure public confidence in their work, recommendations, so are actively involved both with stakeholders, but more so with the public, providing them with opportunities to express their views. Their task is to make recommendations on the best option, or combination of options, for the long-term management of radioactive waste, so as to ensure protection of both people and environment.

They hold meetings all over the United Kingdom, making visits to several facilities and *many of their committee meetings are held in public*. On 9th February 2004 in London their closed session was 9-10 am, the open committee meeting lasted 10am-6pm, with public questions to the committee 6-7pm. Any member of the public may attend, but for convenience prior booking is expected. The website [www.corwm.org.uk](http://www.corwm.org.uk) lists the locations of the meetings and you can e-mail [contact@corwm.org.uk](mailto:contact@corwm.org.uk) but I have found that it bounces and so used the fax (020 - 7082 - 8495) or telephone (020 - 7082 - 8491) numbers. During breaks members of the committee are available to talk to the public present. At this meeting about 35 people attended. Apart from the normal expected activities of a committee, 3 special work areas were addressed this time.

The first was to establish the guiding principles of the committee.

- Carry out work openly, transparently, upholding public interest, taking into full account both public and stakeholder views, to achieve fairness of procedures for communities and future generations.
- Recommendations will consider both process and outcome, aiming for a safe and sustainable environment now and in the future.

- They will operate within resource and time constraints, maintaining direction and objectives of the programme and reach conclusions within timescales. Other matters that are raised will be considered in appropriate ways. They will endeavor to present recommendations which have broad support that they believe will provide a solution to the problem.

The second, I would say the major topic of the day, was "public and stake holder engagement" for which the committee is seeking the advice of University College London's Environment & Social Research Unit in the Department of Geography. They are proposing a technique called 'Deliberative Mapping' which has been trialed for 2 years by the Wellcome Foundation and has the ability to unravel multi-criteria assessments using the simplest theoretically valid mathematical scoring procedure giving a performance range of options against criteria, augmented by more qualitative assessments of the reasoning logic or argument used in arriving at a decision ie 'how the participant worked it all out'. The method works with individual or group based deliberations. Specialists, stakeholders and public complete the *same process*. Indeed members of CoRWM will be the first guinea pigs! Sample selection and self selection of the participants, emphasis on scoring and deriving ranking worried some members, but others were more than happy to have data collected on a reasoning processes. The gap between the understanding was never bridged and the lack of representative sampling was lost. Within these constraints, in effect the discussion was saying that scoring will lead to ranking of options with large errors and qualitative but more fundamental understanding of *why* participants are choosing their particular options will be evident from the analysis of reasoning data collected.

The third topic was the waste inventory. Three key questions will need to be considered throughout their deliberations: is the waste inventory adequately accurately known? What criteria should be used in treating Pu, U and spent fuel as waste? Are there any energy policy scenarios that would radically change the wasting inventory? They will be consulting on these issues via CoRWM website. The priority tasks are to report on high and intermediate level wastes that presently exist or likely to exist next century or two. Also low level wastes unsuitable for disposal at Drigg. The technical discussion was kept to a very minimum.

The public's questioning hour consisted of queries being posed on 'how the committee will deal with so and so problem'. Obviously this was premature. At times members stated that they wished to keep away from technicalities.

*Feroze Duggan*

## UK s Onshore Oil & Gas

The lesser known cousin, of the ubiquitous offshore oil and gas, are the much smaller resources on the mainland that have been playing a part since the 19th century in local production and are presently owned by smaller companies. They are now sufficiently interesting that they exist on the DTI website [www.og.dti.gov.uk/information/onshore.htm](http://www.og.dti.gov.uk/information/onshore.htm) Dr. Melvyn Horgan, Technical Director, Star Energy in Hampshire, explained recent developments of the onshore business and potential new opportunities, at the Energy Institute on 9th March, 2004. Some 1900 wells were drilled onshore since 1818 in a number of phases, with a surprising rise during the 1980's:

- Up to 1930's mostly US on surface anticlines in Northern England.
- 1930-1960's BP (D'Arcy) and Esso (Anglo-American). Driven by war effort.

- 1960-1970 active drilling but without good control data
- 1980's : modern seismic methods employed by majors (BP, Shell, Amoco, Conoco). Most of significant discoveries were during this period.
- 1990 - : large companies sold out. *Dominated by smaller companies* now .

There are about 38 areas where fields of 2 million tonnes each of oil exist with the best find at Wytch Farm with 70 million tonnes. The oil is stored in pores of rocks and mainly found in Cheshire, East Midlands, Wessex and Weald basins. The Associated gas fields are smaller with the largest at Salt Fleetby. The ratio of production Onshore/Offshore is 100k/2m barrels per day.

Recovery technology is “fit for purpose”. Expensive North Sea high tech is just not economic at the much lower production rates onshore. Typical the fields are single well, landscaped/trees to screen and local population probably doesn't know it exists. The Rig is basically a crane (derrick plus draw works) and a hydraulic system (mud pumps plus tanks). Almost all fields employ artificial lift mechanisms of some sort to get the production to surface, pumping via the compressibility of the oil itself with beam pumps, down hole pumps, gas lift, etc. Reservoirs are generally low energy systems and without water injection, as there are few readily available sources of water on shore to maintain pressure, the recoveries onshore are generally low <10% of in place oil, with Wytch Farm being the exception. Offshore recoveries are ~ 30% usually and exceptionally 50%. Onshore also has wax deposits compared to offshore. Advances in drilling technology have made a significant contribution to the onshore business: directional and horizontal drilling have allowed *increased well productivity from single surface location* . Wells at Wytch Farm now reach out 15 km under the sea from Poole Harbour. With such technologies possible gas reserves in Wales and under explored areas of Cheshire etc could be better harnessed.

Associated gas is often a problem for onshore fields as flaring/venting is damaging for the environment but treatment and pipeline for export expensive. Gas is usually used for power generation plus liquefied and exported. The only onshore gas field exporting by pipeline is Salt Fleetby. Wytch Farm has some Liquid Natural Gas (LNG) capacity. All others convert gas to electricity on site and transmit the power. So the concept of local delivery of power already exists as a model in the UK system.

So what is the future for onshore exploration? Over 50 companies are involved in new licenses being sought. Three significant fields: Cold Hanworth, Salt Fleetby gas field (ROC) and Avington oil field (Pentex), show there are still significant prizes to be won. Others not developed or are one well fields. Some 40 to 50 exploration wells have been drilled recently, and over 200 exploration wells in total have been drilled, but most developments are on existing fields. Owning land does not give rights to hydrocarbons below, which belongs to the Crown, so licences for mineral exploration are given.

Feroze Duggan and Peter Gill



## Transport Fuels

The Energy Institute has been running a series of seminars on transport fuels, present and future.

Liquid natural gas (LNG) fuels were considered by Roy James of Chive Fuels on 3<sup>rd</sup> March 2004. Environmental pollution arises mainly from the amount of carbon present in the fuel - hydrocarbon smog, Nitrogen oxides NO<sub>x</sub> - city smog, Carbon monoxide CO - a poison, and particulates. LNG, being mainly Methane CH<sub>4</sub> is a clean burning hydrocarbon with a ratio of 4: 1, hydrogen: carbon, has an envelope of 1/10th that of diesel, for all these pollutants. In 1994 the World Health Organisation (WHO) was concerned about microscopic particulates, from diesel, causing lung damage, increased taxation in most European countries. In the UK government grants are provided to offset start-up costs for gas powered vehicles and are exempt from congestion charging. These grants are guaranteed for a period of three years. Now 400,000 trucks run on natural gas, 200,000 being larger than 32 tons GVW.

Roy James argued that LNG (kept at -140<sup>o</sup>C) is preferred to CNG (Compressed Natural Gas held at 200-250 bars) for large intensively used vehicles. He cited a number of reasons including fuel storage and vehicle design considerations. LNG has a density advantage of 435Kg/m<sup>3</sup> over CNG's 175Kg/m<sup>3</sup>, which all adds up to 2.4 times vehicle range for the same mass of fuel carried, increased vehicle payload of 0.75 tonnes and reduced vehicle manufacturing costs. However when fueled-up and garaged venting of methane will occur as even a well insulated fuel tank will heat-up. So for smaller vehicles that are less intensively used CNG is more suitable as fuel losses are more easily preventable.

The speaker said that natural gas is safer than petrol, but less safe than diesel. However gas is operationally equally efficient, in fact gas powered vehicles are quicker.

The LNG refuelling infrastructure is beginning to appear (6 stations so far with a further 4 being built this year including a wind powered station commissioned in January) and is economical if long-term contracts allow amortization of assets. The fuelling station essentially consists of a super insulated vacuum flask, requiring virtually no electricity and a consistent the quality fuel can be delivered each time. A HGV can travel 400 - 700 miles per fuel load. A LNG station can deliver CNG pumped under pressure to light vehicles.

The theme of 'more performance - less pollution' was taken up on 7<sup>th</sup> April 2004 by BP's John Mumford and Paul Beckwith. Considering the 3 major drivers of climate change, air quality and security of supply with energy diversification, they examined road transportation ranging from conventional fuels, biomass and fuel cells. Road transportation is a major contributor to UK air pollution and there is a high priority to develop engines and fuels that will reduce this impact. At present the Well to Wheel (WTW) order in decreasing greenhouse emissions (producing less than 150 g/kg of CO<sub>2</sub> equivalent) are direct injection gas or diesel, hybrid diesel + bio energy, hybrid gas + bio energy and eventually hydrogen fuel cell. Although the fuel cell is best, it is costly, requires production and storage with distribution of hydrogen, expected to be available around 2030. Thus intermediate options are immediately required with low emissions, zero local pollutants and improved use of energy. The introduction of biomass energy will depend upon its availability, economics and supply chain. Logistical and economic reasons are likely to reduce market penetration of conventional bio components (sugar starch and oil crops) to ~ 10%, although if biomass from all societal sources (retail, pharmaceutical etc) were incorporated, then a substantial contribution (30 - 40%) might be made from this source. Therefore in the short term increased optimization of conventional fuels, hybrid vehicles and a reduction of ultra fine particulates are required together with high performance and efficient engine design to cater for both environmental and transportation needs.

The speakers showed tests and trials of BP's improved (Ultimate) fuels, including a test-track comparison using identical cars run at 80mph, one fuelled with conventional fuel, the other with

improved conventional fuel. The test demonstrated a 9.5% better performance for the improved fuelled vehicle together with environmental benefits. The latter were stated as reductions of hydrocarbons (5%), NO<sub>x</sub> (5%), CO (15%), CO<sub>2</sub> (2.5%); reduction of particulates (dependent on velocity) reduced by of the order of 60% at 120 KPH; engine power is increased by 3.5% while fuel consumption is reduced by 3.5%.

BMW's John Hollis gave his talk on BMW's Car of the Future on May 12. He said that car manufacturers now agree that the fuel of the future is hydrogen (whether as compressed gas or in liquid form) and the only questions remaining are what technology will be used (e.g. internal combustion, fuel cell electric or hybrid) and when will it happen. BMW itself have been producing dual fuel cars (liquid hydrogen/petrol) for research purposes since 1979.

Environmentally clean air initiatives take about 20 years to reap rewards. Although cars have emitted less CO<sub>2</sub> since 1995, the increased world usage will mean CO<sub>2</sub> emissions from cars will flatten rather than reduce dramatically. Hollis argued that it is better to remove carbon from the fuel cycle altogether, to achieve IPCC's requirements of 70% reduction in CO<sub>2</sub>. Then, hydrogen fuel is the ultimate candidate, available in unlimited quantities.

The energy density of fuel tanks using petrol and LNG are superior to those with liquid hydrogen. A very effective insulated multi-layer tank storing hydrogen at -253<sup>0</sup>C would have a shelf life of 2 weeks of inactivity losing 2%/day, thus a garage will need to be vented. Safety tests on the tank have included a pointed spike being dropped from a height of 25 metres, a 1000<sup>0</sup>C fire and application of excessive tank pressure. The spike, considered to be reasonable for car crashes, did not pierce the tank; the fire burnt out unlike a petrol tank explosion and at a pressure of 6 bar the tank is designed to fracture neatly. (I personally feel such tests need to be specified more rigorously, as I am sure it will be, when real prototype systems are assessed). BMW have taken the dual fuel approach using a normal petrol car ~ 155 KW with its proven power/weight performance and combined it with hydrogen injection 5 KW fuel cell which has a high starting torque and zero emissions. It is expected, as usual, that innovations will all take place on top of the range cars and then be passed on lower down the ranges, assuming 5 years for building up the hydrogen fuelling network, in 10 years having comprehensive availability and declining financial incentive in 15 years. Their hydrogen infrastructure assumes hydrogen and petrol filling can be done simultaneously at common stations. BMW expect that hydrogen will be sourced from different technologies at different times, initially from natural gas, then wind and solar power. In desert regions hydrogen may be produced using solar energy. Germany, not having oil or gas, is likely to be the greatest driver for hydrogen fuel. UK will also have to import hydrogen. Both for suppliers, consumers and public authorities it will be necessary to form strategic alliances for delivering the required infrastructure, cryogenics and R&D.

To make hydrogen powered land transport a reality BMW have identified six key factors as follows: a clear decision in favour of renewable generated hydrogen as the only sustainable energy carrier in unlimited supply; long-term priority to support hydrogen in terms of fuel taxation; research activities focused on hydrogen issues; development of Standards and Codes of Practice; support for the production of renewable hydrogen; promotion of the idea of a European hydrogen society.

Feroze Duggan & Peter Gill

## Understanding weather calculations

A tall order but increasingly becoming important for the energy physicist to effectively utilise intermittent renewable energy sources which would require forewarning of abnormally still or violent behaviour. In many respects weather forecasting is the other side, almost, of the same coin as climate change, which Richard Bloodworth has examined in this issue.

First is a lecture at the Lighthill Institute of Mathematical Sciences of UCL and Institute of Mathematics and its Applications (IMA) given by Dr Leonard Smith of London School of Economics & Pembroke College Oxford on 17<sup>th</sup> March 2004. Though no history lesson, he traced the role of meteorology and advances in predictability theory over the last 200 years. The theme of the lecture was action under uncertainty. In 1820 Laplace, in the then deterministic world, of perfect laws of physics, perfect present conditions and ability to calculate i.e. unlimited computing power envisaged leading to a perfect forecast. Taking us through uncertainties and errors, and randomness, unpredictability and probability distribution of Galton Board (binomial) and non Galton Board he contrasted the notions of chaos, randomness and model inadequacy. All these were demonstrated using real weather forecasts of recent successes and failures of how ensemble calculations sometimes lead to unequivocal conclusions, while other times the evidence is very weak or inconclusive. The main sources of errors are: knowing the present conditions accurately and having weather data with resolutions of 30 - 40 Km. With these tools it is tricky to decide whether a storm will occur or not when only a few ensemble calculations showing such a signature and sometimes the signature is even absent. How many ensemble members have to indicate a signature before abnormal weather is concluded. These are some of the real life difficulties facing weather forecasters. However with better resolution weather data and the regular improvement in calculational techniques, errors are being reduced and in this century it is more likely to look quite different e.g. in chaotic systems he considers it is better to treat initial errors by using a probability density distribution of initial states leading to a distribution of possible predictions. Better probability of picking up abnormal signatures and an increase in the number of days of accurately forecasting normal weather conditions are both on the horizon.

Following on at the IoP on 19th May 2004 Dr Paul Williams of Reading University elaborated on the issues of the resolution of weather data and potential improvements to calculational procedures, both issues developed from his DPhil thesis at Oxford with Peter Reid and Thomas Haine. First understanding the resolution of weather data required to improve the forecasts. Three distinct modes of waves arise: vortex modes with wavelengths of ~1000 Km, called Rossby waves, divergent modes with wavelengths of ~10 Km called inertia gravity waves and acoustic modes which are sound waves of wavelength of ~1 metre. The weather arises from the energy transfer between these modes. Weather forecasts only include Rossby waves and the resolution of the weather data being say ~ 50 Km is perfectly adequate to pick up its structure, which gives us the present accuracy of the forecasts. Earlier it was thought that inertia gravity waves would not be capable of energy transfer with Rossby waves, but in 1977 it was shown theoretically that energy could indeed be exchanged if the phase speed of the long Rossby wave matched the group speed of the shorter inertia gravity wave. Thus giving us the required resolution required for increasing the accuracy of forecasts by having **data of resolution < 10 Km**. With the present state of the art such data would be available in about 30 years. In 1995 the theoretically predicted energy exchange was tested in a laboratory experiment where strong correlations in the fluid were found that short wavelength inertia gravity type waves would induce an irreversible wave number transition. If we assume that the shorter waves structure cannot be felt by the longer wave, then a stochastic model is feasible. For modelling the transition between appropriate wave numbers a double potential well model would simulate the process. Randomly such waves would interact,

stochastically producing a transition. This is the process of stochastic resonance. For weather forecasting it would amount to including random noise in every cell for which we have data. This process would simulate the energy transfer between the plentiful inertia gravity waves found in the short wavelength region that is presently missing. However introducing these ideas to meteorology has only just begun at the beginning of this century and the finer details need to be proved before being incorporated into conventional weather forecasts. There is the potential for improving normal forecasts from 5 days by a few extra days, probably improving the temporal sequence of projected weather more accurately and also giving us better direction when ensembles predict uncertain weather.

Feroze Duggan

## **Media Reports**

### Independent 18<sup>th</sup> June 2003

The world's first underwater rotating turbine using tidal energy has been installed off the coast of north Devon. The peak output is about 300 kW. The turbine is about 20 m below sea level-the 16m wide blades spin at about 15 revs. per minute. Unlike wind generators, tidal turbines produce predictable amounts of energy for about 16 hours/day. It is not presenting any hazard to marine life or shipping. The cost is about £3m but proposals for a national network of 8-10,000 machines generating about 10GW could bring the cost/machine down to £1m.

### Times July 15<sup>th</sup> 2003

The Government has proposed that one in six homes will switch to wind power within seven years. This would be provided by giant wind turbines with up to 300 turbines in a group. Many of these will be offshore providing 5% of total UK energy supply or 15% of domestic supply. The first round of farms would provide 4% of domestic supply. The advantages are low CO<sub>2</sub> emission with clean energy. The artificial reefs produced would make ideal fish breeding grounds and tourism to view the huge installations would generate additional income. On the negative side, the wind only blows for about 1/3 of the time so other backup sources or storage systems would be needed. The installations are large-80m high with a blade span of 120m and would be at least 3 miles from the shore. Studies show no significant impact on sea birds. Most sites are off the east coast with a proposed site in the North West east of a line from Solway Firth to Rhyl Flats.

### Independent 24<sup>th</sup> March 2004

Big City investors are sceptical about the Government's green energy programme. Most think that the target 10% of energy generated by 2010 will not be achieved. About £10bn of investment is needed-most from the private sector-to reach the target. The DTI survey found ¾ of investors were interested in investing in renewable energy, but were put off by the low level of long term commitment to green energy beyond 2015.

### BBC News 14<sup>th</sup> April 2004

Norway's North Sea oil reserves are running out but there is still 50 years supply left. More reserves exist in the Barents Sea but the extent and feasibility of extraction are unknown. Gas production, however, is expanding.

BBC News 13<sup>th</sup> April 2004

Plans to remove CO<sub>2</sub> from the air have been announced by 2 US companies. The system draws air into contact with a sodium hydroxide solution to remove the CO<sub>2</sub> as sodium carbonate.

Telegraph 13<sup>th</sup> April 2004

The Sustainable Development Commission and Jonathon Porritt have reported that the growth in car and aviation emissions are unsustainable. Labour will not reach its manifesto commitment to a 20% cut in CO<sub>2</sub> by 2010.

Telegraph 16<sup>th</sup> April

Satellite measurements show that part of the ocean circulation connected to the Gulf Stream current that keeps Britain warm is slowing. It is not known whether this has been caused by global warming or is a natural event but it has the potential to change the UK climate drastically.

NASA 18<sup>th</sup> May 2004

NASA are developing a fuel cell to provide electricity from human waste.

<http://science.nasa.gov>

BBC 11<sup>th</sup> May 2004

UK Government could do more to encourage the use of biomass to produce power e.g. from farm and forestry waste in CHP plants.

BBC 6<sup>th</sup> May 2004

The UK is likely to build more waste incinerators which could be used to generate power - no link to any pollution or health problems is apparent.

Times 9<sup>th</sup> May

Utility companies are increasingly reluctant to invest in new plant because of UK Government uncertainty over policy on power generation. Blackouts could follow in the worst case scenario.

Guardian 7<sup>th</sup> May

A recent report on wind farms has highlighted advantages and disadvantages. The UK Government is encouraging development with about £1 bn in the next few years to provide ultimately 9000 MW to meet the Government target of 10% from renewables. Opposition comes from David Bellamy and also the Country Guardian Group, worried about the effect on the environment. 80% of wind farm applications in the last 14 years have been turned down. James Lovelock, the Gaia theorist is another opponent. The Conservative Party is likely to oppose wind farms. The basic problem with wind is seen as cost (2-3 times higher) and intermittency. It is probably more cost effective to save the energy by conservation. The Government needs to make up its mind in the next few years to back renewables or nuclear power.

## Climate change and energy use

The current position adopted by several governments is that climate change is being made worse by our use of energy in two ways; firstly in the increased production of low grade thermal energy as the end result of all energy consumption and secondly by the emission of CO<sub>2</sub>, which as a greenhouse gas is causing the climate to warm up. Doomsday scenarios are portrayed-melting of the icecaps causing the sea level to rise up to 10metres and possible interruption of the Gulf Stream which would make the UK much colder. In a sense, we are being held responsible for climate change via our energy use. Is this realistic ?What is the evidence ?.....

We all know from our own experience that climate varies all the time on a daily, weekly and annual basis. Weather forecasters cannot predict the weather tomorrow with any certainty. Climate records of the past show that it also varies on much longer timescales of thousands, millions or billions of years. The causes of these long term variations are not fully understood, but we do know they were not caused by burning hydrocarbons! We have all heard of the ice ages-the last one ended about 10,000yrs ago. One theory that attempts to explain this is the Milankovitch effect-very small changes in the orbit and inclination of the Earth's axis can be a trigger for change ; nothing we can do anything about. Other evidence of our inability to understand climate is the phenomenon of sky falls. Throughout recorded history, documented and witnessed reports have shown how material can fall from the sky with no apparent cause. Reports have mentioned showers of fish, frogs, toads, shellfish, worms, snakes, seaweed, cobwebs, nuts and berries. A thunderstorm on the night of May 27<sup>th</sup> , 1984 left scores of fish-identified by the Natural History Museum as flounder and smelt -strewn over Newham, East London.

Many similar events have been reported. They cannot all be dismissed as fabrication and exaggeration-something happens occasionally to produce these events which we do not understand-but they are all part of the climate and its effects. I mention these events to show that our ability to explain climate is extremely limited –if we cannot explain these effects, why should we expect to understand global “ warming “?

We know CO<sub>2</sub> is not the only greenhouse gas; methane and water vapour are also important in absorbing infrared radiation from the ground. One estimate by Maurellis and Tennyson (2003) gives water vapour 60% of the greenhouse effect,CO<sub>2</sub> 26%, ozone 8% and methane & nitrous oxide 6%. CO<sub>2</sub> does seem less important than water vapour-and we can't do much about the water! There are other factors that affect climate which lie outside and beneath the Earth.Shaviv &Veizer(2003) studied past climates back to 545 million years ago, looking at CO<sub>2</sub> levels and temperature. They found that more than half the variation of temperature in the past could be explained by the Earth passing through the spiral arms of the galaxy and its associated dust. The Sun also affects climate as its magnetic field varies with time –this can affect the cosmic rays that enter the atmosphere which can promote cloud formation (Morner et.al 2003) .The Earth's magnetic field also has a similar effect and is currently decreasing at a rate of about 1 part in a thousand per year .

Other work has shown the Earth was warmer in the Middle Ages (9<sup>th</sup>-14<sup>th</sup> centuries) with a “little” ice age around 1300(Robert Matthews 2003). It seems that climate change is the result of very many influences ,most of which are beyond our control.CO<sub>2</sub> may well be a very minor influence on any greenhouse effect –politicians should not be considering ‘climate change’ levies on fuels until these effects are more fully understood-particularly as there is little choice of energy source for cars& aircraft and a significant amount of electrical energy comes from burning methane-a greenhouse gas !

Richard Bloodworth

See [www.clearlight.com/~mhieb/WVFossils/global-warming.html](http://www.clearlight.com/~mhieb/WVFossils/global-warming.html) for more details !

## Contacts

This newsletter is produced by the Energy Management Group of the Institute of Physics, a professional group comprising members with interests in all aspects of energy use, energy policy, power generation and energy technologies. Further information can be obtained from the following:

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Contributions to the newsletter from group members are always welcome. In particular if you would like your company or research institute to feature in the snapshot section, please draft a short description and send it by e-mail for inclusion. The deadline for contributions to the September newsletter will be end of August 2004 and all contributions should be sent to the Group Honorary Secretary at the e-mail address above.

For further information on the Energy Management Group see our website at [www.iop.org/groups/emg](http://www.iop.org/groups/emg)

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