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The Energy White Paper: An academic critique

Meeting Report

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Background

"Meeting the Energy Challenge", the White Paper on Energy, was published on May 23, 2007 following several years of intense energy policy review and debate. The BIEE and UKERC one day seminar brought together prominent academics in each of the topics of the White Paper, to present their assessment and critique of the paper and to lead discussion of its implications.

The workshop was structured around the Energy Review Consultation Topics

- Valuing Carbon
- Saving Energy
- Distributed Energy
- Energy Security
- Transport
- Electricity Generation (Renewables Clean Coal and Nuclear)

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Introduction

Vicky Pryce Chief Economic Advisor and Director General, Economics and Joint Head of the Government Economic Service

Vicky Pryce presented a brief overview of the Energy White Paper (EWP), setting the policy and analytical context and identifying some key highlights. The presentation outlined some of the key economic analysis that underpins the EWP policies and explained the conclusions the Government has reached and the action it now wants to take to tackle the challenges.

The EWP 2007 sets out responses to the two key challenges faced in the energy sector:

1. climate change
2. security of supply

The Stern review provided the evidence base for taking action, highlighting the fact that the costs of inaction could be devastating for the world economy. At the same time, the costs of mitigation – perhaps in the order of 1-3% of global GDP in 2050 – would be manageable.

However, tackling climate change is far from straightforward. As countries around the world continue to exhibit healthy economic growth, they also continue to consume energy and emit CO_2. Under the IEA "business as usual" projections, global primary energy demand is expected to rise by 53% by 2030, leading to a 55% increase in global carbon dioxide emissions. Over 70% of the increase in energy demand will come from developing countries and the share of developing countries in world emissions will rise from 39% at present to 52% by 2030. Therefore, the approach to tackling the issues of climate change and CO_2 emissions must also be international.

The UK also has a moral responsibility to act domestically. In line with recommendations by the IPCC and others, the UK has committed to reducing CO_2 emissions by 60% from 1990 levels. This will involve every sector – not just electricity – heat and transport are also important, although it is within electricity that some of the opportunities arise in the next 20 years to move to a low carbon economy and to ensure security of supply. This represents a huge challenge: for example, it is likely that to meet this target, our electricity generation by 2020 will need to be close to carbon-free – a big step from today's technologies and infrastructure.

In parallel with the climate change challenge, the UK is also facing a number of transformational shifts in energy supplies. The production of oil and gas from UK

North Sea is now in decline, moving the UK towards greater import-dependency – it is expected that imports will make up around two-thirds of total UK energy (compared with less than 20% today). This will require infrastructure to import and store the gas to be developed in time to ensure sufficient supplies. The UK will be more influenced by fluctuations in markets elsewhere, such as in the emerging global LNG market or in European gas markets.

There is also the issue of ageing generating capacity; a significant proportion of it will need to close between now and 2020. It is important to ensure that the regulatory framework, including EU ETS and CO2 prices, incentivises the right kind of investment. The UK needs 30-35 GigaWatts of investment in electricity generation over the next two decades and around two-thirds of this by 2020. Around 18GW of capacity will close by 2016, with an extra 4GW needed for possible increase in demand. Current forecasts of gas demand also imply that the UK might need to increase import capacity by 2020 by about 15%-30%. Ofgem have recently agreed funding arrangements, incorporating allowances for capital investment for gas and electricity transmission systems, totalling over £5.1 billion over the next 5 years.

In order to develop robust responses to these challenges, the Energy White Paper went through a rigorous analytical process. Each one of the proposed measures was analysed in terms of its costs and benefits, and the analysis was peer-reviewed extensively.

The three principles underpinning the UK Government's approach to the energy challenges are:

1. Climate change and energy security are international issues, requiring international action as well as action in the UK.
2. Independently regulated competitive markets are the most cost-effective and efficient way to deliver the goals.
3. But there is a need to correct market failures to align the objectives of market participants with the energy policy goals, e.g. through a carbon price.

The UK also has a role at a global level, influencing the future markets and frameworks. The UK Government believes that tradable carbon allowances, if implemented correctly, are the most cost-effective way of reducing carbon emissions within the EU. However, the way EU ETS has worked to date has not been perfect. The White Paper outlines a number of key commitments for the future of ETS. For example, the inclusion of aviation and the importance of reducing the distortions created in earlier phases by increasing auctioning and minimising wind-fall profits generated by free allowances.

At the same time, the Government is working closely with other nations in the run up to Bali in order to start shaping the post-Kyoto framework to ensure global commitment to green-house gas reductions.

Domestically, measures fall into three key categories:

- Save energy
- Develop cleaner energy supplies
- Secure reliable energy supplies at prices set in competitive markets

The most cost-efficient way to reduce CO_2 emissions is to improve energy efficiency. However, there are clearly many barriers to the take up of these opportunities and so the energy efficiency policies are a combination of regulatory standards and market incentives targeted at removing barriers. However, in the longer run, it is also necessary to influence people's behaviour – this is where some of the new technology, such as smart meters and visual displays can have a key role to play. Information and regulation are also important.

In addition to saving energy, the energy consumed needs to be cleaner and less carbon-intensive. In the industrial and business sectors, this will mainly be driven by EU ETS and the Carbon Reduction Commitment. In the domestic sector, this means making the arrangements for distributed generation more flexible and increasing the amount of information available to individuals, developers and communities.

In terms of electricity generation, the more carbon-intensive fossil fuels tend to be some of the most cost effective sources of electricity, even after incorporating a carbon price. This is why the Government is not focusing on a single solution but is taking a range of different measures to tackle CO_2 in the power sector:

1. a stronger EU ETS;
2. increasing the Renewables Obligation to 20% by 2020 on a "headroom" basis and creating separate bands to ensure that a wide variety of technologies is developed and deployed;
3. launching a competition for a full-scale carbon capture and storage demonstration plant in the UK as well as working internationally to ensure the development of this key technology;
4. consulting on whether the Government should allow private sector companies the option of investing in new nuclear power stations; and
5. investing more in energy technology research and development.

In the longer-term challenges, the UK Government is working with UKERC in using the MARKAL model to understand the potential least-cost path to delivering the CO_2 reductions targets. The results indicate that this will result in a complete transformation of the UK's electricity generating mix. This illustrative modelling example suggests that by 2050, very little electricity will come from traditional fossil fuel plants; and that renewables will play a key role alongside other technologies.

In the transport sector, in addition to bringing aviation into the EU ETS, the UK is also increasing the requirement to source some of our transport fuel from renewable sources. However, aside from energy efficiency, transport may not be a very cost-effective source of CO_2 emissions reductions, so while it has to bear its share, there is less of an emphasis on it in the EWP.

Finally, as suggested by the Stern review, investment and collaboration in R&D for new technologies across sectors and countries will be critical in accelerating the pace at which we move towards a low-carbon economy.

In terms of security of supply, a key element of the EWP framework is that the Government should only intervene where there are serious market failures. In the case of gas and oil markets, analysis shows that while there may be some market failures, they are not material enough to warrant further intervention. In oil, the UK already has international obligations to operate an oil-stocking system for use in emergencies. In gas, interventions to artificially and unilaterally increase the level of supply available to the UK market – as an 'insurance policy' against adverse events – do not appear to have a positive cost-benefit and could have serious unintended consequences. Modelling work carried out by Oxera indicates that, as long as planning and regulatory barriers are manageable, the incentives are there for the market to build both import and storage capacity to ensure sufficient gas market flexibility. Therefore, policies here are aimed at maximising the effectiveness of market operation, including removing any barriers, such as planning, that might make it more difficult for investment to come forward.

Risks clearly remain in terms of the market's ability to anticipate and act upon future capacity needs and so the Government is committing to monitoring and publishing scenarios-based forward-looking information and analysis regarding the future supply/demand balance in our new Energy Markets Outlook.

Together with the EU ETS, the measures outlined in the EWP will help save 23-33 million tonnes of carbon in 2020, on track towards the 2050 trajectory of 60% reduction in CO_2 emissions from 1990 levels. However, the science of climate change is moving forward and, together with Stern, suggests that further cuts in emissions may be necessary. Therefore, the Government will of course continue to engage with the international and domestic policy agenda and work on further measures that can reduce our CO_2 emissions cost-effectively. But in parallel, it is of course critical that the measures now in place are delivered effectively. The focus will therefore be on implementation, as much as on development of new policy.

Overview

Professor David Newbery, Cambridge University

David Newbery started his presentation with a summary of what has changed since the last Energy White Paper in 2003: the Stern review has been published, greater awareness of the role of India and China. There has been some policy progress, with the EU ETS and Kyoto, and the energy environment has also changed, with, for example, gas prices increasing. The same challenges still exist today but the problem has got bigger, yet there is still no mention of energy taxes in the 2007 EWP. Taxes vary across countries and between fuels within countries and so reform is important. In the UK, domestic fuel consumption is essentially subsidised by 12.5% due to the lower VAT rate and the policy instruments are currently not optimally set to bring about the desired changes.

Energy price is important and electricity is not price inelastic as is often thought. A tax on energy affects price which in turn affects demand over long periods of time, consequently affecting investment and consumption decisions that determine energy intensity.

Reductions in the electricity sector are likely to be the easiest and energy consumption in heat needs to be a priority. Reductions in the transport sector are likely to be the hardest to achieve. 56% of person emissions, under an individual's immediate control, are in the home which is where taxes are peculiarly perverse.

What is needed to encourage investment in low carbon options? Policies aren't generally about prices - many policy instruments address quantities rather than profits or loss, since international negotiations are easier based on quotas. The claim is that these give a predictable estimate which provides certainty to investors. However, such polices may not be providing the correct signals for the market and investors. For example, within the EU ETS, prices varied considerably and did not produce a predictable, certain price for investors.

Security of supply is not an issue for the UK – the country is not strongly interconnected to the continental electricity system and it also operates on DC rather than AC. Future gas supplies from more unreliable supplies are negligible, with more reliance on imports from Norway and of LNG.

A high level of investment in electricity infrastructure is required in the UK, with long lasting implications for the system. France has demonstrated that it is possible to cut the carbon intensity of electricity over a relatively short time frame if there is the commitment to do so. France had a large and sustained investment in nuclear which transformed the carbon intensity of the sector.

Carbon Capture and Storage is currently the least economic option but is an important technology for China and India. The EWP is ‘wishy-washy’ on the nuclear issue (and it is optimistic to consider that any new nuclear will be delivered by 2020) and it is silent on underwriting the future carbon price.

The UK does not have a good track record in delivering wind capacity. Even in Germany where they are delivering 2500 MW of effective capacity, this only represents 10% of what France achieved through its nuclear programme. This raises the question as to whether it is wise to rely so much on wind.

The Renewable Transport Fuel Obligation is likely to have serious adverse consequences by driving up food prices, which is morally irresponsible and unnecessary, given that transport fuels are already heavily taxed. Biofuels are not an intelligent approach to reducing the carbon intensity of transport. The cost of carbon per km (assuming 25€ per tonne) is not all that different across different modes of transport – train, car, air. The MARKAL least cost modelling approach also indicates that action in the transport sector is likely to be least effective. The easiest way to reduce carbon in transport is to reduce weight but this is unlikely to be acceptable – observed price mechanisms suggest that transport is something that people are prepared to pay a high price for.

Despite lots of good intentions, the Energy White Paper does little to reassure investors and, strangely, has no mention of taxes. The emphasis on renewables is the most costly option which maximises uncertainty. It would be better to specify a carbon price (a floor underneath carbon prices would encourage investment) or have capacity auctions.

Valuing Carbon

Professor Michael Grubb, The Carbon Trust

Michael Grubb based his presentation on two main discourses around carbon – what should the cost of carbon be and which instrument is best?

What should the cost of carbon be?
The theory of costing carbon is straightforward – add in non-market impacts, integrate across world and over time – gives you an answer. First raised in 1992 and since then there has been 15 years of debate over the issue – ‘extended footnotes’.

The PAGE model used in the Stern Review was capable of producing a wide range even given constant ethical parameters. The analysis found that under a range of physical impact assumptions, but without variation in ethical parameters, the cost of carbon will rise. However, the model has come under some criticism about its sensitivity: two of the ethical parameters were the top two in a sensitivity analysis conducted by Hope & Newbery; analysis by DICE found that changing just three of the parameters could increase the cost of carbon by a factor of 40.

The Stern Review provided a language and clarity to allow economists and scientists to talk to each other. Stern has been called to task for some of his parameter assumptions and some internal inconsistency in the assumptions used – eg treatment of inequality vs discounting over time.

Cost-benefit analysis usually assumes a normal distribution of probability, but in the case of climate change, this does not apply - economists cannot really apply cost-benefit analysis to a problem of this type.

One of the main conclusions from this is that uncertainty around climate change is sufficiently high that it is not possible to identify policy options on a mathematical basis. Stern is right but for the wrong reasons – scientific views should dominate. There is no empirically grounded answer but a long term precautionary approach is sensible.

Which is the best instrument?
Literature has long considered two instruments dating back to 1929:

- using taxes to correct for externalities
- an equilibrium achieved though a market price reflecting externalities ('cap and trade')

These two have been treated essentially as the same instrument despite the fact that they have opposing characteristics e.g. in terms of who gets the money.

The classic Weitzman (1972) argument suggests superiority of carbon taxes over quantity constraints – if the marginal benefits of abatement are flatter than marginal cost (on the cost-benefit graph). For example, if CO_2 damage from emissions today are effectively the same as tomorrow then the marginal benefit of near-term abatement is almost flat and the marginal cost of near-term abatement is steep. The implication is that the best way to deal with climate change is to set prices at the best estimate of the marginal price/social cost of carbon.

However, the relative magnitude of the uncertainties throws the Weitzman argument into question. The determinants of theoretical optimum policy are much more subtle than classical Weitzman. Damages uncertainty is actually far bigger than the marginal cost range and mitigation today may have a big influence on mitigation tomorrow (stock lifetimes, etc). The Stern Review distinguishes between tax in the short term and a quantity constraint in the long term, but didn't actually specify how to move from one to the other.

A rational carbon pricing policy has to be international, and yet this brings two additional considerations to the fore:

- Additionality

- Political economy

How much of the global situation do we unilaterally reflect rather than conditionally reflect in decisions – e.g. to what extent do we make decisions conditional on action at a global level? Ideally, we should aim to consider what we can do moderately cheaply and effectively and undertake this unilaterally, particularly if it reduces exposure later on.

The international aspect introduces additional complexities. For example, how to base international treaties on carbon prices when underlying economies and taxes vary hugely. Political economy problems of taxation are also multiplied many times at the international level. Political economy and the capacity to evolve are paramount.

Basing a UK carbon price instrument on the EU ETS policy potentially makes sense but with a number of provisos. The establishment of a single CO_2 price across the EU is a big achievement but greater auctioning capacity is essential. Phase 2 of the EU ETS is an improvement but it will reveal further problems along the way. Eventually it may evolve towards a hybrid scheme with a price corridor. Whilst the ETS is effective in achieving operational abatement it is not currently effective in supporting low carbon investment.

Neither the White Paper nor the UK Climate Change Bill really solves the problem of ‘low carbon investment security and time horizons’. One of defining features of a low carbon society is capital intensity – many of the options require a big investment up front, which will be highly contingent on the assumed discount rate. There is a fundamental dilemma between policy goals and investment decisions in a market orientated approach.

The EWP appeals for a strengthening of the EU ETS but this core instrument is not in UK control. The Climate Change Bill seeks to create a serious institutional structure to set national goals at least 15 years ahead but these are quantity goals whereas industry investment relies on price.

Hence our theories are still not adequate for the needs of policy.

Saving Energy

Dr Brenda Boardman, Environmental Change Institute

The Energy White Paper is a difficult document to deal with – somewhat like a complex jigsaw puzzle.

The carbon task is huge – CO_2 emissions are approximately the same level now as they were in 1994. Climate science indicates that we need at least an 80% cut but we are not making any progress towards this so far.

However, although the task is challenging it is still possible – the 40% House study illustrated how to achieve a 60% reduction from within the UK housing stock: two-thirds from energy reduction and a third from low carbon technologies. This does not require any new technology, just commercialisation of existing technologies. It is important to reduce demand first so that money is not wasted on unnecessary technologies – this also increases security of supply. These reductions are possible if the will is there.

As an example, there are major opportunities in lighting: halogens and GLS bulbs will be phased out so that nothing less than an efficacy of 40 lumens per Watt is available on the market. LEDs with an efficacy of 150 lumens per Watt are expected to be economically viable in just 10 years time.

There needs to be careful consideration of the emphasis on energy efficiency – many of the more efficient fridges available on the market are also bigger and therefore have higher energy consumption. It is energy conservation that is required – it is not just about efficiency.

Dr Boardman doesn't agree that the domestic sector is subsidised and believes that taxes would have little effect: electricity consumption has increased marginally between 2002 and 2006, despite a 44% increase in price – there has been no visible energy saving as a result of this price increase.

Increasing prices are a particular problem if you are fuel poor. Fuel poverty was a central feature of the 2003 EWP but lacking in coverage in the 2007 EWP. However, the Government still has a legal obligation to eliminate fuel poverty for the vulnerable by 2010 and for all by 2016 (Warm Homes and Energy Conservation Act 2000 in England and Wales, with similar legislation in Scotland and Northern Ireland).

Most of the reduction in fuel poverty between 1996 and 2002 was mainly due to falling fuel prices. Now that prices are increasing, the number of households in England in fuel poverty has doubled between 2004 and 2006 and will increase further if prices continue to rise.

Paragraph 10.32 of the EWP states that 'As incomes are assumed to rise faster than fuel prices, the central case will fall to around 700,000 in 2016'. However, for most fuel poor households, their income comes from benefit and it is therefore up to the Government to decide whether their income increases through setting the benefit levels. If incomes do rise, then it will increase the amount households could spend on energy, which is not good from a carbon perspective - energy efficiency is the one certain way of removing people from fuel poverty but it is not mentioned in the EWP.

The policies announced in the Energy Review and EWP are expected to deliver a further 23Mtonnes of carbon by 2030. If all works perfectly with the Climate Change Bill, this will achieve a further 26% reduction. But will the policies announced actually deliver?

A large proportion of the reductions are dependent on utility action, which is meant to cover electricity and gas in both the domestic and non-domestic sectors, but focus to date has been more on the domestic sector. The range of options is currently out to consultation so it is uncertain as to what will be delivered. And it also depends on how the polices are implemented – compare with disclosure where European legislation has been implemented at the absolute minimum in the UK reducing its impact.

In terms of buildings, the Energy Performance Certificate is being brought in as a result of the European Energy Performance in Buildings Directive, which will cover all buildings in the domestic sector by December 2007. The label is crucially important – on its own it will be pretty ineffective but will be very powerful if combined with other policies e.g. mandatory minimum standards. The UK currently has a large number of inefficient properties. Houses built to current building regulations are at the B/C border on the label and there is virtually nothing better than this built in the UK yet. Ironically, 3.9 million English houses fall into the G and F categories which are defined as unfit for human habitation under the Health Housing and Safety Regulation Scheme. It is difficult to see how this might work in practice?

In order to transform the housing market, today's average has to become the minimum standard and today's best must become the average – but there is no evidence in the EWP that the Government has taken this on board.

Product policy is also important – domestic lights and appliances account for 25% of all electricity consumption. There is quite a lot of activity at EU level – the UK will find it difficult to have influence as one amongst 27 countries. But there is the opportunity for the UK to take the lead and introduce a voluntary action on inefficient bulbs – this would be up to industry since as a traded good, such action cannot be enforced by the Government. This could result in 1.3Mtonnes carbon saved by 2020.

In summary, the EWP contains some useful initiatives, but has no overall vision and lacks a sense of urgency.

Distributed Energy

Professor Goran Strbac, Imperial College

Goran Strbac considered the treatment of distributed energy in the Energy White Paper. His view is that although the EWP lists the key issues, it doesn't give a clear direction. However, here is currently not enough information available to give a confident decision between centralised vs decentralised, so perhaps this is not surprising.

The background to the centralised electricity system is that it was developed after WW2 to support economic development. The system enabled bulk transport of electricity, through various stages, until it reached the point of demand. Centralisation provides a means of control – demand is passive and generally uncontrollable and needs to be met by ensuring sufficient generating capacity, the generators being controlled by the system operators.

A key characteristic of the system is that the system has to be bigger than the load required – generation capacity utilisation is around 55%. Efficiency levels are up to a maximum of 60% (for combined cycle gas turbines) – the rest of the energy is lost and ends up heating rivers. Distributed networks can cause disruption to the system and reduce system performance.

There are a number of drivers behind a move to change the current centralised system. The UK infrastructure has a number of ageing assets that will need to be replaced soon. New forms of generation are emerging as a result of the climate change challenge, which are quite different to conventional plants e.g. wind, CHP. Security of supply is becoming more important. The present system is not very smart and it is not easy to incorporate developments in new information and communication technologies which could lead to a complete change in the philosophy of the system. The supply industry has not yet taken on board new demand response techniques which could have an impact on future investment.

Distributed systems consist of a variety of generation technologies being connected at various points in the system. There are significant challenges in integrating renewables into the present system. The framework is currently being developed around the incumbent system – whilst this has delivered in past, it is now necessary to change, but this process is still at the early stages.

The choice essentially comes down to the efficiency of operation. Centralised systems generate in bulk and have huge losses in heat. Distributed systems allow options to use this waste heat in a variety of ways, giving an efficiency of up to 80%. The UK has not taken to distributed energy systems in a big way so it is difficult to compare these two futures comprehensively, although there is considerable experience in Europe.

The Ofgem/DTI Review identified a number of key barriers to distributed generation, including cost, electricity industry issues, regulatory barriers and lack of reliable information.

The number of measures mentioned in the EWP in support of distributed generation is modest in terms of capital investment and will not bring about any major changes.

Within a distributed system, demand diversity and size of the electricity system are important. It is too difficult to try to balance supply and demand at the household level. Ideally the system needs to have a minimum of around 10000 consumers, which results in a coincidence factor of around 10% and gains all the benefits in terms of diversity. Such a system would only require low and medium voltage, not high voltage, thus reducing costs. Development of heat networks in the UK would be an important factor in helping to develop distributed networks to enable the heat from generation to be used effectively.

Massive developments in demand response and storage are both important for distributed networks. More work is required to understand the full economic, environmental and security performance of distributed energy systems.

In terms of competitiveness, the cost of higher levels of centralised systems (e.g. generation and transmission) is often used to compare the costs of distributed systems. However, it would be more accurate to compare with lower levels of the centralised system (i.e. at the distribution level) since this is where the actual competition between distributed and centralised exists. These local levels are significantly more expensive than higher levels in a centralised system. This requires further information and analysis.

Microgeneration can have a big impact on losses as installed capacity increases. The savings are potentially high – but the question is whether the savings are sufficient to make distributed generation work.

Significant progress has been made in the UK to achieve cost effective integration of distributed generation, but this needs to be taken further to develop a full blown level playing field. There is a lack of the necessary skills and resources, both in the UK and abroad. The case for distributed power is not yet clear – there is an urgent need to undertake the necessary comprehensive analysis.

Energy Security

Professor Jonathan Stern, Oxford Institute for Energy Studies

When defining energy security, both domestic and international dimensions need to be considered. The energy security definitions in the Energy White Paper are overwhelmingly concentrated on external risks. By contrast, most of the important energy disruptions experienced in the UK over the past decade have been domestic rather than international. For instance, the Rough storage incident in February 2006 disrupted 80% of gas storage, but this incident is not mentioned in official documents despite the substantial price increases which occurred in its wake, and the fact that had it happened at the beginning (rather than the end) of the winter, the consequences would have been much more severe. Storms, such as those in January 2007, which led to widespread power outages, are also not considered to be an energy security issue. Indeed, in the UK, incidents which result in consumers losing their energy supplies only appear to “count” as security problems if they have been caused by foreigners.

The main reason the UK energy policy has become more concerned about security since 2000 is that the country is moving from exporter to importer, and therefore feels vulnerable to external dependence, at a time when the external energy environment has deteriorated significantly. There is very little that the UK alone can do to influence the external energy environment. As far as the geopolitics of oil is concerned, the UK is unlikely to be able to exert much influence on conflicts in the Middle East. In relation to gas, UK relations with Russia are currently among the poorest in Europe and UK policy is unlikely to have a significant impact in this area either.

The White Paper appears to take the view that lecturing and lobbying other countries to promote open and competitive energy markets will be an effective international energy security policy. This is unlikely to be the case. The merits of open and competitive energy markets cannot obscure the fact that the UK is not willing to recognise the security shortcomings which have resulted from its gas and electricity market frameworks.

As far as gas is concerned, it can reasonably be asked whether security of supply will be a problem in future. The UK market framework has successfully encouraged infrastructure build, although this happened at least two years too late, resulting in the supply problems in 2004/06. The UK currently has an excess of import capacity which will increase in future, and although much of the capacity does not have firm gas behind it, supply is likely to be possible to procure, albeit at uncertain prices.

The major problem of gas security is the uncertain rate of decline, and increasing unreliability, of UK Continental Shelf (UKCS) supplies. Failure to anticipate faster than expected production decline arguably caused the 2004-06 problems, and frequent minor outages continue to have a significant short term effect on prices.

The UK has a low level of insurance in respect of major supply and infrastructure “shocks” – whether internally or externally caused. In order to deal with such shocks, provisions for surge production or storage capacity would need to be made. However, such provisions would require altering the current market framework and therefore unacceptable to policy makers. For example, because strategic storage would have a negative impact on the development of commercial storage, this is not being pursued.

There is an assumption that electricity generated from domestically produced energy sources is more secure power generated from imported fuels, but this is misplaced. All UK domestic generation options involve security risks: renewables because of their intermittency, nuclear because of the risk of breakdown and accident. Only coal has few obvious serious security (as opposed to carbon) problems because of the ease of transporting and storing the fuel, combined with a range of supply sources.

Lack of resilience of production and network infrastructure to weather-related events and catastrophic technical failure or accident, need to be added to the existing security definitions and risks in the White Paper. Despite the fact that most of the academic, policy and media literature on security is focused on the international risks, the way forward for policy should be to recognise that most recent UK energy security incidents have been caused by domestic supply and infrastructure failure. The continued ageing of offshore and onshore infrastructure means that such risks are unlikely to diminish. But since these problems are not recognised in the White Paper, it will be difficult to devise policy solutions.

Future energy security events are as likely (and probably more likely) to have domestic, rather than international origins. The inability of the UK’s market frameworks for both gas and electricity, to adequately address insurance investments, and the unwillingness of policymakers to change those frameworks, should be addressed in a transparent fashion. If policy dictates that insurance investments are not justified by the balance of costs and risks, the vulnerability of the country to unexpected and unforeseeable supply or infrastructure breakdown – however caused – needs to be clearly stated as a policy decision.

Transport

Professor David Banister, Transport Studies Unit, Oxford University

David Banister started his presentation by emphasising that transport is important! However, there is very little of substance on transport in the Energy White Paper – transport is expected to make an unspecified contribution but there are no explicit targets. The relative and absolute contribution from the transport sector to CO_2 emissions are both expected to increase by 2010.

There have been a variety of measures used in the transport sector. For example, the fuel duty escalator. However, in 2000, as evidence was starting to show that it was becoming effective, it was abolished. Since then duties have not been increased, although the 1.9Mt of carbon reductions is still being used in savings calculations.

Road pricing has been successful, but this has been more about congestion rather than energy – environmental issues have not been a major feature. The London congestion charge both decreased congestion and reduced CO2 emissions by 15%, as well as improving local air quality, although these environmental factors were not included in the initial analysis for Transport for London. The process involved a substantial amount of consultation which is important in developing an effective policy. However, pricing & transport are only mentioned once in the EWP. The fact that that pricing can be an environmental as well as congestion tool is not covered.

The EWP does outline three main options for transport: voluntary standards for fuel efficiency, biofuels and the EU ETS.

Voluntary standards don't work – what is needed is mandatory targets with car manufacturers. The UK Government has been promoting these but without much progress. For every one hybrid sold, 25 SUVs are sold, so there is a long way to go.

Biofuels are seen as the main mechanism by which transport can make a contribution to carbon reductions through the Renewable Transport Fuel Obligation. However, there is a major question as to whether biofuels can deliver or if they are even appropriate. In the UK there is no debate yet about where the biofuel required under EU Biofuels Directive would be produced. The scale of change required is substantial – it will affect most/all of UK production to transport – but it is not necessarily a good use of this technology.

The UK Government is active in the debate around whether transport should be integrated into or separate to the ETS. There are lots of unknowns e.g. around radiative forcing, but this shouldn't be a reason for inaction.

The EWP quotes a range of savings from transport, the lower level being equivalent to the expected increase in emissions from transport if looking at a stabilisation target. The higher figure results from just stabilising emissions not contributing to reductions – this is the best that it assumes transport could do.

Hence transport has an uneasy role in the energy debate – the escalator was abolished, voluntary measures are ineffective and biofuels are suspect. Most initiatives are coming from the EU at present.

In terms of the way forward, the scale and nature of the challenge has been underestimated. It is likely that we will be travelling more but perhaps in a slightly more efficient way. Four main ways to reduce transport energy consumption:

1. Making fewer trips
2. Encouraging modal shift away from the car
3. Reducing trip lengths
4. Encouraging greater efficiency in the transport system

Reorganisation of lifestyles, cities, businesses is needed to allow shorter trips. Increasing load factors are a big determinant in efficiency – there is a lot of capacity available to be used. Technology may result in slower and noisier flights but there is also a need to travel less.

The VIBAT project looked at a 60% CO_2 reduction target in transport between 1990 - 2030 under two scenarios. A key feature of the scenarios was that the policy measures need to be in packages – policies are not effective alone and need to be used in combination to get close to the required targets. Strong behavioural change and technical innovation are necessary to achieve a 60% reduction. The major problem is the expected growth in travel – which is assumed to be high. Cost of carbon was not included in this study but it is important to widen the debate to incorporate the Stern agenda.

The key conclusions are:

1. Important to open up the debate about the issues raised in the 2007 EWP with all stakeholders – barriers to implementation, sector based targets and making energy central to transport decision making
2. Raising public awareness and getting active involvement in seeking solutions – take ownership and individual responsibility for change
3. Low Carbon Transport Innovation Strategy, the King Review and the communications strategy on smarter driving – some progress
4. Air transport – huge issue not addressed here and only covered through the EU ETS in the 2007 EWP
5. Behavioural change must lead debate and actions needed, as technology innovation on its own cannot succeed

Electricity Generation – Renewables

Professor Catherine Mitchell, University of Exeter

UK is currently around 7th in Europe in terms of installed wind capacity but it is about to be overtaken by other countries and will soon be at the bottom of the ranking. Deployment of renewables is down to the policies employed. It is not just an issue of technology; consideration also needs to be given to the wider system. Changes to the framework are crucial to enable renewables to happen.

The primary support mechanism for renewables in the UK is the Renewables Obligation (RO). However, there is a perverse economic incentive on suppliers not to fulfil their obligation – if they did meet their obligations; they would no longer benefit from the recycled funds collected from not meeting the obligation, which are then sent back to them. The RO is a risky mechanism because the only thing that is fixed is the percentage obligation – how the supplier fulfils this obligation is left to them. The RO has not encouraged new entrants and was previously non-banded resulting in support for the cheapest rather than the less mature technologies.

Renewable electricity represents 4.4% of UK electricity generation. There is a discrepancy between the RO and the amount of renewable electricity generation – performance hovers around 60% of the RO met. The amount of renewable energy used to generate heat is actually decreasing.

The EWP 2007 contains an aspirational target of 20% renewables by 2020 on a 'headroom basis' – meaning that the target will always be set 6% above what has been achieved e.g. if renewable generation reaches 14%, the target will be set at 20%, so it will be absolutely related to how much is generated.

There is little in the EWP on renewable heat.

The major change in the EWP is banding of the RO. This will only be effective if it allows the new technologies to become competitive. If the extra funds provided through the bands aren't sufficient then it won't work. This makes a complex system more complex and its success is highly dependent on getting the ROC value right.

There is another problem building – the devolved administrations are putting in additional measures which will lead to different incentives in different parts of the country with a knock on effect as to where certain technologies will be developed (ie where it is most attractive for investment).

Infrastructure is a major problem for renewables – the current system doesn't fit with new technologies but this system has a long life. The rules around offshore transmission are still unclear. There is a need to 'connect and manage' (effectively priority access) - a feed-in tariff with priority access to a large extent bypasses many of the problems.

A major failing of the EWP is that it failed to take notice of the EU Action Plan which the UK signed up to in March prior to EWP in which it committed to 'a binding target of a 20 % share of renewable energies in overall EU energy consumption by 2020'.

The EWP also lacks a long term strategy beyond 2020 which is crucial since energy infrastructure is so long term. The important thing is that the mechanisms are risk free and allow for new entrants. Innovations tend to happen in smaller companies.

The UK currently has a closed system so incumbents can take things at their own rate.

In conclusion

- Lack of long-term strategy: does not deal with urgency of CC
- Missed opportunity: scandalous lack of commitment to EU Action Plan and there is a need for a new WP for the Action Plan – already
- Limited interconnectedness between electricity, heat and transport
- Limited system view eg renewables requires policy, institutional, market, infrastructure and planning to be supportive together
- RO now even more complex: banding will do little
- Potential problems for English developers as devolved administrations add extra support

Electricity Generation – Clean coal and CCS

Dr Jon Gibbins, Imperial College

Jon Gibbins (with co-author Hannah Chalmers) assessed the EWP from the perspective of exam markers. He compared the inclusion of various terms between the 2003 and 2007 EWP and found that there was a marked increase in the number of mentions of both CCS and nuclear, indicating a shift of emphasis.

Jon then went on to assess various sections from the EWP in terms of what it was promising to deliver. One statement 'CCS demonstration in the UK could save 0.25 - 1.0 Mt/yr of carbon by 2020 (depending on the size, technology and the number of demonstration power stations built)' was about a factor of 10 out compared to what CCS could deliver[1].

Jon also raised concerns about the criteria for assessing the CCS demonstration projects – specifying that these projects must store around 90% of the carbon dioxide produced is a bit restrictive. This represents the maximum possible and rules out the possibility of being flexible in terms of when capture is used or not, since it may not always be appropriate. It would be better to specify a level of 80%.

Jon then went on to compare the EWP with documents relating to the European energy policy. CCS did not feature strongly in the EU documents. The European approach now includes a binding commitment for 20% of total energy from renewables by 2020 and also significant energy demand reduction. This would allow a 20% reduction in CO_2 emissions without the need for CCS, unless these targets are not, in fact, met, eg demand increases, renewables deployment lower etc.

It is critical to get global agreement on serious action to tackle climate change and bring in China and India – this requires demonstrating CCS technology on a commercial scale, which the UK could take a lead on. The developing countries are looking for leadership – more of a political point rather than an economic one but also important.

The aim is to have CCS rollout globally from 2025 but this can't happen without a sustained effort to get it fully proven by then. There is a critical path to follow which

[1] Jon Gibbins, Stuart Haszeldine, Sam Holloway and Jonathan Pearce, John Oakey, Simon Shackley and Carol Turley, "Scope for Future CO_2 Emission Reductions from Electricity Generation through the Deployment of Carbon Capture and Storage Technologies", Ch. 40 in "Avoiding Dangerous Climate Change", Ed. Schellnhuber, H.J., Cambridge University Press, 2006, ISBN: 13 978-0-521-86471-8 hardback, ISBN: 10 0-521-86471-2 paperback, pg. 379 (http://www.defra.gov.uk/environment/climatechange/internat/pdf/avoid-dangercc.pdf)

requires starting immediately. There is a very big difference in gains to be made between having one learning cycle and two learning cycles before rollout.

There are currently a number of CCS projects planned in the UK – both full CCS and others capture ready – most will get built, but possibly slowly.

Coal and CCS have a low marginal cost compared to high cost LNG (because they are not paying the carbon price). Therefore, having a coal option, with an option for CCS, is a great way to negotiate reasonable LNG contracts.

The carbon savings from distributed generation using fossil fuels (i.e. gas-fired CHP) are modest (e.g. perhaps 15% emissions reduction compared to conventional generation and condensing boilers) and so not enough – need to have CCS instead.

Using CCS involves a different mindset – the aim is to produce less carbon rather than be economic with fossil fuels – hence there is a trade off between using more fossil fuel per unit of energy output but releasing less carbon. CCS will be the only way to avoid dangerous climate change unless people can be persuaded to leave large amounts of fossils fuels unused for ever.

Electricity Generation – Nuclear

Professor Gordon MacKerron, SPRU, University of Sussex

Nuclear power is now coming back up the agenda for a number of reasons:

- Political fall-out from Chernobyl has receded
- Oil and gas prices higher/less stable: prospects of large hydrocarbon imports – all badged as ‘security’
- The international revival in nuclear investment now seems real: a *vital* context
- Climate change now being taken more seriously (although not the most important factor)
- Nuclear power is well-established, offers bulk baseload power and has small carbon footprint

The future economics for nuclear are likely to be better, with a number of things weighing in its favour. Big project management techniques have improved and, crucially, operating performance has increased significantly - 85-90% performance is now not uncommon – this transforms the economics.

The EWP contains two main arguments in favour of nuclear:

1. ‘Nuclear is a genuinely low-carbon option’: a good argument (comparable to, if not better than renewables in terms of CO_2 emissions)

2. 'Nuclear improves security of supply': a less clear-cut argument, especially since it won't be until 2020 before the first plant could come on line.

The economics of nuclear are still clouded in uncertainty. Although the UK now has an agreed policy on waste /decommissioning it is still yet to be implemented. There are still significant risks with the technology – the Finland EPR is already two years late and 20% over budget due to some fairly major problems and contending designs are significantly more complex and different (and therefore a higher risk of problems/delays). The liberalised market may raise obstacles in the UK that don't exist in other countries – there is a trade off between competitiveness and the internal learning resulting from a monopoly utility. The French carefully scheduled labour and site teams as part of their nuclear programme so that the learning and knowledge was transferred between sites.

The Government's economic analysis is based on a cost-benefit of nuclear vs gas. This is an appropriate framework given that gas is the main competing fuel. However, the assumptions are conservative but somewhat flawed – it is a hybrid part economic/part financial analysis. Therefore the results have limited meaning. A positive 'welfare' balance is not same as being attractive to a private investor, but it is probably important to have this as a basis for the analysis.

The reality is that there is a huge amount of uncertainty over what the economics might be. The UK has no control over carbon price in ETS which is a problem for investors looking at nuclear power. The high cost estimates are possible but not conservative enough given the recent experience in Finland. And the forecasts of gas prices are probably over-influenced by recent turbulence/price rises.

The 'Facilitative action' package contains four key elements:

- Generic design assessment, or pre-certification of designs: following US model. This would mean that the safety cases don't have to be considered from scratch each time. But many designs submitted and few resources available – this will take 3 years or more
- Changes to planning regime and 'National Policy Statement' – intended to force public inquiries to consider only local issues. Whilst laudable this may not be deliverable.
- Requiring private operators to meet 'full share' of back end costs. Unlikely to be problematic
- 'Justification' process for new practices involving radiation –will depend heavily on economic justification

Overall, there is very heavy weight being placed on some untried initiatives.

A new departure is explicit consideration of ethical issues in the EWP and nuclear consultation, in particular equity between future generations. Creating new waste has a different ethical aspect to the legacy of existing waste. There is no definitive answer – it depends very much on own views about the future of nuclear.

In conclusion:

- Nuclear has re-emerged as a genuine contending option, and much of this is due to an international revival in nuclear fortunes
- Substantial cost uncertainty will persist until reactors have been completed in countries comparable to the UK, and even then forecasting will be difficult
- If nuclear makes it, a substantial 'programme' will be likely in order to minimise costs, but it will also raise major CO2 and security risks if the programme falters (investment 'lumpiness' problem)
- Government economic analysis is not very convincing
- 'Facilitative actions' are critical, yet to be tested - and bear very large weight

What the costs and characteristics of future energy technologies will be, and how markets and individuals choose to use these technologies, is one of the principal and fundamental drivers in the evolution of energy systems. Future technology cost and choice is also critical in assessing the costs of energy policies, across a wide spectrum of public policy goals. These include price and non-price mechanisms, supply side policies to push technologies forward or demand side policies to pull technologies into the market. Future technology characteristics are instrumental in meeting key energy issues ranging from economic competitiveness, environmental protection and emission mitigation, security of supply and equitable access to energy services.

In response, a major ongoing effort by the energy modelling community has sought to better understand and incorporate this key driver of technological change into their energy models. This has included understanding the interacting process of technological change from basic R&D through innovation and market diffusion with multiple feedbacks between these stages.

Furthermore the underlying features of the systems context in which technologies develop and the pervading issue of uncertainty regarding technology characteristics needs to be addressed. In addition a range of observed features in technology innovation and diffusion need to be considered and explicitly modelled (if feasible) including learning by doing and learning by using, negative and positive spill-overs in the development and use of technologies, path dependency, clustering of interlinked technologies, non-economic barriers to use, and regulatory and infrastructure constraints to technology market penetration.

Technological change can be modelled autonomously or endogenously. Autonomous technological change is not explicitly driven by market conditions within the model and tends to be calibrated to past experience in technology improvements and uptake of efficiency measures. In practice such a route can yield interesting insights, especially in smaller energy markets where global assumptions can be made exogenously. With this approach, in the nearer term, care is taken to utilise the insights of the expert knowledge, recent trends and other bottom-up metrics of energy improvements.

Programme

Seminar Programme

The Energy White Paper: An Academic Critique

Tuesday 25th September 2007: 10.00 - 4.00

09.15 Registration

10.00 Introduction: Vicky Pryce Chief Economic Advisor and Director General of Economics BERR.

10.30 Overview: David Newbery, Cambridge University

11.00 Valuing Carbon: Michael Grubb, The Carbon Trust

11.30 Coffee

11.50 Saving Energy: Brenda Boardman, Environmental Change Institute, Oxford

12.20 Distributed Energy: Goran Strbac, Imperial College

12.50 Lunch

1.30 Energy Security: Jonathan Stern, Oxford Institute for Energy Studies

2.00 Transport: David Banister, OUCE, Oxford University

2.30 Electricity Generation

a. **Renewables**: Catherine Mitchell, Warwick Business School
b. **Clean coal and CCS**: John Gibbins, Imperial College
c. **Nuclear:** Gordon Mackerron, SPRU, Sussex University

4.00 Tea

List of Attendees

BIEE in association with UKERC and The Energy Institute

The Energy White Paper: An Academic Critique

One Day Seminar, September 25th 2007
DBERR Conference Centre, 1 Victoria Street, London, SWIH OET

Title	First name	Surname	Organisation
Mrs	Tera	Allas	BERR
Ms	Judith	A-Cherni	Imperial College London
Miss	Alice	Attenborough	Centrica plc
Prof	David	Banister	OUCE, Oxford University
Mr	Mike	Barclay	WWF-UK
Mr	Christopher	Beauman	European Bank for Reconstruction and Development
Mr	Simon	Bennett	Imperial College London
Mr	Martin	Blaiklock	Independent
Dr	Brenda	Boardman	Environmental Change Institute
Mr	David	Buchan	Oxford Institute for Energy Studies
Mr	Ian	Burdon	PB Power
Miss	Chiara	Candelise	Imperial College London
Miss	Hannah	Chalmers	Imperial College London
Mr	Modassar	Chaudry	University of Manchester
Dr	Mona	Chitnis	University of Surrey
Miss	Jaruwan	Chontanawat	SEEC University of Surrey
Dr	Peter	Connor	University of Exeter
Mrs	Ann	Cormack	BIEE
Mr	Nigel	Cornwall	Cornwall Energy Associates
Ms	Katie	Crabbe	Energy Institute
Mr	Peter	Craig	Peter Craig Consultants Ltd
Mrs	Elisabeth	Cuthbertson	BERR
Dr	Athanasios	Dagoumas	University of Cambridge
Mr	Matteo	DiCastelnuovo	Imperial College London
Ms	Angela	Druckman	University of Surrey
Mr	Colm O	Duibi	Bord Gas
Mr	David	Fitzsimmons	Oakdene Hollins
Ms	Emily	Flatt	OFGEM
Dr	Tim	Foxon	University of Cambridge
Dr	Jack	Frost	Johnson Mathey Fuel Cells
Dr	Jon	Gibbins	Imperial College
Prof	Michael	Grubb	The Carbon Trust
Mr	John	Hall	John Hall Associates

Mr	Nick	Hartley	Oxera Consulting
Mr	Charles	Henderson	Independent
Mrs	Debbie	Heywood	BIEE
Mr	David	Hirst	Hirst Solutions Limited
Ms	Anouk	Honore	Oxford Institute for Energy Studies
Mr	David	Hough	Indepen Consulting
Prof	Lester	Hunt	SEEC University of Surrey
Mr	Jack	Jenkins	Hurley Palmer Flatt
Mr	David	Joffe	Imperial College London
Mr	Sudhir	Junakar	Cambridge Econometrics
Ms	Mayu	Kano	Japan Petroleum Exploration Co. Ltd.
Dr	James	Keirstead	Imperial College London
Mr	David	Kennedy	The Office of Climate Change
Prof	Matthew	Leach	CES University of Surrey
Mr	Hugh	Lee	Independent
Mr	Philip	Li	BP
Mr	James	Logan	Rolls-Royce plc
Mr	Mathieu	Lucquiaud	Imperial College London
Prof	Gordon	Mackerron	University Of Sussex
Miss	Deborah	Mann	Global Insight
Mr	Alaric	Marsden	Ernst & Young
Prof	Catherine	Mitchell	University Of Exeter
Prof	David	Newbery	University of Cambridge
Mr	David	Odling	Oil & Gas UK
Mr	William	Orchard	Orchard Partners London Ltd
Mr	Peter	Osbaldstone	National Grid
Mr	Koji	Otobe	Japan Petroleum Exploration Co.Ltd
Dr	Ritsuko	Ozaki	Imperial College London
Ms	Jane	Palmer	UKERC
Mr	Mark	Partington	Trading Emissions plc
Prof	Peter	Pearson	Imperial College London
Dr	Michael	Pepler	Ashden Awards
Mr	Andrew	Porter	PricewaterhouseCoopers
Ms	Joanna	Robinson	BIEE
Dr	David	Saal	Economics and Strategy Group
Mr	Tunji	Salami	Herriot Watt University
Mr	Kevin	Sara	Imperial College London
Mr	Norman	Selley	Hess
Dr	Anser	Shakoor	Imperial College London
Prof	Jim	Skea	UKERC
Miss	Stephanie	Squire	Imperial College London
Prof	Jonathan	Stern	OIES
Prof	Goran	Strbac	Imperial College
Mr	Stephen	Stretton	Cambridge University
Mr	Paul	Tempest	Windsor Energy

Mr	Davy	Thielens	Kema
Dr	James	Tipping	Redpoint Energy
Dr	David	Vincent	The Carbon Trust
Ms	Judith	Ward	UK Business Council for Sustainable Energy
Dr	Jim	Watson	SPRU University of Sussex
Mr	Aaron	Webb	Gemserv
Mr	Daniel	Widdon	Fulcrum Consulting
Dr	Mark	Winskel	University of Edinburgh
Mr	Chris	Winter	British Energy