The Alternative Energy Report

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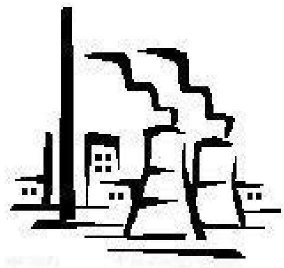
Executive Summary

The construction of new nuclear power stations will need to be subsidised, most likely through increases in electricity bills. This report discusses how the Government can achieve reductions in carbon emissions much more cheaply through investment in demand reduction, combined heat and power and renewable energy.

A nationally organised programme of demand reduction, financed through revenues from gas and electricity sales, can deliver massive energy savings that will reduce consumer bills. This programme would be focused on the commercial, public, industrial and domestic sectors. The Renewables Obligation can be expanded to deliver carbon savings at lower costs compared to nuclear power.

The Report analyses a selection of measures which fall outside current Government policies and programmes. These measures would deliver reductions equivalent to almost 40 per cent of UK electricity-related carbon emissions by 2020 – nearly 30 per cent through demand reduction and combined heat and power and 10 per cent by expanding the Renewables Obligation from 15 per cent by 2015 to 25 per cent by 2020. This set of measures would be achieved at no net cost to the economy – indeed, there would be some savings. By contrast, even if there was 'fast-track' replacement of all of the nuclear reactors due to retire by 2020 this would generate no more than 8 per cent reductions in electricity-related UK carbon emissions by 2020.



1. Nuclear power will increase consumer bills

The Government intends to build new nuclear power stations. Because no nuclear power has been initiated since the electricity industry was privatised in 1990, logic dictates that subsidies of some sort will be needed to finance a new round of nuclear power stations. These subsidies are almost certain to come from increases in the electricity bills that consumers pay.

This report looks at ways in which the money spent on nuclear power stations could be spent on other measures which will reduce carbon dioxide emissions and fuel use by greater quantities and at lower cost compared to spending on nuclear power. We focus on demand reduction, combined heat and power and renewable energy, and we count only those measures which do not feature in existing Government policies, programmes or projections. We deal with the electricity and gas sectors since these are the sectors that are the main focus of this Energy Review

Inside this report:

Delivering the measures

See Page 8

- **Demand Reduction Obligation**
- **Regulatory changes for energy efficiency**
- **Expand the Renewables Obligation to 25 per cent by 2020**
- **Much better incentives for CHP**
- **Good rates for micro-power**
- **Personal carbon credits**

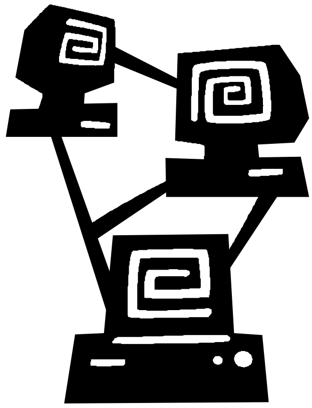
2. Government bias against demand reduction

The Government's Energy review document is biased against energy efficiency. The Government describes barriers to energy efficiency without offering significant means of overcoming them (DTI 2006). It quotes evaluations by the Carbon Trust (2005a), but which only confirm this bias in favour of nuclear power over demand reduction. For example, the Carbon Trust identifies some 0.8 million tonnes of cost-effective annual carbon reductions out of 6 million tonnes of annual carbon generated by the public sector, yet the Government suggests a mere £20 million as a means of capturing this resource. In fact, even on the basis of nuclear supporters own estimates, it would take roughly £1 *billion* worth of investment in nuclear power stations to save these carbon emissions – and that does not take into account continuing fuel and maintenance costs for nuclear power and also questions about whether nuclear power does reduce carbon emissions at the rate that its advocates claim.

In addition, the Carbon Trust's own financial yardsticks for evaluation of energy efficiency measures are much stiffer than those being applied to nuclear power. The Carbon Trust evaluates energy efficiency with a fifteen per cent discount rate, meaning projects will have to pay back in less than 5 years. On the other hand nuclear power stations built by what will be consumer-subsidised 'project finance' (where banks loan most of the money at low interest rates) will have discount rates of no more than 5 per cent and payback periods of ten years or longer.

Energy consumers do not have access to long term financing options for energy efficiency measures– they are short of money, need rapid returns, and lack time and information about action to take. The obvious solution to this problem is to finance energy efficiency from a national funding programme so that longer payback periods can be used to finance measures guided by centralised expertise. This is already employed in the fledgling Energy Efficiency Commitment applied to the domestic sector. Specified types of individual efficiency measures (e.g. cavity wall insulation) are funded through a levy on domestic gas and electricity prices paid by consumers. This principle needs to be dramatically expanded, especially to the services and industrial sectors.

The Government should organise the central funding of demand reduction in industry, commerce, the public sector and the domestic sector, and evaluate this on the same basis as project funding for large power stations. Demand reduction needs to become a central, rather than marginal, contribution to supplying energy services and reducing carbon dioxide emissions. Also, the Government is overlooking key, cheap, practical means of delivering energy efficiency through the realignment of various regulatory policies. We shall elaborate some proposals for delivering demand reduction later in this document. In addition we shall suggest some means of promoting combined heat and power. Combined heat and power is a cheap, low carbon means of delivering energy but it is being forgotten in the rush to find ways of subsidising nuclear power.



A national programme of investment in **Building Energy Management Systems** will save more energy than is produced by two big nuclear Power Stations

The Government describes barriers to energy efficiency without offering significant means of overcoming them (DTI 2006).

3. Government failure to support renewables obligation

However much we reduce demand, we are still going to need to reduce the carbon content of the fuel supply. We need major investment in this area. Yet the Government is not even establishing the policy mechanisms to achieve its own renewable energy targets. It has so far refused to extend the Renewables Obligation target from 15 per cent of electricity supply by 2020 to the 20 per cent 'aspiration' that was mentioned in its 2003 White Paper (DTI 2003). We believe that even this 20 per cent figure is too small and, in our study we examine the costs, carbon savings and practicalities of extending the renewables obligation to 25 per cent of electricity supply by 2020. Even more than this is technically possible.

Planning acceptance rates for windfarms are much better than media impressions. Careful analysis suggests that 20 per cent of electricity from wind power alone by 2020 is a practical proposition. There are plenty of other renewable energy sources.

In addition the Government is failing to come up with clear mechanisms of how to pay for grid connection of offshore windfarms, something which is essential to the attainment of the renewables obligation targets. Developers are postponing plans for offshore windfarms. By contrast the Government is set to 'guarantee' payment of funds that developers need to build nuclear power stations.

Planning acceptance rates for windfarms are much better than media impressions

4. Evaluating carbon reduction strategies

This report evaluates the relative effectiveness of various deliverable carbon reduction measures in the UK's consumption of gas electricity. Our method is to assess the amount of deliverable carbon savings from different, selected, sources as well as the cost (per tonne of carbon saved) of delivering those sources to the energy consumer. We emphasise two points. Note that a) we have not had time to consider many cost-effective demand reduction methods, and secondly that b) **we include only those measures that are fully deliverable though centrally organised funding programmes or changes in regulatory policy**.

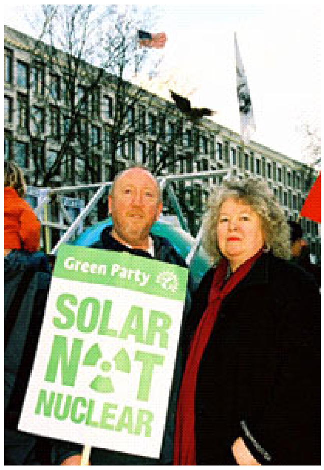
CCGT plant. In the case of energy saving measures the cost of the different measures is calculated relative to retail consumer energy costs for gas and electricity. In the measures we have chosen these costs are lower than the cost of supplying energy, by varying amounts, after taking account of the annualised cost of the capital investment in energy saving.

When we have calculated this cost of supplying (or saving) energy we then divide the cost by the carbon savings made to produce a cost of saving per tonne of carbon saved.

eration from nuclear. We make no account for losses of carbon savings owing to secondary emissions in fuel preparation, although there are claims that these are considerable.

In the case of renewable energy the existing Government target is for 15 per cent of UK electricity to be supplied by renewable energy. We assume that this is increased by 10 per cent over 15 years in addition to the existing renewables build-up.

We assume that the non-nuclear measures are progressively introduced over the 15 year period so that the full value of all the measures is in evidence at the end of the period.
We assume September 1st 2005 energy prices as appropriate for the sector under consideration.



Principal Speaker Keith Taylor and Jean Lambert MEP

We have collected data on costs and savings from a variety of sources, including a various studies produced by the Carbon Trust. Assumptions upon which the individual measures are based are set out in the following text.

However, there are some important common yardsticks. First, we assess all options on the same financial basis, that is a five per cent discount rate over a 15 year period on all investments. As explained earlier this is broadly the same as that which will be applied to project-financed large power stations such as nuclear power. Second, in order to relate our study to the costs of supplying energy services to the consumer, we calculate the costs of supplying the carbon savings relative to the costs which energy consumers would otherwise avoid using available alternative sources (the opportunity cost principle).

So, in the example of electricity production, we assume that the alternative to providing renewable or nuclear electricity is governed by the cost of electricity supply from a new combined cycle gas turbine (CCGT). Using September 1st 2005 wholesale industrial gas prices this will be around £26.5/MWh (2.65 p/kWh). Hence, in Figure 1, the costs of renewables and nuclear appear as 'positive' costs, since their generation costs are higher than the cost of electricity from new

Hence, adapting Jackson and Robert's description (1989, p5-6), we have:

$$\frac{\text{Cost of energy saving (£/MWh)}}{\text{Carbon savings made (tonne/MWh)}} = \text{Cost of saving carbon (£/tonne)}$$

We calculate the amount of savings that can be achieved over a 15 year period for a range of measures, as shown in Figure 1. We assume an end-of-2005 start. Our calculations concern measures that would not otherwise have taken place through current policy.

We use Government data on energy in the Digest of United Kingdom Energy Sources and also Energy Consumption in the UK (DTI 2005). We assume Government projections that UK electricity consumption will increase from 340 TWh in 2004 to 381 TWh in 2020. In the case of nuclear power we make the 'heroic' assumption that the nuclear industry's demand for a 'fast track' approval and construction of new nuclear plant is achieved by 2015. We assume that this would replace the generation coming from the nuclear power stations that are due to retire by 2020. Hence we have five years' worth of gen-

We include only those measures that are fully deliverable through centrally organised funding programmes or changes in regulatory policy.

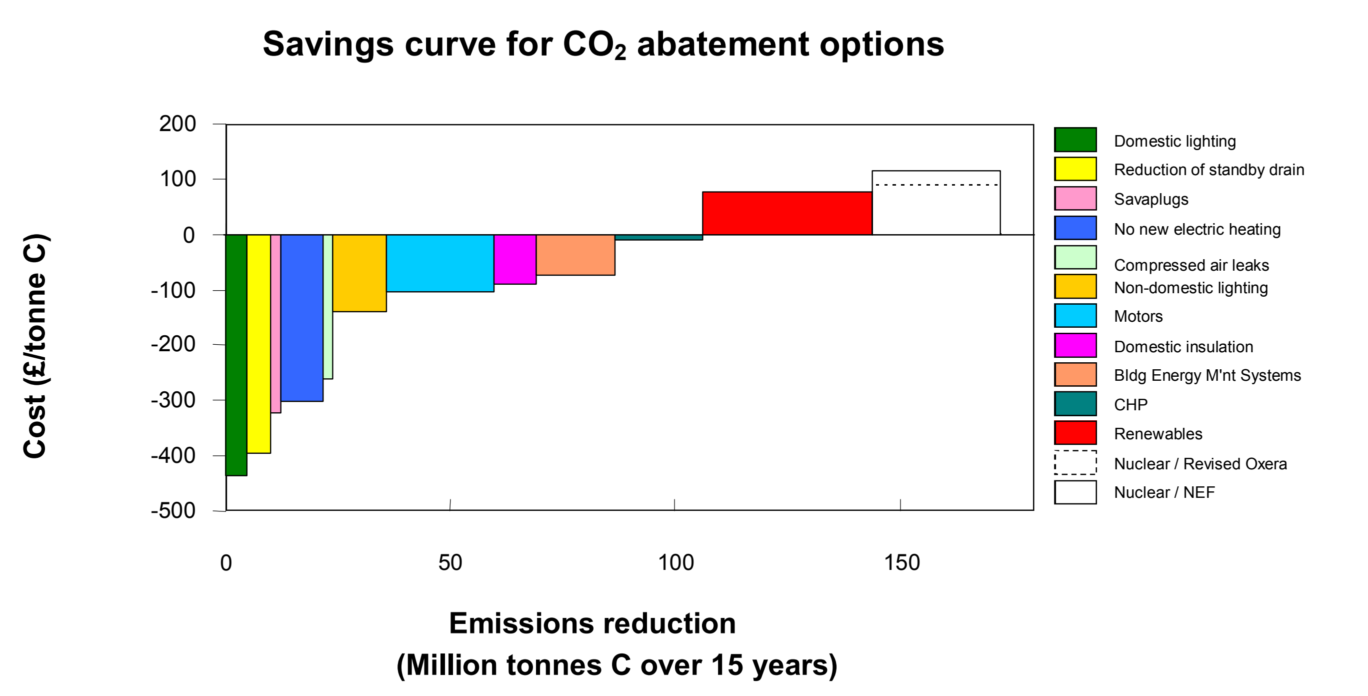
A national programme of retro-fit **lighting efficiency measures** in services and industry will save a lot more carbon emissions than a large nuclear power station

(FACING PAGE) - <u>Charts showing selected carbon reduction options that are not included in current Government policies plans or programmes</u>

Figure 1 shows the quantity and cost of carbon saving that can be achieved in 15 years. Even if we assume unrealistically rapid deployment of nuclear power the amount of carbon saved through nuclear power over the next fifteen years will be around 28 million tonnes of carbon compared to nearly 150 million tonnes of carbon saved by the (much cheaper) measures mentioned in this report. The limited energy efficiency and renewable energy programmes so far organised in the UK have been broadly implemented according to original cost estimates. However the nuclear industry has habitually produced projects that have grossly overrun projected costs and timetables

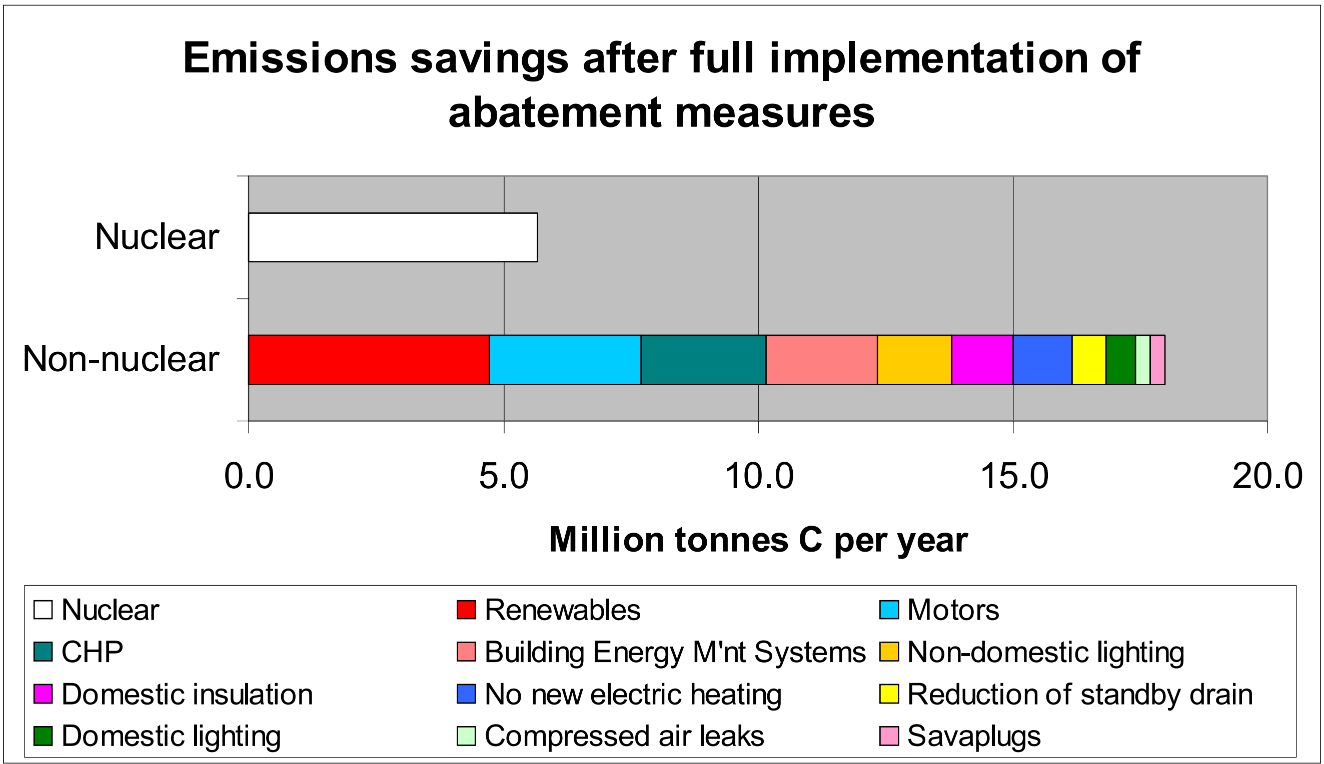
Figure 2 shows the annual savings in carbon emissions that are achieved after the full implementation of the measures. The non-nuclear measures constitute the equivalent of a reduction in annual carbon dioxide emissions from the electricity sector of nearly 40 per cent of present levels. This is well over three times the maximum annual contribution of new nuclear build and almost double the present contribution of nuclear power. All of these measures are cheaper than the nuclear option. Cost-effective demand reduction and combined heat and power measures on their own will reduce carbon dioxide emissions from UK electricity by the equivalent of approaching 30 per cent. Another 10 per cent of cuts in emissions comes from expansion of the Renewables Obligation.

FIGURE 1



Key gives measures starting from left (domestic lighting) to right

FIGURE 2



Read key from left to right

5. Description of the measures

Building Energy Managements Systems (BEMS)
BEMS control energy usage in buildings, for example ensuring that boilers do not operate longer than necessary for a particular ambient temperature. They are also used to control lighting, ventilation and other energy using services. Here we calculate only heat savings from retrofitting BEMS in existing building, which makes our resource estimate a very conservative figure. We assume an economic resource of 15 per cent savings of heat use covering 70 per cent of services and industrial heating and we assume a 4 year payback period. Data on capital costs of BEMS and energy savings are derived from actual experience from a scheme in North Lanarkshire District Council under a energy efficiency programme funded by the Scottish Executive (Hill, R., 2005). Carbon reduction resource: 17.5 m tonnes. Marginal Cost: -£73.9/tonne C. The installation of BEMS systems will be achieved by a Demand Reduction Obligation on suppliers who will fund the installation of BEMS through a levy on consumer electricity and gas prices.

Motors
Motors are ubiquitous in industry and services. Exploitation of the demand reduction resource in motors involves a) programmes to retrofit existing motors driving items such as ventilation units with variable speed drives, high efficiency motors and replacing existing pumps, fans and compressors with units that use less energy; and b) regulatory changes to make new buildings and machinery use high efficiency motors and systems. The marginal cost of the retrofit programme is -£104 per tonne of C. The resource is 2.3 million tonnes of carbon. Source: de Barrin (2003). Motor efficiency improvements can be achieved through the Demand Reduction Obligation.

No new electric heating in domestic and services sector
Use of electric heating in new buildings is increasing and should be restricted at least in areas covered by gas mains. Electricity produces more than twice the carbon dioxide emissions of gas heating due to inefficiencies in power stations. We make allowances for some increases in installation costs and also for the extra maintenance and safety check costs of gas heating compared with electric heating. The cost of gas heating is much lower for the consumer than electric heating. Community heating, via combined heat and power (CHP), can provide high quality heating in apartment blocks where individual gas heaters are inadvisable on safety grounds. Cost of carbon saving: -£313 per tonne; new buildings resource: 8.1 million tonnes of C. The Government needs to pass a law ensuring that electric heating is not supplied in areas connected to mains gas except in the case of use of heat pumps or buildings supplied directly by renewable sources. Heat pumps generate 3-4 times the quantity of heat energy compared to electric input.

Reduction of Standby drain
The standby facility provided on appliances such as TVs and stereo systems soaks up around 6 per cent of UK domestic electricity consumption (DTI 2005). We assume that effective regulatory action will reduce standby consumption by 80 per cent producing a total carbon saving of 5.46 m tonnes C at a price of -£395.7 per tonne. EU regulation can set maximum levels for stand-by use for particular machines. In addition regulations could require appliance manufacturers to buy vouchers to cover the cost of the electricity that is likely to be used by the stand-by mode. The vouchers would be given to the purchaser of the appliance. This will encourage the manufacturers to reduce electricity used in stand-by mode.

Renewables
Assuming a) continuation of current rates of onshore windfarm planning acceptances, sufficient now for 2 per cent of UK electricity (BWEA 2005), b) schemes in pipeline, c) taking into account some increase resulting from expected relaxation of MOD radar objections to windfarms and d) increasing plans for offshore windfarms - we assume 20 per cent of wind power is supplied by wind power by 2020, half onshore, half offshore. At least 5 per cent will come from other sources including biofuels, small hydro, wave power, tidal stream power and solar power. Using wind power costs as the basis at an average of £1050 per kW (Enviros 2005), costs declining at 1 per cent over the next fifteen years (following earlier patterns) and average capacity factors of 31 per cent we can expect carbon savings to cost £76.40 a tonne and 37.8 million tonnes of carbon to be saved. The means of delivering this 25 per cent target would be by extending the target for the Renewables Obligation to 25 per cent by 2020. Currently it is only 15 per cent by 2015. The Green Party target is for 40 per cent of UK electricity to be supplied by renewable energy by 2020.

Home insulation
There will still be at least 1.5 million homes suitable for cavity wall insulation (CWI) that have not been insulated by CWI by the end of the currently projected rounds of the energy efficiency commitment (2011). In addition there will still be a great unfulfilled need to refurbish existing loft insulations. We assume that 7.5 million homes will be fitted with home insulation in addition to existing plans. Loft insulation will be cheaper than CWI, but save less energy. We assume that 30 per cent of energy savings are taken as comfort leaving an average of 2.1 MWh annual saving per home insulated in our mix at an average cost of £280 per house (DEFRA 2005). This produces savings of 9.6 m tonnes of carbon at a cost of -£90 per tonne C. These figures are an underestimate of the resource since we do not include savings can be achieved through measures such as solid wall insulation. This domestic insulation can be delivered through an extension of the existing Energy Efficiency Commitment which is funded by a levy on domestic electricity and gas prices.

Description of the measures (continued)

Non-domestic lighting efficiency
State-of-the-art lighting efficiency techniques can be retro-fitted in old buildings in the industrial and services sectors which are still using inefficient types of fluorescent strip lighting or even incandescent bulbs. High efficiency lamps or bulbs, efficient reflector and diffuser designs and up to date control gear can be installed. The Carbon Trust case study (Carbon Trust 2005b) on lighting efficiency suggests a payback period of 3.6 years for the investment. We assume a payback period of 5 years and assume that buildings consuming 70 per cent of the lighting energy in the industrial and services sector can be retro-fitted. The measure will produce savings of 11.8 m tonnes C at a cost of -£138.2 per tonne. Its delivery will be achieved through the establishment of a Demand Reduction Obligation.

Domestic lighting
Compact fluorescent lamps (CFLs) now give high quality light for very cheap prices (£2 per lamp) and ought to be taking over the domestic light market if only they were promoted properly. Their payback periods are a couple of months in the most used light fittings. We estimate up to 75 per cent provision of light through CFLs by 2020 provided early promotion is given via general subsidies from Energy Efficiency Commitment funds, a tax on incandescent light bulbs and big advertising campaigns. The measure will provide savings of 4.64 m tonnes of carbon and cost -£435 per tonne.

Savaplugs
These can be retro-fitted to existing fridges and save around 20 per cent of electricity. The large majority of fridges in use and also a high percentage of those still being sold do not have this function - and so can be retrofitted as an additional measure to home insulation fitted under the Energy Efficiency Commitment. By the end of the fifteen year period minimum efficiency standards should be raised by the EU to incorporate this device. A total of 2.3 m tonnes of carbon is saved at a cost of -£322/tonne of carbon. Much greater savings could be achieved than this if electronically commutated permanent magnet (ECPM) motors were made a regulated standard for electrical appliances.

Combined Heat and Power
CHP produces power and heat simultaneously and currently generates around 7 per cent of UK electricity, mainly from industrially based plant. The Government's target of 10 per cent of electricity from CHP by 2010 is not being met. We assume that new incentives for CHP are introduced which gives payments to CHP electricity production based on the extent to which the CHP plant reduces carbon emissions compared to the average for CCGT plant. This can lead to new CHP capacity that will give around 20 per cent of carbon reductions compared to CCGTs, similar to that which is being achieved in Denmark. We assume: a) 5000 hours use a year, b) industrial power exchange electricity and gas export and import prices and c) a cost of £500 per kW based on a quote for a hospital project supplied by Clark Energy Ltd using a Jenbacher gas engine (Hill, P. 2005). We assume that around 10 GWe of CHP will be installed mostly in the industrial and services sectors. 19.5 million tonnes of carbon will be cut at a cost of -£9.85 per tonne. is hoped that domestic gas CHP (microgeneration) units can be developed that will cut carbon emissions by around 20 per cent and these machines could add to this capacity.

Compressed air
Health and safety regulations demand tough control on releases of noxious gases, but there are no controls on the extensive leakages of compressed air used in industry. This leakage could be very cheaply reduced (Carbon Trust 2001). We assume that eventually up to 90 per cent of compressed air leaks could be eliminated through more frequent replacement of air nozzles and other actions. Such actions would be necessitated by the inclusion of checks in compressed air leakages in Health and Safety Inspections. Total savings will be 0.29 m tonnes of carbon at a cost of -£261 per tonne of carbon.

Nuclear Power
Currently nuclear power supplies around 21 per cent of UK electricity. However, if nuclear power stations are retired according to current plans, then the equivalent of 14 per cent of current electricity generation would have to be replaced by 2020 to maintain current levels of nuclear generation. As mentioned earlier, we assume that this quantity of new nuclear comes on line in ten years time. According to Government advisers Oxera, the first nuclear station will cost £1.6 billion per GW and operate at over 90 per cent capacity (Oxera 2005). This capital cost is well under half the cost of the last nuclear power station (Sizewell B) that was built in the UK (MacKerron 1991 using 2005 prices), but it applies to a design that has never been built. Moreover, the high capacity factor attributed to this design comes from operating data for (expensive) Sizewell-B type PWRs for which there is great experience.

We use two bases for evaluating the costs of new nuclear build, both of which accept considerable cost reductions since Sizewell B. The first is the median estimate made by Simms (2005). The second is a revised version of the Oxera estimate. We revise this Oxera estimate by a) using the average recent UK performance of British nuclear power stations (76 per cent) and b) like Oxera assuming that decommissioning will cost £500 million but unlike them assuming that this is an upfront payment made to the Government to defray its existing nuclear decommissioning programme. Oxera effectively write off the current cost of decommissioning to close to zero by saying it will be paid through a sinking fund. Windfarm developers are required to make upfront decommissioning payments to guard against the possibility that the developer will not be around in only 15-20 years. Hence it is logical to insist full upfront payment of decommissioning costs for nuclear installations since the companies that operate them (and the sinking funds notionally dedicated for decommissioning) are likely to have been absorbed in reorganisations over the 100 or more years until decommissioning actually takes place.

We do not take account of secondary emissions from the fuel cycle in the estimate of carbon savings. We estimate that the new nuclear power will lead to a reduction of 28.4 m tonnes of carbon savings by the end of 2020 at a cost of £115.80 per tonne according to the NEF cost estimate and £87.6 per tonne according to the Revised Oxera estimate.

6. Delivering the measures

Demand Reduction Obligation: A demand reduction obligation could be established which requires electricity and gas suppliers to fund the installation of energy saving equipment (such as have been described in this report) in the commercial, industrial and public administration sectors. This would be funded by a levy on energy prices sufficient to allow investment in specified, qualifiable, equipment to achieve targets for reduction of carbon emissions. This is the principle behind the existing Energy Efficiency Commitment which provides energy savings in the domestic sector. The Association for the Conservation of Energy has called for the carbon reductions delivered by the Energy Efficiency Commitment in the period 2002-05 to be tripled in the period 2008-11. **Demand reduction in commercial, public, industrial and domestic sectors will achieve the carbon emission reductions for less money than nuclear power. The difference will be that while energy bills will increase with spending on new nuclear build, they will decrease with spending on demand reduction.**

Expansion of the Renewables Obligation The Government has not even set up the means to achieve its own declared 'aspiration' of 20 per cent of electricity from renewable sources by the year 2020. The British Wind Energy Association has called for the Renewables Obligation to be expanded from 15 per cent by 2015 to 20 per cent by 2020. This report says that 25 per cent by 2020 is deliverable.

Much better incentives need to be given to CHP. The incentives could be given in proportion to their contribution to emissions reduction. For example, 1 p/kWh could be paid for all of the electricity produced by CHP plant which reduce carbon emissions by 25 per cent compared to CCGT plant, while 0.6 p/kWh would be given to electricity from CHP plant that reduce emissions by 15 per cent and so on. These incentives could apply to microgeneration as well as conventional CHP. Also, the Government could set a framework that gives greater certainty to future earnings by CHP plant, for example through the Whitehead 'spark-spread' proposals.

Regulatory changes favouring energy efficiency need to be made. At the EU level regulations need to be brought in to reduce stand-by usage, not only through setting a maximum consumption standard, but also by making equipment manufacturers pay in advance for the energy that their appliances will consume (see section on Standby drain). This would encourage manufacturers to reduce standby load. EU standards on electrical appliances need to be dramatically improved to incorporate motor efficiency controls and other measures. Health and Safety Officers need to be given responsibility to check that air compression equipment is leak-free. Electric heating needs to be banned in new buildings in areas with access to mains gas, except in the case of use of heat pumps. Compact fluorescent light bulbs need to be vigorously promoted.

Good rates for micropower The UK could adopt the German practice of giving electricity from solar photovoltaic sources a feed-in tariff of around 35 p/kWh. Electricity sent to the grid from domestic wind turbines should be paid at full domestic rates for electricity (about 8 p/kWh). A Renewable Heat Obligation could be established (the Lazarowicz proposal) which could fund sources such as solar thermal and heat pumps.

Green Party action Local Green Party activists are taking a lead. For example Kirklees Council, inspired by Green Party Councillor Andrew Cooper, has established a rule that all new public buildings should provide at least 30 per cent of their energy from renewable energy sources. Green Party Parliamentary candidate Adam Twine has organised a 6.5 MW community windfarm on his own land in Oxfordshire. **Green Party policies favour** a much more rapid expansion of renewable energy sources generally including full utilisation of offshore and onshore sources of renewable energy. Green Party policy advocates a target of 40 per cent of electricity from renewables by 2020. A system of personal, tradable, carbon credits needs to be introduced to reduce emissions in the domestic sector. The Green Party believes that action needs to be taken leading to a reduction of 50 per cent of carbon dioxide emissions by 2020 and 85-90 per cent by 2050.

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