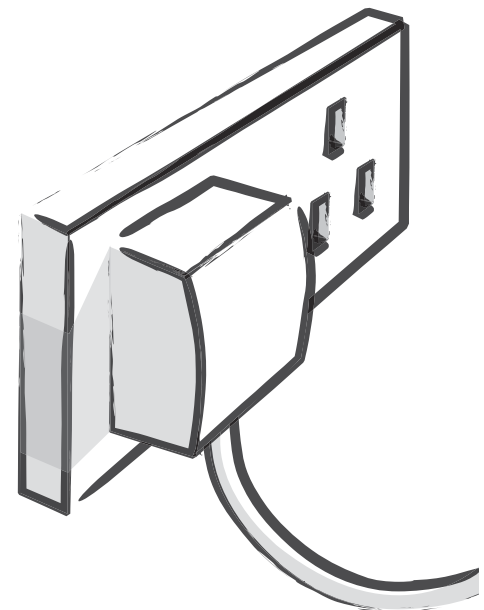




# The **balance** of power

Reducing CO<sub>2</sub> emissions from the UK power sector

A summary of WWF-UK's response to the 2006 Energy Review



## Summary

The UK government's Energy White Paper, published in 2003, set out a prioritised plan of action for reducing the UK's carbon dioxide (CO<sub>2</sub>) emissions, primarily through the promotion of energy efficiency measures, renewable energy and the effective use of an emissions trading scheme. It also restated the government's commitment to its domestic target of reducing CO<sub>2</sub> emissions by 20 per cent, below 1990 levels, by 2010 – and set a new long-term goal to reduce emissions by 60 per cent by 2050.

However, the government has failed to implement the vision set out in the Energy White Paper. The promised "step change" in energy efficiency has yet to emerge, targets for renewable energy are not being hit and the government has failed to set tough pollution limits under the EU-wide Emissions Trading Scheme (EU ETS). In March 2006, the government issued its long overdue review of the climate change programme – and effectively abandoned the 20 per cent CO<sub>2</sub> reduction target for 2010.

Against this backdrop, the review of the government's energy policies, launched in January 2006, offers an opportunity to get back on track for the goals set out in the White Paper. However, the public debate around the Energy Review has focused mainly on whether it will be necessary to construct new nuclear power stations. Many have sought to create the impression that new reactors are the only way of achieving climate change targets while meeting the UK's energy needs.

In order to test this assumption, WWF commissioned ILEX, a leading independent energy market consultancy, to undertake research into the likely impacts on the UK power sector's CO<sub>2</sub> emissions and fuel mix if no new nuclear power stations are built to replace the existing reactors as they are decommissioned over the next 20 years. ILEX explored three main scenarios, looking ahead to 2025:

- **business as usual (BAU);**
- **a scenario which assumes the continuation and success of existing policy measures and targets, including those set out in the White Paper; and**
- **a scenario which includes modest extensions to existing policies and targets to promote energy efficiency and renewables.**



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The research found that:

- If the government continues on its present course (the BAU scenario), the power sector's emissions will be just 18 per cent down on 1990 levels by 2025 – and considerably above the level of emissions in 2000.
- If the government effectively implements the measures identified in the Energy White Paper, by 2025 emissions from the power sector could be reduced by 43 per cent from 1990 levels. A realistic and modest extension of these policies could reduce emissions by 55 per cent from 1990 levels – a saving of 73 million tonnes of CO<sub>2</sub> per year compared to business as usual.
- Substantial ongoing reductions in the power sector's CO<sub>2</sub> emissions can be achieved without new nuclear power stations. A renewed focus on reducing demand for electricity, and promoting renewable energy and microgeneration, could ensure that the claimed "energy gap" arising from the loss of nuclear and coal-fired capacity is much less of a problem than many have claimed.
- All scenarios show an increased reliance on imported gas for power generation. However, considerably more gas is required under business as usual than under the other two scenarios, mainly because total demand for electricity is higher.



The low emission scenarios do not involve significant costs to society – and may offer considerable economic benefits. **By 2025, the costs of generation could be 26 per cent lower than under business as usual.** And while the low emission scenarios lead to a modest increase in unit prices, total electricity bills will tend to fall because of reduced consumption.

The emerging technology of carbon capture and storage (CCS) was not included in ILEX's three scenarios, as significant questions still surround its environmental impacts, technological feasibility, legal status and cost. However, if these barriers could be overcome CCS has some potential to reduce CO<sub>2</sub> emissions even further while reducing dependency on gas. **ILEX estimates that replacing 4GW of gas-fired capacity with coal-fired plant fitted with CCS could reduce CO<sub>2</sub> emissions by 4 million tonnes per year.**

**In other words, the UK can maintain its international leadership on climate change by delivering significant ongoing reductions in the power sector's emissions – without resorting to nuclear power.**

## Background

Climate change is one of the most serious threats to the environment and human development facing the world today. Levels of CO<sub>2</sub> in the global atmosphere have risen by more than a third since the industrial revolution and are now rising faster than ever before, mainly because of mankind's addiction to fossil fuels. According to the

Intergovernmental Panel on Climate Change, the world's most authoritative body on climate change, stabilising CO<sub>2</sub> concentrations at even double pre-industrial levels will eventually require cuts of more than 60 per cent in global emissions. Such concentrations would almost certainly lead to global average temperature increases of more than 2°C – greatly increasing the risk of irreversible and catastrophic changes to the climate.

The present UK government declared its commitment to tackling climate change at an early stage. Prime Minister Tony Blair has taken a personal interest in the topic and made climate change a priority in his Presidency of the G8 in 2005. At home, the government has a long-standing commitment to cut CO<sub>2</sub> emissions by 20 per cent from 1990 levels by 2010.<sup>1</sup> The 2003 Energy White Paper accepted the Royal Commission on Environmental Pollution's recommendation that the UK should put itself on a path to reduce emissions by "some 60 per cent from current levels" by about 2050. The Energy White Paper prioritised action to cut emissions by: energy efficiency measures to reduce our current profligate use of energy; substantial support for CHP and renewable energy technologies; and the effective implementation of a carbon emissions trading scheme.<sup>2</sup> Nuclear power was not supported because of its costs and because of the lack of any solution to the problem of radioactive wastes.

However, in March 2006 the government effectively abandoned its target to cut emissions by 20 per cent by 2010. The long overdue review of the climate change programme offered policies which would deliver a reduction of just 15-18 per cent.<sup>3</sup> This failure is to a large extent due to rising emissions from the power sector, which the government has failed to address through tighter caps under the EU ETS.

The government is also revisiting its wider energy policies, just three years after the White Paper. Its consultation on the Energy Review, announced in January 2006, is officially focused on the UK's overall use of energy (of which the generation of electricity represents one third).<sup>4</sup> However, the public debate around the review has focused largely around electricity supply, and particularly, the issue of nuclear power.

There is certainly considerable justification for concern about the power sector's contribution to climate change.

1 Commitment made in Labour's election manifestos of 1997 and 2005.

2 DTI. 2003. Energy White Paper. <http://www.dti.gov.uk/energy/whitepaper/ourenergyfuture.pdf>

3 Defra. 2006. Climate Change: the UK Programme 2006. <http://www.defra.gov.uk/environment/climatechange/uk/ukccp/index.htm>

4 DTI. 2006. The Energy Review. Our Energy Challenge – Securing clean, affordable energy for the long-term. <http://www.dti.gov.uk/energy/review>



The production of electricity accounts for about 30 per cent of the UK's total CO<sub>2</sub> emissions. Although a switch from coal-fired power stations to gas (known as the "dash for gas") in the 1990s caused a decline in emissions, this trend is now reversing as current market conditions once again favour coal and electricity demand continues to rise. Overall, carbon emissions from the UK power sector have risen by 15 per cent since Labour came to power.<sup>5</sup> The government has failed to set strong limits on the power sector under the EU ETS – meaning that the industry could even be allowed to pollute more in the future than in the current phase of the scheme.<sup>6</sup> Indeed, the Department of Trade and Industry's (DTI's) "Business as Usual" projections for carbon emissions up to 2020 fail to take any account of the EU ETS at all.<sup>7</sup>

In combination with this is the question of an "energy gap." Within the next 20 years it is expected that all but one of the UK's nuclear power stations (which currently contribute 19 per cent of our electricity) will be decommissioned, and many of the ageing coal stations will be closed under anti-pollution European legislation (Large Combustion Plant Directive). An intense lobbying campaign by the nuclear industry, allegedly supported by Tony Blair, has created a climate of opinion among many commentators and politicians that a new generation of "carbon-free" nuclear power stations is the only way to maintain supplies of electricity and tackle climate change.

5 DTI. March 2006. Energy Trends. Provisional CO<sub>2</sub> data for 2005. [http://www.dti.gov.uk/energy/inform/energy\\_trends/mar\\_06.pdf](http://www.dti.gov.uk/energy/inform/energy_trends/mar_06.pdf)

6 See [http://www.wwf.org.uk/news/n\\_0000002431.asp](http://www.wwf.org.uk/news/n_0000002431.asp)

7 DTI. 2006. UK Energy and CO<sub>2</sub> Emissions Projections – updated projections to 2020. [http://www.dti.gov.uk/energy/sepn/uep\\_feb2006.pdf](http://www.dti.gov.uk/energy/sepn/uep_feb2006.pdf)

## The reason for this study

In order to address many of these questions, WWF commissioned ILEX, a leading independent energy market consultancy, to undertake research and modelling into three different scenarios for the UK power sector up to 2025.<sup>8</sup> ILEX was asked to examine the implications for emissions and fuel mix of current policies, and of policies based on the vision set out in the 2003 Energy White Paper and other policy documents. If effective energy efficiency measures, strong investment in renewables and a strong EU ETS were put in place, what would be the impacts on energy supply and CO<sub>2</sub> emissions in the UK? The assumptions contained in the modelling are deliberately modest and most of the policy measures and targets have been proposed and agreed by the UK government over the last few years.

This report is an update on a previous study undertaken by ILEX on behalf of WWF in 2004.<sup>9</sup> That research found that it would be possible for the UK power sector to reduce emissions by 60 per cent by 2020, whilst meeting energy needs and without the use of nuclear power. Since then, however, there have been changes to the assumptions used, particularly regarding fuel prices and the price of CO<sub>2</sub> allowances under the EU ETS. WWF therefore commissioned ILEX to undertake a new assessment focusing on the potential to achieve significant CO<sub>2</sub> emissions reductions in the UK power sector by 2025.

## Scenarios modelled

The three scenarios modelled in the report were:

- **Business as Usual (BAU)** – which assumes the continuation of existing policy measures with currently predicted levels of success;
- **Powerswitch "Policy Delivered" scenario (PS1)** – which assumes the continuation and successful delivery of existing policy measures and targets; and
- **Powerswitch "Policy Evolution" scenario (PS2)** – which assumes the implementation of new measures which are a realistic, modestly ambitious extension of policies identified in the Energy White Paper

The full assumptions behind the scenarios can be viewed in the full report. Briefly:

- **Electricity demand** – electricity demand is not predicted to fall in any of the scenarios. In the BAU scenario demand rises by 1.15 per cent per year, in line

8 WWF. 2006. The balance of power - reducing CO<sub>2</sub> emissions from the UK power sector. A report for WWF-UK by Ilex Energy consulting, April 2006. [www.wwf.org.uk/climatechangecampaign/thebalanceofpower.pdf](http://www.wwf.org.uk/climatechangecampaign/thebalanceofpower.pdf)

9 WWF. 2004. The Power to Save our Climate – reducing CO<sub>2</sub> emissions in the UK power sector. A report for WWF-UK by ILEX Energy Consulting. [www.wwf.org.uk/climatechangecampaign/powerertosaveclimate.pdf](http://www.wwf.org.uk/climatechangecampaign/powerertosaveclimate.pdf)

with forecasts by the DTI and National Grid. The two low emission scenarios reduce the growth rate to 0.44 per cent and 0.11 per cent per year – figures which are based on the DTI's forecasts of what could be achieved by energy efficiency policies. WWF believes that measures to encourage a shift to energy services companies and a new UK emissions trading scheme for large, less energy-intensive organisations could readily deliver such low growth rates.

- **Impact of EU ETS** – the BAU scenario assumes continued implementation of the EU ETS, but without stringent targets so carbon prices stay at a relatively low €20/tCO<sub>2</sub>. Under the PS1 scenario, tougher allocation is assumed to lead to a higher carbon price of €30/t. Under the PS2 scenario, the price of carbon rises in increments to €40/tCO<sub>2</sub> in 2025.
- **Renewable capacity** – the Renewables Obligation (RO), which requires electricity suppliers to purchase a proportion of their supplies from renewable sources, remains the chief policy mechanism in all three scenarios. The BAU scenario assumes that the government will fall short of current targets under the RO<sup>10</sup> (as looks likely under current predictions). Under PS1 the government's renewables targets for 2010 and 2015 are met through the RO and extended to deliver the White Paper's aspirational target for 2020. Under PS2 the government's current targets are met and extended for 2020 and 2025. In addition, from 2020 microgeneration – small-scale renewables and other highly efficient decentralised power generation technologies – supply a small share of total electricity under PS2.
- **Combined Heat and Power (CHP)** –The BAU scenario assumes that the government is likely to miss its target of 10GW of CHP capacity installed by 2010 by

20 per cent. The PS1 and PS2 scenarios assume that the target is achieved, and PS2 assumes that a new target for 15GW of CHP by 2025 is set and achieved.

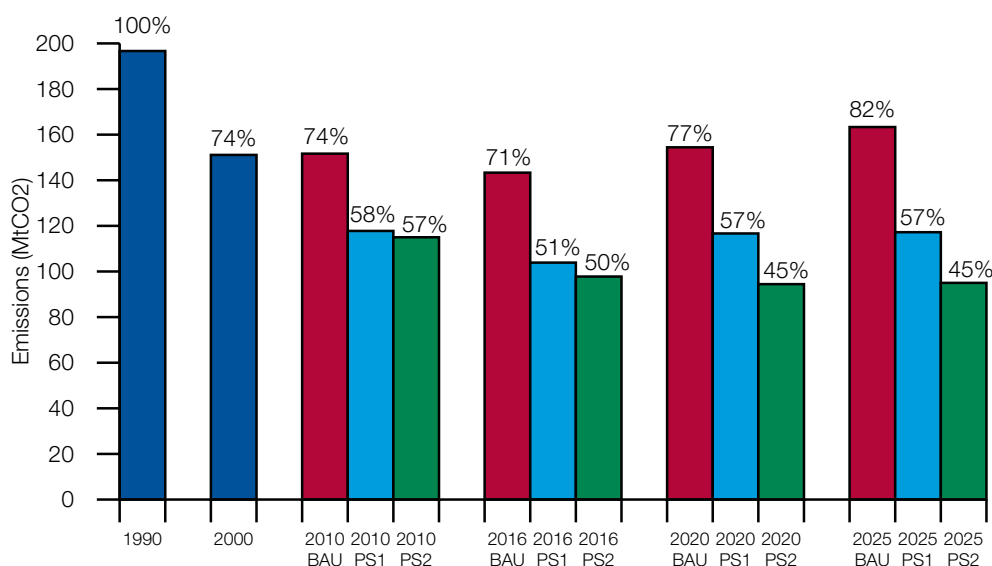
- **Coal and nuclear capacity** – Under all three scenarios, the nuclear power stations we currently have are steadily decommissioned, with no new nuclear build. Coal fired stations that have “opted out” under EU anti-pollution legislation<sup>11</sup> are closed at the end of 2015. Other than renewables and CHP, all new capacity is provided by gas fired plant. By 2020, the remaining coal fired stations will be 50 years old or more and with low thermal efficiency. Under the PS2 scenario, a regulation is introduced in 2020 requiring coal-fired plant to run behind less polluting and more efficient gas fired plant.

## Key findings

The research upon which the ILEX report is based aims to provide a realistic assessment of the potential to achieve CO<sub>2</sub> emission reductions in the UK power sector up to 2025, and the associated cost implications. Key findings are summarised below.

1. **It is perfectly possible for emissions from the power sector to be reduced by 55 per cent (below 1990 levels) by 2025.** The market-led “dash for gas” has already led to significant reductions in power sector emissions relative to their levels at the beginning of the 1990s. However, emissions are on the rise again – and under business as usual, will continue to increase throughout the next decade. Simply ensuring successful implementation of the vision set out in the Energy White Paper would reduce emissions by 43 per cent by 2025 – and modest extension of these policies could yield still greater reductions (see Figure 1).

Figure 1 – CO<sub>2</sub> emissions projections compared to historic levels (MtCO<sub>2</sub>)

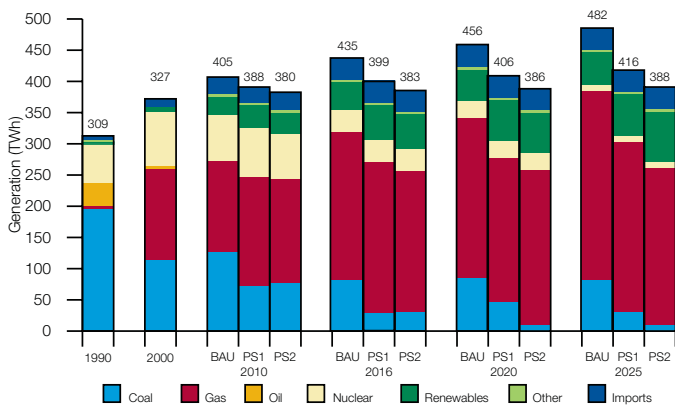


10 The current government target for renewables is to generate 10 per cent of electricity from renewable sources by 2010, with an aspiration for 20 per cent by 2020.  
 11 The Large Combustion Plant Directive (LCPD) requires coal plant to limit the amount of sulphur dioxide, nitrogen oxides and dust pollution they emit to certain levels. If they do not do this they have to close by 2015 at the latest.

**2. It is possible to make significant reductions in CO<sub>2</sub> emissions and maintain electricity supplies without resorting to the construction of new nuclear power stations, with all their attendant dangers, costs and unresolved issues of radioactive wastes.**

As old nuclear power stations are decommissioned and the ageing coal power fleet is shut down, it is quite possible to replace them with renewables and limited new gas-fired capacity (see Figure 2). The modelling confirms that limiting the growth in electricity demand is central to a sustainable energy system – not least because very little new gas-fired capacity would then be needed to plug the perceived “energy gap”.

Figure 2 – Generation by fuel type (TWh)



**3. Reliance on gas for power generation can be reduced by reducing total electricity consumption.**

In recent months considerable concerns have been raised about the UK’s transition from being a gas exporter to an importer dependent on other countries for our natural gas supplies. The UK government predicts that, by 2020, we may be importing 90 per cent of our gas as supplies in the North Sea run out.<sup>12</sup> Concerns about using gas for electricity generation have been accentuated by a cold winter, the current lack of gas storage capacity in the UK, spikes in gas prices and disputes over Russian gas pipelines in Central and Eastern Europe. There is potential to ease many of these concerns by the construction of new gas storage facilities and pipeline infrastructure, along with ongoing work to liberalise the EU gas markets.

It should also be remembered that this situation is hardly unique in the developed world – and most of the UK’s competitors are used to relying on imported fuel to meet their energy needs. Additionally, the UK economy as a

whole is highly dependent on gas for use in industry, domestic heating and public administration. In 2004, power generation accounted for just 30 per cent of gas used in the UK – household heating accounted for 35 per cent, and manufacturing industry for 21 per cent.<sup>13</sup>

Crucially, the two low emission scenarios in ILEX’s report show a significantly lower absolute demand for gas than under business as usual because of the lower demand for electricity. Relatively high percentage use of gas by 2025 is not surprising, given that this period coincides with the closure of most coal and nuclear capacity. Beyond 2025, gas use could be expected to decline through further development in renewables, reductions in energy demand and technological innovation, potentially including CCS.

**4. We could go even further at reducing emissions if CCS is effectively implemented.**

This technology involves the “capture” and storage of CO<sub>2</sub> emissions in underground deposits, for example in depleted oil and gas fields under the North Sea. CCS is being energetically promoted by many in the power industry as the solution to the emissions problem.

WWF considers that CCS may well have an important role to play in meeting the massive international challenge of reducing global emissions sufficiently quickly to ensure that average temperature rise is kept below 2°C – beyond which the risk of irreversible “tipping points” grows rapidly. This is particularly true in China and India, which are currently expanding their coal power at a massive rate. At the moment, however, the rhetoric appears to be running ahead of the reality. WWF is cautiously supportive of demonstration projects in the UK to help confirm whether CCS is environmentally, technologically and economically acceptable.

CCS was therefore not included in the scenarios modelled. However, illustrative calculations by ILEX suggest that if 4GW of gas-fired generation were replaced with 4GW of coal-fired capacity fitted with CCS, CO<sub>2</sub> emissions would be reduced by 3.9 million tonnes. CCS therefore has significant potential to deliver further reductions in emissions while reducing gas dependency.

**5. Reductions in emissions can be achieved at low cost to society and with savings for the consumer.**

The study assessed the costs to society, industry and the consumer of the various scenarios for energy supply and use. Consistent with many other recent studies on the costs of energy efficiency, the report finds a large and

12 DTI. 2006. The Energy Review. Our Energy Challenge – Securing clean, affordable energy for the long-term. <http://www.dti.gov.uk/energy/review>

13 DTI. 2005. Digest of UK Energy Statistics (DUKES) [http://www.dti.gov.uk/energy/inform/energy\\_stats/gas/dukes05\\_4\\_2.xls](http://www.dti.gov.uk/energy/inform/energy_stats/gas/dukes05_4_2.xls)

extremely cost-effective potential for savings in energy use. And although wholesale electricity prices are predicted to be somewhat higher under the Powerswitch scenario, total energy bills are expected to fall as individual energy use is reduced by energy efficiency measures. The results, however, are somewhat variable as different factors come into play. It would therefore be important to consider the distribution of efficiency gains across all users to ensure that poorer and more vulnerable sections of the community are not exposed to any increased prices.

## WWF-UK policy recommendations

The government's recent admission that it will miss its long-standing target of reducing CO<sub>2</sub> emissions by 20 per cent by 2010 is an indictment of its lack of commitment to tackling climate change. But the Energy White Paper's "aspiration" of reducing emissions by 60 per cent by 2050 is not an ambitious dream that we can afford to miss, but a target that must be achieved. If industrialised countries like the UK fail to reduce emissions rapidly, then developing countries will have no incentive to do so and greenhouse gas concentrations in the atmosphere will continue to rise – committing the world to potentially catastrophic climate change in the very near future.

As this report demonstrates, the power sector is one area where the government has the opportunity to make significant and rapid reductions in emissions, with a beneficial effect on the economy. Moreover, it can do so without resorting to the dangerous and costly option of nuclear power.

### WWF recommends that:

- **The government should introduce a Carbon Budget that would set year-on-year emission reduction targets for the UK as a whole, backed by full and transparent reporting to parliament.** Such a trajectory would ensure continued focus in Whitehall on delivery of climate change objectives, as well as providing greater certainty to business to inform its investment decisions.
- **The government should set a robust cap on the power sector's CO<sub>2</sub> emissions for the second phase of the EU ETS, and press other European countries to take similar action through their National Allocation Plans.** As this research shows, the EU ETS has the potential to be a key tool in bringing about reductions in emissions from the power sector. Without it, it is likely that emissions will continue to rise. WWF is also calling for

a move away from free allocation of allowances, which would greatly increase the environmental and economic efficiency of the EU ETS.

- **The government must prioritise policies to reduce, and eventually reverse, the growth in demand for electricity.** WWF believes that current policies on energy efficiency are confused and lacking in coherence. It is time to refocus policy on reducing absolute demand for energy, recognising that energy efficiency is a tool to deliver this end and not a goal in itself. Possible policies to achieve this goal include a new UK emissions trading scheme for larger, less energy-intensive organisations, as proposed by the Carbon Trust, along with improved building regulations, fiscal incentives, appliance efficiency standards and policies to promote a shift towards provision of energy services in the domestic sector.
- **The government and OFGEM should reform the regulatory and market framework to drive a switch away from bulk energy sales to the provision of energy services.** By becoming energy service providers rather than suppliers of units of energy, power companies would ensure that business and private households meet their needs at a lower cost without forfeiting comfort and lifestyle. WWF is calling on the government to adopt a supplier cap and trade scheme, as proposed by the Energy Saving Trust, which would trigger a full and effective transition to a new market in energy services.
- **The government must introduce policies to ensure that renewables deliver 20 per cent of the UK's electricity by 2020, and 25 per cent by 2025. It must do more to support a diversified portfolio of renewable energy technologies, including biomass, solar, wave and tidal technologies.** ILEX bases its analysis on extending the Renewables Obligation. However, the way in which the Obligation operates at present means it has a built-in shortfall against targets – suggesting that further measures are needed to deliver the goals set out in the White Paper. Moreover, the obligation has the effect of incentivising the cheapest technologies – almost exclusively offshore and onshore wind. WWF is calling for other measures to bring forward a more diverse portfolio of renewables – many of which have huge potential, and will be needed on a large scale beyond 2025 to ensure continued progress towards the UK's long-term emission targets. This has wider benefits in terms of security of energy supply, rural development and reduction of system costs, particularly for biomass generation.

• **The government should consider additional regulations from 2015 to ensure that gas-fired plant always operate ahead of coal-fired power stations.**

By 2020, most of the remaining coal-fired stations will be 50 years old, with low thermal efficiency and high CO<sub>2</sub> emissions. WWF regards it as unacceptable that such old, inefficient plant could continue to play a significant role in the UK energy mix in 2020, by which time global CO<sub>2</sub> emissions will need to be on a steep downward trend. The government should also regulate to ensure that no new coal-fired stations are built in the UK without carbon capture and storage.

• **The government should rule out investment in new nuclear capacity.**

As this research demonstrates, it is possible to achieve significant emissions reductions without replacing existing nuclear power stations. WWF regards nuclear power as a costly technology which is fundamentally incompatible with the wider aims of the government's sustainable development strategy. The government should focus its efforts on dealing with the dangerous existing legacy of the nuclear industry rather than on supporting new nuclear build. Concerns about security of energy supply can be addressed by diversifying our fuel sources, investing in a wide variety of renewable sources and, above all, reducing energy consumption.

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ILEX Energy Consulting is a leading energy markets consultancy specialising in the electricity, gas, carbon and renewables markets, and with considerable experience in modelling the UK power sector.

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To download the ILEX report "The balance of power - reducing CO<sub>2</sub> emissions from the UK power sector" visit: [www.wwf.org.uk/climatechangecampaign/thebalanceofpower.pdf](http://www.wwf.org.uk/climatechangecampaign/thebalanceofpower.pdf)

To download WWF's full submission to the government's Energy Review visit: [www.wwf.org.uk/filelibrary/pdf/cc\\_rspnsenrgyrvw.pdf](http://www.wwf.org.uk/filelibrary/pdf/cc_rspnsenrgyrvw.pdf)

The mission of WWF is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by:

- conserving the world's biological diversity
- ensuring that the use of renewable natural resources is sustainable
- reducing pollution and wasteful consumption



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