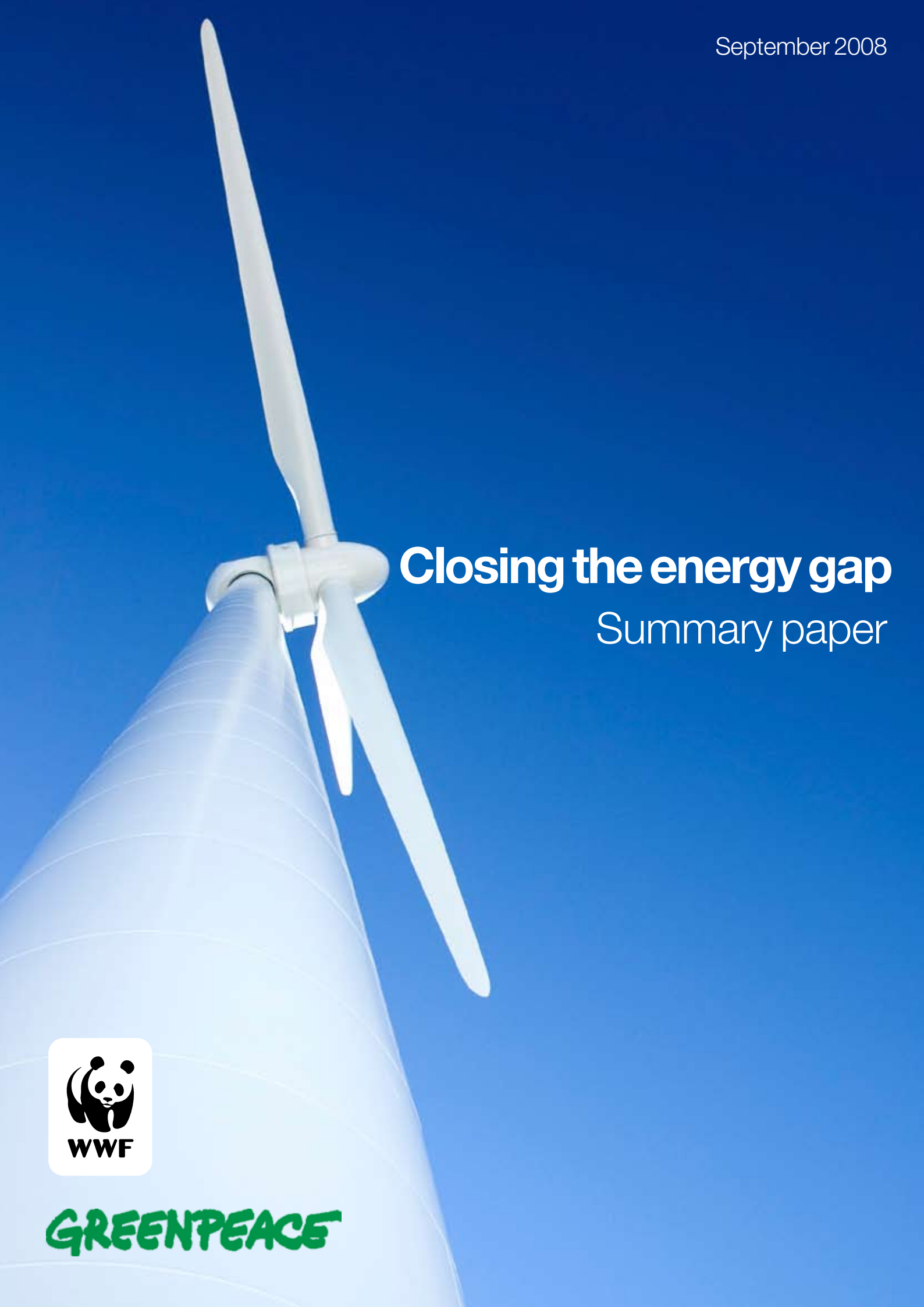

September 2008

Closing the energy gap

Summary paper

WWF

GREENPEACE

Acknowledgements

This summary paper was written by Russell Marsh, a consultant in environmental advocacy strategy and analysis, with contributions from Dr Keith Allott and Andrea Kaszewski of WWF-UK and Robin Oakley and Jim Footner of Greenpeace.

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Executive Summary

In the next 20 years a substantial amount of the UK's existing electricity generation capacity will close. How this capacity is replaced will have a major impact on the UK's ability to meet its international and domestic carbon emissions reduction targets.

To explore this issue WWF-UK and Greenpeace commissioned Pöyry energy consultants to look at the implications for the UK electricity sector of meeting the UK's share of the EU renewable energy target. This requires the UK to produce 15% of its energy from renewables by 2020.

The report was based on the assumption (supported by government analysis) that there was around 76GW of connected capacity in 2007. Of this, 22.5GW is expected to close by 2020.

Pöyry constructed various scenarios of energy demand and renewable energy growth to ascertain whether these technologies would be able to meet the so-called 'energy gap'.

Key findings of the Pöyry analysis are:

• if the government meets its energy efficiency and renewable targets, new baseload electricity generation capacity will not be needed until the period beyond 2020. By this point other low carbon technologies will be close to commercialisation. Therefore, there is no need to build new unabated fossil fuelled power plants such as E.ON's proposed coal station at Kingsnorth in Kent;

• this combination of renewable energy generation and energy efficiency results in a reduction in gas use of up to 42%;

• in the scenarios developed, carbon dioxide (CO_2) emissions are reduced by up to 37% (from 1990 levels) by 2020. The current target in the Climate Change Bill passing through Parliament is for a 26% reduction, on 1990 levels, in CO_2 emissions by 2020.

This analysis shows that in contrast to the views of government and industry, there is no need to build new fossil-fuelled power generation to keep the lights on. Instead, the focus should be on delivering existing targets and meeting current commitments for energy efficiency and renewable energy.

Introduction

UK energy policy is at a crossroads. In the next 20 years around 30% of our conventional electricity generation capacity is scheduled to close. This will need to be replaced. At the same time the government is committed to delivering substantial CO_2 emission reductions as part of the EU's overarching climate change package and its own domestic policies. For example, the Climate Change Bill will require CO_2 emissions reductions of at least 60% by 2050 and around 26% by 2020 (both from 1990 levels). However, the latest science is indicating that we will need to go much further than this and make reductions of at least 80% by 2050 and around 40% by 2020.

As the government's 2007 Energy White Paper[1], the Stern Review[2] and various other reports have shown[3], achieving these targets will require the rapid de-carbonisation of the electricity generation sector. The fact that we will need to replace a substantial proportion of our electricity generation capacity in the next few years is a fantastic opportunity to drive forward the development of low carbon energy technologies and energy efficiency, enabling us to both keep the lights on and meet our emission reduction targets.

Under the EU's climate and energy package, published earlier this year and due to be finally agreed in December 2008, the UK has committed itself to ensuring that 15% of the energy it consumes is generated from renewable sources by 2020 across the electricity, transport and heat sectors. Given that there are limited options at present to deploy renewable energy in the transport and heat sectors, renewable electricity is expected to deliver the bulk of this target.

This commitment to dramatically increase the amount of electricity produced from renewable sources coincides with the need to replace a proportion of our existing generation capacity over the next few years. Until now, a key question has been: would the development of renewable electricity capacity to meet the 15% target be enough to close the perceived energy gap and remove the need to build new fossil-fuelled power stations?

To explore this question WWF-UK and Greenpeace commissioned energy consultants Pöyry to investigate the implications for the UK electricity system of deploying the levels of renewables necessary to meet the 15% renewable energy target for 2020. In particular they looked at what impact it would have on the balance between supply and demand.

1 Department for Business Enterprise and Regulatory Reform, 2007. Energy White Paper : meeting the energy challenge. Available from: www.berr.gov.uk/energy/whitepaper/page39534.html [accessed 27 August 2008]
2 HM Treasury, 2006. Stern review on the Economics of Climate Change. Available from: www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm [accessed 27 August 2008]
3 See for example: 80% challenge: delivering a low-carbon UK, wwf.org.uk/filelibrary/pdf/80percent_report.pdf

UK climate change targets

There are a number of targets for greenhouse gas emissions reduction that the UK has committed itself to. These include:

- 12.5% reduction in greenhouse gas emissions (from 1990 levels) by 2008-2012 under the Kyoto Protocol;
- a domestic commitment of a 20% reduction in CO_2 emissions (from 1990 levels) by 2010. The status of this target has been downgraded several times and is now referred to as the UK domestic goal. The government has admitted it is extremely unlikely the UK will meet this target;
- a target in the current draft of the Climate Change Bill to reduce CO_2 emissions by at least 60% below 1990 levels by 2050 and by 26% below 1990 levels by 2020;
- a set of targets that form part of the EU climate and energy package, published by the European Commission in January 2008. This includes an overarching target to reduce emissions across the EU by 20% from 1990 levels by 2020, rising to 30% in the context of a new international agreement on climate change. There are also a variety of sub-targets, such as 20% of final energy consumption to come from renewable sources by 2020.

The UK power sector

As shown in figure 1 the majority of the electricity generation in the UK is fossil-fuelled at present, with coal the predominant fuel.

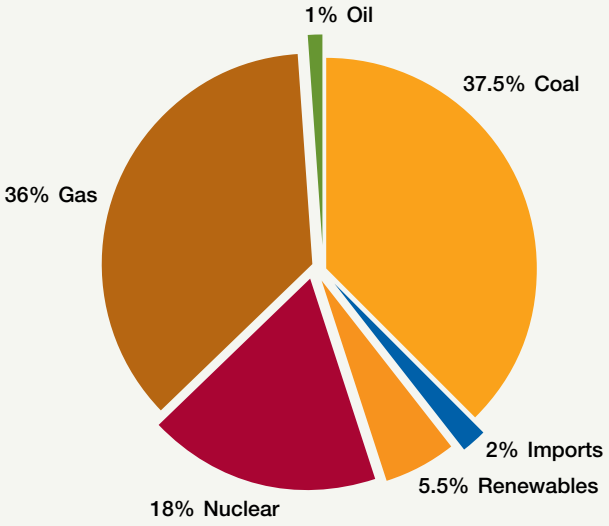
Additional WWF analysis, published in 2007, has shown the dramatic rise in emissions from the power sector in recent years, driven by an increase in coal use as a result of increasing demand and high gas prices. The report, UK Power Sector Emissions – Targets or Reality?,[4] shows how the UK power sector's carbon emissions have rocketed by nearly 30% since 1999, with a rise of 6% in 2006 alone. (Figure 2).

This increasing reliance on coal for power generation is the reason why this sector is the largest source of CO_2 emissions in the UK. It also highlights the importance of de-carbonising the power sector if the UK is to meet its overall CO_2 reduction targets.

A large proportion of the UK's current electricity generation capacity is due to close in the period up to 2030. The Pöyry analysis cites government figures that there was around 76GW of connected capacity in 2007. Of this, 22.5GW is expected to have closed by 2020 and between 30 and 35GW of new capacity is forecast to be needed by 2030. In the period to 2020 the majority of the closed capacity will be coal and oil, with some 11GW expected to close by 2015. An additional 7GW of nuclear generation capacity is also scheduled to close by 2020 with a further 9.5GW closed by 2030. Figure 3 outlines the timetable of these closures and their impact on overall system capacity.

Retiring this amount of capacity will clearly have implications for the overall security of the electricity system. Some, if not all, of this capacity will need to be replaced over the next few years. The exact amount of replacement capacity needed will depend on both the overall level of electricity demand and the level of peak capacity margin required.[5]

Figure 1:
Electricity supplied by fuel type (2006)

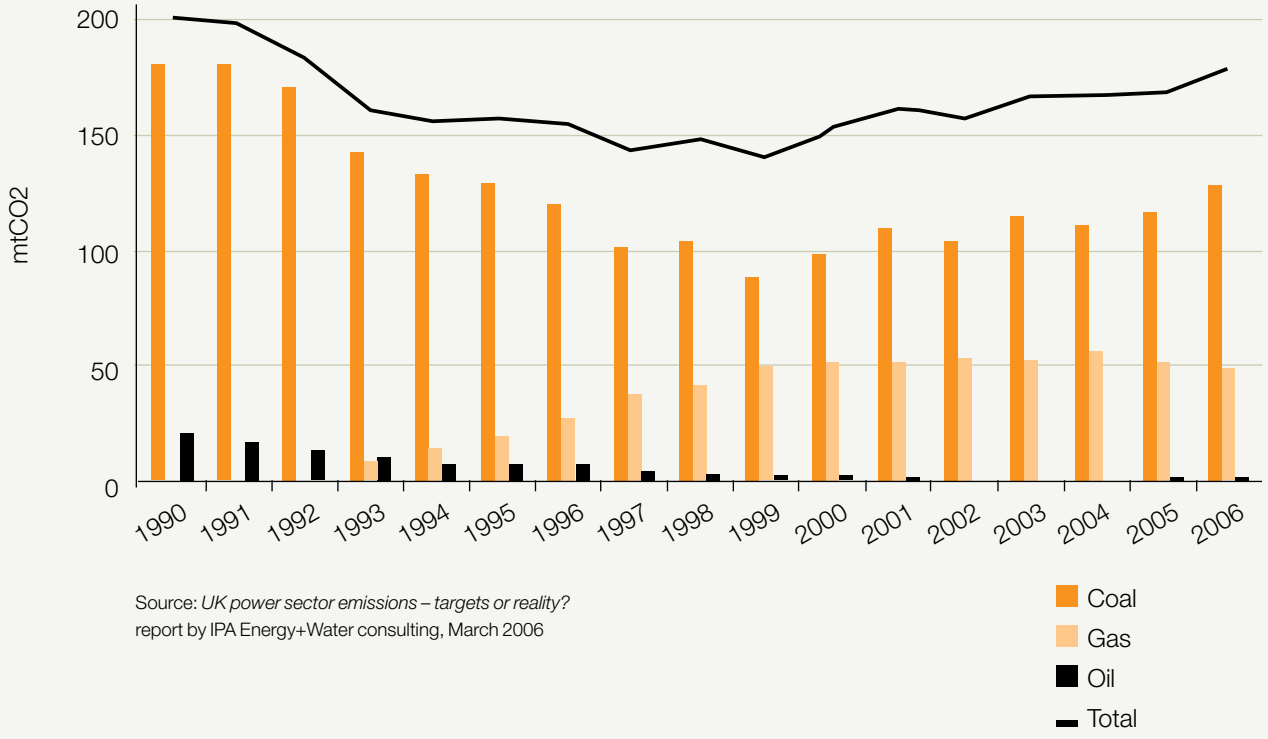


Source: www.berr.gov.uk/files/file39881.pdf

4 WWF-UK, 2007. UK carbon emissions rocket as government fails to tackle the roll to coal. Available from: www.wwf.org.uk/news/n_0000003754.asp [accessed 27 August 2008]

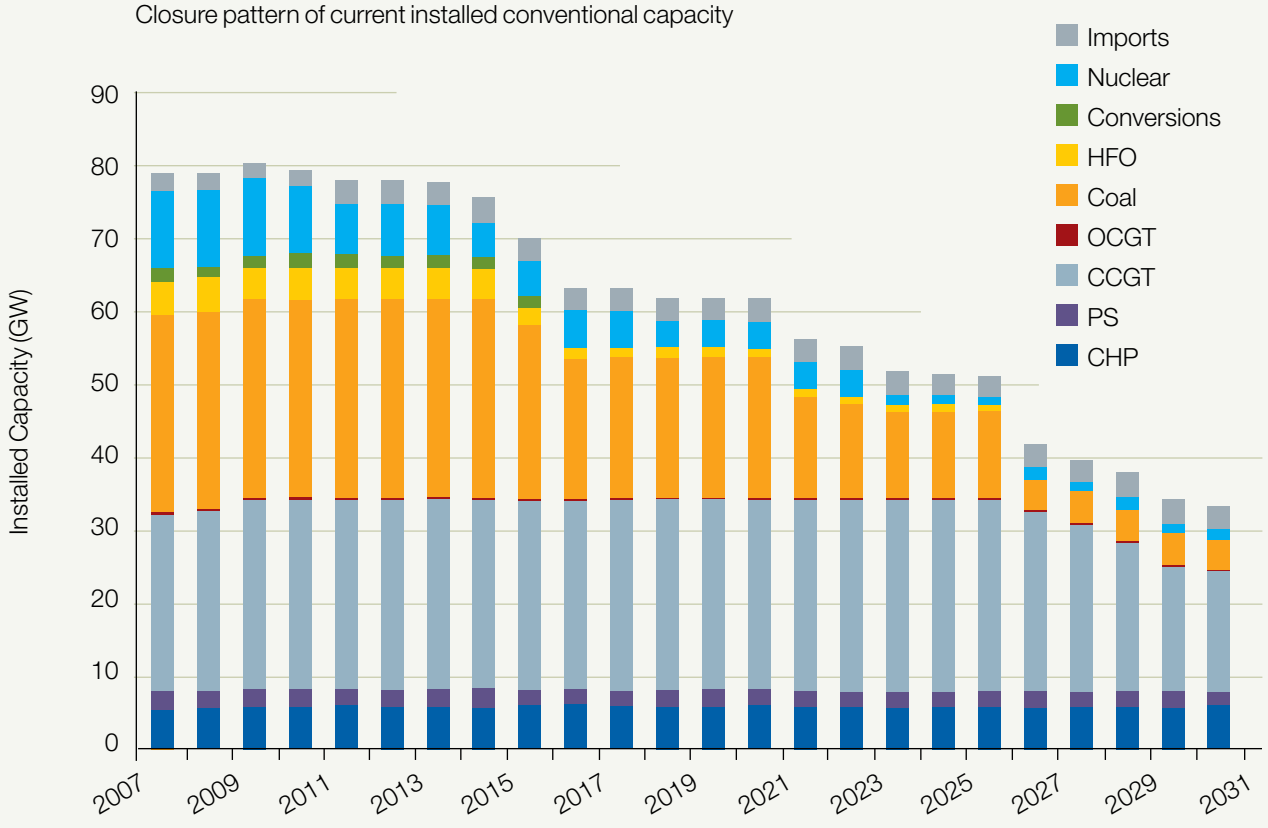
5 The peak capacity margin is the level of capacity needed over and above actual peak demand to ensure system security. There is no formal standard to maintain a 20% cap margin. Pöyry used 20% as this has been an historic average.

Figure 2:
UK power sector emissions



Source: *UK power sector emissions – targets or reality?* report by IPA Energy+Water consulting, March 2006

Figure 3:
Closure pattern of current installed conventional capacity



Source: Pöyry Energy Consulting

Closing the gap

There is a need to build new electricity generation capacity to replace old and existing capacity that is scheduled to close between now and 2015. The question therefore becomes what type and how much new capacity is needed when at the same time the UK must decarbonise the power sector in order to reduce CO_2 emissions.

The Pöyry analysis

Pöyry's energy analysts began by developing scenarios of future electricity demand and renewable energy generation capacity over the period to 2030 to investigate what impact these would have on the identified capacity gap.

Electricity demand scenarios

Three electricity demand scenarios were developed – high, medium and low. These were derived from two potential energy demand scenarios. One was based on a European Commission[6] study that models a rise in UK energy demand from 2006 to 2030 and the other was based on the UK's existing energy efficiency plan that aims to achieve an 18% reduction in energy use by 2030.[7] Pöyry then applied various assumptions about the future demand for electricity in various sectors[8] to produce the set of three electricity demand scenarios. These are shown in figure 4, alongside the electricity demand projections used in the government's recently published Renewable Energy Strategy Consultation.[9]

It should be noted that while the medium and low demand scenarios developed by Pöyry are significantly lower than the demand scenario laid out in the government's Renewable Energy Strategy Consultation, they are based on the government's own stated expectations for energy efficiency improvement.

Renewable generation scenarios

Pöyry then explored what level of renewable generation would apply to each of the three electricity demand scenarios based on two levels of renewable penetration:

- a 35% share of electricity output, which reflects a contribution in line with government proposals outlined in its Renewable Energy Strategy Consultation;
- a 45% share of electricity output to reflect the view that renewable electricity will bear the brunt of the compliance burden, as there are limited opportunities for renewable energy use in the heat and transport sectors.

This produced six scenarios for the contribution of renewable energy across the electricity, heat and transport sectors, as shown in figure 5.

Impact of renewable generation scenarios on the capacity gap

The different renewable generation scenarios developed by Pöyry result in varying levels of installed capacity in 2020. Figure 6 gives the breakdown of installed capacity under each scenario. In all scenarios the renewable energy capacity plateaus in 2020 as the model includes only what is assumed to be built under the current targets in the analysis. Further expansion of renewable energy deployment after 2020 is not modelled, but significant potential renewable resources remain untapped in the scenarios.

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6 DG for Energy and Transport, 2007. Energy in Europe: Trends to 2030 (2007 Update). Available from: www.ec.europa.eu/dgs/energy_transport/figures/trends_2030_update_2007/energy_transport_trends_2030_update_2007_en.pdf [accessed 27 August 2008]
7 Defra, www.defra.gov.uk/environment/climatechange/uk/energy/pdf/action-plan-2007.pdf (link dead)
8 These include assumptions about the use of electricity for transport and heating and the development of decentralised heating options.
9 Department for Business Enterprise and Regulatory Reform, 2008. Renewable Energy Strategy Consultation. Available at : www.renewableconsultation.berr.gov.uk/consultation/consultation_summary [accessed 27 August 2008]

Figure 4:
Electricity demand scenarios

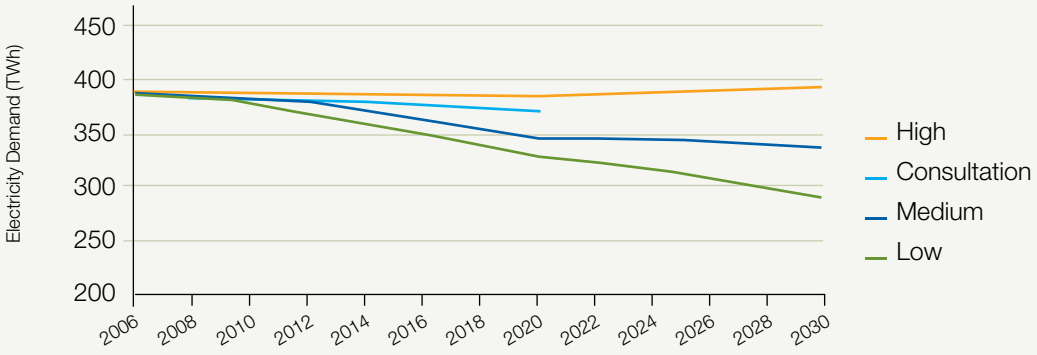


Figure 5:
Contribution of electricity, transport and heat

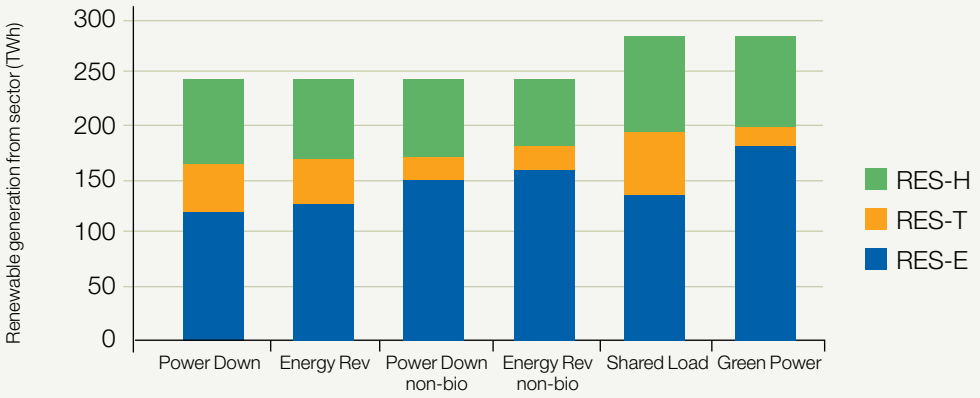
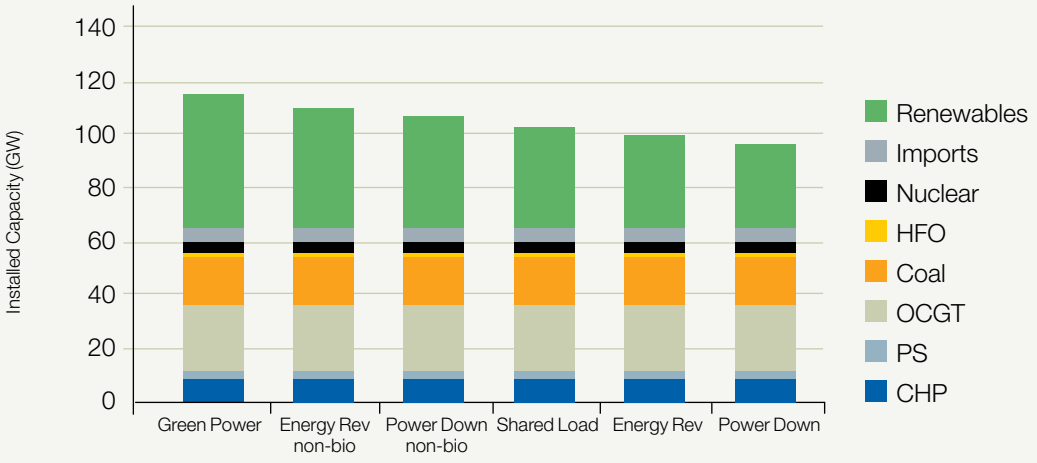


Figure 6:
Installed capacity by scenario 2020



Source: Pöyry Energy Consulting, July 2008

Combining Pöyry's six renewable scenarios with its projections for future conventional capacity produces the following results:

• The overall peak capacity margin is much improved. There is a temporary dip in the peak capacity margin around 2015/16, but in only two scenarios does it fall below 20%. After that, margins continue to improve as additional renewable capacity comes online so that even in the scenario with the lowest margin, it is still close to 20%.

• It should be noted that in 2020 all conventional generation is from existing plant. It is only after 2025 that margins begin to decline substantially.

• The report observes that a number of further options could be deployed in the post-2020 period, including highly efficient industrial combined heat and power plants, further expansion of renewable sources, such as wave and tidal power, and, potentially, carbon capture and storage – provided this technology has been shown to be technically and economically viable.

• The highest capacity margins are observed where there is the highest contribution from renewables and the lowest level of peak electricity demand.

In short, this analysis finds that if the UK government is able to achieve its commitments to meet EU renewable energy targets and its own ambitious action plan to reduce demand through energy efficiency, then major new power stations (burning either coal or gas) would not be needed to ensure that Britain can meet its electricity requirements up to at least 2020.

The intermittency question

Several commentators have claimed that renewable energy can not be relied upon to plug the energy gap because it is variable or intermittent in nature. Pöyry explored in more detail what the implications could be for having a large amount of intermittent generation on the system and included the additional generating capacity that could be used in those instances when the margin dips below 20%.

The Pöyry renewable generation scenarios result in a large amount of wind power being built and the main results of Pöyry's analysis are:

• In only one scenario is there a shortfall (relative to a 20% margin) in 2016 and here the gap is very short-term – less than three hours duration over the whole year.

• A peak capacity margin of 20% is sufficient to cover the loss of intermittent output up to 2016 in high renewable penetration scenarios (45% share) and out to 2020 in low penetration scenarios (35% share). That is, there is no need for additional conventional generation to back-up the wind generation that would be built in these scenarios.

Overall the analysis indicates that any additional balancing measures required in the period to 2020 are needed only to meet very short-term fluctuations. Pöyry concludes that this requirement could be met through a combination of demand-side management measures and the use of peaking plant and that there is no need for additional baseload generation capacity until at least 2020.

Key conclusions of the Pöyry analysis

The main conclusion from this analysis is that if the UK government focuses its efforts on delivering its existing ambitions for energy efficiency and on meeting the 15% renewable energy target, there will be no need to build additional conventional power generation until at least 2020.

It can also be concluded that:

- CO_2 emissions are reduced by between 23% and 37% (from 1990 levels) by 2020, with reductions in 2030 between 25% and 47%.[10] The biggest reductions are in the scenarios with the lowest energy demand;
- total UK gas consumption falls between 15 and 42% due to a reduction in the use of gas-fired plant and reductions in direct gas demand for space and water heating through increased use of renewable heat sources;
- no additional baseload capacity is needed to back-up the renewable generation that is built in each of the scenarios;
- a small amount of flexible capacity may be needed in the period from 2015-2020 to deal with very short-term capacity fluctuations. This capacity demand can be best met through demand-side management and/or peaking plant;
- additional baseload capacity is likely to be needed from the mid-2020s onwards. The report observes that a number of further options could meet this need including highly efficient industrial combined heat and power plants, further roll-out of renewables such as tidal power and other safe sustainable low carbon energy technologies that may be available in 2025.

10 This is based on the assumption that the additional capacity required after 2020 is made up of gas powered units.

Implications for UK government policy

The UK government and industry have used the perceived existence of an emerging 'energy gap' in 2015 as a reason for approving the construction of new fossil-fuelled power stations. In particular, they are focusing on the development of coal-fired power stations as they say this will not only ensure that the "lights stay on" but will also contribute to broader energy security by reducing our reliance on imported gas for our energy needs.

These views are highlighted in the following quotes from government ministers and industry representatives:

"As a country we have to accept the reality that, even in meeting our EU 2020 renewables target, fossil fuels will still play a major part for the next couple of decades at the very least."

Speech by John Hutton, Secretary of State for Business, Energy and Regulatory Reform to the Adam Smith Institute, 10 March 2008.[11]

"Electricity demand fluctuates continually... We therefore will continue to need this back up from fossil fuels, with coal a key source of that flexibility, as we increase the proportion of renewable energy in our electricity mix."

Speech by John Hutton, Secretary of State for Business, Energy and Regulatory Reform to the Adam Smith Institute, 10 March 2008.[12]

"Cleaner coal plants, like the new Kingsnorth power station, are necessary until alternatives come on stream... If we want diversity of supply – not being over dependent on one fuel, such as gas – and security of supply, we need coal for the foreseeable future."

David Porter, Association of Electricity Producers, The Guardian, 5 August 2008.[13]

"Between now and 2020 the UK must replace about a third of its existing electricity generating capacity. That is an unprecedented and enormously expensive challenge. The climate campers believe that a combination of wind and wave power and increased energy efficiency will be enough to bridge the gap. But that is simply unrealistic."

Paul Golby, Chief Executive, E.ON UK, The Guardian, 31 July 2008.[14]

"We have to have regard, to put it mildly, to supply – the good British people are not going to thank us if we tackle global warming by the country getting darker."

Interview with Malcolm Wicks, Energy Minister, Financial Times, 1 August 2008.[15]

Coal was needed to reduce the UK's future dependence on gas imports from some "fairly unstable parts of the world".

Interview with Malcolm Wicks, Financial Times, 1 August 2008.[16]

11 Department for Business Enterprise and Regulatory Reform, 2008. The future of utilities [online]. Available from: www.berr.gov.uk/pressroom/Speeches/page45211.html [accessed 27 August 2008]
12 Ibid

13 PORTER, D., 2008. Coal plugs the energy gap – for now [online]. The Guardian. Available from: www.guardian.co.uk/commentisfree/2008/aug/05/kingsnorthclimatecamp.climatechange1 [accessed 27 August 2008]
14 GOLBY, P., 2008. Energy to burn [online]. The Guardian. Available from: www.guardian.co.uk/commentisfree/2008/jul/31/utilities.activists [accessed 27 August 2008]
15 EAGLESHAM, J., 2008. Opponents of new stations naïve, says Wicks [online]. Financial Times. Available from: www.ft.com/cms/s/0/cac19866-5f54-11dd-91c0-000077b07658.html [accessed 27 August 2008]
16 Ibid

However, these views are not at all supported by the Pöyry analysis outlined in this summary paper. Pöyry's findings clearly show that a strong focus from government and industry on delivering the new renewable energy and energy efficiency targets will ensure the UK meets the capacity demands created by the closure of a number of existing power plants between now and 2020, as well as improving energy security.

These government and industry comments also claim that coal is needed to reduce the UK's reliance on imported gas and improve security of supply. The Pöyry analysis has shown that this is not the case and that by focusing on energy efficiency and renewables the UK can reduce gas use by up to 42%. Furthermore, these views on energy security are not supported by the government's own analysis, as the 2007 Energy White Paper indicated that we currently import 75% of our coal, with the main sources being Russia and South Africa.[17]

In addition and again according to the government's own figures, 60% of the gas used in the UK is to supply heat.[18] Building new coal fired power stations that will only supply electricity will do nothing to reduce our reliance on gas for heating.

Further government analysis has indicated that the global economics of coal do not favour UK production,[19] meaning we will continue to be reliant on imports for our supplies in the future. Therefore, the building of new coal-fired power stations in the UK will not reduce our reliance on imported fuels, and is not needed in order to ensure security of our generation capacity if the government delivers on its efficiency and renewable energy commitments.

The Pöyry analysis indicates that it is not until the period beyond 2020 that new baseload electricity generation capacity is needed. If the UK is to stay on track to meet its longer term target of at least 60% reduction in CO_2 emissions by 2050 – let alone the much more ambitious targets indicated by the science – any new capacity built now or in the future must be low or zero carbon. There are a range of low carbon options that could provide additional baseload capacity in this way, such as;

– **small-scale and industrial combined heat and power (CHP)** – already technologically mature and commercially proven today. Analysis, also by Pöyry, of the potential for industrial CHP on a small number of UK sites suggests that as much as 13GW of unharnessed potential exists in Britain today.[20]

– **marine energy technologies**, such as wave and tidal generators – by 2020 these technologies need to be commercially mature and ready to be deployed on a large scale to provide significant additional zero carbon renewable energy capacity in that decade.

- it is also possible that by 2025 other safe sustainable low carbon energy technologies may be available.

The findings from the Poyry analysis are also supported by research undertaken in 2007 for WWF, RSPB and the Institute for Public Policy Research (ippr), which shows how an 80% reduction target by 2050 can be met with a strong focus on energy efficiency, renewable energy and other low carbon technologies.[21]

It is therefore imperative that the government puts in place now the right set of policies and incentives to ensure that the next generation of low carbon electricity generation technologies are available for deployment by 2020.

17 Department for Business Enterprise and Regulatory Reform, 2008. Energy White Paper, p. 112 [online]. Available from: www.berr.gov.uk/files/file39568.pdf [accessed 27 August 2008]
18 Department for Business Enterprise and Regulatory Reform. Commodity balances [online]. Available from: www.dtistats.net/energystats/dukes4_1.xls [accessed 27 August 2008]
19 Overview of the work of the UK Coal Forum November 2006-June 2007 [online]. Available from: www.berr.gov.uk/files/file41186.pdf [accessed 27 August 2008]

20 Greenpeace UK, 2008. Securing Power [online]. Available from: www.greenpeace.org.uk/media/reports/securing-power [accessed 27 August 2008]
21 WWF-UK, 2008. 80% Challenge [online]. Available from: www.wwf.org.uk/filelibrary/pdf/80percent_report.pdf [accessed 27 August 2008]

Final conclusions and recommendations

From the discussions set out in this briefing paper and drawing on the recent detailed Pöyry analysis (July 2008) WWF-UK and Greenpeace make the following conclusions and recommendations.

Conclusions:

• Delivery by the UK government and industry on the new 2020 targets for energy efficiency and renewable energy will mean that the short-term 'energy gap' created by the closure of a number of existing power plants between now and 2020 will not materialise.

• Meeting these targets will deliver a triple win for the government and the country: the lights will stay on, CO_2 emissions will be reduced and our reliance on imported fossil fuels, such as gas and coal, will be dramatically reduced.

• New coal-fired power stations such as E.ON's Kingsnorth proposal are not needed.

• A step-change in energy efficiency and reduction in final energy demand and energy wastage is crucial, as well as technically and economically feasible. The lower the UK's final energy demand is, then the cheaper it is for the UK to meet its new EU 2020 renewable energy targets.

Recommendations:

• **A new policy and delivery framework for renewable energy is urgently needed in the UK**. This needs to include; the development of a robust industrial policy to support the roll out of renewable energy and energy efficiency; commitment to provide the necessary research, development and demonstration funding; priority access for renewables ahead of coal and nuclear power; and continued and substantially increased support (funding and incentives) for renewable energy beyond 2020.

• **Government and industry need to deliver a step-change in energy demand trends and ensure achievement of targets in the national energy efficiency action plan**. At present, there is a lack of sufficient and simple financial incentives on offer from government and energy companies – many more are needed urgently, such as attractive grants and green loans for energy efficiency measures. Other policies and measures could help to create a new energy services industry in the UK.

• **The government must also put in place now the right set of policies to drive the development of, and investment in, the next generation of renewable and CHP technologies**, to ensure that they are available to be deployed from the mid-2020s.

• **The introduction of a new legal standard setting a limit on CO_2 emissions for all new generating plants that have yet to secure planning consent**. Similar to the policy that is already in force in the state of California, a UK standard should be set at 350g of CO_2 /kWh, a level that could be achieved by an efficient gas-fired power station that makes some use of waste heat. The emissions performance standard should be tightened significantly if CCS technology is proven to be technically and economically viable.[22] This would then rule out the building of new carbon intensive fossil-fuelled power stations and prevent carbon lock-in.

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22 WWF-UK, 2008. Joint statement on coal and carbon capture and storage. Available from: www.wwf.org.uk/filelibrary/pdf/ngo_js_ccs.pdf

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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
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