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Britain's high energy prices: the folly of wind-power

Introduction

Last week's economic news was mixed, biased towards the negative. Starting with the good news, exports picked up in August, whilst imports fell back, resulting in a modest improvement in the trade balance. But, given the downturn in our major export markets, the much-desired export led growth projected by the OBR in March is far from guaranteed. Manufacturing slipped back in the month and unemployment jumped to 2.57 million (June to August) to a 17-year high.

Economic growth, or the lack of it, is now central to any economic debate. And many eyes will be focussed on the growth measures due to be announced in the Chancellor's Autumn Statement on 29 November. It should, of course, be remembered that the March Budget was tagged as one "unashamedly about growth" but *The Plan for Growth* released at the time, jointly authored by the Treasury and BIS, was very unambitious.[1] The British economy needs a really radical growth strategy in order to reverse the lost competitiveness experienced since 1998.[2]

High energy prices

One area which should be tackled is energy policy, where "green policies" are damaging business.[3,4] In July 2011 DECC estimated that electricity prices for industry could be up to 52% higher because of "green polices" by 2020 than prices in the absence of such policies.[5] (In 2009 the estimates of the green "add-ons" were, if anything, higher.[6]) For chemicals and steel, for example, these are competitiveness-shredding, viability-wrecking increases in energy costs. They risk driving these industries to migrate overseas, along with their CO2 emissions, thus having zero net impact on global emissions totals.

There are indications that the Government is taking heed of business's complaints about high energy prices. In his speech to the recent Conservative Party conference the Chancellor hinted strongly that British companies would not be sacrificed in the race to build a greener economy. He said that Britain would move "no slower, no faster than our fellow countries in Europe" and "we are not going to save the planet by putting our country out of business".[7] And there have already been some hints that he may unveil some support for energy-intensive firms, especially badly affected by rising energy costs, in the Autumn Statement.[8]

The Chancellor's comments were, however, not wholly unprecedented. In May 2011 Secretary of State for Energy and Climate Change Chris Huhne stated there would be a review of policy "in early 2014 to ensure our own carbon targets are in line with the EU's" when he released the details of the Fourth Carbon Budget.[9]

Such a review is only too necessary given the unprecedented costs if current emissions targets are pursued. The 2008 Climate Change Act prescribed an overall target of cutting greenhouse gases (GHG) by 80% by 2050 compared with the 1990 level. This is tantamount to the near-decarbonisation of the economy – with huge implications for the energy sector, in particular, and the economy, more generally. To date four 5-year Carbon Budgets have been announced. The first three were set in May 2009, the 4th in May 2011. Table 1 shows the prescribed cuts in greenhouse gases under these budgets. The first budget (2008-12) may be met, not least of all because of the 2008-09 recession and expected slow growth into 2012.

Table 1 Greenhouse gas (GHG) emissions, million tonnes, carbon dioxide equivalent (MtCO2e)

Years	Carbon Budget	Compared with 1990 level	MtCO2e
5-year periods			
2008-12	First	-22%	3018
2013-17	Second	-28%	2782
2018-2022	Third	-34%	2544
2023-27	Fourth	-50%	1950
2050	Target	-80%	

Source: DECC website, www.decc.gov.uk

Mitigating dangerous manmade global warming

The Government's energy policy is inextricably tied up with its climate change policy, which is principally concerned with cutting greenhouse gas emissions, especially CO2, in order to "mitigate dangerous manmade global warming". We will not discuss the evidence for or against this phenomenon in this Perspective, but will note that the UK was responsible for just 1.7% of global emissions in 2008.[10] China was responsible for over 23% of the emissions and the USA for 18%.

There are two crucial pieces of legislation that are driving energy policy:

- The Climate Change Act (2008), which is driving the draconian reduction in greenhouse gas emissions, discussed above.
- The EU's Renewables Directive (2009) whereby the UK is committed to sourcing 15% of final energy consumption (fec) from renewables by 2020. Renewable energy sources include wind, hydro and biomass, but not nuclear power. Note that the Renewables Directive does not add to the pressures on Britain to cut GHG emissions further, it merely insists that renewables must contribute to the overall, overarching cuts determined by other legislation. There is little chance that Britain will be able to meet the renewables target.[11,12]

Britain's technology of choice in order to meet these twin targets is wind power, even though it is costly and intermittent. And the Government is also pressing for new nuclear build in order to reduce CO2 emissions. The Government's strategy is to incentivise investment in low-carbon technologies, partly by increasing the costs of fossil fuels, by an assortment of carrots and sticks. These carrots and sticks mainly comprise:

- The Climate Change Levy (CCL), introduced in April 2001, is a tax on the use of energy in industry, commerce and the public sector (i.e. all non-domestic sectors) intended to encourage energy efficiency and reduce carbon emissions. There are exemptions but, notably, nuclear generated electricity is not one of them - despite the fact such generation has no carbon emissions.
- The Renewables Obligation (RO), introduced in 2002, is the obligation placed on licensed electricity suppliers to deliver a specified amount of their electricity from eligible renewable sources. The costs associated with the RO are rising reflecting increasing obligation levels. The RO is currently the primary mechanism to support deployment of large-scale renewable electricity generation.
- The EU's Emissions Trading System (ETS) is the EU-wide "cap and trade" scheme which started in 2005. Phase I ran from 2005 to 2007, phase II is currently operative (2008 to 2012). The allocation of free permits (or carbon credits) will be substantially reduced under phase III (2013-2020). Carbon costs can be expected to rise significantly.
- The Feed-in Tariffs (FiTs) scheme was introduced in April 2010. The scheme provides a fixed payment for the electricity generated privately from renewable or low-carbon sources called the "generation tariff". Any unused electricity can be exported to the grid. FiTs work alongside the Renewables Obligation (RO) and the Renewable Heat Incentive (RHI) which, when implemented, will support generation of heat from renewable sources.
- In addition, the Carbon Price Floor (CPF), starting in April 2013, will raise the carbon costs of fossil fuel energy sources further. The CPF is intended to "provide greater support and certainty to the price of carbon in the power sector to encourage investment in low-carbon electricity generation". The Government is proposing to achieve these aims through reforms to the CCL and, where oil is used for electricity generation, fuel duty.[13]

Mott MacDonald's analysis of electricity costs

The engineering consultancy Mott MacDonald was commissioned by DECC to update UK electricity generation costs and its report was released in mid-2010.[14,15] Mott MacDonald emphasised that estimating such costs is far from straightforward, many assumptions about fuel prices and the maturity of technology (for example) have to be made. We would refer readers interested in the detailed assumptions to the original paper, which is easily available.

Mott MacDonald costed some minor technologies including biomass and hydro as well as the major technologies (gas-fired, coal-fired, wind and nuclear). Concerning the major technologies they specifically looked at several options including:

- Gas-fired combined-cycle gas turbines (CCGT).
- Advanced supercritical (ASC) coal-fired power plants.
- Gas CCGT with carbon capture and storage (CCS).
- Coal (ASC) with CCS.
- Onshore wind.

- Offshore wind.
- Nuclear pressurised water reactors (PWR).

For these major technologies they considered ten different cases, using different assumptions about the timing of the project, the discount rate used, the maturity of certain technologies, and different fuel and carbon prices. We have chosen just two of these cases for this Perspective:

- Near-term project (Mott MacDonald used 2009 for the start date): with a 10% discount rate and a mixed maturity of technologies.[16] Only CCGT, ASC coal and inshore wind were regarded as mature technologies. See charts 1a, 1b and 3.
- Medium-term project (2017 start date): with a 10% discount rate, all mature technologies and assuming DECC's central fuel and carbon prices assumptions. See charts 4a, 4b and 4c.

Charts 1a and 1b show the costs of generating electricity for the near-term project, in terms of £/MWh.[17] If the carbon costs are omitted the ASC coal-fired plants and the unabated gas CCGT are the lowest cost generators. Offshore wind and gas and coal with CCS are the most costly. Integrating CCS into coal or gas fired plant substantially raises capital and operating costs. If the carbon costs are taken into account the gas CCGT is the least costly, with onshore wind in second place.

Chart 1a: Near-term project, basic costs of generating electricity, £/MWh

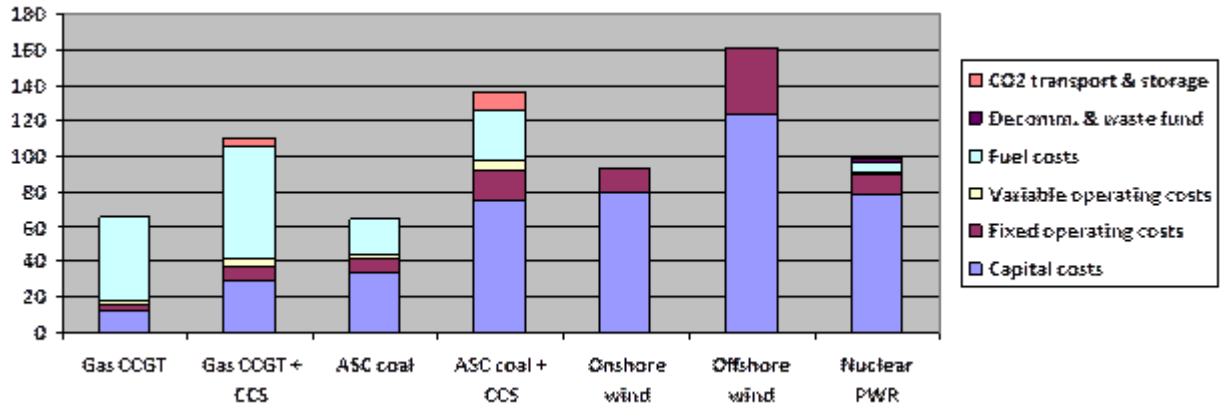
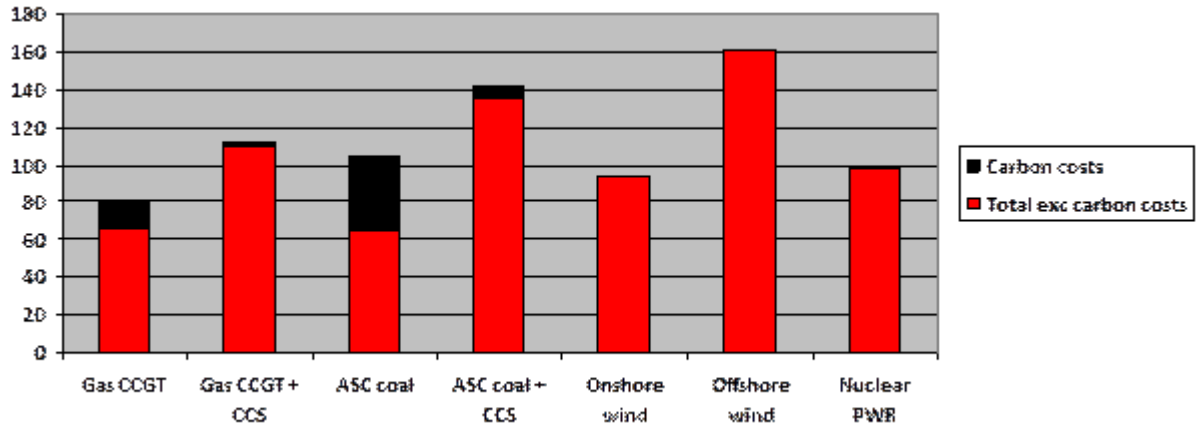


Chart 1b: Near-term project, including of the carbon costs, £/MWh



Source: Mott MacDonald, *UK electricity generation costs update*, June 2010.

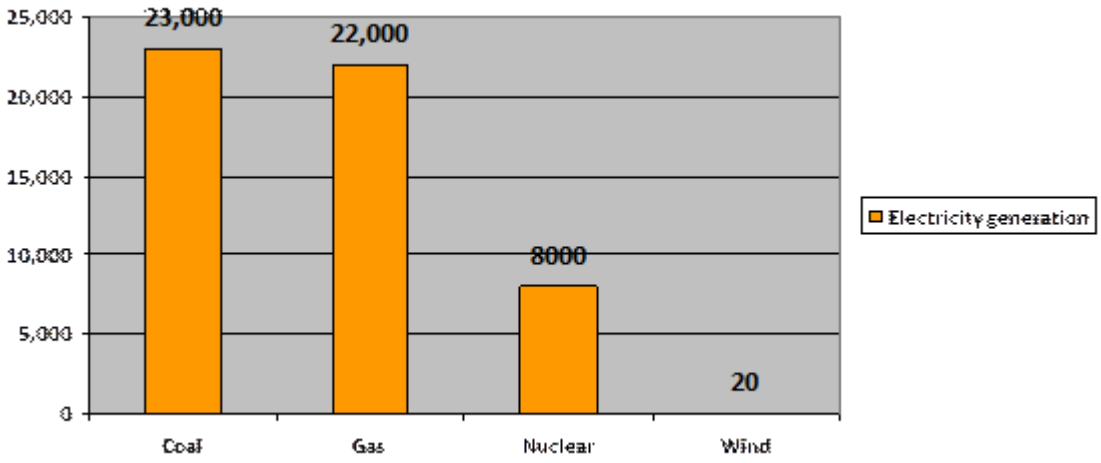
However, these Mott MacDonald figures flatter wind-power for two major reasons. The first reason is that wind-power is intermittent and requires conventional stand-by generating capacity, which increases the costs of wind-power. Mott MacDonald assumed load factors of just 25-31% for onshore wind and 35-45% for offshore wind, though they made no allowance for stand-by costs.[18]

However it should be noted that these figures for load factors can mislead. In spells of very cold weather associated with high pressure areas, when there is enhanced demand for electricity, there tends to be little wind. This analysis was confirmed by BBC weatherman Paul Hudson, who wrote in January 2011:[19]

- "…during the recent intense cold weather, it's been our traditional coal and gas fired power stations that have been working flat out to keep our homes and businesses warm. And for the third winter running, the intense cold has gone hand in hand with periods of little or no wind. This should come as no surprise since prolonged cold is invariably associated with areas of high pressure".

And the following chart (chart 2) was included in this BBC report. Wind's contribution to electricity output (53,020 Megawatts) on 21 December 2010 was, according to the BBC, 0.04%. This insight is a useful reposte to those who say "the wind is always blowing somewhere" in defence of wind-power. In Britain on very cold days it effectively isn't.

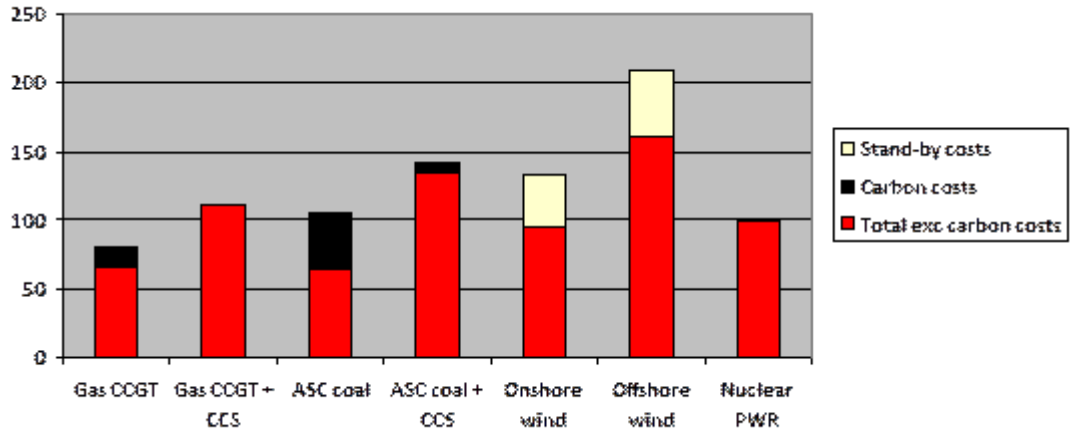
Chart 2: Electricity generation, 21 December 2010, Megawatts



Source: Paul Hudson, "Coal takes the strain...again", *BBC website*, 10 January 2011.

Parsons Brinckerhoff' (PB) Power, another engineering consultancy, in a report for the Royal Academy of Engineering (RAE) estimated in 2004 that stand-by costs could add around 45% to the costs for onshore wind and 30% to offshore wind.[20] If this were the case, and taking our afore-quoted near-term project, the cost of onshore wind would become quite uneconomic and offshore wind even more absurdly expensive, as shown in chart 3.

Chart 3: Near-term project, including stand-by costs, £/MWh



Source: RAE, "The cost of generating electricity", Parsons Brinckerhoff (BP) Power, 2004.

The second reason for believing the Mott MacDonald estimates underestimate the cost of wind-power is the need for transmission reinforcement. Wind farms tend to be situated in the north of the country in order to exploit higher wind speeds to improve load factors. This exacerbates the existing north to south flow of power and brings forward requirements to reinforce the system. According to Colin Gibson, who was Power Network Director at the National Grid Group (1993-97), it would not "seem unreasonable…to include a cost of up to £20/MWh for all associated reinforcements".[21]

Charts 4a and 4b show Mott MacDonald's cost estimates for our chosen medium-term project, with a start-date of 2017. Before the additions of the carbon costs, coal and gas remain the cheapest technologies, with nuclear a close third. After taking carbon costs into account nuclear is the most cost-effective, with gas and especially coal significantly more expensive because of the high (and increasing) carbon costs. Onshore and offshore are more expensive than nuclear, even before taking into account the need for stand-by capacity and transmission reinforcement. Chart 4c includes estimates for stand-by costs for wind-power, as calculated above for the near-term project.

Chart 4a: Medium-term project (2017): basic costs of generating electricity, £/MWh

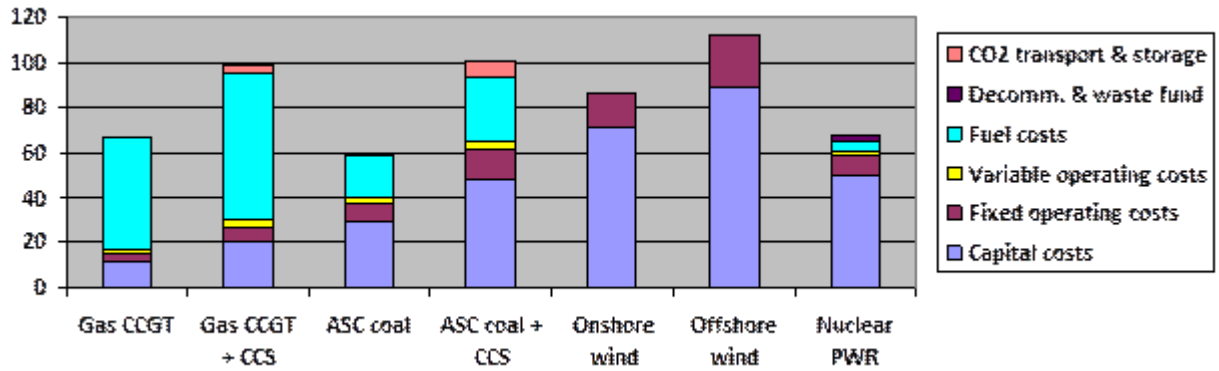


Chart 4b: Medium-term project (2017): including of the carbon costs, £/MWh

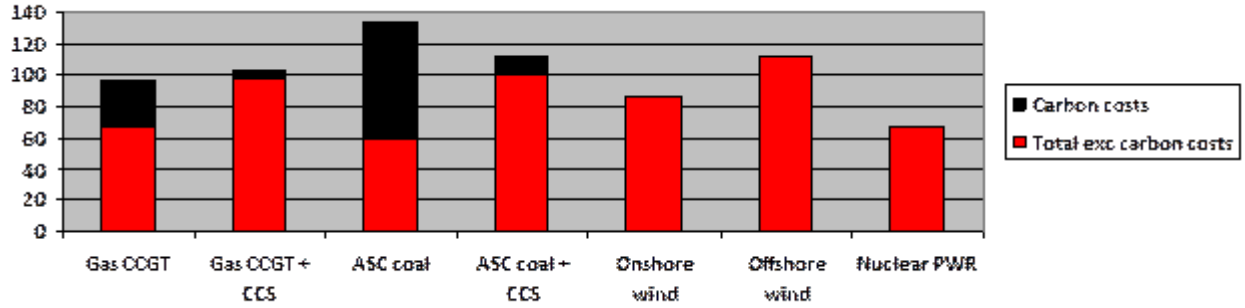
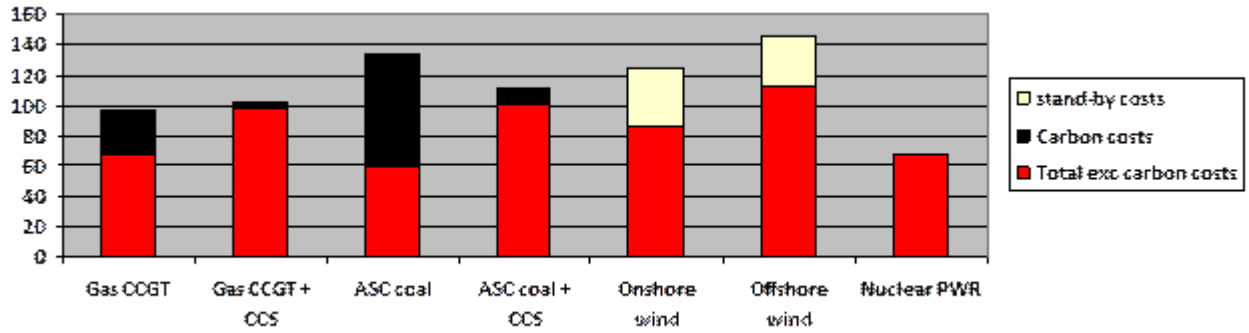


Chart 4c: Medium-term project (2017): including stand-by costs, £/MWh



Source: Mott MacDonald, *UK electricity generation costs update*, June 2010.

Mott MacDonald analysis: conclusions

To sum up, these were Mott MacDonald's main findings, allowing for carbon costs:

- Gas fired CCGT was expected to be least cost main technology option in the near-term.
- Nuclear power was projected to be least cost option in the longer term, assuming DECC's central fuel and carbon prices assumptions.
- Excluding carbon costs, coal is the cheapest technology in the near-term and the medium-term, assuming DECC's central fuel and carbon prices assumptions.

Other things being equal this would suggest that investment should be concentrated in gas and nuclear technologies. (A mix of technologies is preferable for operational reasons.) Both onshore and, especially, offshore wind fared relatively badly in this analysis, even though Mott MacDonald's analysis for DECC excluded the costs of stand-by generation and transmission reinforcement. There is no economic case for expensive wind-power. It only adds to consumers' energy bills – both domestically and business.

Even if one accepts the need to cut carbon emissions, not a universal sentiment by any means, it is clear that the dash for wind-power can only be "justified" by Britain's misguided commitment to the 15% renewables target by 2020 under the EU's Renewables Directive. It is proving, and will continue to prove, a very costly commitment indeed.

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5. DECC, *Provisional estimates of the impacts of energy and climate change policies on prices and bills of large energy users*, July 2011. The energy division of BERR and the climate change responsibilities of DEFRA were transferred to the new Department of Energy and Climate Change (DECC) in October 2008. Website: www.decc.gov.uk. These costs mainly comprise Feed-in Tariffs, the Climate Change Levy (CCL), Carbon Price Floor (CPF, from 2013), Renewables Obligation and the EU Emissions Trading System (ETS).
6. HM Government, *The UK Renewable Energy Strategy*, July 2009.
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8. *CityAM*, "Industry to get carbon tax breaks", 5 October 2011.
9. DECC, "Fourth Carbon Budget: oral ministerial statement by Chris Huhne", 17 May 2011.
10. Data from the Carbon Dioxide Information Analysis Center **(**CDIAC), for the UN.
11. Ruth Lea, "The EU's renewables policy: official cost estimates to Britain", Global Vision and the Taxpayers Alliance, December 2008.
12. Ruth Lea, "Britain's renewable energy targets are quite unrealistic", Arbuthnot Banking Group, 5 May 2008.
13. HM Treasury and HMRC, "Carbon price floor: support and certainty for low-carbon investment", consultation document, December 2010.
14. Mott MacDonald, *UK electricity generation costs update*, June 2010.
15. Mott MacDonald used levelised costs. The levelised cost of generation is the lifetime discounted cost of ownership of using a generation asset converted into an equivalent unit cost of generation in £/MWh or p/kWh. This is sometimes called a life cycle cost, which emphasises the cradle to grave aspect of the definition.
16. Mott MacDonald used "first of a kind" (FOAK) for new technologies and "nth of a kind" (NOAK) for mature technologies.
17. Kilowatt hour (kWh) = 10^3 watt hours; Megawatt hour (MWh) = 10^6 watt hours; Gigawatt hour (GWh) = 10^9 watt hours; Terawatt hour (TWh) = 10^{12} watt hours.
18. The load factor (or capacity factor) is the ratio of the actual output of a power plant over a period of time and its potential output if it had operated at full "nameplate capacity" the entire time.
19. Paul Hudson, "Coal takes the strain...again", BBC website, 10 January 2011.
20. RAE, "The cost of generating electricity", Parsons Brinckerhoff (BP) Power, 2004.
21. Colin Gibson, "The cost of wind", Journal of the Institution of Engineering and Technology, 19 October 2010.

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