Subsidies for nuclear power in the UK government's proposals for electricity market reform¹

Energy Fair

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Executive summary

This report examines proposals by the UK government for reform of the UK market for electricity to identify and describe those parts of the proposals that have the effect of creating new subsidies for nuclear power.

As background and context, the report describes how the UK market for electricity is part of several different markets for energy, how energy markets are distorted, and how those distortions may be corrected.

The subsidies or potential subsidies which are considered are:

- *Exemption from tax.* Uranium is exempted from the tax on fuels used for the generation of electricity.
- *Feed-in tariffs with contracts for difference*. Although it is a mature technology that should not need subsidies, nuclear power would be eligible for the same system of subsidies as is proposed for renewable sources of power.
- *Capacity mechanism*. The UK government's proposals for a 'capacity mechanism' as a backstop for the power supply system are not yet finalised. However, there is potential for the proposed mechanism to be used to provide unjustified support for nuclear power.
- *Emissions Performance Standard*. Although nuclear power emits between 9 and 25 times more fossil carbon than wind power, it appears that the effect of the proposed new standard would, for the foreseeable future, be to lump them together as if they were equivalent in their carbon emissions.

Possible justifications for subsidising nuclear power are considered but all of them are rejected.

1 Introduction

Proposals by the UK government to reform the UK market for electricity have been described in consultation documents [DECC2010, HMT2010] and are now incorporated, with revisions, in a white paper [WP2011] and in the Finance Act 2011 [FA2011].

The Energy and Climate Change Committee, amongst others, has said that the proposals have the effect of introducing new subsidies for nuclear power.² The purpose of this document is to

¹ An electronic version of this document, with live links, may be downloaded via <u>http://www.mng.org.uk/emrdoc</u> and also via a link from <u>http://www.energyfair.org.uk/actions</u>.

² See [ECCC2011A] and, for example, "MPs attack government's covert subsidies for nuclear industry" (The Guardian, 2011-05-16, <u>http://www.guardian.co.uk/environment/2011/may/16/nuclear-energy-industry-select-committee</u>), "UK

examine the new proposals to identify and describe those parts of the proposals that have the effect of creating new subsidies for nuclear power.

Background and context 2

As a background and context for the sections that follow, this section describes relevant markets, distortions in those markets, and ways in which those distortions may be corrected.

2.1 Relevant markets

The supply of electricity to customers in the UK is part of several different markets, not just a single UK market for electricity.

2.1.1 The UK, the EU, and beyond

The UK is not a self-contained market for electricity. It is already part of a geographically-larger market for electricity and that larger market is likely to become increasingly significant in the future:

- There is two-way trading in electricity between the UK and its neighbours: ٠
 - Via a 2 GW connection with France.
 - Via a 600 MW connection between Northern Ireland and the Republic of Ireland, and, since 2002, an indirect connection between the Republic of Ireland and mainland Britain via the 500 MW Moyle interconnector between Northern Ireland and Scotland.
 - Since early in 2011, via the 1 GW 'BritNed' transmission link with the 0 Netherlands.
- There are proposals for new transmission links between the UK and its neighbours:
 - With the Republic of Ireland.³ A 500 MW link, between Rush North Beach, Co Fingal, and Barkby Beach, north Wales, is already under construction.
 - With the Channel Islands and France.⁴
 - With France, through the Channel tunnel.⁵ 0
 - Between the UK and Denmark and between the UK and Norway.⁶ 0

http://www.guardian.co.uk/environment/2011/jun/18/ireland-wind-power-grid).

⁵ "French power link to run through Channel tunnel (The Independent, 2011-05-27, http://www.independent.co.uk/news/business/news/french-power-link-to-run-through-channel-tunnel-2289665.html).

breaks promise on nuclear power subsidies, say MPs" (BBC News, 2011-05-16, http://www.bbc.co.uk/news/scienceenvironment-13393732), "Coalition should be up-front about nuclear subsidy' says Committee" (press release from Energy and Climate Change Committee, 2011-05-16, http://www.parliament.uk/business/committees/committees-az/commons-select/energy-and-climate-change-committee/news/emr-report-findings/), "MPs should keep their promises - not back £1 billion windfall for nuclear power" (Greenpeace blog, 2011-07-04, http://www.greenpeace.org.uk/blog/nuclear/mps-should-keep-their-promises-not-back-%C2%A31-billionwindfall-nuclear-power-20110704.

³ See "Imera to boost Ireland's energy supply" (The Calco Power Presidium, 2007-12-07,

http://powerpresidium.blogspot.com/2007/12/imera-to-boost-irelands-energy-supply.html); "Swedish firm ABB to link Irish grid to UK" (Irish Times, 2009-03-09,

http://www.irishtimes.com/newspaper/finance/2009/0330/1224243690854.html), "UK urges Ireland to build wind farms on west coast" (The Guardian, 2011-06-18, http://www.guardian.co.uk/environment/2011/jun/18/ireland-windpower-grid). ⁴ "UK urges Ireland to build wind farms on west coast" (The Guardian, 2011-06-18,

- Those existing and proposed connections will be part of the European supergrid, composed largely of submarine HVDC cables, which is envisaged in the North Sea, in the Irish Sea, and elsewhere around the coasts of European countries—to service offshore wind farms in those waters and also to enhance energy security by allowing a shortfall in any area to be met from other areas, to allow excess power in any area to be transmitted to where it is needed, and to smooth out variations in supply and demand.⁷ This concept is endorsed by our own Prime Minister.⁸
- A much larger supergrid, spanning the whole of Europe, the Middle East and North Africa (EUMENA), is envisaged in the Desertec programme, now being developed by two consortia of companies, the Desertec Industrial Initiative⁹ and the Medgrid consortium.¹⁰ It is likely that, in the coming years, Europe will benefit from imports of solar and wind power from desert regions in North Africa and the Middle East and that, via a 'cascading' principle, that electricity may be available on relatively short timescales to customers throughout the EU, including the UK.¹¹ There may also be exports from Europe to countries in North Africa and the Middle East, particularly in the winter when decreases in solar power in the south may be offset by increases in wind power in the north. The Desertec concept has been endorsed by the EU Energy Commissioner, Guenther Oettinger.¹²
- Since the European Commission's 1997 Electricity Directive, work has been proceeding to create a single market for electricity throughout the EU and there are now calls for a single EU market for all kinds of energy to be completed by 2015.¹³
- Since 1 November 2007, there has been a single electricity market in the Republic of Ireland and Northern Ireland with the trading of wholesale electricity carried out on an 'all-Ireland basis'.

2.1.2 Generation and transmission

As indicated in the previous subsection, there is something of a trade-off between the generation of electricity within the UK and importing it from elsewhere. In effect, there is a market which includes both generation and transmission, with competition between the two.

⁶ "UK – Denmark connection could jumpstart the European supergrid (Offshore Wind, 2011-02-11, <u>http://www.offshorewind.biz/2011/02/11/uk-denmark-connection-could-jumpstart-the-european-supergrid/</u>).

⁷ See, for example, Friends of the Supergrid (<u>http://www.friendsofthesupergrid.eu/</u>), the European Commission's proposal for a North Sea Offshore Grid (http://en.wikipedia.org/wiki/North_Sea_Offshore_Grid). "UK steps up plans for European energy 'supergrid' (The Telegraph, 2011-01-21,

http://www.telegraph.co.uk/finance/newsbysector/energy/8272344/UK-steps-up-plans-for-European-energy-supergrid.html).

⁸ See "PM back European supergrid plan", DECC press release, January 2011,

http://www.decc.gov.uk/en/content/cms/news/pn11_005/pn11_005.aspx.

⁹ <u>http://www.dii-eumena.com/</u>.

¹⁰ See, for example, "Medgrid to study developing a Mediterranean power grid for solar solar energy" (Bloomberg, 2010-12-10, <u>http://www.bloomberg.com/news/2010-12-10/medgrid-to-study-mediterranean-power-grid-for-solar-energy.html</u>).

¹¹ Owing to the 'cascading' principle (<u>http://www.desertec-uk.org.uk/elec_eng/cascade.html</u>), imports of 'desert' electricity into Europe can be made available to customers throughout the EU on relatively short timescales via existing transmission networks. As volumes increase, new transmission links may be installed.

¹² See, for example, "EU talks up Desertec plan: Saharan solar just five years away" (Financial Times, 2010-06-21, <u>http://blogs.ft.com/energy-source/2010/06/21/eu-talks-up-desertec-plan-saharan-solar-just-five-years-</u>away/#axzz1SAIK9LBV).

¹³ See, for example, "European energy giants call for EU single energy market" (Globe-Net, 2011-02-11, http://www.globe-net.com/articles/2011/february/2/european-energy-giants-call-for-eu-single-energymarket.aspx?sub=).

Contrary to what is suggested in [ECCC2011A, para. 171], transmission links can be built quite fast, certainly much faster than nuclear power stations. The BritNed link was completed in less than 18 months.¹⁴

Imports of electricity can be cheaper than locally-generated electricity, even allowing for the cost of transmission. For example, detailed country-by-country projections in [TRANS-CSP2006, Annex 1] show that 'desert' electricity from North Africa and the Middle East is likely to be one of the cheapest sources of electricity in Europe, including the cost of transmission—which is about 20% of the delivered cost.

As mentioned in Section 2.1.1, the cascading principle means that countries throughout Europe may begin to benefit from these imports without it being necessary to wait for the full EUMENA-wide supergrid to be built.

2.1.3 Electricity, other forms of energy, and negawatts

Electricity is also in competition with other forms of energy and with the conservation of energy. For example:

- Road vehicles and trains may be powered by electricity, diesel fuel, petrol, LPG or biofuels.
- Buildings may be heated in a variety of ways, including heat pumps powered by electricity.
- Perhaps more importantly, the need for dedicated heating systems in both new and existing buildings may be largely eliminated via the use of super-insulation and other measures to achieve the 'passivhaus' standard¹⁵ or better. Any residual needs for heating may be met by judicious use of heat from electrical and electronic equipment (computers, TVs etc), cooking, lighting, body heat, and passive solar heating.

It is likely that electrification of road and rail transport will increase UK demand for electricity by about 50%.¹⁶ But with measures to conserve energy in UK buildings and elsewhere in the economy,¹⁷ there is no reason to assume, as the UK government does, that "by 2050 electricity demand is set to double".¹⁸

In connection with 'negawatts', the Green Alliance has made the very logical proposal that energy efficiency should be eligible for subsidy via feed-in tariffs.¹⁹ This makes perfect sense since watts saved are equivalent to watts generated.

¹⁸ "Electricity market reform: keeping the lights on in the cheapest, cleanest way" (DECC press release, 2011-07-12, <u>http://www.decc.gov.uk/en/content/cms/news/pn11_061/pn11_061.aspx</u>).

¹⁴ See, for example, <u>http://en.wikipedia.org/wiki/BritNed</u>.

¹⁵ See, for example, <u>http://www.passivhaus.org.uk/</u>.

¹⁶ See Appendix 8 of "Energy UK", From Greenhouse to Green House, April 2008, http://www.mng.org.uk/gh/resources/energy_UK3.pdf.

¹⁷ It has been estimated that 73% of global energy use could be saved by practically achievable design changes to 'passive systems' (eg ensuring that buildings are well insulated). This reduction could be increased by further efficiency improvements in 'conversion devices' (engines, generators etc). See 'Reducing energy demand: what are the practical limits?'' (report by Jonathan M. Cullen, Julian M. Allwood, and Edward H. Borgstein of the Department of Engineering, University of Cambridge, 2011-01-12, <u>http://dx.doi.org/10.1021/es102641n</u>).

¹⁹ See "Paying people to use less energy will save money", The Guardian, 2011-10-18, http://www.guardian.co.uk/environment/2011/oct/18/energy-bills-save-money?CMP=EMCENVEML1631.

2.1.4 Balancing the grid

Somewhat independent of the market for electricity, but closely related to it, is the market for mechanisms that will enable supplies of electricity to be matched with constantly-varying demands. These mechanisms include the provision of large-scale grids, sources of electricity that can provide power on demand, a variety of methods for storing power, a variety of methods for managing demand, the provision of spare generating capacity, and methods of predicting variations in supply and demand.²⁰

2.2 Distortions in energy markets

Energy markets in the EU and the UK (and elsewhere) are highly distorted:

- Charges for emissions of fossil carbon into the atmosphere are either non-existent or much too low. It is widely recognised that the price of fossil carbon under the EU Emissions Trading System is much lower than they should be, largely because of over-allocation of allowances, because of the practice of giving away allowances for nothing, and because less than 50% of fossil carbon that is used in the EU is covered by the system.²¹
- In a report published in 2010, Bloomberg New Energy Finance showed that, worldwide, fossil fuels receive 12 times as much subsidy as renewables.²² It is true that the subsidies for fossil fuels look much more modest if we take account of relative volumes of fossil fuels and renewables-but with current concerns about emissions of CO₂, there should not be any subsidies for fossil fuels. It is also true that most of the subsidies are provided by countries outside the EU—but, via the world market in fossil fuels, those subsidies have an impact on prices in the UK.
- Quite apart from the proposed new subsidies for nuclear power which are the subject of • this document, nuclear power is already heavily subsidised, as detailed in [NSUBS2011] and in [UCS2011].²³

In case anyone objects that subsidies are justified for fossil fuels and nuclear power because renewables are receiving subsidies, the fossil fuel and nuclear industries have been established for many years and should be commercially viable without support. Without subsidies for those industries, the need for subsidies for renewable sources of power would be greatly reduced or eliminated. For those renewable energy technologies that are relatively new and still not properly established, it is likely that some subsidies will be needed until they reach the bottom of their costreduction curves.

2.3 How distortions in energy markets may be corrected

Within the EU, probably the simplest and most effective ways to correct the distortions outlined in the previous subsection are:

²² See "Fossil fuel subsidies are twelve times renewables support" (Bloomberg New Energy Finance, 2010-07-29, http://www.bloomberg.com/news/2010-07-29/fossil-fuel-subsidies-are-12-times-support-for-renewables-study-<u>shows.html</u>. The report may be downloaded via <u>http://bnef.com/Download/pressreleases/123/pdffile/.
 ²³ Further evidence for the high cost of nuclear power may be found at <u>www.mng.org.uk/gh/nn.htm#subsidies</u>.
</u>

²⁰ See <u>http://www.desertec-uk.org.uk/elec_eng/supply_demand.html</u>.

²¹ See "EU emissions trading scheme on course to make tiny savings, says report" (The Guardian, 2010-09-10, http://www.guardian.co.uk/environment/2010/sep/10/eu-emissions-trading-savings); "EU Emissions Trading System: failing at the third attempt" (Corporate Europe Observatory press release, 2011-04-07, http://www.corporateeurope.org/climate-and-energy/content/2011/04/eu-ets-failing-third-attempt).

- Introduce 'upstream' reform of the EU Emissions Trading System, as described in [K2S2011]. That will mean control over 100% of fossil carbon in the EU, instead of less than 50% as the system is now, and it will create the budget discipline for fossil carbon which is needed to minimised the risk of dangerous climate change. Within that framework, the auctioning of permits and their trading will raise the price of fossil carbon much closer to its proper level. Border-levelling measures in the proposals will protect high-emissions businesses from unfair competition from businesses in countries or regions with weaker controls on emissions.
- Work to remove subsidies for fossil fuels throughout the world as the G20 group of countries has said that it will do.²⁴
- Until such time as subsidies for fossil fuels have been removed, and until such time as there are proper charges for emissions of fossil carbon throughout the world, the EU may correct for these deficiencies via border-levelling charges, as described in [K2S2011].
- Remove the subsidies for nuclear power which are described in [NSUBS2011] and in [UCS2011], and avoid introducing any new subsidies such as those described in this document.

We recognise that some of these reforms are outside the UK government's direct control and that, until such reforms can be put in place, it may be necessary to try to correct distortions in energy markets using mechanisms that the Government can control. However, the reforms just outlined provide a touchstone for the coherence and validity of alternative measures, including those that are currently proposed by the Government.

3 Subsidies for nuclear power

In subsections below, we consider those elements of the Government's proposals that have the effect of introducing subsidies for nuclear power, or are likely have that effect. And in a following subsection, we give reasons why those subsidies are not justified.

3.1 Exemption from tax

There is no doubt that, in the UK, in the EU, and elsewhere, the price of fossil carbon is much too low (Section 2.2). But, despite its name, the Government's proposed 'carbon price floor' [WP2011, Section 2.2; HMT2010; FA2011, Clause 78] is not a solution to that problem. It is simply a tax on fuels used in the generation of electricity, with an exemption for uranium.²⁵ Far from correcting for market failures, as suggested by the Government in [ECCC2011B, pp12-13], it introduces new distortions in energy markets, additional to those outlined in Section 2.2, as described in the subsections below.

3.1.1 Generation and alternatives

By narrowing the scope of the measure so that it only raises the price of fossil fuels used for electricity generation, the proposal introduces a bias in favour of generation (and, for example, the use of electricity for space heating) and against alternatives (such as super-insulation and other

²⁴ See, for example, "Green view: how to save \$300 billion" (The Economist, 2010-11-12, http://www.economist.com/blogs/newsbook/2010/11/fossil-fuel_subsidies).

²⁵ The exemption for uranium is built in to the existing Climate Change Levy which provides the mechanism for implementing the 'carbon price floor': "Renewable fuels (for example, water, solar, biomass, etc) used to generate electricity and uranium used in a nuclear power station would continue to be outside the scope of CCL [Climate Change Levy] and fuel duty." [HMT2010, para. 4.12].

measures to reduce the need for space heating). Likewise for other trade-offs in energy use and conservation (Section 2.1.3).

Since uranium would be exempt from the new tax, there would be a direct subsidy for nuclear power.

It is true that the Energy Bill, introduced to Parliament in December 2010, includes provision for a "Green Deal," intended to improve the energy efficiency of buildings in the UK.²⁶ However the proposals in this area appear to be lacking in ambition²⁷ and it appears that the Government envisages widespread use of electrically-driven heat pumps for the heating of buildings, with incentives provided via a 'Renewable Heat Incentive' and 'Renewable Heat Premium Payments'.²⁸ In short, there appears to be a bias in the Government's thinking and policies in favour of generation and against the conservation of energy, with the exemption of uranium from the proposed new measures providing a direct subsidy for nuclear generation.

3.1.2 Windfall profits

Replying to a written parliamentary question from Martin Horwood MP, the Economic Secretary, Justine Greening MP said, on the 9th of May 2011:²⁹

The existing nuclear sector is likely to benefit by an average of £50 million per annum to 2030 due to higher wholesale electricity prices. Similarly, the renewable energy sector is expected to benefit by an average of at least £25 million a year to 2030.

According to calculations by WWF and Greenpeace, the proposed carbon price floor could result in windfall profits for existing nuclear generators of up to £3.43 billion between 2013 and 2026.³⁰ This equates to £264 million per year, much higher than the estimate given by Justine Greening.

These windfall profits for existing nuclear power stations, which arise because of the proposal that uranium should be exempt from the new tax, is a subsidy for the nuclear industry—as noted by the Energy and Climate Change Committee [ECCC2011A]. A large group of Liberal-Democrat MPs has complained that it violates the Government's commitment to provide no subsidies for nuclear power.³

These windfall profits may be used as a cross subsidy for new nuclear power stations.

The expected benefit for renewables provides no justification for this subsidy for nuclear power (see Section 4).

²⁶ See, for example, "Coalition failing on majority of green pledges, analysis shows", The Guardian, 2011-09-15, http://m.guardian.co.uk/environment/2011/sep/15/coalition-failing-green-pledges?cat=environment&type=article. See http://www.decc.gov.uk/en/content/cms/tackling/green_deal/green_deal.aspx . ²⁷ See also "The Green Deal: a summary of the government's proposals", Department of Energy and Climate Change,

^{2010,} http://www.decc.gov.uk/assets/decc/legislation/energybill/1010-green-deal-summary-proposals.pdf. There is no mention in this document of the passivhaus standard or anything similar.

²⁸ See "UK renewable energy roadmap", Department of Energy and Climate Change, July 2011, http://www.decc.gov.uk/assets/decc/11/meeting-energy-demand/renewable-energy/2167-uk-renewable-energy-²⁹ See <u>http://www.theyworkforyou.com/wrans/?id=2011-05-</u>

⁰⁹a.52152.h&s=section%3Awrans+speaker%3A11494#g52152.q0.

³⁰ "How can zero nuclear subsidy = $\pounds 3.43$ bn profit" (WWF blog, 2011-02-14,

http://www.wwf.org.uk/wwf_articles.cfm?unewsid=4625). "Energy bills to rise as nuclear gets £3.43bn for doing nothing" (WWF press release, 2011-02-14, http://www.wwf.org.uk/what we do/press centre/?4629/Energy-bills-torise-as-nuclear-gets-343bn-for-doing-nothing). ³¹ See "Lib Dem MPs set to rebel against nuclear power 'subsidy'" (The Guardian, 2011-07-01,

http://www.guardian.co.uk/environment/2011/jul/01/lib-dem-rebel-nuclear-power-subsidy.

3.2 Feed-in tariffs with contracts for difference

As a means of encouraging low-carbon generation, [WP2011] proposes "Feed-in Tariffs with Contracts for Difference (FiT CfDs)":

A [FiT CfD] is a long-term contract between an electricity generator and a contract counterparty. The contract enables the generator to stabilise its revenues at a pre-agreed level (the strike price) for the duration of the contract. Under the FiT CfD, payments can flow from the contract counterparty to the generator, and vice versa.

A 'two-way' FiT CfD provides for payments to be made to a generator when the market price for its electricity (the reference price) is below the strike price set out in the contract. However, when the reference price is above the strike price, the generator pays back the difference. That is, generators return money to consumers if electricity prices are higher than the agreed tariff. [WP2011, p 38].

This provides a subsidy in two ways:

- Because the strike price is likely to be higher than the long-term average of electricity prices, there will be a long-term net benefit to generators.
- It transfers risk from generators to taxpayers both by providing long-term contracts above market rates and, via the proposed CfD, by ensuring that generators are compensated when the market price falls below the strike price.

It is reported that David Simpson, global head of mergers and acquisitions at KPMG, has said that the huge costs and risks associated with nuclear construction mean that plants will only be built with public support in the form of long-term power purchase agreements, that he expects the UK government to offer 35-year contracts, and that such contracts could be illegal state aid under European Union competition rules.³²

3.3 Capacity mechanism

The 'capacity mechanism' proposed in [WP2011, Section 3.2] is not yet fully defined but we make a few comments about it here.

As described in [WP2011, paras. 3.2.6 and 3.2.7], the main purpose of the proposed mechanism is to address what the Government sees as the problem of 'resource adequacy': "... how to ensure there is sufficient reliable and diverse capacity to meet demand, for example during winter anticyclonic conditions where demand is high and wind generation low for a number of days.".

We believe that the rather complex and speculative arguments for a capacity mechanism that are advanced in [WP2011] and [DECC2010] do not make a convincing case. In particular, we believe that strengthening the UK's connections with the projected Europe-wide or EUMENA-wide supergrid (Section 2.1.1), widening the range of renewable sources of power, and expanding the facilities for balancing supplies with demand (Section 2.1.4) will ensure that the lights stay on even if there is a flat calm over the UK for some time during the winter.

However, if the Government wishes to provide a back stop against all contingencies, the cheapest and most effective way to do this would be maintain a strategic reserve of gas-fired plants which are still serviceable but near the ends of their working lives, together with a strategic reserve of fuels to power them. Such plants would provide much more flexibility than nuclear plants with a

³² See "Questions over funding for nuclear expansion", Professional Engineering, 2011-10-03, http://profeng.com/news/questions-over-funding-for-nuclear-expansion.

much lower capital cost. Since they would only be used on rare occasions, their running costs would be negligible. The fuels may be any of biogas, biomethane, fossil gas, or hydrogen generated by the electrolysis of water using excess power from wind farms or other renewables when it is available.

When the Government's proposals in this area are more fully defined, it may then be possible to see more clearly whether or how they provide a back-door subsidy for nuclear power. If, for example, they allow the government to help pay for the building of nuclear power stations that would be used only rarely, that would indeed be an unjustifiable subsidy for nuclear power.

3.4 Emissions performance standard

In [WP2011, Section 2.4], the Government proposes an 'emissions performance standard' (EPS) of 450g CO₂/kWh (at baseload) for all new fossil fuel plant, except Carbon Capture and Storage (CCS) demonstration plants. There would be regular reviews as part of the process of three-yearly reports on decarbonisation under the Energy Act 2010. But any changes in the level of the EPS will not apply to plant consented under the framework for a specified period. Details of this 'grandfathering' period will be determined after discussions with stakeholders.

Since nuclear power is excluded from these arrangements, and since CO_2 emissions from the nuclear power cycle can be as much as 288g CO_2e/kWh [SOV2008], there will be an increasing advantage for nuclear power as the EPS falls below that level. As mentioned in Section 3.1.3, the assumption that nuclear power is equivalent to wind power and other renewables in terms of emissions introduces a bias in favour of nuclear power.

Another weakness of this proposal, as pointed out in [ECCC2011A, paras. 212 and 213], is that there would be an incentive for power companies to build a lot of gas-fired power plants quickly while the EPS is weak, and that those relatively high emissions would be locked in, probably for the lifetimes of the plants.

3.5 Objections

The Government argues that nuclear power is simply a 'low carbon' source of electricity and should receive the same kind of support as other 'low carbon' sources. The following subsections give reasons why the subsidies described above are entirely inappropriate for nuclear power.

3.5.1 Nuclear power wrong-footed by changes in the market

Given long lead times and long build times for nuclear power, it is unlikely that any new nuclear power stations will be completed in the UK before 2020. By that time, it is likely that much of the market for UK-generated nuclear electricity will be disappearing, via the tumbling cost of PV, significant reductions in the cost of other renewables, and by the likely completion of the European single market for electricity [RISKS2011].

For example, a report by the European Photovoltaics Industry Association [EPIA2011] shows that, because of rapidly falling prices, PV is likely to become a competitive source of electricity in the UK by 2020, without subsidies—not just for householders paying domestic retail prices but also for wholesale generators and large commercial and industrial consumers. In sunnier countries like Italy, Greece and Spain, PV will become competitive earlier, perhaps as soon as 2014 [EPIA2011].

Small consumers and large commercial and industrial consumers will be empowered to generate much of their own electricity. IKEA, for example, is already rolling out PV on many of its stores and has bought a wind farm in Scotland, producing about 30% of the company's consumption of

electricity in the UK. Consumers will also be able to take advantage of cheap solar electricity from sunny countries in southern Europe.

The potential of PV and other renewables in the UK is many times the UK's present consumption [RISKS2011].

These developments mean that, by the time any new nuclear power station can be completed in the UK, much of the market for its electricity will be disappearing.

If a nuclear company has been given a long-term FiT contract for all the electricity it can produce, it is likely that consumers or taxpayers will end up paying for large amounts of electricity that nobody wants!

3.5.2 Inflexibility in operation

In the scenario just sketched, nuclear power would be left to fill in the gaps left by PV, wind power, other renewables, and load-balancing facilities. But nuclear power stations are quite unsuitable for the gap-filling role because they cannot easily be switched on or off and their output cannot easily be increased or decreased to meet variations in demand. Other sources of power are much better suited to that role: gas-fired power stations (using renewable fuels or fossil gas), power from solid biomass, enhanced geothermal systems (EGS), concentrating solar power (CSP) with heat storage and backup sources of heat, tidal lagoons managed as pumped storage devices, hydropower and pumped storage devices in the UK, Norway, the Alps, and elsewhere, and a range of other storage systems.³³

3.5.3 Emissions from the nuclear power cycle

Research reviewed in [LEN2008] and [SOV2008] shows that the nuclear power cycle produces between 9 and 25 times more carbon emissions than wind energy. By treating nuclear power as if it was equivalent to wind power and other renewables in terms of emissions, the Government's proposals introduce an unjustified bias in favour of nuclear power.

3.5.4 Unintended consequences

It is pertinent to mention that the Government's proposals will provide a perverse incentive for energy-intensive industries to leave the UK,³⁴ although it appears now that the Government may make concessions for such industries.³⁵

Since the cost of the proposed subsidies for nuclear power will be added to consumers' bills, there will be an incentive for consumers, both small and large, to generate their own electricity or buy electricity from suppliers outside the UK, as outlined in Section 3.5.1. The remaining consumers —which are likely to be poorer people—will pick up the tab.

3.5.5 An established technology

Feed-in tariffs and other subsidies are for new technologies that have still not reached the bottom of their cost-reduction curves. They are quite inappropriate for nuclear power which has been established for many years and should now be commercially viable without support.

³³ See <u>http://www.desertec-uk.org.uk/elec_eng/storage.html</u>.

³⁴ See, for example, "CBI: energy-intensive companies should be exempt from carbon floor price" (The Guardian, 2011-08-05, <u>http://www.guardian.co.uk/environment/2011/aug/05/cbi-carbon-floor-price</u>).

³⁵ See, for example, "Reports: carbon tax breaks planned for heavy energy users", Business Green, http://www.businessgreen.com/bg/news/2118035/reports-carbon-tax-breaks-planned-heavy-energyusers?WT.rss_f=Home&WT.rss_a=Reports%3A+Carbon+tax+breaks+planned+for+heavy+energy+users.

3.5.6 Conclusion

We believe that there is a good case for supporting renewable energy technologies that are relatively new and have not yet reached the bottom of their cost-reduction curves.

But nuclear power is far from new and has had ample opportunity to iron out its teething problems. By the time any new nuclear power station could be completed in the UK, the market for electricity is likely to move decisively against it. Nuclear power is quite unsuitable for a market that is dominated by renewables. It is far from being a zero-carbon source of electricity. Subsidies for nuclear power may have the perverse effect of encouraging consumers to choose other sources of power. And for reasons given in Section 4, *there is no justification at all for providing this subsidy for nuclear power*.

The existing and proposed subsidies that we have identified do nothing to correct the distortions in energy markets described in Section 2.2 and introduce an entirely unjustified bias in favour of an old and problematic technology.

4 Justifications for subsidising nuclear power?

Nuclear power is a mature technology that should be commercially viable without subsidies. However, despite the Government's often-repeated claim that there will not be any subsidies for new nuclear power stations, it may be argued that the subsidies we have identified are justified as a means of meeting the Government's objectives, summarised in [WP2011, para. 1.3]:

- Drive the decarbonisation of electricity generation.
- Minimise costs to the consumer.
- Ensure the future security of electricity supplies.

In the subsections that follow, we show how these objectives may be met without subsidies for nuclear power and with much less complexity than what the Government has proposed.

Other possible reasons for subsidising nuclear power are discussed in [NSUBS2011, Section 3], and all of them are rejected.

4.1 Decarbonisation

There is overwhelming evidence that all of the UK's needs for energy, not just electricity, can be met with renewables:

- Evidence for the abundance of renewable sources of power is detailed in [NSUBS2011, Section 5] and <u>www.energyfair.org.uk/pren</u>.
- There is now a large number of published reports from reputable sources, including several that are directly relevant to the UK, showing how the world's economies may be decarbonised without using nuclear power. Details, with download links may be found on: www.mng.org.uk/gh/scenarios.htm.
- There is a wide range of methods for balancing supplies of electricity with constantlyvarying demands, and to ensure security of supplies with 100% renewables (see [NSUBS2011, Section 5.1]).

As mentioned in Section 3.1.3, emissions from the nuclear power cycle are substantially more than they are from wind power. Emissions from other renewables are at the same low levels as wind power.

Conservation of energy is probably one of the most cost-effective ways of decarbonising our energy supplies and should be promoted. But the superabundance of renewable sources of power means that decarbonisation of our energy supplies is possible even if we continue to waste energy.

In general, renewable sources of power can be built much faster than nuclear power stations (see Section 4.3.3, below).

In short, renewables, with conservation of energy, can meet all our needs for energy, not just electricity, they can do so more quickly than nuclear power, and with none of the risks and other problems with nuclear power.³⁶

4.2 Costs

The Government says that it is aiming to minimise costs 'to the consumer' [WP2011, para. 3.1]. Of course, any kind of subsidy for the generation of electricity will mean lower costs 'to the consumer'. What matters is overall costs, including costs to taxpayers, both now and in the future.

As described in Section 2.2, prices for energy in the UK, in the EU, and elsewhere, are highly distorted by subsidies and by failure to internalise environmental costs:

- Contrary to the often-repeated claim that nuclear power is cheap,³⁷ it is one of the most ٠ expensive ways of generating electricity.³⁸
- Fossil fuels, without their subsidies and with proper charges for environmental damage, • would be much more expensive.

Providing new subsidies for nuclear power, additional to the existing subsidies described in [NSUBS2011], would simply add to these distortions, reducing economic efficiency and adding to overall costs for everyone.

Without subsidies for fossil fuels and nuclear power, and with full internalisation of environmental costs, renewables with conservation of energy are almost certainly the most economical way of powering the economy.

Removing distortions from energy markets will largely eliminate the need to subsidise renewables or conservation of energy. But those renewable technologies that are still not fully mature may need support for a time until costs have come down via economies of scale and refinements in the technologies.

4.3 Security

4.3.1 Intermittency

It is often claimed that nuclear power is needed because it can provide continuous 'base load' power, with the implication that it is available 24/7. But all sources of power are intermittent and the demand for electricity is highly variable:

- The capacity factor of nuclear power stations is normally about 70% and, in some cases, • can be below 50%.
- Unscheduled outages of nuclear power stations are, normally, disproportionately disruptive because they usually happen quite suddenly and with little warning and because

³⁶ See http://www.mng.org.uk/gh/nn.htm.

³⁷ See, for example, [CCC2011, p 12, p 19]. Here, the UK's Committee on Climate Change is relying on information provided by Mott McDonald, a company with close links to the nuclear industry. ³⁸ See [NSUBS2011, Section 2.11] and <u>http://www.mng.org.uk/gh/nn.htm#subsidies</u>.

the amount of power which is lost is normally quite large. For this reason, special provision is needed, the 'Large Loss Response', to ensure that the lights stay on when a nuclear power station fails.³⁹

- By contrast with nuclear power, variations in the output of wind farms and other renewables are much less disruptive because they normally happen quite gradually and there are normally several hours warning.
- The inflexibility of nuclear power is an embarrassment. Much more useful are supplies of electricity which can be increased or decreased according to need, providing 'power on demand'. Renewable sources of power that can provide power on demand include enhanced geothermal systems (EGS), hydropower, tidal lagoons managed as pumped storage devices, thermal power plants fired with biofuels, and concentrating solar power with heat storage and backup sources of heat.
- There is now a wide range of techniques available for ensuring a balance between supplies of electricity and constantly-varying demands for electricity. These include:
 - The way in which a large-scale transmission grid can meet a local shortfall in supply by transmission from one or more other areas,
 - The provision of generators that can provide power on demand (as above),
 - o A variety of methods for storing power, including vehicle-to-grid technologies,
 - o A variety of methods for managing demand,
 - The provision of spare capacity, and
 - Methods for predicting variations in supply and demand.

Further information may be found on: <u>www.desertec-uk.org.uk/elec_eng/supply_demand.html</u>.

Nuclear power provides no answer to the problem of balancing supplies of electricity with variable demands—it actually makes the problem worse.

4.3.2 Other aspects of security

Nuclear power also scores badly in other areas of security:

- Nuclear power is not a 'home grown' source of power in the UK since all uranium is imported (see also [NSUBS2011, Section 3.1.3]).
- Nuclear plants and ships and trains carrying nuclear fuel or nuclear waste are vulnerable to attack by terrorists.⁴⁰
- Because of the "Janus-like character of nuclear energy" (Kofi Annan), nuclear power reduces security by facilitating the proliferation of nuclear weapons.

³⁹ See "Exclusive: Will wind farms pick up the tab for new nuclear?" (Business Green, 2010-08-24, <u>http://www.businessgreen.com/business-green/news/2268599/exclusive-wind-farms-pick-tab</u>).

⁴⁰ The Norwegian perpetrator of mass murder in 2011 has criticised the English Defence League for being "dangerously naive" in pursuing a democratic path, and instead advises it to attack a nuclear plant to "cripple the British economy, contributing to creating an optimal climate for significant political change" (see "Killer personifies rise of new far-right", Financial Times, 2011-07-24, <u>http://www.ft.com/cms/s/0/55aab1f8-b60d-11e0-8bed-00144feabdc0.html#axzz1TDanTdWK</u>).

4.3.3 Speed of construction

It is sometimes argued that nuclear power is needed to fill this or that supposed 'energy gap' in UK supplies of electricity. But any such gap can be filled much more quickly with renewables than with nuclear power. In 2010, Germany installed 8.8 GW of photovoltaic solar panels, producing about the same amount of electricity as a 1 GW nuclear plant (allowing for differences in capacity factors). But it would take much longer—seven years or more—to build that nuclear plant. (see also [NSUBS2011, Section 3.1.6]).

4.4 Alternatives

Here is an outline of how the Government's objectives may be met with less complexity and without new subsidies for nuclear power:

- The Government should be working to remove the distortions in energy markets as outlined in Section 2.3. But, since some of the necessary measures are outside its direct control, it is appropriate for the Government to provide support for renewable sources of power and for the conservation of energy until costs have come down via economies of scale and refinements in the technologies . We believe that feed-in tariffs, perhaps with contracts for difference, are an effective way of providing that support.
- Because nuclear power is a mature technology that should be commercially viable without support, it should *not* receive support via feed-in tariffs or any other subsidy.
- The 'carbon price floor' should be dropped because of the distortions that it introduces into energy markets, described in Section 3.1.
- Most of the various forms of capacity mechanism that the Government has proposed appear to be unnecessary and should be dropped. If the Government wishes to provide a back stop against all contingencies, it can do so effectively and cheaply with a strategic reserve, as outlined in Section 3.3.
- To avoid creating unfair competition in the EU single market for electricity, subsidies for renewable sources of power should be provided for imports as well as for domestically-generated electricity. Of course there would need to be verification, via the already-established 'guarantees of origin' or similar mechanisms, that imported electricity comes from renewable sources.

5 Conclusions

The Government's proposals for electricity market reform have the effect of introducing new subsidies for nuclear power. In particular:

- The proposal to exempt uranium from new taxes on fuels used in the generation of electricity would create a new subsidy for nuclear power which, by the Government's own admission, would result in windfall profits for the nuclear industry.
- Applied to nuclear power, feed-in tariffs with contracts for difference are a direct subsidy for that industry.

These subsidies for nuclear power are harmful in the fight against climate change by diverting resources away from alternatives that are cheaper, quicker to build, more effective in cutting emissions, and with none of the many problems with nuclear power. There are simpler and more effective ways of decarbonising the economy, ensuring the security of energy supplies, and holding costs down.

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