Response to "The UK's energy supply: security or independence," an enquiry by the Energy and Climate Change Committee, February/March 2011

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Executive summary

The UK is over-dependent on fossil fuels and its economy is vulnerable to disruption via rises in prices of those fuels arising from 'peak oil' and conflict in countries like Libya.

For that reason, and also because of the urgent need to cut emissions of CO_2, there should be substantial increases in investment in renewable sources of power and conservation of energy.

There is good evidence from reputable sources that renewables, with conservation of energy, can provide all of the UK's present needs for energy (not just electricity) and anticipated needs in the future. There is also good evidence that renewables can provide robust and resilient supplies of energy without the need for power from fossil fuels or nuclear plants.

For political reasons, the nuclear industry is vulnerable to events like the nuclear crisis at Fukushima in Japan. For that reason, and several others, nuclear power should be phased out in the UK.

1 Introduction

Although I am Coordinator of Desertec-UK,[1] of the Energy Fair group,[2] and of the Kyoto2 Support Group (K2S),[3] this is a personal response to the enquiry.

2 How resilient is the UK energy system to future changes in fossil fuel and uranium prices?

Given the heavy dependence of the UK on fossil fuels, increases in the cost of those fuels could be very disruptive.

The cost of uranium is a relatively small part of the cost of nuclear power, and nuclear power provides only a small proportion of the UK's energy, so any increase in the cost of uranium, within limits, is not likely to be very disruptive.

[1] http://www.desertec-uk.org.uk/.
[2] http://www.energyfair.org.uk/home.
[3] http://www.k2support.org/.

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3 How sensitive is the UK's energy security to investment (or lack of investment) in energy infrastructure, including transmission, distribution and storage?

To reduce our dependence on fossil fuels (and cut emissions of CO_2), substantially more investment is needed in renewable sources of power, conservation of energy, and associated infrastructure.

3.1 There are more than enough renewable sources of power to meet our needs

There is good evidence from reputable sources that there are more than enough renewables to meet the UK's current needs for energy (not just electricity),[4] and anticipated needs in the future.[5] For example:

- The Offshore Valuation Group has shown that for five offshore electricity generating technologies—wind with fixed and floating foundations; wave; tidal range; and tidal stream—the full practical resource, estimated to be 2,131 TWh/year, is nearly six times current UK electricity demand.
- A report from the European Environment Agency has shown that the "economically competitive potential" of wind power in Europe is 3 times projected demand for electricity in 2020 and 7 times projected demand in 2030. Offshore wind power alone could meet between 60% and 70% of projected demand for electricity in 2020 and about 80% of projected demand in 2030.
- A report from the Tyndall Centre has shown that photovoltaics (PV) could generate about 266 TWh/yr in the UK—about 66% of the UK's present electricity demand.
- Geothermal company EGS Energy estimates that there is potential in the UK (mainly in Cornwall) to produce over 35 TWh/yr by enhanced geothermal systems (EGS)—almost10% of the UK's electricity demand.[6]
- The Welsh Assembly Government has stated that renewables can provide twice the electricity that Wales is using.[7]
- Although the UK and Europe could be entirely self-sufficient in renewable energy, as outlined above, the Desertec Industrial Initiative aims to provide 15% of Europe's electricity by 2050, with potential benefits both for Europe and the 'desert' countries.[8]

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[4] Electricity may be used for such things as transport by road and rail where liquid fuels dominate at present. This is likely to mean an increase in the demand for electricity but not as much as one might think (see Section 4). There is likely to be a continuing need for liquid fuels for such things as air travel but that need may be met by biofuels or synthetic fuels (see Section 9).

[5] See http://www.energyfair.org.uk/pren and http://www.mng.org.uk/gh/scenarios.htm.

[6] See http://www.egs-energy.com/resource/uk-and-europe.html.

[7] "A low carbon revolution: the Welsh Assembly Government energy policy statement" (March 2010, http://www.mng.org.uk/gh/resources/100315energystatementen.pdf).

[8] See the Desertec Industrial Initiative (http://www.dii-eumena.com/). Research at the German Aerospace Centre (DLR, see http://www.desertec-uk.org.uk/reports.htm) has shown that solar and wind power in places like the Sahara could easily supply *all* of Europe's needs for energy, not just electricity, now and in the foreseeable future. The DII's goal of supplying 15% of Europe's *electricity* supplies by 2050 (not total energy) is realistic, achievable, and provides for the integration of 'desert' electricity with a wide range of other renewable sources of power across the whole of Europe, the Middle East and North Africa, thus safeguarding the overall robustness and resilience of the energy supply system in the region.

It is to be hoped that current political protests are resolved in favour of democracy but even if they are not, Desertec can be a substantial benefit for local people by providing jobs, earnings and plentiful supplies of clean

One advantage for Europe is that it is likely to help hold down the price of power throughout Europe, as described in detail in the 'TRANS-CSP' report from the German Aerospace Centre.[9] As a source of 'power on demand', concentrating solar power in desert regions with heat storage and backup sources of heat can also make a useful contribution to balancing supplies with demands across the grid.

- In research published in the journal *Energy Policy* and reviewed in the *Scientific American*,[10] Mark Jacobson and Mark Delucchi show that renewable sources of power can provide 100% of the world's energy, not just electricity, and that it is feasible to make the transition by 2030. In this connection, they make the interesting point that, although 51% of the world's power in their scenario would be provided by 3.8 million large wind turbines, and although that number may seem to be a great challenge, it looks rather modest compared with the 73 million cars and light trucks that are produced in the world, every year.

There is now a large number of reports from reputable sources showing how to decarbonise the world's economies using renewable sources of power. Details, with download links, may be found at: http://www.energyfair.org.uk/pren and http://www.mng.org.uk/gh/scenarios.htm.

3.1.1 Costs

There is good evidence from a variety of sources that nuclear power is one of the most expensive ways of generating electricity.[11] We do not yet know the cost of carbon capture and storage because no commercial-scale plant has yet been built. It is likely that, when the several distortions of the energy market have been removed,[12] renewables will prove to be the most economical sources of power. Connie Hedegaard, the European climate commissioner, has said recently that offshore wind power is cheaper than nuclear power.[13]

It is widely assumed that decarbonising the world's economies will be much more expensive than business-as-usual. But two recent reports suggest otherwise:

- An economic model conducted for the *New Scientist* suggests that radical cuts to the UK's emissions will cause barely noticeable increases in the price of food, drink and most other goods by 2050.[14]
- A report from the European Climate Foundation found that in several scenarios, including the generation of electricity from 100% renewable sources, the future cost

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electricity. The amount of desert that is required is tiny compared with the amount that is available and it is likely that Desert projects can go ahead successfully in several of the countries in the region.

[9] The TRANS-CSP report may be downloaded from http://www.desertec-uk.org.uk/reports.htm.

[10] "A path to sustainable energy by 2030", Mark Z. Jacobson and Mark A. Delucchi, *Scientific American*, November 2009, 58-65, http://www.scientificamerican.com/article.cfm?id=a-path-to-sustainable-energy-by-2030. See also, by the same two authors, "Providing all global energy with wind, water, and solar power", *Energy Policy*, 39(3), March 2011, "Part I: Technologies, energy resources, quantities and areas of infrastructure, and materials", pp 1154-1169 and "Part II: Reliability, system and transmission costs, and policies", pp 1170-1190.

[11] See http://www.mng.org.uk/gh/nn.htm#subsidies.

[12] See http://www.energyfair.org.uk/reducing-subsidies.

[13] See "Wind power cheaper than nuclear, says EU climate chief", The Guardian, 2011-03-17, http://www.guardian.co.uk/environment/2011/mar/17/wind-cheaper-nuclear-eu-climate.

[14] See "Low-carbon future: we can afford to go green" (*New Scientist*, 2009-12-02, http://www.newscientist.com/article/mg20427373.400-lowcarbon-future-we-can-afford-to-go-green.html?full=true).

of electricity is comparable to the future cost of electricity under the current carbon-intensive infrastructure—and supplies would be at least as reliable.[15]

3.2 Transmission

If 'security' is interpreted as robustness and resilience, then, with regard to electricity supplies, there are many advantages in integrating the UK transmission grid into an HVDC 'supergrid' spanning a large area, as proposed in the Desertec concept,[16] by Friends of the Supergrid,[17] and others,[18] and now endorsed by our own Prime Minister.[19]

Even without storage, a shortfall in any area can normally be made good, via the supergrid, with supplies from one or more other areas. But, in addition, hydropower and pumped storage in places like Norway and the Alps can serve as a giant battery for the whole system.

There are several other potential benefits from such a grid, including smoothing out variations in supply and demand, avoidance of wastage by allowing a surplus in any one area to be transmitted to one or more other areas where it is needed, providing access to large but remote sources of renewable power (such as the EGS resources of Iceland), reducing the need for 'plant margin', facilitating the workings of a single market for electricity across Europe and beyond, and more.[20]

If 'security' means military security in the face of hostile neighbours, then the UK or Europe may be tempted to pull up the drawbridge and try to become a self-contained energy fortress. Even in those terms, there are potential advantages in staying connected:

- Solar and wind power from the Middle East and North Africa may help Europe to avoid over-dependence on gas supplies from possibly-unreliable sources such as Russia.
- Despite the import of 'desert' electricity into Europe, the Desertec scenario would mean an overall *reduction* of energy imports into Europe, an increase in the *diversity* of sources of energy (from a range of renewable sources across the whole of Europe, the Middle East and North Africa), and a corresponding *increase* in the security of energy supplies compared with what we have now.[21]
- By providing opportunities for win-win collaboration, the Desertec concept can help to improve relations amongst different groups of people, thus improving security for everyone.[22]
- Since the UK has clear potential to become a net exporter of renewable electricity (see Section 4), it will need good connections to other countries and regions to take advantage of that potential.

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[15] See "Roadmap 2050" (European Climate Foundation, with others, in 3 volumes, April 2010, http://www.roadmap2050.eu/). See also "Europe's energy in 2050: cutting CO_2 by 80% no more expensive than business as usual" (Financial Times, 2010-04-13, http://blogs.ft.com/energy-source/2010/04/13/european-energy-in-2050/).

[16] See http://www.desertec-uk.org.uk/, http://www.desertec.org/, http://www.dii-eumena.com/. The Desertec concept proposes an HVDC supergrid spanning the whole of Europe, the Middle East and North Africa.

[17] See http://www.friendsofthesupergrid.eu/.

[18] See http://www.desertec-uk.org.uk/elec_eng/grid.htm.

[19] 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.

[20] See http://www.desertec-uk.org.uk/elec_eng/grid.htm.

[21] See also "Desertec: security of energy supplies", http://www.desertec-uk.org.uk/resources/desertec_security2.pdf.

[22] See http://www.desertec-uk.org.uk/csp/bonuses.htm.

3.3 Storage: tidal lagoons

In the UK, there appear to be limited opportunities for further development of pumped storage schemes such as the pumped storage plant at Dinorwig in North Wales. However, tidal lagoons, which are normally seen primarily as a source of power, may also serve as pumped storage devices, thus helping to match supplies of electricity with constantly-varying demand. This is achieved by the use of tidal lagoons in groups of 3 or more, together with clever computer systems to manage the interplay amongst tides, the generation of electricity, and the pumping of sea water to store power at opportune times.[23] Since there are many places around the UK where tidal lagoons may be developed, this technology could provide a valuable means of smoothing out peaks and troughs in supply and demand for power.

3.4 Other means of matching supplies of electricity with varying demands

Apart from pumped storage and the use of tidal lagoons for storage (Section 3.3), and the provision of a large-scale supergrid (Section 3.1), there is a range of techniques for matching supplies of electricity with varying demands (see http://www.desertec-uk.org.uk/elec_eng/supply_demand.html). These include:

- *Renewable sources of power that can provide power on demand*. These include EGS power, hydropower, thermal power plants fired by biogas, tidal lagoons[24] and concentrating solar power with heat storage and backup sources of heat. With the provision of an HVDC supergrid, we can draw on such load-balancing resources not only from within the UK's borders but, in addition, from as far away as Iceland (EGS power), continental Europe (hydropower and EGS power), or the Sahara (concentrating solar power).
- *Vehicle-to-grid technologies*, using batteries of electric vehicles to store power.[25] This option will become increasingly attractive and important with the roll out of electric vehicles and plug-in hybrid electric vehicles.
- *A range of methods for managing demand*, including 'dynamic demand', 'interruptible service', 'time-of-use billing', and reductions in demand from air conditioners by the use of excess electrical power to create ice, and systems for reducing demand in combined-heat-and-power plants by storing excess electrical power as heat.
- The provision of *spare capacity* or 'plant margin'.
- *Prediction* of, for example, increases or decreases in wind speed in a given area.

A demonstration of the way that renewables can provide a comprehensive and robust source of electrical power is the "Combined Power Plant"[26] which links and controls 36 wind, solar, biomass and hydropower installations spread throughout Germany. It has proved to be just as reliable and powerful as a conventional large-scale power station.

It is sometimes suggested that nuclear power is needed because it provides 'base load' power. This is misleading for two main reasons:

- Nuclear power stations can and do fail (see Section 3.5, next) and their capacity factors are normally well short of 100%.

[23] Peter Ullman of Tidal Electric (http://tidalelectric.com/index.html), personal communication.
[24] See http://tidalelectric.com/index.html
[25] See, for example, http://en.wikipedia.org/wiki/Vehicle-to-grid.
[26] See http://www.kombikraftwerk.de/index.php?id=27.

- Nuclear generation is an inflexible source of power because it cannot easily be turned up or down according to need. For balancing supplies and demand, nuclear power is much less useful than the renewable generators that can provide power on demand, mentioned above.

3.5 Intermittency

Contrary to what is sometimes suggested, *all* sources of electricity are intermittent because all kinds of generators can and do fail. When a nuclear or coal-fired power station fails, it is particularly disruptive because it removes a relatively large amount of capacity from the grid and it normally does so quite suddenly and without much warning. By contrast variations in wind power are much more gradual and there are normally several hours warning.

The disruptive effect when a nuclear power station fails is described in "Exclusive: Will wind farms pick up the tab for new nuclear?"[27]

In a report published in 2009,[28] independent consultant David Milborrow says that electricity transmission networks in the UK are *already* designed to cope with variability arising from the failure of power stations and from variations in consumer demand, and that, for a small additional cost, wind power could provide up to 40% of the UK's electricity. Further increases in the level of wind penetration are feasible and do not rely on the introduction of new technologies.

3.6 A flat calm with an increase in demand?

It is sometimes suggested that a flat calm over the UK and neighbouring countries, coupled with an increase in demand, would be a problem if we were to rely on wind power.[29] If we were to rely exclusively on wind power, that would be true. But:

- Apart from wind power, there is a wide range of renewable sources of power available to us which would not be affected by a drop in wind speeds. These include EGS power, tidal streams, tidal lagoons, wave power, power from biomass, photovoltaics, and concentrating solar power.
- There is a range of techniques for matching supplies to demand, outlined above.
- As mentioned in Section 3.1, there is now a large number of reports from reputable sources showing how to decarbonise the world's economies using renewable sources of power.[30]

The weight of evidence is that renewable sources of power, with conservation of energy, can provide robust and resilient supplies of power even in the scenario outlined above.

[27] Business Green, 2010-08-24, http://www.businessgreen.com/business-green/news/2268599/exclusive-wind-farms-pick-tab.
[28] "Managing Variability", David Milborrow, July 2009, commissioned by Greenpeace, WWF, RSPB, Friends of the Earth, http://www.trec-uk.org.uk/reports/milborrow_managing_variability_final_July_2009.pdf.
[29] See, for example, "Will British weather provide reliable electricity?", James Oswald *et al.*, *Energy Policy*, 36(10), 4005-4007, 2008.
[30] See http://www.energyfair.org.uk/pren and http://www.mng.org.uk/gh/scenarios.htm.

3.7 "Nuclear plants are mutual hostages: the world's least well-run plant can imperil the future of all the others."[31]

Politics provides the main reason why nuclear power is a threat to energy security in the UK. The current nuclear crisis in Japan may not in itself lead to the closure of nuclear plants around the world—although Germany has already decided to close older plants, at least for a time, and the European energy commissioner, Günther Oettinger, has raised the prospect of a nuclear-free future for Europe.[32] But it is likely that any repetition, anywhere in the world, of a nuclear crisis like that at Fukushima, would make it very difficult, politically, to continue running nuclear power stations in the UK and elsewhere. This is a good reason, but not the only reason, why the Government should not permit the building of any new nuclear power stations and should close down existing plants as soon as possible. Other reasons include:

- The fact that nuclear power stations, and trains and ships carrying nuclear fuel and nuclear waste, are vulnerable to bombs or missiles from terrorists or enemy forces.
- The fact that most of the nuclear sites around the UK are vulnerable to flooding and will become increasingly vulnerable with rises in sea level from climate change.
- The high cost of nuclear power, draining resources from renewables and conservation of energy where the money would be better spent.[33]
- Incompatibilities between nuclear power and renewables, holding back the development of renewables.[34]
- The fact that most renewable sources of power can be built much more quickly than nuclear power stations.[35]
- The still-unsolved problem of what to do with nuclear waste that will be dangerous for thousands of years.
- And the several other problems with nuclear power detailed on http://www.mng.org.uk/gh/nn.htm.

4 What impact could increased levels of electrification of the transport and heat sectors have on energy security?

Electrification of the transport and heat sectors will increase the demand for electricity but not as much as one might think:

- Complete electrification of road and rail transport in the UK is likely to increase the demand for electricity by about 50%.[36] Although the demand for electricity may

[31] From "A plan to keep carbon in check," by Robert Socolow and Stephen Pacala in the *Scientific American*, September 2006, p 33.
[32] See "Political fallout of Japan's nuclear crisis reaches distant shores", Reve, 2011-03-21, http://www.evwind.es/noticias.php?id_not=10904.
[33] See http://www.mng.org.uk/gh/nn.htm#subsidies.
[34] See, for example, "Slash renewables target to protect nuclear, says EDF", ENDS Report Bulletin, 2009-03-12, http://www.mng.org.uk/gh/resources/ends_report_bulletin_2009-03-12.html. In a world powered by renewables, the inflexibility nuclear power is a problem. Much more valuable are the renewable sources of power that can deliver power on demand, mentioned in Section 3.4.
[35] In 2010, Germany installed 8.8 GW of photovoltaic panels, producing about the same amount of electricity as a 1GW nuclear power station—but the nuclear power station would take about 7 years to build. In general, renewables can be rolled out much faster than nuclear power. They provide a much speedier solution to the urgent problem of cutting emissions of CO_2.

increase by 50%, it is likely that a smaller increase in generating capacity will be required. This is because it is likely that electric vehicles will be charged mainly at night when there is likely to be surplus power available from wind farms, wave farms and the like, and because the use of vehicle-to-grid technologies will reduce the need for plant margin.

- With 'zero-carbon eco-renovation' of the UK's stock of buildings,[37] the need for electricity to drive heat pumps or other sources of heat, would be small.[38]

As we saw in Section 3.1, there is good evidence that there are more than enough renewable sources of power to meet the UK's needs, now and in the future.

5 To what extent does the UK's future energy security rely on the success of energy efficiency schemes?

Energy efficiency, especially zero-carbon eco-renovation of buildings (see Section 4), makes good sense but, as outlined in Section 4, it is probably not necessary for the UK to meet its needs for energy, now and in the foreseeable future.

Although the superabundance of renewable sources of power available to UK might tempt us to continue in our profligate ways, it would be prudent, and probably cheaper, to take advantage of the many opportunities that are available to reduce wastage of energy.

In this connection, it is pertinent to mention that a recent report from the Department of Engineering, University of Cambridge[39] estimates that 73% of global energy use could be saved by practically achievable design changes to passive systems. This reduction could be increased by further efficiency improvements in conversion devices.

An interesting point is that, in the research by Mark Jacobson and Mark Delucchi, detailed in Section 3.1, they argue that a transition to renewables is likely to mean that the anticipated world demand for power in 2030 is likely to be 11.5 terawatts, compared with 16.9 terawatts if we were to stick with conventional sources of energy. This is because a transition to renewables would dramatically reduce the gross inefficiencies in power generation and in road transport that currently exist with conventional sources of energy.

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[36] See Appendix 8 of "Energy UK", http://www.mng.org.uk/gh/resources/energy_UK3.pdf. This seemingly modest increase in demand is because electric vehicles are *very* much more efficient than vehicles power with the internal combustion engine.

[37] See http://www.mng.org.uk/gh/ecorenovation.htm.

[38] It appears that, at present, the Government's policies on the ecorenovation of buildings is based on the document *Element Energy: The uptake of energy efficiency in buildings, a report to the Committee on Climate Change* (2009, http://downloads.theccc.org.uk/docs/Element%20Energy_final_efficiency_buildings.pdf). I believe the main shortcoming of this document is that it fails to recognise the urgency of the need to cut emissions from buildings and it fails to recognise the potential of 'super' insulation and other measures for making deep cuts in the need for heating or cooling of buildings.

[39] "Reducing energy demand: what are the practical limits?", Jonathan M. Cullen, Julian M. Allwood, and Edward H. Borgstein, *Environmental Science & Technology*, 45(4), 1711–1718, 2011, DOI: 10.1021/es102641n, http://pubs.acs.org/doi/abs/10.1021/es102641n.

6 What will be the impact on energy security of trying to meet the UK's targets for greenhouse gas emissions reductions as well as increased penetration of renewables in the energy sector?

There is good evidence, outlined in Sections 3, 4, and 5, that renewable sources of power, with conservation of energy, can provide all the energy we need now in a robust and resilient manner, and anticipated needs in the future.

The UK is particularly well endowed with renewable sources of power and is likely to become a net exporter of renewable energy in the future. Even if we were surrounded by hostile neighbours, we could meet all our needs for energy from within our own shores and territorial waters.

But otherwise, 'fortress UK' would not be a good policy. There are substantial advantages, outlined in Section 3.2, for the UK's energy supply system to be integrated with others across Europe, the Middle East and North Africa.

7 What would be the implications for energy security of a second dash-for-gas?

Given that supplies of gas are apparently plentiful, and likely to remain so for some time, and that the price of gas has apparently become decoupled from the price of oil;[40] and given that gas-fired power stations are relatively quick and cheap to build, it will be tempting for electricity supply companies to invest in gas-fired generation of electricity. There would be the added attraction that gas-fired generation is a flexible source of power that can help balance supplies of electricity with variable demands.

In terms of energy security, a dash-for-gas is likely to mean increased dependence on imports with corresponding implications for security of supplies.

There would be the added problem that, although gas-fired electricity (without carbon capture and storage) produces about half the CO_2 emissions as coal-fired generation, it does still emit substantial quantities of CO_2 and would be a hindrance in the urgent task of bringing down emissions of greenhouse gases.[41]

For those two reasons, it would be best for the UK to avoid another dash for gas. One way to discourage it would be to require that all power plants than burn fossil fuels, including gas, should be equipped with fully-effective carbon capture and storage.

As described above, there are more than enough renewable sources of power to meet our needs, and there is a range of techniques for balancing supplies and demand. If there was a real prospect of shortages of power then, as a stop-gap measure, gas-fired plants could be

[40] Although the Japan nuclear crisis appears to have produced a spike in the price of gas.

[41] An analysis published recently by the Royal Society "suggests that despite high-level statements to the contrary, there is now little to no chance of maintaining the global mean surface temperature at or below 2°C." and that "the impacts associated with 2°C have been revised upwards, sufficiently so that 2°C now more appropriately represents the threshold between 'dangerous' and 'extremely dangerous' climate change." (see "Beyond 'dangerous' climate change: emission scenarios for a new world", Kevin Anderson and Alice Bows, *Philosophical Transactions of the Royal Society A*, 369 (1934), 20-44, January 2011.

built quite quickly. But most renewable sources of power can also be rolled out fast,[42] so there is really no need for us to go down the gas-fired route.

8 How exposed is the UK's energy security of supply to international events?

At present, the UK is heavily dependent on oil for transport by road, rail, air and the sea, for some space heating and other applications. Since most of that oil is imported, international events may disrupt supplies and raise prices. Apart from the rebellion in Libya, the main worry now is that the world is at or past 'peak oil' and that prices could rise steeply in the future.[43]

The UK also depends heavily on imports of gas and coal. Although supplies may be less vulnerable to disruption and rising prices, the pressing need to cut emissions of CO_2 means that we should wean ourselves off all fossil fuels soon as possible.

9 Is the UK's energy security policy sufficiently robust to be able to deal with uncertainties and risks inherent in all of the above areas? If not, how could this be improved?

The UK is far too dependent on fossil fuels and the UK economy is vulnerable to disruption via increases in the prices of those fuels. Here, in brief, are some of the steps that can be taken to improve energy security for the UK and, at the same time, help to solve the urgent problem of cutting emissions of CO_2:

- Vigorously promote the development of the full range of renewable sources of power, both within the UK and elsewhere in Europe, the Middle East and North Africa.[44]
- Take steps to promote and develop technologies that can help to balance supplies of electricity with variable demands, including:
    - EGS power and other renewables that can provide power on demand.
    - Tidal lagoons, the HVDC supergrid, and other technologies for the storage of power and balancing the grid.
- Vigorously promote zero-carbon eco-renovation[45] of the existing stock of domestic and public buildings throughout the UK, and ensure that all new buildings are zero-carbon with minimal need for heating or cooling, and without the use of carbon offsets.[46]
- Build on present policies to promote the electrification of transport by road and rail. Promote traffic-calming 'home zones,'[47] cycling and walking, and public transport.
- Promote research into the synthesis of fuels using clean sources of power,[48] to meet the need for energy where electricity cannot be used (eg air travel).

[42] As noted earlier, Germany installed 8.8 GW of photovoltaic panels in 2011, producing about the same amount of electricity as a nuclear power station that would take about 7 years to build.
[43] See, for example, http://en.wikipedia.org/wiki/Peak_oil.
[44] The Government may like to consider becoming a partner in the Desertec Industrial Initiative.
[45] See http://www.mng.org.uk/gh/ecorenovation.htm.
[46] Associated with this, there appears to be considerable potential for the use of inter-seasonal heat stores (see, for example, http://www.howedell.herts.sch.uk/eco_issues/sustainable_elements.pdf).
[47] See, for example, http://en.wikipedia.org/wiki/Home_zone.

- To help create an appropriate framework of incentives for these developments:
    - Work to create a robust and effective successor to the existing EU Emissions Trading System via 'upstream' reform of the system.[49] In accordance with the 'Kyoto2' proposals,[50] part of the money from the auctioning of permits in the reformed system may help to bring forward early-stage renewables and the conservation of energy.
    - Work to remove all subsidies for fossil fuels in the UK and elsewhere around the world,[51] and, because nuclear power is a long-established technology that should be commercially viable without subsidies, and because unfair competition from a subsidised nuclear industry may divert funds away from renewables and the conservation of energy, withdraw the several subsidies currently enjoyed by the nuclear power industry.[52]
- For the reasons given in Section 3.7, prohibit the building of any new nuclear power stations in the UK and close down the existing plants as soon as possible.

[48] See, for example, http://www.desertec-uk.org.uk/csp/synthesis.htm.
[49] See "'Upstream' reform of the EU Emissions Trading System" and "Turn off greenhouse gases at source" which may be downloaded via links from http://www.k2support.org/.
[50] See www.kyoto2.org.
[51] In 2004, the New Economics Foundation estimated that, worldwide, subsidies for fossil fuels amounted to about $235bn and there seems not to have been much change since then (see "Fossil fuel subsidies 'must end'", BBC News, 2004-06-21, http://news.bbc.co.uk/1/hi/sci/tech/3818995.stm).
[52] Those subsidies, and the way they may be withdrawn, are described in some detail in the "Nuclear Subsidies" report from the Energy Fair group which may be downloaded via http://www.energyfair.org.uk/. See also "Nuclear power: still not viable without subsidies" (Union of Concerned Scientists, February 2011, http://earthtrack.net/documents/nuclear-power-still-not-viable-without-subsidies). A formal complaint has now been made to the European Commission that subsidies for nuclear power in the UK are unlawful state aid under EU competition law (see http://www.energyfair.org.uk/actions).