UK ENERGY SECURITY
Myth and Reality

Philipp Mueller

The Global Warming Policy Foundation

GWPF Briefing 9

UK ENERGY SECURITY
Myth and Reality

Philipp Mueller

Contents

About the author

Philipp Mueller is the former assistant director of the Global Warming Policy Foundation. He holds a MA in global affairs from the University of Buckingham.

Introduction

Over the last two decades, subsidies for renewable energy sources have been justified by the supposed need to decarbonise the world economy. Decarbonisation was thought to be necessary to avoid an increase in atmospheric carbon dioxide, which threatens to warm the planet, and to avoid the disasters that global warming supposedly causes. However, this argument has lost some of its force in recent years. One reason for this development has been the global financial crisis and the economic downturn. Environmental concerns have taken a backseat to worries about high unemployment, slow economic growth, huge public debt levels, massive budget deficits and cuts in government spending. Another reason is the lack of warming over the last 16 years;[1] a third is the growing realisation that an international treaty with legally binding targets for reductions of greenhouse gas emissions will not be achieved.

The supporters of renewable energy are therefore anxious to find a further argument to justify subsidies and tax breaks for wind farms and solar panels. One such justification used to be the claim that fossil fuels are running out. However, the exploitation of unconventional oil and gas resources has put paid to this claim and it has become obvious that fossil fuels are actually abundant.[2] Another argument is energy security. Ministers, DECC officials and supporters of renewable energy argue that renewable energy enhances British energy security by reducing dependency on fossil fuel imports. The ongoing crisis over the Ukraine and Crimea between Russia on one side and Western countries on the other has given greater urgency to this energy security argument.[3]

This paper will examine the merits of the energy security argument. In Section 1 will describe received opinion, namely that being dependent on fossil fuel imports is risky or even dangerous and thus that domestic renewable energy sources enhance energy security. It also assumes that state A is dependent on state B if much of the oil, gas or coal imported by consumers in state A comes from state B. In Section 2 the paper will outline the three main reasons why fossil fuel imports are not a threat to energy security and argue that energy markets provide security. Ironically, it is in fact intermittent wind and solar power that are threats to UK energy security, as Section 3 will show.

[1] Whitehouse, David, 'The Global Warming Standstill', The Global Warming Policy Foundation, 2013, http://www.thegwpf.org/content/uploads/2013/03/Whitehouse-GT_Standstill.pdf

[2] Mueller, Philipp, 'The Abundance of Fossil Fuels', The Global Warming Policy Foundation, 2013, http://www.thegwpf.org/content/uploads/2013/01/Mueller-Fossil-fuels.pdf

[3] Macalister, Terry, 'Wind turbines stand firm as gas prices take off during Crimea crisis', The Guardian, 3 March 2014, http://www.theguardian.com/business/2014/mar/03/wind-turbines-gas-prices-crimea-crisis

1 Received opinion

Definitions of energy security

There is no agreed definition of the term 'energy security'. The term can be used to describe the reliability of supplies, the resilience of the supply infrastructure against attacks or natural disasters, the supply of 'affordable' energy and the extent of national self-sufficiency.[4] The International Energy Agency (IEA) defined energy security as:

> The uninterrupted physical availability [of energy] at a price which is affordable, while respecting environment concerns.[5]

The House of Commons' Energy and Climate Change Committee suggested the following definition:

> A secure energy system is one that is able to meet the needs of people and organisations for energy services such as heating, lighting, powering appliances and transportation, in a reliable and affordable way both now and in the future.[6]

For its part, the Department of Energy and Climate Change (DECC) described energy security in these terms:

> At its heart, energy security is about ensuring that we have access to the energy services we need (physical security) at prices that avoid excessive volatility (price security).[7]

Threats to energy security

As there is no agreed definition, it should not come as a surprise that there is a large variety of perceived threats to energy security. For the IEA, energy security risks include:

- the incapacity of electricity infrastructure to meet growing load demand
- threats of an attack on centralised power generation infrastructure, transmission and distribution grids or gas pipelines
- global supply restrictions resulting from political actions
- extreme volatility in oil and gas markets.[8]

Other observers have identified as energy security risks the heightened competition over (allegedly) depleting fossil fuels, the security of supplies from the Middle East,

[4] House of Commons, 'UK Energy Supply: Security or Independence?', Volume 1, 2011, http://www.publications.parliament.uk/pa/cm201012/cmselect/cmenergy/1065/1065.pdf, p. 8

[5] International Energy Agency, 'Energy Security', 2012, http://www.iea.org/subjectqueries/keyresult.asp?KEYWORD_ID=4103

[6] House of Commons, 'UK Energy Supply', Op. cit., p. 8

[7] Department for Energy and Climate Change, 'Energy Security Strategy', November 2012, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/65643/7101-energy-security-strategy.pdf, p. 13

[8] Olz, Samantha, Sims, Ralph and Kirchner, Nicola, 'Contributions of Renewables to Energy Security', International Energy Agency, 2007, http://www.iea.org/papers/2007/so_contribution.pdf, p. 7.

and energy-rich countries using their energy exports as a political weapon.[9] According to DECC, the range of potential energy security risks includes natural disasters, industrial disputes, technological failure, attacks and the failure of a major energy supplier.[10] Elsewhere it adds to the list political disruption, conflict between and within countries, the closure of a major energy choke point (for example the Straits of Hormuz) and rising fossil fuel prices.[11]

Energy supply constraints may occur due to political unrest, armed conflict, trade embargoes or other countries successfully negotiating exclusive supply deals. Such supply constraints rarely result in physical supply interruptions but they do have consequences for price developments in fossil fuel energy markets. According to a 2007 IEA report, the impact of market volatility of such 'geopolitical' threats has been increased by the uneven global distribution of fossil fuel resources. The paper noted that the world's proven conventional oil and gas reserves were at that time concentrated in small number of countries. The members of the Organisation for the Petroleum Exporting Countries (OPEC) – Venezuela, Nigeria, Algeria, Libya, Iraq, Iran, Saudi Arabia, Kuwait, Qatar, Indonesia and the United Arab Emirates – accounted for 75% of global oil reserves. Similarly, over half of global proven conventional gas reserves were located in three countries: Russia (27%), Iran (15%) and Qatar (14%). This uneven concentration of fossil fuel resources was the most enduring energy security risk according to the IEA paper.

The 'Business as Usual' scenario in the IEA's '2006 World Energy Outlook' projected that oil demand would become increasingly insensitive to price, reinforcing the potential impact of a supply disruption on international oil prices. Since global oil consumption was projected to rise, oil demand would become less responsive to movements in international oil prices.[12] Rising oil demand would increase the consuming countries' vulnerability to a severe supply disruption and resulting price shock.[13] Others have pointed out that many energy-exporting states are unstable. Because of political, social and economic instability, unrest, conflict or corruption, there are potential risks to continued trade in oil, gas or coal.[14]

Perceived threats to British energy security

According to a report by the House of Commons Energy and Climate Change Committee, Britain faces several energy security threats, among them a lack of gas storage capacity, growing global demand for oil and gas, the scheduled closure of coal and nuclear power plants, and international events that constrain or reduce global oil or gas production.[15] Virtually all British oil and gas production occurs in the UK Continen-

[9]Winestone, Ruth, Bolton Paul and Gore, Dona, 'Energy Security', House of Commons Library, Research Paper 07/42, 2007, http://www.parliament.uk/documents/commons/lib/research/rp2007/rp07-042.pdf. p. 1

[10]DECC, 'Energy Security Strategy', Op. cit., p. 7

[11]Ibid, p. 27

[12]Olz, Sims, and Kirchner, 'Contributions of Renewables to Energy Security', Op. cit., pp. 13–14

[13]Ibid, p. 5

[14]Vivoda, Vlado, 'Diversification of oil import sources and energy security: A key strategy or an elusive objective?', Energy Policy, 2009; 37: 4617–4618

[15]House of Commons, 'UK Energy Supply', Op cit, pp. 54-55

tal Shelf (UKCS). However, production of oil peaked in 1999 and production of gas in 2000. As a result, the report argued, the UK is moving from a position of self-sufficiency to increasing dependence on imported oil and gas. A House of Commons research paper argued that the increasing dependence on fossil fuel imports is one of the greatest threats to British energy security and Britain would become increasingly dependent upon imported oil and gas.[16]

These concerns were echoed in a report by the Institute for Public Policy Research, which observed that the UK is already a net importer of coal and gas and will soon become a net importer of oil too.[17]

The Energy and Climate Change Committee argued in its report that greater reliance on imported oil and gas would leave the British economy more vulnerable to global supply constraints and price volatility. Influenced by these and similar fears, the British government aims to reduce the need for oil and gas imports by maximising production from the UKCS and through promotion of low-carbon energy sources, biofuels and fuel and energy efficiency.[18] The Committee welcomed the Government's aim of moving away from dependence on fossil fuels in the long term.[19]

According to a publication by the Parliamentary Office of Science and Technology, Britain was a net importer of 38% of its gas and 14% of its oil needs in 2010 while it imported 52% of the coal it used.[20]

When assessing the UK's vulnerability to disruption of imports, the source of these supplies is important. In 2009, imported gas accounted for approximately 32% of total gas used. Of these imports, about 58% came from Norway, 25% were liquefied natural gas (LNG) from various countries and 16% came from the Netherlands. The majority of the UK's crude oil imports (almost 70%) were from Norway. The Energy and Climate Change Committee's report noted that although the UK sources little of its fossil fuel supply from Russia (see Table 1), the UK remains vulnerable to fluctuations in the supply of fossil fuels from that country.

Table 1: UK fossil fuel supplies from Russia

Fuel type	Share of UK total for type %
Gas	<2
Oil	<10
Coal	37

Source: Energy and Climate Change Committee. Figures for 2010.

The report argued that it was likely that the UK would experience indirectly any disruptions in Russian gas supplies, as happened during the 2006 and 2009 Russia–

[16] Winestone, Bolton, and Gore, 'Energy Security', Op cit, p. 3

[17] Bird, Jenny, 'Energy Security in the UK', Institute for Public Policy Research, August 2007, p. 13

[18] House of Commons, 'UK Energy Supply', Op cit, p. 13

[19] Ibid, p. 14

[20] Allen, Stephen, 'Measuring Energy Security', Parliamentary Office of Science and Technology, Postnote Number 399, January 2012, http://www.parliament.uk/business/publications/research/briefing-papers/POST-PN-399/measuring-energy-security, page 1

Ukraine crises, which led to reductions in supply to EU member states and to increases in gas prices on the continent.[21] Although Britain imports very little gas directly from Russia, Gazprom, the main Russian gas company, claims it sells between 11 billion and 12 billion cubic metres to the UK, which would be about 15% of the UK's total demand. Supplies of Russian gas thus reach Britain indirectly through other European countries. This would explain why in 2009 British gas prices soared by 17% percent when Gazprom cut off gas supplies to Ukrainian customers.[22] The natural gas shortages experienced throughout Europe due to the Russian–Ukrainian crises of 2006 and 2009 showed how vulnerable European states are because of their dependence on Russian natural gas exports.[23]

So far, the current (2014) crisis in the Ukraine has not led to a disruption of Russian gas supplies to European countries. Dieter Helm, an energy expert at Oxford University, argues that Gazprom is portrayed as at arm's length from the Kremlin when suitable, but it is clearly an instrument of the Russian government too. He points out that in Russia the managements of energy companies are very closely linked to the political leadership. Ministers and managers are to a large extent members of the same elite. According to Helm, Gazprom uses its market power very effectively. Its long-term contracts are often opaque and differ from country to country.[24]

Before the general election in May 2010, the Conservative Party published a paper on energy policy. In this paper, the authors claimed that Britain faced two major energy security threats: firstly, the growing dependence on potentially unreliable fossil fuel imports, and secondly, the retirement of much of the electricity generating capacity. The report noted that British coal production peaked in 1952, oil production in 1999 and gas production in 2000. It concluded that after years of self-sufficiency, Britain was becoming ever more dependent on fossil fuel imports and argued that the depletion of North Sea oil and gas reserves meant that this trend would continue.

The National Grid's base case prediction is that imports will account for 70% of gas demand by 2018 – up from 1% in 2000 and 40% in 2008.[25] The Conservative Party paper claimed that UK energy policy was designed for an age of abundant fossil fuel supplies and that this benign condition no longer existed. The authors thought a new era of global energy insecurity was beginning, in which energy production would become concentrated in unstable and sometimes hostile parts of the world and energy supply would struggle to meet growing demand from China, India and other emerging economies. If nothing was done, so the paper claimed, the British economy would be increasingly exposed to volatile and rising fossil fuel prices.[26] The authors concluded that Britain needed to diversify its energy mix.

[21] House of Commons, 'UK Energy Supply', Op cit, p. 17

[22] Sun Wei, 'UK to lead EU frack fight?', Global Times, 17 April 2014, http://www.globaltimes.cn/content/855082.shtml#.U1JoU1fbAe4

[23] Goodrich, Lauren and Lanthemann, Marc, 'The Past, Present and Future of Russian Energy Strategy', Stratfor, 12 February 2013, http://www.stratfor.com/weekly/past-present-and-future-russian-energy-strategy

[24] Helm, Dieter, 'European energy and climate policy in the face of the Russia interventions in Crimea and Ukraine', 17 March 2014, Energy Futures Network Paper, http://www.dieterhelm.co.uk/sites/default/files/Ukraine%20implications_0.pdf, p. 3

[25] The Conservative Party, 'Rebuilding Security: Conservative Energy Policy For An Uncertain World', 2010, http://www.conservatives.com/~/media/Files/Green%20Papers/Rebuilding-Security.ashx, pp. 4–5

[26] Ibid, p. 7

According to DECC's 'Energy Security Strategy', increased international demand for energy resources combined with limitations on production is likely to drive up prices. The paper argues that most forecasts expect rising oil prices and continued high gas prices in Europe over the coming decades.[27] Coming decades will see global energy consumption increase substantially, driven by the rapid expansion of Asian economies. The report claims that as result of this trend the UK will likely face greater competition for more expensive resources.[28]

Claims that renewable energy sources can contribute to energy security

In 2007, the International Energy Agency (IEA) published an information paper with the title 'Contribution of Renewables to Energy Security'. The paper assessed opportunities presented by renewable energy technologies to mitigate risk to energy supply.[29] It claimed that introducing a broad range of renewable sources of energy – hydro, geothermal, bioenergy, solar and wind – into the electricity system and establishing a decentralised power generation system could provide more energy security. The report asserted that renewable energy could reduce geopolitical security risks by contributing to fuel mix diversification and that indigenous renewable energy sources reduce import dependency. It claimed that deploying renewable heating and cooling technologies could reduce supply risks and provide energy security benefits as a result of distributed supply. According to the paper, many governments perceive biofuels as a solution to their high dependence on imported oil and the increasing costs of foreign exchange expenditure from high gas and oil prices.[30] For those countries where growing dependence on imported gas can be seen as a significant energy security issue, the report claimed that renewable energy could provide alternative, and usually indigenous, sources of electric power.[31]

Policymakers in Britain seem to be convinced by such claims. Both the previous Labour government and the present coalition have been seeking to enhance energy security by reducing energy demand and by decarbonising electricity generation. The last Labour government argued that the most secure energy is energy that is not used, and they developed a range of initiatives to deliver energy savings in the home, the workplace and the transport sector. They claimed that decarbonisation was key to ensuring the security of supply in the long term because it would reduce reliance on fossil fuel markets and increase the diversity of supply.[32] In its manifesto for the 2010 general election, the Labour Party claimed that in government they had been 'building a clean energy system, which [would] reduce Britain's dependence on imported oil and

[27] DECC, 'Energy Security Strategy', November 2012, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/65643/7101-energy-security-strategy.pdf, p. 8

[28] Ibid, p. 21

[29] Olz, Sims, and Kirchner, 'Contributions of Renewables to Energy Security', Op cit, p. 7

[30] Ibid, p. 9–10

[31] Olz, Sims, and Kirchner, 'Contributions of Renewables to Energy Security', Op cit, p. 5

[32] House of Commons, 'The UK's Energy Supply: Security or Independence? Government Response to the Committee's Eight Report of Session 2010-12', 22 February 2012, http://www.publications.parliament.uk/pa/cm201012/cmselect/cmenergy/1813/1813.pdf, p. 2

gas and increase our energy security'.[33]

The coalition government has followed the lead of its predecessor in emphasising renewables as a way of providing energy security. In July 2012, Edward Davey, Secretary of State for Energy and Climate Change, announced more subsidies for renewable energy:

> The support we are setting out today will unlock investment decisions, help ensure that rapid growth in renewable energy continues and shows the key role of renewables for our energy security.[34]

The 'Energy Security Strategy' published by DECC in November 2012 recommended decarbonising energy supplies to help reduce dependence on international fossil fuel markets in the longer term.[35] The report states that the reduction of carbon dioxide emissions will reduce Britain's dependence on international oil and gas markets. Emissions reductions are a fundamental pillar of the UK's energy security strategy. The reports sets out the policies the Coalition government has adopted to enhance energy security, through the vehicle of its Renewable Energy Strategy, which is designed to increase the deployment of renewable energy in the UK.

The Government provides significant financial support for renewable energy, in particular through the Renewables Obligation and the Feed-in Tariff scheme. The strategy paper goes on to say that the British government has committed to introducing a subsidy system known as 'Contracts for Difference' for low-carbon technologies to ensure that renewable energy sources can compete for market share.[36]

The strategy also claimed that low carbon policies will reduce the dependence of the heating and transport systems on fossil fuels. The Renewable Heat Incentive and Renewable Heat Premium Payments are supposed to reduce the demand for fossil fuels, while policies to decarbonise the transport sector include the Plugged-in Places schemes and Plug-in power car and vans grants, which promote use of electric vehicles. Moreover, as part of Britain's obligations under the EU Renewable Energy Directive, biofuels are now blended into transport fuels in order to reduce the amount of oil products used.[37] According to DECC's strategy paper, changing to a low-carbon transport system will produce significant energy security benefits through reducing the exposure to, and dependence on, an increasingly tight global oil supply.[38]

In March 2014, Ed Davey claimed that Britain's growing number of offshore wind farms provide a vital national security role as Western countries engage in a stand-off with Moscow over the Ukraine. He argued:

> [Windfarms] are not just the local providers of green energy we need for our low-carbon future, but play an important role at a time of international uncertainty that we see with now Russia and Crimea.

[33] The Labour Party, 'The Labour Party Manifesto 2010: a future fair for all', 2010, http://www2.labour.org.uk/uploads/TheLabourPartyManifesto-2010.pdf, p. 8:3

[34] DECC, 'Renewable Energy to bring 25bn of investment into UK Economy – Davey', Press Notice 2012/086, July 2012, http://www.decc.gov.uk/en/content/cms/news/pn12_086/pn12_086.aspx

[35] DECC, 'Energy Security Strategy', Op cit, p. 6

[36] Ibid, p. 35

[37] Ibid, p. 57

[38] Ibid, pp. 22–23

Davey said the coalition government had always understood the importance of wind power for strategic as well as climate change reasons.[39]

2 Reality

It is pointless to try to increase energy security by replacing fossil fuel imports for the simple fact that importing fossil fuels does not threaten energy security. There are three main reasons for this.

Energy markets provide security

First of all, oil and coal can be safely bought in the world market. Many people think that energy markets are unreliable, unstable and volatile. However, markets are in fact far more stable and reliable than the government policies on which renewable energy strategies depend. Governments change, adapt and repeal their energy policies all the time. This means that government policies are inherently unreliable and thus untrustworthy. The subsidies for wind and solar power that many European governments have introduced over the last decade, are a good example of this. In recent years, many governments have cut solar or wind feed-in tariffs and have even begun to tax profits made by generating electricity with renewables. Greece has introduced a levy on photovoltaic systems for electricity generation[40] and in Spain, photovoltaic producers will have to pay a 6% tax on any income they earn from generating solar power, including feed-in tariffs.[41] Belgium is mulling a solar panel tax too.[42]

The premise of modern economics – that market actors are better informed than political actors – would seem to hold here. [43] If and when a market actor – an energy company for example – makes a big mistake (say, investing in solar power instead of shale gas), it might go bankrupt. In that case, the consequences of its mistake are borne by its shareholders, management, employees and suppliers – a limited group. Energy companies that did not make the same mistake – and *their* shareholders, management, employees and suppliers – are not affected. However, if the government implements an energy policy that turns out to be a mistake, all market actors are affected because the government normally forces all companies and households to comply with its policies. Thus, a government blunder carries a much heavier price tag than a mistake by a company.

Energy markets are a source of security. Large, flexible and well-functioning markets with many buyers and sellers provide security by absorbing supply shocks and

[39] Macalister, Terry, 'Offshore wind farms vital amid tensions with Russia, says energy secretary', *The Guardian*, 25 March 2014, http://www.theguardian.com/environment/2014/mar/25/offshore-windfarms-vital-tensions-russia-ed-davey

[40] Liaggou, Chryssa, 'Levy planned for rooftop solar systems', Ekathimerini, 18 April 2013, http://www.ekathimerini.com/4dcgi/_w_articles_wsite2_1_18/04/2013_494644

[41] Ristau, Oliver, 'Spain Introduces 6% energy tax', PV Magazine, 14 September 2012, http://www.pv-magazine.com/news/details/beitrag/spain-introduces-6-energy-tax_100008498/#axzz2UU9LJpSS

[42] Lomas, Ulrika, 'Belgium Mulls Solar Panel Tax', Tax-News, 17 May, 2013, http://www.tax-news.com/news/Belgium_Mulls_Solar_Panel_Tax____60790.html

[43] Van Doren, Peter and Taylor, Peter, 'The Energy Security Obsession', Cato Institute, 24 October 2008, http://www.cato.org/publications/commentary/case-against-government-support-alternative-energy, p. 12

allowing supply and demand to respond more quickly and with greater ingenuity than a government-controlled system could.[44] There is only one global oil market, moving and selling about 86 million barrels every day. It is complex, integrated and highly liquid and for consumers, security resides in its stability.[45] The global oil market is in no danger of falling apart and accessing it requires no military capabilities. Freedom to import and the absence of price regulation protected US consumers from physical disruption of oil supplies during the strike of oil workers in Venezuela's national oil company PdVSA in 2002 and after hurricane Katrina in 2005.[46]

The same principles also apply to coal. Coal is mined commercially in over 50 countries and used in over 70 countries. Coal is readily available from a wide variety of sources in a well-supplied worldwide market.[47]

Energy embargoes do not work

The second reason why fossil fuels imports are not an energy security risk is that fears of energy embargoes are vastly overblown. Oil embargoes against a particular state do not work. The reason for that is there are no such things as national oil markets; there is only a global oil market. Oil shipments tend to go where the best prices are offered. Oil can easily be transported by lorry, train, ship or pipeline. Once an oil tanker leaves the territorial waters of a producer country, that country no longer has control over it. In 1973, during the Arab oil embargo against the United States, oil-producing countries continued to ship oil to European countries or to the Caribbean, but much of it was then re-shipped to the United States, bypassing the embargo. With a growing global market, buyers of oil can be confident of finding sellers who need the money their oil can bring them.[48] The same is true for coal: coal can be easily transported by ship, rail or lorry and it is traded in a global market with many buyers and sellers.[49]

OPEC has often experienced the chronic cheating that generally affects cartels. It is in the interests of each member of a cartel to have everybody else cut back sales so that prices are high, while selling as much as possible 'under the table' themselves. This behaviour causes prices to collapse. Algeria, Indonesia, Iraq, Kuwait, Nigeria, Qatar, the United Arab Emirates and Venezuela have become notorious for gaming the OPEC system in this way.[50] OPEC's power has also been reduced by the growing number of non-OPEC producers, such as Russia, Norway, Mexico, Canada and Brazil.[51]

[44] Yergin, Daniel, 'Ensuring Energy Security', Foreign Affairs, 2006, http://www.un.org/ga/61/second/daniel_yergin_energysecurity.pdf, pp. 79–80

[45] Ibid, pp. 75–76

[46] Noël, Pierre, 'Challenging the myths of energy security', European Council on Foreign Relations, 11 January 2008, http://ecfr.eu/content/entry/commentary_noel_on_energy_supplies

[47] World Coal Association, 'Coal Market & Transportation', 2011, http://www.worldcoal.org/coal/market-amp-transportation/

[48] Powell, Jim, 'Why 'Dependence' on Foreign Oil Is A Bogus Worry', Forbes, 15 November 2011, http://www.forbes.com/sites/jimpowell/2011/11/15/global-oil-and-gas-markets-our-best-energy-security/2/

[49] EDF Energy, 'How secure are the UK's coal supplies?' 2013, http://www.edfenergy.com/energyfuture/energy-gap-security/coal-and-the-energy-gap-security

[50] Powell, Jim, 'Dependence on Foreign Oil', Ibid.

[51] Feathestone, Charles, 'The Myth of "Peak Oil"', Ludwig von Mises Institute, 12 January 2005, http://mises.org/daily/1717

Even if an embargo were to succeed, the Western world's emergency oil stockpiles have grown dramatically in recent decades. The United States stores more than 700 million barrels of crude oil in its strategic petroleum reserves; the UK maintains emergency oil stocks and stocks of refined oil products that can be released in case of a serious domestic or global supply disruption;[52] European and Asian states have hundreds of millions of barrels between them; private inventories have also expanded. Adding up government and private stockpiles, the industrialised countries control more than four billion barrels of oil in ready-to-access storage tanks and salt caverns. These reserves might seem inadequate when compared to total daily consumption of oil, but they should actually be measured against the size of plausible disruptions, not against total global consumption. A disruption in one place, even in the Persian Gulf, cannot cut off all oil imports. The worst oil disruptions in history – the 1973 Arab oil embargo, the collapse of Iranian oil industry during the revolution in 1979 and the sanctions on Iraq after its invasion of Kuwait in 1990 – each deprived the global oil market of less than 5.5 million barrels a day. If a future disruption were as bad as these, Western governments could replace every lost barrel for more than six months.[53]

Major fossil-fuel-producing countries have strong incentives to sell their coal, oil and gas. In most cases, these sales dominate their economies and generate a substantial part of their government revenues. Saudi Arabia's oil revenues amount to almost 40% of its GDP while for Kuwait the figure is 75%. About half of Qatar's government revenues come from oil exports. Oil revenues provide 84% of Oman's government revenues and about 80% of Iran's export earnings and half of its government revenues. Nigeria's oil revenues make up between 63 and 81% of total revenues. Oil makes up 57% of Kazakhstan's exports and 46% of its government revenues and generates about two-thirds of Russia's export revenues. These countries would therefore run into serious economic difficulties if they stopped selling oil and gas.[54] The record strongly suggests that oil-producing countries, regardless of their feelings towards the West, act in their own best economic interests. In this respect, the behaviour of the Islamic Republic of Iran has been no more menacing or unpredictable than Canada's or Norway's. Despite all its anti-western rhetoric, Iran has not reduced its oil output out of hostility towards the West: the Iranian economy is dependent on oil revenue.[55] The only reduction has been a result of sanctions imposed by importers of oil.

Several observers agree that Russia's dependence on Europe for its gas market is greater than Europe's dependence on Russia for its gas supply. Professor Stern of the Oxford Institute of Energy Studies has stated that Russian energy companies have generally proved to be highly reliable suppliers.[56] In order to use gas exports for foreign policy purposes, the Russian government must be able to lower or raise the price and threaten to cut off supplies, a move that would run in opposition to the use of gas exports to generate revenue. The Russian leadership therefore have to choose just

[52] DECC, 'Energy Security Strategy', Op cit, p. 64

[53] Gholz, Eugene, and Press, Daryl, 'Footprints in the Sand', The American Interest, March-April 2010 issue, http://www.the-american-interest.com/article-bd.cfm?piece=788

[54] Powell, 'Why 'Dependence' on Foreign Oil Is A Bogus Worry', Op cit.

[55] Van Doren, Peter and Taylor, Peter, 'The Energy Security Obsession', Cato Institute, 24 October 2008, http://www.cato.org/publications/commentary/case-against-government-support-alternative-energy, pp. 4–5

[56] House of Commons, 'UK Energy Supply', Op cit, p. 17

one of these two uses of energy exports and it has unequivocally chosen the revenue-generating one.[57] On the rare occasions when Gazprom has cut off gas supplies (as it did to the Ukraine in 2006 and 2009), it has been a very short-term expedient. One must also consider the fact that Gazprom stopped gas deliveries in 2006 and 2009 because of price disputes and because Ukrainian customers had been in overdue in paying their bills and not because the Russians wanted to put the then Ukrainian government under pressure.[58] Unfortunately for EU member states, about half of EU gas imports from Gazprom comes from pipelines that run through the Ukraine (see Figure 1). This is why they were also affected by the dispute.[59]

Figure 1: Gas pipeline routes through Europe

Source: *The Economist*

If Russian energy companies were really to cut off all oil, coal and gas supplies to EU member states as payback for EU sanctions over the current (2014) crisis over the Ukraine, British companies could replace any lost supplies by buying oil and coal from other suppliers in the global market and gas from LNG suppliers, although at a much higher price in the case of LNG.[60]

The impact of LNG and the shale revolution

The third reason why fossil fuel imports are no energy security risk is the impact of liquefied natural gas (LNG) technology and shale gas on gas markets. LNG is gas that has been cooled down in special facilities to liquefy it. In liquid form, it can be transported

[57] Goodrich and Lanthemann, 'Past, Present and Future', Op cit.

[58] BBC Europe News, 'Russia shuts off gas to Ukraine', 1 January 2009, http://news.bbc.co.uk/2/hi/europe/7806870.stm

[59] Blair, David and Gosden, Emily, 'Ukraine: Vladimir Putin threatens to turn off the gas', *The Daily Telegraph*, 10 April 2014, http://www.telegraph.co.uk/news/worldnews/europe/ukraine/10758766/Ukraine-Vladimir-Putin-threatens-to-turn-off-the-gas.html [accessed April 2014].

[60] The Economist, 'Conscious uncoupling', 5 April 2014, http://www.economist.com/news/briefing/21600111-reducing-europes-dependence-russian-gas-possiblebut-it-will-take-time-money-and-sustained

via tankers just like oil or coal. Therefore, exporters and importers of LNG do not rely on pipelines to sell and buy gas. British companies are developing LNG facilities.[61] Until recently, sellers had leverage in natural gas markets, something that was not possible in oil or coal markets because oil and coal can easily be shipped while natural gas is mostly transported by pipelines. Gas buyers therefore had few short-term alternatives if natural gas sellers reduced shipments. However, as LNG will continue to gain market share (see Figure 2), natural gas markets will look increasingly like the global oil market and the ability of Russia and other gas-exporting states to extract concessions from consumers will decline.[62] Today, the cost of liquefying and subsequently re-gasifying gas is still quite substantial and hence there is no global price for gas. However, these costs are expected to come down. Growing demand and the declining cost of liquefication and regasification will, over the coming decades, merge natural gas markets that have previously been regional or continental into one global gas market, much like that for oil.

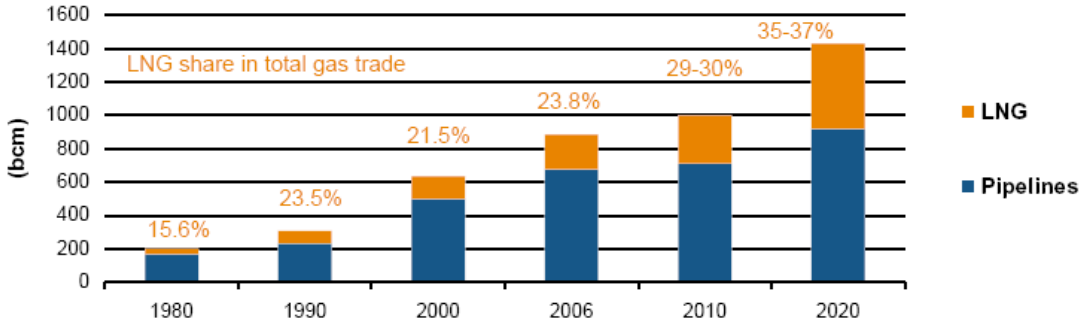

Figure 2: Increasing LNG share in total gas trade

Source: Cedigaz

Such a global market for LNG will increase security for consumers and boost the confidence of the countries that import it.[63] Because of the shale gas boom in the United States the American market for LNG has disappeared. East Asia and Europe are now the main destinations for the rapidly growing amount of shipped LNG. Scores of new LNG terminals are being constructed in the Arabian Gulf, Africa, Europe and elsewhere. Already, market prices for LNG have declined in Europe, which in turn, has forced pipeline gas suppliers such as Norway's Statoil or Russia's Gazprom to renegotiate contracts with their biggest European customers.[64] Contracts are becoming more flexible as competition increases and isolated regional markets are linked. These developments will provide consumers with an increasing degree of supply security.[65]

[61] House of Lords European Union Committee, 'No Country is an Energy Island: Securing Investment for the EU's Future', May 2013, http://www.publications.parliament.uk/pa/ld201213/ldselect/ldeucom/161/161/16102.htm, p. 60

[62] Van Doren, and Taylor, 'The Energy Security Obsession', Op. cit., p. 5

[63] Yergin, 'Ensuring Energy Security', Op cit, pp. 79-80

[64] EurActiv, 'Shale gas and EU energy security', 16 June 2010

[65] Noël, Pierre, 'Challenging the myths of energy security', European Council on Foreign Relations, 11 January 2008, http://ecfr.eu/content/entry/commentary_noel_on_energy_supplies

Before the dramatic development of shale gas in the United States almost 60% of the world's gas reserves were thought to be in Russia, Iran and Qatar. There were therefore fears that these three countries might form a cartel similar to OPEC. Russia and the other members of the Gas Exporting Countries Forum regularly discussed this idea. However, the shale gas revolution and new finds of conventional gas have allowed many more countries to make available gas for export.[66]

The shale gas boom in the United States has already had an impact on natural gas markets in Europe. LNG supplies, which were originally going to the USA, have been diverted to European buyers. This has presented consumers in Europe with an alternative to Russian and North African gas. In fact, Gazprom has already accepted lower prices for its natural gas and is even allowing a portion of its sales in Europe to be indexed to spot natural gas markets, or regional market hubs, rather than (as in the past) oil prices.[67] It has become much harder to use gas reserves as a tool for energy diplomacy.

The shale gas boom in the United States has also had an effect on the price of coal. Because gas is now cheaper than coal in the United States, most coal power plants there have either switched to gas or have closed down. Thus demand for coal has fallen in America. However, in Europe, coal is cheaper than gas and American coal companies now export coal to Europe.

What is more, the supply of energy is likely to become more secure still. Large shale gas resources have also been found in China, Argentina, Mexico, South Africa and Australia,[68] and Algeria also has considerable deposits.[69] In Europe, the chances of finding shale gas are geologically every bit as good as in the United States. France, Poland, and the Ukraine look the most promising locations, but decent quantities might also be found in other countries, particularly Germany and Romania. The US Energy Information Administration puts Europe's recoverable shale gas resources at the same level as America's.[70] Britain has its own very considerable shale gas deposits: a report by the British Geological Survey and DECC, published in 2012, identified significant potentialin northern England, including Widmerpool Gulf near Nottingham and a large area centred on the Elswick gasfield, near Blackpool.[71] According to the report, the UK shale gas reserve potential could be as large as 5.3 trillion cubic feet.[72]

For these three reasons, fossil fuel imports are no threat to energy security.

---

[66] The Economist, 'An unconventional bonanza', Special Report on Natural Gas, 14 July, 2012, http://www.economist.com/node/21558432

[67] Medlock, Kenneth B. III., 'U.S. LNG Exports: Truth and Consequence', James A. Baker III Institute for Public Policy, Rice University, 10 August 2012, http://bakerinstitute.org/publications/US%20LNG%20Exports%20-%20Truth%20and%20Consequence%20Final_Aug12-1.pdf, p. 7

[68] U.S. Energy Information Administration, "World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States", 5 April 2011, http://www.eia.gov/analysis/studies/worldshalegas/

[69] Helm, 'European energy and climate policy in the face of the Russia interventions in Crimea and Ukraine', Op cit, p. 6

[70] The Economist, 'An unconventional bonanza'. Op cit, p. 9.

[71] The British Geological Survey, 'How much shale gas do we have?', 2014, http://www.bgs.ac.uk/research/energy/shaleGas/howMuch.html

[72] DECC, 'The unconventional hydrocarbon resources of Britain's onshore basins – shale gas', 2012, https://www.og.decc.gov.uk/UKpromote/onshore_paper/UK_onshore_shalegas.pdf , p. 1

3 Genuine threats

As shown in Section 2, claims that fossil fuel imports are an energy security threat are false. However, the statements by the IEA, the British government and renewable energy supporters that renewable energy enhances energy security are wrong too.

Wind and solar power are an energy security risk

The central factor in managing the electricity grid is to match supply and demand minute by minute throughout the year. Any failure of the grid managers to do this will result in blackouts. In this regard, it is important to distinguish between dispatchable and intermittent forms of electricity generation. Dispatchable generators can be operated to meet demand when it arises. Nuclear, coal and gas power plants all provide dispatchable generation, as do hydro plants if they have storage reservoirs. In contrast, most forms of renewable generation are intermittent and not dispatchable because they produce electricity only when the wind is blowing or the sun is shining rather than when there is demand for electricity. Because of the fact that the demand for electricity varies throughout the day and the year, one megawatt hour generated at 9 am on a December morning is simply not same product as one megawatt hour generated at 2 am in mid-June.[73]

Wind and solar power are therefore in fact a serious energy security risk because they are intermittent and thus unreliable. Wind turbines only produce electricity when there is the right amount of wind: if there is not enough wind, they cannot produce energy and if the wind blows too strongly, they have to be switched off to avoid being damaged. Similarly, solar panels do not produce electricity if there is no sunshine.

At times when demand is high, wind turbines and solar panels might not generate enough electricity. Therefore, intermittent renewable energy sources need to be backed-up by dispatchable power plants – mostly gas-fired power stations – which can be ramped up quickly when wind and solar power do not generate enough (or any) electricity.

Energy demand varies both during the day and over the year. The lowest demand for electricity in the UK is normally in the early hours of summer mornings. If there is a lot of wind at times of low demand, wind farms produce too much electricity for the grid and they have to be switched off. The demand for energy is highest in the mornings and evenings of cold, dark winter days. This peak demand often coincides with very large, slow-moving anticyclones that bring extreme cold weather and almost no wind, and therefore little or no wind power production. No matter how many wind turbines are built, if the wind does not blow during periods of peak power demand, their potential generating capacity is worth nothing.[74] Germany, which has deployed a significantly larger amount of renewable energy and for longer than Britain, provides a good example of these problems. In early December 2013, Germany's wind and so-

[73] Hughes, Gordon, 'Why Is Wind Power So Expensive?', The Global Warming Policy Foundation, 5 March 2012, http://www.thegwpf.org/images/stories/gwpf-reports/hughes-windpower.pdf, p. 12

[74] Sharman, Hugh, 'The Coming UK Energy Meltdown', Business Insider, 19 July 2011, http://www.businessinsider.com/the-coming-uk-energy-meltdown-2011-7

lar power generation came to an almost complete halt. More than 23,000 wind turbines stood still. Meanwhile, due to a lack of sunshine, one million photovoltaic systems stopped working almost completely and only generated a few kilowatt hours for a few hours in the middle of the day. For a whole week, coal, nuclear and gas power plants had to provide almost all of Germany's electricity supply.[75]

The ability of the grid to absorb intermittent renewable energy becomes increasingly more hazardous with scale. The scale of intermittence to be accommodated in the British grid is daunting given the determination of both the current and the previous government to promote wind farms.[76] The problem has the potential to destabilise the grid.[77] Derek Birkett, a former grid control engineer and author of the book *When Will The Lights Go Out?*, calls the policy to promote wind power 'thoroughly misconceived'. He considers the stability risk that intermittent wind power poses to the grid to be 'unacceptable' and says that support for uneconomic intermittent renewable electricity generation cannot continue without a serious risk of grid instability, which can only be delayed by mitigating measures at an unsustainable cost.[78] How much wind power can be installed on the national grid without risking destabilisation and blackouts is still an open question. Experts agree that wind-generated electricity could be accommodated as long as it provides less than 10% of total electricity but there is a lack of agreement above that level.[79] The management of electricity systems becomes increasingly difficult if the share of wind and solar power in total system capacity approaches or exceeds the minimum level of demand during the year.[80]

The problems of intermittent electricity generation from wind turbines and solar panels could be managed if the surplus produced at times of insufficient demand could be stored and then released onto the grid when demand is high. However, storing electricity is grossly uneconomic. Battery technology is not up to the task on an industrial scale and in Britain pumped storage plants lack the capacity to store all the surplus at economic cost. Hence, once the electricity is produced, one has either to 'use it or lose it'.

This means that when wind turbines and solar panels generate large amounts of electricity (on a sunny and windy summer day for example), conventional power plants need to be switched off to match supply and demand and keep the grid stable. It is expensive and inefficient to run large nuclear or coal power plants in such a way that their output matches fluctuations in demand and so their economic viability is undermined.[81] This being the case, when existing nuclear and conventional power plants reach the ends of their lives, investors may be unwilling to fund replacements and their generating capacity will be lost, despite it still being required for when wind and solar generators are not working. And this generating capacity cannot be replaced by wind

[75] Wetzel, Daniel, 'Renewables Fiasco: Doldrums and Clouds Bring Green Electricity Production To A Halt', Die Welt, 25 December 2013, http://www.thegwpf.org/renewables-fiasco-doldrums-clouds-bring-green-electricity-production-halt/

[76] Birkett, Derek, 'When Will The Lights Go Out?', Stacey International, 2010, p. 62

[77] Ibid, p. 59

[78] Ibid, p. 98

[79] Ibid, p. 130

[80] Hughes, Gordon, 'Why Is Wind Power So Expensive?', Op. cit., p. 7

[81] Ibid, p. 7

or solar power because solar and wind power are not dispatchable technologies.

This development, a direct result of the promotion of intermittent solar and wind power, is a genuine energy security risk.

4 Conclusions

Many people think that fossil fuel imports are a risk to energy security and that renewable energy sources such as wind, solar and biofuels can reduce oil, gas and coal imports. However, renewable energy sources are not able to reduce fossil fuel imports on a large scale. More importantly, fossil fuel imports are not an energy security risk. Oil and coal can be freely bought in global markets. In coming decades, shale gas and LNG will create a global market for gas too. Free markets provide better security than government guarantees or interventions and ensure that energy embargoes fail. For these reasons, fossil fuel imports are no threat to energy security. It is therefore mistaken to justify subsidies for renewable energy sources by claiming that fossil fuel imports are an energy security risk. In fact, wind and solar power, because of the intermittent nature of the electricity generated, are the real risk to security of supply.

References

Allen, Stephen. 'Measuring Energy Security'. Parliamentary Office of Science and Technology. Postnote No. 399, January 2012.

BBC Europe News, 'Russia shuts off gas to Ukraine, 1 January 2009', http://news.bbc.co.uk/2/hi/europe/7806870.stm

Bird Jenny. 'Energy Security in the UK'. Institute for Public Policy Research, August 2007.

Birkett, Derek. *When Will The Lights Go Out?* Stacey International. 2010.

Blair, David and Gosden, Emily. 'Ukraine: Vladimir Putin threatens to turn off the gas'. *The Daily Telegraph*, 10 April 2014. http://www.telegraph.co.uk/news/worldnews/europe/ukraine/10758766/Ukraine-Vladimir-Putin-threatens-to-turn-off-the-gas.html [accessed April 2014]

Department for Energy and Climate Change. 'Energy Security Strategy'. November 2012. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/65643/7101-energy-security-strategy.pdf [accessed January 2014].

Department for Energy and Climate Change. 'Renewable Energy to bring 25bn of investment into UK Economy – Davey'. Press Notice 2012/086. July 2012. http://www.decc.gov.uk/en/content/cms/news/pn12_086/pn12_086.aspx [accessed January 2013].

Department for Energy and Climate Change, 'The unconventional hydrocarbon resources of Britain's onshore basins – shale gas', 2012, https://www.og.decc.gov.uk/UKpromote/onshore_paper/UK_onshore_shalegas.pdf [accessed April 2014].

Department for Energy and Climate Change. 'Why is onshore wind an important part of the UK energy mix?' http://www.decc.gov.uk/en/content/cms/meeting_energy/wind/onshore/delivering/why_onshore/why_onshore.aspx [accessed January 2012].

EDF Energy. 'How secure are the UK's coal supplies?', 2013. http://www.edfenergy.com/energyfuture/energy-gap-security/coal-and-the-energy-gap-security.

Evans-Pritchard, Ambrose. 'Europe left behind as shale shock drives America's industrial resurgence'. The Daily Telegraph. 28 October 2012. http://www.telegraph.co.uk/finance/comment/ambroseevans_pritchard/9639192/Europe-left-behind-as-shale-shock-drives-Americas-industrial-resurgence.html [accessed October 2012].

Featherstone, Charles. 'The Myth of 'Peak Oil'. Ludwig von Mises Institute. 12 January 2005. http://mises.org/daily/1717 [accessed November 2011].

Gholz, Eugene and Press, Daryl. 'Footprints in the Sands'. The American Interest. March-April 2010. http://www.the-american-interest.com/pdf/v5/n4/Gholz-Press.pdf [accessed April 2013].

Goodrich, Lauren and Lanthemann, Marc. 'The Past, Present and Future of Russian Energy Strategy'. Stratfor. 12 February 2013. http://www.stratfor.com/weekly/past-present-and-future-russian-energy-strategy [accessed February 2013].

HM Government. 'The Coalition: our programme for government'. 2010. http://www.direct.gov.uk/prod_consum_dg/groups/dg_digitalassets/@dg/@en/documents/digitalasset/dg_187876.pdf [accessed February 2013].

Helm, Dieter. 'European energy and climate policy in the face of Russian interventions in Crimea and Ukraine'. 17 March 2014. Energy Futures Network Paper. http://www.dieterhelm.co.uk/sites/default/files/Ukraine%20implications_0.pdf [accessed March 2014].

House of Commons. 'UK Energy Supply: Security or Independence?' Eight Report of Session 2010-2012. Volume 1. 25 October 2011. http://www.publications.parliament.uk/pa/cm201012/cmselect/cmenergy/1065/1065.pdf [accessed February 2012].

House of Commons. 'The UK's Energy Supply: Security or Independence? Government Response to the Committee's Eight Report of Session 2010-12'. 22 February 2012. http://www.publications.parliament.uk/pa/cm201012/cmselect/cmenergy/1813/1813.pdf [accessed October 2012].

House of Lords. 'No Country is an Energy Island: Securing Investment for the EU's Future'. European Union Committee. May 2013. http://www.publications.parliament.uk/pa/ld201213/ldselect/ldeucom/161/161/16102.htm [accessed June 2013].

Hughes, Gordon. 'Why Is Wind Power So Expensive?' The Global Warming Policy Foundation. 5 March 2012. http://www.thegwpf.org/images/stories/gwpf-reports/hughes-windpower.pdf [accessed March 2012].

International Energy Agency. 'Energy Security'. 2012. http://www.iea.org/subjectqueries/keyresult.asp?KEYWORD_ID=4103 [accessed January 2012].

International Energy Agency. 'World Energy Outlook 2009'. http://www.worldenergyoutlook.org/media/weowebsite/2009/WEO2009.pdf [accessed October 2012].

Intergovernmental Panel on Climate Change. Working Group III. 'Special Report on Renewable Energy Sources and Climate Change Mitigation'. 2011. http://srren.ipcc-wg3.de/report/IPCC_SRREN_Ch10.pdf.

Kefferpütz, Roderick. 'Shale Fever: Replicating the US gas revolution in the EU?'. CEPS Policy Brief. June 2010. http://aei.pitt.edu/14544/1/PB210_Shale_gas_Kefferputz_e-version.pdf [accessed April 2013].

Liaggou, Chryssa. 'Levy planned for rooftop solar systems'. Ekathimerini, 18 April 2013. http://www.ekathimerini.com/4dcgi/_w_articles_wsite2_1_18/04/2013_494644 [accessed July 2013].

Lomas, Ulrika. 'Belgium Mulls Solar Panel Tax'. Tax-News, 17 May 2013. http://www.tax-news.com/news/Belgium_Mulls_Solar_Panel_Tax____60790.html [accessed July 2013].

Macalister, Terry. 'Offshore wind farms vital amid tensions with Russia, says energy secretary'. *The Guardian*, 25 March 2014. http://www.theguardian.com/environment/2014/mar/25/offshore-windfarms-vital-tensions-russia-ed-davey [accessed April 2014].

Macalister, Terry. 'Wind turbines stand firm as gas prices take off during Crimea crisis'. *The Guardian*, 3 March 2014. http://www.theguardian.com/business/2014/mar/03/wind-turbines-gas-prices-crimea-crisis [accessed April 2014].

Marquez, Humberto. 'Shale Gas Turns the Tables on Petroleum Powers'. Inter Press Service. 3 January 2012. http://ipsnews.net/news.asp?idnews=106359 [accessed January 2012].

Medlock, Kenneth B. III. 'U.S. LNG Exports: Truth and Consequence'. James A. Baker III Institute for Public Policy, Rice University. 10 August 2012. http://bakerinstitute.org/publications/US%20LNG%20Exports%20-%20Truth%20and%20Consequence%20Final_Aug12-1.pdf [accessed January 2013].

Mitcha, Andrew A. 'Shale Storm'. *The American Interest*, January/February 2012. http://www.the-american-interest.com/article-bd.cfm?piece=1168 [accessed January 2012].

Myers Jaffe, Amy, Medlock III, Kenneth B. And Soligo, Roland. 'The Status of World Oil Reserves: Conventional and Unconventional Resources in the Future Supply Mix'. James A. Baker III Institute for Public Policy, Rice University. October 2011. http://www.bakerinstitute.org/publications/EF-pub-WorldOilReserves-101911.pdf [accessed November 2012].

Mueller Philipp. 'The Abundance of Fossil Fuels'. The Global Warming Policy Foundation, 24 January 2013. http://www.thegwpf.org/content/uploads/2013/01/Mueller-Fossil-fuels.pdf [accessed January 2013].

Noël, Pierre. 'Challenging the myths of energy security'. European Council on Foreign Relations, 11 January 2008. http://ecfr.eu/content/entry/commentary_noel_on_energy_supplies [accessed June 2013].

Oliver, Henry. 'Shale Potential'. The Adam Smith Institute, 20 October 2011. http://www.adamsmith.org/blog/environment/shale-potential/ [accessed October 2011].

Olz, Samantha, Sims, Ralph and Kirchner, Nicola. 'Contributions of Renewables to Energy Security.' International Energy Agency, April 2007. http://www.iea.org/papers/2007/so_contribution.pdf [accessed January 2012].

Powell, Jim. 'Why 'Dependence' On Foreign Oil Is A Bogus Worry'. *Forbes*, 15 November 2011. http://www.forbes.com/sites/jimpowell/2011/11/15/global-oil-and-gas-markets-our-best-energy-security/2/ [accessed November 2011].

Ridley, Matt. 'The Shale Gas Shock'. The Global Warming Policy Foundation, May 2011. http://www.thegwpf.org/images/stories/gwpf-reports/Shale-Gas_4_May_11.pdf [accessed May 2011].

Ristau, Oliver. 'Spain introduces 6% energy tax'. *PV Magazine*, 14 September 2012, http://www.pv-magazine.com/news/details/beitrag/spain-introduces-6-energy-tax_100008498/#axzz2UU9LJpSS [accessed July 2013].

Sharman, Hugh. 'The Coming UK Energy Meltdown'. *Business Insider*, 19 July 2011. http://www.businessinsider.com/the-coming-uk-energy-meltdown-2011-7 [accessed July 2011].

Stratfor. 'LNG's Expanding Role in Europe'. 26 January 2012. http://www.stratfor.com/analysis/lngs-expanding-role-europe [accessed February 2012].

The British Geological Survey, 'How much shale gas do we have?', 2014, http://www.bgs.ac.uk/research/energy/shaleGas/howMuch.html [accessed April 2014].

The Conservative Party. 'Rebuilding Security. Conservative Energy Policy For An Uncertain World'. 2010. http://www.conservatives.com/~/media/Files/Green%20Papers/Rebuilding-Security.ashx [accessed February 2013].

The Economist. 'Cleaner, not cooler'. 6 August 2011. http://www.economist.com/node/21525418 [accessed August 2011].

The Economist. 'Coming soon to a terminal near you'. 6 August 2011. http://www.economist.com/node/21525381 [accessed August 2011].

The Economist. 'Conscious uncoupling. 5 April 2014. http://www.economist.com/news/briefing/21600111-reducing-europes-dependence-russian-gas-possiblebut-it-will-take-time-money-and-sustained [accessed April 2014].

The Economist. 'An unconventional bonanza'. Special Report on Natural Gas. 14 July 2012. http://www.economist.com/node/21558432 [accessed July 2012].

The Labour Party. The Labour Party Manifesto 2010: A future fair for all'. 2010. http://www.labour.org.uk/uploads/TheLabourPartyManifesto-2010.pdf [accessed February 2013].

The Parliamentary Office of Science and Technology. 'Measuring Energy Security'. January 2012. [accessed January 2014].

U.S. Energy Information Administration. 'Levelized Cost of New Generation Resources in the Annual Energy Outlook 2011'. November 2010. http://www.eia.gov/oiaf/aeo/electricity_generation.html [accessed October 2011].

Van Doren, Peter and Taylor, Jerry. 'The Case against Government Support for Alternative Energy. Cato Institute. 24 October 2008. http://www.cato.org/publications/commentary/case-against-government-support-alternative-energy [accessed July 2013].

Vivoda, Vlado. 'Diversification of oil import sources and energy security: A key strategy or an elusive objective?' Energy Policy 37 (2009).

Wei, Sun. 'UK to lead EU frack fight?'. Global Times. 17 April 2014. http://www.globaltimes.cn/content/855082.shtml#.U1JoU1fbAe4 [accessed April 2014].

Whitehouse, David. 'The Global Warming Standstill'. The Global Warming Policy Foundation. 15 March 2013. http://www.thegwpf.org/content/uploads/2013/03/Whitehouse-GT_Standstill.pdf [accessed March 2013].

Winestone, Ruth, Bolton Paul and Gore, Dona. 'Energy Security'. House of Commons Library. Research Paper 07/42. 9 May 2007. http://www.parliament.uk/documents/commons/lib/research/rp2007/rp07-042.pdf [accessed February 2012].

World Coal Association. 'Coal Market & Transportation'. 2011. http://www.worldcoal.org/coal/market-amp-transportation/ [accessed November 2011].

Yergin, Daniel. 'Ensuring Energy Security'. *Foreign Affairs*, March/April 2006. http://www.un.org/ga/61/second/daniel_yergin_energysecurity.pdf [accessed January 2012].

GWPF BRIEFINGS

1	Andrew Turnbull	The Really Inconvenient Truth or 'It Ain't Necessarily So'
2	Philipp Mueller	The Greening of the Sahel
3	William Happer	The Truth about Greenhouse Gases
4	Gordon Hughes	The Impact of Wind Power on Household Energy Bills
5	Matt Ridley	The Perils of Confirmation Basis
6	Philipp Mueller	The Abundance of Fossil Fuels
7	Indur Goklany	Is Global Warming the Number One Threat to Humanity?
8	Andrew Montford	The Climate Model and the Public Purse

The Global Warming Policy Foundation is an all-party and non-party think tank and a registered educational charity which, while open-minded on the contested science of global warming, is deeply concerned about the costs and other implications of many of the policies currently being advocated.

Our main focus is to analyse global warming policies and their economic and other implications. Our aim is to provide the most robust and reliable economic analysis and advice. Above all we seek to inform the media, politicians and the public, in a newsworthy way, on the subject in general and on the misinformation to which they are all too frequently being subjected at the present time.

The key to the success of the GWPF is the trust and credibility that we have earned in the eyes of a growing number of policy makers, journalists and the interested public. The GWPF is funded overwhelmingly by voluntary donations from a number of private individuals and charitable trusts. In order to make clear its complete independence, it does not accept gifts from either energy companies or anyone with a significant interest in an energy company.

Views expressed in the publications of the Global Warming Policy Foundation are those of the authors, not those of the GWPF, its trustees, its Academic Advisory Council members or its directors.

Published by the Global Warming Policy Foundation

For further information about the GWPF or a print copy of this report contact:

The Global Warming Policy Foundation
10 Upper Bank Street, London E14 5NB
T 020 7006 5827
M 07553 361717

www.thegwpf.org

Registered in England, no 6962749
Registered with the Charity Commission, no 1131448