No need to step on the gas

Why cutting gas use, not fracking, is the solution for UK energy security

The world has far greater known reserves of fossil fuels than we can afford to burn if we want to avoid catastrophic climate change¹. As the Governor of the Bank of England says: “The vast majority of reserves are unburnable”².

The UK’s share of a safe amount of burnable fossil fuels is extremely low – far lower than the emissions that would be produced by the Government’s plans to maximise North Sea oil and gas production, let alone additional fossil fuels such as shale gas and oil³. Tackling climate change means keeping most fossil fuels in the ground, and cutting the use of fossil fuels such as gas, rather than looking to bring more into production. So discussions about the role of gas in the future should start by asking ‘how much gas do we need?’, rather than ‘where can we get our gas from?’

Supporters of UK shale gas argue that fracking in the UK is essential to ensure our energy security. In the medium- to long-term, between now and 2030, they say it is essential to stop the UK being reliant for its energy on unpalatable regimes or unstable areas of the world.

This briefing shows that UK shale gas would make only a small dent in the UK’s net imports of gas. In contrast, a focus on demand reduction and decarbonisation could make a far bigger difference:

- Going ‘all out for shale’ would still mean gas imports staying around today’s level or rising by up to 11% whereas following a ‘Climate Safe’ approach would cut gas imports by 30% from current levels.
- The ‘Climate Safe’ approach is achievable, and could be delivered by decarbonising electricity generation as recommended by the Committee on Climate Change, a nationwide programme of energy efficiency across the board - in homes, industry, commerce and the public sector, and by using alternatives to fossil fuel gas.
- A ‘Climate Safe’ approach would mean that UK shale gas did not add to global unburnable carbon.
- A ‘Climate Safe’ approach would bring substantial co-benefits, such as lower household energy bills, savings for the NHS from reducing the health impacts of cold homes and substantial job creation⁴.

For more than 40 years we’ve seen that the wellbeing of people and planet go hand in hand – and it’s been the inspiration for our campaigns. Together with thousands of people like you we’ve secured safer food and water, defended wildlife and natural habitats, championed the move to clean energy and acted to keep our climate stable. Be a Friend of the Earth – see things differently.
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As the table below shows, the UK will be importing some gas in 2030, whether or not we drill for shale. With demand reduction, we can meet our needs and stay secure primarily from Norwegian sources of gas.

**Gas demand and supply (millions of tonnes of oil equivalent)**

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2030 scenarios</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DECC</td>
<td>Dash for Gas</td>
</tr>
<tr>
<td>UK demand</td>
<td>73</td>
<td>60</td>
</tr>
<tr>
<td>UK supply</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conventional gas</td>
<td>37</td>
<td>15</td>
</tr>
<tr>
<td>Green gas</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Shale gas</td>
<td>0</td>
<td>5 – 12</td>
</tr>
<tr>
<td>Net Imports</td>
<td>36</td>
<td>33 - 40</td>
</tr>
</tbody>
</table>

Energy security and energy independence are not the same thing. Part of our security comes from already having multiple supplies of natural gas from an increasingly integrated European gas network and our substantial investment in LNG import facilities.

**Keeping shale gas in the ground, and focussing instead on energy efficiency, reducing demand for gas, and developing green alternatives would be far better for tackling climate change. It would also mean the UK importing less gas than at present, and less gas than under the Government’s current projections. This plan is better for energy security, better for climate change, and better for saving money. It is a triple-win.**

In the words of energy security expert Professor Michael Bradshaw⁶: "The best way to reduce the energy security risks associated with the UK’s growing gas import dependence is to … promote renewable power generation, improve energy efficiency and reduce overall energy demand”

1 **Introduction**

After years of being a net exporter of natural gas, the UK is now a significant net importer. As the chart⁶ below shows, the Government predicts that net imports – shown by the gap between production and demand - will increase as UK North Sea gas production continues to fall.

Some people are worried that this growing import dependency is risky, as we might have to source our gas from unstable or unpalatable sources: former Energy Secretary Ed Davey spoke of Russia holding the world to ransom over energy⁷. This has led to suggestions that developing UK shale gas is the solution to this perceived energy security problem.
This briefing looks at what we can do to reduce gas demand to 2030, how the gas we need can be supplied, and whether exploiting UK shale gas is necessary to meet UK gas demand.

2  How much gas do we use now and where does it come from?

2.1  Demand: how much gas do we use and on what?

In 2013\(^9\), the UK used\(^9\) 73.2 million tonnes of oil equivalent (mtoe) of gas, split as follows\(^10\):

<table>
<thead>
<tr>
<th>Gas use (mtoe)</th>
<th>Percentage of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity generation</td>
<td>17.4</td>
</tr>
<tr>
<td>Energy industries</td>
<td>4.7</td>
</tr>
<tr>
<td>Industry</td>
<td>8.0</td>
</tr>
<tr>
<td>Domestic</td>
<td>29.6</td>
</tr>
<tr>
<td>Public and commercial</td>
<td>9.0</td>
</tr>
<tr>
<td>Other(^11)</td>
<td>4.4</td>
</tr>
</tbody>
</table>

2.2  Supply: where do we get our gas from?

The UK produced around 36.5 mtoe of gas in 2013\(^12\). Some is exported, mainly to Ireland. We also export gas to and import gas from different countries at different times of the year.

In total, to make up for the shortfall between domestic production and domestic demand, we have net gas imports of around 36mtoe. 80% of gross imports come by pipeline, mostly from Norway. The other 20% is shipped Liquid Natural Gas (LNG), almost entirely\(^13\) from Qatar:
3 Future UK gas demand and production

The Department for Energy and Climate Change (DECC) forecasts that UK gas demand in 2030 will be 60 mtoe and that total UK gas production will be 15 mtoe\(^\text{15}\). Thus the gap between demand and production will be 45 mtoe, considerably higher than the 2013 gap, around 36 mtoe. This gap could be addressed in several ways:

- Imports
- Increased North Sea Gas production, or other UK gas production such as shale gas
- Finding non-fossil fuel sources of gas – such as biogas
- Reducing the need for gas, through energy efficiency
- Reducing the need for gas, through switching energy sources: using alternatives to gas for electricity generation, using alternatives to gas for heat – such as geothermal energy, using alternatives to gas for home heating, such as heat pumps

The Government's focus seems to be very much on the first two of these. This paper suggests that the latter three options have not been considered enough, and generates a ‘Climate Safe’ Scenario.
4 How can we cut future gas demand

The starting point should be to cut the amount of gas we need. Forecast gas demand in 2030 can be cut significantly. The work that follows, using DECC data, shows that 2030 gas demand can be cut from DECC’s projected 60 mtoe to 46 mtoe primarily by:

- A major push to improve home energy efficiency,
- Increased ambition for energy efficiency in industry, commerce and the public sector
- More ambitious decarbonisation of power generation

More detail on each of these is provided below. There are also other ways, not quantified here, to cut gas demand further, for example through using heat pumps instead of gas for home heating. The Committee on Climate Change note the large potential for electrification of home heating\textsuperscript{18}: if this is given support it could lead to large additional cuts to gas demand.

4.1 Home energy efficiency

The domestic sector accounts for nearly 40% of UK gas use. Analysis by Cambridge Econometrics and Verco for the Energy Bill Revolution (EBR) campaign\textsuperscript{17} has calculated the impact of a radical new approach to home energy efficiency, with all low income homes being given measures by 2025 to bring them up to Energy Performance Certificate Band C\textsuperscript{18}, and for all other households to be offered 0% loans to improve them to an equivalent standard by 2035. This would cut total gas demand in 2030 by approximately 19% on current levels, equivalent to a cut of over 40% in domestic gas demand.

For context, Ecofys has assessed the possible cut in domestic gas demand at the EU level to be 58% by 2030\textsuperscript{18}. Our calculations are based on a cut of 40%. Cutting 2030 domestic gas demand by 40% would reduce this from 30 mtoe in 2013 to 18 mtoe, a cut of 12 mtoe.

4.2 Energy efficiency in commerce, the public sector and industry

Energy efficiency measures would reduce gas burned for heat and power. Ecofys find that the built environment, which includes commercial and public sector buildings as well as homes “has a greater potential for energy saving than any other sector; significant reductions can be made in energy demand for heating, in particular, through improvements to the building envelope and heating systems”\textsuperscript{20}. ‘Building envelope’ improvements include insulation and glazing. Ecofys estimate a possible reduction in demand for gas from such buildings of around 58% by 2030. Our calculations assume a more conservative 40% reduction.

According to Ecofys, “industrial energy demand can be reduced firstly by implementing technical measures to save energy, such as best practice technologies, and secondly by shifting production to less energy-intensive products or processes, for example by increasing production of recycled steel\textsuperscript{21}. Ecofys only consider the first of these options, which leads to gas demand falling by around 16%, which they describe as a “conservative estimate”\textsuperscript{22}.”
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This would reduce gas demand as follows:

<table>
<thead>
<tr>
<th></th>
<th>2013 use (mtoe)</th>
<th>Cut (%) by 2030</th>
<th>2030 use (mtoe)</th>
<th>Saving (mtoe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commerce</td>
<td>5.2</td>
<td>40</td>
<td>3.1</td>
<td>2.1</td>
</tr>
<tr>
<td>Public Sector</td>
<td>3.8</td>
<td>40</td>
<td>2.3</td>
<td>1.5</td>
</tr>
<tr>
<td>Industry</td>
<td>8.0</td>
<td>16</td>
<td>6.7</td>
<td>1.3</td>
</tr>
<tr>
<td>Total</td>
<td>17.0</td>
<td></td>
<td>12.1</td>
<td>4.9</td>
</tr>
</tbody>
</table>

4.3 More ambitious decarbonisation of power generation

DECC’s demand forecast for 2030 does not go far enough in decarbonizing power generation. It assumes that electricity generation produces around 100 grammes of CO₂ per kilowatt hour (gCO₂/kWh) rather than the 50 gCO₂/kWh recommended by its official advisors, the Committee on Climate Change (the CCC). The CCC has said that this is essential for cutting carbon emissions across the economy and meeting the UK’s legally-binding climate change targets.

Meeting the CCC’s decarbonisation target would mean a reduced role for gas in generating electricity, and a greater role for renewable sources.

Figures published by DECC show the differing levels of gas use for different decarbonisation scenarios. DECC’s latest projections predict gas use for electricity of 13.2 mtoe in 2030, compared with 17.4 mtoe now. Their sensitivity analysis for different amounts of gas on the electricity grid in 2030 show:

<table>
<thead>
<tr>
<th></th>
<th>Mtoe in 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>50g/kWh electricity</td>
<td>7.5</td>
</tr>
<tr>
<td>100g/kWh electricity</td>
<td>16.4</td>
</tr>
<tr>
<td>200g/kWh electricity (Treasury ‘Dash for Gas’ scenario)</td>
<td>33.5</td>
</tr>
</tbody>
</table>

Thus meeting a 50g/kWh scenario would use 7.5 mtoe of gas in 2030 compared to 17.4 mtoe in 2013, a cut of 9.9 mtoe (57%).
4.4 Agriculture and other sectors

DECC’s gas forecasts also include other sectors, such as heat generation, agriculture, energy industry own use – in 2013 these total 4.4 mtoe. We assume just 10% energy savings here – saving 0.4 mtoe by 2030.

4.5 Overall gas demand

Bringing together the reductions above produces a very different picture for possible UK gas demand in 2030, as the table below illustrates.

<table>
<thead>
<tr>
<th></th>
<th>Demand reduction on 2013 levels (mtoe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic</td>
<td>11.8</td>
</tr>
<tr>
<td>Commercial and public</td>
<td>3.6</td>
</tr>
<tr>
<td>Industry</td>
<td>1.3</td>
</tr>
<tr>
<td>Power generation</td>
<td>9.9</td>
</tr>
<tr>
<td>Other</td>
<td>0.4</td>
</tr>
<tr>
<td>Total</td>
<td>27.0</td>
</tr>
</tbody>
</table>

This would reduce gas demand from 73.2 mtoe in 2013 to 46.2 mtoe in 2030.

A third possibility is a “Dash for gas”, advocated by the Treasury and hinted at in the Conservative Party’s election manifesto (which refers to “a significant expansion in new nuclear and gas”27) with the electricity sector running at 200g/kWh in 2030. This would increase gas demand by 17.1 mtoe compared with DECC’s projection. This gives three possible scenarios for UK gas demand in 203028:

<table>
<thead>
<tr>
<th></th>
<th>Gas demand in 2030, mtoe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand reduction scenario</td>
<td>46</td>
</tr>
<tr>
<td>DECC projection</td>
<td>60</td>
</tr>
<tr>
<td>Dash for Gas</td>
<td>77</td>
</tr>
</tbody>
</table>
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5 Future gas supply

5.1 North Sea gas

The Government assumes that North Sea gas production will continue to decline. The Government’s stated policy aims are to slow this decline by “maximizing economic recovery” of gas and oil production from the North Sea. Friends of the Earth believes that this “maximizing” approach is incompatible with the UK’s repeatedly stated aims to do its part in preventing dangerous climate change. Based on the carbon budgets provided in the latest IPCC reports for a reasonable probability of meeting international commitments to “stay below” 2°C. If we want to avoid catastrophic climate change, the world cannot burn more than a quarter of its existing fossil fuel reserves, let alone look for more. For the UK to seek to maximise conventional fossil fuel production is hugely irresponsible. If other nations did the same, then catastrophic climate change would be unavoidable. The UK would be burning for more than any reasonable share of the world’s remaining burnable carbon if it produced the amount it is projecting to, to 2030.

Rather than seeking to maximise UK gas production, to do our part in tackling climate change, we should at the very most be only exploit existing proven North Sea gas reserves. This would reduce UK gas production to around 9 mtoe by 2030. Even this is extremely generous to the UK in terms of our share of the remaining carbon budget.

5.2 UK alternatives to North Sea gas

5.2.1 Shale gas

Several different estimates have been made of potential UK shale gas production. National Grid has produced four future scenarios as part of its ‘UK Future Energy Scenarios’ work – see chart below.
UK shale gas production in 2030 in these scenarios varies significantly:

<table>
<thead>
<tr>
<th>Scenario</th>
<th>UK shale gas production 2030 (mtoe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Progress</td>
<td>0</td>
</tr>
<tr>
<td>Slow Progression</td>
<td>4.8</td>
</tr>
<tr>
<td>Gone Green</td>
<td>11.9</td>
</tr>
<tr>
<td>Low Carbon Life</td>
<td>28.7</td>
</tr>
</tbody>
</table>

National Grid state\textsuperscript{33} that, in the absence of any UK production data, they have based their scenarios on a report published by the Institute of Directors\textsuperscript{34} and funded by Cuadrilla, one of the main shale gas drilling companies. The figures in the ‘Low Carbon Life’ scenario are broadly similar to the production estimates in the Institute of Directors report, which has been criticised as using very optimistic production assumptions\textsuperscript{35}. We therefore believe that the ‘Low Carbon Life’ scenario is unrealistic and have not included it in subsequent calculations.

The scale of production in the ‘Gone Green’ scenario would also involve a substantial number of wells. Howard Rogers of the Oxford Institute for Energy Studies has estimated that producing 8 bcm (about 7 mtoe) of gas a year would be “achieved by drilling 300 new wells each year (from 25 new pads per year, each with its own drilling rig)”\textsuperscript{36}. This is around 60% of production in the ‘Gone Green’ scenario, so the number of new wells and pads can be expected to be correspondingly larger. There are doubts whether this level of production would be economically viable or publicly acceptable.

5.2.1 Bioenergy and geothermal heat

Bioenergy can be produced from a range of different sources. These include

- waste resources (such as food waste, municipal waste, sewage sludge and landfill gas).
- residues and co-products from the agricultural and forestry sectors (such as animal slurries as well as straw and residues from forestry and wood processing activities)\textsuperscript{37}.
- energy crops and material arising from landscape and habitat management.

Bioenergy can be used in a variety of ways to meet demands for heat, electricity and transport fuels, including the combustion of solid biomass and anaerobic digestion to produce biogas. These offer alternatives to gas for both heat production and electricity generation. However the availability of sustainable biomass is limited and it should be deployed in the most efficient way, which is usually heat. A report\textsuperscript{38} by the Institute for European Environmental Policy has assessed the sustainable bioenergy potential of the UK at 11.7 mtoe.
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Geothermal heat can also reduce the need for gas in heating. Geothermal heat involves the use of heat stored within underground rocks or aquifers. The Institution of Mechanical Engineers (IMechE) stated in a 2013 paper that district heating could account for 20% of total heat demand by 2020, and that 10% of district heating could be provided by geothermal resources. Thus geothermal energy could replace approximately 2% of gas use for domestic heating. Based on projected demand of 380 TWh in 2030, this is equivalent to approximately 8 TWh, or 0.35 mtoe.

Thus bioenergy and geothermal heat together could replace 12 mtoe of fossil fuel gas. Combined with exploiting proven North Sea gas reserves, this gives 2030 gas production (or equivalent) of around 21 mtoe.

6 The new 2030 demand / supply balance

Bringing together all the above data shows gas import needs under different scenarios:

### Gas demand and supply

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2030 scenarios</th>
<th>DECC</th>
<th>Dash for Gas</th>
<th>Climate Safe &amp; Secure</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK demand</td>
<td>73</td>
<td>60</td>
<td>77</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>UK supply</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conventional gas</td>
<td>37</td>
<td>15</td>
<td>15</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Green gas</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Shale gas</td>
<td>0</td>
<td>5 – 12</td>
<td>5 - 12</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Net Imports</td>
<td>36</td>
<td>33 - 40</td>
<td>50 - 57</td>
<td>25</td>
<td></td>
</tr>
</tbody>
</table>

### Summary table

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Net gas imports (mtoe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best energy security</td>
<td></td>
</tr>
<tr>
<td>2030 ‘Climate Safe’</td>
<td>25</td>
</tr>
<tr>
<td>2013</td>
<td>36</td>
</tr>
<tr>
<td>2030 DECC + shale</td>
<td>33 - 40</td>
</tr>
<tr>
<td>2030 Dash for gas</td>
<td>50 - 57</td>
</tr>
<tr>
<td>Worst energy security</td>
<td></td>
</tr>
</tbody>
</table>
A ‘Climate Safe’ strategy involving high demand reduction plus green alternatives would mean gas imports not just significantly lower overall than currently, but also lower than current imports from Norway.

National Grid project gas supplies to the UK from Norway in 2030 to be between 13.3 mtoe (in the ‘Low Carbon Life’ scenario) and 24 mtoe (in the ‘No Progression’ scenario) \(^\text{40}\). Thus the UK’s 2030 gas imports could come almost entirely from Norway, with other Western European sources making up the rest. Using gas from the Norwegian North Sea would have lower risks for the local environment and human health than onshore fracking.

Importing gas from Norway and Western Europe is not a high-risk strategy – it would indeed be more high-risk from an energy security perspective to be cut off from such European networks.

Under DECC’s 2030 projections and even allowing for UK shale gas production in line with the highest of National Grid’s more realistic scenarios, the level of imports needed in 2030 is substantially higher than under the demand reduction strategy.

The aim has to be tackling climate change, and improving energy security. Our scenario does both. The others do not.

### 7 Co-benefits

Reducing our demand for gas will not just address energy security concerns, but will also have other benefits:

- Cutting carbon emissions: reducing gas use through greater energy efficiency and use of renewables will cut carbon emissions. Cambridge Econometrics and Verso have calculated that the Energy Bill Revolution programme of domestic energy efficiency would cut UK carbon emissions by 23.6 MtCO\textsubscript{2} in 2030, equivalent to cutting the emissions of the UK transport fleet by one-third\(^\text{41}\).
• If we keep UK shale gas in the ground, we are helping tackle climate change. Fossil fuels need to stay in the ground. UK shale gas production would not be “instead” of gas production as well, it is far more likely it will be in addition to gas production elsewhere. In a report for DECC, its then chief scientist Professor David Mackay wrote: “If a country brings any additional fossil fuel reserve into production, then in the absence of strong climate policies, we believe it is likely that this production would increase cumulative emissions in the long run. This increase would work against global efforts on climate change.”

• Reducing our exposure to gas price volatility. Gas price rises in recent years have been the main cause of rises in domestic energy bills, and this could continue into the future if we do not cut gas demand. Professor Paul Ekins has written that “burgeoning global demand from India, China and other emerging economies would eat up new gas supplies as fast as they became available, so prices would remain high and supplies potentially constrained. In this scenario, UK households and industry would be tied to a highly unpredictable roller coaster of gas prices that are generally high and can spike higher due to volatility.”

• Benefits for households: the average household energy bill nearly doubled between 2004 and 2012, largely due to the rising price of gas. Millions of households are struggling to pay their fuel bills; a family in a typical uninsulated 3-bedroom home wastes around £653 per year on heating. Improving home energy efficiency would cut heating bills and save households money.

• Macro-economic benefits: calculations for the EU by Cambridge Econometrics have shown that a 40% cut in energy use by 2030 through efficiency measures would increase the UK’s GDP by £62bn and create 40,000 new jobs. Also, Verco and Cambridge Econometrics have calculated the benefits of implementing the domestic energy efficiency programme advocated by Energy Bill Revolution. These include:
  o Improved health and reduced healthcare expenditure – for every £1 spent on reducing fuel poverty, a return of 42 pence is expected in NHS savings.
  o For every £1 of Government investment there will be £1.25 of increased tax revenue through increased economic activity, meaning the programme is self-financing.

8 The short-term: could UK shale gas reduce the risk of the lights going out?

Another current energy security concern is around the perceived risk that ‘the lights will go out’ in the next two or three years because of the closure of coal and gas-fired power stations. Whatever the scale of this risk, UK shale gas will have no impact:

• The main concern is about generating capacity rather than the availability of gas
• Even if there are problems with gas supply to the UK in the next two to three years, maybe as a consequence of reduced supply from Russia or problems in the Middle East, UK shale gas could not come on stream fast enough to have an impact. Francis Egan, CEO of Cuadrilla, told a Chatham House seminar last year that even if a national emergency was declared and all constraints were removed, it would still take up to four years to get
appreciable production of shale gas\textsuperscript{48}. (However the majority of industry experts believe that appreciable UK shale gas production is at least a decade away\textsuperscript{49}).

9 Conclusions

Government forecasts estimate that UK gas demand in 2030 will be around 18% lower than in 2013. However, as production from the North Sea is declining, it is claimed that this will mean a greater reliance on imported gas – unless we exploit the potential shale gas under the UK.

But it is now broadly accepted that we will have to leave the majority of proven global fossil fuel reserves underground if we want to avoid the worst impacts of climate change. Exploiting the UK’s possible shale gas resources will just add to this unburnable carbon. As DECC’s then chief scientist wrote: ‘If a country brings any additional fossil fuel reserve into production, then in the absence of strong climate policies, we believe it is likely that this production would increase cumulative emissions in the long run. This increase would work against global efforts on climate change.’\textsuperscript{50}, Anthony Hilton, City Editor of the London Evening Standard has put it more succinctly. Refering specifically to UK shale gas, he wrote “we have already discovered more fossil fuels in the world than can possibly be burned without risking cataclysmic global warming. Do we really need to go looking for more?”\textsuperscript{51}.

However exploiting UK shale gas or increasing imports are not the only options. This briefing shows that UK shale gas is not needed in the period to 2030 to tackle the UK’s perceived energy security problem.

By focusing on minimising demand for gas through decarbonising power generation and energy efficiency in homes, commerce, industry and the public sector, we do not have to exploit UK shale gas or maximise North Sea gas production, and we can still have lower gas imports and energy security than is currently the case or would be the case in 2030 under DECC or Treasury plans.

\textsuperscript{1} Carbon Tracker, 2013. Unburnable carbon. \url{http://www.carbontracker.org/resources/}
\textsuperscript{2} Reported in the Guardian, 13\textsuperscript{th} October 2014. Mark Carney: most fossil fuel reserves can’t be burned \url{http://www.theguardian.com/environment/2014/oct/13/mark-carney-fossil-fuel-reserves-burned-carbon-bubble}
\textsuperscript{3} Friends of the Earth, 2013. The UK, shale gas and unburnable carbon, \url{http://www.foe.co.uk/sites/default/files/downloads/unburnable_gas_2013.pdf}
\textsuperscript{4} Investing in renewable energy and energy efficiency would create create over six times as many jobs as gas per unit of power generated or saved, and around three times as many jobs for the same investment. See Friends of the Earth ‘Making a better job of it’ \url{https://www.foe.co.uk/sites/default/files/downloads/making-better-job-it-full-report-75291.pdf}
\textsuperscript{5} Professor Michael Bradshaw for Friends of the Earth, ‘Time to take our foot off the gas?’ \url{http://www.foe.co.uk/sites/default/files/downloads/time_to_take_our_foot_off.pdf}
\textsuperscript{7} Daily Telegraph 22\textsuperscript{nd} April 2014, ‘Ed Davey: Russia holding world to ransom over energy’ \url{http://www.telegraph.co.uk/news/earth/energy/10778864/Ed-Davey-Russia-holding-world-to-ransom-over-energy.html}
8. 2013 is the most recent year for which finalised official data is available. Government data for 2014 is still provisional.
11. “Other” = heat generation 2 mtoe, non-energy use 0.5mtoe, agriculture 0.1 mtoe, losses 0.6 mtoe and “miscellaneous” 1.2mtoe
12. Digest of UK Energy Statistics, 2014. Table 4.3. Gross production was 36.5mtoe, 4mtoe was used in production – for drilling, pumping operations etc.
13. The other 7% of non-Qatari LNG imports come from Algeria, Norway, Trinidad and Tobago and Egypt
14. The Netherlands is a major gas producing nation, so imports from the Netherlands can reasonably be seen as being from Dutch production. However, Belgium is not. Belgian imports are in reality imports from the wider European gas network.
18. Energy Performance Certificate (EPCs) are a measure of the level of energy efficiency of a home. The ratings span from A to G. A-rated homes would have relatively low energy bills, whereas G-rated homes would have high energy bills, and be expensive to heat. An EPC band of C represents a reasonably good level of energy efficiency. The average EPC rating in England and Wales is currently D. Increasing the energy efficiency rating (or EPC) delivers a warmer, healthier, and more comfortable home for the resident, whilst reducing the energy bills.
20. Ecofys op cit section 3.2
21. Ecofys op cit section 4.2
22. ibid
31. Friends of the Earth, The UK, shale gas and unburnable carbon: questions for the UK Government
33. Ibid p182
35. The production rates are based on one US study which only analysed data from so-called ‘sweet spots’ (the most productive areas) and assumed this could be replicated across the UK. It also ignored other geological studies which sampled a larger number of wells and came up with lower production numbers. Different assumptions used could lead to lower estimates of production.
No need to step on the gas

37 Friends of the Earth does not support the logging of trees for bioenergy as this reduces forests’ carbon stores and endangers biodiversity. See the briefing ‘Felled for fuel?: why burning trees should not get UK government subsidies’ http://www.foe.co.uk/sites/default/files/downloads/felled-fuel-46611.pdf
38 Institute for European Environmental Policy (2011) ‘Securing biomass for energy – developing an environmentally responsible industry for the uk now and into the future’ http://www.ieep.eu/assets/856/IEEP_UK_responsible_bioenergy.pdf
40 National Grid (op cit section 4.5.3) comment that “the difference in Norwegian flows between scenarios is not as great as for other imported gas however, reflecting the fact that opportunities for Norwegian gas to find other markets are more limited than for other import supplies”
41 Verco & Cambridge Econometrics for Energy Bill Revolution, op cit
43 Committee on Climate Change 21st October 2013, CCC analysis: low-carbon policies account for only a small part of energy bill increases, http://www.theccc.org.uk/2013/10/21/ccc-analysis-low-carbon-policies-account-for-only-a-small-part-of-energy-bill-increases/
47 Verco & Cambridge Econometrics for Energy Bill Revolution, op cit
50 Mackay & Stone op cit