



## Energy consumption in the UK and the world

Larger populations, industrial developments and more wealth have increased energy demand greatly. Currently, the world relies predominantly on fossil fuels that are not only harmful for our environment but are also limited in supply. The UK mainly uses gas and coal to generate electricity for its citizens, but it has gradually been investing more in renewable energy sources.

In this briefing the characteristics of different sources of energy will be considered. It will be argued that the UK is rightfully investing in renewable energy, and that it is consequently reducing its carbon emissions successfully for now. It cannot reduce its energy consumption indefinitely in this way, however, given population growth expectations.

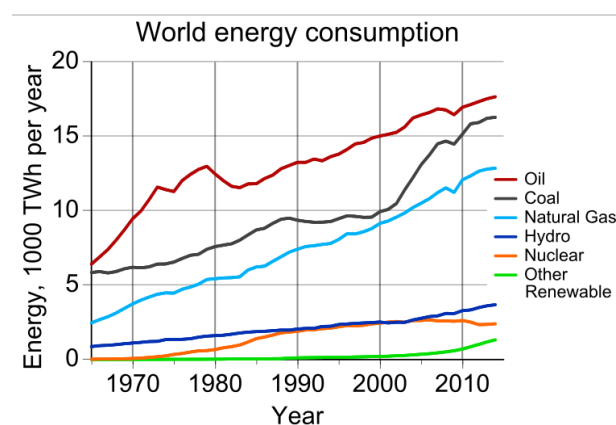
The UK will also be adversely affected by global population growth, because the climate damage this causes transcends borders. Consequently, the government should stimulate the use of renewable energy sources internally while also promoting population growth stabilisation both nationally and internationally.

## Energy consumption

Energy usage is directly linked to prosperity and well-being, as it allows our societies to produce goods and provides humans with domestic comforts. Meeting the growing global demand for energy is a challenge, because, on the one hand, the world faces depleting fossil fuel reserves and environmental degradation, and on the other hand, we also face rapid population growth and increasing demand for energy.

### Global

Energy consumption is usually expressed in terawatt hours (TWh), while it is common to define the amount of energy released by a particular unit of energy in million tonnes of crude oil equivalent (Mtoe).

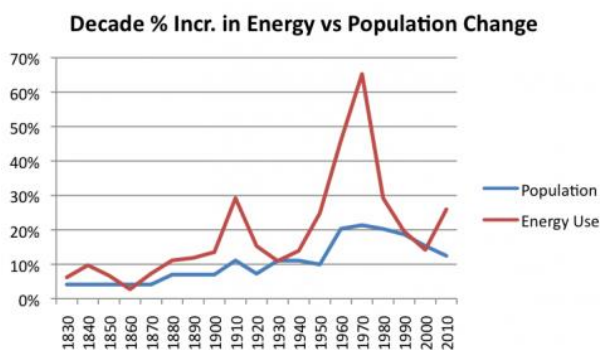


Graph: BP Global

In the past 30 years, global energy consumption has increased dramatically. While the world needed a total of 6,100 Mtoe in 1973, it required 13,541 Mtoe in 2013. The world has predominantly relied on fossil fuels to supply its energy needs.<sup>1</sup>

Alongside the increase in global energy consumption, world population size has grown rapidly from 2.5 billion in the 1950s to 7.4 billion

in 2016.<sup>2,3</sup> This number is predicted to rise to nine billion by 2050, with the majority of the increase expected to be in developing nations.<sup>4</sup>



Graph: *Financial Sense*

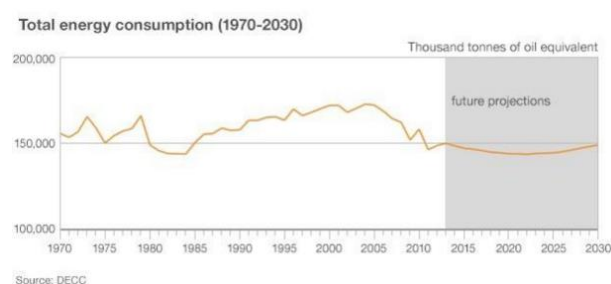
There appears to be a strong causal relationship between population growth and energy consumption. Each new individual uses energy, and the availability of energy has improved living conditions, thereby increasing life-expectancy, which in turn leads to greater energy uses.

While most energy is consumed by developed nations, developing nations are using more energy as their economies grow. More and more countries are industrialising and, with the industrial sector consuming 52 per cent of all global energy, this industrialisation will raise the demand for energy.<sup>5</sup> Mass production of cars in China, for instance, has allowed 58 of every 1000 Chinese citizens to own a car. It is expected that this will increase to 200 – 300 cars per 1000 citizens by 2030. The impact this has on the world's energy reserves is great; China would have to consume up to 18 per cent of all oil produced today to run all these vehicles.<sup>6</sup>

Similarly, it is expected that global electricity demand will rise by more than two-thirds between 2011 and 2035. In 2012, 42 per cent of all energy sources was already used to generate electricity.<sup>7</sup> Increasing electricity demand would thus put a great strain on primary energy sources.

## UK

The UK consumes less energy today than it did in 1970, in spite of its population growing by more than nine million people between then and now.<sup>8</sup> The Department of Energy and Climate Change (DECC) predicts that, while the UK's population could have increased to over 70 million by 2030, the country as a whole will consume the same amount of energy.<sup>9</sup>



Graph: *BBC*

## Use per sector

- The industrial sector has consumed 44 per cent less energy since 1980, due to a shift towards less intensive industries and increased energy efficiency.<sup>10</sup>
- Services used eight per cent less energy in 2011 than they did in 1980, even though the service sector has doubled in size.<sup>11</sup>
- The transport sector has consumed 55 per cent more energy since 1980, mostly due to increased road and air travel.<sup>12</sup>
- In the domestic sector, energy consumption fell by three per cent between 1980 and 2011, while the number of households in the UK has increased by 30 per cent. The decrease is mostly ascribed to energy efficiency improvements and improved insulation.<sup>13,14</sup>

## Sources of energy over time

### Coal

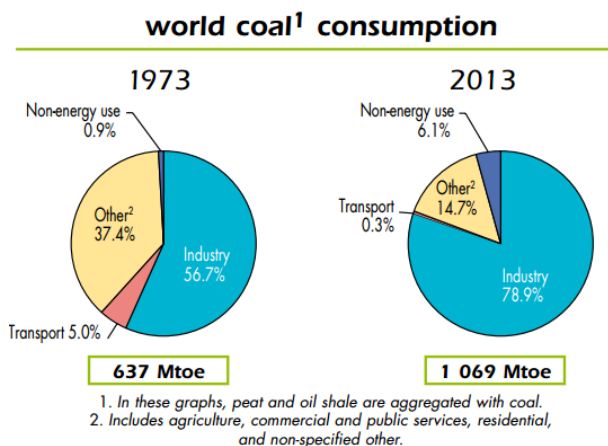


Chart: *International Energy Agency*

The total consumption of coal increased by approximately 167 per cent between 1973 and 2013. While coal consumption grew by 0.4 per cent on average in 2014, production levels fell by 0.7 per cent.<sup>15</sup> Current predictions are that there are sufficient coal reserves for 110 more years of consumption.<sup>16</sup> It has been projected that coal consumption will peak worldwide in 2025, before declining by 10 per cent by 2040.<sup>17</sup>

### UK

Until the late 1960s, the UK's main energy-source of choice was coal: 228 million tonnes were mined in 1952 from surface and deep mines.<sup>18</sup> Before the 1970s, a large proportion of coal was used for the fuelling of trains, cooking and the heating of homes. Currently, around 80 per cent of all coal is used to generate electricity.<sup>19</sup>

Whilst around 80 per cent of the UK's energy came from coal in 1960, this fell to 30 per cent by 2009.<sup>20</sup> The UK also has to import a greater proportion of its coal every year: of the 48.5 million tonnes that were consumed in 2014, 41.8 million were imported, mostly from Russia.<sup>21,22</sup>

### Advantages and disadvantages

Coal is a reliable and relatively affordable energy source. It is an easy source to work with, and produces large amounts of energy upon combustion<sup>23</sup>. In spite of these advantages, it produces large quantities of carbon dioxide (CO<sub>2</sub>), which is damaging to the environment. Mining also causes environmental damage, and it is a dangerous occupation. Moreover, coal is a non-renewable resource that will, in due course, become prohibitively expensive to extract.<sup>24</sup>

### Oil

Global oil consumption increased by approximately 165 per cent in 30 years. In 2014, 840,000 more barrels of oil per day were consumed than in 2013. This increase is related to rapidly-growing emerging economies.<sup>25</sup> By the end of 2014, 1700.1 billion barrels of oil remained, meaning that there is sufficient oil available for another 52.5 years.<sup>26</sup> It is projected that the demand for oil will grow strongly in the future.<sup>27</sup>

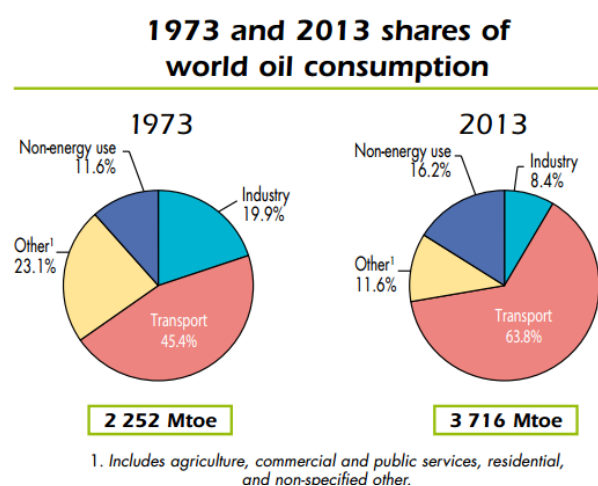


Chart: *International Energy Agency*

## UK

Between 1970 and 2013, the amount of oil that the UK consumed annually fell from 13 million to 780,000 tonnes.<sup>28</sup> This sharp decrease was largely caused by the availability of cheap North Sea gas from the 1990s onwards.<sup>29</sup>

### Advantages and disadvantages

Oil is one of the most abundant primary natural resources. It is easily transportable due to its liquid form, and is currently a relatively inexpensive resource. It also has a high energy density, and is reliable because its function does not depend on weather conditions.<sup>30</sup> Despite these advantages, oil is a finite resource that leads to high carbon emissions. Oil recovery processes are not efficient, and both transport and extraction of oil are damaging to the environment.<sup>31</sup>

## Natural Gas

The global consumption of natural gas more than doubled between 1973 and 2013. In 2014, it grew by 0.4 per cent, which was well below the average of the 2.4 per cent of the previous decade.<sup>32</sup> It is expected that there are enough natural gas reserves for another 54.1 years.<sup>33</sup> Yet, it is projected that the global demand for gas will have almost doubled by 2040.<sup>34</sup>

### 1973 and 2013 shares of world natural gas consumption

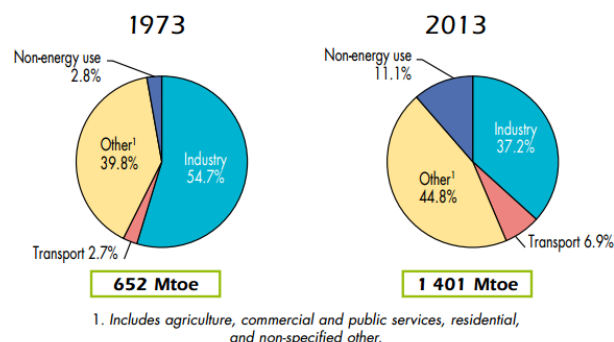


Chart: *International Energy Agency*

## UK

Gas-powered generators produce 30 per cent of the electricity used in the UK.<sup>35</sup> The total demand for gas has been in decline. Between 2013 and 2014, consumption declined by 8.9 per cent.<sup>36</sup> Since 2004, the UK has imported around 45 per cent of its gas supply, mostly from Norway, Belgium and the Netherlands.<sup>37</sup>

### Advantages and disadvantages

Natural gas burns clean compared to oil and coal. It also releases 70 per cent less CO<sub>2</sub>, which is relatively less damaging for the environment when compared to the impact of burning coal or oil. It is inexpensive compared to coal, and has a high heating value — but it is also a finite resource, and technology to recover it efficiently from the earth has not been developed.<sup>38</sup>

## Hydroelectric

Global hydroelectric energy output has grown continuously since the 1990s. In 2014, it grew, on average, by two per cent.<sup>39</sup>

## UK

In 2011 the UK generated 1.5 per cent of its consumed electricity from a hydroelectric scheme.<sup>40</sup> It is unlikely that this technology will develop much in the future, however, as options for large-scale usages are limited due to environmental concerns, and because most economically attractive sites in the UK have already been used.<sup>41</sup>

### *Advantages and disadvantages*

Hydroelectric dams do not consume fossil fuels, and are therefore clean and inexpensive to run. It is, however, costly to build hydroelectric power plants. The creation of such dams also causes damage to the environment and river life, and increases the risk of flooding.<sup>42</sup>



## Nuclear

After a period of decline following the Fukushima disaster, the world's nuclear power production increased by 1.8 per cent in 2014. Growth rates in France, South Korea, China and North America compensated for falling production in Japan, Belgium and the UK.<sup>43</sup>

## UK

Nuclear reactors currently generate 19 per cent of the UK's electricity.<sup>44</sup> All but one of these reactors

are, however, due to be closed by 2023.<sup>45</sup> Building new reactors is considered expensive, and the problem of radioactive waste storage has so far not been overcome.<sup>46</sup> Insurance, and the costs of potential hazards, make further use of nuclear power unattractive for the UK.<sup>47</sup>

### *Advantages and disadvantages*

Nuclear power does not lead to atmospheric emissions. It is a low-cost source of energy for which only low levels of uranium are required.<sup>48,49</sup> This energy source does not depend on weather conditions and, given that the Earth still has huge uranium reserves, it is unlikely that we will run out of nuclear energy any time soon.<sup>50</sup>

Uranium is, however, a naturally unstable element that gives off harmful radiation. After splitting the element, radioactive by-products remain, and storing this waste is a challenge. Moreover, while the safety systems of nuclear reactors are extensive, accidents with nuclear reactors have severe consequences for mankind and the environment, as disasters in Chernobyl and Fukushima have illustrated.<sup>51,52</sup>

## Renewables

All energy that is derived from natural processes that do not consume finite resources is considered renewable. This includes biofuel production and geothermal, wind and solar energy.<sup>53</sup> In 2014, renewable power sources provided six per cent of the world's electricity. This means that renewable energy production almost doubled in five years. Most renewable power — 68 per cent — is generated in the OECD countries.<sup>54</sup>

## UK

Renewable energy powered generators produce 19 per cent of the UK's electricity.<sup>55</sup> For the UK to



reach planned European Union targets, this amount will have to increase to 30 per cent by 2020.<sup>56</sup> Currently, wind energy and bioenergy are most popular, and according to experts, bioenergy shows the greatest potential for the UK.<sup>57,58</sup>

### *Advantages and disadvantages*

Renewable energy is sustainable because it does not depend on finite resources. It is clean energy that results in low carbon emissions. Renewable energy can be reliable when generators are used in a widespread pattern, as it is less likely to be affected by poor weather conditions in all locations. In the long term, sustainable energy is cheap, and its prices should be more stable as they are not dependent on the costs of natural resources.<sup>59</sup>

The major challenge that renewable energy faces is that it is difficult to produce as much energy as fossil fuel generators using renewable energy sources. The development of generators and the improvement of technology is also costly. Moreover, solar panels and windfarms require a lot of land and, at the moment, energy supply is not yet reliable, as it depends heavily on the weather and generators are not yet widespread enough to overcome this problem.<sup>60</sup>

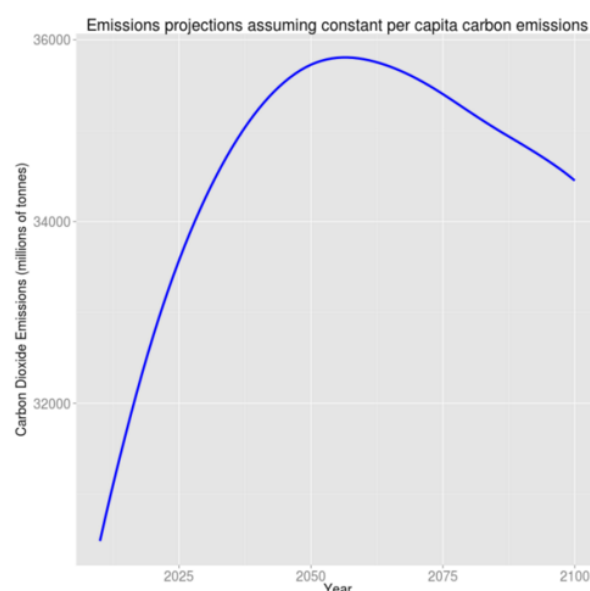


## Implications

Even though it has been forecast that the UK will consume less energy in 2030 than it did in 1970, UK society will still face severe energy-related challenges. The graph shown earlier on page two, in fact, shows a curved future projection line after 2022. This implies that, while the UK is currently successfully reducing its total energy consumption, it is expected that it will fail to do so in the future.

### Climate change

The burning of fossil fuels has a devastating effect on the climate. While Britain has committed to a programme of reducing CO<sub>2</sub> emissions, it will not be able to reduce its production of greenhouse gases indefinitely. Climate change also transcends borders. Global projections are grim. As the world faces strong population growth, especially in developing nations, it is assumed that total CO<sub>2</sub> emissions will continue to increase until at least the 2050s, before falling slightly.<sup>61</sup>



Graph: *the energy collective*

## Scarcity

It is reasonable to expect that the UK will grow to rely more on fossil fuel imports, as import numbers have strongly increased in previous years. This is not only costly, but it also means that the UK will grow increasingly dependent on other states. This problem will worsen as fossil fuels become increasingly scarce.

## Extraction costs

Scarcity of certain fossil fuels may drive people to turn to other fuels that are more costly to extract. These increased extraction costs will be very harmful to businesses, even making some no longer financially viable.

While new technology may allow humans to extract fossil fuels for a longer time, this is only a temporary solution. Moreover, certain extraction methods, such as fracking, are extremely damaging for our environment. They pollute the atmosphere, spoil clean water and could cause earthquakes.<sup>62,63</sup>

## Potential solutions

The world is facing increasing demand for energy. It is critical that this energy is generated in a sustainable fashion.

### Technological developments

Existing energy-consuming facilities could be improved in many ways, including:

- Improving the insulation of dwellings to reduce the need for heating by encouraging the use of double glazing and wall insulation.
- Promoting the use of solar thermal collectors so that the sun is used to heat water for domestic use.<sup>64</sup>

- Improving the efficiency of the internal combustion engine to keep down energy consumption in transport.<sup>65</sup>
- Promoting sustainable consumerism over mass consumerism that is damaging to the environment.<sup>66</sup>
- Exploring cradle-to-cradle technology could, in the long term, sharply decrease the amounts of waste produced by businesses, thereby reducing CO<sub>2</sub> emissions. It promotes the principle of upcycling — creating products of higher environmental value than their material inputs — over recycling processes that focus on downcycling, which leads to quality loss.<sup>67,68,69</sup>
- Investing in technology that would lead to the development of renewable energy sources, rather than techniques to extract even more fossil fuels. This would improve the climate, and is a better investment given that fossil fuels are finite.



### Population stabilisation

Exponential population growth will lead to faster depletion of natural resources.<sup>70</sup> It will cause higher resource demand and lead to scarcity crises. Improved technology could create sustainable supply routes, but it will take some time before these are developed to be as efficient

as existing unsustainable energy sources. It is probable that technologists will choose to develop less sustainable ideas further, as this will in the short term yield greater results. This is, however, never a sustainable solution.

A smaller population would give the world the time to develop renewable sources so that they can generate the same quantities of energy as traditional fossil fuel generators currently do. This would ensure a consistent supply of energy before fossil fuels run out. To enable this, the UK must actively promote policies that aim at population stabilisation. While it must do so internally, it must also do so beyond its borders.

## Conclusion

Increased global energy consumption creates challenges that affect everyone. Currently, the world relies predominantly on fossil fuels that are not only harmful for our environment but also limited in supply. The UK still mostly uses such energy sources, though it is gradually investing more in renewable energy. Despite this investment, the UK is not expected to be able to successfully reduce its CO<sub>2</sub> emissions in the long run, due to increased energy demand as a result of population growth.

The UK will also be adversely affected by global population growth, which will increase global energy demand, causing environmental problems. Climate change transcends borders. To tackle this issue, the government should stimulate the use of renewable energy sources internally while also promoting population growth stabilisation policies both nationally and internationally.

<sup>1</sup> [https://www.iea.org/publications/freepublications/publication/KeyWorld\\_Statistics\\_2015.pdf](https://www.iea.org/publications/freepublications/publication/KeyWorld_Statistics_2015.pdf)

<sup>2</sup> <http://www.populationmatters.org/>

<sup>3</sup> <http://www.prb.org/Publications/Lesson-Plans/HumanPopulation/PopulationGrowth.aspx>

<sup>4</sup> <http://www.prb.org/Publications/Lesson-Plans/HumanPopulation/PopulationGrowth.aspx>

<sup>5</sup> <https://www.education.psu.edu/earth104/node/1346>

<sup>6</sup> <http://www.accessmagazine.org/articles/fall-2012/will-chinas-vehicle-population-grow-even-faster-forecasted/>

<sup>7</sup> <http://www.world-nuclear.org/information-library/current-and-future-generation/world-energy-needs-and-nuclear-power.aspx>

<sup>8</sup> <http://www.worldometers.info/world-population/uk-population/http://www.bbc.co.uk/news/business-24823641>

<sup>9</sup> <http://www.bbc.co.uk/news/business-24823641>

<sup>10</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/65598/6918-energy-efficiency-strategy-statistical-summary.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/65598/6918-energy-efficiency-strategy-statistical-summary.pdf)

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<sup>15</sup> <http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/coal-review-by-energy-type/coal-consumption.html>

<sup>16</sup> <http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/coal-review-by-energy-type/coal-reserves.html>

<sup>17</sup> [http://www.imperialoil.ca/canada-english/about\\_what\\_upstream\\_energy.aspx](http://www.imperialoil.ca/canada-english/about_what_upstream_energy.aspx)

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<sup>21</sup> <http://www.coalimp.org.uk/3.html>

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<sup>23</sup> <http://fossil-fuel.co.uk/coal/advantages-of-coal>



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- <sup>69</sup> <http://intercongreen.com/2010/02/17/recycling-vs-upcycling-what-is-the-difference/>
- <sup>70</sup> <http://serc.carleton.edu/quantskills/methods/quantlit/popgrowth.html>