

Energy Usage in the UK Economy

THE ROAD TO A NET ZERO CARBON FOOTPRINT

Ignite
Economics:
Energy Report
Series

October 2020

PREPARED FOR:



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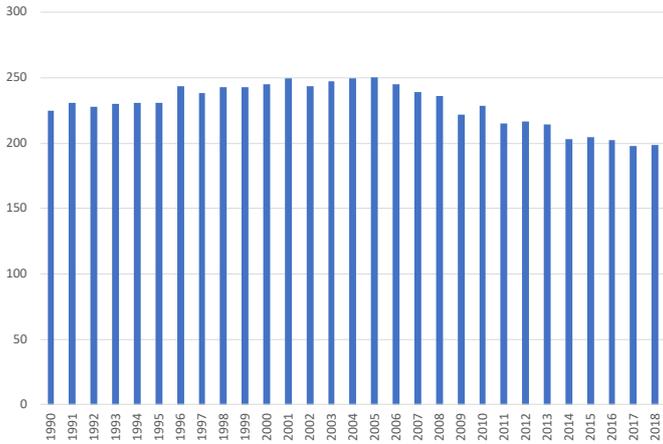
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Energy Usage in the UK Economy: The Road to a Net Zero Carbon Footprint

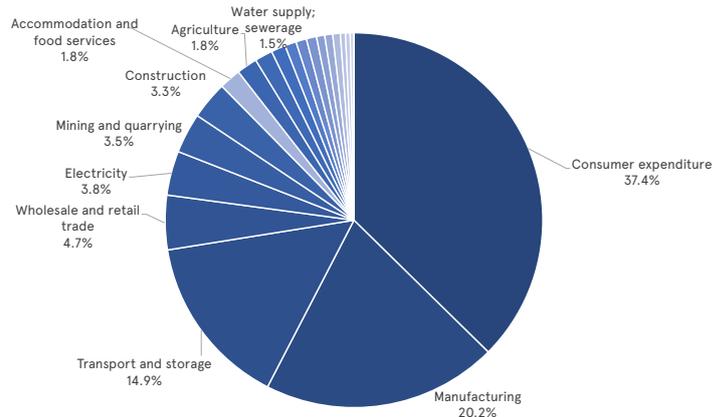
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Fig A: The UK Economy has seen a sustained decline in energy usage over the past few years – Million tonnes of oil equivalent (Mtoe) 1990-2018....



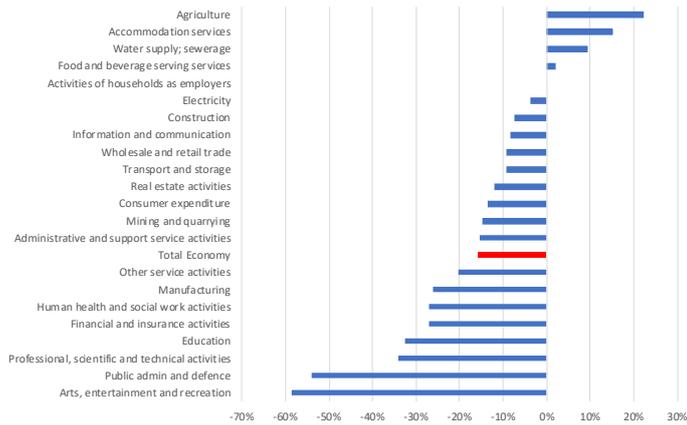
Source: ONS data, Ignite Economics analysis

Fig B: ... consumers use the most energy in the UK, followed by manufacturing and transport, accounting for over 72% of total energy usage – Reallocated Energy Usage by Industry (Mtoe) – 2018...



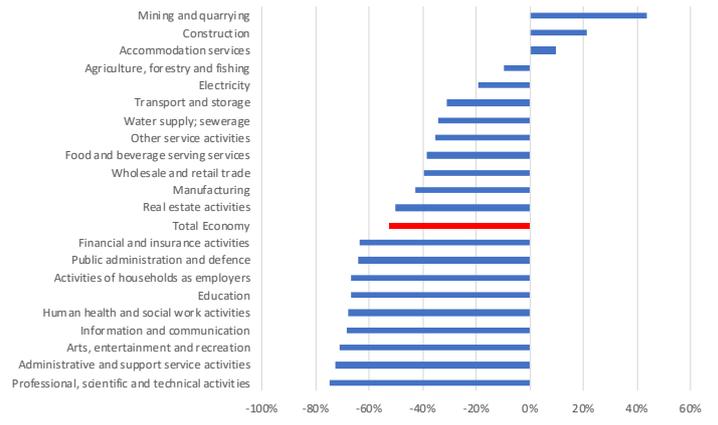
Source: ONS data, Ignite Economics analysis

Fig C: Since 1990, the accommodation sector has increased its energy usage more than any other sector (+79%). Over the past decade only 4 industries have increased their energy consumption – Change in Energy Usage by Industry (Mtoe) 2018 vs 2008...



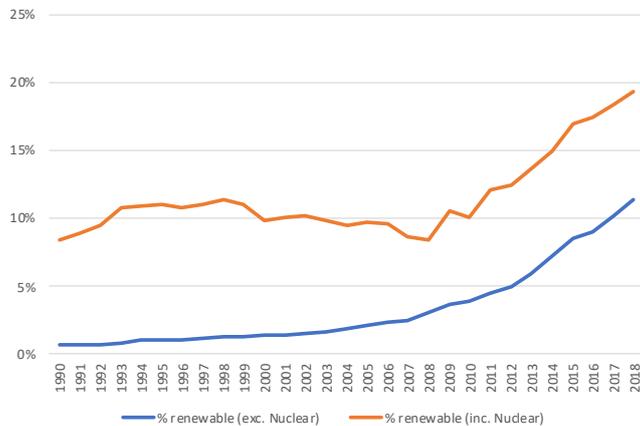
Source: ONS data, Ignite Economics analysis

Fig D: ... However a fairer comparison is the change in energy intensity, which takes into account growth of different industries. Only 3 industries have seen an increase in energy intensity - Change in Energy Intensity 2018 vs 1990 – Terajoules per million pounds (TJ/£ million)...



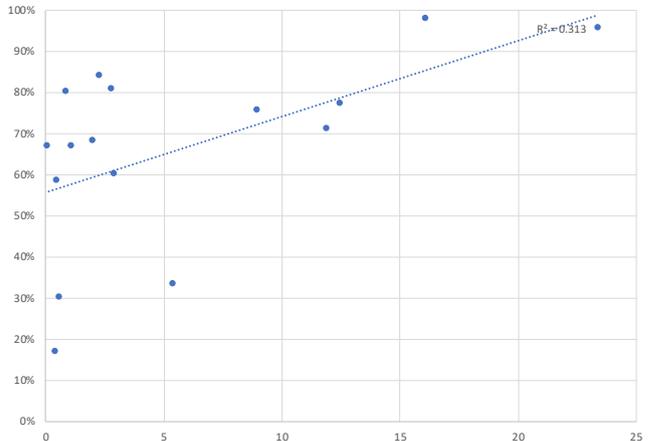
Source: ONS data, Ignite Economics analysis

Fig E: The proportion of non-fossil fuel energy (i.e. renewable plus nuclear), has been trending up since 1990, but the vast majority of the gains have been achieved in the past decade - % of Renewable Energy Consumption, excluding and including Nuclear (Mtoe)



Source: ONS data, Ignite Economics analysis

Fig F: There is a weak correlation between fossil fuel percentage and energy intensity i.e. the more energy intensive the industry, the higher the proportion of fossil fuel energy usage – % Fossil Fuel Usage (Y-axis) vs Energy Intensity TJ/£ million (X-axis) - 2018



Source: ONS data, Ignite Economics analysis

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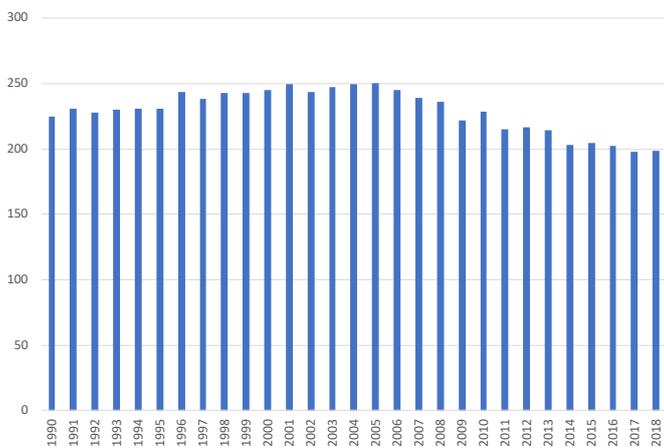
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Executive summary

Total Energy Usage

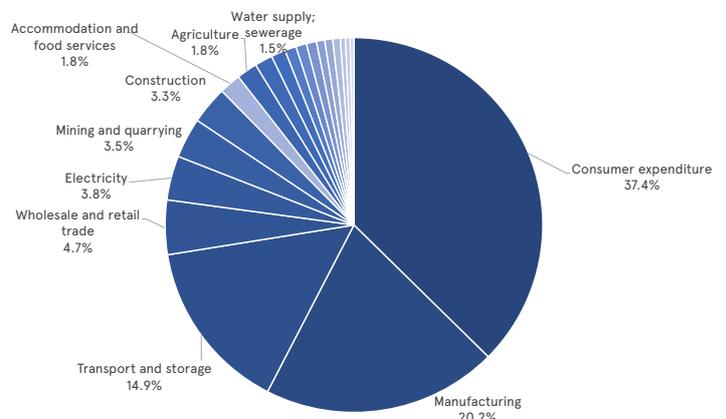
- In 2018, the total energy used in the UK economy was 199 million tonnes of oil equivalent (Mtoe). There has been a material decline in energy usage since the start of the ONS data time series in 1990 (-11%), and particularly over the past 10 years (-16%).
- When transformation and supply losses are reallocated to each industry group, consumers use the most energy in the UK, followed by manufacturing and transport. Between them, these 3 groups account for over 72% of total energy usage.

Fig A: Total UK Economy Energy Usage – Million tonnes of oil equivalent (Mtoe) 1990-2018



Source: ONS data, Ignite Economics analysis

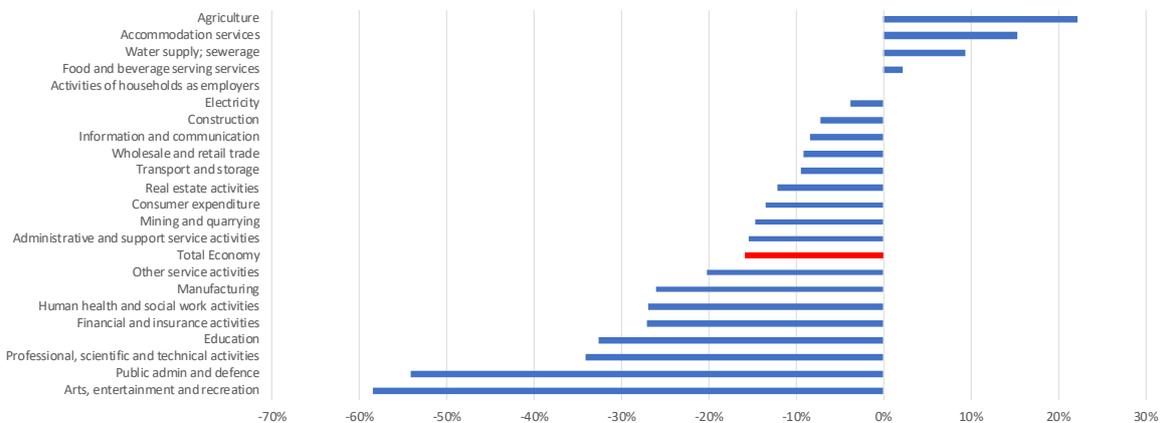
Fig B: Reallocated Energy Usage by Industry (Mtoe) - 2018



Source: ONS data, Ignite Economics analysis

- Since 1990, the accommodation sector has increased its energy usage more than any other sector, with energy consumption increasing by 79%. More recently, over the past decade only 4 industries have increased their energy consumption, while manufacturing is one of the sectors that have seen a greater than 25% fall in energy usage.

Figure C: Percentage Change in Total Use of Energy (Mtoe) – 2018 vs 2008



Source: ONS data, Ignite Economics

- However, over this period certain industries such as accommodation services have significantly expanded, and others such as manufacturing have declined. Therefore, we believe that changes in energy intensity is a fairer comparison of sectors.

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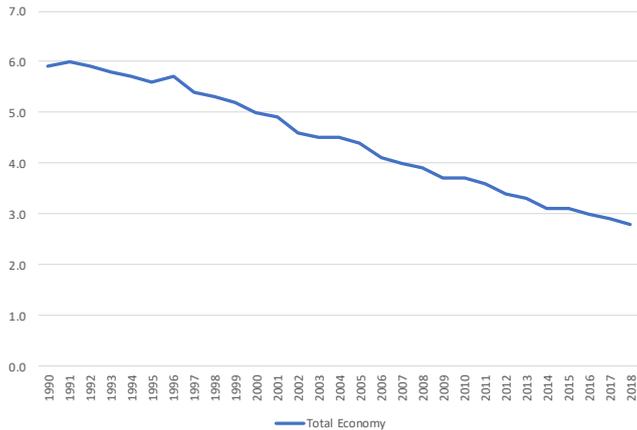
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Energy Intensity

Energy intensity measures the terajoules of energy used to generate each million pounds of GVA (economic contribution to the economy), and we view this as a fairer measure of performance:

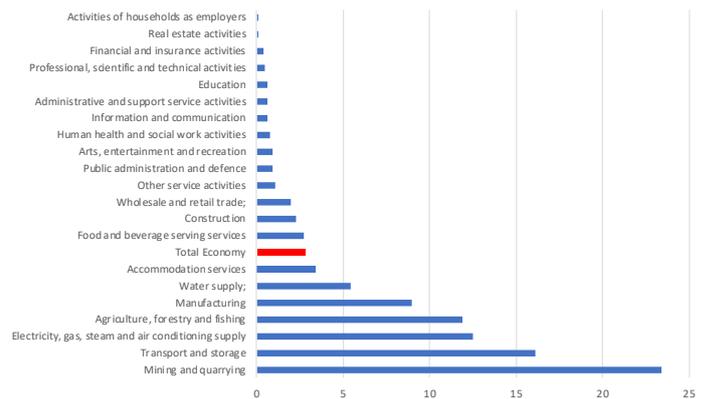
- The UK has seen a 53% decline in energy intensity since 1990 (GVA at constant prices 2016)
- There is a very wide variation in energy intensity across industry sectors, and the overall UK economy has benefitted from low energy intensive industries (e.g. services) growing faster than more energy intensive industries (e.g. manufacturing)

Fig D: UK Economy Energy Intensity– Terajoules per million pounds (TJ/£ million)



Source: ONS data, Ignite Economics analysis

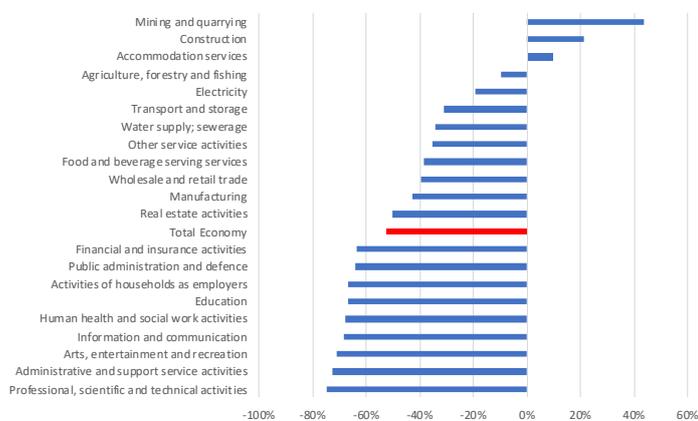
Fig E: Energy Intensity 2018 – Terajoules per million pounds (TJ/£ million)



Source: ONS data, Ignite Economics analysis

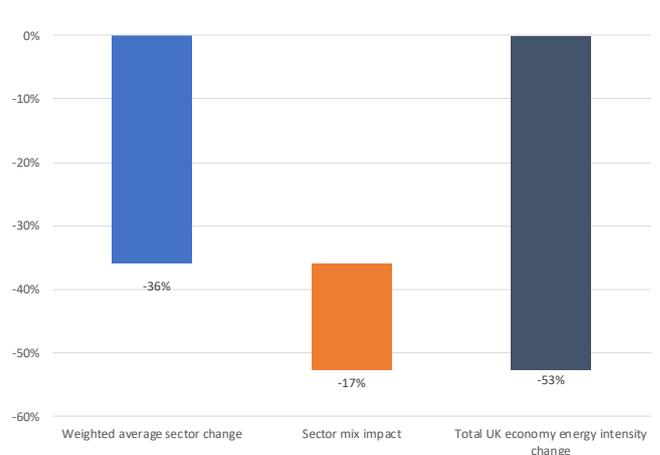
- However, the majority of industries have also improved their own energy intensity. When looking since 1990, there are only 3 industry groups to have a worsening energy intensity – that is to say, use more energy to generate the same amount of gross value add to the economy – Mining, Construction and the Accommodation sector.
- When weighting the individual industry change in energy intensity, we found that 68% of the overall UK economy improvement in energy intensity was as a result of improvements by individual industries, and 32% was due to the mix effect of low energy intensive industries growing faster than high energy intensive industries.

Fig F: Change in Energy Intensity 2018 vs 1990 – Terajoules per million pounds (TJ/£ million)



Source: ONS data, Ignite Economics analysis

Fig G: Contributors to Change in Energy Intensity 2018 vs 1990



Source: ONS data, Ignite Economics analysis

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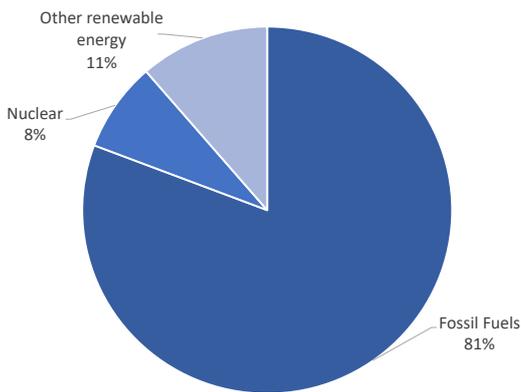
Proportion of energy from fossil fuels

Renewable energy growth has driven the decline in fossil fuels...

Over the past 28 years, the proportion of energy derived from nuclear fuel (including net imports) has remained unchanged at c.8% of total energy. The decline in the proportion of energy being generated by fossil fuels has been driven by the significant increase in renewable energy:

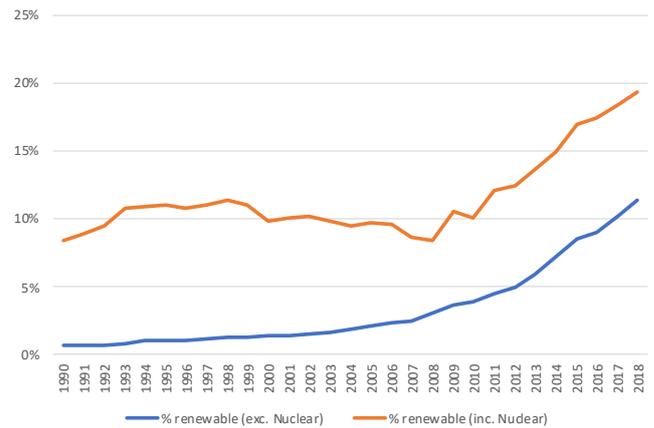
- In 2018, 81% of energy usage in the UK was generated from fossil fuels, down from 92% in 1990.
- If we look at the proportion of renewable energy, and the proportion of non-fossil fuel energy (i.e. renewable plus nuclear), while it has been trending up since 1990, the vast majority of the gains have been achieved in the past decade

Fig H: UK Economy Split of Energy Usage 2018



Source: ONS data, Ignite Economics analysis

Fig I: % of Renewable Energy Consumption, excluding and including Nuclear – Millions of Tonnes of Oil Equivalent (Mtoe)

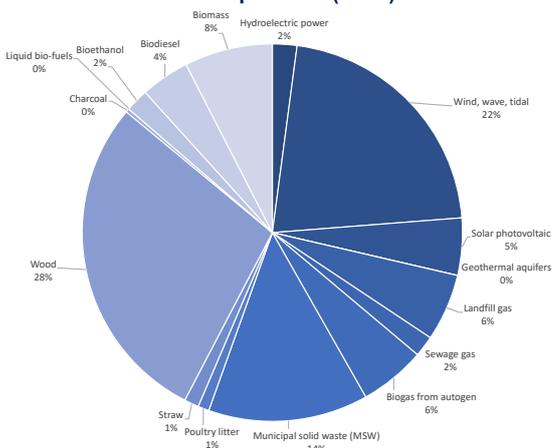


Source: ONS data, Ignite Economics analysis

... weak correlation between energy intensity and fossil fuel usage...

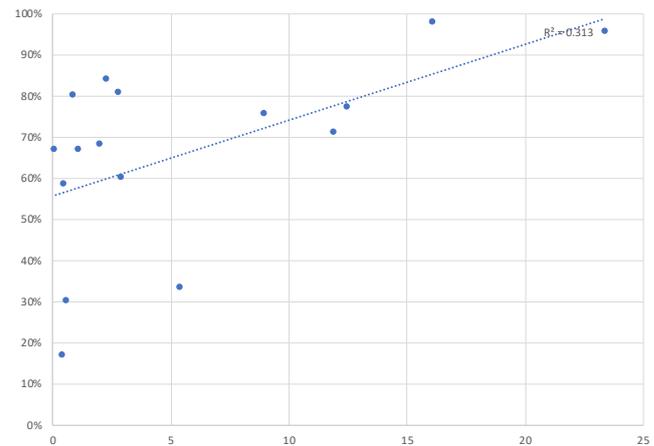
- Below we show the split of renewable energy in the UK, where 50% of renewable energy is generated from wind / wave / tidal and wood.
- We also plot the proportion of fossil fuel usage for each industry against the energy intensity. An R squared value of 0.313 shows a weak correlation between fossil fuel percentage and energy intensity – that is to say, the more energy intensive the industry, the higher the proportion of fossil fuel energy usage.

Fig J: Split of Renewable UK Energy Usage - Millions of Tonnes of Oil Equivalent (Mtoe) - 2018



Source: ONS data, Ignite Economics analysis

Fig K: % Fossil Fuel Usage (Y-axis) vs Energy Intensity TJ/£ million (X-axis) - 2018



Source: ONS data, Ignite Economics analysis

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Introduction

Background to the report

Independent report commissioned by the Energy & Environment Alliance...

This is an independent report by Ignite Economics, a specialist economic analysis firm focusing on the hospitality and leisure industries, commissioned by the Energy & Environment Alliance (EEA).

The EEA is a new member organisation established to help hotels and other hospitality businesses tackle the challenge of climate change and become a leading industry in the move to a world of clean, sustainable energy.

... to analyse the change in energy usage of the total economy...

This report provides an up-to-date assessment of the energy usage of the UK economy, and the performance of different sectors within this.

As well as examining the change in overall energy usage, we analyse the split between fossil fuel energy usage and renewable energy, as well as the change in energy intensity of different sectors.

Report methodology

UK Government data from the Office of National Statistics...

The report uses Government data taken from the Office of National Statistics, which has varying levels of granularity. When analysing energy usage and energy intensity, we look at the data according to the 2007 Standard Industrial Classification (SIC) on an industry level. However, in some areas of the report, we also separate out individual data for the 'Accommodation Services' segment (SIC group 55).

Any data that focuses on the overall energy usage or energy intensity is based upon the reallocated split of energy whereby any energy losses from the transformation and supply of energy are reallocated from energy producers to the end consumers. By contrast, any split between the differing types of energy (fossil fuels vs renewables) is analysed using data on direct energy use (i.e. before any energy losses are reallocated). This has been labelled throughout the report.

Finally, given the delay in the ONS reporting energy usage data, the most recent year's data is 2018, with the datasets starting in 1990.

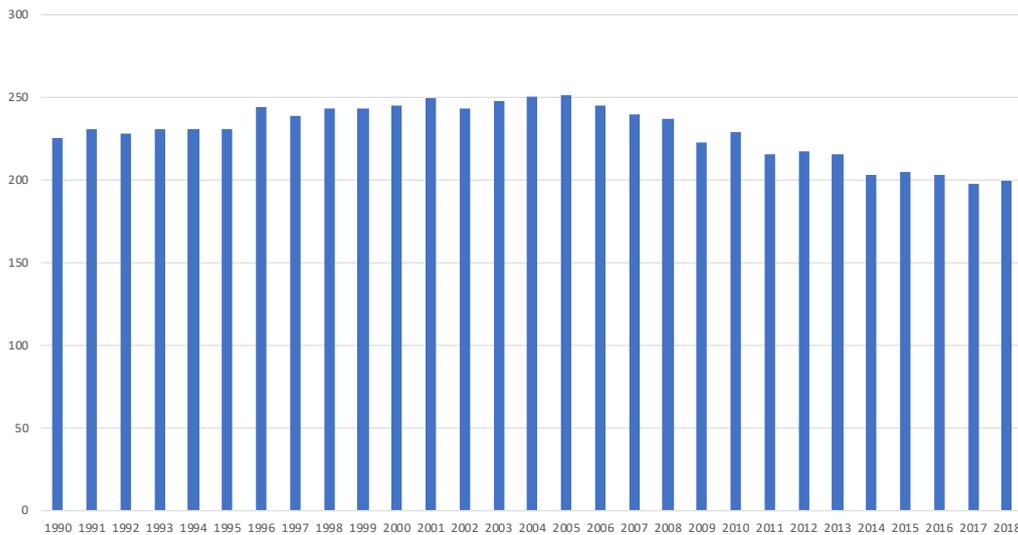
Overall Energy Usage

UK Economy Energy Usage

The UK economy has seen a sustained reduction in energy usage over the past few years...

The UK economy overall has seen a sustained reduction in energy usage over the past few years, having been steadily climbing in the 1990s. In 2018, the UK economy consumed 199 million tonnes of oil equivalent (Mtoe), compared to 225 Mtoe in 1990, and a peak of 251 Mtoe in 2005.

Figure 1: Total UK Energy Consumption - Millions of Tonnes of Oil Equivalent (Mtoe)

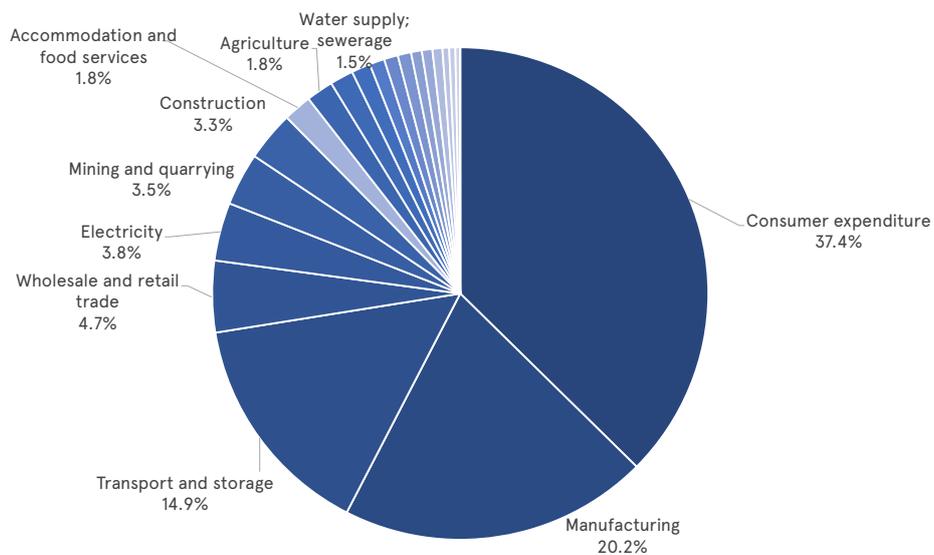


Source: ONS data, Ignite Economics

... consumers, manufacturing and transport are the largest consumers of energy...

When transformation and supply losses are reallocated to each industry group, consumers are the largest consumers of energy in the UK, followed by manufacturing and transport.

Figure 2: Split of Total UK Energy Consumption by Industry – Reallocated Energy



Source: ONS data, Ignite Economics
(All industry segment labels below 1.5% removed from chart)

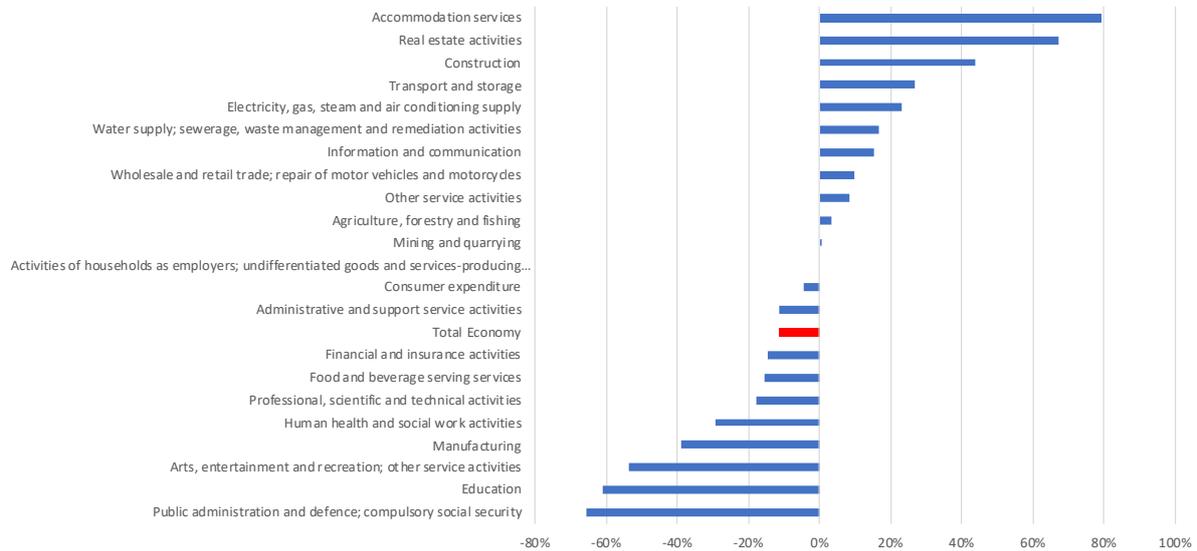
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... accommodation has seen the largest increase in energy usage since 1990...

When comparing the different industry segments, the accommodation sector has seen the largest increase in energy usage since 1990, increasing its energy usage by 79%, compared to the overall economy that has seen an 11% decline in energy usage over the same period. Manufacturing, which is the largest consumer of energy, has seen a 39% fall in energy usage since 1990.

Figure 3: Percentage Change in Total Use of Energy (Mtoe) – 2018 vs 1990

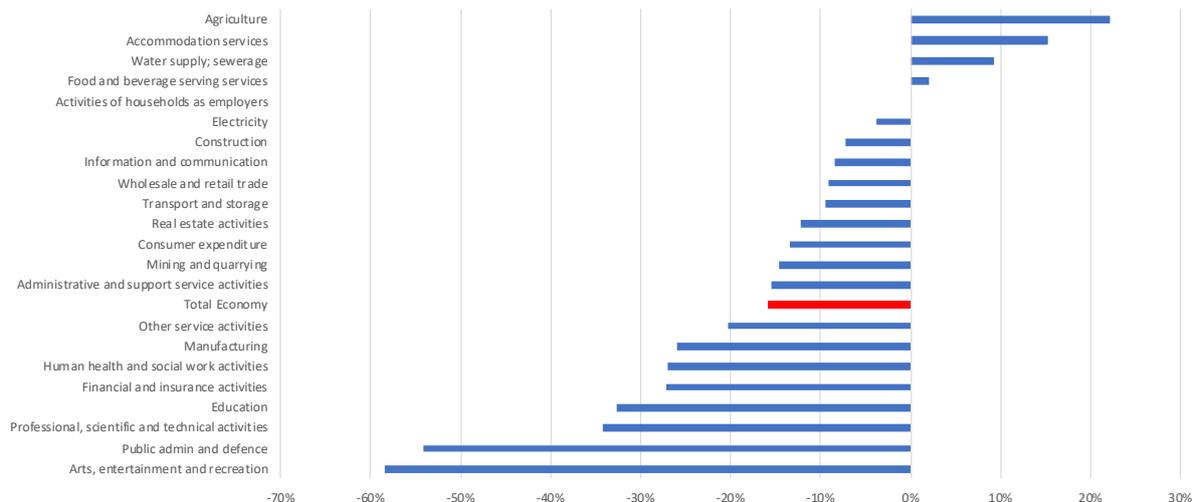


Source: ONS data, Ignite Economics

... only 4 industries have not reduced their energy usage in the past 10 years ...

When looking at the more recent performance, there are only four industries to have increased their energy usage over the past decade.

Figure 4: Percentage Change in Total Use of Energy (Mtoe) – 2018 vs 2008



Source: ONS data, Ignite Economics

However, this data only looks at total energy usage, and does not take into account the relative growth or decline in the size of each industry over each period, which will have a significant impact on energy use. Therefore, the change in energy intensity is a fairer measure of the performance of each industry segment in terms of improvements to energy usage.

Energy Intensity

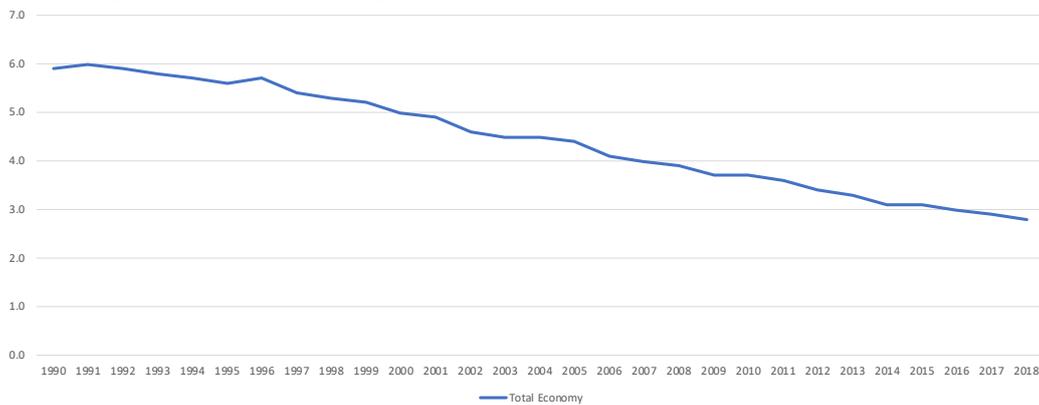
The energy usage of each industry is a function of both the size and the energy efficiency of the industry. As an industry increases in size, then all else being equal, the energy use will increase, and therefore looking at energy usage in isolation can be misleading.

In order to better capture the energy efficiency of each industry, the ONS produce data on the energy intensity, which is calculated by dividing reallocated energy consumption by Gross Value Added (GVA) in constant prices. Gross value add is the economic benefit generated by each industry to the overall economy, or the difference between the value of goods and services produced (output) and the cost of raw materials and other inputs which are used up in production (intermediate consumption). All energy intensity numbers exclude consumer expenditure.

Energy intensity of the UK has been steadily declining...

We have already noted that the overall energy usage of the UK economy has fallen by c.11% since 1990, but over this period of time, the overall economy has seen significant growth. Therefore, there has been an even greater decline in energy intensity, which has declined by just over 50% since 1990. We note that GVA data are in constant prices with 2016 defined as the base year.

Figure 5: UK Economy Energy Intensity – Terajoules per million pounds (TJ/£ million)

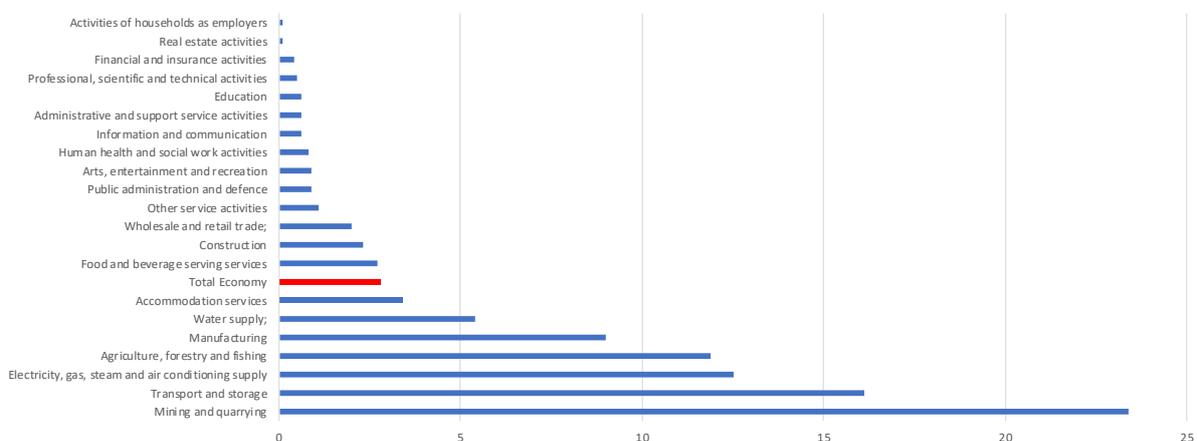


Source: ONS data, Ignite Economics

... there is a significant variation in energy intensity across industries ...

There is a very wide variation in energy intensity across different industry sectors, much as there is a significant variation in intensity of many other inputs – for example, the hospitality industry is very labour intensive, whereas the transport or mining industries are very energy intensive.

Figure 6: Energy Intensity – Terajoules per million pounds (TJ/£ million) - 2018



Source: ONS data, Ignite Economics

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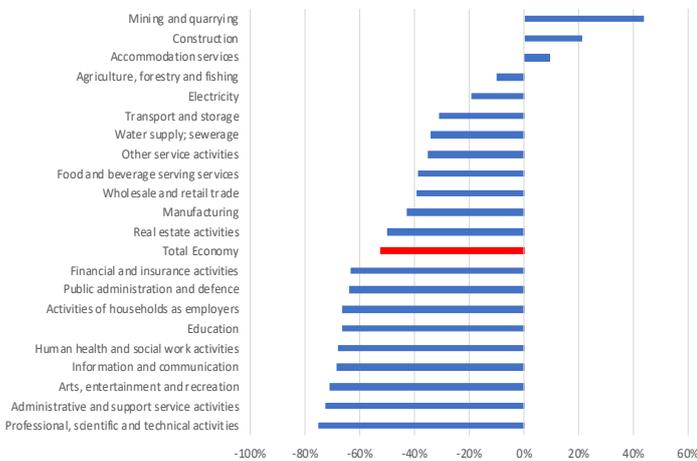
... and a 'mix effect' can impact the performance of the overall economy ...

The overall energy intensity of the UK can improve or decline due to the relative growth of different industries within the economy – for example, the overall energy intensity of the UK will improve if services grow faster than manufacturing, even if neither of these individual industries improve their own energy intensity.

Therefore, to fairly judge the UK's performance, we analyse the main industry groups since 1990, and over the past decade. We note that GVA data are in constant prices with 2016 defined as the base year.

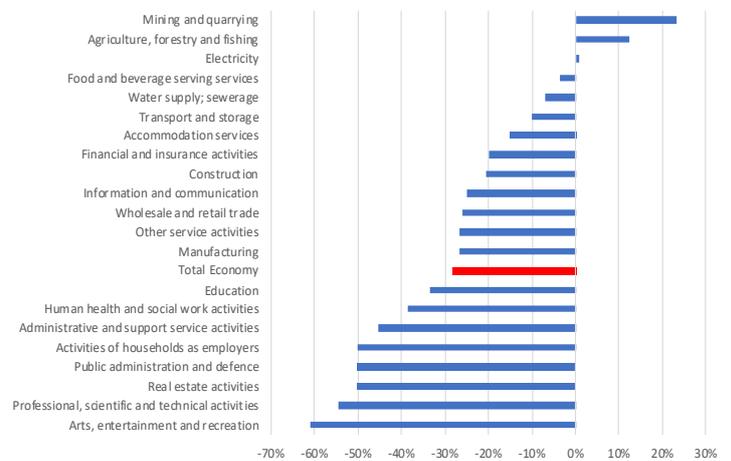
- When looking since 1990, there are only 3 industry groups to have a worsening energy intensity – that is to say, use more energy to generate the same amount of gross value add to the economy
- If we look at the past 10 years, the vast majority of industries have also continued to improve their energy intensity.

Fig 7: Change in Energy Intensity 2018 vs 1990 – Terajoules per million pounds (TJ/£ million)



Source: ONS data, Ignite Economics analysis

Fig 8: Change in Energy Intensity 2018 vs 2008 – Terajoules per million pounds (TJ/£ million)

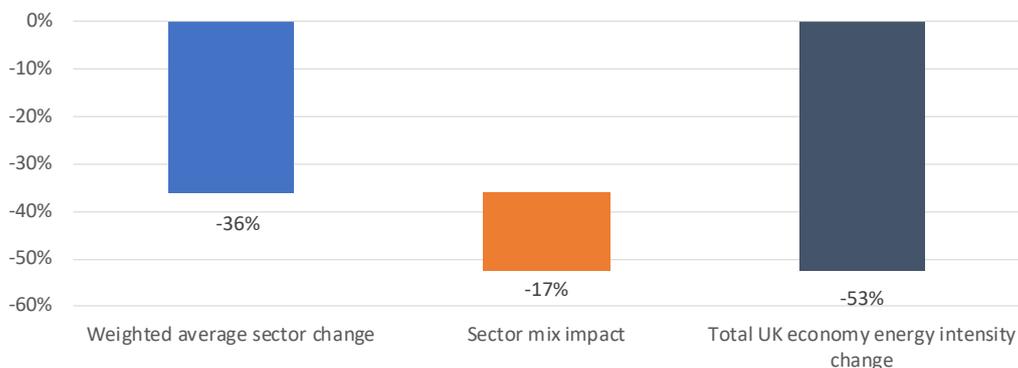


Source: ONS data, Ignite Economics analysis

... but the decline in energy intensity of individual industries has been the key driver...

- The sustained improvement in energy intensity of individual industries is evidence that the improvement of the overall UK energy intensity is not just the mix effect of lower intensity industries growing more quickly.
- If we weight the change in energy intensity to the industry size, we calculate that 68% of the improvement in UK energy intensity is from individual industry improvements, and the remaining 32% is from the mix effect of less intensive industries growing quicker.

Figure 9: Contributors to Change in Energy Intensity 2018 vs 1990



Source: ONS data, Ignite Economics

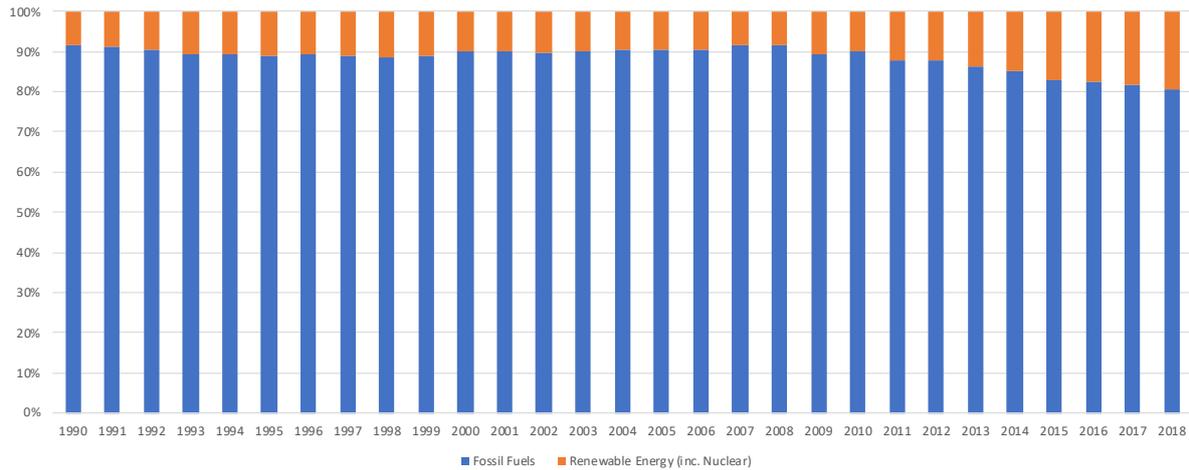
Split of renewable vs fossil fuel

Overall UK Economy

The UK economy has reduced the proportion of fossil fuel usage to 81% of total energy ...

As well as reducing the overall energy usage over time, the UK's total energy consumption generated by fossil fuel has declined from 92% in 1990 to 81% in 2018.

Figure 10: Split of Total UK Energy Consumption - Millions of Tonnes of Oil Equivalent (Mtoe)

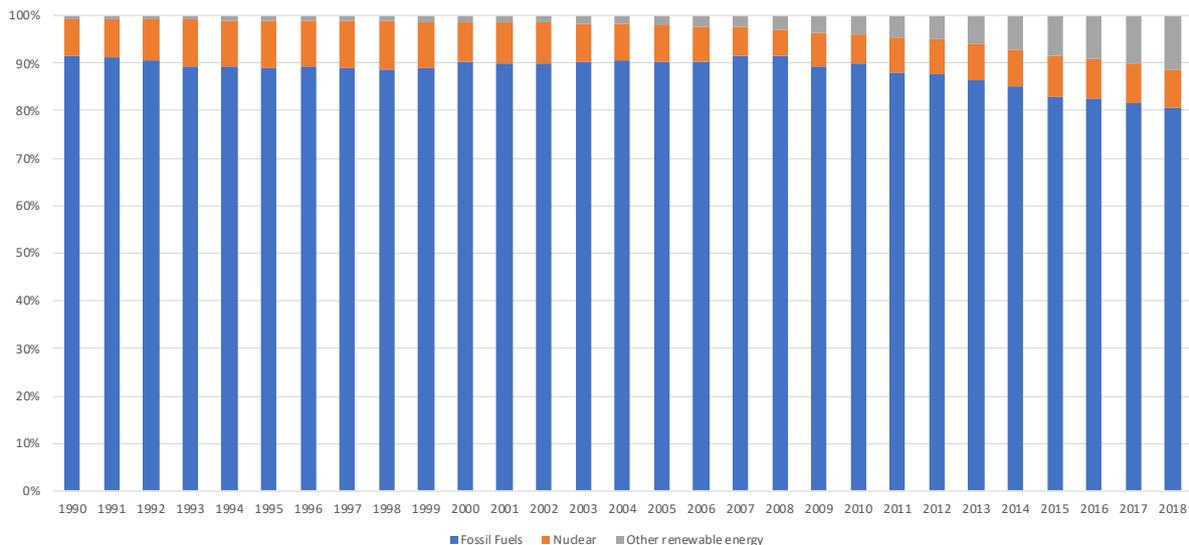


Source: ONS data, Ignite Economics

... 11% of energy generated by renewable fuel, 8% by nuclear fuel...

Out of the 19% of energy usage that is generated by non-fossil fuels, 11.4% of this is generated by renewable energy, and 8% is generated by nuclear energy*.

Figure 11: Split of Total UK Energy Consumption - Millions of Tonnes of Oil Equivalent (Mtoe)



Source: ONS data, Ignite Economics

*Net imports - which equates to less than 1% of energy usage - included in nuclear energy

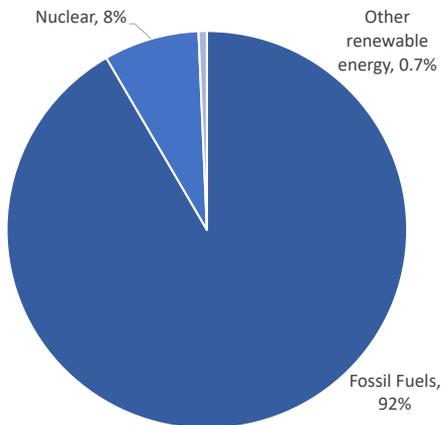
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... renewable energy growth has driven the decline in fossil fuels...

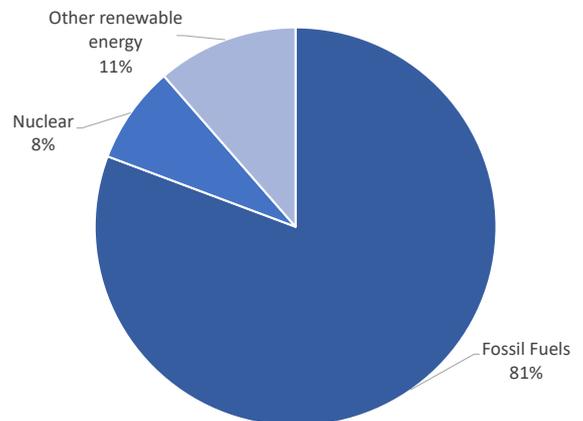
Over the past 28 years, the proportion of energy derived from nuclear fuel (including net imports) has remained unchanged at c.8% of total energy. The decline in the proportion of energy being generated by fossil fuels has been driven by the significant increase in renewable energy.

Fig 12: UK Economy Split of Energy Usage 1990



Source: ONS data, Ignite Economics analysis

Fig 13: UK Economy Split of Energy Usage 2018

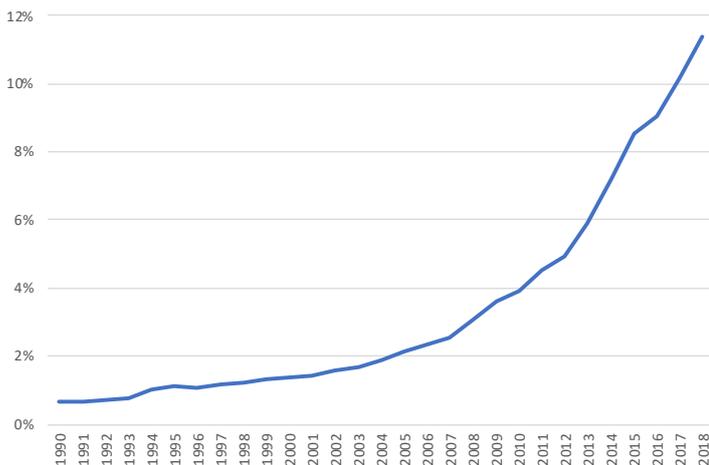


Source: ONS data, Ignite Economics analysis

... with significant gains made in the past 10 years

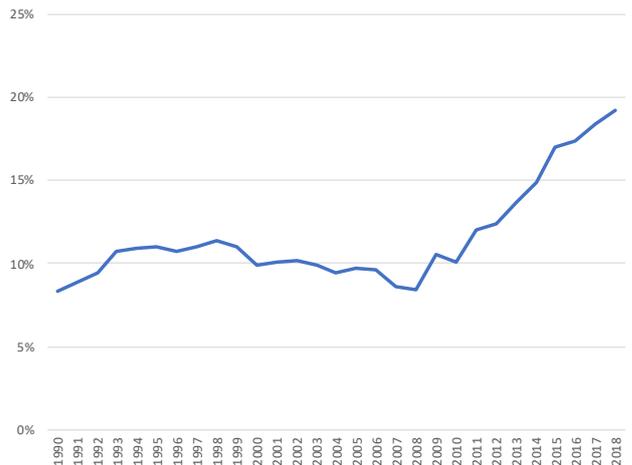
If we look at the proportion of renewable energy, and the proportion of non-fossil fuel energy (i.e. renewable plus nuclear), while it has been trending up since 1990, the vast majority of the gains have been achieved in the past decade

Fig 14: % of Renewable Energy Consumption – Millions of Tonnes of Oil Equivalent (Mtoe)



Source: ONS data, Ignite Economics analysis

Fig 15: % of Renewable Energy Consumption, including Nuclear – Millions of Tonnes of Oil Equivalent (Mtoe)



Source: ONS data, Ignite Economics analysis

Change in Actual Energy Usage by Source

Nuclear and Fossil Fuel Energy Usage in Decline...

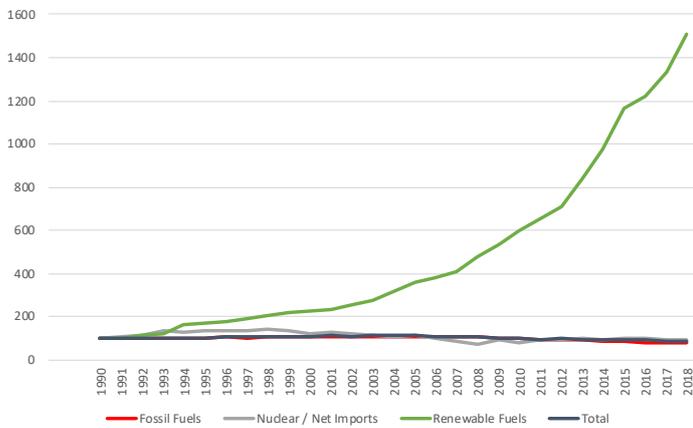
While nuclear energy has remained at c.7% of total energy usage in the UK economy since 1990 (c.8% including net imports), given the reduction in overall energy consumption over this period of time, the total energy usage from nuclear has declined. While the proportion of energy from fossil fuels has declined, the actual energy from fossil fuels has declined even faster.

Since 1990:

- Energy from fossil fuels has declined by 22%
- Energy from nuclear has declined by 14% (or by 9% including net imports)
- Energy from renewable sources has increased 14 fold (1,407%)

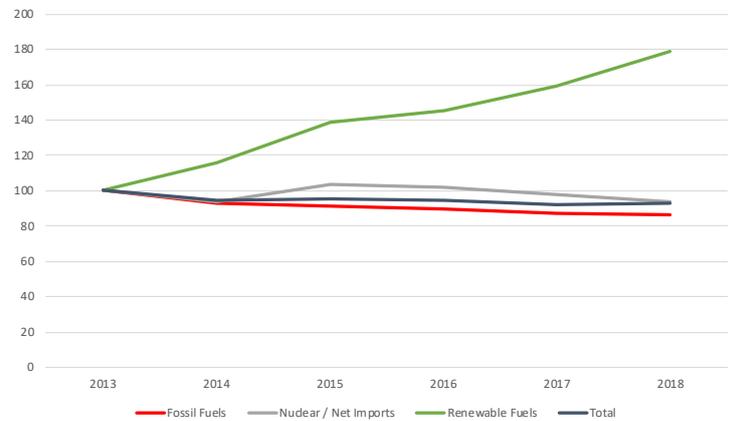
Below we show the relative growth by indexing each of these energy sources back to 1990, and also over the past five years to show the more recent growth.

Fig 16: Actual Energy Usage by Source (Mtoe) – Indexed to 100 in 1990



Source: ONS data, Ignite Economics analysis

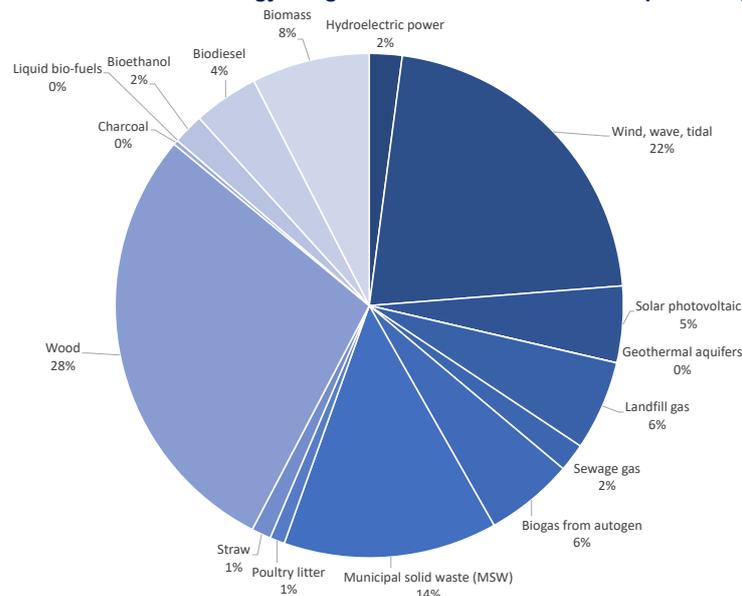
Fig 17: Actual Energy Usage by Source (Mtoe) – Indexed to 100 in 2013



Source: ONS data, Ignite Economics analysis

Below we show the split of renewable energy in the UK, where 50% of renewable energy is generated from wind / wave / tidal and wood.

Figure 18: Split of Renewable UK Energy Usage - Millions of Tonnes of Oil Equivalent (Mtoe) - 2018



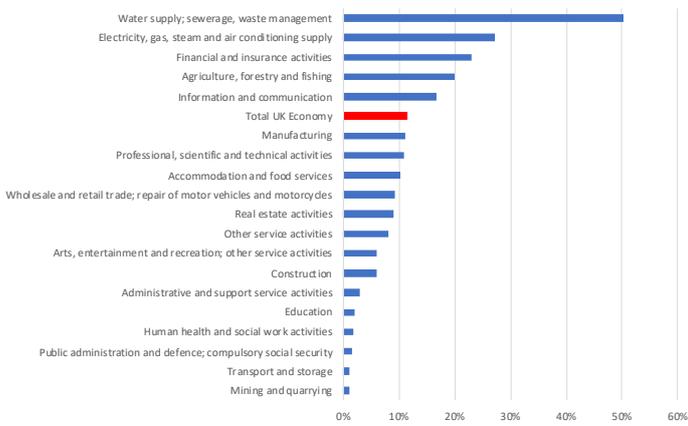
Source: ONS data, Ignite Economics

Split of Energy Usage by Industry

Water supply / waste management uses the most renewable energy...

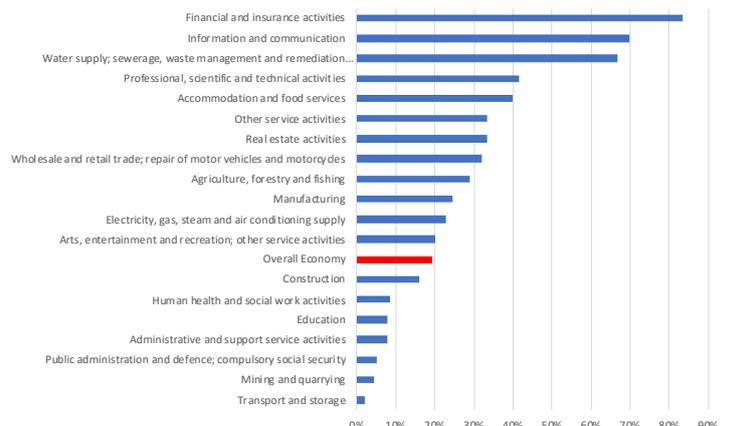
- When we break down the proportion of renewable energy consumed by each industry, it is perhaps unsurprising that the water supply / waste management industry has by far the highest proportion of renewable energy consumption, given the different forms of renewable energy.
- By contrast, mining and quarrying use almost entirely fossil fuels, given they are more readily available.
- When you include nuclear energy, services industries such as financial and insurance activities, and information and communication, come out top in terms of the proportion of energy generated from non-fossil fuel sources.

Fig 19: % of Renewable Energy Consumption by Industry – Millions of Tonnes of Oil Equivalent (Mtoe) - 2018



Source: ONS data, Ignite Economics analysis

Fig 20: % of Renewable Energy Consumption, including Nuclear, by Industry – Millions of Tonnes of Oil Equivalent (Mtoe) - 2018

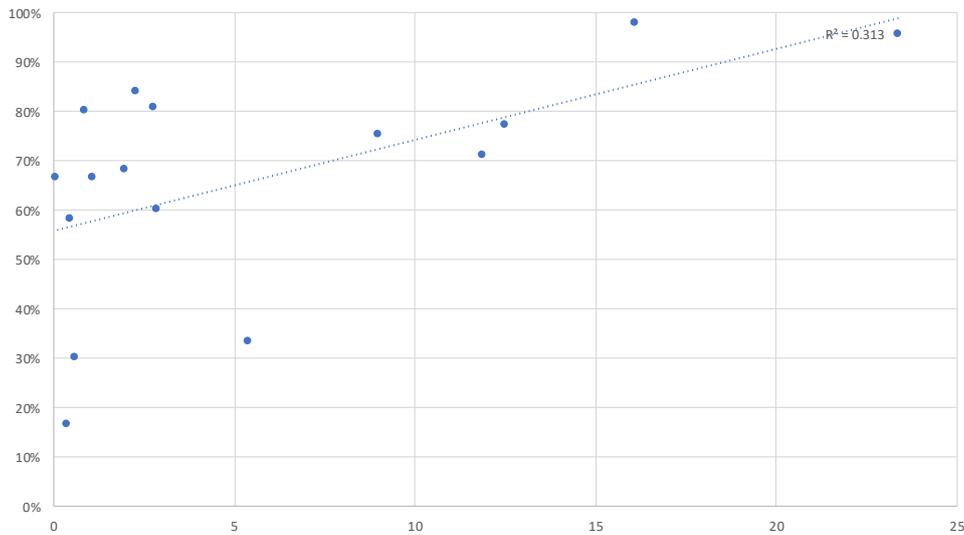


Source: ONS data, Ignite Economics analysis

... weak correlation between energy intensity and fossil fuel usage...

We also plot the proportion of fossil fuel usage for each industry against the energy intensity. An R squared value of 0.313 shows a weak correlation between fossil fuel percentage and energy intensity – that is to say, the more energy intensive the industry, the higher the proportion of fossil fuel energy usage.

Figure 21: % Fossil Fuel Usage (Y-axis) vs Energy Intensity TJ/£ million (X-axis) - 2018



Source: ONS data, Ignite Economics