ANALYSIS

# Future Energy Security

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# Executive summary

The UK's energy mix is currently dominated by oil and gas, and the decline in North Sea oil and gas production since the turn of the century has caused imports to rise. In 2024, around 66% (two-thirds) of the end-use energy used by consumers requires imported energy. This includes imported gas and oil-based fuels that are used directly, plus the share of electricity that is produced from imported fuels such as gas and biomass.

The North Sea Transition Authority projects that UK gas production will fall by 55% by 2030, and oil production by 40%, even if new licences were approved and led to new production. The decline could be steeper, given that new licences are no guarantee of obtaining the projected volumes.

Without a reduction in demand for oil and gas, the amount of UK end-use energy consumption that relies on imported fuels will rise to 82% even with new licences for oil and gas production, which is 1.25x the current level. That is, by this measure, the UK's energy security will be a quarter worse than today.

Policies to reduce oil and gas demand, such as the deployment of renewables and the switch to electric vehicles (EVs) and heat pumps, will serve to slow the rise in energy import dependence. Under the current trajectory for demand, alongside new licences, 72% of our end-use energy consumption in 2030 would be reliant on imports, which is 1.1x the current level. That is, by this measure, the UK's energy security will be a worse by a tenth compared to today.

Under faster net zero deployment, reducing oil and gas demand, this value could be 68% in 2030, even without new licences for oil and gas production, which is only marginally higher than the current level. That is, demand reduction for oil and gas has the potential to slow or even halt the rise of import dependence this decade, without new licences.

These faster trends are not an upper limit. The quicker that oil and gas demand are reduced by renewables and electrification, the slower the rise of energy import dependence and the sooner the UK will improve its energy security beyond today's level.

# Introduction

The UK in recent years used around 2,000TWh of energy per year, dominated by fossil fuels: over 750TWh of oil-based fuels, and around 800TWh of gas, with the rest predominantly biomass and nuclear fuel.

Most of the oil-based fuels are used directly by customers, e.g. in transport and heating. And two-thirds of the gas is used directly by customers e.g. in industry and heating. About a third of the gas is used to generate electricity, along with other fuels such as biomass and nuclear fuel.

And each of the fuels that we use is currently provided by a mixture of UK and imported sources.

Our mixture of energy sources will evolve over time, particularly as North Sea oil and gas production decline as projected by the North Sea Transition Authority (NSTA). Whilst new licences could lead to more oil and gas production, this is by no means guaranteed and any extra volumes could be small.

However, around a third of our electricity is currently generated by renewables such as wind, solar and hydro that don't use any fuel, and so obviously don't require energy imports.

Therefore, the UK's future energy imports will depend upon four factors:

- UK energy demand, overall and for each type of energy;
- the level of UK production of primary energy such as oil and gas;
- the extent to which direct use of fossil fuel is replaced by electricity i.e. using EVs, heat pumps, etc; and
- the extent to which electricity is generated using renewables that use no fuel and hence involve no energy imports.

This report presents a comparison of results for overall UK energy demand in 2024 and 2030, and then examines gas and electricity as case studies.[1]

[1] Oil is not covered in detail. It is a more complicated matter, partly due to the complex web of exports and imports of oil and oil-based refined fuels, and many of the issues can be more easily illustrated with reference to gas.

# UK Energy Security

Analysis of oil, gas and electricity can be combined to build up a picture of the UK's evolving energy security under different circumstances. These results are illustrated in Figure 1 using four examples:

- *2024 Forecast* is based on data from recent years and assessment of trends.
- *2030 New Licences* considers the effects of UK energy demand staying at the same levels as are forecast for 2024, and with new licences yielding the maximum amount of oil and gas in 2030 as are projected by the NSTA.
- *2030 Current Trajectory* considers the situation based on the current direction of travel for technologies such as renewables, heat pumps and EVs, and assuming that licences yield the maximum amount of oil and gas projected by the NSTA.
- *2030 Faster Trends* illustrates the situation without new oil and gas licences and more rapid deployment of technologies, e.g. higher sales of EVs and heat pumps, more insulation of homes, and more rapid renewables deployment. This scenario is not a maximum. It is broadly in line with DESNZ's Net Zero Pathway.

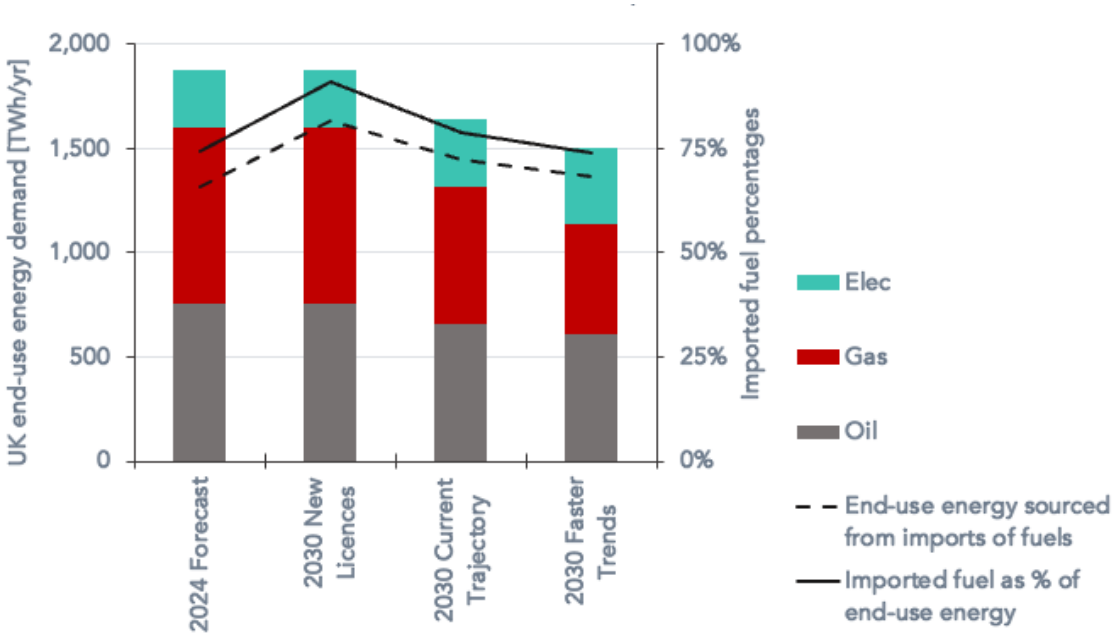


***Figure 1: Bar chart (left axis) of UK end-use energy demand in 2024 and in 2030 under three scenarios; and line chart (right axis) of (dotted line) percentage of end-use energy reliant on imports of fuels and (full line) imported fuel as percentage of end-use energy***

The proportion of end-use energy consumption that is sourced from imports of fuels is currently 66%. This measure is dominated by oil and gas, and this effect can only increase by 2030 as UK oil and gas production falls, irrespective of new licences.

If new licences were to yield the maximum projected amount of oil and gas production (which is by no means certain), but if no further renewables were deployed and no further action was taken on the demand-side to transition away from oil and gas use, then the proportion of end-use energy consumption that requires imports of fuels would rise to 82%. That would be 1.25x the current level i.e. by this measure, the UK's energy security will be a quarter worse than today.[2]

Total end-use energy consumption will fall due to the net zero transition, because of the inherent high efficiency of electrical systems such as heat pumps and EVs compared to their fossil fuel equivalents. Under current trends, total end-use energy consumption could fall by 10-15% by 2035. Under faster trends, it could fall by 20%. And the proportion of electricity that requires fuel will decline if more renewables are deployed.

The current trajectory for changes in energy demand and deployment of renewables, alongside new licences, would result in the proportion of end-use energy consumption that requires imports of fuels rising to 72% by 2030. This is 1.1x the current level, i.e. the UK's energy security will be a tenth worse than today, despite with new licences.

If trends were to be faster, the use of heat pumps, EVs and renewables would begin to balance out the decline in North Sea oil and gas even without new licences, such that the overall percentage of UK energy consumption that is sourced from imports of fuels would be 68% in 2030. That is almost the same as today, suggesting that renewables and electrification have the potential to stabilise UK energy import dependence, even without new licences for North Sea oil and gas.

These faster trends are not an upper limit. Were policies to be put in place to encourage quicker deployment of heat pumps and EVs, and more renewables to power them, then this measure of energy security could be better in 2030 than today. And, regardless. the benefits would continue to grow beyond 2030, overcoming the negative impacts of oil and gas and providing lasting improvements to the UK's energy security.

[2] Note that some calculations might appear to not tally precisely, due to rounding of intermediate results..

As well as illustrating how much of our end-use energy consumption relies on energy imports, Figure 1 also illustrates the depth of that reliance. That is, it shows how much energy would be imported to meet demand. These are two subtlety different concepts.

For oil and gas, these two measures say essentially the same thing, as oil and gas are primary fuels. And, again, oil and gas currently dominate imported energy. For every unit of end-use energy used in the UK, 0.75 units will be imported in 2024. This measure of imported energy as a proportion of end-use consumption will rise irrespective of new licences, unless oil and gas demand fall sufficiently.

Electricity will follow a different trend, requiring smaller proportions of energy imports for each unit of electricity that is used in 2030, provided that new renewables are deployed. And electricity's growing role in the UK energy mix means that it will begin to dilute the negative impacts of declining North Sea oil and gas production.

If new licences were to yield the maximum projected amount of oil and gas production, but if no further renewables were deployed and no further action was taken on the demand-side to transition away from oil and gas use, then the amount of primary energy imported would equate to 0.9 unit for every unit of end-use energy. This is over 1.2x the current level.

Under the current trajectory, the amount of energy imported in 2030 would equate to around 0.8 units for every unit of end-use energy, which is slightly above the current level. And if trends were to be faster, the amount of energy imported in 2030 would equate to just under 0.75 units for every unit of end-use energy, almost exactly the same as today. That is, deployment of renewables can halt the growth in the UK's energy imports as a proportion of energy consumption. And this scenario of faster trends is illustrative and is not an upper limit.

# Gas Import Dependence

Figure 2 summarises the key historical data about UK production, exports, imports and consumption of natural gas, and also illustrates two future scenarios.

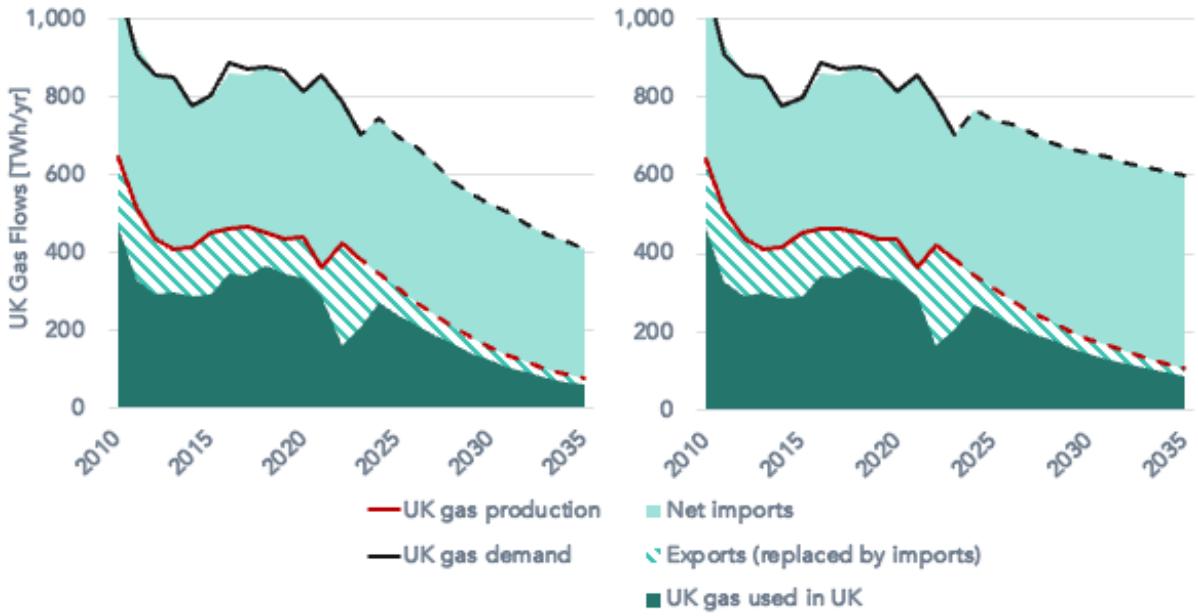


***Figure 2: UK gas flow data for 2010-2023, and under two future scenarios: (left) production from existing fields, and demand falling in line with faster trends; and (right) production including new licences, and demand falling in line with current trajectory.[3]***

The NSTA uses industry data to project that UK gas production will fall by 55% by 2030, even if new licences yield the maximum potential amount of gas. Production would be at most 45% of recent levels, and only slightly lower without new licences at around 40%.[4]

If demand for gas were to stay at current levels, the reduced amount of gas production in 2030, even with new licences, would equate to just under 20% of demand. Allowing for exports of about 20% of production,[5] imports would be around 85% of demand in 2030. Under the current trajectory for net zero technologies alongside new licences, imports would equate to almost 80% of demand in 2030. Under faster trends without new licences, the value would be around 75%. The decline in North Sea gas production, even with new licences, will continue so rapidly that UK imports of gas will certainly rise, but can be slowed by demand reduction.

[3] Some parts of charts don't match perfectly in some years, due to stock changes and transfers e.g. in 2011 and 2016.

[4] Gas production forecasts for 2030 are from the Production Projections (NSTA, February 2024). Gas demand forecasts are based factors including heat pumps replacing gas boilers and renewables displacing gas power stations' output, sense-checked *Future Energy Scenarios* (National Grid, 2023)..

[5] This value of the UK exporting 20% of its gas production is based on data from 2018 to 2021, deliberately excluding the excluding the extraordinary flows of 2022.

# Electricity Generation

In 2024, UK electricity is likely be provided by; 35% gas; 30% other generators that use fuels, such as nuclear and biomass; 30% renewables that use no fuels, such as wind and solar; and 5% from imports when Continental generators offer cheaper prices.

The UK's gas power plant fleet operates at an average annual efficiency of 50%, i.e. they burn on average 2MWh of gas for every 1MWh of electricity that they generate. And, with 60% of our gas being imported in 2024, for every 1MWh of electricity generated by gas power plants, about 1.2MWh of gas will have been imported. Repeating this exercise for other types of fuelled power stations reveals that 40% of the electricity that we will use in 2024 will have been generated using imported fuels.

For every 1MWh of electricity that we use in 2024, power stations will on average use 1.75MWh of fuel, of which 1MWh will be imported. These values would be higher were it not for renewables such as wind and solar that do not use fuels.

By 2030, under the current trajectory, the UK's grid mix could be 60% renewables that use no fuel, 15% gas, 20% other power plants, and 5% from electricity imports.[6] This scenario includes new gas licences.

- Over 25% of electricity used in 2030 would be generated using imported fuels.
- Each 1MWh of electricity used in 2030 would on average be made up of a higher level of renewables, and so would need just 0.9MWh of fuels, of which 0.6MWh would be imported.
- That is, each unit of electricity would use 0.8MWh (about 45%) less fuel, and 0.4MWh (40%) less imported fuel than in 2024.

In the 'faster trends' scenario, we could see a different grid mix in 2030 e.g. at least 70% renewables such as wind and solar, just 10% gas, 15% other power plants, and 5% from electricity imports.[7] This scenario does not include new gas licences.

- Only 20% of electricity used in 2030 would be generated using imported fuels.
- Each 1MWh of electricity would on average need around 0.7MWh of fuels, of which a little over 0.4MWh would be imported.
- That is, with more rapid renewables deployment and even without new gas licences, each unit of electricity in 2030 would require around 20% less fuel and about 25% less imported fuel than on the current trajectory.

[6] See, for example, the *Falling Behind* scenario in the *Future Energy Scenarios* (National Grid ESO, 2023)

[7] See, for example, the *Leading the Way* scenario in the *Future Energy Scenarios* (National Grid ESO, 2023)

# Conclusions

This analysis illustrates the negative impacts of our high use of gas and oil in the context of declining North Sea production on the UK's energy security.

It also illustrates the positive influences of reducing our demand for oil and gas and increasing our deployment of renewables on the UK's energy security.

These positive influences from switching to electrical technologies and using more renewables will help to limit the negative impacts of oil and gas dependence in 2030.

And as the UK increases its use of heat pumps and EVs, and deploys more renewables to power them, the benefits will continue to grow beyond 2030, overcoming the negative impacts of oil and gas and providing lasting improvements to the UK's energy security.

# Methodology

Analysis of recent trends was based on data from DESNZ: DUKES 1.1 (overall energy), 4.1 (gas), 5.1 & 5.6 (electricity fuels, generation and demand), Production, Imports & Exports (oil) and Inland Deliveries of Products (oil). From the data, estimates were made for 2024.

Projections of oil and gas production were from the North Sea Transition Authority.

Scenarios of renewables deployment were based on government targets and an assessment of data from DESNZ's Renewable Energy Planning Database (REPD) and the LCCC's CfD Register. Scenarios of demand for oil, gas and electricity were developed based on different policy assumptions for measures that will reduce demand, such as home energy efficiency standards, heat pumps, and electric vehicles. Scenarios were sense-checked against scenarios by DESNZ and National Grid.

Assumed values for power plant efficiencies in 2024 are: gas 50% based on DUKES data for overall fleet; biomass and nuclear 30%. Assumed values for power plant efficiencies for overall fleets in 2030 are: gas 45%, on the basis of new plants with CCS having 40% efficiency; biomass and nuclear 35-40%, on the basis of around 45% for new plants.

Proportion of fuels that are imported in 2024 are based on recent data from DUKES (DESNZ, 2023), giving approximate values of: gas 60%; biomass 50%; nuclear 100%, on the basis that the UK has no commercial uranium mines. With the exception of gas, for which the imported percentage is deduced in the analysis, it is assumed that the values are the same in 2030.