

Getting off Gas

Why UK energy independence is a pipedream unless we reduce our gas consumption

April 2023

EXECUTIVE SUMMARY

The Government's aim of greater UK energy security is incompatible with ongoing high gas demand, more so as North Sea gas production continues to decline. The only way to limit gas imports in the medium and long term is to reduce gas consumption, and yet effective policies are not currently being pursued.

Failure to accelerate deployment of renewables, heat pumps and insulation, and to achieve energy efficiency improvements across the economy, would leave UK gas demand stubbornly high, perhaps just 10% below current levels by 2035, and the UK more dependent on foreign gas imports.

With North Sea production forecast to decline by 55% by 2030, and 75% by 2035, in spite of plans to expand drilling, net imports would rise to meet demand, increasing to almost 60% above current levels by 2035 and worsening our trade deficit. By that stage, almost 85% of UK gas demand would be met by net imports, over five times that met by UK production, compared to an even split today.

Meeting existing targets for net zero technologies could reduce gas demand by 40% by 2035, which would help to limit the rise in net imports during the 2020s before they fell back to 5% below current levels by 2035. However, with North Sea production inevitably declining in the coming years, these net imports would equate to almost 80% of UK demand, four times the level met by UK production.

Accelerating the deployment of net zero technologies would see a sustained downward trend in UK gas demand, falling by almost 65% (two-thirds) by 2035. This would cut net gas imports year on year, taking them down by as much as 230TWh/yr by 2035, 55% below current levels.

And with North Sea production costs rising and the industry warning that output could fall even faster – by 80% by 2030 – the UK's import dependency could be even higher, further emphasizing the urgency of cutting gas demand.

Effective policies to reduce net gas imports would include: ramping up insulation rates (which have fallen during the energy crisis) and boosting the heat pump rollout; providing a stable regime for renewables, including lifting the ban on onshore wind in England; and implementing policies to deliver the Government's target of an overall 15% cut in energy demand by 2030.

Policies would also have to guard against the risk of gas demand potentially rising, for example by ensuring new homes aren't connected to the gas grid. Furthermore, if the UK were to try to pursue hydrogen boilers for home heating at scale, the dependency on gas imports could rise significantly. Given that there is unlikely to be sufficient spare renewable electricity for generating green hydrogen in the medium term, we would have to use methods that involve natural gas, but with inefficiency penalties that would increase our gas consumption at the very time that it needs to fall.

ENERGY INDEPENDENCE AND GAS IMPORTS

The gas crisis has spurred the UK Government to seek to ["secure Britain's energy independence"](#), including a series of announcements in March [dubbed 'Energy Security Day'](#).

The financial arguments alone are compelling. With gas costs sitting at the core of high UK inflation, a [member of the Bank of England's Monetary Policy Committee](#) has noted that the UK's high gas dependence makes us one of the "most susceptible" countries to energy price shocks. This echoes an [assessment last year by the International Monetary Fund](#) (IMF) that British households have been the worst hit in Western Europe because of our high dependence on gas.

And with the UK importing around half of the gas that we use, our high gas consumption has a negative impact on our balance of trade, with a recent study estimating that [the UK spent £49billion](#) importing gas in 2022.

On top of the financial motivation at the macro-level, with UK gas prices largely being set by the international market, British bill payers have suffered from the volatility in prices with the Treasury and tax-payers having stepped in to effectively subsidise the high cost of gas.

In reality, it is unlikely that the UK will ever be totally energy independent. In fact, there are benefits to having some degree of connection with other countries, for example to trade power to bring down bills and effectively share energy storage facilities. But the Government's meaning is clear: to increase the UK's energy security by reducing our dependence on energy imports.

This report focuses on natural gas, which the current crisis has exposed as the 'Achilles heel' of the UK energy sector. Addressing the risk from gas imports clearly has to be the priority in any efforts to improve energy security and seek energy independence. This report briefly examines the two options for reducing net imports: by reducing demand; and by increasing domestic production.

A NOTE ON (NET) IMPORTS

This report considers 'net imports' of gas i.e. imports minus exports. For example, in 2016 to 2019, before the pandemic and the gas crisis, the UK typically imported c.520 TWh/yr of gas and exported c.105 TWh/yr, giving net imports of c.415 TWh/yr. The fact that the UK exports some gas, despite being a net importer can seem strange, but it reflects features of the UK's gas sector.

Firstly, the UK has very limited gas storage. So, during the summer, when demand is low, some of our production can be exported by pipelines and stored in Continental storage facilities. Conversely, the UK imports some gas from the Continent during the winter when demand is higher. Secondly, the UK has substantial LNG import facilities, that have sufficient capacity to process extra shipments to be piped to the Continent. This happened in normal times before the gas crisis, and even more so in 2022 to help Europe reduce imports of Russian gas. Thirdly, the Republic of Ireland has gas interconnection to no country other than the UK, so any gas that the RoI imports from a third country will pass through the UK and be counted as imports and then exports.

GAS PRODUCTION: DECLINING UK OUTPUT

UK gas production has been declining for two decades. We have gone from being self-sufficient to producing only half of what we use: in 2022 we produced around 425TWh of gas and used around 835TWh. This decline will continue, as illustrated by forecasts from the [UK North Sea Transition Authority](#) (NSTA) shown in Figure 1. These figures were used in the analysis for this report.

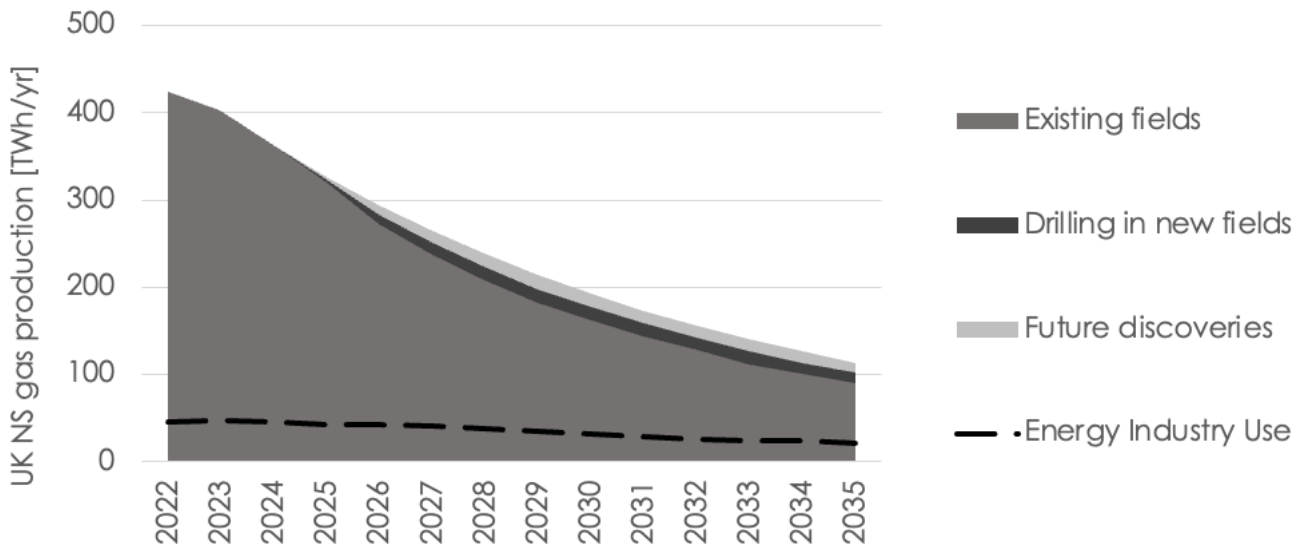


Figure 1: Forecasts of UK gas production (NSTA, February 2023)

These forecasts show that UK gas production is set to decline rapidly from current levels, by 55% by 2030 and by almost 75% by 2035 – and further thereafter. The curved decline is typical of the way that output from individual fields tail off over time. In the past, the overall UK output could stay more or less level because new fields would come online as older ones declined. But the fact that the overall UK production is following a declining path illustrates that we no longer have substantial new resources to call upon.

However, these forecasts are potentially optimistic, for three reasons.

Firstly, the main bulk of the forecast production is from existing fields. Proposals for new drilling in these existing fields could increase output in the short-term, but only serves to hasten the end of those fields and deepen the problem in later years.

Secondly, the forecasts include two thin slivers of less certain resources. Drilling in new fields takes years to commence and can encounter unexpected issues – one example is the Rosebank oil and gas field, expected to receive Government approval in Q2 2023. Exploitation of future discoveries is even more speculative. If new fields and future discoveries did not deliver as much as expected, UK production would be lower than forecast. And even if they did deliver as much as is forecast, it would not have any impact upon prices which are largely dictated by international gas markets.

Thirdly, the industry body Offshore Energies UK recently said that output [could fall by 80% by 2030](#). Reasons for this view included rising costs (the North Sea is an expensive basin to operate in) and recent taxation changes in light of record profits (but [UK tax rates are still lower than in Norway](#) for drilling in the same basin). So, the NSTA's production forecast used in this report could be optimistic.

Estimated volumes of shale gas in the UK have fallen with each major survey, extraction is disruptive and public opposition is strong. Given this and the political turmoil fracking has created, it is now even more unlikely to happen.

Also shown on this chart are forecasts of 'energy industry use' of gas, largely for fossil fuel extraction and refining, which currently equates to c.10% of UK production, rising to c.20% by 2035.

In the drive to cut imports and boost self-sufficiency, and in light of the UK's declining gas production, the only long-lasting option open to us is to reduce gas consumption.

GAS DEMAND: REDUCING UK CONSUMPTION

The move to energy independence will be aided if the Government pursues solutions that are known to be effective in cutting gas demand. The Government has an energy efficiency target to [cut overall energy demand by 15% by 2030](#), which presumably must include gas. And it has a target of installing [50GW of offshore wind by 2030](#) as a boost to renewables that reduce our dependence on gas for power generation.

But these targets are not fully supported by current policies.

Energy efficiency efforts have been undermined: over the past decade, [household insulation rates](#) have been just 10% of their 2012 peak; and [improved standards for new homes](#) have been repeatedly delayed. Limited ambition for insulating existing homes and installing heat pumps from Government is a missed opportunity to reduce our gas import dependence. Efforts by companies like [Octopus](#) and [British Gas](#) to offer heat pump packages from £2-3k might go some way towards bridging this gap.

Renewables deployment has been hindered by the [onshore wind ban in England](#), and industry voices have warned that even the successful offshore wind sector could stutter due to [recent changes in taxation](#) that favour oil and gas extraction over renewables.

Finally, the aim of energy independence would be hindered by anything that maintains our use of gas or even creates new demand. Allowing housebuilders to connect new homes to the gas grid, and the proposal to permit ['hydrogen-ready boilers'](#), risk adding to our gas import dependency.

SCENARIOS: REDUCING GAS DEMAND AND NET IMPORTS

Three scenarios were developed to illustrate potential future UK gas demand:

- *Current Policies*: This scenario considers the impact of current policies including from 'Energy Security Day', which are largely insufficient to meet existing targets for different sectors.
- *Government Targets*: This scenario considers the impact of meeting key Government targets, which would require additional policies to those currently in place.
- *Energy Security*: This scenario considers the impact of more ambitious targets and policies to meet them, to accelerate the reduction of gas demand.

These scenarios are illustrated in the charts, below, which also include the NTSA's forecast of UK gas production and 'energy industry use' (e.g. gas used for fossil fuel extraction and refining). Thereafter follows a brief analysis of the scenarios' implications for UK net gas imports.

Current Policies scenario

Without new policies to support current targets, we risk remaining near current high levels of gas demand, with gas demand potentially falling by only c.10% fall by 2035 – see Figure 2.

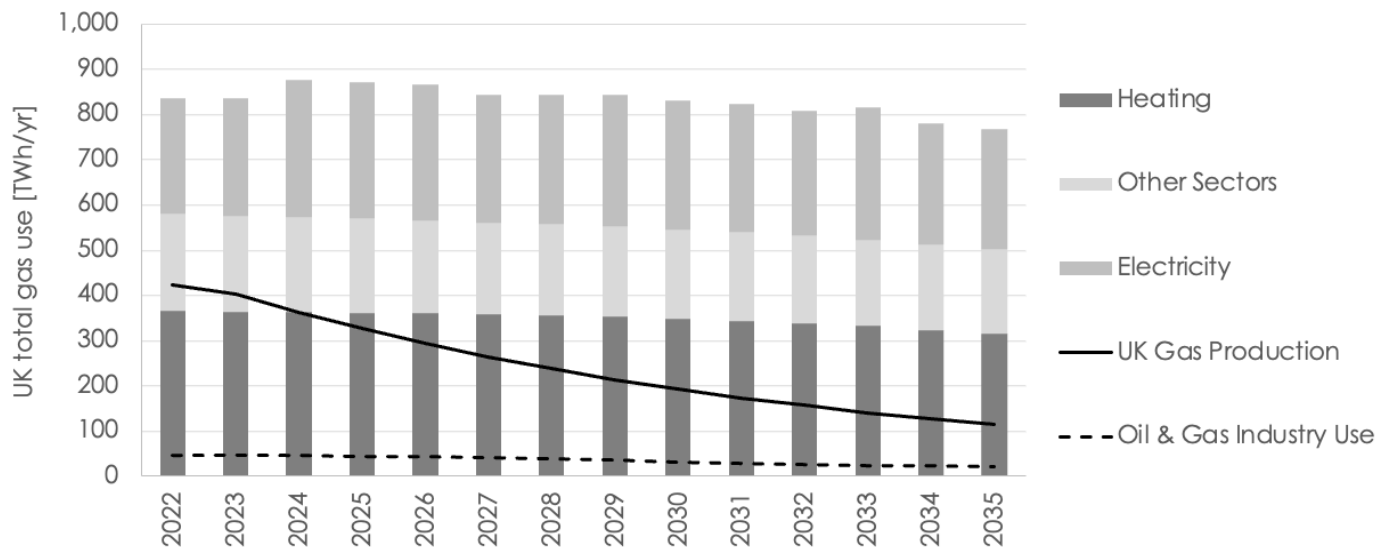


Figure 2: Current Policies scenario

Key input assumptions and results for the *Current Policies* scenario are:

- Insulation schemes continue as per the Great British Insulation Scheme (GBIS) and similar programmes, upgrading 200,000 homes on the gas grid per year. (These schemes have higher overall targets, but some of the homes are off the gas grid e.g. with oil boilers.)
- Heat pump rollout rises in line with the Government's proposed [Clean Heat Market Mechanism](#), across homes and other buildings.
- Insulation and heat pumps combined serve to reduce gas demand associated with heating and hot water for the UK's buildings by almost 15% from its current level.
- Renewables deployment somewhat stalls due to policies such as recent taxation changes, small allocations for CfD auctions, failure to speed grid connections, and ineffective proposals for lifting the ban on onshore wind in England – impacts modelled in this analysis are based on discussions with industry experts. With lower levels of renewables, gas produces around 25% of the UK's power generation.
- Insufficient policies are implemented to reach the Government's target of a 15% cut in UK energy demand by 2035, but a smaller cut of 1% per year is assumed on the basis of companies taking action to reduce their exposure to gas prices.

There is an outcome that is potentially even worse than the *Current Policies* scenario. Gas demand could conceivably even rise, for example if new homes to carry on being connected to the gas grid, or if (non-green) hydrogen was to be used for home heating.

Hydrogen poses a particular risk of pushing up gas demand. In the future, when the UK has ample renewable generation, we could produce green hydrogen from electrolysis when wind and solar output exceed our demand. But in the short-to-medium term, hydrogen production would involve gas by one of two processes. Blue hydrogen could be produced via Steam Methane Reforming, provided that CCS can be applied effectively, or hydrogen could be produced via hydrolysis powered by a grid mix that includes a significant amount of gas power. Either way, inefficiencies at various points in these processes would serve to increase the amount of gas that was used to provide home heating. This is obviously counter to the aim of energy self-sufficiency.

Government Targets scenario

If policies are improved such that the UK can meet the Government's own targets, gas demand could fall by almost 40% by 2035 – see Figure 3.

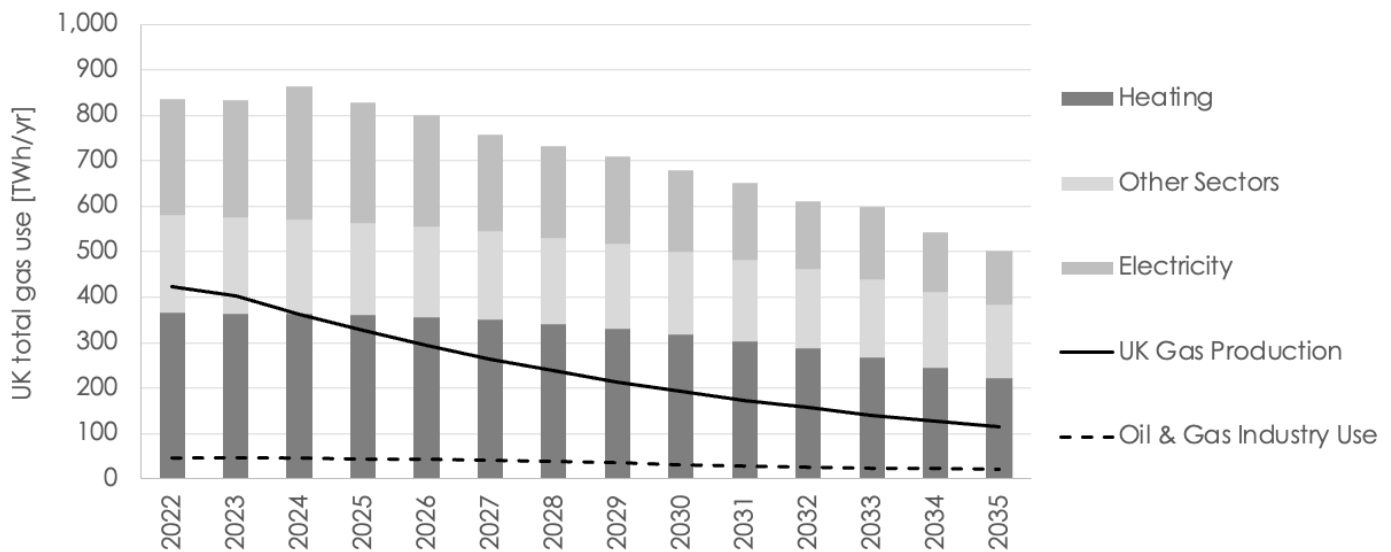


Figure 3: Government Targets scenario

Key input assumptions and results for the Government Targets scenario are:

- Insulation is installed to upgrade homes to EPC band C, which is part of the Government's EPC target. Upgrades ramp up to 1million homes per year by 2028, which equates to the [rate achieved in the UK in 2012](#) (on the basis that each home could receive two main insulation upgrades). Over 11million are upgraded by 2035, which is some way to the Government's target that as many homes as possible should be rated EPC band C by 2035 (out of an estimated 19million rated worse than EPC band C).
- Heat pump rollout ramps up to 600,000 units per year by 2028, as per the Government's target, and then continue rising to 1.9million per year by 2035 (i.e. accounting for most new and replacement heating sources). No new homes are connected to the gas grid under the Future Homes Standard.
- Insulation and heat pumps combined serve to reduce gas demand associated with heating and hot water for the UK's housing stock by 40% from its current level. The same reduction is achieved for non-domestic buildings.
- Renewables deployment continues, with offshore wind achieving its target of 50GW by 2030 and continuing at a similar rate thereafter, but onshore wind and solar are deployed more slowly due to barriers to deployment. Gas would provide almost 10% of our power in 2035, compared to just under 40% currently, but 10% of a larger total. This could potentially be compatible with the Government's aim of decarbonising the power sector that year, but at the cost of large amounts of CCS technology.
- Other sectors achieve a 15% cut in gas demand, as part of reaching the Government's target of a 15% reduction in overall energy demand, with savings then continuing to grow at the same rate to 2035.

Energy Security scenario

In this scenario, in which UK policies accelerate towards the goal of energy independence, gas demand could fall by almost 65% by 2035 i.e. by two-thirds – see Figure 4.

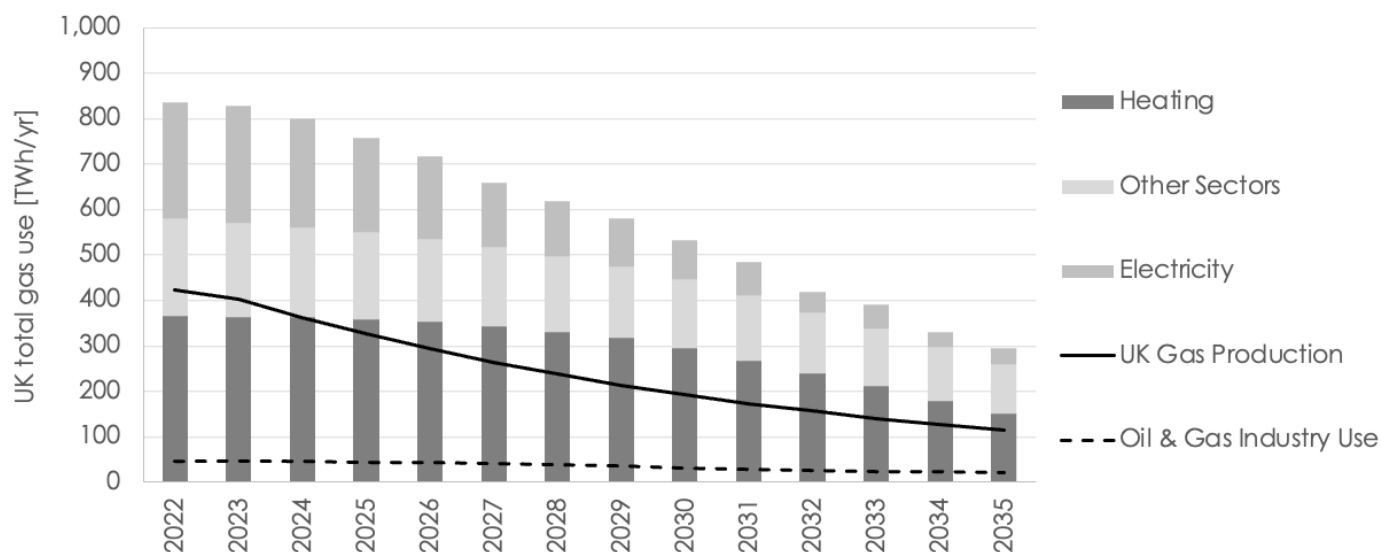


Figure 4: Energy Security scenario

Key input assumptions and results for the *Energy Independence* scenario are:

- Insulation is installed to upgrade homes to EPC band C, the Government's target band, ramping up to 2million homes per year by 2028, such that c.19million homes are upgraded by 2035, which would be a full achievement of the Government's target that as many homes as possible should be rated EPC C or better by 2035.
- Heat pump rollout reaches 600,000 per year by 2028, as per the Government's target, and then reaches 1.9million per year by 2030, which is equivalent to the level in Norway in 2022 on a per capita basis, such that almost 15million home heat pumps are in place by 2035. Similar improvements are achieved for non-domestic buildings. Overall, insulation and heat pumps combined serve to reduce gas demand associated with heating and hot water by almost 60% from its current level.
- Renewables deployment includes offshore wind capacities as per the *Government Targets* scenarios. But wider renewables deployment occurs, with solar reaching 70GW by 2035 and onshore wind reaching 45GW by 2035 (mooted to be have been a potential target for the 2022 British Energy Security Strategy), aided by lifting the ban on onshore wind in England. Gas accounts for just 2% of power generation in 2035, which is compatible with the aim of decarbonizing that sector, with the use of reasonable levels of CCS.
- Other sectors achieve a 30% cut in gas demand by 2030 (twice the Government's target), partly through energy efficiency to meet the Government's target, and also through customers moving away from gas entirely to low-carbon energy sources (e.g. green hydrogen in steel manufacture), and annual savings continue to grow at the same rate to 2035.

GAS IMPORTS

The gas demand levels in each scenario can be compared with the NSTA's forecasts of UK gas production (as per Figure 1), to estimate the impact on UK net gas imports. This is illustrated in two ways. Figure 5 illustrates net gas imports in each year, as a percentage of UK gas demand in each year. Figure 6 illustrates net gas imports in each year, as absolute values (TWh/yr) and as a percentage of current levels.

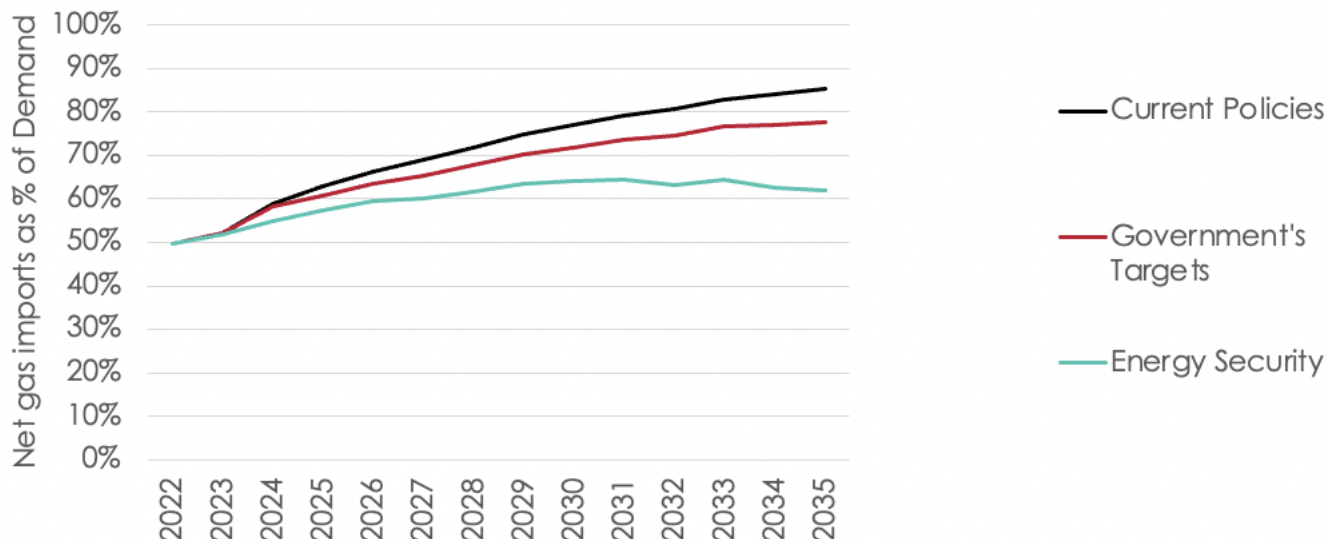


Figure 5: UK gas net imports as percentage of current levels, under three scenarios.

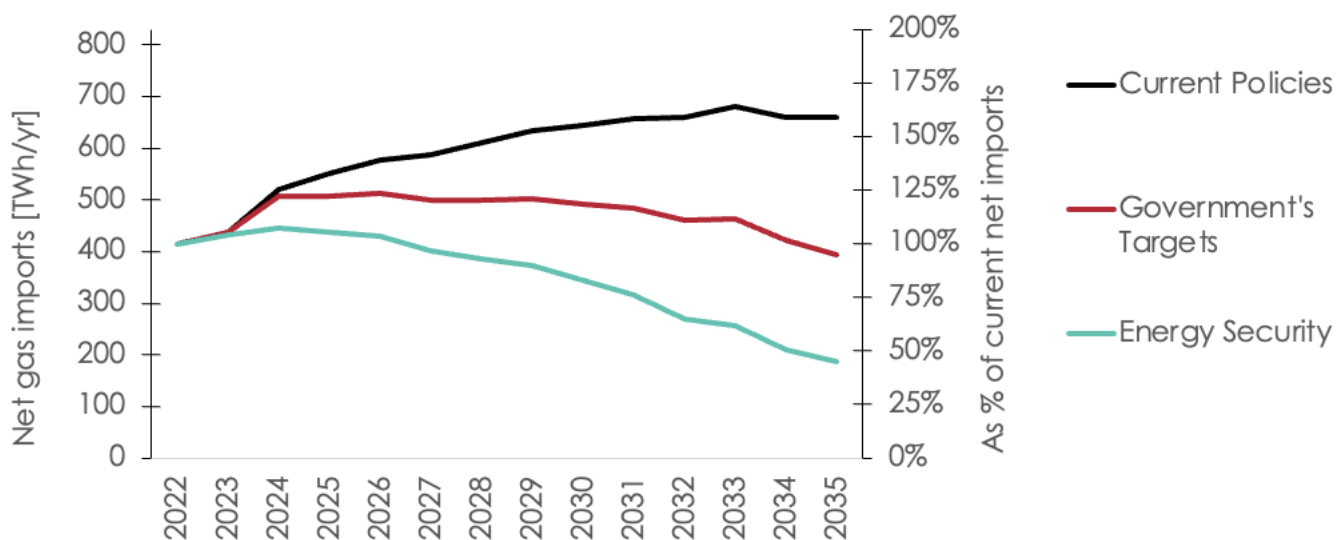


Figure 6: UK gas net imports as percentage of gas demand, under three scenarios.

As shown by the *Current Policies* scenario, without further action to reduce demand, UK gas net imports are set to rise, potentially by almost 250TWh/yr by 2035, 60% above today's levels, further harming our balance of trade. At that point, net imports would equate to 85% of demand – put another way, net gas imports would be at least five times the size of remaining UK gas production.

As shown by the *Government Targets* scenario, applying new policies to meet existing targets would slow the rise in gas net imports, adding around 100TWh/yr in the near-term, before falling to 5% below their current levels by 2035. However, with UK production having declined by 75% by that stage, the net imports would account for almost 80% of demand – that is, net gas imports would be four times the size of UK gas production.

By contrast, the more ambitious *Energy Security* scenario sees net gas imports fall in absolute terms, by 230TWh/yr by 2035, 55% below current levels. Net imports as a percentage of demand would rise into the early 2030s, but would then decline towards 2035, unlike in the other scenarios in which this percentage would carry on rising.

As noted earlier, these three scenarios are based on the NSTA's forecasts of North Sea gas production, which is set to fall by 55% by 2030 and by 75% by 2035. And with the prospect that high costs could contribute to an even faster decline in UK gas production, pushing up UK import dependency under every scenario, the need for reducing gas demand becomes even more urgent.

CONCLUSIONS

The UK's high level of dependence on gas has made us particularly vulnerable to the current gas crisis. And this analysis illustrates that this high level of gas dependence also means that the UK is starting on the back foot in the Government's pursuit of energy security.

With declining North Sea gas production, net imports of gas are set to carry on rising. Only through a concerted effort of demand reduction can the UK limit this rise and start to reduce net imports below current levels.

And whilst the UK has some targets that point in the direction of reducing gas demand, they are not sufficiently backed up by policies to achieve the savings. On the other hand, with an acceleration of policies, the UK could make much faster progress towards weaning itself off gas – a critical step towards energy independence.

The UK would need to start now. These new industries can be built and expanded, but not overnight. A knee-jerk reaction in a few years' time in response to the realisation gas imports are rising likely won't deliver in time.

METHODOLOGY

Data for gas demand in the UK overall and by sectors, along with (net) imports are from DUKES 4.1 (DESNZ, 2023 latest update) and UK Energy Trends 4.1 (DESNZ, 2023 latest update). For UK gas demand, the figure used is the total of demand from each sector (e.g. housing, power generation, industry, etc.) plus 'energy industry use' (e.g. for fossil fuel extraction and refining).

For heating buildings, scenarios are generated by multiplying savings per home by the number of homes upgraded by the end of the previous year. Uptake rates of insulation and heat pumps are discussed in the main text.

For insulation savings, median home gas demand by EPC band, along with estimates of numbers of homes in each EPC band, are based on data from National Energy Efficiency Database (NEED) (DESNZ). The average gas saving (weighted across EPC bands D-G) of upgrading a gas home to EPC band C is estimated to be almost 3,500kWh/yr.

For heat pump savings, gas demand is translated into electricity demand using a heat pump via gas boiler efficiency of 85% and heat pump COP of 3.0, to give just over 3,750kWh/yr. Heat pump analysis was based on EPC band C homes, simply because insulation upgrades would mean that most homes would be at that level during the period of the analysis. Gas savings are calculated on the basis of grid mix (see below) and the average efficiency of gas power stations (see below).

Savings for heating and hot water in non-domestic buildings are based on the assumption that deployment of insulation and heat pumps can have similar overall effects in that sector. The savings are calculated by scaling up savings for homes, using the fact that other buildings currently use just over 30% as much gas for heating and hot water as do homes (Energy Consumption UK (DESNZ)).

A simple model was used to forecast parameters for the power sector. Demand was based on the rising baseline from the CCC's 6th Carbon Budget, plus demand from heat pumps (see above) and electric cars and vans (estimated to be 2.0MWh/yr and 5.2MWh/yr per vehicle, respectively, based on typical efficiencies and average mileages). Numbers of heat pumps were based on trends as described in the main text, and numbers of electric cars and vans in each of the three scenarios were based on projected sales: without a ZEV Mandate; with the Government's proposed ZEV Mandate; and with a more ambitious ZEV Mandate (akin to the SMMT's high EV sales scenario).

Renewable deployment (wind, solar, hydro, marine) was modelled under different conditions (including industry expert's views for the *Current Policies* scenario), and standard load factors were applied. Levels of other generation (mainly nuclear and biomass) were based on National Grid's *Leading the Way* scenario from its Future Energy Scenarios (FES 2022), as were electricity net exports. Losses were estimated from recent historical data (ET 5.1 & 5.2, DESNZ). Curtailment was based on National Grid's *Leading the Way* scenario (FES 2022), with that power increasingly used for electrolysis. Gas generation was then used to top up to meet demand, and grid mix was calculated.

Modern gas power plants can operate at up to 60% efficiency, but the overall efficiency of the UK's fleet is currently 50% (DUKES 5.1 & 5.2 (DESNZ)). For future years, this same value of 50% was used as an approximation, on the basis that whilst gas plants with CCS will incur an energy cost, their evolving role in the market might allow them to be operated more efficiently than at present, making it difficult to predict their behaviour and overall efficiency.

Small 'bumps' in scenario charts (e.g. in 2024 and 2033) reflect the 'granular' nature of some changes in the energy sector e.g. if a large power station is commissioned or decommissioned.