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# Options for Energy Bill Reform

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Authors: Rachel Wolf, Jonathan Dupont and Ruth Newton

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# Executive Summary

**Policy change is needed to meet the UK's targets on heat pumps, which are a stated part of the government's plan to decarbonise heat**. Decarbonising and electrifying residential heat is crucial if the UK is to achieve its Net Zero targets. At present, however, many policy costs - such as Feed-In Tariffs, Renewable Obligation Certificates and Contracts for Difference - are imposed on electricity bills but not on gas, penalising those who do invest in cleaner options. Far from putting a price on pollution, we are actively encouraging the use of fossil fuels.

Unless policy changes, UK households that opt for an air source heat pump will be paying £305 more a year in 2030 in energy bills than those with a gas boiler.

**The UK lags behind its international comparators on decarbonised heating, heat pump purchases and trajectory.** A number of countries offer high incentives for decarbonised heating as part of their drive towards net zero. They have also introduced, or are introducing, more balanced costs between electricity and gas:

- Germany has 2.6 times the number of heat pump sales per capita as the UK. Germany has higher renewable policy costs on electricity than the UK, but has recently introduced a carbon charge on gas which will reach £55/tCO2e by 2025. Their stimulus package last year included reductions on the electricity renewable levy.

- France has ten times the number of sales per capita as the UK. It has lower renewable policy costs on electricity than the UK, and also levies an additional carbon charge across fossil fuels, including gas.

- The Netherlands has 4.7 times the sales per capita as the UK. It has placed considerable policy costs on gas: it has the highest costs on gas, once taxes are added, in the EU[1].

It is worth noting that the numbers in these countries - while much higher than the UK's - are still well below the government's targets.

[1] BEIS, Domestic gas prices in the EU for medium consumers, including environmental taxes and levies, Dec 2020

**There are a number of ways the UK could rebalance costs between gas and electricity.** Public First modelled scenarios for the running costs of residential heating against four aims:

**1.** Reversing the disincentive on electrified heating;

**2.** Maintaining affordability of heating for average households across the country;

**3.** Not substantially increasing costs for the fuel poor; and

**4.** Not putting an undue burden on government expenditure.

Our scenarios are summarised below.

<table>
<tr><th>Scenario</th><th>Renewable subsidies[2]</th><th>Carbon taxation</th></tr>
<tr><td>Baseline</td><td>No change</td><td>No change</td></tr>
<tr><td>1</td><td rowspan="2">Move from electricity bills to general government expenditure</td><td>Current charges only (and therefore on electricity, not gas)</td></tr>
<tr><td>2</td><td rowspan="2">A higher carbon tax of £54 rising to £75/tCO2e applied equally to electricity and gas, consistent with independent recommendations.[3]</td></tr>
<tr><td>3</td><td>Spread equally between gas and electricity</td></tr>
</table>

[2] In the case of renewable support costs (RO, FiT, CfD) we have assumed for simplicity that any change applies to the entirety of renewable support costs. An alternative policy choice would be to move only the legacy component of the costs, rather than new costs. As legacy costs account for the majority of renewable costs to date, however, this would not significantly change the modelling results.
[3] http://zerocarbonreport.com/

| | | |
|---|---|---|
| 4 | Move onto gas alone | Current charges only[4] |

In the case of changes to carbon tax and renewable support, we have quantified the impact on government income and expenditure of changes to domestic arrangements. This paper does not consider the merit or impact of making equivalent changes to the non-domestic market.

In all scenarios (other than the baseline) we moved efficiency costs – the Energy Company Obligation[5] – from both electricity and gas bills onto gas bills alone, as these are more closely linked to heating. We have also assumed in all scenarios that current carbon prices – in the form of ETS and CPS costs – would either remain on electricity or be replaced by a higher carbon price.

We have summarised the impact below. When looking at fuel poor consumers we have estimated the cost for gas users. Clearly if they switch to electricity, they would see a substantial saving - and many will be using electrical storage heaters already.

| | *Incentive to take up heat pumps in 2030* | *Fuel bills in 2030 compared with baseline* | *Government revenue and spending in 2030 compared with baseline* |
|---|---|---|---|
| 1. Policy costs onto government expenditure | The running cost of heat pumps is near equalised to gas boilers by 2030. | The average fuel bill would decrease by £168 (-12%) per year by £178 a year for the fuel poor | This would have a significant impact, increasing government net spending by £5.7 bn |

[4] We also modelled spreading between gas and electricity without a carbon price, which did find heat pumps would remain more expensive in 2030, even once energy efficiency costs were transferred and that dual fuel bills would increase for the average consumer and the fuel poor. However 100% movement of policy costs onto gas does make heat pumps less expensive to run.

[5] Given the Warm Home Discount's position as a consumer protection, and given that its inclusion or exclusion in the modelling doesn't change the overall position of the scenarios, we chose not to move this in our scenarios.

| | | | |
|---|---|---|---|
| 2. Policy costs onto government expenditure and an increased carbon tax on electricity and gas | Heat pumps become £159 a year cheaper to run than a gas boiler | Costs would increase slightly - by £38 (+3%) a year for the mean consumers and £40 for the fuel poor | Government net spending increases by £0.2 billion. |
| 3. Policy costs even between electricity and gas, with an additional carbon tax on electricity and gas | Heat pumps become £154 a year cheaper to run than a gas boiler | Dual fuel bills substantially increase – by £234 a year (+17%) by 2030 for the average consumer and £248 for the fuel poor | Government net revenue increases by £5.5 billion. |
| 4. All policy costs onto gas. | Heat pumps become £200 a year cheaper to run than a gas boiler | Increases overall bill by £70 (+5%) a year for the average consumer and £65 a year for the fuel poor | Government revenue unchanged. |

**Our view is that scenario 2 - which moves the policy costs onto government expenditure and then introduces a carbon tax - is the best balance in terms of incentivising heat decarbonisation; properly pricing emissions on gas; not penalising the fuel poor or the average consumer; and limiting impact to the Treasury. Regardless of the scenario the government chooses, it is clearly essential that the government shields the poorest from substantive rises on their energy bills.**

# The Challenge - Introduction

***We will aim for 600,000 heat pump installations per year by 2028, creating a market led incentive framework to drive growth, and will bring forward regulations to support this especially in off gas grid properties. This ambition still leaves open the choice as to whether we ultimately pursue hydrogen heating, an electrified heating system, or a mixture of both, whilst we continue to pilot the options.***

- The Ten Point Plan for a Green Industrial Revolution, 2020[6]

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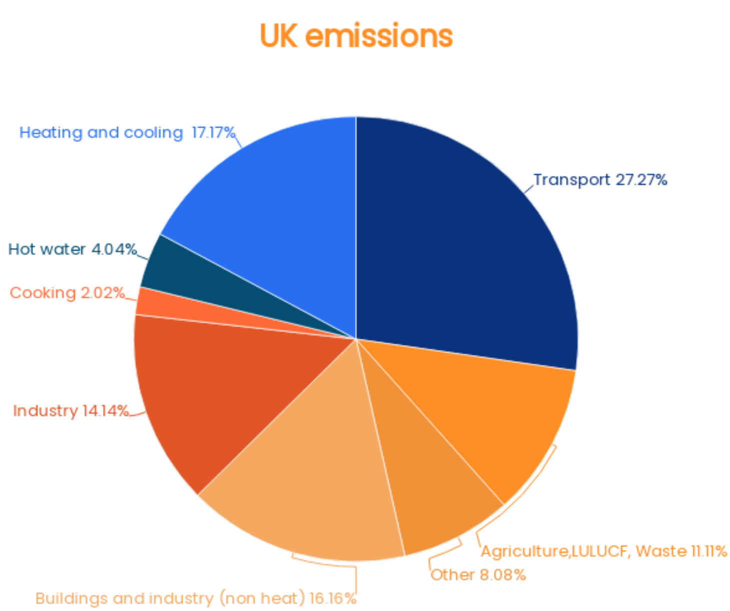
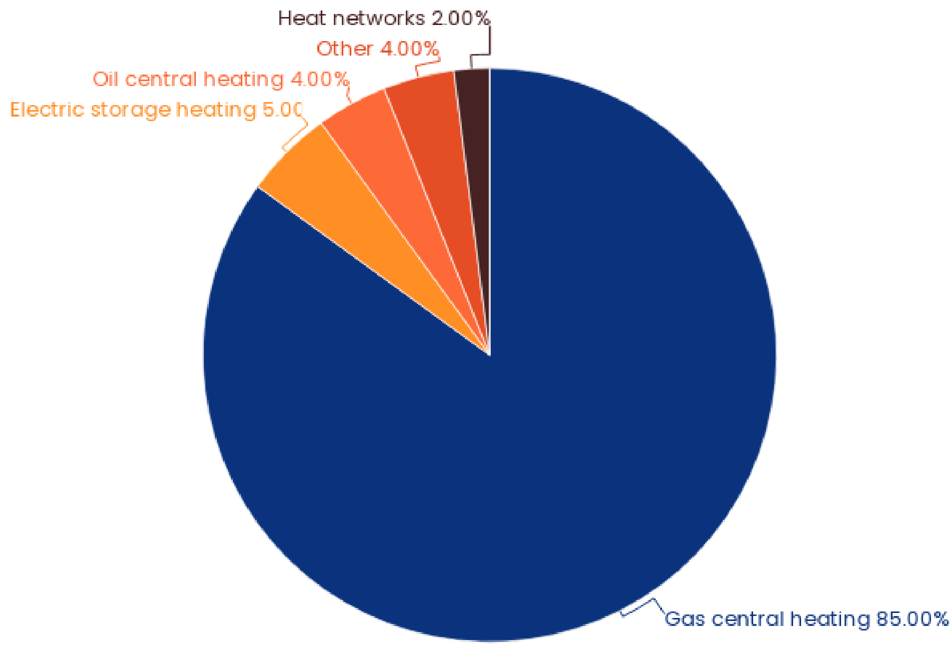
Without changes to policy costs on both electricity and gas, there is a far higher chance that the government will not meet its heat pump target and we will fail to decarbonise heating in the UK.

As is widely recognised, heating is one of the most important sectors in the next few decades to decarbonise. 21% of UK emissions come from non-industrial heating, the majority of which is domestic. Today, UK households are extremely reliant on gas, with just 2% using heat networks. UK households install more than 1.6 million new boilers per year, and just 30,000 electricity powered heat pumps.




[6]https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution/

## Make up of heating in homes



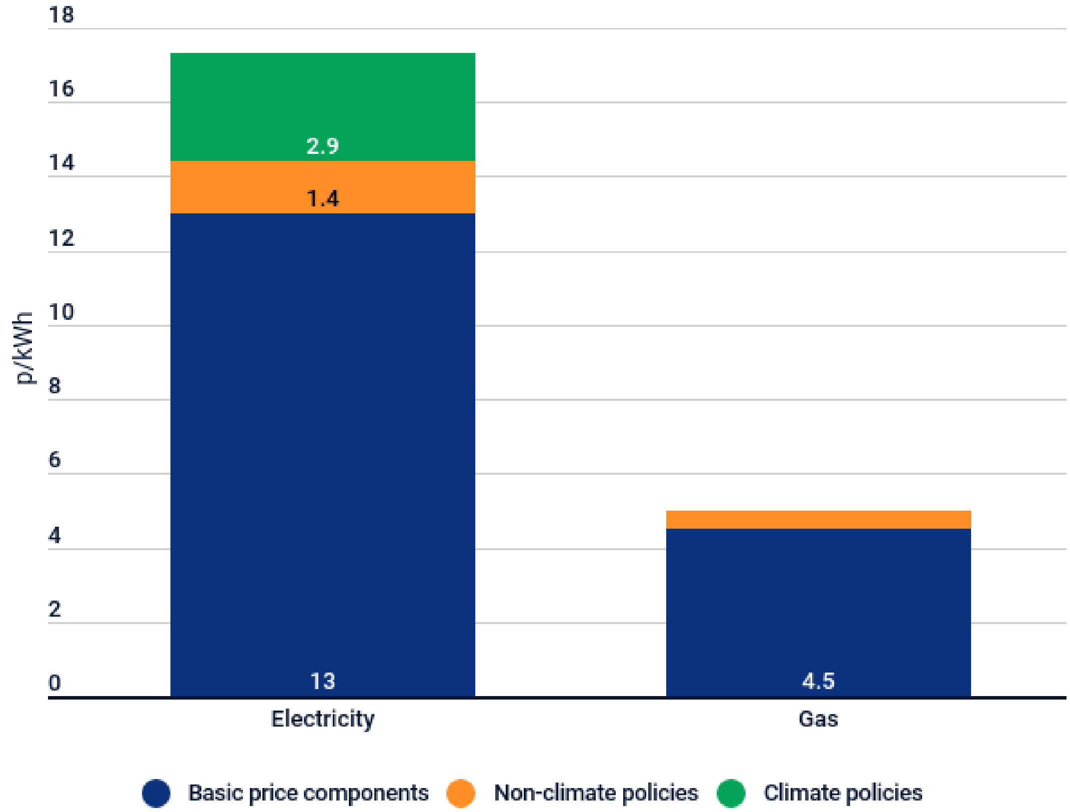

This year has seen, for understandable reasons, problems with the delivery of home decarbonisation.

We need to avoid the same situation, longer-term, for heat pumps, which remain an important part of the government's drive to hit net zero by 2050. Yet today, leaving aside higher capital costs of heat pumps, it remains cheaper for a household to stick to gas.

One reason for this is that, at present, many policy costs are imposed on electricity bills but not gas. The cost of subsidies for renewable energy such as Feed-In Tariffs, Renewable Obligation Certificates and Contracts for Difference are currently charged to electricity bills, but not gas. According to Ofgem, around 23% of the costs of the average residential energy bill are accounted for by policy costs, compared to less than 2% of the costs of residential gas.[7]

[7] https://www.ofgem.gov.uk/publications-and-updates/infographic-bills-prices-and-profits

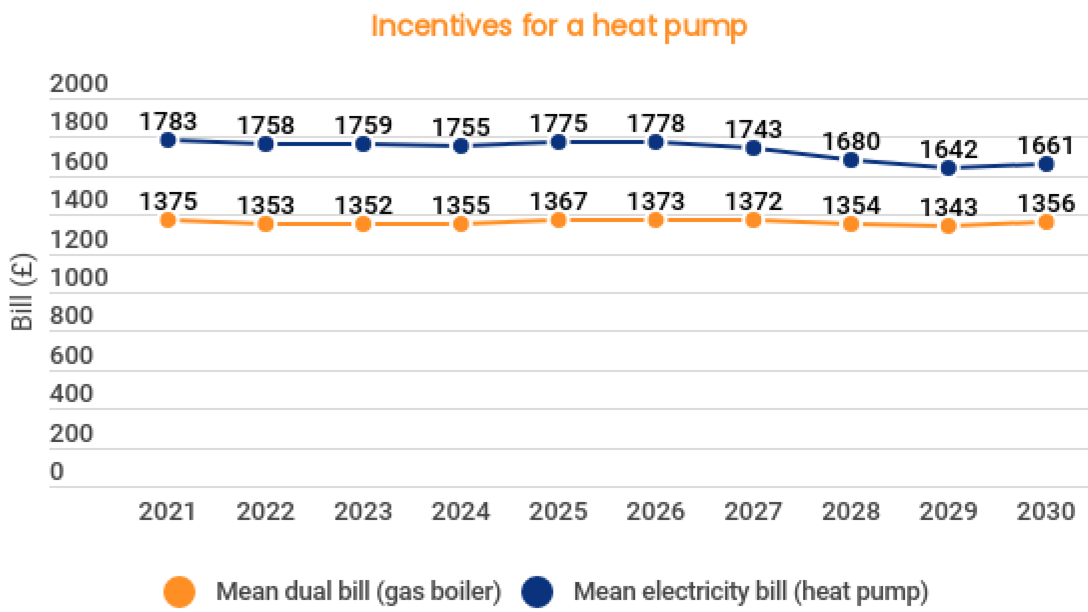
## Breakdown of average residential energy bills (CCC, 2020, p/kWh)




Without policy changes, we will continue to implicitly penalise households that switch to electric powered heat pumps - despite these being far better for the environment.

As the chart below shows, in 2022 a household with mean consumption with a gas boiler would spend £405 less a year than the equivalent household with a heat pump - and that is only taking into account running costs. By 2030, the gap is still an estimated £305 per year[8].

[8] BEIS assumptions include a reduction in electricity costs, regardless of policy changes, by 2030, and some small increase in gas costs.




**Making decarbonised heating work for consumers**

There are three current challenges with heat pumps, all of which need to be tackled:

- They are expensive to buy. Upfront capital costs remain high and there are highly variable estimates by companies about how rapidly they will come down, especially on the technology. Many of the companies that funded this paper are optimistic about savings to be made as the market develops, particularly through reduction of friction costs and availability of installers.
- There are consumer concerns about disruption and associated costs. We know that heat pumps face several behavioural barriers. Other research shows that people continue to have concerns about their size and the requirements for installation, potential noise, and the need to change radiators in their home. That makes it even more important that the benefits – in the form of lower prices – are clear[9].

Neither of the above are the subject of this paper but tackling them has to be part of an overarching policy response.

[9] For example see DGA, Getting Net Zero Done, May 2020.

They are too expensive to run compared with alternatives (particularly gas boilers). This is the core subject of this paper.

Unless policy costs are dealt with, and the running costs of heat pumps are addressed, reducing capital costs is insufficient to transform take-up.

# The Purpose of this Paper

This paper presents policy options that would allow the government to remove the running cost disincentive on electrified heating, while still achieving three other core aims:

**1.** Maintain affordability of heating for average households across the country;

**2**. Not substantially increase costs for the fuel poor; and

**3.** Not put an undue fiscal burden on the government finances.

The paper is focused on residential households, and particularly mean and median households, and those in fuel poverty. While the modelling did not address business costs, the profile for SMEs – whose primary fuel costs come from heating buildings – is likely to be relatively similar (though with larger bills).

**The modelling was undertaken by Public First in March 2021, with support from:**

- OVO Energy;
- E.ON;
- EDF Energy;
- ScottishPower; and
- Centrica.

**Policy costs**

By policy costs, we are referring to decisions made by the government to place additional costs on energy bills in order to achieve policy aims (chiefly decarbonisation of the power sector and energy efficiency). These are summarised below:

a. Efficiency
   i. Energy Company Obligation (ECO)
   ii. Smart meter roll-out
b. Carbon tax:
   i. EU ETS costs (EU ETS);
   ii. The additional Carbon Price Support cost (CPS)
c. Renewable costs:
   i. Renewable Obligation Certificates (ROCs)
   ii. Feed-In Tariffs (FITs)
   iii. Contracts for Difference (CfDs)
d. Other:
   i. Warm Homes Discount (WHD)

We have not modelled the Renewable Heat Incentive (RHI) or the Clean Heat Grant and focused solely on running costs.

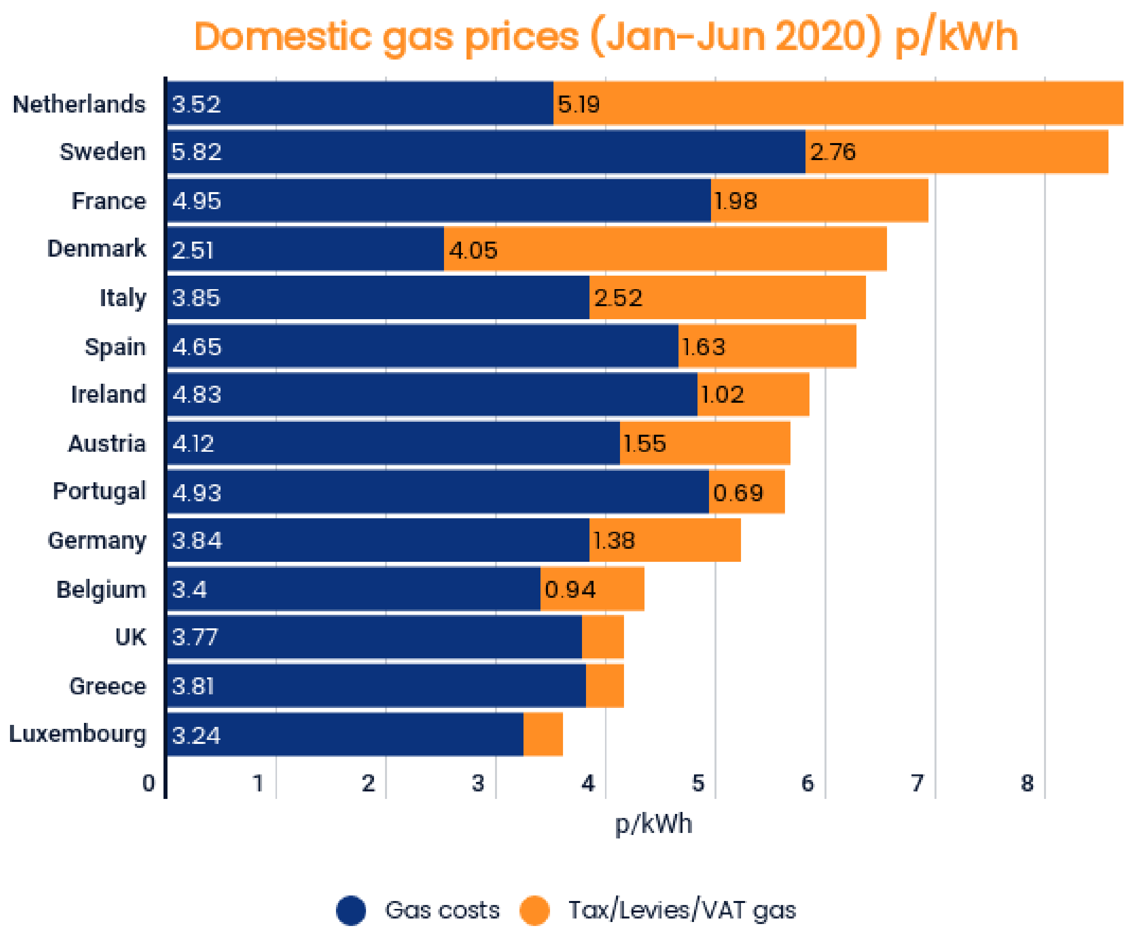
As we write this, the only policy costs levied on domestic gas are much smaller and primarily for energy efficiency and provision of the Warm Homes Discount. (the incoming green gas levy is not included in our modelling and is also relatively small).

Our central argument is that these policy costs are necessary to achieve decarbonisation, but should not be placed solely on domestic electricity rather than gas when so much of the government’s plans are – rightly - to encourage the update of electric heating.

# The UK's comparative position

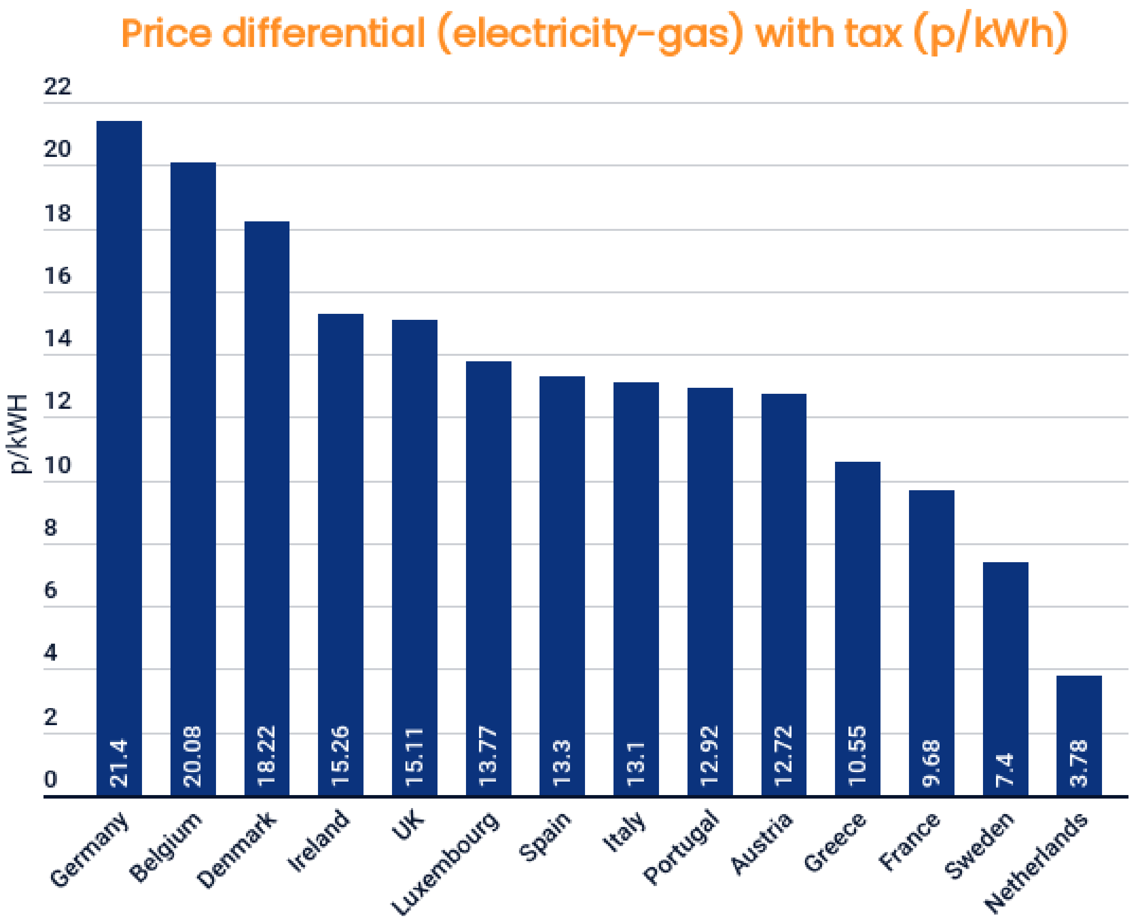
*Prices*

The UK places high relative costs on electricity but low relative costs on gas, as the chart below shows.




(BEIS Energy Prices, International Comparisons, Dec 2020)

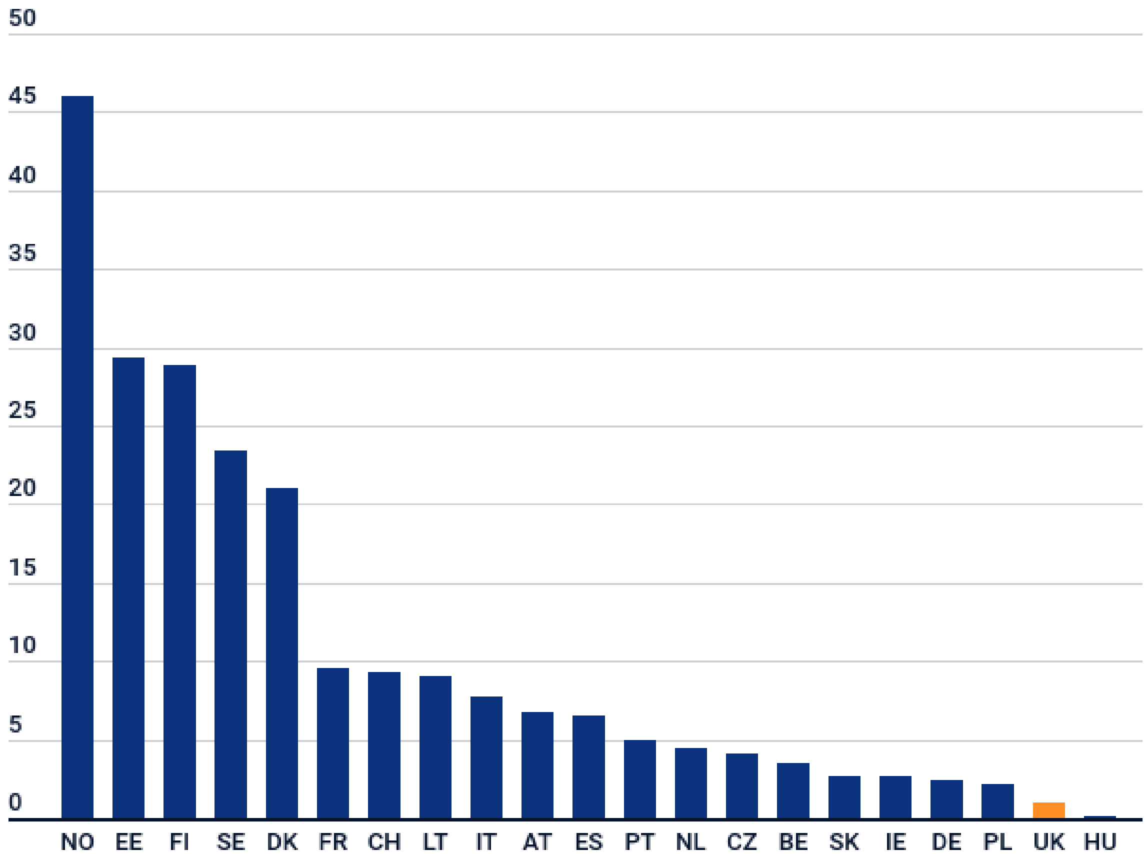
The UK's differential price (the cost of electricity compared with gas, once taxes and levies are included) is also relatively high by European standards.




(BEIS Energy Prices, International Comparisons, Dec 2020)

At the same time, the UK has lagged very significantly behind its counterparts in heat pump use and purchase.

Heat Pump units sold per 1000 households




(latest EHPA data-2018)

To reverse the trend, policy will need to change. Below, we outline some examples of comparator countries and their approaches to heat pump incentivisation and running costs. We have not focused on the Nordic countries, since both their policy environment and source of energy is so markedly different. Instead, we have selected:

- France which is one of the top 3 heat pump markets in Europe, and has a relatively low differential price between electricity and gas;
- Germany, a top ten market for heat pumps, has very expensive electricity with high levies, but has instituted a number of major recent policy changes to increase the relative price of gas; and

- The Netherlands, which has been cited in a number of recent case studies for heat pump introduction, and which has relatively high gas prices.

All three have higher market share of heat pumps in absolute terms, as well as per capita, than the UK. However, all three have also seen more success in new builds than in existing properties, and both Germany and France are instituting new policies to increase take up.

We summarise the differences between these countries and the UK below, and then describe them in more detail.

| **Country** | **Renewable levy rate (pkWh)** | **Price differential (electricity-gas) (pkWh)** after taxes included | **Costs on gas** | **Upfront incentives for heat pumps** | **Regulation on heat pumps** |
|---|---|---|---|---|---|
| UK | 3.1 | 15.1 | Ofgem estimates that policy costs make up 1.9% of average gas bill. | | |
| Germany | 5.5 | 21.4 (this is likely to reduce as the new gas carbon tax comes into effect) | A new carbon tax at £25/t$CO_2$e rising to £55/t$CO_2$e in 2025 | Up to 35% of the cost of a heat pump up to €30, 000 (or up to 45% where the heat pump is replacing an oil-based system).<br>20% of retrofitting costs are tax deductible up to €40,000.<br>30% of the cost of replacing heat pumps with more efficient models is funded | New buildings are required to use renewable energy for at least some of their heating, with strict standards highly incentivising the use of heat pumps. |
| France | 2 | 9.7 | Carbon tax at £38/t$CO_2$e | Up to €20, 000 over five years.<br>Eco loan offers 0% interest for up to €30, 000. | Regulation limits energy consumption in new builds, but this is less strong than in other countries. |

| | | | | | |
|---|---|---|---|---|---|
| Netherlands | 0.9 | 3.8 | Dutch renewable costs are levied on gas. They also provide a fixed lump sum relief of €461.62 for electricity bills. | A subsidy (ISDE grant) is available for heat pumps. The subsidy varies substantially but is typically 20% of the cost. | The main regulatory lever has been on new builds which ban gas connections – more than 50% of new builds use heat pumps. The Dutch government also has overall stringent targets to reduce gas use. |

*We have not discussed the Renewable Heat Incentive in this comparator table or the rest of the paper because it will cease to be in use, and there is no certainty about any replacement.*

***Germany***

Most of Germany's historic growth of heat pumps has been driven by new builds – in 2018 renewable energy overtook gas as the primary source of heating in new builds for the first time[10]. Germany very recently introduced a new carbon tax on gas which will reach to £55/t$CO_2$e alongside a bigger incentive package for existing homes.

*Policy costs*

- Germany runs an auction based mechanism under their renewable energy law (*Erneuerbare-Energien Gesetz*, EEG)[11]. Germany's EEG surcharge accounts for around 20% of consumer power bills, and in 2021 is at c. 5.5p/kWH compared with 3.1p/kwH in the UK rising to 4.3p/kwH (x3) in 2030[12][13].

10 https://www.cleanenergywire.org/factsheets/heating-40-million-homes-hurdles-phasing-out-fossil-fuels-german-basements

11 https://www.unendlich-viel-energie.de/themen/politik/foerderung2#:~:text=Der%20Ausbau%20Erneuerbarer%20Energien%20ist%20politischer%20und%20gesellschaftlicher%20Konsens.&text=Erneuerbare%20W%C3%A4rme%20wird%20auf%20Bundesebene,oder%20Hackschnitzelheizungen%20finanziell%20unterst%C3%BCtzt%20wird

12 https://www.cleanenergywire.org/glossary/letter_e#eeg_surcharge and https://www.bundesnetzagentur.de/SharedDocs/A_Z/E/EEG_Umlage.htm

13 https://www.e-wie-einfach.de/faq/faqs/was-ist-die-eeg-umlage and https://www.verivox.de/strom/themen/eeg-umlage

- However unlike the UK, Germany has no additional carbon price on electricity other than the ETS price (the UK has an additional £18/$tCO_2e$).
- Germany *has also* recently announced an increasing carbon price on gas, at £25/$tCO_2e$ rising to £55/$tCO_2e$ in 2025[14].
- €11 billion was invested last year as part of a Covid-19 stimulus package in order to keep the renewable levy from rising by 40% in 2021 to a forecasted 9.651 cents per kWh, keeping it at 6.5 cents per kWh instead.

*Upfront incentives*

- Germany has a Market Incentive Programme (MAP) which has allocated over €400 million a year. Homes can get up to 35% of the cost of a heat pump (40% if replacing an oil-based system) for a total maximum of €30,000.
- In addition, 20% of spending on retrofitting is tax deductible up to €40,000, and 30% of the cost of replacing heat pumps with more efficient models is funded.

*Regulation*

- New buildings are required to use renewable energy for at least some of their heating under the Renewable Energies Heat Act. There are also strict standards which are very hard for heating systems using fossil fuels to meet[15].
- Energiewende and Energy Efficiency Ordinance in the buildings sector have stringent targets for energy efficiency[16].

The German Heat Pump Association (IWP) and funded information campaigns have also supported take up.

***France***

France's high heat pump rate of take-up (at 120k pa) is supported by a much lower differential between gas and electricity costs than other comparator countries, which in turn is because of carbon taxation on gas and lower renewable levies on electricity. There

[14] https://www.thelocal.de/20210101/germany-rings-in-2021-with-co2-tax-coal-phase-out/
[15] https://www.sunwindenergy.com/new-buildings-germany-now-required-to-use-renewable-energy-heating
[16] Vivid Economics for BEIS, International Comparisons of Heating, Cooling and Heat Decarbonisation Policies, November 2017

have also been a range of substantial up front incentives to support heat pump take up. These have recently been increased as part of a Covid-19 stimulus package.

*Policy costs*

- A CSPE tax is levied on electricity bills at a rate of c.2p/kwH (i.e. substantially below German and UK levels). This level hasn't changed since 2016[17]. Traditionally, this funded renewable energy – however it is paid into the general state budget of France and is not hypothecated. It has also traditionally funded some fuel poverty measures.
- In addition, France has a carbon tax, including on gas, that is set (and has also been frozen for several years) at £38/t$CO_2$e.

*Upfront incentives*

- The MaPrimeRenov scheme is replacing the older CITE scheme to support upfront costs of heat pumps and other renewable energy equipment, with level based on income and carbon abatement potential. There are a number of bonuses in the scheme – depending on the energy label before and after the renovations are complete. The work also benefits from reduced VAT rates[18].The total amount of funding obtained through the MaPrimeRénov' scheme may not exceed a maximum threshold of €20,000 and can be used over 5 years[19]. Some households will get up to 90% of the cost of installation.
- There is also a 0% interest Eco-loan of up to €30,000 for energy-efficient residential renovations, including the installation, regulation, or replacement of heating or hot water systems, including those using renewable energy[20].

*Regulation*

[17] https://www.edf.fr/sites/default/files/contrib/groupe-edf/espaces-dedies/espace-finance-en/financial-information/publications/facts-figures/facts-and-figures-2019.pdf
[18] https://www.economie.gouv.fr/particuliers/prime-renovation-energetique
[19] https://www.connexionfrance.com/French-news/France-boosts-eco-renovation-How-to-benefit
[20] Vivid Economics for BEIS, International Comparisons of Heating, Cooling and Heat Decarbonisation Policies, November 2017

- 2012 regulation limits energy consumption for new buildings constructed after 1 January 2030.

***The Netherlands***

The Netherlands faces the challenge of being a highly gas-dependent country which is trying to phase gas out, with the Groningen gas fields due to close in 2022. It has combined stringent regulations with much greater incentives to move from gas to electricity than other countries.

*Policy costs*

- The Netherlands have used their SDE+ to support renewable energy production. This is about to be replaced by SDE++, which supports technologies such as carbon capture (emissions removed or avoided, as well as renewable energy). This is reflected in a tariff on gas bills, with an additional €461.62 refund to households for electricity bills.

*Upfront incentives*

- A subsidy (ISDE grant) is available for heat pumps. The subsidy varies substantially but is typically 20% of the cost[21].

*Regulation*

- A ban on new gas connections in new builds was instituted in 2018. More than 50% of new builds now use heat pumps, doubling from 2016.
- Social housing renovation targets have also meant that 2/3 of heat pump retrofits are into social housing properties.

[21] https://debreed.nl/en/financing-form/isde/

- As of 2020 a new higher energy standard is in place for new builds ("Nearly Zero Energy")[22]

[22] https://heatpumpingtechnologies.org/annex46/wp-content/uploads/sites/53/2020/10/hpt-an46-02-06-task-1-counry-report-netherlands.pdf

# The model and options for the government

We have modelled four core scenarios and compared them with a 'do nothing' scenario (our baseline). In each case, we have looked at the dual fuel bill for the household with median and mean consumption, and fuel-poor household between now and 2030, and compared it with the cost of running a heat pump.

In all four of our scenarios, we moved efficiency costs – the Energy Company Obligation – from both electricity and gas bills onto gas bills alone as a step towards a better balancing of the policy costs on electricity and gas. We have also assumed in all scenarios that current carbon prices – in the form of ETS and CPS costs – would either remain on electricity or be replaced by a higher carbon price. We have been conservative in our estimate of heat pump efficiency[23] - if this is higher than modelled the operational savings will increase. More details on our assumptions and the impact of varying them is given in the appendixes.

In the case of changes to carbon tax and renewable support, we have quantified the impact on government income and expenditure of changes to domestic arrangements. This paper does not consider the merit or impact of making equivalent changes to the non-domestic market.

The difference in scenarios is then described below.

**1. Removing the domestic cost of renewable subsidies off energy bills onto government expenditure, with no additional carbon tax:**

- In this scenario, ROCs, FITs, and CfD costs would be paid for through government expenditure. Carbon pricing remains in line with current policy.
- *This would be the most straight forward change for households but would also significantly increase government expenditure.*

**2. Removing the domestic cost of renewable subsidies off energy bills onto government expenditure and introducing an additional carbon tax onto electricity and gas:**

[23] We have modelled at 233% not 300%.

- In this scenario, ROCs, FITs, and CfD costs would be paid for through government expenditure. In addition, a carbon tax would be levied across electricity and gas, starting at £54/tCO2e at a consistently increasing rate up to £75/tCO2e in 2030. Given electricity is assumed to become increasingly renewable, gas would bear an increasing proportion of the carbon charge.
- *This would be consistent with pricing carbon emissions across the economy - and provide additional revenue that could be recycled to cover the cost of legacy renewables payments.*

**3. Evening out the current policy costs across electricity and gas, and introduce an additional carbon tax on electricity and gas:**

- In this scenario, 50% of the currently anticipated ROCs, FITs, CfD costs would be moved onto gas bills from electricity bills. In addition, a carbon tax would be levied across electricity and gas, at a consistently increasing rate up to £75/tCO2e in 2030.
- *This would remove some of the imbalance in how current policy costs are allocated, while not requiring any additional government revenue.*

**4. Moving the cost of renewable subsidies from electricity to gas, with no additional carbon tax.**

- In this scenario, all of the currently anticipated ROCs, FITs, CfD costs would be moved onto gas bills from electricity bills. No other changes would be made.
- *This would more than correct the correct policy cost imbalance, and deliberately encourage consumers to switch away from gas.*

These are summarised below.

| **Scenario** | **Renewable subsidies**[24] | **Carbon taxation** |
|---|---|---|

[24] In the case of renewable support costs (RO, FiT, CfD) we have assumed for simplicity that any change applies to the entirety of renewable support costs. An alternative policy choice would be to move only the legacy component of the costs, rather than new costs. As legacy costs account for the majority of renewable costs to date, however, this would not significantly change the modelling results.

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<tr><td>1</td><td rowspan="2">Moves from electricity bills to general taxation</td><td>Current charges only (and therefore on electricity, not gas)</td></tr>
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<tr><td>3</td><td>Spread between gas and electricity</td></tr>
<tr><td>4</td><td>Move onto gas alone</td><td>Current charges only</td></tr>
</table>

*Scenarios 2,3, and 4 all achieve the aim of making heat pumps less expensive to run than a gas boiler by 2030.*

## Our principles

We looked at each of the scenarios under the following criteria:

- What incentive does it provide to take up heat pumps?
- What does it mean for fuel bills for the mean and median customer?
- What does it mean for fuel bills for the fuel poor, who may be stuck on gas?
- What does it mean for government revenue and spending?

No solution can optimise across all four. We have summarised below what we think each scenario means under these criteria.

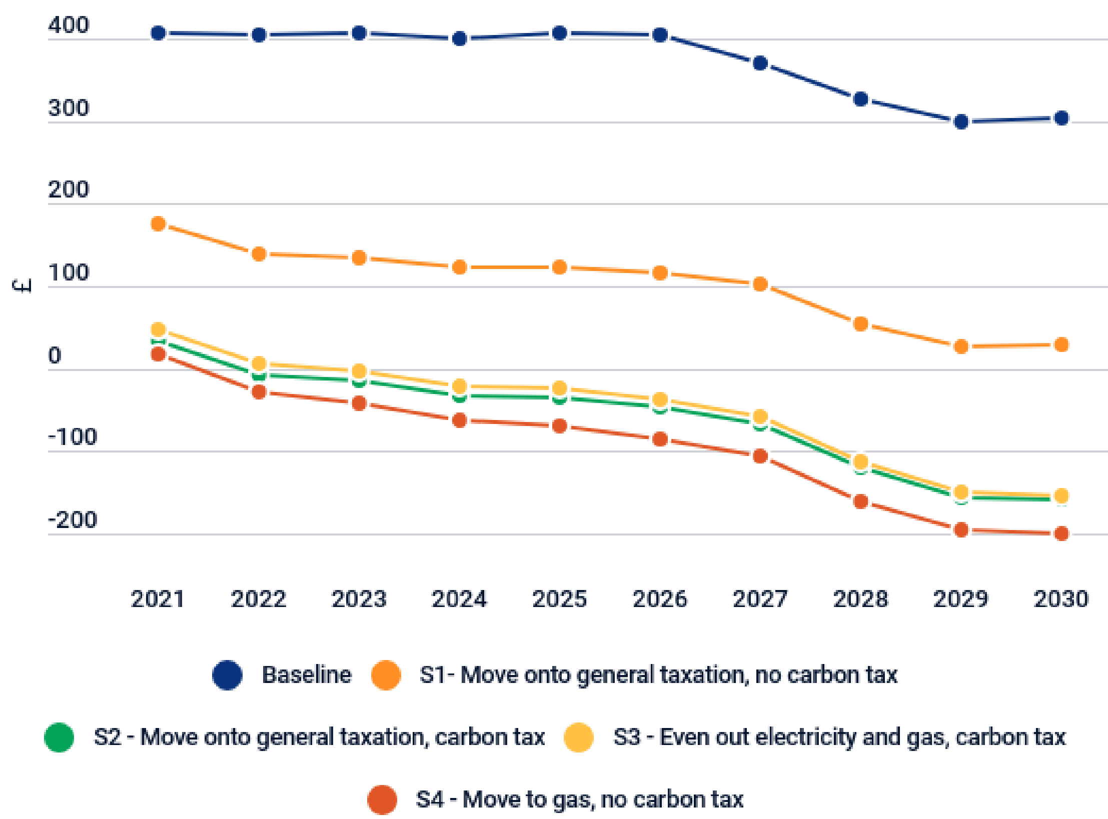
| | *Incentive to take up heat pumps in 2030* | *Fuel bills in 2030 compared with baseline* | *Government revenue and spending in 2030 compared with baseline* |
|---|---|---|---|
| 1. Policy costs onto general taxation | The running cost of heat pumps is near equalised to gas boilers by 2030. | The average fuel bill would decrease by £168 (-12%) per year for the average consumer and by £178 a year for the fuel poor | This would have a significant impact, increasing government net spending by £5.7 bn |
| 2. Policy costs onto general taxation and an increased carbon tax on electricity and gas | Heat pumps become £159 a year cheaper to run than a gas boiler | Costs would increase slightly - by £38 (+3%) a year for the mean consumers and £40 for the fuel poor | Government net spending increases by £0.2 billion. |
| 3. Policy costs even between electricity and gas, with an additional carbon tax on electricity and gas | Heat pumps become £154 a year cheaper to run than a gas boiler | Dual fuel bills substantially increase – by £234 a year (+17%) by 2030 for the average consumer and £248 for the fuel poor | Government net revenue increases by £5.5 billion. |

| | | | |
|---|---|---|---|
| 4. All policy costs onto gas. | Heat pumps become £200 a year cheaper to run than a gas boiler | Increases overall bill by £70 (+5%) a year for the average consumer and £65 a year for the fuel poor | Government revenue unchanged. |

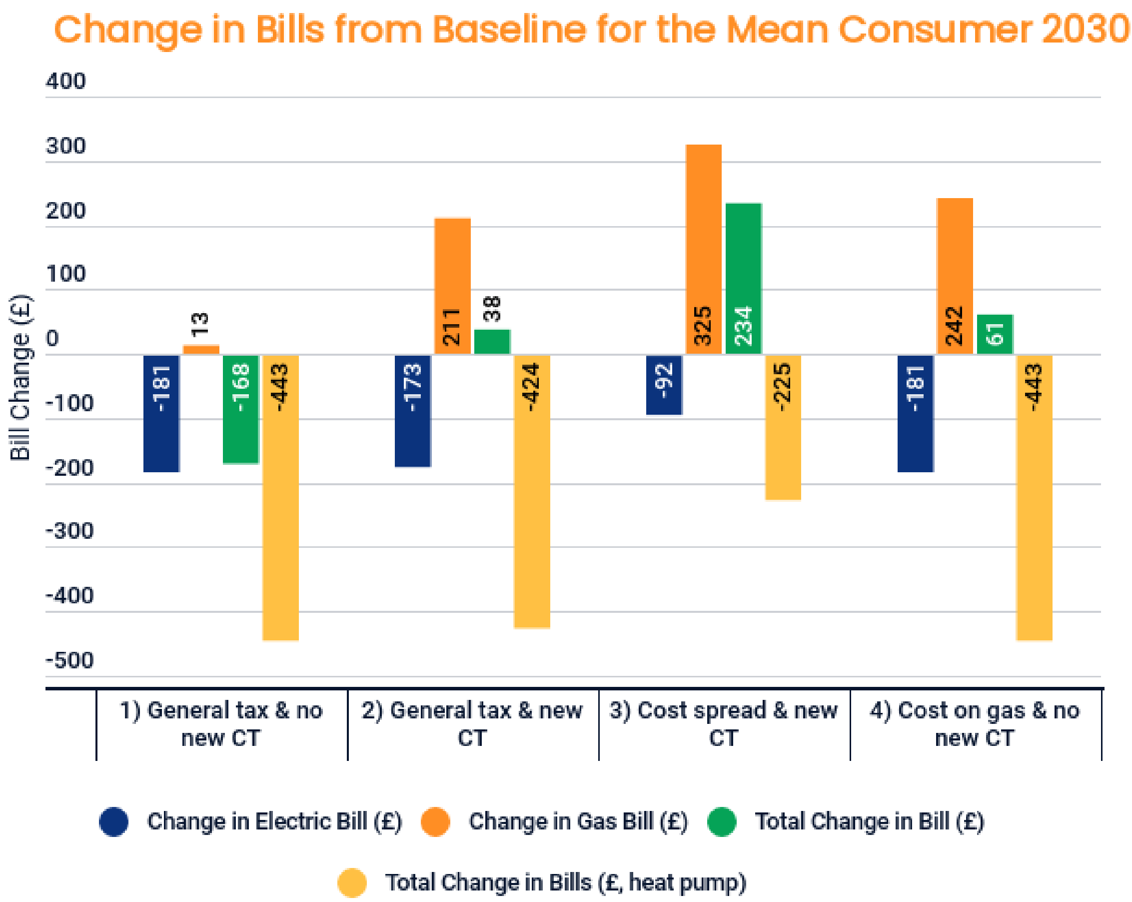
The charts below show what this means across the scenarios in 2030.

The two charts below show that all the scenarios reduce the cost of running a heat pump compared with current policy, and all but scenario 1) make them cheaper to run in 2030 than gas.

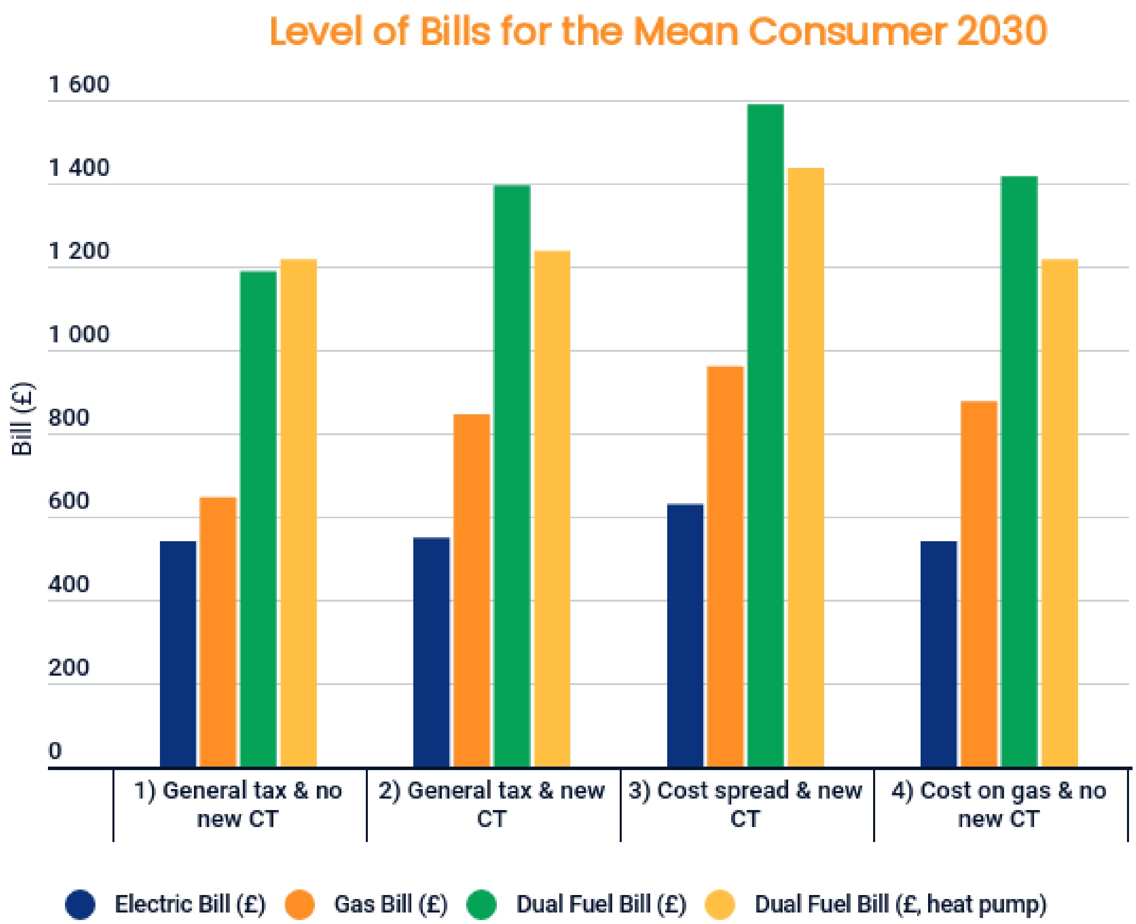
## Additional annual cost of air source heat pump for average household



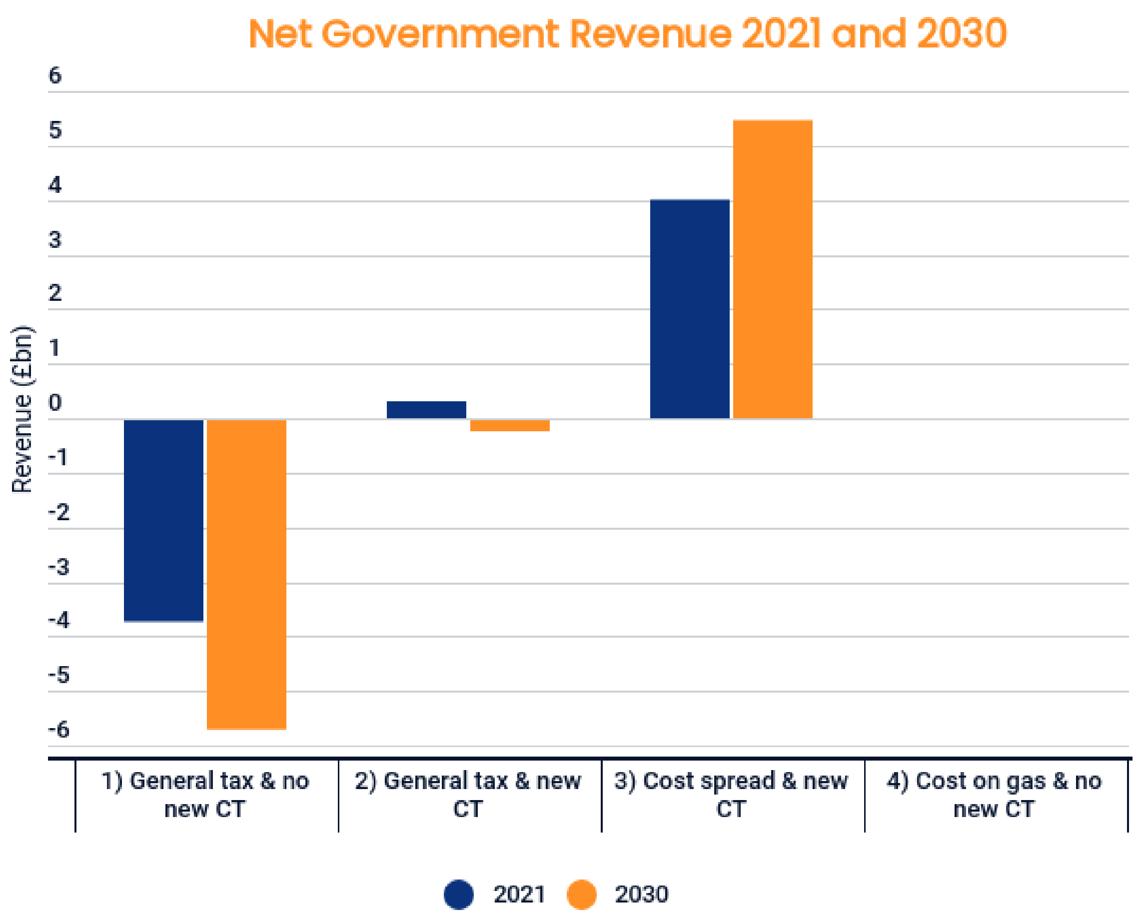

Equally, all scenarios except 1) increase bills in 2030 for those who stick to gas, although when policy costs are moved to general taxation and a carbon tax is introduced, the impact on dual fuel bills is relatively low (£38 a year, or £3.20 a month). We know from other polling that there is a direct relationship between the amount bills go up, and the support for new taxation on gas bills[25].



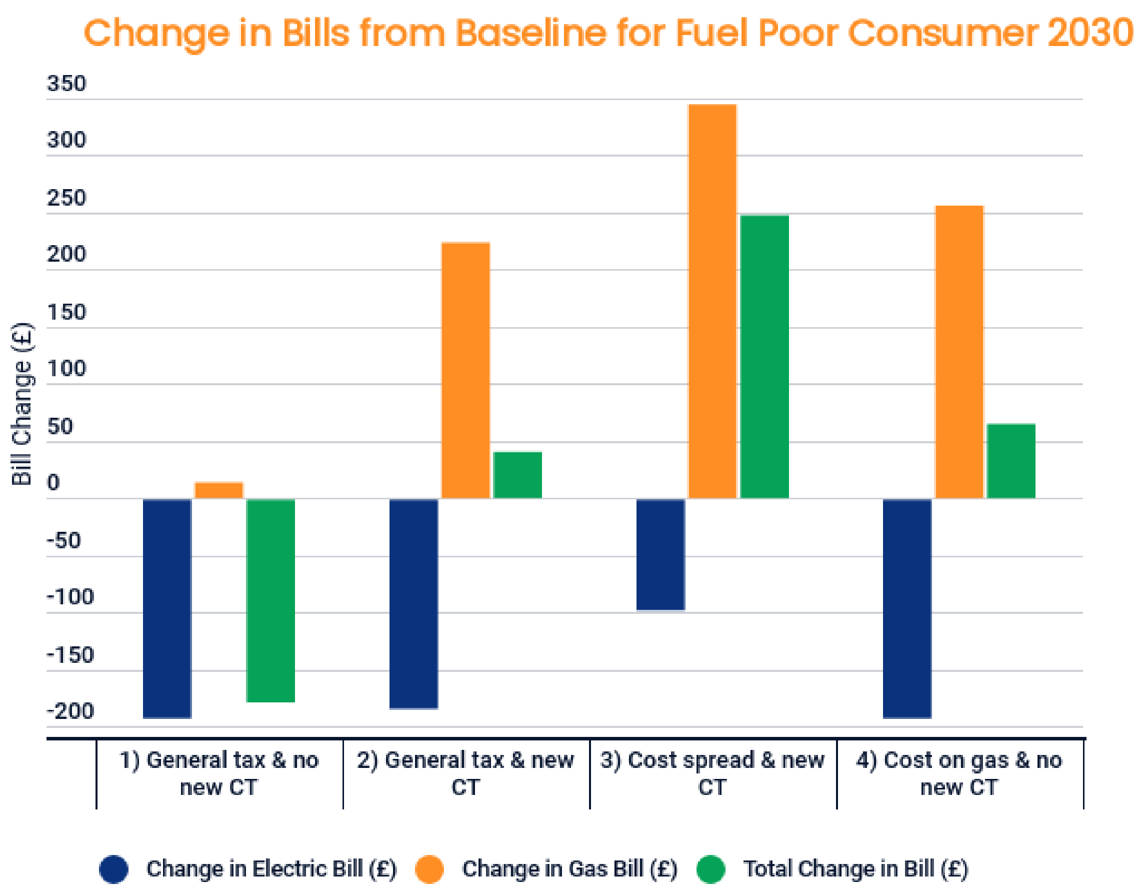

[25] See ZeroC polling, 2020

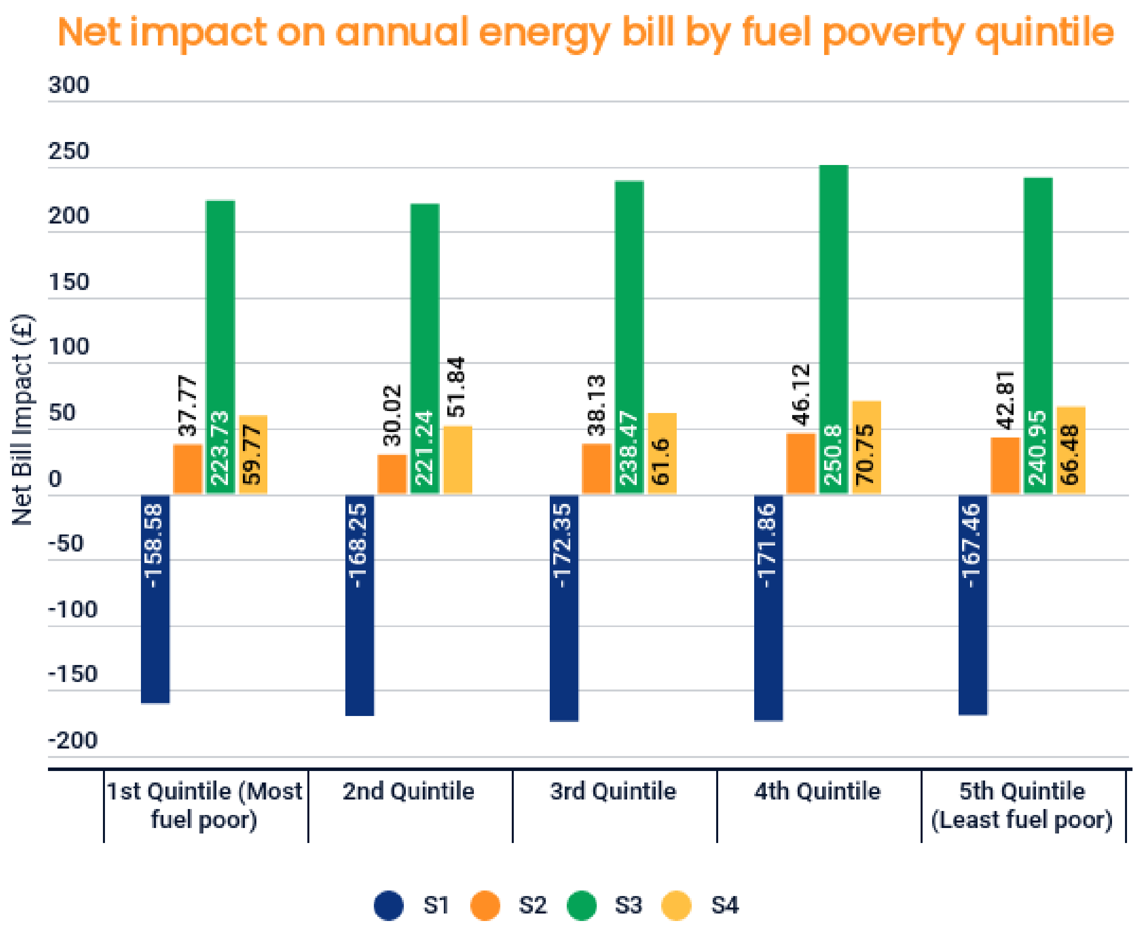

Level of Bills for the Mean Consumer 2030
Bill (£)
1 600
1 400
1 200
1 000
800
600
400
200
0
1) General tax & no new CT
2) General tax & new CT
3) Cost spread & new CT
4) Cost on gas & no new CT
Electric Bill (£)
Gas Bill (£)
Dual Fuel Bill (£)
Dual Fuel Bill (£, heat pump)

In terms of government revenue (but not fuel bills) scenario 3) is by far the most positive (with a concomitant rise on bills), while scenarios 1 and 2 would require some additional funding from government.



The impact on the fuel poor is similar to the average consumer – overall bills are slightly affected in scenario 2, somewhat affected in scenario 4, and extremely adversely affected in scenario 3. When we break down the impact by fuel poverty quintile, we again see that the differences between scenarios are much more significant than within them




Net impact on annual energy bill by fuel poverty quintile
Net Bill Impact (£)
300
250
200
150
100
50
0
-50
-100
-150
-200
-158.58
37.77
223.73
59.77
-168.25
30.02
221.24
51.84
-172.35
38.13
238.47
61.6
-171.86
46.12
250.8
70.75
-167.46
42.81
240.95
66.48
1st Quintile (Most fuel poor)
2nd Quintile
3rd Quintile
4th Quintile
5th Quintile (Least fuel poor)
S1
S2
S3
S4

# Appendix A: Core assumptions

All models that look at the future require assumptions. Crucially, we have tried to structure our assumptions so that, even if they prove to be out, they do not change the fundamental policy choices we present:

- **Energy Consumption.** We draw our estimates of mean and median fuel consumption by household type from National Energy Efficiency Data framework (2018). For consumption from fuel poor households, we use data for Low Income Low Energy Efficiency (LILEE) household from BEIS data for 2019.

- **Energy Efficiency.** For the purposes of this modelling, we have assumed average electricity and gas consumption for each household type remain unchanged - allowing us to focus more on the impact of policy shifts than changes in efficiency. In the next Annex, we present some sensitivity analyses of how changes in efficiency would impact our core results.

- **Residential Electricity and Gas Prices.** We use the reference scenario estimates from BEIS' estimates for *Updated energy and emissions projections: 2019*. For the purposes of our modelling, we isolate the standing charge and assume this remains constant.

- **Cost of renewables.** We build on CCC (2017)'s estimates of the cost of renewables and energy efficiency support running through to 2030, updating the latter for announced increases in the energy efficiency budget.

- **Carbon Tax.** There are obviously a large number of different carbon taxation scenarios the government might eventually choose to pursue, and there could be either a fluctuating ETS-based price, a fixed carbon price, or both. We have therefore chosen to link our carbon tax to the LSE's recommended level which reaches £75/tCO2e by 2030. For comparison, Canada's carbon taxation level is due to reach £100/ tCO2e by 2030. Sweden's level is already beyond this. Germany will reach £55/tCO2e for gas by 2025, in line with this trajectory.

- **VAT.** We have not modelled a switch in VAT levels as part of this project and assumed that VAT remains constant across energy at 5%.

- **Heat pump efficiency.** Based on stakeholder discussions with the five established energy companies that commissioned this research, we assume efficiency of 233%
- **Carbon intensity.** We use LSE (2020) estimates of average carbon intensity for electricity and gas.

In all four of our scenarios, we moved efficiency costs – the Energy Company Obligation – from both electricity and gas bills onto gas bills alone as a step towards a better balancing of the policy costs on electricity and gas.  An alternative approach which we have not modelled here - but which could also be considered in more detailed analysis - would be to move ECO costs on to general government spending.  For simplicity, our modelling assumes no change to the Warm Home Discount (WHD) scheme but the option of moving these costs either to government spending or wholly to gas bills could also be considered in any more detailed analysis. Given that ECO and WHD costs are much less than renewable support costs[26], neither of these changes would substantially affect the overall conclusions.

In the case of renewable support costs (RO, FiT, CfD) we have assumed for simplicity that any change applies to the entirety of renewable support costs. However, a distinction can be made between 'legacy' renewable support costs under closed early support schemes, where the relatively high levels of support for renewables in the early years can be justified on the basis of driving costs down through innovation/learnings, and ongoing renewable support costs (notably more recent CfD support for renewable generation such as offshore wind, subsequent to the FIDeR allocation process) which are now much less significant.  An alternative policy choice would be to move only the legacy component of the costs, but since this accounts for the majority of renewable costs to date this would not significantly change the modelling results.

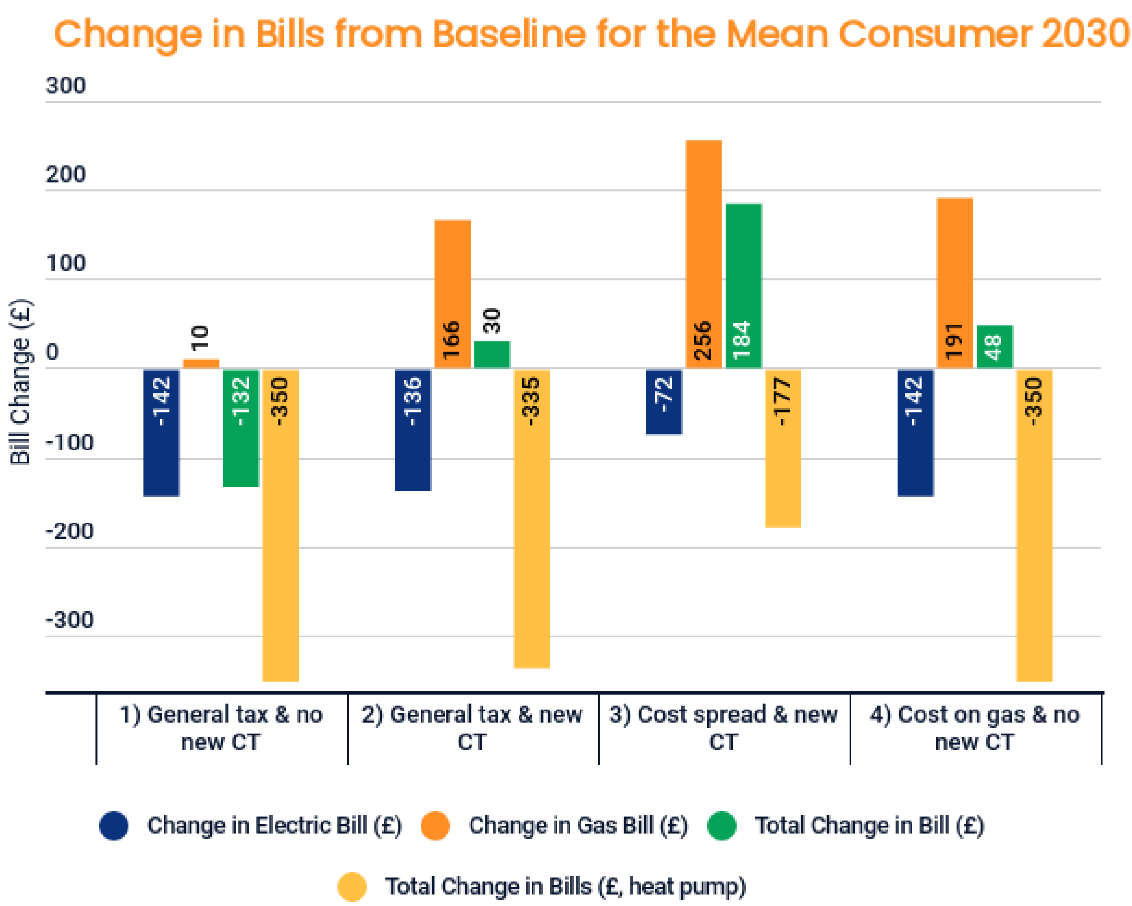
[26] We use the term renewable support costs, but other forms of low carbon electricity generation such as nuclear and CCUS are also expected to receive support under these schemes by 2030.

# Appendix B: Sensitivity Checks

*Energy Efficiency*

In our central scenario, we hold energy consumption constant to allow us to better focus on the impact of policy changes. In practice, changes to average energy efficiency are likely to be as important as changes to policy costs.

If we instead allow average household energy consumption to fall by a more realistic 2% a year, we see the overall level of bills come down across the board - but the relative story of the benefits of our different policies remains largely the same.



*Heat Pump Efficiency*

In our central scenario, we use a relatively conservative assumption of average heat pump efficiency of 233%.

If we instead use a more optimistic assumption of 300%, this significantly reduces the cost penalty a gas boiler household would face switching to an air source heat pump from £305 a year in 2030 to £95 a year.

Because of this reduced gap, all four scenarios would now see a positive incentive to move to a heat pump. Other than that change, the pattern of relative impacts again tells a similar story to our central scenario.