Heat Street

Additional analysis on bill impact of the low carbon heat transition and fuel poverty

Analysis completed April 2021
by elementenergy

For more information, visit
https://innovation.ukpowernetworks.co.uk/projects/heat-street-local-system-planning/

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Introduction to the impact analysis on average fuel bills

- The following slides show the impact on fuel bills of the deployment of low carbon heating and energy efficiency measures within Heat Street's modelled scenarios. The mean fuel bill across the housing stock in the UK Power Networks license areas is shown, first for the entire stock, and second for only the fuel poor segment.

- The definition of fuel poverty used is the same here as in the [Heat Street final report.](#) The fuel poor stock segment is defined as those households initially in fuel poverty in 2020. This segment is modelled based on sub-regional fuel poverty data (BEIS, 2020) at LSOA level, combined with correlations to building attributes. Households do not enter or leave the fuel poor segment based on modelled changes to fuel bills in our analysis.
  - The total number of fuel poor homes in the UK Power Networks license areas is approx. 760,000 (9.6%).

- Within this analysis, "fuel bills" include only the bill for space heating and hot water. Electricity use for other purposes, such as lighting and appliances, is excluded.

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Average Fuel Bill Impact Analysis

Introduction to the impact analysis on average fuel bills

- Fuel bill impacts are disaggregated based on the following steps, in the order stated:
  1. Fuel price projections are applied to give the fuel bill in 2030 and 2050, before any measure deployment
  2. Energy efficiency measures are applied, reducing the fuel bill in proportion to the heating demand saving
  3. The heating technology for each archetype is switched from the initial system to the final, low carbon, system

- Fuel price projections used are:
  - For oil, electricity and natural gas: BEIS Energy and Emissions Projections, updated May 2019
  - For hydrogen: CCC 6th Carbon Budget and National Infrastructure Commission sources

- Further information on the modelling approach and other data can be found in the project report, available at:
  https://innovation.ukpowernetworks.co.uk/projects/heat-street-local-system-planning/

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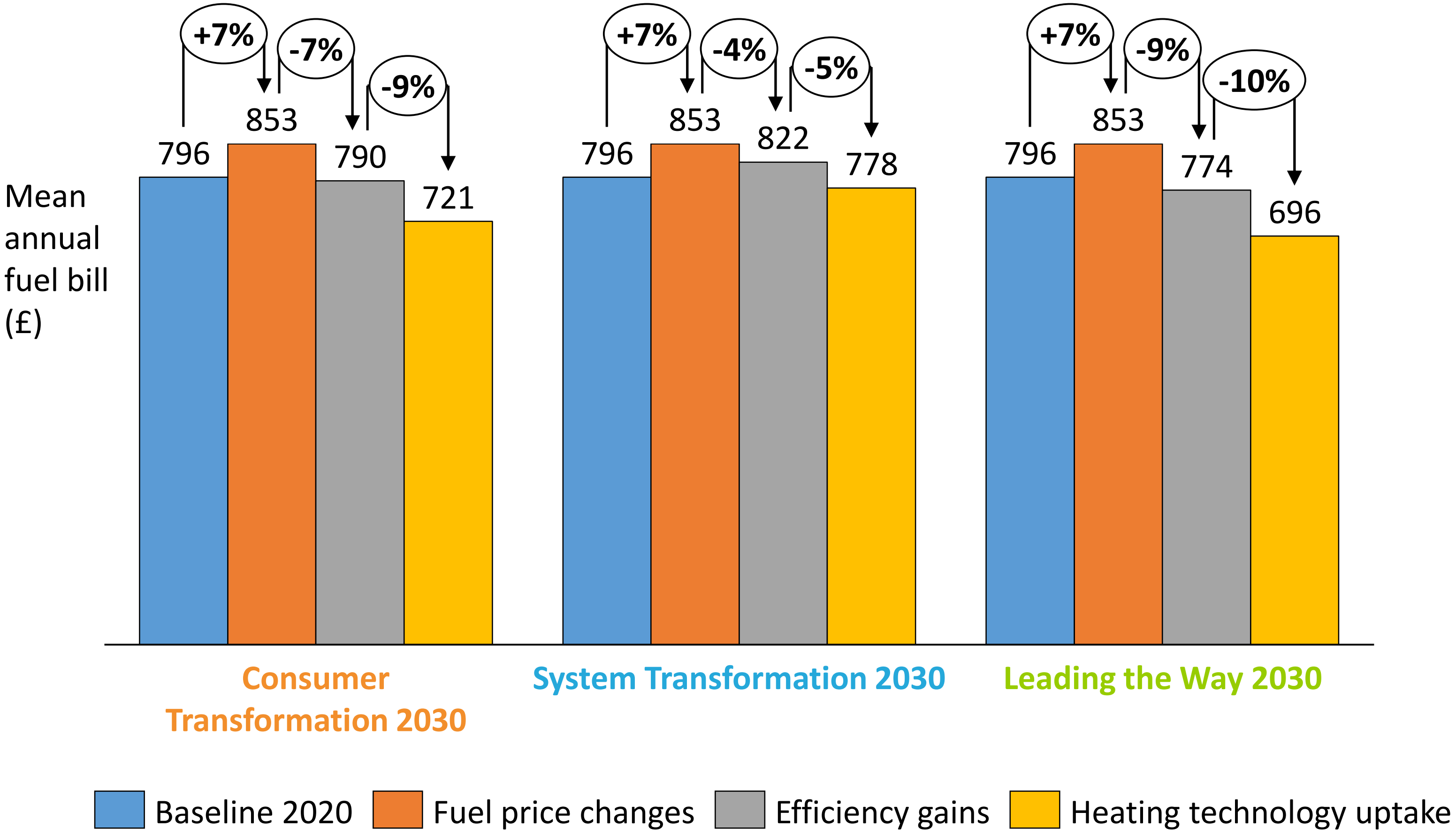
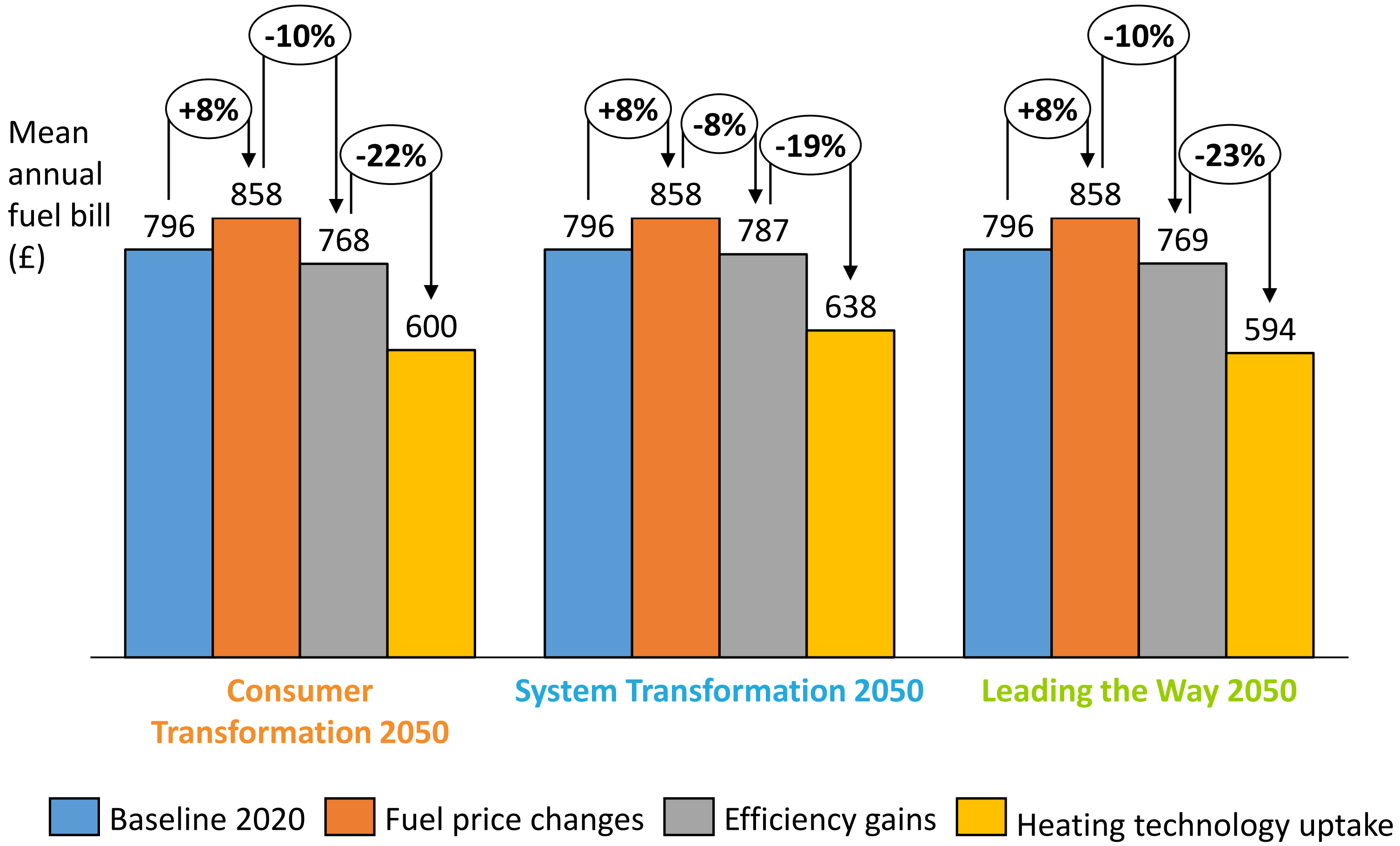
All stock mean annual fuel bill impacts, 2030

- By 2030, a projected increase in natural gas prices, despite a slight decrease in electricity prices, results in a 7% bill rise, averaged across the stock.
- Differing levels of energy efficiency deployment are achieved by 2030 across the scenarios
- The limited deployment of low carbon heat achieved by 2030 results in a fall in average fuel bill
  - However, the change in fuel bill in different stock segments are hidden within this average behaviour (see case studies)



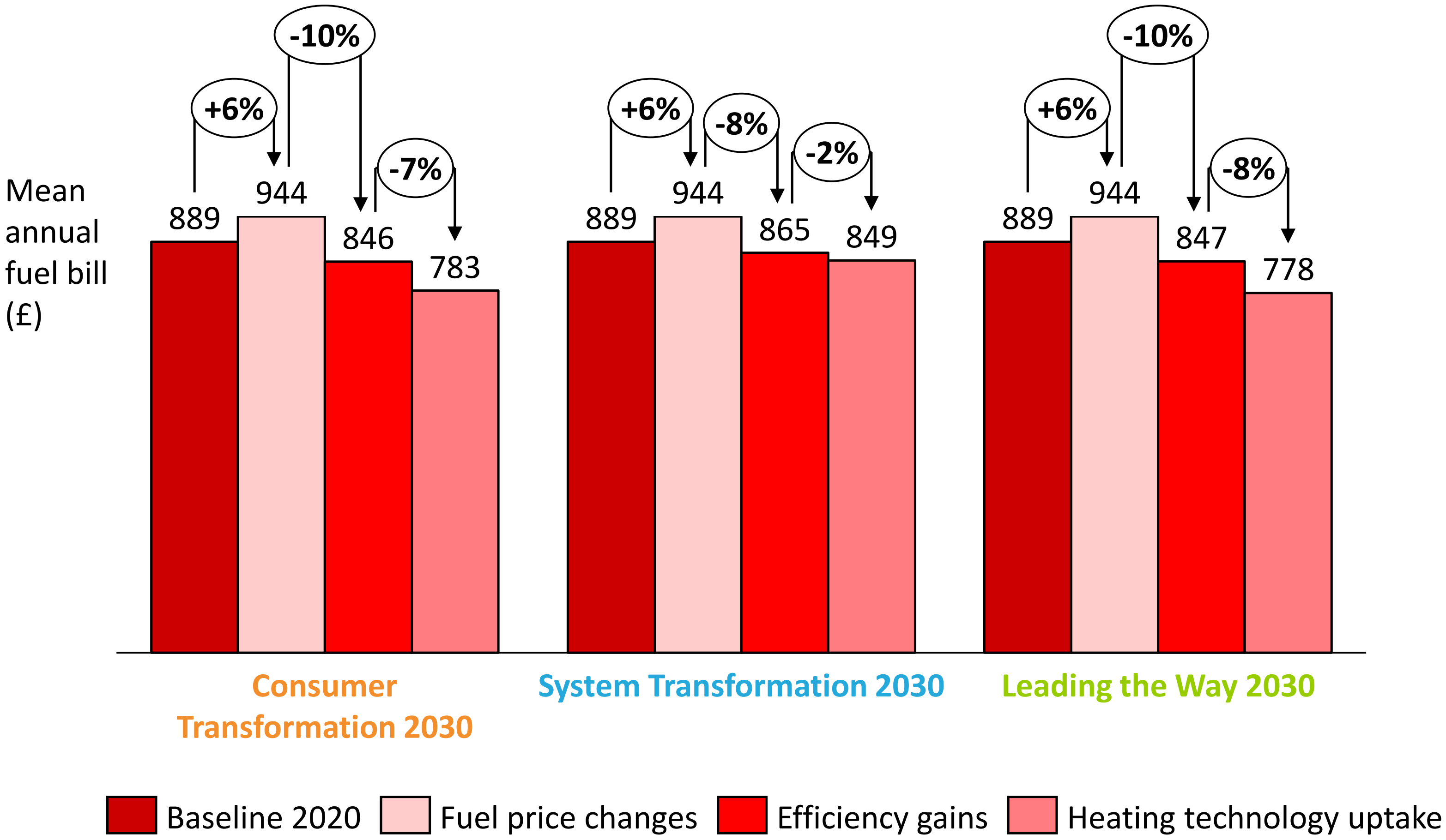
All stock mean annual fuel bill impacts, 2050

- By 2050, the deployment of low carbon heating reduces the average bill by around 20%, independently of the efficiency gains.
- The larger bill savings from heating technology uptake in this case relative to 2030 are mostly due to the wider uptake – 100% of the stock takes up low carbon heating by 2050.
- The average reduction in fuel bill on switching heating technology is not equally distributed across the stock:
  - In the System Transformation scenario, households with a gas boiler as their initial heating system, 66% of which take up hydrogen boilers, see a 7% increase in average fuel bill, but
  - However, those starting on electric resistive heating, 99% of which take up heat pumps, see an average reduction of 67%.



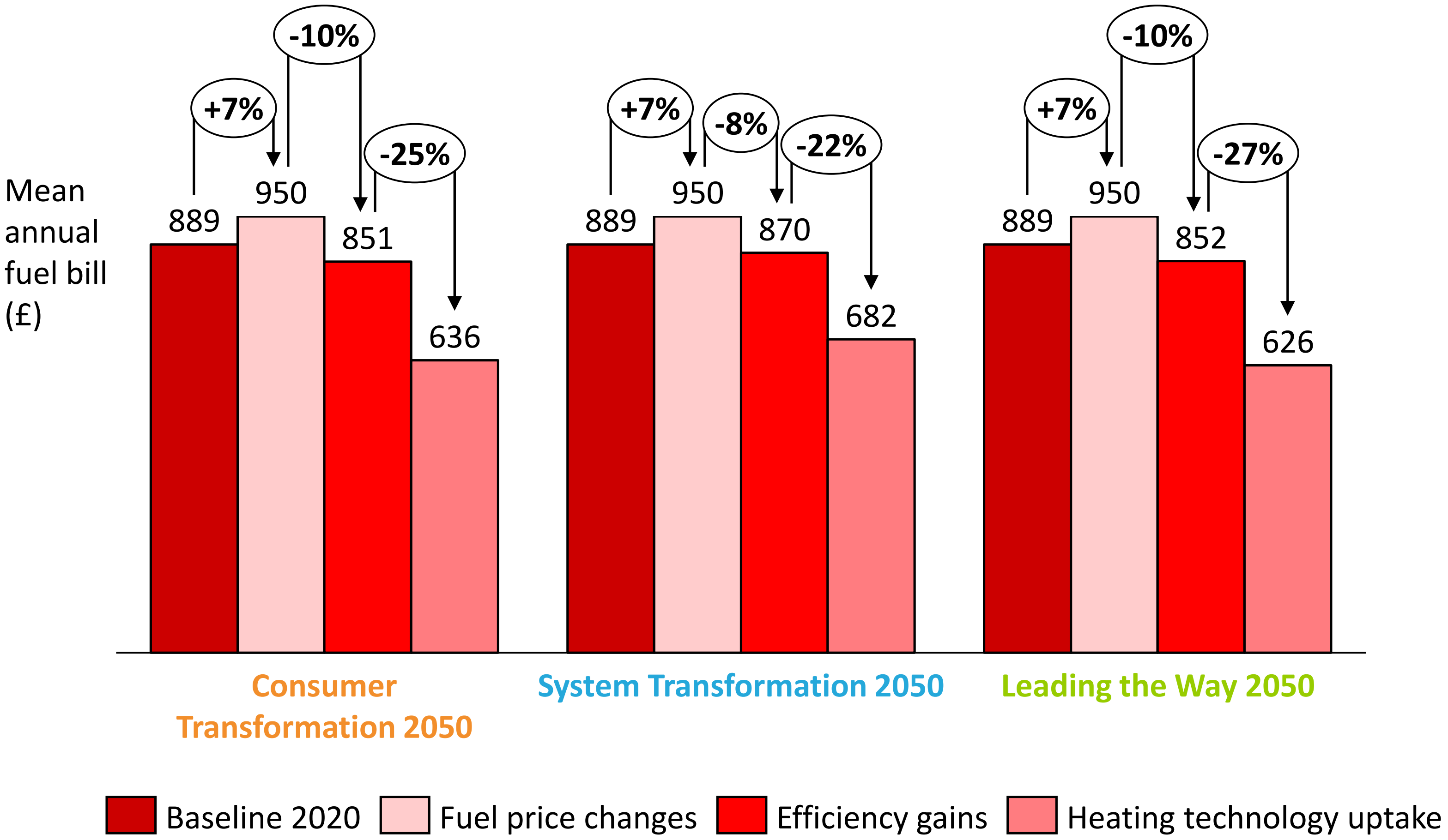
Fuel poor stock mean annual fuel bill impacts, 2030

- The average initial fuel bill of the fuel poor stock is 12% higher than for the full stock.
- The fuel poor stock is assumed to receive energy efficiency measures earlier than the wider stock, meaning a greater cost reduction to efficiency is seen by 2030.



Fuel poor stock mean annual fuel bill impacts, 2050

- The fuel poor stock sees larger reductions in fuel bill due to uptake of low carbon heating than the wider stock.
  - This mainly reflects the higher proportion of fuel poor stock starting on more expensive electric heating.



Archetype case studies

Introduction to the archetype case studies

- The following slides show the impact on fuel bills of the deployment of low carbon heating and energy efficiency measures for 3 individual building archetypes.
- These archetypes were chosen to represent a diversity of qualitatively different cases.
- As above, fuel bill impacts are disaggregated based on the ordered application of individual calculation steps. For case studies 1 and 3, the efficiency gains and final heating system are identical in all scenarios, and therefore only a single scenario is shown. In case study 2, the System Transformation scenario sees different behaviour to the other net zero scenarios, and so two contrasting bill impacts are shown.

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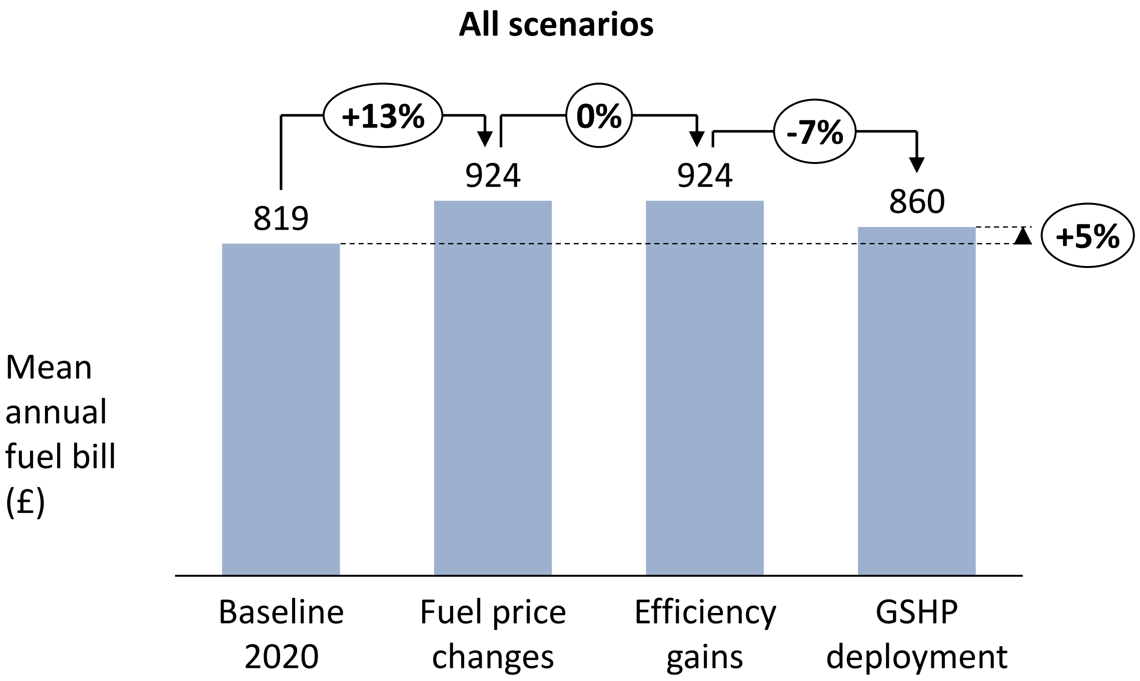
Case study 1 | large detached house

229,000 households in UK Power Networks' license areas

	Initial state	Final state
Type	Detached	
Size	Large	
Heating system	Gas boiler	Ground-source heat pump
Cavity wall insulation	✓	✓
Loft insulation	✓	✓
Floor insulation		
Behavioural & other efficiency measures		



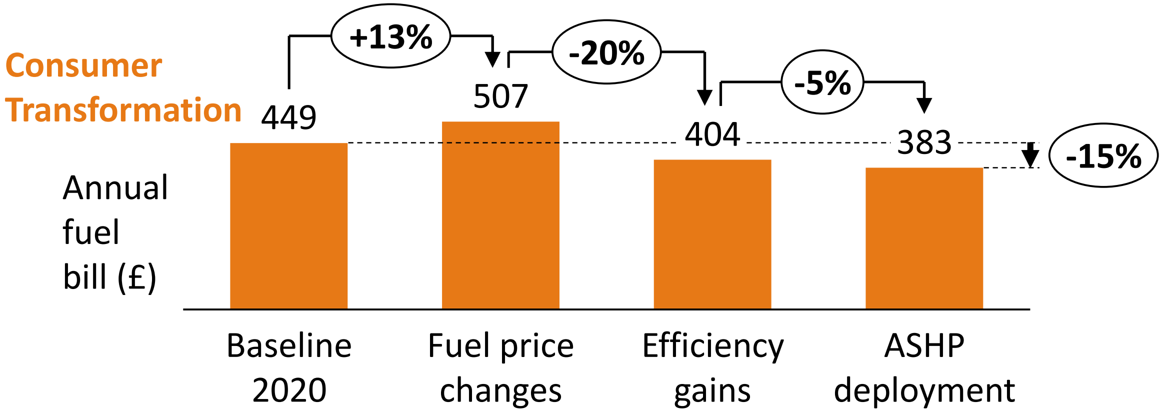
- In all scenarios, this archetype receives no efficiency measures and moves to a ground-source heat pump.
- Changing from a gas boiler to the heat pump system causes a 7% in annual bill*.
- However, given projected fuel price changes, there is a net increase in bill relative to 2020.

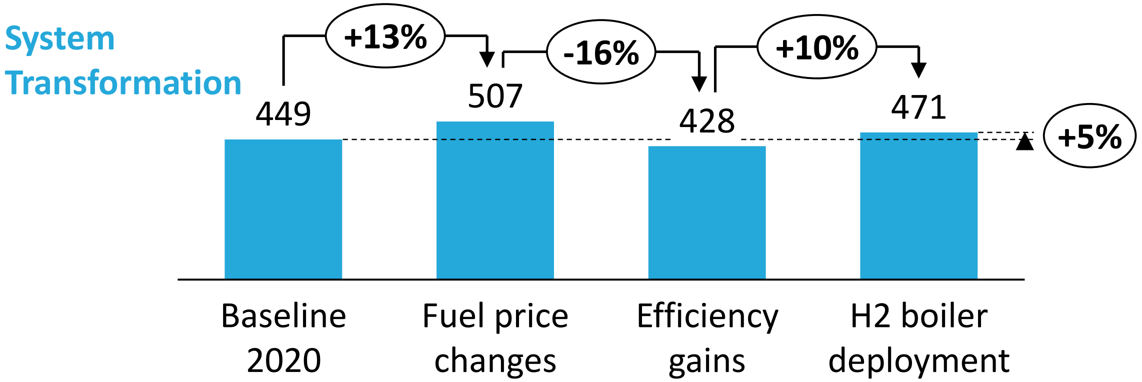
*Calculated using 2050 fuel prices. However, the equivalent values for 2030 prices are almost identical as the assumed hydrogen price does not change over time, and Gas and electricity prices projections for 2030 and 2050 differ only slightly (approx. 1%)

Case study 2 | mid-sized terraced house

220,000 households in UK Power Networks' license areas

	Initial state	Final state
Type	Terrace	
Size	Mid-sized	
Heating system	Gas boiler	**ASHP**/**H2 boiler**
Cavity wall insulation	✓	✓
Loft insulation	✓	✓+
Floor insulation		✓
Behavioural & other efficiency measures		✓





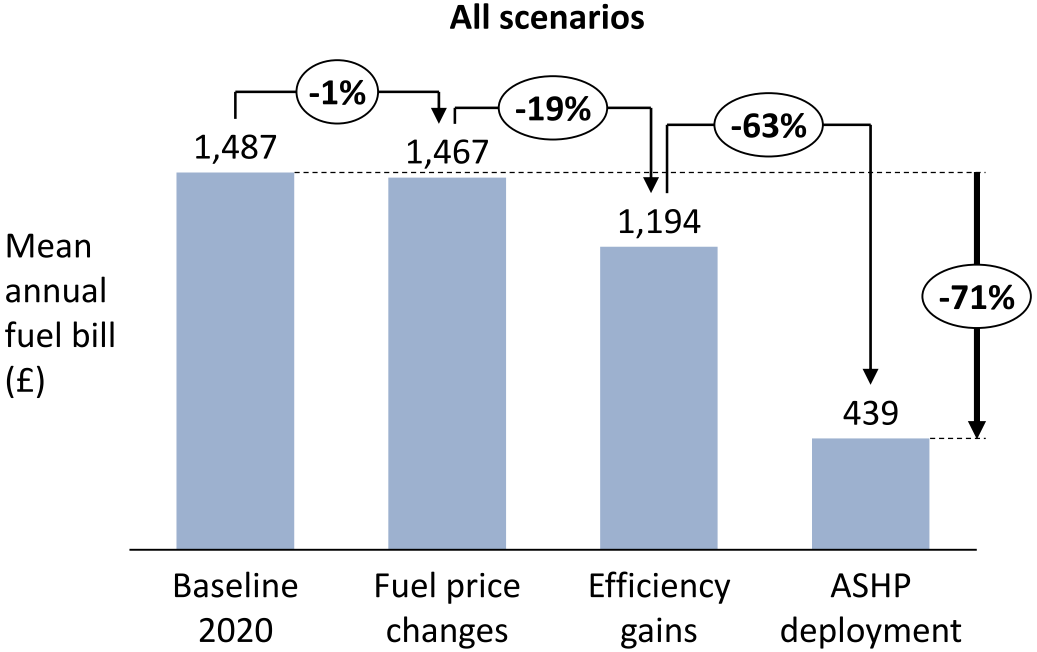
- Energy efficiency measures reduce heat demand by 20% and 16% in the Consumer and System Transformation scenarios, respectively.
- Switching from gas boiler to an ASHP causes a 5% annual bill reduction*.
- In the System Transformation scenario, the home takes up a hydrogen boiler, leading to a 10% increase in bill*, given the 5.6 pence/kWh hydrogen price assumed in this scenario.

*Calculated using 2050 fuel prices. However, the equivalent values for 2030 prices are almost identical as the assumed hydrogen price does not change over time, and Gas and electricity prices projections for 2030 and 2050 differ only slightly (approx. 1%)

Case study 3 | small flat on electric heating

19,000 households in UK Power Networks' license areas

	Initial state	Final state
Type	Flat	
Size	Small	
Heating system	Electric storage heater	Air-source heat pump
Cavity wall insulation		✓
Loft insulation	✓	✓+
Floor insulation	No floor (flat below)	
Behavioural & other efficiency measures		✓



- In all scenarios, this archetype receives efficiency measures resulting in a 19% heat demand reduction, and moves to an air-source heat pump.
- The efficiency gain of the ASHP system relative to direct electric heating causes annual electricity use to fall by 68%.
- Costs fall slightly less (63%) than electricity use when switching from electric storage to ASHP, since the ASHP uses more peak-time electricity, which the storage heater can avoid.

*Calculated using 2050 fuel prices. However, the equivalent values for 2030 prices are almost identical as the assumed hydrogen price does not change over time, and Gas and electricity prices projections for 2030 and 2050 differ only slightly (approx. 1%)

Fuel Prices

- To calculate the running costs of heating technologies, we assume a trajectory for fuel prices out to 2050.
- For oil, electricity and natural gas, we follow the BEIS Energy and Emissions Projections, updated May 2019*.
- In the case of Hydrogen, prices are derived from Element Energy analysis based on several sources**.
- The table shows the assumed fuel prices in 2030 and 2050, for domestic customers.

Fuel	2030	2050
Gas	5.8	5.9
Hydrogen (low/high)	-	5.6/8.4
Electricity (peak/off-peak)	22.2/18.5	21.2/18.3
Bio LPG	4.8	4.8
Oil	6.1	6.1
Biomass	4.4	4.4

Fuel price for domestic customers by type and year, in pence/kWh

*Annex M Updated energy and emissions projections: 2019 - GOV.UK (www.gov.uk)

**Element Energy and E4Tech report for the National Infrastructure Commission, Cost Analysis of Future Heat Infrastructure, and Element Energy analysis for the Committee on Climate Change's 6th Carbon Budget