

Existing Dwelling Heating & Hot Water Costs

Version control

Date	Version number	Approved by	Description/revisions made
06/02/19	1.0	Rob Honeyman (Ecuity)	-
25/04/19	2.0	Rob Honeyman (Ecuity)	Updated carbon emission factor, fuel prices and ASHP efficiencies

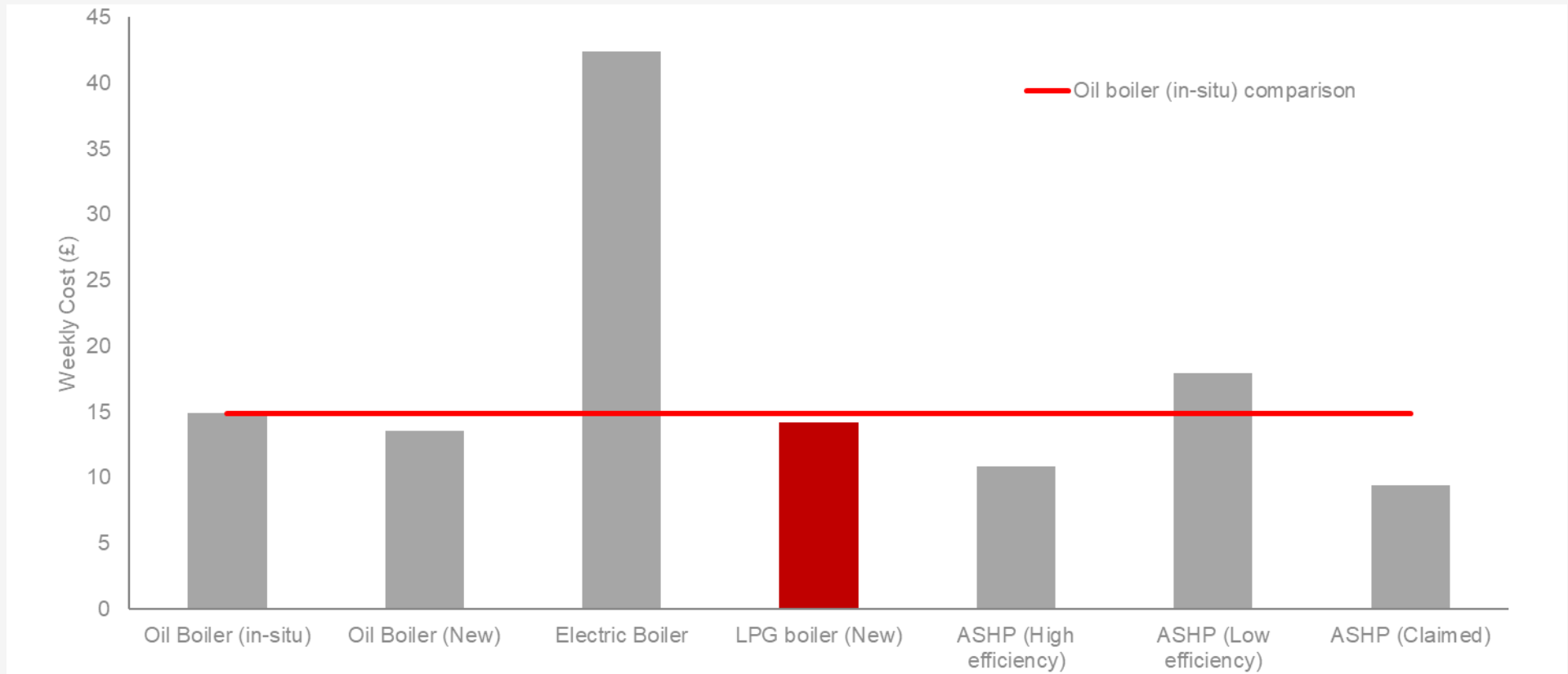
Introduction

- This document shows the annual and weekly heating costs of different technologies in existing dwellings
- Heating costs are produced for an existing terrace, semi-detached and detached house
- Various parameters are used to model heating costs including:
 - Fuel cost
 - Energy demand
 - Energy consumption
 - Efficiency of technology
 - Carbon intensity of fuel source
- LPG is compared against various fuel sources including electricity and oil
- LPG weekly costs are compared against a social households weekly income to see if the household would be in fuel poverty if it were to use LPG as a heating source.

Cost of Heating and Hot Water – Terrace house

Fuel Type	Cost (ppLitre)	kWh/litre	Cost (p/kWh)	CO2 Emissions (CO2/kWh)	Heating & Hot Water Demand (kWh/year)	System Efficiency	Fuel Consumption (kWh/year)	Cost (£/Year)	RHI Payment (£/Year)	Cost (£/week)
Oil Boiler (in-situ)	50.06	9.80	5.11	0.245	12,144	0.80	15,180	775.39	0.00	14.91
Oil Boiler (New)	50.06	9.80	5.11	0.245	12,144	0.88	13,800	704.90	0.00	13.56
Electric Boiler			18.16	0.283	12,144	1.00	12,144	2,205.06	0.00	42.40
LPG boiler (New)	39.55	7.08	5.59	0.214	12,144	0.92	13,200	737.35	0.00	14.18
ASHP (High efficiency)			18.16	0.283	12,144	3.90	3,114	565.40	947.23	10.87
ASHP (Low efficiency)			18.16	0.283	12,144	2.36	5,146	934.35	734.09	17.97
ASHP (Claimed)			18.16	0.283	12,144	4.50	2,699	490.01	990.78	9.42

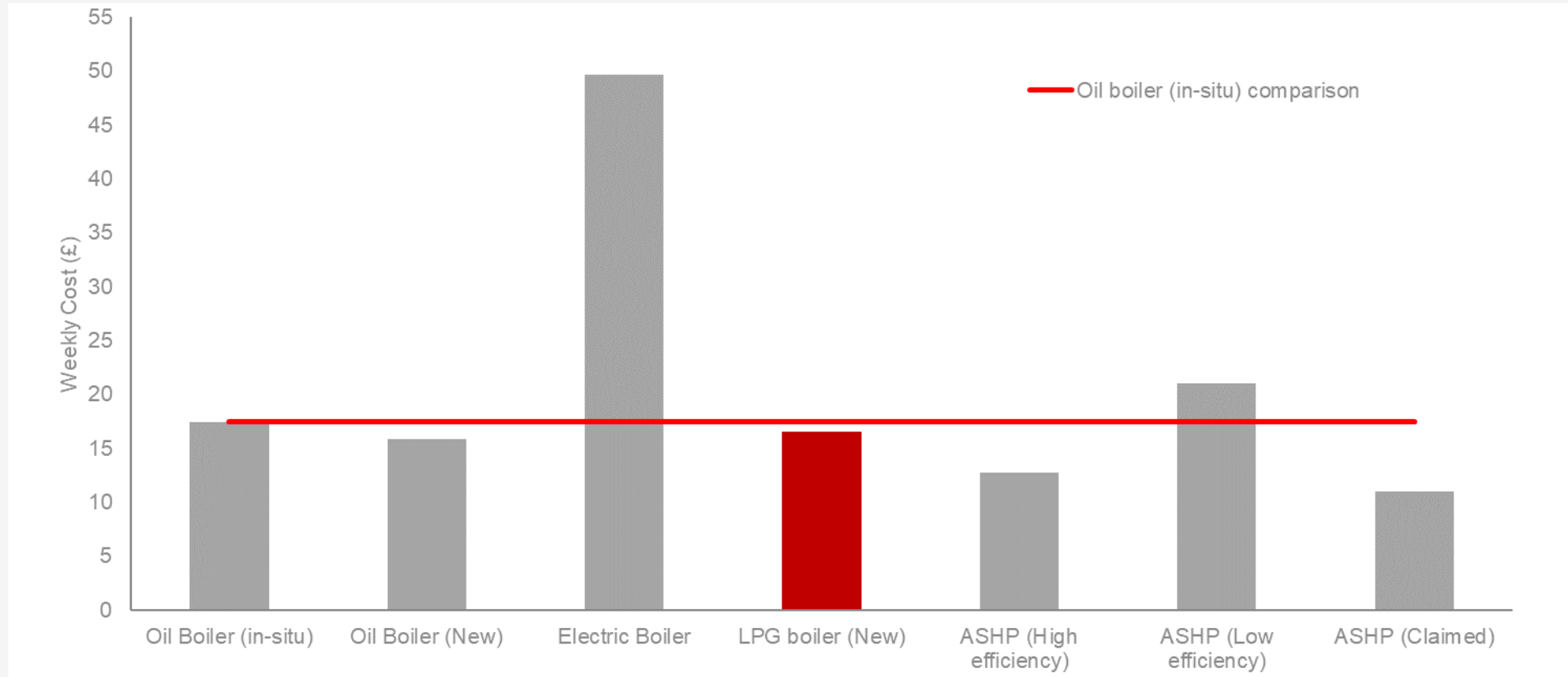
Cost of Heating and Hot Water – Terrace house



Cost of Heating and Hot Water – Semi-detached house

Fuel Type	Cost (ppLitre)	kWh/litre	Cost (p/kWh)	CO2 Emissions (CO2/kWh)	Heating & Hot Water Demand (kWh/year)	System Efficiency	Fuel Consumption (kWh/year)	Cost (£/Year)	RHI Payment (£/Year)	Cost (£/week)
<i>Semi-detached</i>										
Oil Boiler (in-situ)	50.06	9.80	5.11	0.245	14,207	0.80	17,759	907.16	0.00	17.45
Oil Boiler (New)	50.06	9.80	5.11	0.245	14,207	0.88	16,145	824.69	0.00	15.86
Electric Boiler			18.16	0.283	14,207	1.00	14,207	2,579.78	0.00	49.61
LPG boiler (New)	39.55	7.08	5.59	0.214	14,207	0.92	15,443	862.65	0.00	16.59
ASHP (High efficiency)			18.16	0.283	14,207	3.90	3,643	661.48	1,108.20	12.72
ASHP (Low efficiency)			18.16	0.283	14,207	2.36	6,020	1,093.13	858.84	21.02
ASHP (Claimed)			18.16	0.283	14,207	4.50	3,157	573.28	1,159.15	11.02

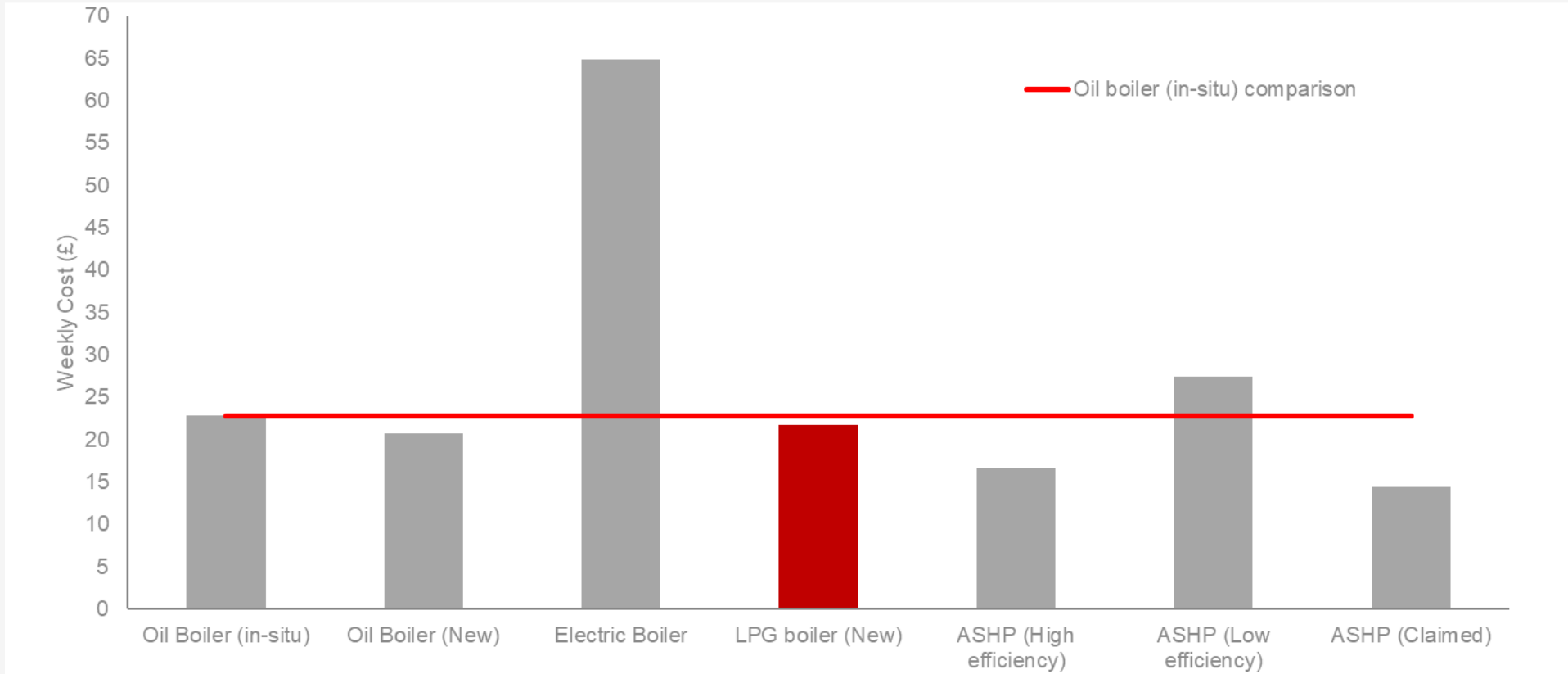
Cost of Heating and Hot Water – Semi-detached house



Cost of Heating and Hot Water – Detached house

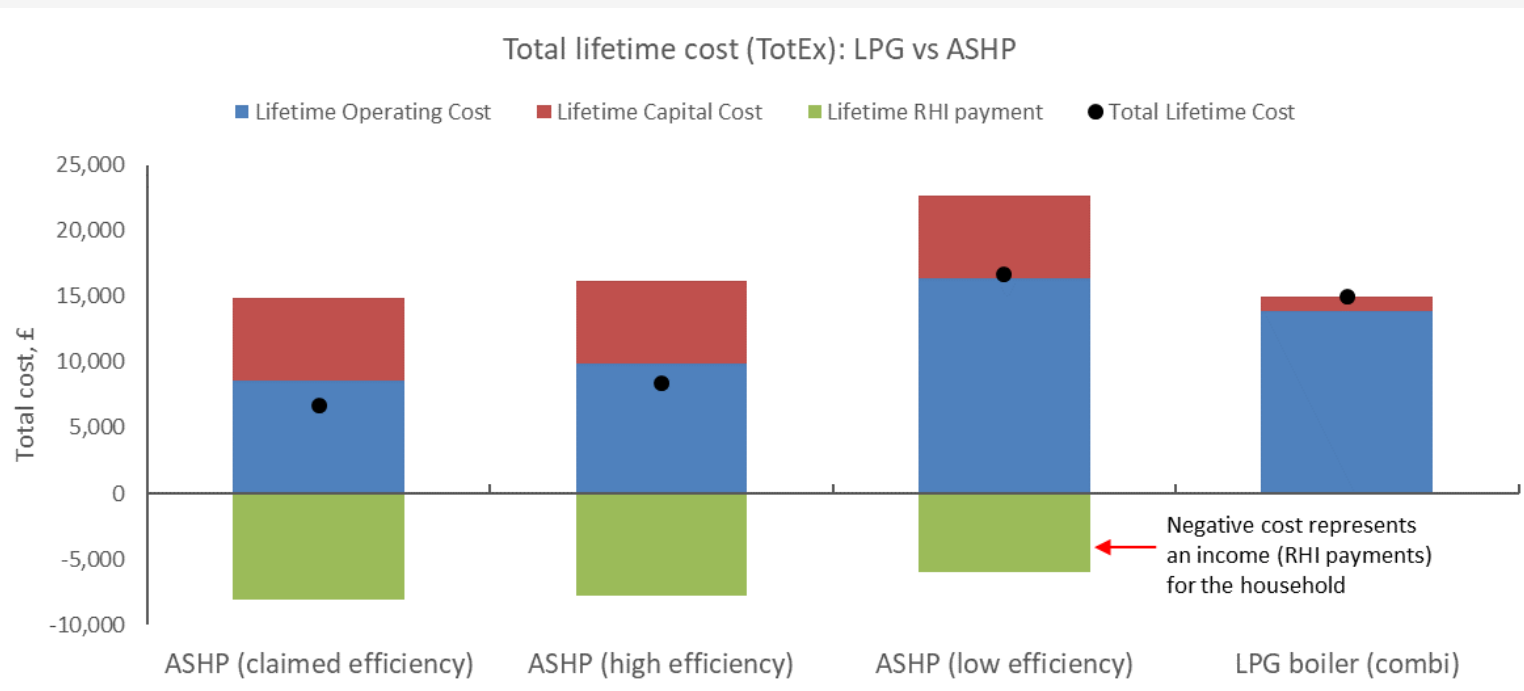
Fuel Type	Cost (ppLitre)	kWh/litre	Cost (p/kWh)	CO2 Emissions (CO2/kWh)	Heating & Hot Water Demand (kWh/year)	System Efficiency	Fuel Consumption (kWh/year)	Cost (£/Year)	RHI Payment (£/Year)	Cost (£/week)
Detached										
Oil Boiler (in-situ)	50.06	9.80	5.11	0.245	18,573	0.80	23,216	1,185.90	0.00	22.81
Oil Boiler (New)	50.06	9.80	5.11	0.245	18,573	0.88	21,105	1,078.09	0.00	20.73
Electric Boiler			18.16	0.283	18,573	1.00	18,573	3,372.44	0.00	64.85
LPG boiler (New)	39.55	7.08	5.59	0.214	18,573	0.92	20,188	1,127.71	0.00	21.69
ASHP (High efficiency)			18.16	0.283	18,573	3.90	4,762	864.73	1,448.71	16.63
ASHP (Low efficiency)			18.16	0.283	18,573	2.36	7,870	1,429.00	1,122.73	27.48
ASHP (Claimed)			18.16	0.283	18,573	4.50	4,127	749.43	1,515.32	14.41

Cost of Heating and Hot Water – Detached house



Total Expenditure analysis – LPG vs ASHP

- Total Expenditure (TotEx) considers both the operating costs (OpEx) and capital costs (CapEx) over the lifetime of a heating technology.
- The chart below models the total lifetime cost for an existing semi-detached house.



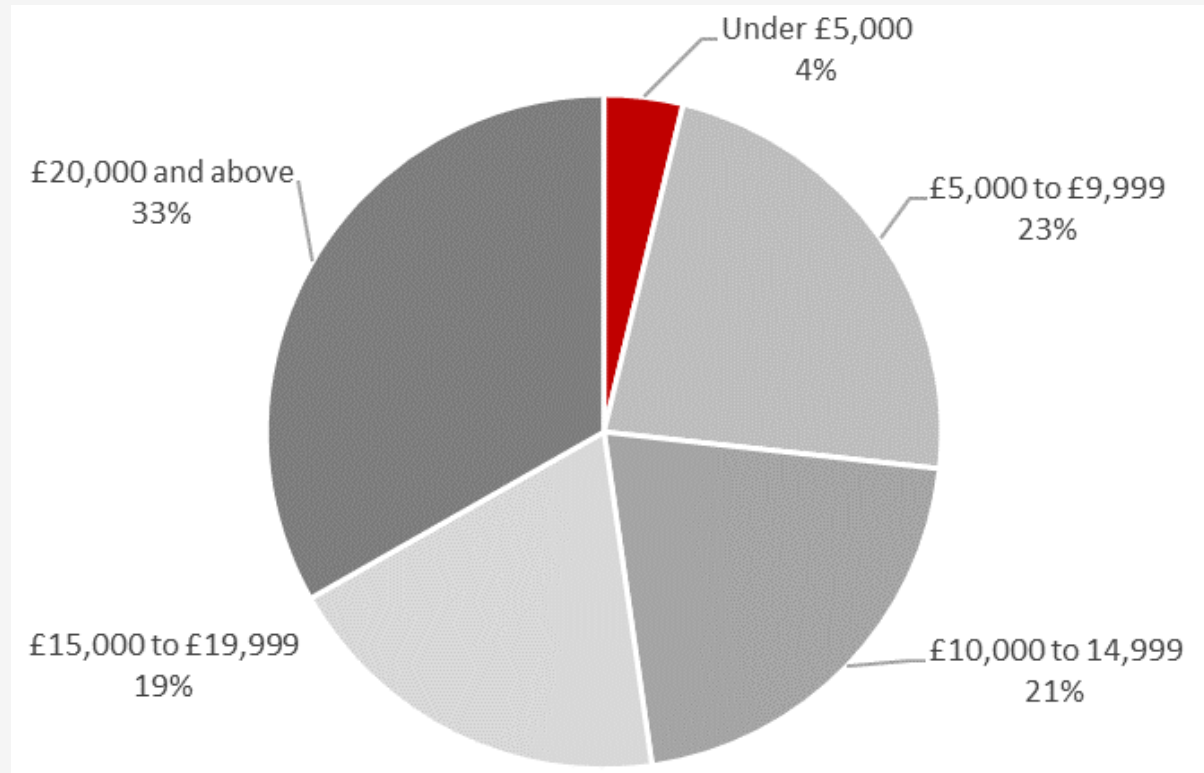
Main input and assumptions

- 6kW ASHP
- 28kW LPG combi boiler
- Assume 15-year lifetime for both ASHP and LPG combi boiler
- Cost and revenue are undiscounted
- See data table in appendix for more info

Fuel Poverty & Social Housing

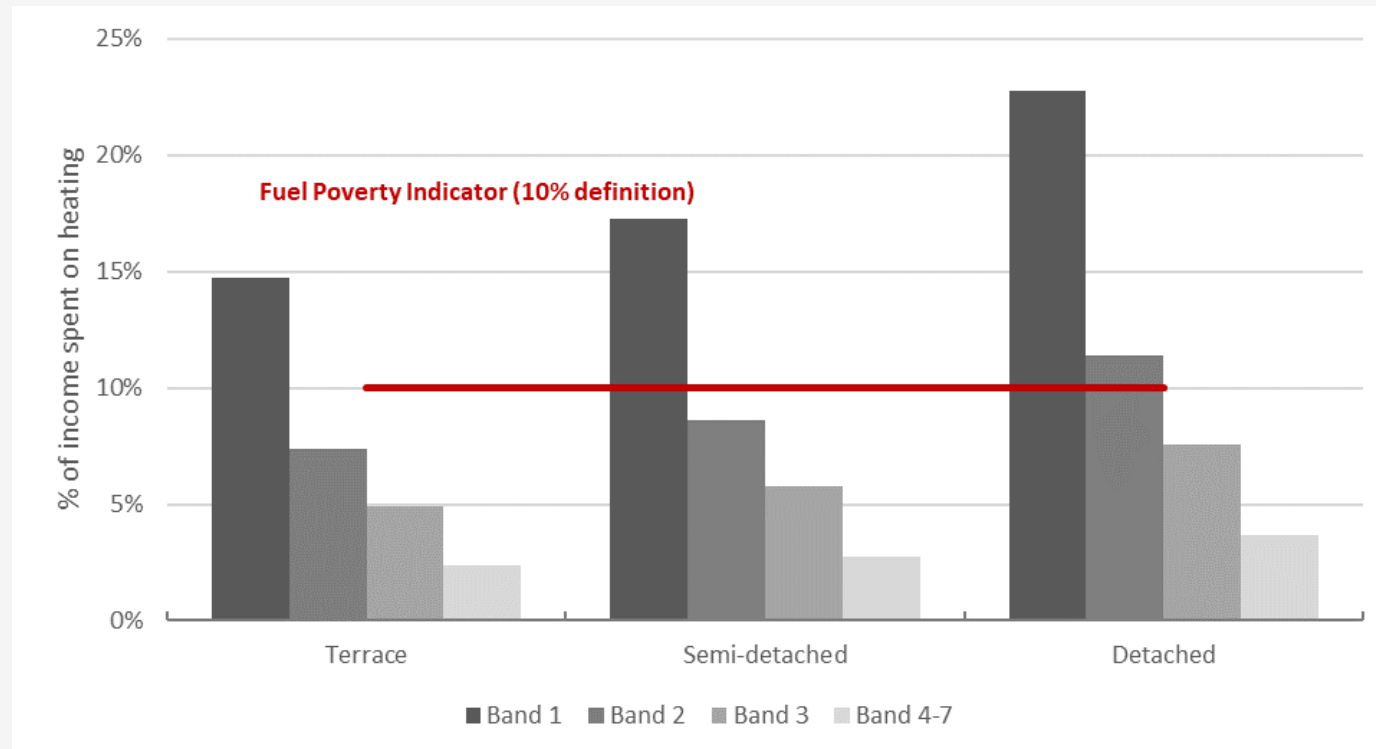
- A household is considered to be fuel poor if: they have required fuel costs that are above average (national median level); and, were they to spend that amount, they would be left with a residual income below the official poverty line (60% of median UK household income). ([BEIS 2018](#))
- One measure of fuel poverty is the **10% definition**:
*“a household is considered to be fuel poor if **they are required to spend more than 10% of their income on fuel**, so as to maintain an adequate standard of warmth”.* (BEIS 2018)
- Therefore, in order to be a viable fuel source for social housing tenants, the weekly cost of heating with LPG must not represent over 10% of a tenants weekly income.
- Other definitions include the **Low-Income High Cost (LIHC)** – a dual indicator, which allows measurement of both the level (number of households) and depth (fuel poverty gap) of fuel poverty.
- For simplification purposes, we consider the 10% definition.

Social Housing Tenant Income



- Two-thirds (67%) of social household tenants have a gross annual income below £20,000
- This equates to having a weekly of below £385
- 4% of households in social housing have an annual income of less than £5000 (<£96 per week)

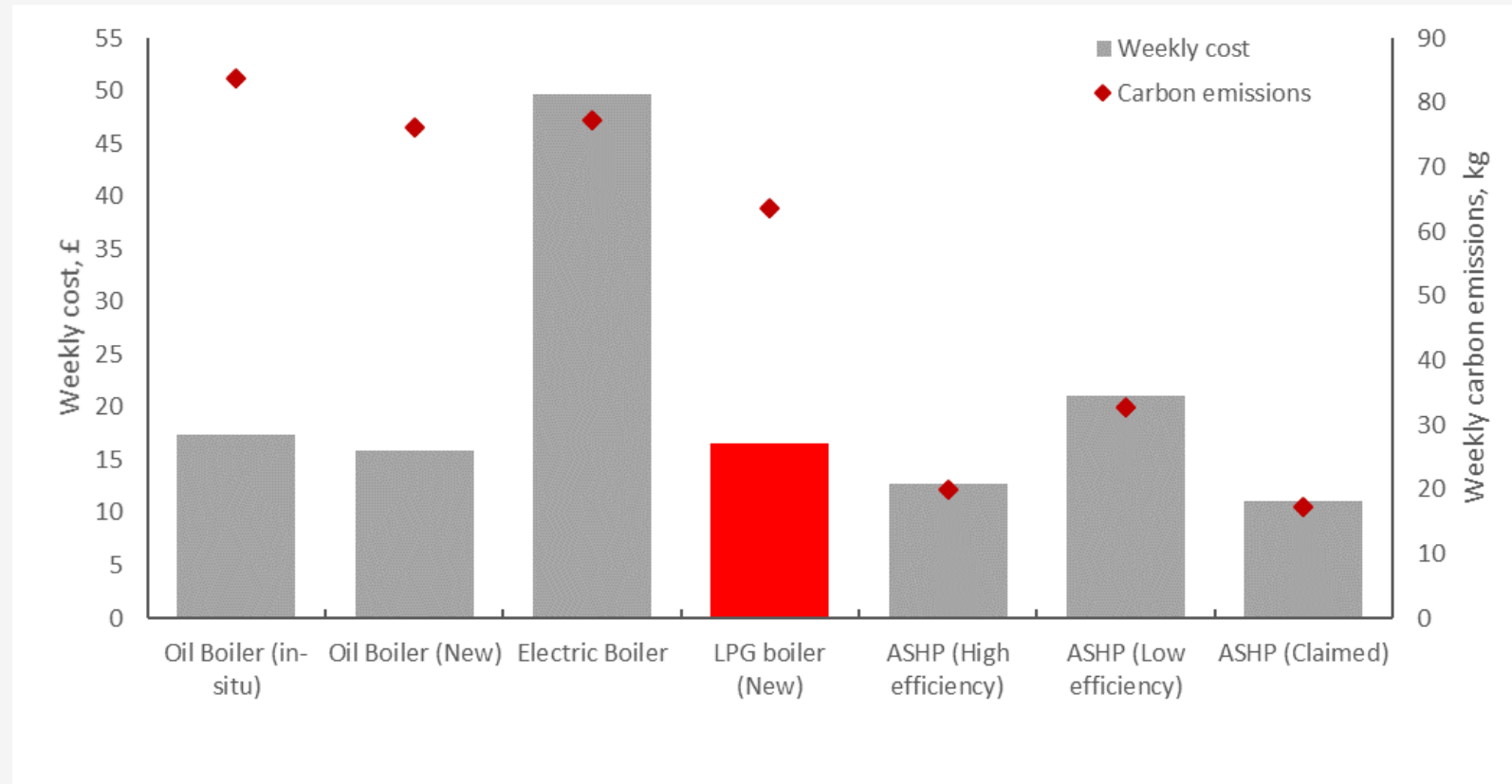
LPG Heating Costs - % of Social Housing Tenant Income



Band	Weekly Income	Annual Income
Band 0	£0 to £96	Under £5,000
Band 1	£96 to £192	£5,000 to £9,999
Band 2	£192 to £288	£10,000 to 14,999
Band 3	£288 to £385	£15,000 to £19,999
Band 4-7	£385 and above	£20,000 and above

- LPG weekly heating costs are more than 10% of a social households weekly income for those in Band 1 across all three house types. Those living in a detached house with a weekly income in Band 2 would also be in fuel poverty if they used LPG as a heating source.

Carbon emissions produced by each heating technology



- The weekly heating costs and amount of CO₂ produced are shown for an existing semi-detached house
- The bars show the weekly costs (left axis) while the markers above the bars show the amount of carbon produced (right axis)

Assumptions

Share of heating and hot water demand

- For simplification purposes we assume total fuel demand is made up of only heating and hot water demand
- Product categories such as cooking and lighting have been excluded for simplification purposes
- Energy consumption figures from BEIS show that heating and hot water consumption totalled 26,871 kilotonnes of oil equivalent
- Heating accounted for 76% of this. Hot water made up the difference (24%)

Existing building total demand

- Average energy consumption of a typical terrace, semi-detached and detached house have been taken from the National Energy Efficiency Database (NEED) framework
- Average energy consumption is the sum of gas and electricity consumption
- Average energy consumption is converted to average energy demand by adjusting by the average boiler efficiency in the UK. Using the Energy Consumption 2018 tables this value is 79.37%
- For example the average energy consumption of a terraced house is 23,400kWh (18,500kWh of gas consumption and 4,900kWh of electricity consumption. Adjusting by boiler efficiency gives average energy demand of 18,573kWh (23,400 x 79.37%)

Assumptions

ASHP efficiencies

- Three values for the efficiency of an ASHP are quoted
- The high efficiency is taken from BEIS's monthly RHI deployment statistics
- The low efficiency value is taken from the report on RHPP by UCL and DECC (now BEIS)
- The claimed efficiency value is taken from a Samsung brochure on ASHPs
- Current RHI tariff for ASHPs is 10.49p/kWh

References & Links

Item	Source	Document name	Link/URL	Reference
Average energy consumption by house type	BEIS	National Energy Efficiency Data-Framework (NEED)	https://www.gov.uk/government/collections/national-energy-efficiency-data-need-framework	Sum of mean electricity and gas consumption (tables 5 and 6)
Average boiler efficiency	BEIS	Energy Consumption in the UK (2018 update)	https://www.gov.uk/government/collections/energy-consumption-in-the-uk	Average boiler efficiency Tab 3.20
Energy consumption (heat & hot water)	BEIS	Energy Consumption in the UK (2018 update)	https://www.gov.uk/government/collections/energy-consumption-in-the-uk	Tab 1.04
Fuel prices (electricity and mains gas)	BEIS	Data tables 1-19 supporting the toolkit and the guidance 2018	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/793632/data-tables-1-19.xlsx	Tables 4-8 (Domestic Central Prices in 2019)
LPG price	Calor	-	-	-
ASHP efficiency (High efficiency)	BEIS	RHI deployment data	https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-february-2019	Tab 2.6 (Max value)
ASHP efficiency (Low efficiency)	BEIS/UCL	Analysis of data from heat pumps installed via the renewable heat incentive premium payment (RHPP) scheme to the Department of Energy and Climate Change (DECC)	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/606778/DECC_RHPP_16_0112_Detailed_analysis_report_v5.3.pdf	Page 10

References & Links

Item	Source	Document name	Link/URL	Reference
ASHP efficiency (claimed)	Samsung	EHS Technical Data Book: EHS Mono for Europe	https://www.samsung.com/common/files/techinfo/AE160JXYDGH/EU/EHS%20DU%20and%20ODU%20Mono%20for%20Europe_50Hz_Ver1_4_TDB.pdf	Page 6 (SCOP at 35 degrees fro 5kW system). Efficiencies for 5kW-16kW at 4.5COP, minimal variation.
RHI tariff	Ofgem	Tariffs and payments: Domestic RHI	https://www.ofgem.gov.uk/environmental-programmes/domestic-rhi/contacts-guidance-and-resources/tariffs-and-payments-domestic-rhi/current-future-tariffs	See table on 'current and future tariffs' for applications submitted between 01/10/2018 and 30/12/2018
Heating oil price	NottsEnergy	Price of heating oil in the UK	https://nottenergy.com/our-services/resources/energy-cost-comparison/	Kerosene (fuel price per litre)
System efficiencies	Ofgem	ECO3 Deemed Scores Methodology	https://www.ofgem.gov.uk/system/files/docs/2018/07/eco3_deemed_scores_methodology_document_200718.pdf	Page 19 – Replacement heating assumptions (before) New LPG boiler efficiency is 92% following Boiler Plus
Oil-boiler (in-situ) efficiency	DECC	Final Report: In-situ monitoring of efficiencies of condensing boilers and use of secondary heating	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/180950/In-situ_monitoring_of_condensing_boilers_final_report.pdf	Page 29

References & Links

Item	Source	Document name	Link/URL	Reference
ASHP total cost	BEIS	RHI monthly official statistics table 30 June 2018 final	https://www.gov.uk/government/statistics/rhi-deployment-data-june-2018	Tab 2.13. Average reported cost of a 6kW ASHP (domestic RHI installation)
LPG combi boiler (capex only)	Mr Central Heating	LPG combi boiler prices	https://www.mrcentralheating.co.uk/baxi-428-condensing-lpg-combi-boiler	Baxi 428 (28kW) LPG combi boiler
Cost to install LPG boiler	Price Your Job	Installation cost of LPG gas central heating	https://www.priceyourjob.co.uk/lpg-gas-central-heating-cost/	Tradesmen labour cost
RHI tariff for ASHP	Ofgem	Tariffs and Payment: Domestic RHI	https://www.ofgem.gov.uk/environmental-programmes/domestic-rhi/contacts-guidance-and-resources/tariffs-and-payments-domestic-rhi/current-future-tariffs	Table on 'current and future tariffs'
Carbon intensities	BEIS	Greenhouse gas reportings: conversion factors 2018	https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2018	UK electricity tab (F23) and fuels tab. Intensities measured in kgCO ₂ / kWh (gross)

Data sheet – TotEX analysis (ASHPs vs LPG)

	ASHP (claimed efficiency)	ASHP (high efficiency)	ASHP (low efficiency)	LPG boiler
System size	6kW	6kW	6kW	28kW
System efficiency	450%	390%	236%	92%
System lifetime	15 years	15 years	15 years	15 years
Capital cost	£6,240	£6,240	£6,240	£6,240
Installation cost	(included in capital cost)	(included in capital cost)	(included in capital cost)	£300
Other costs	-	-	-	£65/pa for tank rental
Fuel cost	£0.182/kWh	£0.182/kWh	£0.182/kWh	£0.059/kWh
RHI tariff	£0.1049/kWh (7 years only)	£0.1049/kWh (7 years only)	£0.1049/kWh (7 years only)	-