



## Carbon Trust Options Appraisal for building decarbonisation: Summary of results

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### Summary of current building

#### WANDSWORTH ROAD SW8 3JW

Hotel / Hostel	1 Units
Floorspace (m2)	3451
EPC Rating	AB
Occupied space heating consumption (kWh)	275,906
Cooling consumption (kWh)	103,530
Water heating consumption (kWh)	197,200
Occupied area electricity use (kWh)	362,355
Annual total fuel bill	£83,976
Annual fuel bill per flat (including share of communal areas)	£83,976

Occupied area Thermal Energy Demand Intensity (kWh per m2 pa)	70
Occupied area Energy Use Intensity (kWh per m2 pa)	272

Age of construction	2012 onwards
Windows	Double glazed windows post 2002
Wall	Cavity as built
Roof	Flat roof
Floor	Insulation unknown or as-built
Primary heating	Existing - condensing gas boiler
Air tightness (ACH @ ambient pressure)	Good new build performance (3 n50)
Radiators / emitters	Existing radiators - double panel, double convector



## Description of Options for Appraisal

### Thermal fabric

This hotel building is of modern construction with excellent levels of thermal fabric efficiency and an EPC rating of A. We have therefore assumed that no further thermal fabric improvements are undertaken.

### Energy systems

Heating is currently provided by a condensing gas boiler and scenario considers a like for like replacement.

In scenario 2 we consider the use of an air source heat pump.

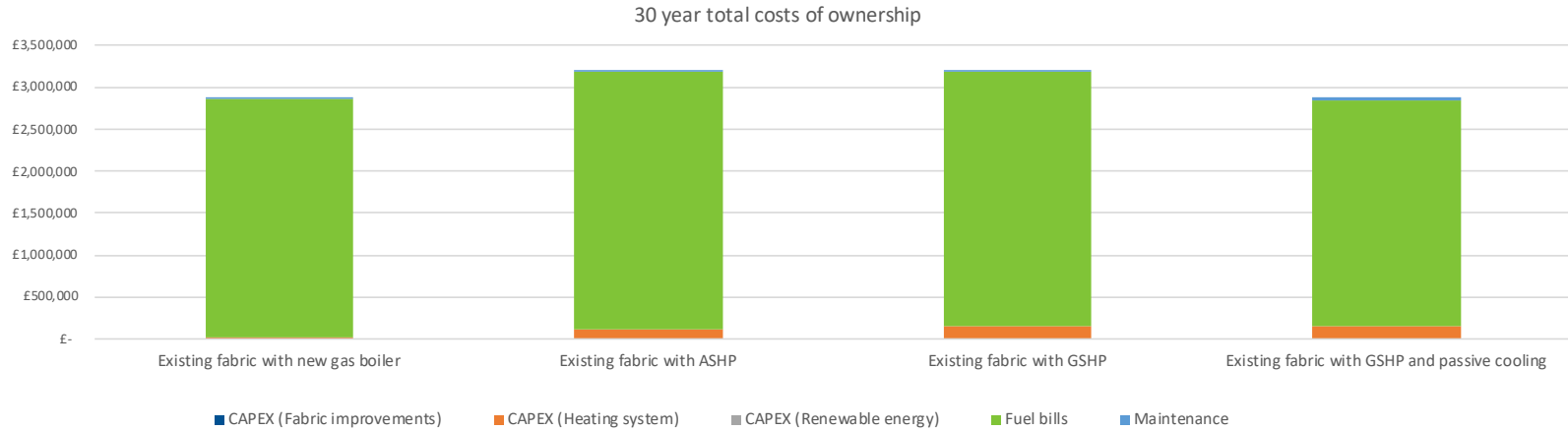
In scenario 3, we consider the use of a ground source heat pump.

In scenario 4, we consider the use of a ground source heat pump that is also configured to provide a level of passive cooling.

## Summary of options appraisal measures, costs & CO<sub>2</sub> emissions

	Existing fabric with new gas boiler	Existing fabric with ASHP	Existing fabric with GSHP	Existing fabric with GSHP and passive cooling
<b>HVAC system</b>	56kW New Condensing gas boiler, 0, 0, hot water from main system (gas), 0, Existing - AHUs with chillers	56kW New ASHP Air to water <55°C, 0, 0, hot water from main system (electric), Communal thermal store	56kW New GSHP/ WSHP <55°C, 0, ground loop (borehole), hot water from main system (electric), Communal thermal store	56kW New GSHP/ WSHP <55°C, 0, ground loop (borehole), hot water from main system (electric), Communal thermal store
	<b>£14,000</b>	<b>£60,541</b>	<b>£108,141</b>	<b>£108,141</b>
<b>Heat emitter and distribution</b>	Existing pipework, Existing radiators - double panel, double convector	Existing pipework, Existing radiators - double panel, double convector	Existing pipework, Existing radiators - double panel, double convector	Existing pipework, Existing radiators - double panel, double convector
	<b>£0</b>	<b>£0</b>	<b>£0</b>	<b>£0</b>
<b>Thermal fabric measures installed</b>	'''	'''	'''	'''
	<b>£0</b>	<b>£0</b>	<b>£0</b>	<b>£0</b>
<b>Air tightness</b>	Existing AHUs (energy use accounted for in emitters), Good new build performance (3 n50)	Existing AHUs (energy use accounted for in emitters), Good new build performance (3 n50)	Existing AHUs (energy use accounted for in emitters), Good new build performance (3 n50)	Existing AHUs (energy use accounted for in emitters), Good new build performance (3 n50)
	<b>£0</b>	<b>£0</b>	<b>£0</b>	<b>£0</b>
<b>Total CAPEX</b>	<b>£14,000</b>	<b>£60,541</b>	<b>£108,141</b>	<b>£108,141</b>
<b>Clean Heat Grant</b>	<b>£0</b>	<b>£0</b>	<b>£0</b>	<b>£0</b>
<b>Net CAPEX</b>	<b>£14,000</b>	<b>£60,541</b>	<b>£108,141</b>	<b>£108,141</b>
<b>Electricity tariff</b>	Treasury Green Book Central Commercial Tariff	Treasury Green Book Central Commercial Tariff	Treasury Green Book Central Commercial Tariff	Treasury Green Book Central Commercial Tariff
<b>Annual fuel bills</b>	<b>£83,976</b>	<b>£94,831</b>	<b>£93,424</b>	<b>£83,058</b>
<b>Annual OPEX (maintenance)</b>	<b>£650</b>	<b>£950</b>	<b>£1,050</b>	<b>£950</b>
<b>30 year total cost of ownership (excluding grant)</b>	<b>£2,877,284</b>	<b>£3,210,590</b>	<b>£3,210,078</b>	<b>£2,871,099</b>
<b>Annual tCO<sub>2</sub> emissions (2021)</b>	<b>218.7</b>	<b>178.7</b>	<b>176.1</b>	<b>156.5</b>
<b>Predicted annual tCO<sub>2</sub> emissions (2030)</b>	<b>147.4</b>	<b>82.1</b>	<b>80.9</b>	<b>71.9</b>
<b>Predicted annual tCO<sub>2</sub> emissions (2050)</b>	<b>90.1</b>	<b>4.4</b>	<b>4.4</b>	<b>3.9</b>

### 30 year total costs of ownership



**CAPEX**

CAPEX forms a relatively small proportion of overall costs due to the high energy usage of the building. CAPEX is significantly higher for the heat pump options in scenarios 3 - 4.

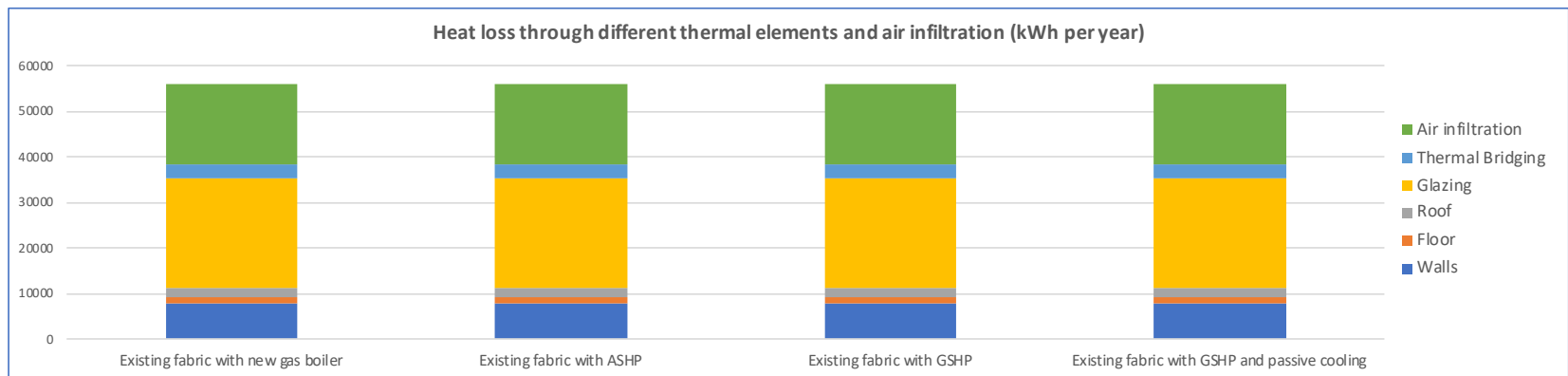
**Fuel bills**

Fuel bills increase in scenarios 2 & 3 (ASHP and GSHP respectively). However, fuel bills are modelled as being marginally lower in scenario 4 than the BAU. This is because of the assumed configuration of the ground source heat pump to also provide passive cooling in to the existing air handling units.

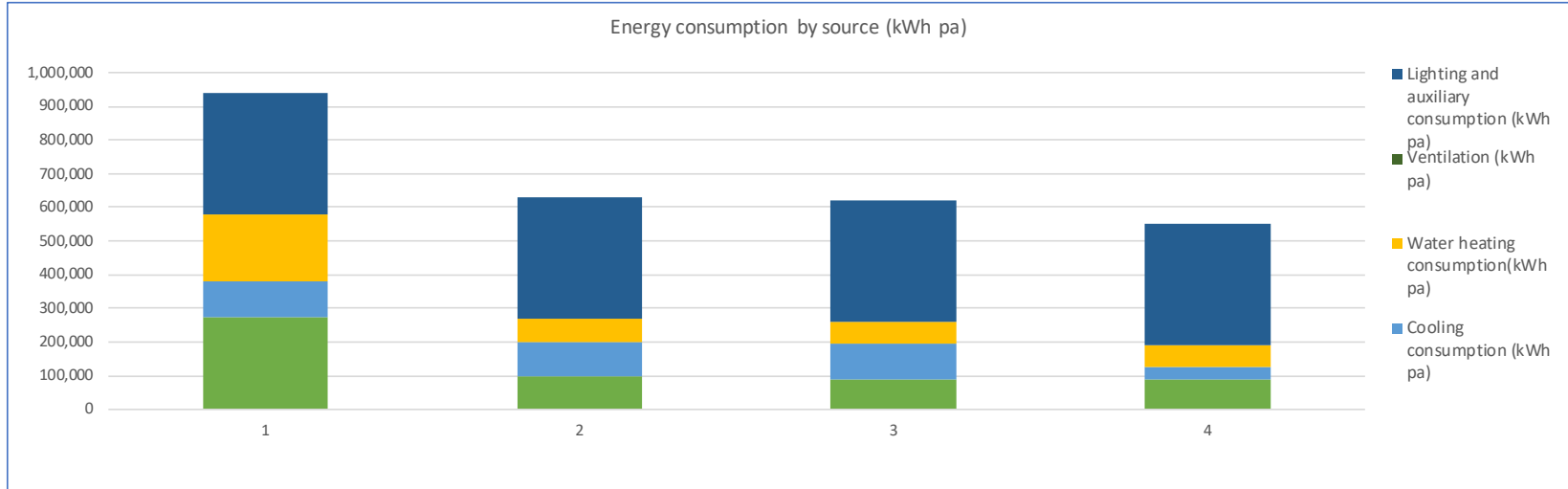
**30 year costs of ownership**

Scenario 4 has the lowest costs of ownership. This is due to a) the higher efficiency of the ground source heat pump and b) the reduction in electricity demand associated with cooling that is now provided passively by the ground source heat pump.

### Heat loss through thermal elements



## Energy Consumption kWh pa



## Heat demand and heating system efficiency

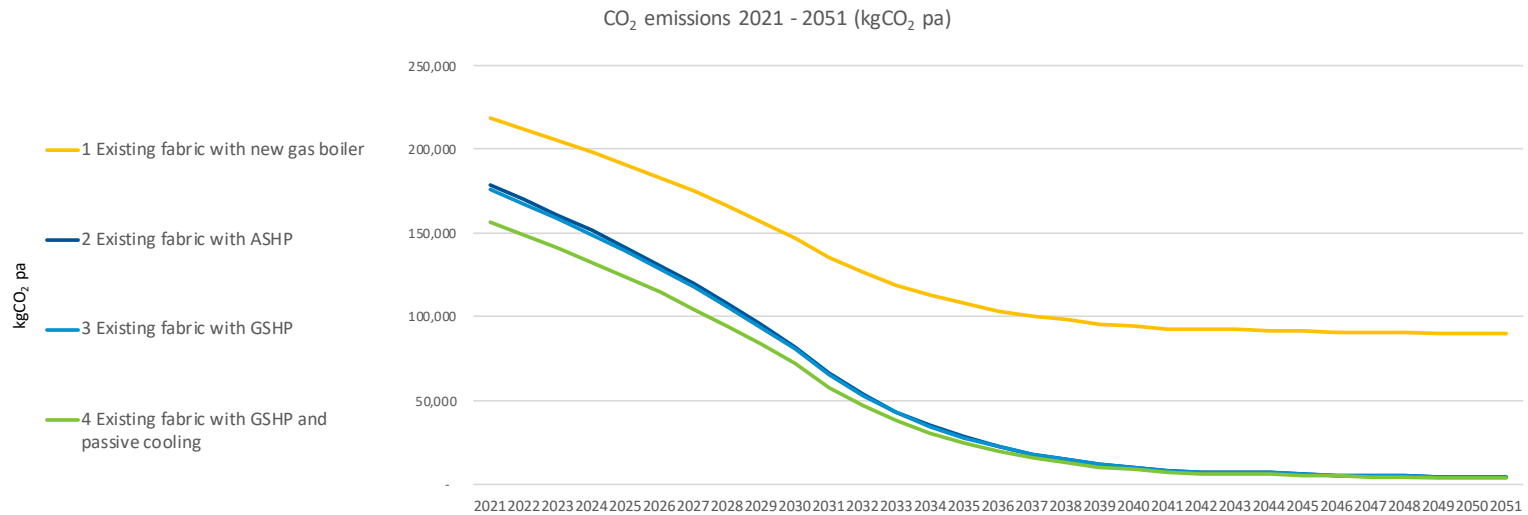
System efficiency is highest in scenario 4. This does not include the additional efficiency that arises from providing passive cooling.

	Existing fabric with new gas boiler	Existing fabric with ASHP	Existing fabric with GSHP	Existing fabric with GSHP and passive cooling
Space heating demand (kWh pa)	241,417	241,417	241,417	241,417
Space heating peak demand (kW)	55.9	55.9	55.9	55.9
Peak electricity load @ 6:00pm	0.0	87.5	109.3	108.0
Required flow temperatures °C	55	55	55	55
Space heating consumption (kWh pa)	275,906	96,567	91,101	91,101
Cooling consumption (kWh pa)	103,530	103,530	103,530	34,510
Water heating consumption (kWh pa)	197,200	69,020	65,113	65,113
Lighting and auxiliary consumption (kWh pa)	362,355	362,355	362,355	362,355
Assumed heating system Seasonal Performance Factor (SPF)	<b>88%</b>	<b>250%</b>	<b>265%</b>	<b>265%</b>
Assumed distribution losses	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>
Space heating Thermal Energy Demand Intensity (kWh per m2 pa)	<b>70</b>	<b>70</b>	<b>70</b>	<b>70</b>
Energy Use Intensity - all energy use (kWh per m2 pa)	<b>272</b>	<b>183</b>	<b>180</b>	<b>160</b>

### Retrofit package CO<sub>2</sub> emissions

tCO <sub>2</sub> in 2021	219	179	176	157
Predicted annual tCO <sub>2</sub> emissions (2030)	147.4	82.1	80.9	71.9
Predicted annual tCO <sub>2</sub> emissions (2050)	90.1	4.4	4.4	3.9
tCO <sub>2</sub> cumulative 2021 - 2050	3863	1705	1680	1493
tCO <sub>2</sub> saved relative to BAU (30 year cumulative)	0	-2158	-2183	-2369
CO <sub>2</sub> saving relative to baseline (30 year cumulative)	0%	56%	57%	61%
Additional cost over BAU scenario (30 years)	£0	£333,306	£332,794	-£6,185
£ per tonne of CO <sub>2</sub> reduction (30 year cumulative)	NA	£154	£152	-£3

### 30 year predicted CO<sub>2</sub> emissions



CO<sub>2</sub> emissions fall significantly for all electrification scenarios. The greatest CO<sub>2</sub> emissions savings are associated with scenario 4 at 61% relative to the BAU over 30 years. Scenario 4 has a negative cost of carbon, with carbon savings coming at a net cost saving relative to the BAU.

## Potential impact of Solar PV on all scenarios

	Existing fabric with new gas boiler	Existing fabric with ASHP	Existing fabric with GSHP	Existing fabric with GSHP and passive cooling
Included in package? (Y/N)	N	N	N	N
System size kW Peak	15.0	15.0	15.0	15.0
System generation kWh pa	14,454	14,454	14,454	14,454
Utilisation on site kWh pa	14454	14454	14454	14454
Utilisation on site kWh pa	100%	100%	100%	100%
Exported to grid kWh pa	0	0	0	0
Assumed system cost £	22500	22500	22500	22500
<b>Net impact on fuel bills £ pa</b>	<b>-£ 2,171</b>	<b>-£ 2,171</b>	<b>-£ 2,171</b>	<b>-£ 2,171</b>

We modelled the impact of a 15kW solar PV system for all scenarios. The high year round demand for electricity results in a very high on-site utilisation of electricity and reasonable cost savings.

## Impact of Solar PV on Scenario 3 - typical summer and winter days

