



Carbon Trust Options Appraisal for building decarbonisation: Summary of results

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Summary of current building

LEISURE CENTRE 141 CLAPHAM MANOR STREET SW4 6DB

Leisure/sports facility	1 Units
Floorspace (m2)	5800
EPC Rating	B
Occupied space heating consumption (kWh)	162,345
Cooling consumption (kWh)	232,000
Water heating consumption (kWh)	530,286
Occupied area electricity use (kWh)	1,421,000
Annual total fuel bill	£20,513
Occupied area Thermal Energy Demand Intensity (kWh per m2 pa)	25
Occupied area Energy Use Intensity (kWh per m2 pa)	404

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 - Air handling units (heating and cooling)



Description of Options for Appraisal

Thermal fabric measures:

This Leisure Centre has an EPC rating of B and is of a modern, energy efficient construction, having been constructed Post 2012. Therefore, further additional fabric measures were not considered for this building and the Options Appraisal focuses on Options for removing the gas boiler for heating.

Heating systems:

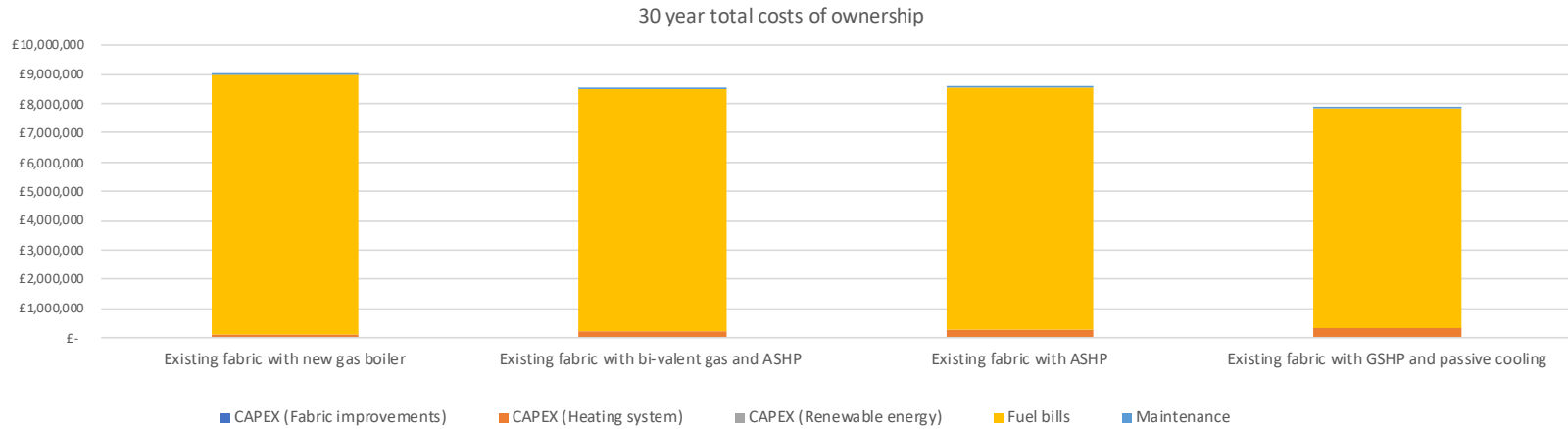
Despite the relatively efficient building fabric, gas consumption is assumed to be high for this building due to the very high, year round demand for hot water. In scenarios 2-4 we consider the options for replacing the gas boiler with heat pump options, sized to deliver the peak load in hot water demand.

In scenario 2, we assess a hybrid option, whereby an air source heat pump is sized to deliver 80% of heating demand, with a gas boiler providing the remaining 20%. In scenario 3, we appraise the installation of an Air Source Heat Pump to completely replace gas heating.

Summary of options appraisal measures, costs & CO₂ emissions

	Existing fabric with new gas boiler	Existing fabric with bi-valent gas and ASHP	Existing fabric with ASHP	Existing fabric with GSHP and passive cooling
HVAC system	108kW New communal gas boiler (n+1), 0, 0, hot water from main system (gas), Communal thermal store, Existing - AHUs with chillers	108kW ASHP (Bi-valent) 80% of heating demand, Gas Boiler (Hybrid system) 20% heating demand, 0, hot water from main system (electric), Communal thermal store	108kW New ASHP (Communal), 0, 0, hot water from main system (electric), Communal thermal store	108kW New GSHP/WSHP (Communal), 0, ground loop (borehole), hot water from main system (electric), Communal thermal store
	£66,593	£129,963	£141,778	£222,333
Heat emitter and distribution	0, Existing - Air handling units (heating and cooling)	0, Existing - Air handling units (heating and cooling)	0, Existing - Air handling units (heating and cooling)	0, Existing - Air handling units (heating and cooling)
	£0	£0	£0	£0
Thermal fabric measures installed
	£0	£0	£0	£0
Air tightness	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)
	£0	£0	£0	£0
Total CAPEX	£66,593	£129,963	£141,778	£222,333
Clean Heat Grant	£0	£0	£0	£0
Net CAPEX	£66,593	£129,963	£141,778	£222,333
Electricity tariff	Treasury Green Book Central Commercial Tariff	Treasury Green Book Central Commercial Tariff	Treasury Green Book Central Commercial Tariff	Treasury Green Book Central Commercial Tariff
Annual fuel bills	£268,752	£255,364	£256,293	£232,925
Annual OPEX (maintenance)	£650	£950	£950	£1,050
30 year total cost of ownership (excluding grant)	£8,991,200	£8,544,011	£8,589,167	£7,894,092
Annual tCO₂ emissions (2021)	594.9	532.9	533.5	488.5
Predicted annual tCO₂ emissions (2030)	342.0	248.5	245.1	224.4
Predicted annual tCO₂ emissions (2050)	138.7	19.9	13.2	12.1

30 year total costs of ownership



CAPEX

CAPEX is highest in scenario 4, with the Ground Source Heat Pump option. Scenario 2 offers lower CAPEX than scenario 3, with the heat pump in scenario 2 sized for only 80% of the heating load.

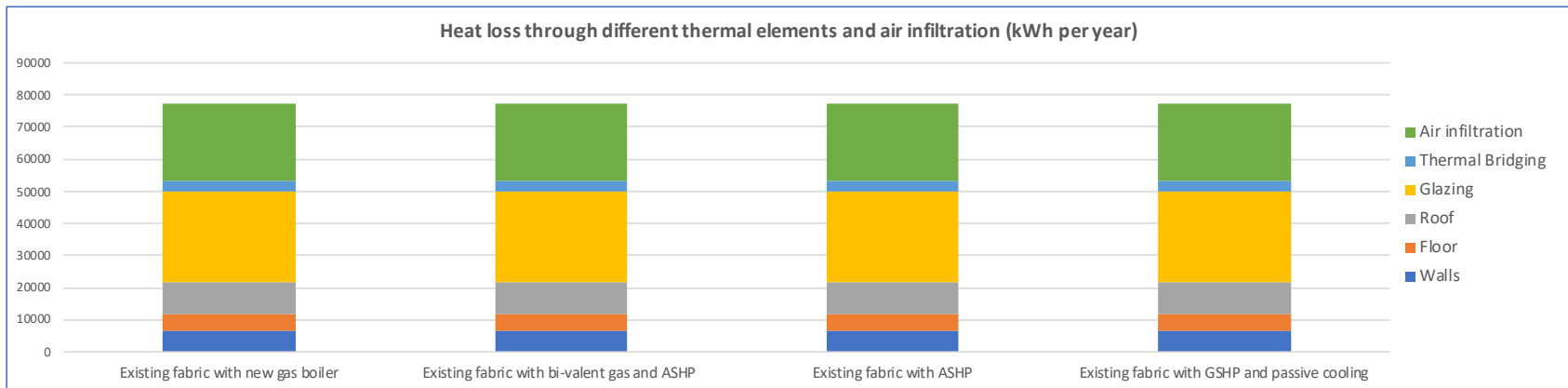
Fuel bills

Fuel bills are broadly equivalent across scenarios 2 - 3. The lowest fuel bills are in scenario 4, where electricity use for cooling is lower due to the configuration of the ground source heat pump loop to provide passive cooling.

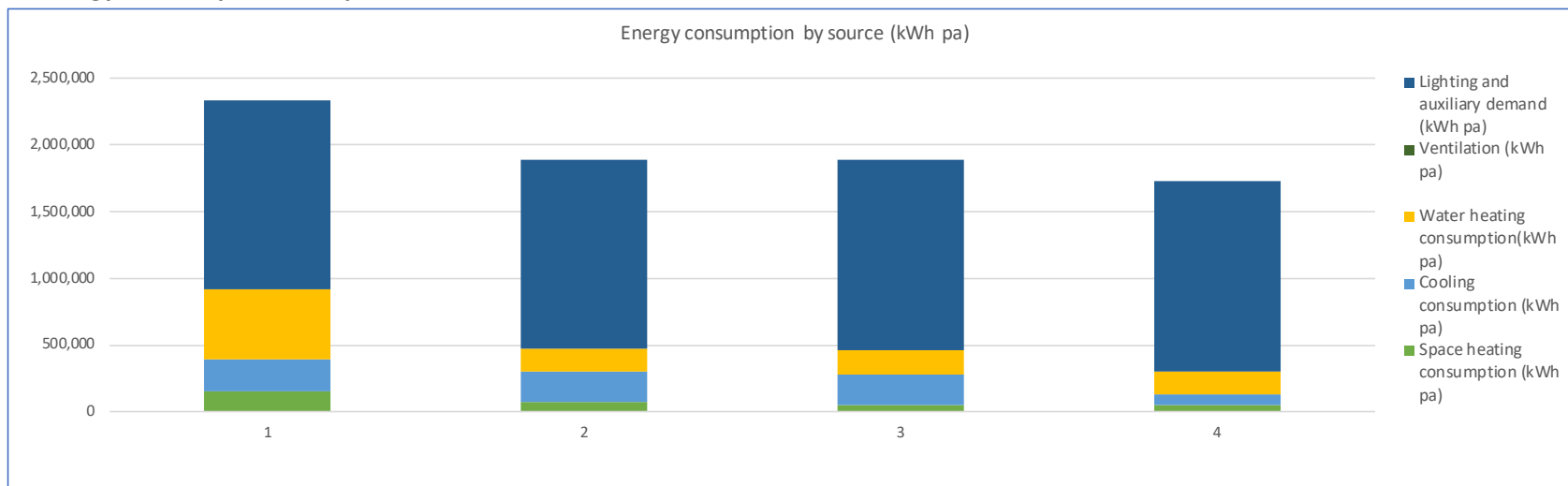
30 year cost of ownership

Scenario 4 provides the lowest 30 year cost of ownership, with the additional CAPEX for the ground source heat pump system repaid via a higher efficiency for heating and the reduction of cooling load through passive cooling.

Heat loss through thermal elements



Energy Consumption kWh pa



Heat demand and heating system efficiency

System efficiency is modelled to be highest for the Ground Source Heat Pump option in scenario 4. The combined efficiency of the heating and cooling is particularly high with the GSHPs passive cooling significantly reducing cooling energy consumption.

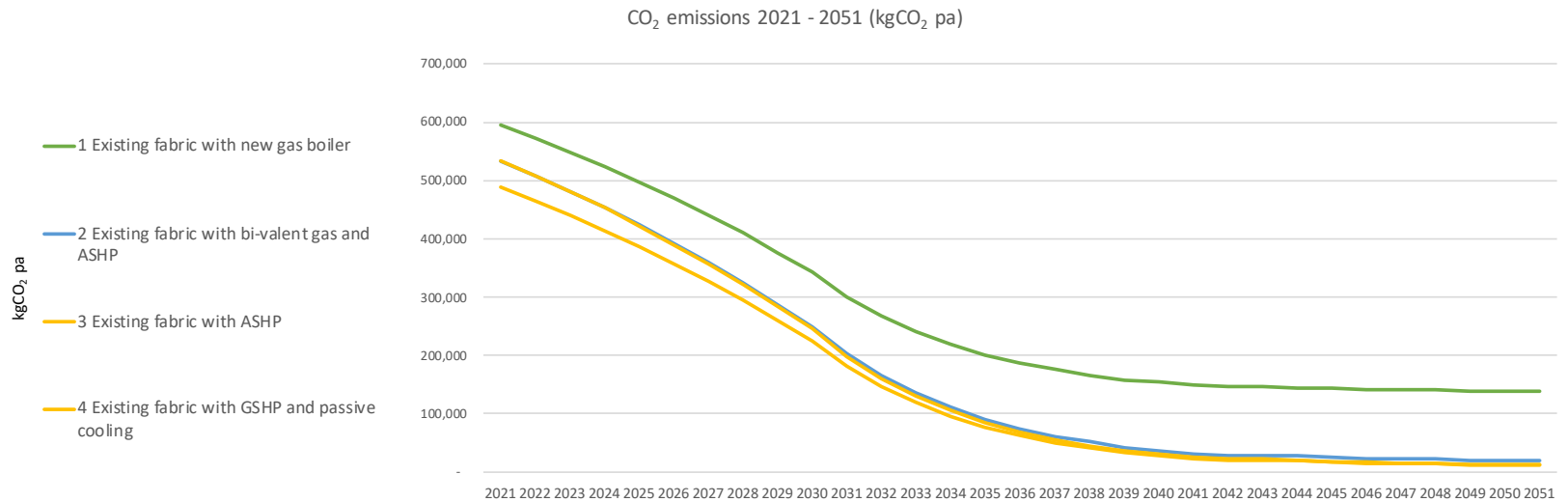
	Existing fabric with new gas boiler	Existing fabric with bi-valent gas and ASHP	Existing fabric with ASHP	Existing fabric with GSHP and passive cooling
Space heating demand (kWh pa)	143,018	143,018	143,018	143,018
Water heating demand (kW)	464000	464000	464000	464000
Required flow temperatures °C	45	45	45	45
Space heating consumption (kWh pa)	154,614	73,893	51,078	50,182
Cooling consumption (kWh pa)	232,000	232,000	232,000	77,333
Water heating consumption (kWh pa)	530286	165714	178462	175094
Lighting and auxiliary demand (kWh pa)	1421000	1421000	1421000	1421000
Space heating peak demand (kW)	77.3	77.3	77.3	77.3
Water heating peak demand (kW)	107	107	107	107
Required heating system size (kWtherm)	107	107	107	107
Peak electricity load kW @ 6:00pm	343.3	357.7	362.6	362.3
Assumed primary heating system SPF	93%	256%	280%	285%
Assumed distribution losses	5%	5%	5%	5%
Space heating Thermal Energy Demand Intensity (kwh per m2 pa)	25	25	25	25
Energy Use Intensity - all energy use (kWh per m2 pa)	404	327	325	298

* negative figures indicate a negative cost of carbon reduction. i.e. the packages of measures reduce 30 year costs and reduce CO2.

Retrofit package CO₂ emissions

tCO ₂ in 2021	595	533	533	488
Predicted annual tCO ₂ emissions (2030)	342.0	248.5	245.1	224.4
tCO ₂ in 2050	138.7	19.9	13.2	12.1
tCO ₂ cumulative 2021 - 2050	8276	5225	5090	4661
tCO ₂ saved relative to BAU (30 year cumulative)	0	-3051	-3187	-3616
CO ₂ saving relative to baseline (30 year cumulative)	0%	37%	39%	44%
Additional cost over BAU scenario (30 years)	£0	£-447,189	£-402,033	£-1,097,109
£ per tonne of CO ₂ reduction (30 year cumulative)	NA	£-147	£-126	£-303

30 year predicted CO₂ emissions



CO₂ emissions

CO₂ emissions decline significantly across all scenarios due to the high level of electricity demand in all scenarios. However, emissions reductions are greatest in scenarios 2 - 4 that replace gas heating with heat pumps.

Scenarios 2 - 4 all reduce CO₂ emissions at a negative cost of carbon with CO₂ emissions co-occurring with reduced costs of ownership.

Potential impact of Solar PV on all scenarios

	Existing fabric with new gas boiler	Existing fabric with bi-valent gas and ASHP	Existing fabric with ASHP	Existing fabric with GSHP and passive cooling
Included in package? (Y/N)	N	N	N	N
System size kW Peak	25.0	25.0	25.0	25.0
System generation kWh pa	24,090	24,090	24,090	24,090
Utilisation on site kWh pa	24090	24090	24090	24090
Utilisation on site kWh pa	100%	100%	100%	100%
Exported to grid kWh pa	0	0	0	0
Assumed system cost £	37500	37500	37500	37500
Net impact on fuel bills £ pa	-£ 3,618	-£ 3,618	-£ 3,618	-£ 3,618

Renewable energy:

Due to the high year round requirement for electricity (primarily for lighting and cooling) solar PV utilisation on-site would be high under all scenarios with assumed 100% utilisation.

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

