Carbon Trust Options Appraisal for building decarbonisation: Summary of results

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Summary of current building

55-57 LOUGHBOROUGH ROAD SW9 7TB

Retail (Shop) with natural ventilation and cooling	1 Units
Floorspace (m2)	175
EPC Rating	G
Occupied space heating consumption (kWh)	16,839
Cooling consumption (kWh)	0
Water heating consumption (kWh)	1,575
Occupied area electricity use (kWh)	24,500
Annual total fuel bill	£6,445
Annual fuel bill per flat (including share of communal areas)	£6,445
Occupied area Thermal Energy Demand Intensity (kWh per m2 pa)	96
Occupied area Energy Use Intensity (kWh per m2 pa)	245
Age of construction	pre 1900
Windows	Single glazed windows
Wall	Solid brick, as built, no insulation (assumed)
Roof	Another dwelling above
Floor	Insulation unknown or as-built
Primary heating	Existing - electric room heaters
Air tightness (ACH @ ambient pressure)	Average air tightness (7.5 n50)
Radiators / emitters	Existing electric

Description of Options for Appraisal

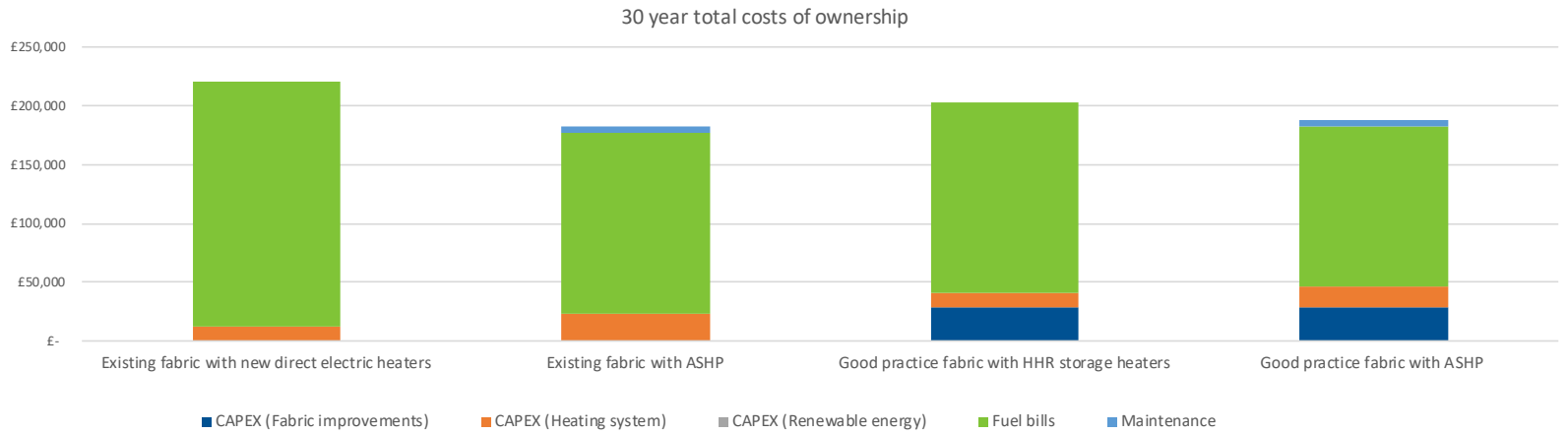
Thermal fabric
This double fronted shop currently has poor thermal fabric efficiency with a large glazed area with single glazing and assumed low levels of air tightness. In scenario 2 we look at the impact of installing a high temperature heat pump in to the existing fabric. In scenarios 3 & 4 we consider a good practice retrofit with high performance triple glazing and insulation under the floor.

Energy systems
The shop is currently heated by direct electric heaters leading to high fuel bills.
In scenario 2 we consider the installation of a high temperature heat pump alongside the installation of new wet heating system and radiators.
In scenario 3 we consider HHR storage heaters.
In scenario 4 we consider ASHP installation.

Summary of options appraisal measures, costs & CO_2 emissions

	Existing fabric with new direct electric heaters	Existing fabric with ASHP	Good practice fabric with HHR storage heaters	Good practice fabric with ASHP
HVAC system	10kW New electric room heaters, 0, 0, New electric immersion heater, Hot water cylinder and associated pipework , 0	10kW New ASHP Air to water <55°C, 0, 0, hot water from main system (electric), Hot water cylinder and associated pipework	5kW New smart high heat retention storage heaters, 0, 0, New electric immersion heater, Hot water cylinder and associated pipework	5kW New ASHP Air to water <55°C, 0, 0, hot water from main system (electric), Hot water cylinder and associated pipework
	£6,690	**£9,750**	**£6,850**	**£7,750**
Heat emitter and distribution	0, 0	New in-home distribution pipework to radiators, New - triple panel triple convector radiators	0, 0	New in-home distribution pipework to radiators, New - triple panel triple convector radiators
	£0	**£5,275**	**£0**	**£3,950**
Thermal fabric measures installed	, , ,	, , ,	, , high performance triple glazing , Insulate Suspended Floor (easy access)	, , high performance triple glazing , Insulate Suspended Floor (easy access)
	£0	**£0**	**£27,783**	**£27,783**
Air tightness	Natural ventilation , Average air tightness (7.5 n50)	Natural ventilation , Average air tightness (7.5 n50)	MEV, Building regs airtightness (5 n50)	MEV, Building regs airtightness (5 n50)
	£0	**£0**	**£875**	**£875**
Total CAPEX	**£6,690**	**£15,025**	**£35,508**	**£40,358**
Clean Heat Grant	£0	£0	£0	£0
Net CAPEX	**£6,690**	**£15,025**	**£35,508**	**£40,358**
Electricity tariff	Treasury Green Book Central Commercial Tariff	Treasury Green Book Central Commercial Tariff	Business Economy 7 tariff	Treasury Green Book Central Commercial Tariff
Annual fuel bills	**£6,445**	**£4,746**	**£4,986**	**£4,196**
Annual OPEX (maintenance)	£0	£148	£0	£148
30 year total cost of ownership (excluding grant)	**£220,966**	**£181,923**	**£202,693**	**£187,432**
Annual tCO_2 emissions (2021)	**12.1**	**8.9**	**10.0**	**8.0**
Predicted annual tCO_2 emissions (2030)	**5.6**	**4.1**	**4.6**	**3.7**
Predicted annual tCO_2 emissions (2050)	**0.3**	**0.2**	**0.2**	**0.2**

30 year total costs of ownership

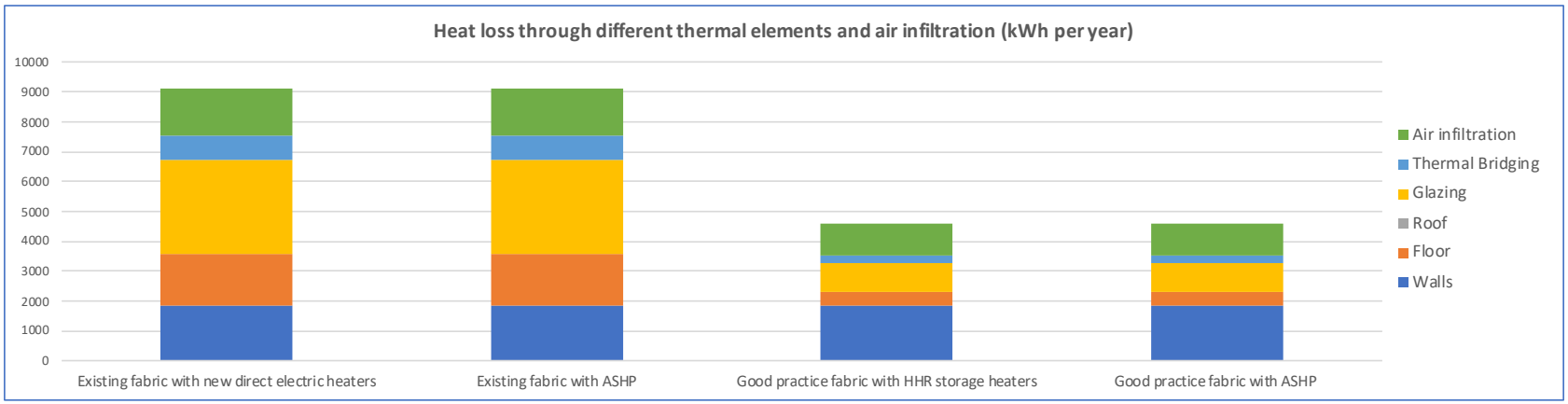


CAPEX
CAPEX associated with the heat pump systems (in scenario 2 & 4) is higher than for storage heaters and direct electric heaters. This is partly because installing a heat pump would involve the installation of new pipework and radiators. However, the largest CAPEX is for the glazing upgrades in scenarios 3 & 4.

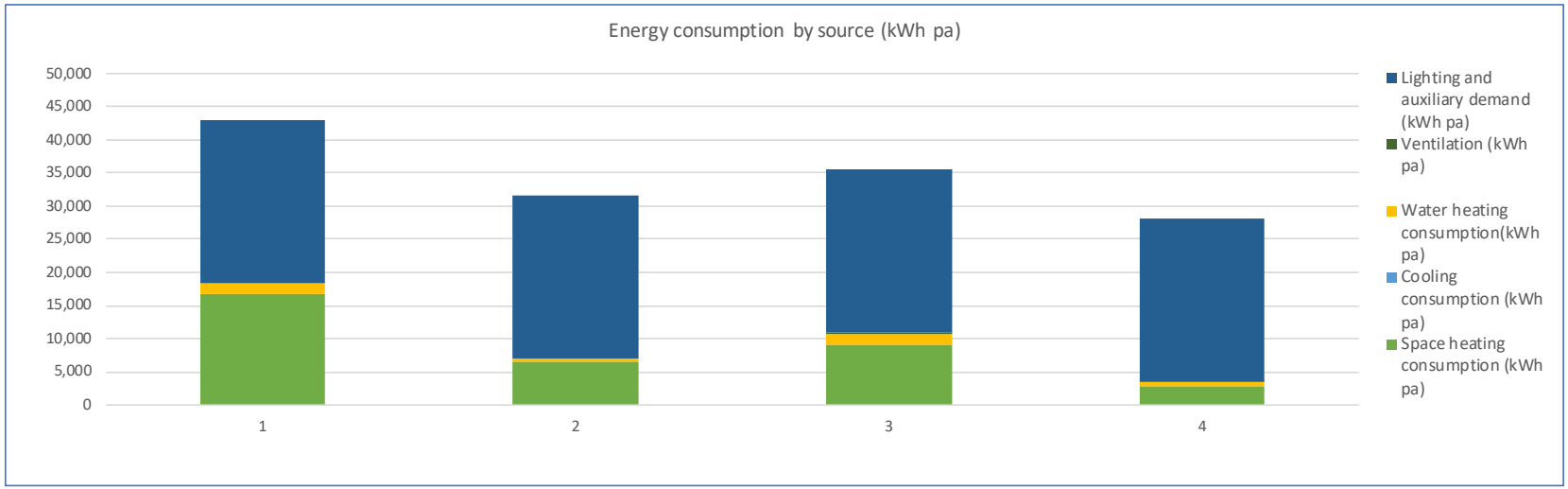
Fuel bills
Fuel bills reduce relative to the BAU in each of scenarios 2 - 4. The lowest fuel bills are in scenario 4.

30 year costs of ownership
Scenarios 2 & 4 have the lowest 30 year costs of ownership with the additional CAPEX investment in the heat pumps system paying for itself within the 30 year time period relative to the lower cost HHR storage heaters.

Heat loss through thermal elements



Energy Consumption kWh pa



Heat demand and heating system efficiency

	Existing fabric with new direct electric heaters	Existing fabric with ASHP	Good practice fabric with HHR storage heaters	Good practice fabric with ASHP
Space heating demand (kWh pa)	16,839	16,839	8,498	8,498
Space heating peak demand (kW)	9.1	9.1	4.6	4.6
Peak electricity load @ 6:00pm	12.0	8.3	5.9	6.9
Required flow temperatures °C	60	50	39	29
Space heating consumption (kWh pa)	16,839	6,476	9,187	2,814
Cooling consumption (kWh pa)	0	0	0	0
Water heating consumption(kWh pa)	1575	630	1575	630
Lighting and auxiliary demand (kWh pa)	24500	24500	24500	24500
Assumed primary heating system SPF	**100%**	**260%**	**93%**	**302%**
Assumed distribution losses	**0%**	**0%**	**0%**	**0%**
Space heating Thermal Energy Demand Intensity (kwh per m2 pa)	**96**	**96**	**49**	**49**
Energy Use Intensity - all energy use (kWh per m2 pa)	**245**	**181**	**202**	**161**

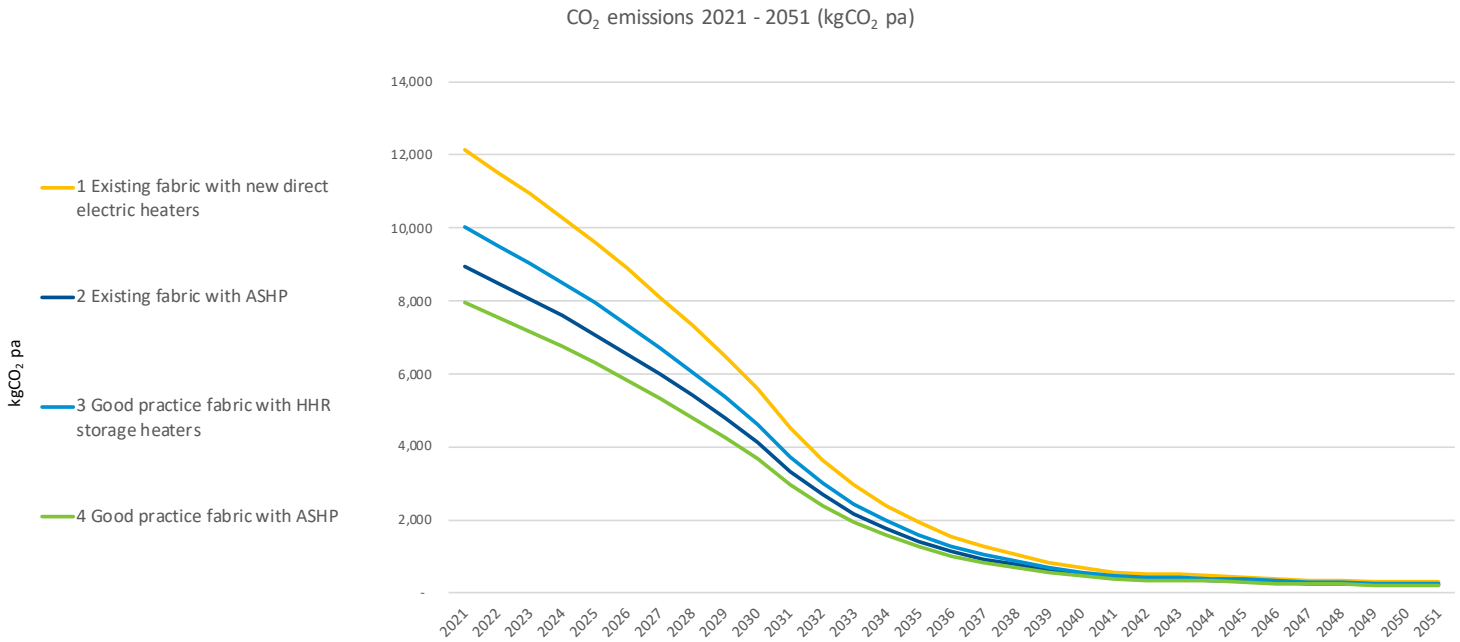
System efficiency
Whilst the heat pump scenarios (2 & 4) have the highest system efficiencies. The storage heaters in scenario 3 would bring wider benefits to a low carbon energy system including no additional peak demand.

Retrofit package CO_2 emissions

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

tCO_2 in 2021	12	9	10	8
Predicted annual tCO_2 emissions (2030)	5.6	4.1	4.6	3.7
tCO^2 in 2050	0.3	0.2	0.2	0.2
tCO^2 cumulative 2021 - 2050	116	85	96	76
tCO_2 saved relative to BAU (30 year cumulative)	0	-31	-20	-40
CO_2 saving relative to baseline (30 year cumulative)	0%	26%	17%	34%
Additional cost over BAU scenario (30 years)	£0	-£39,043	-£18,273	-£33,534
£ per tonne of CO_2 reduction (30 year cumulative)	NA	-£1,279	-£905	-£839

30 year predicted CO_2 emissions



CO_2 emissions
As all scenarios are electrically heated, CO_2 emissions fall substantially for all with the forecast reduction in grid carbon intensity.

Potential impact of Solar PV on all scenarios

	Existing fabric with new direct electric heaters	Existing fabric with ASHP	Good practice fabric with HHR storage heaters	Good practice fabric with ASHP
Included in package? (Y/N)	N	N	N	N
System size kW Peak	0.0	0.0	0.0	0.0
System generation kWh pa	0	0	0	0
Utilisation on site kWh pa	0	0	0	0
Utilisation on site kWh pa	0%	0%	0%	0%
Exported to grid kWh pa	0	0	0	0
Assumed system cost £	0	0	0	0
Net impact on fuel bills £ pa	£ -	£ -	#N/A	£ -

We did not model solar PV for this building.

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