Carbon Trust Options Appraisal for building decarbonisation: Summary of results

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Summary of current building

393 BRIXTON ROAD SW9 7DE

Retail (Shop)	**1 Units**
Floorspace (m2)	**298**
EPC Rating	**E**
Occupied space heating consumption (kWh)	**9,228**
Cooling consumption (kWh)	**8,344**
Water heating consumption (kWh)	**2,682**
Occupied area electricity use (kWh)	**41,720**
Annual total fuel bill	**£9,307**
Annual fuel bill per flat (including share of communal areas)	**£9,307**
Occupied area Thermal Energy Demand Intensity (kWh per m2 pa)	**75**
Occupied area Energy Use Intensity (kWh per m2 pa)	**208**
Age of construction	1900 - 1929
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 - VRF
Air tightness (ACH @ ambient pressure)	Average air tightness (7.5 n50)
Radiators / emitters	Existing electric

Description of Options for Appraisal

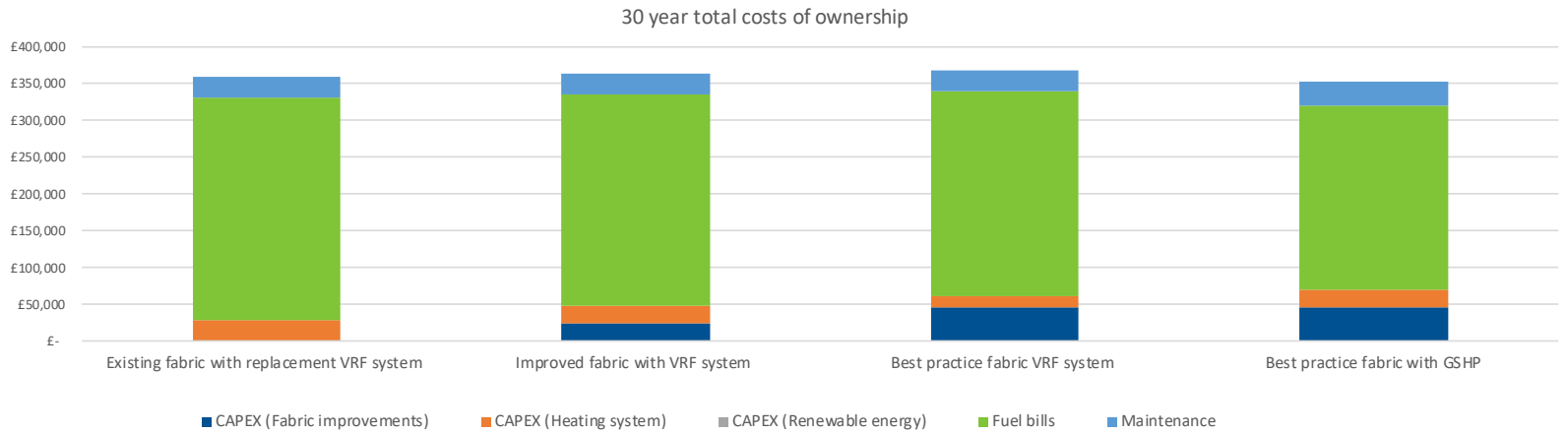
Thermal fabric
Halifax occupies the extended ground floor of this building. The building fabric is currently of low thermal efficiency with solid stone walls and single glazing to a large proportion of the building.
In scenarios 2 - 4 we consider replacing all single glazing with triple glazing. In scenarios 3 & we additional consider installing internal wall insulation.

Heating systems
The building is currently heated and cooled with VRF units. We consider direct replacement of the VRF units in scenarios 1 - 3.
In scenario 4 we assess the impact of installing a Ground Source Heat Pump supplying the heat demand and also providing passive cooling through newly installed fan coil units. it should be noted however, that there are significant barriers to installing a borehole at this particular site.

Summary of options appraisal measures, costs & CO_2 emissions

	Existing fabric with replacement VRF system	Improved fabric with VRF system	Best practice fabric VRF system	Best practice fabric with GSHP
HVAC system	13kW New ASHP (VRF), 0, 0, New electric immersion heater, Hot water cylinder and associated pipework , 0	10kW New ASHP (VRF), 0, 0, New electric immersion heater, Hot water cylinder and associated pipework	7kW New ASHP (VRF), 0, 0, New electric immersion heater, Hot water cylinder and associated pipework	7kW New GSHP/ WSHP <55°C, 0, ground loop (borehole) , New electric immersion heater, Hot water cylinder and associated pipework
	£15,167	**£12,017**	**£8,867**	**£14,667**
Heat emitter and distribution	0, New - VRF system / split air to air units	0, New - VRF system / split air to air units	0, New - VRF system / split air to air units	New in-home distribution pipework to radiators, New - Fan coil units
	£0	**£0**	**£0**	**£4,470**
Thermal fabric measures installed	, , ,	, , high performance triple glazing ,	Internal wall insulation (High price - complex interior), , high performance triple glazing ,	Internal wall insulation (High price - complex interior), , high performance triple glazing ,
	£0	**£24,444**	**£43,329**	**£43,329**
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**	**£1,490**	**£1,490**
Total CAPEX	**£15,167**	**£36,461**	**£53,686**	**£63,956**
Clean Heat Grant	£0	£0	£0	£0
Net CAPEX	**£15,167**	**£36,461**	**£53,686**	**£63,956**
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	**£9,307**	**£8,872**	**£8,588**	**£7,730**
Annual OPEX (maintenance)	£950	£950	£950	£1,050
30 year total cost of ownership (excluding grant)	**£359,858**	**£363,908**	**£368,780**	**£353,492**
Annual tCO_2 emissions (2021)	**17.5**	**16.7**	**16.3**	**14.7**
Predicted annual tCO_2 emissions (2030)	**8.1**	**7.7**	**7.5**	**6.7**
Predicted annual tCO_2 emissions (2050)	**0.4**	**0.4**	**0.4**	**0.4**

30 year total costs of ownership



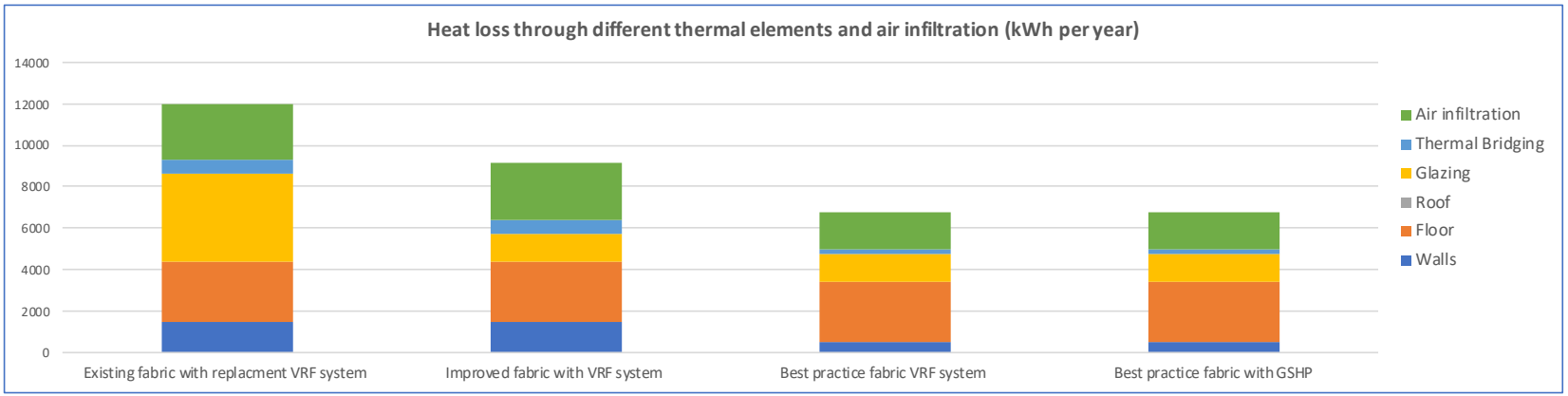
CAPEX
The highest CAPEX is associated with the thermal fabric measures, particularly the high performance triple glazing in scenarios 2 - 4. The GSHP unit in scenario 4 has the highest CAPEX of the heating systems, due to the extra costs of the ground loop and the installation of new heat emitters.

Fuel bills
Scenario 4 has the lowest overall fuel bills with the combination of reduced thermal demand and the provision of passive cooling the ground loops reducing energy consumption.

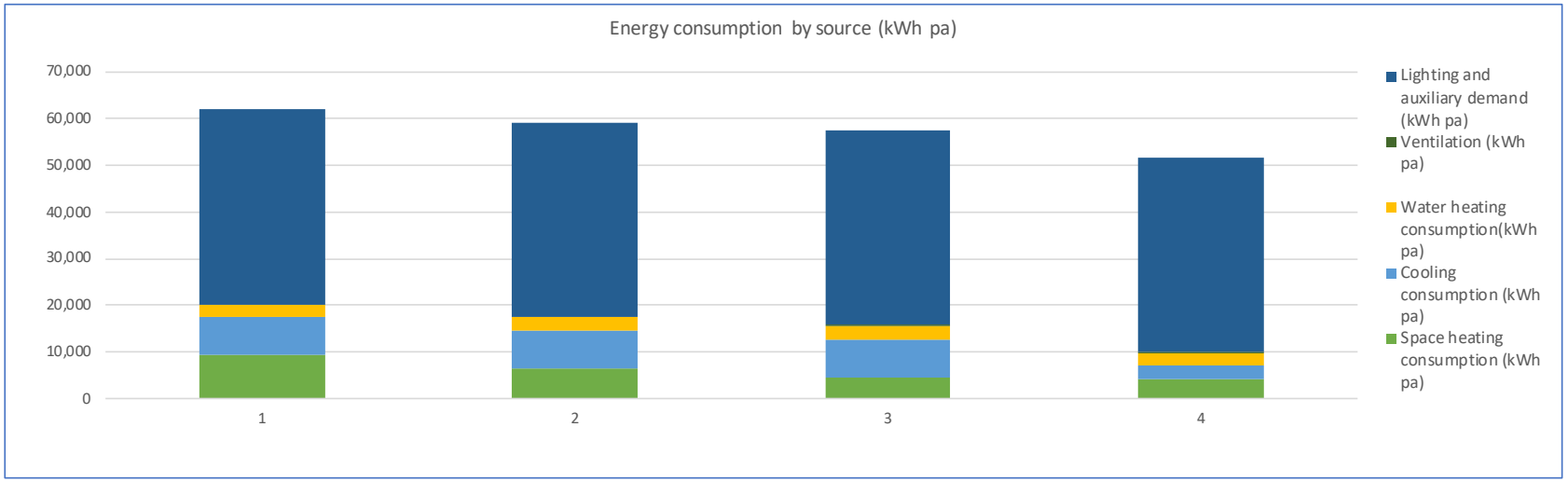
Fuel bills are broadly similar across the other scenarios reflecting the fact that a) the existing VRF heating system is already highly efficient and b) heating accounts for a minority of the overall energy use of the building.

30 year costs of ownership
Scenario 4 has the lowest 30 year costs of ownership. The investment in fabric efficiency reduces heat demand. However, the main factor driving the cost effectiveness of this scenario is the reduction in electricity demand

Heat loss through thermal elements



Energy Consumption kWh pa



Heat demand and heating system efficiency

Energy use intensity is high in all scenarios due to the high level of electricity demand for cooling and for non-heat electricity consumption. However, the passive cooling of the GSHP in scenario 4 does make a tangible difference in Energy Use Intensity providing a high overall combined heating and cooling system efficiency.

	Existing fabric with replacement VRF system	Improved fabric with VRF system	Best practice fabric VRF system	Best practice fabric with GSHP
Space heating demand (kWh pa)	22,240	16,906	12,567	12,567
Space heating peak demand (kW)	12.0	9.1	6.8	6.8
Peak electricity load @ 6:00pm	13.6	12.5	11.8	11.7
Required flow temperatures °C	55	49	41	41
Space heating consumption (kWh pa)	9,228	6,332	4,441	4,289
Cooling consumption (kWh pa)	8,344	8,344	8,344	2,781
Water heating consumption(kWh pa)	2682	2682	2682	2682
Lighting and auxiliary demand (kWh pa)	41720	41720	41720	41720
Assumed primary heating system SPF	**241%**	**267%**	**283%**	**293%**
Assumed distribution losses	**0%**	**0%**	**0%**	**0%**
Space heating Thermal Energy Demand Intensity (kwh per m2 pa)	**75**	**57**	**42**	**42**
Energy Use Intensity - all energy use (kWh per m2 pa)	**208**	**198**	**193**	**174**

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.

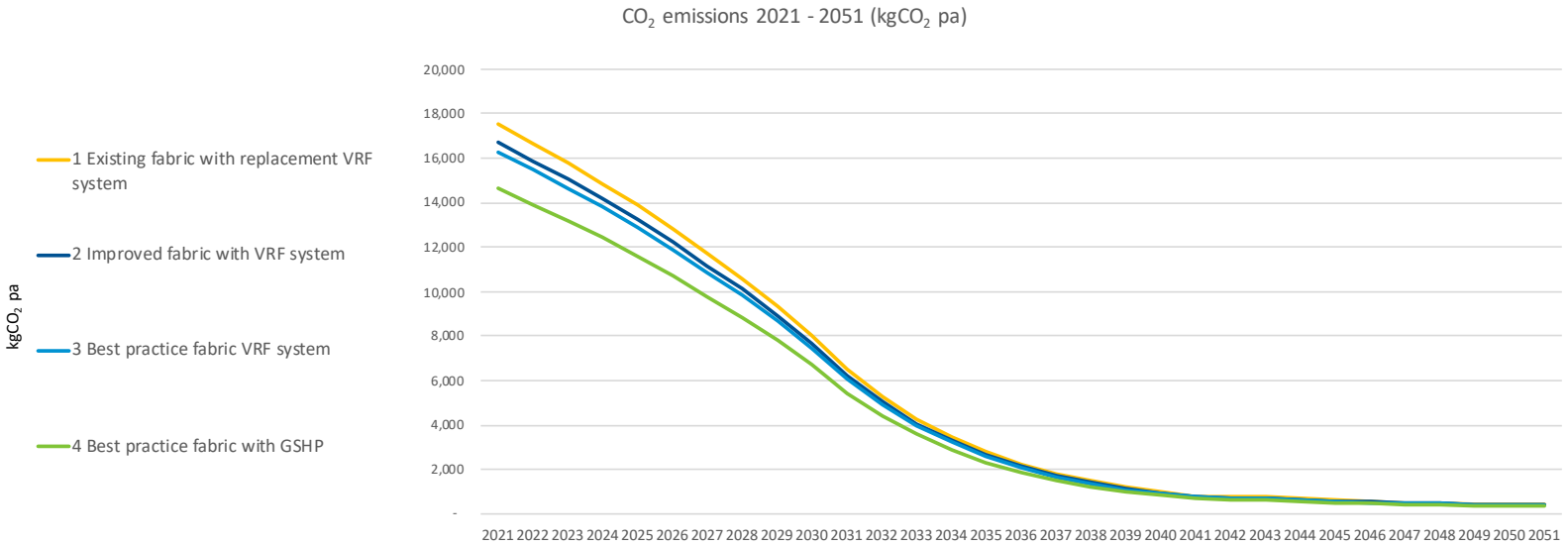
tCO_2 in 2021	18	17	16	15
Predicted annual tCO_2 emissions (2030)	8.1	7.7	7.5	6.7
Predicted annual tCO_2 emissions (2050)	0.4	0.4	0.4	0.4
tCO2 cumulative 2021 - 2050	167	160	155	140
tCO_2 saved relative to BAU (30 year cumulative)	0	-8	-12	-28
CO_2 saving relative to baseline (30 year cumulative)	0%	5%	7%	16%
Additional cost over BAU scenario (30 years)	£0	£4,050	£8,922	-£6,366
£ per tonne of CO_2 reduction (30 year cumulative)	NA	£518	£736	-£231

30 year predicted CO_2 emissions

CO_2 emissions

Because all scenarios involve electric heating, CO_2 emissions savings are similar across all scenarios. The passive cooling provided by the GSHP does provide an additional CO_2 saving.

Scenario 4 provides carbon reduction at a negative cost of carbon, with carbon savings coming alongside a net cost saving to the building owner.



Potential impact of Solar PV on all scenarios

	Existing fabric with replacement VRF system	Improved fabric with VRF system	Best practice fabric VRF system	Best practice fabric with GSHP
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				

We did not model solar PV for this property.

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