APPENDIX G – CURRIE AND BROWN DECARBINISATION REPORT

Exeter City Council

Northbrook Swimming Pool

Beacon Lane, Exeter EX4 8LZ

Decarbonisation Strategy Report

FUTURES
Bringing projects to life

Currie & Brown

Revision control

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Executive summary

There are opportunities to significantly improve Northbrook Swimming Pool as part of Exeter City Councils decarbonisation strategy. This has been documented within this report as a 3-stage project proposal.

At stage 1, it was found that energy demand could be reduced by implementing fabric and LED upgrades to achieve an annual 15% carbon emission reduction compared to existing.

Implementing stage 2, this could be further reduced by 65% with the introduction of an air source heat pump (ASHP) which would eliminate fossil fuel consumption on site.

Then at stage 3, a further 10% carbon emission reduction could be made by installing PV panels in which additional electricity demands from the ASHP could be offset.

Overall, total carbon emissions can be reduced by 73% compared to existing.

The following table provides a summary of the full decarbonisation strategy in which anticipated expenditure and associated savings are detailed.

Proposals	Estimated Project Costs	Electrical Usage	Fossil Fuel Usage	Energy Saved Type	Carbon Emissions	Carbon Saving (Annual)	Carbon Saving	Energy Saving (Annual)	Energy Saving (Annual)	Carbon Savings	Payback
	£	kWh	kWh		tCO2	tCO2	tCO2eLT	kWh	£	£/tCO2eLT	Years
Baseline		59,221	650,270		128.5						
Lighting	£ 19,350	56,510	650,270	Electric	128.0	0.52	13.1	2,711	£ 670	£ 1,477	28.9
Roof upgrades	£ 85,350	56,510	640,989	Gas	126.3	1.67	50.1	9,281	£ 454	£ 1,703	188.1
Wall upgrades	£ 3,800	56,510	633,689	Gas	125.0	1.31	39.4	7,300	£ 357	£ 96	10.6
Windows	£ 162,900	56,510	563,174	Gas	112.3	12.69	355.4	70,515	£ 3,448	£ 458	47.2
Doors	£ 16,850	56,510	557,023	Gas	111.2	1.11	31.0	6,151	£ 301	£ 544	56.0
Rooflights	£ 12,950	56,510	546,878	Gas	109.4	1.83	51.1	10,145	£ 496	£ 253	26.1
Draught-proofing	£ -	56,510	533,034	Gas	106.9	2.49	72.9	13,844	£ 677	£ -	-
ASHP (FF contribution)	£ 584,500	56,510	-	Gas	10.9	95.95	1,918.9	533,034	£ 26,065	£ 305	22.4
ASHP (Elec contribution)		200,019	-	Electric	38.7	- 27.75	- 555.0	- 143,509	-£ 35,461	£ -	-
PV System	£ 23,800	179,395	-	Electric	34.7	3.99	89.7	20,624	£ 5,096	£ 265	4.7
Total	£ 909 , 500	179 , 395	-		34 . 7	93 . 8	2 , 066 . 7	530 , 096	£ 2 , 103	£ 440	432 . 5

Due to the age and condition of the existing fossil fuel heating system, the full project proposal is **COMPLIANT** under PSDS Phase 3 criteria in which an application can be made to receive funding towards heat decarbonisation.

The following table portrays the estimated available funding that could be received in a successful PSDS Phase 3 application.

Proposals	Estimated Project Costs	Carbon Saving (Annual)	Carbon Saving	Energy Saving (Annual)	Carbon Savings	Payback	Available funding	Additional Funding Requirement	% of project Salix Funded
	£	tCO2	tCO2eLT	£	£/tCO2eLT	Years	(£325 tC02eLT)	£	%
Proposal 1 - Full Proposal	£909,500	93.8	2,066.7	£2,103	£ 440	432	£800,360	£109,140	88%

1. About the Survey

1.1 Brief

Futures, Currie & Brown and SDS Engineering Consultants have been appointed to provide baseline energy analysis and decarbonisation strategy reports for Exeter City Council. This report details findings from a site survey and investigation into adopting low carbon technology on site, including load modelling and technology appraisals. These outputs are intended to direct the energy upgrade and carbon reduction opportunity, including applying for the Public Sector Decarbonisation Scheme grant (PSDS) through Salix. The PSDS scheme offers grant funding for decarbonisation projects that meet specific eligibility criteria.

This process requires completion of an energy analysis spreadsheet with embedded persistence factors and carbon calculations. The locked calculations have some bias towards technologies that Salix have prioritized through the Public Sector Decarbonisation Fund. Our results therefore look to compare our modelling of operational performance with those within the Salix application form to ensure that Exeter City Council understand revised operational expenditure as well as capital expenditure.

This report details decarbonisation strategy for Northbrook Swimming Pool.

1.2 Survey Details

- The site survey was carried out by Currie & Brown on: 11/09/2023

- The site survey was carried out by SDS Engineering on: 11/09/2023

1.3 Limitations

- Our site surveys were limited to a visual inspection only, no intrusive investigations were undertaken.
- Where insulation levels such as within cavity walls or within roof construction could not be confirmed, we have assumed insulation levels to be comparable to minimum building regulation levels at the time of construction with refence to the guidelines provided within the Standard Assessment Procedure (SAP 2012)
- Energy Analysis and benchmarking has been undertaken in accordance with CIBSE guidelines.

1.4 Philosophy

The construction industry is required to comply with ever tightening legislation surrounding energy use within buildings. Currie & Brown's energy and sustainability consultancy team have been providing advice to the government with regards to proposed changes to the Building Regulations Approved Document L – Conservation of Fuel and Power and to the Climate Change Committee, the independent statutory body established under the Climate Change Act 2008. Currie & Brown are signatories to the World Green Building Council commitments and contributing authors to their recent report 'Beyond Buildings'.

The regulatory framework regarding energy use will become progressively more stringent over coming years, as designers Currie & Brown and SDS Engineering Consultants design and encourage organisations to go beyond current minimum levels in order to promote best practice, reduce operational costs and mitigate the effect of any potential future regulatory changes. Adopting a best practice approach provides the greatest contribution towards achieving the UK Governments ambitious net zero by 2050 target.

We suggest adopting the universally applied and well used energy hierarchy. This sets out the priority of measures for energy use reduction in order of which typically, can produce the greatest available improvements and the simplest to implement.

The three strategy headings are:

Be Lean

Be Clean

Be Green

Be Lean - reducing the demand of energy consuming appliances on site, wherever possible

Be Clean - using the best possible efficiency of equipment and using an energy source which produces the least emissions

Be Green - implementing renewable technology, generating heat or electricity from a renewable source

2. Site Details

2.1 Location

Northbrook Swimming Pool, Beacon Lane, Exeter EX4 8LZ

2.2 Site Description

Northbrook Swimming Pool is a public swimming pool facility within Exeter. There is one 19m internal pool located on site with changing rooms.

The Display Energy Certificate is attached to the report in Appendix B and provides a DEC rating of E.

Our energy assessment results often deviate from the DEC and advisory report as we have undertaken a more detailed investigation and analysis, focussing on the buildings which are responsible for the majority of the energy use across site. Temporary buildings and low energy users have been omitted from our calculations with relevant GIFA and assumed energy use omitted from the base data.

2.3 Usage

The site is generally in constant use throughout the year including bank holidays but closed on Sundays.

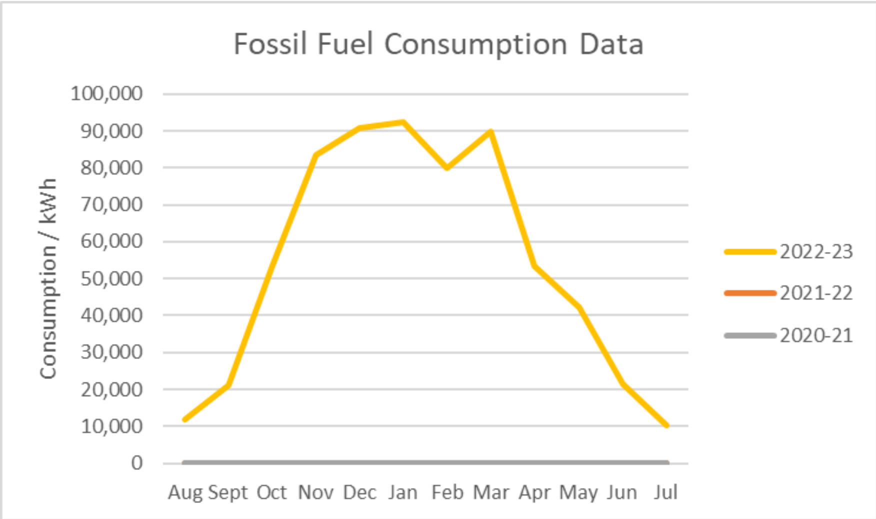
The open hours are generally between 7:30 – 15:00 Monday to Friday and 08:00 – 12:00 Saturdays.

3. Existing Site Energy Use

Where available, we have analysed three years of accounts data consumption. As worst-case scenario, the highest consuming years have been used as the basis for benchmarking and proposal calculations.

3.1 Gas Data

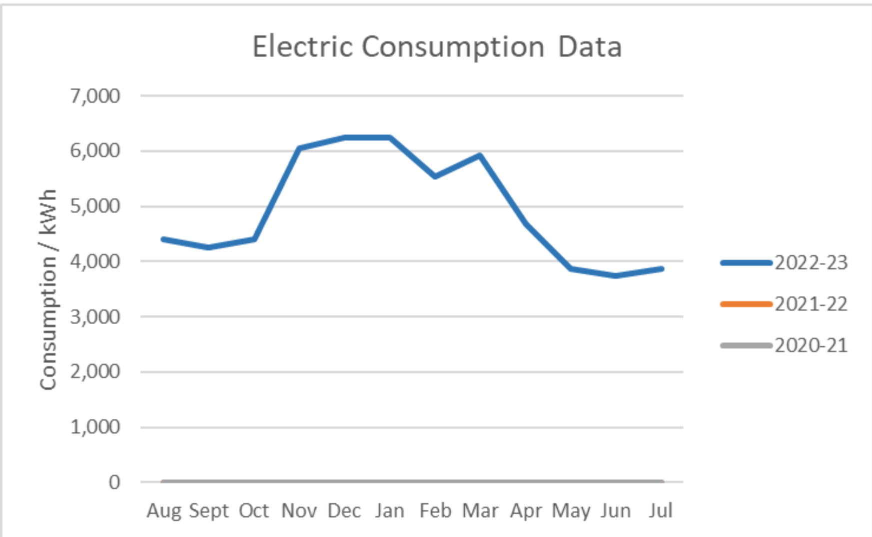
**Only one year of energy consumption data available.*



2022-23	
Month	**Usage (kWh)**
Aug	11,915
Sept	21,149
Oct	53,320
Nov	83,406
Dec	90,853
Jan	92,343
Feb	79,832
Mar	89,959
Apr	53,320
May	42,299
Jun	21,447
Jul	10,426
Total	650,270

3.2 Electric Data

**Only one year of energy consumption data available.*



2022-23	
Month	**Usage (kWh)**
Aug	4,406
Sept	4,260
Oct	4,406
Nov	6,048
Dec	6,248
Jan	6,248
Feb	5,549
Mar	5,925
Apr	4,674
May	3,861
Jun	3,738
Jul	3,861
Total	59,221

Current Site Energy Costs		
	Fossil Fuel Usage (kWh)	Electricity Usage (kWh)
Total	650,270	59,221
Annual Cost	£ 31,798	£ 14,634
Annual Carbon Emissions (Tonnes)	117.0	11.5

Total Annual Cost	**£46,432**
Total Annual Emissions (Tonnes)	**129**

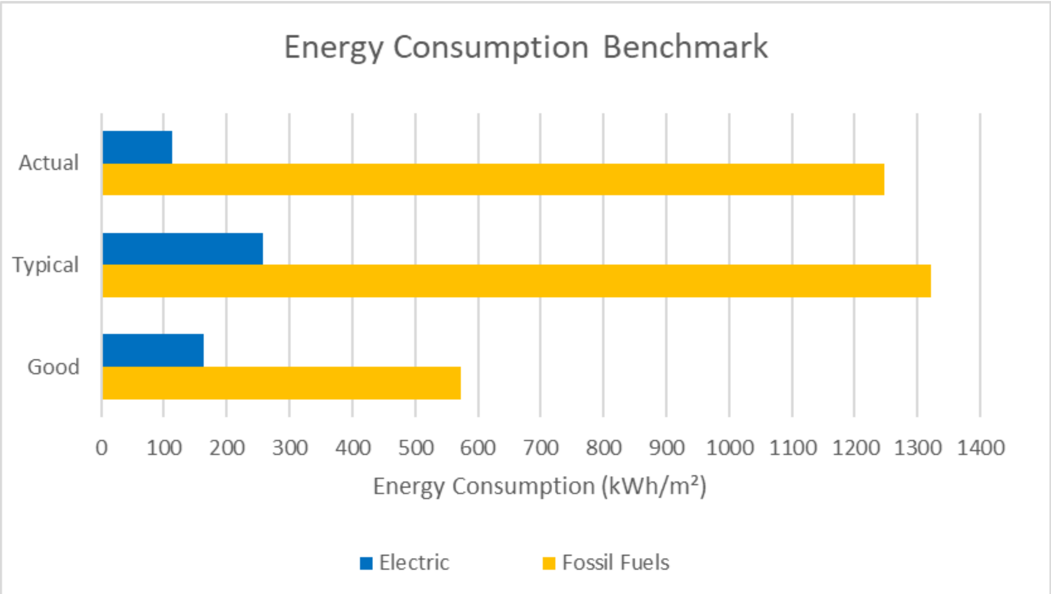
Energy tariff rates for gas and electricity have been based on BEIS GOV Energy Rates 2023 Q1 for non-domestic buildings. This may not be reflective of the site's actual energy tariff.

Gas = £0.049 / kWh
Electricity = £0.25 / kWh

3.3 Benchmarking Energy Data

The following table and graph portrays the existing site energy consumption data (kWh/m²) against typical and good practice as described in CIBSE Guide F table 20.1.

Building Type	Leisure pool centre	
	Fossil fuels	Electric
Good	573	164
Typical	1321	258
Actual	1248	114



4. Northbrook Swimming Pool – Main Building

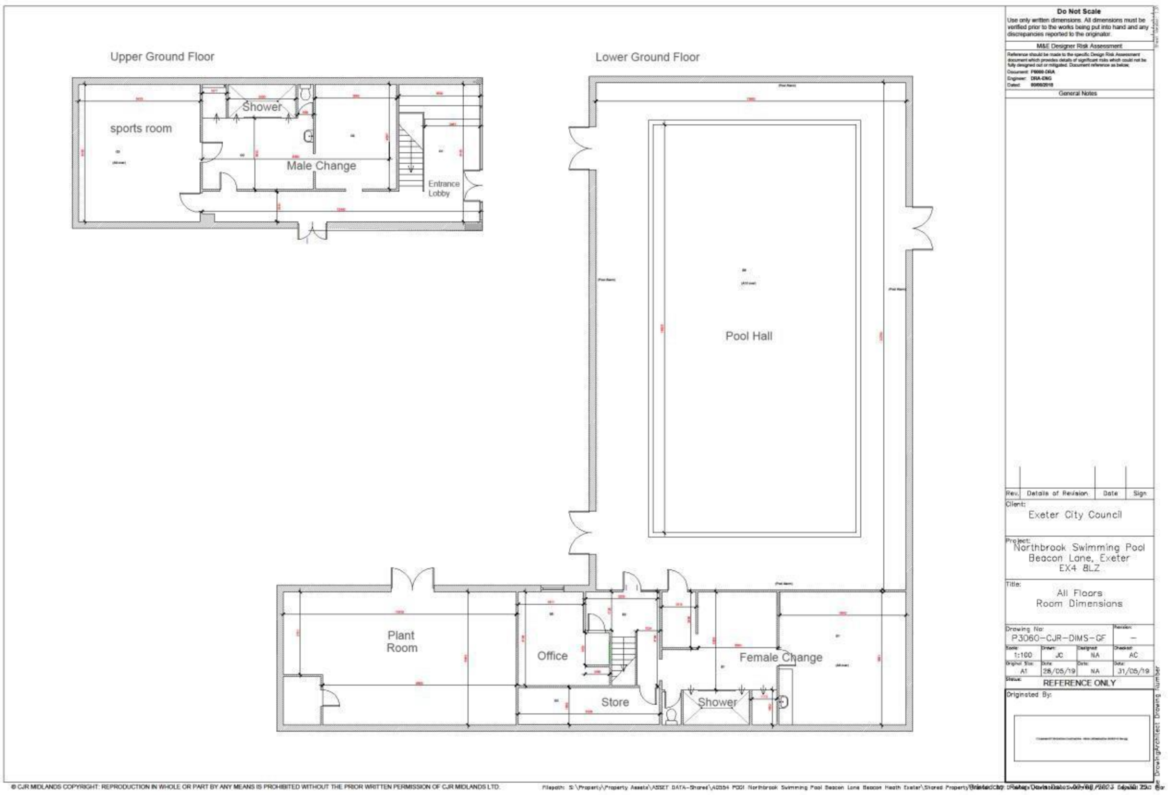
It is understood that Northbrook Swimming Pool was constructed in the late 1980's-early 1990's, originally with an external pool. The external pool was later enclosed around 1998 with new external walls and a roof. The site predominantly consists of the pool hall and male and female changing rooms. There is additional ancillary reception and small office space.

Planning Restrictions

Our review of public records has indicated that Northbrook Swimming Pool is not subject to any listed status or located within a within a Conservation Area, under the Planning (Listed Buildings and Conservation Areas) Acts 1990. However, the installation of Air Source Heat Pumps in some local authorities are not considered under permitted development rights for non-domestic buildings. In such cases, a planning application would be required. We have not engaged with the local planning authorities at this stage.

Asbestos

The building was originally constructed and extended whilst some asbestos containing materials were still common in the construction supply chain. We have identified the block at MEDIUM-HIGH risk. The asbestos register has not been consulted.



4.1 Existing Building Fabric

Roof

The buildings main roof area is a flat roof structure with felt covering. The pool hall is covered with a curved pitched, steel roof structure. The level of insulation within both roof build ups could not be determined without intrusive investigations. We have therefore assumed insulation levels to be comparable to construction practice at the time of build.

Installing additional insulation within the roofs can significantly improve thermal performance. The felt covered flat roofs appear to be approaching the end of their service life where insulation upgrades can be suitably made. The pitched roof insulation is contained within the roof build-up, with improvement opportunities limited in terms of practicality. It is recommended the pitched roof areas are upgraded when the covering is next due for renewal.

Rooflights

There are some localised rooflights installed within the main building areas which are single glazed, Georgian wire installations. These are in poor condition, with cracked panes and contributing to significant heat loss comparted to modern alternatives.

It is recommended the rooflights are replaced with modern double-glazed alternatives.

Walls

The external walls are traditional masonry cavity wall construction throughout. Without undertaking any intrusive investigations, we have assumed the walls are insulated comparable to construction standards at the time of build.

Cavity fill wall insulation could be installed as a cost-effective measure to improve existing performance. It is recommended intrusive investigations are carried out to the existing walls to determine if they are insulated, the levels of insulation and overall condition. Cavity wall insulation could become defective from being incorrectly installed resulting in cold spots or damaged due to dampness which affects its thermal performance. Following investigations, an assessment can be made on its suitability

Windows

There are localised timber frame single glazed windows and a curtain wall section to the entrance lobby. The pool hall contains a half-height poly-carbonate glazed curtain wall to the pool area which includes openable aluminium double-glazed sections. These windows are contributing to significant heat loss compared to modern alternatives.

It is recommended the windows are replaced with modern installations throughout. We recommended the pool areas are upgraded to triple glazing with the remaining areas upgraded to modern double glazing.

Doors

The entrance doors are timber frame with single glazed vision panels and missing draught proofing measures. There are additional aluminium framed installations containing obscured vision panels. Generally, doors are weathered and installation resulting in increased air leakage and heat loss. External doors are of timber construction and dated in nature. Majority of doors have single glazed vision panels and are missing draught proofing measures contributing to heat loss.

It is recommended the external doors are replaced with modern installations throughout with integrated draught proofing measures.

4.1.1 Fabric Heat Loss Calculations

The static heat load analysis below incorporates fabric loss, infiltration and thermal bridging. It is estimated there is an existing peak heat load of 71.6kW throughout the building.

			Fabric Heat Loss													Infiltration	Thermal Bridging	Total	Total + Margin
Asset Name	Floor	Temp(°C)	Grd floor area (m^2)	Heat Loss (W)	Roof area (m^2)	Heat Loss (W)	Wall area (m^2)	Heat Loss (W)	Window area (m^2)	Heat Loss (W)	Door area (m^2)	Heat Loss (W)	Rooflight area (m^2)	Heat Loss (W)	Total Fabric Loss (W)	Heat loss (W)	Heat loss (W)	Total heat loss (W)	Total heat loss (W)
Northbrook (Pool Hall)	0	21.0	310	697	328	2133	105	1184	110	8548	12	908	0	0	13469	39745	395	53608	58969
Northbrook (Remaining Areas)	0	21.0	103	1363	59	517	75	1124	2	288	6	413	13	1524	5229	2071	281	7580	8338
Northbrook (Remaining Areas)	1	21.0			110	962	0	0	7	792	0	0	0	0	1754	2184	0	3937	4331
																	Total (W)	65126	71638
																	W/m^2	125	137

4.2 Existing Mechanical and Electrical Installations

4.2.1 Heating and Hot Water installations

The central heating is supplied via a single 205kW Robin hood boiler that has been reconfigured in 1986 to include a gas burner. The heating within the pool space is supplied by an external Moducel AHU with a gas heater that has up to 55kW capability. The boilers supply wall mounted radiators around the building, domestic hot water calorifier and swimming pool.

The heating pipework is distributed to radiators which are located to the perimeter of the building under windows where available. The men's changing room and toilet appears to be naturally ventilated, whilst the women's changing room and toilet has an extract connected to the pool hall ventilation.

The building includes toilets and changing facilities with Domestic Hot Water Service (DHWS) generated from the boiler feeding an indirect calorifier within the plant room.

The boiler is an old Beeston robin hood boiler with no plate to identify the year of manufacture or initial set up of the boiler. Beeston boilers have been insolvent since 1976, so assumed this boiler is in excess of 47 years old with the Nuway Natural Gas Burner being installed in 1986. The heat generators are life expired, in a poor condition and in need of replacement. The systems within the plant room are generally in a poor condition and need numerous rectifications.

The radiators within the building are in a reasonable condition with minor aesthetic damage, however, could do with thermostatic radiator valves being installed to reduce energy consumption.

The age of the AHU is a minimum of 14 years old, based on the Powrmatic gas burner manufacture year of 2009. Upon inspection of the unit one of the fans is completely corroded through, no lights are visible despite the unit being in operation and is generally in an unacceptable condition. There is a fan within the plantroom that appears to be a replacement for the one corroded through, however the council have suggested this has been there for years. This unit, as a minimum, needs fans to be replaced and the gas burner replaced with a low carbon alternative.

Like-for-like Fossil Fuel System Replacement Cost

The age and condition of the existing fossil fuel heating system means it is economically viable to replace in the short-term due to being end of life.

PSDS Phase 3 funding calculation is partially influenced by the marginal cost of the like-for-like replacement and new low carbon system. The like-for-like cost of a replacement conventional fossil fuel system is £24,185.

A funding criteria of PSDS Phase 3 was conventional fossil fuel heating system must be at or coming to end-of-life. Under Phase 3 criteria, a Salix application would be eligible to provide a potential source of funding for heat decarbonisation works.

Capital Cost Conventional Fossil Fuel Boiler system		
System Size kWht		205
Boiler	£	12,545
Metering and Monitoring	£	2,790
BWIC	£	2,250
Remove Existing Boiler Plant	£	4,350
Flushing/Commissioning	£	2,250
Total	£	24,185
Price per kWp	£	118

4.2.2 Electrical Supply and Infrastructure

The electrical installation to the site is a three Phase / 400V 100A with a TN-C-S earthing arrangement.

The main incoming electrical supply and distribution is in a satisfactory condition.

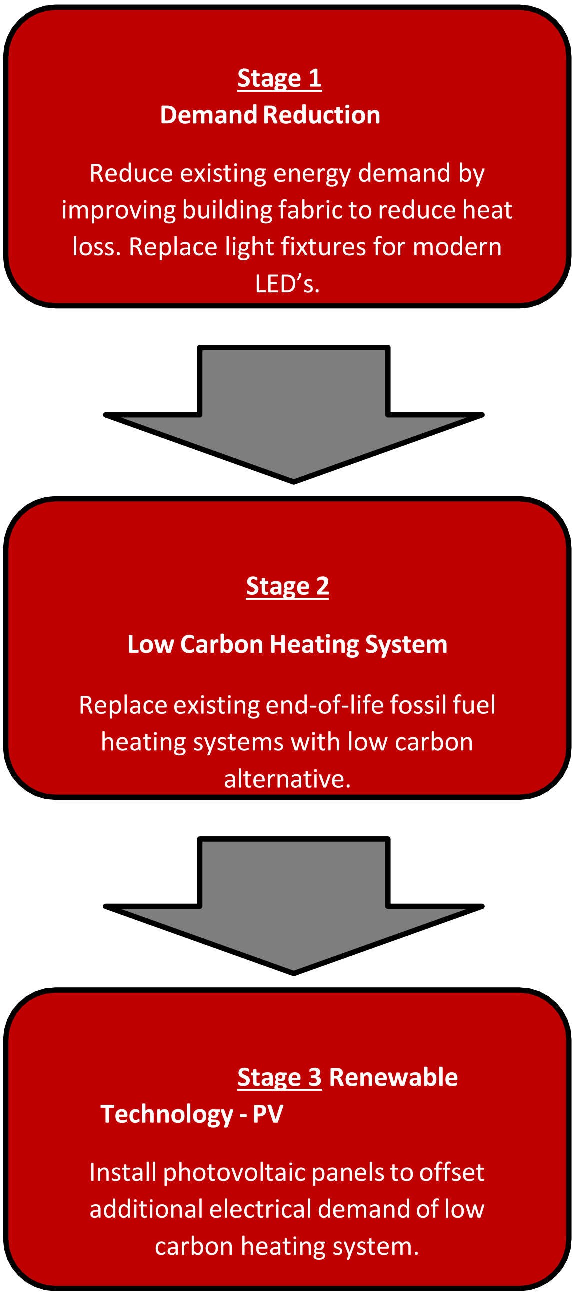
A request for information has been submitted with the DNO regarding site upgrade, based on the current allowances it is likely that an upgrade in supply will be required. This is TBC upon the DNO providing further information.

4.2.3 Lighting

Lighting is a fluorescent throughout the building and would benefit from being upgraded to LED throughout.

4.3 Decarbonisation Proposal

Our decarbonisation proposal adopts a ‘whole building approach’ consisting of three key stages.



4.3.1 Stage 1

Stage 1 incorporates measures to reduce energy demand comprised of two parts; fabric upgrades and LED lighting replacement.

4.3.1.1 Fabric Upgrades

Asset	Works area	Works Proposal	Fuel Saved	Area	Install Cost	Install Cost Total	Lifetime	Annual Energy Savings	Annual Cost Savings	Payback	carbon saved
				m²	£/m²	£	Years	kWh/year	£/year	Years	kg/kWh
Northbrook (Pool H	Wall TYPE 1	Cavity wall insulation	Gas	105	13.50	£1,420	42.0	2,626	£ 128.41	11	472.7
Northbrook (Pool H	Window TYPE 1	Triple glazing	Gas	102	1,099.79	£111,848	28.0	58,389	£ 2,855.21	39	10,510.0
Northbrook (Pool H	Window TYPE 2	Triple glazing	Gas	9	1,099.79	£9,458	28.0	4,937	£ 241.44	39	888.7
Northbrook (Pool H	Doors TYPE 1	New door with draught proofing	Gas	12	750.00	£9,075	28.0	4,229	£ 206.78	44	761.1
Northbrook (Pool H	Draught-proofing	Draught-proofing (new windows/d	Gas	105	-	£0	29.3	9,799	£ 479.15	0	1,763.7
Northbrook (Rema	Roof TYPE 1	Re-roof (flat) with insulation	Gas	169	392.78	£66,380	42.0	9,281	£ 453.84	146	1,670.6
Northbrook (Rema	Wall TYPE 1	Cavity wall insulation	Gas	75	13.50	£1,011	42.0	4,674	£ 228.57	4	841.3
Northbrook (Rema	Window TYPE 1	Double glazing	Gas	9	785.56	£7,070	28.0	7,189	£ 351.55	20	1,294.0
Northbrook (Rema	Doors TYPE 1	New door with draught proofing	Gas	6	750.00	£4,125	28.0	1,922	£ 93.99	44	346.0
Northbrook (Rema	Rooflights TYPE 1	Double glazed rooflight	Gas	13	785.56	£9,977	20.0	10,145	£ 496.07	20	1,826.0
Northbrook (Rema	Draught-proofing	Draught-proofing (new windows/d	Gas	75	-	£0	29.3	4,046	£ 197.83	0	728.2
		TOTALS				**£ 220,365**		**117,236**	**£ 5,733**	**38**	**21102**

By implementing all proposed fabric upgrades there is an estimated carbon saving of 21.1 tonnes equating to approximately £5,733 per year to be made based on current tariff rates.

Fabric Upgrade Projects

The below tables group fabric upgrades into building elements to take forward as fabric upgrade projects including all anticipated project costs. The anticipated energy savings are calculated on a accumulative basis, implementing each building fabric project proposal.

Project.	Roof upgrades
Actual kWh (Fossil Fuel)	650,270
kWh savings (Fossil Fuel)	9,281
After kWh savings (Fossil Fuel)	640,989
Design and engineering cost	£4,200
Main equipment capital cost	£36,500
Installation cost	£29,850
Project delivery cost	£7,050
Contingency	£7,750
Total project cost	£85,350

- Re-roof flet roof areas with greater insulated build-up.

Project.	Windows
Actual kWh (Fossil Fuel)	633,689
kWh savings (Fossil Fuel)	70,515
After kWh savings (Fossil Fuel)	563,174
Design and engineering cost	£6,300
Main equipment capital cost	£70,600
Installation cost	£57,750
Project delivery cost	£13,450
Contingency	£14,800
Total project cost	£162,900

- Replace all single glazing to main building areas with modern double glazing.
- Replace pool hall glazing and polycarbonate curtain walling with triple glazing.

Project.	Rooflights
Actual kWh (Fossil Fuel)	557,023
kWh savings (Fossil Fuel)	10,145
After kWh savings (Fossil Fuel)	546,878
Design and engineering cost	£700
Main equipment capital cost	£5,500
Installation cost	£4,500
Project delivery cost	£1,050
Contingency	£1,200
Total project cost	£12,950

- Replace Georgian wire single glazed rooflights with modern alternatives.

Project.	Wall upgrades
Actual kWh (Fossil Fuel)	640,989
kWh savings (Fossil Fuel)	7,300
After kWh savings (Fossil Fuel)	633,689
Design and engineering cost	£700
Main equipment capital cost	£1,350
Installation cost	£1,100
Project delivery cost	£300
Contingency	£350
Total project cost	£3,800

- Install cavity fill wall insulation to external masonry walls.

Project.	Doors
Actual kWh (Fossil Fuel)	563,174
kWh savings (Fossil Fuel)	6,151
After kWh savings (Fossil Fuel)	557,023
Design and engineering cost	£700
Main equipment capital cost	£7,250
Installation cost	£5,950
Project delivery cost	£1,400
Contingency	£1,550
Total project cost	£16,850

- Replace all external doors thorughout with modern alternatives with integrated draught proofing measures.

Project.	Draught-proofing
Actual kWh (Fossil Fuel)	546,878
kWh savings (Fossil Fuel)	13,844
After kWh savings (Fossil Fuel)	533,034
Design and engineering cost	£0
Main equipment capital cost	£0
Installation cost	£0
Project delivery cost	£0
Contingency	£0
Total project cost	£0

- Draught proofing improvements made as part of window and door replacement works.

Lighting LED upgrade

It is proposed that all the existing lighting should be changed to a modern LED equivalent. Lighting models would be available to directly change the fittings currently in use to avoid any wider internal builders work changes.

It has been assessed that approximately 4,744kWh of the current electrical demand (59,221 kWh) is due to lighting. The capital cost for the installation is estimated to be £15,650. The final installation cost is estimated to be £19,350.

Project.	Lighting
Actual kWh (Electric)	59,221
kWh savings (Electric)	2,711
After kWh savings (Electric)	56,510
Design and engineering cost	£350
Main equipment capital cost	£8,600
Installation & commissioning cost	£7,050
Project delivery cost	£1,600
Contingency	£1,750
Total project cost	£19,350

Stage 1 - Fabric Improvement & Lighting		
	Fossil Fuel Usage (kWh)	Electricity Usage (kWh)
Total	546,878	56,510
Annual Cost	£ 26,742	£ 13,964
Annual Carbon Emissions (Tonnes)	98.4	10.9

Total Annual Cost		**£40,706**
Total Annual Emissions (Tonnes)		**109**
Energy Cost Reduction	**12%**	**£5,726**
Emissions Reduction	**15%**	**19**

By implementing fabric improvements and lighting upgrades it is estimated a 15% carbon emissions reduction can be made.

4.3.2 Stage 2

Stage 2 incorporates sustainable heating technology with the intention of omitting fossil fuel consumption.

Air Source Heat Pump

It is proposed to replace the current gas-fired boiler for heating to a refrigerant based heat pump equivalent, including the replacement of emitters with larger low temperature radiators suitable for heat pumps which produce a lower flow temperature.

The proposed location of the heat pumps is to the side of the plantroom. A suitable acoustic enclosure would be required to fence off the new heat pumps.

The current emitters shall be replaced with larger surface area emitters to cater for the reduction in flow temperature from the air source system.

Analysis of the electrical supply has shown that an upgrade to the incoming mains cable is likely necessary, and a new distribution board would be required for increased electrical consumption on-site with 2 no. heat pumps based on 100kW Three phase units, with an electric heat battery of up to 55kW to be supplied on the AHU.

2x 100kW R32 air source heat pumps will deliver low temperature hot water at 50 degrees to the central heating system via ancillary equipment in the mechanical plantroom. These units have a maximum efficiency / Seasonal coefficient of performance (SCOP) of 2.6

The current boiler would be decommissioned, with the new ancillary heating equipment, including circulation pumps, heat exchanger, control panels located. The new mains will then connect to the existing distribution from this location

The heat pump system would then heat the building using entirely electrical power, therefore, to offset the increase in electrical consumption we would strongly suggest the system is implemented alongside solar electricity generated on site.

A new zonal control, sensor and valve arrangement shall be included with the installation to minimise energy use.

The site has an existing three Phase 400V 100A electrical supply. The maximum demand to the site is unknown currently but the DNO has been contacted for further information. Given the proposal for 2 no. heat pumps running at 100kW each and an electric heater battery, it is assumed there is not enough supply capacity.

A provisional allowance has been included within our cost build up for the local site electrical upgrade. Further upgrades are subject to confirmation from DNO engagement.

The installation of the heat pumps will displace 533,034 kWh of annual gas usage and 71 tonnes of CO_2. The capital cost of the installation is estimated to be £451,600. The final installation cost is estimated to be £584,500.

Project.	ASHP
Actual kWh (Fossil Fuel)	533,034
kWh savings (Fossil Fuel)	533,034
After kWh savings (Fossil Fuel)	0
Design and engineering cost	£31,500
Main equipment capital cost	£248,350
Installation & commissioning cost	£203,200
Project delivery cost	£48,300
Contingency	£53,150
Total project cost	£584,500

Stage 2- Heat Pump			
Fossil Fuel Usage after ASHP installation (kWh)	Electricity Usage (kWh)	Additional Heat Pump Power (kWh)	Net Electricity Import (kWh)
0	56,510	143,509	200,019
Annual Cost	£ 13,964	£ 35,461	£ 49,425
Annual Carbon Emissions (Tonnes)	10.9	27.8	38.7

Total Annual Cost		**£49,425**
Total Annual Emissions (Tonnes)		**39**
Energy Cost Reduction	**-21%**	**-£8,719**
Emissions Reduction	**65%**	**71**

By implementing an ASHP it is estimated a further 65% carbon emissions reduction can be made. Due to the additional electricity demand, energy cost is likely to increase by approximately £8,719 annually.

4.3.3 Stage 3

Stage 3 is intended to offset additional electrical consumption demand developed from stage 2 by installing PV panels.

Solar PV

There is the possibility to benefit from solar energy using the available roof space by installing up to 54no. PVs in a Southwest facing arrangement – this would be an installed capacity of 21.6kWp. This would likely displace the energy used on site, help reduce bills and support the Government's climate drive.

To utilise the roof area of the site and produce solar PV electricity, it is proposed to install a PV system with a peak generation of 21.6 kW with losses accounted for, there is the opportunity to generate and reduce electricity import by 20,624kWh annually.

This would reduce equivalent carbon emissions by 4 tonnes per year and is estimated that this could reduce electricity import costs (at 2023 prices) by £5,096.

This survey was conducted remotely based on site information and was deemed to be safe for the installation of PV. Due to the age and nature of the building and surrounding area conservation consent maybe required for the installation of PV.

For G99 and district network operator (DNO) considerations, there shall be local voltage and frequency control for export to the grid in moments of excess power generation. A G99 application will need to be completed as part of the installation process by the DNO.

PV arrangement for Northbrook Swimming Pool

Battery Storage for Solar PV

There is a possibility to add battery storage to the proposed solar PV array, to enable the site to benefit from the storage of the excess solar energy that is generated when the site is closed, or the buildings demand has dropped below that of the size of the PV array.

The PV battery would harness power that would normally be exported to the grid in these peak conditions. The battery storage would also provide power for a short period in times of power cuts or loss of power to the main incoming supply.

The battery storage unit could be located on the external wall of the building. The PV array would be directly coupled to be battery to ensure all the supply from the PV is used to supply the battery and the swimming pool directly. This ensures the most optimal use of the PV energy to charge the battery. Carbon reduction would depend on the base load and load provide of the swimming pool and may vary depending on the size of PV array. Further investigations maybe required to optimise the size of battery storage to the demand of the site.

Project.	PV System
Actual kWh (Electric)	200,019
kWh savings (Electric)	20,624
After kWh savings (Electric)	179,395
Design and engineering cost	£1,400
Main equipment capital cost	£10,050
Installation & commissioning cost	£8,250
Project delivery cost	£1,950
Contingency	£2,150
Total project cost	£23,800

By introducing the PV array, carbon emissions can be further reduced 10%.

Overall total carbon emissions can be reduced by 73% on site compared to existing by implementing all 3 proposal stages equating to 94 tonnes of CO_2 annually.

4.4 Proposal summary

The below table details a summary of the identified decarbonisation proposal for Northbrook Swimming Pool. The total project costs, payback and equivalent carbon emissions savings are detailed.

Proposals	Estimated Project Costs	Electrical Usage	Fossil Fuel Usage	Energy Saved Type	Carbon Emissions	Carbon Saving (Annual)	Carbon Saving	Energy Saving (Annual)	Energy Saving (Annual)	Carbon Savings	Payback
	£	kWh	kWh		tCO2	tCO2	tCO2eLT	kWh	£	£/tCO2eLT	Years
Baseline		59,221	650,270		128.5						
Lighting	£ 19,350	56,510	650,270	Electric	128.0	0.52	13.1	2,711	£ 670	£ 1,477	28.9
Roof upgrades	£ 85,350	56,510	640,989	Gas	126.3	1.67	50.1	9,281	£ 454	£ 1,703	188.1
Wall upgrades	£ 3,800	56,510	633,689	Gas	125.0	1.31	39.4	7,300	£ 357	£ 96	10.6
Windows	£ 162,900	56,510	563,174	Gas	112.3	12.69	355.4	70,515	£ 3,448	£ 458	47.2
Doors	£ 16,850	56,510	557,023	Gas	111.2	1.11	31.0	6,151	£ 301	£ 544	56.0
Rooflights	£ 12,950	56,510	546,878	Gas	109.4	1.83	51.1	10,145	£ 496	£ 253	26.1
Draught-proofing	£ -	56,510	533,034	Gas	106.9	2.49	72.9	13,844	£ 677	£ -	-
ASHP (FF contribution)	£ 584,500	56,510	-	Gas	10.9	95.95	1,918.9	533,034	£ 26,065	£ 305	22.4
ASHP (Elec contribution)		200,019	-	Electric	38.7	- 27.75	- 555.0	- 143,509	-£ 35,461	£ -	-
PV System	£ 23,800	179,395	-	Electric	34.7	3.99	89.7	20,624	£ 5,096	£ 265	4.7
Total	£ 909,500	179,395	-		34.7	93.8	2,066.7	530,096	£ 2,103	£ 440	432.5

This template has fixed performance criteria that may not be representative of in-operation performance. The total project value is estimated at £909,500 which aims to eliminate gas consumption on site.

4.4.1 PSDS Salix Funding Opportunity

The classification of opportunity is based on assessment within the publicly accessible Salix application template. Under Phase 3 criteria, this proposal is **COMPLIANT** for Salix funding due to the condition of existing heating system. We recommend an application is targeted in the short-term for decarbonisation works.

The following table provides the estimated available funding allowance based on the full project proposal as recommended within this report. PSDS Phase 3 funding is focused on the decarbonisation of heat. Funding is granted up to £325 tCO2eLT CCT (carbon cost threshold) for the marginal cost of upgrading to a low carbon heating system and direct CO2 savings only. Applicants are encouraged to focus proposal measures with direct CO2 saving measures as this is what ultimately drives down the £/direct carbon savings, allowing more funding to be available within the £325 tCO2eLT threshold. A minimum client contribution of 12% is required.

Proposals	Estimated Project Costs	Carbon Saving (Annual)	Carbon Saving	Energy Saving (Annual)	Carbon Savings	Payback	Available funding	Additional Funding Requirement	% of project Salix Funded
	£	tCO2	tCO2eLT	£	£/tCO2eLT	Years	(£325 tC02eLT)	£	%
Proposal 1 - Full Proposal	£909,500	93.8	2,066.7	£2,103	£ 440	432	£800,360	£109,140	88%

In all scenarios we recommend undertaking the full decarbonisation proposal which aims to eliminate fossil fuel consumption on site incorporating both direct and in-direct carbon saving measures. This proposal is directed at taking a 'whole building approach' in which the largest contribution to 'net zero' aspirations can be made, ensuring carbon emissions and energy cost from both fossil fuel and electrical sources are reduced.

However, the following tables and graphs have been produced to provide the estimated available funding, project cost and proposed energy cost comparison by targeting reduced project proposals. The reduced proposals focus primarily on introducing a low-carbon heating system as the primary intervention and minimising overall project cost.

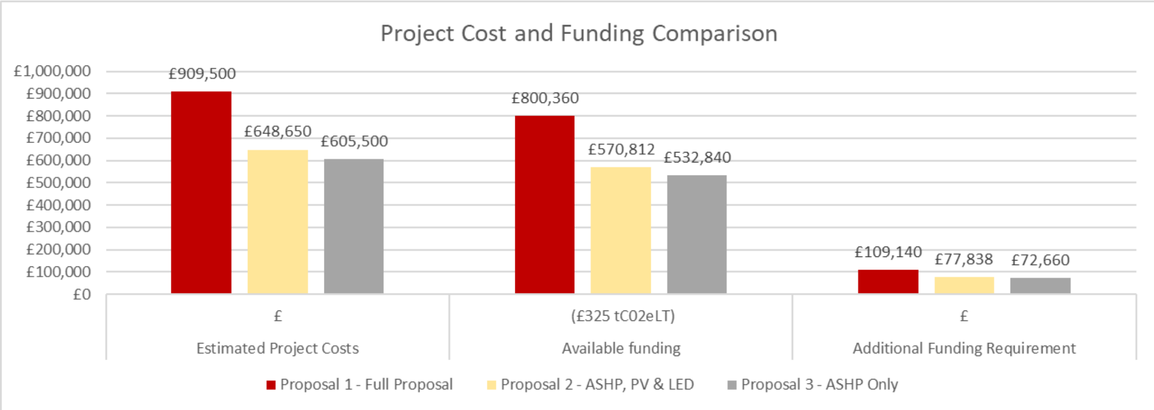
Proposal 1 – Portrays the full decarbonisation strategy as recommended within this report which aims to eliminate fossil fuel consumption and minimise electrical consumption from site. A 'whole building approach' is implemented through fabric first upgrades prior to replacing the heating system, which is then supplemented by further technology demand reduction proposals such as LED and PV. This proposal has the largest contribution to net zero aspirations.

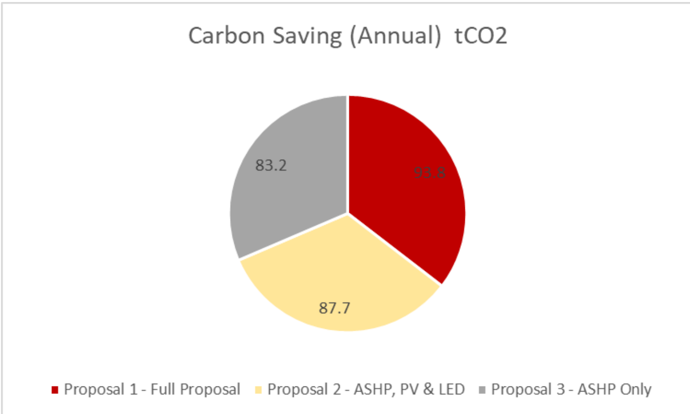
Proposal 2 – Portrays a reduced proposal which focuses on the implementation of a low-carbon heating system, omitting the fabric first upgrades. Additional electrical demand is offset by introducing LED and PV upgrades to offset energy cost.

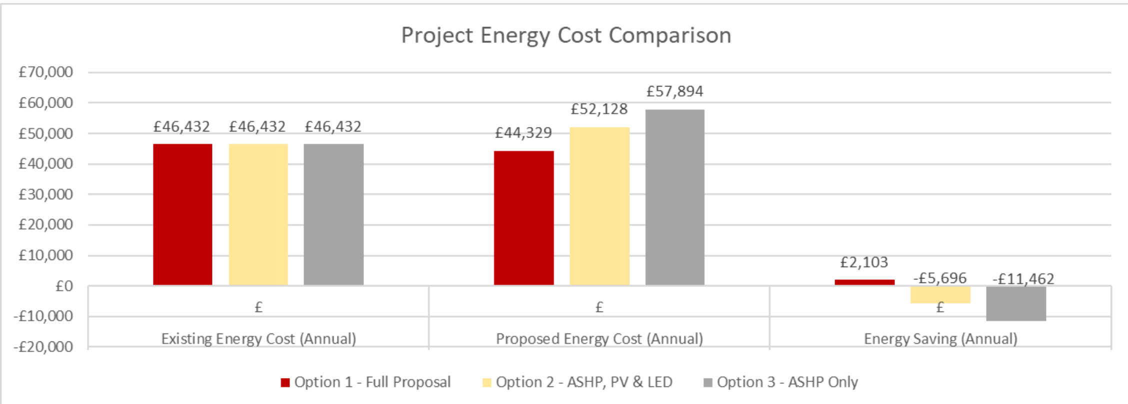
Proposal 3 – Portrays a further reduced proposal which focuses solely on the implementation of a low-carbon heating system without undertaking any further upgrades.

4.4.2 Proposal Options Appraisal

Proposals	Estimated Project Costs	Carbon Saving (Annual)	Carbon Saving	Energy Saving (Annual)	Carbon Savings	Payback	Available funding	Additional Funding Requirement	% of project Salix Funded
	£	tCO2	tCO2eLT	£	£/tCO2eLT	Years	(£325 tC02eLT)	£	%
Proposal 1 - Full Proposal	£909,500	93.8	2,066.7	£2,103	£ 440	432	£800,360	£109,140	88%
Proposal 2 - ASHP, PV &	£648,650	87.7	1,766.7	-£5,696	£ 367	N/A	£570,812	£77,838	88%
Proposal 3 - ASHP Only	£605,500	83.2	1,663.9	-£11,462	£ 364	N/A	£532,840	£72,660	88%





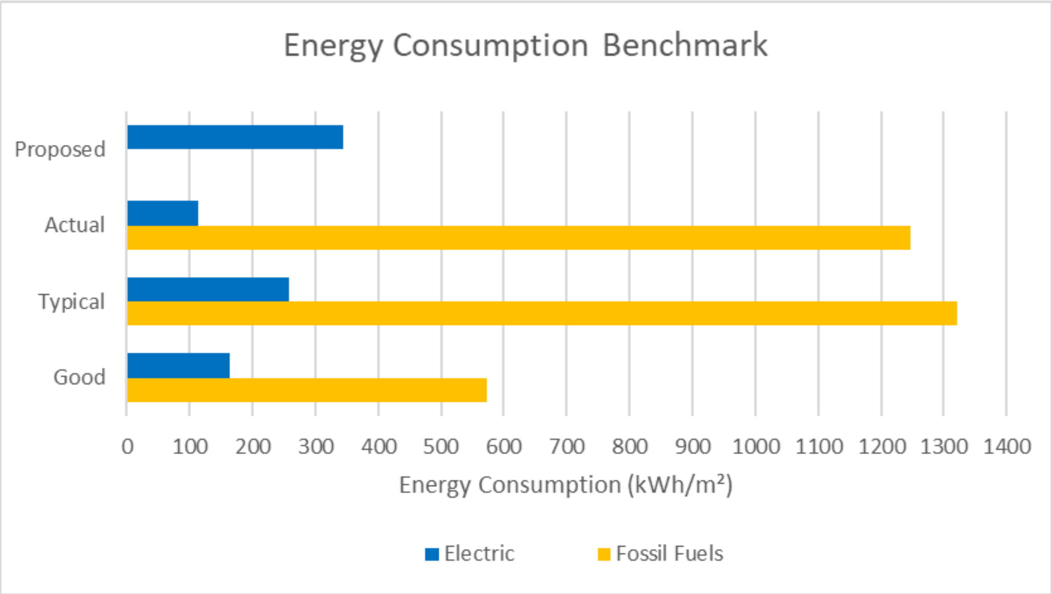


5. Conclusion

Overall, there is good opportunity to implement decarbonisation measures at Northbrook Swimming Pool. This can be achieved through a combination of building fabric upgrades and renewable technology which can be utilised to reduce heat loss and energy consumption.

The existing fossil fuel heating system is end of life making it the optimal time to transition to a low-carbon heat source. This makes the works eligible under Salix PSDS Phase 3 criteria in which an application can be made to receive funding towards the heat decarbonisation works.

The following table shows the anticipated revised energy consumption for the site implementing the full project proposal. This identifies a strategy to omit fossil fuel consumption from site and minimise electrical demand.



Appendix A

Low-carbon heating system options appraisal.

		Option 1		Option 2		Option 3	
	Title	**Air Source Heat Pumps**		**Ground Source Heat Pump (Slinky)**		**Ground Source Heat Pump (Thermal Pile)**	
	Description	Replacement of the existing fossil fuelled heating system with new sustainable Air Source Heat Pumps (ASHPs)		Replacement of the existing fossil fuelled heating system with new sustainable Ground Source Heat Pump Slinky (GSHP).		Replacement of the existing fossil fuelled heating system with new sustainable Ground Source Heat Pump Thermal Pile (GSHP).	
1	**Project Outcome**	Option to install ASHPs will address space heating, DHW and pool heating needs of the establishment whilst omitting fossil fuels for heat generation on site. In doing this, the project is contributing to the governments ambitious targets of acheiving net zero carbon by 2050. It is anticipated the ASHPs will be supplemented with solar panels to offset additional electrical demands. Whilst it is anticipated this will entail sizable initial capital costs, the new system will ultimately reduce energy consumption costs for the site. The existing fossil fuel heating system is end of life making it the optimal time to transition to a low-carbon heating system.		Option to install GSHP will address space heating, DHW and pool heating needs of the establishment whilst omitting fossil fuels for heat generation on site. In doing this, the project is contributing to the governments ambitious targets of acheiving net zero carbon by 2050. It is anticipated the GSHPs will be supplemented with solar panels to offset additional electrical demands. Whilst it is anticipated this will entail sizable initial capital costs, the new system will ultimately reduce energy consumption costs for the site. The existing fossil fuel heating system is end of life making it the optimal time to transition to a low-carbon heating system.		Option to install GSHP will address space heating, DHW and pool heating needs of the establishment whilst omitting fossil fuels for heat generation on site. In doing this, the project is contributing to the governments ambitious targets of acheiving net zero carbon by 2050. It is anticipated the GSHPs will be supplemented with solar panels to offset additional electrical demands. Whilst it is anticipated this will entail sizable initial capital costs, the new system will ultimately reduce energy consumption costs for the site. The existing fossil fuel heating system is end of life making it the optimal time to transition to a low-carbon heating system.	
	Score (min 1 - max 5)	5		5		5	
A	**Weighted Score (0.7)**	**3.5**		**3.5**		**3.5**	
		(Ecluding project costs)		*(Ecluding project costs)*		*(Ecluding project costs)*	
2	**Project Capital Cost**	ASHP	£ 119,556	Plant Room	£ 110,300	Plant Room	£ 110,300
		Metering and Monitoring	£ 6,974	Metering and Monitoring	£ 2,790	Metering and Monitoring	£ 2,790
		ASHP ancillaries	£ 52,400	GSHP ancillaries	£ 52,400	GSHP ancillaries	£ 52,400
		Drainage	£ 1,116	Drainage	£ 1,116	Drainage	£ 1,116
		Radiators	£ 36,200	Radiators	£ 110,300	Radiators	£ 110,300
		LTHW pipework	£ 17,450	LTHW pipework	£ 17,450	LTHW pipework	£ 17,450
		Domstic hot and cold water system	£ 32,500	Domestic hot and cold water system	£ 34,900	Domestic hot and cold water system	£ 34,900
		Electrics and Controls	£ 65,650	Ground Array/Slinky pipe	£ 258,600	Thermal Pile	£ 386,000
		BWIC	£ 15,700	Electrics and Controls	£ 65,650	Electrics and Controls	£ 65,650
		Remove Existing Plant	£ 4,650	BWIC	£ 15,700	BWIC	£ 15,700
		Flushing/Commissioning	£ 4,050	Remove Existing Plant	£ 6,416	Remove Existing Plant	£ 6,416
		Electric ASHP cables	£ 13,948	Flushing/Commissioning	£ 4,050	Flushing/Commissioning	£ 4,050
		Electrical Reinforcement	£ 27,896	Electric GSHP cables	£ 10,471	Electric GSHP cables	£ 10,471
		Pool Pumps	£ 6,500	Electrical Reinforcement	£ 27,896	Electrical Reinforcement	£ 27,896
		Air Handling Units / Fans (Provisional)	£ 42,000	Pool Pumps	£ 6,500	Pool Pumps	£ 6,500
		Heat Exchanger (Provisional)	£ 5,000	Air Handling Units / Fans (Provisional)	£ 42,000	Air Handling Units / Fans (Provisional)	£ 42,000
				Heat Exchanger (Provisional)	£ 5,000	Heat Exchanger (Provisional)	£ 5,000
	Total Cost	**£451,590**		**£771,538**		**£898,938**	
	Score (min 1 - max 5)	5		4		3	
B	**Weighted Score (0.15)**	**0.75**		**0.6**		**0.45**	
3	**Project Planning**	Air Source Heat Pumps are the simplest of the three proposed low-carbon heat sources in terms of speed, cost and disruption. The site has viable locations these could be installed and appropriately secured. Dependant on local authority, installing air source heat pumps may require a planning application to be made which largley relates to the noise impact. The site is is close proximity to residential land uses.		Installing GSHP slinky system requires coils to be laid out over a large area for the system to work effectively. The site has limited green space available that can be appropriately developed. It is not deemed the available space would be sufficient for the needs of the site.		Installing GHSP thermal piles can result in noise distrubance and would need to be managed due to the proximity of local residential land uses. The effectiveness of a thermal pile system is dependant upon the thermal properties of the ground they are being installed. No investigations have been undertaken at this stage. The further the piles are required to be driven the more expensive it becomes.	
	Score (min 1 - max 5)	4		2		3	
C	**Weighted Score (0.15)**	**0.6**		**0.3**		**0.45**	
4	**Total Weighted Score (A+B+C)**	**4.85**		**4.4**		**4.4**	

Appendix B

Display Energy Certificate (DEC).

Display energy certificate (DEC)

HM Government

Legacy Leisure
Northbrook Pool
Beacon Lane
EXETER
EX4 8LZ

Operational rating

E

Certificate number:	0970-6931-0171-7890-3060
Valid until:	29 December 2029
Total useful floor area:	573 square metres

Energy performance operational rating

The building's energy pe fo r mance operational rating is based on its carbon dioxide (C02) r e missions for the last year.

It is given a score and an operational rating on a cale s from A (lowest emissions) to G (highest emissions)

Th e typical score for a public building is 100. This typical score gives an operational rating of D.

Score	Operational rating	This building	Typical
0-25	A		
26-50	B		
51-75	C		
76-100	D		
101-125	E	105 E	
126-150	F		100
150+	G		

Previous operational ratings

	Operational rating
December 2019	105 E

Total carbon dioxide (CO2) emissions

This tells you how much carbon dioxide the building emits. It shows tonnes per year of CO2

Date	Electricity	Heating	Renewables
Dece m b er 2019	55	140	0

This building's energy use

		Other fuels
Annual energy use (kWh/m2/year)	175	1262
Typic a energy use (kWh/m2/y ear)	245	986
Energy from renewables	0%	0%

Assessment details

Assessor's name	Mrs. Tara Taylor
Employer/Trading name	Future Energy Performance 3 &
Employer/Trading address	5 lbstock Road, Ellistown 01530 453940
Assessor's declaration	Contractor to the occupier for EPBD services only.
Accreditation scheme	Elmhurst Energy Systems Ltd 25
Issue date Nominated	March 2020
date	30 December 2019

Appendix C

Risk Register.

Risk Register

No.	Category	Risk Description	Original Risk		Risk rating	Mitigation	Revised Risk		Risk rating
			Likelihood	Impact			Likelihood	Impact	
1	Design	Current proposals based off assumptions currently to RIBA stage 2/3. Inaccuracies to specific site requirements possible.	3	4	12	Further design development is required to reach RIBA stage 4. Current proposal designed with assumptions with contingencies allowed for in costings.	2	4	8
2	Design	Structural integrity for roof to support solar PV.	2	5	10	Detailed on site structural review to happen upon appointment of design team. Potential structural upgrade works to be incorporated at design stage. Additional cost subject to survey findings.	1	3	3
3	Design	Building fabric works improving thermal performance and airtightness creating risk of condensation and ventilation.	3	4	12	Design solutions to be progressed to RIBA stage 4 upon appointment of design team. Designs to comply with building regulations guidance in Approved Document C and F.	1	4	4
4	Design	Risk of proposed works coming into contact with asbestos causing delay, high risk based on building ages.	5	5	25	Asbestos R&D surveys to be instructed as priority task during planning year. Separate programme of enabling works to be instructed for removal prior to project commencement. Investigative and asbestos enabling works will be self-funding by the client.	3	3	9
5	Planning	Project implementation timetable delays.	4	5	20	Close co-ordination with Main Contractor required upon appointment to agree construction programme with regular monitoring on-site to mitigate delays. Professional fees for project management has been included within the total project cost build-up to ensure effective management of the project.	2	4	8
6	Planning	SALIX, procurement. If project is progressed under SALIX finance, periods between application, confirmation of funding and delivery timelines can be problematic especially in an active school environment.	5	5	25	Project needs to commence quickly if progressed under SALIX finance route. The procurement process for this requires early Contractor selection and financial commitment. Timely involvement of Operations / Construction team to procure and secure packages early. An outline programme has been developed detailing the planning year through to construction. Early engagement with appointed contractor to develop detailed construction phase programme prior to Salix Funding spend year.	3	4	12
7	Planning	SALIX, resource. If project is progress under SALIX finance, potential challenge to resource as project will pursue accelerated timeline to meet SALIX delivery requirements.	5	5	25	All parties to put in place agreed resources with additional secured degree of resilience in the allocation of tasks. All parties to establish a clear governance structure to support the project at appointment.	3	4	12
8	Planning	Long lead time procurement risk increased due to volatile market conditions.	5	5	25	Review with Main Contractor upon appointment to work with supply chain/suppliers to order in advance. Potential for materials to be stored in contractor compounds/site.	3	3	9
9	Planning	Electrical loadings and grid connection.	4	5	20	Electrical load surveys and consultation with DNO initial engagements already undertaken. Proposal to be agreed with DNO as priority task in programme of the planning year to mitigate potential delay to project start.	2	3	6
10	Planning	Not achieving planning approval causing delays to construction phase.	3	4	12	Early consultation with local planning department upon appointment of design team. To be noted in programme as priority item. Early design works to progress towards preparation of planning application if deemed necessary.	1	4	4
11	Planning	Not achieving building control plans certification causing delays to construction phase.	3	4	12	Preparation of building control application to be undertaken in tandem with design stage. Submission upon complete design.	2	4	8
12	Planning	Risk of inadequate planning leading to disruption from not engaging with all stakeholders due to project timescales.	4	3	12	Communications plan to be developed. Initial stakeholder meeting to be set up upon confirmation of funding to ensure approvals agreed as required.	2	3	6
13	Budget	Budget could be challenged if subject to abnormal inflation or unforeseen costs incurred.	3	4	12	Contingency of 10% has been included as part of the capital build-up. Costs to be updated to account for inflation at next stage.	2	4	8
14	Budget	Salix funding criteria subject to change with future rounds.	5	5	25	Review future rounds funding criteria as soon as available to confirm potential funding eligibility under a successful application.	4	3	12
15	Construction	Works causing disruptions to site activity.	5	4	20	Works plan to be discussed in detail and agreed by all relevant stakeholders upon confirmation of funding.	2	3	6
16	Construction	Works in occupied environment.	5	5	25	Stakeholder meeting to be undertaken to agree construction phase strategy to ensure project can be safely delivered within site confines. Decanting strategy to be agreed if deemed suitable. Should works be required to take place within occupied or partly occupied site, the contractor shall clearly demonstrate how works will be segregated from public, ensuring safety is not compromised to meet project deadlines.	2	5	10
17	Construction	Dust/Noise/General disturbance to adjacent land uses.	5	5	25	Weekly and/or daily notifications to occupants, informing of planned construction activities. Implement additional H&S precautions to protect students and staff. Inform school in advance and agree works programme to allow decanting schedule.	3	4	12
18	Site Safety	General site safety.	3	5	15	All parties to be informed of and act in accordance with their duties under CDM 2015. The Contractor will be required to submit a site-specific construction phase plan demonstrating safe delivery of the works within the required programme period.	2	4	8

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