



north east &
yorkshire
ENERGY HUB

North East & Yorkshire Net Zero Hub

Heat Decarbonisation Plan and Feasibility Study Anytown Leisure Centre

Report

Report produced in April 2026



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Association for Public Service Excellence
3rd floor Trafford House
Chester Road, Old Trafford
Manchester, M32 0RS
Telephone: 0161 772 1810
fax: 0161 772 1811
Email: enquiries@apse.org.uk
Web: www.apse.org.uk

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1 Executive Summary

The North East and Yorkshire Net Zero Energy Hub wish to gain a further understanding of the viability of installing low and zero carbon technologies to reduce the energy consumption and carbon emissions at Anytown Leisure Centre.

APSE Energy were appointed to visit the site and undertake a survey of the existing installed mechanical and electrical plant and equipment and recommend energy saving opportunities. This is a feasibility study and options appraisal for the concept design (RIBA Stage 2) of decarbonisation measures.

The site was visited in February 2026. The survey consisted of visual inspections of the installed plant and equipment; no operational or performance testing was undertaken. The service and breakdown history documentation were not reviewed.

The table below summarises the costs of the works and professional fees associated with the core carbon reduction recommendations. These proposals offer the potential for achieving significant carbon and financial savings.

Table 1: Energy Saving Measures

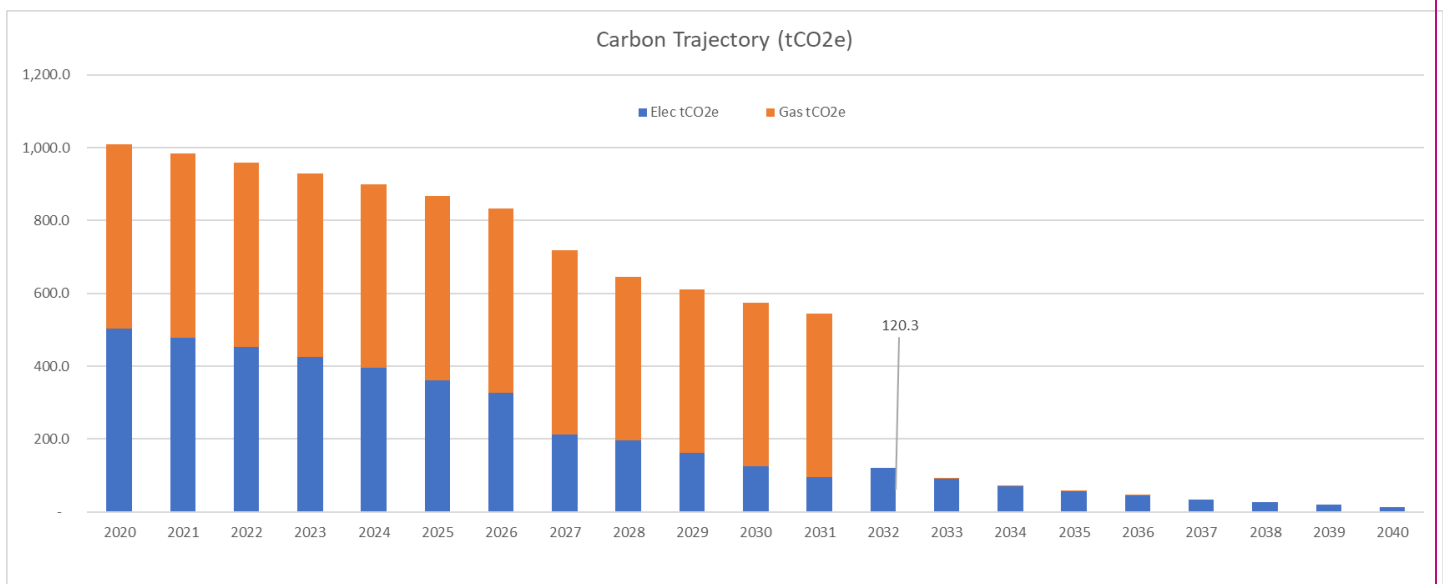
Item	Recommendation	Annual Electricity Savings (kWh)	Annual Gas Savings (kWh)	Annual Saving (£)	Capital Cost (£)	Payback in Years	Carbon Saving (tCO ₂) per year
1	Ice Plant: New Electric Dehumidification	-86,174	311,473	-£3,613	£250,000	N/A	41.7
2a	Ice Plant: High Temperature Air Source Heat Pump for Space Heating	-28,435	94,889	-£1,559	£262,800	N/A	12.3
2b	Ice Plant: High Temperature Air Source Heat Pump for DHW	-11,205	31,783	-£875	As Above	N/A	3.8
2c	Ice Plant: High Temperature Air Source Heat Pump for AHU Dehumidification	-56,187	159,210	-£4,396	As Above	N/A	19.2
3a	Ice Plant: 4-Pipe Chiller to Supply Ice AHU	30,400	-	£6,384	£1,914,825	N/A	5.4
3b	Theatre & Pool Plant: 4-Pipe Chiller & Water Source Heat Pump. System A: Pool Heating	-133,402	688,956	£4,022	As Above	N/A	102.4
3c	Theatre & Pool Plant: 4-Pipe Chiller & Water	-100,052	516,717	£3,017	As Above	N/A	76.8

	Source Heat Pump. System A: Pool AHU Space Heating						
3d	Theatre & Pool Plant: 4- Pipe Chiller & High Temperature Air Source Heat Pump. System A: Domestic Hot Water	-32,436	167,515	£978	As Above	N/A	24.9
4	Theatre & Pool Plant: High Temperature Air Source Heat Pump System B: Space Heating	-72,573	445,551	£5,478	As Above	N/A	68.7
5a	Dry side: High Temperature Air Source Heat Pump for Space Heating	-28,094	102,793	-£1,135	£600,000	N/A	13.8
5b	Dry side: High Temperature Air Source Heat Pump for Domestic Hot Water	-66,335	206,304	-£4,367	As Above	N/A	26.0
6a	Solar Panels Ice Inc (496 kWp) Own Use	395,364	-	£83,026	£1,137,726	13.0	70.0
6b	Solar Panels Ice Inc (496 kWp) Export	39,898	-	£4,788	As Above	As Above	7.1
7	LED Lighting Replacement	71,934	-	£18,792	£143,300	7.6	12.7
8	Kitchen Equipment	-22,884	38,140	-£3,021	Unknown	N/A	2.9
	Total	-100,180	2,763,331	£107,517	£4,308,651	N/A	487.8

Item	Alternative Recommendation	Annual Electricity Savings (kWh)	Annual Gas Savings (kWh)	Annual Saving (£)	Capital Cost (£)	Payback in Years	Carbon Saving (tCO ₂) per year
6ai	Solar Panels Ice Rink Exec (118 kWp) Own Use	97,668	-	£20,510	£160,700	7.8	17.3
6bi	Solar Panels Ice Rink Exec (118 kWp) Export	0	-	£0	As Above		

To achieve the site's decarbonisation, and comply with net-zero objectives, it would be necessary to decommission all existing gas-fired equipment by 2032. The figure below shows the carbon trajectory if all recommended projects are completed.

Figure 1: Buildings Carbon Trajectory - Recommended Proposals



Main Recommendations and Next Steps

Strategic Overview for Decarbonisation by 2032:

- Full decarbonisation requires removal of all gas-fired plant by 2032, including CHP & kitchen appliances.
- A phased approach is recommended to manage cost, risk, and resilience.
- Existing distribution systems should be retained where possible to reduce significant disruption and capital costs.

- Making most of opportunity's that the site presents, such as the consistent heating and cooling demand, alongside maximising the potential of existing infrastructure is central to the decarbonisation strategy.

Ice Rink Plant Replacement:

- Decommission and remove one gas boiler by 2032, the other should be retained for resilience and power outage protection.
- Install two high-temperature air source heat pumps (HT-ASHPs) to provide 65°C LPHW to the existing heating distribution, pumps, and DHW cylinder.
- Continue to avoid heating the ice rink space using the VT circuit serving under seating heating due to constant cooling demand.
- Use local electric heaters for staff comfort where required.
- Retain the existing ice rink chiller and Glycol system and replace only at end of life. When replacing, the Council should access the potential application and opportunities of installing a 4-pipe chiller to replace it. The costs would be higher, so a significant heating load would be required for it to be worth considering.
- Investigate and improve insulation on frosted pipework and pumps.
- Replace the gas dehumidifier with a modern electric system. Allow £250,000 budget for dehumidifier upgrade, subject to specialist design.
- Reduce air leakage around the rink to lower dehumidification demand.

Pool & Theatre Plant Replacement:

- In the short term the Council should retain gas boilers and CHP between 2026–2031. This will make use of the CHP and allow maximum electrical generation over its lifetime. It can also allow for preparation works over this time.
- From 2031, remove one gas boiler and the CHP serving space heating, with one of the gas boilers being retained for backup and resilience.
- Two systems, A & B are proposed to replace the existing equipment. This is to separate the secondary circuits into consistent loads over the year and inconsistent loads dependant on the heating season.
- System A will include a 4-pipe chiller, which operates at its most efficient when operating in simultaneous heating and cooling mode. It does this by recovering heat from cooling to meet consistent heating demands
- This will be used to supply chilled water to the Ice Rink AHU and heating to a Water source heat pump to supply the consistent heating loads thought the year, which are pool water heating, pool AHU and DHW.
- System B will be installed to serve the remaining heating secondary circuits in the theatre plant room. It includes the Installation of high temperature air source heat pumps and buffer vessels that are capable of supplying 70°C but will be intended to use lower system flow temperatures to improve heat pump efficiency.
- In the short term, Investigate CHP heat meter anomalies and consider undertaking a detailed CHP operational review to confirm the best valued option in terms of finance and carbon over the next few years.

Dry Side Plant:

- Decommission and remove the non-working gas boiler by in 2027-2028 to stagger the proposed works, the other should be retained for resilience and power outage protection.

- Install four high temperature air source heat pumps with buffer vessels to provide LPHW to the existing heating distribution pipework.
- Retain existing heating distribution, low loss header, and DHW systems, with the return pipework connected to the new buffer vessels.
- Operate ASHPs at 55°C for most of the year when appropriate to operate at higher efficiency's, using higher temperatures only during extreme winter conditions.

General Building Decarbonisation Measures

- Retain the existing building fabric and monitor its condition annually, installing draught strips where appropriate if air leakage is identified.
- Retain existing efficient electric heating and cooling systems such as split units serving indoor cassettes in the Gym as they are already highly efficient and decarbonised.
- Retain the existing Sauna and Steam plant.
- Retain existing AHUs and inverter driven fans throughout the building. Any improvements to save energy are not cost effective.
- Install LED lighting to replace existing fluorescent lighting across the building, with exception to the theatre lighting.
- Install a 118 kWp solar PV system as a minimum on the roof of the building. The Council should also investigate the possibility of installing ultralight PV on the ice rink roof, subject to cost and feasibility.
- Review electricity and export tariffs following electrification, although is worth noting that if progressing the smaller PV design no electricity was modelled to be exported.
- Engage the DNO early to assess electrical supply upgrades, of which a total of **£250,000** has been allocated across the different proposed system installations. **This is a high risk item.**
- A number of heat meters were installed across the building; it is recommended to investigate why they are not generating useable data so the Council can utilise all heat and electricity sub-metering. This can be used to identify wastage and drive immediate and long-term savings.
- Undertake detailed thermal modelling at design stage.
- Replace gas-fired kitchen equipment with electric alternatives before 2032.

2 Survey and Observations

2.1 General

Anytown Leisure Centre is located at Anytown.

It is a sizeable building, with 14,184 m² of floor area. It houses swimming pools, an ice rink, a gym, sports hall, climbing centre and a Grade II listed theatre. The theatre was granted listed building status in 2004 by the Department for Culture, Media and Sport.

The ice rink is also used to host a number of events over the year, ice skating clubs and is also the home ground of the Anytown Ice Hockey team. It was originally constructed in 1967 and was the first leisure centre to amalgamate sports facilities with a theatre under the same roof. It was opened by Queen Elisebeth and Prince Philip.

It underwent significant refurbishments in 2009 – 2011, totalling £18.5 million. Full details are available in Section 2.2.

Main Building Opening Times

Monday 06:00 – 22:00
Tuesday 06:00 – 22:00
Wednesday 06:00 – 22:00
Thursday 06:00 – 22:00
Friday 06:00 – 22:00
Saturday 06:30 – 19:00
Sunday 06:30 – 21:30

Ice Rink Opening Times

(The main building closes from 22:00 to the public, but remains open to 23:45 for Ice Hockey Training in season)

Monday 09:00 – 20:15
Tuesday 09:00 – 21:00
Wednesday 09:00 – 18:00
Thursday 09:00 – 20:45
Friday 11:00 – 20:30
Saturday 10:00 – 15:30
Sunday 10:00 – 15:30

Gym Opening Times

Mondays – Thursdays: 06:00 – 22:00
Fridays: 06:00 – 21:00
Weekends: 08:00 – 18:00

Figure 2: Leisure Centre Ground Floor Plan

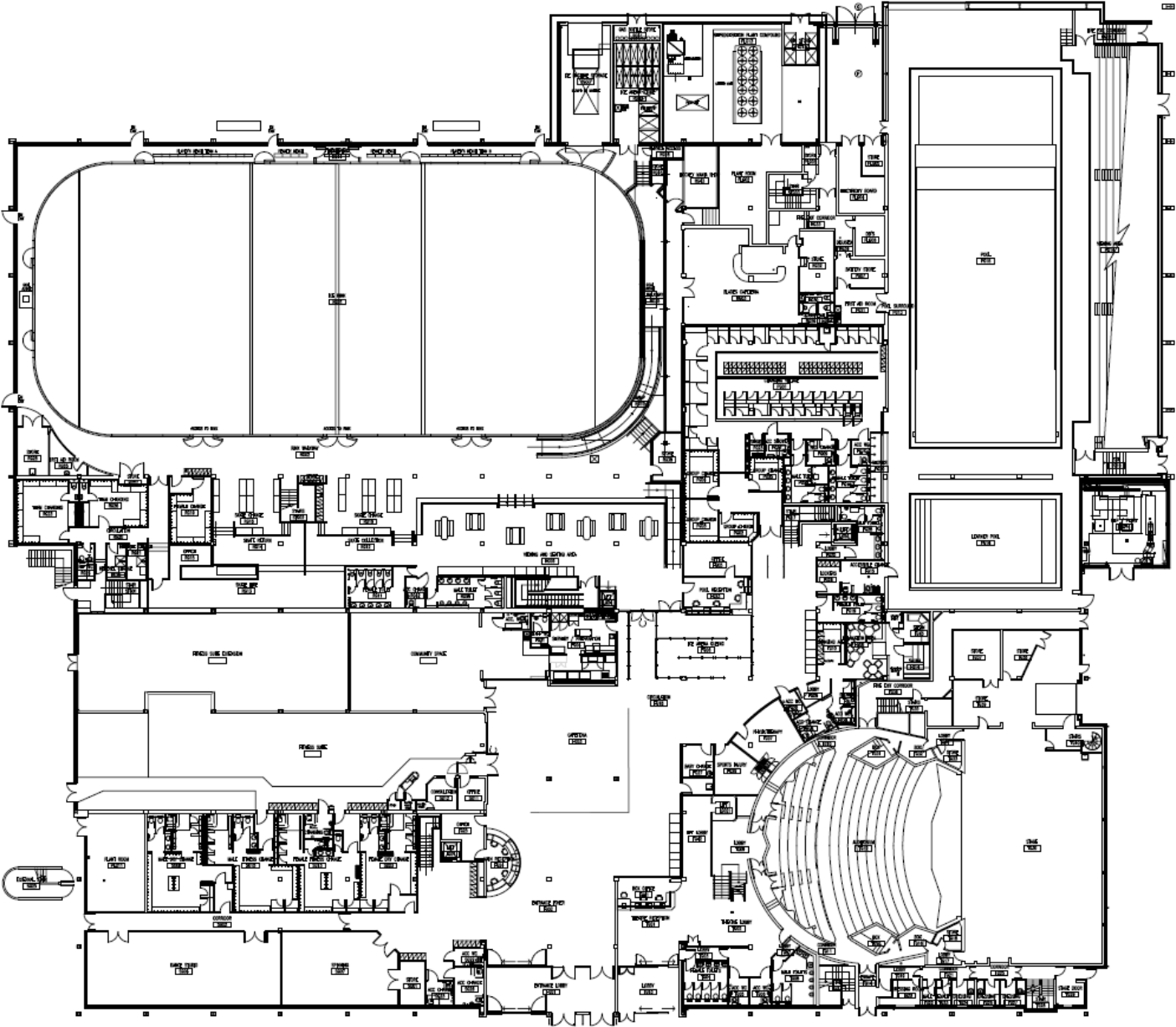


Figure 3: Leisure Centre First Floor Plan

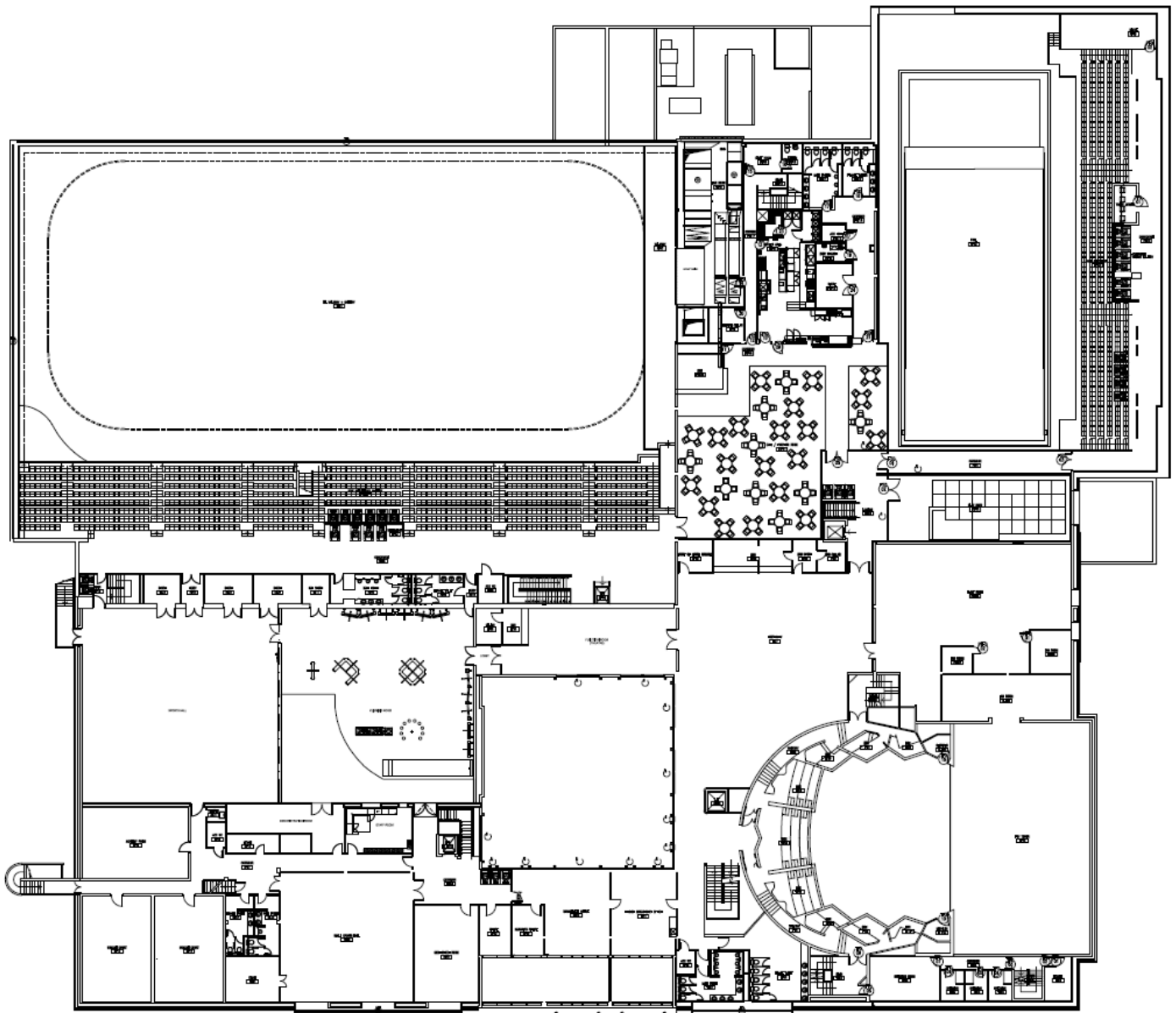


Figure 4: Theatre Basement Plan

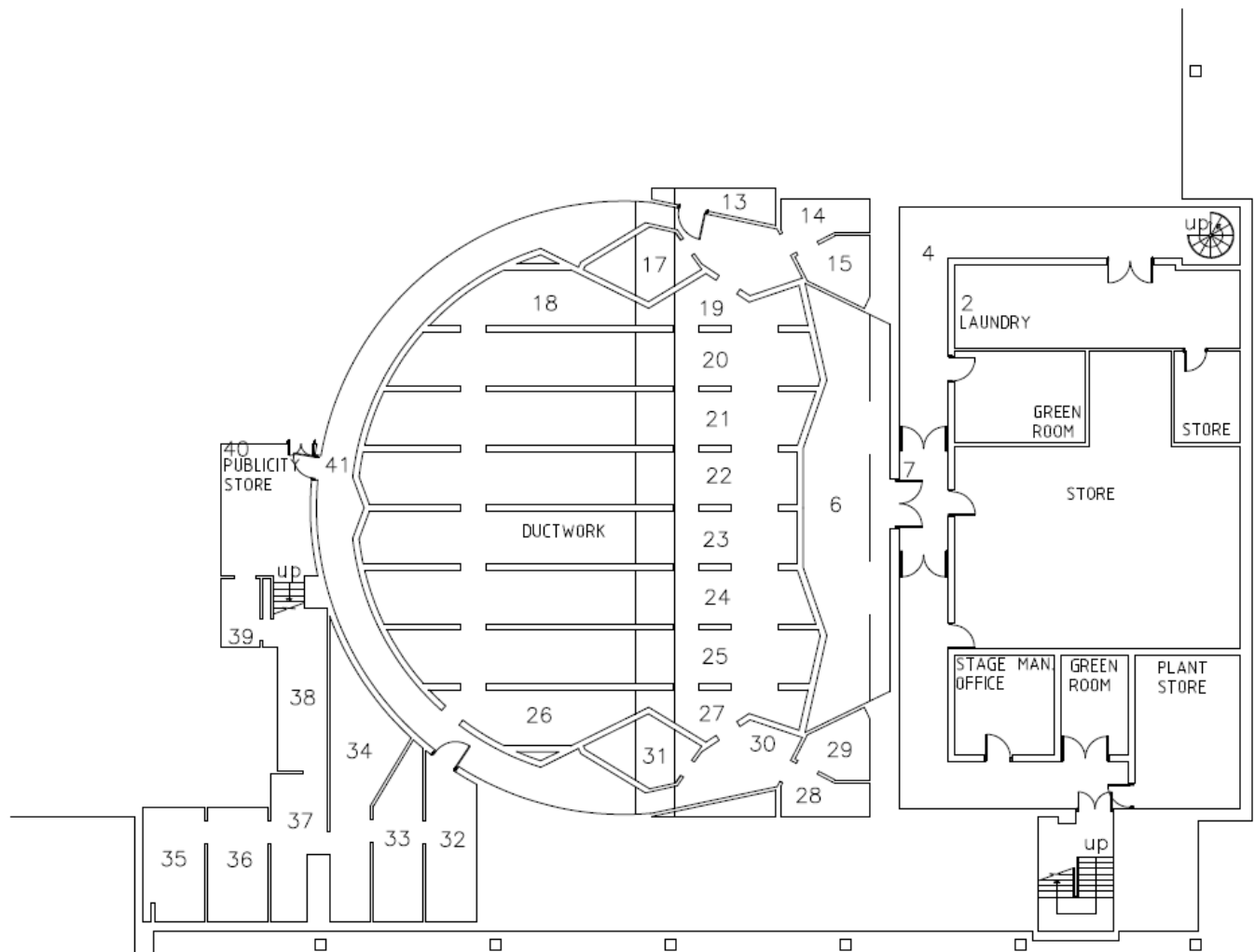


Figure 5: Theatre 1st Floor Plan

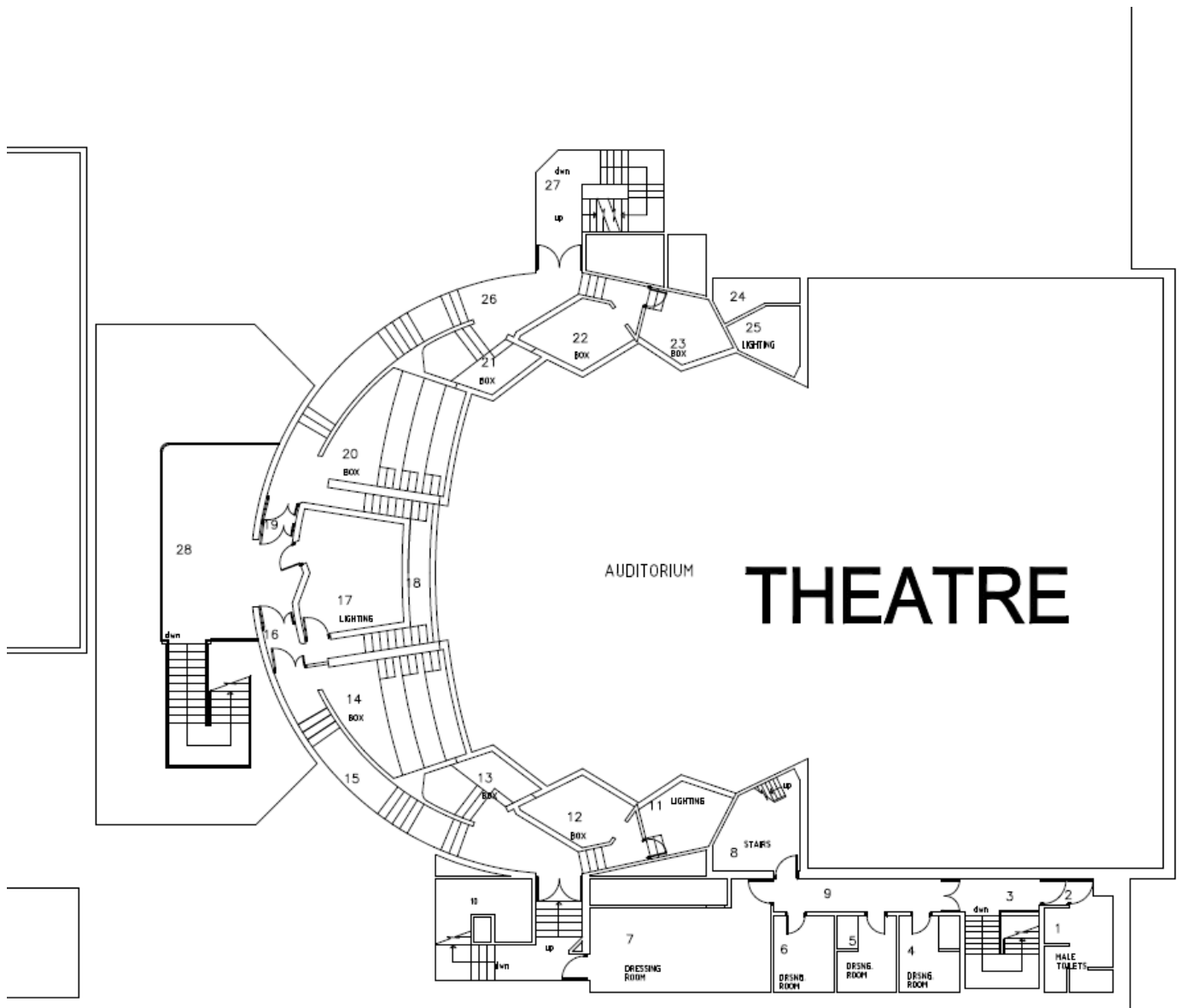


Figure 6: Theatre 2nd Floor Plan

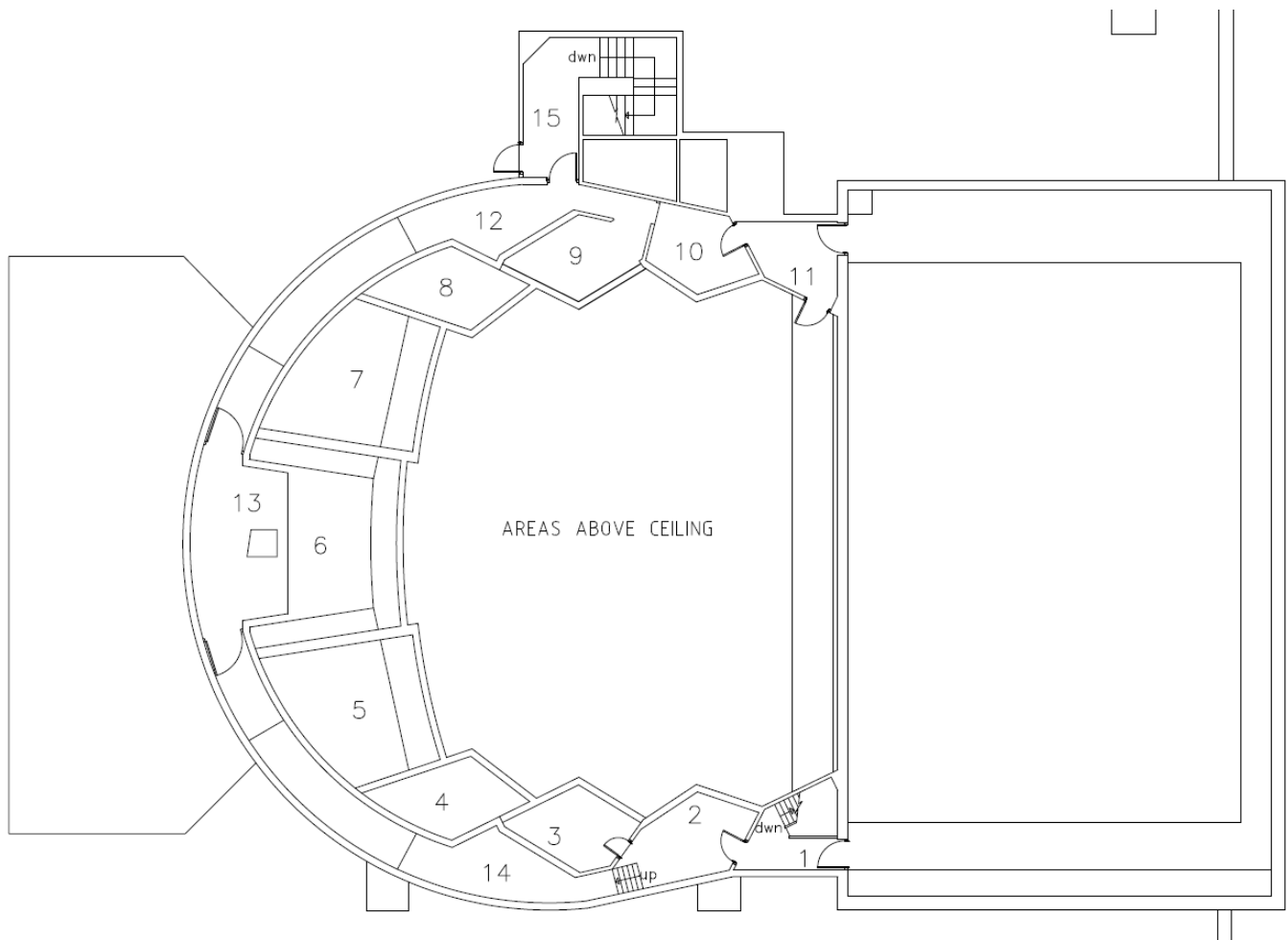
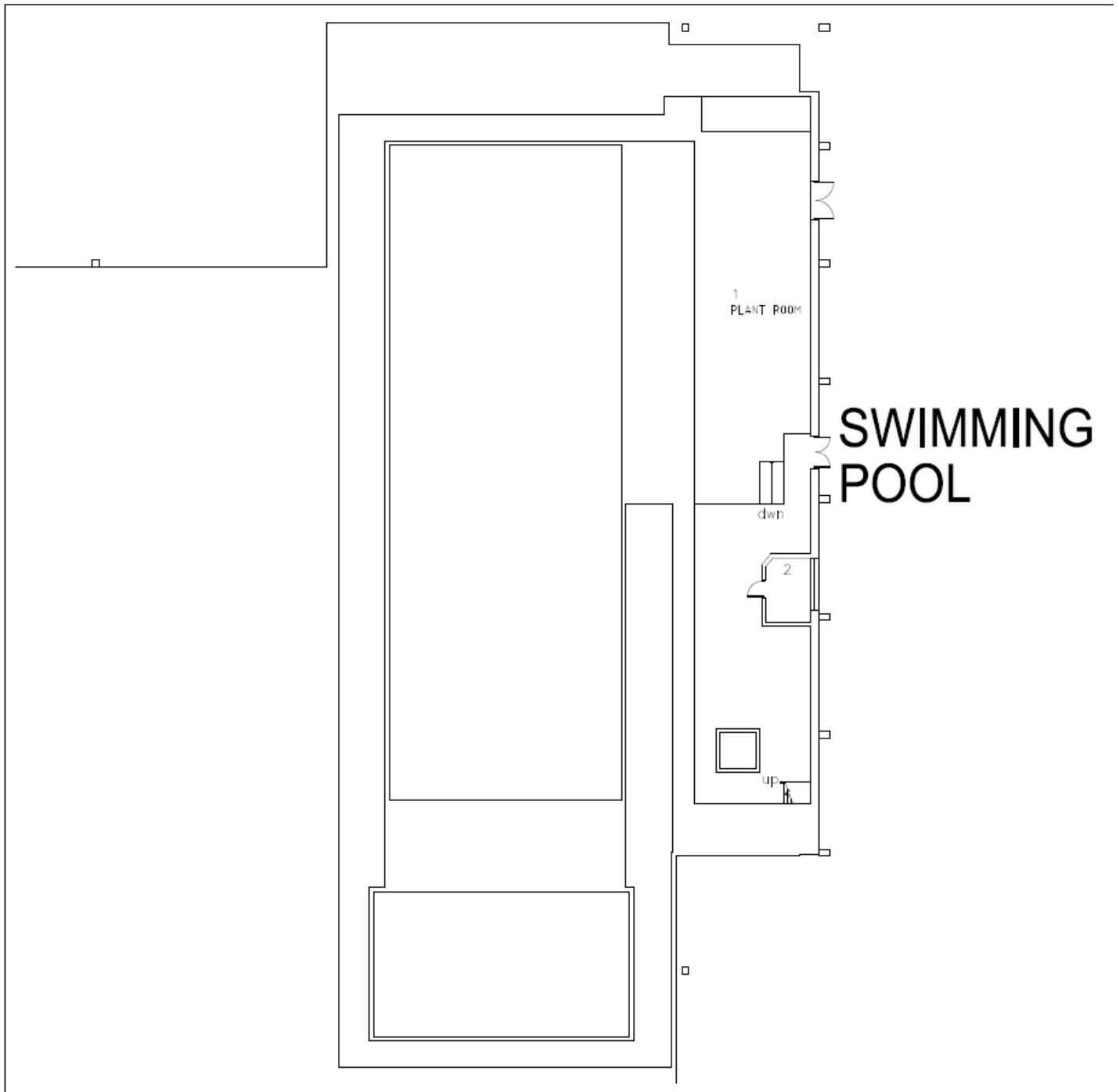


Figure 7: Swimming Pool Basement Plan



The survey of the building was carried out on 19th and 20th February 2026, with daily average high temperature of 8°C and low of -1°C. The survey was non-invasive, excluding any intrusive assessments that would involve a detailed examination of the condition of the installed plant and equipment.

2.2 Building Fabric

The U-value quantifies the ease with which heat can pass through a material, such as a wall or window. Lower U-values signify better insulation and heat retention within a building, while higher U-values indicate greater heat loss. No architectural details were provided, so the U-values have been assumed to meet the relevant building regulations at the time of construction.

The Leisure Centre was originally opened on the 19th October 1967 by Queen Elizabeth and Prince Philip. The building is constructed from concrete and steel, with minimal aluminium framed glazing in the original design. The building's external walls were also covered in pre-cast concrete cladding panels.

The swimming pool and ice rink were clad in metal panels, with the ice rink having a suspended ceiling

From 2009 – 2012 the building was closed for extensive refurbishment that totalled £18.5 million. The design and access statement published as part of the planning application of the works can be summarised below.

Anytown Refurbishment (2009 - 2012) – Summary of Key Points

Internal Alterations

- Creation of a new glazed atrium replacing the original internal courtyard.
- New main entrance, lobby, reception, and circulation spaces.
- Swimming pool upgraded to a standard 6x25 m pool using a boom; new changing village installed.
- Ice rink improvements, including new ice pad, upgraded café, toilets, changing and skate hire, and improved spectator areas.
- Fitness suite expanded to 70 stations; relocated and redesigned.
- Dry sports facilities upgraded, including sports hall, small hall, squash courts, and bowls hall.
- Theatre improvements to hospitality and toilet areas.
- Widespread asbestos removal, full electrical rewire, and major mechanical services upgrades.
- Installation of Part M compliant passenger lifts to improve accessibility.

External Alterations (Building Fabric & Envelope)

- Existing concrete cladding panels over-clad with new insulated composite cladding panels.
- Existing metal Galbestos cladding to ice rink, sports halls removed and replaced with insulated composite cladding panels.
- High-level glazing and gable-end glazing to the pool and rink replaced with insulated anti-glare Xtralite polycarbonate glazing in aluminium framing.
- All external windows, doors and roller shutters replaced with new aluminium glazing and steel systems.

- Roofs replaced or over-insulated with composite roofing panels or new insulation plus a single-ply membrane system.
- Ground floor brickwork rendered and redecorated for improved appearance.
- External concrete columns, stair towers and steelwork cleaned and redecorated.
- **New External Structures**
 - New CHP plant room (approx. 65–73 m²).
 - New ice-machine garage and refrigeration plant compound.
 - New ice-hockey dugouts, store room, and refuse store.

***Figure 8:** Plaque showcasing building opening date*

Figure 9: Original Plans before 2009 - 2012 refurbishment

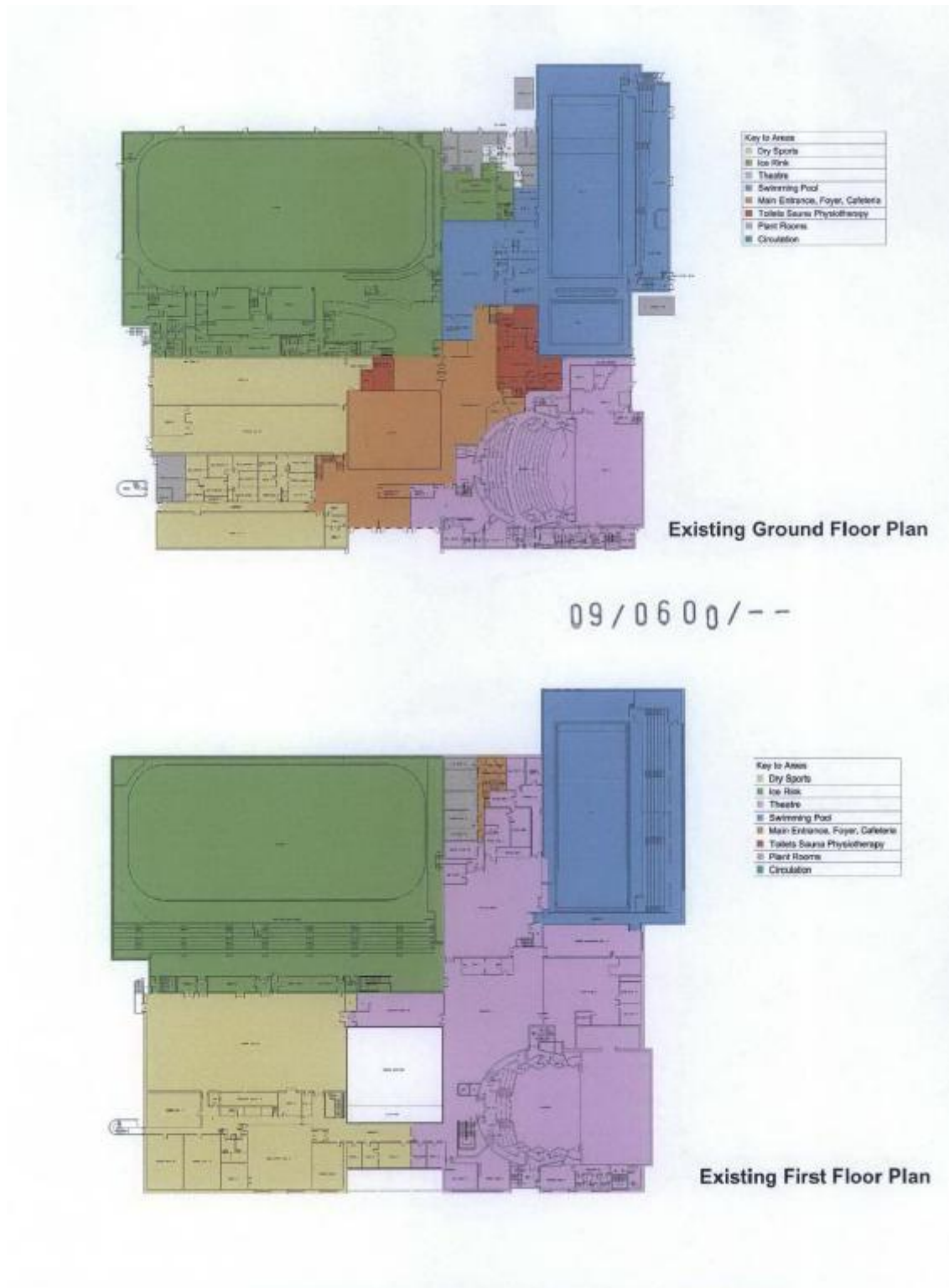


Figure 10: Original Building Fabric



East Elevation indicating the metal cladding to the swimming pool gable end

Figure 11: Current Swimming Pool Building Fabric



Figure 12: Old West Facade



West Elevation with main entrance indicating pre-cast concrete cladding panels at First Floor level, aluminium windows, concrete clad columns and brickwork Ground Floor storey. The Theatre fly tower is on the right.

Figure 13: Existing Modern West Facade

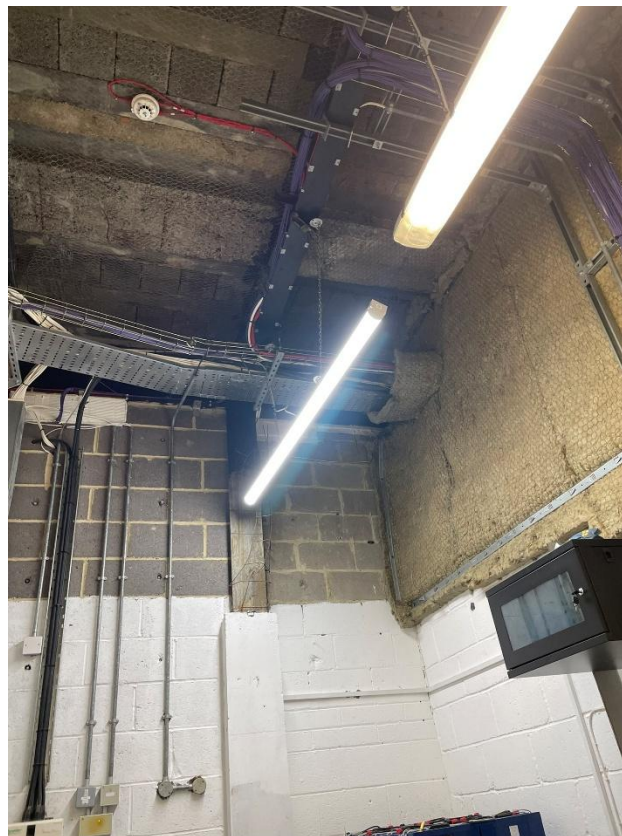


Unfortunately, no U-values of the improvement works were provided or found. As such, the U-values have been assumed to be of the minimum standards at the time of construction, with exception to the ground floor as it is assumed this was not altered during refurbishment.

Table 2: Assumed U-Values of different construction elements of the building based on the minimum requirements to the 2010 building regulations

Construction element	Construction type	U-Value (W/m ² K)
Ground floor	Concrete	1.20
External walls	Concrete Frame with Exterior Cladding (retrofitted)	0.70
Swimming Pool/Ice Rink Polycarbonate 'Glazing'	Xtralite Polycarbonate glazing in Aluminium frame	1.80
Double Glazed Windows	Double glazed Aluminium frame	1.80
Roof light(s)	Xtralite Polycarbonate glazing in Aluminium frame	1.80
Roof(s)	Flat (retrofitted)	0.35
Exterior doors	-	1.80

Figure 14: Roof Insulation seen above storage and plant space



2.3 Lighting

The lighting was observed to have a mixture of LED and fluorescent lighting installed.

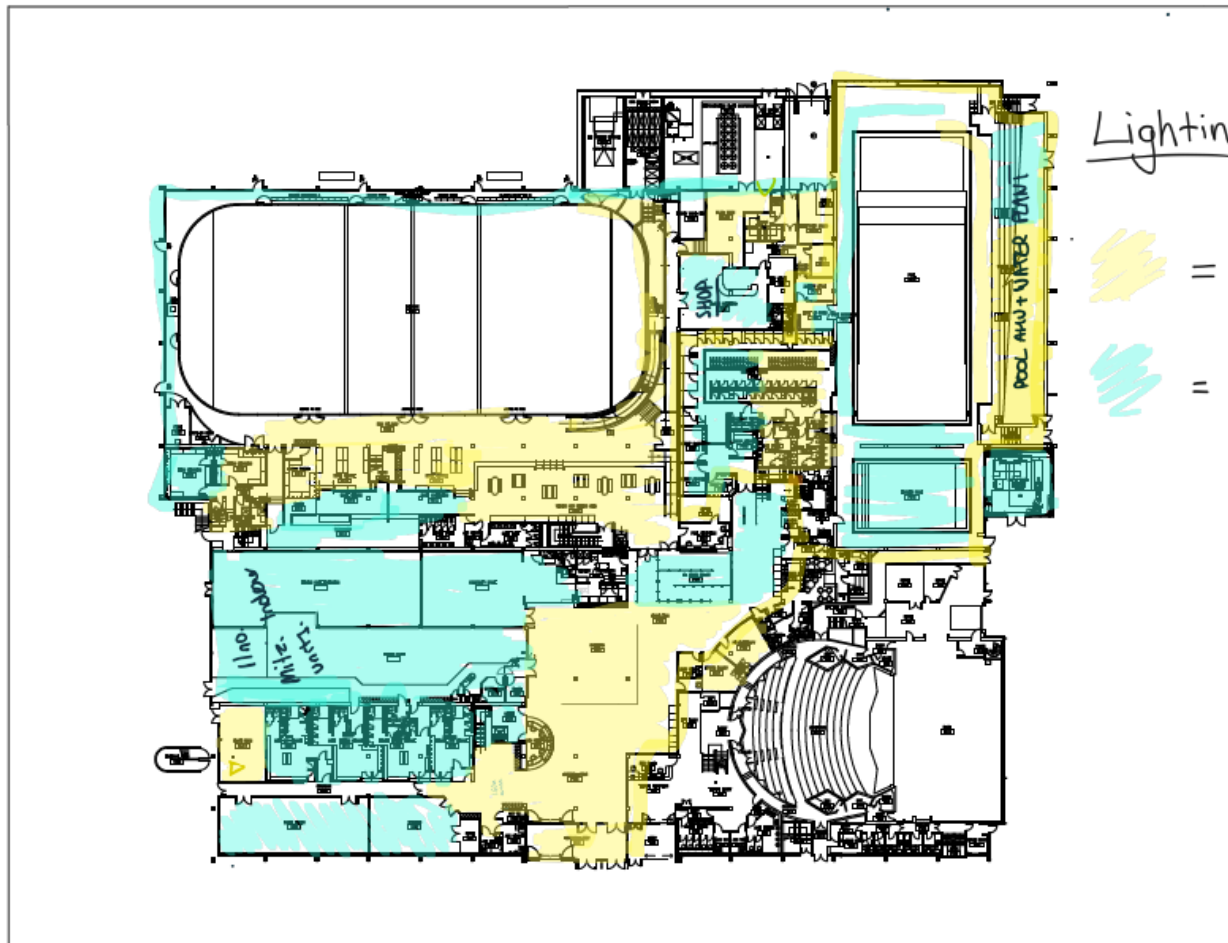
The table below shows the number and type of existing lighting that could be upgraded to LED. The existing lighting that is already LED should be retained.

Table 3 *Non-LED Lighting Fixture Inventory*

Lighting Fixture	Count
Uplighter with twin CFL 2x26W 4000k lamps	233
150mm diameter recessed single CFL	40
1163mm (4ft) T5 single 28W batten	6
1163mm (4ft) T5 twin 2x28W batten	9
1463mm (5ft) T5 single 35W batten	78
1463mm (5ft) T5 twin 2x35W batten	35
2D 28W surface mounted bulkhead	40
600x600 T5 2 tubes surface mounted	15
600x600 T5 4 tubes recessed	48
CFL 26W	105
70W Metal halide lamp	20
Total	629

The attached diagrams show the marked up site plans, showing the areas of the building that were served by LED and fluorescent light fixtures. **Blue** indicates LED, **Yellow** indicates fluorescent fittings. The outlined spaces indicate the areas that heating plant serves.

Figure 15: Lighting Diagrams



Theatre Plant

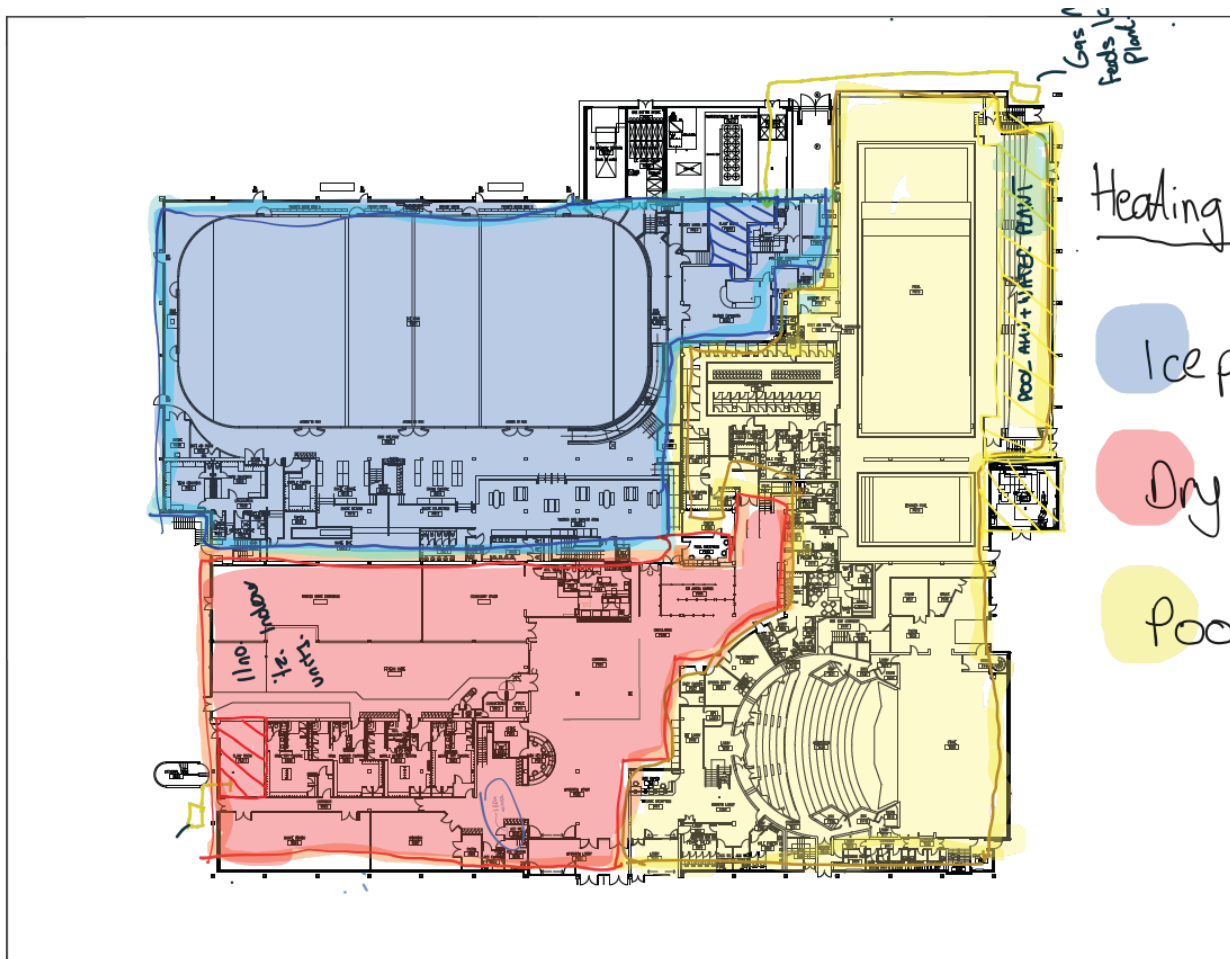
- Theatre & General Heating, AHU + DHW Plant (Served LPHW from Pool Heating + CHP Plant)

Dry Side Plant

- Dry Side Heating, DHW & AHU
- Dry Side additional AHUs (Including Ice Rink AHU)

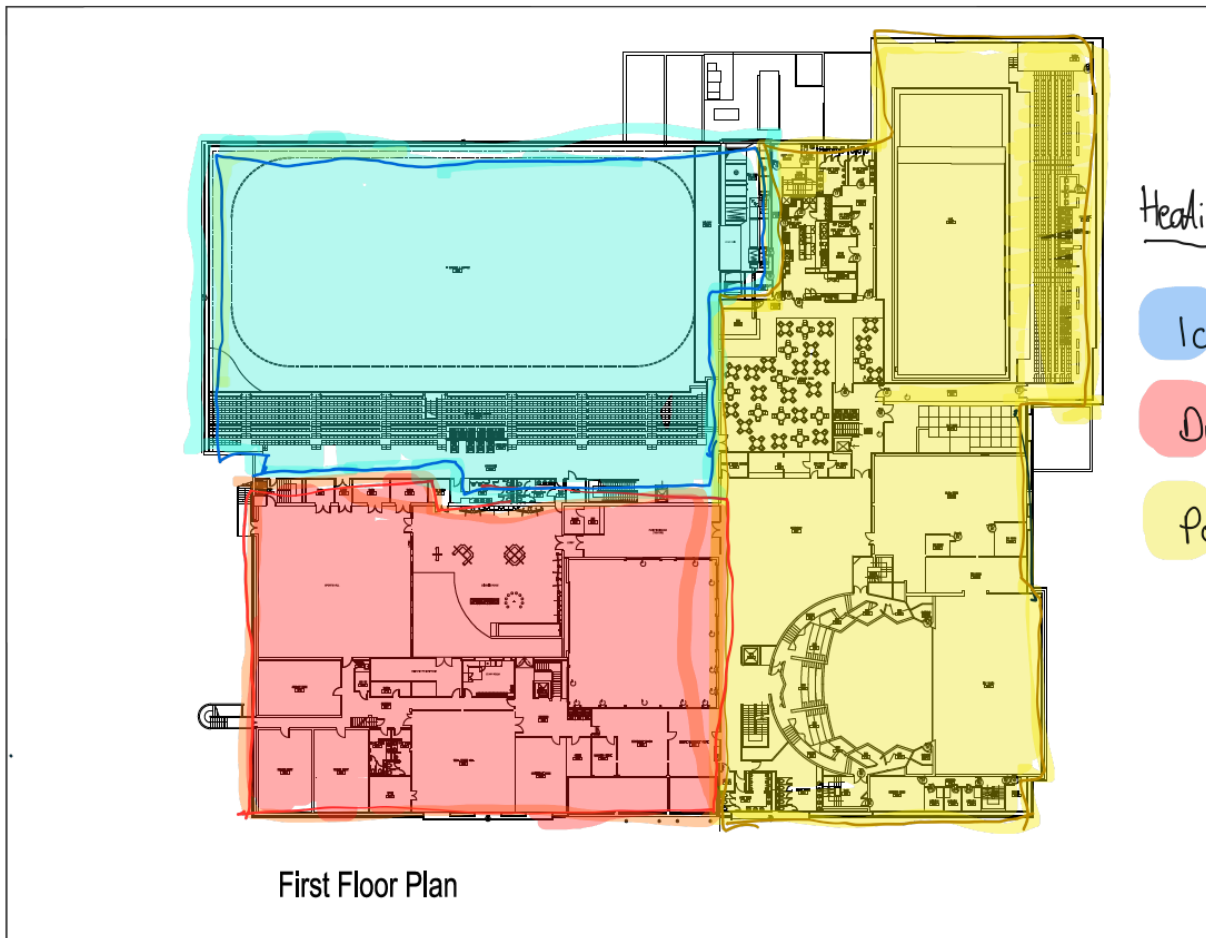
The areas of the building served by the plant is demonstrated below in the diagrams.

Figure 16: GF Heating Zones



* the pool plant also supplies the theatre plant with LPHW.

Figure 17: 1st Floor Heating Zones



* the pool plant also supplies the Theatre plant with LPHW to Air Handling Units (AHU).

2.4.1 Mechanical Plant (Heating, Cooling, Pool, Ventilation)

2.4.1.1 Ice Rink Main Plant

Above the main heating ice rink plant (GF) is the Ice AHU plant (1F), with the chiller serving the AHU at roof level above.

The equipment serving the Ice Rink are as follows:

Table 4: Table summarising existing plant in the Interior Ice Rink Plant

Heating/cooling Element	Fuel Type	Capacity (kW)	Gross efficiency (%)	Year Installed
Interior Ground Floor				
2no. Viessmann Vitoplex 100 Boilers	Gas	400	86	2008
Unbranded DHW cylinder (Served from Boiler)	Gas (indirect)	Unknown	86	Unknown

Table 5: Table summarising existing plant in the Ice Rink Exterior Plant

Heating/cooling Element	Fuel Type	Supplied By	Heating/Cooling Coil (kW)	Capacity/flow rate	Gross efficiency (%)	Heat Recovery	Year Installed
Exterior Ground Floor							
Climaveneta FOCS/D/SL-BT/S 4202	Electricity	-	-	852 kW (Cooling)	356	-	2009
Toshiba RAV-GM801ATP-E (Split Unit)	Electricity	-	-	6.7 kW (Cooling) 7.7 kW (heating)	Unknown	-	2024
Mitsubishi SRC50ZM-S (Split Unit)	Electricity	-	-	5.0 kW (Cooling) 5.8 kW (heating)	320 (Approx.)	-	2024
Dehumidification Plant. Munters MCD140E	Electricity (Fan) & Gas (Burner)	-	150	Unknown	Unknown	No	2010
First Floor							
Ice Rink Air Handling Unit	Electricity	Rooftop Chiller CWS	Cooling: Unknown Heating: Unknown			No	
Office Air Handling Unit	Electricity/ Indirect Gas	LPHW from Interior	Heating: Unknown			Yes	

		Plant Room					
Rooftop Plant							
Climaveneta NECS/R/L.N 1204	Electricity			306 (Cooling)	406		2010
3no. Toshiba RAV- SP160	Electricity			14.0 (Cooling) 16.0 (heating)	300 (Cooling) 348 (Heating)		2017

Figure 18: 2no. Viessmann Boilers

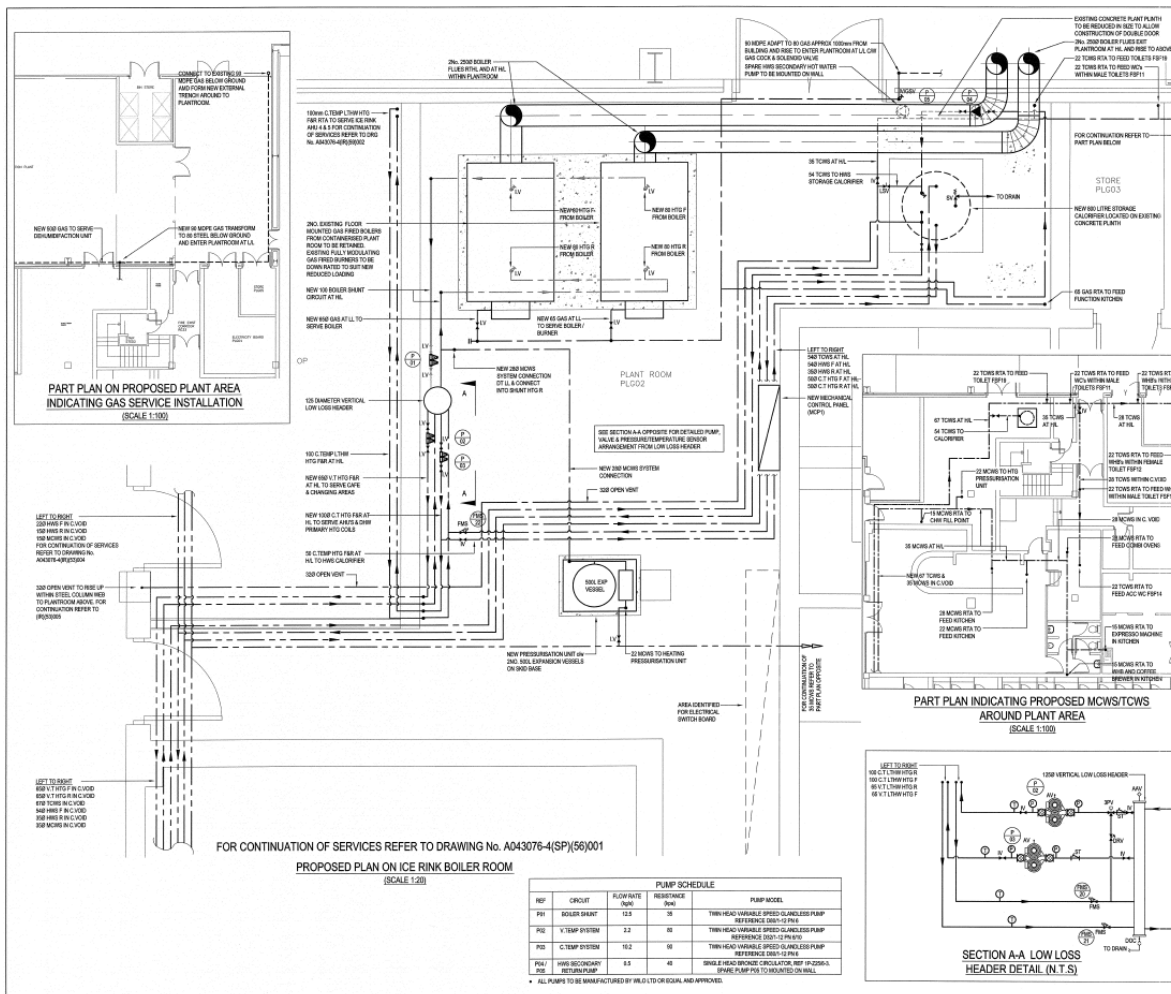


Figure 19: Climaveneta Chiller (Direct Ice Rink)



Type Modello Model	FOCS/D/SL-BT/S 4202		Modèle Modelo Typ
Item Articolo Einzelteil	B8A78000	Article Artículo Produktkodning	
Serial number Matricola unità Seriennummer	32001193	Matricule unité Matricula unidad Seriennummer	
Manufact. year Anno di costruz. Baujahr	2009	Année construction Año de construcción Tiliverkningsår	
Operating weight Peso in funzionam. Betriebsgewicht	9060 kg	Poids en fonction. Peso en funcionam. Driftsvikt	
Refrigerant Gas refrigerante Kältemittel	R134A Group 2.97/23/CE	Gaz réfrigérant Gas refrigerante Köldmedium	
Refr. charge Carica refrigerante Füllgewicht	kg	Q.té gaz réfrig. Carga refrigerante Köldmediefyllning	
Oil type Tipo olio Öltyp	BITZER BSE170	Huile type Tipo aceite Oljetyyp	
ELECTRICAL SUPPLY			
Voltage	400V/3/50HZ+PE		
F.L.A.	403		kW
F.L.A.	661		A
MAXIMUM ALLOWABLE PRESSURE (PS)			
Gas circuit:	HP=2,8 MPa	LP=2,0 MPa	
Water circuit:	1,0 MPa		
Maximum transport and storage temperature: 55 °C			
Contains fluorinated greenhouse gases covered by the Kyoto Protocol.			
Manual n°: 90200690 - FOCS/D/SL-BT/S 4202			
Wiring Diagrams: E8A58732 rev. 0			
CLIMAVENETA		CE 0948 36061 BASSANO DEL GRAPPA (VI) ITALIA - via SARSON, 57/C Tel. +390424 609600 - Fax +390424 609609 e-mail: info@climaveneta.it	

Figure 20: Existing Ice Plant Interior Schematic



2.4.1.2 Swimming Pool Plant & CHP

The equipment serving the different swimming pools in the main pool plant are as follows:

Table 6: Table summarising existing plant in Swimming Pool Plant

Plant Equipment	Fuel Type	Supplied By	Coil Size (kW)	Capacity	Heat Recovery	Year Installed
Main & Learner Pool Air Handling Unit Dantherm DANX	Elec/Gas Indirect	LPHW from Pool Heating & CHP Plant	Unknown	8.8 m³/s (Supply) 9.0 m³/s (Extract)	Yes	2010 (Est)
Plate Heat Exchanger for Main Pool	-	LPHW from Pool Heating & CHP Plant	Unknown	Unknown	-	2012 (Est)
Plate Heat Exchanger for Learner Pool	-	LPHW from Pool Heating & CHP Plant	Unknown	Unknown	-	2012 (Est)

3no. Sand Filters	-	-	-	-	-	-
UV Filtration	-	-	-	-	-	-

Table 7: Table summarising existing plant in the Pool Heating & CHP

Heating/cooling Element	Fuel Type	Capacity (kW)	Gross efficiency (%)	Year Installed
2no. Viessmann Vitoplex 100 SX1	Gas	895	83	2004
ENER.G CHP Unit	Gas	60 (Electricity) 109 (Heat)	80 combined heat and power	2010

Figure 21: Main Pool & Learner Pool AHU



Figure 22: Pool filtration equipment



Figure 23: Learner Pool Plate Heat Exchanger (Left) & Main Pool Plate Heat Exchanger (Right)



Figure 24: 2no. Viessmann gas boilers (2004)

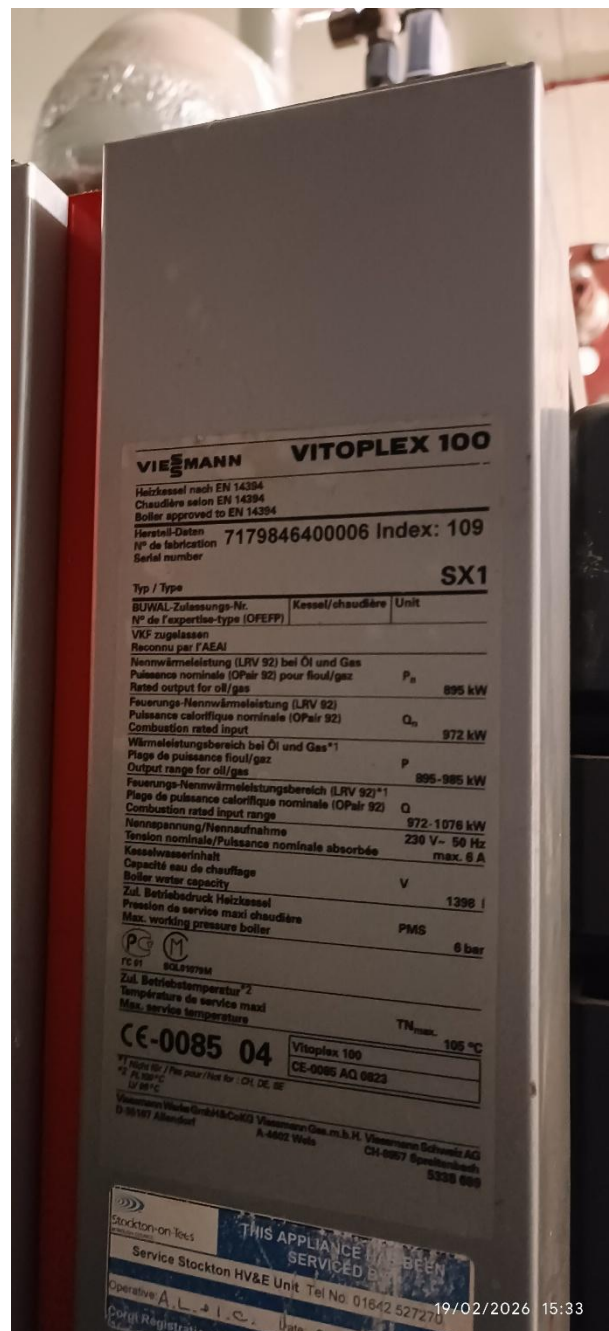
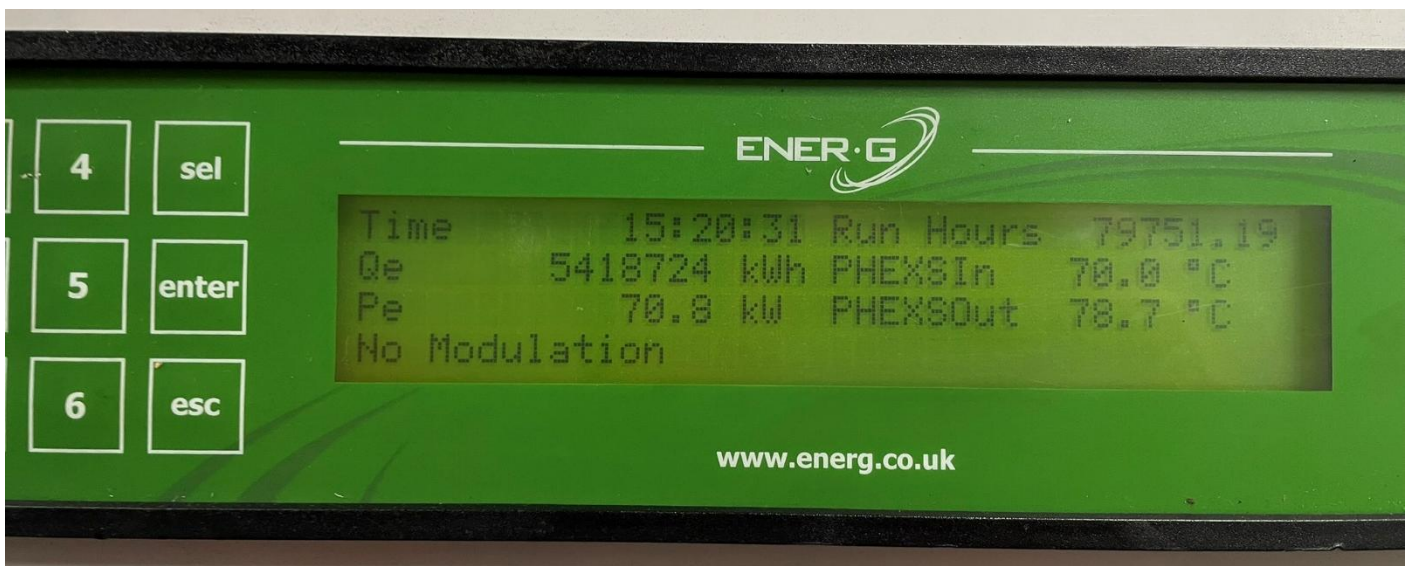
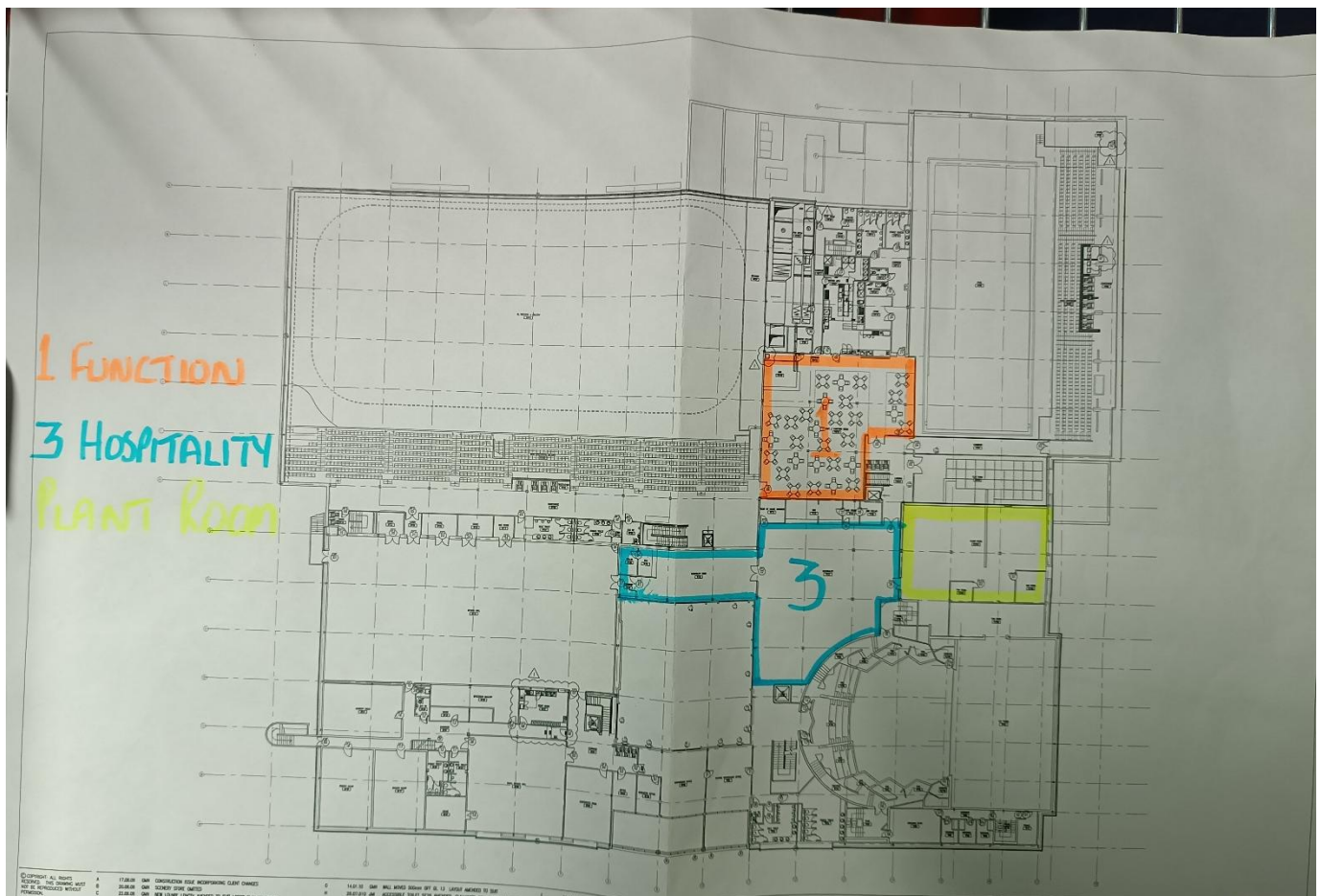


Figure 25: ENER.G E70 CHP



				5.5 m ³ /s (Extract)		
Pool Change Air Handling Unit	Elec/Gas Indirect	LPHW from Pool Heating & CHP Plant	48 & 82	3.9 m ³ /s (Supply) 3.9 m ³ /s (Extract)	Yes	2012 (Est)
Theatre Hospitality Air Handling Unit	Elec/Gas Indirect	LPHW from Pool Heating & CHP Plant	43 & 73	3.5 m ³ /s (Supply) 3.5 m ³ /s (Extract)	Yes	2012 (Est)
Theatre Air Handling Unit	Elec/Gas Indirect	LPHW from Pool Heating & CHP Plant	64 & 109	Not given	No	2012 (Est)

Figure 27: Marked up floor plan showing AHU service areas on GF and 1st F



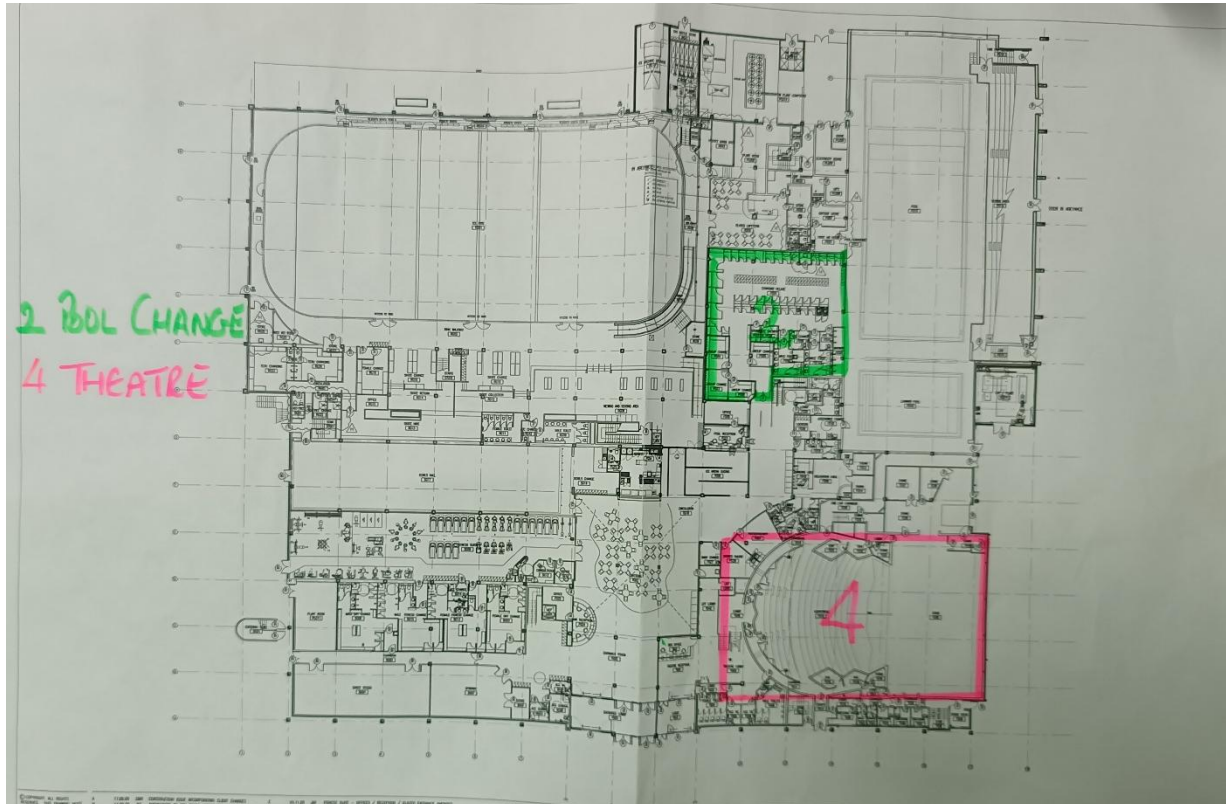
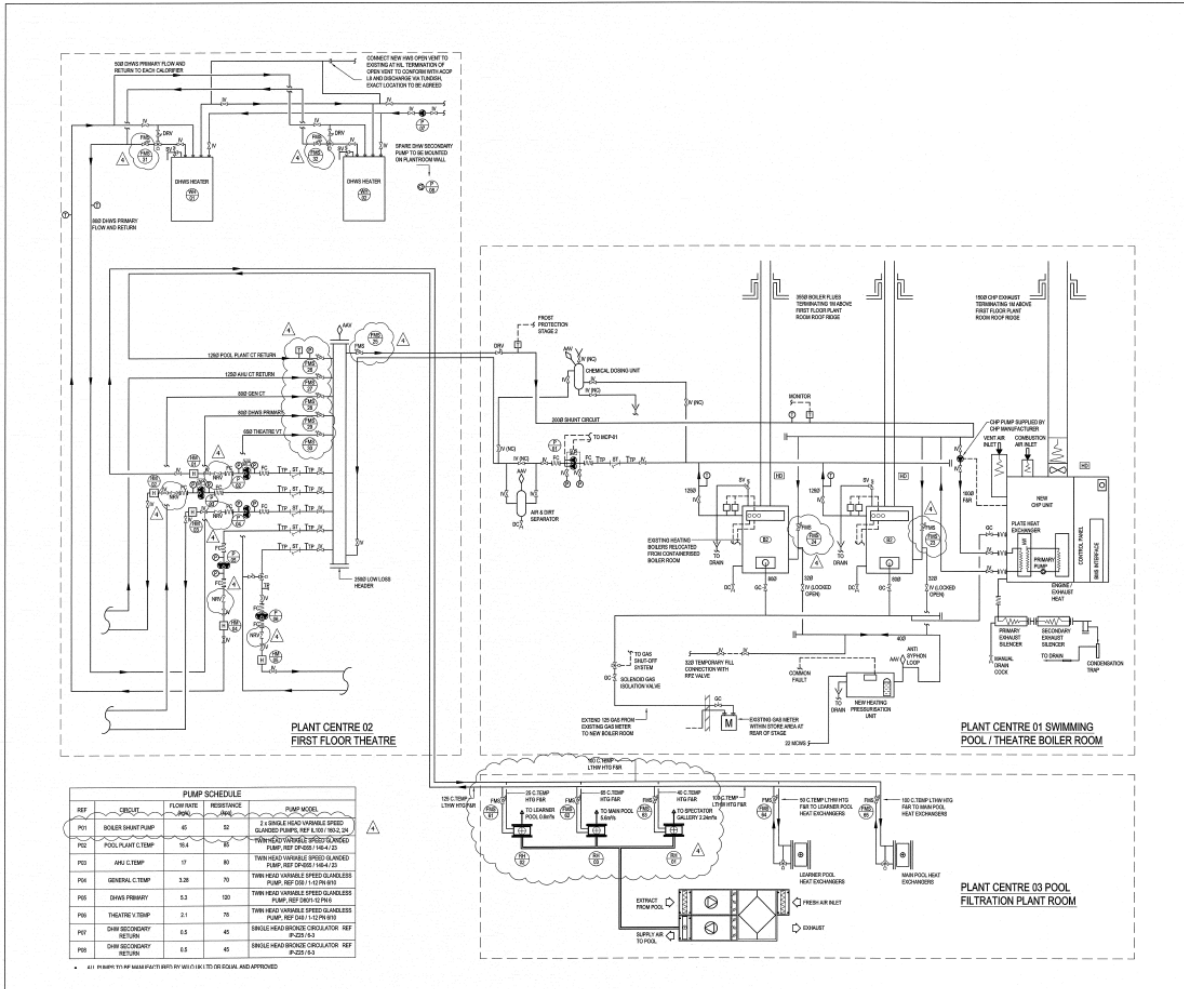


Figure 28: Pool & Theatre Plant Existing Schematic



2.4.1.4 Dry side Plant

The Dry side plant room contains the following:

Table 9: Table summarising existing plant in Dry side Plant

Heating/cooling Element	Fuel Type	Supplied By	Capacity	Gross Efficiency (%)	Heat Recovery	Year Installed
2no. Remeha Gas 210 ECO PRO-200 (One was not operational)	Gas	-	205 kW (One boiler was non-operational. Both Boilers Combined: 410 kW	87.8	-	2010

Unknown DHW Cylinder	Gas (indirect)	2no. Remeha Boilers	Unknown	Unknown	Unknown	Unknown
01 Changing Room Air Handling Unit	Elec/Gas Indirect	LPHW from Dry Side Heating Plant	73	1.5 m3/s (Supply) 1.6 m3/s (Extract)	Yes	
02 Gym (Old Bowls) Air Handling Unit	Elec/Gas Indirect	LPHW from Dry Side Heating Plant	68	1.40 m3/s (Supply) 1.40 m3/s (Extract)	No	
03 Squash Courts Air Handling Unit	Elec/Gas Indirect	LPHW from Dry Side Heating Plant	17	0.40 m3/s (Supply)	No	
04 Academy Air Handling Unit	Elec/Gas Indirect	LPHW from Dry Side Heating Plant	15	0.35 m3/s (Supply) 0.35 m3/s (Extract)	No	
05 Office Air Handling Unit	Elec/Gas Indirect	LPHW from Dry Side Heating Plant	10	0.31 m3/s (Supply) 0.31 m3/s (Extract)	No	

There was also the documentation for AHU 4 & 5 which were listed as Academy and Office. They were not located in this plant room, with both AHUs located in void spaces. These were not observed during the survey. All the fans were inverter driven.



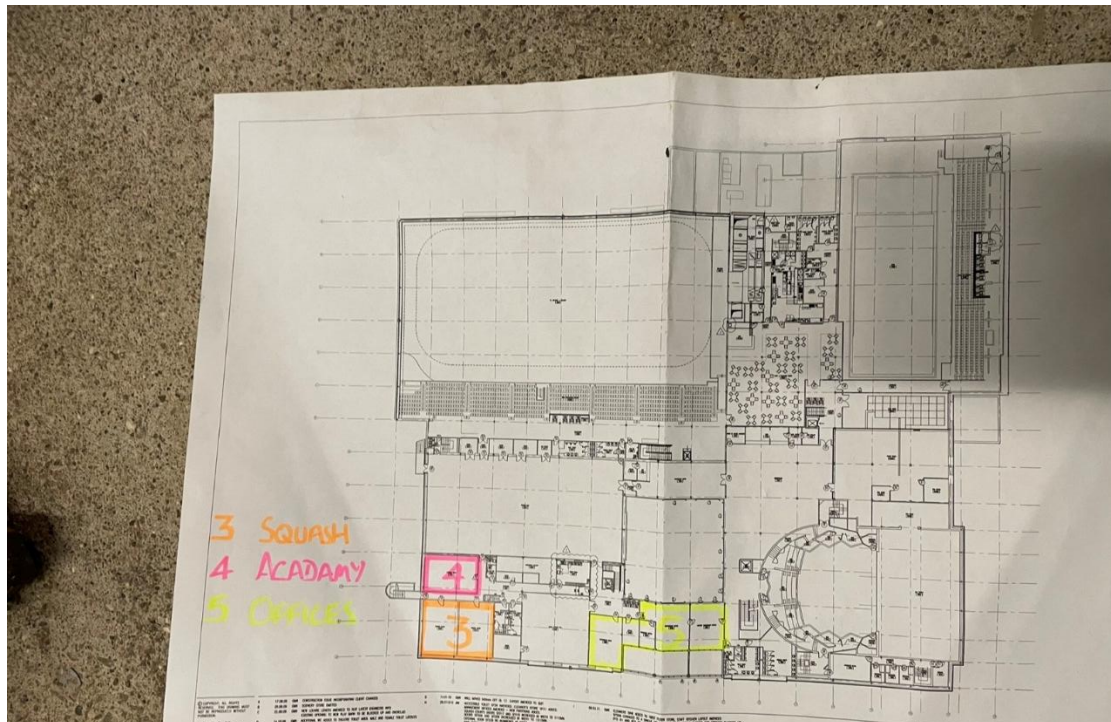


Figure 30: AHU 5 Schematic

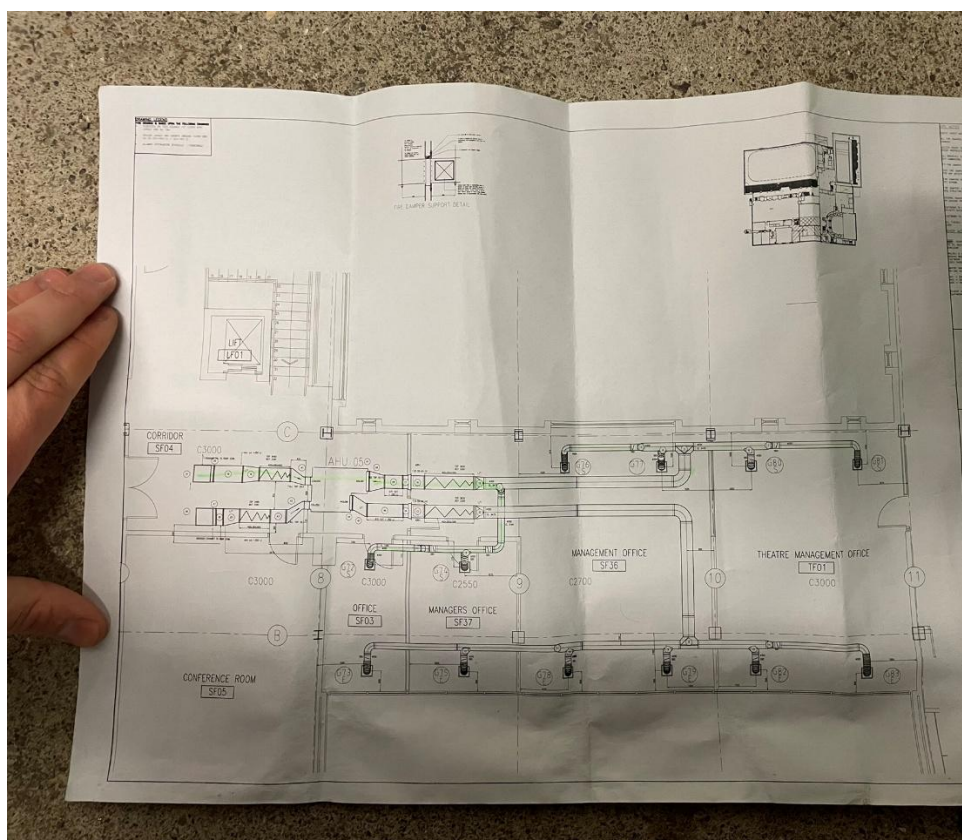
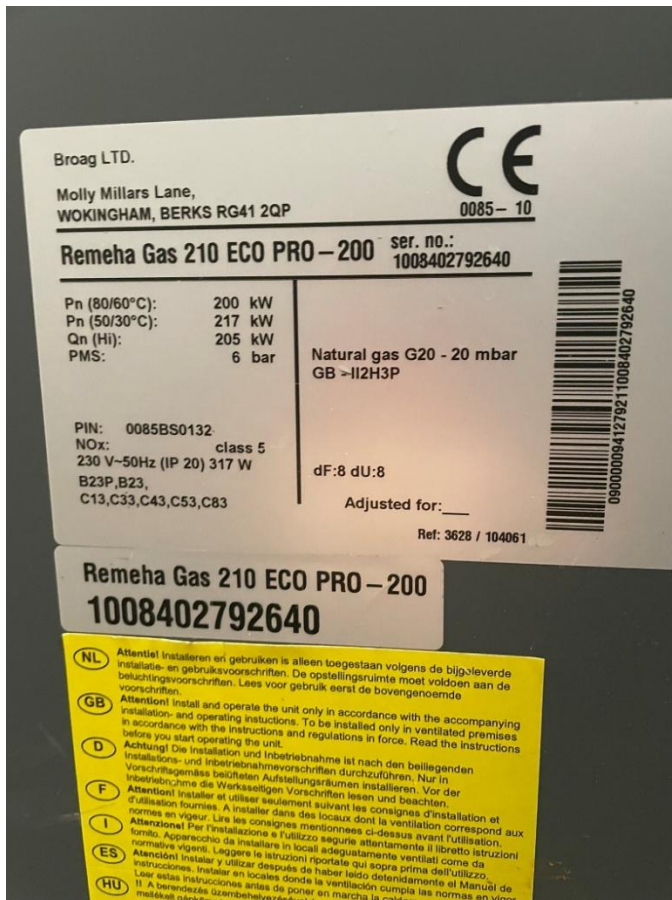


Figure 31: 2no Remeha Boilers (1 turned off)



There was also a gas submeter located in the plantroom, though unfortunately no submeter data was available.

Figure 33: Example of 2no. Mitsubishi split units serving the Gym



Figure 34: Indoor Cassette Serving Gym



2.4.2 Heating distribution

Across the building, there are a number of different methods of heat distribution from the various plant rooms. The different areas of the building are heated.

Table 10: Heating Distribution Across the Building

Area of the Building	Heated/Cooled	Supplied By	Ventilation	Heat/Cooler Emitter
Ground Floor				
Ice Rink pipework	Cooled	Ground Floor Chiller	No	Under ice pipework
Ice Rink	Cooled	Rooftop Chiller via AHU	Yes AHU	Ductwork at high level
Ice Rink Changing Rooms	Heated + Cooled	Ice Heating Plant + Ice AHU	Yes AHU	Radiators (Circuit not used) + Ductwork

Ice Rink Spectators	Heated + Cooled	Ice Heating Plant + Ice AHU	Yes AHU	Exposed Pipework (Circuit not used) + Ductwork
Swimming Pool	Heated	Swimming Plant AHUs	Yes AHU	High level Ductwork for Supply + Extract
Pool Changing Rooms	Heated	Swimming Changing AHU	Yes AHU	High level Ductwork for Supply + Extract
Theatre	Heated	Theatre AHU & Pool/CHP Plant	Yes AHU	High level Ductwork for Supply + Extract. Radiators on perimeter
Gym	Heated + Cooled	Spilt Units + AHU	Yes AHU	Ceiling Cassettes + ductwork
Gym Changing Rooms	Heated + Cooled	Spilt Units + AHU	Yes AHU	Ceiling Cassettes
Spin Studios & Dance	Heated + Cooled	Spilt Units	Yes, Split Units	Ceiling Cassettes *Previous Radiators all off.
General Areas	Heated	Various Plant rooms	-	Radiators + Fan Convectors
Atrium	Heated	Dry Side Plant	Dampers at high level if required.	Underfloor Heating + Radiators & fan convectors
Main Entrance Draught Lobby	Heated	Dry Side Plant	No – Door frequently opens	Warm Air Elec Fan Convectors above doors + Radiators
First Floor				
Ice Rink Spectators Seating	Heated + Cooled	AHU & Ice Plant Boilers	Yes AHU	High level Ductwork for Supply + Extract. Radiators on perimeter
Concourse	Heated + Cooled	AHU & Ice Plant Boilers	Yes AHU	High level Ductwork for Supply + Extract. Radiators on perimeter
Climbing Room	Not Heated or Cooled	-	-	-
Theatre and Hospitality	Heated	AHU in theatre plant, supplied by pool plant boilers and AHU	Yes AHU	High level Ductwork for Supply + Extract
Management Offices	Heated + Cooled	AHU and boilers from dry side plant and boilers Cooled via split units with outdoor units.	Yes AHU	High level Ductwork for Supply
Small Sports Hall and Squash Courts	Heated			
Large Sports Hall	Not Heated or Cooled	-	-	-
Function Room	Heated	AHU in Theatre Plant – served by pool plant and CHP	Yes AHU	High level Ductwork for Supply + Extract
Swimming Pool Spectators.	Heated	AHU in Pool Plant – Served by pool plant and CHP	Yes AHU	High level Ductwork for Supply + Extract

Please note that the Ice Rink Heating circuits were not in use and were stated to never be in use. It is recommended to continue not using them.

Figure 35: Heating circuit under Ice Skate Spectator Seating



2.4.3 Domestic Hot Water

The Domestic Hot Water (DHW) across the building is served via the main plant rooms. The plant rooms where DHW equipment was found were as follows.

Ice Rink Heating Plant

The existing gas fired boilers serve an indirect 800 litre DHW cylinder.

Theatre Plant

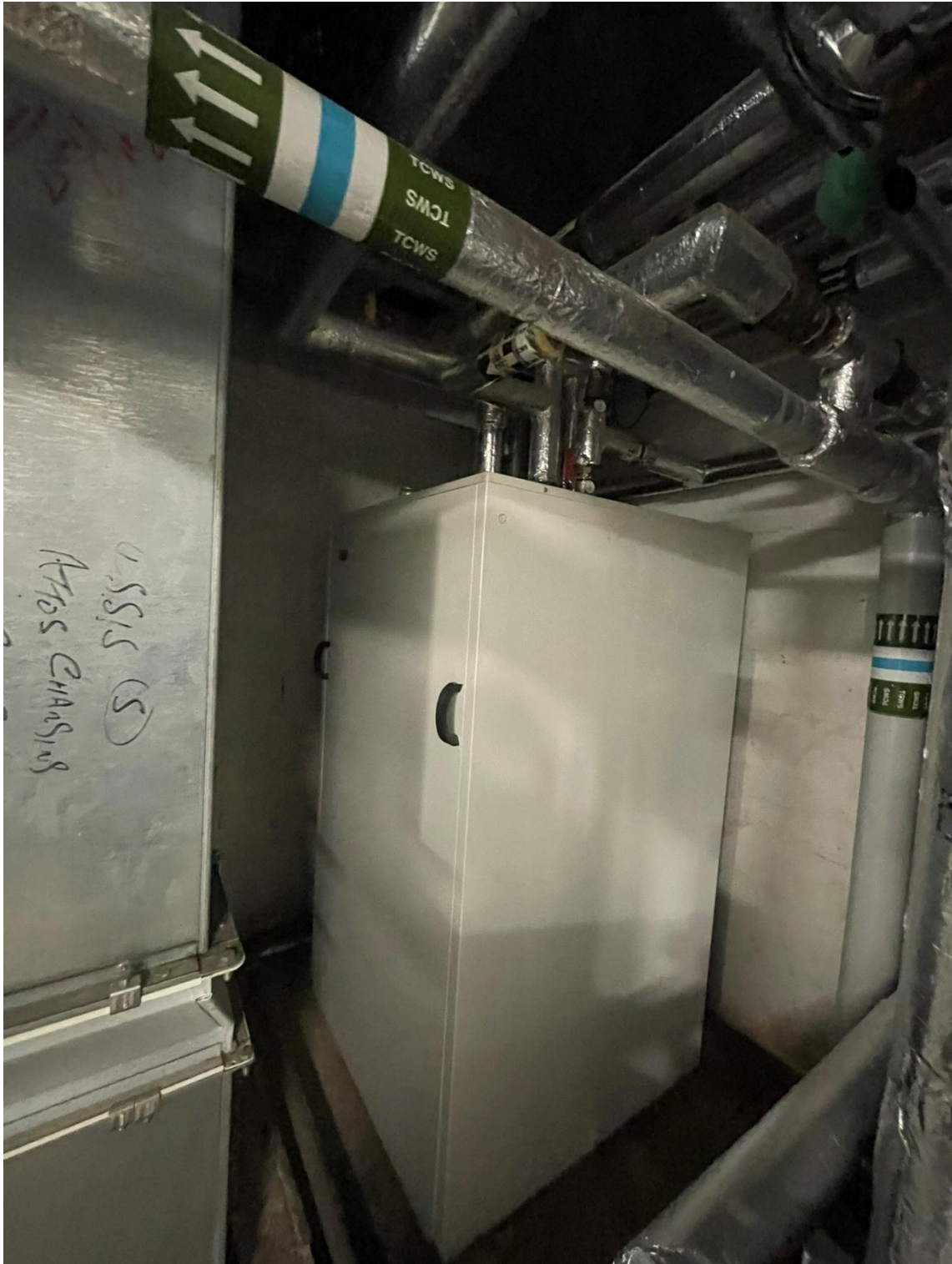
The DHW in the Theatre plant consists of 2no. DHW cylinders. One is a Boss, 800 litre indirect cylinder, the other an unknown brand 800 litre indirect cylinder, the same type as from the Ice Rink Plant.

Dry side Plant

The DHW in the dry side plant is served by an indirect cylinder, fed from 2no. gas fired boilers. It is again the same unknown cylinder as seen in the other plant rooms.

As a result of the various DHW cylinders being installed that are unbranded with no technical information, it is difficult to access the building's DHW demand accurately. Given the buildings use, the overall DHW usage will be significant, but that is likely to be led from the pool changing rooms. The usage profile in the Ice Rink will likely be drastically different.

Figure 36: Indirect Water Heater – Unknown Manufacturer



2.4.4 Automatic controls

The plant rooms across the building had various different set ups in terms of how the systems and plant were controlled. There was not one consistent manufacturer of the control panels, nor an obvious consistent manufacturer of the head end controls and BMS.

We did not see evidence of a central computer or Building Management System being used to interlink all of the plantrooms across the building.

As part of the costs associated with installing low carbon equipment across the building, a fee has been included to introduce more consistent and sophisticated controls across the building.

Figure 37: Ventilation Controller in Main Atrium

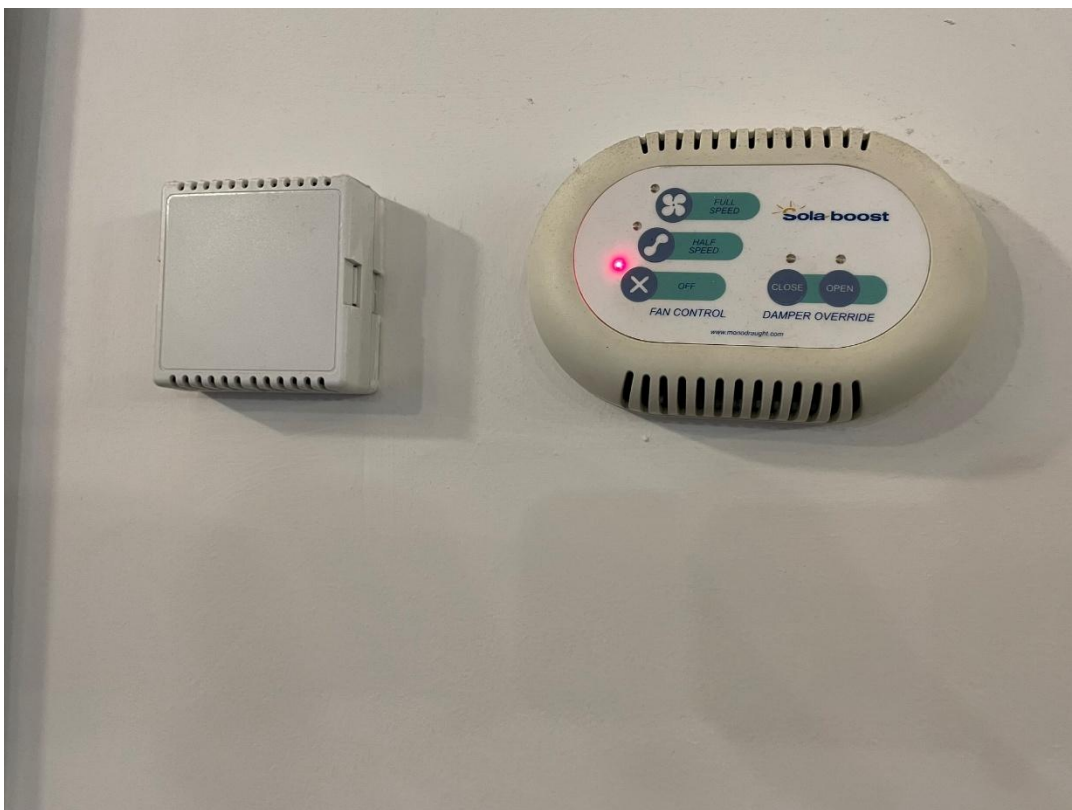


Figure 38: Control Panel and BMS control panel Dry side Plant



Figure 39: Control Panel at Pool & Theatre Heating Plant



2.4.5 Sauna and Steam Room

The Leisure centre has a space dedicated to a Steam and Sauna room. It can be used by members and has an hourly timetable.

The plant equipment that provides the steam and sauna are listed below. They are all electrically powered and as a result already decarbonised. It is recommended that the Council retain them and replace as and when they fail. The shared spaces have areas where users can sit down for a break, and also house changing facilities, showers and WCs.

Figure 40: Steam (left) and Sauna (right) rooms

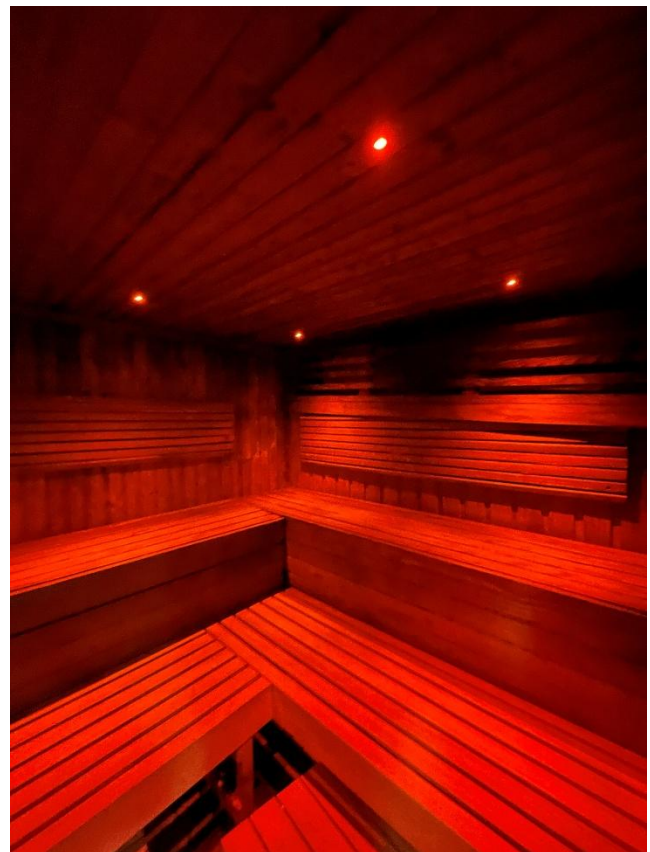


Table 11: Table summarising existing plant in the Sauna and Steam Plant

Heating/cooling Element	Fuel Type	Capacity (kW)	Gross efficiency (%)	Year Installed
Vapac PV15-D	Electricity	12	100	-
Harvia Sauna Controller.	Electricity	Unknown (est. 9kW)	100	-

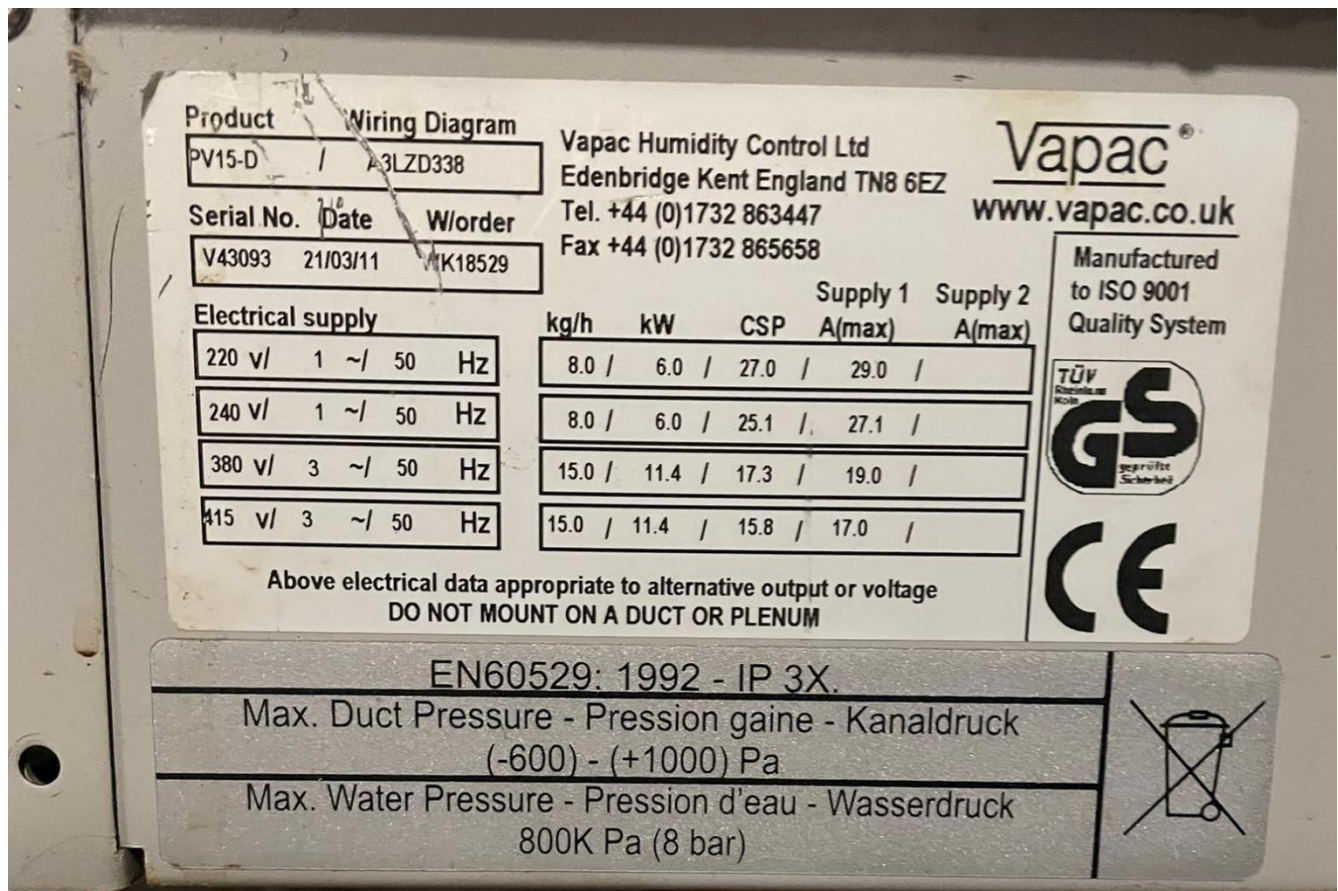
Figure 41: Harvia Sauna Controller



Figure 42: Steam Humidifier



Figure 43: Vapac Steam Boiler Nameplate



2.5 Kitchens

On the first floor of the leisure centre is a commercial kitchen. Regrettably there was not access during the site visit and as such it is not confirmed if there is gas firing equipment in the kitchens. There is no gas submeter data for the kitchen, but the electrical submeter data showed that it used approximately 24,000 kWh of electricity over April 2025 to March 2026.

This usage would be significantly higher if the kitchen only had electrical equipment. Due to this it has been assumed that the kitchen has gas fired equipment. Staff have since confirmed that the kitchen has gas fired equipment.

2.6 Incoming Gas

The site has 3no. Incoming gas meters. They are broken down as follows:

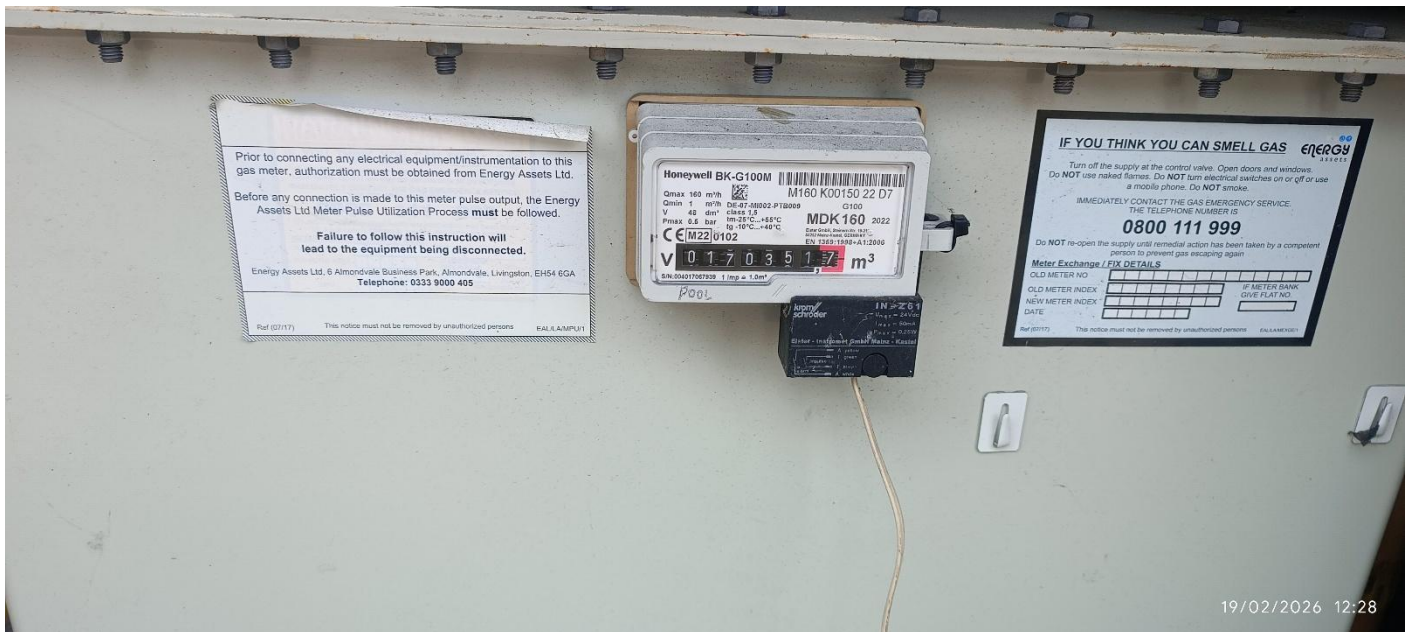
Area Serving	Meter Type	Meter no.	MPRN	Location
Dry Side	Main	M065K0042522D6	9216105408	Southwest corner of the building
Ice	Main	M160K0015022D7	9110014906	Northeast corner of the building
Pool & Theatre	Main	M0250D509823B7	9110015201	Unknown
Dry Side Plant	Sub	M025 A06574 10D6 2010		Dry side plant room intake to boilers
CHP (Pool Plant)	Sub	3400609426/2012		On gas intake to CHP

Both the installed meters at the site were compatible with AMR, although the Ice and pool plant meter appeared to have had it installed retrospectively.

Figure 44: Gas Meter: M065K0042522D6



Figure 45: Gas Meter M160 K00150 22 D7



2.7 Incoming Electrical Supplies

There appears to be only one main electrical incomer at the leisure centre. A review of the electrical switch room and associated documentation confirms that the leisure centre is supplied via a dedicated high-voltage (HV) / low-voltage (LV) substation located on site. The main components are:

1. High-Voltage Ring Main Switchgear (11 kV)

The site forms part of a local 11 kV distribution ring, with two labelled incoming/outgoing circuits.

2. On-Site Distribution Transformer

A central HV panel supplies an onsite transformer labelled 11 kV / 400–230 V transformer with 1,600 Amp, 1,108 kVA capacity to supply the leisure centre.

3. Low-Voltage (LV) Metering

An Elster A1700 LV meter (property of Western Power Distribution) is installed on the outgoing LV side.

The meter records:

- kWh import;
- kVA demand;
- Phase voltage and current parameters.

This is the billing meter for all energy consumed by the leisure centre.

Figure 46: Main DB Diagram showing 1,600 Amp supply

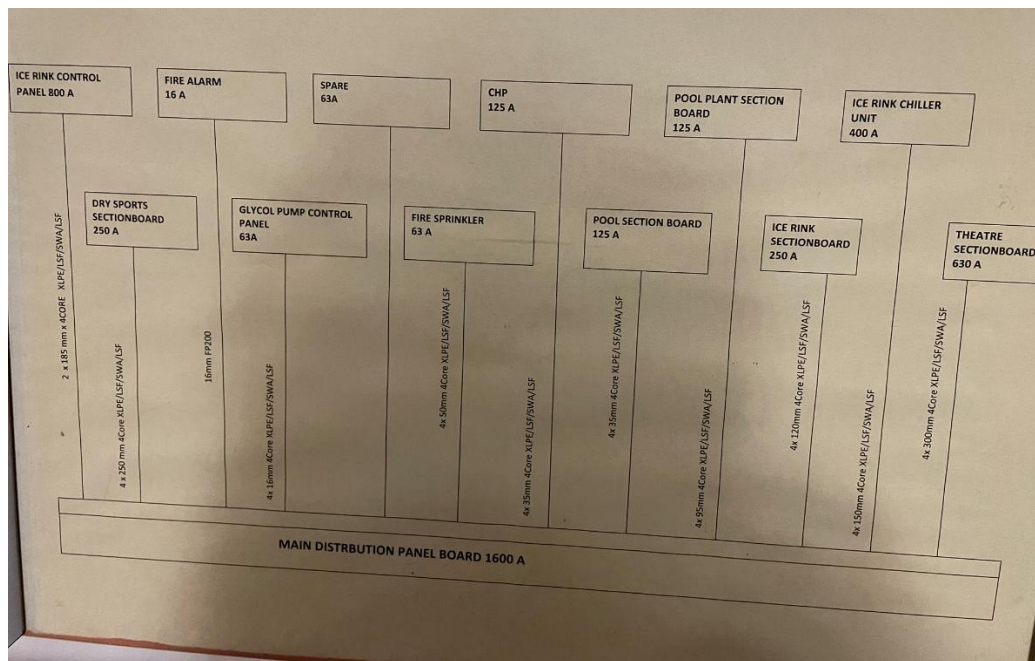


Figure 47: Electrical Infrastructure Schematic

Figure 48: Main Site Transformer and Incoming Meter



Table 12: Installed Electrical Meter

Area served	Meter Number	MPAN	Location	Maximum Demand Half Hourly Data (kW)	Maximum Demand Meter Reading (kW)
Whole Leisure Centre	K1720 K05D00014	1592008764509	Main Electrical Incomer with Transformer	477*	584

*The maximum demand calculated from supplied half-hourly electrical data covering the previous year was 477 kW. However, the reading on the meter indicated the maximum demand recorded was 584 kW. It was unclear how far back this reading is from. The larger of the two readings will be used for the purposes of this report.

2.8 Renewable Technologies

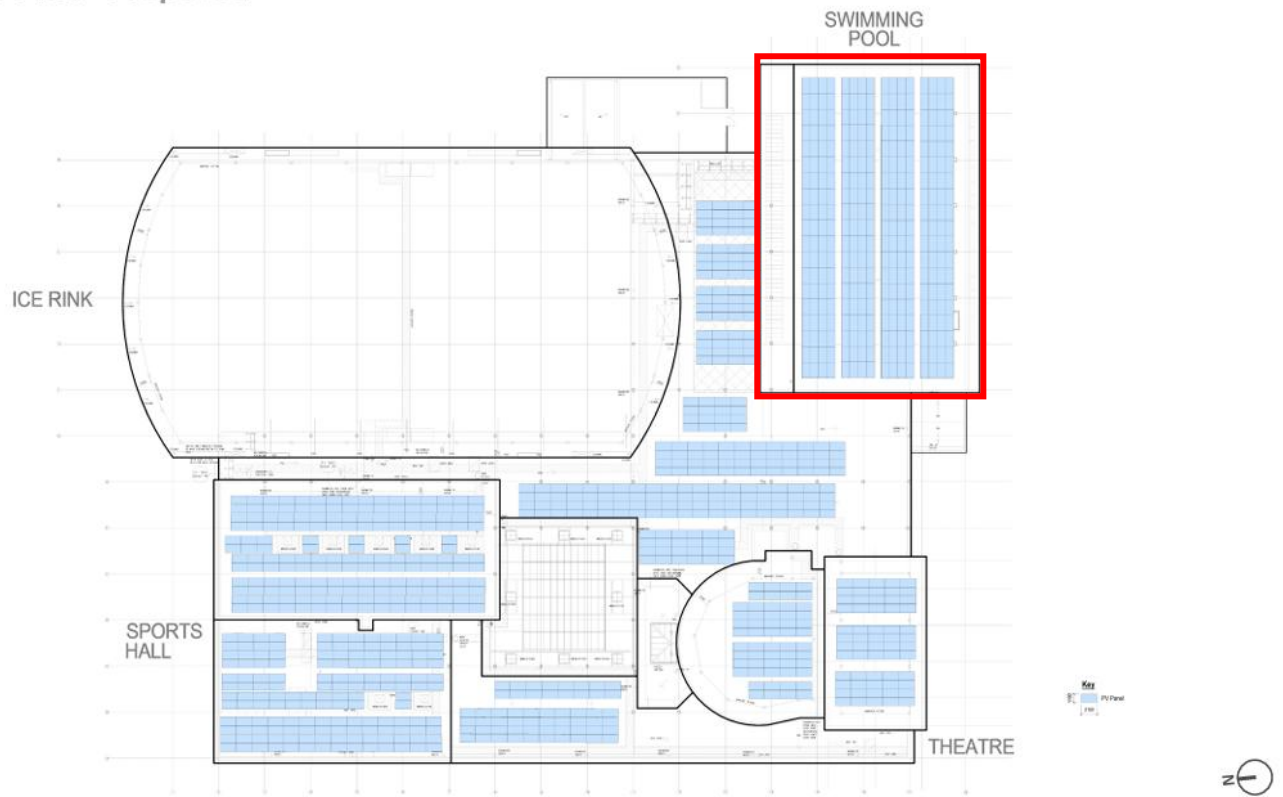
There are a number of Alfen electric vehicle chargers installed in the carpark at the site. They took contactless payment and were managed by Blink, presumably who have a contact with the CA to install electric vehicle chargers across Anytown and the surrounding area.

In addition, a large solar panel array (160 kWp) had been installed on the roof of the swimming pool (marked in red). Originally, there were plans for a larger array on the building. In the figure below, the original plans for the solar PV array were much larger.

The design and access statement showed originally a much larger area of the roof was intended to house PV panels. It is unclear why the reduced in size PV system was installed.

Figure 49: Design and Access Statement - Original Plans for a PV System. Installed labelled in red.

2.2 Roof Plan - Proposed



H O W A R T H L I T C H F I E L D

25068-HL-XX-XX-RP-A-0001-S3-P02 - Design and Access Statement & Heritage Statement VII

Figure 50: Installed 160 kWp PV System



3 Energy Saving & Decarbonisation Proposals

3.1 Options Appraisal and Discounted Technologies

3.1.1 Solar Thermal

While a solar thermal array installed on the roof could contribute to domestic hot water generation, this option has been excluded as the space would be better utilised by solar photovoltaic panels. Given the leisure centres use, there is likely high DHW demand. If there was a lower electricity demand at the site, it could have been a good option to consider as a smaller PV system could offer roof space for solar thermal panels.

3.1.2 Ground Source Heat Pumps (Space Heating)

Ground source heat pumps (GSHPs) can provide a more efficient alternative to air source heat pumps (ASHPs) and have a steady year-round efficiency (Coefficient of Performance – COP) of approximately 4.0. This means that typically for every 1.0 kW of electricity used, 4.0 kW of heat is generated. The efficiency of the air source heat pumps varies over the year with the outside air temperature but could have a seasonal COP (SCOP) of 3.2.

However, the capital cost of GSHPs can be significantly greater relative to ASHPs due to the extensive groundworks associated with the installation of the underground piping, known as the ground loop, a crucial component of the GSHP system.

GSHPs can operate with two types of ground pipework arrays: horizontal pipework installation or vertical borehole installation.

As a general guideline, a borehole in loose stones produces approximately 20W of heat per meter depth (known as the heat/energy extraction rate), while one in granite has an extraction rate of 55 to 70 W/m. For an installation with multiple boreholes, a minimum spacing of 12m between borehole centres is typically required. However, this spacing can vary depending on whether the system is designed for heat extraction and rejection (i.e., providing heating and cooling).

The site does have available space where boreholes could be viable to be installed but given the significant capital expense compared to alternative low carbon heating systems, it has been discounted at this stage.

3.1.3 District Heating

During the site survey, staff mentioned that in the past the leisure centre had been connected up to a district heat network. At the time, the town of Anytown was home to a large private network of pipework owned and operated by a local firm, which operated extensive private pipeline corridors for steam, hydrogen and process heat across their sites, including a dedicated tunnel beneath the river. These systems were restricted to industrial operations and did not supply civic buildings such as Anytown.

However, currently the Combined Authority is actively developing strategic heat-network expansion plans that could significantly reshape the energy landscape of Anytown in the coming decades. Regional modelling by the ADE (Association for Decentralised Energy) indicates that heat-network capacity in the area could potentially supply **4.8 TWh of heat annually by 2050** under high-ambition scenarios, supported by approximately **1,306 km of new primary pipework** and an estimated **£5.1 billion in capital investment**, particularly concentrated during the 2030s.

In addition, council meeting documents and the City Deal document, published in 2015 detail plans of the Anytown District Heating Scheme, which has completed pre-feasibility studies that have identified GrowHow as a potential

generator for the network. The scheme would take waste heat from the processes of exothermic reactions in the production of fertiliser. They currently distribute waste heat and CO₂ to nearby companies, using the historic pipework from ICI.

There is potential to extend this network to cover local authority buildings, large commercial premises and a prison. The work undertaken so far has confirmed the available supply of industrial heat, secured support from the supplier of this heat and secured backing from a number of potential large commercial users.

Although these networks are still in feasibility and planning stages, the ongoing **residential-led regeneration of Anytown town centre**, backed by Levelling Up funding and large-scale redevelopment proposals means future heat-network zoning and connection of new or redeveloped buildings, including potentially Anytown, may become technically and economically viable in the future.

Given the Leisure Centre's substantial and consistent thermal demand, particularly from its swimming pool, it is a leading candidate for connection to any future heat network serving the regenerated town centre. In the short to medium term, it is recognised that the leisure centre should decarbonise by other means when heat networks are in development.

The current proposals for the decarbonisation of Anytown retain the existing heating distribution, but the Council should monitor plans with the development of heat networks in the area, and the potential supply flow temperatures. If there are solid plans with agreed details, it could substantially change the best approach for the decarbonisation at the leisure centre.

3.1.4 Traditional Air Source Heat Pumps

Traditionally, Air Source Heat Pumps are most efficient when producing lower flow temperatures, such as 45°C or even 35°C LPHW. However, traditional heating distribution was not designed to operate and heat buildings at these temperatures and were traditionally at 75°C. This means that to utilise lower temperatures and higher efficiency's, heating pipework and emitters such as radiators often will need to be replaced.

In buildings as large and complex as Anytown, the cost to remove and install new pipework and emitters, retrofit AHUs, civil works, etc. can be significant, likely 7 figures. Due to this, and the significant disruption these works would cause, it has been discounted at this stage.

It is highly recommended that the Council reconsider if and when they have to replace heating distribution and emitters as part of maintenance works, as this offers the opportunity to install heat pumps that operate at the lower temperatures.

Alternatively, if the Council have progressed with the proposals to install high temperature ASHPs, they can also operate at the lower flow temperatures to offer better efficiencies than at high temperatures, albeit not as high as dedicated low temperature ASHPs.

3.1.5 Building Fabric

As detailed in Section 2.2, the building has had significant refurbishment works to its building fabric in 2011. During 2011 the existing building regulations were to a decent standard, and it has been assumed that the works on the building were compliant with these regulations.

The images below give further evidence to this conclusion, as spray foam insulation can be seen to have been used to fill in the existing cavity in the wall construction of the Ice Rink.

Figure 51: Ice Rink Wall Construction



Due to this, it is assumed the rest of the building's fabric is to a similar standard and improving the fabric further would require significant capital investment for little energy savings. For these reasons improving the building's fabric has been discounted at this stage.

3.2 Proposed Building Loads

At this stage, the Salix Heating Load V2 calculation tool has been employed instead of conducting in-depth thermal modelling to estimate the required space heating heat demand within the buildings. This calculation relies on assumptions regarding the U-values of building fabric elements, as outlined in section 2.2, along with estimates of their associated surface areas. The table below indicates the current installed heating capacity, alongside the calculated peak heat loss (kW). The total useful floor area of all the buildings, as per the measured floor plans is 13,800m².

Given there are three main separate plant rooms across the site that contribute to the building's heating, and some with vastly different set point temperatures, we have separated the different areas of the building in the calculations.

Staff explicitly stated that the VT heating circuit in the Ice Rink heating plant to supply the under seat pipework in the stands of the ice rink has never been used. We have made the decision to exclude the Ice rink, ice rink spectator space and changing room spaces in the ice rink from this calculation given they will not be heated in practice and to do so would raise the load on the cooling.

It is not recommended to heat any area of the ice rink, given the space is constantly cooled. However, if staff are uncomfortable and small spaces do require heating, it is recommended small electric heaters be used under desks as heating the entire space is counterintuitive.

Also excluded from these calculations are the gyms and their changing rooms. This is because they were recently refurbished and are now heated and cooled via the 9no. Mitsubishi air conditioning units, with indoor cassettes and their corresponding outdoor units.

The measured floor areas of the areas were as follows:

- Dry side (excluding Gym): 4,425m²
- Theatre: 3,525m²
- Pool + Pool Changing: 2,225m²

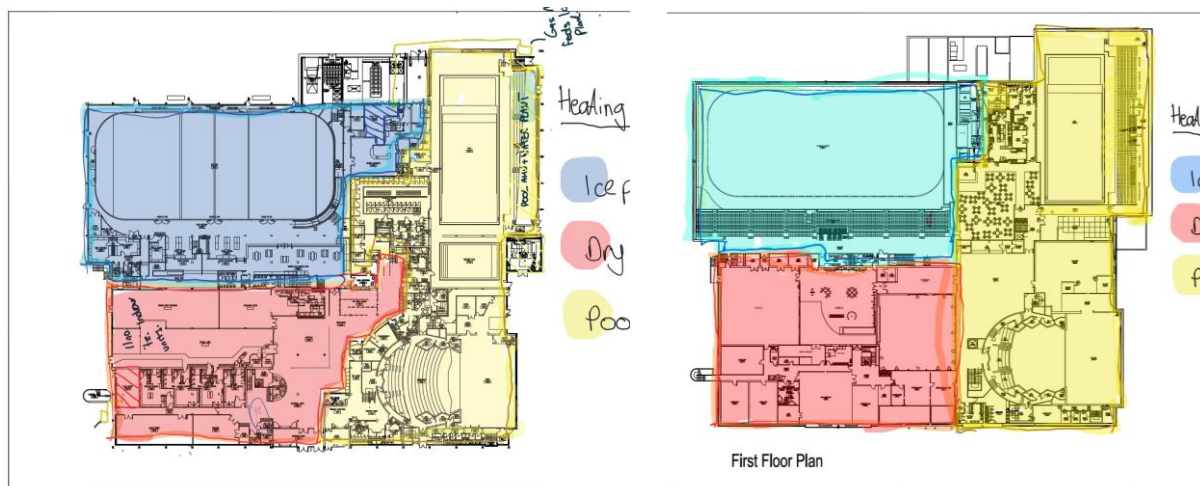


Table 13: Peak Heat Loss Summary for Dry side Plant

Existing Heat Capacity (Boilers) (kW)	Existing W/m2	Calculated Existing Peak Heat Loss (kW)	Proposed New Heating W/m2
410	97	275	65

The theatre and pool are both supplied from the same heating plant and capacity.

Table 14: Peak Heat Loss Summary for Pool, Theatre and Changing

Existing Heat Capacity (Boilers) (kW)	Existing W/m2	Calculated Existing Pool Peak Heat Loss (kW)	Calculated Existing Theatre Peak Heat Loss (kW)	Proposed New Heating W/m2
1,899	327	365	326	105

It is important to note that the pool and theatre plant also provides a significant load to DHW and pool water heating. The peak heat loss will be used to size proposed equipment, but the context and other significant loads of the plant rooms will be strongly considered as well.

Oversizing heat-generating equipment is a common issue in engineering design, leading to excessive system cycling — frequent equipment start and stop — which lowers system efficiencies. Therefore, detailed thermal modelling is highly recommended during the detailed design stage, considering factors such as the building envelope, indoor comfort setpoints, occupancy patterns, and local climate conditions. This would confirm the building's design heat loads and guide in determining the optimal size and configuration for the heating system, ensuring optimal performance, energy efficiency and occupant comfort.

3.2.1 Pool Heat Loss

The pool water heating is served via the main pool and theatre heating plant via 2no. plate heat exchangers (PHEs). Using the combined measurements of the pools and industry benchmarks the load required to heat the entire volume of water from 10 degrees to 29 degrees over a 48 hour period was calculated.

This is to ensure that the proposed equipment is sized appropriately to ensure it is capable of heating entire volume of the pool's water from cold to the desired temperature. This came to a figure of 391 kW as the peak load.

As well as this, we have calculated the operating load of the pool during periods when it is open and when it is closed with the pool covers on. This allows a better understanding of both the realistic constant load that the proposed equipment will have to provide on a consistent basis and allows for a good understanding of the energy consumed over the year due to pool heating.

The pool's operational loads, and corresponding heat load over the year were as follows. (This is based on the pool's timetable, which showed that it is open on average 12.5 hours a day over the year, and closed 11.5 hours.)

Table 15: Pool Heating Loads

Operational Loss – Pool not covered (kW)	Annual Heat Load – Pool not covered (kWh)	Operational Loss – Pool covered (kW)	Annual Heat Load – Pool not covered (kWh)
73	331,992	22	91,610

3.3 CHP

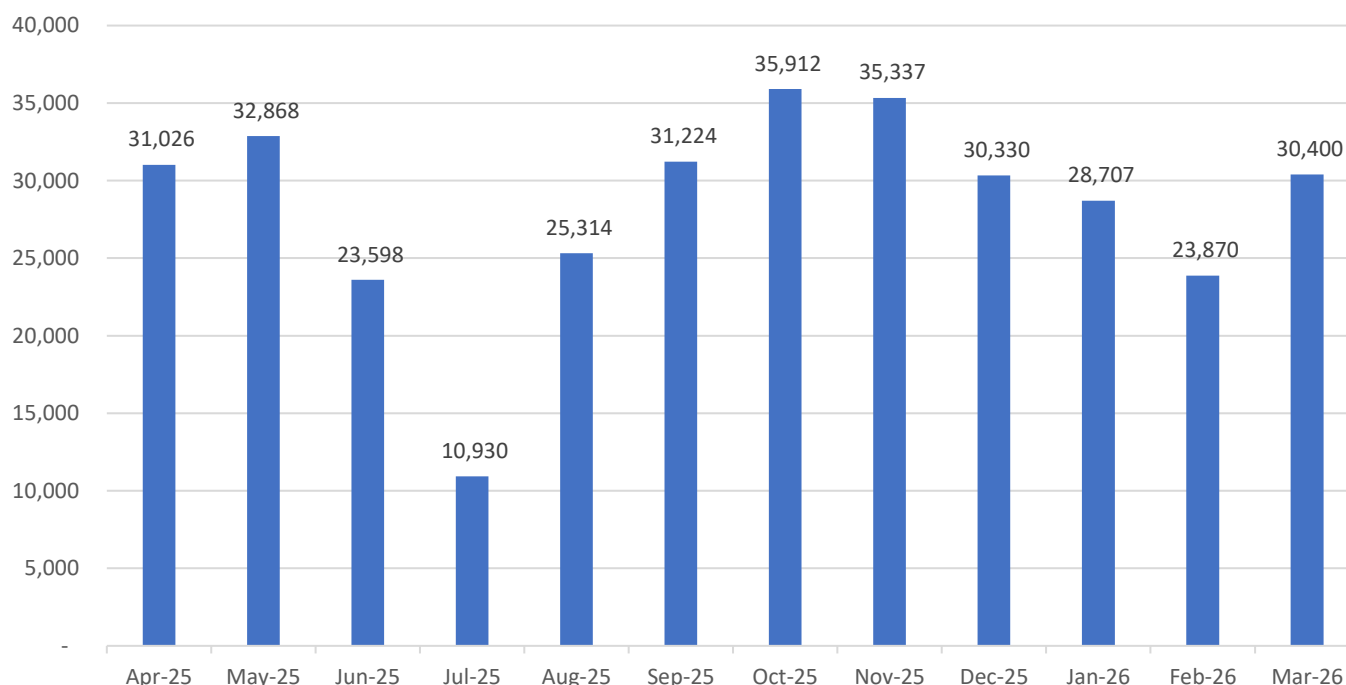
In the Pool and Theatre Plant room was a Combined Heat and Power (CHP) unit. Conversations with staff revealed that the unit is run frequently to provide the heating load for the pool and theatre, as well as generating electricity for the leisure centre.

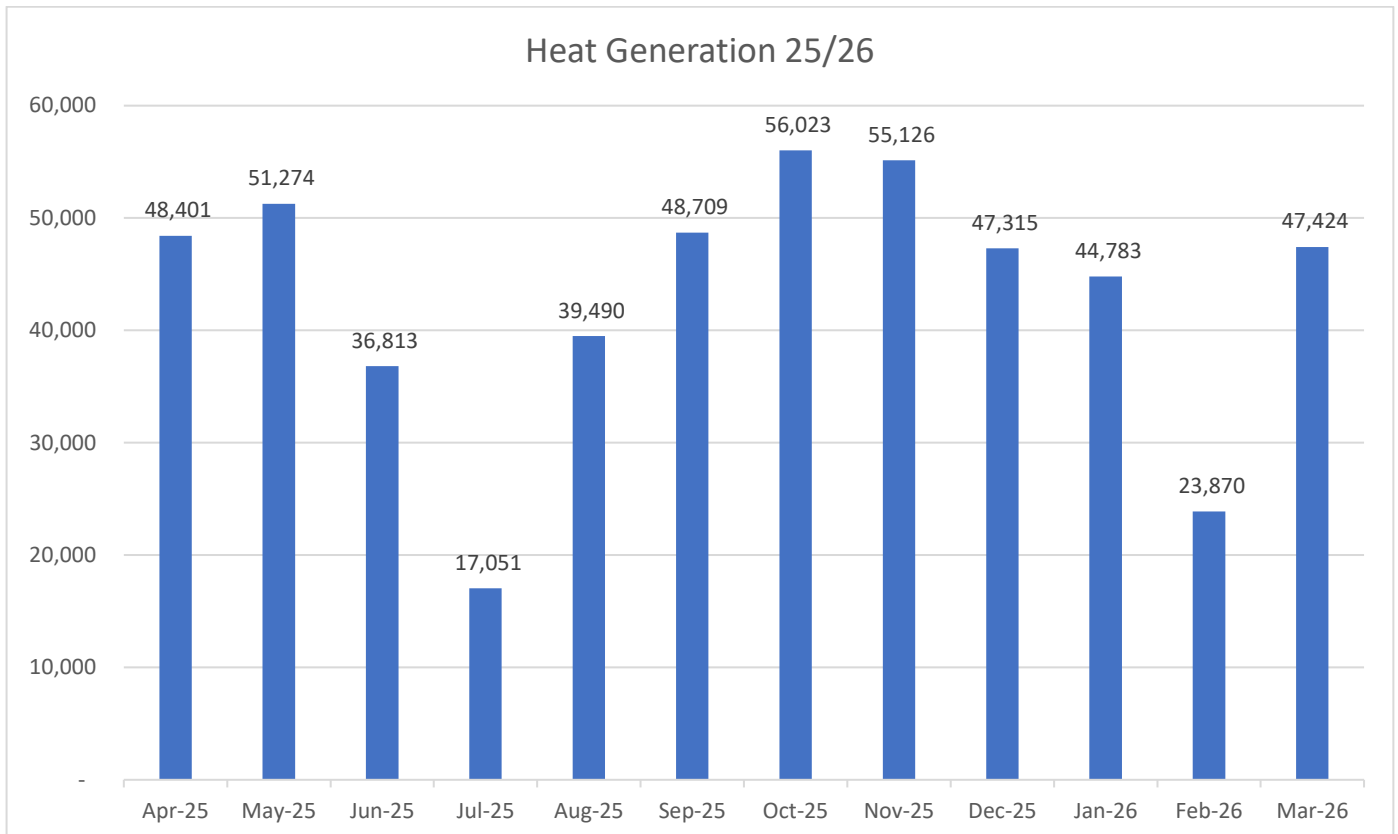
It was not confirmed if the unit was heat or electrically led but given the rate of gas consumption drops off in the summer months, it is assumed to be heat led. The table below showcases the CHPs performance over the last 12 months.

Table 16: CHP Performance

	Hours Run	Elec Gen	Gas Con	Heat Gen	Heat meter kWh	Max Hrs Avail	
Apr-25	447.5	31,026	100,084	48,401	1,550	510	87.7%
May-25	474	32,868	106,026	51,274	1,640	527	89.9%
Jun-25	347	23,598	76,123	36,813	1,230	587	59.1%
Jul-25	432	10,930	35,258	17,051	870	527	82.0%
Aug-25	443.2	25,314	81,658	39,490	1,380	527	84.1%
Sep-25	489.5	31,224	100,723	48,709		510	96.0%
Oct-25	517.7	35,912	115,845	56,023	1,930	527	98.2%
Nov-25	510.3	35,337	113,990	55,126	1,910	510	100.1%
Dec-25	441.7	30,330	97,839	47,315	1,620	527	83.8%
Jan-26	415.9	28,707	92,603	44,783	1,500	527	78.9%
Feb-26	346.5	23,870	77,000	23,870	1,280	476	72.8%
Mar-26	439	30,400	98,065	47,424	1,610	527	83.3%
Totals	5,304	339,516	1,095,214	516,279	16,520	6,282	

CHP Electricity Generation 25/26



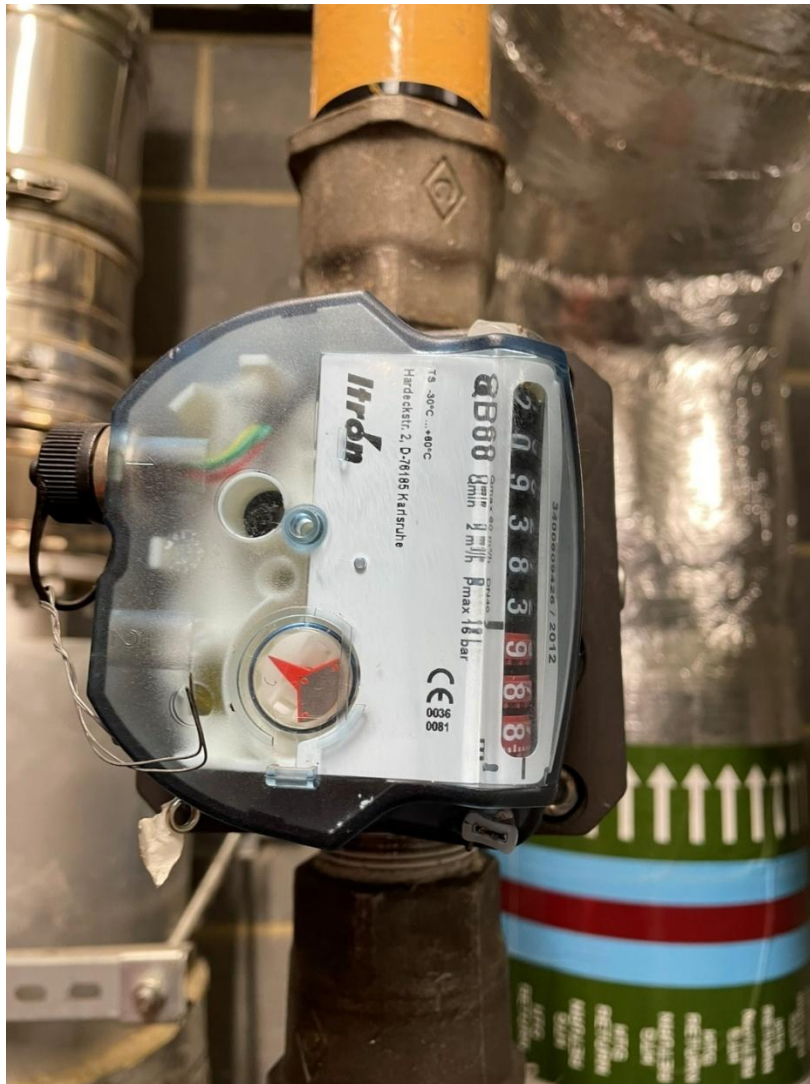


The data for the heat generated in the CHP and the heat passing through the heat meter is inconsistent. Over 25/26, the CHP data shows that there was 499,759 kWh more heat generated by the CHP than passed through the heat meter over the same period. The current figures suggest the CHP is dumping a significant load of heat, though no heat dump was seen on the site survey. Further conversations with staff confirmed there is no heat dumping.

It is recommended that the Council investigate this issue, it is possible that the heat meter needs recalibrating. If the Council would like, we could perform a detailed CHP analysis to determine if the unit was currently being operated in the most optimum way. This would involve detailed analysis to confirm if the CHP is financially viable, as well as impact on the carbon footprint at the site.

APSE Energy has completed several detailed CHP analysis in the past that have been used as a business case to either retain, or dispose of, CHP. They are modelled over the long term to gauge a better understanding of carbon and financial impacts of running the unit. The efficiency of the CHP unit at Anytown was calculated to be 47.1% so it is not always a simple case that running the CHP is for the best.

Figure 52: CHP Gas Sub-meter



3.4 Plant Replacement

Given the size of the building and the vast array of different mechanical service equipment across the building. The proposed decarbonisation measures have been separated, based on the different plant rooms and services.

3.4.1 Ice Rink Plant

The Ice Plant at the leisure centre provides:

- Chilled Glycol Refrigerant to cool the underside of the ice rink.
- Dehumidification via gas fired equipment.
- LPHW to 2no. Heating circuits. (Including AHU supplies)
- LPHW to a DHW cylinder.
- Split units serving air conditioning units.
- Rooftop Chiller and AHU (Will be addressed in the Pool and Theatre Plant replacement)

The Climaveneta FOCS/D/SL-BT/S 4202 chiller is a specialist item and is already decarbonised. It is recommended to retain and replace as and when it is needed.

It was noted that there was substantial frost build up, both on the distribution pumps and the pipework. The images below show where excessive frost was seen. Given the excessive frost build up, it is hard to tell, but it appeared that the pipework lacked insulation. It is recommended that the Council investigate this and install insulation to the pipework if this is the case.

Figure 53: Frost build up on the Refrigerant Pipework



The dehumidification plant located externally of the Ice plant room is a Munters MCD140E and was manufactured in 2010. The display controller indicated that the volume of air it was treating was at 9°C and 57% humidity, with the humidification set point at 60%. It is a desiccant dehumidifier and is designed to cope with the lower temperature air that the condensation system in the AHU is not as well versed to deal with. They use a desiccant rotor coated in an absorption material to absorb moisture from the air. The desiccant wheel must be 'refreshed' to ensure continued operation, so the wheel has a separate heated stream of air passed through a separate section of the wheel to drive off and remove the absorbed moisture, this air is then exhausted to the outside.

Due to the lack of submeter data, the space heating load has been estimated after establishing the summer baseline load, which would exclude the space heating. The rest of the end use gas consumption has been estimated based on typical guidance from CIBSE. However, it should be noted that there is a lack of substantiated data for the breakdown of gas consumption at Ice Rinks given it's a specialised building.

It is recommended that if the Council would like to have greater confidence in the breakdown of the Ice Rink's gas consumption, and therefore the resultant energy savings, that they install a sub meter at either the boiler or dehumidifier connection.

The below table indicates the expected gas consumption end use split.

Table 17: Expected Ice Rink Gas Consumption End Use Split

Ice Plant Annual Gas Consumption (kWh)	
Space Heating (Offices)	94,889
DHW	31,783
AHU Dehumidification	159,375
Exterior Plant Dehumidification	311,473
Commercial Kitchen	38,140
Total Boiler load:	286,047
Total Exterior Dehumidification Load:	311,473

To fully transition from fossil fuel plant and to align with the Council's goal of achieving their 2032 net-zero carbon emission targets, the currently installed dehumidification plant would need to be decommissioned, disconnected and removed from the site. While still in place, we propose:

- Installing a High Temperature Air Source Heat Pump (HT-ASHP) system to produce Low-Pressure Hot Water (LPHW) to meet space heating, DHW and AHU dehumidification requirements on the existing CT circuit in use today.
- It would provide LPHW to the existing AHUs and LPHW to the existing DHW Cylinder.
- The Council should continue to not use the VT heating circuit that would provide LPHW to the under seat pipework in the ice rink spectator area.
- Installing a new dehumidifier that is electrically powered. Can allow for the option to provide recoverable heat for use to provide LPHW to the existing heating distribution.
- Retain one of the gas boilers to provide resilience and back up to ensure continued operation all year.

While ice rinks have historically relied on gas-regenerated desiccant dehumidifiers to achieve stable low-dew-point conditions, modern refrigeration-based (electric) dehumidification systems purpose-designed for ice arenas can meet humidity requirements in many facilities. Their suitability depends on dew-point requirements, building airtightness and control strategy. Where appropriate, such systems offer significant decarbonisation potential, particularly when their recovered heat can be utilised elsewhere.

It has been assumed that the gas dehumidifier will be replaced by a modern electrical equivalent. This is a specialist item, and it is recommended that the Council consult with respected Ice Rink electrical dehumidifier manufacturers such as Condaire, Industrial Frigo and others etc. to understand the options available to them. At this stage, it has been assumed that the efficiency of the new system is around 300%, a typical value consistent with ice rink

dehumidification process. A fee of **£250,000** has been assigned to this work, but specialists will be able to provide a more detailed breakdown of the potential costs of such an installation.

If electrical dehumidification is a viable option at the site, then it is recommended that the Council strongly consider maximising the heat recovery with the unit. Modern electrical dehumidifiers produce 'waste heat water' at around 40-50°C, so cannot be used directly to provide heating and DHW with the current heating distribution in the Leisure Centre.

Air leakage is a significant driver for the load of the dehumidification. Whilst extremely difficult to give a quantitative value to this, it is highly recommended that the Council investigate the fabric around the Ice rink and install draught strips, and work to limit openings to reduce this air leakage and therefore energy consumption.

Replacing the Ice Rink Chiller that works with Glycol refrigerant system to supply super chilled water to the ice rink with a 4-pipe chiller was strongly considered. This would have been in view to utilise recovered heat to contribute to the building's heating. However, because of the following reasons it was not progressed:

- The output temperature of water was too low to enable operation with the existing heating infrastructure and would require 'step up' equipment.
- The significant cooling capacity of the Ice Rink (852kW) meant that the equivalent heating capacity was too large when compared to the available consistent heating loads in the building.
- Due to the low flow temperatures, a water source heat pump would be required, and the combined efficiency of the system (approximately 202%) was not large enough to justify the significant capital investment that would be required.
- Furthermore, not all the heating demands require high temperature (80°C) water all year round, meaning separate smaller systems with lower design complexities can utilise lower flow temperatures and higher efficiencies are preferable solutions.

When the Ice Rink chiller does require replacement, the Council should consider if any of the above restrictions have changed, for example at the time of replacement, is there a more viable heating load/demand or perhaps sections of the heating infrastructure now can operate at lower temperatures.

The high temperature ASHP will be installed to provide the plant room with LPHW. New auxiliary equipment, such as buffer vessels, will need to be installed to allow connection to the existing heating distribution. For optimal performance, ASHP's require unrestricted airflow around the unit. Consequently, the current enclosed plant room is not ideal for ASHP installation. Therefore, we recommend installing the ASHP system externally on a level surface on the roof above the plant room. This is subject to a structural survey approving the new load on the roof structure.

If this is not possible, the ASHP could be installed in the existing external compound, in the fenced off section used for storage next to the pool. If this isn't possible the compound would have to be extended. The cost for this work has not been accounted for in the cost breakdown.

The location shown below are presumed to offer good airflow, essential for the optimal performance of the ASHP unit. The final location of the proposed installation will be determined during the detailed design stage, considering existing infrastructure, such as mains water supply and incoming electrical supply spatial requirements of the installation and optimisation of associated costs of distribution pipework to the plant rooms.

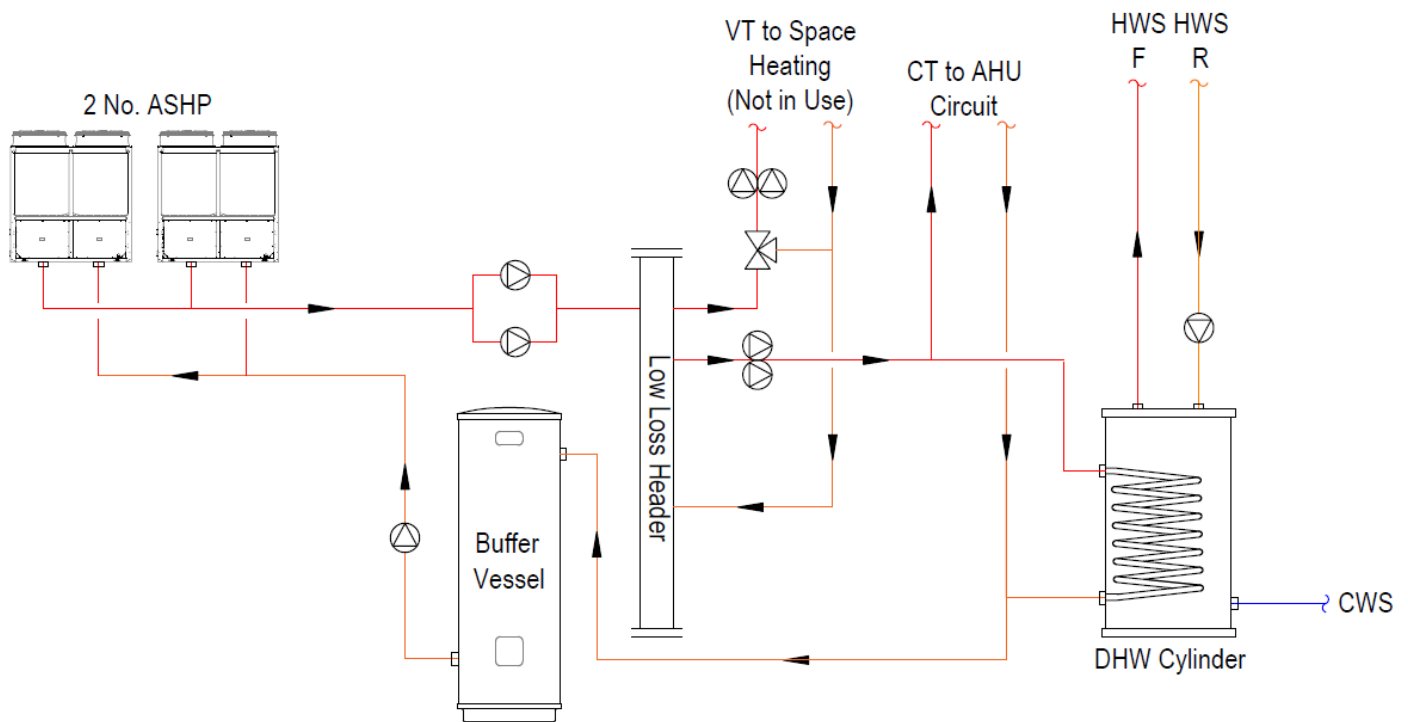
Figure 54: Ice ASHP proposed equipment location



Given the calculated gas usage of the boilers, they appear to be significantly oversized. This is likely due to the original design intention to provide heating in the Ice Rink and installing n+1 to ensure back up reliance. It is important to note that there is no sub-meter data to clarify this, but the estimated annual consumption of the boilers amounts to approximately 286,047 kWh over the year. Over the operational hours of the centre and the areas the boilers serve (estimated at 5,600 based on the Ice Rink opening hours) this accounts to an average thermal output of 50 kW. Significantly under the 800kW installed capacity.

This is importantly not the peak load, which is what the boilers were likely sized too, however it does indicate that they are significantly oversized as the dehumidification (the largest load over the year) is a consistent and steady load. It is recommended for the Council to install a heat or submeter to measure the half-hourly consumption over a year to understand the peak load requirements. This will allow them to understand what sized equipment is required to meet the building's heating, DHW and dehumidification demands. For the purposes of this report, the equipment has been sized on double the average thermal output to account for peak surges and diversity. A calculation of the peak heat loss was not appropriate given the boiler is primarily used for dehumidification and DHW.

Figure 55: Proposed Ice Plant Schematic



Proposed Ice Rink Plant

3.4.1.1 Budget Cost Estimate

The costs associated with the proposals for the Ice plant are **£262,800** and are broken down as follows:

Table 18: Ice Plant HT-ASHP Cost

Item	Description	Costs
1	Preliminaries	£4,000
2	HT-ASHP & Plant Room	
2a	Air Source Heat Pump	£79,600
2b	ASHP Buffer Vessel(s)	£2,200
2c	Pressurisation Unit(s) & Expansion Vessel(s)	£2,000
2d	Plant Room Pipework, Valves, & Ancillaries	£10,900
2e	Automatic Controls Upgrade	£30,000
2f	Electrical Works	£8,200

2g	Interconnecting Pipework (ASHP to Plant Room)	£3,400
2h	Glycol Antifreeze	£1,300
2i	Builders Work	£6,600
3	Upgrading Main Incoming Electrical Supply	£50,000
4a	Testing & Commissioning	£1,500
4b	Demonstration & Training	£1,000
4c	Record Information	£500
5	Contingency Sum	£30,200
6	Works Budget Total	£231,400
7a	Design Fees	£20,900
7b	Project Management Fees	£10,500
8	Project Budget Total	£262,800

The costs outlined above are exclusive of VAT and are based on the assumption that a mechanical contractor will be appointed as the Principal Contractor, with specialist work elements being subcontracted. These costs do not account for overhead, profit associated with further contracting or framework fees.

3.4.2 Dry side Plant

The dry side plant houses equipment that provides:

- LPHW to a VT heating circuit serving radiators and fan convectors;
- LPHW to a CT heating circuit serving AHUs;
- LPHW to an underfloor heating circuit;
- LPHW to a DHW cylinder.

The building was surveyed in February 2026 when the ambient air temperature was quite low (6°C). Despite this, the existing heating circuits in the dry side plant room ranged from 57°C (CT Serving AHUs), 22°C (VT Rads) to 37°C (underfloor heating circuit). It suggests that the heating circuits are likely to be able to support slightly reduced flow temperatures than traditional 70°C flows. However, it is important to note that the heating circuits would likely require higher flow temperatures in colder months.

With this in mind, it is proposed that a high temperature ASHP be installed to provide the plant room with LPHW. It is proposed that for the majority of the year that 65°C Low Pressure Hot Water (LPHW) is supplied to the plant room,

as the evidence seen on the site survey suggests that would be adequate. In the colder months the ASHP has the capability of providing flow rates of up to 75°C if required, although this is not the design intention.

New auxiliary equipment, such as buffer vessels, will need to be installed to allow connection to the existing heating distribution. For optimal performance, ASHP's require unrestricted airflow around the unit. Consequently, the current enclosed plant room is not ideal for ASHP installation. Therefore, we recommend installing the ASHP system externally on a level surface and providing a secure perimeter for access control and protection against vandalism.

The locations shown below (blue rectangles) are presumed to offer good airflow, essential for the optimal performance of the ASHP unit. The final location of the proposed installation will be determined during the detailed design stage, considering existing infrastructure, such as mains water supply and incoming electrical supply spatial requirements of the installation and optimisation of associated costs of distribution pipework to the plant rooms.

If the structure of the roof above the plant room should be surveyed to determine if it is appropriate to house the ASHP and the buffer vessel. If it is deemed to not be a viable solution, the car park should be used to construct an external compound. The cost of the structural survey and the external compound has not been included.

Figure 56: Proposed Locations of Dry Side ASHP Compound (Blue Rectangle)

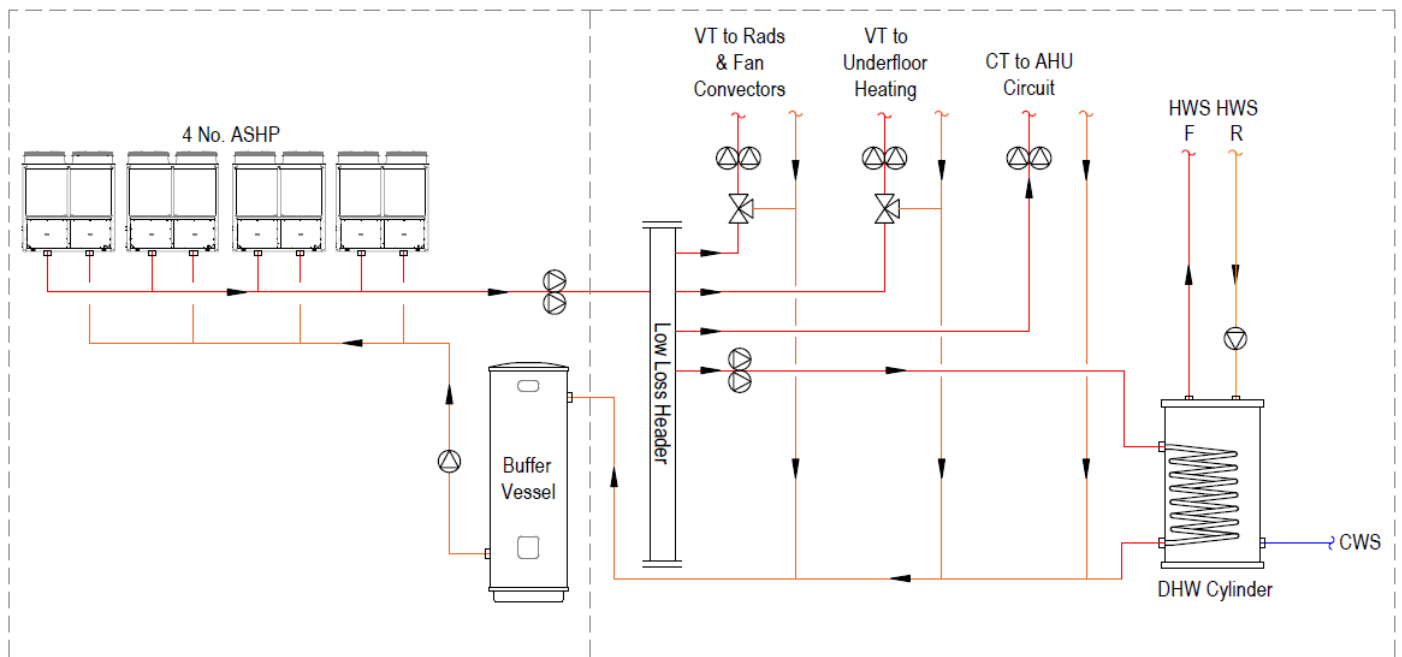


Table 19: Proposed Dry Side Space Heating Equipment

Building	Air Source Heat Pump	Total Proposed Capacity (kW) (@ -5°C Ambient)	SCOP at 65°C (-5°C Ambient)	Flow temperature (°C)	Heat Emitter Replacement
Dry Side Plant	LAHP-260HTR290	355	2.76	55-75	No*

*Currently, the ASHP has been costed to reflect that the existing heating pipework and heat emitters in the wet heating circuits are retained and can heat the space at a flow temperature of 65°C. In the winter months, the ASHP is capable of providing higher temperatures. For the majority of the year, 65°C should suffice, but if not the high temperature ASHP can provide temperatures up to 75°C.

Figure 57: Dry side Proposed Schematics



3.4.2.1 Budget Cost Estimate

The costs associated with the proposals for the dry side plant is **£600,000** and is broken down as follows:

Table 20: Dry Plant HT-ASHP Cost

Item	Description	Costs
1	Preliminaries	£9,100

2	ASHP and Equipment	
2a	Air Source Heat Pump(s)	£205,000
2b	ASHP Buffer Vessel(s)	£3,900
2c	Pressurisation Unit(s) & Expansion Vessel(s)	£2,000
2d	Plant Room Pipework, Valves, & Ancillaries	£35,600
2e	Automatic Controls	£50,000
2f	Electrical Works	£26,700
2g	Interconnecting Pipework (ASHP to Plant Room)	£3,400
2h	Glycol Antifreeze	£4,100
2i	Builders' Work (Including removal of existing equipment)	£16,800
3	Upgrading Main Incoming Electrical Supply	£100,000
4a	Testing & Commissioning	£1,500
4b	Demonstration & Training	£1,000
4c	Record Information	£500
6	Contingency Sum	£69,000
7	Works Budget Total	£528,600
8a	Design Fees	£47,600
8b	Project Management Fees	£23,800
9	Project Budget Total	£600,000

The costs outlined above are exclusive of VAT and are based on the assumption that a mechanical contractor will be appointed as the Principal Contractor, with specialist work elements being subcontracted. These costs do not account for overhead; profit associated with further contracting or framework fees.

This is with the assumption that the equipment such as the ASHPs and buffer vessels can be housed on the building's roof above the Theatre Plant Room. No costs for structural surveys have been included. If installation on the building's roof is not possible, then an external compound would need to be constructed in the car park.

In addition, the costs associated with this work are based upon the existing DHW cylinders, pipework, LPHW pipework and secondary pumps being retained. Costs have been attributed to construct new connections to the existing circuits to buffer vessels, etc.

3.4.3 Theatre and Pool Plant

When undertaking considerations for the decarbonisation of Anytown, it was important to understand how the building was used throughout the year to ensure all opportunities to save energy were identified. The leisure centre has consistent cooling loads (the ice rink) and heating loads (the heating of the pool water and supply to the pool AHU) throughout the year.

The heating of the pool water is a constant load, and the air supplied by the pool AHU needs to be heated to 31°C (Based on being 2°C warmer than the main pool water temperature of 29°C). This means that even in milder to warm external temperatures the pool air will still likely need to be heated.

The main pool is open Monday to Sunday 06:30 – 20:30

The Ice Rink is open:

Monday 09:00 – 20:15

Tuesday 09:00 – 21:00

Wednesday 09:00 – 18:00

Thursday 09:00 – 20:45

Friday 11:00 – 20:30

Saturday 10:00 – 15:30

Sunday 10:00 – 15:30

This does not include the out of hours use for the Ice Hockey training and matches that often run to midnight.

This consistent heating and cooling load throughout the year provides an excellent opportunity to install a 4-pipe chiller. 4-pipe chillers can provide both chilled and heated water, and when required to produce both simultaneously, can do so at extreme high efficiencies. (+700%)

Given the split between the consistent and inconsistent heating loads, it is proposed that two systems are installed as part of the plant replacement in the pool and theatre plant rooms.

- System A: 4-pipe chiller and Water Source Heat Pumps;
- System B: High Temperature ASHPs.

System A

To make use of the consistent cooling and heating loads, it is proposed that a new 4-pipe chiller be installed. As part of this work, the existing Climaveneta NECS/R/LN 1204 chiller serving the Ice Rink AHU should be retained to be used as back up resilience to new 4-pipe chiller. It is proposed a new 4-pipe chiller be installed that would:

- Provide chilled water at 7°C to the Ice Rink Air Handling Unit;
- Provide Low Pressure Hot Water (LPHW) at 50°C to new Water Source Heat Pumps (WSHP).

The WSHPs would then raise the temperature of the water from 50°C to approximately 70°C to supply to consistent heat loads through the year in the theatre and pool plant. This would ensure the heating and cooling are met at the high efficiencies that can be achieved with simultaneous heating and cooling.

Replacement of the ice rink chiller with a 4-pipe chiller was considered but was ultimately discounted. This is because the ice slab refrigeration system operates at much lower evaporating temperatures and substantially higher cooling duties than could be efficiently matched to the available heating loads. Heat recovery was impractical when

compared with recovery from the ice rink AHU cooling load. The heat loads proposed to be provided by the 4-pipe chiller and WSHPs are:

- Supply to the Pool Plate Heat Exchangers to ensure pool water temperature is maintained;
- Supply to the Pool AHU;
- Supply to the DHW cylinders.

Contributing factors for this proposal are as follows:

- The pool AHU has a large supply air volume flow rate and a lack of plant room space. This means that it would be extremely unlikely that retrofit is possible due to the space constraints and significant capital costs;
- The pool AHU and plate heat exchangers (PHEs) are on the same circuit. Providing the pool PHEs with lower temperatures would require significant alterations to distribution pipework;
- The pool plate heat exchangers would need to be replaced if a lower water temperature was provided. It is not clear that there is enough space in the existing plant room.

By utilising the 4-Pipe chiller to preheat the water entering the WSHPs, the efficiency of the combined system is 317%. That is slightly higher than the efficiency of the HT-ASHPs used in System B which is 276% (detail below). This is due to the high efficiency of the 4-pipe chiller (790%) when operating in simultaneous heating and cooling modes.

For optimal performance, 4-Pipe Chillers require unrestricted airflow around the unit. Consequently, the current enclosed plant room is not ideal for the installation. Therefore, we recommend installing the 4-Pipe Chiller and WSHPs externally on the building's roof where the current chiller for the Ice Rink AHU is located.

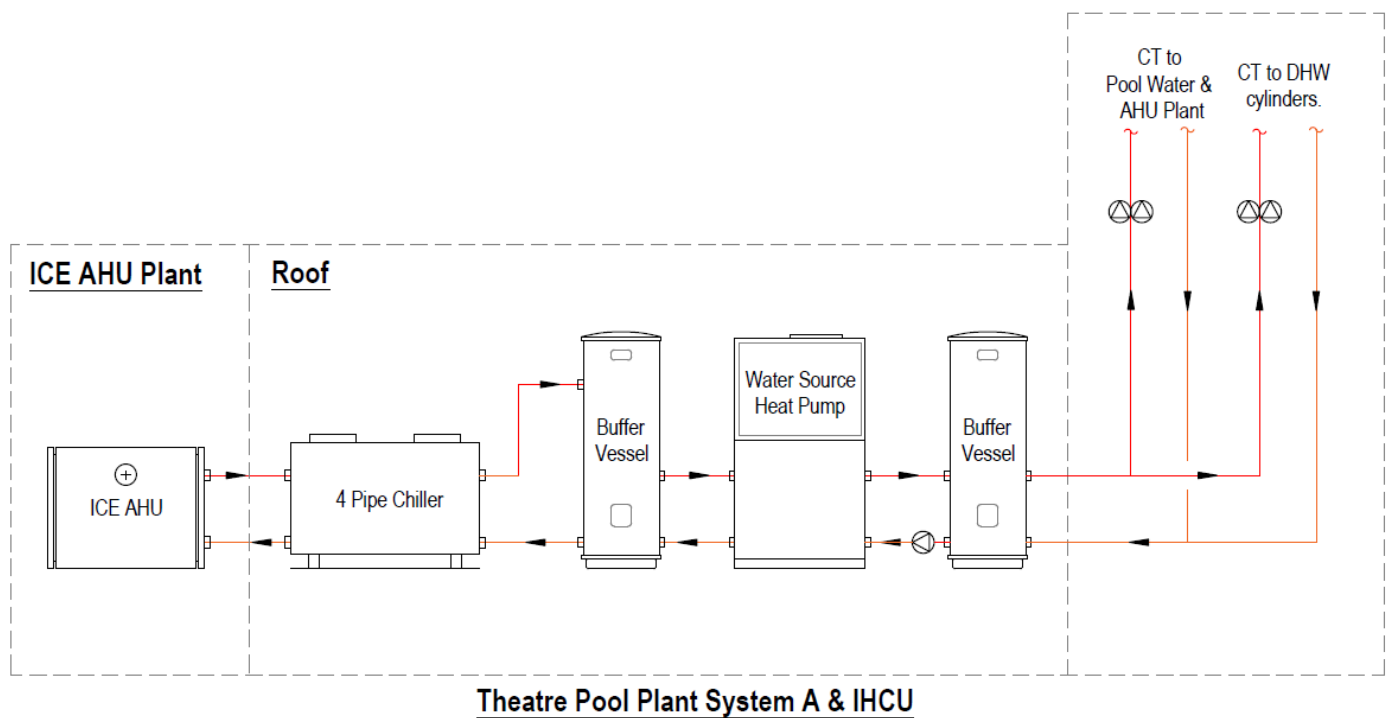
The locations are presumed to offer good airflow, essential for the optimal performance of the ASHP unit. The final location of the proposed installation will be determined during the detailed design stage, considering existing infrastructure, such as mains water supply and incoming electrical supply spatial requirements of the installation and optimisation of associated costs of distribution pipework to the plant rooms.

Given the heavy duty of the proposed equipment, a detailed structural survey will be required to access the existing roofs suitability to house more equipment. If it is not suitable an external compound would need to be constructed. The costs associated with this have not been included in the cost breakdown.

Figure 58: 4-Pipe Chiller Proposed Location with pipework to Theatre Plant Room



Figure 59: System A Proposed Schematic



System B

System B focuses on the existing heating circuits that **do not** have consistent heating loads throughout the year and follow typical heating season patterns. These are the following:

- VT heating circuit serving Theatre radiators and fan convectors;
- VT heating circuit serving general circulation;
- CT heating circuit serving 4no. AHUs in the plant room.

All these circuits will not be consistent loads throughout the year, meaning they are less suitable for their heat source to be the 4-pipe chiller.

Instead, it is proposed that an HT-ASHP provide the LPHW to supply the circuits. The ASHP would be capable of providing 55°C - 70°C, so it is highly recommended that the Council investigate the minimum flow temperature the existing heat emitters can be supplied and still meet the building's heating requirements.

It is likely that during milder months, that a water flow temperature of 55°C could suffice. This would allow the Council to run the ASHPs at lower temperatures at greater efficiencies for much of the year, only using the higher flow rates during the winter months.

This option avoids the highly disruptive and costly task of replacing the existing heating distribution pipework and emitters. Also, due to the higher volume flow rates in the AHUs, retrofitting them with new heating coils was not a realistic option. There was also the issue of a structure containing asbestos was limiting the potential works in the plant room.

Like 4-pipe chillers, for optimal performance ASHPs require unrestricted airflow around the unit. Consequently, the current enclosed plant room is not ideal for the installation. Therefore, we recommend installing the ASHP externally on the existing building's roof.

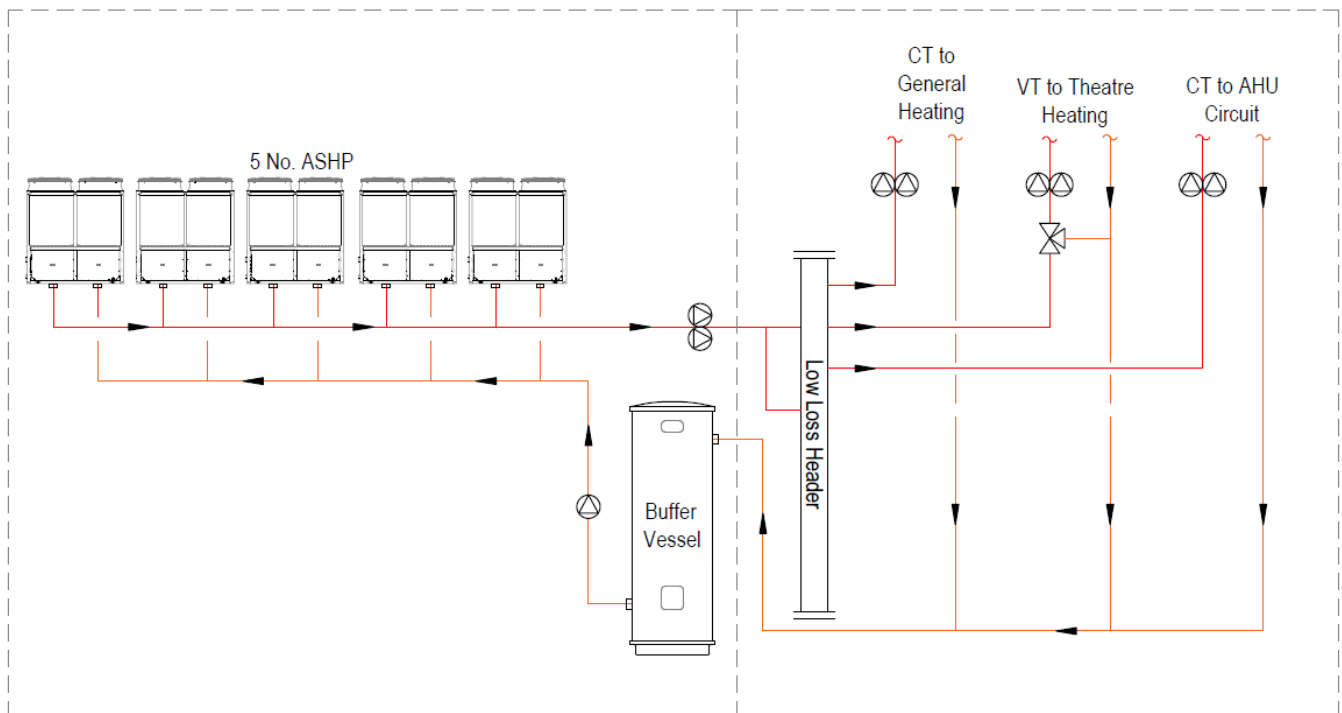
The locations are presumed to offer good airflow, essential for the optimal performance of the ASHP unit. The final location of the proposed installation will be determined during the detailed design stage, considering existing infrastructure, such as mains water supply and incoming electrical supply spatial requirements of the installation, and optimisation of associated costs of distribution pipework to the plant rooms.

Figure 60: Proposed Location of Equipment



In the case of system B, an option worth considering should the Council want to reduce costs, would be to retain one of the existing gas boilers and CHP to serve as the role of the HT-ASHP. It is important to note that this would not fully decarbonise the building, but if the proposed projects create an issue with the capital budgets, it is a viable solution to drastically reduce the building's carbon emissions while keeping costs, both capital and operational, down.

Figure 61: System B Proposed Schematic



Area of Building Serving	Equipment	Total Proposed Capacity (kW)	SCOP/TER	Flow temperature (°C)	Heat Emitter Replacement
System A					
Ice Rink AHU	Trane CMAF 100	341	7.92 (During Simultaneous Heating and Cooling)	7	No
Pool Heating, Pool Water & DHW	Trane CMAF 100	369	7.92 (During Simultaneous Heating and Cooling)	50	N/A
Pool Heating, Pool Water & DHW	Trane RTSF 066 HT (WSHP)	534	4.63	70	No
System B					
Heating for Theatre Plant Room AHUs, Radiators and Fan Convectors	Lochinvar LAHP-325HTR290 (5 Units in series)	445	2.76	65	No

3.4.3.1 Budget Cost Breakdown

Systems A & B will provide the leisure centre with the following:

- Chilled Water to the Ice AHU.
- LPHW to the Pool AHU, Pool Water and DHW. (New connection to existing pipework from buffer vessel)
- LPHW to the Remaining AHUs and Secondary Heating circuits. (New connection to existing pipework via low loss header)

The cost to install both systems is estimated at **£1,914,825** and is broken down as follows:

Table 21: Pool and Theatre System A & B Cost Breakdown

Item	Description	Costs
1	Preliminaries	£28,800
2	4-Pipe Chiller and Equipment (System A)	
2a	4-Pipe Chiller	£168,500
2b	4-Pipe Buffer Vessel	£1,600
2c	Indirect Cylinder(s)	£3,200
2d	Water Source Heat Pump(s)	£420,000
2e	WSHP Buffer Vessel(s)	£3,900
2f	Existing Plant Room Pipework modifications	£88,995
2g	Pressurisation Unit(s) & Expansion Vessel(s)	£2,400
2h	Interconnecting Pipework (4-Pipe to Plant Room & 4-Pipe to AHU)	£11,200
2i	Plant Room Pipework, Valves, & Ancillaries	£36,900
	ASHP and Equipment (System B)	
3a	Air Source Heat Pump(s)	£256,300
3b	ASHP Buffer Vessel	£3,900
3c	Pressurisation Unit(s) & Expansion Vessel(s)	£3,300
3d	Plant Room Pipework, Valves, & Ancillaries	£44,500
3e	Interconnecting Pipework (ASHP to Plant Room)	£5,700
3f	Existing Plant Room Pipework modifications	£39,030
	General Requirements	
4a	Automatic Controls	£100,000
4b	Electrical Works	£61,100
4c	Builders' Work	£85,000
5	Upgrading Main Incoming Electrical Supply	£100,000

6a	Testing & Commissioning	£1,000
6b	Demonstration & Training	£1,000
6c	Record Information	£500
7	Contingency Sum	£220,100
8	Works Budget Total	£1,686,925
9a	Design Fees	£151,900
9b	Project Management Fees	£76,000
10	Project Budget Total	£1,914,825

The costs outlined above are exclusive of VAT and are based on the assumption that a mechanical contractor will be appointed as the Principal Contractor, with specialist work elements being subcontracted. These costs do not account for overhead; profit associated with further contracting or framework fees.

This is with the assumption that the equipment such as the 4-Pipe Chiller, ASHPs and buffer vessels can be housed on the building's roof above the theatre plant room. No costs for structural surveys have been included. If installation on the building's roof is not possible, then an external compound would need to be constructed outside the pool/theatre plant room. The costs for this work has not been included.

In addition, the costs associated with this work is based upon the existing DHW cylinders, pipework, LPHW pipework and secondary pumps being retained. Costs have been attributed to construct new connections to the existing circuits to buffer vessels, etc.

3.4.4 Air Handling Units

Across the building there are a number of Air Handling Units (AHUs). The below table summarises the existing AHUs across the site.

Table 22: AHU Information Across the Site

AHUs (retrofit capability)	Volume flow rate (m ³ /s)	Heating Coil Size (kW)	Heat Recovery	Retrofit Potential Status
Theatre Plant AHUs				
Function	6.5	176	Yes	No
Pool Changing	3.9	130	Yes	No
Hospitality	3.5	116	Yes	No
Theatre	Unknown	173	No	No

Pool Plant AHUs				
Main & Learner Pool	9	Unknown	Yes	No
Ice Plant				
Ice Rink	12.5	N/A	No	No
Office	2.7	Unknown	Yes	Yes
Dry side Plant				
Changing Rooms	1.66	73	Yes	Yes
Bowls	1.4	68	Yes	Yes
Squash Courts	0.4	17	No	Yes
Academy Room	0.35	15	Yes	No (in ceiling Void)
Offices	0.31	10	Yes	No (in ceiling Void)

Installing lower flow temperature heating equipment to serve these AHUs was considered, as it would enable greater efficiencies. Regrettably, this was not a practical option as many of the AHUs across the site would require retrofit, which was not possible for a large portion due to space constraints.

The AHUs with large volume flow rates regrettably cannot realistically be retrofitted to work with water at lower flow temperatures that traditional ASHPs would provide. This is because the large volume flow rates require larger surface areas on the heating coils when operating at lower temperatures to transfer the same amount of heat to the air.

This often means that there is insufficient space in the AHUs to physically fit the coils, meaning the units themselves could require physical alterations. This is not easily possible across the leisure centre, due to the significant capital cost and lack of physical space in the plant rooms.

Due to this, where AHUs have lower volume flow rates (less than 2.0 m³/s) it has been assumed that retrofit is possible and/or there is some scope for them performing well at lower temperatures. Where AHUs have greater volume flow rates than 2.0 m³/s, it has been assumed it is not possible, and proposed systems have the capability of providing water to the heating coils at more traditional flow temperatures. Any retrofit costs have been included in the system costs breakdowns for each plant room.

In addition, the AHUs were all fitted (with one exception) with inverter driven fans. This would have been a good opportunity for energy savings had they all been belt driven, but given they have all been converted it is recommended to retain them.

The fan that was still belt driven is advised to be surrounded by asbestos. Given this, it is recommended that no works takes place near this fan and it is retained. It should be considered during the detailed design of the proposed systems.

3.4.5 Boiler Like for Like Replacement Cost Breakdown

The table below shows a comparable estimate to replace the space heating boilers like-for-like:

Table 23: Space Heating Boiler Like for Like Replacement

Item	Estimated Cost
Removal of Existing Equipment	£7,000
Main Equipment	£136,500
Plinth, Pipework Connections, Insulation	£13,800
Installation	£34,200
Commission	£1,500
Total	£193,000

3.4.6 Electrical Capacity

When incorporating electrically powered low-carbon heating systems in a building, it is crucial to acknowledge the increased electrical load. Thus, evaluating the site's current electrical capacity and determining any additional capacity requirements is essential.

Table 24: Electrical Capacity Requirements

Maximum Import Capacity (kVA)	Current Max Demand (kVA)	Current Spare Capacity (kVA)	Lighting Reduction (kVA)	Proposed Equipment Electrical Demand (kVA)	Resultant Spare Capacity (kVA)
1,110	584	526	14.0	902.7	-377

The maximum demand was calculated by examining the half-hourly electrical data of the site provided by the Council. However, the recorded maximum demand was a higher value. It is not clear over what time period this has been recorded, but for the purposes of this report the higher value has been used.

The maximum import capacity was 1,600 Amps and translates to 1,110 kVA. This value was taken from the EICR and schematics located in the plant room.

The resultant spare capacity after the proposed low carbon electrically powered equipment is installed is approximately -377 kVA. It is also important to note that this is with the CHP, rated at 60 KW in operation.

The installation of the new low carbon heating equipment requires the site to upgrade the electrical capacity. The costs of this are often unknown and can be significant. We have distributed costs of this upgrade across the different proposed systems, but the total cost of electrical infrastructure upgrades is estimated at **£250,000**.

This is a high-risk item as the cost to upgrade the electrical infrastructure can be significant and vary significantly.

Electrically powered low-carbon heat sources such as heat pumps typically contain variable speed drives (VSDs), which could contribute to harmonic disturbances within the electricity network. Where issues persist, it could lead to a decision by the network operator to disconnect the supply to the site until it is rectified.

Therefore, we recommend that a harmonics assessment be carried out at the site in line with EREC G5/5, which would provide evidence of compliance with the harmonic's limits set by the network operator. We have also allowed for the cost of harmonic filtration equipment, if required, within the contingency in the ASHP cost table. The applicable cost would be confirmed during the detailed design stage following equipment selection.

3.5 Solar Photovoltaics

3.5.1 System Installation

The building has large areas of available roof space which could be a good location for the installation of solar panels for on-site renewable energy generation. However, the best opportunity for installation, the swimming pool roof, already has solar panels installed.

There are limited spaces left available for solar panel installation, and it has been proposed that a reasonable portion of the available roof space is left to be used to house mechanical equipment, subject to the results of a structural survey. If the results of the survey show that the roof is not suitable to house this equipment, but could house solar panels, it is recommended that the Council maximise the available roof space for solar generation. For the purposes of this report, the areas of roof being considered to house mechanical equipment has been excluded.

The Ice Rink roof is unsuitable for traditional solar panels due to the structural construction of the roof not being able to take the load. However, it could be suitable to house ultralight, bonded, MCS-certified photovoltaic technologies (e.g. semi-flexible monocrystalline panels at $\sim 4 \text{ kg/m}^2$).

The feasibility has not been confirmed due to roof build-up, condensation risk, membrane compatibility and wind uplift considerations. It is highly recommended that the Council consult with the structural engineer who previously conducted a structural survey on the Ice Rink roof and an ice rink specialist contractor to gain a better understanding of the possibilities.

Installing a PV canopy over the car park was considered, however the building would likely heavily shade any construction. In addition, the installation costs are substantially higher than rooftop PV because of the need for dedicated structural framing. Due to this constructing a PV canopy was discounted.

At the detailed design stage, a survey will need to be carried out to understand if the roof has the capacity to support an array of this size and weight.

A desktop study was carried out which involved 3D modelling of the site to evaluate the suitability of the space for solar panel installation and to identify the optimal placement of the PV modules to maximise energy yield. The heights of surrounding objects have been estimated utilising Google Earth, these measurements alongside the building's geometry were used to produce a shading analysis. However, it should be noted that a higher degree of precision in the PV simulation could be achieved through detailed and exact measurements.

The modelling was based on the half-hourly electricity consumption data from the April 2025 to March 2026 for Meter MPAN: 1592008764509.

This is not ideal as the newly installed PV on the swimming pool roof was installed recently and part way through this time period, so its electrical generation is only reflected partly in this data. Because of this, it is likely that the

electrical demand of the building will be reduced. Meaning, the larger PV system (496 kWp) would likely export a higher percentage of its electrical generation.

Two designs have been proposed:

- Traditional Solar panels & Ultralight flexible panels on the Ice Rink roof (496 kWp);
- Traditional Solar panels & no development on the Ice Rink Roof (118 kWp).

This is with a view to show the Council the potential benefits for installing PV on the roof of the Ice Rink, despite the challenges and higher capital cost to do so.

The safer and lower risk option is undoubtedly the smaller traditional PV system (118 kWp), but it is recommended that the Council should investigate the potential of installing the ultralight PV panels on the rooftop of the Ice Rink and consider the pros and cons of the larger PV system. It would incur significantly greater capital costs, largely driven by the cost of the panels themselves and the difficulty in the installation.

The pricing for the PV system including the Ice Rink roof assumes an ultra-light bonded PV system installed on a non-walkable lightweight roof with crane access, temporary load-spreading walkways, and reduced installation productivity to traditional load bearing roof structures.

Energy generation has been modelled using a representative crystalline silicon PV module with equivalent rated output to select ultralight solar panels in the case of loading on the Ice Rink roof. Structural feasibility and module mass have not been assessed within calculations.

Figure 62 *Proposed 496 kWp PV System Option*



Figure 63: Proposed 118 kWp PV System Option



Figure 62 visualises the proposed PV installation on the building's roofs. Additional investigations involving the structural integrity of the roofs with respect to the additional weight of the PV installation and wind loading would be required and are subject to product manufacturer and installation contractor recommendations. PV design options would be investigated during the detailed design stage and may have an effect on the budgetary estimate provided in **Table 26**.

The actual yields from the solar power system may differ as a result of weather variations, the efficiency of the modules and inverter, and other factors.

Table 25: 118 kWp P v 496 kWp (ice Rink) PV System Performance

PV Generator Output			
Size of PV System	118	496	kWp
Number of Panels	196	196	
Number of Ultralight Panels	0	714	
Spec. Annual Yield	830.41	877.43	kWh/kWp
Performance Ratio (PR)	73.81	89.1	%
Yield Reduction due to Shading	21.2	5.9	%

PV Generator Energy (AC grid)	97,668	435,263	kWh/Year
Own Consumption	97,668	395,364	kWh/Year
Clipping at Feed-in Point	0	0	kWh/Year
Grid Export	0	39,898	kWh/Year
Own Power Consumption	100.0	90.8	%
Level of Self-sufficiency	5.6	23.0	%

The charts below show the proportion of the PV generated electricity to the electrical consumption of the building.

Figure 64: 118 kWp PV System Output Split by End Use

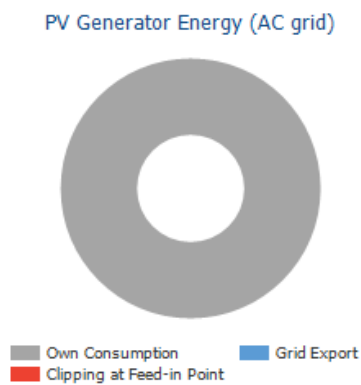


Figure 65: 118 kWp PV System Building Consumption by Energy Source

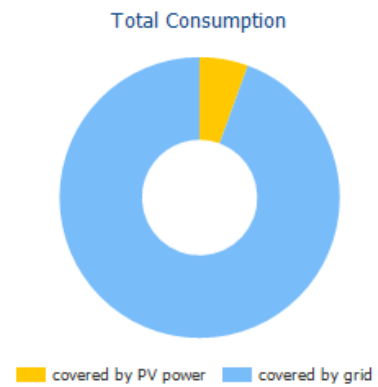


Figure 66: 496 kWp PV System PV System Output Split by End Use

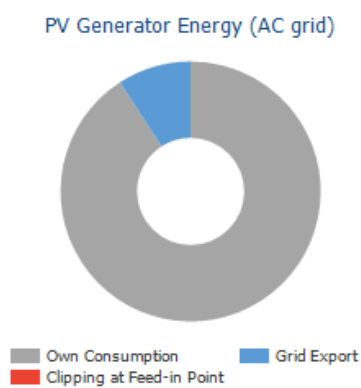


Figure 67: 496 kWp PV System PV System Building Consumption by Energy Source

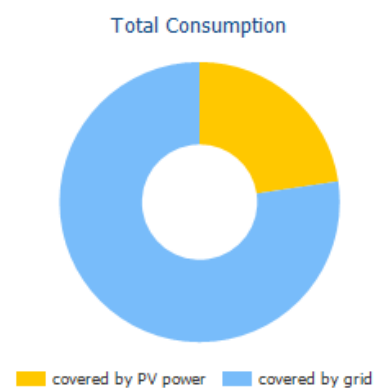


Figure 68: 118 kWp PV Generator Output Allocation by Month

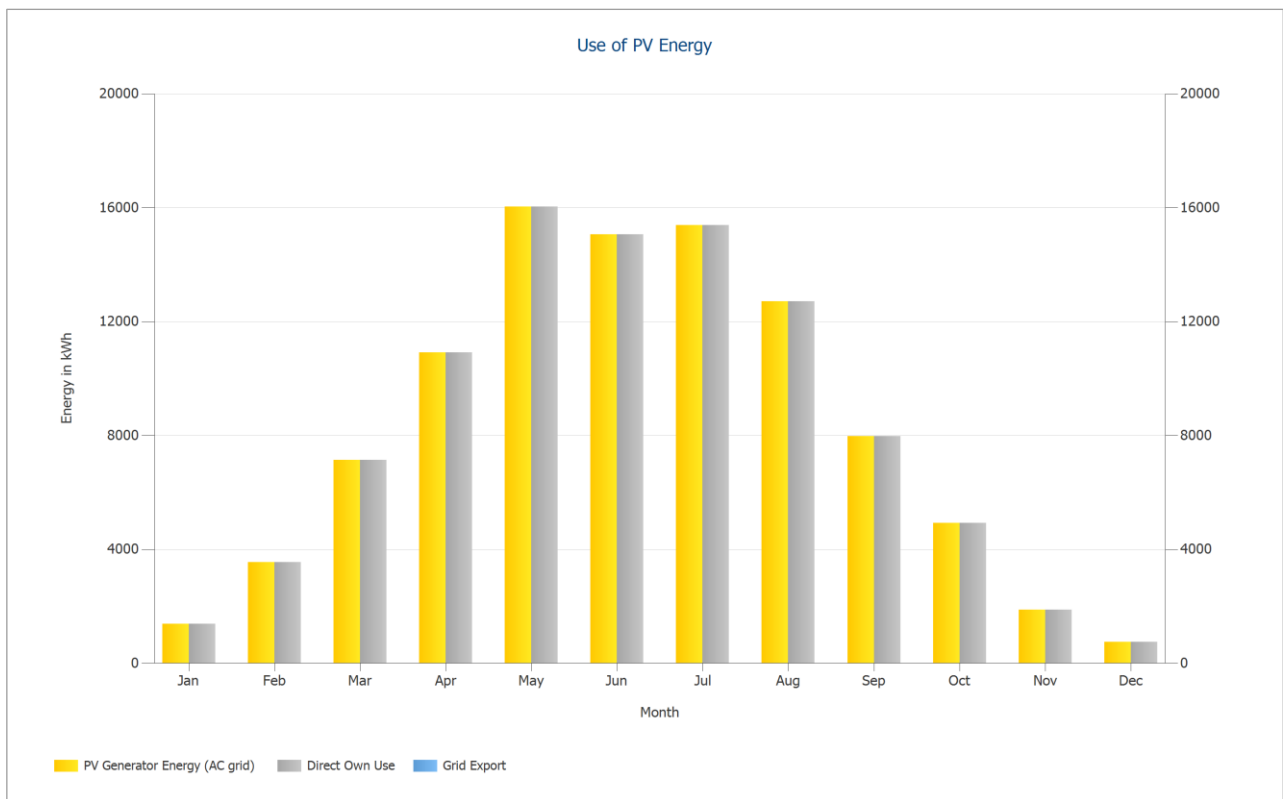
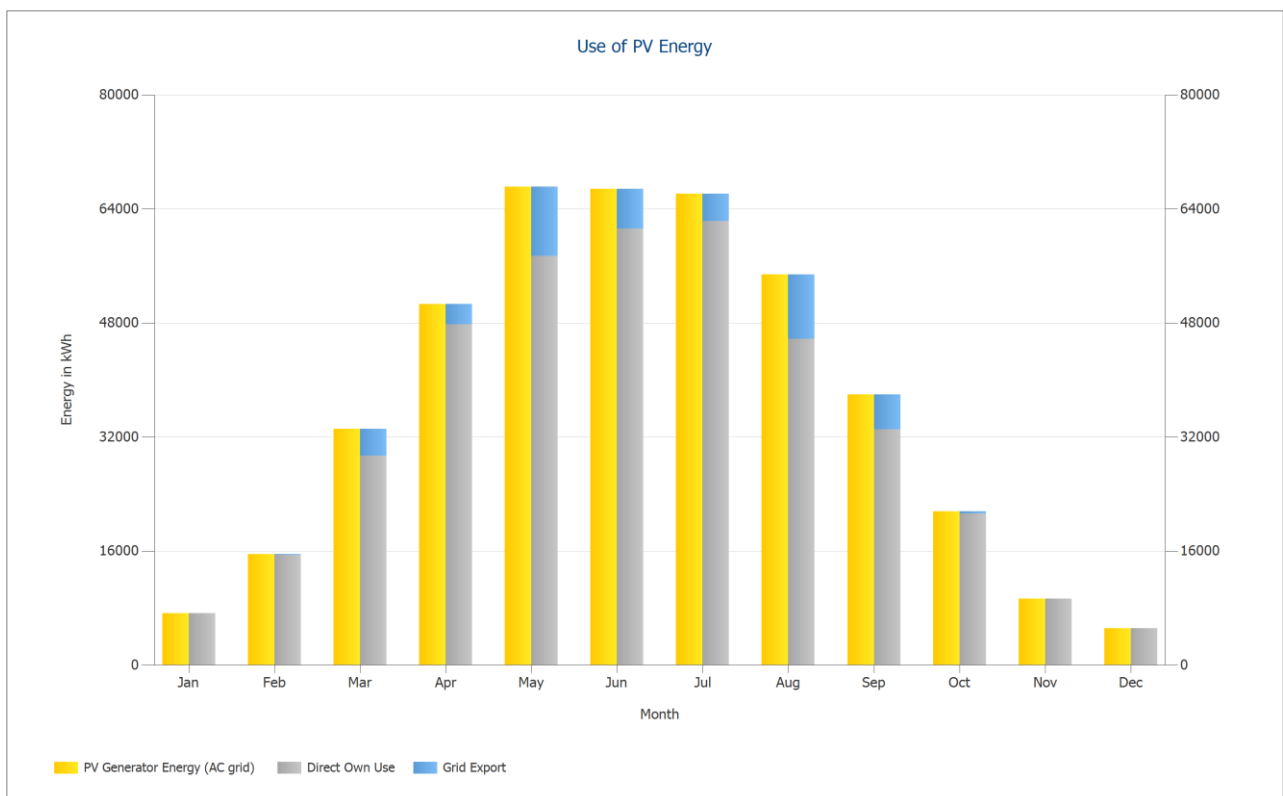


Figure 69: 496 kWp PV Generator Output Allocation by Month



3.5.2 Budget Cost Estimate

The associated budgetary cost for the two different PV Systems is **£160,700** and **£1,137,700** and is broken down as follows:

Table 26: 118 kWp PV System v 496 kWp (ice Rink) Cost Breakdown Comparison

		Excluding Ice Rink Roof	Including Ice Rink Roof
		118 kWp	496 kWp
Item	Description	Cost	Cost
1	Preliminaries	£6,400	£44,800
2a	Photovoltaic Array	£20,900	£20,900
2b	Photovoltaic Array (Ultralight)	£0	£278,100
2c	Ultralight PV Panels Installation	£0	£123,500
2d	Inverters	£4,400	£17,800
2e	Electrical Connections	£42,200	£224,300
3a	Builders' Work & Frame	£28,000	£199,400
3b	Scaffolding	£29,800	£29,800
4a	Testing & Commissioning	£500	£1,000
4c	Record Information	£500	£500
5	Contingency Sum	£13,300	£94,100
6	Works Budget Total	£146,000	£1,034,200
7a	Design Fee	£10,300	£72,400
7b	Project Management Fee	£4,400	£31,100
8	Project Budget Total	£160,700	£1,137,700

3.5.3 Surplus PV Generation

The smaller PV system does not export any electricity due to the size of the electrical demand at the site. However, when modelling the larger PV system that includes the Ice Rink roof there was some exported electricity. The majority of surplus PV generation is observed during summer, as illustrated in the figures above. Under the current modelling parameters for the PV system, the amount of surplus energy - when the PV system produces more electricity than the building's use - is 39,898 kWh/year.

It is advised that the surplus electricity be exported to the grid; cost savings calculations assume that this is sold to the grid at a rate of 12p/kWh. We have assumed this as it is currently an available export tariff from different providers that any generator has access to, even if they are not a customer of said energy supplier.

However, there are better value tariffs available that would make any exported energy to the grid even more valuable to the Council and could help to save even more money. The Council should investigate what export tariffs are available to them to come to a more considered final solution to the sizing of the array. It could be the case the Council would have to switch energy provider to gain access to certain tariffs.

The Council should also engage with the local District Network Operator (DNO) to understand any export limitations that might be in place in the area to prevent overloading the network.

The building's electrical demand is expected to increase after the implementation of electrically powered heating systems, which could impact the estimated electrical peak load. However, it is worth noting that peak PV generation coincides with the summer months when space heating demands are minimal or non-existent.

A comprehensive PV feasibility study and load modelling, factoring in the forecast electricity usage after the implementation of low-carbon heating solutions, would assist in determining the facility's demand per half-hour throughout the year, optimal PV system size and the feasibility of battery storage for surplus PV generation.

3.6 Lighting Replacement

3.6.1 Lighting Installation

It is recommended to replace all existing fluorescent lighting with more energy efficient LED luminaires. The quantity of fluorescent lighting is shown in **Section 2.3**.

Incorporating lighting control systems with absence detection and daylight dimming features can contribute to additional energy and carbon emission reductions. The extent of these savings could vary, depending on the existing and proposed configurations. For this case, we have assumed a saving of 15%, considering that sensors would be fitted to 10% of the new LED light fixtures. It is important to note that implementing comprehensive lighting control across all areas could necessitate significant rewiring of the lighting power and switch circuits.

The energy savings from implementing LED luminaries have been approximated based on the methodology of replacing the existing light fittings with LED alternatives based on luminance output. However, this is not ideal as it could result in mismatched lux levels compared to recommendations.

Consequently, we recommend considering conducting a comprehensive lighting design study. This would aim to model and implement lighting levels aligned with recommended guidelines. Such an approach can yield multiple advantages, including potential energy and cost savings, the assurance of appropriate lighting levels, optimal distribution of fixtures and a comprehensive assessment of the retrofit's impact on the environment and users. Additionally, the study can assist in identifying the most suitable LED lights and their optimal installation orientations to maximise benefits and assess any potential limitations or issues related to the existing electrical system.

To optimise visual perception for all users, the lighting design will consider factors such as recommended colour index, lighting levels and avoidance of light spill and glare. Further energy savings could be realised across the entire facility if all utilised spaces are matched to the recommended lux levels with the implementation of lighting controls.

All new lighting would be designed to meet the requirements of the applicable CIBSE Lighting Guide.

3.6.2 Budget Cost Estimate

The budgetary estimate for replacing fluorescent lighting with LED fittings is as follows:

Table 27: Lighting Replacement Cost Breakdown

Item	Description	Cost
1	Prelims	£5,400
2a	Access for works	£800
2b	Installation	£26,200
2c	Removal and Disposal	£7,100
3a	Lighting	£58,000
3b	Controls	£5,000
3c	Emergency	£8,700
4a	Record Information	£500
4b	Testing & Commissioning	£1,400
5	Contingency costs	£11,400
6	Works Budget Total	£124,500
7a	Design and Engineering Fee	£12,500
7b	Project Management Fee	£6,300
8	Total Project Costs	£143,300

The cost estimate includes all non-LED luminaires identified during the site survey excluding the specialist lighting in the theatre.

Given the theatre fixture's low use, it is recommended that they be replaced as and when they fail as they are not as cost efficient to replace because the energy savings will be minimal.

3.7 Efficiencies through Small Power

Switching to energy-efficient appliances can result in substantial long-term power savings. By gradually replacing outdated appliances such as hand dryers, air conditioning and computers, costs can be distributed more evenly over time as they reach the end of their service life. This approach makes the expense more manageable.

3.8 Catering Equipment

To fully eliminate the use of fossil fuels at the site, replacing all gas-fired cooking appliances with electric equivalents is recommended. By switching to energy-efficient commercial catering appliances, substantial energy savings can

be achieved. Rational¹, an established commercial catering equipment manufacturer, estimates potential energy savings of 40% by switching to these energy-efficient appliances.

The gas consumption associated with catering equipment is 38,140 kWh. The cost of the cooking appliances is unknown as this is specialist equipment.

3.9 Filtration Equipment

It is recommended that the Council consider the installation of regenerative media filters (RMF) to replace the existing filtration units within the plantroom.

The equipment manufacturer of the Defender RMF, Evoqua², has provided an estimate indicating potential water savings of up to 90%, primarily achieved through the reduction of backwash water discharge, and an accompanying 50% reduction in energy consumption, amongst other savings. The energy savings are said to be primarily realised through a combination of factors, including decreased head loss resulting in reduced pumping power requirements, as well as a reduction in the need for water re-heating and chemical treatment to compensate for backwashing, as is necessary for a sand filtration system.

It is difficult to estimate the precise energy savings for the site due to limited information. Nonetheless, the Council is advised to explore this energy conservation measure, as it holds the potential for substantial long-term energy and cost savings.

4 Energy and Carbon Savings

4.1 Energy Consumption

The table below presents a summary of the energy usage at the site. Both the gas and electricity were originally provided by the Council as an annual figure, but at a later date electrical half-hourly data over a period of a year, including electrical sub-meter and monthly gas data were provided.

The energy prices are based on tariff rates provided by the Council via invoices. It is important to note that higher rates lead to increased operational costs and quicker paybacks, which further reinforces the business case for delivering energy efficiency projects.

Carbon emissions have been calculated using the 2025 UK Government emission conversion factors for greenhouse gas (GHG) reporting published by the Department for Energy Security and Net Zero (DESNZ).

Table 28: Building Energy Consumption: Cost and Carbon Emissions

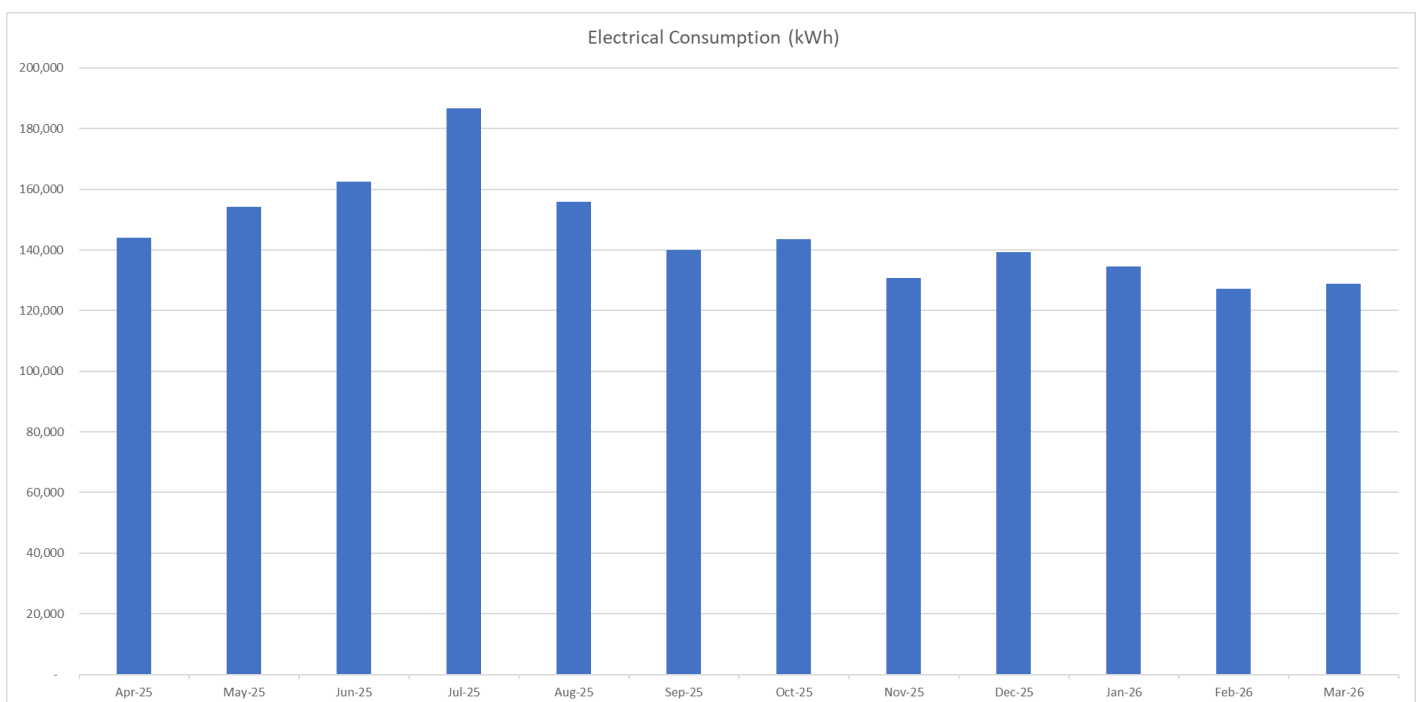
Energy Source	Energy Consumption (kWh)	Cost	CO ₂ e (tonnes)	Unit Rate (£/kWh)
Electricity	1,747,590	£366,994	309.3	0.21
Dry Side Gas	309,097	£14,460	56.6	0.05
Ice Plant Gas	635,659	£29,100	116.3	0.05
Pool/Theatre Gas Total	1,818,575	£84,564	332.7	0.05

¹ [Vario Pro. In the restaurant. The Game Changer. | RATIONAL AG \(rational-online.com\)](https://www.rational-online.com)

² [Defender® Regenerative Media Filter \(evoqua.com\)](https://www.evoqua.com)

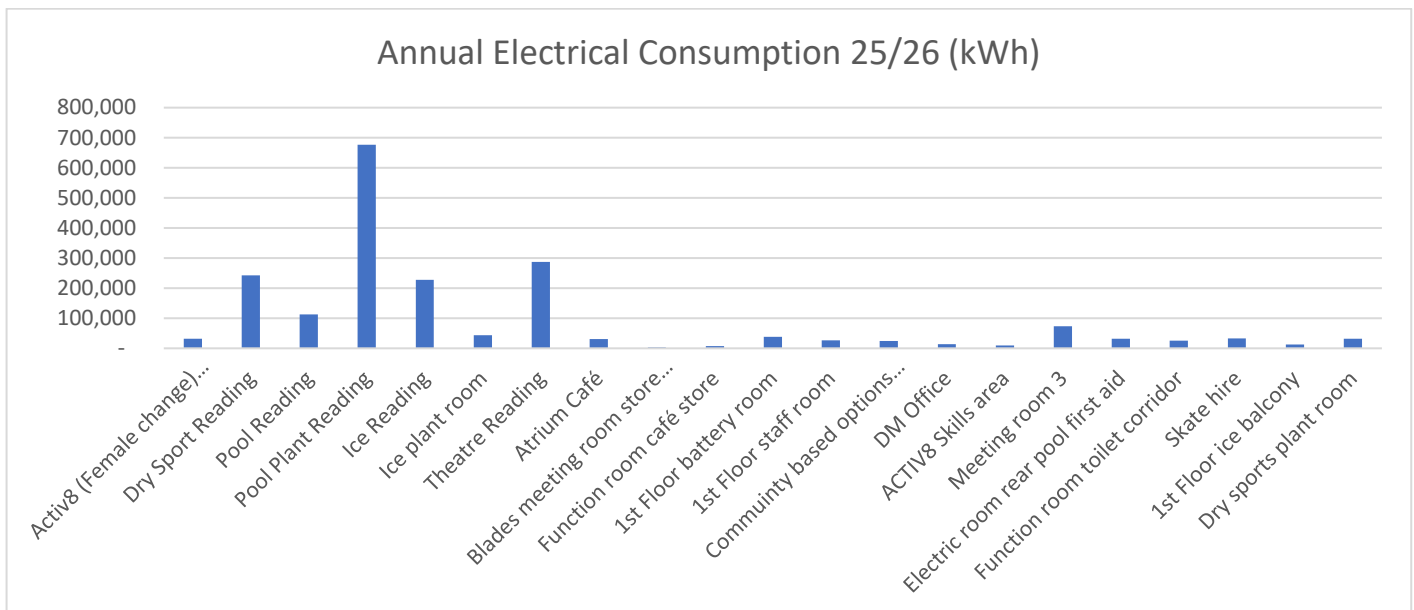
Total Gas	2,763,331	£128,124	505.6	0.05
Total	4,510,921	£494,881	814.9	
Pool/Theatre Gas Split				
Pool/Theatre Gas Boilers	723,361	£33,636	132.3	0.05
Pool/Theatre Gas CHP	1,095,214	£50,927	200.4	0.05

Figure 70: Electrical Consumption April 25– March 26



The building's electrical demand is relatively constant through the year, peaking in the summer months when the cooling demand on the chillers supplying the Ice Rink and Ice AHU peaks when the exterior temperature is high. Submeter data further breaks the electrical consumption down, with the 'Pool Plant Reading' the largest consumer by a significant distance at 676,845 kWh. This is not unexpected, and is likely due to the extensive pool water treatment equipment, as well as the fans in the AHU.

Figure 71: Electrical Sub Meter Breakdown

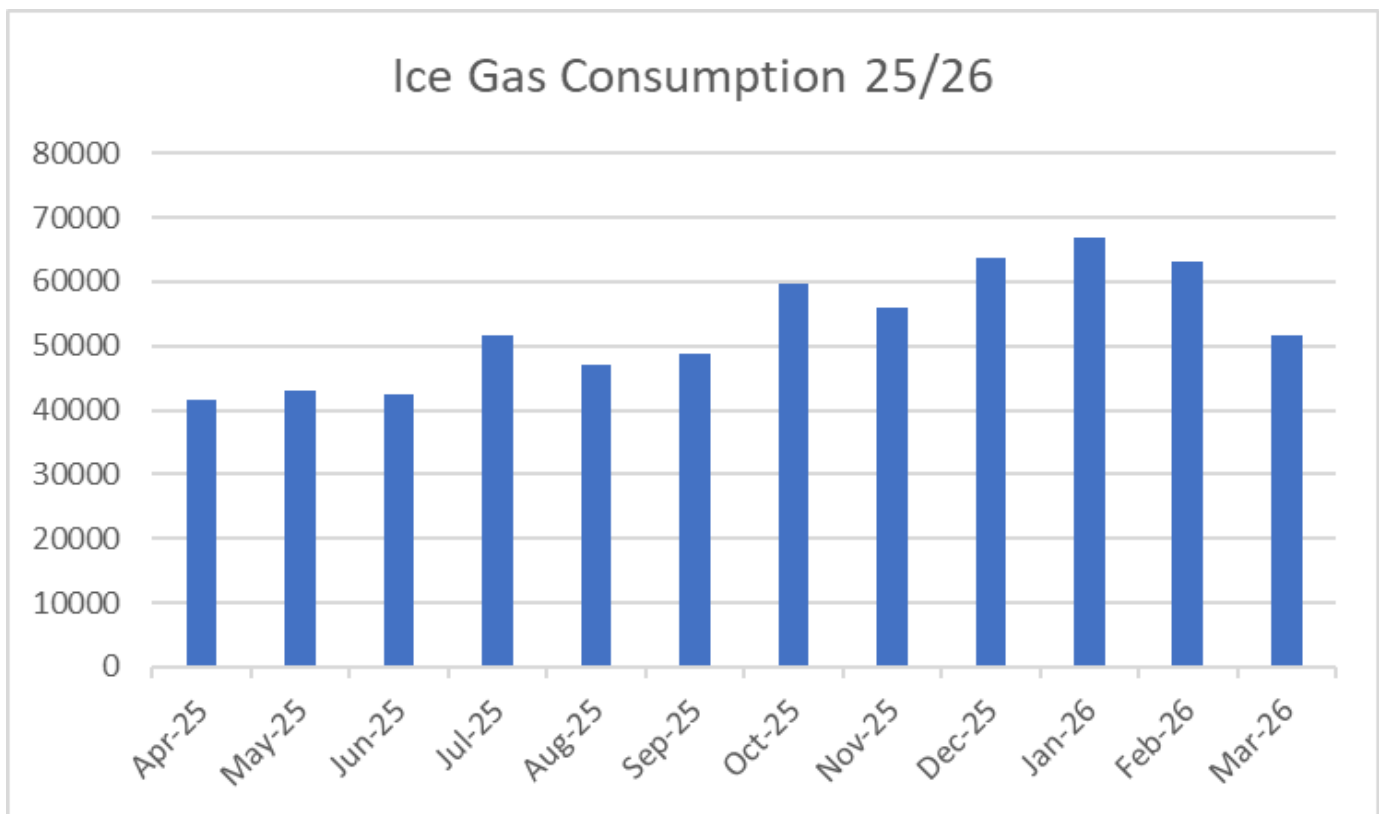
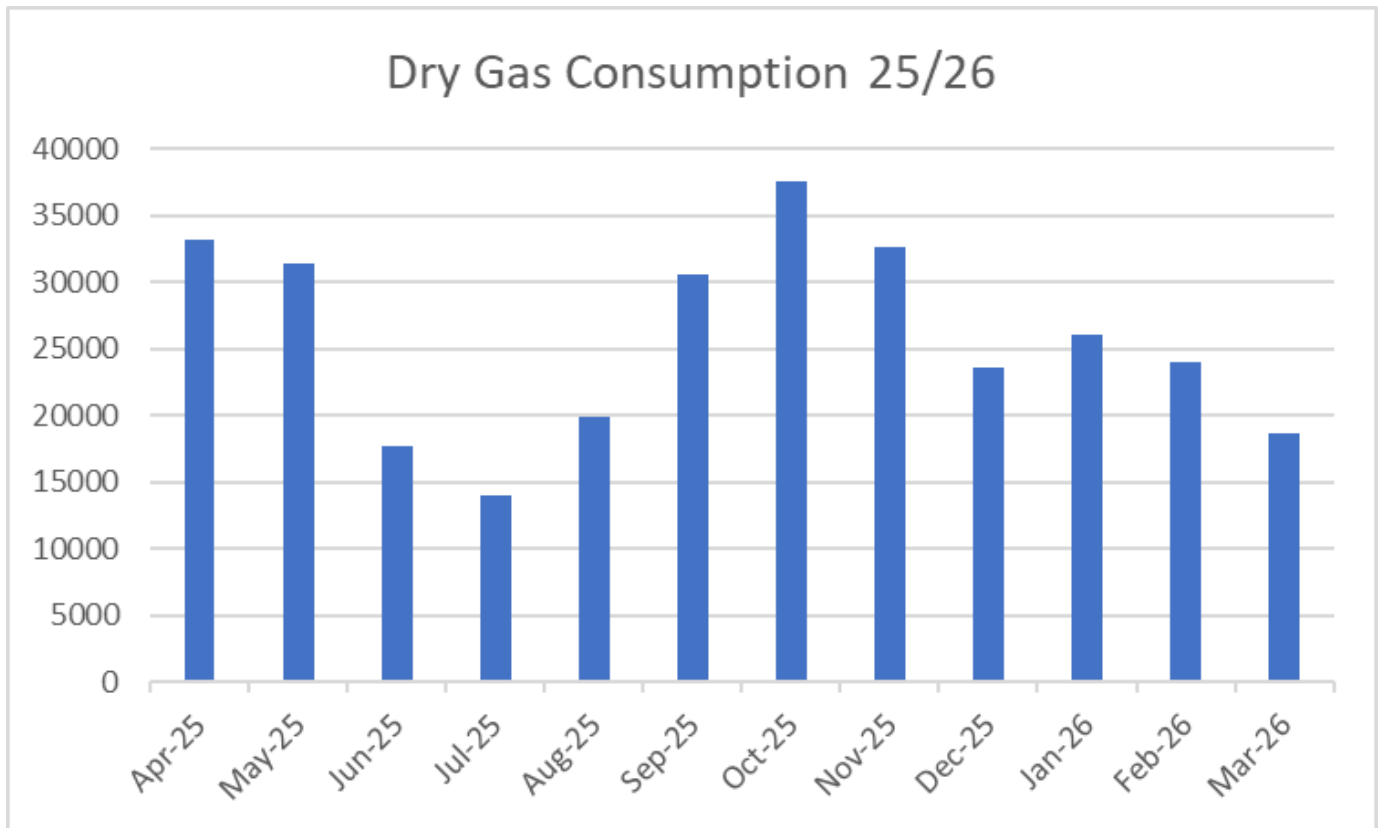


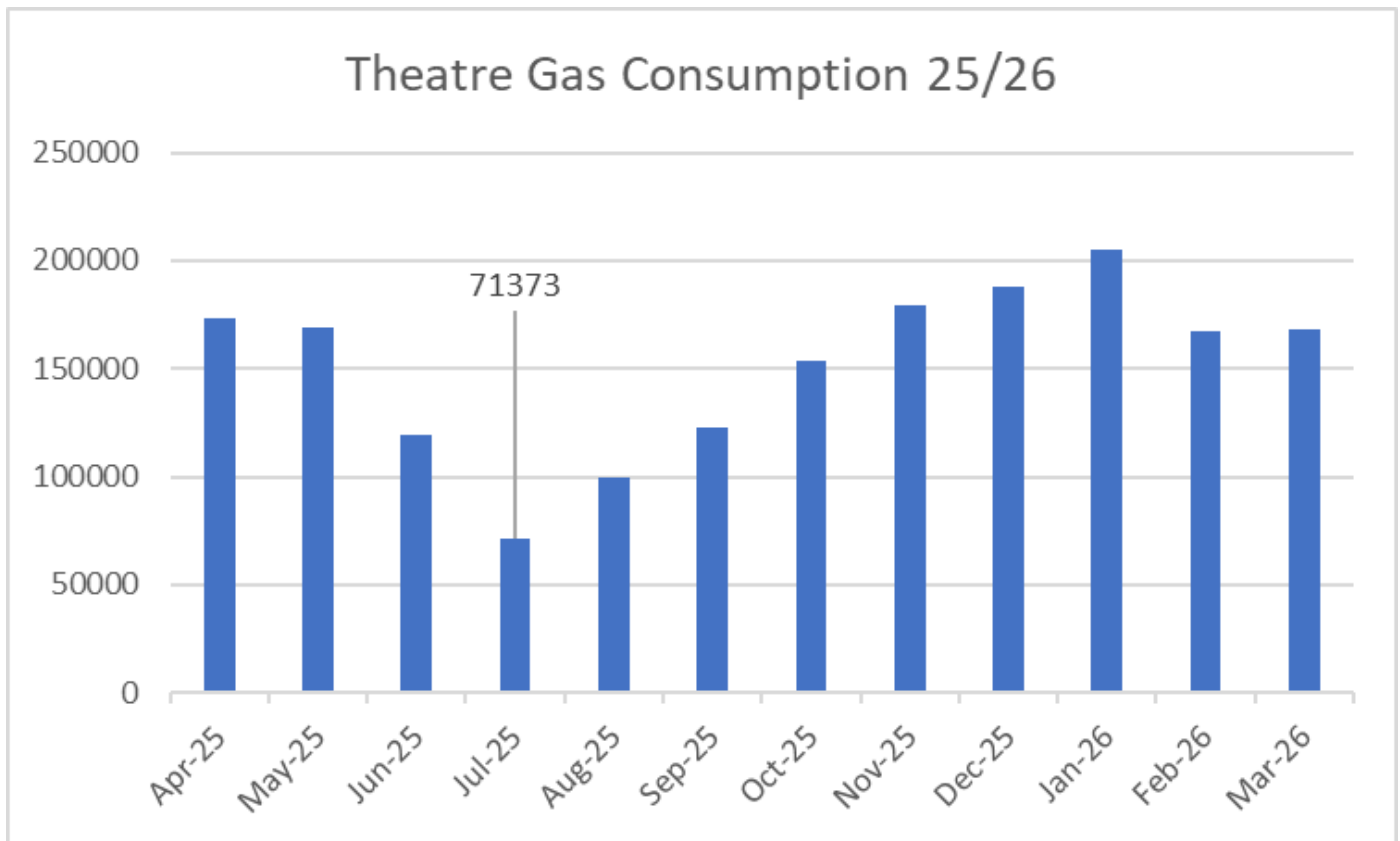
When contacted, staff were unsure what sub-meters fed both of the chillers serving the Ice Rink. For the purpose of the report, it has been assumed that they were both served from the Ice Reading sub-meter. This and other notable or significant assumptions to further calculate the end use consumption and energy savings across the building are as follows:

Electrical

- Both Ice Rink Chiller and Ice Rink AHU Chiller are served from 'Ice Reading' submeter;
- Ice AHU fans was served from 'Ice Plant' submeter;
- The Ice Rink AHU and Pool operational times are very similar over the year. The Ice Rink AHU load and Pool water heating is assumed to be simultaneous in terms of operation.

Figure 72: Three Gas Meters Annual Consumption





Notable or significant assumptions to further calculate the end use gas consumption and energy savings across the building are as follows:

Gas

- Theatre and Pool Gas Meter served the small pool plant room containing 2no. Viessmann Vitoplex 100 SX1 and the CHP;
- The Ice meter served the Ice plant boilers, external dehumidifier and the commercial kitchen;
- The Dry meter served the Dry plant room;
- Where space heating is present, the additional gas consumption load over the heating season is assumed to be a fair representation of the space heating load over the year that is not a consistent load, i.e. it is not representative of the pool water heating;
- The pool water operational heating demand and equivalent gas consumption has been calculated based on typical heat loss factors during operation of 0.15 kW/m^2 and 0.045 kW/m^2 during hours where the pool covers are used.

Further clarification is required to ascertain the exact breakdown of energy consumption within the site. Obtaining accurate and comprehensive data regarding both electricity and gas consumption is crucial for monitoring energy usage and assessing the performance of energy efficiency programmes.

There were a number of sub-meters, such as heat meters seen during the site survey, in particular each secondary circuit in the theatre plant room has heat meters installed. No data was available for these meters.

It is recommended that this be investigated or the meters upgraded to ensure a submetering programme be implemented to account for all key end-uses in the interim to obtain a comprehensive understanding of usage and benchmarking baseline for future comparisons.

Particular equipment or heating circuits to meter to better understand are as follows:

Electricity Sub-Meters

- Ice Rink Chiller;
- Ice AHU Chiller;
- Pool AHU (fans) – to separate from pool water treatment equipment.

Gas/Heat Sub-Meters

- Ice Rink Dehumidification gas consumption;
- Pool Water Plate Heat Exchangers;
- Pool AHU Heating Coil;
- DHW consumption across the building;
- Commercial kitchen.

The Council did also provide detailed data from the CHP installed in the Pool and Theatre Plant Room. The heat meter data did not align with the heat generation data from the CHP. It is recommended that the Council investigate this issue as it appears that the meter is not calibrated correctly.

Where there has been an absence of more detailed sub-meter data, we have used the energy end-use breakdowns from the Building Energy Efficiency Survey (BEES)³ and/or insights from data analysis of the existing data as well as observations during the site survey for the relevant non-domestic sector in estimating how electricity and gas consumption is divided across the building.

4.2 Energy Savings

The table below shows the energy and carbon savings from the recommended projects. This represents the comparison of the sites current operation in 2025 compared with 2032. It assumes that the CHP is no longer in operation and is disconnected at the end of 2031.

Table 29: Recommended Decarbonisation Projects: Energy, Cost and Carbon Saving

Item	Recommendation	Annual Electricity Savings (kWh)	Annual Gas Savings (kWh)	Annual Saving (£)	Capital Cost (£)	Payback in Years	Carbon Saving (tCO ₂) per year
1	Ice Plant: New Electric Dehumidification	-86,174	311,473	-£3,613	£250,000	N/A	41.7
2a	Ice Plant: High Temperature Air Source	-28,435	94,889	-£1,559	£262,800	N/A	12.3

³ [Building Energy Efficiency Survey \(BEES\) - GOV.UK \(www.gov.uk\)](https://www.gov.uk/building-energy-efficiency-survey-bees)

	Heat Pump for Space Heating						
2b	Ice Plant: High Temperature Air Source Heat Pump for DHW	-11,205	31,783	-£875	As Above	N/A	3.8
2c	Ice Plant: High Temperature Air Source Heat Pump for AHU Dehumidification	-56,187	159,210	-£4,396	As Above	N/A	19.2
3a	Ice Plant: 4-Pipe Chiller to Supply Ice AHU	30,400	-	£6,384	£1,914,825	N/A	5.4
3b	Theatre & Pool Plant: 4-Pipe Chiller & Water Source Heat Pump. System A: Pool Heating	-133,402	688,956	£4,022	As Above	N/A	102.4
3c	Theatre & Pool Plant: 4-Pipe Chiller & Water Source Heat Pump. System A: Pool AHU Space Heating	-100,052	516,717	£3,017	As Above	N/A	76.8
3d	Theatre & Pool Plant: 4-Pipe Chiller & High Temperature Air Source Heat Pump. System A: Domestic Hot Water	-32,436	167,515	£978	As Above	N/A	24.9
4	Theatre & Pool Plant: High Temperature Air Source Heat Pump System B: Space Heating	-72,573	445,551	£5,478	As Above	N/A	68.7
5a	Dry side: High Temperature Air Source Heat Pump for Space Heating	-28,094	102,793	-£1,135	£600,000	N/A	13.8
5b	Dry side: High Temperature Air Source Heat Pump for Domestic Hot Water	-66,335	206,304	-£4,367	As Above	N/A	26.0
6a	Solar Panels Ice Inc (496 kWp) Own Use	395,364	-	£83,026	£1,137,726	13.0	70.0
6b	Solar Panels Ice Inc (496 kWp) Export	39,898	-	£4,788	As Above	As Above	7.1

7	LED Lighting Replacement	71,934	-	£18,792	£143,300	7.6	12.7
8	Kitchen Equipment	-22,884	38,140	-£3,021	Unknown	N/A	2.9
Total		-100,180	2,763,331	£107,517	£4,308,651	N/A	487.8

Table 30: Alternative PV Option Cost and Energy Savings

Item	Alternative Recommendation	Annual Electricity Savings (kWh)	Annual Gas Savings (kWh)	Annual Saving (£)	Capital Cost (£)	Payback in Years	Carbon Saving (tCO ₂) per year
6ai	Solar Panels Ice Rink Excl (118 kWp) Own Use	97,668	-	£20,510	£160,700	7.8	17.3
6bi	Solar Panels Ice Rink Excl (118 kWp) Export	0	-	£0	As Above		

The solutions, systems and equipment detailed within this report are provided to demonstrate a method for reducing the onsite carbon emissions, when considering the existing installed systems, site operation and constraints and financial viability to maximise the opportunity for funding support. The proposed projects are based on specific technologies and manufacturer information. However, other systems and technologies or combination of technologies may prove to be more favourable during the detailed design stage and completion of thermal modelling to confirm the building heating load.

The annual carbon and cost savings are based on the same carbon emission factors and energy tariff rates as described in Section 4.1. The presented carbon and cost savings above do not consider future cost increases or decarbonisation of the grid.

The electricity savings for Items 1, 2, 3, 4, 5 & 8 are negative, indicating the expected increase in electricity consumption at the site from transitioning to electrically powered low-carbon solutions. However, the cost savings are influenced by the interplay between the improved performance of the proposed low carbon systems and the Council's current energy tariffs.

The low-carbon alternatives notably outperform traditional systems in terms of efficiency, and as mentioned the electricity tariff rates used in the modelling are approximately 4 times higher than gas rates. However, it is anticipated that the cost of fossil fuels will increase much faster than electricity in the future making the low-carbon solutions comparably more cost-effective in the long run.

Implementing the proposed PV system and LED Lighting installation within the site presents the Council with the greatest electrical energy and cost savings, accompanied by a short payback period. The Council should opt to proceed with this initiative in the very near term.

4.3 Carbon Trajectory

The use of gas at the site will need to cease and all gas-fired equipment will need to be decommissioned to decarbonise the site and align with the Councils set net-zero targets in 2032.

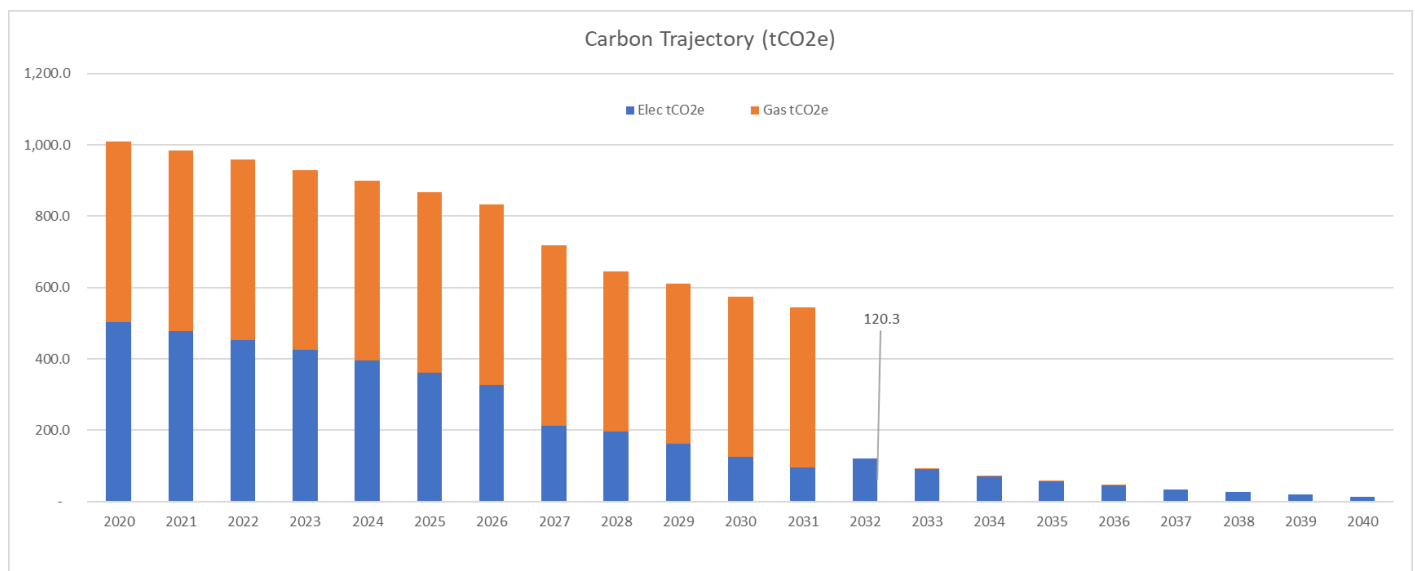
The assessment of future emissions considers that the electricity grid will decarbonise much faster than the traditional gas. Therefore, replacing gas-fired equipment with electrically powered low-carbon heating equipment results in a high carbon savings in the future.

The trajectory is also based upon the assumptions that the Council will continue to use the CHP unit up until 2032. The decarbonisation measures at the pool and theatre plant are proposed to be installed at the end of 2031 to ensure the CHP unit can be used for as long as possible.

The suggested programme of works is:

- 2026: Installation PV solar array and LED Lighting.
- 2027: Installation of the Dry side high temperature ASHP to provide space heating and DHW.
- 2031: Installation of the 4-pipe chiller, WSHP & HT-ASHPs in the Theatre and Pool Plant. Installation of the HT-ASHP and Electric Dehumidification in the Ice Plant. Disconnection of the CHP. Installation of the electric commercial kitchen equipment.

Figure 73 Carbon Trajectory – Recommended Projects



The trajectory shows what the emissions would be if the site transitioned to electricity from 2026, and if all gas-fired equipment is removed from site and the proposed heating system alongside all energy-efficiency programmes are implemented before the Council's net-zero target of 2032.

Achieving net-zero carbon emissions requires a strategy that focuses on reducing emissions as much as possible through energy efficiency/conservation measures and low-carbon projects, alongside generating energy onsite

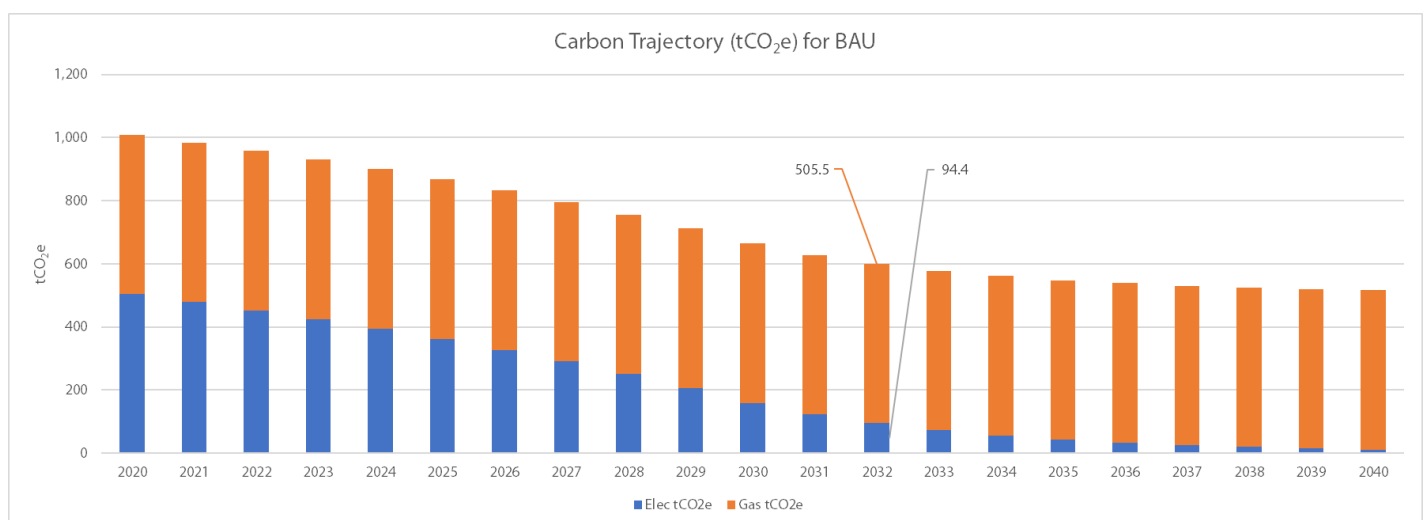
from renewable sources. After these carbon reduction initiatives, the remaining emissions are often hard to mitigate and require offsetting strategies to reach a net-zero carbon footprint. Consistent with the Council's net-zero objectives, some plausible strategies to fully offset these hard-to-reduce emissions (120 tCO₂e) by the year 2032 and in the years following include:

- Investing in renewable energy projects to replace fossil fuel energy;
- Planting trees or other vegetation to absorb carbon dioxide through photosynthesis;
- Supporting projects that reduce emissions in other sectors, such as the production of low-carbon products;
- Purchasing carbon credits from verified carbon offset programmes.

The electricity usage within the site is modelled as being static after the projects have been delivered. However, related CO₂e emissions continue to fall as the electricity grid continues to decarbonise.

Figure 74 visualises the carbon trajectory where no projects are implemented to reduce energy usage or carbon emissions at the site. In this scenario, business continues as usual and the energy consumption at the site is modelled as being constant through the years.

Figure 74: Business as Usual (BAU) Carbon Trajectory



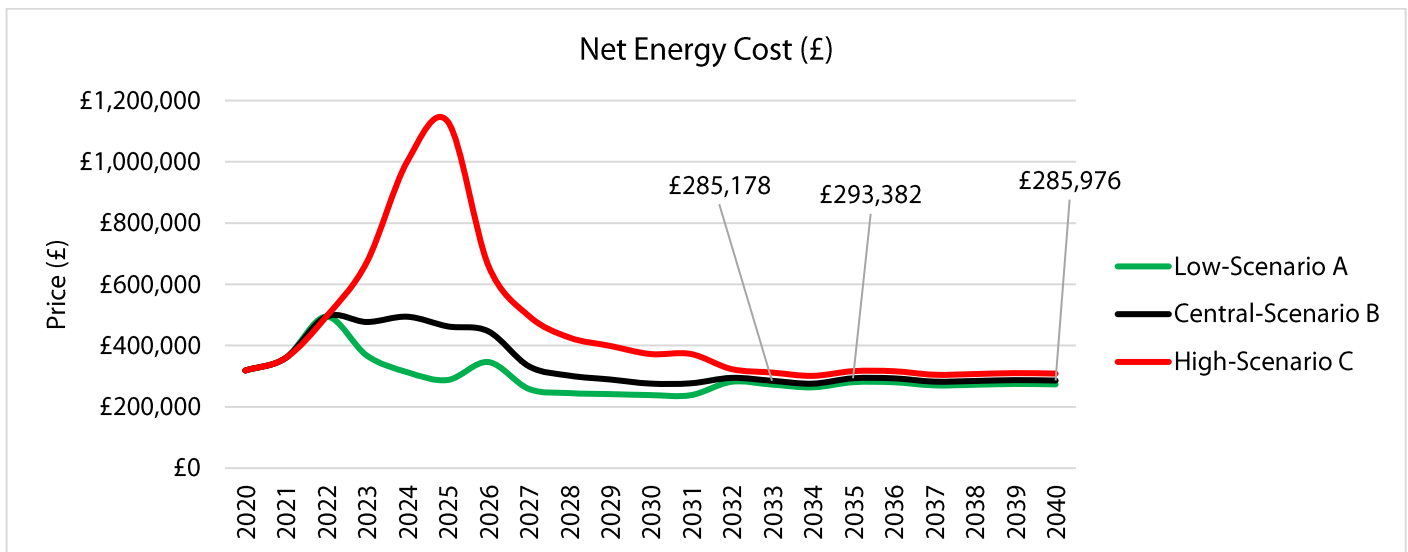
4.4 Forecast Energy Costs

The future retail fuel prices have been adopted and utilised in forecasting associated running costs following the implementation of decarbonisation proposals under the following parameters:

- Modelling central electricity retail prices.

This was done to account for uncertainties surrounding energy prices at present using the best available data from DESNZ. Further guidance about the various scenarios and methodologies involved in forecasting long-run price trend is available from DESNZ.

Figure 75 Year to Year Net Energy Running Costs



The annual operating costs by 2032 for the proposed low-carbon heating solutions, in conjunction with the recommended energy efficiency projects, has been highlighted.

The energy cost modelling in the scenarios is aimed at providing the Council with insight into how fluctuations in energy prices may affect running costs, a form of sensitivity analysis. However, from experience and historic markets, we anticipate that energy prices will increase higher than DESNZ are suggesting.

5 Recommendations

To achieve the site's decarbonisation, and comply with net-zero objectives, it would be necessary to decommission all existing gas-fired equipment by 2032. Given the scale of the building, we have separated our main decarbonisation recommendations into the different areas of the main plant. Some recommendations are general and have been included in their own section.

Ice Rink Plant Recommendations

To fully decarbonise, it is recommended that one of the gas-fired boilers is decommissioned and removed from site. The other is recommended to be retained. This will enable the Council to have some redundancy in the case the existing systems fail or there is a power outage.

It is proposed that in its place, two High Temperature Air Source Heat Pumps (HT-ASHPs) alongside the auxiliary equipment are installed to provide 65°C Low Pressure Hot Water (LPHW) to the existing heating distribution system. By removing one of the existing boilers there should be sufficient space in the existing plant room for the new buffer vessel.

It is recommended that the existing heating distribution system, pumps and DHW cylinder are retained and connected up to the new buffer vessel. This will avoid the costly and highly disruptive measure of replacing the existing distribution and emitters.

It is not recommended to heat any area of the ice rink, given the space is constantly cooled. Therefore, the proposed equipment has not been sized to supply LPHW to the VT heating circuit. However, if staff are uncomfortable to the

point that they are cold, it is recommended that they first wear appropriate clothing. Further to this, it is recommended small electric heaters be used under desks as heating the entire space is counterintuitive.

The Climaveneta FOCS/D/SL-BT/S 4202 chiller is a specialist item and is already decarbonised. It is recommended to retain and replace as and when it is needed.

It was noted that was substantial frost build up, both on the distribution pumps and the pipework. Given the excessive frost build up, it is hard to tell, but it appeared that the pipework lacked sufficient levels of insulation. It is recommended that the Council investigate this and install insulation to the pipework if this is the case.

The existing dehumidifier located externally to the building and the main plant consumes a significant amount of gas. It has been assumed that the gas dehumidifier will be replaced by a modern electrical equivalent. This is a specialist item, and it is recommended that the Council consult with respected Ice Rink electrical dehumidifier manufacturers such as Condair, Industrial Frigo and others etc, to understand the options available to them.

At this stage, it has been assumed that the efficiency of the new system is around 300%, a typical value consistent with ice rink dehumidification process. A fee of **£250,000** has been assigned to this work, but specialists will be able to provide a more detailed breakdown of the potential costs of such an installation.

Air leakage is a significant driver for the load of the dehumidification. Whilst extremely difficult to give a quantitative value to this, it is highly recommended that the Council investigate the fabric around the Ice rink and install draught strips, and work to limit openings to reduce this air leakage.

When the Ice Rink chiller does require replacement, it is recommended that Council should consider if it would be beneficial to replace it with a 4-pipe chiller, for example at the time of replacement, is there a more viable heating load/demand or perhaps sections of the heating infrastructure now can operate at lower temperatures.

Pool and Theatre Plant Recommendations

From 2026 – 2031 it is recommended that the council retain the existing gas boilers and CHP unit to make the most out of the cheaper fuel and electricity generation of the CHP.

From 2031 it is recommended that the Council decommission one of the existing gas boilers and the CHP that provides the main buildings space heating demand and remove them from site. It is proposed that in its place, two different systems are installed to serve the plant room with LPHW.

It is recommended that the Council retain the use of one of the gas fired boilers currently installed in the pool and theatre heating plant room. This way they can ensure they have back up resilience and protection.

It is recommended that two separate systems are installed to replace the old gas boilers and to provide the cooling load in the Ice Rink AHU. This will be achieved by installing an a 4-pipe chiller. The 4-pipe chiller requires a constant heating and cooling load all year round to access the greatest efficiency's. Due to this, the different secondary circuits in the Theatre plant room have been separated based on their loading profile through the entire year.

System A will be designed to work alongside the cooling load to the Ice Rink AHU, using a 4-pipe chiller to recover heat generated by cooling water for use in the Ice Rink AHU. The 4-pipe chiller requires a constant heating and cooling load to run at its most efficient setting. Due to this, the heating load selected to be provided by it is the Pool water heating, pool AHU and DHW loads.

The 4-pipe chiller produces hot water at 50°C so requires further energy input to raise it to temperatures that can be used with the existing equipment. It is proposed that alongside the 4-pipe chiller a water source heat pump (WSHP) be installed to raise the water temperature heat from 50°C to 70°C to be used to provide:

- Pool Water Heating and AHU Heating Coil (CT);
- DHW (CT).

The existing heating distribution pipework, pumps and DHW cylinders should be retained, with works required to separate the existing secondary circuits from the low loss header and attached to the new buffer vessel. The existing low loss header can be retained for use in System B.

Alongside System A, it is recommended that System B be installed to provide LPHW to the remaining secondary circuits in the theatre plant room. These are:

- AHUs (CT);
- Theatre Heating (VT);
- General Heating (VT).

High Temperature Air Source Heat Pumps (HT-ASHPs) alongside the auxiliary equipment are installed to provide 65°C Low Pressure Hot Water (LPHW) to the existing heating distribution system. New buffer vessels would be installed alongside, and connected up to the existing low loss header to serve the existing secondary circuits, minus the circuits that have since been disconnected and attached to System A.

It is also recommended that the Council lower the flow temperatures of the boilers to see what the lowest temperature they can provide to the existing heating distribution that still effectively heats the building. This will allow the Council to operate the ASHP at the highest efficiency possible once installed to lower operating costs.

It is recommended that the Council investigate the potential issue with the heat meter recording heat generated by the CHP as the data provided is currently suggesting vast amounts of heat is dumped.

It is recommended that the Council consider conducting a detailed CHP analysis to determine if the unit is currently being operated in the most optimum manner. APSE have done several detailed CHP analysis in the past that has been used as a business case to either retain or dispose of CHP.

Dry Side Plant Recommendations

To fully decarbonise, it is recommended that one of the gas-fired boilers is decommissioned and removed from site. The other is recommended to be retained. This will enable the Council to have some redundancy in the case the existing systems fail or there is a power outage.

It is proposed that in its place, four High Temperature Air Source Heat Pumps (HT-ASHPs) alongside the auxiliary equipment are installed to provide 65°C Low Pressure Hot Water (LPHW) to the existing heating distribution system. It is recommended that the existing heating distribution system, pumps and DHW cylinder are retained and connected up to the new buffer vessel.

The existing heating distribution and low loss header will be retained, with the return pipework of the heating circuits connected to the new buffer vessel.

It is recommended that the Council run the ASHPs at 65°C for the majority of the year. During the site survey (which was in very cold temperatures) the secondary circuits were run at lower flow temperatures, suggesting that would be adequate for the majority of the year. In the colder months the ASHP has the capability of providing flow rates of up to 75°C if required.

General Building Recommendations

The building fabric was upgraded across the building in 2011 as part of the general refurbishment works. Due to this, the fabric is to a good standard. It is recommended to retain the existing fabric but consider installing draught strips to limit ventilation loss where appropriate. The Council should monitor this every year as stopping a developing issue could save significant amounts of energy.

Across the building there are a number of electrical heating and cooling plant. These are already highly efficient and decarbonised. It is recommended that the Council retain these and replace them like for like when they fail. Examples of this Includes:

- Split units across the building serving internal air conditioning units and cassettes. Most notably the Gym;
- Sauna and Steam Plant;
- Ventilation fans in bathrooms.

The air handling units across the site were all fitted with inverter driven fans. There is no scope for significant improvement without replacing all the units at a significant capital cost. There was one belt driven fan, but it is not possible to retrofit with inverter driven fan due to the risk of disturbing asbestos. It is recommended these are all retained.

Consideration should be given to installing LED lighting and solar PV on the roof. These measures offer significant carbon savings and a good return on investment and procuring a loan from the Public Works Loan Board to fund the installation could be a viable option.

Given the Theatre lighting fixture's low use, it is recommended that they be replaced as they fail as they are not as cost efficient to replace as the energy savings will be minimal.

It is recommended that the Council install the smaller (118kWp) PV system regardless but that in addition, the Council should investigate the potential of installing the ultralight PV panels on the rooftop of the Ice Rink. Traditional solar panels are not possible to be installed due to their weight, but installing ultralight flexible panels could be an option. It is recommended that the Council consider the significantly greater capital costs at installing such a system, driven by the cost of the panels themselves and the difficulty in the installation.

Given the proposals to move the building towards electric heating and the installation of a solar PV array, it is highly recommended that the Council reviews its utilities contracts and consider if switching energy supplier could be advantageous. For example, as well as paying less for electricity there could be the opportunity to gain access to a favourable export tariff to benefit from any installed PV arrays exported electricity.

The electricity usage on site will increase if proceeding with installing a low carbon electric heating system. The building will require its electrical supply to be upgraded to install and operate this equipment. The Council should liaise with the District Network Operator to get a better estimate of this cost as soon as possible if proceeding with proposals to install electrically powered heating equipment. At this stage, the estimated cost for the upgrade is **£250,000**, but costs can vary significantly. **Due to the unknown costs, this is a high risk item.**

There were a number of electrical sub-meter and heat meters across the site. Electrical submeter data was provided, but there was none available for the heat metering data. It is recommended the Council investigate why this data was not available and rectify it. By ensuring all the meters across the site are operational and producing data, the Council will effectively be able track the electricity and heating consumption as well as special uses and renewable energy generation. Energy monitoring can result in immediate savings while providing a baseline for comparing operational energy usage in the future.

At the detailed design stage, undertaking detailed thermal modelling is highly recommended, considering factors such as the building envelope heat loss, indoor comfort setpoints, occupancy patterns and local climate conditions. This would confirm the building's design heat loads and guide in determining the optimal size and configuration for the heating systems, ensuring optimal performance, energy efficiency and occupant comfort.

It is recommended that the Alphen electric chargers are retained, and if not already in place, the Council negotiate a reduced rate for its staff and/or the leisure centre staff to use them.

It is recommended that the Council replace the existing gas fired kitchen equipment with electrical equivalents, either when the existing equipment fails or before their net zero carbon target of 2032.

6 Appendix A

NOTE

Local authorities should undertake their own due diligence where appropriate rather than relying on this report. This is a feasibility study and detailed design is required prior to undertaking any works. APSE does not provide financial or investment advice and is not registered with the Financial Conduct Authority.

The options and recommendations contained within this report provide a reasonable forecast for the pre-tender capital cost and cost/carbon savings for selected projects. Further detailed design is required to determine more cost certainty and to ensure that appropriate systems are installed that optimise energy usage and provide a healthy working environment.

Products referred to in this report do not constitute a recommendation. They are for example purposes only and alternatives are available unless stated.

The current military situation impacting the supply of oil and gas from the Middle East has not been taken into account within this report. Although it is likely to have a short term impact on fuel prices the extent of this is unknown and cannot be accurately predicted.

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