



North East & Yorkshire Net Zero Hub

Heat Decarbonisation Plan and Feasibility Study Anytown school and nursery

Report

Report produced in May 2026



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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 Primary School and nursery.

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	Double Glazing Installation	-	49,746	£4,975	£268,700	54.0	12.3
2	Cavity Wall Insulation	-	75,939	£7,594	£100,800	13.3	18.7
3a	Air Source Heat Pump for Space Heating	-51,890	237,406	£5,227	£1,051,700	N/A	49.4
3b	High Temp Air Source Heat Pump Domestic Hot Water	-17,674	54,199	£365	As Above	N/A	9.3
4a	Solar Panels (59 kWp) Own Use	44,140	-	£9,603	£78,600	6.2	7.8
4b	Solar Panels (59 kWp) Export	25,723	-	£3,087	As Above	As Above	4.6
5	LED Lighting Replacement	39,817	-	£10,223	£59,000	5.8	7.0
6a	2011 Extension Electric Combi Boiler (Space Heating)	-24,428	31,932	-£3,323	£8,200	N/A	1.5

6b	2011 Extension Electric Combi Boiler (Domestic Hot Water)	-4,221	4,771	-£621	As Above	N/A	0.1
	Anytown Primary School Total	11,467	453,994	£37,128	£1,567,000	42.2	110.8

Table 2: Recommendations at Nursery

Item	Recommendation	Annual Electricity Savings (kWh)	Annual Gas Savings (kWh)	Annual Saving (£)	Capital Cost (£)	Payback in Years	Carbon Saving (tCO ₂) per year
1a	Air Source Heat Pump for Space Heating	-12,861	61,694	£1,049	£185,400	N/A	9.0
1b	High Temp Air Source Heat Pump Domestic Hot Water	-6,131	16,816	-£285	As Above	N/A	2.0
2	Kitchen Equipment Replacement	-2,537	4,228		Unknown	N/A	
3	Rectifying Overcharged Capacity	-	-	£8,000	Unknown	0.0	0.0
	Nursery Total	-21,528	82,738	£8,763	£185,400	21	11

To achieve the site's decarbonisation, and comply with net-zero objectives, it would be necessary to decommission all existing gas-fired equipment by 2030. The figure below shows the carbon trajectory if all recommended projects are completed.

Figure 1: Buildings Carbon Trajectory - Recommended Proposals Anytown Primary School

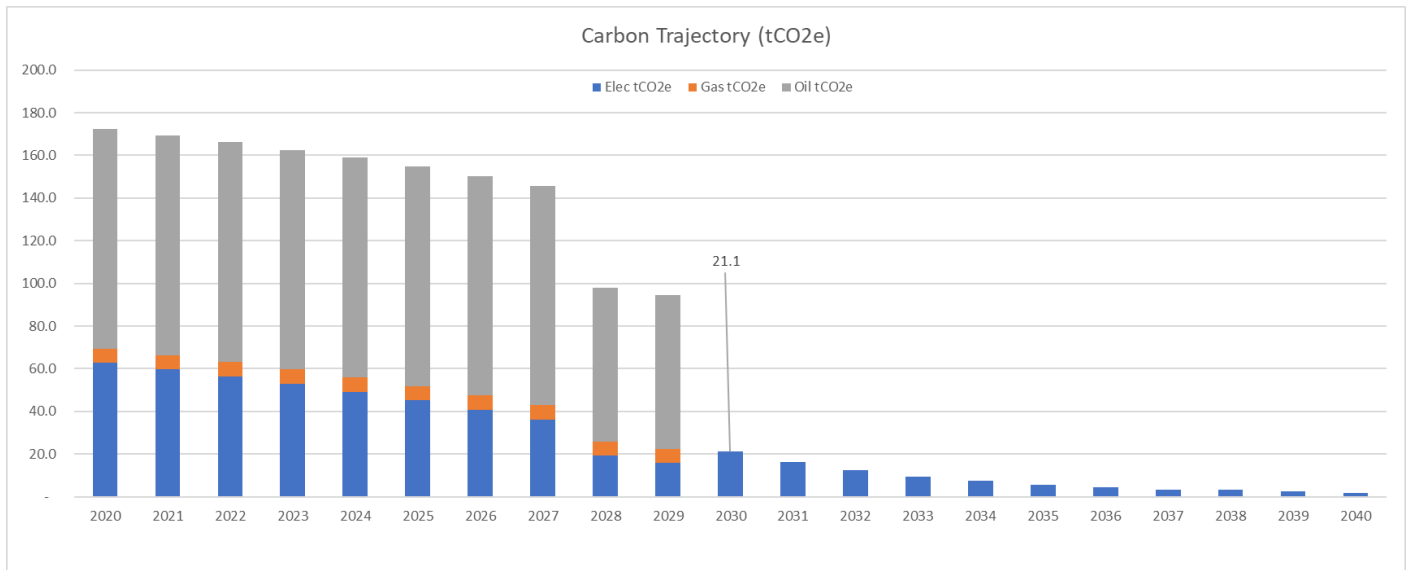
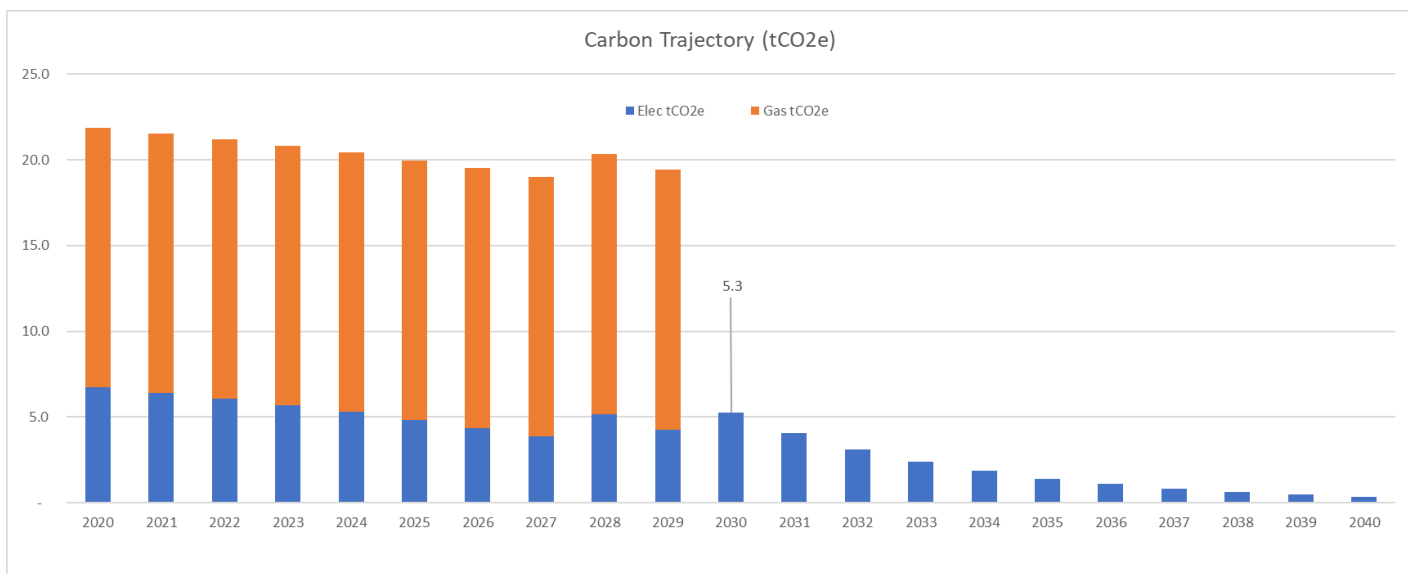


Figure 2 Carbon Trajectory – Recommended Projects at Nursery



Main Recommendations

Main Recommendations and Next Steps

Anytown Primary School

- Decommission existing oil-fired boilers by 2029 and transition to low-carbon heating. Retain one of the boilers for backup resilience.
- Install Air Source Heat Pumps (ASHPs) for space heating (LPHW) at 50°C to the new heating distribution. Install a dedicated high-temperature ASHP for domestic hot water.
- Retain and integrate upgraded heating distribution system with new plant.
- Implement sub-metering and heat metering to improve energy data accuracy and monitoring
- Deliver building fabric improvements (double glazing, cavity wall insulation subject to survey)
- Undertake thermal modelling and ventilation assessment to optimise system design and performance at detailed design stage.
- Consider LED lighting upgrades and solar PV installation (with potential external funding)
- Review and optimise utility contracts, including export tariffs for PV generation
- Plan for electrical infrastructure upgrades (~£100k estimated, high risk) to support electrification
- Retain existing electric systems (e.g. split units) and replace on failure

Nursery

- Reduce agreed electrical capacity with the DNO in the short term to achieve ~£8,000 annual savings
- Decommission gas boilers and install ASHPs to supply low-temperature heating to existing systems
- Trial lower boiler flow temperatures ahead of ASHP installation to maximise future efficiency
- Replace gas-fired water heating with high-temperature ASHP and indirect cylinder for DHW
- Implement sub-metering to track energy use and establish performance baselines
- Undertake thermal modelling to ensure correct system sizing and efficiency
- Retain existing electric systems (e.g. split units) and replace on failure
- Transition kitchen equipment from gas to electric over time (aligned with net zero targets)

2 Survey and Observations

2.1 General

Anytown Primary School and Nursery are both located at Anytown.

The School was originally constructed in 1952 of brick and blockwork but has seen a number of later refurbishments and extensions. Originally, the School was separated into a Junior and Infant School, but a 2003 extension saw the two schools connected when a reception block was constructed.

Nursery was completed in 2004. It is run separately from the School but works with the Council.

The School and Nursery are both generally open from 06:45 – 18:00 Monday to Friday.

A site plan is presented below.

Figure 3: Ground Floor Plan (School & Nursery)

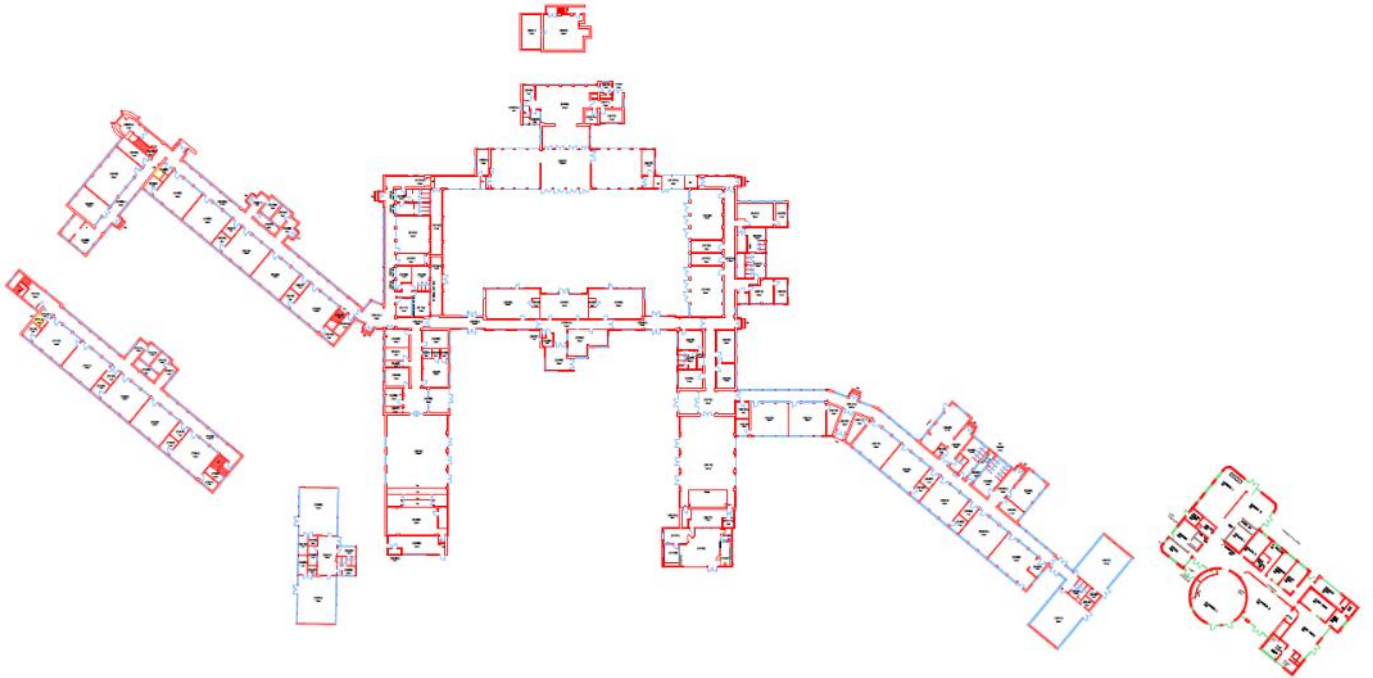
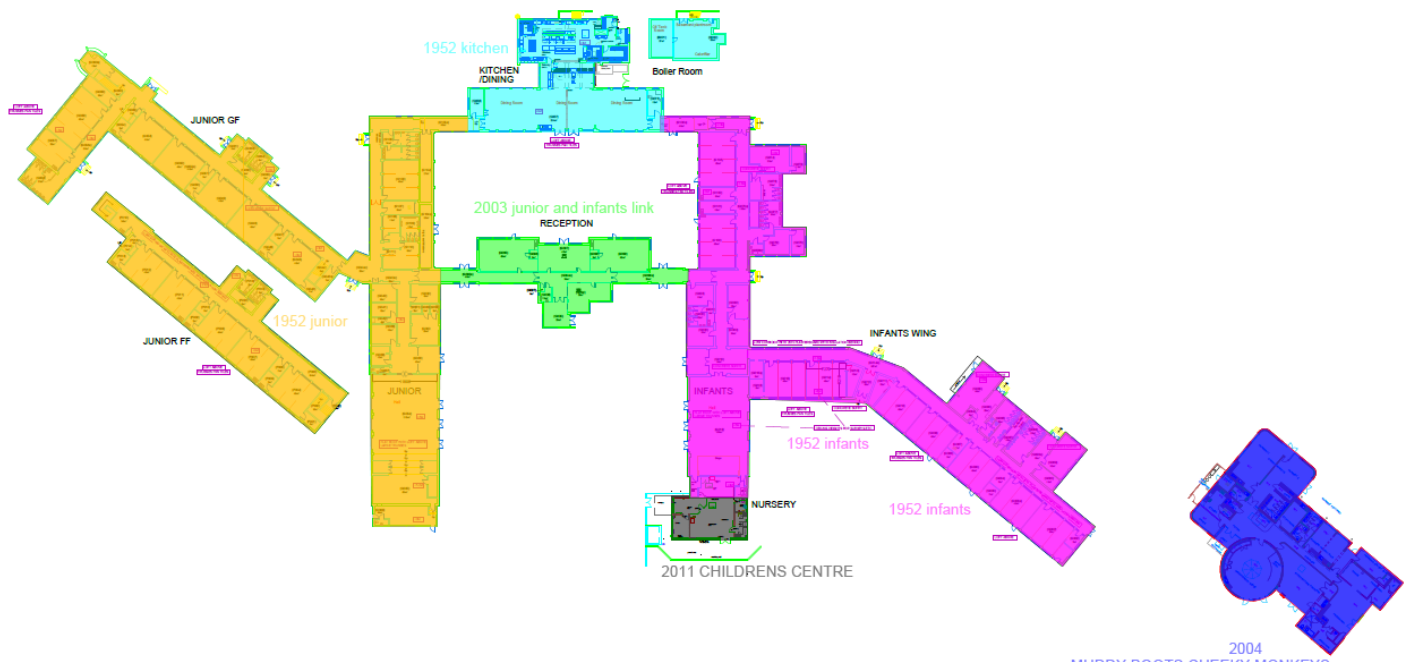


Figure 4: Ground Floor with Dates of Construction



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.

Anytown Primary School

The original School building was constructed in 1952 but has undergone numerous refurbishments and fabric improvements. The structure of the building is brick and blockwork but has a mixture of pitched and flat roofs.

Sections of the School have had their original single glazing replaced with modern double glazing. For example, the west wing, which also had broken windows boarded up, has. We were told during the site survey that there are already plans in place for the existing single glazed steel framed windows to be replaced with new double glazing with U-values of 1.1W/m²k.

Documentation provided show that there are plans for the full replacement in this section of the building. Some of the windows had already been installed at the time of the survey. However, the majority of the School still have the original steel framed single glazing installed. It is assumed that there are plans for replacement, but currently there are no solid plans in place.

Across the School, a number of the building's roof tiles have been replaced. Documentation provided by the Council showed that the areas of the building with suspended ceilings have had 250mm of insulation installed. It was not explicitly stated where this insulation was installed, so for the purposes of this report, it has been assumed that all the building's suspended ceiling has been fitted with new insulation.

The areas of the building with flat roofs and no suspended ceiling have been assumed to be as built and had no fabric improvements. The below figures clearly show replacement tiling has been installed at the west wing of the school when it is compared to a similar section constructed at the same time.

Figure 6: Newly Installed Roof Tiling



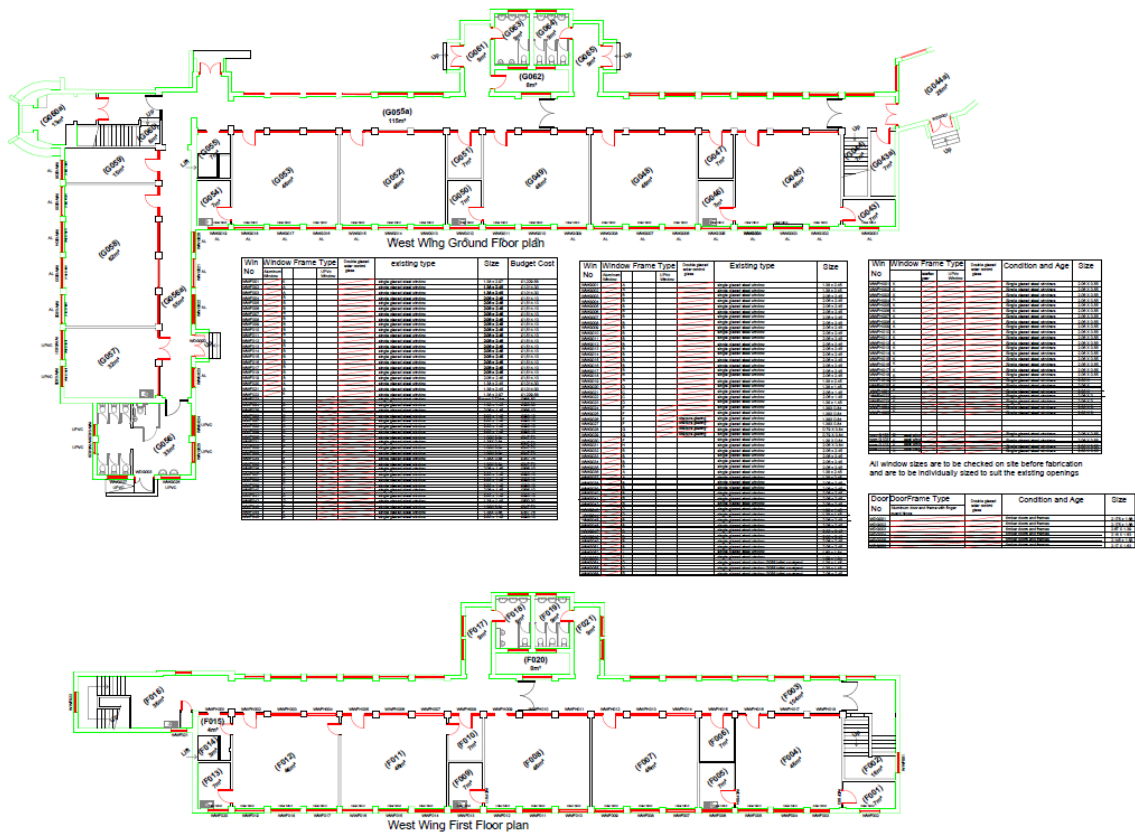




Figure 7: Brickwork and Single Glazing



Table 3: Assumed U-Values of different construction elements of the School based on historic U-values and relevant building regulations

Construction element	Construction type	U-Value (W/m ² K)
Ground floor	Concrete (1950s)	1.30
Ground Floor	Concrete (2011)	0.70
External walls	Brick (Cavity – Filled 2004)	0.35
External walls	Brick (Cavity – Filled 2011)	0.30
External walls	Brick (Cavity – Unfilled 1950)	1.50
Windows	Double Glazing (2025)	1.40
Windows	Double Glazing (2004)	2.00
Windows	Double Glazing (2011/16)	1.80

Windows	Single Glazing	5.70
Skylights	Single Glazing	2.20
Roof	Pitched with Insulation Installed	0.17
Roof	Flat (as original)	2.30
Exterior doors	-	3.00

Nursery

Nursery was constructed in 2004 and as such its building fabric is to a reasonable thermal standard. No U-values for the different fabric elements have been provided, so it has been assumed that it has been constructed to the relevant building standards.

Table 4: Assumed U-Values of different construction elements of the Nursery based on relevant building regulations.

Construction element	Construction type	U-Value (W/m ² K)
Ground floor	Concrete	0.25
External walls	Brick, filled Cavity	0.35
Windows	Double Glazing	2.00
Roof	Pitched (Loft Insulated)	0.16
Exterior doors	-	2.00

2.3 Lighting

Across Anytown School, the lighting was observed to have a mixture of LED and fluorescent lighting installed. They were all predominantly operated by manual switches, though some areas such as bathrooms did utilise PIR (Passive Infrared Sensors).

At , the majority of the lighting was already LED, with the non-LED fixtures in infrequent use.

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 5 Non-LED Lighting Fixture Inventory Anytown Primary School

Location	Lighting Fixture	Count
Various Locations	1463mm (5ft) T5 single 35W batten	123
Various Locations	1463mm (5ft) T5 twin 2x35W batten	92
Various Locations	1200mm (4ft) T8 single 36W batten	4
Various Locations	1500mm (5ft) T8 single 58W batten	4
Various Locations	600x600 T5 4 tubes recessed	17
Various Locations	600x600 T8 4 tubes surface mounted	7

Various Locations	CFL	4
Total		251

2.4 Heating and Hot Water Services

2.4.1 Heating & DHW plant

Table 6: Table summarising existing plant in the building

Equipment	Use	Building Serving	Fuel Type	Total Capacity	Gross efficiency (%)	Year Installed
3no. Hoval SR Plus 360	Heating	School	Oil	1080 kW (heat)	90	2010 (Serial)
Vaillant 824 R1	Heating & DHW	School (2011 Extension)	Gas	23	88	2011
Hoval CT Plus 520 Calorifier	DHW	School	Served from Boilers	520	-	2010
Multiple Point of Use Water Heaters	DHW	School	Electric	-	100	Various
Viesman Vitodens 200	Heating	Nursery	Gas	90	88.5	2021
Andrews Water Heater Ecoflo Compact	DHW	Nursery	Gas	21 kW 200 Litres	91	2021

Figure 8: 3no. Hoval SR Plus 360 Oil Fired Boilers



Figure 9: Existing Heating Schematic (School)

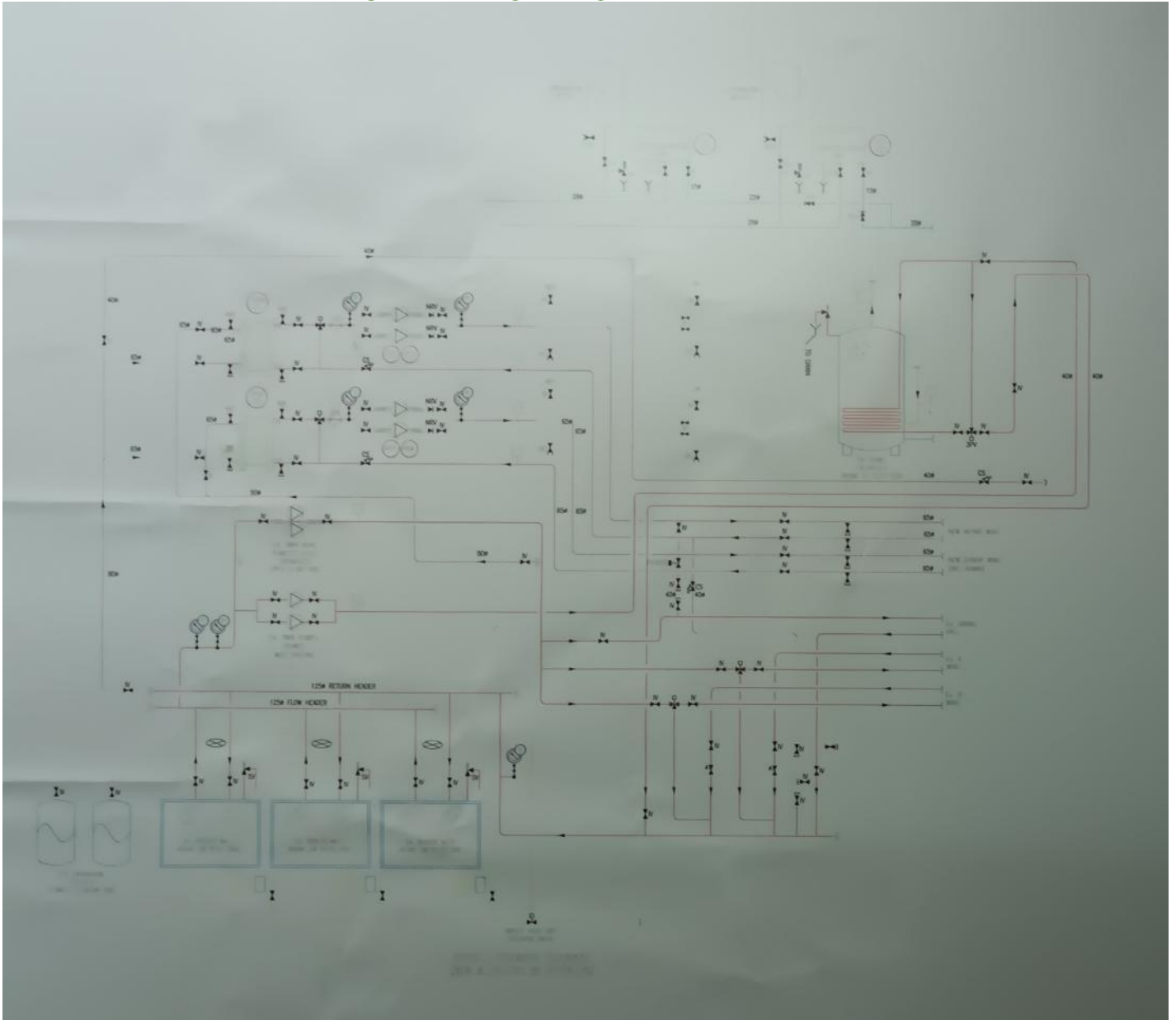


Figure 10: Anytown 2011 Extension Vaillant Gas Combi Boiler

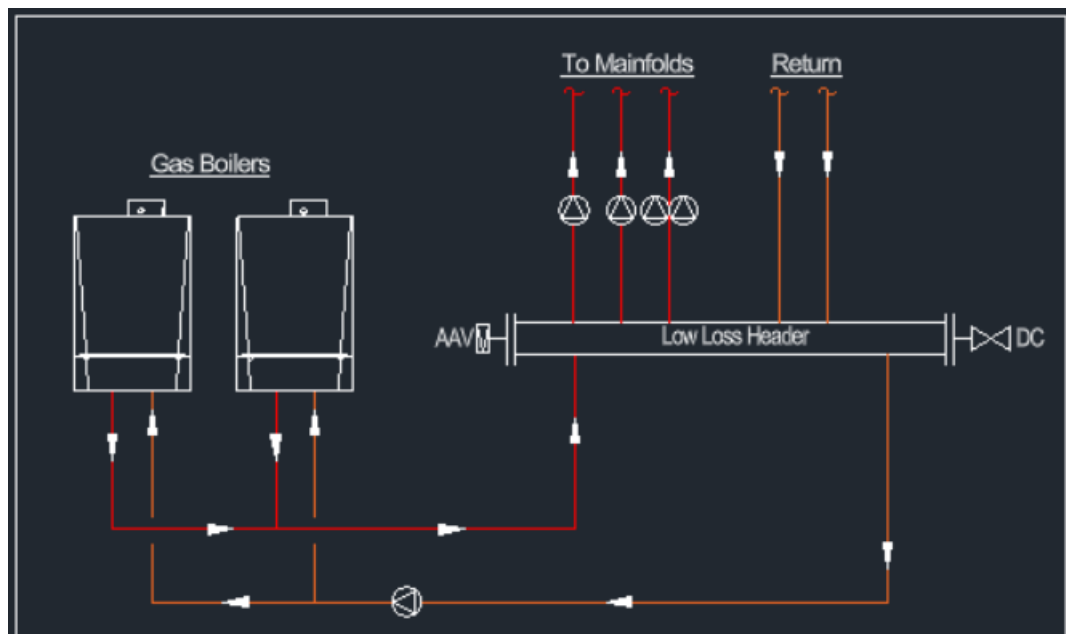


Figure 11: MBN Existing Viessmann Boilers





Figure 12: Existing Schematic



2.4.2 Heating distribution

Anytown School

The three oil boilers (with a total heating capacity of 1080 kW) originally served two secondary circuits.

The first of these secondary circuits provided LPHW for radiators across the building through the original pipework and split into three individual heating circuits, although all were supplied from two single head pumps in parallel operation.

They were labelled as the following:

- CT serving DHW Calorifier
- VT serving LPHW to dining hall
- VT serving LPHW to A Wing
- VT serving LPHW to B Wing

However, the original pipework (designed to operate at 80°C) was installed in the 1950s and has since deteriorated and needs replacement. They are having pressurisation issues on the original pipework, likely due to leaks somewhere in the building.

The Council has since identified the need to slowly replace the existing pipework and heat emitters and have a phased plan to make these improvements. Staff have mentioned that they are in phase 3 of 7, scheduled to be complete approximately in 2028.

There is no mention of phases 6 & 7, but phases 1-5 are described as:

- Phase 1: Run and Install new heating mains from basement to Junior and Infant Wing (2024). (complete)
- Phase 2: Install pipework and emitters to West Wing Ground & 1st Floor (2025) (complete)
- Phase 3: Install pipework and emitters to Junior Wing & Admin Wing (2026) (complete)
- Phase 4: Install pipework and emitters to Infant Wing 1/2 (2027)

- Phase 5: Install pipework and emitters to Junior Wing 2/2 (2028)

All these proposals are designed to operate at 50°C flow temperatures.

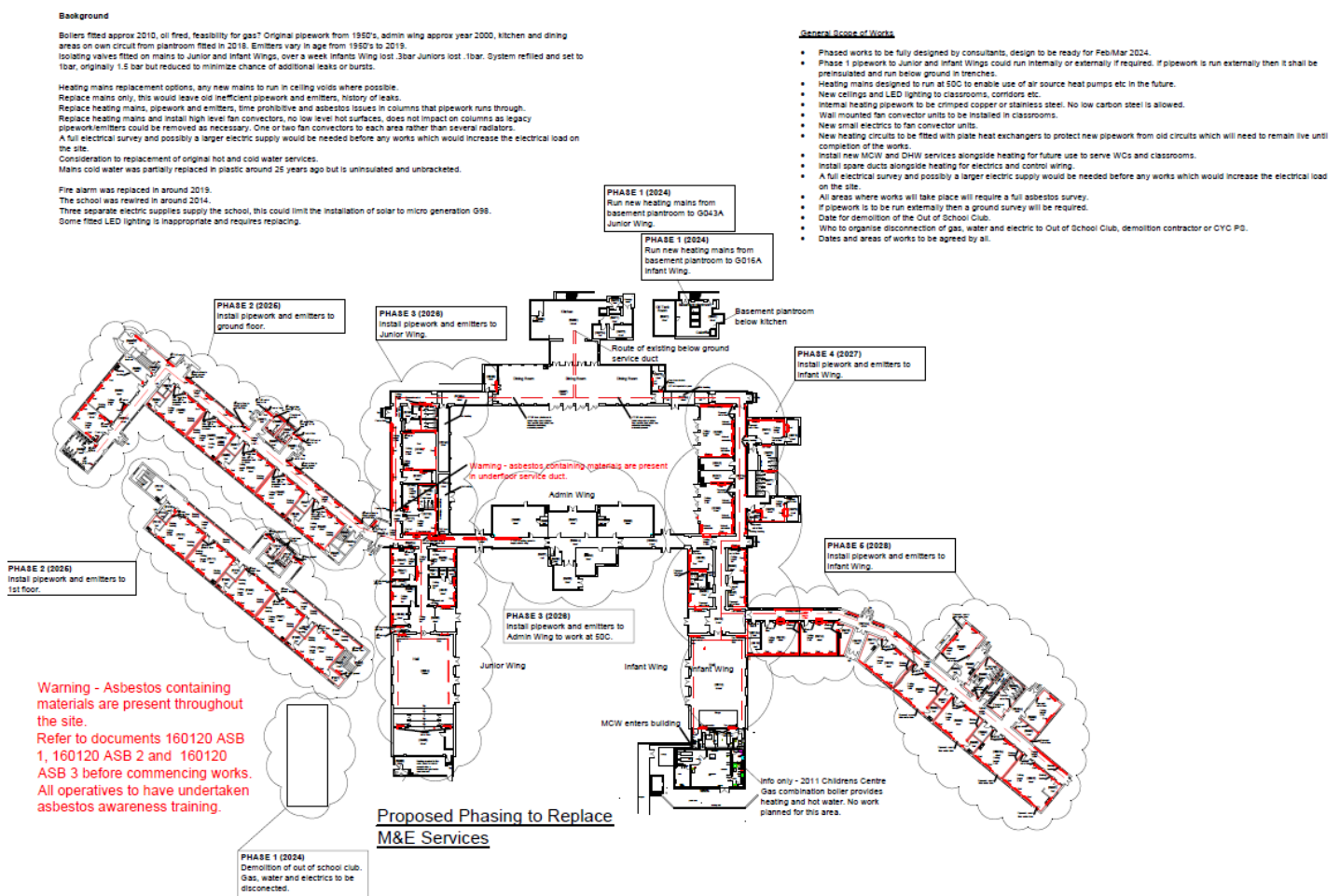
There has already been works to improve the heating distribution with Phase 1-3 complete. These works include the connection of a new separate heating circuit to the original pipework. They are hydraulically separated via 2no. Plate Heat Exchangers.

The new circuits installed are as follows:

- VT serving New Infant Wing
- VT serving New Junior Wing (Inc. Admin)

There is a desire to run the new heating distribution pipework in ceiling voids where possible to connect them to high level fan convectors to replace the radiators. Given the Council has already commissioned the work and is in the process of installation of new heating distribution pipework and emitters, we will not assign costs to install new heating distribution in any proposals.

Figure 13: Detail on Phasing of Heating Distribution Replacement



The areas marked in red above are areas identified for the new heating pipework and emitters.

Figure 14: Existing Single Pipe Heating pipework and radiator



Figure 15: Example of new High Level Fan Convectors

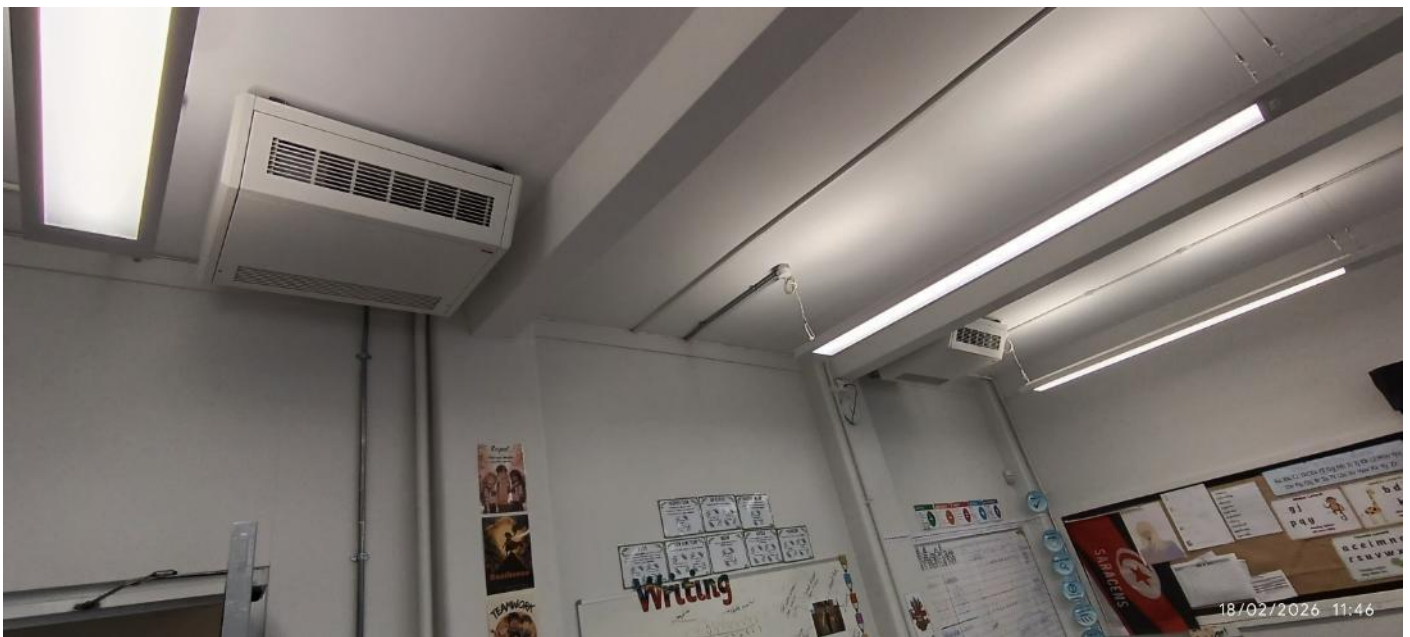


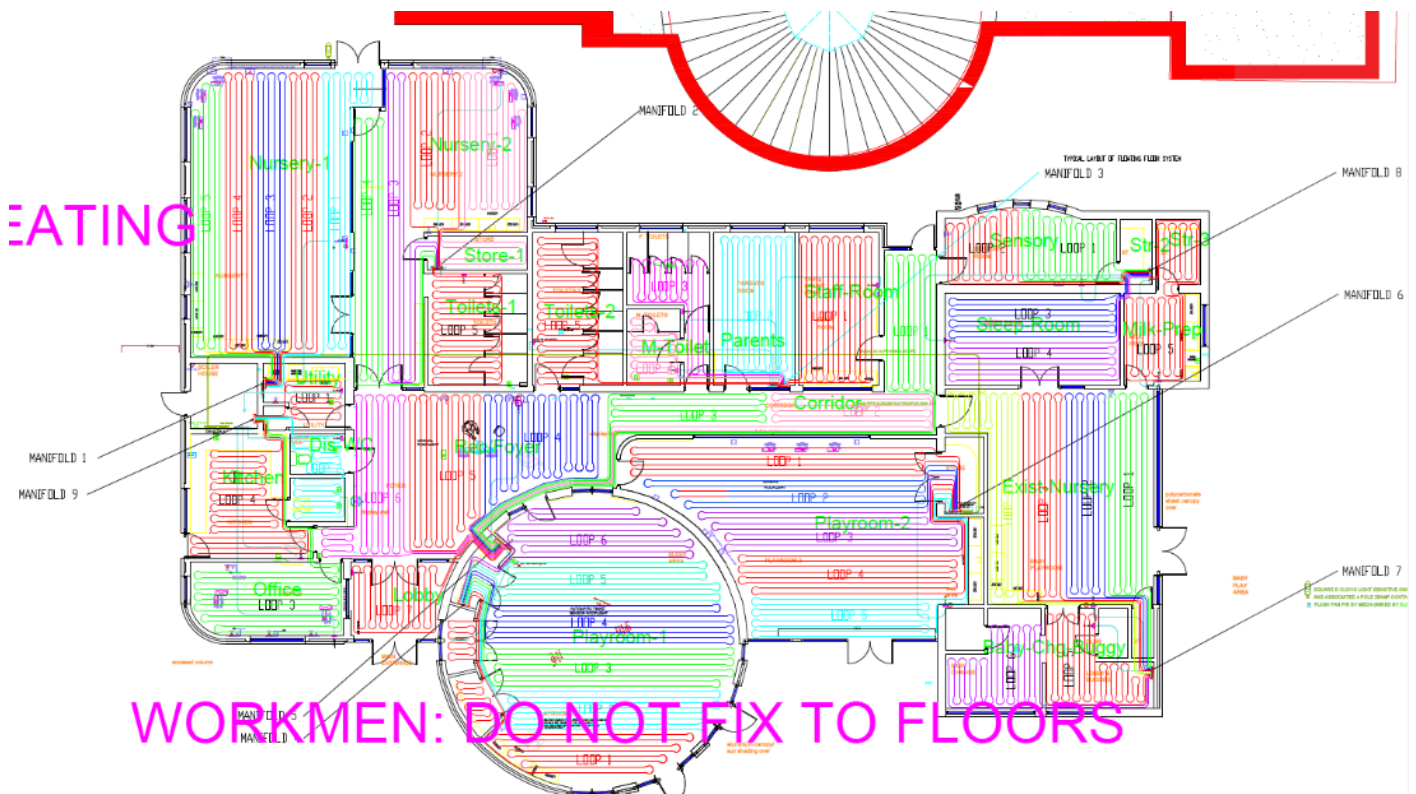
Figure 16: Overhead Radiant Panels



Nursery

The heating distribution at is all via a number of manifolds connected to an extensive underfloor heating distribution pipework. The figure below showcases the underfloor heating pipework.

Figure 17: Marked Up Plans Showing Underfloor Heating



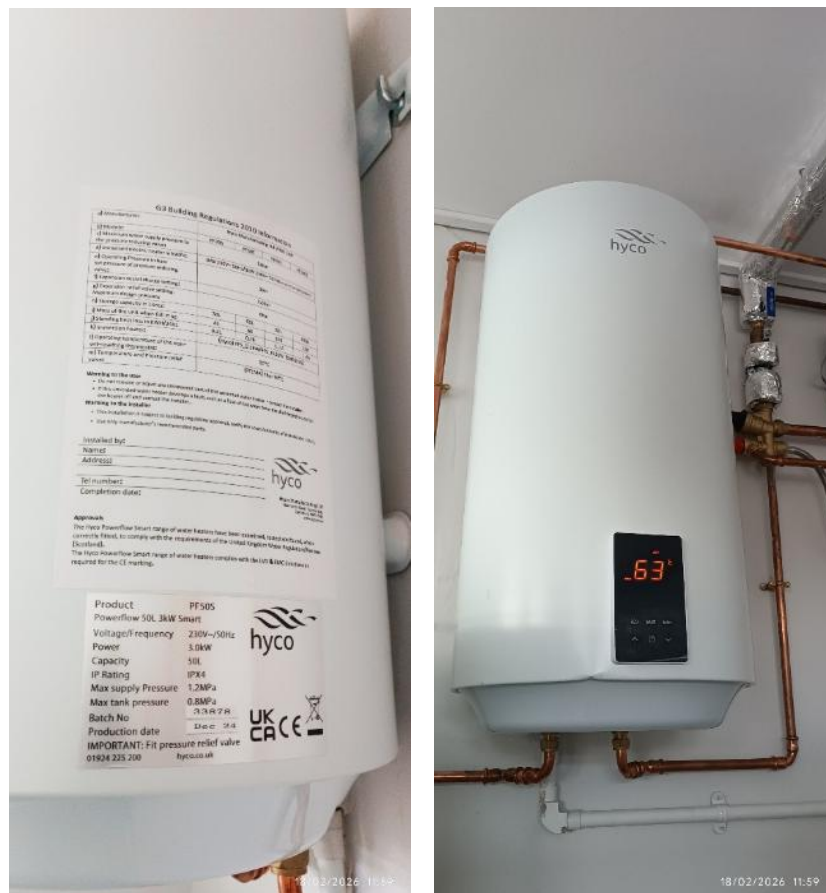
2.4.3 Domestic hot water

Anytown Primary School

The Domestic Hot Water (DHW) across the School is served via point of use electric water heaters and from the central plant Hoval CT Plus 520 Calorifier.

The electric point of use water heaters are already decarbonised, and it is recommended that the Council retain these and replace them as and when they fail.

Figure 18: Point of Use Water Heater



Nursery

At , the existing DHW is provided by a direct gas fired calorifier located in the boiler room.

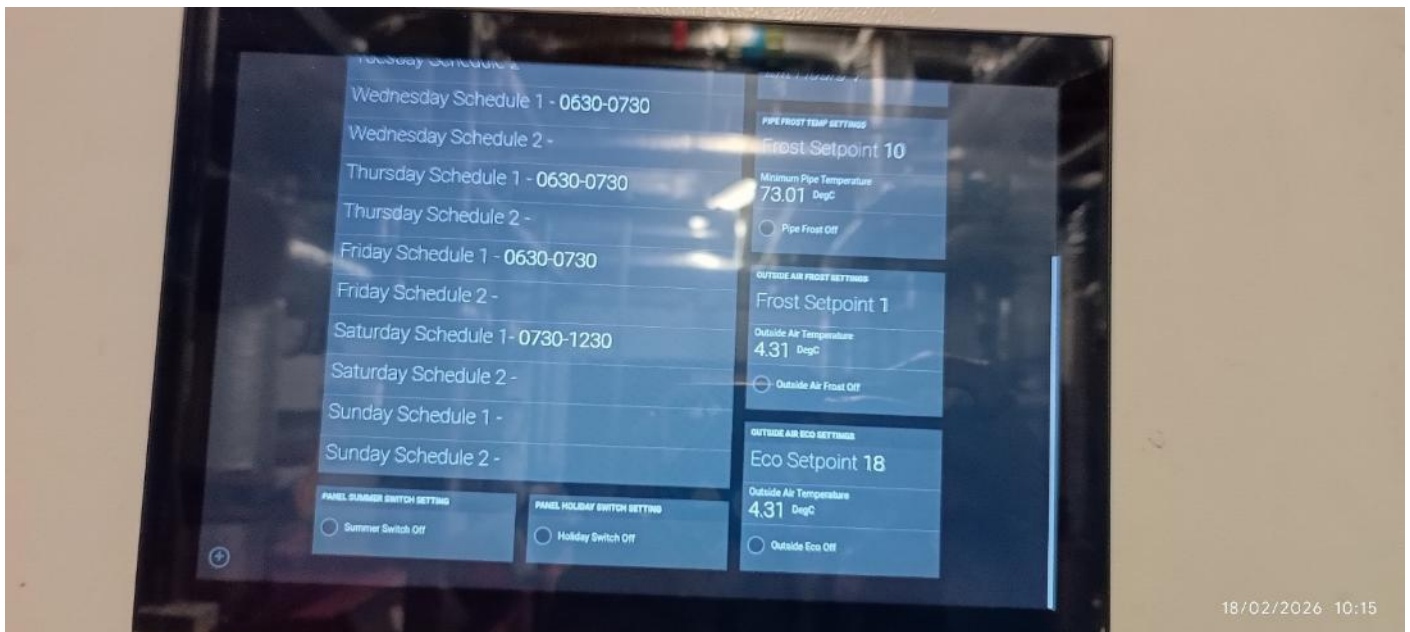
Figure 19: Andrews Water Heater at the Nursery



2.4.4 Automatic controls

Anytown Primary School

During the site survey, a comprehensive BMS and controls was observed to have been installed in the School's plant room. It was not clear what make and model the BMS was, but it displayed the ability to alter set points and time schedules. A setpoint temperature of 24°C was seen to be used across the heating zones of the School.

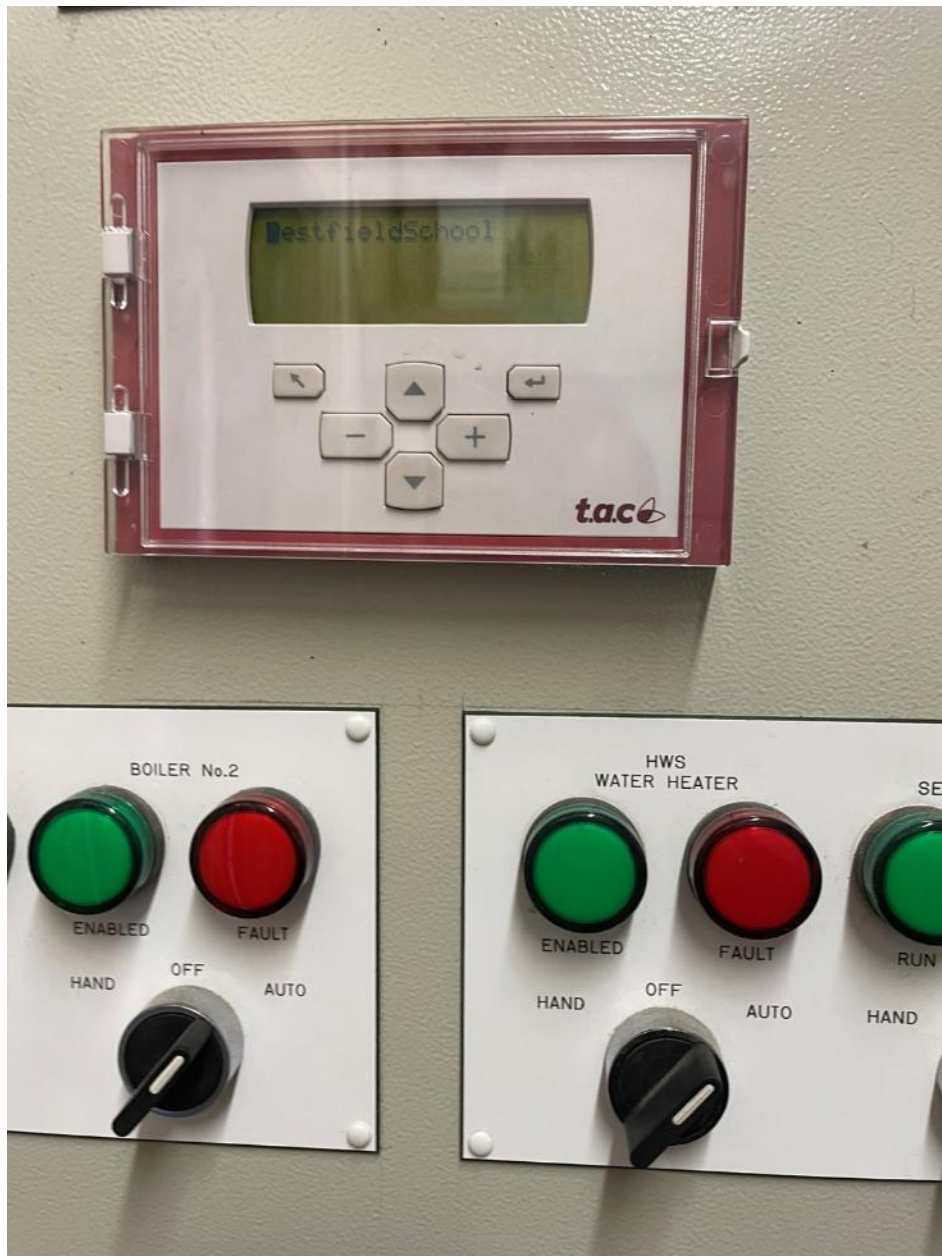


The 2011 extension in the School included a gas boiler that had a simple Honeywell controller. In addition to this, each classroom had its own digital thermostats.

Nursery

At , the existing control panel had a display screen with t.a.c controller that is assumed to be as-built. Whilst it is basic in its function, it is likely sufficient for a building of this size and function. This is due to the fact the building is unlikely to ever be in part use and so zoning controlling is less useful when compared to say a significantly larger building such as the nearby school.

Figure 20: TAC interface controller at the Nursery



2.5 Kitchens

Anytown School

There was a commercial kitchen on the ground floor of the building that both schools had originally shared. During the site survey staff reported that there was no gas fired cooking. However, during the survey a gas hob was seen installed. It is assumed that the gas has been disconnected given the staff comments and the low gas consumption at the site.

Figure 21: Gas Hob in Kitchen



Nursery

The Nursery also had a kitchen, though it was smaller and did have a gas connection. There was a gas hob and oven installed in the kitchen, and with a gas sub-meter connection too.

Figure 22: Kitchen with Gas Fired Equipment



2.6 Incoming Gas

Table 7: Installed Gas Meters

Area served	Meter Number	MPRN	Location
Anytown School	M040K0040011D6	17955104	Gas Intake Room (2011 Extension)
	M025A0122604A6	9108957805	In Boiler Room

The main gas incomer at Anytown School was fitted with a Telenor Sim.

There is also a Gas sub-meter that serves the Kitchen in .

2.7 Incoming Electrical Supplies

Table 8: *Installed Electrical Meters Anytown School*

Area served	Meter Number	MPAN	Seen During the Survey	Maximum Demand (kW)
Anytown School	E10BG63845	1591021690651	Yes	Unknown
Anytown School	E10BG63840	1591021690786	Yes	Unknown
Anytown School	E10BG63841	1591021667909	No	Unknown
Anytown School	E10BG63844	1591121667904	No	Unknown

Data has been provided for 4no. electrical meters. Only 2 were seen during the site survey. Unfortunately, a full year's consumption data has not been provided. In the absence of a full year's consumption data the average annual electrical consumption of a typical school that size has been used. The maximum demand at the school was unavailable.

Table 9: *Installed Electrical Meters Nursery*

Area served	Meter Number	MPAN	Location	Maximum Demand (kW)
Nursery	E23W000529	1580000216950	Plant Room	24

The main intake and distribution panel indicated that the supply was rated at 400 Amps and had a CT ration of 150:5

***The maximum demand was calculated based on half hourly electrical data provided by the Council.**

2.8 Renewable Technologies

There is PV installed on the main flat roofs of the School. It was unclear what size and age the PV system was

At they have installed a solar panel system via the solar for schools scheme. It is unclear exactly how large the system is or when it was installed. The Inverter, a Solis S5-GR3P15K for the PV system is located in the boiler room indoors.

There are also a number of outdoor split units across the two buildings that provide air conditioning. It is recommended that these be retained as they are already decarbonised.

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 limited space not clearly seen from the ground would be better utilised by solar photovoltaic panels. In addition, given the part of the buildings DHW is supplied by point of use water heaters it has been discounted.

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 20 W 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 12 m 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).

There is very limited space at the site, and any boreholes would be extremely expensive and disruptive, so at this stage has been discounted.

3.1.3 Building Fabric

Anytown Primary School

The original building was constructed in the 1950s and as such the fabric is not to a good standard. There are some measures that have been taken already to improve the buildings fabric, such as:

- Double glazing replacing single glazing (part of the building)
- Loft Insulation (250mm) installed in space above suspended ceilings.

Some of the external walls are originally from the 1950's and as such we have assumedly are unfilled, it would be more appropriate to use spray foam insulation compared with external wall insulation. In addition, the suspended ceilings have had 250mm of insulation installed in the cavity.

The following fabric improvement measures have been discounted at this stage:

- Loft Insulation (already installed)
- External Wall Insulation (cavity is preferred)
- Replacing double glazed windows (already decent thermal performance).

Figure 23: Building Facade



Nursery

At , the building was recently constructed in 2004, so the building fabric is already to a good standard. Due to this, it would not be cost effective to install improvements in order to lower the energy consumption so this has been discounted at this stage.

3.1.4 District Heating

Currently, there are four district heat networks planned to be developed in Anytown and the surrounding area according to the government's heat network database. (Gov.UK)¹ However, none of these heat networks are in close proximity to the building.

It is unlikely that in the near future that the building will be able to connect up to a district heat network. None are listed as in development.

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 the buildings, as measured from the provided floor plans is approximately:

- Anytown Primary School: 5,000m².
- Anytown Primary School 2011 extension: 75m².
- Nursery: 520m².

The different buildings have been separated as they will have separate heating systems. The School's 2011 extension has also been separated, as it is heated on a separate system to the rest of the School. Though, given this also supplies domestic hot water, it is proposed an electric combi boiler of equal size is installed.

Where plans are in place for fabric improvements, such as the proposed plan to install new double glazing in the west wing, the proposed U-values have been used rather than the existing given the works are already commissioned.

Table 10: Anytown School Peak Heat Loss Summary

Existing Heat Capacity (Boilers) (kW)	Existing W/m2	Existing DHW Capacity (kW)	Calculated Existing Peak Heat Loss (kW)	Calculated Existing Peak Heat Loss Post Fabric Changes (kW)	Proposed New Heating W/m2
1080	216	Point of Use & Unknown	684	602	119

Table 11: Peak Heat Loss Summary

Existing Heat Capacity (Boilers) (kW)	Existing W/m2	Existing DHW Capacity (kW)	Calculated Existing Peak Heat Loss (kW)	Proposed New Heating W/m2
90	174	21	60	116

¹ www.data.gov.uk/dataset/8a5139b3-e49b-47bd-abba-d0199b624d8a/heat-networks-planning-database

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.

3.3 Fabric Replacement (Cavity Wall Insulation & Double Glazing)

Given Anytown Primary School was originally constructed in the 1950's there are elements of the building that can be improved upon. Conversely, Nursery was recently constructed in 2004 and to good thermal standards. It is not recommended that any fabric improvements are made at the Nursery.

It is proposed that the existing fabric at Anytown Primary School be improved upon by:

- 1951 cavity wall be insulated with spray foam insulation.
- The single glazing be replaced with modern double glazing.

Table 12: Proposed Fabric Improvements

Construction element	Construction type	U-Value (W/m ² K)	Improved U-Value (W/m ² K)
Ground floor	Concrete (1950s)	1.30	1.30
Ground Floor	Concrete (2011)	0.70	0.70
External walls	Brick (Cavity – Filled 2004)	0.35	0.35
External walls	Brick (Cavity – Filled 2011)	0.30	0.30
External walls	Brick (Cavity – Unfilled 1950)	1.50	0.40
Windows	Double Glazing (2025)	1.40	1.40
Windows	Double Glazing (2004)	2.00	2.00
Windows	Double Glazing (2011/16)	1.80	1.80
Windows	Single Glazing	5.70	1.80
Skylights	Single Glazing	2.20	2.20
Roof	Pitched with Insulation Installed	0.17	0.17
Roof	Flat (as original)	2.30	2.30
Exterior doors	-	3.00	3.00

NOTE: Items without retrofit U-values are not recommended for improvement and should be retained unless there are existing defects that need addressing.

The table below shows the budgetary capital costs for the proposed fabric improvements. No allowances have been made for handling deleterious/hazardous materials (i.e. asbestos), where present, or for improvement works to the

existing building structure before retrofitting. It is recommended that further investigations and design be conducted prior to the proposed works to ensure that the proposals are suitable for the building and that any existing structural/fabric issues are identified and remedied.

3.3.1 Budget Cost Estimate

The following table breaks down the proposed fabric improvements and the cost.

Table 13: Fabric Costs Breakdown

Item	Description	Cost
1	Preliminaries	£6,900
2	Double Glazing	£227,600
3	Cavity Wall Insulation	£85,300
4	Scaffolding	£32,000
5	Contingency Sum	£17,600
6	Total	£369,400

3.4 Plant Replacement & Heat Decarbonisation

To fully transition from fossil fuel plant and to align with the Council's goal of achieving their 2030 net-zero carbon emission targets, the currently installed gas and oil fired boilers and water heaters that provide the different buildings with LPHW for space heating and DHW would need to be decommissioned, disconnected, and removed from the site. (excluding equipment retained for backup resilience).

For the purposes of this report, the two buildings: Anytown Primary School and Nursery have been treated separately. The following sections detail the proposals for the plant replacement at each building separately.

3.4.1 Anytown Primary School

At Anytown Primary School the existing heating distribution is in the process of being replaced with new distribution pipework and emitters. The new distribution pipework is designed to be able to effectively heat the building at lower flow temperatures of 50°C. Any new proposals will be designed to produce flow temperatures at 50°C to enable compatibility with this new distribution pipework and emitters, alongside being sized to meet the peak heat loss at an ambient temperature of -5°C.

To fully decarbonise the site, the existing oil boilers would need to be decommissioned and removed from the building. However, in the interest of energy security and having back up reliance, it is recommended to retain one of the boilers in the plant room. The design intent would be for the oil boiler to not be used, and only in place to be

used if the ASHPs require maintenance. It does also cover the Council if extreme weather conditions require higher flow temperatures.

It is proposed that in the oil boilers place, 10no. ASHPs and associated equipment are installed to provide 50°C to the new distribution pipework, due to be fully installed in 2028. The ASHPs will require the installation of buffer vessels, which will be connected to the new distribution pipework's secondary circuits.

Given the Council's net zero goal is in 2030, the existing oil boilers will be connected to the new distribution at first, with works then commencing in the summer of 2029 to enable the connection of the new ASHPs to the distribution pipework ready for 2030. As the work to install new heating distribution and emitters is already underway, the cost of this has not been included in the cost breakdown.

Domestic Hot Water

Currently, there is an indirect water cylinder that the existing oil boilers feed that provides the building with DHW.

To fully decarbonise the existing gas fired water heater should be decommissioned and removed from site. Due to the temperature requirements, the ASHPs that are intended for use with the space heating cannot provide DHW to the building by themselves.

Alternatively, it is recommended that a dedicated high temperature heat pump be installed to provide the building with DHW. It is proposed that it be connected up to the existing indirect heating coil and cylinder via connection from a buffer vessel. While this system won't have as high efficiency as the lower temperature ASHPs, it will be significantly more efficient than a standard electric boiler.

System Locations

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 systems externally outside the existing plant room. An external compound with acoustic attenuation would have to be constructed given the building's use as a School.

The proposed location is 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 and subject to approval from local planning. Considerations include but are not limited to retaining the character of the building, 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.

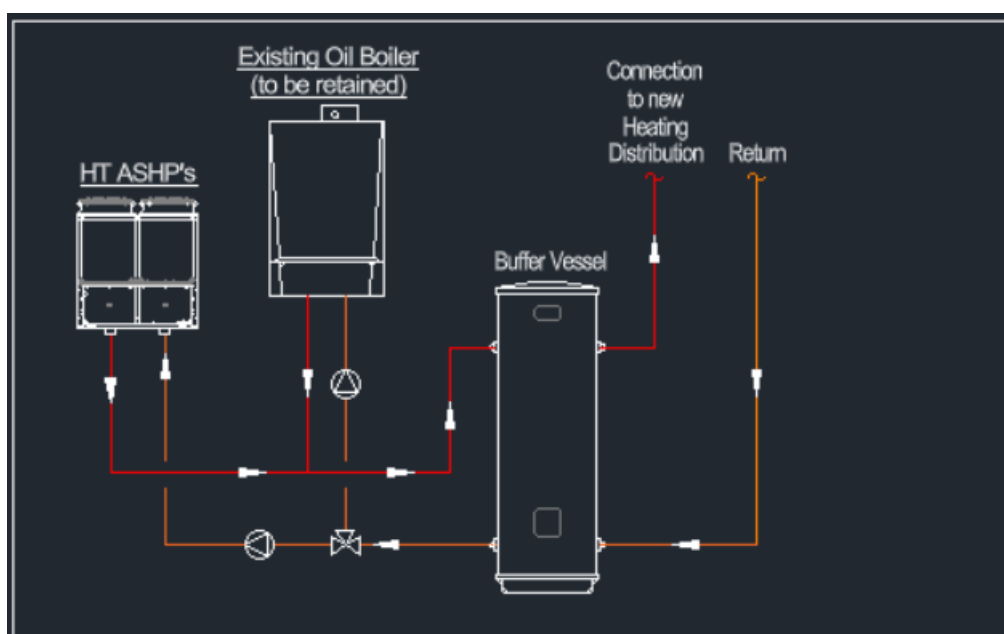
Figure 24: Proposed Locations of ASHP Compound (Blue Hatch)

Table 14: Proposed Space Heating & DHW Equipment

Space Heating or DHW	Equipment	Total Proposed Capacity (kW)	SCOP	Flow temperature (°C)	Heat Emitter Replacement
Space Heating	10no. Lochinvar LAHP-88HTR290	600	3.50	50	No
DHW	1no. Lochinvar LAHP-88HTR290	57	2.76	65	N/A

Due to the different load and temperature requirements, the same equipment has different SCOP and capacity values per unit (kW) when providing 50°C and 65°C at -5 ambient temperatures. The ASHP selected is capable of producing a range of flow temperatures.

Figure 25: Typical Proposed ASHP Space Heating Schematic



The budgetary estimate for implementing the ASHPs for space heating and HT-ASHP for DHW to serve the building is approximately **£1,051,700** and is broken down as:

Table 15: Anytown Primary School ASHP for Space Heating & DHW Cost Breakdown

Item	Description	Costs
1	Preliminaries	£15,800
2	ASHP and Equipment	
2a	Air Source Heat Pump	£382,200

2b	DHW Air Source Heat Pump	£38,300
2c	Acoustic Attenuation/ External Compound	£51,000
2d	Pressurisation Unit(s) & Expansion Vessel(s)	£3,200
2e	Plant Room Pipework, Valves, & Ancillaries	£65,600
2f	Buffer Vessel (heating)	£6,500
2g	Buffer Vessel (DHW)	£800
2h	Automatic Controls	£25,000
2i	Electrical Works	£49,200
2j	Interconnecting Pipework (ASHP to Plant Room)	£3,600
2k	Glycol Antifreeze	£6,800
2l	Builders' Work	£54,700
3	Upgrading Main Incoming Electrical Supply	£100,000
4a	Testing & Commissioning	£1,500
4b	Demonstration & Training	£1,000
4c	Record Information	£500
5	Contingency Sum	£120,900
6	Works Budget Total	£926,600
7a	Design Fees	£83,400
7b	Project Management Fees	£41,700
8	Project Budget Total	£1,051,700

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.

It also assumes that the planned works to improve the heating pipework will be implemented. A cost has been attributed to the construction of an external compound.

3.4.2 Anytown Primary School – 2011 Extension

In 2011 an extension on the south side of the School was constructed and is highlighted in the figure below. This extension was served via a small capacity gas combi boiler that provided both LPHW to the heating distribution alongside DHW.

Given the small scale and limited use, installing an ASHP would not be cost effective. Instead, it is proposed that the gas-fired combi boiler be decommissioned and an electric combi boiler be installed in its place.

Figure 26: Location of 2011 Extension

The electric boiler would be a 1:1 replacement and would require no additional work as it is able to work with the existing pipework infrastructure for heating as well as DHW.

The budgetary estimate for implementing the electric combi boiler for space heating and DHW to serve the 2011 extension is approximately **£8,200** and is broken down as:

Table 16: Anytown Primary School 2011 Extension Electric Boiler for Space Heating & DHW Cost Breakdown

Item	Description	Cost
1	Preliminaries	£200
2	Plant Room(s)	
2a	Removal of Existing Building Plant & Equipment	£200
2b	Electric Combi Boiler	£1,200
2c	Plant Room Pipework, Valves, & Ancillaries	£500
2d	Electrical Works	£500
2e	Civil Works	£100
2f	Builders' Work	£1,200
3a	Testing & Commissioning	£1,000
3b	Demonstration & Training	£1,000
3c	Record Information	£500
4	Contingency Sum	£700
5	Works Budget Total	£7,100
6a	Design Fees	£700
6b	Project Management Fees	£400
7	Project Budget Total	£8,200

This is with the assumption that all of the existing distribution pipework and equipment are retained.

3.4.3 Nursery

At Nursery the existing heating distribution is already capable of working alongside an Air Source Heat Pump. There is underfloor heating installed across the building, which is expected to be able to effectively heat the building at lower flow temperatures.

Given the building was constructed in 2004, the existing underfloor heating is likely designed to operate at flow temperatures of approximately 45°C – 50°C. These temperatures mean that the existing underfloor heating can be retained to work alongside new ASHPs that can provide these flow temperatures at high efficiencies.

It is highly recommended that before any of the recommendations are implemented by the Council, that the staff at first test to see if the proposed heating flow temperatures can heat the building over a winter period when the building will be losing the most heat.

To fully decarbonise the site, the existing gas boilers would need to be decommissioned and removed from the building. However, in the interest of energy security and having back up reliance, it is recommended to retain one of the gas boilers in the plant room. The design intent would be for the gas boiler to not be used, and only in place to be used if the ASHPs require maintenance. It does also cover the Council if extreme weather conditions require higher flow temperatures.

It is proposed that all the existing distribution pipework and pumps be retained as the new equipment will be designed to work alongside them and avoid the heavy capital cost of replacement.

Domestic Hot Water

Currently, there is a direct gas fired Andrews water heater that provides the building with DHW. Due to the temperature requirements, the ASHPs that are intended for use with the space heating can not provide DHW to the building by themselves.

To fully decarbonise, the existing gas fired water heater should be decommissioned and removed from site. In its place, it is recommended that a dedicated high temperature heat pump be installed to provide the building with DHW. It is proposed that a new indirect cylinder with an indirect heating coil is installed alongside the new high temperature ASHP, that be connected to the existing DHW distribution pipework. While this system won't have as high efficiency as the lower temperature ASHPs, it will be significantly more efficient than a standard electric boiler.

This was an important design consideration, as the expected demand of DHW at the site is high. Due to this it was decided to recommend a higher capital cost but more efficient system, than a low capital but high operational cost electric boiler. If the DHW demand at the site was low, like in an office for example, then installing an electric boiler could have been the better option.

System Locations

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 systems externally on the roof of the building and have the connection pipes run overhead to the plantroom. This is due to the available space on the roof and lack of free space alongside the building.

This is subject to a structural survey, and if it is not possible to install the equipment on the building's flat roof, then an external compound would have to be constructed. There is insufficient space adjacent to the plant room due to a public footpath, but there could be space to the north of the building. It is assumed that this would be undesirable

due to the fact it would involve reducing the available outdoor play area and space, but options will be limited if the equipment cannot be installed on the roof.

Due to the uncertainty concerning whether equipment can be housed on the roof, the cost to construct an external compound has been included in the cost breakdown to install low carbon heating and DHW across the building.

The proposed location is 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 and subject to approval from local planning. Considerations include but are not limited to retaining the character of the building, 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 27: Proposed Locations of ASHP Compound (Blue Hatch)



The above figure highlights possible locations to install equipment such as ASHPs

Table 17: Proposed Space Heating & DHW Equipment

Space Heating or DHW	Equipment	Total Proposed Capacity (kW)	SCOP	Flow temperature (°C)	Heat Emitter Replacement
Space Heating	2no. Daikin EWYT040BCZNBA2	66	3.60	45	No
DHW	1no. Daikin EWYE030CZ	21.2	2.50	65	N/A

Figure 28: Proposed Schematic

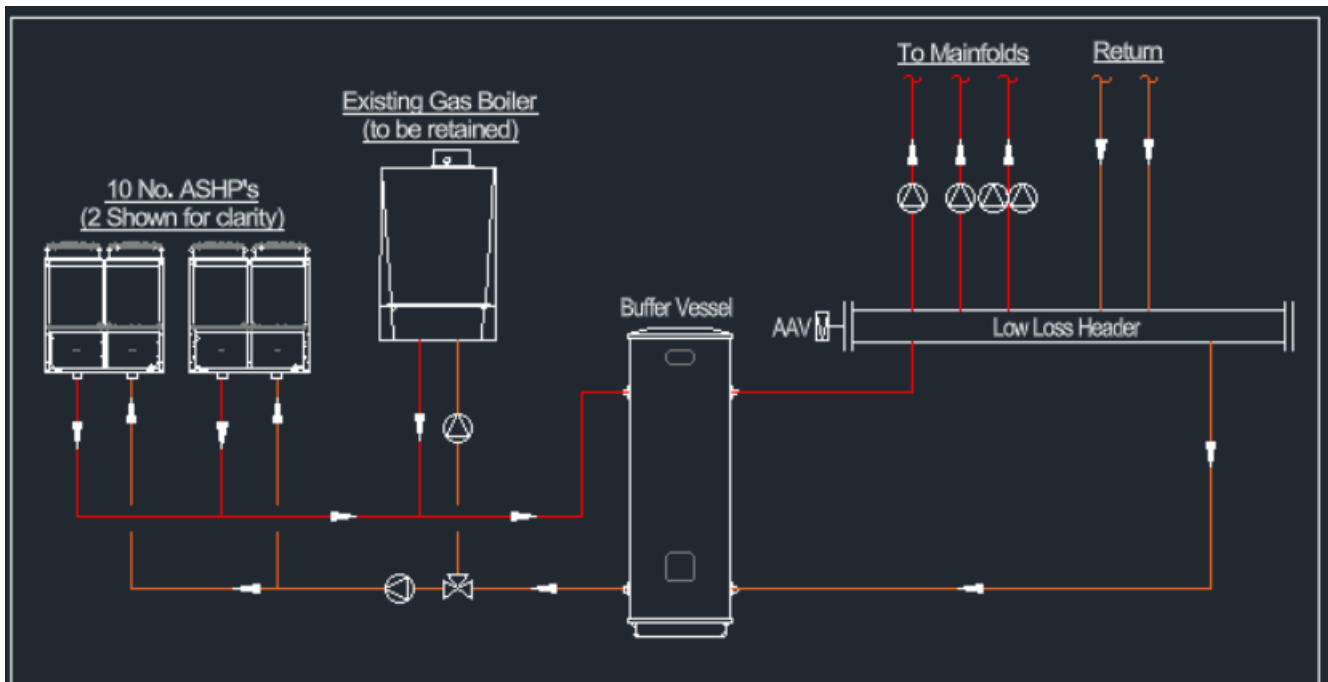
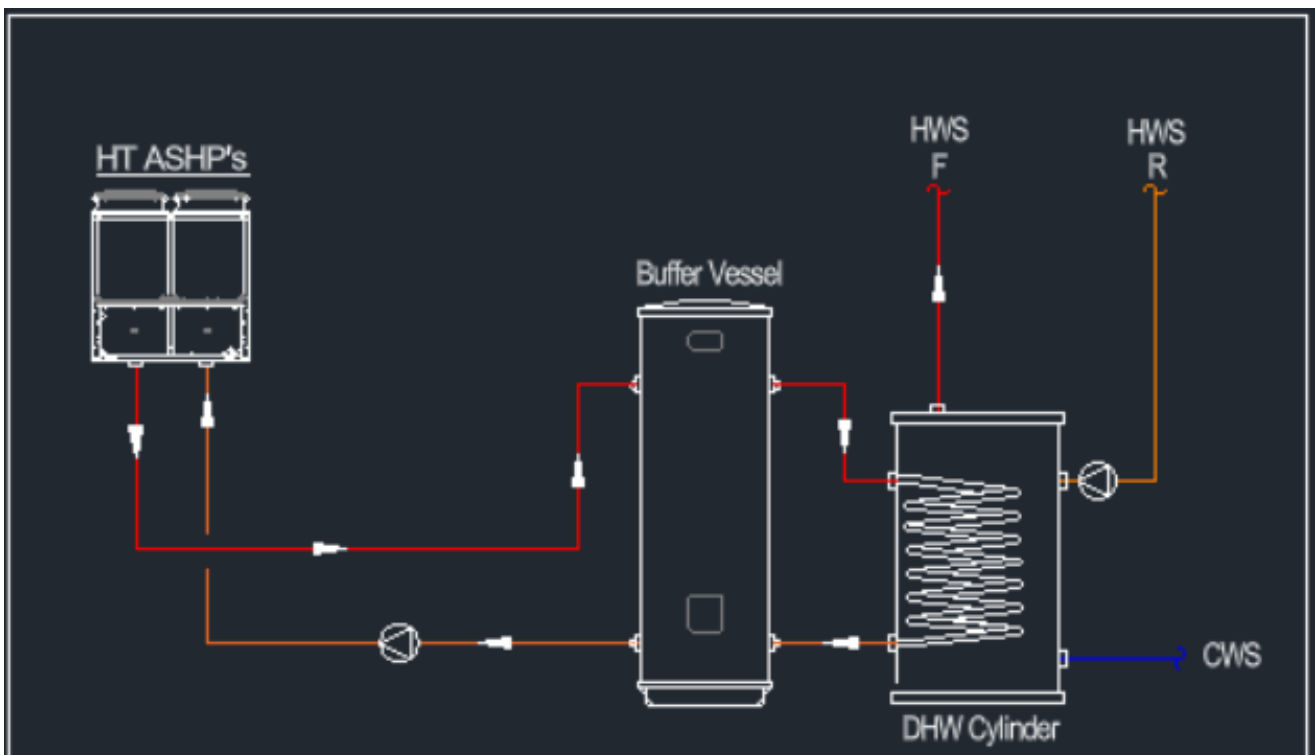


Figure 29: Proposed DHW Schematic



The budgetary estimate for implementing the ASHP's for space heating and HT-ASHP for DHW to serve the building is approximately **£185,400** and is broken down as:

Table 18: Nursery ASHP for Space Heating & DHW Cost Breakdown

Item	Description	Costs
1	Preliminaries	£2,800
2	ASHP and Equipment	
2a	Air Source Heat Pump (Heating)	£40,800
2b	Air Source Heat Pump (DHW)	£16,300
2c	Acoustic Attenuation	£12,000
2d	Construction of External Compound	£12,700
2e	Pressurisation Unit(s) & Expansion Vessel(s)	£2,700
2f	Plant Room Pipework, Valves, & Ancillaries	£6,400
2g	Buffer Vessel (Heating)	£900
2h	Buffer Vessel (DHW)	£700
2i	Indirect Cylinder (300 Litres)	£700
2j	Automatic Controls	£20,000
2k	Electrical Works	£4,800
2l	Interconnecting Pipework (ASHP to Plant Room)	£9,100
2m	Glycol Antifreeze	£800
2n	Builders' Work	£8,300
3a	Testing & Commissioning	£1,500
3b	Demonstration & Training	£1,000
3c	Record Information	£500
4	Contingency Sum	£21,300
5	Works Budget Total	£163,300
6a	Design Fees	£14,700
6b	Project Management Fees	£7,400
7	Project Budget Total	£185,400

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.

It also assumes that the existing heating distribution and existing pumps will be retained. A cost has been attributed to the construction of an external compound, but subject to a structural survey of the building's roof might not be required.

3.4.4 Boiler Like for Like Replacement Cost Breakdown

The table below shows a comparable estimate to replace the space heating boilers at both the School and Nursery like-for-like:

Table 19: Space Heating Boiler Like for Like Replacement

Item	Estimated Cost
Removal of Existing Equipment	£2,000
Main Equipment	£59,900
Plinth, Pipework Connections, Insulation	£6,000
Installation	£15,000
Commission	£1,000
Total	£83,900

3.4.5 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.

Anytown Primary School

As mentioned, there are a number of electrical meters across the school, although only two were seen at the School. It is not clear which meter serves the boiler plant, nor what their existing agreed import capacity is at the site. The details are shown below.

Table 20: Electricity meters across the School

Meter Number	MPAN	Seen During the Survey	Amps	Voltage	Maximum Demand (kW)
E10BG63845	1591021690651	Yes	250	415	Unknown
E10BG63840	1591021690786	Yes	Unclear	Unclear	Unknown
E10BG63841	1591021667909	No	-	-	Unknown
E10BG63844	1591121667904	No	-	-	Unknown

Meter: E10BG63845 and E10BG63840 were the main meters the two PV arrays at the School were connected to.

Due to the lack of information, and the large capacity of the proposed electrical equipment, it has been assumed that the existing electrical infrastructure at the site will need to be upgraded.

The costs of this are often unknown and can be significant. We have associated a cost of **£100,000** for these upgrades at this stage for the ASHPs install. **This is a high-risk item as the cost to upgrade the electrical infrastructure can be significant and vary significantly.**

It is recommended that the Council liaise with the DNO ahead of 2030 when the proposed electrical equipment is installed to ascertain if this is possible or if they will have to fund electrical infrastructure upgrades.

The main meter is 3-phase, 400 Volts with a 496 KVA capacity according to a provided invoice.

Table 21: Electrical Capacity Requirements

Maximum Import Capacity (kVA)	Current Max Demand (kVA)	ASHP Electrical Demand (kVA)	Resultant Spare Capacity (kVA)
496	23	67	406

The maximum demand was calculated from half-hourly electrical data provided by the Council over a larger time period than the invoice. It is worth noting that currently, the Council is unnecessarily paying for a significant capacity that they are not utilising and do not need with the current equipment at the Nursery.

The Council are paying £726 a month for a capacity of 496 kVA, of which they have used a maximum 23 kVA over a period of 2 years. That translates to approximately 5% of the available capacity being used

This translates to an **annual cost of £8,712**, just to supply the 496 kVA capacity. A more sensible capacity of 40 kVA would cost £763.58 annually. **By making this change, the Council could save approximately £8,000 annually.** Over a period of 5 years (assuming the current rates) this translates to a saving of £40,000.

Due to this, it is not required to pay to upgrade the electrical infrastructure at the site as it will be able to provide supply to the proposed ASHPs without exceeding the agreed capacity.

The resultant spare capacity after the proposed low carbon electrically powered equipment is installed is approximately **406 kVA**. The maximum import capacity was taken from an electrical invoice provided by the Council.

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 Estate Wide Portfolio Review

Following a review of a recent electricity invoice and meter data, we have identified a potential saving of approximately **£8,000 per annum** at a single site, driven primarily by an over-specified supply capacity relative to actual demand.

For context, the Nursery is currently contracted for **496 kVA**, while recorded maximum demand is only **~ 23 kVA**, indicating a significant opportunity to optimise capacity charges.

This type of issue is not uncommon across estate portfolios and can often go unaddressed for extended periods.

We believe there is an opportunity to replicate this saving across multiple sites across the Hub's vast estate.

To support this, we suggest:

- a **review** of electricity invoices and half-hourly consumption data across key buildings your portfolio
- Identification of **capacity optimisation and tariff inefficiencies**
- Delivery of **actionable recommendations** and supplier engagement support

APSE Energy suggest that the Hub consider either:-

a no-cost initial review of the steps above with a success-based fee model that would ensure that costs are only incurred once verified savings are delivered, minimising risk for the Council. This is a success-based model, which aligns incentives and minimises risk with fees only applied as a percentage of verified savings achieved over an agreed upon time period.

or

APSE Energy could provide a fixed fee proposal to carry out the steps noted above with any resulting savings benefitting the Council.

We would be happy to discuss this further and outline a structured review approach.

3.6 Lighting Replacement

3.6.1 Lighting Installation

Anytown Primary School

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 22: Lighting Replacement Cost Breakdown

Item	Description	Cost
1	Prelims	£2,200
2a	Access for works	£400
2b	Installation	£10,400
2c	Removal and Disposal	£2,900
3a	Lighting	£24,000
3b	Controls	£2,000
3c	Emergency	£3,500
4a	Record Information	£500
4b	Testing & Commissioning	£600
5	Contingency costs	£4,700
6	Works Budget Total	£51,200
7a	Design and Engineering Fee	£5,200
7b	Project Management Fee	£2,600
8	Total Project Costs	£59,000

The cost estimate includes all non-LED luminaires identified during the site survey excluding the specialised sports hall lighting.

Given these fixtures 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.

Nursery

There were a couple of non-LED fixtures at the Nursery, but they were in infrequent use. As a result, it is recommended to replace them with LED lighting fixtures as they fail as opposed for energy saving matters.

3.7 Solar Photovoltaics

3.7.1 System Installation

No system was proposed at as there is limited roof space and it has only recently had PV installed.

The School has available roof space which could be a good location for the installation of solar panels for on-site renewable energy generation. At the detailed design stage, a survey will need to be carried out to understand if the selected roofs have 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 buildings' 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 estimated annual electricity consumption data from a typical school of its size, in the absence of accurate annual data. This is not ideal, as it does not accurately represent the electrical consumption at the building. Ideally by using half hourly data, the systems performance can be modelled with greater accuracy.

Figure 30 Proposed 70 kWp PV System



No system was proposed at as there is limited roof space and it has only recently had PV installed.

The School has available roof space which could be a good location for the installation of solar panels for on-site renewable energy generation. At the detailed design stage, a survey will need to be carried out to understand if the selected roofs have 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 buildings' 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 estimated annual electricity consumption data from a typical school of its size, in the absence of accurate annual data. This is not ideal, as it does not accurately represent the electrical consumption at the building. Ideally by using half hourly data, the systems performance can be modelled with greater accuracy.

Figure 30 visualises the proposed PV installation on the building's roof. Additional investigations involving the structural integrity of the roof 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 24**.

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 23: 70 kWp PV System Performance

PV Generator Output	70	kWp
Spec. Annual Yield	995.01	kWh/kWp
Performance Ratio (PR)	92.27	%
Yield Reduction due to Shading	0.1	%
PV Generator Energy (AC grid)	69,863	kWh/Year
Own Consumption	44,140	kWh/Year
Clipping at Feed-in Point	0	kWh/Year
Grid Export	25,723	kWh/Year
Own Power Consumption	63.2	%
Level of Self-sufficiency	22.1	%

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

Figure 31: PV System Output Split by End Use

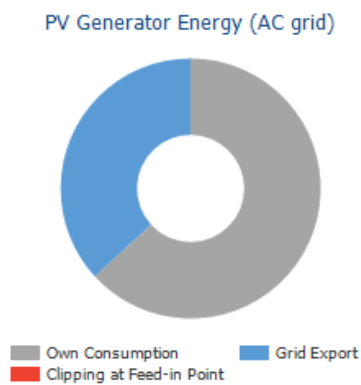


Figure 32: Building Consumption by Energy Source

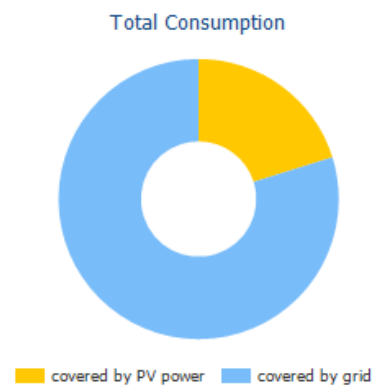
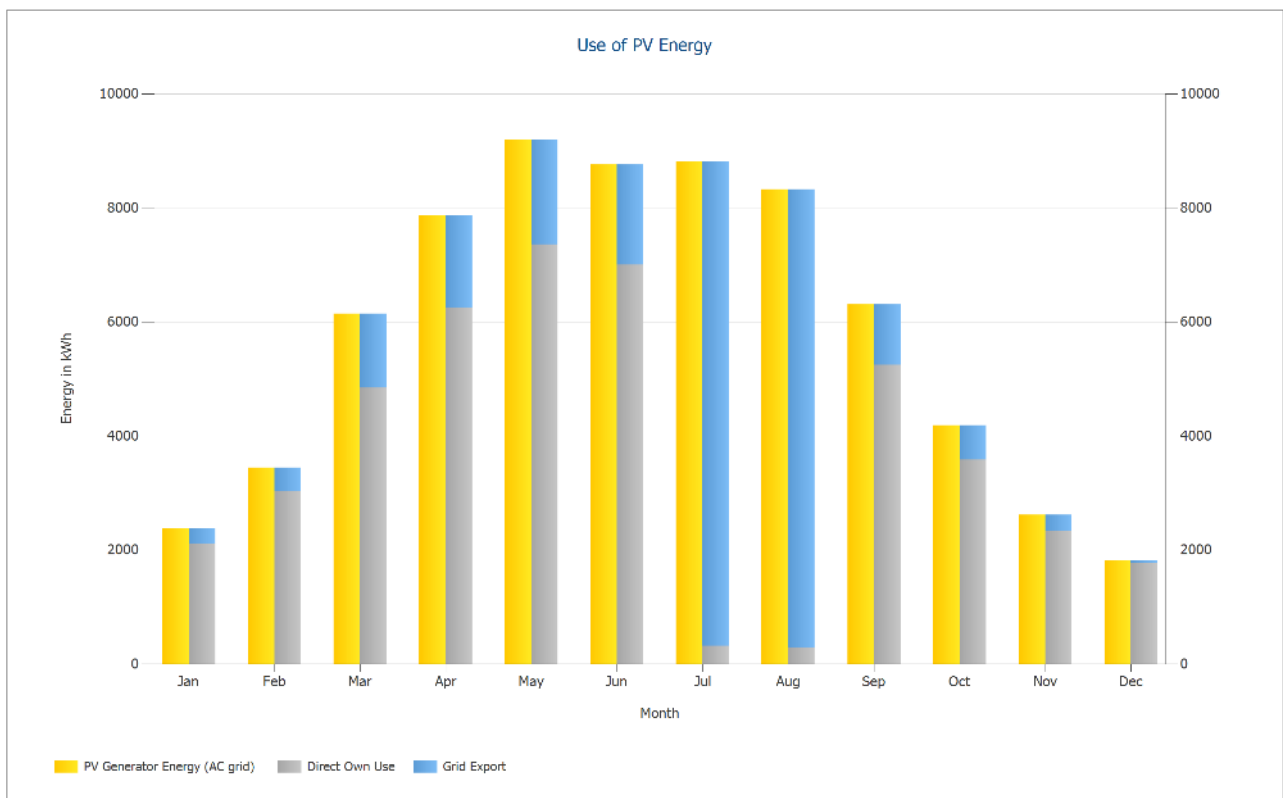


Figure 33: PV Generator Output Allocation by Month



3.7.2 Budget Cost Estimate

The associated budgetary cost for the proposed 70 kWp PV installation is **£78,600** and is broken down as follows:

Table 24: 70 kWp PV System Cost Breakdown

Item	Description	Cost
1	Preliminaries	£3,100
2a	Photovoltaic Array	£14,400
2b	Inverters	£3,900
2c	Electrical Connections	£21,600
3a	Builders' Work & Frame	£14,000
3b	Access/ Scaffolding	£6,900
4a	Testing & Commissioning	£500
4b	Record Information	£500
5	Contingency Sum	£6,500
6	Works Budget Total	£71,400
7a	Design Fee	£5,000
7b	Project Management Fee	£2,200
8	Project Budget Total	£78,600

3.7.3 Surplus PV Generation

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 25,723 kWh/year.

This is higher than expected, and likely a result of an annual figure of electricity consumption used and the fact that the School is projected to be vacant during the summer holidays when generation peaks. A more accurate picture would be seen of the amount of electricity exported if half hourly data was used to model the PV System.

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.

3.8 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, costs can be distributed more evenly over time as they reach the end of their service life. This approach makes the expense more manageable.

3.9 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. Rational², an established commercial catering equipment manufacturer, estimates potential energy savings of 40% by switching to these energy-efficient appliances.

Despite there being a gas hob in the main School's kitchen, staff reported that there was no connected gas fired equipment. Therefore, it has not been included in this calculation.

However, at there is gas cooking in the kitchen and even a gas sub-meter. Unfortunately, no sub-meter data has been provided so the annual gas consumption of the kitchen has been estimated using industry conventions.

The gas consumption associated with catering equipment at is 2,537 kWh. The cost of the cooking appliances is unknown as this is specialist equipment.

4 Energy and Carbon Savings

4.1 Energy Consumption

The table below presents a summary of the energy usage across both buildings.

Anytown Primary School

Gas, electricity and oil data has been provided by the Council. The data provided was not ideal for the following reasons:

- No complete annual data for the electricity was provided. In some cases, it was duplicate.
- The oil consumption was based on invoices of orders rather than monthly consumption data.
- The gas data was invoices rather than consumption

Due to the incomplete electrical data, the electrical consumption has been based on typical industry standards of a building of its size and type. The energy prices are based on tariff rates provided by the Council and invoices where

² [Vario Pro. In the restaurant. The Game Changer. | RATIONAL AG \(rational-online.com\)](#)

available. The price of oil was never provided so has been assumed at £0.07/kWh which is an average rate in the industry for kerosene.

The annual oil and gas consumption has been based upon the last 12 months of invoices provided.

Nursery

The electrical data provided for was Half-hourly and covered the last 24 months. The gas consumption was calculated via the last 12 months of invoices. The energy prices are based on tariff rates provided by the Council and invoices where available.

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 25: Anytown Primary School & Nursery Energy Consumption: Cost and Carbon Emissions

Energy Source	Annual Energy Consumption (kWh)	Cost	CO ₂ e (tonnes)	Unit Rate (£/kWh)	Energy Benchmarking Typical Consumption (kWh)
Anytown School					
Electricity	217,838	£47,391	38.6	0.22	217,838
Oil	417,291	£29,029	103.0	0.07	618,052
Gas	36,703	£2,288	6.7	0.06	-
Nursery					
Electricity	23,363	£4,148	4	0.18	22,231
Gas	82,738	£2,646	15	0.03	63,074
Total	777,933	£85,502	167.5		

The “Energy Benchmarking” figures provide a means to compare the building’s energy usage to similar building types. The benchmarking figures are based on the “typical” energy usage for the building type as obtained from the CIBSE Energy Benchmarking Dashboard³ and a measured floor area from the DEC for each building.

The energy benchmarking figures allow for comparison to other buildings of type and size. As the electrical data of Anytown School was not reflective of a full 12 months, the typical consumption has been used. The other consumption data shows that the buildings are both using less energy than typically would be expected.

An Energy Performance Certificate (EPC) is good indicator of the energy efficiency rating (relating to running costs) within buildings that are sold or rented out and in which energy is used to condition the indoor climate. The energy rating from the most recent EPC is as follows:

³ [Energy Benchmarking Dashboard](#)

	Anytown Community Primary School
Source	
Energy rating	D
Score	77

As a result of the absence of submetering data, we have used the energy end-use breakdowns from the Building Energy Efficiency Survey (BEES)⁴ and insights from observations during the site survey for the relevant non-domestic sector in estimating how electricity and gas consumption is divided across the site and the three main buildings.

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 2030.

Table 26: Recommended Decarbonisation Projects Anytown Primary School: 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	Double Glazing Installation	-	49,746	£4,975	£268,700	54.0	12.3
2	Cavity Wall Insulation	-	75,939	£7,594	£100,800	13.3	18.7
3a	Air Source Heat Pump for Space Heating	-51,890	237,406	£5,227	£1,051,700	N/A	49.4
3b	High Temp Air Source Heat Pump Domestic Hot Water	-17,674	54,199	£365	As Above	N/A	9.3
4a	Solar Panels (59 kWp) Own Use	44,140	-	£9,603	£78,600	6.2	7.8
4b	Solar Panels (59 kWp) Export	25,723	-	£3,087	As Above	As Above	4.6
5	LED Lighting Replacement	39,817	-	£10,223	£59,000	5.8	7.0

⁴ [Building Energy Efficiency Survey \(BEES\) - GOV.UK \(www.gov.uk\)](https://www.gov.uk/building-energy-efficiency-survey-bees)

6a	2011 Extension Electric Combi Boiler (Space Heating)	-24,428	31,932	-£3,323	£8,200	N/A	1.5
6b	2011 Extension Electric Combi Boiler (Domestic Hot Water)	-4,221	4,771	-£621	As Above	N/A	0.1
	Anytown Primary School Total	11,467	453,994	£37,128	£1,567,000	42.2	110.8

Table 27: Recommended Decarbonisation Projects Nursery: 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
1a	Air Source Heat Pump for Space Heating	-12,861	61,694	£1,049	£185,400	N/A	9.0
1b	High Temp Air Source Heat Pump Domestic Hot Water	-6,131	16,816	-£285	As Above	N/A	2.0
2	Kitchen Equipment Replacement	-2,537	4,228		Unknown	N/A	
3	Rectifying Overcharged Capacity	-	-	£8,000	Unknown	0.0	0.0
	Nursery Total	-21,528	82,738	£8,763	£185,400	21	11

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.

For some recommendations, the electricity savings 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 6 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 LED lighting and PV system 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

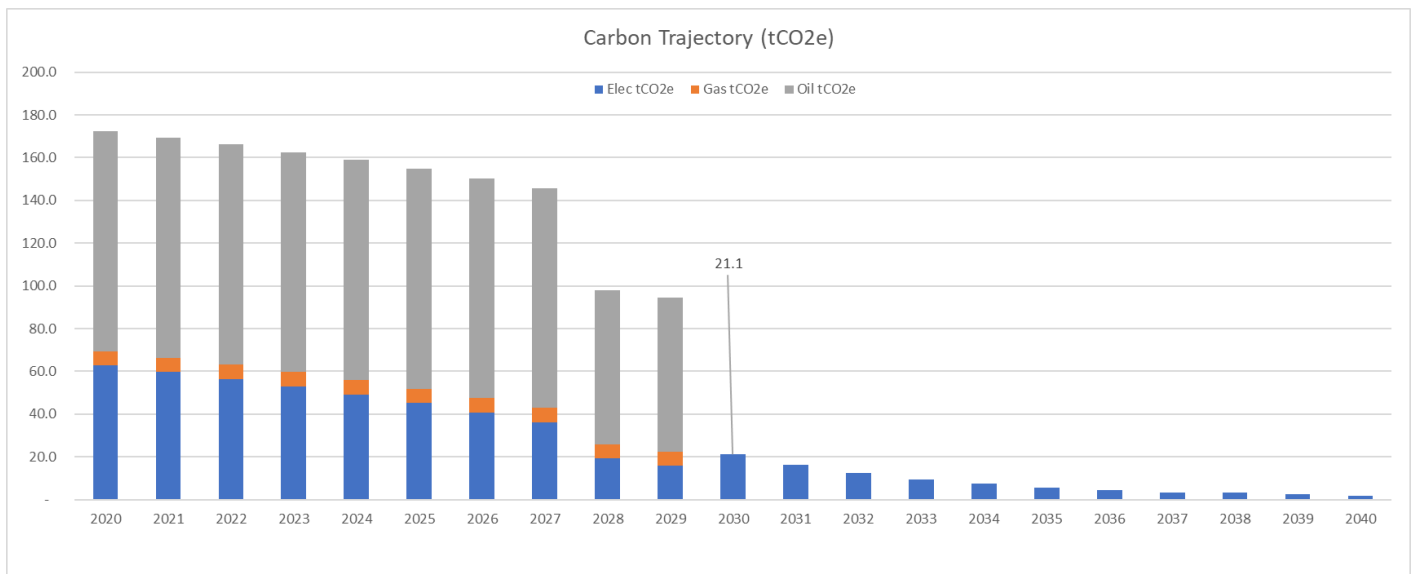
The use of gas at the site will need to cease and all gas-fired equipment will need to be decommissioned to decarbonise the site and align with the Council's set net-zero targets in 2030.

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 suggested programme of works at Anytown Primary School is:

- 2027: Installation of PV solar array and LED lighting. Installation of cavity wall insulation and replacing the single glazing with modern double glazing.
- 2029: Decommissioning of gas fired equipment and the installation of air source heat pump for space heating and DHW. Installation of the electric combi boiler to serve the 2011 extension.

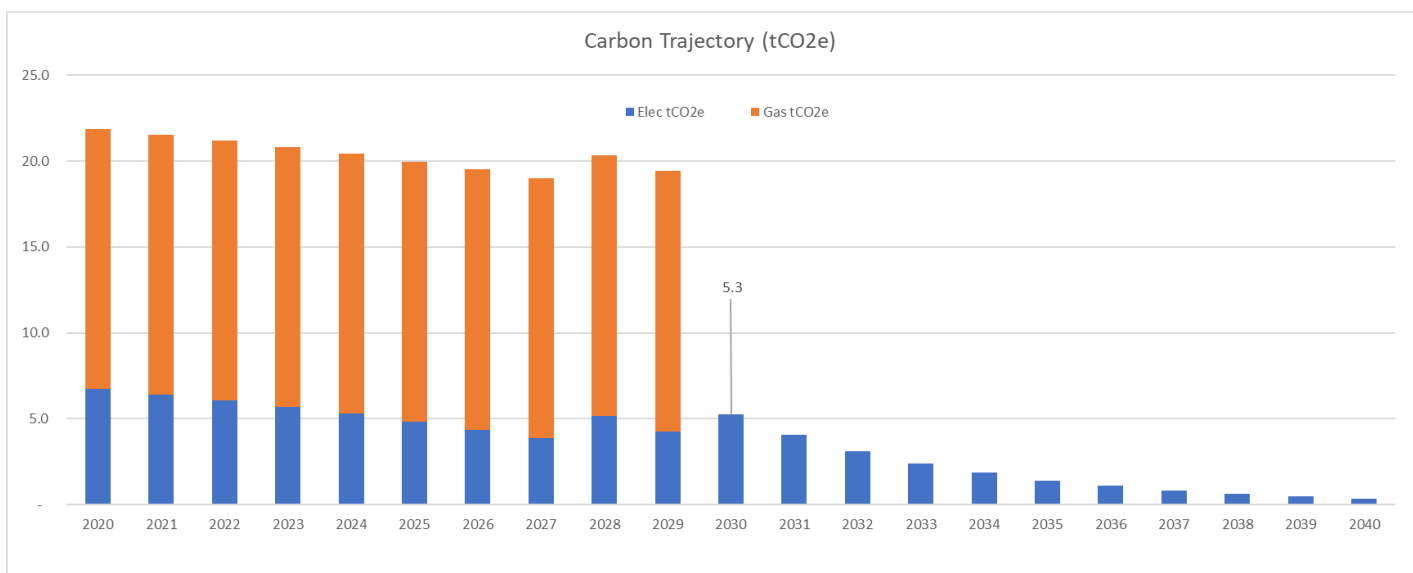
Figure 34 Carbon Trajectory – Recommended Projects at Anytown School



The suggested programme of works at is:

- 2026: Rectify electrical capacity overspend at the Nursery.
- 2029: Decommissioning of gas fired equipment and the installation of air source heat pump for space heating and DHW.

Figure 35 Carbon Trajectory – Recommended Projects at Nursery



The trajectory's shows what the emissions would be if the site transitioned to electricity before the Council's net-zero target of 2030.

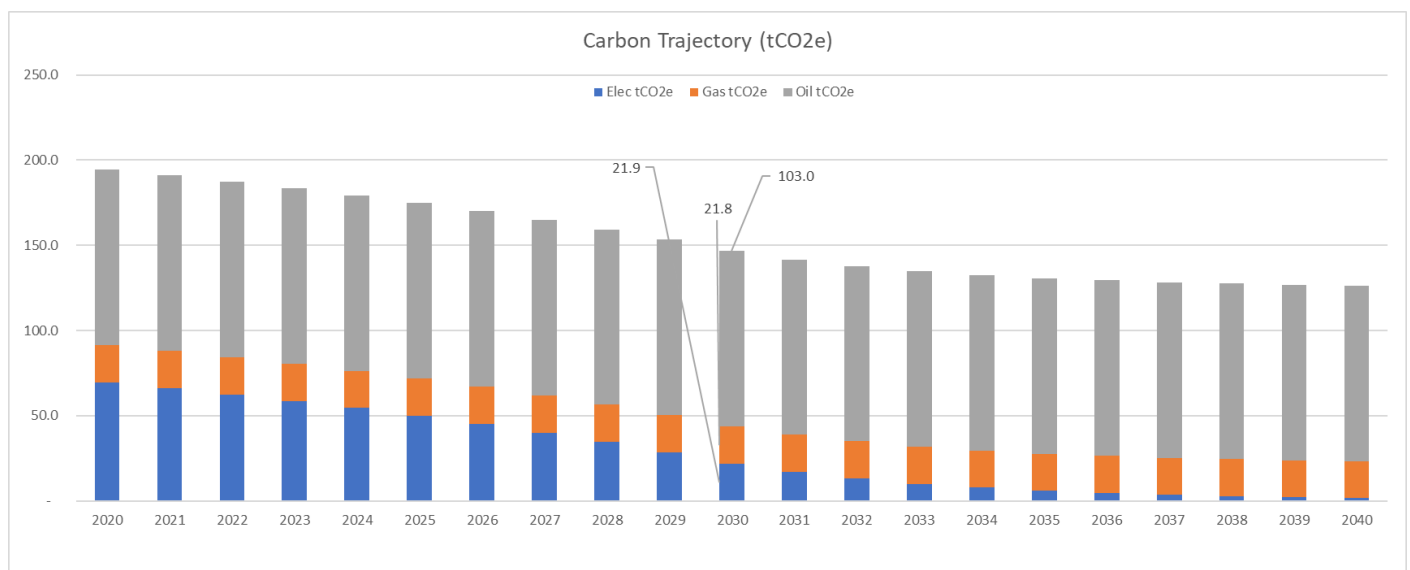
Achieving net-zero carbon emissions requires a strategy that focuses on reducing emissions as much as possible through energy efficiency/conservation measures and low-carbon projects, alongside generating energy onsite from renewable sources. After these carbon reduction initiatives, the remaining emissions 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 (21.1 and 5.3 tCO₂e) by the year 2030 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 36 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 36: Business as Usual (BAU) Carbon Trajectory at Both Sites



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 37 Year to Year Net Energy Running Costs – Anytown School

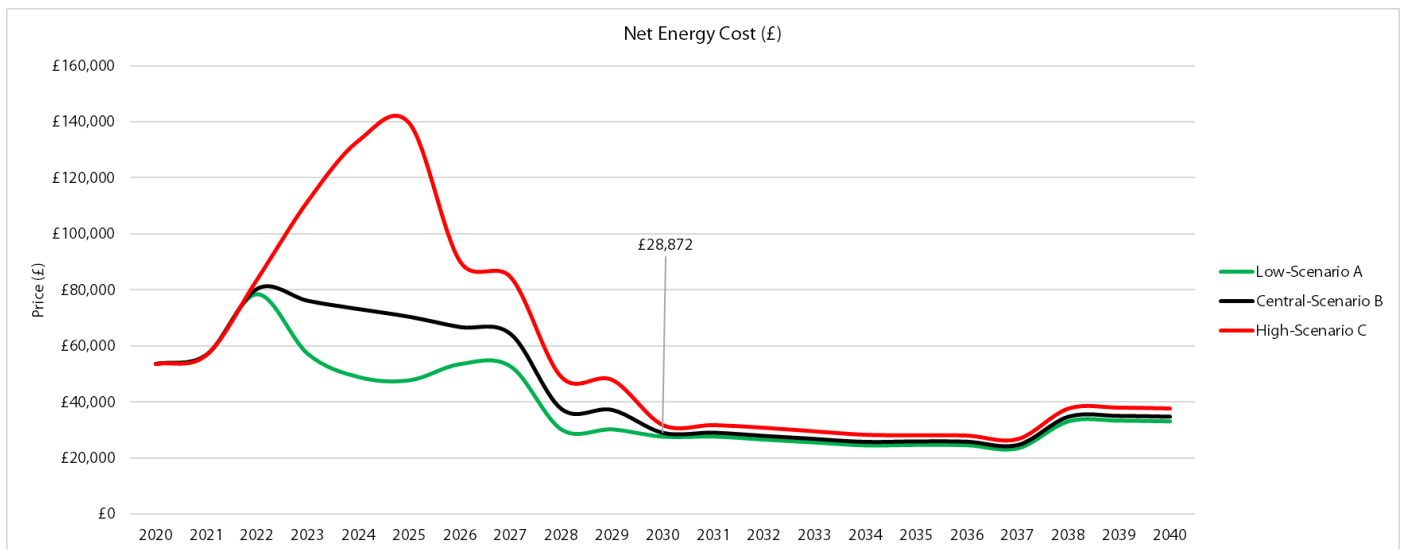
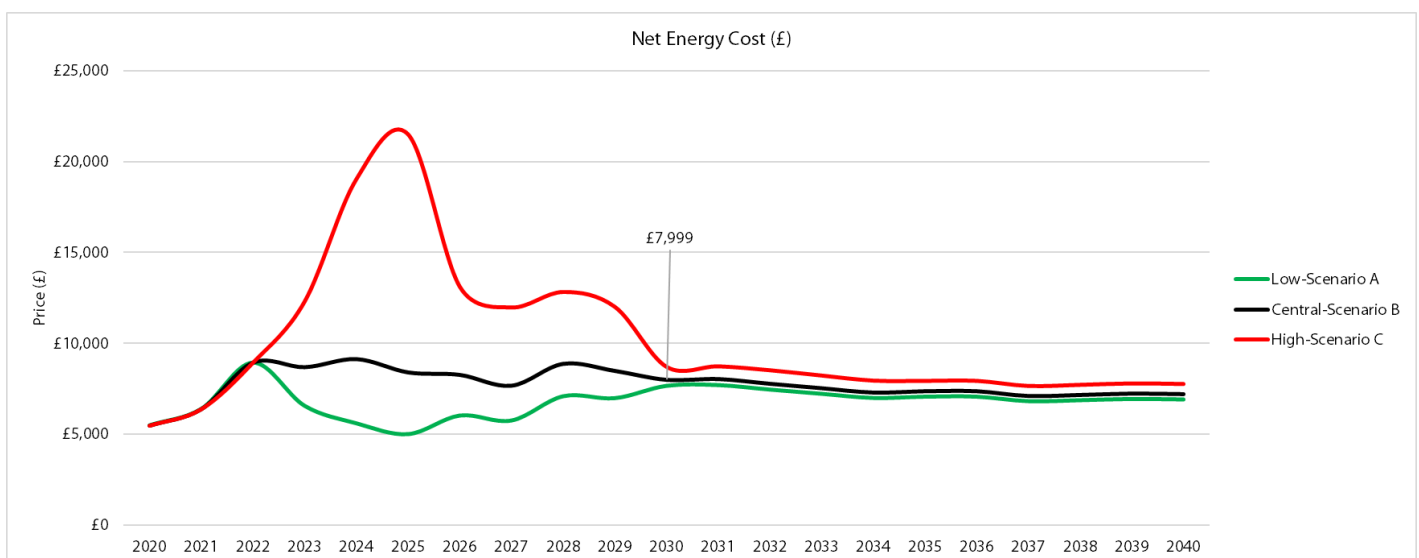


Figure 38 Year to Year Net Energy Running Costs – Nursery



The annual operating costs by 2030 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 and oil-fired equipment by 2030.

Firstly, it is recommended that the Council consider reviewing the electricity capacity arrangements at the Nursery. This could result in a potential saving of around £8,000 before the electrical heating equipment is installed. This is driven by significantly over-contracted supply capacity compared to actual demand. This type of inefficiency is common across large estates and presents a broader opportunity to reduce costs across multiple sites.

It is suggested that the Hub consider either undergoing a no-cost initial review of electricity invoices and consumption data across its estate to identify capacity and tariff optimisation opportunities, supported by clear recommendations and supplier engagement. A success-based fee model would ensure that costs are only incurred once verified savings are delivered, minimising risk for the Council. Alternatively APSE Energy could provide a fee proposal to carry out the review noted above with any resulting savings benefitting the Council. See 3.5 Above.

The main decarbonisation recommendations in this report centre around the installation of ASHPs at both buildings in 2029 to meet the net zero carbon goal of 2030.

Anytown Primary School

The existing oil-fired boilers that provide LPHW (Low Pressure Hot Water) for space heating and DHW water demand should be decommissioned and removed from site in 2029. Given the existing heating distribution will be replaced by 2030, it is also proposed that this new heating pipework be used alongside the new proposed equipment.

It is proposed that in its place, new Air Source Heat Pumps (ASHPs) and the associated auxiliary equipment are installed to provide 50°C Low Pressure Hot Water (LPHW) to the new heating distribution system and higher surface area heat emitters.

In the case of Domestic Hot Water (DHW), it is proposed that a dedicated HT-ASHP and indirect cylinder be installed to provide DHW. This ASHP and the associated auxiliary equipment would be installed to provide 65°C LPHW to a heating coil within the new indirect cylinder. This cylinder would be connected to a heating coil within the new indirect cylinder.

It is recommended that in the short term before the majority of energy efficiency improvements take place, that a sub meter or load monitoring equipment are installed to enable a better understanding of the electrical consumption of the equipment as well as ensuring that accurate electrical data is recorded.

An additional measure could be to install heat metering covering the existing boilers. That would enable the Council to see the true heating energy consumption rather than just the oil invoice data.

The Council should consider installing the fabric improvement proposals at the site. Including:

- New double glazing to replace the single glazing.
- Installing cavity wall insulation.

However, before insulating the cavity walls the Council should investigate the cavity to clarify the standard of the existing cavity or if there is any cavity insulation already in place. This would be done by conducting a borescope test to assess its suitability for retrofitting insulation. Depending on the size and condition of the cavity, the energy savings of filling the cavity with insulation could change significantly, so confirming the status of the cavity is important.

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.

Improving fabric efficiency improves air tightness and could affect natural ventilation within the buildings. Therefore, it is advised that a ventilation assessment be carried out and adequate measures be implemented to ensure that the fabric improvements do not negatively impact the building post-retrofit.

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 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.

As the point of use water heater and split units that are scattered across the site are fuelled by electricity and are already decarbonised, it is recommended that they are retained and replaced as and when they fail.

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 £100,000** but costs can vary significantly. Due to the unknown costs, this is a high risk item.

Incorporation of a smart building controls and monitoring energy use across the site is encouraged. The proposed ASHP cost includes the upgrade/additions to the building management system (BMS). This will enable data-driven decisions for reducing energy consumption and associated costs. An annual review of the building controls is recommended to ensure continued optimisation.

Nursery

It is recommended to reduce the agreed electrical capacity in kVA at the site with the District Network Operator in the short term before the installation of electric heating equipment. This will allow the Council to **save approximately £8,000 each year**.

It is recommended that the Council decommission the existing gas boilers that provides the main building's space heating demand and remove them from site. It is proposed that in its place, two Air Source Heat Pumps alongside the auxiliary equipment are installed to provide 50°C Low Pressure Hot Water (LPHW) to the existing underfloor heating distribution system.

It is also recommended that the Council lower the flow temperatures of the boilers in the short term before the installation of ASHPs 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.

The existing gas fired water heater should be decommissioned and removed from site. In its place, it is proposed that a higher flow temperature ASHP be installed alongside a new indirect cylinder to provide the domestic hot

water at the site. It is proposed that the cylinder be connected to the existing DHW pipework. It will provide DHW to the site at higher efficiency than typical electrical heating (200% + compared to 100%)

As the split units are fuelled by electricity and are already decarbonised, it is recommended that they are retained and replaced as and when they fail.

It is recommended to implement a metering scheme where sub-meters are installed to 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 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 2038.

6 Appendix A

NOTE

This review has listed a range of responses to pre-set questions as well as a qualitative opinion from APSE Energy on some of the elements within the services on offer. The Council should engage closely with their chosen supplier to ensure they are fully conversant and happy with the choice they intend to make.

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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