The Highland Council

Agenda Item	9.
Report No	CCC/8/25

Committee: **Climate Change**

Date: **29 January 2025**

Report Title: **Net Zero Audit Surveys Update**

Report By: **Assistant Chief Executive - Place**

1 Purpose/Executive Summary

1.1 The purpose of this paper is to update Members of the work undertaken in relation to the ongoing programme of Net Zero audits and surveys for the Council's non-domestic estate.

2 Recommendations

2.1 Members are asked to **note** progress to date.

3 Implications

3.1 **Resource** - there are no ongoing resource implications, delivery of future work will be met from existing resources. Due to staff long term absence other workloads are being met from the staff resource associated with this workstream, impacting overall delivery.

3.2 **Legal** - there are no legal implications arising from this report

3.3 **Risk** - There is no risk directly relating to this paper.

3.4 **Health and Safety (risks arising from changes to plant, equipment, process, or people)** – There are no implications arising from this workstream

3.5 **Gaelic** - There are no Gaelic implications arising from this workstream.

4 Impacts

4.1 In Highland, all policies, strategies or service changes are subject to an integrated screening for impact for Equalities, Poverty and Human Rights, Children's Rights and Wellbeing, Climate Change, Islands and Mainland Rural Communities, and Data Protection. Where identified as required, a full impact assessment will be undertaken.

4.2 Considering impacts is a core part of the decision-making process and needs to inform the decision-making process. When taking any decision, Members must give due regard to the findings of any assessment.

4.3 This is an update report and therefore an impact assessment is not required.

5 Net Zero Audit & Survey Programme

5.1 Property surveys have been undertaken for 34 sites with another 40 scheduled by the end of March 2025, dependent upon ongoing staff recruitment efforts.

5.2 Four reports have been fully completed with presentations scheduled with relevant property representatives. A further four reports are in final draft stage.

5.3 For reference a copy of the report for Deshar PS can be found in **Appendix 1**.

6 Heating Option Appraisals

6.1 Heating Option Appraisals assess in detail the practicalities, associated costs and benefits of potential replacement heating systems, e.g. transitioning from oil boilers to fully electric heating systems, such as heat pumps.

6.2 Seven appraisals have been completed with findings and recommendations fed back to Property Services for consideration.

Designation:	Assistant Chief Executive - Place
Date:	6 January 2025
Author:	Ronnie Macdonald, Energy Manager
Background Papers:	None
Appendices:	Appendix 1 – Deshar PS Report

Appendix 1.

The Highland Council
Comhairle na Gàidhealtachd

Deshar Primary School

Net Zero Audit Report

Climate Change and Energy Team

Original			
Version	**Author**	**Note**	**Date**
0.1	William Grant	First Draft	03/09/2024
0.2	William Grant / Laura Barnfield	Final Draft	11/11/2024
Revisions			
Version	**Author**	**Note**	**Date**
1.0	William Grant / Laura Barnfield	Final Report	15/11/2024

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1 Executive Summary

Table 1 details the measures identified and recommended from the Net Zero Audit & Survey at Deshar Primary School, undertaken on Thursday 29th August 2024. The recommendations outlined are those within a 20-year payback (i.e. pay for themselves by 2045 carbon reduction target). Further detail can be found in Section 4.

Recommendations	Estimated Annual Savings (£)	Estimated Cost of Works (£)	Cost per lifetime ton of carbon (£/LTt.CO_2)	Estimated Annual Carbon Savings (tCO_2e)	Simple Payback (years)
Roof Insulation	£1,635	£30,522	£3,125	1.2	19
Draughtproofing	£433	£8,004	£2,464	0.3	19
Heating Infrastructure	£4,539	£70,435	£2,782	3.4	16
HW Pipework Insulation	£413	£673	£286	0.3	2
External Lighting Upgrade	£66	£345	£707	0.0	5
Solar PV	£4,741	£28,248	£1,020	1.2	6
Total	**£11,827**	**£141,295**	**£2,052**	**6.5**	**12**

Table 1: Recommendations for Deshar Primary School

Combined they are projected to reduce total electricity costs and carbon emissions by £135,685 and 44tCO_2e respectively by 2045 (from 2024), in comparison to a 'Do Nothing' scenario.

Table 2 highlights low cost and behavioural recommendations that can be implemented immediately. While it's challenging to quantify the savings resulting from these actions, each item will contribute positively to enhancing the schools' Net Zero performance.

Improvement Area	Recommendation
Behaviour and awareness (heating and electrical)	Support staff and pupil net zero groups to educate and encourage good behaviour practice and activities, e.g. removing items blocking heat emitters, switching off at end of day, closing windows when heating is on, etc
Behaviours and awareness (water)	Support staff and pupils to reduce water consumption (particularly in Nursery - large number of sinks/WHBs), e.g. through water awareness campaigns.
Out of hours heating settings	Ensure all heating programmers are set for in use periods only and are in line with GMT/BST as required.
Fix leaking taps and urinals	Fix leaking hot water taps and urinals to reduce water consumption on site.
New electrical equipment	Any new or replacement equipment to be energy efficient models.

Table 2: Low Cost & Behavioural Recommendations

Electric vehicle charging points (EVCP):

The school has potential to facilitate at least one EVCP, although further investigations are required to ascertain appropriate electrical supply and existing capacity. Adding EVCP would improve travel related emissions.

2 Introduction

As a public body, The Highland Council (THC) are legally bound to contribute to Scotland's Net Zero target by 2045. Our Net Zero strategy defines a route map to net zero by 2045, with key interim targets to reduce carbon emissions by 75% by 2030 and by 90% by 2040.

This report directly supports this strategy as 67% of the total Council emissions are associated with the built estates' energy consumption.

The net zero audit included:

- Desk-based review of building (energy and carbon performance, building and site layout, building fabric, heating, water, ventilation and cooling systems, lighting, and electrical equipment).
- Site survey focusing on existing condition and potential energy / carbon-saving improvements.
- Review and modelling of physical and technical improvements and associated budget costs (capital and lifetime), to reduce energy consumption and carbon emissions.

2.1 Site Introduction

Deshar Primary School (Figure 1) is situated in Boat of Garten, a rural village within the wider Associated School Group (ASG) area of Grantown. The school's capacity is 47 pupils with a current school roll (23-24) of 45 (five in nursery). It has approximately 14 permanent staff (mix of part and full time), with nine staff generally on site daily.

The occupancy patterns follow a typical school year and holidays. Table 3 outlines the weekly occupancy patterns.

Monday – Friday	9am-3.30pm (pupils) 8:30am-5pm (staff)
Saturday - Sunday	Unoccupied
Out-of-Hours Use	Some – Horsa Hut used infrequently by community / GP

Table 3: Occupancy Patterns

The Gross Internal Floor Area (GIA) is approximately 622m^2 and incorporates classrooms, toilets, canteen, kitchen, office areas, staffroom, library, and storage facilities. The site is composed of distinct elements:

- Main Building (built circa 1900) contains classrooms, staff and office areas, library and storage facilities as well as two WC and cloakroom extensions (one on the north side, and one on the south, built 1960).
- Horsa Hut (unknown – assumed post 1945) contains a commercial Kitchen and Canteen/multipurpose space.
- Nursery (completed in 2020) contains a cloakroom, play area, office space, toilets and storage areas.

Figure 1: Deshar Primary School and Site Boundary Details

2.2 Building Overview

Buildings are electrically heated (Main Building & Horsa Hut: primarily storage heaters; Nursery: air source heat pump (ASHP)), with hot water provided on site via three 3kW electric immersion heaters and seven point-of-use water heaters. Appendix B provides more detail on building fabric and services.

Table 4 outlines the building fabric. All windows (except one rooflight) are double glazed.

Main Building	Horsa Hut	Nursery
Solid stone walls, uninsulated roof and floor	Prefab concrete panels (uninsulated), uninsulated roof and floor	Built to Building Regulations 2015 (fully insulated)

Table 4: Building Fabric

Internal lighting all LED (except one) and external lighting majority LED (with the exception of 4/6 lights on Main Building).

3 Building Performance

3.1 Benchmarking

Benchmarking energy performance is a process that either compares the energy use of a building with other similar structures, or how energy use varies from a baseline. It informs organisations about how and where they use energy and what factors drive their energy use. Benchmarking enables energy, building, and asset managers to determine the key metrics for assessing performance, to establish baselines, and to set performance goals.

The school's energy performance can be assessed as poor when compared to a typical primary school in Scotland. This assessment relates to electricity and water consumption as well as carbon emissions. Table 5 outlines the 23-24 results.

Performance Area	Typical School	Deshar PS	Comparison[1]
Electricity – kWh/m^2	143	224	56%
Water – m^3/m^2	1	1.7	70%
Carbon – $kgCO_2e/m^2$	45	51	13%

Note:- Percentage difference compared to typical school benchmark; positive % indicates poor performance/efficiency - negative % indicates good performance/efficiency

Table 5: Benchmarking Energy Performance

The schools' performance, along with all other Highland Council primary schools, is available to view on the Highland Council's Energy Benchmarking Tool.

3.2 Utility Consumption

Annual electricity and water consumption figures for Apr-23 to Mar-24 are shown in Table 6 along with associated annual emissions.

Utility	Annual Consumption	Cost	Annual Emissions (tCO_2e)
Electricity	139,357kWh	£41,502	31.4
Water	1,037m^3	£995	0.4

Table 6: Utility Consumption and Emissions

3.2.1 Energy Breakdown

Due to the absence of sub-metering, a precise breakdown of the school's electrical consumption isn't possible. Figure 2 offers an estimated breakdown based on standard heat loss patterns and industry guidance.

This analysis reveals that the provision of space heating contributes to most of the electrical consumption (56%) at the school. As such, focusing efforts on reducing heat loss and improving heating control will likely have the most significant impact on improving overall energy efficiency.

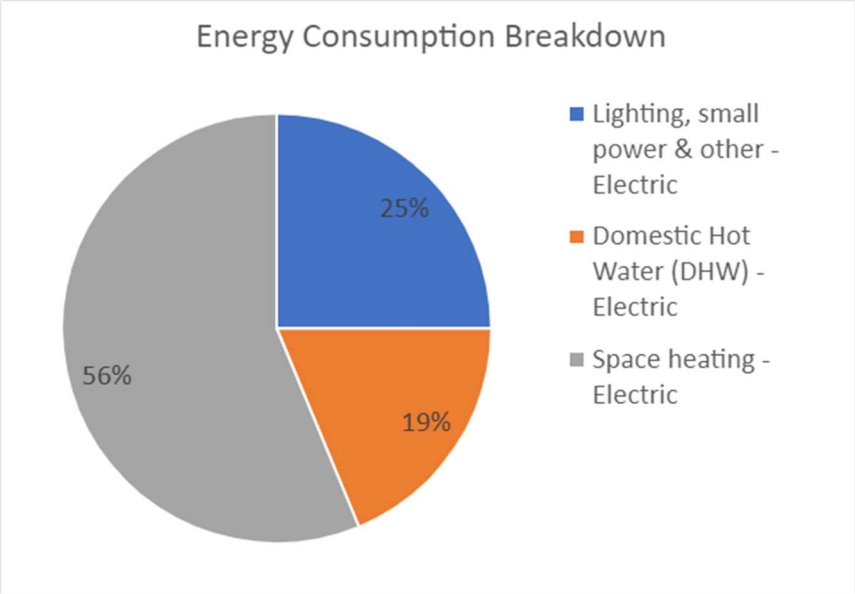


Figure 2: Energy Consumption Breakdown

3.2.2 Carbon Emissions

Figure 3 outlines the estimated carbon emissions of different energy end-uses in the school. Note, this does not include travel or waste related emissions. The main area of carbon emissions is space heating (electric).

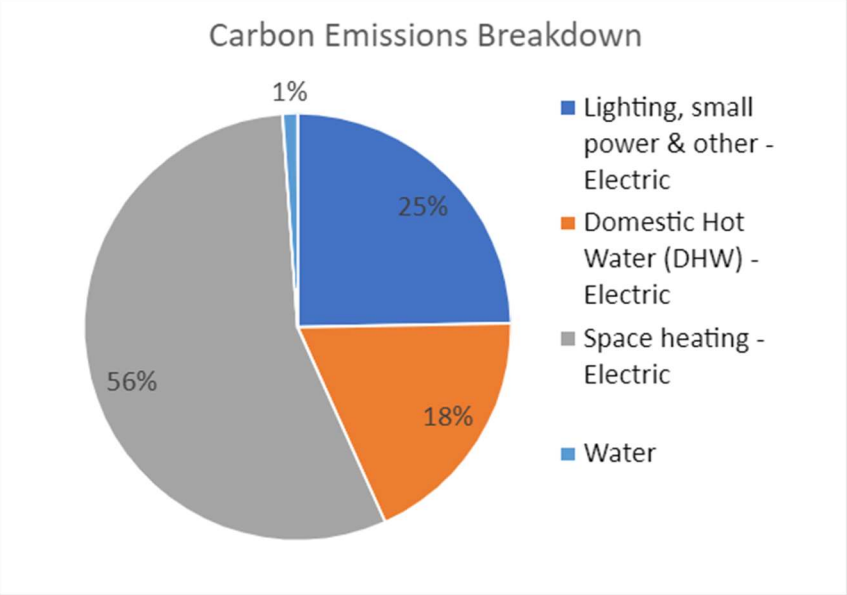


Figure 3: Carbon Emissions Breakdown

4 Recommendations

To support a sustainable transition to Net Zero, the Energy Hierarchy in Figure 4 has been followed when assessing suitable improvement measures and providing appropriate recommendations.

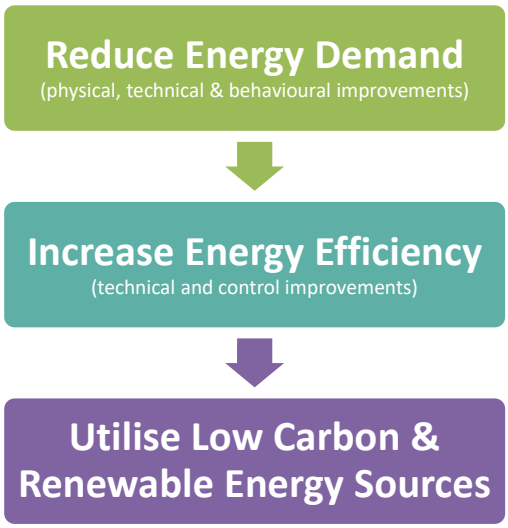


Figure 4: Energy hierarchy principles

Appendix A details all physical and technical improvements that were evaluated for their suitability within the school.

4.1 Physical and Technical Measures

Table 7 provides a summary of recommended measures with detail of their cost, energy and carbon savings. The improvements relate only to the Main Building and Horsa Hut as the Nursery was built in 2020 to Building Regulation standards. Only measures that have a maximum 20-year payback have been included. More information on additional suitable measures can be found in Appendix A.

Improvement	Estimated Annual Savings (£)	Estimated Cost of Works (£)	Cost per lifetime carbon (£/LTt.CO_2e)	Carbon Savings (tCO_2e)	Simple Payback (years)
Roof Insulation	£1,635	£30,522	£3,125	1.2	19
Draughtproofing	£433	£8,004	£2,464	0.3	19
Heat Emitter & Controls Upgrade	£4,539	£70,435	£2,782	3.4	16
HW Pipework Insulation	£413	£673	£286	0.3	2
External Lighting Upgrade	£66*	£345	£707	0.0	5

*Note:- *Saving based upon electricity savings only. It is anticipated that the maintenance related savings would at least match or exceed energy savings.*

Table 7: Recommended Physical and Technical Measures

Fabric Improvements (Horsa Hut)

As well as lacking roof insulation, this building has uninsulated walls.

- Heat loss walls: 9%
- Heat loss roof: 22%

Upgrading building fabric would be a natural recommendation, however it is suspected that the building is already beyond expected design lifespan. Progression of energy efficiency improvements should therefore only be undertaken as part of wider refurbishment works to the building.

4.2 Renewable Potential

The site was assessed for the potential installation of a variety of renewable technologies. An overview of these can be found in Appendix A.

4.2.1 Solar Photovoltaic (PV) Panels

The school presents an opportunity for solar PV installation, but there are current site constraints that must be considered. A south-west facing roof on the Nursery could provide up to 122m^2 available space for PVs. This is addition to the 14m^2 of space on the south-facing flat roof of the South Block WCs (Figure 5).

These areas could provide a PV system of up to 22.6kW, with an estimated annual generation of 15,006kWh. This would meet approximately 11.4% of the school's annual electricity consumption (Figure 6). Table 8 outlines the estimated costs and savings of the system.

Renewable Measure	Estimated Annual Savings (£)	Estimated Cost of Works (£)	Cost per lifetime ton of carbon £/LTt.CO_2	Annual Carbon Savings (tCO_2e)	Simple Payback (years)
Solar PV	£4,741	£28,248	£1,020	1.2	6.0

Table 8: Recommended Renewable Measures

Figure 5: Possible PV Locations and Constraints

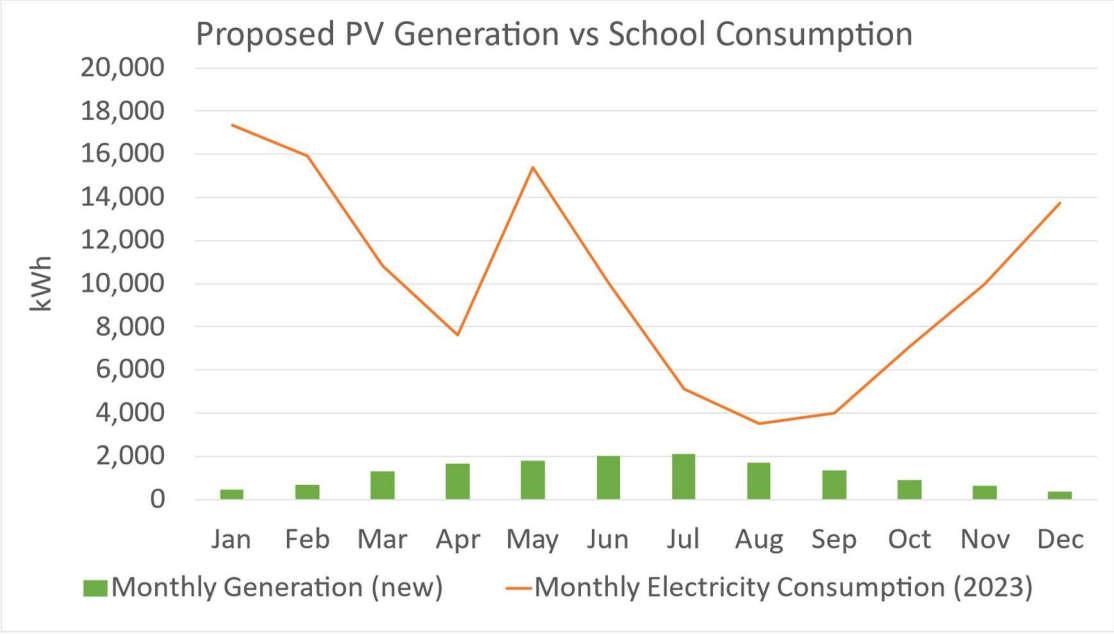


Figure 6: Potential PV Generation vs School Consumption

Site specific considerations include:

- Young trees adjacent to Nursery (outwith school boundary) currently do not pose significant shading but could in future if not managed appropriately.
- Limited storage space in plantroom of Nursery for inverter and metering for proposed PV on Nursery roof. *Alternative location for PV inverter and associated cabling and meters required (potential space in Store or dedicated external cabinet).*
- Electrical Services cupboard in Main Building significant distance from flat roof (potential space within Boys WC Store).
- Structural capabilities of the South Block WCs flat roof will require further investigation.
- Network constraints require further assessment.

To ensure a safe and efficient installation, any solar PV system should adhere to the Council's Solar PV specification including a full assessment by a competent designer/contractor, encompassing structural appraisals as required.

4.3 Behavioural Change Measures

Introducing behavioural changes and awareness programmes presents another avenue for reducing energy consumption within the school. Such initiatives create a collective commitment to sustainability within the school community. By encouraging students, teachers, and staff to adopt simple yet impactful behaviours, it can have a significant impact on energy consumption, and generally have little to no costs attached. Measures relevant to observations during the site visit are detailed below. Whilst the level of energy savings due to these measures cannot be accurately calculated, further detail can be found in Appendix C.

- **Electrical Consumption Awareness:**
    - Turn Off Campaigns: campaigns and advocacy led by pupils (e.g. Energy Champions) to encourage switching off when not in use.
    - Initiatives such as energy audit projects can help occupants understand where and when their school is consuming electricity.
- **Energy Consumption (Heating) Awareness:**
    - Activities with relevant staff to understand heating and hot water controls and change settings to ensure heating is only on when required.
    - Recommended temperatures and heating periods are listed in the Highland Council's Heating Policy (for further information, contact the Climate Change and Energy Team).
- Online resources include Energy Sparks, Eco Schools, National Energy Action and the Energy Saving Trust. Specifically related to water consumption in schools, there is the Scottish Water's Generation H_2O project with resources and activities for all ages.

4.4 Electrical Vehicle Charge Points

The implementation of electric vehicle charge points (EVCPs) aims to positively impact emissions by encouraging EV travel to and from the site. The school has space for approximately 16 cars (used by staff and visitors). Scottish Government guidance recommends 10% of car parking spaces should be designated for EVCPs.

Ideally therefore, one EVCP would be situated within the school's existing car parking area. One EVCP will provide for two EVs being charged at once. To ensure inclusivity, hatching around the EV charging bays for accessible needs is recommended. This effectively means the equivalent of three standard bays will be given over to the provision of two EVCP bays.

The proposed cable routing outlined in Figure 7.

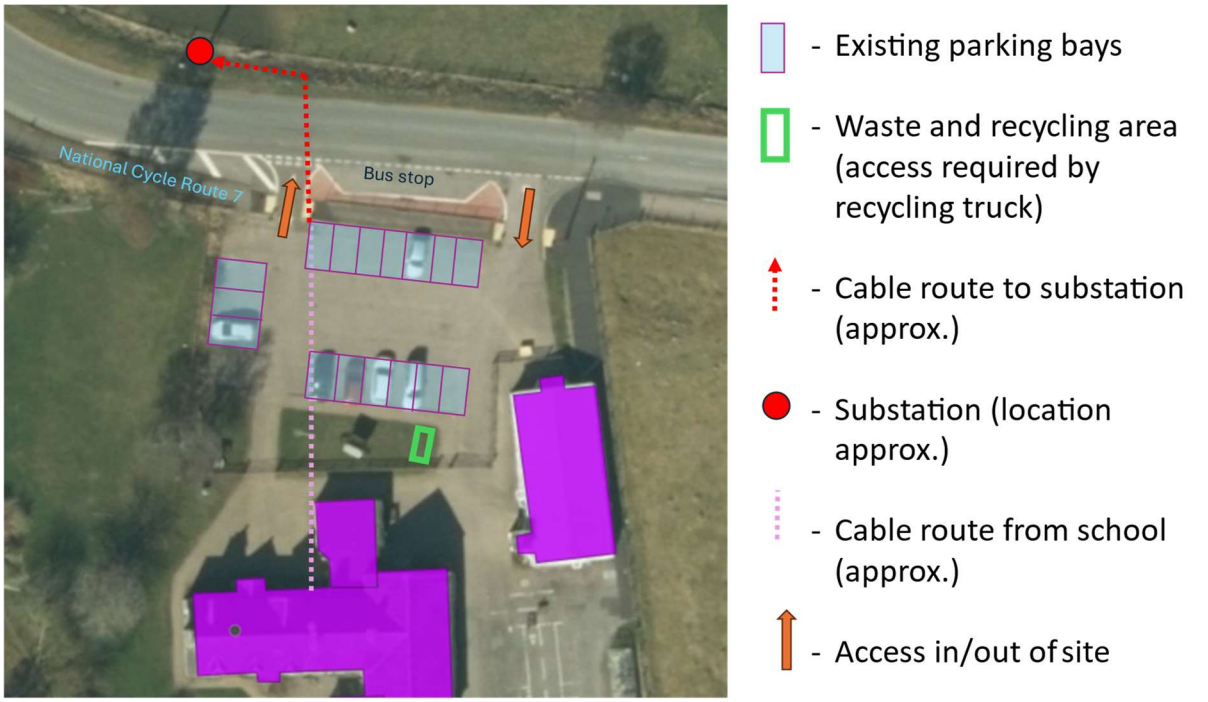


Figure 7: Proposed EV Charger Location

Further investigation is necessary to determine whether the EVCPs should be directly connected from the location substation (red line) or utilise the schools spare electricity capacity (pink line):

- School's current available capacity is 69kVA but the maximum demand is unknown. This would need to be investigated further to understand the number of EV chargers that could be accommodated this way.
- Substation that supplies the site has an available headroom of 61kVA. If EV chargers are under consideration for future installation, a connection request to SSEN would need to be submitted to confirm the available capacity. Costs for direct supply also affected by distance substation is from site and must be considered.

Depending on capacity allowance, it is recommended that either one 7kW (14kVA) slow charger or one 22kW (44kVA) fast charger is installed.

4.5 Forecasting

4.5.1 Annual Energy Consumption and Costs

Figure 8 and Figure 9 highlight the changes in annual energy consumption and energy costs from implementation of the recommended measures (max 20-yr payback), with doing nothing (red) vs doing something (green). Profile is based upon the measures being progressed over the period 2025-27.

Between 2024 and 2045 the cumulative cost savings and energy reduction are estimated to be £135,685 and 710,815kWh respectively.

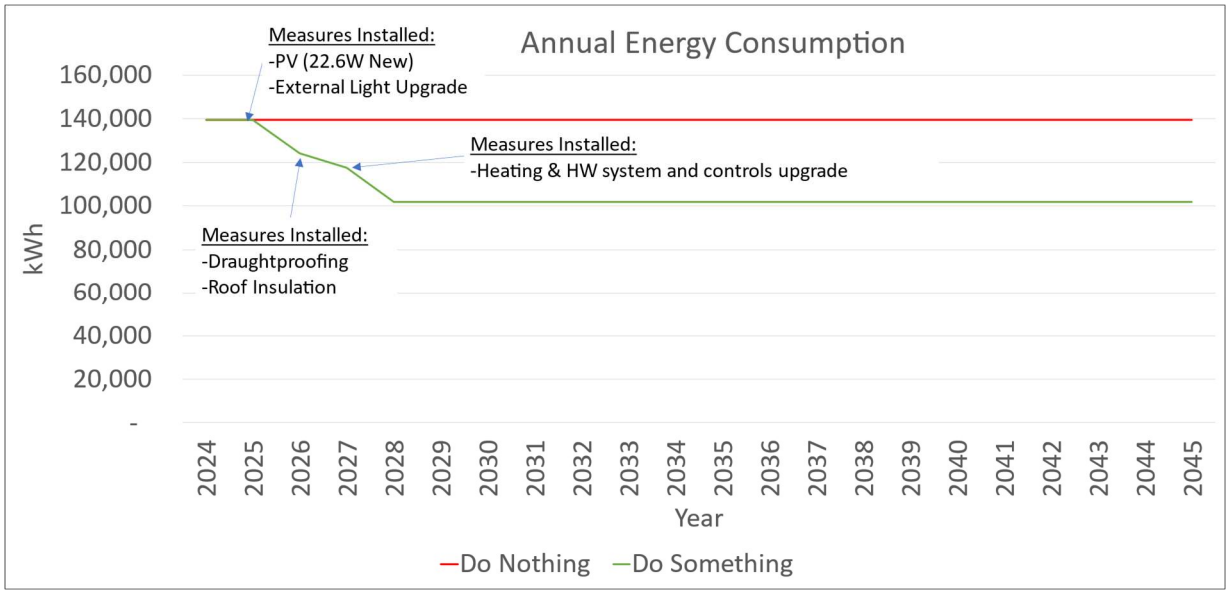


Figure 8: Annual Energy Consumption Forecast

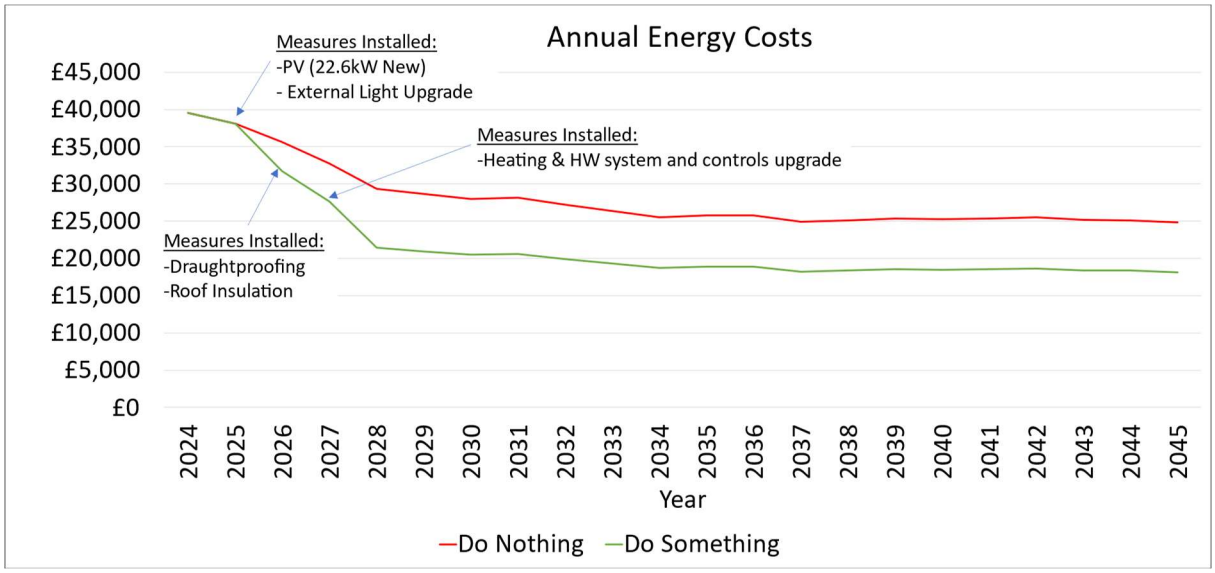


Figure 9: Annual Energy Cost Forecast

4.5.2 Net Zero Emissions Forecast

Figure 10 showcases the projected impact of taking action on the school's carbon footprint.

As demonstrated, these proactive steps lead to a reduction in annual emissions earlier than if nothing is done. In comparison to the 'Do Nothing' approach, the estimated reduction in carbon emissions of the recommended measures between 2024 and 2045 is 44tCO_2e. This reduction is equivalent to 297 cars driving the North Coast 500 route.

Note:- The natural downward trend of both "Do Nothing" and "Do Something" is due to the decarbonisation of the grid and the fact that the building is electrically heated and not reliant on any fossil fuels.

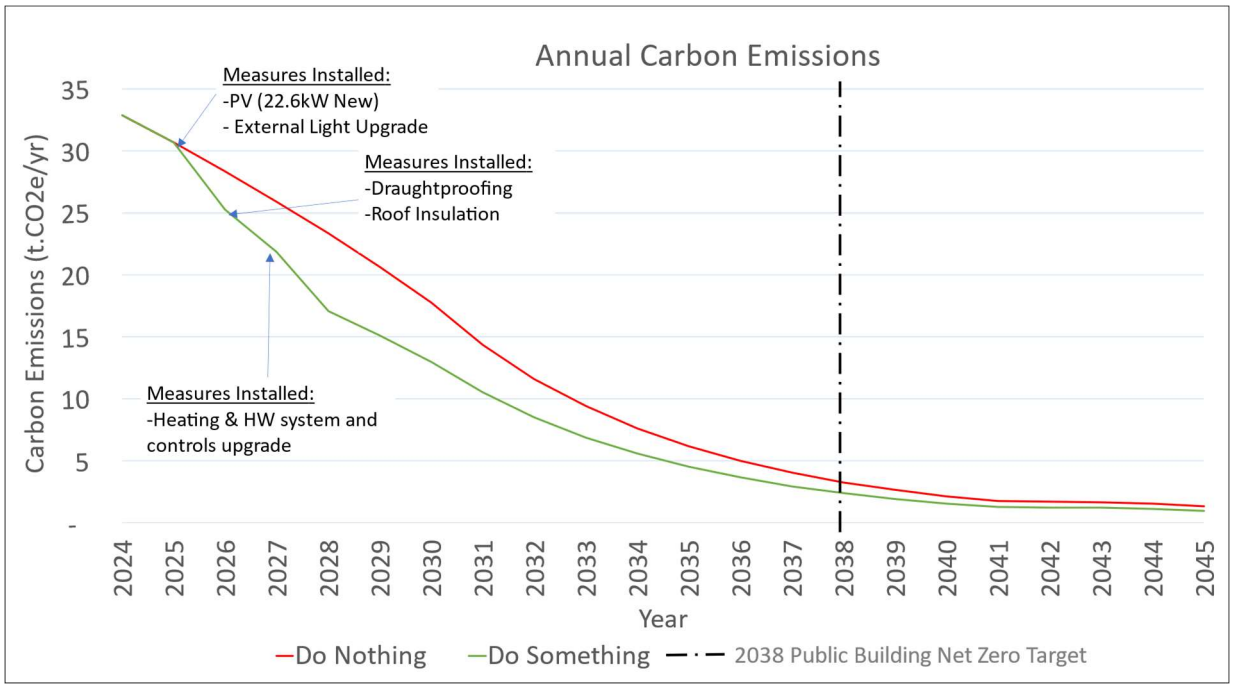


Figure 10: Annual Carbon Emissions Forecast

4.6 Additional Considerations

- **Travel:** Transport and active travel aspects were not included within the scope of this study.
- **Waste:** Waste management, recycling, and food waste aspects were not included in the scope of this study.
- **Cost:** Modelled costs and savings stated in this document are based on current figures and assumptions. A full survey, investigations and in-depth cost analysis should be undertaken as part of any future improvement works undertaken.
- **Disruption:** All projects will have a degree of disruption, some more than others, however appropriate planning and co-ordination with the school would help minimise any impact on service delivery.

- **Maintenance requirements:** Maintenance requirements for new equipment, heating, renewable systems and building fabric improvements should be identified and included into maintenance schedules and budgets accordingly.
- **Asbestos:** The site is known to have asbestos in various locations and as part of any project, a "Refurbishment and Demolition Asbestos Survey" would be required.
- **Network Capacity:** Please note any changes that will potentially increase the electricity demand, and impact on the existing available capacity, will require a connection request with the DNO to ensure suitability. They can also impact on the school's wider electrical infrastructure and implications will need to be determined.
- **Climate Change Adaptation**: Climate change is expected to result in the area being hotter, drier and cloudier by 2050 (Table 9). Review of SEPA flood map modelling indicates the area is at a medium risk of future river and surface water flooding, but there is no risk of coastal flooding. Appendix C outlines the key impacts and adaptation measures to be considered when undertaking any future building work due to such changes in climate.

	Temperature (°C)	Rainfall (mm/day)	Cloudiness (W/m2)	Windiness (m/sec)
Yearly	+3.15	-0.1	+12.5	-0.03
Summer	+3.25	+0.25	+21.6	-0.16
Winter	+2.69	-0.2	+3.7	+0.03

Table 9: Climate change impacts in 2050 from 1980 baseline figures for Badenoch and Strathspey Central – 06 Data Zone under worst case scenario (equivalent to global warming level of 3.2-5.4C which is RCP 8.5). [Taken from: Local Climate Adaptation Tool (lcat.uk)]

4.7 Recommendation Action Plan

Table 10: Overview of Recommended Measures provides an overview of the recommended measures to support the school's progress to Net Zero. It is requested that feedback from both the property occupier/service as well as Property, is sought and provided to refine and decide which measures will be progressed and implemented.

Recommendations	Supported by Site/Service	Supported by Property	Action By	Timescale
Install Solar PV system				
Upgrade electric heating and controls				
Draughtproofing of windows and doors				
Roof insulation / Suspended insulated ceiling (Main Building)				
Wall and roof insulation in Horsa Hut *(if building being retained and upgrade works being undertaken)*				
Replace all external lighting with LEDs				
Fix leaking tap in Cleaner's Cupboard (Nursery)				
Fix leaking urinal in Boy's WC (South Block)				
Any new or replacement equipment to be energy efficient models				
Check ASHP programmer and amend as required to ensure it corresponds with GMT/BST.				
Check timeclock settings on SH weather watcher control and amend if required.				
Remove items from in front/on top of heat emitters				
Heating & Control Settings/Behaviours: Activities with relevant staff to understand heating and hot water controls and change settings to ensure heating is only on when required.				
Water Usage/Behaviours: Encourage water efficiency behaviours, particularly in Nursery.				

Table 10: Overview of Recommended Measures

Appendix A : Evaluation of Energy Reduction Measures

Table below outlines all measures evaluated for their suitability within the building. Measures that were assessed to be suitable are highlighted, and investigated further in terms of cost, energy and carbon savings.

Measures		Comments	Measure Further Investigated?
Building Fabric	**Glazing Upgrade / Replacement**	Double glazing (DG) in Main Building old, w'some frames showing signs of rot. Would involve replacement or upgrade of over 50% DG and frames with new DG and frames.	**Y**
	Wall Insulation (WI)	Solid walls (exposed stone external finish) in Main Building – disruption/complexity of install potentially outweighs energy efficiency gains. Would involve internal wall insulation to all external walls. Horsa Hut – uninsulated walls (would benefit from WI but only as part of wider structural upgrades). Would involve significant works required to existing structure plus external insulated cladding.	**Y**
	Floor Insulation (FI)	Suspended timber floor (likely small void) – access would be via removing floorboards. Disruption/complexity of install likely to outweigh energy efficiency gains.	N
	Draughtproofing	Some window units requiring replacement; upgrade draughtproofing on windows and doors throughout.	**Y**
Heating & Hot Water	**Heating Infrastructure**	Older storage heaters present. Upgrade electric heating and controls in Main Building and Horsa Hut from SHs to electric radiators or panel heaters with localised smart controls.	**Y**
	Heating Controls	Controls old and lack customisable options for occupancy patterns (eg. Not able to set different weekday vs weekend timings). Involve upgrade to appropriate localised smart controls.	**Y**
	Hybrid / Bivalent Heating	As the school is electrically heated this would require a full heating replacement which is not advised in this scenario.	N
	HW Ancillaries	Some HW pipework requiring insulation. Some older water heater models – advise upgrading to increase efficiency.	**Y**
	HW Controls	HW controls are basic, but occupants using them efficiently.	N
Ventilation	Heat Recovery	Lack of physical space for HR system to be installed; natural ventilation strategy deemed appropriate for building.	N
Lighting	**Lighting (LED Upgrade)**	Recommend replacement of all external light fittings to energy efficient LED.	**Y**
	Lighting Controls	Manual switches only present; deemed acceptable for size and use of building.	N
Cooling	Cooling Replacement	Minimal cooling equipment present, and minimal savings would be achieved in replacement.	N
	Cooling Control	As above.	N

Renewables	**Solar PV**	School is potentially suited for Solar PV.	**Y**
	Battery Storage	Given the balance of proposed generation against electrical demands, battery storage is not required. However, should additional generation be installed, batteries would be an applicable technology to be considered for periods of low demand.	N
	Solar Thermal	Not relevant to existing hot water demands and electric heating infrastructure.	N
	Air Source Heat Pump	Main Building is already electrically heated, this would require a full heating replacement which is not advised. *If significant works is undertaken to Horsa Hut, ASHP should be considered.*	N
	Ground Source Heat Pump	As above.	N

Table below provides a summary of all suitable improvements in relation to their cost, energy and carbon savings. The improvements relate only to the Main Building and Horsa Hut.

Improvement	Estimated Annual Savings (£)	Estimated Cost of Works (£)	Cost per lifetime carbon (£/LTt.CO_2e)	Carbon Savings (tCO_2e)	Simple Payback (years)
Glazing Upgrade	£322	£25,789	£13,529	0.2	80
Wall Insulation	£669	£168,397	£42,149	0.5	252
Roof Insulation / Lower Ceiling in Classrooms	£1,635	£30,522	£3,125	1.2	19
Draughtproofing	£433	£8,004	£2,464	0.3	19
Heating Infrastructure & Control Upgrade	£4,341	£70,435	£2,909	3.2	16
HW Pipework Insulation	£413	£673	£286	0.3	2
External Lighting LED Upgrade	£66*	£345	£707	0.0	5

*Note:- *Saving based upon electricity savings only. It is anticipated that the maintenance related savings would at least match or exceed energy savings.*

Appendix B : Building Overview

1 Site Overview

Figure 11 provides an overview of the site, including accessibility, waste facilities, parking and green spaces.

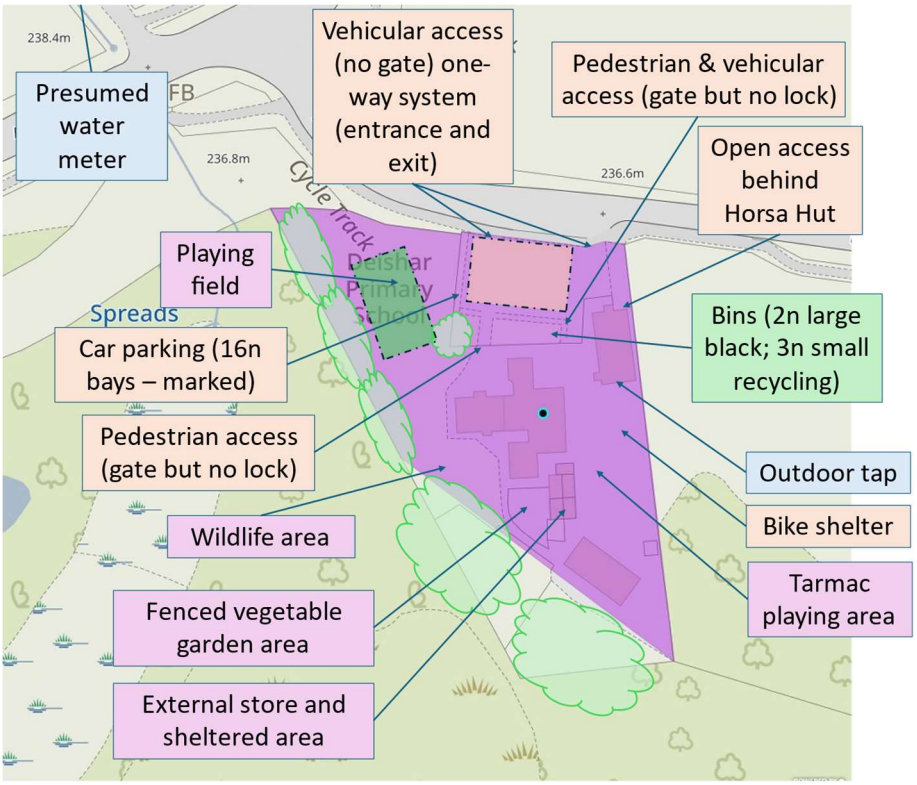


Figure 11: Site Overview Diagram

2 Building Fabric

Table 11 outlines the assumed building fabric components. The Nursery has been built to Scottish Building Regulations 2019.

Element	Main Building Area: 273 m²	Horsa Hut Area: 122 m²	Nursery Area: 115 m²
External Walls	Solid stone (uninsulated).	Brickwork and concrete w'painted finish (uninsulated).	Timber frame with rendered masonry external finish (insulated).
Floor	Suspended timber floor (uninsulated).	Solid uninsulated floor.	Concrete with insulation.
Roofs	Pitched timber frame with slate tiles (uninsulated).	Reinforced concrete frame (uninsulated).	Pitched timber frame with metal sheet cladding (insulated).

Windows and Doors	Mix of timber frame and uPVC frame w' double glazing (DG). External doors timber panel (some glazed areas).	Timber framed DG windows.	Aluminium framed DG doors and windows. Insulated external doors.

Table 11: Building fabric

Onsite Observations : Building Fabric

WALLS:
- Some cracks visible, and repointing may be of benefit to reduce risk of water ingress in Main Building.
- Horsa Hut walls poor condition: concrete spalling, many visible cracks, holes, paint flaking.

ROOF & CEILING:
- Some loose tiles on the roof of the Main Building. Besides one visible patch in Library, Main Building, no major signs of water ingress.
- High internal ceilings in Main Building classrooms (approx. 4.25m).
- Roof of nursery appears to be in good condition.
- Signs of corrosion and flaking paint on gutters and drainpipes of older buildings.
- Drainpipe on south side of Horsa Hut disconnected.
- *No access to roof space to inspect insulation levels*

WINDOWS:
- All DG and draughtproofing >10 years.
- Some exposed/rotten timber window frames and loss of draughtproofing.
- Most windows in classrooms open during site visit despite SHs being switched on and set at highest setting.
- Single glazed rooflight in Main Building.
- Roller blinds in Main Building classrooms; vertical blinds in Nursery.

3 Building Services

3.1 Electricity

There is a three-phase electrical supply for the school with a current available capacity of 69kVA, with a 200/5 LV CT Meter.

Information from SSE's LENZA tool indicates the Secondary Substation that supplies the site has a capacity of 100kVA and has an available headroom of 61%.

3.2 Metering

As shown in Figure 12, the main electrical meter and incoming supply is located within the main electrical services cupboard. The location of the water meter is outwith the site.

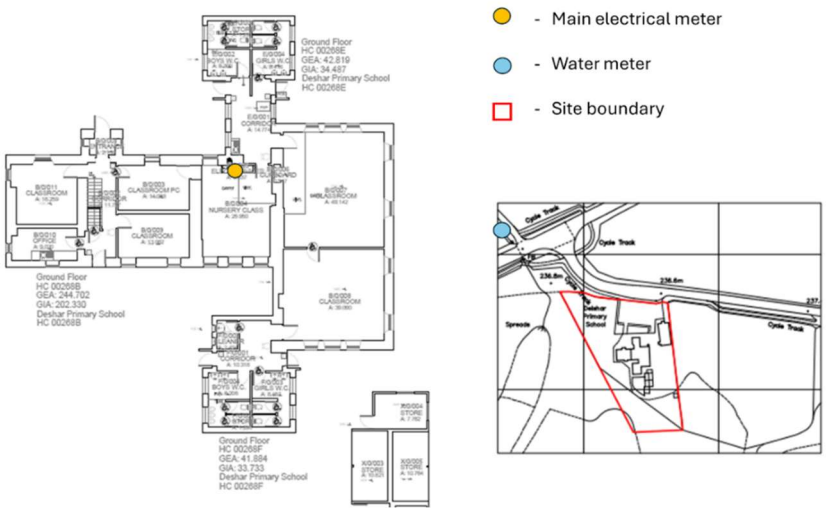


Figure 12: Electrical and Water Meter Locations

3.3 Heating

All heating is electrically based. A breakdown of the heating strategy is presented in Table 12. Storage heaters (SHs) are the main source of heating throughout the Main Building, and the Horsa Hut (Figure 13). The Nursery is heated via a 14kW Air Source Heat Pump (ASHP).

In total, there are approximately 27 SHs (Main Building: 23, Horsa Hut: 4). It was not possible to determine exact specifications for all units, however based upon size, age and type, it is expected they vary between 2-4kW each.

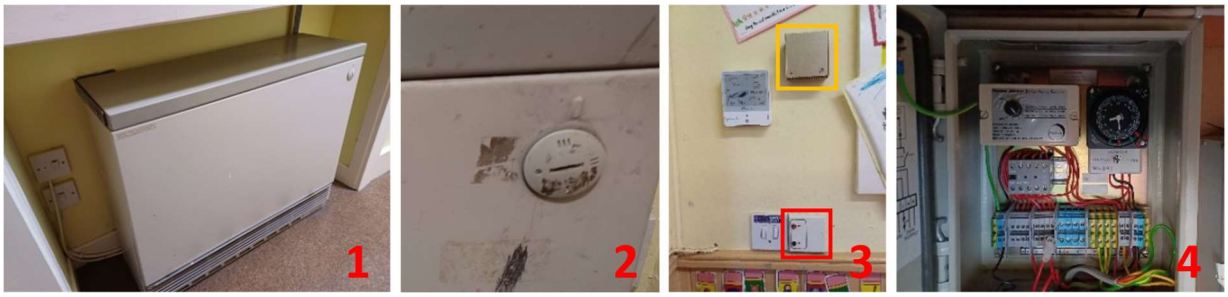


Figure 13: Storage heater [1]; Dial Controls [2]; Room Thermostat (yellow box) and Boost Control (red box) [3]; Weather Watcher Control [4]

Figure 14: Wall Fan Heater (Classroom) [1]; Radiant Panel Heater (Kitchen Store & Cleaner's Cupbd) [2]; Overhead Air Heater (Horsa Hut) [3]; Infrared Heater (Horsa Hut) [4]

Space	Heat Emitters	Controls
Main Building and WCs	Electric SHs plus portable heaters and Dimplex wall fan heaters (Figure 14).	Overnight storage through centralised Weather Watcher SH controller w'localised dial control (o-III), room thermostat and override boost control.
Horsa Hut	SHs, overdoor air heaters, infrared heaters and overhead radiant panel heaters (Figure 14). Additional overhead heater in vestibule.	Timer switches at rear of canteen, controlling infrared heaters. Programmer & timer controlling SHs and overhead heaters.
Nursery	Underfloor heating.	Programmer & Timer with room thermostats.

Table 12: Heating Strategy

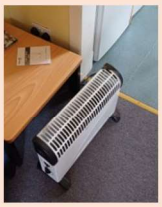
Onsite Observations : Heating

HEAT EMITTERS:

- Some SHs blocked by items and equipment (e.g. in classrooms, offices, etc).
- SHs in Staffroom and Staff Kitchen newer than in other rooms (had improved local control). All SH appear more than 10 years old (reduction in efficiency).
- One new electric radiator in Classroom.

HEATING CONTROLS:

- Commercial Weather Watcher control which enables climatic response set close to maximum. Holiday setback timeclock appears to be 12 hours 'out' and does not appear to be in use (set to constant instead of timed).
- All storage heaters caged restricting access to local controls and heat output.
- Limited local control settings (only four settings on SHs and boost button in each room) and no visible room temperature/thermostat settings.
- ASHP programmer out by one hour.
- FM reported finding controls difficult to adjust resulting in heating system remaining fully operational during Christmas and Easter holiday periods.



THERMAL COMFORT:

- Head Teacher highlighted repeated instances during winter months where the heating system was unable to provide a comfortable internal temperature. Reasons cited included high ceilings and ineffective heating system.
- Horsa Hut reported as particularly cold. Heating has been set to timed programme in line with Heating Policy. However, during site survey, the heating had been set to 'boost 1 hour'.
- Occupants confirmed use of additional portable heaters throughout to keep heating above 16°C in Main Building, particularly in winter.
- Main SHs were on during site visit throughout building including unoccupied spaces such as Library.
- Comfort in Nursery is generally good, although occupants noted space can be cool during winter.
- Nursery staff reported to not have received any training on how to control or set the heating programmer for ASHP.

3.4 Domestic Hot Water (DHW)

The overall DHW (Figure 15) storage provision on site is approximately 495 litres, supplied by three 3kW electric immersion calorifiers:

- 90litre calorifier (South Block WCs wash hand basins (WHBs))
- 210litre calorifier (Kitchen and Canteen sinks)
- 150litre calorifier (Nursery sinks and WHBs)

Seven 5-10litre point-of-use 2kW water heaters (Cloak, North Block WCs, Staff and Food Prep areas) provide hot water for sinks and WHBs.

Figure 15: Electric Immersion Calorifier (Horsa Hut) [1]; Electric Immersion Calorifier (South Block WCs) [2]; Hot Water Calorifier (Nursery) [3]; Point-of-Use Water Heater (North Block WCs) [4]; Under sink Point-of-Use Water Heater (Cloak/Craft Area) [5]

Onsite Observations : Hot Water

POINT-OF-USE WATER HEATERS, CALORIFIERS & CONTROLS:

- Generally appear to be in good condition, some PoU WH older models.
- All three calorifiers monitored by the Energy Team's IoT sensors. Readings correspond with findings on site.
- HW programme and timers installed for the Kitchen and Nursery calorifiers: Nursery on timed settings and not touched by occupants, Kitchen programmer set to 'off' and 1 hour boost override is being used by occupants as required.

TAPS & PIPEWORK

- Lack of insulation around HW pipework throughout Main Building & Horsa Hut.
- HW tap in Cleaner's Cupboard in Nursery was found to be dripping.

3.5 Cold Water

Cold water is assumed supplied directly from the mains to a number of outlets, including sinks/basins, WCs, urinals, dishwasher, potwash, washing machine, and outdoor taps.

Onsite Observations : Cold Water

OUTLETS:

- Drinking fountain labelled 'out-of-use'.
- Constant dripping from urinal in Boys WC (South Block).
- 12 sinks/WHBs present in Nursery and all in regular use.

3.6 Ventilation

The school utilises a mix of natural and mechanical ventilation systems, as detailed in Table 13 and Figure 16.

Space	Ventilation Strategy
Classrooms / Hall / Staff Areas / Canteen	Naturally ventilated (NV): openable windows; some w'tricklevents.

Kitchen	NV: openable windows; some w'tricklevents. Wall mounted extract fan mounted within window (on/off control).
Staff Toilets	Localised extract unit controlled via light switch.
Boys & Girls WC (North)	NV: openable windows, no tricklevents. Extract vent (constantly open) with no controls apparent.
Boys & Girls WC (South)	NV: openable windows, no tricklevents. Gap between threshold and bottom of door leaf.
Nursery	Mechanical Ventilation (MV) system w'ceiling vents and DG windows w'tricklevents.

Table 13: Ventilation Strategy

Figure 16: Openable DG windows (no tricklevents) [1]; Openable DG windows (tricklevents) [2]; Extract in Kitchen [3]; Vent (North Block WCs) [4]; MV System Outlet (Nursery) [5]

Onsite Observations : Ventilation

EXTRACT UNITS:
- Vents in North Block WCs permanently open, with no apparent control.
- Extract in Kitchen reportedly unused by occupants.

TRICKLEVENTS (TVs) & WINDOWS:
- Main Building: No TVs present.
- Horsa Hut & Nursery: present and generally open at all times.
- Classroom windows: controls difficult to access.

3.7 Lighting and Electrical Equipment

Table 14 outlines the lighting strategy for the school. Most of the internal and external lighting is LED. Emergency lighting predominately fluorescent, with some LEDs.

Electrical equipment noted was found to be typical of a primary school with catering facilities.

Space	Lighting Strategy
All indoor areas	Ceiling mounted LEDs with manual control (dimmer switch only in Office) (Figure 17).
External (Horsa Hut and Main Building)	Four out of six wall mounted security lights fluorescent (Figure 17), controlled via Sangamo time switch and external photocell.
External (Nursery)	Under-roof and wall mounted LED security lights, controlled via timer in Nursery Plant Room.

Table 14: Lighting Strategy

Figure 17: Typical Internal LED Lighting [1]; Typical Internal LED Strip Lighting [2]; External LED Lighting [3]; External Fluorescent Lighting [4]

Onsite Observations : Lighting & Electrical Equipment

LIGHTING:

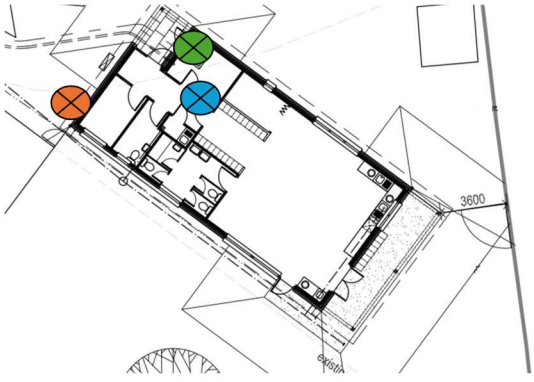
- All new fittings appear in good condition.
- One ceiling mounted light in understairs cupboard appeared to be fluorescent.
- External lighting solar time switch clock out by one hour. Does not allow daily or weekly time settings to reduce use during holidays/summer.
- Facilities Officer confirmed fluorescent lights (internal and external) replaced at end-of-life with LEDs.

ELECTRICAL ITEMS:

- One classroom in Main Building had many tablets (assumed one per student) plugged in and switched on whilst students were outside.
- Active labelling of light switches and equipment.
- Commercial catering equipment in use, fridge/freezers and other white goods generally older stock.

3.8 Renewables

A 14kW air to water heat pump provides space heating (underfloor) and hot water for the Nursery (Figure 18). It is controlled by a programmer and room thermostats.



- Air Source Heat Pump
- Hot Water Calorifier
- Programmer Control Panel

Figure 18: Air Source Heat Pump System (External Unit [1]; Room Thermostat [2]; Programmer [3]

Onsite Observations : Existing Renewable Systems

- All aspects of ASHP appear in good condition.
- Programmer out by one hour.
- Staff noted that they did not know how to change programme settings.
- Room thermostats reading 19-21°C (acceptable thermal conditions).

Appendix C : Behavioural Change Measures

Behavioural Change Measure	Commentary	Potential saving opportunity
Active labelling of light switches	Many schools have excessive installed lighting and multiple light switches in rooms. Mark up light switches that are not required to be on under normal daylight.	As much as 30% of lighting can, at times, be left off (up to 12% saving).
Switch off lighting in daylight and when room is unoccupied	Switch off lighting when not required and maximise use of natural daylight. Also check that lights are switched off at breaks etc.	Savings are dependent on existing practices and windows (up to 10% saving).
IT equipment labelling and switch off	The active labelling of all equipment (switches and plugs) can help reduce energy consumption to help school users know what they can switch off.	Up to 5% saving.
Reducing out of hours electrical load	School opening hours can be less than 2,000 hours per year meaning they're unoccupied for 5,000 – 6,000 hours a year. If electrical items such as computers are left on, out of hours, this causes a major waste of energy. Energy Champions and Monitors can help ensure equipment is off at the end of the day/holidays.	Up to 20% saving.
Checking that heating times fit with school usage	Heating accounts for the majority of energy consumption in a school. By making sure occupants are aware of this and reduce thermostats and set local heating controls to only be on when spaces are in use will reduce use of fuels, emissions, and costs.	Reducing heating by 1 hour a day can reduce heating costs by 10%.
Keeping windows and doors closed if the heating is on	If the heating system is being run ineffectively rooms can overheat and occupants open windows to reduce the temperature. Thermostats in rooms should be maintained and adjusted to the correct temperature. Recommended temperatures are listed in THC heating policy.	
Dressing appropriately for the weather	Encourage staff and pupils to wear more clothes if they're cold rather than turning the heating up.	Turning the thermostat up by 1°C can increase the heating costs by up to 8-10%.
Water behaviours	Small changes within schools can also reduce overall energy consumption as well as save water. Campaigns to turn off taps both in school and at home can help. If the school has outside space or growing areas, installing a water butt and using water cans instead of a hose and outdoor tap. Fixing leaking toilets, urinals and taps can also make a big difference in water consumption – a leaking toilet can waste between 215 and 400 litres of water every day.	

Note, the percentage figures stated above relate to the consumption of the application or system, not the overall school consumption.

Appendix D : Climate Change Impacts & Adaptation Measures

	Impact on buildings	Potential damage	Adaptation measures
Hotter, wetter summers	Higher internal humidity	Increased prevalence of insect pests and fungal attack; warping of timber elements	Ensure adequate ventilation through inspection and improvement of existing natural ventilation strategies (e.g. Ensuring cross ventilation in classrooms)
	Increased moss and algal growth	Dampness, mould, staining and discolouration of building fabric	Regular and scheduled maintenance of building fabric; Improved weathering details
	Rising ground water levels	Dampness in wall footings	Enhanced drainage adjacent to building; Regular inspection and maintenance of water vapour handling of walls
	Prolonged saturation of masonry	Algal growth, vegetation	Regular and scheduled repointing and maintenance of masonry; Improved weathering details when undergoing any renovation
Warmer, drier winters	Increased thermal stress on building fabric	Cracking of hard materials	Repair and maintenance schedules of cracks or missing plaster coatings to include flexible traditional materials
	High internal temperatures	Thermal discomfort; warping/splitting of timber elements	Maintenance schedules of windows and ventilation systems; Installation of blinds and/or canopies and soft flooring
	Ground shrinkage	Movement of foundations	Adaptation of surface draining and landscaping/planting
	Flash flooding from watercourses and roads	Physical damage; saturation of fabric; Sewage contamination	Regular maintenance of adjacent culverts & water causeways; Routes for surge waterflows around building installed
Cloudier days	Reduction in performance of solar PV and solar thermal systems	-	Ensure PV systems appropriately sized and situated to maximise performance
Windier days	Increased physical stress on building fabric and external services and equipment	Physical damage (e.g. Solar panels or roofing materials ripped off/damaged)	Regular and scheduled maintenance of building fabric and external equipment; Improved weathering details and fixings of external equipment e.g. Solar panels

Key building impacts and potential adaptation measures (adapted from Historic Environment Scotland Guidance on Climate Change Adaptation for Traditional Buildings)

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