West College Scotland

Authority Data Pack Report
for
Scottish Funding Council

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Colleges Energy Efficiency Pathfinder
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1 Executive Summary

This report outlines the process undertaken by Turner & Townsend to establish a high level summary of key areas for investigation into the implementation of Energy Conservation Measures to save energy within the West College Scotland estate utilising the Scottish Government's NDEE Framework.

The process undertaken followed the following steps:

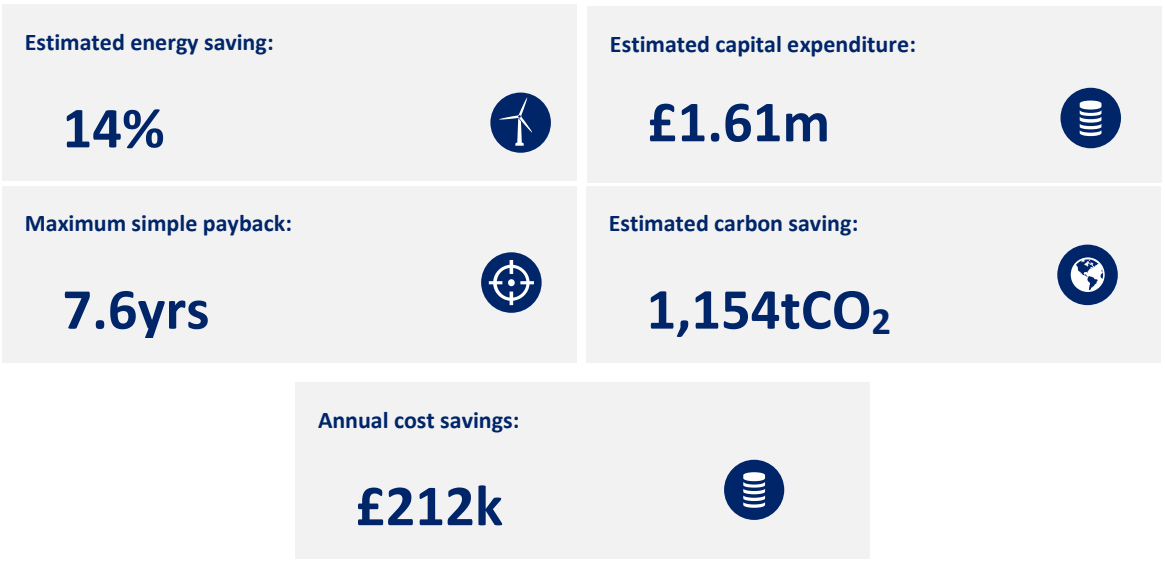
1. Data Gathering
2. Desktop Energy Assessment
3. Site Surveys
4. Project Register Development

The initial step was to gather appropriate data that could be used to investigate the energy performance of the West College Scotland estate and the potential energy saving against the benchmark which in turn leads to the implementation of ECMs. Data required to be gathered included:

- Campus Name
- Building Name
- Building Usage including number of users, usage hours etc
- Fuel Unit Costs
- Type of Tenure
- Heritage Status
- Floor Areas
- Year of Construction
- Refurbishment Details
- Energy Usage Data
- Energy Performance Certificate
- Metering Details

Following the data gathering exercise Turner & Townsend completed a desktop energy assessment of the College, at the building level, to identify estimated capital expenditure, return on investment and energy, carbon dioxide and financial savings. The output of this analysis can be seen in Figure 1 but in summary it is estimated that an energy saving of **14%** is possible at the College, equating to a saving of **1154tCO_2**, using a variety of ECMs requiring an estimated capital expenditure of **£1.61m** with a maximum payback period of **7.6 years** with an annual saving of approximately **£212k**.

Figure 1 – Benchmarking Output – West College Scotland



To ensure the robustness of the Desktop Energy Assessment site surveys were carried out at each of the sites within the West College Scotland Estate which have led to the identification of a number of Energy Conservation Measures that could be installed to meet the energy saving target identified.

It should be noted that the list of ECMs identified in the Project Registers are only as a recommendation and in no way exhaustive. A final list of ECMs will need to be developed by the selected Framework Contractor in order to meet the performance standard identified in the desktop energy review.

The following categories shown in Table 1 of Energy Conservation Measure have been considered.

Table 1 – ECM Categories

ECM Cat. Ref.	ECM Cat Name	ECM Category Description
01	Automatic Meter Reading (aMR) systems	Energy consumption measurement, logging, communication & reporting systems.
02	Passive Measures (Passive)	Passive renewable energy technologies and measures, e.g. solar shading
03	Building Fabric (BF)	Building fabric thermal performance improvements, such as loft insulation.
04	Heating, Ventilation & Air Conditioning (HVAC)	Measures to improve energy efficiency of heating and cooling sources, distribution systems, heat emitters etc.
05	HVAC Controls	Building energy management systems and other HVAC controls.
06	Lighting and Lighting Controls (Light & Cntrl)	Artificial lighting systems and their control.
07	Electrical Equipment and Distribution (Electrical)	Efficient motors and other equipment; voltage management etc.
08	Low and Zero Carbon Technologies (LZC)	Biomass, solar thermal, heat pumps, photovoltaics, combined heat and power etc.
09	Specialist Systems (Specialist)	Swimming pools, lifts, catering, fume cupboards, process energy use etc.
10	Water Management (Water)	Management of water using devices, such as taps, WC cisterns, urinals etc.
11	Others (Others)	ECMs that do not fit into the above categories.

The Project Register for West College Scotland can be identified within Appendix 8 of this report.

2 Baseline Information

The College has a number of buildings across its main campuses at Clydebank, Greenock and Paisley.

- The Clydebank campus is a single building constructed in 2009 and therefore is in good condition. This campus has a GIFA of 17,806m^2
- The Greenock campus includes the Finnart Street building and the Waterfront building. Finnart Street was constructed in 1976 with the refectory area and main entrance benefiting from an internal and external refurbishment in 2013. The Waterfront building was constructed in 1995 and has not had any major refurbishment works. This campus has a GIFA of 27,534m^2
- The Paisley campus including the main buildings within this project at are a variety of ages with the dates of construction in a range from 1916 through to 2013 - the ICE building, a dedicated renewable training centre. The plant and condition of the buildings therefor varies hugely as there have been few refurbishment works carried out. This campus has a GIFA of 32,425m^2

Below are a number of photographs to detail the current condition of the buildings.

Figure 2 - Finnart Street - Boiler Room

Figure 3 - Waterfront - AirCon Units

Figure 4 - Clydebank – Boiler

Figure 5 - Paisley Campus - Chimneys

Site specific information presented within this authority data pack was gathered through site visits carried out the 22nd and 24th of February. The information is based on what was observed during site visits, discussions with Facilities Managers and through access to Operation and Maintenance (O&M) manuals and other documentation which is provided as an appendix to this document where possible.

The following information is available as appendices to this report:

Appendix 1 – Building Drawings and Site Plans

Appendix 2 – Condition Registers and Survey Reports

Appendix 3 – Carbon Management Plans

Appendix 4 – Asbestos Survey Reports (also available on site)

Appendix 5 – BMS Information

Appendix 6 - Building and Energy Data Sheet

Appendix 7 – Site Visit Report

Appendix 8 – Project Register

3 Authority's Minimum Requirements

Utilising the baseline data information gathered and in order to facilitate the process of identifying potential scope for energy savings across the College estate Turner & Townsend have completed a desktop energy assessment, at the building level, to identify estimated capital expenditure, return on investment and energy, carbon dioxide and financial savings.

3.1 Benchmarking approach

3.1.1 Energy and carbon savings

Turner & Townsend's benchmarking approach is a desktop based assessment which establishes current energy consumption per metre squared floor area (kWh/m2) and compares this against a blend of industry benchmarks including CIBSE's TM46, Carbon Trust Energy Benchmarks and Display Energy Certificates (DECs) as well as Turner & Townsend's own in-house data resources.

Where a building is performing above expected ranges, a proportion of the difference between actual and expected performance is calculated providing the estimated energy and carbon savings that are realistically achievable.

Where a building is performing below expected ranges, a proportion of expected energy savings is still calculated (albeit to a lesser extent) as it is recognised that energy benchmarks include old, inefficient buildings reflective of the overall building stock.

This does not involve detailed design work, which is considered at a later stage. However, if specific plant or systems are known to be inefficient/at end of life we are able to adjust the benchmarking calculations to recognise the increased availability of energy savings.

3.1.2 Capital expenditure

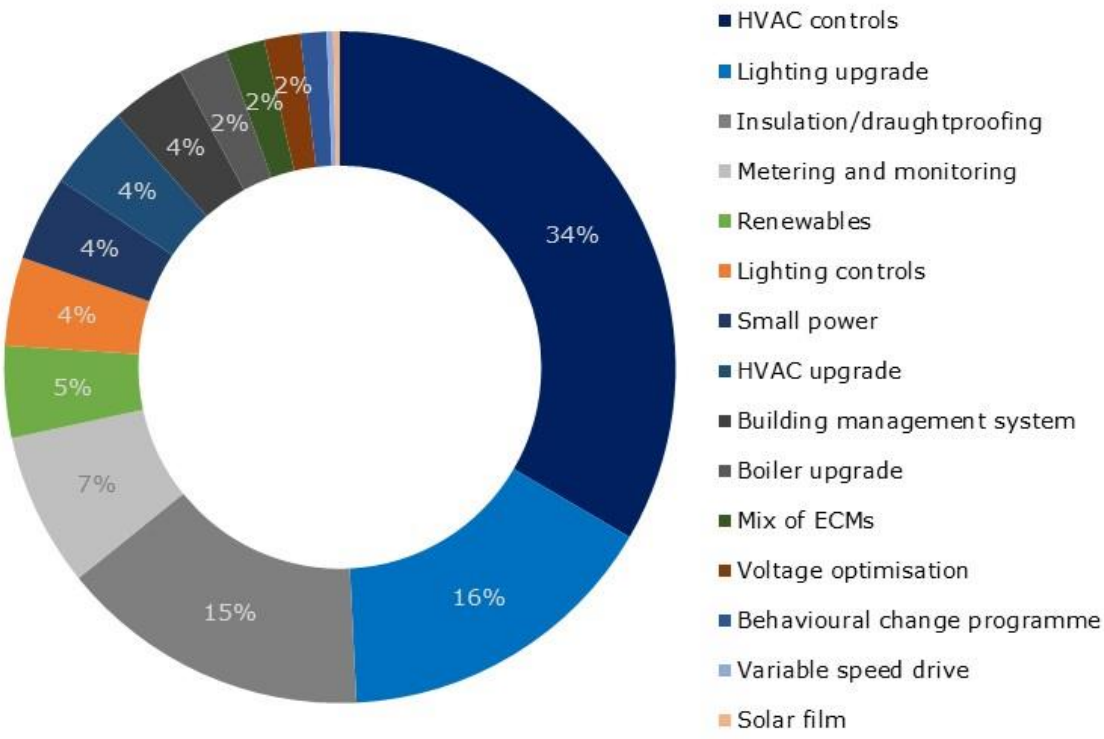
Through Turner & Townsend's experience of implementing energy conservation measures we have compiled an extensive database of project costs from the supply chain. With over 3,000 individual energy conservation measures, across a wide range of technology types, we are able to calculate the capital expenditure required to mitigate one tonne of carbon dioxide according to building type (e.g. school, office, leisure centre etc.).

Having established estimated carbon savings (Section 3.1.1); average capital expenditure costs can be applied to each building to establish the total indicative capital expenditure.

It is important to emphasise that estimated capital expenditure is based on a blend of energy efficiency measures (see Figure 6). This has the benefit of taking into account technologies with both short and long term payback periods providing flexibility during the later design stage.

Capital costs quoted in this report are at current day prices. This excludes preliminaries, VAT, client adviser fees and any specific client contingency/functional costs.

Figure 6 – Typical energy conservation measures implemented in EnPCs



3.1.3 Return on investment

Having calculated estimated energy savings and estimated capital expenditure, individual utility unit rates (£/kWh) for each building are used to calculate the maximum return on investment.

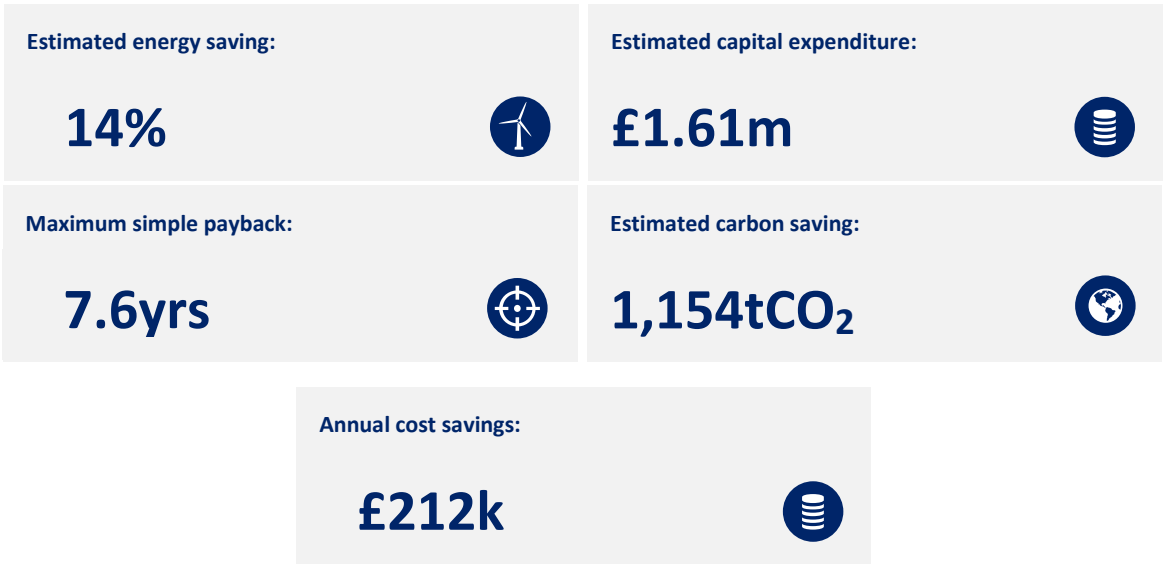
As the maximum return on investment is directly linked to utility unit rates, organisations with low energy unit rate costs tend to experience longer payback periods compared to those that pay relatively more for energy

3.2 Benchmark result

This analysis sets the business case criteria, guiding tendering framework contractors by providing minimum performance standards.

The results of this analysis are provided below.

Figure 7 – Benchmarking output – West College Scotland



Minimum estimated energy savings are expected to be 14% when comparing current performance against 'typical' building performance benchmarks. In financial terms this equates to a minimum annual saving in the region of £212k against an estimated capital expenditure of £1.61m. This equates to a maximum payback period of 7.6 years.

Figure 8 and Figure 9 present building level benchmarking results separately by electricity and heating fuel energy consumption with actual energy consumption (kWh/m2) expressed as a percentage difference against benchmark energy rates (shown by the y-axis). Poorly performing buildings are above the 0% line and are found towards the left side of the graph. This highlights that there is greater scope to invest and make savings. Better performing buildings will be below the 0% line (i.e. they are performing under the benchmark rate) and are found towards the right-hand side of the x-axis.

The size of each bubble represents the energy spend for the given fuel type e.g. the larger the bubble, the more significant the energy spend.

Figure 8 – West College Scotland – Electricity comparison to benchmark

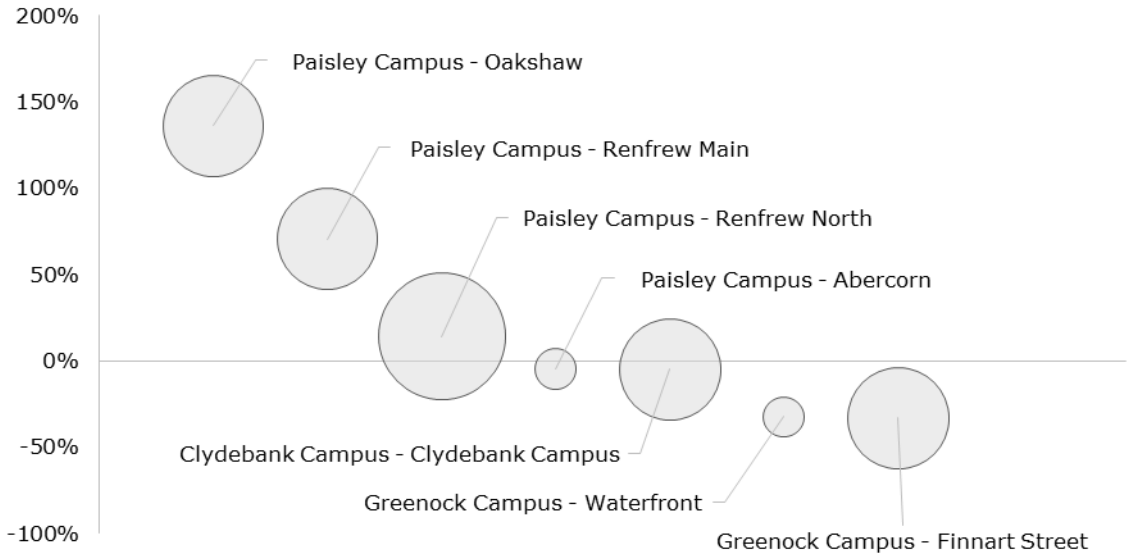
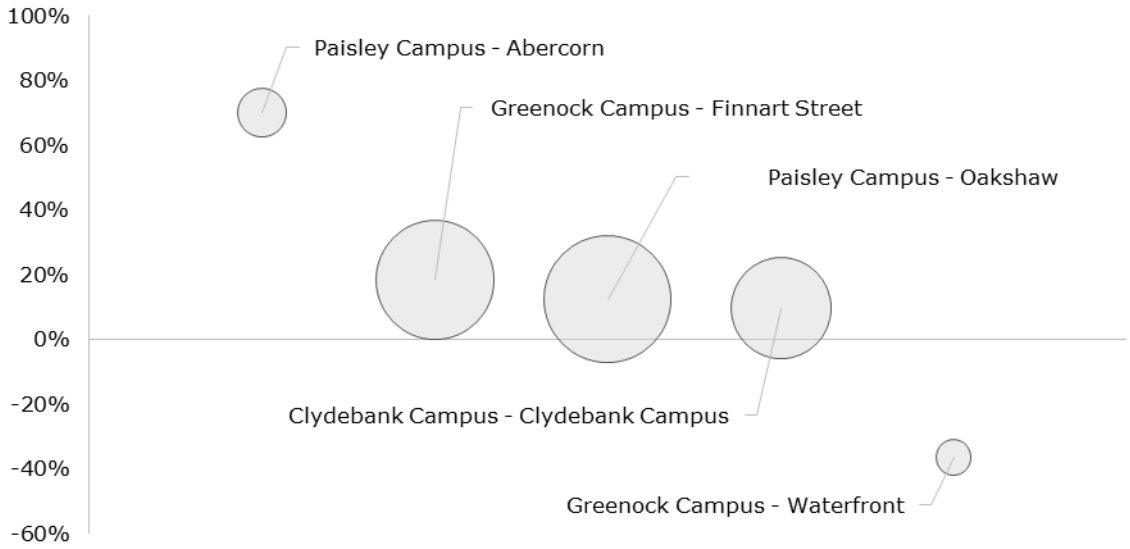


Figure 9 – West College Scotland – Heating fuel comparison to benchmark



As the boiler is two years old at the Paisley Campus - Abercorn site the potential energy savings linked to heating fuel have been reduced despite the performance against benchmark rates. It was assumed that investment was unlikely to focus on boiler upgrades but focus on controls.

Table 2 shows current building energy consumption (kWh/m2) for both electricity and heating fuel and the percentage energy savings that can be expected to be achieved. Certain buildings were grouped together due to metering arrangements.

Table 2 – West College Scotland – Current performance and estimated savings

Campus	Building	Current (kWh/m²)		Estimated energy savings (%)	Comments
		Electricity	Heating fuel		
Clydebank Campus	Clydebank Campus	[redacted]	[redacted]	14%	
Greenock Campus	Finnart Street			11%	
Greenock Campus	Waterfront			13%	
Paisley Campus	Abercorn			14%	
Paisley Campus	Renfrew Main			21%	Includes Barshaw
Paisley Campus	Renfrew North			16%	Includes ICE and Inchinnian (ICE excluded from heating fuel analysis due to efficiency of biomass system)
Paisley Campus	Oakshaw			14%	Includes gas consumption for Renfrew Main and Renfrew North groupings

4 Project Register

The Project Register is defined for each of the properties within the West College Scotland estate and is presented in Appendix 8.

Table 3 contains a description of the key heading within the Project Register.

Table 3: Description of key headings in the Project Register

Identifier		Description
ECM Category		Numerical code identifier of the energy conservation measure (ECM) group.
Description of ECM		Identification of the potential energy conservation measure (ECM) that, based on energy data from the College and site visits, could contribute to a reduction in energy demand.
Notes		Additional notes describing the ECM and relationship to other building maintenance factors that should be considered.
Utility		Identification of which utility is principally affected by the energy saving measure (gas, electricity, oil, water, telecoms)
Savings	Cost (£)*	Energy cost savings will include variable costs only[1].
	Energy (kWh)	The estimated energy saving per year will be presented resulting from the ECM.
	Carbon (tCO2e)	The resultant carbon saving should be presented based on 2015 carbon intensity figures.
Capital Cost (£)		The capital cost of the implementation of the ECM is presented.
Payback (Years)		The simple payback is calculated based on the capital cost and cost savings identified above.
Salix Persistence Factor		This should be presented based on the most recent set of performance factors published by Salix. The SPF takes into account the expected life of the installed product and the potential loss of savings due to poor maintenance and gradual degradation.
Year of Implementation		The Project Register will include a projection of the year that measures will be implemented. This can also be used retrospectively as a register of when ECMs were implemented.

[1] A breakdown of energy costs will be appended for each ECM, showing fuel unit costs, TUoS and DUoS charges, climate change levy, CRC, feed in tariff, renewable heat incentive and VAT where this is non-reclaimable by the Colleges.

The selection of individual ECMs will depend on the capital cost and the resulting economic savings which will come from reduced energy use resulting from the installation of ECMs. There will also be a resultant Carbon emissions saving that will offer a cost saving to the building owner. The economics and the payback for the investment is calculated based on the capital cost and cost savings identified above.

The Project Register identifies a list of potential ECM that were identified as a result of the site visits. These are presented as a register of potential ECMs that can be taken forward to deliver energy savings. The list is not limited and other measures can be added.

The Project Register in Appendix 8 has identified a series of measures including installation of on-site renewable energy, fabric energy efficiency measures and draught proofing, reduction in electricity demand through low carbon fittings and voltage management and building management upgrades and improved metering. The Project Register further identifies the potential for replacement boiler plant at the end of the lifetime of the existing system.

The Project Register further identifies the potential for replacement boiler plant at the end of the lifetime of the existing system. The Clydebank campus is currently supplied with heat from its own boiler plant, however there is ongoing consideration of a district heating network at Queens Quay. It should be noted that boiler plant replacements should consider the role of communal or district heating for these campuses as well as the wider community. Consultation with West Dunbartonshire Council is recommended so that the heating system is safeguarded for a future connection to any forthcoming district heating network.

5 Energy Conservation Services Register

The energy conservation services (ECS) is a list of required interventions that require non-physical works to measure energy savings. Some of these services may result in direct or indirect energy savings.

The purpose of the ECSs are to ensure that energy conservation is prioritised. The list is not limited and other measures can be added.

5.1 Measurement and Verification

Measurement and verification will involve the production of reports by the contractor will quantify the effect of ECMs against the baseline. The real measurement will be compared to the forecast of energy usage including the effect of the deployment of ECMs and ECSs. The measurement and verification is required at a building or campus level and will include the following steps:

- Establishing and agreeing the baseline
- Defining a forecast of predicted performance
- Measurement and verification of the performance of the combination of ECMs at agreed frequencies

5.2 Bureau Service

The energy performance can be enhanced with better data collection, remote monitoring and control of the system. Installation of meters and sub-meters are recommended to allow enhanced quantification of energy demand and impacts on the performance of ECMs. The West College Scotland estate will benefit from an automatic meter reading system and control of energy use through a building energy management system (BEMS).

5.3 O&M Manual and Training

The building O&M manuals will require updating with details of ECMs.

Training of the facilities management team is required from the Contractor in all building upgrades to achieve best practice application of ECMs.

5.4 Maintenance Requirements

The installation of ECMs will require commissioning to demonstrate the improved energy performance. Ongoing specialist maintenance support will be required in accordance with manufacturer's requirements and in agreement with West College Scotland facilities management team. It is likely that photovoltaic installation and CHP, biomass or gas boiler replacements will require specialist operation and maintenance support.

5.5 Lifecycle

The lifecycle replacement of proposed ECMs should be documented in the O&M manual. This should highlight the service frequency in terms of fixed maintenance periods or preventative maintenance based on fixed run hours. It should also document the anticipated lifecycle replacement period of ECMs or critical components with shorter lifetimes.

5.6 Behaviour Change

Significant energy efficiency is achievable through a positive attitude and behaviours. This may include training of the facilities management team to deliver high standards. It will also require energy efficiency is a priority to all building occupants, both students & staff.

Publicity and promotional materials directed at staff, students and visitors may form part of the ECSs to clearly explain how basic actions could offer benefits to the College.

6 Summary of Buildings and their Services

The section below provides a brief description of each building and their main services. All buildings are of mixed construction in urban areas close to other buildings:

- Clydebank - steel framed, steel cladding with external walls cavity masonry finished with render or cladding
- Paisley Abercorn - red ashlar sandstone and bullnose red sandstone external walls which are load bearing, carrying the timber roof structure. The roof is weathered utilising natural Scottish slate, clay ridge cappings and lead flashings
- Paisley ICE - Steel framed building with external cladding of stone and metal. Pitched roof finished with profiled metal sheeting.
- Paisley Inchinnian - single storey steel framed. Multiple roof types - steel framed single ply, concrete gramed monitor roofs, double pitched with high level eaves. External walls comprise single skin profiled cladding to the Inchinnan (North) building in a two tone arrangement with brickwork to low level external walls. The workshop buildings (Inchinnan South) are clad in imperial sized brickwork with link buildings comprising full height, single storey metal framed and glazed curtain walling
- Paisley Oakshaw - multiple roof constructions - flat, steel framed, insulated, single ply polymeric membrane, polycarbonate panels, mineral felt external walls - brickwork cladding, precast concrete lintels, metal framed curtain walling incorporating casement.
- Paisley Renfrew North - Steel framed construction. roof over the building is pitched and finished with profiled metal sheeting. External walls are clad with a mix of metal and stone cladding
- Paisley Renfrew Main - Concrete framed structure. Roof concrete cast insitu with overcald rigid insulation. External walls brick work clad with dry dash render.
- Greenock Finnart Street - Concrete framed tower block, steel framed two storey block. Asphalt/mineral coating on slanted roofs.
- Greenock Waterfront - Steel framed building cavity masonry external walls. Pitched roof with galvanised steel purlins.

The U-values (W/m2K) for building elements for each building are shown below:

- Clydebank : Walls – [redacted]
  Windows – [redacted]
  Roofs – [redacted]
- Paisley Abercorn : Walls – [redacted]
  Windows – [redacted]
  Roofs – [redacted]
- Paisley ICE : Walls – [redacted]
  Windows – [redacted]
  Roofs – [redacted]

- Paisley Inchinnian: Walls – [redacted] Windows – [redacted] Roofs – [redacted]
- Paisley Oakshaw : Walls – [redacted] Windows – [redacted] Roofs – [redacted]
- Paisley Renfrew North : Walls – [redacted] Windows – [redacted] Roofs – [redacted]
- Paisley Renfrew Main : Walls – [redacted] Windows – [redacted] Roofs – [redacted]
- Greenock Finnart Street : Walls – [redacted] Windows – [redacted] Roofs – [redacted]
- Greenock Waterfront : Walls – [redacted] Windows – [redacted] Roofs – [redacted]

Table 4 shows the general details of the buildings.

Table 4 - General Building Details

Building	Floor Area	Orientation	EPC Rating
Clydebank	17806m^2	South East	C (35)
Paisley - Abercorn	2750m^2	East	C (44)
Paisley - ICE	3740m^2	East	B (17)
Paisley - Inchinnian	4246m^2	South East	F (81)
Paisley - Oakshaw	6717m^2	North West	E (70)
Paisley - Renfrew North	10064m^2	East	C (39)
Paisley - Renfrew Main	4908m^2	East	E (70)
Greenock - Finnart Street	23813m^2	South West	D (56)
Greenock -Waterfront	3721m^2	South East	E

A brief description of all buildings mechanical equipment can be found below.

- Clydebank - The campus at Clydebank has two boiler rooms with three boilers in one and two in the other, all gas fired condensing. Each has its own hot water calorifiers serving specific sides of the building. The air handling units (AHUs) have heating and cooling coils and are located on the roof areas with the chillers. All plant is original from 2009 construction and is controlled and monitored via a central building management system (BMS). The Building has mixture of natural ventilation and mechanical, all the equipment in relatively good condition.

- Paisley Abercorn - The building was refurbished in 1998 and is split into two, with the College occupying one side and the other sub-leased as offices. The building has four gas fired condensing boilers installed in 1998 (two for each side of the building) with radiators and a warm air system providing heating to the building. Each side has its own domestic hot water storage cylinder and cold water storage tank. The building has natural ventilation in most areas with a heat recovery unit providing space heating to large areas. The only cooling in the building comes from split cooling units located in certain areas. All equipment was replaced in 1998. The building has no BMS monitoring. All equipment is in relatively good condition.

- Paisley ICE - The building's main heat source is from a wood pellet biomass boiler with top up from two gas fired condensing boilers supplying radiators and warm air blowers in workshops. The building has two calorifiers with solar pre-heat, topped up from the boilers. The building has mainly natural ventilation with a heat recovery unit supplying tempered air to dedicated locations. Local cooling is provided via split cooling units. All mechanical plant was installed at original construction. Building has a BMS system but remote monitoring is disconnected. All equipment is in good condition.

- Paisley Inchinnian - The building is heated by two gas fired condensing boilers with radiators and warm air blowers in the workshops. The domestic hot water (DHW) comes from an electric immersion storage heater. There is no mechanical ventilation, only local extract fans in the workshops. All rooms are naturally ventilated. There is no BMS only a mechanical control panel in the boiler house. New boiler room equipment was installed in 2014, and is in relatively good condition.

- Paisley Oakshaw - The building is heated by two gas fired boilers from 1977 as the main heat source with radiators throughout the building and warm air blowers for workshops. The DHW is provided from a gas fired water heater (Install date is unknown but appears newer than existing plant). There is no mechanical ventilation, only local extract fans for the canteen and gym. All rooms are naturally ventilated. There is no BMS only a mechanical control panel. Equipment appears in very bad condition.

- Paisley Renfrew North - The building is heated by three gas fired condensing boilers, serving radiant panels, radiators and warm air to heat the building. The DHW is provided from two indirect storage calorifiers. The building has a mixture of mechanical and natural ventilation. The AHU has heating and cooling coils, cooling is provided via external chillers. There is a BMS system with remote monitoring. All plant is from original construction so is in relatively good condition.

- Paisley Renfrew Main - The building is heated from the Oakshaw building plant room, with radiators in rooms. DHW comes from indirect storage calorifiers heated from the Oakshaw boiler circuit (Installed 1981). The building is naturally ventilated, with the exception of the training kitchens which has supply and extract fans for the induction canopies. Local cooling in offices is via split cooling systems. The building has no BMS. All mechanical plant is from original construction, and appears in bad condition.

- Greenock Finnart Street - The building is heated by three gas fired boilers, heating the building with radiators and warm air. The DHW comes from two indirect hot water storage calorifiers. The building has a mixture of natural ventilation and mechanical, with heating from AHUs. Local cooling is via split cooling systems. The building has a BMS with remote monitoring. Boiler room equipment is from 1990, AHUs updated during 2013 refurbishment. Boiler house equipment is in poor condition, but the AHUs are in good condition due to recent refurbishment.

- Greenock Waterfront - The building is heated by four gas fired boilers, supplying low temperature hot water (LTHW) to radiators and fan coil units (FCUs) in the ceiling voids. The DHW comes from a gas fired direct hot water (HW) storage calorifier. The building has a mixture of natural and mechanical ventilation, with heating from the AHUs. Local cooling is via split cooling systems in specific areas. The building has a BMS with remote monitoring located at Finnart Street. The boiler house equipment is approximately 8 years old, the AHUs and FCUs are as old as the building. All mechanical equipment is in relatively good working order, two boilers were broken during the survey however they were due to be replaced.

Appendix 1 - Building Drawings and Site Plans

Appendix 2 - Condition Registers and Survey Reports

Appendix 3 - Carbon Management Plans

Appendix 4 - Asbestos Survey Reports

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