Newbattle Abbey College

Authority Data Pack Report
for
Scottish Funding Council

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Scottish Funding Council

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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 Newbattle Abbey College estate utilising the Scottish Government's NDEE Framework.

The process undertaken followed the following steps:

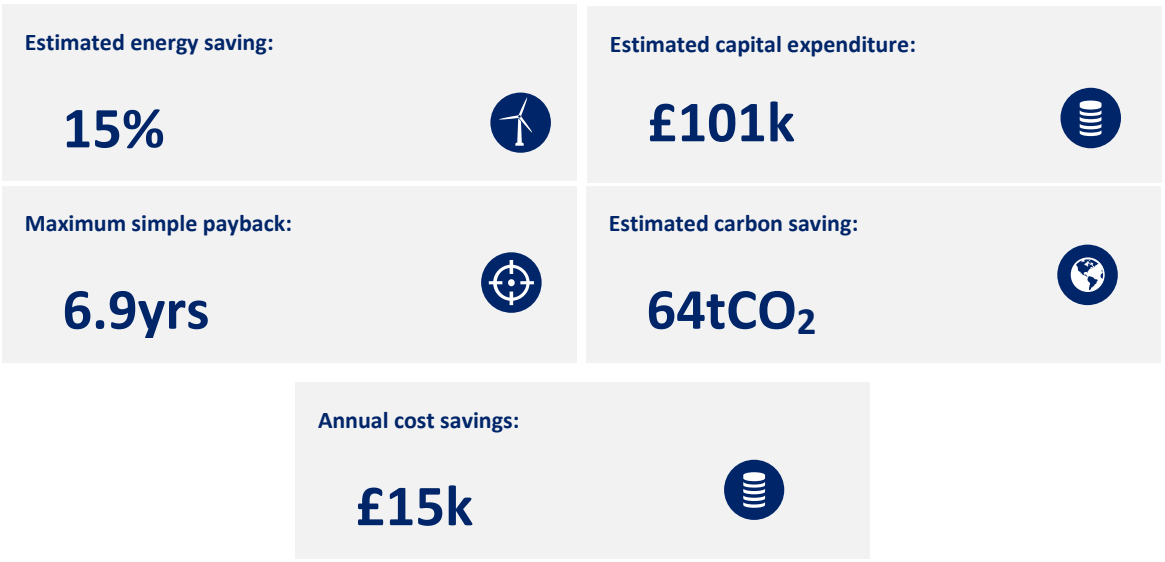
1. Data Gathering
2. Desktop Energy Assessment
3. Site Surveys
4. Project Register Development

The initial step was to gather appropriate data that could be used to investigate the energy performance of the Newbattle Abbey College estate and the potential energy saving against the benchmark which in turn leads to the implementation of Energy Conservation Measures. 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 **15%** is possible at the College, equating to a saving of **64tCO_2**, using a variety of ECMs requiring an estimated capital expenditure of **£101k** with a maximum payback period of **6.9 years** with an annual saving of approximately **£15k**.

Figure 1 – Benchmarking Output – Newbattle Abbey College



To ensure the robustness of the Desktop Energy Assessment site surveys were carried out at each of the sites within the Newbattle Abbey College 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 Newbattle Abbey College can be identified within Appendix 8 of this report.

2 Baseline Information

Newbattle Abbey College is situated within the Grade A listed Newbattle Abbey in Dalkeith and a unit in the nearby industrial park for the rural skills courses.

- Newbattle Abbey (Main House and Residency) – The largest building of the estate with a GIFA of 6503m^2. Due to its listed status the building still remains largely very close to its original format despite the fact that there have been several upgrades and modifications in the past. The building is used for both mixed use collage rooms and accommodation.

- Industrial Park Unit - The rural skills unit was built in 1938 and utilises two wood burning stoves as a heating source. The ceiling was lowered and insulation installed on part of the unit in 2003, other than this it has had limited investment. The GIFA is 280m^2.

Below are a number of photographs to detail the buildings' condition and plant.

Figure 2 - Boiler Room

Figure 3 - Traditional Fireplace

Figure 4 - Traditional Wood Burning Stoves in Rural Skills Unit

Site specific information presented within this authority data pack was gathered through site visits carried out the 18th of February. The information is based on what was observed during site visits, discussions with the Facilities Manager and through access to various form of documentation which are included within the appendices

The following information is available as appendices to this report:

Appendix 1 – Building Drawings

Appendix 2 – Condition Survey Reports

Appendix 3 – Carbon Management Plans

Appendix 4 – Asbestos Register (non-exhaustive – survey not carried out)

Appendix 5 – Water Systems Risk Assessment

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.

Benchmarking approach

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.

Capital expenditure

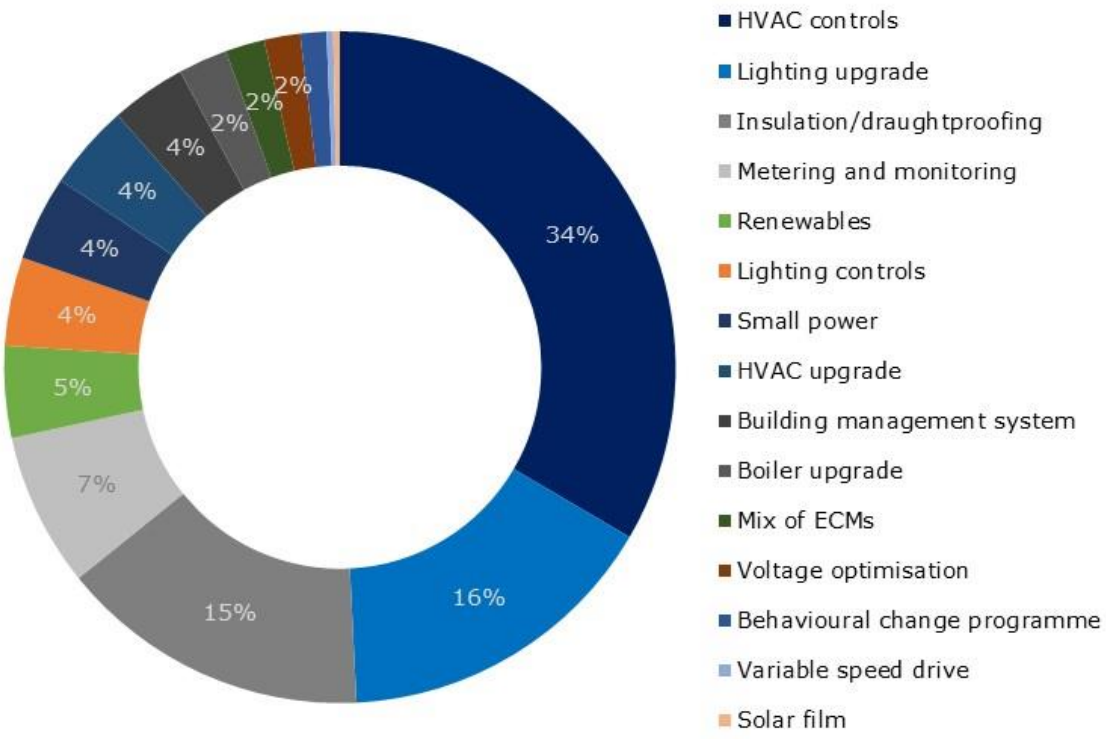
Through Turner & Townsend's experience of implementing energy conservation measures we have compiled an extensive database of project costs from the supply chain. With over 3,000 individual energy conservation measures, across a wide range of technology types, we are able to calculate the capital expenditure 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 0); 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 5). 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 5 – Typical energy conservation measures implemented in EnPCs



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.

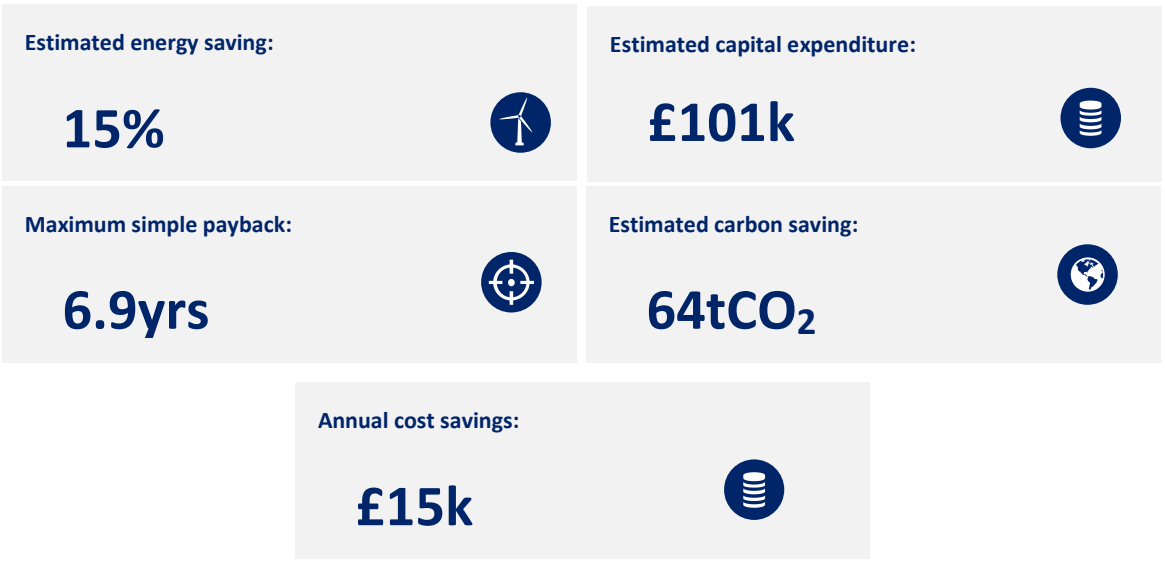
As the maximum return on investment is directly linked to utility unit rates, organisations with low energy unit rate costs tend to experience longer payback periods compared to those that pay relatively more for energy

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 6 - Benchmarking output – Newbattle Abbey College



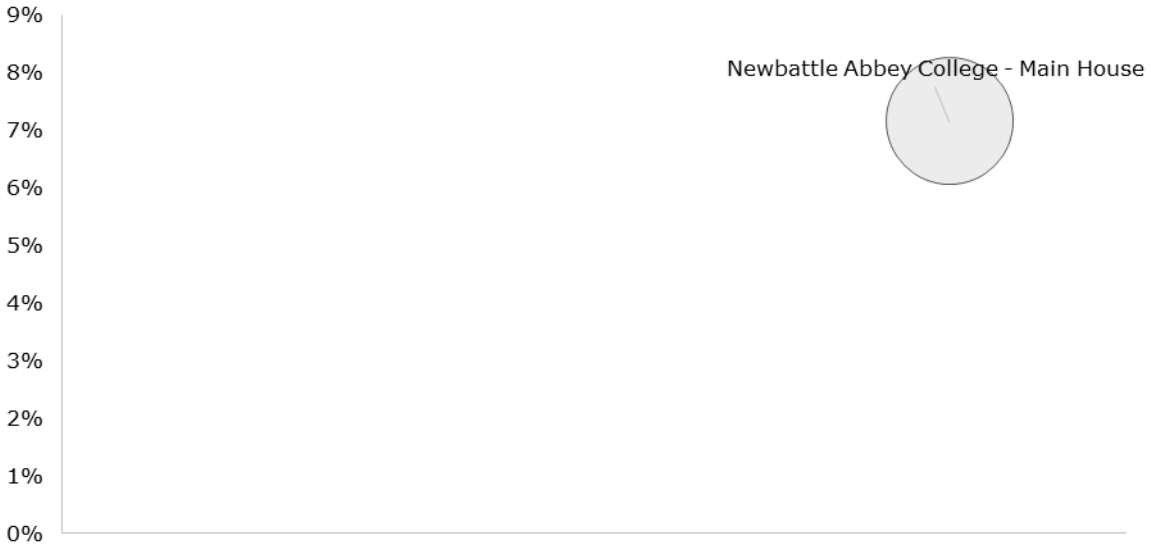
Minimum estimated energy savings are expected to be 15% when comparing current performance against 'typical' building performance benchmarks. In financial terms this equates to a minimum annual saving in the region of £15k against an estimated capital expenditure of £101k. This equates to a maximum payback period of 6.9 years.

Figure 7 and Figure 8 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 7– Newbattle Abbey College – Electricity comparison to benchmark

Figure 8 – Newbattle Abbey College – Heating fuel comparison to benchmark



The Rural Skills Unit 10b utilises wood burning stoves for primary heating. For the purposes of the benchmarking analysis it has been excluded as, given the size of the asset and the age of the system, it is deemed that there are few cost effective measures to improve the efficiency of the heating system.

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.

Table 2 – Newbattle Abbey College – Current performance and estimated savings

Campus	Building	Current (kWh/m²) Electricity	Current (kWh/m²) Heating fuel	Estimated energy savings (%)	Comments
Newbattle Abbey College	Main House	[redacted]	[redacted]	15%	Includes Residency
Newbattle Abbey College	Residency				
Newbattle Abbey College	Rural Skills Unit 10b			10%	Wood burning stoves

4 Project Register

The Project Register is defined for each of the properties within the Newbattle Abbey College 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.

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.

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

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 Newbattle Abbey College campus will benefit from an automatic meter reading system and control of energy use through a building energy management system (BEMS).

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.

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 Newbattle Abbey College facilities management team. It is likely that photovoltaic installation and CHP, biomass or gas boiler replacements will require specialist operation and maintenance support.

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.

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 and 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. The buildings differ in construction material which is listed below:

- Main House – Traditional stone building with no cavity construction
- Residency – Traditional block built double skin building with cavity
- Rural Skills Unit 10b – Traditional single brick construction with no cavity

All the buildings are located in a medium sized urban area in general close proximity to other buildings.

The U-values for building elements for each building are shown below:

Main House
- Construction: Walls U-value
- Construction: Windows U-value
- Construction: Roofs U-value

Residency
- Construction: Walls U-value
- Construction: Windows U-value
- Construction: Roofs U-value

Rural Skills Unit 10b
- Construction: Walls U-value
- Construction: Windows U-value
- Construction: Roofs U-value

Table 4 provides some general details of the buildings surveyed.

Table 4 - General Building Details

Building	Floor Area	Orientation	EPC Rating
Main House	6503m2	South West	F
Residency	6503m2	North West	F
Rural Skills Unit 10b	280m2	North West	F

The Main House and Residency are heated via two oil-fired boilers (one each) and radiators. The Rural Skills Unit is heated via two Burley Wood Burners. There are no air conditioning systems on site.

The mechanical equipment such as boilers and hot water cylinders are about 20-30 years old. The Burley Wood Burners in the Rural Skills Unit were installed in 2014.

There are no ventilation systems in the building except for the Residency where there are fans in the shower rooms. Window openings are a mixture of centre pivot (Residency), side and top hung (Rural Skills Unit) and sash and case (Main House).

The equipment in the buildings (excluding the Wood Burners in the Rural Skills Unit) are not in great condition. The oil fired boilers are not efficient and usually trip out.

Appendix 1 - Building Drawings

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Appendix 5 - Water Systems Risk Assessment

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