Impact report

1st Oct 2024 – 30th Sept 2025

CeNZ-HighDB

THE UNIVERSITY of EDINBURGH

University of Glasgow

Edinburgh Napier UNIVERSITY

University of Strathclyde Glasgow

UNIVERSITY OF THE WEST of SCOTLAND UWS

Built Environment – Smarter Transformation

Contents

The Centre for Net Zero High Density Buildings launch at the Edinburgh Futures Institute – 8th May 2025

Overview

High density building areas within cities and towns have the greatest challenges in meeting net zero targets and are ‘keystones’ of the future UK green economy. Diverse complexities of building archetypes, multi-use, historic and ‘listed status’ planning constraints requires a range of innovative low carbon green solutions. This is a critical net zero challenge not just for the UK (6M buildings) but also globally with 55% of the world’s population living and working in urban areas, rising to 68% by 2050. Currently, Glasgow and Edinburgh have the highest proportion of flats of any UK city.

CeNZ-HighDB will develop, test and underpin delivery of identified new ‘green’ innovations including high-energy efficiency building fabrics, new lower cost rapid-fit heating technologies, novel community heating-cooling systems for complex multi-use streetscapes and advancements in thermal-cooling modelling and data driven innovation to drive green economy growth.

A major proportion of the UK’s key workers, low-income households and disadvantaged groups live in high density buildings and the Centre’s impacts will enable reduced energy costs, substantial carbon emission reductions and accelerate ‘inclusive’ retrofit delivery for social housing sectors and urban buildings.

The Centre has approved more than 30 projects to date and this impact report highlights those successfully completed during the first year.

Professor Sean Smith delivering a keynote speech at the Innovate UK Net Zero Living event at Dynamic Earth.

Thematic Working Group I

Building Fabric and Performance

Retrofit Scotland website review and upgrade

1st May 2025 – 31st August 2025

Aim

Upgrading Retrofit Scotland into a relevant online sharing platform that showcases a diverse range of retrofitting case studies, with CeNZ-HighDB research output contributing to the content and serving as a key resource for dissemination.

Objectives

1. Review and utilise the existing Retrofit Scotland (RS) case studies to ensure new platform will be built on progressed work and dataset.

2. Establish a clear and consistent process for new case studies to be reviewed, documented and disseminated through Retrofit Scotland website. The documentation will be supplied to a web designer for website upgrade.

Main outcomes

- A documented guide was produced through literature review, stakeholders' discussions, analysis of existing RS cases studies and iterative mock-up design and review, which will be used to upgrade the Retrofit Scotland website into a comprehensive online platform for public use.
- Feedback received will be used to make further changes to the website, with suggestions including standardising content, ensuring clarity and accessibility of content, and integrating the process of acquiring new case studies, which will use captured information to fill in a template managed by the web host.
- The guide prepared includes the way to embed resources through the new website, comprising of online retrofit pattern books; archetype selection and outlining best practices, energy-saving measures, developing retrofit skills and pinpointing to other relevance guides. These resources contribute to the development of effective energy policies and delivery programs, supporting Scotland's goal of achieving Net Zero by 2045.

Next steps

- Future engagement for the website upgrade includes:
- Preparing the tender brief based on the project outcomes to produce new website.
- Engage with Screen Media (previous RS host) to establish the methodology for data/archive transfer. This will be included within the briefing document.
- Getting feedback from wider CeNZ groups relating to hosting their case studies to new website.

Retrofit Scotland website review and upgrade: workshop at BE-ST Fest 2025

Thematic Working Group II

Heating-Cooling and Energy Storage within Buildings

Allume Energy SolShare feasibility study (building type 1)

7th July 2025 – 7th August 2025

Allume Energy have developed a world's first technology for connecting multiple flats to a single solar system. The SolShare system can allocate solar energy (kWp) to each flat based on EPC requirements to maximise solar energy consumption and bill savings. Using SolShare modelling software to evaluate the feasibility of deploying Allume Energy's SolShare PV technology in a social housing complex of 36 flats, with the goal of reducing tenant energy costs, supporting decarbonisation, and forming a re-use case similar housing stock.

The project aimed to use site assessment, data collection, technical feasibility analysis of the site, and financial modelling, to create a feasibility report. This was successfully created, and has been shared with stakeholders. A final presentation was delivered highlighting the project's outcomes and a clear reuse case for similar social housing stock.

The project provided a validated framework for deploying shared solar solutions in a multi-residential building (type-1), supporting tenant affordability and the transition to net-zero housing.

Main outcomes

- Successfully advancing understanding of how Allume Energy's SolShare technology can deliver economic, environmental, and social benefits for multi-unit social housing, with potential financial benefits to tenants, and with housing authorities and asset managers gaining insights into a scalable approach for deploying shared solar solutions.
- Allume Energy has validated the feasibility of SolShare in a social housing context, creating a platform for real-world trials, with multiple benefits including the potential for reduced grid reliance and CO_2 emissions through shared solar energy, a verified feasibility study, and laying the groundwork for lower bills and improved comfort in disadvantaged communities.

Next steps

- Contribution to a comprehensive retrofit design package for the buildings, with the potential to progress to full implementation. If the solution is rolled out across all three buildings, a new project will be initiated to document the retrofit process and measure the actual benefits delivered compared to the projections in the feasibility report.
- A separate project will assess the result of retrofit upgrades on the social housing tenants – currently being scoped out to take place in 2026/2027.
- A follow-on CeNZ-HighDB project that is looking at the most common building types to generate a list of common properties and a cost-benefit handbook without need for site visit.
- The next steps are to review the wider housing stock available from EAC and conduct similar feasibility studies across a range of properties. This work will end in the creation of a comprehensive handbook that details housing archetypes, feasibility outcomes, installation costs, and expected benefits—providing a one-stop reference that can be used by other councils with similar housing stock.

Thematic Working Group II

Heating-Cooling and Energy Storage within Buildings

Mixergy Ltd. Feasibility study (building type 1)

20th August 2025 – 22nd September 2025

Mixergy Ltd, an Oxford University spin-out, has pioneered smart hot water storage systems that act as thermal batteries, enabling households to reduce energy bills and carbon emissions. Using patented top-down heating and advanced controls, Mixergy systems can integrate with solar PV, heat pumps, and smart tariffs to optimise energy use and reduce grid demand. This project aimed to evaluate the feasibility and benefits of deploying Mixergy's technology within social housing and high-demand residential settings.

The project aimed to use site assessment, data collection, technical feasibility analysis of the site, and financial modelling, to create a feasibility report. This was successfully created, and has been shared with stakeholders, providing evidence on system performance, potential cost savings, and scalability within social housing.

Results demonstrated strong potential for cost and carbon savings, particularly when integrated with renewable energy systems. The study also identified pathways for large-scale deployment across social housing stock, supporting the UK's transition to low-carbon heating.

Main outcomes

- The study also considered how Mixergy's top-down heating technology could align with solar PV, heat pumps, and smart tariffs to support energy efficiency and decarbonisation goals in a social housing setting.
- The feasibility study provided evidence on system performance, potential cost savings, and scalability within social housing. Green, carbon, and knowledge benefits arise from improved understanding of how smart thermal storage can reduce demand and support renewable integration.

Next steps

- The project serves as a basis for a retrofit of the blocks under consideration for hot water heating. A further project may be initiated to carry out a feasibility study into retrofitting in the blocks identified and measure the actual benefits. As this building stock is common in the UK, this study could then be used as a guide for similar building stock, avoiding the need for a site visit.
- The partners intend to build on this feasibility work by seeking further funding to support pilot installations and extended data monitoring within social housing.

Building of Edinburgh Homes Demonstrator (EHD) legacy: Case study to understand regional adaptability and EDI barriers for Net-Zero Housing

Thematic Working Group IV

Modelling and Data Analysis

Decarbonised Heating Technology Analysis for High Density Social Housing Retrofit, Barshare, Cumnock

27th June 2025 – 17th October 2025

The Barshare area of Cumnock features high density social housing and significant fuel poverty. Using modelling and simulation, this project assessed the technical performance and potential environmental, economic, and social benefits from novel solar-recharged ground source heating (GSHP) and other net-zero-ready heating technologies: air source heat (ASHP) and direct electric heating (DE).

A dynamic simulation model of the Meagher Court flats in Barshare was developed, with extensive data collection on site. The model was simulated using a range of operating scenarios co-created with the project partners to provide extensive performance data on heat pump and radiant heating systems. Additionally, analysis of the potential contribution of a roof top PV array was investigated.

The results of the simulations are presented in detail in final technical reports and summary sheets targeted at project partners East Ayrshire Council (EAC) and Ambion Heating Ltd.

Main outcomes

- Guidance was created around synthesising the outcomes of the modelling work for air and ground source heat pumps and radiant heating systems
- Simulations were used to yield performance data for all three technologies types, which led to the development of technical guidance for the partners. Additionally, the impact of solar recharging of ground source heat boreholes was investigated, along with the potential contribution of solar PV.
- A dynamic building simulation model of the Meagher Court flats was created featuring detailed representations of all three heating systems. The model uses data captured on a site visit, and details culled from EAC plans. The air leakage characteristics were calibrated using data collected from blower door tests.
- EAC and Ambion heating were involved in the creation of the heating operating schedules and occupancy details used in the simulations.
- A workshop to disseminate the outcomes of the heat pump modelling work is scheduled for December at EAC in Kilmarnock. This will inform EAC's retrofit strategy.

Next steps

- Investigating if the intrinsic energy value of flats can be used when allocating flats to occupants (e.g. avoiding high-usage properties such as ground floor or corner flats when allocating to occupant more vulnerable to fuel property).
- Recommending that solar recharging of ground source heat pump (GSHP) is considered for specification in East Ayrshire Council's new GSHP installations.
- A further study, with Ambion Heating, to investigate the use of environmental temperature as an alternative to standard controls for radiant panels, as a means to reduce energy use.

"The modelling and simulation work undertaken by ESRU for the Meagher Court CENZ-HighDB/CORE project, appraising heat decarbonisation and fabric improvement options, has provided invaluable information to guide ongoing CORE project retrofit activities. More widely, the data emerging from your work will help inform East Ayrshire Council's future retrofitting strategy as we seek to decarbonise our social housing stock. We greatly value the contribution of the CENZ-HDB team to the Meagher Court project and we look forward to continued opportunities for collaboration".

Diarmid Turnbull, CORE Project Lead at East Ayrshire Council

Decarbonised Heating Technology Analysis for High Density Social Housing Retrofit, Barshare, Cumnock

Thematic Working Group VI

EDI, Skills and Training

Building of Edinburgh Homes Demonstrator (EHD) legacy: Case study to understand regional adaptability and EDI barriers for Net-Zero Housing

April 2025 – November 2025

The Edinburgh Home Demonstrator (EHD) project, established in 2020, is a collaborative initiative aimed at addressing the need for sustainable and affordable housing in Scotland's South East region. The initial aim of this project was to look at the legacy of the EHD project, particularly through various activities, including identifying EDI-related adoption barriers in net-zero housing, exploring regional adaptability of MMC-based-net-zero housing delivery to ensure inclusivity across different socio-economic groups, identifying implementational barriers of policy and delivery approach of EHD, evaluating if workforce challenges are slowing/hindering the adoption of net-zero MMC housing, running a series of workshops with master level students to pilot and then to full professional audiences of policy makers and stakeholders, determining how the approach can be adapted for alternative es/audiences, looking to internationalise the approach by engaging with partners including the University of California Berkeley Terner Centre and MODX in the USA.

The EHD legacy project advanced significantly, exploring the original aims, and a full case study of the Edinburgh Homes demonstrator (EHD) was completed, which further provides practical guidance on what works for sustainable, efficient housing and transferable learnings for organisations seeking to scale similar models.

Main Outcomes

- Completed a full EHD case study, supplemented with an EDI focused analysis to assess inclusion and diversity factors of the EHD offering practical insights and recommendations.
- A regional adaptability assessment was undertaken through a roundtable discussion, generating insights into rural-urban implementation challenges and approaches for MMC models in rural Scotland.
- Skills-related outcomes were supported through workshops involving MSc students from Nottingham Trent University and Edinburgh Napier University, who were shown an EHD case study presentation delivered by key stakeholders from Edinburgh Council and Scottish Funding Trust, as well as visiting the BE-ST innovation centre.
- A US delegation from the University of California, Berkley were also shown the EHD case study, with a site visit, and a visit to BE-ST. The EHD case study was also presented to the MODX delegation of USA industry professionals.

Next Steps

- A key next step is to explore the development of an online educational module to complement the Edinburgh Homes Demonstrator final report, which could be used across NMITE BSc Programmes, BEST and CeNZ Workshops.
- The project work aligns with Scotland’s Net Zero Strategy and broader policy shift towards inclusive and regionally adaptable housing delivery, driving towards a future possibility of collaboration with CPD development through skills and training provider.
- There is a potential for publication of the case study as an academic or industry paper alongside the dissemination through CeNZ-HighDB, as well as future collaboration internationally.
- Potential research is possible through cross-collaboration with Thematic Working Group V and VI, can be carried out participatory research/focus group observing the post-occupancy evaluation study.
- At this stage, no additional funding has been secured, but opportunities to create an educational output are being explored.

NTU Delegation Visit

US Delegation Visit: Building of Edinburgh Homes Demonstrator (EHD) legacy: Case study to understand regional adaptability and EDI barriers for Net-Zero Housing


CeNZ-HighDB