Active Building Centre

ABC Blueprint

Our approach to achieving net zero

Foreword by CEO

The Active Building Centre (ABC) was setup to transform construction – have we? The honest answer is 'not yet' because overall the UK construction sector still lags behind, continues a business-as-usual approach, is slow to act and not adventurous enough. The most recent Committee on Climate Change Report highlights the building sector as off track to meet net zero by 2050: 'There has been no sustained reduction in emissions from buildings in the last decade'.[1]

If we want to achieve net zero by this time, we need to be bolder.

What ABC has shown through real-life projects is that, where there is willingness and commitment across construction project teams, clients and occupiers, we can achieve active energy principles and lower-carbon buildings to be delivered.

As we seek to decarbonise our society, we can expect greater pressure on the built environment sector to do more towards getting to a net zero pathway. The built environment alone accounts for at least 25% of emissions today and both new-build and existing stock need to change in order to reduce this impact.

One of the attractions in joining ABC to lead the team completing their first major research project has been to help draw key learnings that can help the buildings sector to accelerate this journey.

I have been impressed at what has been achieved over the past three years by the ABC team to influence a range of new-build projects against a backdrop of the challenges arising from a global pandemic and Britain's exit from the European Union, with a number of linked supply chain challenges. With some external projects still at construction stage now, there is still much work to do to analyse data and to research the outcomes of the performance of these buildings in use to add evidence showing value and outcomes of such interventions.

[1] 'Progress in Reducing Emissions 2022'.

This document, our blueprint, draws on the learnings gained and the talents of the team that was built, and is a collective contribution to help industry, society and government alike. It draws together theory and practical examples from our team's work in creating lab-based demonstrations and embedding active energy systems in a range of building types since 2019. We believe that people are central, with Comfort, Cost and Carbon (our 3Cs) as the critical attributes to measure to get this agenda right across the built environment sector going forward.

Our approach starts to outline key considerations across the lifecycle of development for the professionals and technicians who work to design, plan, build and manage buildings and places.

The key questions this document answers are:

- Who are we and what is ABC's role in the net zero space?
- What are active buildings and why do we need them?
- Why do comfortable, lower-cost and lower-carbon buildings matter?
- What are the opportunities from better, more efficient integration of energy?
- How can we deliver more active buildings and communities?
- What more can be done to accelerate the uptake of active buildings to support the decarbonisation agenda?

At the heart of our considerations are the people who occupy homes, workplaces and other buildings. Getting active energy approaches right can improve comfort while reducing carbon and cost.

Going forward, as we explore a potential future for the active building approach based within the catapult network and seek to further our research and innovation agenda, our work will focus on encouraging further interventions to accelerate the journey to net zero for the built environment sector through a wide range of measures and lessons explored in the rest of this document.

Dan Cook

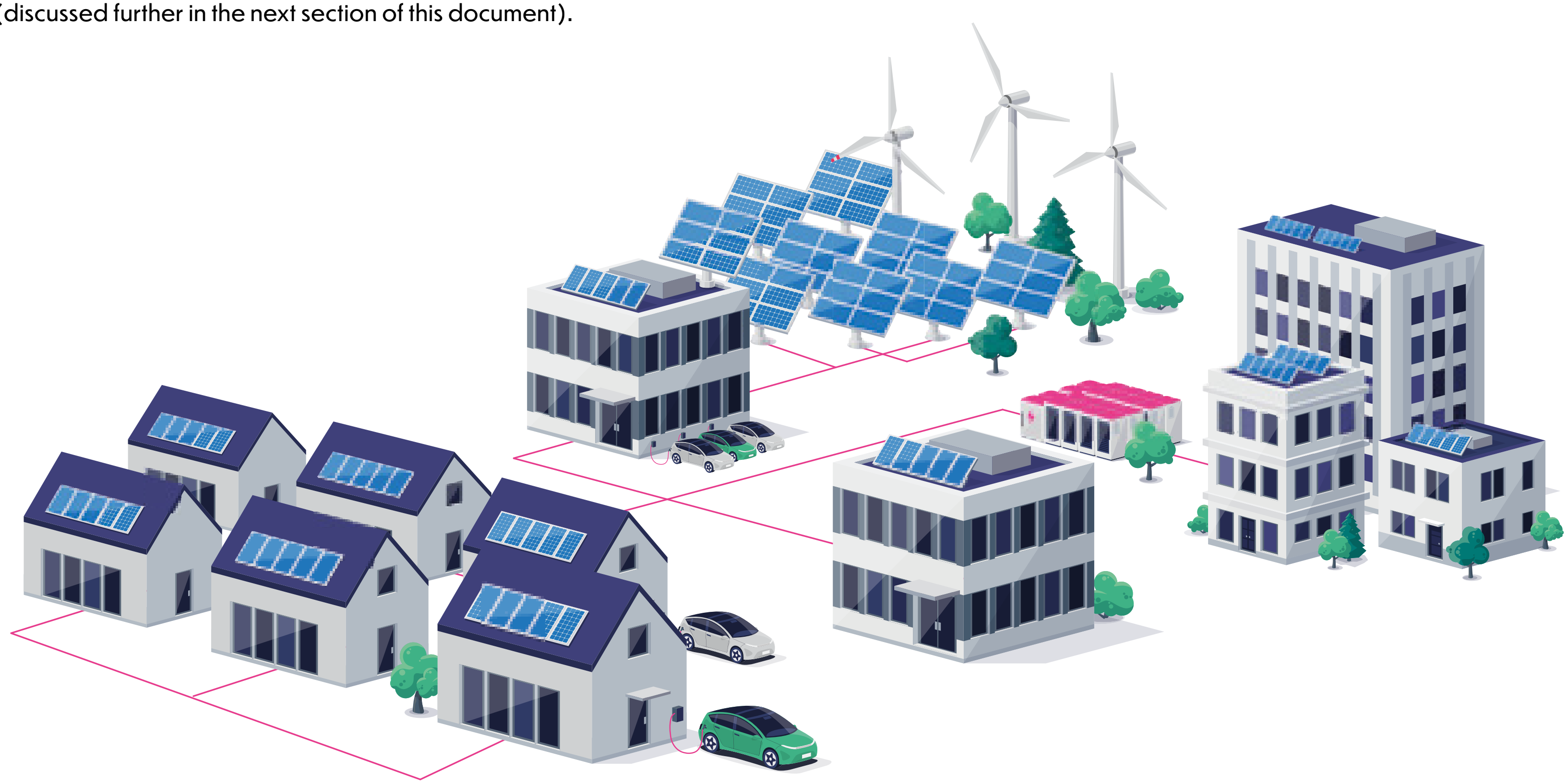
Energiesprong has developed an innovative financial model to support the delivery of comfortable and affordable retrofits. The model is to support the financing of the upgrades by future energy cost savings plus the budget for planned maintenance and repairs over the coming 30 years. This model has been adopted by housing associations where tenants pay an energy service plan equivalent to their previous energy supplier bill. This income stream aids the association in funding the renovation works.[33]

Introducing carbon reduction measures in the construction industry is integral to the decarbonisation of the built environment. However, to encourage a large-scale uptake of these measures, including the integration of low carbon technologies, it is necessary to demonstrate their cost effectiveness. As discussed earlier the capital cost of delivering these measures will reduce as the demand is realised within the industry. Incorporating energy-efficiency measures in the design has demonstrated reduction in the operational cost and these can be further reduced by integrating the energy systems with smart controls (discussed further in the next section of this document).

Next steps

Achieving net zero ambitions requires a larger and industry-wide collaboration and buy-in from all stakeholders across the value chain where the principles of Comfort, Carbon and Cost are embedded across the stages of a building's lifecycle.

The adaptation of the 3Cs in the built environment, along with the active building principles, is further detailed in section 4 of this document which will set out guidance for all the stakeholders involved in a construction project.



Cross Hands East Strategic Employment Site

Location: Cross Hands, Carmarthenshire

Client: Carmarthenshire County Borough Council, in partnership with Welsh Government

Project managers: Blake Morgan

Architects: Stride Treglown

Mechanical and electrical consultant: Auxilium Engineering Services

Civil and structural: Curtains

Active Buildings Advisor: SPECIFIC IKC

Principal contractor: Andrew Scott Ltd

Background

Cross Hands East is part of the Welsh Government's drive to create better business facilities in more rural parts of Wales. It comprises 32,500 square feet of low-carbon offices, light industrial units and hybrid spaces for letting across three buildings.

The project has been delivered via a joint venture between the Welsh Government and Carmarthenshire County Council, comprising a large programme of infrastructure works. With support from ABC, it will help transform the way commercial buildings are powered and heated using innovative technology and ABC's design principles. The new buildings will generate electricity using on-site renewables and incorporate high levels of insulation to deliver a low-carbon development with reduced running costs. The ultimate aim is to achieve 'net zero carbon in-use standard', which would see the development produce enough renewable energy to meet the lighting and heating needs of the buildings.

The project is due for completion April 2023 and ABC will be supporting the client with data collection and analysis, including in-use data monitoring. Ongoing learning will come from the metering and monitoring from this site once completed.

Innovative Housing Programme (IHP)

Location: various throughout Wales
Client: Welsh Government
Principal supplier: Tyrrells Systems

Background

IHP (Innovative Housing Programme), operated by the Welsh Government and providing funding for developers to trial innovative housing schemes. Working with Swansea University Research Programme (ABC RP), ABC provided £850k of project investment funding delivered over two phases involving 350 various types of homes. A sample of the Registered Social Landlords and Housing Association we are working with are Caerphilly County Borough Council, Coastal Housing Group Ltd, Flintshire County Council, Isle of Anglesey County Council and Monmouthshire Housing Association.

The evaluation of monitoring data gathered will be conducted on behalf of the Welsh Government by ABC Research Programme using anonymised data This will be analysed and stored on ABC's database to inform R&D packages.

Trent Basin

Location: Nottingham

Client: Research project with Nottingham University SmartKlub

Development manager: igloo

Background

Trent Basin is a riverside neighbourhood of low-energy homes and apartments located on the banks of the River Trent. The development is part of a regeneration project in Nottingham and sees Nottingham University working with Smartklub and Blueprint, among others. ABC part-funded the project as well as collecting data to inform future developments with regards to energy systems integration.

An essential part of the project was to trial three different scenarios for making on-site renewables and arbitraged energy storage services available to 20 residents, including a control group. The findings aimed to show residents their savings from the different analyses, as well as the impact any behaviour change has on money or carbon.

	General
	Review site information to identify potential opportunities and challenges to delivering an active building development.
	Optimise site layout to maximise benefits from passive design, on-site energy generation, EV infrastructure and the natural environment.
	Consider adopting *Passivhaus* certification and LETI key performance indicators for operational energy and embodied carbon as a baseline to achieving the active building approach.
	Work in BIM from the outset to minimise duplication of drawings and geometry creation for modelling.
	Undertake predictive energy demand and overheating modelling to establish the demand profile, peak load and overheating risks of different design options that meet the project requirements; this should be in addition to standard compliance modelling and undertaken at this early design stage (pre-planning) and should provide the basis for detailed assessments, such as CIBSE's *TM54* or PHPP, to be undertaken at the pre-construction stage.
	Ensure information for whole life carbon and lifecycle cost assessments is collected from the outset and retained for assessments later in the development process.
	Hold regular design team workshops to explore options and work through decisions.

	For efficient energy systems
	Identify suitable low-carbon technologies to provide hot water and space heating, ensuring there is sufficient space allocated.
	Ventilation strategy designed to meet the air flow rates by adopting passive strategies and energy efficient systems like MVHR.
	Ensure energy systems integrate with the passive design strategy and on-site energy-generation technologies.

	For on-site energy generation and storage
	Identify appropriate renewable energy-generation and storage technologies for the building by undertaking a feasibility study and analysing any potential trade-offs between the 3Cs.
	Undertake location-specific predictive dynamic energy-generation and storage modelling to establish the energy balance, taking account of energy demand.

	For passive design and building fabric
	Orientate building(s) to maximise benefit from site climate (solar radiation and prevailing winds) and natural vegetation.
	Adopt simple form to reduce exposed surface area, which increases heat loss, and quantity of materials required.
	Optimise roof design to maximise density and output from solar panels.
	Adopt a baseline specification, such as *Passivhaus* or LETI design standards to ensure energy demand is minimised through low U-values and air leakage.
	Optimise use of materials with high thermal mass, ensuring these are exposed to the internal spaces, to reduce overheating risks and the introduction of a cooling demand.
	Optimise window design and specification to maximise solar gains to provide natural daylight and free space heating in the winter, and to ensure visual comfort.
	Avoid complex window frame designs as it increases heat loss from frame components, including transoms and mullions.
	Optimise solar shading to mitigate the risk of overheating.
	Use low embodied carbon materials to reduce the embodied carbon emissions associated with the building fabric.
	Use durable materials to minimise repair and maintenance requirements throughout the life of the building.
	Use outputs from whole life carbon and lifecycle cost assessments to make informed decisions on building fabric materials.

Smart controls, integration and monitoring	
	Design for EV infrastructure by ensuring parking spaces are provided with chargers which are linked to the building(s)' individual energy system (i.e. not public).
	Develop a robust building-performance monitoring and evaluation strategy to be fully integrated into the energy system for validating designed performance against in-use and support self-consumption to be maximised through real-time monitoring.
	Contact the innovation team at local distributed network operator (DNO) to discuss the proposed approach and explore appetite for innovation to support reduced grid stress.
	Consider three-phase supply for domestic and non-domestic buildings to support a transition to full electric space heating and transportation, and increased export capacity.
	Consider adopting a microgrid through integration with wider active building networks and allowing for dynamic energy sharing between communities of active buildings.

Planners and local authorities	
Local authorities should:	
	Conduct local-area energy plans.
	Understand key grid constraints in their area.
	Consider targets requiring active buildings for all new developments (e.g. for renewable energy generation, use of micro grids and on site energy storage).
Planners should:	
	Set requirements for active buildings within local planning policy which include reference to comfort for occupants, both embodied and operational carbon performance and overall lifecycle cost reduction.
	Consider post-occupancy monitoring of outcomes for energy efficiency and management as part of planning approvals.
	Ensure planning committees understand their powers in relation to ensuring that new developments meet the 2050 legislated pathway to net zero.

What to look out for !
Ensure achieving net zero carbon aims are considered at this stage. Key decisions around making space for infrastructure and flexibility on siting of buildings are key at this point.
Recommendations to demolish structurally sound existing buildings and build new as the best way to achieve an energy-efficient solution are unsustainable as this does not account for the embodied carbon of an existing building that would therefore be disposed of unnecessarily.
If net zero carbon was not part of the original planning permission, other contractual and procurement tools may be needed to achieve this at the construction stage.
Collaborate with professionals who have a track record of delivering net zero or low carbon solutions. Consult their previous clients before appointment. Encourage teams to shift beyond business-as-usual and avoid use of compliance tools setting default design rules. Using compliance to determine solutions can lead to misleading results and a subsequent performance gap.
Avoid on-site renewable energy systems (e.g. Solar PV) being used in isolation in order to meet compliance requirements.
Ensure resource is allocated to undertake sufficient modelling, including dynamic simulation energy modelling and assessments during the pre-planning stage. This can help avoid: · significant overheating risks · retrospective design alterations or performance compromises to overcome issues identified at the next stage (e.g. overheating) · grid constraints limiting opportunity to maximise on-site generation for self-consumption · not being able to utilise on-site generation for EV charging.
Use Energy Performance Certificate ratings as the metric to meet net zero carbon emissions. Approaches that focus on performance in use of buildings are encouraged.
Finance for projects linked to Energy Performance Certificate ratings can push designs away from net zero carbon emissions. Focus on performance outcomes.
Discourage developers and contractors from using standard components and locations for installation that do not support integration and/or work with their proposed standard design.
Avoid single-phase electric connection to the grid that will limit options for active buildings.