Since our formation in 2008, the Zero Carbon Hub continues to work with Government and industry to identify risks, remove barriers to innovation and help demonstrate that energy efficient, healthy new homes can be delivered by the mainstream house building industry.

This series of building profiles gives examples of manufacturers, developers and clients who have embraced the challenge and are developing practical, commercially viable ways of delivering the next generation of homes in preparation for the nationwide introduction of Nearly Zero Energy Homes from 2020.

SUMMARY
North West Bicester is the UK’s first Eco-town, designed to meet the original Eco-town Planning Policy Statement (PPS) requirements, which includes delivering “true zero carbon” homes. To be “true zero carbon” means taking into account emissions related to both regulated energy (space heating, hot water, lighting and ventilation) and unregulated energy use (such as appliances and cooking).

SPECIAL FEATURES
The energy needs of the highly efficient homes, all designed to meet Code for Sustainable Homes Level 5 (CSH L5), are provided via a combination of on-site photovoltaic (PV) generation and a Combined Heat and Power (CHP) energy centre. This will be the first UK housing development to produce zero landfill waste during construction, including any excavation from roads and trenches. This first phase, an endorsed ‘One Planet Community’, will be part of a wider Masterplan to create 6,000 “true zero carbon homes” at NW Bicester over the next 25 – 30 years.
PROJECT STRATEGY

KEY PLANNING CHALLENGES

Following Cherwell District Council (CDC) identifying land to the north west of Bicester for an Eco-town development, North West Bicester was announced as one of four UK Government designated Eco-towns in 2007. The developers were required to meet challenging minimum standards addressing a range of areas including: energy use, carbon emissions, communities and sustainable growth, green infrastructure, biodiversity and others.

No previous Eco-town development in the UK has demonstrated such a comprehensive set of sustainability features. This level of ambition meant that developing the right delivery strategy to achieve financial feasibility and viability of technical solutions was challenging. The energy strategy had to consider a number of different solutions, including both active and passive design measures. The development team worked collaboratively to produce future proofed, cost effective, viable solutions that are both integrated and robust.

DESIGN AND CONSTRUCTION

All homes are designed to achieve CSH L5 using a ‘fabric first’ approach incorporating high levels of insulation, airtightness and triple glazing. Low water consumption fittings and rainwater harvesting is also specified to reduce water consumption from the UK average of 150 litres to 80 litres per person per day. The homes’ embodied carbon has been reduced by 29% compared to the UK new build average; this was achieved through a combination of timber framing, careful specification and local sourcing of materials. The design strategies have been future proofed by modelling their performance during summer periods using future climate change projections, to ensure the risk of summer time overheating is minimised.

The house designs include a range of mechanical ventilation systems in all types (MVHR & MEV) which will be commissioned by a British Employers Plumbing Council (BPEC) approved installer. Spot checks of flow rates will also be carried out as part of the Building Performance Evaluation programme.

FORWARD THINKING

A key consideration of the project is to reduce the probability of there being a difference between the ‘designed’ and ‘in use’ energy performance, known as the ‘Performance Gap’. This will ensure that the environmental and social benefits are delivered as per the project’s aspiration. An Innovate UK funded site based research team will be monitoring and testing completed dwellings during the first four years of construction.

The energy performance of the units will be thoroughly monitored, supported by range of in-line build quality testing such as; thermographic imaging, in-situ heat flux measurements, staged airtightness tests and co-heating tests. Understanding of how the homes are actually performing will be further enhanced by Post Occupancy Evaluation studies. This project is expected to provide industry with knowledge and information to assist the mainstream delivery of energy efficient homes in the future.
## Project Solutions

### Part L 2010

**Fabric Energy Efficiency**

**Achieved:** 36.7 Kwh/m²/yr

Range of different dwelling types, FEE value above for least favourable.

### Part L 2010

**Carbon Emissions**

**Target (Regulated):** 19.6 kgCO₂/m²/year

**Design (Regulated):** -22.6 kgCO₂/m²/year

**Design (Regulated & Unregulated):** -2.8 kgCO₂/m²/year

Range of different dwelling types, FEE value above for least favourable.

### Space Heating and Domestic Hot Water

Heat delivered through heat interface unit and underground district heating network

Features:
- Community energy center powered by gas CHP
- CHP efficiency of 84%
- 800kWe CHP engine
- Heat to power ratio of 104
- Gas back up boiler with 87% efficiency
- Thermal store, 80m³

### Renewable Energy Generation, On-Site

The development is expected to have the largest domestic PV array in the UK, which includes:
- 1,461 kWp total installed capacity
- 10,639 m² of PV on roofs
- A projected energy generation output of 1,241,850 kWh/year

### Airtightness and Ventilation

**Airtightness**

< 3 m³/m²/h at 50 Pa

Airtightness will be tested at completion for Building Regulations purposes, but also will be tested at first fix and during the handover stage to ensure robustness of delivery. Airtightness is provided by a combined use of:
- Compressible foam gasket between timber frame panels
- Secondary expanding airtightness foam where required and,
- an airtightness membrane at the party wall and damp proof membrane and floor level.

A battened service zone minimises need to puncture the airtightness layer.

**Ventilation**

MVHR or MEV, depending on unit type

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*Fabric Energy Efficiency and Carbon Emissions figures from area-weighted average.*
KEY LESSONS

DESIGN STAGE

Selecting an offsite timber frame system has helped to achieve faster build times onsite and provided a more consistent level of quality due to strict factory control processes. Where the system interfaced with site processes, care was needed to ensure tolerances and detailing was correct, which proved challenging on occasions. It has also been found developing alternative erection sequences is important, particularly for those work packages where problems can significantly delay the entire programme. An example being the floor screed during adverse weather periods.

Factory installed windows were considered at the design stage, however the research and development of a key sliding bracket system took longer than anticipated, meaning they will only become available during phase 2.

CONSTRUCTION AND COMMISSIONING STAGE

Site observations and in-line performance testing have highlighted the challenge of delivering robust airtightness detailing around service penetrations. The inclusion of district heating and rainwater harvesting systems in this develop mean homes contain almost twice the amount of ductwork compared to typical existing homes. Preformed pipe grommets are being trialled to simplify the installation process and improve airtightness performance.

DEMONSTRATING PERFORMANCE

BEPIT RESEARCH

The Bicester Eco Town Process Improvement Toolkit (BEPIT) is a four year, Innovate UK-funded, research project aiming to close the Performance Gap. The research consortium of six partners includes the project delivery team and academics from Loughborough University. They are trialing a novel form of action research applied through collaborative camps to ‘rethink the build process’.

Two full time researchers are involved in the construction phase using a comprehensive suite of Building Performance Evaluation (BPE) testing, plus site observations to inform the findings. All of the lessons learned will be condensed and disseminated to industry via the BEPIT toolkit. Find out more at www.bepit.org

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