

## University of Nottingham Research and Development “Creative Energy Homes: Low-Energy and Zero-Carbon Housing – a living test-site for Energy-efficient Technologies

### About the project

#### Summary

A long-term development of seven “Creative Energy Homes” (CEH) on the University of Nottingham Park Campus provides a living test-site for leading firms to work with the University of Nottingham to investigate the integration of energy efficient technologies into houses. As a result of this work, Lovell homes has won a number of sustainable housing contracts, Roger Bullivant have developed and installed numerous SystemFirst™ foundation systems and Igloo Blueprint have built over £7M worth of new homes. The research findings helped inform the UK Government’s “Green Deal” strategy, the Nottingham Community Climate Change Strategy and received widespread acclaim through a significant number of public engagement activities reaching out to over 5 million people.

#### Project partners

The project has worked with over 200 industry partners and funding for the Creative Energy Homes has come from a range of sources including the Technology Strategy Board (for KTP Projects), Roger Bullivant, EPSRC, Eon, Intelligent Energy Europe, Mark Group and European Regional Development Funding. When developing this project the university has engaged with local organisations to support development of their products. Locally, the CEH has informed the Nottingham Community Climate Change Strategy 2012-2020. The project is cited in the strategy document, in which the homes are used as local examples of sustainable building design and in January 2012 Professor Gillott was invited to give the keynote presentation to approximately 150 politicians, industry, the general public and media at the strategy’s launch event.

### The results

#### The problem

The need to reduce energy consumption and draw upon more sustainable energy sources has never been more pressing. As part of the Climate Change Act 2008, the Department of Energy and Climate Change (DECC) introduced a target to reduce UK carbon emissions, relative to 1990 levels, by 80 per cent by 2050. Domestic buildings account for approximately 27 per cent of that total and consequently low energy housing solutions are an essential part of achieving the Government’s target. More recently, the UK Government has abolished the ‘Code for Sustainable Homes’ BREEAM Zero Carbon targets, however, the UK is still required to



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#### Profile

- HEI
- 33197 UK-based students
- 7569 Staff
- UK campuses - a mix of urban and rural settings



comply with the European Directive 2010/31/EU (EPBD recast) Article 9 which requires that “*Member States shall ensure that by 31 December 2020 all new buildings are nearly zero-energy buildings*”. Therefore without the ‘Code for Sustainable Homes’ providing guidance and direction for the UK house building industry it is even more essential that demonstration projects exist to inform all house builder stakeholder organisations if we are to reduce carbon emissions associated with energy use in our homes.

## The approach

As early as 1999, researchers at the Department of Architecture and Built Environment at the University of Nottingham (UoN) were approached by construction firms seeking collaborations to help develop and test low-energy housing solutions. Homes were built to varying specifications to support the testing of a variety of design strategies, construction methods and technologies intended for the volume house-builder market. Sponsorship from David Wilson in 2000 (Millennium Eco House), Roger Bullivant Ltd in 2006, BASF in 2006, E.ON in 2007, Tarmac in 2008, Saint Gobain in 2010 and Mark Group in 2013 resulted in the seven homes that comprise the Creative Energy Homes. For example, the E.ON Research House was modelled on a typical 1930s semi-detached home with the aim of using retrofit technology to achieve to modern energy standards.

## Our goals

The seven homes, built at Green Close on the University Campus, aim to act as live laboratories for the investigation of the relationship between occupants and building performance. The research relates to many aspects of sustainability and particularly energy use. Post-occupancy evaluation was also carried out in six of the homes to provide accurate data on how each room was used within the building and subsequently to explore the feasibility of demand-side management, energy storage and smart-grid community energy technologies. The homes also act as a teaching tool for educating the next generation of architects and engineers at the University and beyond.

## Obstacles and solutions

- Changing Government legislation - through demonstration and public/industry engagement demonstrate with real data that sustainable housing solutions work in order to drive the market and convince policy makers of a need for change.

## Performance and results

- The momentum gained through the research and development activities taking place in the houses has led onto international research collaborations. Prof Mark Gillott and Dr Lucelia Rodrigues, together with researchers from Power Electronics, Machine and Control Group have been awarded a grant worth over €1m as part of a €15m project by European Horizon 2020. Led by Siemens in Germany, the project titled Storage Enabled Sustainable Energy for Buildings and Communities (SENSIBLE) aims to address the issues surrounding energy storage, both thermal and electrical, in homes and communities. The University's team will work closely with a local community in order to integrate energy storage solutions with the specific focus being in the socio-economic benefits that can be gained.
- The project has been geared towards addressing the needs of industry For example, regeneration property developer Igloo Blueprint used the research team's studies of occupant behaviour in the CEH house to inform the design of an innovative £7M housing development just outside Nottingham city centre. Nick Ebbs, the company's CEO, has remarked: “The insight we gained on the practical delivery of Code Level 4 housing, through our discussions regarding the research results on use of low carbon technologies and post occupancy evaluation from the Creative Energy Homes project, has helped

inform our own thinking in relation to the design and specification of our 'Nottingham Green Street' development of 38 Code Level 4 homes... the learning journey we have been on with the University is also shaping our larger developments including the £150M Trent Basin scheme and elsewhere in group our housing schemes in Newcastle and Cardiff"

- The post-occupancy evaluation used radio frequency identification (RFID) to track the real-time location of occupants within the home, leading to a novel methodology which was applied to the data to inform future housing designs and ensure the best use of space. Building on this methodology, further studies used wireless technologies to track energy use in real time, demonstrating intrinsic links between occupancy and energy use. A key recommendation arising from this study was that performance evaluation of domestic buildings should include occupancy monitoring.

## The future

### Lessons learned

1. Never under-estimate the public and industry interest in the work you are doing and plan ahead for important research demonstration activity. For us, low energy housing research really captured public interest and we initially underestimated the attention the project received from public/industry and had to find additional resource for dissemination activity at the start of the project.
2. Good teamwork, for planning delivery and undertaking the project, was an essential part of the successful delivery.
3. As our research was industry linked, it was important to find other avenues for research publication other than traditional academic research journals which industry will not read.

### Sharing your project

The level of public engagement and interest developed with Creative Energy Homes is substantial and has maximised reach through international media coverage, including BBC Breakfast News (December 2009), Voice of America (November 2009) and on BBC Radio 4 Costing the Earth: the 'House that Heats Itself' aired on 13th March 2013. Further engagement has included the BBC programme Blue Peter (March 2011), which alone reached an audience of 370,000 people. The CEH development opened to the general public 13 years ago and between 2008 and 2012 sustained an average of 150 to 250 visitors per month, 96 per cent of whom reported that their knowledge of sustainable housing technologies had been enhanced. CEH also featured in the video 'Britain Through My Eyes', which was released by the UK Foreign & Commonwealth Office in the build-up to the 2012 Olympic Games. In addition, CEH was an award winner at the 2010 Solar Decathlon Europe competition. An independent assessment, provided by public relations firm Tonic PR, has estimated the potential audience for the research as a result of these various forms of engagement to be in excess of five million.

### What has it meant to your institution to be a Green Gown Award finalist?

Being a Green Gown Award finalist is a fantastic accolade for the all involved in the research design, delivery and operation of the Creative Energy Homes. The group works tirelessly undertaking research and providing education to promote sustainability issues within the built environment and it is great that the higher education sector has these awards to recognise significant achievement and help promote the sustainability agenda.

### Further information

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On the web: [www.nottingham.ac.uk/creative-energy-homes/index.aspx](http://www.nottingham.ac.uk/creative-energy-homes/index.aspx)

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