Institution: University of Greenwich

Unit of Assessment: (UoA 16) - Architecture, Built Environment and Planning

Title of case study: Climate Change Mitigation in the Built Environment

1. Summary of the impact

Research carried out at the University of Greenwich has explored issues surrounding sustainable living and climate change mitigation in existing buildings. The research identified the relationships between people and the built environment and developed a series of behavioural interventions to inform building users of the energy they were consuming and provide guidance on how this could be reduced. The socio-technical relationships were used in a public engagement programme to promote debate amongst the over-65s and the interventions by Registered Social Landlords to support behaviour change and reduce energy consumption in domestic buildings. The outputs have also been used to inform Social Housing policy development.

2. Underpinning research

The business (31.6%) and residential (23.6%) sectors account for approximately 55% of UK end-user Green House Gas (GHG) emissions. To reduce these emissions the UK Government has developed design guidance for new building, but hasn't addressed the problems associated with existing buildings. The Sustainable Built Environment Research Group (SBERG) at the University of Greenwich was established by **Professor Jones** in 1996 to undertake research to support the development of a sustainable built environment, and in particular to understand the complex interaction between people, the built environment they use and occupy, the natural environment, and the economics that support daily life. The research underpinning this impact case study is drawn from two EPSRC projects that explored the issues surrounding mitigation of existing buildings to climate change:

1. Innovation in the Design, Construction and Operation of Buildings for People (IDCOP);
2. Carbon, Control & Comfort: user-centred control systems for comfort, carbon saving and energy management (CCC).

In 2004 **Professor Jones** was co-investigator on the EPSRC IDCOP project (2004-2009) [3a], involving three UK universities and 16 industrial partners. It aimed to identify the innovation required to ensure that buildings continued to support the needs of businesses and citizens over the next 50 years. Prof Jones carried out a detailed questionnaire survey and follow up interviews of Social Housing managers to investigate the barriers to the effective retrofitting of low carbon solutions in domestic buildings [3.3]. He identified the importance of human behaviour (both individual and corporate) in reducing energy consumption in the home and the need to understand the socio-technical interface (eg in the development of energy control systems, lifestyle behaviours etc.) when developing low carbon retrofit solutions. The research also identified the significance of individual and corporate *understanding of sustainability* as a key indicator of the willingness to invest in the retrofit of mitigation measures to existing buildings.

The socio-technical factors affecting the retrofitting of low carbon mitigation measures to existing social housing were further investigated in the EPSRC CCC project (2009-2012) [3b]. This multidisciplinary, three-year project investigated the relationship between comfort in the home and the systems used to deliver it, involving seven universities, EoN, three commercial partners and seven social landlords. Prof Jones was a co-investigator and led the University of Greenwich team (comprising engineers and psychologists) which explored the meaning of comfort and its

relationship to CO_2 emissions through a controlled extensive intervention study of 53 households (pre and post intervention interviews, physical house surveys and monthly energy use monitoring). Prof Jones's team developed and tested no-cost behavioural interventions (local benchmarking with monthly feedback and a home user guide with helpful hints). The interventions resulted in an 18% reduction in energy consumption between the control and intervention sample homes [3.1]. The project also identified the importance that habit plays in energy consumption and how energy providers and social housing landlords could play a crucial role in changing habits by engaging with tenants during periods of change, either through an energy systems retrofit or change in tenancy [3.2].

The research from both these projects identified the importance of socio-technical factors (eg linking technology to lifestyle, linking personal understanding to built asset management etc.) in the effective mitigation of climate change in the home.

3. References to the research (REF1 submitted staff in **bold**, **REF2 Output)

3.1 Cooper, J., Huebner, G. H. & **Jones, K.** (2013) 'Energy Reduction Study Report', unpublished project report for EoN' available on request.

3.2 Huebner, G. M., Cooper, J., & **Jones, K. A. (2013). Domestic energy consumption—What role do comfort, habit, and knowledge about the heating system play? *Energy and Buildings*, *66*, 626–636. http://dx.doi.org/10.1016/j.enbuild.2013.07.025

3.3 **Jones, K.** & Kaluarachchi, Y. (2009) Stakeholder engagement in sustainable housing refurbishment in the UK. In: *SUEMoT Conference 2009, 2nd International Conference on Whole Life Urban Sustainability and its Assessment*, 22-24 April 2009, Lougborough. ISBN 13 978 0 947974 80. Available at: http://gala.gre.ac.uk/id/eprint/1823

External Research Grants

3a Innovation in the Design, Construction and Operation of Buildings for People (IDCOP) project. Funded by the Engineering and Physical Sciences Research Council (GR/T04878/01). Awarded to: Prof Bahaj (PI), Prof Jones (CI), Prof Clements-Croome (CI). Duration 2004-2009. Value £1,733,507. Details available at: http://gow.epsrc.ac.uk/NGBOViewGrant.aspx?GrantRef=GR/T04878/01

3b Carbon, Control & Comfort: User-centred control systems for comfort, carbon saving and energy management. Funded by the Engineering and Physical Sciences Research Council (EP/G000395/1). Awarded to: Dr Shipworth (PI), Prof Jones, one of 11 CI's. Duration 2009-2012. Value £2,094,702. Details available at: http://gow.epsrc.ac.uk/NGBOViewGrant.aspx?GrantRef=EP/G000395/1

4. Details of the impact

The UK needs to develop more solutions to reduce GHG emissions from existing buildings. By identifying the role of human behaviour, importance of socio-technical factors and need to raise awareness of sustainability, SBERG has been able to pilot schemes which have successfully engaged householders, changed their behaviour and reduced emissions. The group's work has also raised public awareness and influenced local and national policy.

The research outputs have had a direct impact on household behaviour; policy development; environmental performance of buildings; and public awareness.

Social landlords and tenants

The research outputs from the CCC project have had a direct impact on social landlords and their

tenants. First, the research had a direct impact on 53 tenants who received energy use feedback and guidance on how to reduce their energy consumption. All these people reduced their energy consumption over the 12 months between March 2011 and March 2012, by an average of 18%, through a range of behaviour changes.

Subsequently, Harrogate Borough Council (who were one of the research subjects studied in the project) integrated the research outputs into their approach to mitigation of their social housing, recognising the need to develop *"strategies for promoting and encouraging people to save energy",* based on the *"research outcomes from the extensive CCC study"*. Harrogate specifically commented that *"the marked success of the Benchmarking group in changing behaviour/breaking habits and reducing energy use has been really useful in persuading people of the importance of a) feedback and b) a feedback method that works."* [5.1]

In addition to those directly involved with the CCC project, the research outputs have had a direct impact through the following campaigns and events:

- The National Housing Federation (NHF) *Count us in* campaign, running from April 2012 – present, has used the research outputs, specifically the comparative feedback tool, as one of their five pilot schemes to reduce energy consumption. They have also used the lessons learnt from the CCC project to help them develop their monitoring protocols. A researcher from SBERG (J Cooper) is a member of the *Count us in* Advisory Committee [5.2, 5.3].
- A series of presentations and workshops at the NHF Conference (06/07/2012); end of project conference (22/10/2012); and the Green Vision webcast (29/03/2012) have raised awareness and stimulated discussion amongst 109 social housing managers and built environment professionals, on the role that behaviour change can play in reducing energy consumption in social housing. These events were considered "*useful to housing practitioners and can contribute to their and local authorities objectives to reduce fuel poverty"* by the Homes and Communities Agency (HCA) [5.4] and provided *"some very useful examples of practical experiences"* and *"useful tools for engaging with customers"*, according to participant feedback.

National policy makers

The research outputs from CCC were regularly fed back to policy advisors from Department for Energy and Climate Change (DECC) and the HCA. The research team made five presentations (05/07/12; 06/03/12; 13/09/11; 16/05/2011; 212/02/13) to DECC where the policy implications of the work were presented and one presentation to HCA (22/10/12). To date, the outputs from Greenwich's part of the project have had a direct impact on the policy discussions within HCA, in particular making *"a significant contribution to the implementation and design of government climate change policy. Specifically, it informs the implementation and design of policy objectives to improve energy efficiency in order to reduce CO2 emissions, by exploring and understanding the issues that affect occupiers' behaviour. The focus on how occupiers use heating systems is also highly relevant to the government's microgeneration strategy and to the success of installations of eg heat pumps. These aspects of occupiers' behaviour and motivation are recognised as critically important to achievement of policy objectives."* [5.4, 5.5]

Enhancing understanding and stimulating behaviour change amongst the older community

The findings from the IDCOP project formed the basis of an EPSRC Public Engagement project, 'Sustainable Living and the Older Community' to engage older people in sustainable living. The project team worked with those agencies trusted by the elderly (Age Concern, Energy Saving Trust and Friends of the Elderly) to support behaviour change and stimulate interest in climate change mitigation and adaptation solutions. Over a 12 month period (2009-2010) the project team had

contact with: 38 people through focus groups; 1,125 through formal presentations; 479 through information stands and 79 through discussion groups. In addition to face-to-face engagement, articles in the Age Concern newsletter *London Age* were sent to 15,050 people and information leaflets were available in Age Concern centres. In total 17,720 people were engaged with.

The impact of the engagement was measured using a methodology proposed by the EPSRC for this type of activity. A questionnaire was administered to 354 event attendees. The impact analysis showed that:

- awareness of sustainability had increased in 84% of respondents;
- 54% of respondents had taken action to change their behaviour (from physical changes, to the fabric of their homes, to changes in consumer behaviour)
- 57% of respondents had encouraged others to take action.

Overall the analysis showed the public engagement programme had a strong (36%) or very strong (13%) impact on those engaged with [5.6, 5.7, 5.8].

5. Sources to corroborate the impact

5.1 Operations Manager (Client), Harrogate Borough Council – email correspondence.

5.2 National Housing Federation – email testimonial for *Count us in* campaign.

5.3 *Count us in*: approaches to engaging households with their energy use. Available at: http://s3-eu-west-amazonaws.com/doc.housing.org.uk/Editorial/NHF_CountUsIn_Review_October2012.pdf

5.4 Manager – Existing Stock, Homes and Communities Agency – email testimonial.

5.5 Manager – Existing Stock, Homes and Communities Agency – available for interview.

5.6 Laura Grant Associates, Engagement Consultants appointed by EPSRC to monitor the impact of the project.

5.7 EPSRC Public Engagement Project Report (EP/F066554/1) 'Sustainable Living and the Older Community' – EPSRC Final Impact Report. Available on request.

5.8 EPSRC Sustainable Living and the Older Community (EP/F066554/1) http://gow.epsrc.ac.uk/NGBOViewGrant.aspx?GrantRef=EP/F066554/1