EVALOC Sustainable Blacon Final Community Report

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EVALOC
EVALUATING LOW CARBON COMMUNITIES

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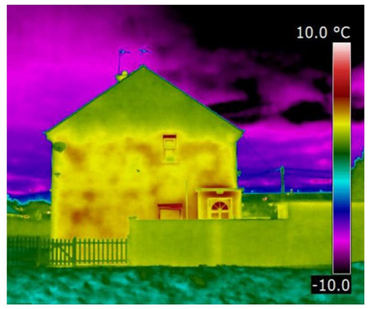
Sustainable Blacon
Final Community Report



EVALOC (evaluating low carbon communities)

Laura Barnfield, Jo Hamilton, Ruth Mayne, Sarah Darby
Rajat Gupta, Nick Eyre, Karen Lucas and Matt Gregg

EVALOC (Evaluating Low Carbon Communities) is one of seven projects funded by the Economic and Social Research Council (ESRC) and Engineering and Physical Sciences Research Council (EPSRC) Energy and Communities stream of the Research Council UK (RCUK) Energy Programme (Grant reference: RES-628-25-001). The EVALOC project brings together researchers from Oxford Brookes University and University of Oxford with six Department of Energy and Climate Change (DECC) funded low carbon communities.

For more information on EVALOC project, please visit: **www.evaloc.org.uk** or contact Professor Rajat Gupta, rgupta@brookes.ac.uk

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Images front cover: EVALOC team | **Back cover:** EVALOC team

Image: EVALOC Team

EVALOC Research Project

The EVALOC research project (Evaluating the impacts, effectiveness and successes of low carbon communities on localized energy behaviours), which was funded by the ESRC-EPSRC Energy and Communities stream of the Research Council UK's (RCUK's) Energy Programme (Grant reference: RES-628-25-001).

The project ran for four years and three months (January 2011 to March 2015), and brought together an interdisciplinary team of building science and social science researchers from the Low Carbon Building Group of Oxford Brookes University and the Environmental Change Institute of University of Oxford, to assess and explain the changes in energy use due to community activities within six selected low carbon community projects, funded under the Department of Energy and Climate Change's (DECC) Low Carbon Communities Challenge (LCCC) (DECC, 2012). The LCCC initiative was a government-supported initiative that ran from 2010 to 2011, and was designed to test the effectiveness of community-scale approaches that combine low carbon technologies with engagement and behaviour change activities. The overall aim of the EVALOC project was to evaluate the role, impacts, effectiveness and limits of low carbon communities in motivating energy reduction and renewable investment amongst local residents. These low carbon community projects were evaluated in terms of their IMPACTS on changing household and local energy behaviours, EFFECTIVENESS on achieving real-savings in energy use and carbon dioxide (CO_2) emissions and SUCCESS in bringing about sustained and systemic change. The research focussed mainly on assessing the LCCs' household energy and carbon reduction activities, which involved a variety of approaches and were resourced from a variety of sources. The research did not investigate in depth the outcomes or impacts from the LCCs' wider sustainability activities relating to waste, transport, food.

Research Team

Principal Investigator:

Professor Rajat Gupta is Director of Oxford Institute for Sustainable Development and Low Carbon Building Group at Oxford Brookes University. He developed the RIBA award-winning DECoRuM model for carbon mapping communities. In 2013 Rajat was voted as one of 13 international building science stars. Rajat's research interests lie in scaling up energy retrofits and monitoring and evaluating impacts of community-led retrofits. Rajat was lead academic on several Government funded Retrofit for the Future and Invest in Innovative Refurbishment projects on advanced low carbon refurbishment solutions, as well as a LEAF project on carbon mapping communities. Presently Rajat is evaluating an Innovate UK funded project on distributed energy generation and storage for reducing peak grid loads. Rajat has published widely, including strategic journal papers on future direction of energy demand research and evaluation of an innovative retrofit programme.

Co-Investigators:

Dr Nick Eyre leads the Lower Carbon Futures Programme at the Environmental Change Institute (ECI) at the University of Oxford, and is a Jackson Senior Research Fellow at Oriel College, Oxford. He is a co-Director of the UK Energy Research Centre leading it work on decision making. Previously he has worked at the Energy Saving Trust as Director of Strategy and on secondment to the Cabinet Office, where he was a co-author of the 2002 UK Government's Review of Energy Policy. Nick has worked on energy, environment and climate issues for 30 years and was a lead author in the Fifth Assessment Report of the IPCC.

Dr Sarah Darby is deputy programme leader with the Lower Carbon Futures team at the ECI. She is particularly interested in how people adopt technologies and make them part of their way of life. Her interest in the social dimensions of energy systems came from evaluating the effectiveness of energy advice programmes. Recently she has been researching social and environmental dimensions of smart grids. This has included modelling the potential carbon impacts of smart grid development for the European Commission and a 'Smart Metering Early Learning' synthesis report for the Department of Energy and Climate Change (published March 2015).

Dr Karen Lucas is Associate Professor of Transport Geography and Director of Research and Innovation at the Institute of Transport Studies, University of Leeds. She has had 20 years of experience in social research in transport. She is a world-leading expert in the area of transport-related social exclusion. Her most recent project was for the Asian Development Bank to develop a training program for Designing Inclusive Transport Projects. She specialises in action-based research and participative planning exercises bringing together local communities with policymakers.

Researchers:

Laura Barnfield is a Research Fellow at the Low Carbon Building (LCB) Group of the Oxford Institute for Sustainable Development (OISD) at Oxford Brookes University (OBU). Prior to joining OBU, Laura worked in a local sustainable architectural practice that drew work from a variety of sectors including the public and housing sectors. Most notably she worked on a young people's centre with solar PV panels and high performance building fabric specification in Oxfordshire. Laura holds an MSc in Sustainable Buildings: Performance and Design as well as a DipArch from OBU. Prior to studying at OBU, she studied an MA (Hons) in Architectural Design at the University of Edinburgh.

Jo Hamilton joined the ECI, University of Oxford in 2006. Jo's research focuses on community-led energy projects and local energy governance through the UNLOC project (Understanding Local Governance of Energy); and monitoring and evaluation of community energy groups through EVALOC and the MESC (Monitoring and Evaluation for Sustainable Communities) projects. Within these projects she has explored the role of social learning and social networks in disseminating energy messages; the role of the arts in engaging individuals and communities with climate change and energy; and has collaboratively developed monitoring and evaluation resources. Jo holds an MSc in Energy and Environment Studies from the Centre for Alternative Technology / UEL.

Ruth Mayne has over 25 years' experience working as a community practitioner, a researcher, and a policy advisor on a range of social, economic and environmental issues, as well as the design and assessment of change strategies. She is also co-founder and currently strategy director of Low Carbon West Oxford. Since joining the ECI, Ruth has worked on a number of research projects including EVALOC which assesses the environmental, social and economic effects of low carbon communities. She has recently won an Impact Acceleration Award from University of Oxford, to bring learning and best practice from her research to Low Carbon Oxford.

Matt Gregg is a Research Fellow in Architecture and Climate Change, based at the OISD: LCB Group at Oxford Brookes University. Matt has worked on a number of climate change adaptation projects including the 3-year EPSRC-funded Suburban Neighbourhood Adaptation for a Changing Climate and has undertaken the carbon mapping of six case study communities as part of EVALOC. In 2009, Matt graduated with an MSc Sustainable Building: Performance and Design from OBU. Prior to joining OBU in 2010, Matt worked over three years in an architecture practice in Tennessee after getting his BArch at the University of Tennessee.

Chiara Fratter is a Researcher based at the Low Carbon Building Group of the OISD at OBU. Her involvement in the EVALOC project has covered several areas of analysis from householder interviews to domestic energy use. She holds an MSc in Sustainability Environment Design (Honours) from I.U.A.V in Venice; her dissertation was entitled *Energy optimization and functional refurbishment of an existing school building*. Previously she achieved a DipArch and MSc in Sustainable Architectural Design from the Polytechnic Institute of Milan. At the same institute she received a Bachelor's degree in Environmental Architecture with a dissertation topic on Life Cycle Assessment.

Dr Bob Irving joined OISD as Research Associate in 2013 after completing his PhD with Rajat Gupta as his Director of Studies. Bob holds an MSc in Energy Efficient & Sustainable Buildings from Oxford Brookes and has a BA from Lancaster University. His previous career was in IT in fields ranging from uranium mining to mail order book-selling. His PhD thesis examined the possible effects of the mass installation of domestic heat pump systems on the UK energy supply. His main work in EVALOC has been the analysis of monitoring data on window opening and performance of air source heat pumps.

Acknowledgements

The EVALOC team would like to acknowledge the input of all the participants in the research. Residents and members of the six case study low carbon communities located across the UK (Swansea and Amman Valleys, Chester, Middlesbrough, Hook Norton, Huddersfield and Oxford) contributed to the project through focus groups, community events, trial of energy feedback devices and monitoring and evaluation of household energy use. They provided the EVALOC team with valuable insights into the challenges of reducing household energy use and changing energy behaviours. We would particularly like to acknowledge the time and commitment of John Barnham, Nathan Brett, Ged Edwards, Mark Fishpool, Jem Hayward, Emily Hinshelwood, Saskya Huggins, Tim Lunel, Frank Lucas, Dan McCallum, Sarah Mitchell, Angie Moray, Dennis Reeves, Sarah Spilliotis, and Ruth Sherrat, as well as the residents of the 88 case study households involved in the research. We would like to thank Dr Bernie Hogan of the Oxford Internet Institute (University of Oxford) for guidance and assistance with the social network analysis, Anthony Psaila for his facilitation of two rounds of focus groups, Adorkor Bruce-Konuah of the Low Carbon Building Group (Oxford Brookes University) for assistance with analysis of energy and environmental monitoring, Marina Topouzi, Priyanka Arora, Ruchi Parakh, Nina Sharp and Tara Hipwood for their help in undertaking the household interviews and data collection, and Dot Kirkham for transcribing all interviews and focus groups. We would also like to thank our Project Advisory Board members and International Visiting Researchers for their valuable contributions to the research.

Case study low carbon communities

Awel Aman Tawe (AAT) is a community energy charity and a social enterprise project focusing on a population of over 13,000 people in 12 villages located in the Upper Amman and Swansea Valley, South Wales. The project grew out of a local community meeting in 1998, and has focused on a community-owned wind farm as a way to rejuvenate the local economy and address fuel poverty, which is a major concern in the local area.

Sustainable Blacon Ltd is a community-based company limited by guarantee, formed in July 2009 dedicated to promoting and developing Blacon, a suburb of Chester, North-West England, as a model sustainable urban community. It was a subsidiary of Blacon Community Trust, a registered Charity and company limited by guarantee.

The Eco-Easterside project was led by Middlesbrough Council, Middlesbrough Environment City and local housing associations, in partnership with local residents in the Easterside area, a suburb of Middlesbrough, North-East England. Its objectives are to raise awareness among residents to reduce carbon emissions from domestic housing and public facilities, cut energy use and household energy bills, encourage the use of active and sustainable transport, and contribute to sustainable, healthy living by encouraging residents to grow their own food.

Hook Norton Low Carbon (HN-LC) is a Co-operative and Community Benefit Society set up by members of **Low Carbon Hook Norton**, a community action group which started in 2008 with the aim of reducing the energy consumption and carbon emissions of the 2,500 strong community in the South-East of England. Hook Norton Low Carbon provides a range of community-based schemes as well as providing low interest loans to local residents for household energy improvements.

Kirklees Council-led *Hillhouse Greening the Gap* project aimed to encourage positive behaviour change among residents to reduce carbon emissions, as well as act as a catalyst for wider community benefits such as affordable warmth, skills development, job creation, improved health, and stronger communities. Hillhouse is an urban neighbourhood in Huddersfield, Yorkshire & Humber, England, with strong community networks and community centres, as well as a diverse mix of residents with over 65% from ethnic minority groups.

West Oxford: Low Carbon West Oxford (LCWO) is a charity set up by local residents, in a neighbourhood of Oxford, South-East England, with the aim of helping local residents take practical action on climate change. **West Oxford Community Renewables** (WOCoRe), a registered society, generates renewable energy and donates the surplus to LCWO to run further carbon-cutting projects in the community. This generates a double carbon cut which reduces the cost of carbon reduction, as well as a range of other community benefits. The residents aim to achieve an 80% reduction in emissions in West Oxford by 2050.

International visiting researchers

Professor Jonathan Fink is Vice President for Research and Strategic Partnerships and Professor of Geology at Portland State University (PSU) in Portland, Oregon. PSU works closely with the City of Portland (the only large city in the U.S. to have reduced its carbon emissions below 1990 levels) to advance a green agenda around transportation, land use, ecosystem services and sustainable construction. Dr Fink, a volcanologist by training, is a member of the Board of Advisors of the Smithsonian Institution's National Museum of Natural History, and the National Board of Advisors for KB Home, the fifth largest homebuilder in the U.S.

Trevor Graham is Head of Sustainable Communities and Lifestyle in the City of Malmö (Sweden) working with sustainable urban regeneration through a wide range of projects and strategic initiatives. He has previously worked with community development, urban sustainability and sustainable building in the UK and Germany and came to Sweden in 1998 to head the Eco-City Augustenborg initiative. Current work includes establishing the new large scale regeneration programmes in Malmö incorporating social innovation and sustainable economic development as key parameters to speed up the process towards the sustainable city. Trevor has also led a bilateral programme for knowledge and technology transfer on sustainable construction between UK and Sweden.

Dr Michael Ornetzeder is a Senior Researcher at the Institute of Technology Assessment at the Austrian Academy of Sciences, and a Lecturer at the University of Natural Resources and Life Sciences in Vienna. His research interest lies in science and technology studies, with a particular focus on participatory forms of technology assessment, user innovation, social learning and innovation networks. His current research is in the field of transition of the energy system towards sustainability and on climate change issues. Michael is also an advisor for a large-scale pilot project on energy efficiency and smart metering in Austria.

Professor Ashok Lall is Principal of Ashok B Lall Architects (India) specializing in low-energy sustainable architecture. He is also chair for Design and Technology at the Kamla Raheja Vidyanidhi Institute for Architecture (KRVIA) in Mumbai, India and Visiting Professor at the Guru Gobind Singh Indraprastha University (GGSIPU) in New Delhi. Prof Lall is currently engaged in several initiatives for the improvement of public spaces in cities and affordable housing. He was convener of the Delhi Urban Arts Commission Work group on Energy, and coordinator of an EU-funded program for the development of a web-based teaching package for low-energy architecture. He was a member of the Holcim Awards jury for Asia Pacific in 2005 and 2011, and head of the Holcim Awards jury for Asia Pacific in 2008.

Advisory board members

Professor Roy Alexander, University of Chester

Graham Ayling, Energy Saving Trust

Chris Church, Low Carbon Communities Network

Professor Paul Ruyssevelt, UCL Energy Institute

Dr David Strong, David Strong Consulting and Visiting Professor, Oxford Brookes University

William Walker, Community Energy Unit, Department of Energy and Climate Change

Chris Welby, Good Energy

Members of the six case study low carbon communities: Awel Aman Tawe, Sustainable Blacon, Eco Easterside, Low Carbon Hook Norton, Kirklees Council, Low Carbon West Oxford

Glossary of terms

Area: In this report, 'area' may mean a geographical neighbourhood, town or city depending on the low carbon community (LCC).

ASHP: Air Source Heat Pump.

Behaviour change interventions: LCC activities that seek to change residents' energy behaviours (as defined below), through increased motivation, knowledge and agency (ability to make change). The intervention may include provision of energy feedback measures such as energy display monitors, face-to-face advice and support, community-based social learning opportunities and events, and energy management or low carbon living programmes.

Carbon mapping: Measuring, modelling and mapping estimated local energy use and resultant carbon emissions. Carbon mapping is performed using a tool called DECoRuM.

DECC: Department of Energy and Climate Change.

DECoRuM: A mapping tool with the capability to estimate the energy performance and carbon emissions on a house-by-house level, and the potential energy savings for a range of home energy improvements. The results can be aggregated to a street, district, suburb or city level. It uses data from publicly available sources including Ordnance Surveys, English House Condition Survey and Energy Performance Certificates, as well as questionnaires completed by local residents.

Dwelling: a self-contained 'substantial' unit of accommodation. In this report it refers to the physical building which is inhabited.

ECO: Energy Company Obligation; a government scheme to obligate larger suppliers to deliver energy efficiency measures to domestic premises in Britain.

EDM: Energy displaymonitor (also known as an in-home display, or IHD).

Energy behaviour: the EVALOC research focuses on energy behaviours relating to electricity and gas use within households, rather than energy use related to food, waste, transport, or other services. This may include the purchase, use, maintenance or lease of energy-using appliances, technologies, goods or services. These energy behaviours may be influenced by a range of individual, social, cultural, technical and economic influences.

Energy champions: local residents enlisted by a LCC to encourage other residents to adopt sustainable energy behaviours and/or take up renewable and energy efficiency measures. The role of the energy champions may involve helping communicate energy saving measures, leading-by-example, and providing face-to-face information and advice.

Extrinsic values: values related to external approval or rewards such as money and status.

FiT: Feed-in Tariff; UK Government scheme designed to promote the uptake of a range of small-scale renewable and low-carbon electricity generation technologies. The FIT scheme is available through licensed electricity suppliers. It requires some of them to make tariff payments on both generation and export of renewable and low carbon electricity.

Household: one or more people who live in the same dwelling and also share meals or living accommodation. A single dwelling can contain multiple households.

Interventions: energy-saving activities or processes that are offered by LCCs. In relation to the households, these were either physical or behaviour change interventions.

Intermediary organisations: organisations which can catalyse, support and facilitate action by LCCs, with a view to helping initiate, replicate, grow and mainstream low carbon innovations. Their roles can include capacity development, communication and networking, coalition building, provision of funding, and aggregating projects. They mostly operate at a national or regional level. Intermediary organisations are typically social enterprises, charities or non-governmental organisations.

Intrinsic values: values which are inherently rewarding to pursue e.g. concern for the environment, social justice.

Know-how: practical knowledge about perform tasks or solving problems, such as how to manage energy use in the home.

LCC (Low Carbon Community): the organisations in a locality involved in promoting community-level energy and carbon reduction. This term can cover a single Low Carbon Community Group (LCCG), or a partnership or multi-agency approach involving LCCGs, local authority, other statutory agencies and intermediary organisations.

LCC roles and activities:

- **Downstream**: refers to LCC roles and activities with local residents.

- **Midstream**: LCC roles and activities with other local organisations or with other LCCs.
- **Upstream**: LCC activities with national policy-makers.

LCCC (Low Carbon Communities Challenge): a government-funded two-year programme of action research carried out with 22 communities between 2010-12. All six of the communities who contributed to EVALOC were involved in the LCCC.

LCCG (Low Carbon Community Group): a group or organisation working on issues of carbon reduction at a local level, where members of the local community govern and run the group, and are beneficiaries of the group's activities.

Learning and action groups: groups taking part in a structured programme of meetings in which participants learn about energy and carbon reduction, set goals to reduce carbon, reflect on their actions, and learn from other participants.

Local: refers variously to village, urban neighbourhood, town or city.

Low- or zero-carbon technologies (LZTs): Technologies that are low- or zero-carbon in operation. For this project, that includes air source heat pumps, as well as renewable systems such as solar PV, solar thermal and wind turbines.

LSOA –Lower Layer Super Output Areas (LSOAs): small areas for the collection of census statistics. On average, they contain roughly 1,500 residents and 650 households. Annual metered gas and electricity datasets are available at LSOA level from 2005 onwards. Further information can be found here: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/359302/subnational_methodology_and_guidance_booklet.pdf

MEC: Middlesbrough Environment City

Monitoring and evaluation (M&E): monitoring is the collection and analysis of information about an intervention, project, programme or process, undertaken while the project/programme is ongoing. Evaluation is the periodic assessment of interventions in terms of process, outcomes, and significance. Evaluation may be conducted internally by the organisation itself or by external evaluators.

Multi-agency: some combination of statutory services, agencies and teams of professionals and other practitioners, working together to provide services.

Partnership: a voluntary but structured collaboration between two or more organisations to address a common problem or issue of concern. In this report, the main forms of partnership referred to are between local authorities, community groups and other agencies to reduce carbon emissions and energy use. A partnership may involve multi-agency working.

Physical interventions: changes made to a building in order to reduce carbon emissions and/or reduce energy demand. They can be:

Fabric measures – energy efficiency measures to upgrade the physical fabric of a dwelling (e.g. draught-proofing, double glazing, loft insulation, cavity/solid wall insulation).

Technical measures – measures relating to services and systems within a dwelling (e.g. condensing boiler, appliances with high efficiency ratings and items such as timers and standby-off switches). In this report they also include LZTs.

Renewables: systems that generate energy (heat or electricity) from resources which are naturally replenished on a human timescale such as sunlight, wind, rain, tides, waves and geothermal heat.

Sense-making: making sense of new information or experiences. It is a process or activity in which we understand, create order, and give meaning to new concepts and experiences, and integrate these concepts and experiences with what we already know (Weick, 1995).

Social learning: at an individual level social learning can occur in social or informal contexts, through interactions with others, or by observing their behaviour and actions. At an organisational level, social learning can involve participative and collaborative approaches to addressing complex problems (for example, workshops which encourage the sharing of experiences and approaches to address issues such as tackling fuel poverty).

Subnational energy data: annual energy datasets published by DECC at various scales including local authority and super output areas.

Super output areas: designed to improve the reporting of small-area statistics, they offer a choice of scale for the collection and publication of data. Local Super Output Area datasets show changes in energy and carbon outcomes in the areas immediately around and adjacent to the EVALOC LCCs.

Summary of Findings and Recommendations

1 Introduction

- This public facing summary report shares the findings from the EVALOC research project about Sustainable Blacon Ltd's (SBL) energy and carbon reduction projects. EVALOC research was carried out between 2011 and 2014 to assess and explain changes in energy use in six low carbon communities (LCCs) in England and Wales.

- Sustainable Blacon Ltd is a community-based company dedicated to promoting and developing the physical suburb area of Blacon as a model sustainable urban community, working on four activity areas: Energy, Transport, Spaces and Enterprise. In 2009 it was awarded £393,111 from the Department of Energy and Climate Change (DECC) as part of the Low Carbon Community Challenge (LCCC) to undertake energy and carbon reduction activities in Blacon.

2 Roles and Capabilities

- SBL is a subsidiary organisation of the Blacon Community Trust (BCT). Whilst operating independently, it has strategic partnerships with other organisations, local government and particularly the University of Chester. SBL was confident about their capacity to engage, motivate and empower residents, and achieve sustained pro-environmental behaviour change. This capacity was evidenced by EVALOC, and by the University of Chester evaluation reports (Alexander and Hunt 2012, and University of Chester 2013).

- However, during the LCCC programme, as with many other communities, SBL experienced difficulties working with funding which was essentially for capital works where their programme was fundamentally about behavioural change, requiring staff time. This involved the team in seeking successfully suitable additional funding. However, at the end of the LCCC Programme and with the economic downturn, insufficient funds were available to maintain the programme's momentum and its work was scaled down to volunteer contributions only in 2013.

3 Change Strategy

- The Sustainable Blacon Ltd project design was tailored to the need of local residents. The change strategy helped residents overcome technical, economic and social constraints on energy and carbon reduction, and working with local organisations to deliver elements of the strategy.

- At a ***downstream level*** (with residents):

- Local residents were recipients of communication messages, engagement methods and projects in SBL's four areas of activity, which were tailored to local concerns and needs.

- SBL aimed to influence energy and carbon reduction in the home through two areas of activity (which were the primary focus of the EVALOC research):

1) The Blacon Energy Management Project (BEMP) which involved 150 households;

2) Two demonstration eco-houses which were open for visits from the public, including an innovative 'behaviour change' house.

- At a ***midstream level*** (with local agencies), SBL sought to make links with public, private and third sector organisations and worked with:

- Cheshire West and Chester Council, through involvement in SBL board, and the BEMP;

- University of Chester , through evaluation of the BEMP project;

- Blacon Community Trust, as SBL was a subsidiary organisation;

- Cheshire and District Housing Trust (CDHT) through support for the first of the two Eco houses, the 'behaviour change house'; and

- Expert advisors in the field of energy and buildings, through involvement in the SBL Board.

- Additionally, SBL held the 'Blacon Sustainability Convention' in November 2011, which shared learning with other Low Carbon Communities across the UK, with relevant national and local government departments, and relevant local organisations.

- At an ***upstream level*** (with government or national interest groups), SBL's experience of strengthening the local community through raising awareness, and encouraging and supporting participation and volunteering in low carbon activities was of interest to the Department of Energy and Climate Change (DECC) and the Prime Minister's office. It was clear that SBL's experience in strengthening civic structures and developing the social capital to

underpin them was also of relevance to other national Government Departments such as the Department for Communities and Local Government (DCLG), even though DECC's interest in the LCCC programme appeared to wane following the election of 2010. In November 2011, Blacon Community Trust (BCT) was awarded the 'Big Society Award', the work of SBL being significant in obtaining the award. Andrew Stunnell MP, the Minister for Communities, gave the Ministerial input into the Blacon Sustainability Convention in November 2011.

- The work of SBL was also recognised at a national level through being awarded a 'Waterwise Award' with Dee Valley Water in October 2012, for their role in bringing together shared benefits from both water and energy efficiency.

4 Learning

- A key aim of SBL was to provide opportunities for learning beyond the project. SBL has been involved in five external research projects, in addition to the DECC LCCC evaluation. The primary learning and evaluation partnership was with the University of Chester, which was an integral part of the BEMP, together with the EVALOC project and work with the Universities of East Anglia, Southampton, and Strathclyde.

5 Effectiveness

- Overall, SBL has successfully managed and implemented energy efficiency projects at community and household level. Below, the key findings relating to the effectiveness of SBL's activities are outlined.

Engagement

- SBL engaged an important sector of residents in the BEMP, with 50% of the BEMP participants in fuel poverty at the outset of BEMP.

- All households in Blacon were reached through newsletters, existing networks, leafleting and door-knocking;

- 1,500 residents participated in SBL community focused events;
- 150 households involved in the BEMP, with 459 individual measures ranging from new gas condensing boilers and solid wall insulation to radiator reflector panels and power-down plugs installed;
- 151 volunteers took part in the wider aspects of SBL, such as the cycle path implementation and regeneration;
- Over 1,300 people visited the two eco-demonstration houses (over 1,000 in nine months).

Household energy use and carbon emissions

- Based on energy data for the wider community, the average carbon emissions from household combined electricity and gas use in Blacon have reduced by 14% over five years (2008-2012), a greater reduction than the national average (12%) over the same period.

- Whilst the percentage reduction in Blacon's annual average household metered electricity use of 4% is the same as the national average over the five year period (2008-2012), percentage reductions in annual average gas use were much higher than the national average; 21% compared with 17%. These reductions are noteworthy as annual average household baseline (2008) gas and electricity use in the Blacon community was lower than the national average (13,613kWh for gas and 3,765kWh for electricity compared to national averages of 16,906kWh and 4,198kWh), which limited the potential for energy reduction.

- Carbon mapping estimated that 288 out of 373 households (77%) reduced their energy use over the five year period. The findings from carbon mapping also indicated reductions in energy use in both households that directly benefitted from LCC activities and those that did not.

- Furthermore, SBL's activities also appear to have had positive impacts in terms of individual household energy use. Long term annual gas and electricity meter data (2008-2012) of the case study households show overall reductions, with 11 out of the 13 households that benefitted from the BEMP directly, reducing either or both gas and electricity, all stating that they felt SBL had directly helped them reduce their energy use.

- However, monitored energy data (2013) showed that six of the case study households involved directly in SBL were using more energy than the national average, despite having physical and behaviour change interventions; which indicates that further reductions are possible (most likely through further physical interventions).

- Carbon mapping indicates that further savings of up to 63% (on 2012 estimates) per dwelling could be made through packages of physical and technical measures.

Performance of physical interventions in case study households

- Thermal imaging surveys indicate that there are potentially significant issues with retrofitted cavity wall insulation, particularly around and under windows.

- Despite this, several of the respondents commented that both fabric improvements and improved heating systems in their home had increased comfort levels, not only in terms of heat and improved warmth but also noise and condensation issues. Only one noted increased condensation following increased insulation (due to loss of adequate ventilation).

Occupant energy behaviours in case study households

- Most occupants in the 19 case study households (13 involved in SBL activities and 6 'control') exhibited high levels of energy saving awareness, motivations and behaviours, as well as confidence in their knowledge in terms of both undergoing their own energy improvements but also in terms of discussing energy improvements with others.

- Most households appear to have sustained habitual energy-saving behaviours, although some returned to previous energy-using behaviours due to other priorities such as comfort, health and cleanliness. This corroborates the University of Chester research carried out for SBL.

- The majority of the households involved in BEMP stated that it had not only changed small behaviours such as boiling less water and turning lights off, but also helped provide useful practical tips in terms of improving the physical performance of the dwelling.

- Energy display monitors have increased awareness and changes in electricity-related behaviours, but not necessarily had significant impact on actual energy use.

Social and economic impacts

- The social and economic impacts of SBL's activities have been significant:

- **Financial:** Most householders reported that they felt they had made energy savings, but due to rising unit energy costs this did not necessarily translate into reduced energy bills; instead their bills remained more or less constant.
- **Comfort and health:** The household energy upgrades have been linked to warmer and more comfortable homes.
- **Social capital:** Participants in the BEMP experienced an increased sense of community and social cohesion due to the programme's meetings and talks. Some participants went on to volunteer in follow-on energy projects. Blacon Community Trust was awarded the 'Big Society' award by DCLG at the 2011 Blacon Sustainability Convention in November 2011 in recognition of their work to increase civic activity.
- **Wider impacts:** Drawing on the household interviews, participation in the BEMP and SBL's wider activities has helped to improve some participant's mental health and wellbeing.
- **Jobs:** Eleven people found work through and beyond their contact with SBL's work. In addition to the original two project staff, funding was obtained for three further jobs, and six longer term volunteers.

6 Sustainability, Scalability and Replicability

Financial sustainability

- SBL received DECC LCCC funding to deliver BEMP and two Eco-demonstration homes. Although making very good use of volunteers, the BEMP required more staff and management time and resource than the 10% of the LCCC funding allowed. It is interesting to note that this was also experienced by other low carbon communities participating in the EVLAOC research project.

- SBL aimed to roll out the BEMP as a service or programme to sell to other LCCs, but this proved difficult in practice. Again, other LCCs have also experienced difficulties in generating revenue from rolling out behaviour change programmes that they have developed, as there is little funding for developing an established programme.

- Despite applying for grants, SBL was unsuccessful in receiving funding to continue work, beyond the two rounds of project funding for 'Save Money Keep Warm' (SMKW). They also mentioned the difficulties of competing with larger national organisations to deliver sustainability projects in the local area.

- It was not financially viable to continue with one of the Eco-demonstration house, thus it was sold to the University of Chester. Despite positive feedback from visitors, including school groups, it was difficult to arrange regular paying school visits which could cover the costs of the eco-house. Some material exhibits in the house were donated by companies. Whilst this could have been used as a marketing

resource, the uncertainty surrounding the Green Deal at the time meant that they didn't receive as much interest from local installers as they had envisaged.

Scalability

- The BEMP required leadership and management to continue, particularly to coordinate the highly successful volunteer programme, but no funding was obtained to pay for those roles. Recruiting participants, organising meetings and discussions, and collecting the energy monitoring data requires a significant amount of time, even when volunteers are involved in many of those activities. Without funding to pay for staff time to manage and oversee the expansion of the programme, it was difficult to scale up to wider participation in the area.

Replicability

- The models of the BEMP and the Eco-demonstration house could be replicated by other LCCs, particularly those operating in similar demographic areas. However, to replicate the project, the LCC would need sufficient funding to manage and oversee it. Part of the incentive for continued participation in the BEMP was the eco-upgrading of the participant's homes, the cost of which was covered by the LCCC grant. If other LCCs were to replicate this project, alternative approaches to funding the home upgrades would need to be considered.

7 External obstacles

- In common with other LCCs, SBL faced a range of ***external structural obstacles*** which were beyond its influence. Obstacles identified by the EVALOC LCCs include: inconsistent national government leadership and mixed messages about tackling climate change; failure to link the 'growth' and 'green' agendas at national level; difficulties in accessing grants and loans for energy efficiency measures; changes in the Feed-In Tariffs (FiTs); financial cuts and lack of revenue funding; withdrawal of statutory duties on local authorities; increased scepticism in part related to media coverage; the effects of austerity and recession on local people (e.g. reduced confidence to take on loans); lack of local infrastructure (e.g. recycling, trusted installers of low and zero carbon technologies).

8 Recommendations

Engagement and involvement

- **Leadership training:** Given the difficulty of obtaining funding for leadership and process roles, it would be good to consider how to integrate training for such roles as part of the learning and action group approach employed in the BEMP, for those who are interested in taking on leadership responsibilities. This is an area that the Low Carbon Communities Network is currently investigating (the Low Carbon Commons[1]). Funding and supporting those in leadership positions is an ongoing challenge for many LCCs; thus would benefit from discussions at a regional or national level.

- **Networking with other LCCs:** Whilst good networking with other local organisations and national LCCs was achieved by the CEO and project managers, some volunteers would have benefitted from attending other networking events such as Low Carbon Communities Network, or other local low carbon networking events. In future, it would be good to consider how to encourage interested volunteers to attend networking and skill-sharing events outside their community. However, whilst external networking can boost the confidence of volunteers, a balance needs to be struck between the internal group work of delivering projects, and networking externally with other groups.

- Given the skills and knowledge the volunteers acquired on the BEMP, it would be good to consider how to utilise these skills in other contexts (e.g. through other non-carbon specific networks that they may be involved with). However, it is recognised that this may be difficult to instigate without an ongoing energy and carbon reduction project.

Delivery and installation of fabric and technical measures

- Quick diagnostic tools such as thermal imaging should be used immediately post-installation of fabric measures, to ensure works have been completed to a satisfactory level.

Monitoring and evaluation of activities

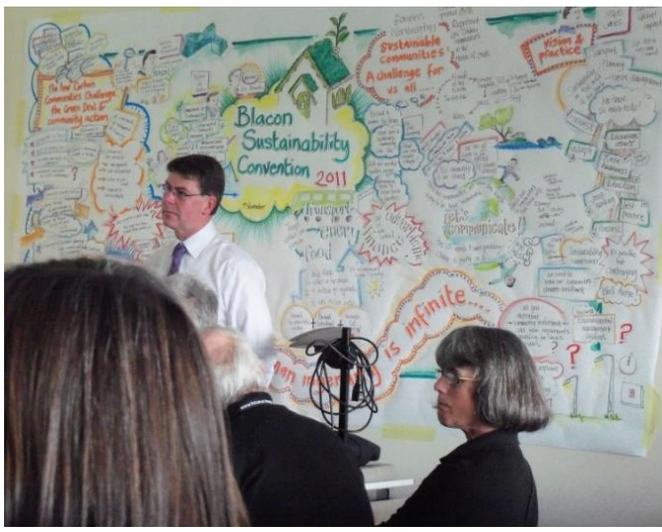
- A holistic approach is worth aiming for; e.g. a programme of annual thermal imaging surveys across the community in order to provide diagnostics on retrofitted cavity wall insulation can be linked to engagement activities and linked with consumption feedback programmes.

[1] http://www.lowcarboncommunities.org/developing-local-action-on-climate-change-meeting-may-15th/

Contents

EVALOC Research Project ii
Research Team ii
Acknowledgements iv
Case study low carbon communities v
International visiting researchers vi
Advisory board members vi
Glossary of terms vii
Summary of Findings and Recommendations ix
Chapter 1: Introduction 1
Chapter 2: Findings 5
2.1 Project design and change strategy 5
2.2 Community engagement 9
2.3 Community carbon reductions and energy savings 18
2.4 Case study households 22
Chapter 3: Reflections and policy implications 45
References 46
Appendices 47
Appendix A: Overall impact pathway and research framework 48
Appendix B: Research activities and survey techniques 49

Image: EVALOC team


Blacon
Sustainability
Convention 2011
Sustainable
Communities
A challenge for
us all
Vision &
practice
Transport
Energy
Food
is infinite

Chapter 1
Introduction

In recent years there has been increasing recognition of and research into the roles that Low Carbon Communities[1] (LCC) can play in reducing carbon emissions and influencing energy behaviours through local-level engagement and action (Seyfang, G. et al, 2013; Burchell, K et al, 2014).

This recognition is also reflected in UK Government strategy, such as the Low Carbon Transition Plan (DECC, 2009) and Community Energy Strategy (DECC, 2014a), and through test bed funding programmes (such as DECC's Low Carbon Communities Challenge (DECC, 2012)). However, there is less evidence about outcomes and impacts (DECC, 2013).

This report summarises the findings from the EVALOC research project (www.evaloc.org.uk) relating to the effectiveness and impacts of Sustainable Blacon Ltd (SBL), which aimed to generate a model sustainable urban community through reducing carbon emissions and promoting sustainable and healthy living.

Table 1.1 outlines the main community characteristics.

Figure 1.1. Physical location of Blacon, Chester.

"Blacon has always been a strong community you know there's several groups that deal with different parts of Blacon but when they get together they work well together"

Figure 1.2. Street view of Blacon, Image taken from GoogleMaps.

[1] For the purposes of the EVALOC research, the definition of Low Carbon Communities include community based organisations such as charities and social enterprises (which could be called Low Carbon Community Groups), Local Government, and local partnership organisations which promote low carbon and sustainable living.

Table 1.1. Main characteristics of the Blacon low carbon community

	Description
Location	North West England
Geographical Type	Suburban (Chester)
Socio-economic status	Disadvantaged. Approximately 2/5 of the area in top 10% of multiple deprivation index.
No. of households	5,600 households (16,000 residents)
Housing stock characteristics	Mixed (mainly post-1960s terraced/semi-detached)
Tenure characteristics	34% social housing
Local facilities	• Two shopping areas with library & post office • Five primary schools and one secondary school • Playing facilities • Social club and pubs • Dee Point community centre • Blacon Community Trust (BCT), and a range of other community development enterprises.
Transport links	Good road access and bus links to Chester city centre and surrounding area
Local low carbon context	Sustainable Blacon Ltd (SBL) is a community based company limited by guarantee, dedicated to promoting and developing Blacon as a model sustainable urban community
Low carbon community project	Sustainable Blacon Ltd
Stage of LCC development	Sustainable Blacon Ltd was established in 2008, thus was already in existence at the time of the LCCC funding. The Blacon Energy Management Programme (BEMP) was conceived for the LCCC funding, which fulfilled the energy part of Sustainable Blacon's work.
Vision	The aims of Sustainable Blacon Ltd were to achieve positive change in the following areas: • *Spaces:* improve Blacon's natural environment • *Transport:* Encourage and develop sustainable transport • *Energy:* implement effective energy efficiency and renewable energy technologies • *Enterprise:* stimulate local enterprise. The aim of the BEMP was to achieve 20% saving of energy bills for those involved in the project.
Main funding avenues	• DECC LCCC funding. • Department of Health funding for Save Money Keep Warm. • In kind support from University of Chester. • Support from 52 organisations for the eco- demonstration homes. • In kind funding from project workers and volunteers.
LCC characteristics	Subsidiary project of Blacon Community Trust, a company limited by guarantee a registered Charity.
Roles & responsibilities	• *Sustainable Blacon Ltd:* lead provider and organiser (physical and behaviour change measures) • *Blacon Community Trust:* Supporting role for Sustainable Blacon Ltd • *Cheshire West and Chester Council:* enabling role (provides finance, tenders for installers/contractors, and legal support and community engagement); Council's Affordable Warmth Steering Group bid for portfolio of projects of which Save Money Keep Warm was one. • *University of Chester:* Monitoring and evaluation of project, helping organise the Blacon Sustainability Convention • *Chester and District Housing Trust (CDHT):* undertook energy efficiency improvements in the 3 tower blocks in Blacon; helped SBL with the behaviour change eco- house. • *Residents and volunteers:* co-design projects and help engage other community members.
Core team members	• At the beginning of research (2011), the core staff of BCT and SB were paid.* • Voluntary participation of local resident in a range of activities, such as energy advice, and guiding visitors around the Eco-demonstration house. ** Note: during the course of the project, SB was not able to attract sufficient funding to retain core staff, thus is now run in a voluntary capacity.*

EVALOC research project

This study has been undertaken as part of the EVALOC (Evaluating the Impacts, Effectiveness and success of Low Carbon Communities on Localised Energy behaviours) research project. It seeks to assess, explain and communicate the impacts of six geographically and socio-economically diverse low carbon communities (LCCs): one in rural South Wales; one in North West England (suburban); one in Yorkshire and the Humber (urban); one in North East England (suburban); and two in South East England (rural and urban). The LCCs were chosen due to their involvement in the government funded Low Carbon Communities Challenge (LCCC) which ran from 2010 to 2012. Although the LCCC activities generally took place between 2010 and 2011, the baseline is taken as 2008 as in some of the case study communities, energy projects had already been undertaken.

The study adopted a collaborative action research approach (Figure 1.3), involving an iterative cycle of action and reflection in which communities are involved as co-researchers in shaping the design, implementation and interpretation of the research programme and its outputs, as well as being subjects of the research. As such the activities undertaken were not just used to conduct research but also to feedback findings to the LCC stakeholders as they became available, to shape future research.

The research was designed to provide in-depth insights into the effectiveness of LCC activities and processes, rather than statistically valid findings. It used a mixed-methods monitoring and evaluation, using qualitative and quantitative techniques, to assess the effectiveness and impacts of the case study community activities at both community and household level, as well as to explore some specific research questions relating to the role of social networks, community events and energy feedback in helping residents reduce energy use (refer to Appendix A for the overall impact pathway and research framework and Appendix B for an outline of research methods and sources).

In addition, EVALOC researchers supported two community events in Blacon (Case Study Box A) and two shared learning events.

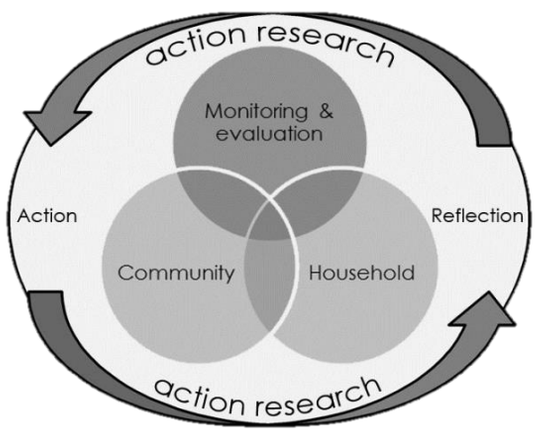


Figure 1.3. Overall research approach of EVALOC

CASE STUDY BOX A: Feedback event from Blacon Energy Management Project (BEMP)

January 9th 2012

Event type: knowledge & Information; Show & Tell; Interactive Learning

Event audience: those involved in the BEMP, University of Chester

Event Objectives: to hear and discuss the results from University of Chester's research into Blacon Energy Management Programme (BEMP), and develop the plans of the emerging volunteers.

Event Description: The first part of the evening consisted of an update on the developments within SBL, which included updates about the second eco-demonstration house, the recent Blacon Sustainability Convention; receiving the Big Society Award in November 2011, and research from other universities. Professor Roy Alexander, who has been leading the research on the BEMP project presented back the final results from the evaluation of the project. This entailed three surveys of the BEMP participants. There was brief discussion about the feedback and results.

The second part of the evening was led by EVALOC researchers, and aimed to reflect on some of the key messages and develop some communication materials for future usage by SB, a theme identified from the first focus group. In small groups, the participants discussed the following questions; *'What's the best thing about your home makeover?' and 'If you had one 'energy top tip' to tell other people in Blacon, what would it be?'.* They designed posters, either to encourage the use of energy displays / energy monitoring, or to promote behaviour change to reduce energy consumption. The posters were briefly shared at the event.

The interactive exercises generated a lot of energy from the participants, the camaraderie that had been built up through participation in the BEMP was evident.

What participants learnt: Focused around the feedback information from the University of Chester. The interactive exercises in the second half were an opportunity for participants to share what they had learnt, and be creative with their ideas.

Attendees: 32 BEMP participants attended the event, around 24 participated in the exercises afterwards.

Chapter 2
Findings

2.1 Project design and change strategy

Initiated in 2008, Sustainable Blacon Ltd's overall strategy had four streams of activity: *Energy, Transport, Spaces and Enterprise*.

In 2009, Sustainable Blacon Ltd (SBL) was awarded £393,311 as part of the Department of Energy and Climate Change's (DECC) Low Carbon Communities Challenge (LCCC) funding. With the funding they implemented two streams of energy activities which aimed to show how simple changes can reduce energy use and damage to the environment; two eco-demonstration homes and the Blacon Energy Management Programme.

Eco-demonstration homes

The first (the Behaviour Change house) was open from September 2010 until August 2011 and the second (the Eco-Demonstration house) was open from August 2011 until January 2013. They provided information to residents, developers, landlords and schoolchildren on how to save energy, reduce fuel bills and have warmer homes.

The eco-demonstration houses complemented the Blacon Energy Management Programme (BEMP), and provided additional outreach and engagement avenues for SBL. BEMP participants learnt about energy efficiency in situ, and many became volunteers to show other visitors or groups around the demonstration homes.

Further detail on the impact of the eco-demonstration homes is given in further sections, and Case Study Box B.

Blacon Energy Management Programme (BEMP)

The BEMP ran from May 2010 to April 2011. The BEMP was designed to engage residents in saving energy use in the home, with the main incentive of saving money through energy efficiency. The aims of the BEMP were:

- To explore changes in household energy use and behaviour in response to a community intervention programme,
- To examine the impact of the programme on broader sustainable behaviours and quality of life.

Residents were attracted into the BEMP with an incentive of up to £2,000 worth of energy efficiency home improvements, and the amount they were given was based on the amount they participated in meetings, meter readings and research. The BEMP involved a mixture of awareness raising and behaviour change, combined into a programme of events and feedback. The project design involved recruiting over 150 participants, who were organised into 3 groups of 50 people each; an active group (who received an Alert Me Monitors[1]), a passive group (received a Wattson monitor[2]) and a control group (who didn't have a monitor).

Participation in the BEMP involved:

1) **Collecting energy monitoring data**: All participants were encouraged to take monthly meter readings, feedback the energy monitor data and participate in research conducted by the University of Chester

2) **Attending eight community events which covered a range of environmental topics**: All participants were encouraged to attend a series of meetings, to learn from experts and each other about energy, climate change, and a variety of other environmental issues which were determined by the group (such as water saving, food, recycling).

3) **Participating in research from University of Chester**: The University of Chester undertook monitoring and evaluation research during the BEMP.

Participating households received an initial energy assessment, and were given guidance in choosing their energy makeover components after the BEMP was completed. Their home makeover consisted of energy efficiency upgrades to their homes, ranging from approximately £200 (e.g. insulation, or a new fridge) to £2,000 (e.g. some solid wall insulation). In total, 459 measures were installed, including energy efficient lighting and appliances, energy display monitors, power-down plugs, radiator reflector panels, draught-proofing, hot water pipe insulation, double glazing, improved heating controls (TRVs and room thermostats), new boilers, loft and wall insulation (cavity and solid) as well as contributions

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[1] Alert Me: A wifi based system which allowed homeowners to adjust their rate of temperature and switch on and off electrical appliances and identify temperature levels and energy consumption through sensors installed by the SBL team.

[2] The Wattson: DIYKyoto's display system. Connected wirelessly to the electricity supply, allows the real-time display of electricity usage (e.g. in a kitchen) as a means of informing the resident so as to promote energy awareness and reduction behaviour.

to solar thermal panel and solar photovoltaic (PV) systems.

Case Study Box A provides detail on the feedback from the BEMP.

Roles and capabilities

Sustainable Blacon Ltd carried out a wide range of roles and activities in addition to the BEMP and eco-demonstration homes. At downstream level, SBL's projects addressed economic and technical influences on energy use, whilst at midstream level they worked in effective partnerships to deliver specific projects, such as the Save Money Keep Warm project focused on fuel poverty, and disseminated their findings to other organisations. These are shown in Table 2.1.

Building on local knowledge and experience of working in the Blacon area, SBL was relatively confident about their capacity to engage and motivate people, empower people and achieve sustained pro-environmental behaviour changes. This is evidenced in the University of Chester evaluation reports (Alexander and Hunt 2012) and in the EVALOC research.

SBL were less confident about their capacity to encourage the adoption of low-zero carbon technologies (LZTs) and address structural constraints. This did not present them with problems however, as they chose to focus on accessible, cost saving, or minimal cost behaviour change activities for the BEMP project. SBL considered that the wider-scale adoption of LZTs such as solar PV and solar thermal was beyond the financial capacity of most residents

Sustainable Blacon Ltd involved a wide range or local partners, brought in advice and expertise from other organisations, local government and individuals. The partnership with the University of Chester was an important part of BEMP, particularly the monitoring and evaluation, and the support received for the Blacon Sustainability Convention. Other organisations contributed to the BEMP through running workshops and information sessions for participants; and through businesses donating items to the eco-demonstration houses.

They also received support from the local authority (Cheshire West and Chester Council), with one local authority (LA) officer being part of SBL's board. However, despite supportive council officers, the research was carried out at a time of reduced budget for Local Government, so there was insufficient financial capacity within the council, as SBL's project officer mentioned in 2012, during the third EVALOC focus group;

'*The local authority here was massively supportive, … they had their heads completely switched on in the right direction but they couldn't … find money from anywhere…but strategically they were brilliant and they were just a very supportive group of people … primarily the private sector housing and the climate change manager*.'

SBL initiated and delivered the Save Money Keep Warm (SMKW) project, which followed on from the BEMP, and involved BEMP participants as volunteers, utilising their skills and knowledge gained on the BEMP. SMKW was part of a portfolio of projects generated through local partnerships, spearheaded by Cheshire West and Chester Council, and funded by the Department of Health.

Overall, participants in the second focus group reflected that a more joined up strategy was needed between local authority, medical services and the community sector to deliver services, as they were aware of people who were slipping through the net particularly with regard to fuel poverty. For example, participants in the second focus group noted that there was missed opportunity to communicate behaviour change to residents of the refurbished tower blocks, with an assumption by other organisations that this would be done by SBL. However, SBL was unable to do this as it didn't have the staff capacity at the time.

Sustainability and capacity of the group

SBL's organisational model was based on paid staff (CEO and project co-ordinators) to run the projects, and encouraged and managed a large amount of voluntary involvement. This model allowed flexibility to determine their project focus, but relied on external funding for the CEO or project co-ordinators. This made it vulnerable to funding shortfalls, which SBL, alongside other LCCs, experienced during the course of EVALOC research.

Drawing on research conducted at the EVALOC focus groups, leadership was recognised as crucial to the successful implementation of the BEMP and other SBL projects. SBL achieved a high level of voluntary activity, which ranged from a volunteer contributing a couple of hours a week, to one volunteer effectively worked full time for six months. Despite this, paid staff were essential to co-ordinate activities, manage volunteers, and provide momentum. However, even these staff effectively gave additional hours voluntarily, as the former CEO mentioned:

'I calculated once that if I was supposed to work thirty-seven hours a week I'd worked three months of that for free and there's no opportunity to take that back but that reflects the commitment I think, I couldn't have done that nor would I have done that if

the community wasn't there and interest in it behind it.'

When considering the amount of time put into delivering the LCCC project, the former CEO reflected that Sustainable Blacon Ltd '*had its own needs as an organisation to … diversify and yet we were focused on delivering the programme particularly after the twelve months project came to an end and there was still the energy retrofit to do which took an awful lot of time so at a time I guess when we should have been focusing on other things it took an enormous amount of energy to deliver [the LCCC project]'.*

EVALOC research shows that other LCCC projects also experienced a significant time requirement to complete the project, which diverted time away from their other activities and projects.

Despite applying and being shortlisted for new grants, only the Save Money Keep Warm applications were successful. Due to the funding shortfalls, the CEO left SBL in 2012. One paid member of staff implemented these projects (which involved many BEMP participants in a voluntary capacity), but there was no capacity for them to support additional strands of SBL's work. Additionally, the short time frame of the SMKW budget did not aid the sustainability of the group;

'The Save Money Keep Warm project … it was one of these things where the money appeared barely in time, you had to bid for it and then start almost instantly.'

SBL was a project of the Blacon Community Trust (BCT), which itself experienced budget and staffing cuts during the research period. Many of the community development roles which BCT used to perform were taken over by a new organisation (Avenue Services), which resulted in redundancies in BCT in 2012. This meant that it could not financially support SBL's work. This is in contrast to partnership (e.g. Eco Easterside / Middlesbrough Environment City) and community-led (such as Low Carbon West Oxford) LCCs involved with the EVALOC project, whose organisational models proved more resilient to financial shortfalls.

SBL's funding and organisational model of reliance on external grant funding could be contrasted to another LCC involved in EVALOC research, Eco Easterside. It was a project of the Middlesbrough Environment City partnership, which had existed for around 20 years. Through its portfolio of projects and track record, it has been successful in securing additional funding from a variety of sources, and was able to provide contingency funding to enable retention of key project staff.

Reflection

In Blacon, process roles such as project leadership, managing and sustaining volunteers, diversifying outreach and participation, future planning and fundraising, were essential to build on the success of the BEMP, access further funding and build on the skills and knowledge of volunteers. However, it proved extremely difficult to attract funding for these types of roles. Whilst Local Government was able to help, it also suffered budget cuts. Sustaining and building on the social capital (e.g. knowledge of local networks and about energy issues) generated by projects such as the BEMP remains a challenge.

Table 2.1. Sustainable Blacon Ltd's roles, activities and funding sources.

Role	***LCC activities***	***Additional support/funding***		
		DECC-funded activities	*EVALOC supported activities*	*Other funding sources*
Downstream – with residents in the community				
Community engagement	Leaflet drops and engagement with existing local community networks and groups	✓*		✓
	Two eco-demonstration homes – visits from schools and other local groups.	✓		✓
	Information and action meetings as part of the BEMP	✓		✓
	Up until 2012, SBL had helped over 800 households become more energy efficient.	✓*		✓
	Active involvement in caring for the Blacon Greenway, which is part of Sustrans National Cycle Network Route 5.			✓
	Dr Bike surgeries and bicycle recycling			✓
Installation of Low-zero Carbon Technologies (LZTs) & physical measures (household level)	Installation of insulation and energy efficiency appliances in BEMP homes	✓		✓
Behaviour change (household level)	Home energy checks (provided by Energy Saving Trust)			✓
	Thermal imaging surveys			✓
	Energy saving advice	✓*		✓
	Practical home support (reading meters, clearing loft space, installing energy display monitors, simple energy DiY)			✓
	Participation in the Blacon Energy Management Programme	✓		✓
Midstream - with other actors at local level to provide infrastructure and services				
Partnership / Joint working	Development of Save Money Keep Warm programmes, which involved input from Penny Smart, partnerships between health and public sector organisations			✓
Catalysing action by other local actors	SBL has influenced residential development projects in the area – e.g. Energy efficiency improvements in the 3 Chester and District Housing Trust tower blocks			✓
Dissemination	Blacon Sustainability Convention (Nov 2011) involved 150 participants from local organisations, Low Carbon Communities, local government, and academic researchers.	✓		✓
Upstream- with government or national level interest groups to provide supportive policy environment and address structural barriers				
Dialogue/lobby	Representatives from DCLG and Baroness Worthington attended the Blacon Sustainability Convention in November 2011.			✓
Other	Recipient of Big Society Award, and Waterwise award for encouraging water and energy saving.			✓

Table 2.1. cont. Sustainable Blacon Ltd's roles, activities and funding sources.

Role	***LCC activities***	***Additional support/funding***		
		DECC-funded activities	*EVALOC supported activities*	*Other funding sources*
Cross Cutting Activities				
Group processes	Project management			✓
Monitoring, learning and evaluation	University of Chester involved in evaluation of the BEMP	✓		✓
	DECC LCCC evaluation	✓		
	Links with universities to evaluate different aspects of BEMP: • EVALOC • University of Strathclyde (AlertMe / metering) • University of East Anglia (Richard Huxworth-Baldwin's PhD research) • University of Southampton (pilot interviewing)		✓	✓

Note:-

** - Activity was in part funded by DECC LCCC, but also received funding from other sources.*

2.2 Community engagement

In this section the extent to which Sustainable Blacon Ltd (SBL) has motivated and engaged residents to get involved in their projects, is assessed. In later sections the effectiveness and impacts of SBL's projects in terms of helping residents actually change their household energy behaviours and reduce their energy use, as well as wider impacts, are assessed.

Numbers Engaged

As outlined in Table 2.1 above, SBL used a range of methods to motivate and engage the community to get involved in its sustainability and health living projects. Table 2.2 shows that SBL was successful in raising awareness about the BEMP through a variety of channels, and in engaging a proportion of the community in energy projects, through the BEMP and visits to the Eco demonstration homes.

Accessibility and relevance of project design

Given the demographics of the area, the BEMP recruitment focused on the money saving aspects of energy saving. This focus seemed apt, as all respondents from the case study households agreed, with the majority strongly agreeing, that SBL's projects were relevant and accessible to them (see Figure 2.1).

The findings from the University of Chester report (Alexander and Hunt, 2010) demonstrated that BEMP participants covered a range of tenures, with the majority being owner occupiers, but over 30 that rented either privately or from a housing association (Alexander and Hunt, 2010). Over half of the initial participants fitted the definition of fuel poverty, spending over 10% of their income on fuel bills (Alexander and Hunt 2010). The follow up report (University of Chester 2013) indicated that only 15% of participants who were involved spent more than 10% of their income on energy, although the sample size for the follow up research was smaller.

Drawing on the household interviews conducted with 13 interviewees who participated in the BEMP, all respondents tended to, or strongly agreed, that SBL's projects were helping people like them to reduce energy consumption. The majority (12 out of 13) of the respondents agreed or strongly agreed that SB's projects are helping people like them to reduce their bills, and is encouraging the wider community to reduce energy consumption. This is illustrated by;

"V*ery good, very good because everybody discussed all sorts of different things that we were doing and the whys and wherefores and some people would come up with maybe a better idea of doing things. … There's a lot of things I've done me-self you know just get on and done them."*

*A*nd;

Table 2.2. Sustainable Blacon Ltd's engagement activities and numbers engaged.

Activity	***Numbers of people reached/engaged***
General engagement	
Recruitment for BEMP	All the Blacon residents received leaflets and information about BEMP participation prior to the commencement of the project, and leaflets were distributed through all schools and the main shopping areas. Also through adverts in the local paper, and through all the existing voluntary networks such as the walking group, local church, residents associations, One Voice for Blacon, Vintage Blacon, and many others.
Blacon Sustainability Convention	150 attendees, from Blacon and other LCCs.
Eco houses	The two houses had over 1,300 visitors.
Community events	
EVALOC supported energy related events	30 participants of the BEMP in January 2012, and around 10 volunteers involved in the Eco-house reflection in December 2012.
Sustainable Blacon presence at general community events	Stall at Chester Green Day, June 2012 Blacon Festival stall in July 2012 – sold 38 bikes
Household energy improvement projects	
DECC funded	Blacon Energy Management Project, 150 participants
Other funding	Save Money Keep Warm 1 (Dec 2011 – March 2012). Targeted those most at risk from ill health due to fuel poverty. 42 vulnerable households were visited and energy efficiency measures installed. 15 visitors to the Eco-house.
Other funding	Save Money Keep Warm 2 (Nov 2012 – May 2013). 98 residents were visited, installed draught-proofing and delivered energy advice, advice around Warm Home Discount, Priority Services Register, national grant schemes
Other sustainable living projects	
Other funding	In kind funding from volunteers involved in BEMP and Save Money Keep warm.

"Yes it definitely made me think … and as I say run round after visitors turning taps off and turning lights off."

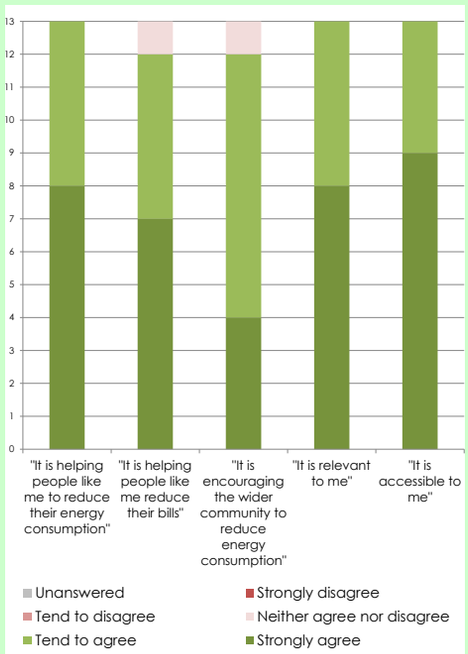


Figure 2.1. Accessibility & relevance of LCC to individuals and wider community

Involvement of the wider community

Whilst there was a lot of activity in Blacon, some interviewees mentioned that it was hard to get people out to meetings generally. Members of the focus group mentioned they were part of other networks, where issues relating to household energy use had been discussed either formally or informally.

Recruitment was achieved by contacting all the existing groups in Blacon, with one participant in the first EVALOC focus group recognising that "*although some folk here would have known each other…they didn't have that environmental…or energy related context that the project brought, and basically it brought loads of different people who were interested in in some similar [issues] but had never had this conversation."*

SBL were successful in achieving wide awareness about the BEMP, which was further spread by participants discussing aspects of the programme with those who did not attend (*for further discussion of this see section on Social Network Analysis*).

Motivations for involvement in the BEMP ranged from getting to know more people who shared environmental interests, those who wanted to feel more part of the community, as one case study household stated; "*I think we might have had a leaflet through the door not long after we moved, I think it was something like that"*; to the incentives offered as part of the BEMP, for example: *"I think we went there to learn about how to reduce things, how to reduce what you used. The freebies helped but I think you'd have still done it without that. RM - We would have done it without that but the freebies were nice, were the icing on the cake."* The sliding scale of incentives appears to have helped ensure the longevity of engagement in the BEMP.

Other routes to the BEMP were through other streams of SBL, such as the Green spaces project: "*And some people got into sustainability through Green Space projects or … through recycling."* (Chief Executive Officer of Sustainable Blacon Ltd, FG3)

The meetings for the BEMP participants were organised to enable people to participate in different parts of Blacon, and arranged in the morning, afternoon and evening to fit with a variety of participant's schedules, which worked well; *"They structured it well so there was meetings in the afternoon for those that couldn't meet so they had evening meetings as well."*

The meetings appeared to have worked well and been valuable for those who attended them, for example;

> *"They were very good…we attended meetings and we had people come to you know to talk, give us talks about what you could do, what you know some hints, energy saving factsheets you know it was very good…I think a lot of people did take on board what they were saying and there was a lot of useful hints."*

Obstacles to wider community engagement

However, for those not involved with the BEMP, attending meetings was either not possible for practical reasons, as shown in responses from the case study households; "*It's not that I don't want to it's just that it's not practical for me"*; or due to not liking attending meetings, for example; "*she'd have got involved with Sustainable Blacon till she realised it was meetings, she won't go to meetings."*

This demonstrates the importance of having a variety of avenues of involvement which aren't predicated on attending meetings. For example, encouraging visits to the Eco-demonstration homes, and providing bespoke advice and practical support in participant's homes, which was provided in the BEMP and further used in the Save Money Keep Warm project.

However, even if people weren't directly involved in the BEMP, many participants had mentioned that their involvement has had an influence on people with whom they see regularly, such as family members or work colleagues (*see section on Social Network Analysis*). Tours of the Eco-demonstration homes allowed wider groups, such as school children, to be engaged with energy efficiency and the work of SBL.

The need for continued funding was mentioned as an obstacle to wider engagement, simply through the recognition that paid coordinators were needed to develop and run SBL, obtain project funding, and ensure SBL's continuity. The main obstacles to wider engagement was that SBL didn't have capacity to engage people above and beyond the BEMP , Save Money Keep Warm, and a number of specific community focused events such as the Blacon Festival. One interviewee reflected;

"I don't know quite how they could do it other than going door knocking which the majority of people would say no thank you, not interested and just shut the door anyway. I mean they had their stall at the Blacon Festival didn't they, that tends to attract quite a bit of interest and I think what they are actually doing at the moment is probably the most effective way of doing it, they're having schools coming into the eco house or they're going out to schools and they're teaching the children and I think that's by far the better starting point."

Another mentioned that whilst there were ample opportunities to engage with SBL, some people just didn't want to get involved;

"It's not for the lack of the Sustainable Blacon advertising it because we've got a house that everybody can pass and go in and have a look but I just think it's I don't know whether it's an age thing or whether it's what would you say it's you know people an education thing."

This sense of frustration was experienced in other LCCs participating in EVALOC, and is common in many low carbon groups.

Energy messages

People are more likely to get involved in a project if they feel that the issue is relevant and salient to their lives. SBL's energy messages were initially focused on the saving money aspect, which did encourage some participants to get involved, such as;

"So I thought well if it saves us money we'll have a go. So we went to a meeting and went from there."

However, others noted that they had prior interest, but that incentives helped;

"…so it's certainly not about the money but the incentives have really sort of helped us along."

It is clear from the interviews that whilst the money saving aspect and incentives were important, the social aspect of meeting others was also important. As the first focus group revealed, despite engagement which focused on money saving, participants gained an environmental perspective and practices from the BEMP, which was not necessarily linked to an environmental identity. The majority of respondents (89%, or 17 out of 19) were fairly, or very, concerned about rising energy prices and fuel bills, which would be expected given the demographics. Alongside this concern, the majority (79%, or 15 out of 19) also had relatively high levels of concern about climate change (see Figure 2.2), illustrating that the BEMP was able to accommodate concerns about money alongside wider concerns.

Social networks and social norms

There was a slight increase, (from two to three out of 12 case study households involved in SBL activities and interviewed in 2012 and 2014; Figure 2.3) who agreed that in their area, trying to reduce your energy use (or carbon footprint) is the 'normal' thing to do', matched by a drop in one of those who tended to disagree or strongly disagreed. [Note: Small sample]. One interviewee reflected on whether reducing energy is the normal thing to do;

"I think not because of choice, it's more that they're being forced to do it I think but I think it's not high on their agenda probably for most people."

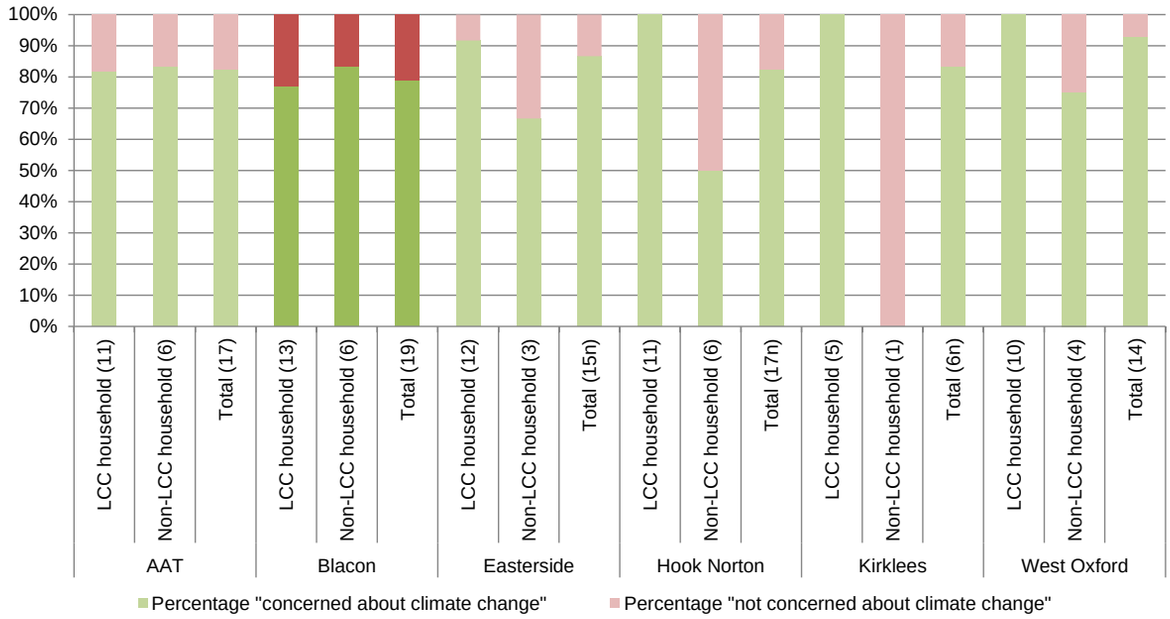


Figure 2.2. Responses from EVALOC case study households in relation to question, 'How concerned, if at all, are you about global warming/climate change.

Informal social networks influence how know-how about energy is transmitted through the community. LCCs can make use of, or shape, these networks to encourage people to get involved in energy projects and reduce energy use.

The EVALOC Social Network Analysis (SNA) conducted with 19 of the household interviewees showed three key learning points:

1. Most of the interviewees (17 out of 19) had recently discussed energy in some form with people they considered very close or somewhat close to them. Of the two who hadn't discussed energy, one mentioned that they did discuss the content of the BEMP with people whilst the project was running; "*When we were on the project people would ask about it but it's sort of drifted away on the horizon*…", and another mentioned that although they discuss energy prices rises, "*apart from that no it [energy] doesn't get discussed*'."

2. The most discussed energy topics in the case study households in Blacon are general efficiency, the BEMP programme, and energy prices (see Figure 2.4).

3. The majority of respondents disseminated their energy knowledge to their personal social networks. The proportion of those they gave advice to is about the same for those who are considered 'very close' (37%) and 'somewhat close' (38%).

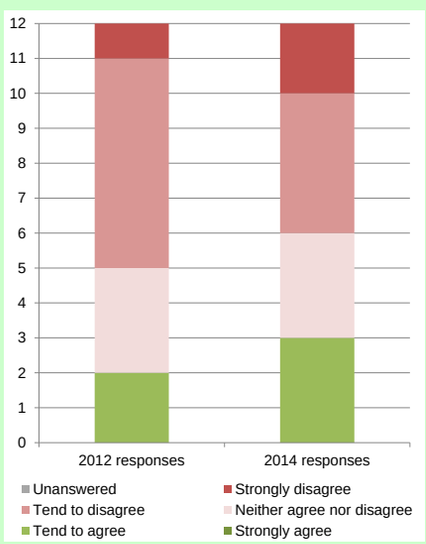


Figure 2.3. Comparative responses from EVALOC case study households (in 2012 and 2014) in relation to the question, 'In my area, trying to reduce your energy use (or carbon footprint) is the 'normal' thing to do'

Whilst the content of discussions around energy is pertinent, a common theme emerging from the interviews and the social network analysis is how important the BEMP meetings were a) in increasing a sense of community locally; and b) in creating a community of interest of those interested in energy, which could reinforce motivations and intentions to take action.

Examples of increasing the sense of community are evident in the following three aspects:

1. The community cohesion created by the BEMP;

"…because it's got people together from all parts of Blacon because it's such a big area you know and if you're not careful it's you know this particular side of what used to be the railway line and that side and it has brought people from all aspects and all walks of life together.";

And;

"I don't know their names I know them by sight now you know so it's made us you know people, more people talk to us and things like that so we are part, we feel that we are part of the community."

2. Participants discovering other parts of the community: Involvement in the BEMP not only increased a sense of community, but helped to create the bridging ties between different social groups, as illustrated by the following quote;

"So anything that would help us to save money is going to be a good idea but it was also partially the social side to get to know other people and potentially then find out of other things that are going on in the community."

Additionally, others had gone on to get involved in other activities organised by SBL;

"*I'd say I've got a sense of belonging to the community more through having been to this survey and now doing this voluntary litter pick … it's amazing how many people …[say] when you're litter picking sometimes, you're doing a good job there, thanks very much."*

3. Providing an introductory gateway for those recently arrived in Blacon;

"*…basically it was in the hope of meeting because we hadn't moved up here long it was basically in the hope of meeting people in the area … rather than come and move in and just be isolated it was really a way of getting to know people."*

Dissemination

The Blacon Sustainability Convention was an important part of the dissemination activities, involving the management and BEMP participants, and the University of Chester who hosted the event. Aside from this, dissemination to other organisations (include LCCs across the UK) was mainly performed by project co-ordinators and managers, but many volunteers involved at a local level were not engaged in this aspect.

Volunteers from SBL were involved in two EVALOC shared learning events in 2013; the 'carbon reduction in communities of disadvantage' and 'creativity and climate change' events. Reflecting on these events demonstrates the value of encouraging volunteers to attend more national events, as one BEMP participant mentioned;

"I*t was a privilege to come to the event and share our thoughts…and to feel I was valued and had something to contribute*."

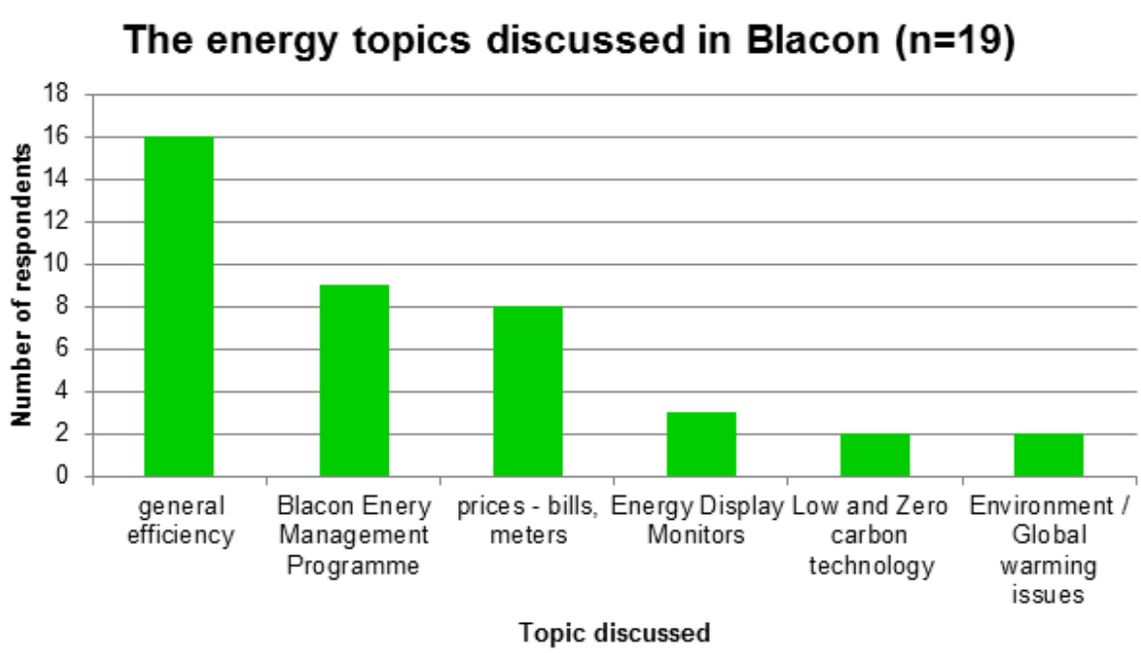


Figure 2.4. Energy topics discussed in EVALOC case study households.

Eco-demonstration houses

As part of the DECC funding, two Eco-demonstration homes were equipped with low carbon appliances and technologies to show residents how they can cut household energy consumption and CO2 emissions and demonstrating this with practical support.

The two demonstration homes were:

1) **The 'behaviour change home'** at 78 Dyserth Road, Blacon (Figures 2.5 and 2.6). This showcased low cost approaches to energy saving, emphasised behaviour change, and was open for 12 months through a lease from the local housing association.

2) **The 'eco-renovation home'** at 2, Stamford Road, Blacon (Figures 2.7 and 2.8). This showcased higher cost processes, such as solid wall insulation, solar thermal panels for hot water, grey water recycling, alongside behaviour change approaches and a garden.

Both homes were staffed by volunteers, and attracted over 1,300 visitors during the time they were open. There were fixed opening times for drop in visits. Additionally, group visits were accommodated from local schools, the Women's Institute and local council departments.

In addition to the visitors to the houses, the eco-houses generated further awareness about SBL's work. The 'eco-renovation' home in particular generated a visual awareness of the solar thermal panel, as it was situated on a prominent position near one of the main shopping areas, and by a main bus route.

Research was conducted with volunteers and visitors to the eco-demonstration homes to consolidate and reflect on the experiences and learning (see Case Study Box B). *A separate report is available on the EVALOC website.*

The most useful things learnt at the houses:

Most respondents to the survey mentioned the demonstration of specific elements, such as '*the importance of draught-proofing'*, '*how to save water by putting a 'hippo' in the system'*, '*loved seeing what can be done with recycled materia*ls', and '*the Veissman boiler'*.

In addition, the feedback session with the volunteers and those involved with the BEMP gave a good indication of the interests of the visitors:

- The reflective radiator panels – visitors reported using these having seen them on display.

Figure 2.5. The behaviour change house, 78 Dyserth Road

Figure 2.6. Example of display in the kitchen

Figure 2.7. Eco-renovation house, 2 Stamford Road

Figure 2.8. Example of the living room

- Loft insulation – useful to know the depth required.
- Wall insulation – cutaway section demonstrated the insulation in situ.
- Light bulbs – demonstrated the LEDS, showed that other light bulbs are available apart from the free CFLs.
- Kitchen – demonstrated the importance of fridge settings, and the costs of energy.
- Wattson (Energy display monitor) – demonstrated the energy requirements of boiling water in the kettle.
- Information displayed in the bathroom.
- Cycle routes.

How visitors learnt:

Visitors to the eco-demonstration homes learnt about energy in a variety of ways. 11 of the 13 survey respondents mentioned the importance of talking with a volunteer or having a tour of the premises. Six mentioned an aspect of the displays, such as '*listening to a talk / and seeing the draught proofing there'.*

Motivations and actions resulting from the visit to the eco-house:

11 of the 13 survey respondents said that they felt more motivated to save energy in the home from visiting the eco-house. 11 respondents mentioned specific actions, such as '*installed cavity wall and loft insulation'*, '*fitted a few more low energy lamps*', and *'got a Veissman boiler fitted'.*

Different group visits were successful when they occurred, with groups such as the Local Authority, Women's Institute and schools visiting the eco-house. School visits were successful and generated a lot of interest from the children, however the project leaders mentioned that it was difficult to attract a large number of schools to visit. This is partly due to the workload of the teachers and the fullness of a school day, and partly to the need for the eco-house to charge visitors to get an income stream which was difficult in the economic climate.

A case study household that hadn't been involved in the BEMP mentioned that the eco-house and those involved in it increased the visibility and accessibility of SBL as an accessible resource for energy information;

"…*yes she's the lady that's involved in the eco house...I'd go to her yes, yes I would because she knows all about it so I'd go and say you know well look you know how do I conserve more energy because she's very much involved in it*."

CASE STUDY BOX B: Eco Demonstration Home Feedback Event

December 2012

Event type: Shared Learning (Group Development)

Event audience: those involved in the Eco-demonstration homes.

Event Objectives: to consolidate the learning and experience from SBL's eco demonstration homes.

Event Description: The event took the form of a facilitated workshop, to elicit the experiences of those involved in the eco- demonstration homes. These homes had energy saving and low carbon technology, approaches and information on permanent display, and were part of the DECC funded BEMP project. Complementary research was done through conducting a survey from December 3rd -20th 2012. An email request was sent to 60 people who had visited the Eco-house and SBL had contacts for.

"You get to be known that's the lady that shows us around the house, well it's the lady that's taught us this and things like that so people know you and the children are taking it in and they're actually doing projects at school based around energy saving and also about recycling.". Volunteer at the Eco-house

Attendees: 10 participants from the BEMP project, plus the current SBL co-ordinator. Most of the attendees were volunteers in some capacity, so had shown groups or individuals around both eco-houses.

Feedback forms: EVALOC also conducted a survey from December 3rd until December 20th 2012. An email request was sent to 60 people who had visited the Eco-house and SBL had contacts for. 13 people responded to the survey, which included two volunteers.

2.3 Community carbon reductions and energy savings

In order to assess the effectiveness of the SBL's activities on the carbon emissions and energy use of the wider local area, and its impacts on individual households, a graduated approach was undertaken (Figure 2.9):

- The wider local area level (approx. 5,590 households)
- Local neighbourhood level (373households)
- Individual household level (19 households)

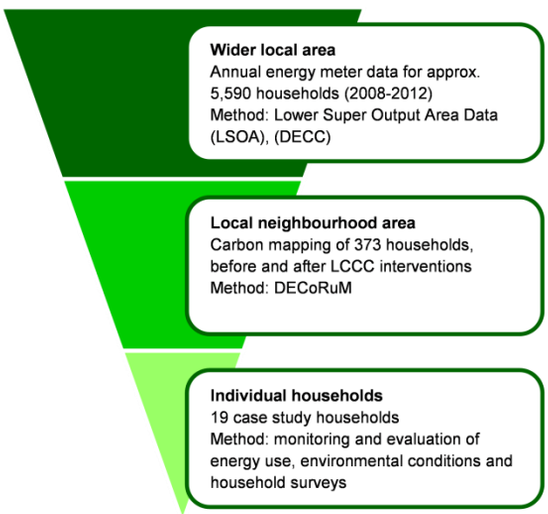


Figure 2.9. Graduated approach to assessing the changes in household energy use

Wider local area energy and carbon reductions

Whilst it is not possible to directly relate changes in the domestic energy use and carbon emissions of the wider local area to LCC activities due to the many factors affecting household energy use, the longitudinal Lower Super Output Area (LSOA)[3] data provide an overview of energy trends and possible 'ripple' effects of the LCC projects across the wider local area. It must be noted that the baseline of 2008 was at a time of national socio-economic change, with the financial crisis and subsequent recession known to have had a significant influence on household expenditure, and thus energy use. In addition, LSOA data can provide useful area-based energy data (particularly when combined with dwelling and household data) that can enable LCCs to target their activities and focus to best suit the local context. The area covered by the LSOA data is shown in Figure 2.10.

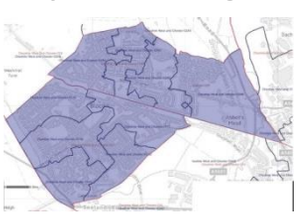


Figure 2.10. Highlighted area covered by LSOA data

The wider local area energy data (Figure 2.11) indicate that there have been reductions in overall average household energy use in Blacon (whether or not they directly benefitted from the LCCC activities), particularly in terms of gas use (highlighted by the reduction trend continuing, despite increases in heating degree days (HDD)[4]):

- Annual average household baseline (2008) gas and electricity use in the Blacon community was lower than national average (13,613kWh in gas, 3,765kWh in electricity compared to national mean average of 16,906kWh in gas and 4,198kWh in electricity).
- Percentage reductions in Blacon's annual average household metered electricity use of 4% was the same as the national average over the five year period (2008-2012).
- Percentage reductions in annual average gas use were much higher than national average; 21% to 17%.
- Overall reductions in average household carbon emissions (from gas and electricity use only) of 14% from 2008 to 2012 (UK national average was a 12% reduction).

The fact that the average baseline household gas and electricity use in Blacon are both lower than the national average figures indicates that there are very positive energy reduction trends in the local area, as the households were already starting at a lower point, and therefore theoretically their potential for further reductions was more limited. As previously stated, although it is not possible to directly relate changes in energy use to LCC activities, it is worth noting that the focus of SBL's activities was on demand reduction through behaviour change and physical interventions such as new heating systems, loft and cavity wall insulation (i.e. focused on reducing gas use). In addition, there have been co-ordinated efforts in terms of increasing the energy

[3] The data analysed are from the publicly available Lower Layer Super Output Areas (LSOAs). These provide boundaries for the collection and publication of small area statistics. LSOAs were first used in 2001 and have roughly 1,500 resident and 650 households within them. The data (annual gas use data from 1st October to 30th September and annual electricity use data from 27th January to 26th January) is based on meter point data, provided by Xoserve and independent gas transporters.

[4] Heating Degree Days are indicative of the number of days in a year that the temperature drops below 15.5°C, and therefore are more likely to require additional heating in homes.

efficiency of the dwellings in the area through national Government schemes such as Warm Front, CERT (Carbon Emissions Reduction Target) and ECO (Energy Company Obligation), which target areas of deprivation and relatively 'simple', low-cost fabric measures such as loft and cavity wall insulation.

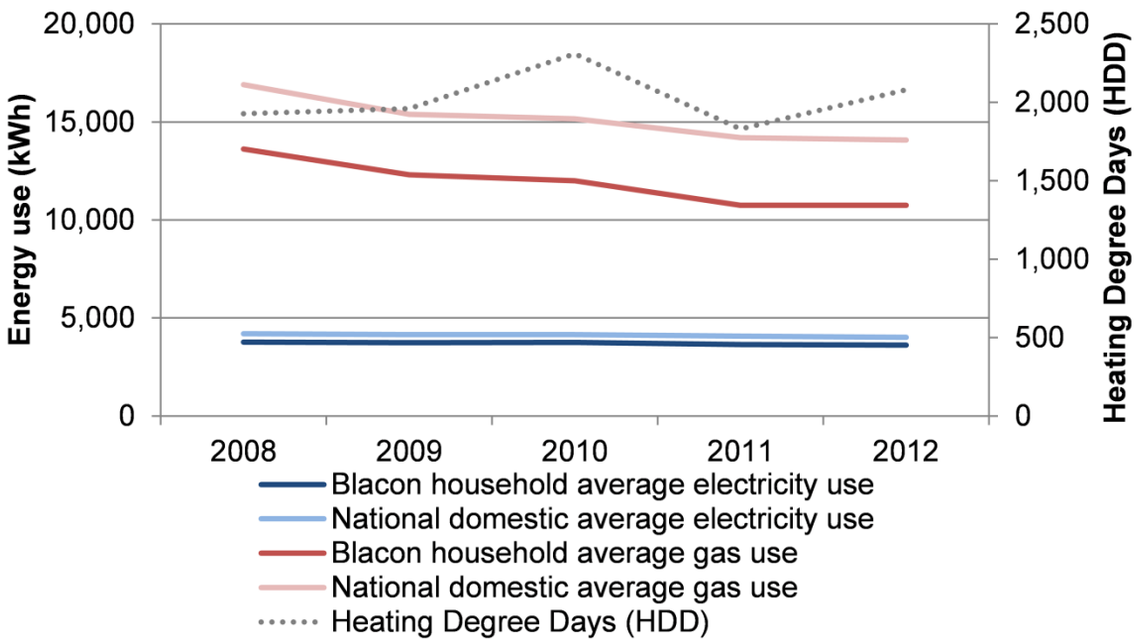


Figure 2.11. Average household annual gas and electricity use for the wider local Blacon area in relation to national averages

Local neighbourhood energy and carbon reductions

Figure 2.12. Area modelled in DECoRuM and carbon mapped

Carbon mapping was used to both assess the changes in household energy use and carbon emissions, before and after the DECC funded Low Carbon Communities Challenge (LCCC) interventions, as well as provide recommendations for further physical improvement packages for the mapped homes at a neighbourhood level. Figure 2.12 shows the area in Blacon that was carbon mapped.

Baseline carbon emissions and energy use (2008)

Figure 2.13 (top) shows the area mapped, and the level of estimated energy use in 373 households before LCCC funded activities in the area (2010-2011). Overall, the average household carbon emissions at the baseline point was 5,378kgCO_2 (23,077kWh or 299kWh/m^2).

Current carbon emissions and energy use (2012)

Figure 2.13 (bottom image) shows the current estimated energy use of households in the carbon mapped area. Overall, the average household carbon emissions at this point was 4,624kgCO_2 (19,816kWh or 258kWh/m^2). Using the baseline and current carbon maps, it is estimated that 288 out of 373 households (77%) have reduced their energy use from the baseline figures, with an average percentage reduction of 14% in household carbon emissions. The total number of households in the carbon mapped area that benefitted directly from SBL activities is unknown due to unavailable records, but the findings indicate that households in the area, with or without LCCC interventions are achieving reductions.

Figure 2.13. Top image: Carbon mapped area showing household carbon emissions before LCCC funded activities in the local area. Bottom image: Carbon mapped area showing household carbon emissions after LCCC funded activities in the local area

Future recommendations

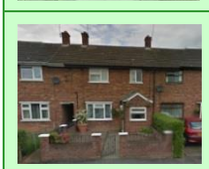
Carbon mapping was used to test the impact of individual measures where they are still needed for further reductions as well as assessing the impacts of community-wide packages of measures, from the 'current' (2012) carbon emission and energy use levels. In terms of individual measures:

- Cavity wall insulation was found to result in a mean 18% reduction
- Solid wall insulation was found to result in a mean 25% reduction
- Condensing boiler, cylinder and pipe insulation was found to result in a mean 20% reduction
- Reducing the thermostat setting from 21-19°C resulted in a mean 7% reduction

In order to understand the savings if more than one measure is undertaken at one time (as the savings from individual measures are not cumulative), packages of measures were also modelled, and are outlined in Table 2.3. As Table 2.3 also demonstrates, for the area mapped in Blacon, it was found that reductions of up to 63% on 'current' (2012) levels could be made, depending on the dwelling type, and the current level of measures already installed. The annual energy cost reductions due to the energy saving packages ranges between dwelling type as follows:

- Fabric package: estimated £23-£536 energy cost reductions
- Fabric and heating upgrade package: £115-£753 estimated energy cost reductions
- Fabric, heating and electricity package: £254-£915 estimated energy cost reductions

Table 2.3. Impact of potential additional energy savings through packages of measures in local Blacon neighbourhood area using DECoRuM carbon mapping modelling (based on 2012 levels)

Measures included:	***Package A: Fabric***	***Package B: Fabric & heating upgrade***	***Package C: Fabric, heating & electricity***
	• *Wall insulation (cavity or solid)* • *Loft insulation* • *Floor insulation* • *Double glazing* • *Draught-proofing*	***Package A+*** • *New condensing boiler* • *Hot water tank insulation* • *Pipework insulation* • *Heating controls*	***Package B +*** • *Energy efficient lighting and appliances* • *Solar PV system* • *Solar hot water system*
Average percentage reductions			
 *1945-64 semi-detached dwelling*	**26%**	**48%**	**52%**
 *1919-44 detached dwelling*	**43%**	**60%**	**63%**
 *1945-64 terraced dwelling*	**21%**	**47%**	**50%**
 *Post-1991 semi-detached dwelling*	**4%**	**17%**	**22%**

2.4 Case study households

The following sections outline the effectiveness and impacts of SBL's activities on individual households in terms of:

- Reducing household energy use and fuel bills
- Changing and sustaining energy-saving behaviours
- Changes in indoor environmental conditions and thermal comfort

It also provides an assessment of the effectiveness and performance of the technical and fabric measures installed in the case study households.

Case study household characteristics

The individual household case studies comprise of 19 households within Blacon (Table 2.4); 13 benefitted directly from the BEMP project and six that did not ('control' households). They are a mix of owner occupied (12) and social housing (six) and one long-term privately rented dwelling. Figure 2.14 outlines the main household types. The 19 households include 34 adults (10 of which are in employment) and three children, with an average main respondent age of 64 years old. 12 out of the 19 main respondents were male. Fifteen of the main respondents were 'economically inactive' (either retired or unemployed due to long-term sickness and/or looking after family members). 11 of the households are occupied by at least one occupant 'most of the time', whilst the remaining eight are occupied mainly at evenings and weekends only. On average, the occupants have lived in their home for 26 years.

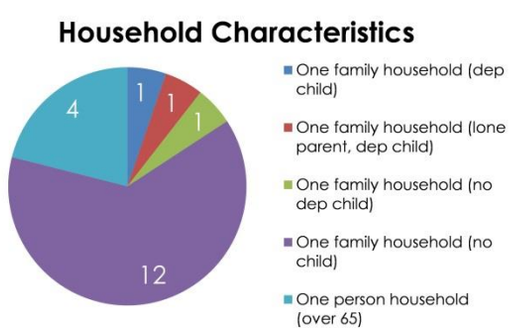


Figure 2.14. Case study household characteristics

The dwelling characteristics are varied, but typical of the area (Figure 2.15); the majority are terraced or semi-detached dwellings built between 1945 and 1980. Most are cavity wall construction (16n), but three are solid wall.

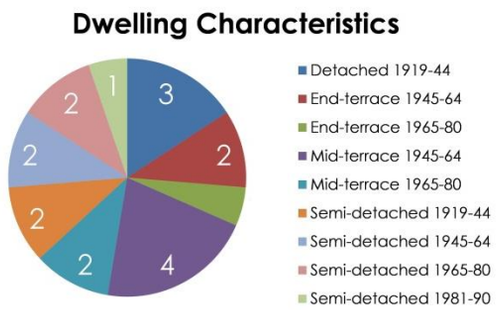


Figure 2.15. Case study dwelling characteristics

Table 2.4 outlines the main dwelling and household characteristics as well as types of physical and/or behaviour change interventions present.

Table 2.4. Characteristics of the EVALOC case study households in Blacon.

SortNo	Dwelling Type & Age	Tenure	Occupancy patterns	Household Type (Summer 2012)	Predominant Wall Construction	Wall Insulation Improvements	Predominant Glazing Type	Improved Loft Insulation	Improved Heating System Installed (post-2005)	LZTs Present	Energy display monitors*	Energy Management Programme
H18	D 1919-44	OO	E&W	2A	SW	x	DG	✓	✓	x	✓	✓
H19	SD 1919-44	OO	ALL	2A	CW	✓	DG	✓	✓	x	✓	✓
H20	MT 1945-64	OO	ALL	2A	CW	✓	DG	✓	✓	x	✓	✓
H21	SD 1981-90	OO	E&W	2A 1C	CW	✓	DG	✓	✓	PV	✓	✓
H22	D 1919-44	OO	ALL	1A	SW	x	DG	✓	✓	x	x	✓
H23	SD 1919-44	OO	ALL	1A	SW	✓	DG	✓	✓	PV	x	✓
H24	SD 1965-80	OO	ALL	2A	CW	✓	DG	✓	✓	x	✓	✓
H25	SD 1945-64	OT	ALL	2A	CW	✓	SG	✓	✓	x	✓	✓
H26	D 1919-44	OO	ALL	2A	CW	✓	DG	✓	✓	x	✓	✓
H27	MT 1945-64	OO	ALL	2A	CW	✓	DG	✓	✓	x	✓	✓
H28	SD 1945-64	OO	ALL	2A	CW	✓	DG	✓	x	x	✓	✓
H29	MT 1965-80	OO	E&W	2A	CW	✓	DG	✓	✓	x	✓	✓
H30	ET 1965-80	SH	E&W	1A	CW	✓	DG	✓	x	x	✓	✓
H31	MT 1945-64	SH	E&W	1A	CW	✓	DG	✓	✓	x	x	x
H32	SD 1965-80	OO	ALL	2A	CW	✓	DG	✓	x	x	✓	x
H33	MT 1965-80	SH	ALL	2A	CW	✓	DG	✓	x	x	x	x
H34	ET 1945-64	SH	E&W	3A	CW	✓	DG	✓	?	x	x	x
H35	MT 1945-64	SH	E&W	2A	CW	✓	DG	✓	✓	x	✓	x
H36	ET 1945-64	SH	E&W	1A 2C	CW	✓	DG	✓	?	x	x	x

Notes:-

D-detached, SD-semi-detached; ET-end-terrace; MT-mid-terrace; OO-owner occupied; SH-social housing; OT-other tenure type; E&W-occupied evenings & weekends; ALL-occupied most of the time; A-adult; C-children; CW-cavity wall; SW-solid wall; DG-double glazing; ST-solar thermal system; PV-solar PV system

*Taken from 2013 data point to include households receiving EDMs from EVALOC trial and Blacon Energy Management Programme. All other data taken from Summer 2012 household survey.

Interventions in case study households

In terms of physical interventions (Figure 2.16), all households have had standard fabric measures and/or an improved heating system installed, with 17 out of the 19 having wall insulation, improved glazing and loft insulation installed and 17 having a condensing boiler installed. Only two households have had solar PVs installed, both following their involvement in SBL's BEMP. 13 households were involved in the BEMP, with two out of the remaining six 'control' households having received energy display monitors from other sources.

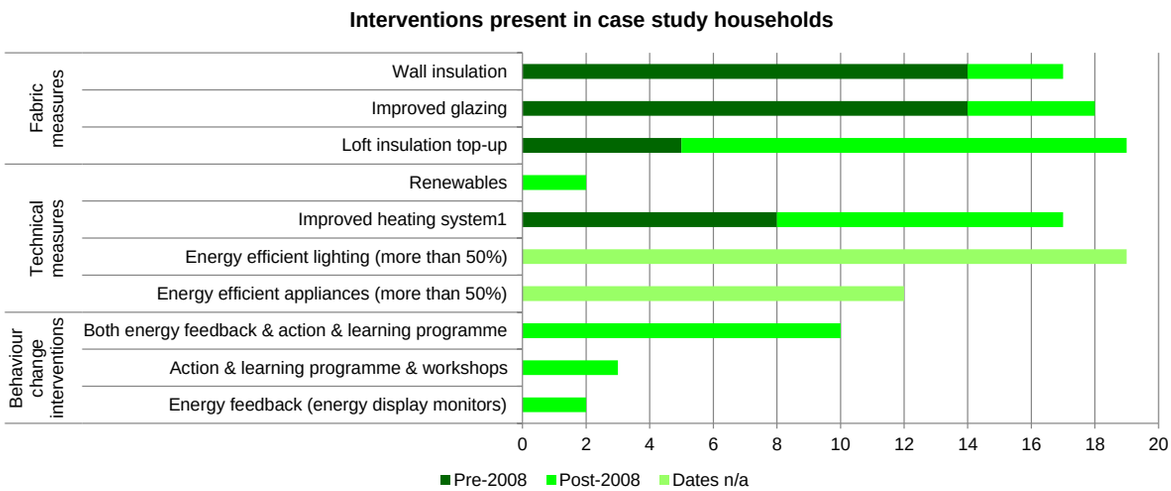


Figure 2.16. Physical and behaviour change interventions present in case study households

Performance of building fabric

In terms of evaluating fabric measures, thermal imaging was used to assess areas of heat loss on the external walls of the EVALOC households. The majority of the households had loft insulation, cavity wall insulation and were predominantly double-glazed. Table 2.5 and Figure 2.17 outline the key problem areas found during the survey, as well as highlighting the constraints on interpretation.

There were particular issues in the case study households, which may be indicative of problems in the wider Blacon area, in relation to 'patchy' finishes to the majority of the dwellings, indicating possible issues with the installation of cavity wall insulation, particularly around and under windows (Figure 2.17). This can have a significant impact on the potential energy reductions within a dwelling.

Further information can be found in the separate report on the thermal imaging survey of Blacon households, which can be found on the EVALOC website; ***www.evaloc.org.uk****.*

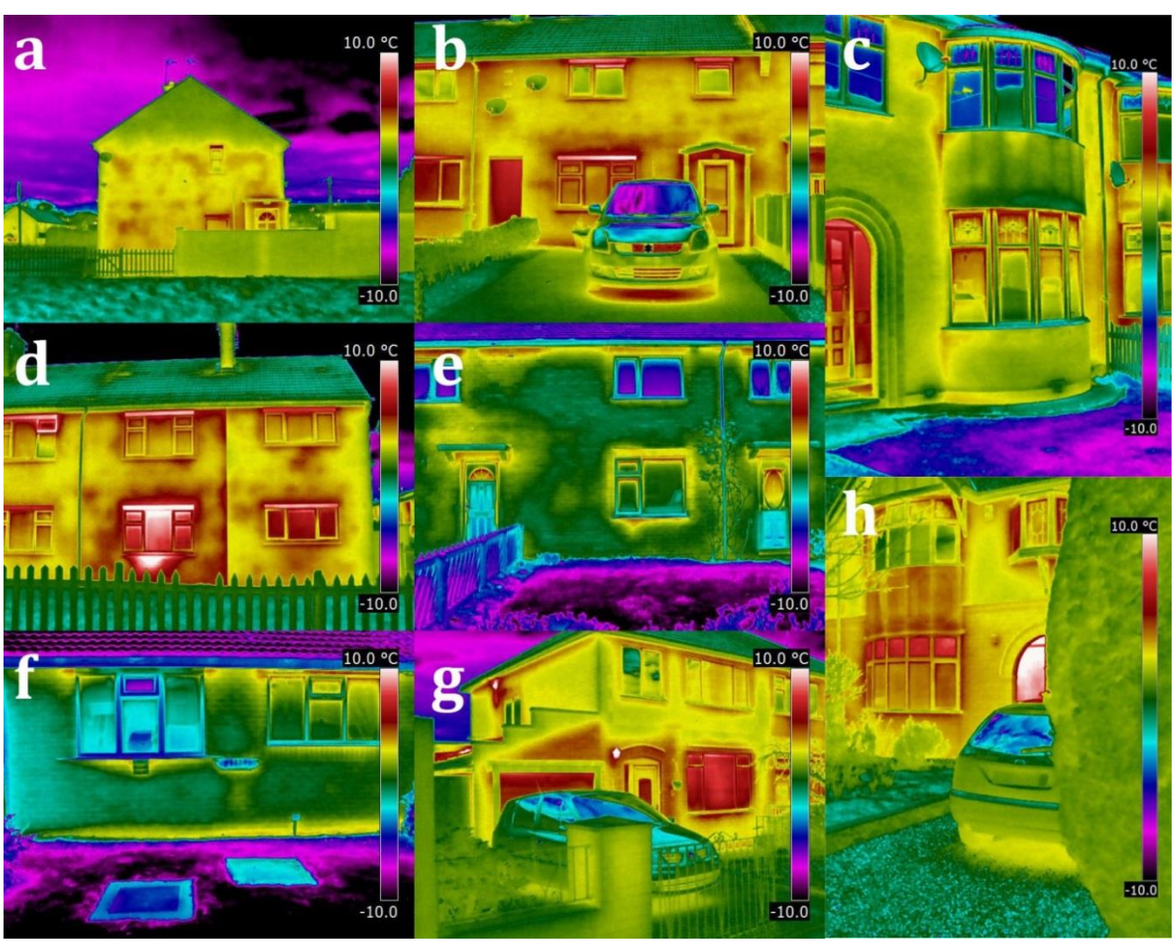


Figure2.17. Series of thermal images undertaken during thermographic survey of case study households in March 2013.

Table 2.5. Typical issues uncovered through thermal imaging of case study households (to be read in conjunction with Figure 2.17).

Problem area	***Potential issues highlighted***	***Potential constraints on interpretation***
Roof and eaves		
Eaves (images c, d & g)	- Thermal bridging (not packing loft insulation in tightly to edges) - Gaps in wall/loft insulation (difficulties in installation at construction joints)	- Sheltered nature of feature, resulting in slow dispersal of heat accumulated here during daylight hours - Ventilation gap in loft space
Walls		
Joints/ connection details (images c, f & h)	- Thermal bridging due to lack of insulation at junctions between walls etc. - Poor workmanship of retrofit improvements - Junctions between original building and new extensions not adequately detailed and constructed	- Sheltered nature of feature, resulting in slow dispersal of heat accumulated here during daylight hours
Patchy walls (images a, b d & e)	- Poor workmanship of retrofitted cavity wall insulation - Areas of inadequate cavity wall insulation - Blocked-up vents with inadequate insulation and/or thermal bridging - Air gaps within wall construction	- Different materials used within wall construction - Location of external lights (both on dwelling itself and streetlights reflecting light (and heat) onto external wall
Windows and doors		
Heat loss around lintels (images b, d & e)	- Thermal bridging - Gaps in draught-proofing of windows/doors - Tricklevents in windows left open (required for ventilation)	- Lintels made of different materials (e.g. Concrete, timber)
Bay and extruded windows (images c, f & h)	- Poor construction particularly at joints allowing heat loss - Lack of insulation (difficult to install)	- Different materials used within wall construction - Sheltered nature of feature, resulting in slow dispersal of heat accumulated here during daylight hours
Heat loss under window cills (images b, d-h)	- Lack of insulation (difficult to install) - Gaps in draught-proofing of windows - Poor workmanship in relation to sealing and draught-proofing window frames - Indicative of localised 'hot' spots (generally due to radiator located on external wall beneath window)	- Sheltered nature of feature, resulting in slow dispersal of heat accumulated here during daylight hours
Other		
Ground level heat loss (images b, c & f)	- Lack of insulation on ground floor of dwelling - Lack of damp-proofing course (DPC)	- Dampness at ground level - Vegetation at ground level - Different materials
Unheated spaces (image g)	- Poor thermal separation from heated areas of dwelling e.g. Integrated garage with no ceiling insulation or insulation on wall between garage and main living areas or insulated door - Poor sealing/draught-proofing of external elements in such areas e.g. Garage door not fitted correctly	

Long term changes in energy use

Annual gas and electricity meter data (Table 2.6) of the case study households show overall reductions with seven out of the 19 households having reduced both gas and electricity use between 2008 and 2012, three having reduced their electricity use and seven having reduced gas use only. Gas data are not available for three households; electricity data not available for one household. Table 2.7 outlines the national average figures for comparison, which are discussed in relation to the case study households in further detail in the next sub-sections.

Changes in electricity use

The overall mean percentage change (2008-2012) in electricity use across the case study households was a 4% reduction, however the median percentage change was an 11% reduction. This highlights the variety in change in electricity use across the case study households. Only two households had a baseline annual electricity use (2008) higher than the national average (4,198kWh), and both experienced significant percentage reductions (17%-29%). Interestingly, however, the greatest reductions (44% and 47%) were found in households with relatively low baseline electricity use (3,134kWh and 3,539kWh respectively) but who had both physical and behaviour change interventions. 16 of the households had a lower than national average electricity use (4,014kWh) in 2012, and the average (mean) electricity use in 2012 across the 17 households for which data was available was 2,702kWh, significantly lower than the national average.

Changes in gas use

The overall mean percentage change (2008-2012) in gas use across the case study households was a 16% reduction, with a median percentage reduction of 22%; which again highlights the variability in individual household energy use. 11 households had a baseline gas use lower than the national average baseline gas use (16,906kWh), of which nine still experienced reductions in gas use. The average (mean) gas use in 2012 was 10,824kWh, which is significantly lower than the national average gas use in 2012 (14,080kWh).

Table 2.2. Changes in annual electricity and gas use (2008-2012) across case study households, and as grouped according to the interventions within the household undertaken post-2008

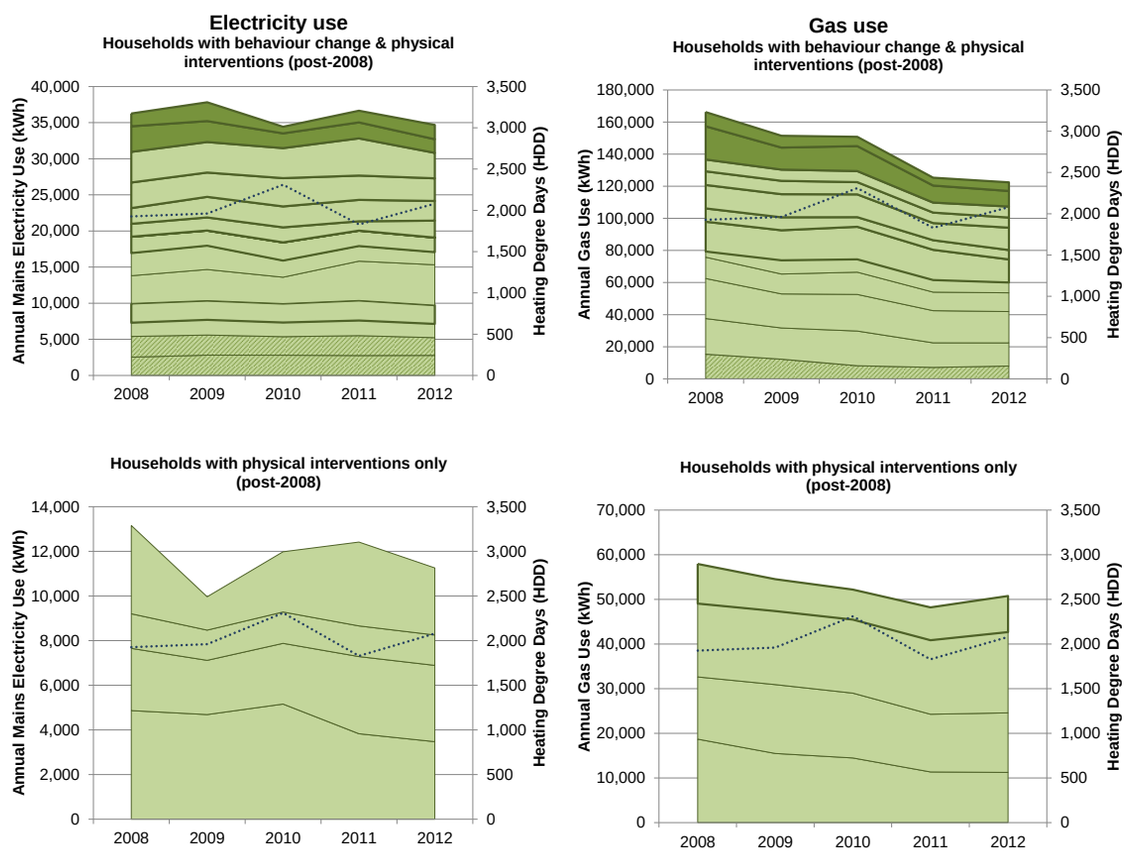
Post-2008 intervention type	***Overall***	***Behaviour & Physical interventions post-2008***	***Physical interventions only post-2008***
Sample No. (Electricity)	17	13	4
Average baseline electricity use (2008)	2,907 kWh	2,789 kWh	3,290 kWh
No. of households experiencing electricity reductions (2008-2012)	10 (59%)	7 (54%)	3 (75%)
Worst percentage change in electricity use	46% increase	46% increase	23% increase
Best percentage change in electricity use	47% reduction	47% reduction	29% reduction
Mean percentage change (electricity use)	**4% reduction**	**2% reduction**	**11% reduction**
Median percentage change (electricity use)	11% reduction	3% reduction	18% reduction
Sample No. (Gas)	16	12	4
Average baseline gas use (2008)	14,008 kWh	13,849 kWh	14,485 kWh
No. of households experiencing gas reductions (2008-2012)	14 (88%)	11 (92%)	3(75%)
Worst percentage change in gas use	82% increase	82% increase	10% increase
Best percentage change in gas use	53% reduction	53% reduction	40% reduction
Mean percentage change (gas use)	**15% reduction**	**16% reduction**	**11% reduction**
Median percentage change (gas use)	22% reduction	22% reduction	7% reduction

Table 2.7. National household gas and electricity use (2008 and 2012) and mean percentage change

Electricity use (national figures)			Gas use (national figures)		
Average mean use (2008)	**Average mean use (2012)**	**Mean percentage change (2008-12)**	**Average mean use (2008)**	**Average mean use (2012)**	**Mean percentage change (2008-12)**
4,198 kWh	4,014 kWh	4%	16,906 kWh	14,080 kWh	17%

Effectiveness of physical and behaviour change interventions on reducing household energy use

As Table 2.6 and Figure 2.18 demonstrate, it is difficult to assess the actual effectiveness of the physical and behaviour change interventions on reducing energy use due to the small sample numbers. However, Figure 2.18 does demonstrate the significant overall reduction in gas use in households with physical and behaviour change interventions, which is perhaps most indicative of the positive effectiveness of the combination of physical and behaviour change interventions; unlike the slight increase in gas use between 2011 and 2012 in the households with physical interventions only which follows the increase in number of heating degree days from 2011 to 2012, the households with both physical and behaviour change interventions still show reductions from 2011 to 2012. In terms of the two households with solar PV systems installed, one actually increases their annual grid electricity use following the installation of the solar PV systems (from 1,616kWh in 2011 to 1,981kWh in 2012) whilst the other does show a significant drop in grid electricity use following the installation of the solar PV system (from 2,211kWh in 2011 to 1,887kWh in 2012).



Key:

- Annual heating degree days (HDD)
- Households with physical (incl. solar PVs) and behaviour change interventions
- Households with physical interventions and energy display monitors only
- Households with physical interventions post-2008 only

Figure 2.18. Annual gas and electricity use from 2008-2012 in case study households, by intervention type.

Impact of the LCC on energy use and fuel bills

All respondents (13) who were involved in the BEMP stated that they believed SBL's advice and/or support had helped them reduce their energy use either 'a lot' or it had been 'crucial/they wouldn't have done it otherwise' (Figure 2.19) and all but two experienced actual reductions in either annual electricity or gas use, or both from 2008 to 2012. A large number stated that it was due to the information and advice received from the BEMP in terms of changing habitual energy-related behaviours, as well as the physical improvements undertaken in the household;

"Probably the biggest thing that helped reduce things down was the changes to the house itself, double glazing and the central heating system, the other things tend to be more small scale you know like reducing the temperature down, putting jumpers on, things like that so it's not big savings but it does help overall."

In addition, several commented on the subsequent impact on their fuels bills because of their reduced energy use;

"…we're saving a little bit of money on the bills, it's more a case in some case we've simply stayed where we were before because the bill prices have gone up the cost of the energy has increased but by cutting the usage we've basically kept what we were paying roughly maybe the same as last year."

The EVALOC findings support the BEMP monitoring and evaluation conducted by the University of Chester (Alexander and Hunt 2010 and 2012) which explored the actual changes in electricity and gas from BEMP participants. They found that during the trial year, there was a small decrease in *gas* consumption for the 46 participants they had data for, with the majority reducing their consumption. They found a small increase in *electricity* consumption for the 43 households they had full data on, with over half reducing their consumption (Alexander and Hunt, 2012). However, the follow up report (University of Chester, 2013) found that where data was available, participants sustained a decrease in energy consumption for the year after the BEMP. However, the sample size of the follow-up report was smaller.

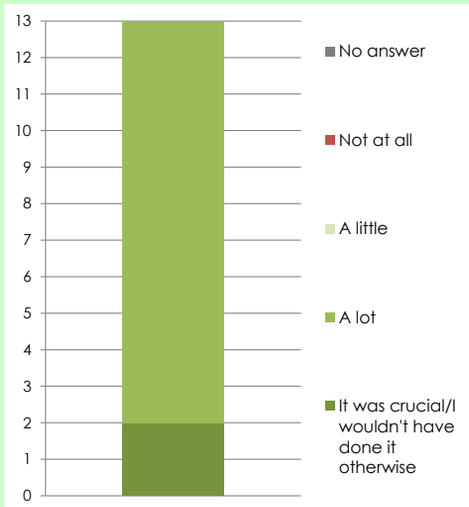


Figure 2.19. Case study household responses to the question, 'Overall how important would you say Sustainable Blacon's advice and/or support has been in helping reduce your home energy use?'

Energy use and carbon emissions

More in-depth monitoring and evaluation of 12 of the households involved in the BEMP was undertaken to further investigate their energy use, and subsequent carbon emissions from December 2012 to November 2014. The findings from this data (Figures 2.20 and 2.21) show that five of the households are using less than the national average in terms of annual energy use (kWh/m^2) and carbon emissions (kgCO_2/m^2). As can be seen in Figure 2.20, both gas and electricity use can vary significantly, even in households with similar energy improvements; emphasising the complexity of household energy use, and the range of factors that can influence the energy use in individual households[5]. Figure 2.20 also highlights the energy use per occupant, and indicates that out of the three households with only one occupant, two are consuming considerably more (H22 and H23), relative to the households with two occupants and relative to their own energy use per square metre.

Two further interesting cases highlighted in Figure 2.20 are H18 and H24. Whilst H18 has below average energy use per square metre, despite having few physical improvements, the energy used per occupant is relatively higher. H24 has just under the national average energy use (per square metre), yet in comparison is using significantly less energy per occupant. Differences in occupants and occupancy patterns may play a role in such variations; for example H18 is occupied by 2 occupants, but who are often joined by another two individuals during the winter months due to work schedules. This not only highlights the variability in energy use, but also emphasises the need to take into consideration the household type and occupants when planning and implementing energy reduction activities in households.

[5] There are a range of factors within households that influence energy use including a) the technical services and systems within the dwelling, b) the physical environment, c) the occupants (and their wider energy-related behaviours), and d) the interactions between these three main aspects. The factors are too numerous to discuss in detail in this report, and as such only the key factors affecting the performance of technical and physical measures and influences upon energy behaviours are discussed in the following sections. Further information on the factors influencing energy use and energy behaviours can be found in separate EVALOC reports and papers.

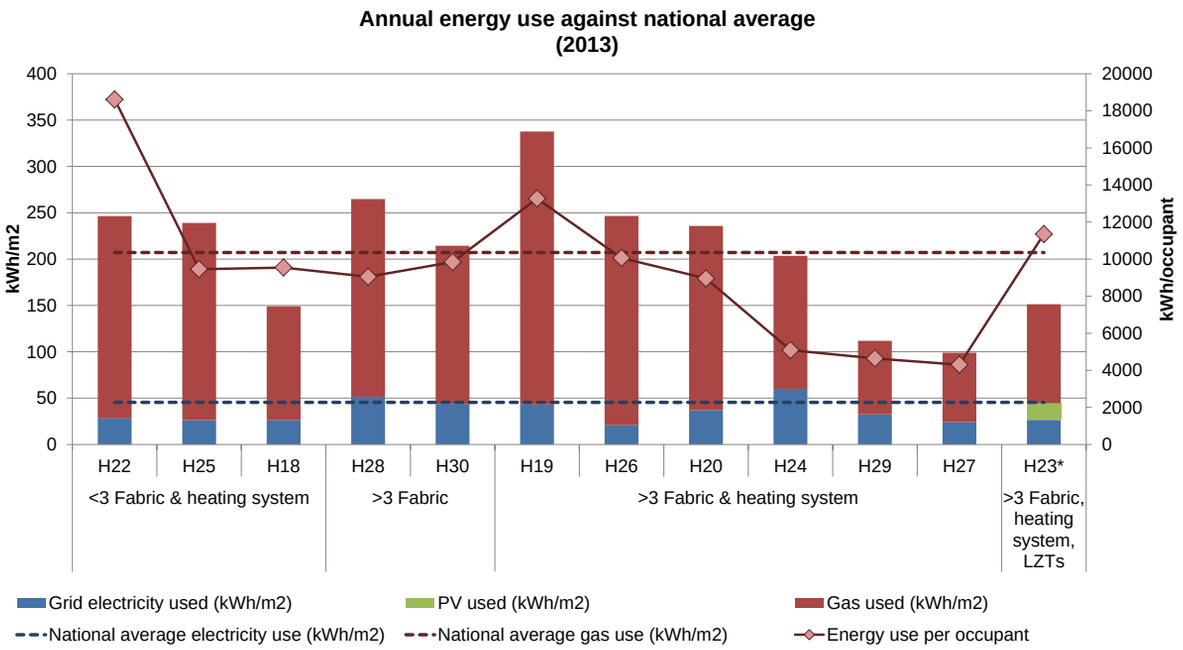


Figure 2.20. Annual household energy use (January – December 2013) in case study households

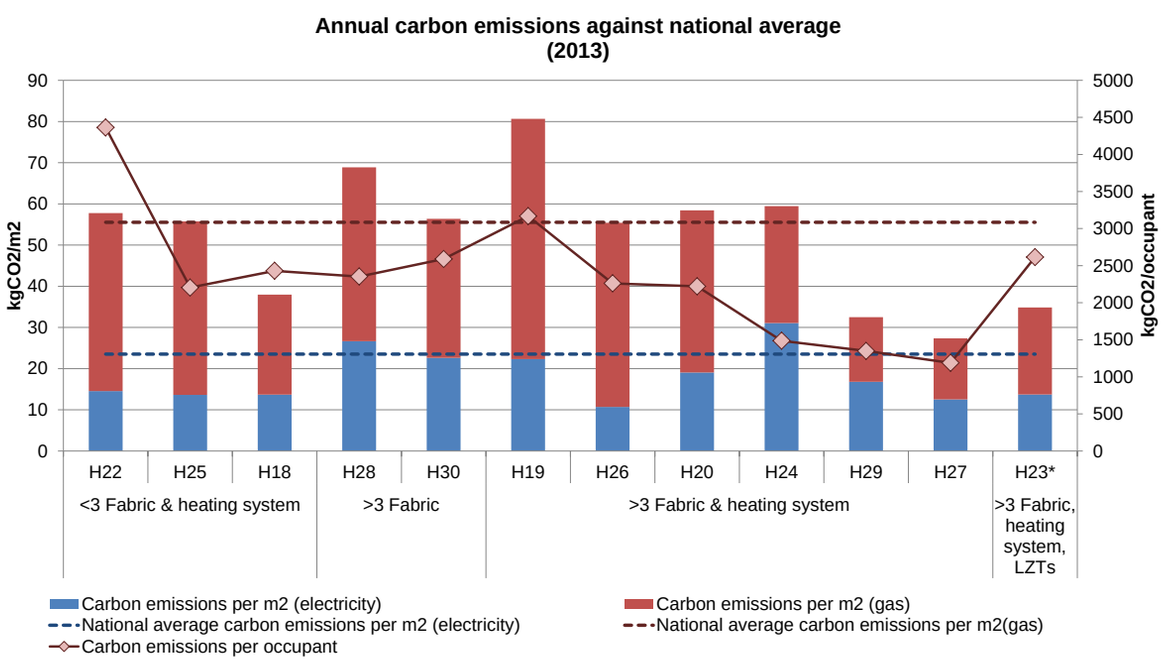


Figure 2.21. Annual household carbon emissions (January – December 2013) in case study households

Notes:

- National average data taken from ECUK Tables 3.07, and both electricity and gas are weather-corrected.

*- Solar PV used data estimated for household with * (50% of annual PV generated assumed used on site).*

Case studies: gas use

In order to understand energy use in the case study households further, in-depth monitoring equipment was installed in five households that monitored gas and electricity use every five minutes, as well as the indoor environmental conditions in the homes.

Case Study Box C highlights findings from such monitoring data using two comparative case study households, in terms of their dwelling characteristics, and heating-related behaviour change interventions. H23 has had significantly more physical improvements, including additional internal wall insulation and draught-proofing. Unsurprisingly, due to the additional physical improvements present, the annual gas use for H23 in 2013 is much less than the gas use of H19. Looking in more detail at the typical weekly gas use and indoor temperature graphs; a comparison of the daily gas peaks in H19 and H23, in relation to indoor temperatures indicate that in H23 more stable and higher indoor temperatures are being achieved, yet the daily peaks in gas use (indicating the heating system being turned on) are less than in H19.

However, the differences between the households cannot just be due to the physical improvements; the typical weekly gas use patterns also demonstrate the impact of the occupants, in terms of number of occupants, occupancy patterns and behaviours. The difference in gas use during the non-heating period particularly highlights this; whilst H23 has only one occupant, and appears to significantly reduce gas use during the non-heating period (despite relying on gas for both cooking and showering), H19 has two occupants and as such has double the demand for gas for cooking and showering. In addition, the occupant of H23 spends most weekends away from the dwelling, and turns the heating down before leaving (as shown in the weekly profiles through the slow decline in indoor temperature levels over Saturday and Sunday), which means that the household will automatically be using less gas than if the occupants were present

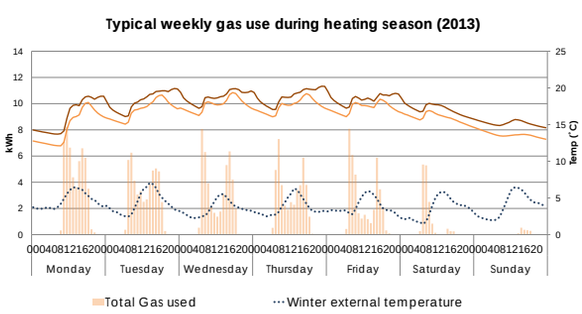
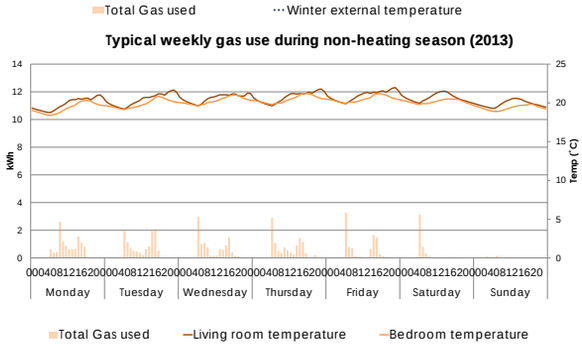
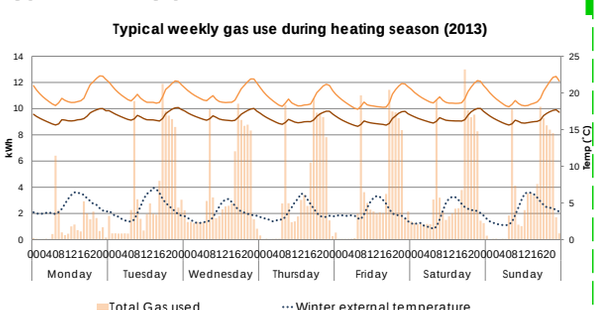
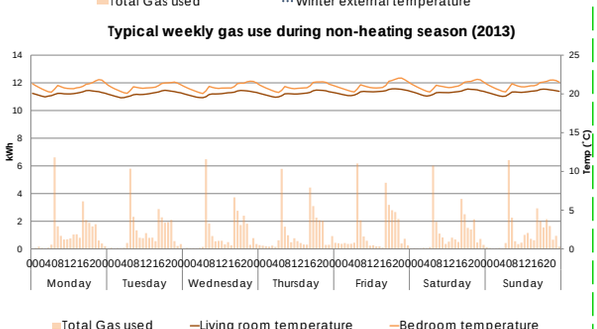
Case studies: electricity use

Case Study Box D outlines key findings in relation to the electricity end uses and daily profiles of two case study households. Both households have had substantial electricity-related behaviour change interventions.

H18 uses more overall annual electricity, and has a higher typical daily electricity use (10kWh to 8kWh) than H20, despite the occupancy patterns being ‘evenings and weekends’, in contrast to H20, which is occupied most of the time. There are several reasons for this being the case, mainly relating to the occupants; whilst H20 is occupied by a couple (both of which attended the BEMP, and actively participate in energy-saving behaviours), H18 is occupied by a parent (who attended the BEMP and actively participates in energy-saving behaviours) and one of their grown offspring who uses electricity-intensive tools and electrical goods as part of their hobby, and who is not as active in energy-saving behaviours as the parent. However, there are also differences in electricity end uses; H18 has an electric shower and oven whereas the shower in H20 is gas-heated from the main central heating and hot water system, and H18 has an electric oven, unlike H20 which has a gas oven.

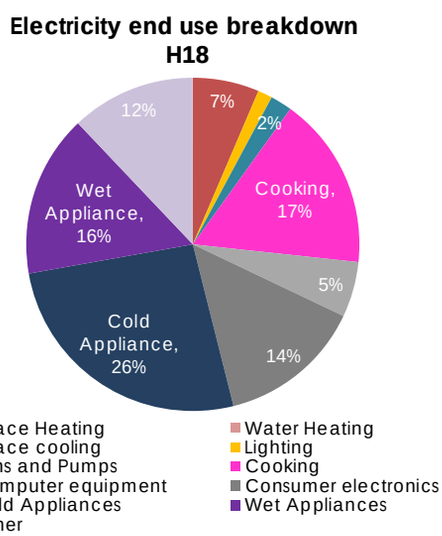
The two case studies highlight the differences that can be found in daily electricity profiles, and are particularly indicative of when the households are occupied; electricity is used throughout the day in H20, and with little variation between weekday and weekend profiles. The weekday and weekend profiles for H18 differ much more, with morning and evening peaks and highlight the impact of showering and cooking on the household’s daily electricity use (peaks of over 0.7kWh).

CASE STUDY BOX C: Household gas use comparison

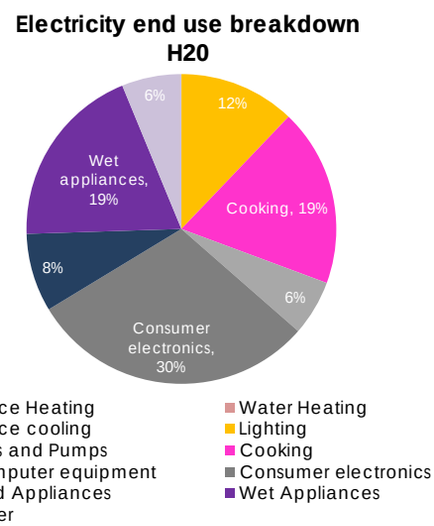
H23	H19
Dwelling age & type: 1919-44 semi-detached	***Dwelling age & type:*** 1919-44 semi-detached
Internal floor area: 75m^2	***Internal floor area:*** 79m^2
Fabric improvements: Cavity wall insulation, partial internal wall insulation, double glazing, loft insulation, draught-proofing incl chimney balloon	***Fabric improvements:*** Cavity wall insulation, double glazing, loft insulation
Improved heating and hot water system: Yes (gas standard condensing boiler)	***Improved heating and hot water system:*** Yes (gas condensing combi boiler)
Number of occupants: 1 adult	***Number of occupants:*** 2 adults
Occupancy patterns: Most of the time (away at weekends)	***Occupancy patterns:*** Most of the time
Behaviour change (gas-related) interventions: Energy Management Programme	***Behaviour change (gas-related) interventions:*** Energy Management Programme
Heating control settings: 07:00-09:00 and 16:00-19:00 (20°C on main thermostat, TRVs used in some rooms)	***Heating control settings:*** 08:15-09:00 and 17:00-23:00 with manual override as required (20°C on main thermostat & high TRV settings)
Gas end-uses: • Heating • Hot water incl. showering • Cooking	***Gas end-uses:*** • Heating • Hot water incl. showering • Cooking
Total annual gas use: 8,006kWh (107kWh/m^2, 8,006kWh/occupant)	***Total annual gas use:*** 23,140 (295kWh/m^2, 11,570kWh/occupant)
Typical daily gas use (heating season): 30kWh (0.4kWh/m^2)	***Typical daily gas use (heating season):*** 67kWh (0.8kWh/m^2)
Typical weekly profiles:   	***Typical weekly profiles:***  

CASE STUDY BOX D: Household electricity use comparison

H18	H20
Dwelling age & type: 1919-44 detached	***Dwelling age & type:*** 1945-64 mid-terrace
Number of occupants: 2 adults	***Number of occupants:*** 2 adults
Occupancy patterns: Evenings and weekends	***Occupancy patterns:*** Most of the time
Behaviour change (electricity-related) interventions: Energy Management Programme & energy display monitor	***Behaviour change (electricity-related) interventions:*** Energy Management Programme & energy display monitor
Technical improvements (electricity-related): 75% energy efficient lighting, about half energy efficient appliances	***Technical improvements (electricity-related):*** 90% energy efficient lighting, some energy efficient appliances
Total annual electricity use: 3,388kWh (27kWh/m^2, 1,694kWh/occupant)	***Total annual electricity use:*** 2,802 (37kWh/m^2, 1,401kWh/occupant)
Typical daily gas use (heating season): 10kWh	***Typical daily gas use (heating season):*** 8kWh
Electricity end-uses:	***Electricity end-uses:***

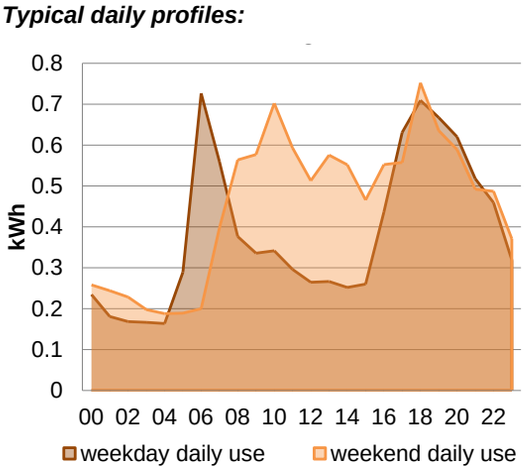


N.B. Electric shower, electric oven

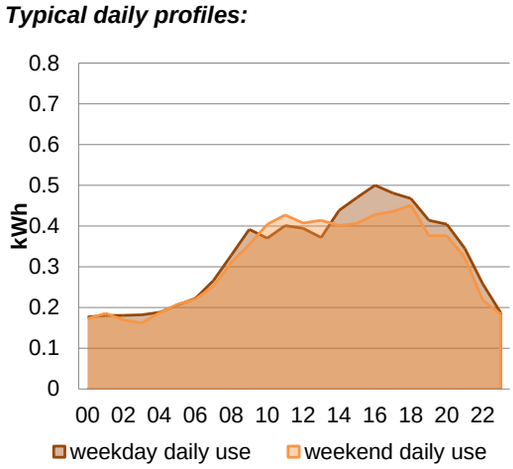


N.B. Shower from gas central heating, gas hob and oven

Typical daily profiles:



Typical daily profiles:



Internal environmental conditions and comfort

Several of the respondents commented that the physical improvements, both fabric improvements and improved heating systems in their home had increased the comfort levels within their household, not only in terms of heat and improved warmth but also noise and condensation issues;

"Positively different, upstairs is a lot warmer. The rooms themselves upstairs were OK but the actual landing itself always struck as being quite cold in comparison and that's all evened out now so yes and the loft itself is colder."

"Yes you can't hear the birds or the cows in the morning so we tend to lie in longer."

One household even commented on the increased quality of life due to being more able to control their heating. However, in one household, negative effects of increased insulation were found;

"because the house is now so insulated we've got a problem with condensation. …I'm in the process of looking to see if it can be retro-fitted you know the trickle vents."

Whilst a *before* and *after* quantitative comparison is not possible, the monitoring data shows that the majority of households have stable indoor temperatures and relative humidity levels that are generally within the 'comfort' range during both the heating and non-heating season (Figures 2.22, 2.23, 2.24 and 2.25). The two households which have the lowest living room relative humidity levels (H30 and H20) are also those with the highest average temperatures (22°C and 23°C respectively) during the heating season. Both also have significant levels of insulation, and also use more gas per square metre than on average.

Interestingly, H19, which has the highest annual gas use out of the case study households as well as substantial physical improvements, has only a 17°C average living room temperature during the winter season, which suggests that further physical improvements could (and should) be made in order to help reduce gas use. The maximum relative humidity levels reached is 92%RH in H22. It is worth noting that H22 is a solid wall dwelling with few significant fabric improvements, and also has an average living room temperature of 14°C for the heating season period. Whilst it is known that the occupant is away a lot during the winter months, the heating is left on and such indoor environmental conditions could result in occupant discomfort, as well as health issues, if and when present. However, the majority (8n) of households have an average indoor temperature around or slightly higher than the national winter average of 18°C (Palmer and Cooper, 2013).

In terms of environmental conditions during the non-heating period (April – September 2013), overall internal temperatures appear comfortable in most households, with only H22 and H20 showing signs of temperatures and relative humidity levels outside comfort ranges for significant periods of time. In terms of overheating, it appears no households are at risk (according to Criteria I of the EN 15251:2007, which states that the difference between the internal temperature and T_{max} should not be greater or equal to 1°C for more than 3% of occupied hours). However, using the static CIBSE Guide A (2015) overheating limits (bedroom temperatures should not be over 26°C for more than 1% of occupied hours, living room temperatures should not be over 28°C for more than 1% of occupied hours), four living rooms and five bedrooms (across eight different households) were at risk of overheating during the summer months (June – August 2013), but none at risk during the winter.

Indoor environmental conditions (heating period)

Comfort ranges: 40-70%RH and 18-21℃

- **Heating period (Jan-Mar, Oct-Dec 2013):** living room temperatures range across households from 9°C to 27°C, with an overall average of 19°C (12 households). Relative humidity levels range between 16%RH and 92%RH in living rooms. Bedroom temperatures range between 7°C and 28°C with an average of 18°C across the households.

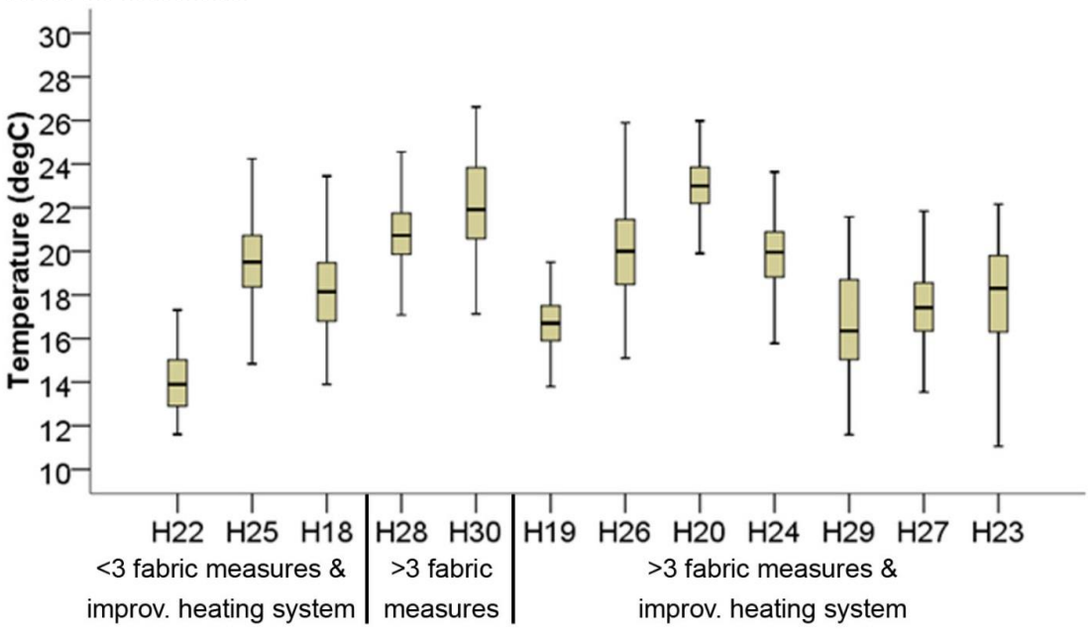


Figure 2.22. Temperature ranges in case study households in living room during heating period (Jan-Mar, Oct-Dec 2013)

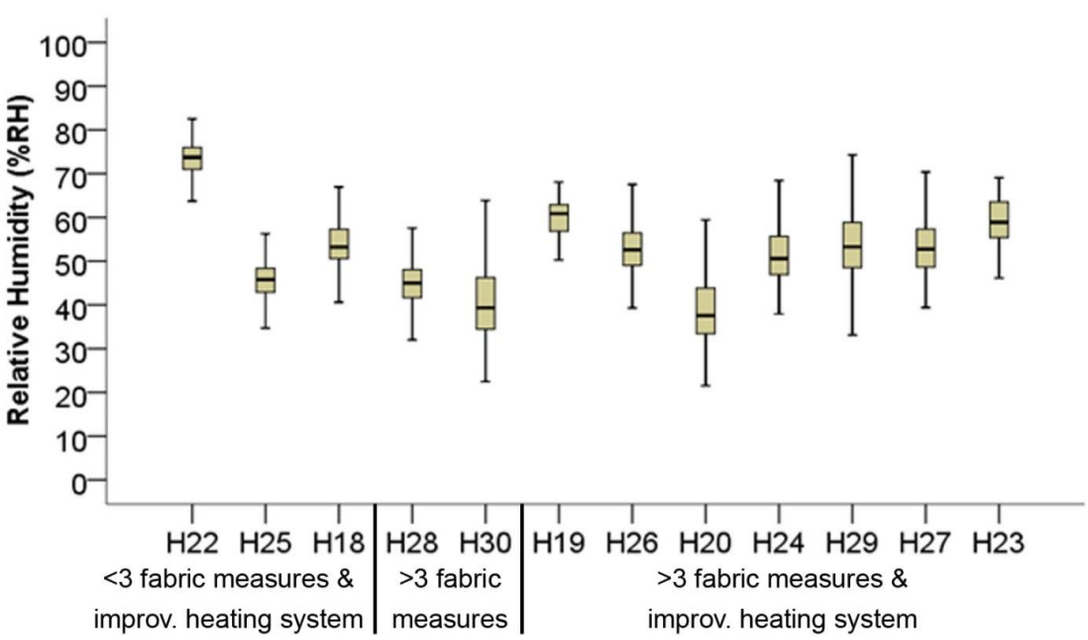


Figure 2.23. Relative humidity ranges in case study households in living room during heating period (Jan-Mar, Oct-Dec 2013)

Indoor environmental conditions (non-heating period)

Comfort ranges: 40-70%RH and 18-25℃

- **Non-heating period(Apr - Sept 2013):** living room temperatures range from 11°C to 34°C, with an overall average of 21°C across all households. Relative humidity levels again range between 15%RH and 90%RH, with an overall average of 57%RH. Bedroom temperatures range from 10°C to 37°C with an overall average of 20°C across all households.

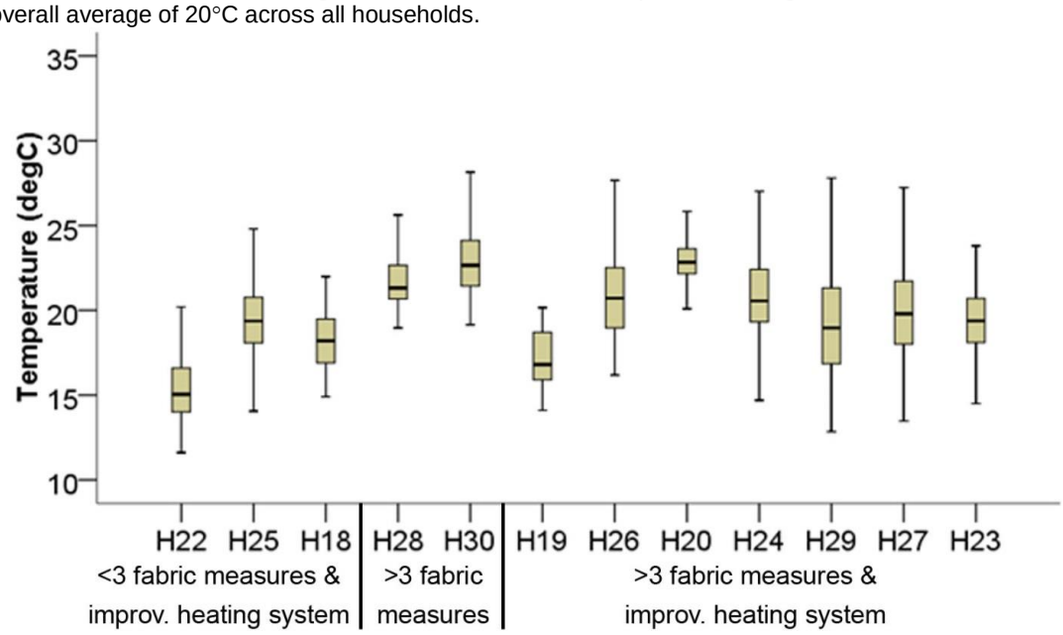


Figure 2.24. Temperature ranges in case study households in living room during non-heating period (Apr-Sept 2013)

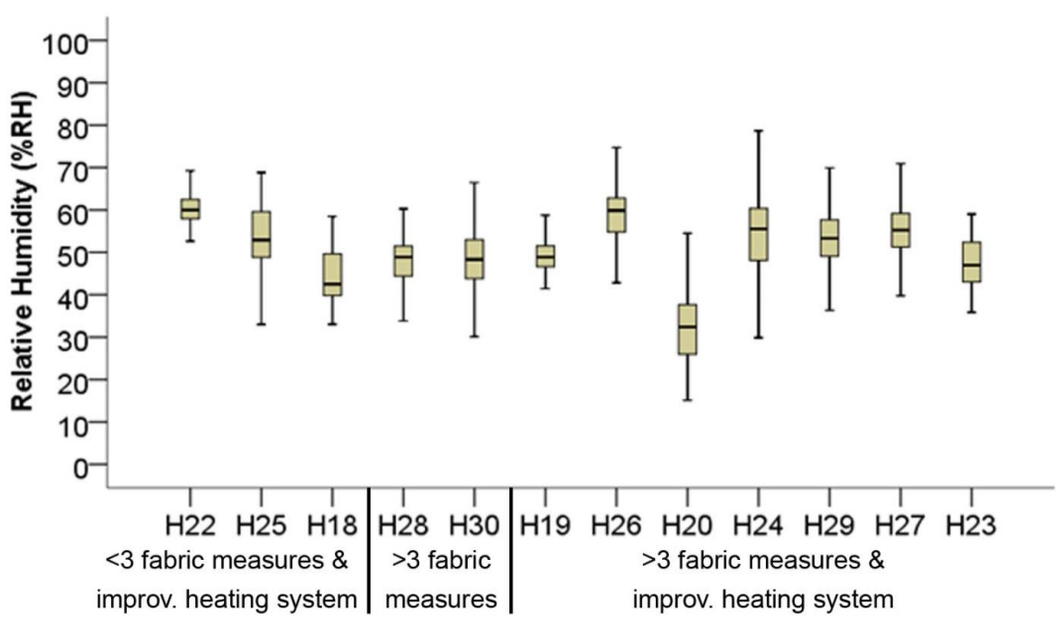


Figure 2.25. Relative humidity ranges in case study households in living room during non-heating period (Apr-Sept 2013)

Indoor air quality

Figure 2.26 shows the CO_2 levels in H23 (dwelling with significant fabric measures including additional draught-proofing and internal wall insulation) over a winter week, and a summer week. As would be expected there are peaks in CO_2 levels in the evening in the living room (when it is occupied) and then the CO_2 levels in the bedroom rise significantly during the night-time (when it is occupied). Interestingly, CO_2 levels in the bedroom overnight during the summer week are much lower, which is indicative of positive energy-saving and comfort behaviours; windows are shut during the winter to retain heat and energy, resulting in higher CO_2 levels whereas during the summer, the data suggest that the bedroom windows are open, thus reducing CO_2 levels in the bedroom during this period. Despite the high levels of insulation, the CO_2 levels are generally below 1,000ppm, and never above 2,000ppm which is indicative of 'normal' air quality (prolonged levels above 2,500ppm can result in negative health impacts).

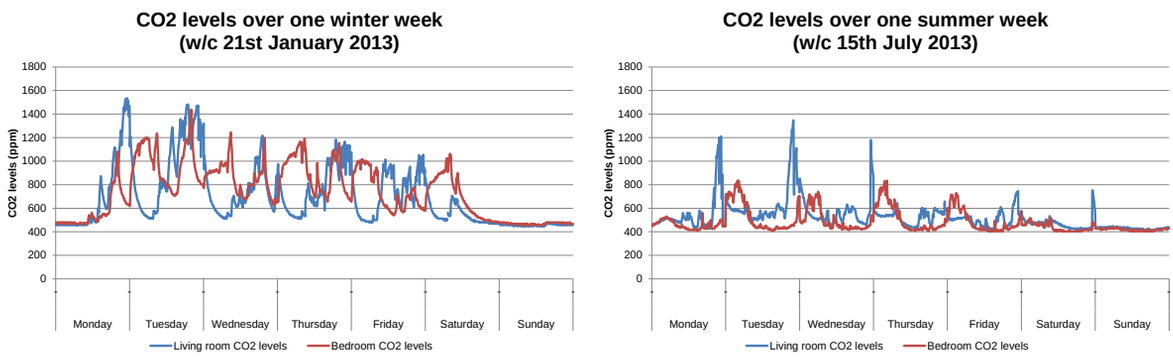


Figure 2.26 CO_2 levels in H23 (dwelling with significant fabric measures) over a winter and summer week.

Changing and sustaining energy behaviours

Occupant behaviours are a key factor in household energy use; both in terms of habitual (everyday) behaviours and 'one-off' behaviours ('purchasing' or 'consumer' behaviours such as installing loft insulation) and how they use technologies which may increase or reduce energy and carbon savings from energy efficiency improvements. Consistent with existing research, findings from EVALOC indicate a range of enabling and constraining factors[6] influencing how people behave. A key aim of behaviour change programme is to help residents ***overcome*** the constraining factors upon occupant behaviours and ***enable*** them to change behaviours and reduce energy use in the ***long term***.

Factors affecting occupant energy-related behaviours

EVALOC investigated a range of factors that influence occupant's energy-saving or energy-using behaviours through the household research:

- **Personal factors** such as attitudes and motivations, feelings of capability (the ability to make changes) and knowledge and awareness of energy use.
- **Financial factors** such as capital costs required for energy efficiency improvements and cost benefits (both in terms of capital costs required for energy efficiency improvements and cost benefits from energy efficiency improvements).
- **Social factors** such as occupant lifestyles, occupancy patterns and relationships between other occupants and social norms (discussed above).
- **Environmental factors** such as health and comfort.
- **Technological and physical (practical) factors** such as lack of control over or understanding of technical services and systems within dwelling and the 'hassle' factor of undertaking home improvements.

INFLUENCING FACTORS ON ENERGY BEHAVIOURS:

"If there was only me on my own I would but because I live with other people it's not so easy." (SOCIAL FACTORS)

"You've got to try and bend your hand at a very awkward angle there is a push button that you can use to switch it off. But it is not convenient [for] every day usage." (PRACTICAL FACTORS)

"Purely from the point of view of X's medical needs so our heating bill is our biggest." (HEALTH FACTORS)

"It's got to the point where it's difficult to reduce it right down without cutting out everyday things that we use or that we enjoy. The only real way to do anything more now is quite expensive changes" (SOCIAL AND FINANCIAL FACTORS)

The EVALOC research followed on from the University of Chester research (Alexander and Hunt 2012), which found that the BEMP was influential in raising awareness and encouraging energy behaviour change. It also found that the project successfully achieved attitudinal change, with a shift in attitudes towards climate change and energy from 'sideline supporters' to 'positive greens' according to Department for Environment, Food and Rural Affairs' Framework for Pro-environmental Behaviours (DEFRA, 2008).

Impacts of Sustainable Blacon Ltd's activities on household energy behaviours

The BEMP involved a range of participants, such as those who were new to energy saving and sustainability to people who had intended to take energy saving action, but who needed support or incentives to do so, as highlighted in the response of one case study household new to the concept; "*I'm like a big convert I'm quite boring for people now when I …tell them all about it.*"

One-off (purchasing) behaviours:

In relation to the physical energy improvements to their homes, the majority of the respondents acknowledged the role of the SBL project in ***enabling*** them to be installed; particularly by helping them get over practical and financial restraints;

[6] There are a range of factors within households that influence energy use including a) the technical services and systems within the dwelling, b) the physical environment, c) the occupants (and their wider energy-related behaviours), and d) the interactions between these three main aspects. The factors are too numerous to discuss in detail in this report, and as such only the key factors affecting the performance of technical and physical measures and influences upon energy behaviours are discussed in the following sections. Further information on the factors influencing energy use and energy behaviours can be found in separate EVALOC reports and papers.

"The physical manual help that we had from them did get us to do a job that we'd wanted to do for ages so yes that was good. [Also] the money that they put into us as part of the project which helped us to do things like the LED lighting and the energy efficient fridges and things."

Several respondents stated that these changes were something they would have done anyway, but for others, involvement in the BEMP clearly provided the motivation to put intentions into action, and go beyond their previous planned actions. For example, when asked about the importance of SBL's advice and support to reducing home energy use, one respondent mentioned that;

"*…certain things I was already doing but it did help with other areas that I didn't know that much about at the time so certain things would have been a little, others quite a lot really. ..I think I probably would have done it all anyway but maybe not as quick and maybe not as effectively with the extra things that I learned."*

Furthermore, there is evidence that the participation in the BEMP led to participants exceeding what they had planned; "*I might have done some of it but not as much as we've done…".* Their participation led several households to self-fund further improvements to their home due to increased motivation through improved awareness and knowledge gained on the BEMP. For example, two respondents installed solar PVs and at least one installed a new heating system, illustrated by;

"*Sustainable Blacon* ***…****certainly gave me the inspiration to get the new heating system put i****n****, to get the loft insulation, to phone up and be cheeky and get a four percent reduction on me gas bill.****"***

The BEMP also gave participants confidence to pick energy efficient appliances: *"When we went out for the washing machine we were able to with confidence pick a decent one."*

Habitual behaviours:

Overall the household survey findings suggest that the majority of the case study households have high levels of habitual energy-saving behaviours. Several respondents stated that they already undertook energy-saving habitual behaviours prior to their involvement in the SBL project, however, they noted that the meetings helped reinforce positive energy-saving behaviours as well as make them think about their more energy-using behaviours;

"I didn't make any particular changes as a result of it, it just reinforces what you already know and put you on a guilt trip for using things which I know I could save."

Some participants found the advice and support was particularly important;

"*…half the stuff, the tips that they gave us we wouldn't have known about if we hadn't have been in the programme would we*."

Whilst others felt that discussing what was learnt was important, for example;

"W*ell it was just sort of bringing it to mind what we could do. It was something you don't generally think about but when people you're in a group and you discuss it so I think it's just general discussion and highlighting, yes*."

A number commented on the many 'small' changes they had made since attending the energy management programme meetings. For example, in response to a question asking if they boiled more water than was necessary, they answered, *"Since Sustainable Blacon, never."*

The respondents indicate that this is due to a heightened awareness and knowledge of the impacts of their behaviours, for example;

"I think I'm more conscious of it, I'm more aware of it, I do think to shut the door after me, I do think to turn the light off so there are changes on that level."

The physical interventions also appear to have had positive impacts on heating and hot water-related behaviours in several households;

"Now I've had this new heating, before it used to take about half an hour for the water to run. Now I've got to be so careful, I turn the tap on and it's instantly hot so I don't have half as much water as I used to have."

Social learning

The BEMP meetings provided important opportunities for learning, with the combination of learning both from experts and from each other proving successful. The experts provided important information;

"It was the way they had the experts there actually telling you about these things that you knew nothing about that you now are doing kind of things you know and I've seen … the electricity usage go down."

The BEMP provided a forum for peer to peer and social learning, as well as opportunities to share learning and know-how, compare experiences and additional motivation and inspiration for taking action, as the following quotes demonstrate;

"I think the [simple] things that you can do to your house … were very important and they're not difficult but you just have to think about them and remember to do them … and meeting the different people every week meant that you kept on being reminded about it you know if you've forgotten."

"I think the [simple] things that you can do to your house … were very important and they're not difficult but you just have to think about them and remember to do them … and meeting the different people every week meant that you kept on being reminded about it you know if you've forgotten."

"…getting together in a group and hearing lots of different things which maybe it was something you wouldn't have thought of but you hear someone else mentioning it and you think oh well maybe that's something I ought to do or I ought to try, just general opinions I would say really just hearing all the different ways and means of actually using less energy."

"The talks … about wasting food and that … was helpful but I think just talking to other people and getting little ideas that what other people did that was helpful."

"…when you went to the meetings because somebody would say oh I do this and you go oh that's not a bad idea you know like we took that to heart.'… [the meetings have] got people talking to each other, listening to other people's ideas, teaching you how to ask for things."

"It was something you don't generally think about but when you're in a group, you discuss it."

The meetings also provided a social opportunity for participants to generate momentum for taking action, such as;

"*…yes and I think once you join, you get involved in something it's sort of infectious isn't it you know the enthusiasm from one to another so you feel you ought to make the effort*."

The design of the meetings was successful, as they provided a good balance of information, sharing experience and know-how, and opportunities to learn from each other.

Furthermore, the bespoke approach, which combined practical action with energy advice, appeared well suited to the participants, and was used in the Save Money Keep Warm project. A volunteer from that project highlights the approach which they adopted, having been a beneficiary of the BEMP;

"I went to a few houses and we fitted bits and pieces and we talked to them about their bills so yes …then we asked them if they'd like a home visit which some of them took up so that was quite good so we were fitting draught excluders and I was up on the ladder doing this and we were talking with them about their bills so hopefully that did make people aware."

Energy display monitors (EDMs)

SBL offered an unusually high level of support for EDM adoption, incorporating energy visibility into the overall programme of activity, and organising meetings and workshops in which EDMs could be introduced and explained.

A relatively high proportion of households had some experience with EDMs. Prior to the EVALOC study, Wattson displays had been tested in 50 homes, while another 50 households had tried out the AlertMe, a more 'active' system which enabled users to manage heating and some appliances remotely, as well as being to monitor their energy use online. There were also residents who had been offered an EDM by their supplier (including one who had had a smart meter installed), or who had bought one on their own initiative. There was no 'display library' in Blacon, though.

The main lessons from the EDM experience in Blacon can be summarised as:

- EDMs have 'worked' as awareness-raisers and as part of household management, and there is evidence that they led to energy-saving practices and encouraged investment in more efficient appliances and efficiency measures.

- The chances of EDMs being effective are increased if they are part of a 'community conversation', where there are people around to give guidance, share experiences, and help develop new energy habits. The 'social' nature of EDM use by several of the SBL households interviewed points to the importance of introducing new gadgets and technologies in a social way, e.g. with a trained installer or knowledgeable friend, and/or through special-interest groups or community meetings. For example;

  "The changes of behaviour came through going to the meetings, not through the AlertMe.",

  And;

  "Well we're more conscious of using electricity… because we had the Wattson meter. I never used to worry about not filling the kettle up, I used to fill it right up and put it on whereas now I tend to guess about two mugs of water and put it on."

- Any display/control system that requires new batteries frequently, or uses substantial amounts of electricity, is of questionable value.

- There are uses for both simple and complex EDM designs, and careful thought needs to be given to 'horses for courses', so that household needs and equipment are matched with suitable types of display or control. EDMs and control systems can be too clever and too complex for purpose, as well as too simplistic.

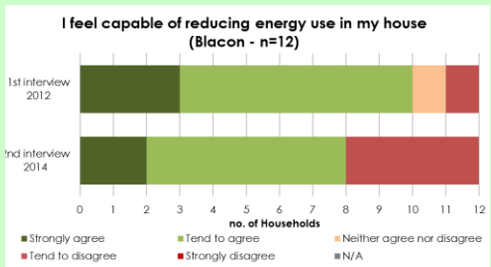


Figure 2.27. Case study household responses to the question, 'I feel capable of reducing energy use in my home.''

Sustaining energy behaviours over time

A follow up report by the University of Chester in 2013 (Alexander and Hunt, 2013) found that of the 33 participants interviewed, as part of the University of Chester's evaluation, indicated that behaviour changes had been sustained and improved a year after the completion of the BEMP. Given that most of the behaviour change activities occurred before a home energy makeovers, the BEMP provides important learning for similar projects, namely monitoring consumption and putting behaviour changes into action before having home energy makeovers.

The EVALOC research corroborates this main trend, although due to the small samples in both cases, it is difficult to draw firm conclusions.

As indicated in previous sections, the majority of the occupants have strong environmental and financial motivations in relation to saving energy in their homes. When comparing responses from 2012 to 2014 regarding energy-related behaviours in the LCC-involved households, it appears that most have changed some of their behaviours (Figure 2.28), and not always positively. Yet on the whole, the majority report very positive energy behaviours, even two years on.

There appears to be a slight reduction in feelings of being ***capable of reducing*** energy use in households from 2012 to 2014 (Fig 2.27). In 2012, the majority of residents (16) in the 19 household interviews strongly agreed or tended to agree that they felt ***capable of reducing*** energy use in their home in 2012. However, of the 12 involved in the SBL project surveyed again in 2014, three negatively changed their opinion and only one felt more capable than they did in 2012. Yet this appears more due to the fact that most feel they have reduced as much as they can do without compromising comfort, or without considerable costs, and the majority were

still positive in their ability to ***manage*** their energy use.

Some respondents commented that they had tried energy-saving behaviours following the BEMP, but had returned to previous behaviours for a variety of reasons including habit, leisure and enjoyment, cleanliness and health;

"I tried that and it worked for a while but then you have to put them on a hotter wash because otherwise they start going whites start going grey and your darker colours eventually they do start to smell, it doesn't kill any bacteria from sweat if the temperature's too low."

Changes in typical energy related behaviours (2012-2014)

- 19 counts of negative change in energy-related behaviours, mainly washing clothes at 30degrees or lower and switching off mobile phone chargers when not in use.
- 12 counts of positive changes in energy-related behaviours such as turning lights off when leaving a room, closing windows when the heating is on, and putting clothes on before turning on/up the heating.

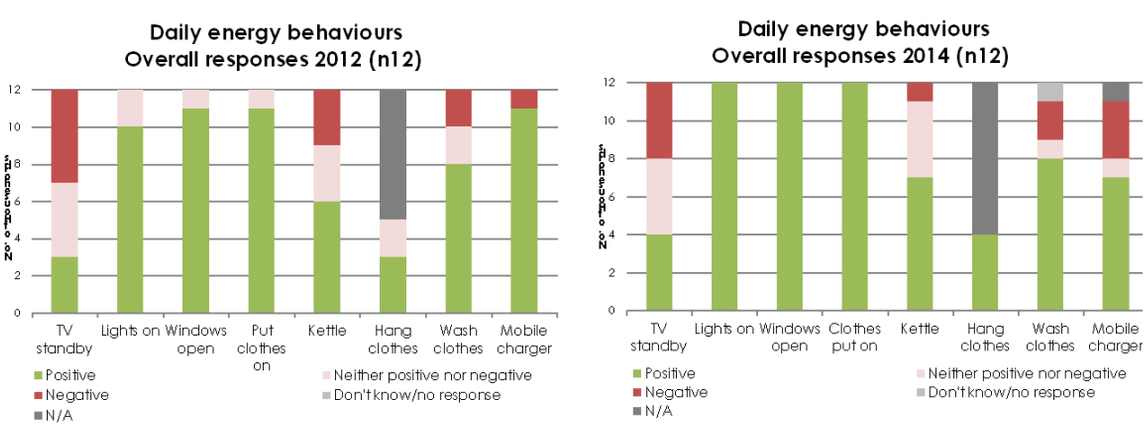


Figure 2.28. Case study household responses to series of questions relating to their energy behaviours in 2012 (left) and in 2014 (right)

Wider impacts and benefits of Sustainable Blacon Ltd's activities

A majority of respondents in the household interviews strongly agreed or tended to agree that SBL had helped them to reduce their energy use and fuel bills, alongside encouraging the wider community, particularly the local school children, to reduce its energy consumption.

However, the case study household respondents indicated that the SBL project had many social benefits (Figure 2.29), including;

- **Given participants the confidence to go out and proactively engage and discuss energy (and other environmental issues) within the wider community**.
- **Motivation to volunteer for further energy and environmental activities within Blacon,** for example;

  "I'd say I've got a sense of belonging to the community more through having been to this [project] and now doing this voluntary litter pick…it's amazing how many people…[say] when you're litter picking sometimes, you're doing a good job there, thanks very much."
- **Increased sense of a community of interest around environmental issues**, for example;

  "It's infectious, you know you get involved in this and if something else comes up as well if the same faces are there well, if it's of interest to them, it's of interest to me as well, which is what communities [are]."
- **Improved mental and physical health and wellbeing**, for example;

  "It's getting out and about helps me mentally, it's also helped me physically because I'm walking a lot more than I used to do and I'm using a bike as well. … I never used a bike for years before I got one off Sustainable Blacon to us.", And;

  "*Yes I know a lot of people, a lot more people, I know a lot of people in the community and a lot of people in the community know me now. I think it's improved me health and it's done quite a lot for me wellbeing as well, I feel a lot better than I did seven, eight years ago*."
- **Increased quality of life (through improved heating controls and indoor environmental conditions).**

Although not all the respondents agreed that it had brought jobs to the area (which it had, see earlier section), nearly all positively commented on the fact that it had provided apprenticeships and the opportunity for volunteering, which then has led to people finding jobs in the wider Chester area in a similar field.

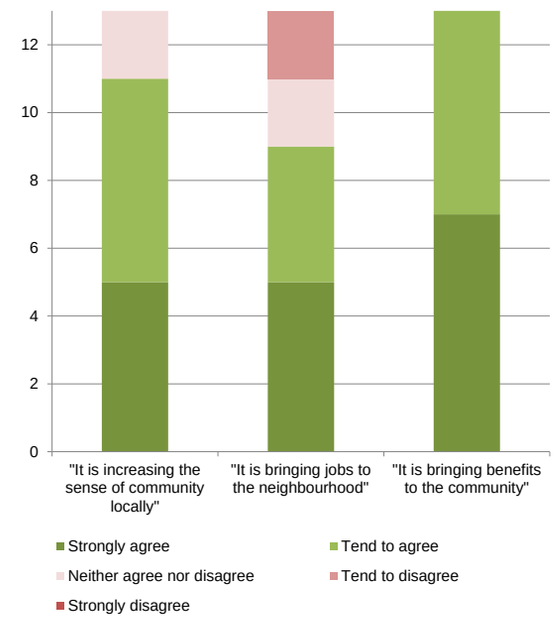


Figure 2.29. Case study household responses to series of questions relating to Sustainable Blacon Ltd's wider contributions

"We've made more friends, we've got involved in the community which we wanted to do, we've saved money."

Chapter 3

Reflections and policy implications

The BEMP project was well designed and run, and tailored to fit the local community. The programme enabled participants to learn, discuss and reflect on their energy behaviours, and make behavioural changes to reduce their energy and carbon emissions. Overall, the change interventions made were effective at reducing CO2 emissions, even when the initial CO2 emission baseline was lower than the national average.

The BEMP project also generated social capital, increased community cohesion. The incentive of a home makeover was an important part of encouraging and sustaining the involvement of participants, and has helped to reinforce energy and carbon reductions through the fabric improvements (such as increased insulation) and one off purchasing behaviours (such as increased efficiency of appliances).

The increased energy, carbon and environmental knowledge and know-how of the BEMP participants was utilised in follow on projects such as Save Money Keep Warm. However, enabling this know-how to be further built on and disseminated beyond the life of the funded projects, needed further support. The case study highlights the importance of support for the leadership and process roles of a project such as the BEMP, and for further training to enable participants to take on some of these roles if they wish.

The findings highlight the need for national follow up and verification of technical interventions in homes, such as cavity wall insulation.

Community energy projects such as these cannot be treated as a 'fund and forget' model. We have endeavoured to bring out the valuable lessons of project design, impact on participants and the wider community, and the technical implications. However, building on the know-how, expertise and commitment of those involved will require longer term investment, both in local energy programmes, and in supporting those in leadership positions. This project, like many LCCs involved in the EVALOC research, developed a successful tailored approach to energy and carbon reduction in their local area. These lessons and approaches are invaluable in developing a comprehensive menu of approaches for future low carbon communities. However, the know-how, expertise and experience of those involved in the project design risks being dissipated without a comprehensive strategy to bring together and build on the lessons learnt.

As outlined in the community energy strategy and the update (DECC, 2015), we recommend that a variety of case studies and overviews of specific projects are included in the Community Energy Hub[1]. Ideally these could be searchable by project type and funder, so that future community energy practitioners, policy makers and researchers can acquire an overview of the strengths and weaknesses of the community energy sector.

[1] See http://hub.communityenergyengland.org/

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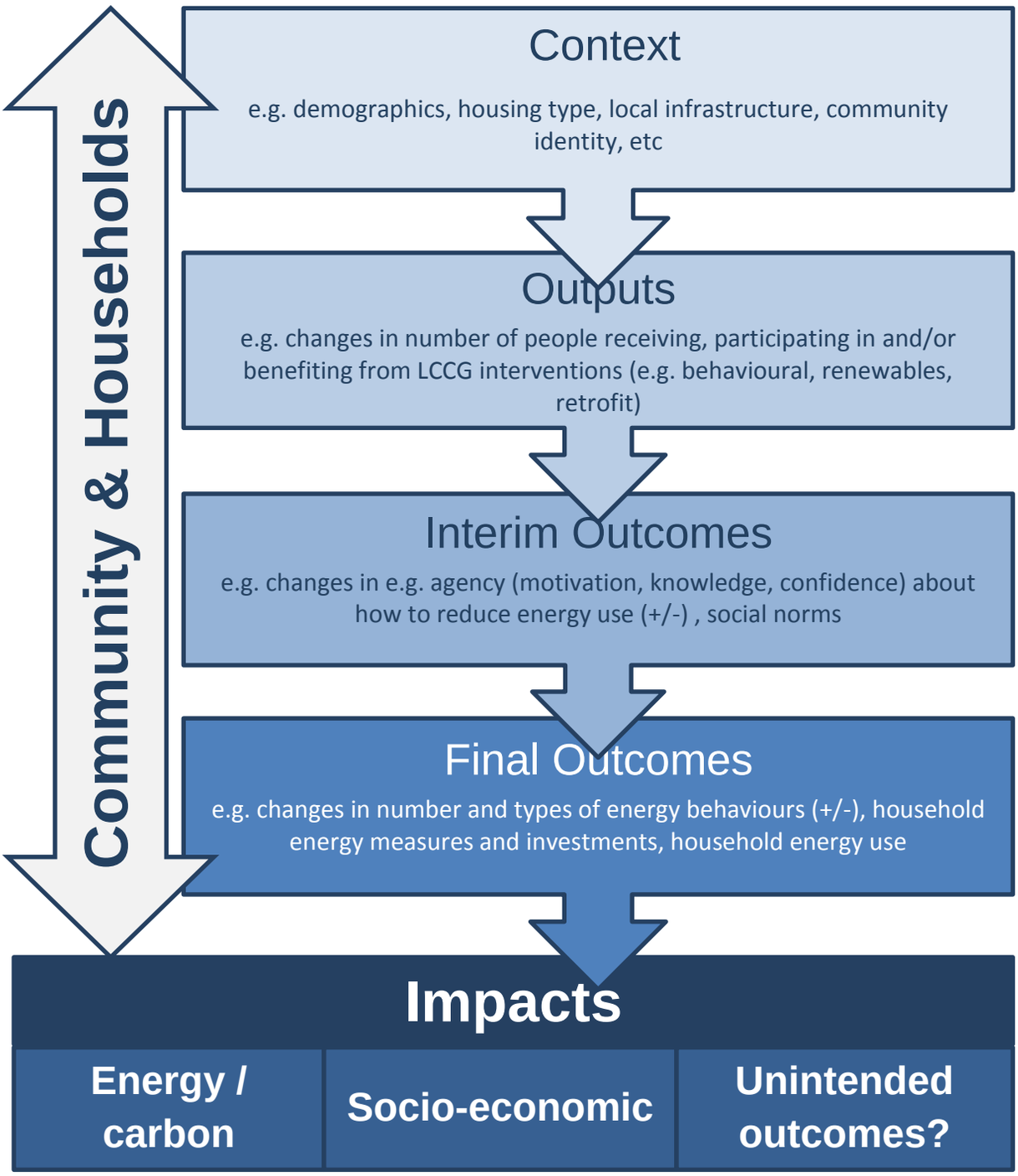
Appendices

Appendix A: Overall impact pathway and research framework



NB: In practice the impact pathway is unlikely to be linear: there may be multiple factors contributing to outcomes and impacts, and interactions and feedback loops between the different parts of the pathway which are not captured here.

Appendix B: Research activities and survey techniques

Research method	Research Objective	Sample No.
Literature review	*Review existing academic and evaluation literature*	N/A
Community level research activities		
Baseline data collection	*To collect base line data about community and LCC context, characteristics, roles and responsibilities, project design, M& E*	- 2 project officers
Focus Group 1	*To investigate: identity of community; the impact of DECC funding on the LCC and wider community; community engagement; ideas for future energy activities and research*	- 11 participants
Community event 1	*To investigate whether and how the community event contributed to social learning (BEMP feedback)*	- 32 participants
Shared learning event with other communities 1	*investigate whether and how the shared learning event contributed to social learning about energy behaviours(Carbon reduction in communities of disadvantage)*	- 6 participants
Focus Group 2	*To feedback research findings.* *To investigate: LCC activities since last year;, impacts and influences; LCCs role and relations with other actors; ideas for future energy activities and research*	- 7 participants
Community event 2	*To investigate whether and how the community event contributes to social learning about energy behaviours (feedback and learning about eco-houses)*	- 7 participants
Shared learning event with other communities 2	*To investigate whether and how the shared learning event contributes to social learning about energy behaviours(Creativity and climate change)*	- 27 participants
Focus Group 3	*To feedback research findings.* *To assess LCC activities since last year, impacts and influences, and to collect feedback on EVALOC's proposed outputs and toolkit*	- 7 participants
Community event 3 (carbon mapping workshop)	*To provide feedback to the communities and assess how useful DECoRuM is in measuring, visualising and communicating carbon savings*	- 7 participants
Supplementary data collection	*To supplement information from baseline, focus groups, and community events*	- 7 participants
Energy data collection (2008-2012)	*Assess changes in energy use at wider community level to understand energy trends and potential 'ripple' effects of LCC activities*	- 5,591 households at LLSOA level
Carbon mapping (DECoRuM)	*Estimate changes in energy use at wider community level to understand energy trends and potential 'ripple' effects of LCC activities*	- 373 households

Research method	Research Objective	Sample No.
Household level monitoring & evaluation activities		
Physical survey (summer 2012)	*Provide data relating to physical characteristics of dwelling as well as assess physical changes following physical and technical improvements*	- 19 households
Energy data collection (2008-2012)	*Assess changes in energy use in order to understand individual household energy trends and effects of LCC activities*	- 18 households [electricity] - 16 households [gas]
Monitoring of energy use (2013-2014) - Monthly data - 5 minute data	*Investigate energy use in relation to national and community averages.* *Provide understanding of household energy use in relation to wider factors*	- 12 households - 5 households
Monitoring of environmental conditions (2013-2014) - Half hourly data - 5 minute data	*Provide understanding of indoor environmental conditions and occupant comfort levels*	- 12 households - 5 households
Monitoring of user interaction (2013-2014)	*Provide quantitative data relating to occupant behaviours in relation to heating and ventilation*	- 5 households
Activity logging sheets and thermal comfort diaries (winter & summer 2013)	*Provide understanding of occupant behaviours (heating and non-heating) and comfort levels during winter and summer*	- 4 households
Heating control questionnaires (winter 2013)	*Provide understanding of heating behaviours within the household*	- 15 households
Energy audit (summer 2014)	*Provide understanding of electricity-related behaviours*	- 12 households
Monitoring of solar PVs (2013-2014) - Annual generation data - 5 minute generation data	*Investigate effectiveness and performance of low-zero carbon technologies*	- 1 household - 1 household
First round semi-structured interviews (summer 2012)	*Provide baseline information and assess impacts of LCC activities upon individual households*	- 19 households

Research method	Research Objective	Sample No.
Household level monitoring & evaluation activities (cont.)		
Second round semi-structured interviews (summer 2014)	*Investigate changes in household (physical and behavioural) and influencing factors upon energy behaviours*	- 12 households
Thermal imaging survey (winter 2013)	*Investigate performance of fabric improvements*	- 19 households
Social network analysis (summer 2012)	*Provide understanding of individual's social networks*	- 19 households