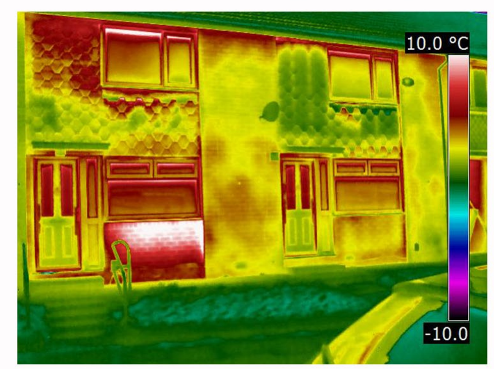
Eco Easterside Final Community Report



EVALOC (evaluating low carbon communities)

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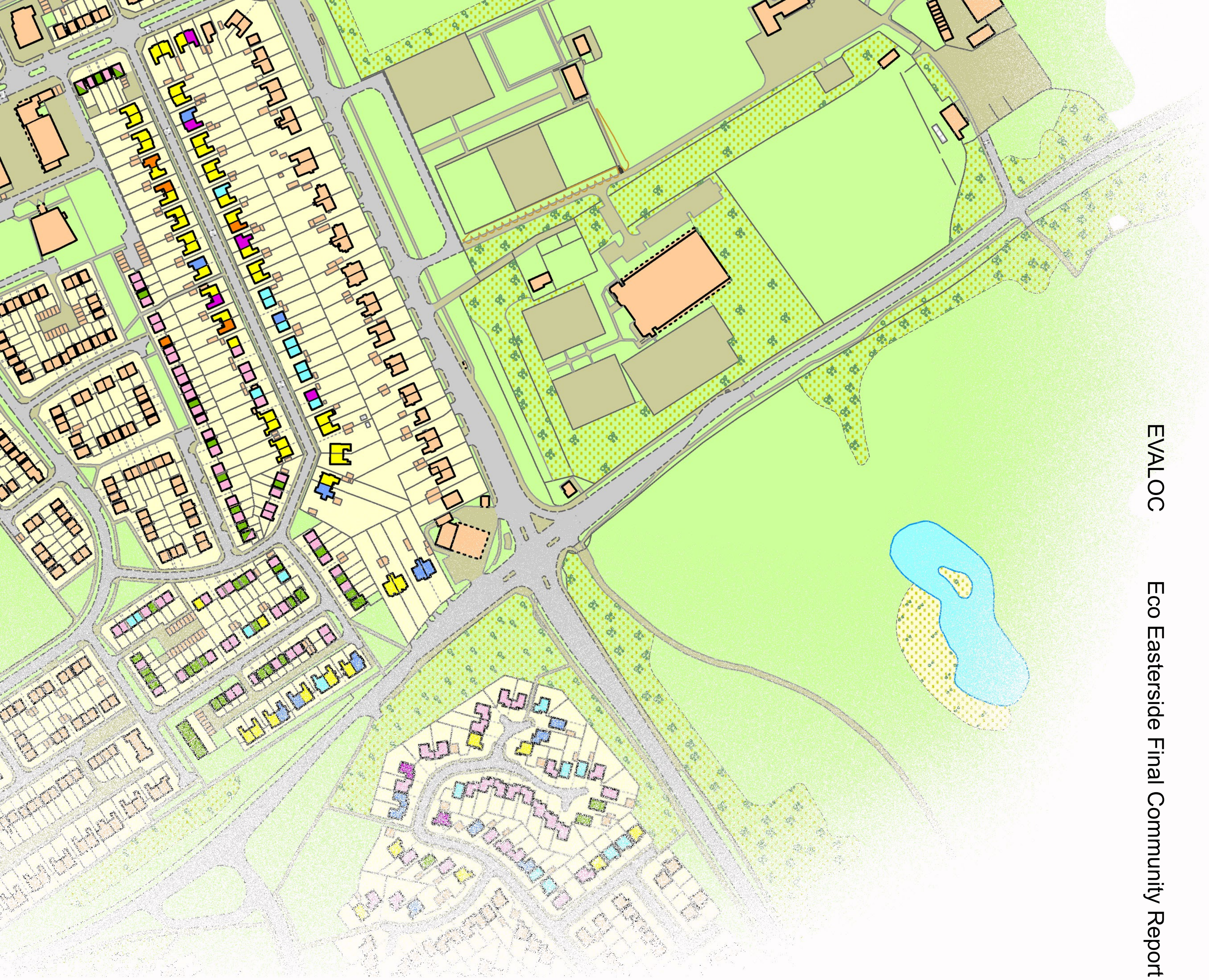

OXFORD BROOKES UNIVERSITY

Environmental *Change* Institute eci UNIVERSITY OF OXFORD

Research Councils UK Energy For a Low Carbon Future

EVALOC
EVALUATING LOW CARBON COMMUNITIES

August 2015

EVALOC 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). 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 summary report shares the findings from the EVALOC research project about Eco Easterside's energy and carbon reduction projects. EVALOC was carried out between 2010 and 2014 to assess and explain changes in energy use in six low carbon communities (LCCs) in England and Wales. A more detailed report has been provided to the Eco Easterside team.

- Eco Easterside is an award-winning local partnership in a disadvantaged estate on the edge of Middlesbrough that aims to reduce local carbon emissions and to promote sustainable and healthy living. In 2010 it won a £400,000 capital grant from the Department of Energy and Climate Change (DECC) as part of the Low Carbon Community Challenge (LCCC) to undertake specific energy-related activities.

- The evaluation found Eco Easterside to be a relevant, accessible, and highly effective and inspiring initiative. The lessons from Eco Easterside are highly relevant to other disadvantaged communities, although not all the projects are replicable.

2 Roles and Capabilities

- Eco Easterside is a highly effective partnership between a town wide charity, Middlesbrough Environment City (MEC), the local authority and other statutory agencies, and local residents that works within Easterside and across Middlesbrough. Its particular strengths are its ability to engage local residents, organise the installation of renewables and energy efficiency measures in their homes, and help address fuel poverty, which can be seen in the high levels of uptake of renewable and energy efficiency measures. The team felt less sure about their ability to empower people, to change energy related behaviours or develop innovatory approaches to reducing energy use.

3 Strategy Design

- Eco Easterside has a motivating and credible vision which balances environmental, social and practical aspirations, and is tailored to local people. It also has a well designed change strategy tailored to local needs which help residents overcome some of the many technical, economic and social influences which constrain them from reducing energy use.

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

- Eco Easterside's communication messages, engagement methods and projects are all highly relevant and accessible to residents;
- Its household energy reduction projects address some of the key economic, technical and social barriers to domestic carbon reduction;
- Complementary community level events and projects raise awareness, and promote more sustainable, healthy living.

- At ***midstream level*** (with local agencies), Eco Easterside has been involved in successful partnership working, which:

- Enables resident engagement and the effective neighbourhood and town wide delivery and installation of household energy efficiency measures to people's homes;
- Provides residents with joined up local services on related issues such as addressing fuel poverty, accessing welfare benefits and assisting people with debt payments;
- Enables scaling up and replication of activities.

- The Eco Easterside has also shared its learning from the project with other communities across the UK.

- At ***upstream level*** (with government or national interest groups):

- Members of the core team engage in dialogue with government to inform policy, but the partnership does not engage in public campaigning nor has it sought to involve residents in influencing policy.

4 Learning

- Research highlights the importance of learning processes to learn about what approaches do and don't work, test the change assumptions underpinning change interventions, and to inform the design of future change strategy. Eco Easterside has participated in a number of external evaluations and is beginning to design and implement its own internal system.

5 Effectiveness and impacts

Overall, Eco Easterside has successfully designed, managed and implemented complex energy projects at community and household level.

Engagement

- It has succeeded in engaging a large number of residents on the estate; 30-33% of whom are on low incomes:

- 1,328 households through newsletters, leafleting and door-knocking and presence at other events;
- 1,000+ residents participating in bespoke community events;
- 20 households benefitting from low-zero carbon technologies (LZTs) and 469 households with insulation measures;
- Community renewable projects has increased awareness among pupils, families and residents;
- Several hundred households participating in complementary energy, transport and food projects.

- Most of the residents interviewed were motivated to reduce energy use and carbon emissions, and a significant number appear motivated by both concerns about climate change and practical benefits.

Renewable energy generation

- The community solar PV system installed on the Easterside Community Hub and two wind turbines installed at the two local primary schools have saved 28 tonnes of CO_2e since their installation in 2011. *(Figures not available for air source heat pump system on local cafe).*

- The solar PV systems installed on 10 local households have saved an estimated 34 tonnes of CO2e since their installation in 2011. *(Figures not available for air source heat pump and solar thermal systems).*

- There are also signs of possible 'ripple' effects; for example, 20 additional domestic solar PV installations have been registered on the Department of Energy and Climate Change's (DECC's) national FiT register from the wider local area, following the installation of the 10 installed by Eco Easterside.

Household energy use and carbon emissions

- Data from the wider local area over a five year period (2008-2012) indicate the average household in Easterside and the surrounding area has reduced its carbon emissions (from gas and electricity use) by 12% from 2008 to 2012 (in line with the UK's national average). This is despite annual average household baseline (2008) gas and electricity use in the wider Easterside community being lower than the national average (15,407kWh in gas and 3,368kWh in electricity compared to national mean average of 16,906kWh in gas and 4,198kWh in electricity); which can reduce the potential for further reductions.

- There have been greater percentage reductions in annual average household metered electricity use than gas use across the wider community (using subnational lower super output area energy data figures) over the 5 year period in relation to national averages; suggesting the relative effectiveness of Eco Easterside's activities focused on electricity generation (electricity: 6% reduction in relation to 4% national reduction; gas: 15% vs. 17% nationally) and also potential for further reductions in household gas use.

- Carbon mapping of 242 households before and after LCC activities in 2010 also indicates reductions in energy use in both households that directly benefitted from LCC activities and those that did not.

- Carbon mapping indicates that further savings of up to 60% (on 2012 estimates) per dwelling could be made through packages of physical measures.

- Eco Easterside's activities also appear to have had positive impacts in terms of the 12 EVALOC case study households' energy use benefitting from LCC interventions:

- Long term annual gas and electricity meter data (2008-2012) of the case study households show overall reductions with nine out of the 12 households involved in Eco Easterside activities (either physical, behavioural or combination) reducing either or both gas and electricity use.
- 10 out of the 12 households involved in Eco Easterside activities stating that they felt Eco Easterside had helped them reduce their energy use.

- Energy display monitors have increased awareness and led to some reported changes in electricity use in the case study households. However, this is not marked enough to show up in the consumption data as significant – not surprising, given the number of variables involved, and the small sample.

Performance of physical interventions in case study households

- Overall performance of solar PVs is good, with four out of the five systems monitored generating more than predicted annually, two years after installation.

- Whilst thermal imaging shows that there are issues with retrofitted cavity wall insulation, particularly around and under windows and infill panels, generally occupants reported high levels of comfort and there were no reports of increased condensation or mould, or issues with the physical integrity of the dwelling as a whole, following fabric improvements.

Occupant energy behaviours in case study households

- Most occupants exhibited high levels of energy-saving awareness, and reported a range of energy-saving behaviours, although some felt that lack of technical knowledge was constraining them from reducing their energy use and from discussing energy improvements with others.

- There have been some positive changes in habitual energy-related behaviours following LCC activities, including better insulation, which has meant that thermostat settings have been turned down in some households.

- However, there has been evidence of a 'rebound effect' in reported increased use of appliances due to availability of 'free' electricity offered by solar PVs. The 'rebound effect' is the idea that the installation of energy efficiency technologies can lead to increased energy use due to negative changes in behaviours.

Social and economic impacts

- The community and household renewable installations have generated an income stream that is being held by the local not-for-profit community association, for use initially towards maintenance and then for additional environmental initiatives in the community.

- There were self-reported financial savings on electricity bills in four out of the five case study households with solar PV installed.

- There was qualitative evidence of warmer and more comfortable homes, linked to the physical interventions in some case study households.

- There was self reported evidence of increased cycling rate across Middlesbrough as a whole linked to Middlesbrough Environment City's (MEC's) cycling training and maintenance courses, dedicated cycle path and incentivised bike schemes for schools; cycling journeys in Middlesbrough rose from 150,000 in 2010 to 350,000 in 2014.

- Increased levels of resident engagement in energy-related community activities (e.g the Eco Gala).

- Self reported anecdotal evidence of an increased sense of community pride reflected in the reduced graffiti and crime rate since project began.

6 Sustainability, Scalability and Replicability

Financial sustainability

- Eco Easterside has been successful in securing both capital funding for physical measures and revenue funding. It has sought to supplement grant funding with income generated by community renewable projects. However, the net income from the Feed-in-Tariff (FiTs) is smaller than anticipated after provision for maintenance, so the partnership will continue to rely on grants to pay staff and reinvest in future projects.

- The DECC capital funding did not provide an ongoing budget line for project management, or for related behavioural- or capacity-building projects, even though the renewable installations involve time-consuming administration and follow-up over a 25-year period.

Scalability

- The partnership approach and success in securing funding has enabled projects to be implemented at scale within Easterside and in other areas of Middlesbrough. However, as in other LCCs, Eco Easterside projects face a range of external structural influences that constrain the scale, pace and reach of change.

- At upstream level in relation to government these included: inconsistent government leadership, mixed messages about tackling climate change, reduced interest in changing attitudes & partnership working, lack of revenue funding for project management, financial cuts, short time frames and lack of budget for capacity building for government grants, and administrative delays on the Feed-in Tariffs (FiTs).

- The partnership faced less external constraints at midstream and downstream level due to effective partnership working, although low aspirations and the invisibility of energy use were mentioned as constraints.

Replicability

- Eco Easterside's change strategy and projects are highly relevant to other communities, and there is much that other LCCs have, and could, learn from them. However, the replicability of other LCCs undertaking renewable generation projects may be limited because of EU state aid rules which now prevent communities from receiving both capital grants and the FiTs, the possible future reductions to the FiTs, and the absence of low-cost loans.

- Wealthier communities can raise capital through share offers, but this possibility needs to be tested in poorer communities. Conversely, it may be difficult for low carbon communities in non deprived areas to attract capital grants for energy efficiency and renewable measures funded under the Energy Company Obligation (ECO) to benefit the pockets of low income and fuel poor households in their areas.

7 Recommendations

- The following recommendations are contingent on financial and human resources being available.

Engagement and involvement

- Provide opportunities for new resident volunteers to get involved in community engagement and project delivery activities in a more structured way.

- Work with the Energy Champions to design a programme of structured outreach to engage other residents, and provide additional training if needed.

- Inform residents about project outputs and outcomes (see below), and if appropriate provide information about climate change impacts and actions by other local, national and international actors.

- Provision of low-cost practical remedies including radiator reflector panels and draughtproofing to help minimise heat loss through the building fabric and engage residents.

Behavioural advice and provision of feedback

- Strengthen technical and behavioural advice and support to residents through:

- Individual tailored advice to residents benefitting from energy efficiency or renewable measures from trained advisers or energy champions, using EDMs as a tool to manage energy and learn about it.
- Targeted information to residents about energy efficient appliances as well as training on accessing low energy appliances and possibly funding them e.g. low interest loans through the credit union.
- Regular advice surgeries at community hub from MEC staff or energy champions.
- Group- action learning groups by using or adapting the approaches used by Sustainable Blacon, Carbon Conversations, Low Carbon Living Programme, or Transition Streets.
- Community-wide awareness programme relating to heating including thermal imaging survey and workshop.
- Further knowledge and awareness workshops/training relating to use of LZTs (particularly solar PV).

Delivery and installation of fabric and technical measures

- Ensure seasonal commissioning procedures are in place to ensure LZTs are working properly.

- Use quick diagnostic tools such as thermal imaging immediately after installation of insulation and draught-proofing, to ensure works have been completed to a satisfactory level.

- Support the provision of concise, easy-to-understand user guides (in variety of formats) on 'unfamiliar' technologies for ease of use, operation and maintenance requirements.

Monitoring and evaluation of activities

- Maintain a dedicated monitoring programme for LZTs and efficiency measures to:

- Monitor performance;
- Uncover issues/faults as early as possible;
- Provide feedback to occupants and other stakeholders.

- Set up a programme of annual thermal imaging surveys across the community to provide diagnostics on retrofitted cavity wall insulation (can be linked to engagement and provision of feedback programmes).

- Design and implement a simple and participatory monitoring and learning system to capture information about selected carbon, financial, social and economic outcomes and impacts, and communicate these to residents and other stakeholders.

Contents

Image: EVALOC team


EASTERSIDE
Eco Gala Day
Thursday
25th July 2013
11am – 3pm
Easterside Community Hub,
St Agnes Church, Shopping Precinct
and Bexley Close Allotments,
HELP SAVE OUR PLANET
For more information
Ring Sam Scott: 01642 513151 / 513

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 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 only patchy evidence about outcomes and impacts (DECC, 2013).

This paper summarises the findings from the EVALOC research project (www.evaloc.org.uk) relating to the effectiveness and impacts of Eco Easterside, an award-winning local partnership that aims to reduce carbon emissions and to promote sustainable and healthy living.

Table 1.1 outlines the main community characteristics.

Figure 1.1. Physical location of Easterside

Easterside is ***"historically a community of place – a very well defined neighbourhood… with a neighbourhood plan with environmental elements"*** but ***"cannot yet be considered as a low carbon community"*** although ***"it is moving towards becoming one."***

Figure 1.2. Street view of Easterside. Image taken from GoogleMaps.

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[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 Easterside low carbon community

	Description
Location	North East England
Geographical Type	Suburban (Middlesbrough)
Socio-economic status	Disadvantaged (in top 20% disadvantaged neighbourhoods in the country based on indices of multiple deprivation)
No. of households	1,328 (3,250 people)
Housing stock characteristics	1960s Terraced/semi-detached
Tenure characteristics	34% social housing
Local facilities	• Small shopping area with library & community centre • Two primary schools • Adjacent to James Cook Hospital • Sports facilities • Social club
Transport links	Good road access and bus links to Middlesbrough city centre and surrounding area
Local low carbon context	Multi-agency approach between Middlesbrough Council, Middlesbrough Environment City, housing associations and other statutory bodies
Low carbon community project	Eco Easterside
Stage of LCC development	Existing
Vision	The partnership's aims are: • To reduce local CO_2 emissions. • To contribute to sustainable, healthy living. Its objectives are based on One Planet Living's ten sustainability principles[2]: • To raise residents' awareness about carbon emissions. • To help residents reduce their energy use and energy bills. • To encourage residents to use active, sustainable transport. • To encourage residents to grow their own food and reduce waste.
Main funding avenues	Council, National Lottery, Central Government, FiT
LCC characteristics	Multi-agency partnership
Roles & responsibilities	• Middlesbrough Environment City (MEC) – lead implementation. • Middlesbrough Council – enabling role (provides finance, tenders for installers/contractors, and legal support and community engagement) • Erimus housing association – helps engage community and deliver energy efficiency improvements to tenants. • Residents – co-design projects and help engage other community members.
Core team members	• Charity, agency and council staff are paid. • Local residents are voluntary, including 20 Energy Champions.

[2] http://www.oneplanetliving.com/index.html

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,

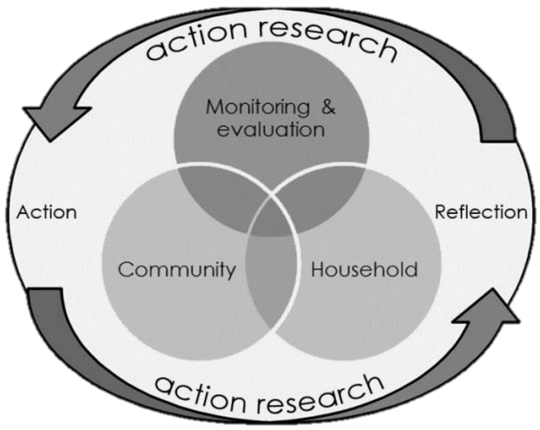

Figure 1.3. Overall research approach of EVALOC

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 and conducted research at three Eco Easterside community events (Case Study Box A) and a carbon mapping workshop.

Some caution is needed in interpreting qualitative findings as the majority of research was conducted with respondents linked to the LCC.

CASE STUDY BOX A: Eco Easterside Gala Day

‘What on *earth* are we doing?’

July 25th 2013

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

Event audience: local community

Event Objectives: to increase awareness and understanding of environmental issues (including energy saving, recycling, water harvesting), and healthy life styles.

Event Description: The event was held in the centre of the Easterside estate at the Easterside Hub, St Agnes Church and the Shopping Precinct. Mix of information stalls (all relating to One Planet Living themes) practical demonstrations (e.g. cooking, chip pan fires, allotment), and activities such as a competition, trail (to allotment with a quiz), raffles, bouncy castle, climbing wall, go-carts and face painting.

Attendees: approximately 1000 over the day

Feedback forms: 35

What people learnt: 60 % of respondents (21 out of 32 respondents) said the most useful thing they learnt related to one or more of the one planet themes including energy saving. Respondents learnt about a range of One Planet Issues including saving water and energy, recycling, climate change and the environment, health eating, health and safety. There was also important incidental learning including that; “…community events are fun and people want change.”; “…how kind people are.”; “…that Easterside is a good community.” and “…how just by using your brains you can make a difference”. One woman who chatted to the EVALOC researcher talked about the relationship between self-esteem and behaviour change, and suggested that parents with low self-esteem were less likely to listen to their children’s messages on climate change or energy use.

How people learnt: Most people learn by listening, reading, talking and speaking to people, watching demonstrations, posters, observing and ‘doing it’. Interaction with stall holders and other people, watching demonstrations and trying and testing things were particularly important.

Motivations, capabilities and intentions: 67% of respondents said they felt more motivated to save energy of which 6 people said this was for financial reasons and 4 said it was for pro-environmental or social reasons (e.g. for future generations, not to pollute the earth).

50% said that the event had increased their ability to save energy in their home, and 67% said they intended to make changes to their home energy use as a result of coming to the event (this included saving money and doing good for the world, using less water or energy and saving money).

Chapter 2

Findings

2.1 Roles and capabilities

Middlesbrough Council had subcontracted lead roles environmental and energy projects to Middlesbrough Environment City (MEC), a town wide charity. The council played an enabling role (providing finance, tenders for installers/contractors, and legal support and community engagement). Erimus Housing Association helped engage the community and deliver energy efficiency improvements to its social tenants. Residents participated in co-designing projects as well as helping engage other community members. The partnership approach built on previous joint work on regeneration issues.

The partnership sought to undertake all the energy and carbon reduction roles identified by EVALOC The team felt relatively confident about their ability to engage residents, enable the installation of renewables and energy efficiency measures in homes, and address fuel poverty, which is reflected in the high levels of uptake of renewable and energy efficiency measures (both from LCCC funded projects and previous initiatives). This effectiveness can be attributed to a number of factors including:

- The range of staff and expertise the partnership can draw on;
- The neighbourhood and town wide approach which increased its ability to access capital grants and deliver at scale;
- The joined-up information and advice provided to residents on related affordable warmth issues;
- The relevant and accessible nature of its communication messages and engagement methods (see below).

On the whole the roles undertaken by the organisations participating in the Eco Easterside partnership reflect their capabilities. Nevertheless, some team members felt that residents' participation in the projects could be enhanced if some of the roles carried out by local residents' could be funded rather than voluntary. As one focus group participant said '*they can't continue running the whole project on thin air*'.

The project team felt relatively less confident about its capability to empower people, change their behaviours or develop innovatory approaches to reducing energy use. As one focus group participant in the partnership case study said;

"*That is the easy bit, the physical bit, the interest in fuel poverty, you know, the installation of things. The harder bit is changing people's attitudes and all the things that flow from that as that takes longer, and I think however well we do it, it takes longer because that's the way people change"*.

Nevertheless, over time the team's confidence to undertake behaviour change has grown. As one team member said at the final focus group;

"*Just putting those things on won't effect a change… **what actually brings the change** is that combination of something big [the renewable interventions] that everyone sees and then the drip feeding of activity, these things like the plays, like the energy efficiency workshops, doing a cycle workshop and it's that combination of things."*

2.2 Overall change strategy

In 2010 Eco Easterside won a £400,000 capital grant from the Department of Energy and Climate Change (DECC) as part of the Low Carbon Community Challenge (LCCC) to undertake specific energy-related activities. As Table 2.1 shows, the DECC-funded projects form one part of Eco Easterside's overall strategy. The DECC funding allowed them to do things that were not previously on their agenda such as installing wind turbines. However, there was no funding for capacity building or ongoing project management.

Taken together, Eco Easterside's projects help residents overcome some of the key economic, technical and social influences constraining them from reducing energy use and carbon emissions. At *downstream level* (i.e. with residents) the Eco Easterside team has designed highly relevant and accessible communication messages (around the One Planet Living concept), engagement methods and projects, tailored to the needs of local residents. The household energy projects address economic and technical barriers to carbon reduction by coordinating the installation of free energy efficiency measures and household renewables and related advice on affordable warmth issues. The team also seeks to influence energy behaviours through demonstration projects, training of energy champions, and running a range of complementary projects aimed at promoting sustainable and healthy living.

At *midstream level* (i.e. with other local organisations), Eco Easterside engages in highly effective partnerships working with other organisations, both within and between communities, that enables the scaling up and dissemination of activities, and also shares learning with other communities. At *upstream level* (i.e. with government), the partnership team engages in dialogue with government, although it has not sought to engage residents in policy influencing.

The academic literature highlights the importance of ***learning processes*** to test change assumptions and inform future strategy. The partnership has been in a number of external research projects including the DECC LCCC evaluation and EVALOC and Monitoring and Evaluation for Sustainable Communities (MESC). It is also increasingly devising and conducting its own internal monitoring and evaluation (M&E).

Table 2.1. Eco Easterside roles and activities

Role	**Eco Easterside activities**	***Additional support/funding***		
		DECC-funded activities	*EVALOC supported activities*	*Other funding sources*
Downstream – with residents in the community				
Community engagement	Financial incentives (free home energy improvements) and installation	✓		✓
	Letters, door-knocking, face to face			✓
	Presence at community events/on streets			✓
	Physical demonstration projects with households and local schools	✓		✓
	Training of community champions			✓
	Community events including 3 EVALOC-supported community events (2 school plays, and Eco Gala day)		✓	✓
Physical interventions (community level)	Renewable energy generation (2 community wind turbines at local schools; solar PV on community centre)	✓		✓
	Air source heat pump installed in local cafe	✓		✓
	Community electric car club	✓		✓
	LED street lighting	✓		✓
Physical interventions (household level)	Free cavity wall insulation for 373 households and loft insulation for 509 households			✓
	Installation of 10 solar PV systems, 6 solar thermal systems and 4 air source heat pumps (ASHP)	✓		✓
Behaviour change (community level)	Community events including 3 EVALOC- supported community events (2 school plays, and Eco Gala day)			✓
	Community events including 3 EVALOC -supported community events (2 school plays, and Eco Gala day)		✓	✓
	Complementary community sustainable food, transport and wildlife projects, and working with local schools			✓
Behaviour change (household level)	Personalised advice & support from dedicated project officer on use of technologies and energy behaviours			✓
	Free energy assessments			✓
	Training of 20 local energy champions	✓		✓
	Energy display monitors (600 households) & power-down plug-ins to switch off standby electricity (300 households)	✓	✓	✓
	Advice and support on affordable warmth (income maximisation, energy bills, damp etc) through leaflets & stalls at community events, and front line workers	✓	✓	✓

Table 2.1.cont. Eco Easterside roles and activities

Role	**Eco Easterside activities**	***Additional support/funding***		
		DECC-funded activities	*EVALOC supported activities*	*Other funding sources*
Midstream - with other actors at local level to provide infrastructure and services				
Partnership/ Joint working	Integrated advice by Council and agency workers on affordable warmth			✓
Catalysing action by other local actors	Multi-agency partnership working and joint projects			✓
	Local media			✓
Dissemination	Participation in shared learning events with EVALOC communities		✓	✓
	Participation in Tees Valley Affordable Warmth Group, British Gas Fuel Poverty Seminars, and other events			✓
	Sharing and demonstrating projects with other communities eg electric cars			✓
	Local and national media			✓
Upstream- with government or national level interest groups to inform government policy				
Dialogue with government	DECC visits to community	✓		✓
	Participation in DECC events	✓		✓
Cross-cutting activities				
Group processes	Project management			✓
Monitoring, learning and evaluation	Some self-monitoring			✓
	DECC LCCC evaluation	✓	✓	
	EVALOC research project		✓	
	MESC research project			✓

2.3 Community engagement

As outlined in Table 2.1 above, Eco Easterside successfully used a range of methods to motivate and engage the community to get involved in its sustainability and healthy living projects. Table 2.2 outlines the approximate numbers reached through Eco Easterside's engagement activities.

As Easterside is an area of multiple deprivation, many of the beneficiaries can be assumed to be on low incomes. Between 8-10% of households are unemployed, 30-33% are on benefits, and 35-41% have no formal qualifications. Both the local primary schools have a high proportion of students eligible for the pupil premium grant (additional funding given to publicly-funded schools in England to raise the attainment of disadvantaged pupils), although they have a low proportion of pupils who speak English as a second language.

The following sections assess some of Eco Easterside's engagement methods.

Accessibility and relevance of project design

A key factor influencing community involvement is project design. People are more likely to get involved in a project or activity if they feel it is relevant and accessible to them. 10 out of the 12 respondents in the household interviews that got involved in the Eco Easterside projects strongly agreed, or tended to agree, that Eco Easterside projects were both accessible and relevant to individuals within the community. 11 out of 12 respondents strongly agreed, or tended to agree, that Eco Easterside was helping people like themselves to reduce their energy consumption, and 10 out of 12 agreed that it was helping people like themselves reduce their bills (Figure 2.1).

The relevance and accessibility of Eco Easterside's work is due to a number of factors. The partnership has involved residents not just as project beneficiaries but also in the co-design and implementation of projects, building on the long history of partnership working and resident involvement in regeneration projects over more than a decade. It also reflects its ability to access and provide free energy efficiency measures and renewables to some residents as well as the enthusiasm and hard work of the project team. A number of respondents mentioned that the (paid) project worker was very approachable ('brilliant').

Table 2.2. Numbers of residents engaged and activity types

Activity	***People reached/engaged***
General engagement	
	Newsletters : **1,328** households
	Leafleting and door knocking : **1,328** households
Community renewable projects	
	2 x 6 kW wind turbines at 2 primary schools: seen by **257** and **142** pupils/families respectively
	5.16 kw solar PV on community centre : potentially seen by **1,328** households
Community events	
EVALOC supported energy related events	**1000+** people attending Eco Gala day **25** people attending 1st primary school play **50** people attending 2nd primary school eco performance
Eco Easterside presence at general community events	Annual Fun Day **1000+** World War Commemorative event **65.** Hanging basket making **50**: Wreath making. **40** annually.
Household energy projects	
DECC-funded	**10** Solar PV, **5** air source heat pumps and **5** solar thermal installations
DECC-funded	**600** free energy displays
Other funding	**225** loft insulations and **129** cavity wall insulations in 2011 for households that were just above benefit qualifying level
Other funding	**244** cavity wall insulations and **284** loft top-ups insulated by Go-Warm
Other sustainable living projects	
Other funding	**147** participants in sustainable food projects.
Other funding	**635** participants took part in sustainable transport projects such as accredited cycle maintenance and learn-to-ride training sessions. Bike events at local cycle circuit and childrens' bike fun days.
Other funding	**135** participants from **Year 3** in pedestrian training in the 3 schools.
Other funding	**165** participants in the "Forest Schools" project from 2 schools
Other funding	**110** participants attended courses at the "Big Dig Allotment project" in the Bexley & Dawlish allotments on Easterside.

The project team were also adept at reducing resistance to the wind turbines and won round initial objections through arguments which emphasised the financial benefits to the schools. One of the objectors subsequently became one of the 'community champions' for the project.

Slightly fewer respondents in the household interviews felt that Eco Easterside was encouraging the community as a whole to reduce energy use, implying that some feel that it is not quite engaging with everyone it could on the estate. The limited number of household low-zero carbon technologies (LZTs) that were provided by DECC funding resulted in some 'jealousy' in the community, despite the fact that letters had been sent to everyone. This contributed to some confusion about how the panels had been allocated, with some residents regretting that they had not seen or responded to the letter offering them solar PV panels.

Energy messages

People are more likely to get involved in a project if they feel the issue it addresses is relevant to their lives. It is therefore sometimes assumed that the most effective way to motivate people to reduce their energy use is by focusing on the personal benefits to them such as saving money, particularly in disadvantaged communities, rather than on climate change or environmental messages.

Eco Easterside's communication messages are informed by One Planet principles and seek to motivate residents to live more sustainably and healthily by outlining both the personal, practical benefits of getting involved (such as health, financial savings) as well as wider environmental and social reasons (such as looking after the planet). As one focus group participant explained;

"I *suppose what we're trying to do is to motivate people into a sense of wanting to change, wanting to do something about it."*

These messages are shared and reinforced by all the agencies in the partnership.

EVALOC research findings suggest that these messages have resonated with residents. 14 out of 15 (three of which were from 'control' case study households) residents in the case study households strongly agreed or tended to agree that it is important to reduce energy in the home, and 13 out of the 15 that it is important to help the community reduce energy in the home. There were also high levels of social and environmental motivation among some residents. For example, the household surveys showed that a number of respondents got

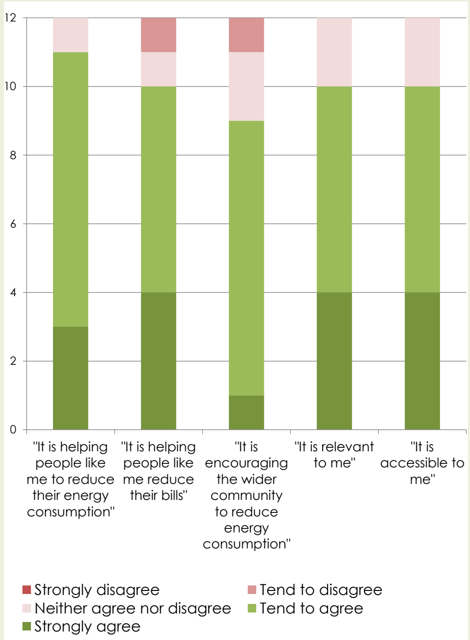

Figure 2.1. Accessibility and relevance of Eco Easterside activities (responses from EVALOC case study households (n12)

involved in Eco Easterside's projects for a mix of cost, environmental and social reasons;

"Finance, environment and future. Future for the rest…"

Similarly 40% of 38 respondents at the three EVALOC- supported community events said that they felt more motivated to reduce their energy use because of environmental or social reasons. A further 29% said they felt more motivated for reasons relating to their process of change (e.g. that their actions their actions mattered) and only 24% said it was for personal reasons such as saving money. Social and environmental motivations for reducing energy use were particularly evident at the Thomas More [school] Eco-Performance, which conveyed a strong ethical message about residents' responsibility to look after *'our beautiful planet'* as well as about individual action being meaningful[1]. As one focus group participant explained;

[1] 93% of the 32 respondents at the St Thomas More school production said they felt more motivated to reduce their energy use from attending the event, and of those who gave their reasons 37% mentioned that it was because they understood change is possible and meaningful (e.g. because 'they now knew what to do' or 'because they now know it is helpful [to take action]', because 'everyone and every little counts', 'it made me think') and 37% said it was

"I think there was a period a few years ago where the message was quite negative, it's too late to do anything about it now we've gone too far, we can't stop it therefore what's the point but I think this work that's happened through the eco-day and through the schools has energised people more to [say] Oh, we can do something, let's do it."

Research respondents also expressed relatively high levels of concern about climate change. EVALOC's in-depth interviews with 15 households showed that the majority of respondents were very or fairly concerned about climate change (13/15), although they were even more concerned about energy prices (15/15) and energy security (14/15) . Levels of concern regarding climate change in the households involved in the LCC (12) were higher than in the control group, and overall expressed higher levels of concern than the majority of the other case study LCCs (Figure 2.2). Similarly, when asked to give one word to describe how they felt about climate change, 47% of the 78 respondents at three EVALOC-supported community events (see future sections) used words expressing concern, worry or fear. However, unlike in other LCCs, a significant minority - 23% - used positive words to describe how they felt. Some of these respondents used terms such as 'motivated', which could reflect the positive impact of Eco Easterside communication messages and activities in the community. However, six respondents explained that they felt positive about climate change because they thought the weather would become warmer, a response not seen in the other LCCs. In addition three felt confused by climate change and 1 person had never heard of it, which suggests the need for continued education about the impacts of climate change.

There was a demand from some residents for more information and feedback about the project outcomes and impacts e.g. how far the project and residents' actions had reduced carbon emissions, as well as reporting on what other LCCs and governments were doing, and on international processes.

Social networks

Informal social networks influence how know how about energy is transmitted through the community. Low Carbon Communities (LCCs) can make use of, or shape, these networks to encourage people to get involved in energy projects and reduce energy consumption. Our social network Analysis (SNA) was conducted with all 15 of the household interviewees in Easterside:

1. All interviewees discussed energy in some form with people they considered very close or somewhat close to them, but conversations about energy were more likely to occur with those who were very close, such as family members. This was a common finding across all EVALOC communities.

2. The most discussed energy topics in Easterside were low-zero carbon technologies (LZTs), insulation, efficiency and energy prices (Figure 2.3).

3. The majority of interviewees (13/15) shared their energy knowledge to their personal networks, through either giving advice to, or being consulted by, other people in their personal network others. Again, they were more likely to give advice to people they considered were very close.

Social network theory suggests that having LZTs installed in the households has aided the dissemination of energy messages, as illustrated by the following quotes from Easterside:

> *"'…since I've got this solar heating a few people have asked me about it, whether it was worth it..." [male respondent]*

> *"One of my next door neighbour's enquired about the FiT programme and so I gave them information about that and told them about Environment City and gave them [project worker's]… phone number and explained about the project and what was involved in the project and …I try and promote the other things as well..." [female respondent*

However, overall findings from SNA research across the six case study communities suggest that having a low carbon technology in your house does not necessarily make someone more likely to talk about energy than people without them. This suggests that other criteria could be considered when recruiting energy champions such as whether the person is well connected in different networks, is known in a variety of contexts (i.e. not just connected to giving energy advice) and can communicate well.

It also suggests the importance of a continued ongoing role for more formal dissemination channels. Information about Energy Display Monitors was also shared through social areas such as the

for environmental reasons (e.g. 'because there is only one planet/world', because 'they want to help save the planet' or because they 'didn't want to leave a ruined one', or to save or conserve energy). However, a little caution is needed about these figures because a large proportion of forms were filled in by children from the neighbouring school who in some instances copied each other.

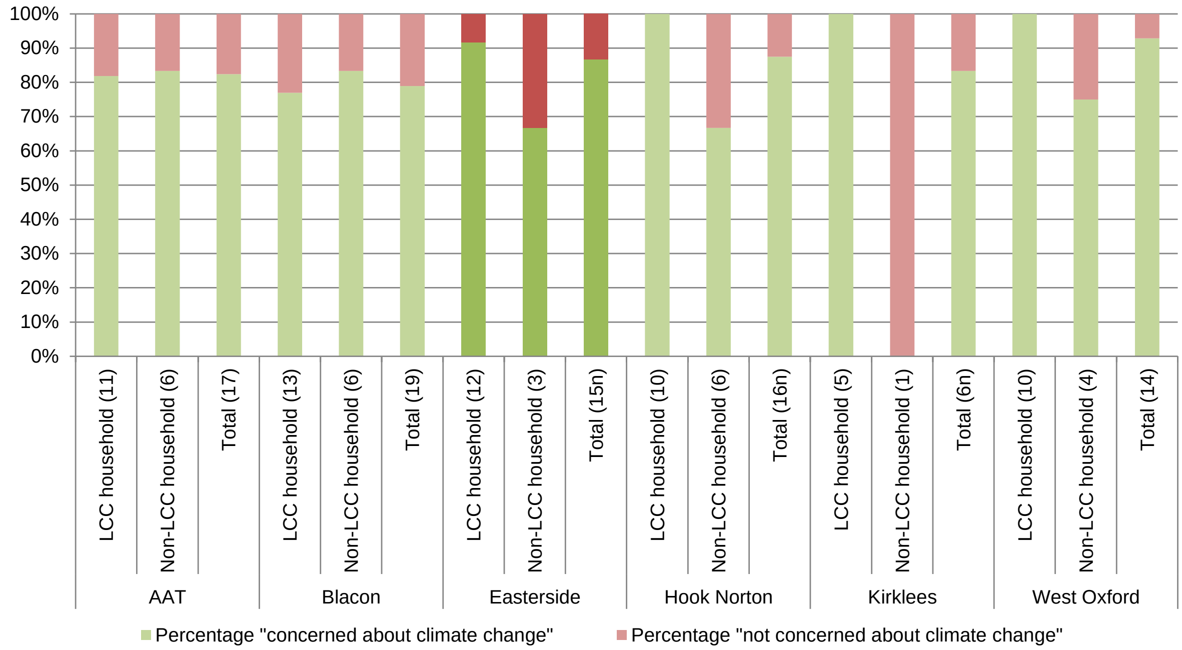

Figure 2.2. Responses from EVALOC case study households in relation to question, 'How concerned, if at all, are you about global warming/climate change.'

library and community hub; *"because I work in the library .. people have come in and I think there was a [energy display] monitor on there … I've talked to about monitors and so that's how it's come up."*

The analysis also revealed that energy is not a neutral subject, it is potentially laden with judgement and 'impression management', wherein the speaker includes fear of being labelled or dismissed, and the listener includes fear of being judged. However, drawing from the evidence in the interviews and SNA, the amount of 'energy stigma' in Easterside was very low compared to that experienced in other LCCs which were part of the EVALOC research project. This could reflect positively on the broad 'One Planet Living' approach adopted by MEC which focusses on personal health and financial, as well as the environmental benefits of action.

Suggested recommendations for the project team to widen the engagement and involvement of residents is to identify activities which aren't necessarily linked with energy, where energy messages could be incorporated / signposted to sources of energy information (formal and informal).

Energy Champions

Energy Champions took part in a 10 hour Open College Network (OCN) training focused on household energy saving and waste. In all 18 champions were trained between 2010 and 2011. All found the training to be helpful, although some felt that a 'generic course' was not sufficient on its own and would like further 'actual advice on the ground'. Another respondent suggested that helping others in their community to reduce energy use is complicated and that they lacked the knowledge of both energy and people;

"I wouldn't know how to approach somebody and say have you tried to reduce your energy by this means or that means."

There was also a sense among some of the Champions that they would like to be used more actively by the LCC.

Social norms

People are more likely to do something if they think other people like them are doing it (i.e. if they think it is the 'social norm'). LCCs can strengthen social norms about energy saving by involving residents in energy activities and communicating this to others.

In 2012 the respondents in the household interviews were split in their views about whether or not reducing energy use (or carbon footprint) was a normal thing to do in the community. By 2014, the views in the households that had been involved in the LCC had become more polarised, but the numbers (seven out of 12) agreeing or tending to agree that reducing your energy use (or carbon footprint) is the 'normal' thing to do in the community had increased (Figure 2.4), suggesting a positive change in the 'social norms' in the community.

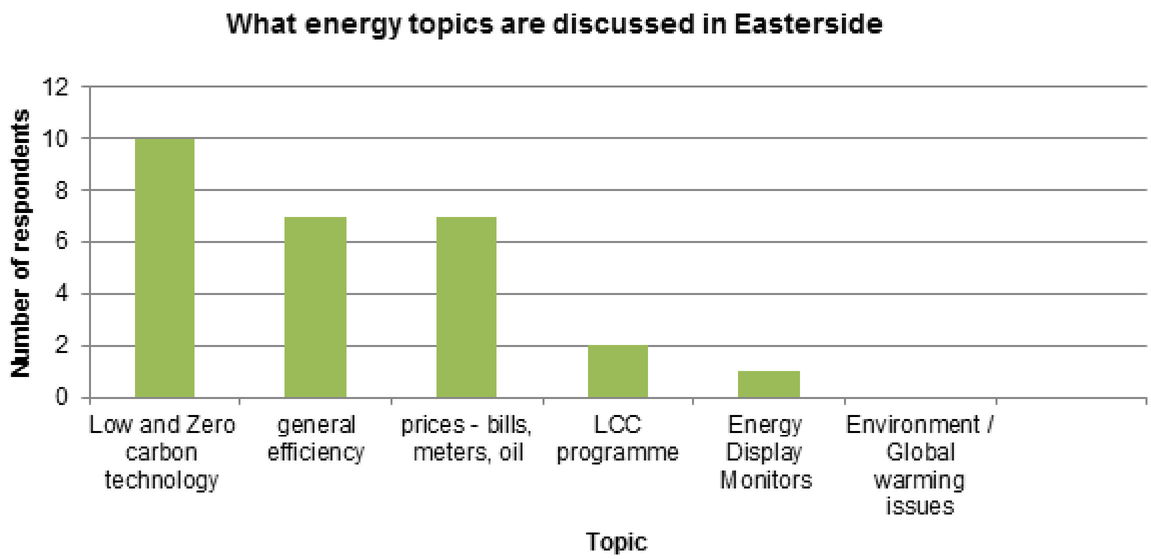

Figure 2.3. Energy topics discussed in EVALOC case study households

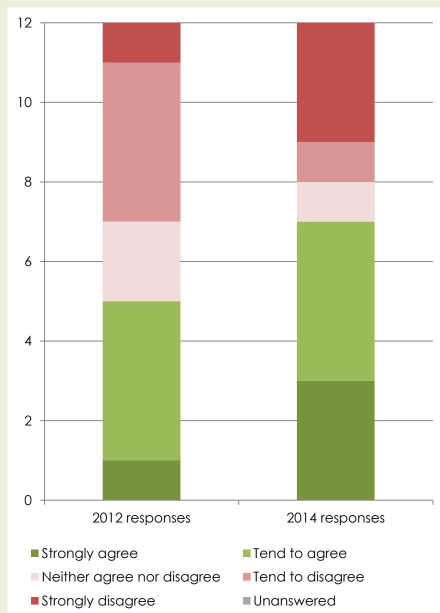

Figure 2.4 Comparative responses from EVALOC case study households (in 2012 and 2014) in relation to the question, 'In my area, trying to reduce your energy use (or carbon footprint) is the 'normal' thing to do'

Some residents pointed to all the low carbon activities now happening on the estate such as the *'solar panels, electric car that people could borrow'.* At the other extreme one resident felt that social norms were not changing;

"No one will save energy on this estate. They all have big fifty-inch tellies."

Linked to this, there was a sense from some residents in the household interviews that community involvement needed to be widened particularly with people who weren't part of the project initially;

"I'd like to see more done in that area [targeting people outside the project] and that's where would be and other people… part of the project could be useful".

Community and shared learning events

Eco Easterside held a number of EVALOC-supported community events in the community with a view to engaging residents and promoting learning action on energy related issues. The events included a school play and Eco-Performance at the two local primary schools and an Eco Gala day for the whole community. A total of 1,080 people attended the events and 89 feedback forms were filled in.

Analysis of feedback forms from the events indicates that they played an important role in engaging and motivating residents to take action. Most people attending the event said they felt more motivated to reduce energy use in their home (82/85) and that they intended to take action to reduce their energy use (63/83) as a result of attending the event. The events also helped residents learn about new energy saving behaviours and technologies with many respondents (43/84) saying that the most useful thing they learned was about energy. A large number said the most useful thing they learnt was about the process of change e.g. that their action were meaningful (17/84), followed by learning about environmental issues (13/84), social issues (8/84) with only two out of 84 mentioning saving money.

> *"The school has massive input into community. They have solar, they have the wind turbine you know and for the children at that school being brought up that way they're coming home and they're telling their parents so I would think this community as a whole is starting to listen."*

The feedback forms show that the main way people learnt was through watching demonstrations (33/65) and discussing or interacting with others (22/65).

Pupils' involvement in the school performances helped deepen their and parents' emotional engagement in the issue.

The Eco Easterside team participated in three EVALOC-supported shared learning workshops with other communities in Community-Council partnerships: Arts; Creativity and Climate Change; and Carbon Reduction in Communities of Disadvantages. Their contribution influenced the approach taken by Low Carbon West Oxford towards its fuel poverty strategy.

Engagement through renewable energy projects

Easterside used part of the DECC grant to implement community renewable projects at two primary schools and a community centre, as a means of;

(a) Raising residents' awareness of low carbon technologies, catalysing their uptake and possibly promoting behaviour changes,

(b) Generating an income for further environmental projects in the community and

(c) Reducing carbon emissions.

To this end, two small wind turbines were installed at St Thomas More and Easterside primary schools, and an ASHP at the community centre café. A small survey (25 respondents) was conducted by EVALOC at the local school and community centre to assess the demonstration or ripple effects of the school wind turbines. This provides some evidence that the wind turbine has changed attitudes and increased motivation and intentions. 22 respondents thought the school wind turbine project was a positive experience for the school, 17 said that as a result of the project they felt more positive about renewable energy, 15 said that they felt more positive that 'we can tackle climate change', 13 said they felt more motivated to get involved in community projects, nine said they had got involved with a community or energy project, and 13 claimed that they had been stimulated to save energy in their daily life.

2.4 Community carbon reductions and energy savings

In order to assess the effectiveness of the Eco Easterside 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 2.5):

- The wider local area level (approx. 1,164 households)
- Local neighbourhood level (242 households)
- Individual household level (15 households)

This section first outlines the renewable energy generation and carbon savings from community buildings in Easterside that were supported and funded through Eco Easterside activities. It then outlines changes in domestic energy use (gas and electricity use) at both the wider local area level and the local neighbourhood level. The following section (2.5) outlines the findings from the case study households.

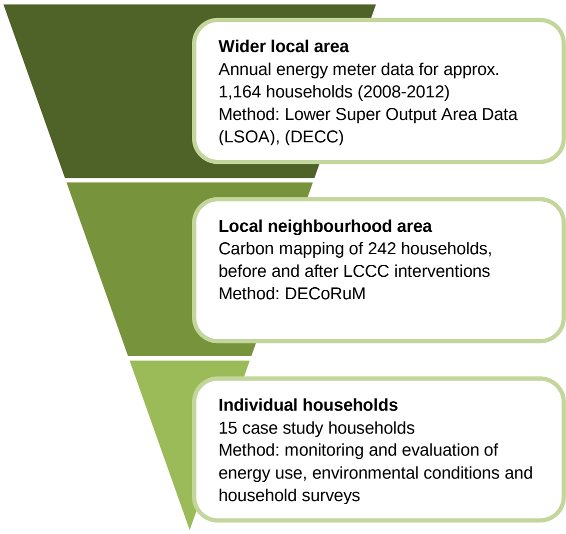

Figure 2.5. Graduated approach to assessing the changes in household energy use

Renewable energy generation and carbon savings from community buildings

Table 2.3 outlines the low-zero carbon and renewable technologies that were installed as part of the DECC funding on community buildings in the project area. The estimated total annual electricity generated (32,470 kWh) roughly equates to the annual total electricity use of ten average Easterside households (3,160kWh/yr each). In addition, 10 PV systems were installed in 10 households in the area. MEC and Fabrick Housing Group have monitored the PV generation of all 10 household systems (including all five of the EVALOC case studies) from their installation. Table 2.4 outlines the total generation and carbon savings from these systems. The electricity generated from these systems is the equivalent to the total electricity use of five average Easterside households over the same period.

Government statistics (DECC) indicate that these ten were the only domestic solar PV systems installed in the local area in 2011, however in the subsequent years (2012-2014), a further 20 domestic systems have been installed. This alongside informal discussions with residents suggest that the Eco Easterside activities have had a positive ripple-effect throughout the wider community; in terms of normalising low-zero carbon technologies and encouraging take-up of such technologies within the wider community.

Table 2.3. The LZTs installed on community buildings in Easterside through Eco Easterside activities.

Location	Type	Commi-ssioning date	Annual generation[3] (kWh)	Annual carbon savings[2] ($kgCO_2$)	Total generation[1] (kWh)	Total carbon savings[2] ($kgCO_2$)
Easterside primary school	6kWp wind turbine	May 2011	4,184	2,163	14,991	7,750
St Thomas More primary school	6kWp wind turbine	July 2011	6,166	3,188	21,582	11,158
Community centre	Two 2.58kWp solar PV systems	June 2011	4,890	2,528	17,521	9,058
EDRA café	Air source heat pump					
Totals			***15,239***	***7,879***	***54,094***	***27,967***

Notes:

[1] From commissioning date to 30/01/2015.

[2] Calculated using carbon emissions factor of 0.517 (SAP 2009) and the following calculation: Carbon savings = carbon factor*energy used.

[3] Based on actual generation data received from Middlesbrough Environment City.

N.B: - solar thermal and air source heat pump installations not included due to lack of data.

Table 2.4. Description of solar PV systems and their monitored generation installed on households in Easterside through Eco Easterside LCCC activities.

Household	System size (kWp)	Commissioning date	Annual generation[3] (kWh)	Annual carbon savings[2] ($kgCO_2$)	Total generation[1] (kWh)	Total carbon savings[2] ($kgCO_2$)
1	2.025	March 2011	2,043	1,056	7,830	4,048
2	2.025	February 2011	1,734	896	6,791	3,511
3	2.025	March 2011	1,949	1,008	7,471	3,863
4	2.025	March 2011	1,948	1,007	7,467	3,860
5	2.025	March 2011	1,833	948	7,028	3,633
6	2.025	March 2011	1,738	898	6,661	3,444
7	2.025	March 2011	2,048	1,059	7,852	4,059
8	2.025	March 2011	1,963	1,015	7,524	3,890
9	1.48	March 2011	1,171	605	4,489	2,321
10	1.11	March 2011	804	416	3,082	1,593
Totals			***17,231***	***8,908***	***66,195***	***34,223***

Notes:

[1] From commissioning date to 30/01/2015.

[2] Calculated using carbon emissions factor of 0.517 (SAP 2009) and the following calculation: Carbon savings = carbon factor*energy used.

[3] Based on actual generation data received from Middlesbrough Environment City.

Wider local area energy and carbon reductions

Figure 2.6. Highlighted area covered by LSOA data

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)[2] 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 2.6.

The wider local area energy data (Figure 2.7) indicate that there have been reductions in overall average household energy use in Easterside (whether or not they directly benefitted from the LCCC activities):

- Annual average household baseline (2008) gas and electricity use in the Easterside community was lower than the national average (15,407kWh in gas, 3,368kWh in electricity compared to national mean average of 16,906kWh in gas and 4,198kWh in electricity.
- The percentage reduction in annual average household metered electricity use was 6%, in comparison to national average of 4% over the period 2008-2012.
- Percentage reductions in annual average gas use over the same period were slightly lower than national average (15% in Easterside, vs. 17% nationally[3]).
- Overall reductions in average household carbon emissions (from gas and electricity use only) of 12% from 2008 to 2012 (UK national average was a 12% reduction also).

As previously stated, although it is not possible to directly relate changes in energy use to LCC activities, it is worth noting that a main focus of Eco Easterside was on local electricity generation, and the wider area data indicates a greater percentage reduction in electricity use. Perhaps a little disappointingly, the percentage reduction in gas use is not as high as the national average. However, not only was the baseline lower than the national average but Easterside is an area of multiple deprivation, and with many residents suffering from health issues. As such, it is likely that a trade-off between reductions in gas use (heating fuel) and thermal comfort is being made.

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[2] 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.

[3] National data used due to same base subnational datasets used; gas data from 1st October – 30th September (weather corrected), electricity data from 27th January – 26th January (not weather corrected).

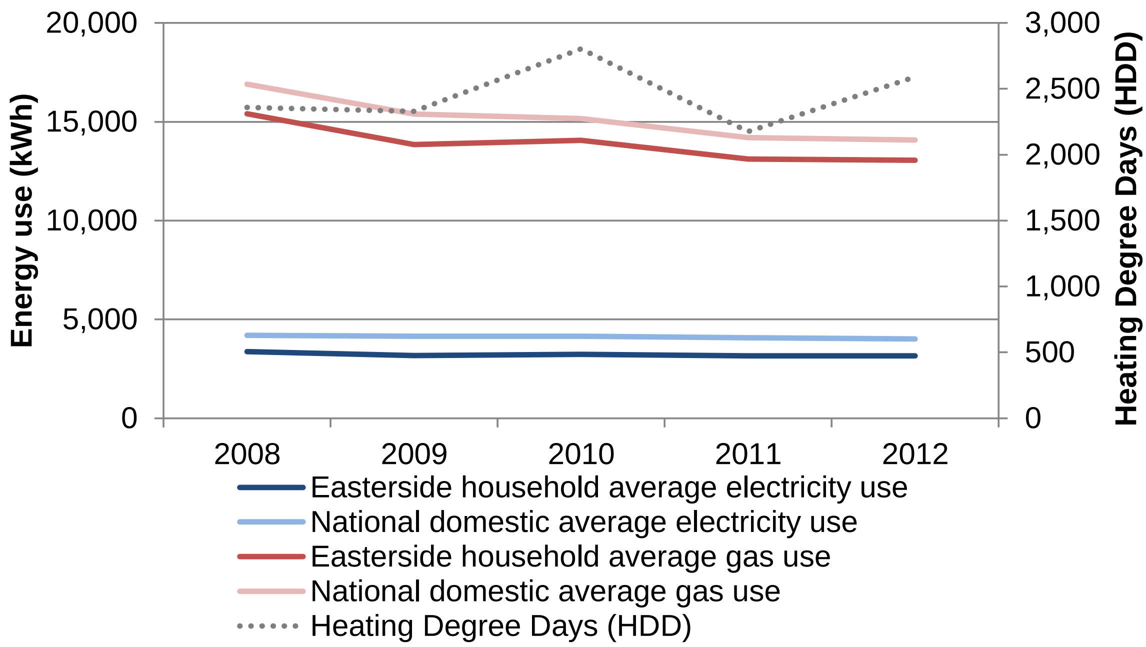


Figure 2.7. Average household annual gas and electricity use for the wider local Easterside area in relation to national averages

Local neighbourhood energy and carbon reductions

Figure 2.8. Area modelled in DECoRuM and carbon mapped

Carbon mapping[4] 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 2.8 shows the area in Easterside that was carbon mapped.

Baseline carbon emissions and energy use (2008)

Figure 2.9 shows the area mapped, and the level of estimated energy use in 242 households before LCCC funded activities in the area (2010-2011). Overall the average household carbon emissions at the baseline point was 5,141 $kgCO_2$ (22,079kWh or 274kWh/m^2).

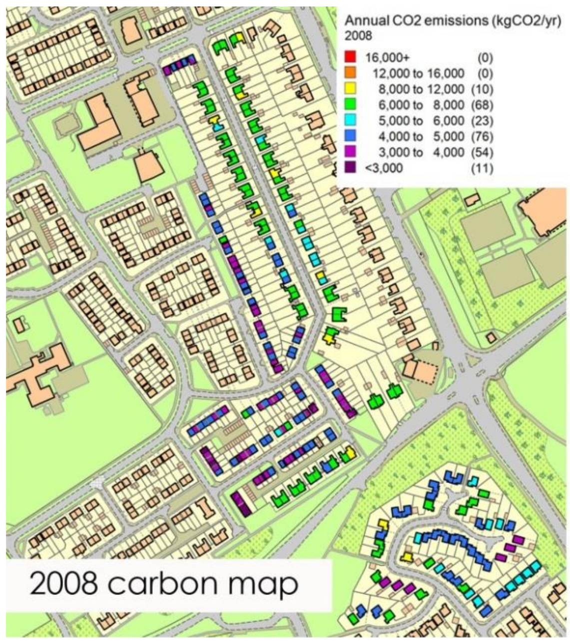


Figure 2.9. Carbon mapped area showing household carbon emissions before LCCC funded activities in the local area

[4] Individual carbon mapping case studies are available for the six communities in which recommendations are made for future activities. These can be found on the EVALOC website: **www.evaloc.org.uk**

Current carbon emissions and energy use (2012)

Figure 2.10 shows the current estimated energy use of households in the carbon mapped area. Overall the average household carbon emissions at this point was 4,595kgCO_2 (19,336kWh or 241kWh/m^2). Using the baseline and current carbon maps, it is estimated that 203 out of 242 households (84%) reduced their energy use from baseline figures, with an average percentage reduction of 11% in household carbon emissions. 26 out of the 34 households that benefitted directly from Eco Easterside activities (76%) were estimated to have reduced their energy use.

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 19% reduction
- Solid wall insulation was found to result in a mean 19% reduction
- Condensing boiler, cylinder and pipe insulation was found to result in a mean 23% 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 2.5. As Table 2.5 also demonstrates, for the area mapped in Easterside, it was found that reductions of up to 60% 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-£421 energy cost reductions
- Fabric and heating upgrade package: £253-£680 estimated energy cost reductions
- Fabric, heating and electricity package: £587-£954 estimated energy cost reductions

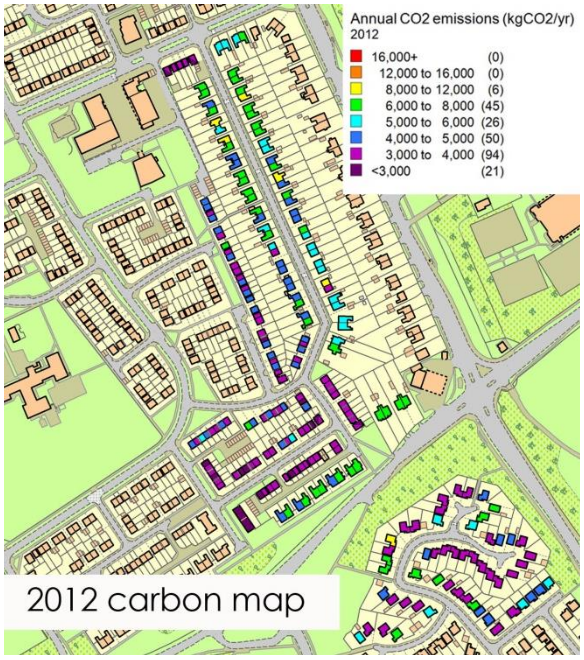


Figure 2.10. Carbon mapped area showing household carbon emissions after LCCC funded activities in the local area

Table 2.5. Impact of potential additional energy savings through packages of measures in local Eco Easterside neighbourhood area using DECoRuM carbon mapping modelling (based on 2012 levels)

		Package A: Fabric	Package B: Fabric & heating upgrade	Package C: Fabric, heating & electricity
Measures included:		• *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				
	*1965-80 terraced dwelling*	7%	34%	53%
	*1965-80 detached dwelling*	3%	27%	49%
	*1919-44 semi-detached dwelling*	30%	49%	60%
	*1965-80 semi-detached dwelling*	16%	38%	58%

2.5 Case study households

The following sections outline the effectiveness and impacts of Eco Easterside 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 15 households within Easterside; 12 benefitted directly from the Eco Easterside project and three are acting as 'control'. They are a mix of owner occupied (nine) and social housing (five), with one household living rent free. Figure 2.11 outlines the main household types. The 15 households included 39 adults and 10 children, with an average main respondent age of 56 years old. 11 out of the 15 main respondents were female. Eight were unemployed due to long-term sickness and/or looking after family members. Only three of the 15 households are occupied during the evenings and weekends only; the rest have at least one occupant present for 'most of the time'. On average, the households had lived in their home for 21 years at the time of the first interview (2012).

The dwelling characteristics are typical of the area (Figure 2.12); terraced dwellings built between 1945 and 1964. Of the dwellings, only one was of solid wall construction.

Table 2.6 outlines the main dwelling and household characteristics as well as types of physical and/or behaviour change interventions present.

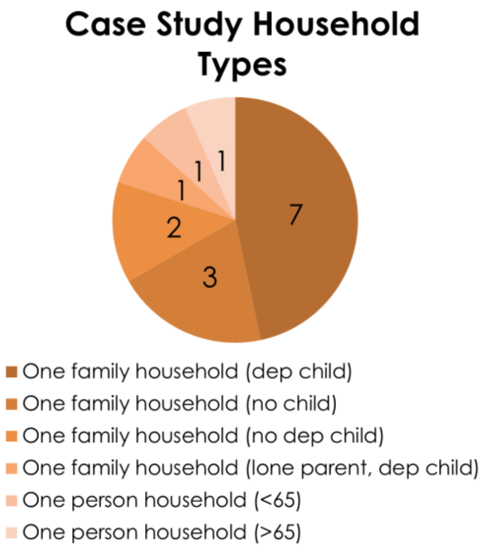


Figure 2.11. Case study household types

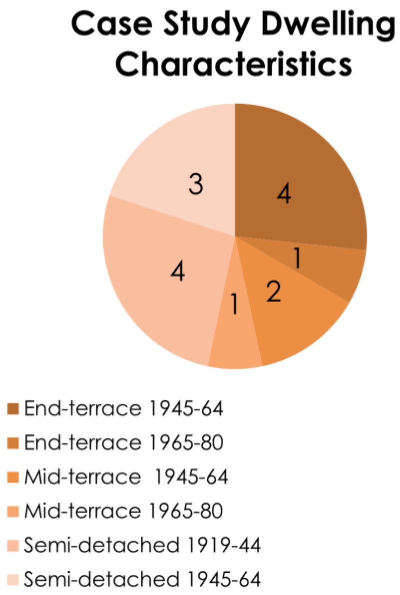


Figure 2.12. Case study dwelling types

Table 2.3. Characteristics of the EVALOC case study households in Easterside

SortNo	Dwelling Type & Age	Tenure	Occupancy patterns	Household Type (Summer 2012)	Improved Heating System Installed (post-2005)	Predominant Wall Construction	Wall Insulation Improvements	Predominant Glazing Type	Improved Loft Insulation	LZTs Present	Energy display monitors*	Energy Champion course
H37	SD 1919-44	OO	E&W	2A 1C	✓	CW	✓	DG	✓	ST	✓	✓
H38	SD 1919-44	OO	E&W	2A	✓	CW	✓	DG	✓	PV	✓	✓
H39	ET 1945-64	SH	ALL	3A	x	CW	✓	DG	✓	PV	x	✓
H40	ET 1945-64	SH	ALL	3A	✓	CW	✓	DG	✓	PV	✓	✓
H41	SD 1945-64	OO	ALL	2A	✓	CW	✓	DG	✓	ST	✓	✓
H42	MT 1965-80	SH	ALL	3A 1C	✓	CW	✓	DG	✓	PV	✓	✓
H43	MT 1945-64	OO	ALL	5A 1C	✓	CW	✓	DG	✓	x	✓	x
H44	SD 1945-64	OO	ALL	2A	✓	CW	✓	DG	✓	x	✓	x
H45	ET 1965-80	SH	ALL	1A 2C	✓	CW	?	DG	?	x	✓	x
H46	ET 1945-64	SH	ALL	4A 1C	✓	CW	✓	DG	✓	PV	✓	✓
H47	SD 1919-44	OT	ALL	4A 2C	✓	CW	✓	DG	✓	x	✓	x
H48	MT 1945-64	OO	ALL	1A	x	CW	✓	DG	✓	x	✓	x
H49	SD 1945-64	OO	ALL	3A 1C	x	CW	✓	DG	✓	x	x	x
H50	SD 1919-44	OO	ALL	3A 1C	✓	SW	x	DG	✓	x	x	x
H51	ET 1945-64	OO	E&W	1A	x	CW	✓	DG	✓	x	✓	x

Notes:

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 library.

Interventions in case study households

In terms of physical interventions (Figure 2.13), the majority of households (13) have all 'standard' fabric measures (double glazing, cavity wall insulation and loft insulation). Eight have a condensing boiler installed (either a combi or standard). Five households have solar PVs installed and two have solar thermal systems installed. Seven of the households were involved in Eco Easterside's Energy Champions course and 11 had an energy display monitor in their home (either through the energy supplier, Eco Easterside or EVALOC).

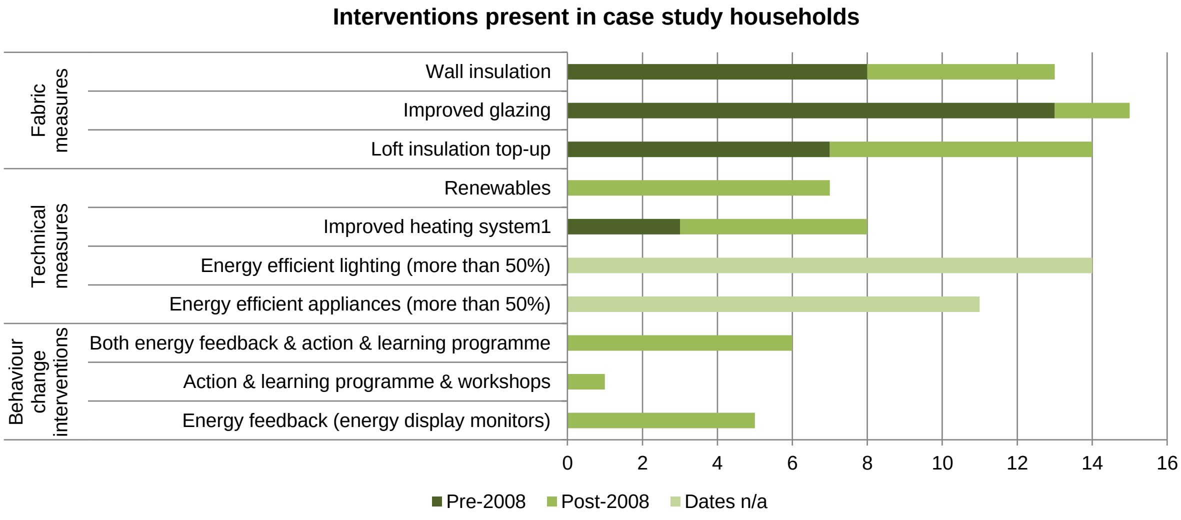


Figure 2.13. Physical and behaviour change interventions present in case study households

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 2.7 and Figure 2.14 outline the key problem areas found during the survey, as well as highlighting the constraints on interpretation. There were particular issues in Easterside in relation to 'patchy' finishes to the majority of the dwellings, indicating possible issues with the installation of cavity wall insulation, particularly around bay windows and under windows and infill panels. In addition, there were potential maintenance issues such as the delamination of wall cladding highlighted, which can also 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 Easterside households, which can be found on the EVALOC website; ***www.evaloc.org.uk****.*

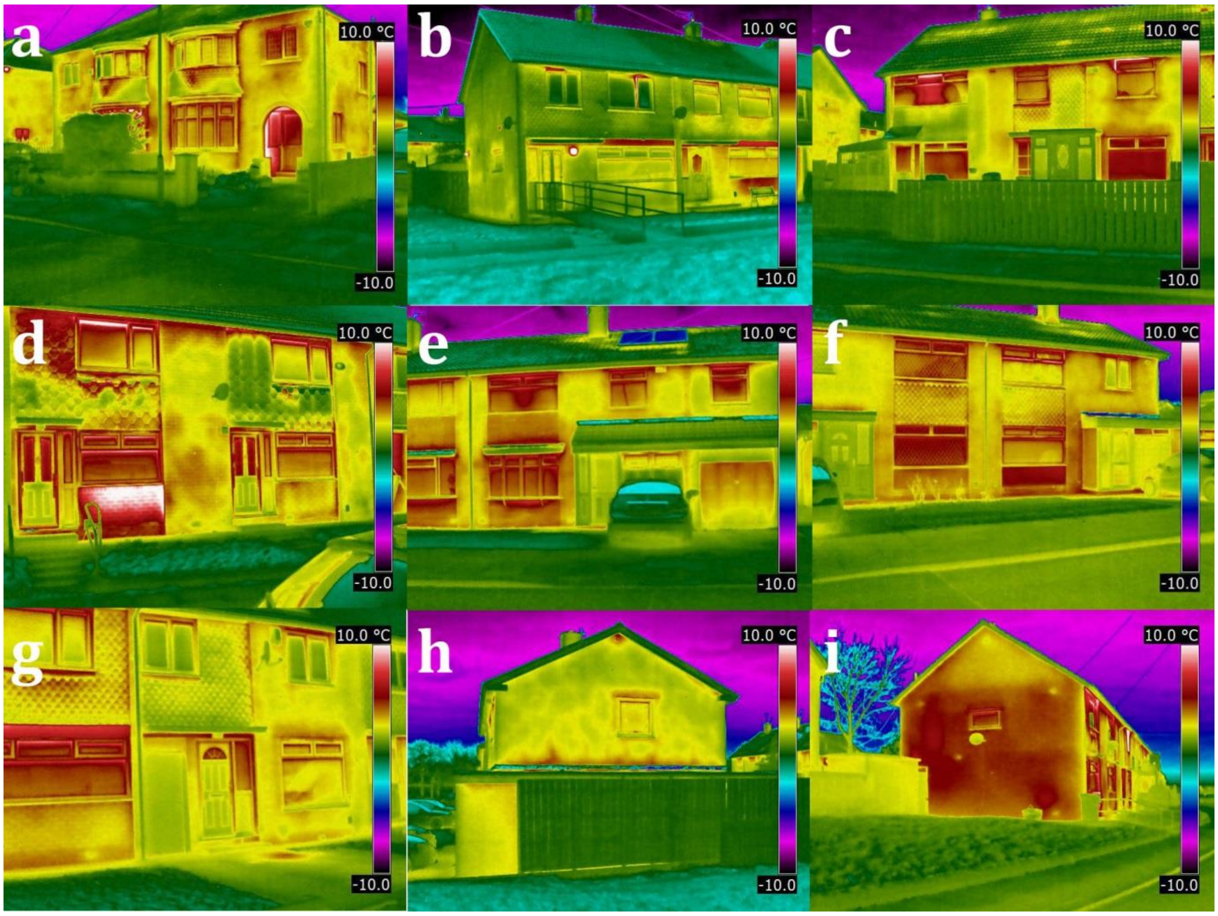


Figure2.14. Images of dwellings in Easterside; all are cavity wall construction, with insulation (Image i unknown).

Table 2.4. Typical issues uncovered through thermal imaging of case study households (to be read in conjunction with Figure 2.14).

Problem area	***Potential issues highlighted***	***Potential constraints on interpretation***
Roof and eaves		
Eaves and loft (images d, f, h & i)	- 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
Joints/ connection details (images d, 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
Walls		
Patchy walls (images a – i)	- 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
Windows and doors		
Heat loss around lintels (images b, c, f & g)	- 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 a & e)	- 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 a - g)	- 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
Door alcoves (image a	- Lack of insulation in external walls in door alcoves - Poorly fitting doors and/or original doors and glazing panels retained with poor sealing/draught-proofing measures	- Sheltered nature of feature, resulting in slow dispersal of heat accumulated here during daylight hours
Other		
Ground level heat loss (image 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

Performance and use of low-zero carbon technologies

As part of the EVALOC project, five households with solar PV were monitored and evaluated from November 2012 to December 2014. Due to space and monitoring equipment issues, daily PV export data are not available for all of the systems. The following section outlines the findings from data available.

Efficiency and performance of case study solar PV systems

All but one of the EVALOC monitored solar PV systems are generating more than expected per annum. However, even this system (H38) is generating more or less what is predicted (Table 2.8).

In terms of the efficiency of the systems, they range from 10-13%. Whilst this is within the 'typical' efficiency range of PV systems, the estimated performance efficiency of the panels is 14% (PV system: Multicrystalline LG225P1C panels (http://www.lg.com/us/commercial/solar-panels/lg-LG225P1C)).

Factors that can influence the performance of solar PV systems include:

- Weather and seasonal variations (solar irradiation and power dissipation)
- Orientation and over-shadowing (from trees, nearby chimneys etc)
- Soiling of PV panels (dirt, snow, fallen leaves, pollen)
- Temperature of the PV module
- Efficiency factor of the PV modules
- Efficiency of the inverter (and relative sizing to the PV modules)

Use of PV-generated electricity

As Table 2.8 also demonstrates, the households are using approximately 45-50% of the PV-generated electricity. This is true even in households that are occupied most of the time, and that are theoretically more able to use the majority of the PV-generated electricity; as Case Study Box B emphasises. H39 (case study household in Case Study Box B) uses 45% of the PV generated electricity, despite the peaks in PV generation being significantly more than the highest peak in the overall household electricity use (during the evening) during the summer months. Such findings highlight the impact lifestyle factors have on the ability of occupants to take advantage of the PV generated electricity, and the need for either battery storage facilities in dwellings with solar PV systems or significant changes in occupant behaviours to take advantage of the PV generated electricity on site.

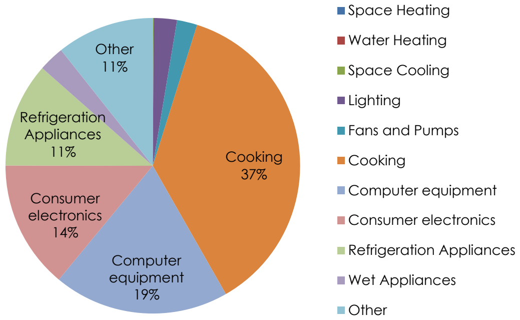
Table 2.5. Characteristics and performance of solar PV systems in case study households

SNo	Occupancy patterns	Orientation of PVs	System Size (kWp)	Predicted annual generation (kWh)	Actual annual generation (kWh)	% Performance	Actual efficiency of system	% of Generated Electricity Used
H38	E&W	SW	1.11	787	**785**	100%	10%	50%
H39	All	SE	2.025	1,664	**1,975**	119%	13%	45%
H40	All	SE	2.025	1,664	**1,989**	120%	13%	46%
H42	All	SW	2.025	1,664	**1,762**	106%	12%	-
H46	all	SE	2.025	1,664	**1,689**	102%	11%	-

CASE STUDY BOX B: Household H39 (Solar PV)

Main dwelling characteristics	1945-64 End-terrace
Main household characteristics	3 adults (1 working adult)
Occupancy patterns	2 adults all day; 1 adult at work 8am-4pm Monday-Friday
Technical improvement measures	Solar PV (2.025kWp) system
Fabric improvement measures	Cavity wall & loft insulation, double glazing
Behaviour change measures	Energy Champion course
Total annual electricity use	3,767 kWh (54kWh/m^2; 957kWh/occupant)
Total annual PV generated electricity	1,987 kWh
Total annual PV generated electricity used	893 kWh
Percentage of PV generated electricity used	45%

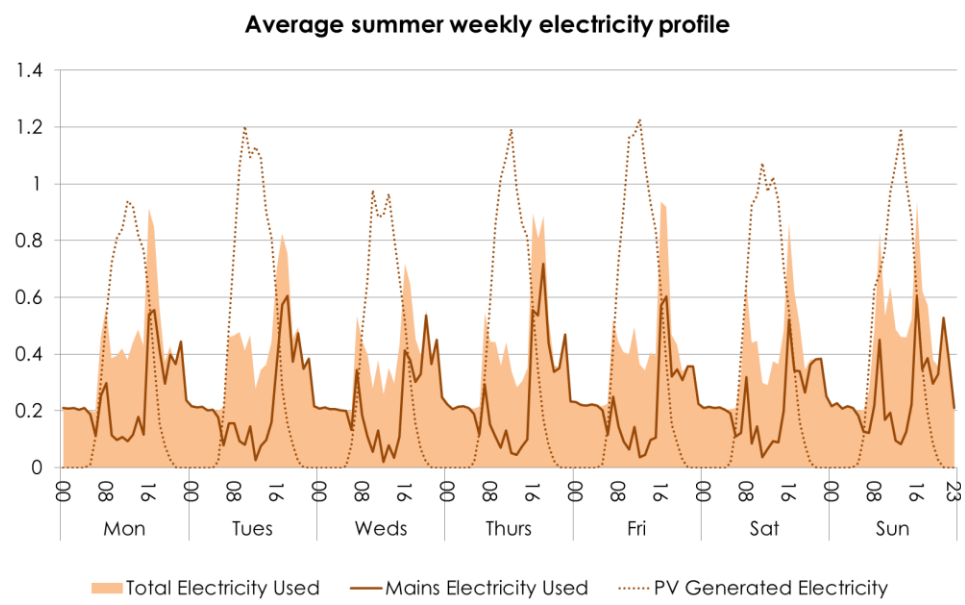
Electricity-related behaviours



Weekly cooking:
Electric hob & oven – 1hr (evening)
Kettle – 6 x day

Weekly cleaning & washing:
2 showers (morning) & 1 bath (evening)
Washing machine – 3 x week
Vacuuming – 1 x day

Home entertainment and office:
TV – 2 hrs (morning), 6 hrs (evening)
Computer & printing – 12 hrs (all day)
Radio – 15 hrs (all day)



Factors affecting the performance of low-zero carbon technologies

From the findings of the wider household M&E study, a number of issues relating to the potential gap between 'intent' and 'outcome' are becoming apparent including:

- Incorrect installation of LZTs
- Lack of adequate commissioning procedures for new and unfamiliar energy technologies
- Lack of knowledge and understanding in occupants relating to the operation and use of technical systems
- Lack of ongoing maintenance and support (whether by installer or resident)

Such issues can influence the overall energy use of the household, and as such should be taken into consideration when assessing any changes in energy use within a household. Table 2.9 outlines the key learnings and findings from the Easterside households in relation to these factors.

Table 2.6. Key learnings and findings from EVALOC case study households on low-zero carbon technologies

Installation & commissioning
• Only one issue uncovered: the valves on solar thermal system valves had remained closed since installation. Partnership approach and the use of structured procedures relating to the physical delivery (tendering and procurement) of technical projects appears to have been relatively successful.
Operation & in-use
• The awareness and knowledge of the respondents relating to the operation and use of the technologies installed was found to be mixed; two out of the 7 households with low-zero carbon technologies were unsure as to how they work and are confused due to the expected outcomes not being achieved; their bills had increased and/or they were using more energy. • Most occupants with solar PVs were aware of how to maximise PV generated electricity. However, in reality they were unable to do that due to various limiting factors such as occupancy patterns and cooking and showering behaviours that are undertaken when the PVs are generating least (evenings).
Ongoing maintenance & support
• MEC and Fabrick Housing Group are monitoring the majority of the systems, but it is found to be time consuming, particularly in terms of administration and need for physical follow-up. • Number of ongoing performance issues with the systems appears to be relatively low but at least one solar thermal system and one solar PV system were found to be underperforming due to the EVALOC monitoring of the technologies. This highlights the importance of monitoring in terms of quick diagnoses and resolution of performance issues. *Ongoing maintenance and support is provided by MEC, through a dedicated project officer and a proportion of the FiTs given towards annual maintenance of the systems. The project officer is thought of very highly, particularly in terms of approachability and support with household queries and concerns.*

Long term changes in energy use

Annual gas and electricity meter data (Table 2.10) of the 15 case study households show overall reductions, with 7 out of the 15 households having reduced both gas and electricity use between 2008 and 2012; three had reduced their electricity use (but not gas) and three had reduced gas use only. Table 2.11 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 9% reduction, and the median percentage change was a 10% reduction. This indicates that there are similarities in the changes in electricity use across the households. Six out of the 15 households had a baseline annual electricity use (2008) higher than the national average (4,198kWh), and three did not experience percentage reductions. Interestingly, however, the greatest reductions (46% and 47%) were found in households with low baseline electricity use (972 kWh and 3,758 kWh respectively); one with both physical and behaviour change interventions, and the other only with physical interventions post-2008. Only seven 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 4,122kWh, which is higher than the national average and indicates that further reductions could be made in electricity use in most of the households.

Changes in gas use

The overall mean percentage change (2008-2012) in gas use across the case study households was a 10% reduction, with a median percentage reduction of 10%; which again highlights the similarities in the changes in individual household energy use. 10 households had a baseline gas use lower than the national average baseline gas use (16,906kWh), of which seven still experienced reductions in gas use. The average (mean) gas use in 2012 was 14,703kWh, which is slightly higher than the national average gas use in 2012 (14,080kWh).

Table 2.7. 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

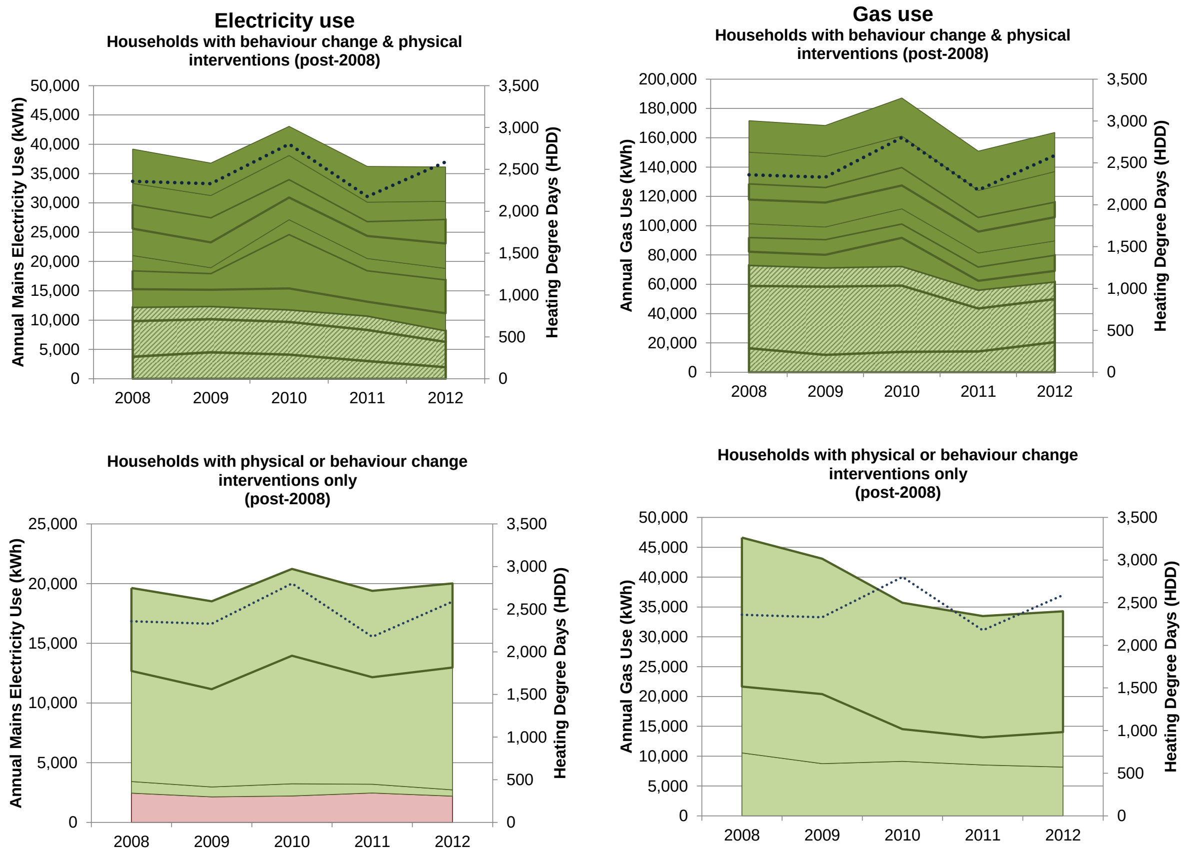
Post-2008 intervention type	***Overall***	***Behaviour & Physical interventions post-2008***	***Physical or behaviour change interventions only post-2008***
Sample No. (Electricity)	**15**	**11**	**4**
Average baseline electricity use (2008)	4,425 kWh	4,249 kWh	4,910 kWh
No. of households experiencing electricity reductions (2008-2012)	10 (67%)	8 (73%)	2 (50%)
Worst percentage change in electricity use	80% increase	80% increase	11% increase
Best percentage change in electricity use	47% reduction	47% reduction	46% reduction
Mean percentage change (electricity use)	**9% reduction**	**8% reduction**	**11% reduction**
Median percentage change (electricity use)	10% reduction	15% reduction	4% reduction
Sample No. (Gas)	**14**	**11**	**3**
Average baseline gas use (2008)	16,485 kWh	16,742 kWh	15,542 kWh
No. of households experiencing gas reductions (2008-2012)	10 (71%)	7 (64%)	3(100%)
Worst percentage change in gas use	26% increase	26% increase	19% reduction
Best percentage change in gas use	47% reduction	36% reduction	47% reduction
Mean percentage change (gas use)	**10% reduction**	**4% reduction**	**30% reduction**
Median percentage change (gas use)	10% reduction	4% reduction	22% reduction

Table 2.8. 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 (2008-2012)**	**Average mean use (2008)**	**Average mean use (2012)**	**Mean percentage change (2008-2012)**
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 2.10 and Figure 2.15 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 2.15 does indicate an overall reduction in electricity use in households with physical and behaviour change interventions. Despite this, it is worth noting that the annual gas use of the households with behaviour change and physical interventions mirror the number of annual heating degree days; suggesting that the households are susceptible to changes in the external weather, despite having fabric improvements installed. The significant continued reduction in gas use of the households with physical or behaviour change interventions emphasise the impacts of 'other' factors such as occupants, occupancy patterns and health and lifestyle upon energy use within the home as well as the significant impacts single measures can have.



Key:

- Annual heating degree days (HDD)
- Households with LZTs present as well as physical and behaviour change interventions
- Households with physical interventions and energy display monitors only
- Households with physical interventions post-2008 only
- Household with behaviour change intervention post-2008 only

Figure 2.15. Annual gas and electricity use from 2008-2012 in case study households, by intervention type.

An example of this is H50 which saw the greatest reduction over the five year period in gas use (47%) but has had few fabric improvements and no formal behaviour change intervention. However, the occupants replaced the boiler in 2010; and subsequently the gas use reduced from 11,655 kWh in 2009 to 5,398 kWh in 2010 (despite 2010 being a much colder winter). In addition, a change in occupancy numbers and patterns due to the ill health of one occupant around the same time is likely to have played a role in the reduction of gas use.

In terms of the five households with solar PV systems installed, four saw reductions in their use of grid electricity (from 4% - 25%) in 2012, compared to 2010 (the year immediately prior to the installation of the PV system). The one which saw an increase (from 3,110kWh in 2010 to 4,146kWh in 2012) in the annual grid electricity also saw an additional two occupants move into the household in 2011; which emphasises the potential impact of occupants upon the overall household electricity use.

Impact of the LCC on energy use and fuel bills

Ten out of the 12 respondents who were involved in the Eco Easterside project stated that they believed the advice and/or support received had helped them reduce their energy use 'a little', 'a lot' or it had been 'crucial/they wouldn't have done it otherwise' (Figure 2.18) and nine of these have experienced actual reductions in either annual electricity or gas use, or both.

The reasons for this were very mixed, particularly with regards to the Energy Champion course and type of advice and information given to the households; whilst some felt that it helped them a lot by making them think of the 'small things', others felt that the course was too generic and they did not necessarily learn anything new. Despite this, two households stated that they wouldn't have undertaken the physical measures without the help of the Eco Easterside project;

"I probably wouldn't have done, no because they're really long-term things because it's not going to save you a lot over the short term, over ten/twenty years it'll probably save you a fair bit but then you know sometimes you've got to look at things in the short term."

In addition, the project officer was highly thought of, and several of the households appreciated the personal contact and accessibility of the project officer in terms of both giving advice and support in relation to potential technical problems;

"Oh they did help a lot yes, explaining what was happening and how it would help and [the project officer] you can phone anytime if you have a problem…very approachable".

And,

"It wasn't so much the advice, it was just that they were there if you needed them you know if you thought that you were going to have a problem or there was a problem you could always get in touch with them."

The impact of the Eco Easterside activities on household fuel bills also appears to have been mixed. Most of the 12 case study households note that whilst they *felt* they had reduced energy use, it was not seen in reductions in fuel bills due to the increasing costs of energy. However, there were reports from four out of the five households with solar PV installed of significantly reduced electricity bills;

"…getting bills of six to seven pounds compared to sixty pounds previously…".

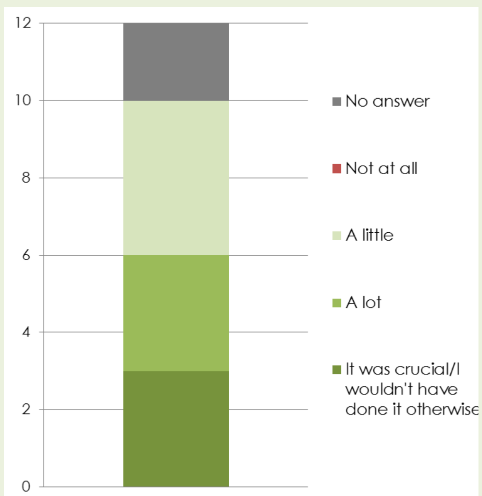


Figure 2.18. Case study household responses to the question, 'Overall how important would you say Eco Easterside's advice and/or support has been in helping reduce your home energy use?'

Energy use and carbon emissions

More in-depth monitoring and evaluation of 11 of the case study households was undertaken to further investigate their energy use, and subsequent carbon emissions from December 2012 to November 2014. The findings from this data (Figures 2.16 and 2.17) show that four of the households are using less than the national average in terms of annual energy use (kWh/m^2) and five are using less than the national average in terms of carbon emissions (kgCO_2/m^2). As can be seen in Figure 2.16, 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 2.16 also highlights the energy use per occupant, and indicates that two households are consuming considerably more (H48 and H41) per occupant, relative to their energy use per square metre. Interestingly, H48 has only one occupant, and H41 is one of only three households with two occupants only.

Two further interesting cases highlighted in Figure 2.16 are H43 and H46. Both are using much less energy per occupant than per square metre. However, this is mainly due to the fact that both households have more than five occupants. Interestingly, both of these households are using significantly more total grid electricity use than national average figures (H43 uses 5,051kWh, and H46 uses 5,707kWh) but significantly lower gas (H43 uses 8,715kWh, and H46 uses 11,516kWh). This not only highlights the need to assess energy use in relation to a variety of variables, but it 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.

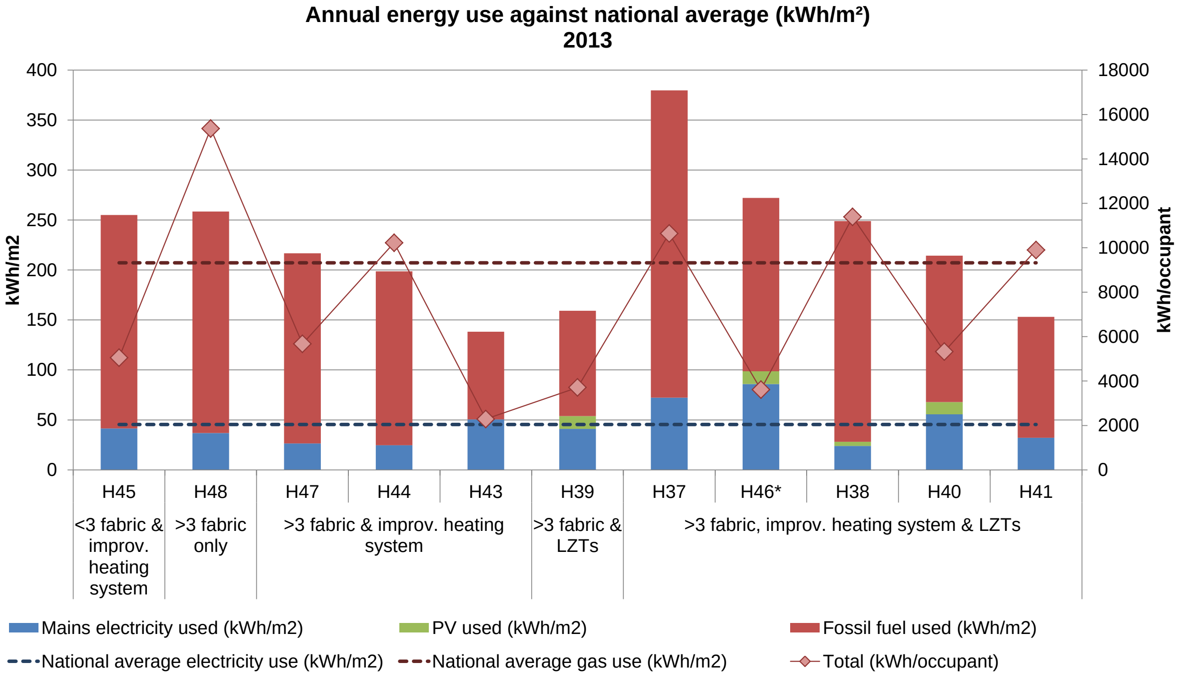


Figure 2.16. Annual household energy use (January – December 2013) in case study households

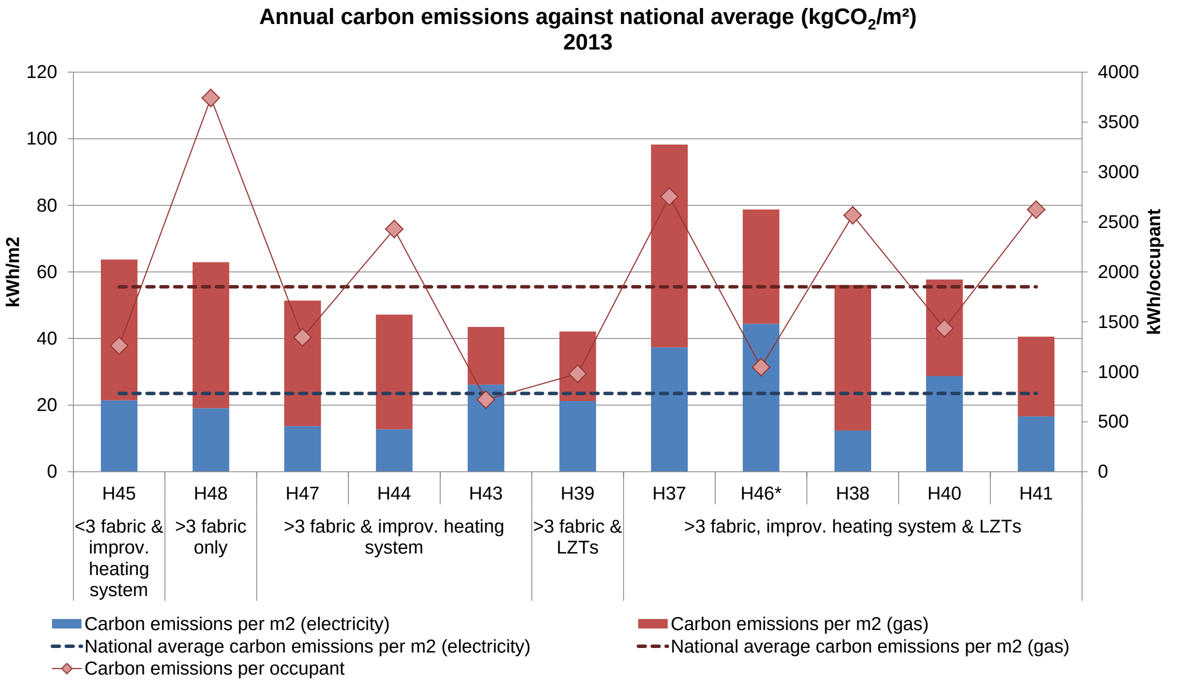


Figure 2.17. Annual household carbon emissions (January – December 2013) in case study households

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 shows the dwelling and household characteristics as well as the daily demand profiles for H37 and H38 over the heating period (Jan-Mar, Oct-Dec 2013). Both have had similar fabric improvements, and both have had an improved heating system installed within the last ten years.

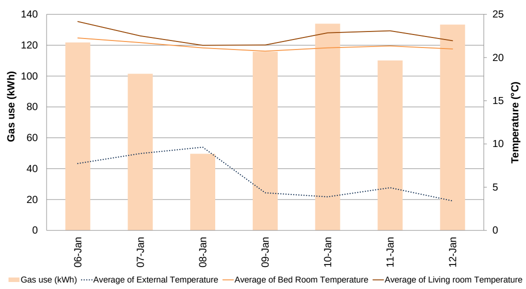
The impact of the occupants and their behaviours are highlighted in the daily gas use profiles; although both are occupied evenings and weekends only, H37 leaves the heating on continuously whilst H38 uses specific programmed settings (2 and ½ hours in the morning, but with manual override as required). Interestingly, the internal temperatures of H37 remain much more constant than H38, yet even in H38 the internal temperature range is no more than 4°C. In terms of total average daily gas use during the heating period, H37 uses more than H38 (109kWh to 86kWh respectively), however, in terms of per occupant, H37 uses 7kWh/occupant less than H38. It must be noted that H38 also uses gas for cooking, unlike H37 which uses electricity.

The weekly gas use profiles indicate that in H38 there is little difference in the daily gas use during the week, despite the changes in external temperature. This is in contrast to H37, where a significantly less amount of gas is used when external temperatures rise. This may be in part due to the solar thermal system installed being used as the external weather improves, but is also likely to be due to the occupant's heating settings which more or less leave the system to run itself. When comparing this to a very similar household (H38) which is using less overall gas throughout the heating period (yet without the additional benefit of a solar thermal system), it appears that further savings in gas use could be made in H37 through simple changes to occupant behaviours and level of control over the heating system.

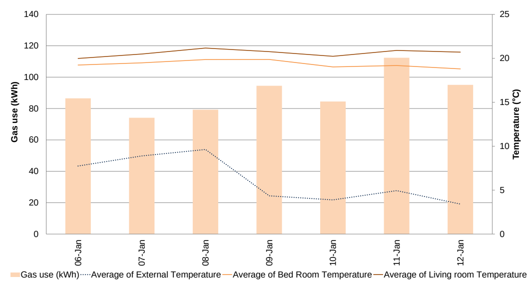
CASE STUDY BOX C: Household gas use comparison

H37	*H38*
Total annual gas use: 25,858kWh (308kWh/m²; 8,620kWh/occupant)	**Total annual gas use:** 20,211kWh (221kWh/m²; 10,106kWh/occupant)
Average daily heating period gas use: 109kWh (1.3kWh/m²)	**Average daily heating period gas use:** 86kWh (0.9kWh/m²)
Dwelling age & type: 1919-44 semi-detached	**Dwelling age & type:** 1919-44 semi-detached
Internal floor area: 84m²	**Internal floor area:** 91m²
Fabric improvements: Cavity wall insulation, double glazing, loft insulation	**Fabric improvements:** Cavity wall insulation, double glazing, loft insulation
Improved heating & hot water system: Yes (gas condensing boiler & solar thermal)	**Improved heating & hot water system:** Yes (gas condensing boiler)
Number of occupants: 2 adults 1 child	**Number of occupants:** 2 adults
Occupancy patterns: evenings & weekends	**Occupancy patterns:** evenings & weekends
Behaviour change (gas-related): Energy Champions course	**Behaviour change (gas-related):** Energy Champions course
Heating control settings: 06:00-22:00 with manual override (21°C on main thermostat & high TRV[1] settings)	**Heating control settings:** 06:30-09:00 with manual override in the evening (21°C on main thermostat & high TRV settings)
Gas end-uses: • Heating • Hot water incl. showering	**Gas end-uses:** • Heating • Hot water incl. showering • Cooking
Average (mean) heating period temperatures: Living room: 22°C (min 17; max 27) Bedroom: 21°C (min 17; max 24)	**Average (mean) heating period temperatures:** Living room: 21°C (min 17; max 27) Bedroom: 19°C (min 16; max 24)

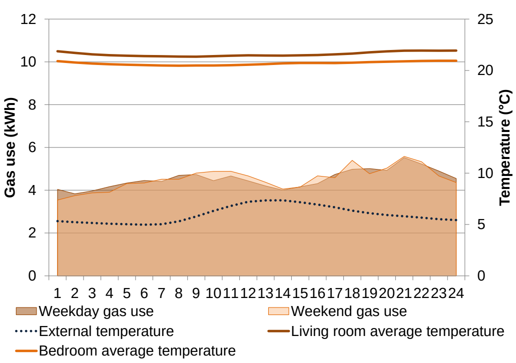
H37 – Weekly gas use (Mon 6th Jan – Sun 12th Jan 2013):



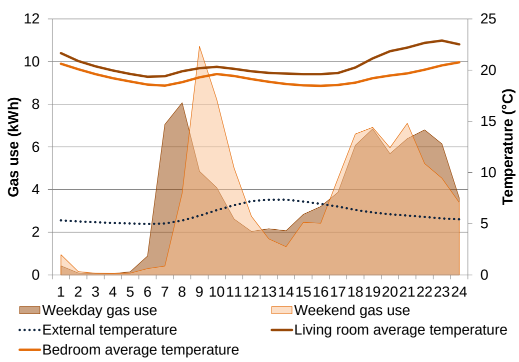
H38 – Weekly gas use (Mon 6th Jan – Sun 12th Jan 2013):



H37 – Typical daily heating period gas profile:



H38 – Typical daily heating period gas profile:



Internal environmental conditions and comfort

The majority of respondents commented that the fabric measures as well as improved heating systems in their home have increased the comfort levels, not only in terms of improved warmth but also noise and condensation issues:

"I couldn't sleep on a night because with it being a main road we could hear every bit of traffic but once we got the double glazing it stopped all the noise."

"…before the central heating they [the windows] were really bad for it [condensation]."

Whilst a *before* and *after* quantitative comparison is not possible, the monitoring data shows that the majority of households have relatively stable indoor temperatures and relative humidity levels (Figures 2.19, 2.20, 2.21 and 2.22) that are generally within the 'comfort' range in both the heating period (Jan-Mar, Oct-Dec; 18-21°C and 40-70%RH) and the non-heating period (Apr-Sept; 19-25°C and 40-70%RH). All the households have a much higher average temperature than the national average of 18°C (Palmer, J. and Cooper, I., 2013) throughout the heating period; with none lower than 20°C, and one (H45) even having an average temperature of 25°C in the living room. This indicates that simple measures such as reducing the thermostat settings could have a significant impact on energy use and yet enable indoor temperatures to remain within the comfort range in most of the households.

Two interesting case studies highlighted in Figures 2.19 and 2.20 are H45 and H39; both experience the greatest variation in temperatures during the heating period. Whilst H45 is believed to have fewer fabric improvements than the rest of the case study households (the thermal imaging survey also indicated that there were potentially significant problems with the external façade in terms of heat loss), H39 has had the majority of standard fabric improvements undertaken. Whilst H39 does not have an improved heating system, which could have an impact on the stability of temperatures, the significant range in temperature (13°C-29°C in the living room) during the heating period suggests that there may be issues with the fabric improvements undertaken, which are allowing heat loss through the building fabric.

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), two living rooms and ten bedrooms (across ten different households) were at risk of overheating during the summer months (June – August 2013). Only one household (H45) appeared to be at risk (according to CIBSE Guide A) during the winter months (Jan, Feb, Dec) in both the living room and bedroom. Despite this, the occupant survey indicated that the occupants of H45 felt that the temperatures were comfortable, and would not want it to be any colder; highlighting the impacts of personal thermal expectations and comfort levels.

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 13°C to 36°C, with an overall average of 21°C (11 households). Relative humidity levels range between 19%RH and 86%RH in living rooms. Bedroom temperatures range between 14°C and 30°C with an average of 20°C across the households.

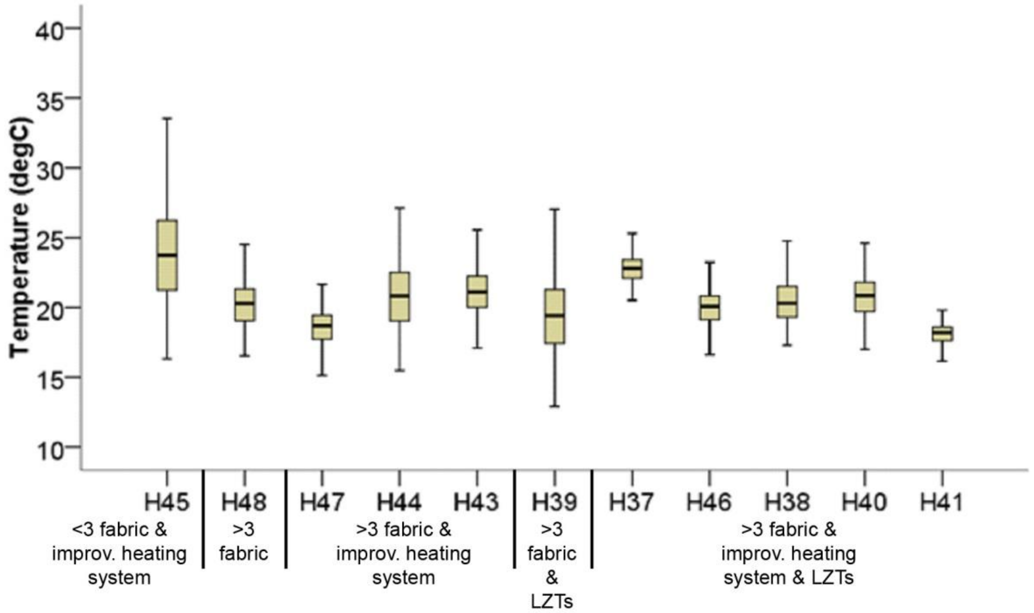


Figure 2.19. Temperature ranges in case study households in living room during heating period (Jan-Mar, Oct-Dec 2013)

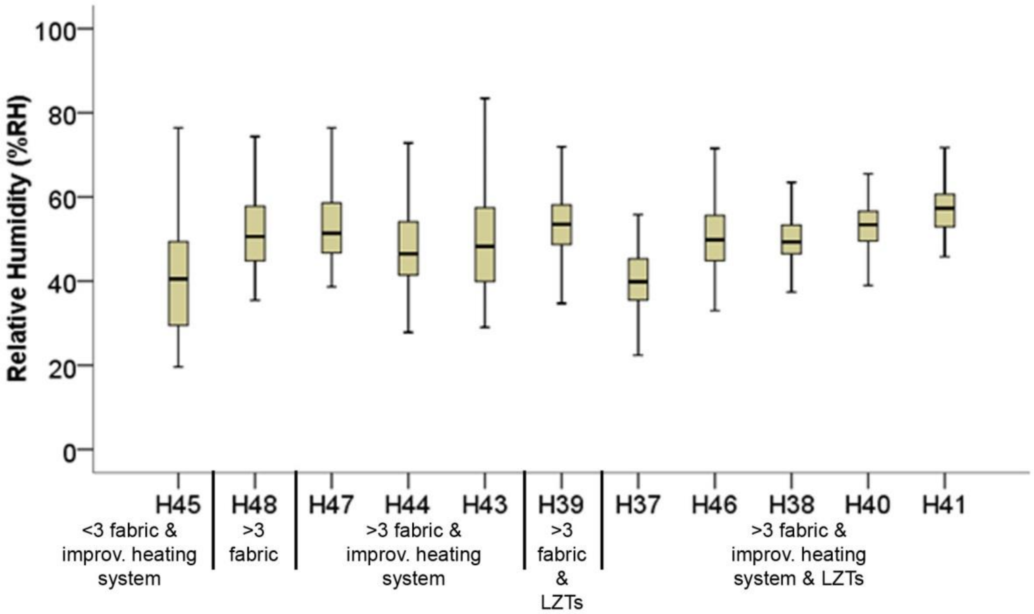


Figure 2.20. Relative humidity ranges in case study households in living room during heating period (Jan-Mar, Oct-Dec 2013)

Indoor environmental conditions (non-heating period)

Comfort ranges: 40-70%RH and 18-25°C

- **Non-heating period(Apr - Sept 2013):** living room temperatures range from 14°C to 34°C, with an overall average of 22°C across all households. Relative humidity levels again range between 21%RH and 90%RH, with an overall average of 56%RH. Bedroom temperatures range from 10°C to 30°C with an overall average of 21°C across all households.

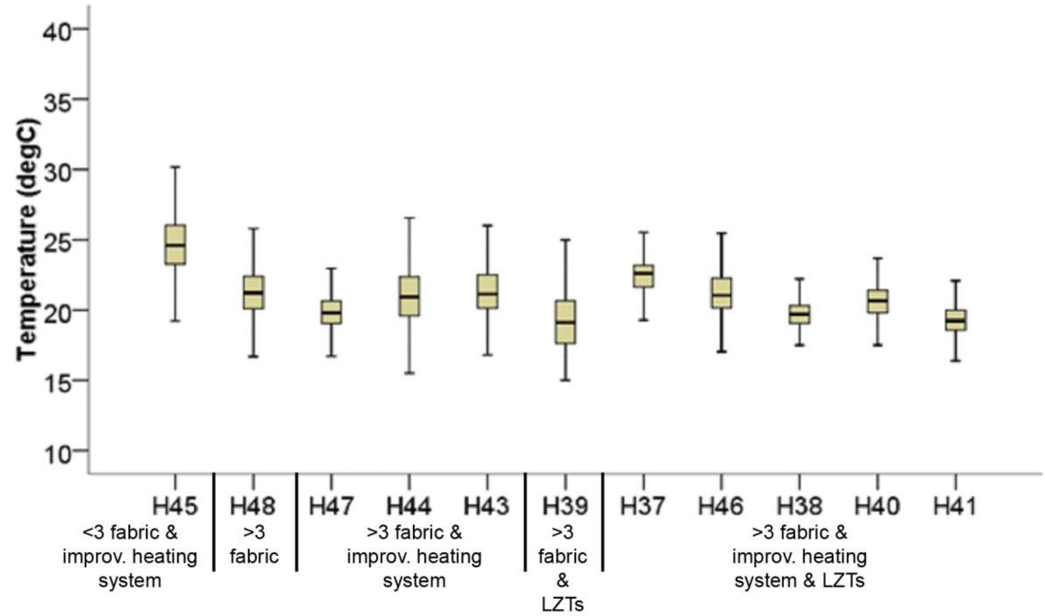


Figure 2.21. Temperature ranges in case study households in living room during non-heating period (Apr-Sept 2013)

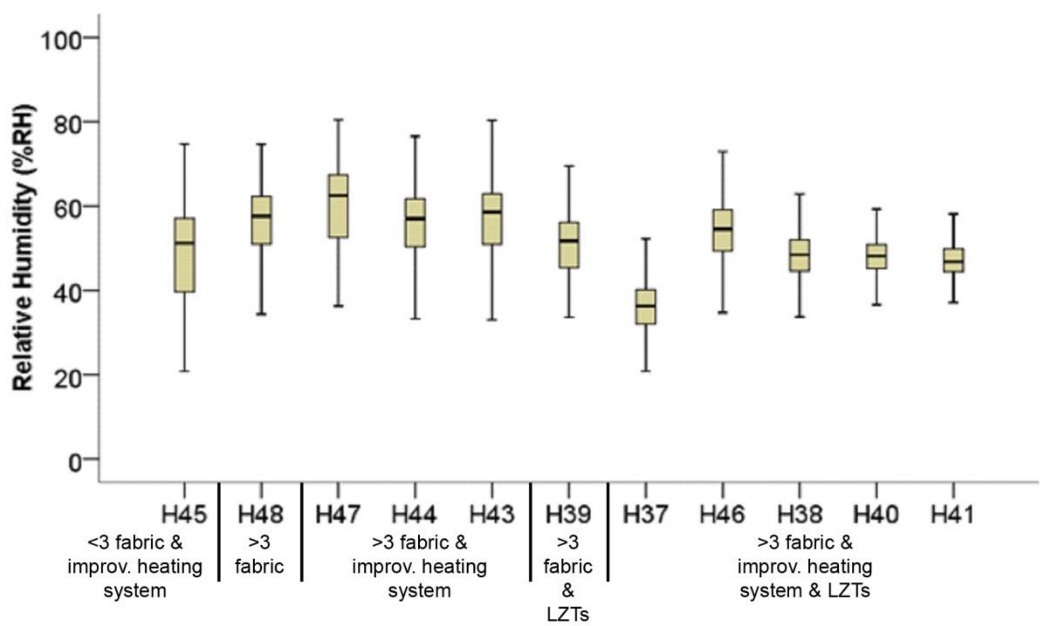
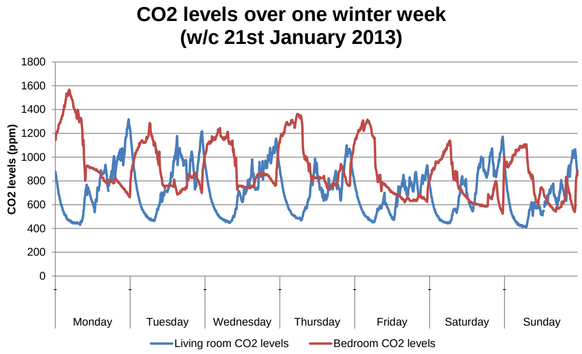


Figure 2.22. Relative humidity ranges in case study households in living room during non-heating period (Apr-Sept 2013)

Indoor air quality

Figure 2.23 shows the CO_2 levels in H41 (dwelling with standard fabric measures as well as an improved heating system) over a winter 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 and the living room during the summer week are much lower (even overnight in the bedroom), 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 1,500ppm, and never above 2,000ppm which is indicative of 'normal' air quality (prolonged levels above 2,500ppm can result in negative health impacts).



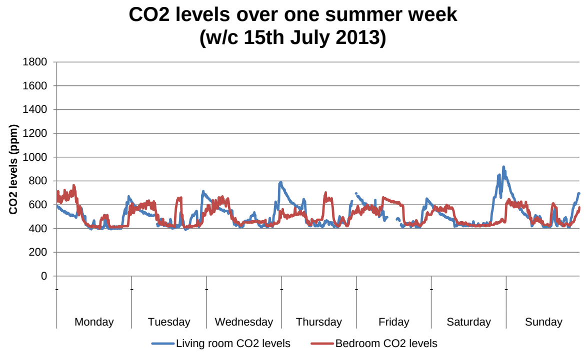


Figure 2.23 CO_2 levels in H41 (dwelling with significant fabric measures) over a winter and summer week.

Changing and sustaining energy behaviours

The findings from the case study households highlight the range of internal and external factors[6] affecting household energy use in individual households. As the case studies documented above demonstrate, 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. There is a range of enabling and constraining factors influencing how people behave. A key aim of behaviour change programmes 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.

INFLUENCING FACTORS ON ENERGY BEHAVIOURS:

"I think I probably [am] aware but whether I put it into practice. It's a bit like the Slimming Club isn't it, I know what I should and shouldn't eat but…" (INDIVIDUAL MOTIVATIONS)

"I haven't got a thirty degree wash on my washer." (TECHNOLOGIES & OCCUPANT CONTROL)

"I've tried nineteen as a setting and it's not comfortable enough. I'm finding I have to turn it up that one degree." (HEALTH AND COMFORT)

"…It could be a bit of a minefield ripping all the boards up." (PRACTICAL ISSUES)

- **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.

Impacts of Eco Easterside activities on household energy behaviours

Overall the household survey findings suggest that the majority of the case study households have high levels of habitual energy-saving behaviours.

In relation to the technical interventions in their homes, the majority of the respondents acknowledged the role of the Eco Easterside project in ***enabling*** them to be installed; a number of respondents commented that they wouldn't have been able to install cavity wall insulation or solar PVs without the help from Eco Easterside, due to costs or practical issues such as lofts full of 'stuff'.

New low-zero carbon technologies such as solar thermal and solar PV appear to have had both negative and positive impacts upon habitual behaviours. In terms of negative effects, the installation of the solar thermal panels in one case led to the household not worrying about leaving the heating on until their bills began increasing again and a respondent with solar PV commented that;

[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.

"When it's been sunny I've thought oh it's going to be free so I'll put them in there [the tumble dryer]."

Despite this, solar PVs appear to have helped change behaviours in terms of shifting demand away from peak demand times (evenings);

"But if we're going out somewhere then we use the timer for the washing so that can happen at a peak kind of generation time."

Furthermore, the installation of fabric measures such as cavity wall insulation and double glazing in several households appears to have led to residents being able to positively change their heating-related behaviours; reducing the thermostat and not leaving the central heating on constantly.

Although most of the case study households involved in Eco Easterside's household energy projects felt that energy saving behaviours were just 'something they have always done', the majority of respondents stated that the courses they attended helped ***reinforce*** positive energy-saving behaviours as well as remind them of practices they had forgotten about. This need for reinforcement is further evidenced by the slight decrease in energy-saving behaviours from 2012 (when the energy champion programme had only just finished) to 2014 (two years later).

Some respondents also attributed feelings of increased awareness of energy use explicitly to Eco Easterside's activities. However, another attributed their increased awareness of energy to 'a gradual seeping into the culture' and others felt they had already been aware due to their interests in environmental issues and financial concerns (i.e. before the LCC projects).

DECC funding for the Easterside LCC covered the cost of 600 'Owl' electricity display monitors (EDMs), which were distributed before the start of the EVALOC project . EVALOC interviewed 11 householders with energy displays. They were also discussed in the focus groups. The main lesson seems to be that the displays can 'work' for people as awareness-raisers and as part of household management, but the chances of their being effective are far greater if they are part of a 'community conversation', where there are people around to give guidance, share experiences, and develop new energy habits.

Energy display monitors (EDMs) seem to have contributed to learning, although only two households stated that the display had affected actual electricity use, with one household commenting that they were 'already at base load'. Despite this, energy display monitors seem to have contributed to positive changes in energy-related behaviours (4 out of 11 respondents from LCC households who used the energy displays said it had an impact on their understanding of electricity use), as do the wider community events. The household with the largest decrease in electricity use post-LCC interventions (a 47% reduction, from 4,115kWh in 2010 to 1,982kWh in 2012) had no significant changes in occupancy or technical measures such as solar PV installed. They did however, receive an energy display monitor, and commented on a change in energy behaviours due to activities happening in the local school that the children attend;

"Well we've been doing a lot at the school about it so we have started doing a lot more to try and save on the energy."

Overall, there were mixed perceptions about the effectiveness of the technical and behavioural advice and support from the LCC. Some were very positive and felt they had received good information and support, whereas others indicated they would like more specific household advice and support,

"I would like more tailored information about energy efficiency appliances, and how to use technologies."

In addition, some did not feel it was important to fully understand the technologies, as they did all they could to save energy anyway, and did not know further ways to improve their home without significant cost and/or disruption to their daily life. In contrast, some respondents commented that their lack of understanding held them back from further energy saving measures, and felt that more knowledge could be achieved if a local support infrastructure was in place to allow guidance and knowledge to be shared on a regular basis.

Sustaining energy behaviours over time

As indicated in previous sections, the majority of the occupants have strong environmental and financial motivations in relation to saving energy in their homes. However, when comparing responses from 2012 to 2014 regarding energy-related behaviours in the LCC-involved households, it appears that many have slipped back into 'old routines' (Figure 2.25).

There also appears to be a reduction in feelings of being ***capable of reducing*** energy use in the households that were involved in Eco Easterside activities from 2012 to 2014 (Figure 2.24). In 2012, the majority of residents in the 12 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 surveyed again in 2014, five had negatively changed their opinion and only one felt more capable than in 2012. It also appears that the majority of the households felt they had reached their limit in terms of reducing energy, yet were still positive in their ability to ***manage*** their energy use.

Although the case study households were aware of the energy use associated with certain behaviours, they choose to retain energy-using behaviours due to the prioritisation of other factors, from leisure and enjoyment to health, comfort and even feelings of security and safety; highlighting the balance needing to be struck between energy economy and comfort, security and enjoyment;

"There's a sense of well-being and homeliness thing about [lights being on] I find and you know I don't like to always have the rest of the house in darkness if I'm in there in winter time particularly. …It just feels safer."

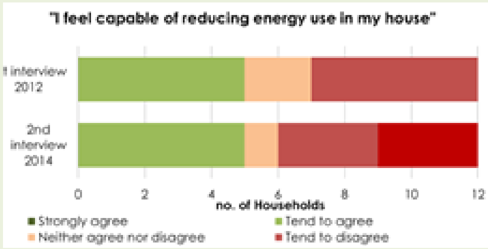


Figure 2.24. Case study household responses to the question, 'I feel capable of reducing energy use in my home.''

Changes in typical energy related behaviours (2012-2014)

- Negative changes in some energy-related behaviours, such as leaving the TV on standby more often.
- Positive changes in some energy-related behaviours such as turning lights off when leaving a room, closing windows when the heating is on.

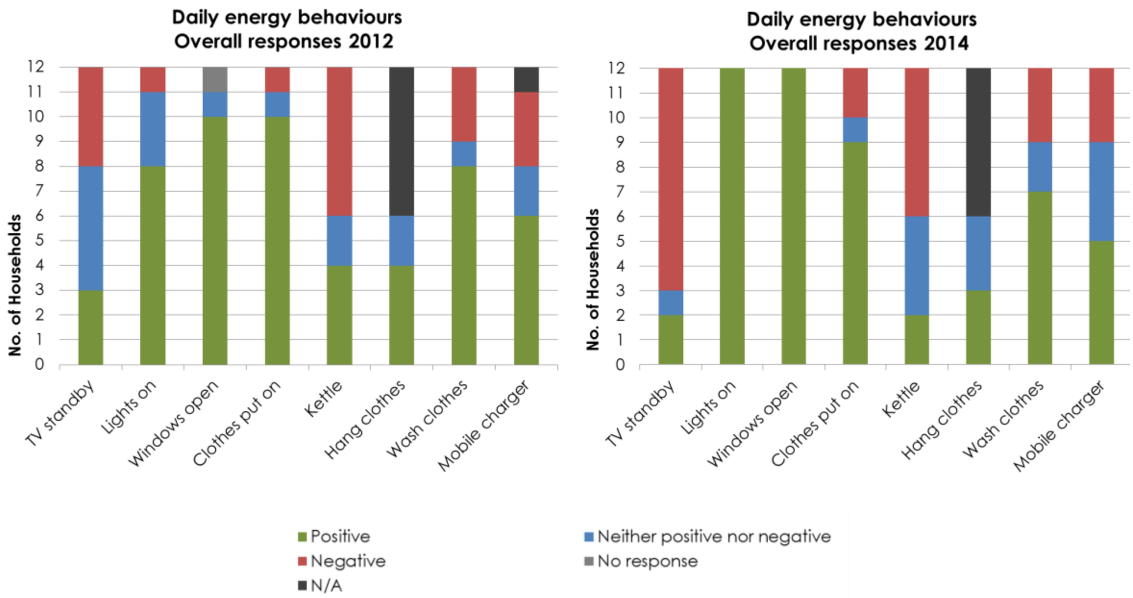


Figure 2.25. Case study household responses to series of questions relating to their energy behaviours in 2012 (left) and in 2014 (right)

Wider impacts and benefits of Eco Easterside activities

There is evidence that the Eco Easterside projects are generating related social and economic benefits including more comfortable homes, income stream for the community, as well as more opportunities for community participation.

Focus group participants described Easterside as historically 'a strong community', with relatively high levels of participation in community events such as the annual Fun Day. As noted above the project team built on these foundations and managed to achieve high levels of resident engagement participation in both the energy projects and energy-related community events.

The majority of respondents in the household interviews strongly agreed or tended to agree (figure 2.26) that the Eco Easterside's activities were bringing more social benefits to the community, particularly in terms of increased sense of community locally and enhanced individual relations, pride and engagement within their community notwithstanding jealousy over solar panels. In addition, team members reported that there were; "*no reports of break-ins reported since the project began*", and that there was a "*reduced level of graffiti on community centre*".

Whilst not all agreed that the LCC was bringing economic benefits to the neighbourhood (through provision of jobs), as one participant explained; "[the] *installers are from Newcastle so it is not creating local jobs*", MEC has been able to attract funding to disseminate projects across other parts of Middlesbrough, creating an additional four jobs which include project delivery in Easterside.

There is also self-reported evidence of increased cycling rate across Middlesbrough as a whole linked to MEC's cycling training and maintenance courses, dedicated cycle path and incentivised bike schemes for schools. Cycling journeys in Middlesbrough rose from 150,000 in 2010 to 350,000 in 2014.

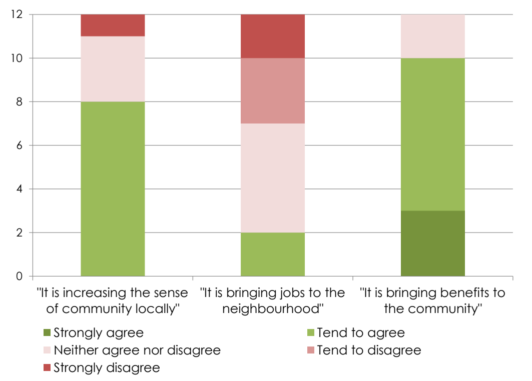


Figure 2.26. Case study household responses to series of questions relating to Eco Easterside's wider contributions

"I think people have felt more proud of the area… Because over the years it's had a bad name you know because a lot of people don't work and a lot of people have council houses."

"…other estates could follow in that… so I think it's a good thing."

Chapter 3

Reflections and policy implications

Eco Easterside is an effective partnership that draws on the respective strengths and contributions of a range of local actors. It has a well-designed, implemented and managed change strategy tailored to the needs of the local community which helps residents overcome some of the many technical, economic and social influences that prevent them reducing their energy use, although the strategy could be strengthened by more structured technical and behaviour change activities and projects. The partnership has achieved some important outcomes and impacts and the partnership approach and success in securing funding has enabled it to scale up projects both in Easterside and the wider Middlesbrough area.

The case study highlights how carbon reduction policies and financial incentives can be harnessed to generate social and economic benefits for local residents and the wider community in a deprived area. It also highlights the value of partnership working and how area wide approaches which coordinate and install free measures can increase the reach, scale and pace of uptake of energy efficient and low carbon technologies (vs residents having to arrange finance and installation themselves as in other EVALOC communities). The case study also indicates the motivational value of energy messages which emphasise the pro-environmental/social value, as well as personal benefits of reducing energy use and carbon emissions and which are shared and reinforced by local organisations. The Eco Easterside experience challenges received wisdom that residents in disadvantaged areas are only likely to be motivated by practical personal benefit.

The Eco Easterside approach is highly relevant to other communities and shows what can be achieved when capital and revenue financing is available and used to good effect. However the possibility for replication is constrained by subsequent policy changes to the FiTs and the difficulties that many other communities face in accessing ECO (e.g. if not in disadvantaged areas) or attracting revenue funding (e.g. if voluntary and without paid staff dedicated to this task).

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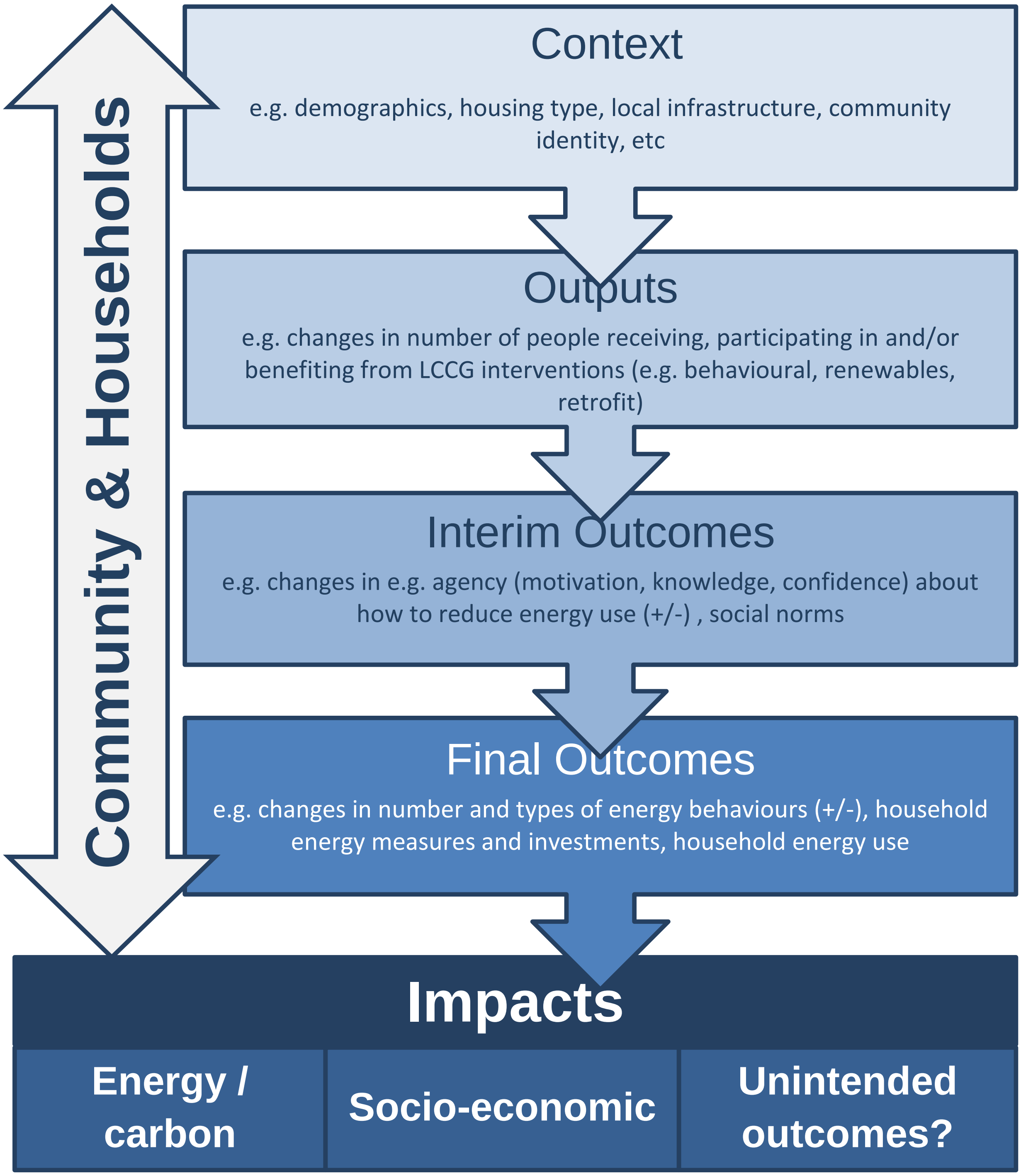
Appendices

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.***
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*	Review of grey literature Semi structured interviews with 2 key stakeholders
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*	14 participants from core team, wider community and stakeholder organisations
Community event 1 (school play 1)	*To investigate whether and how the community event contributed to social learning*	25 participants 22 feedback forms
Shared learning event with other communities 1 (Community-Council Partnership working)	*investigate whether and how the shared learning event contributed to social learning about energy behaviours*	45 participants 21 feedback forms
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*	8 participants from core team wider community and stakeholder organisations
Community event 2 (School play 2)	*To investigate whether and how the community event contributes to social learning about energy behaviours*	55 participants 32 feedback forms
Shared learning event with other communities 2 (Carbon Reduction in Communities of Disadvantage)	*To investigate whether and how the shared learning event contributes to social learning about energy behaviours*	6 participants 5 feedback forms
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*	8 participants from core team, wider community and stakeholder organisations
Community event 3 (Eco Gala day)	*To research whether and how community events contribute to social learning about energy behaviours*	1000 participants 35 feedback forms
Shared learning event 3 (Creativity and Climate Change	*To investigate whether and how the shared learning event contributes to social learning about energy behaviours*	27 participants 19 feedback forms
Community event 4 (carbon mapping workshop)	*To provide feedback to the communities and assess how useful DECoRuM is in measuring, visualising and communicating carbon savings*	20-25 participants 10 feedback forms
Supplementary data collection	*To supplement information from baseline, focus groups, and community events*	Ongoing correspondence and phone calls with 3 key stakeholders
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*	1,164 households at LSOA level
Carbon mapping (DECoRuM)	*Estimate changes in energy use at wider community level to understand energy trends and potential 'ripple' effects of LCC activities*	242 households [34 LCC-involved 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 energy improvements*	- 15 households
Energy data collection (2008-2012)	*Assess changes in energy use in order to understand individual household energy trends and effects of LCC activities*	- 15 [14 gas] households
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*	- 10 households - 4 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 - 6 households
Monitoring of user interaction (2013-2014)	*Provide quantitative data relating to occupant behaviours in relation to heating and ventilation*	- 6 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*	- 6 households
Heating control questionnaires (winter 2013)	*Provide understanding of heating behaviours within the household*	- 11 households
Energy audit (summer 2014)	*Provide understanding of electricity-related behaviours*	- 12 households
Monitoring of solar PVs (2013-2014) - Annual generation data - Annual export/use data - 5 minute generation data - 5 minute export/use data	*Investigate effectiveness and performance of low-zero carbon technologies*	- 5 households - 3 households - 2 households - 2 households
First round semi-structured interviews (summer 2012)	*Provide baseline information and assess impacts of LCC activities upon individual households*	- 15 households
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*	- 15 households
Social network analysis (summer 2012)	*Provide understanding of individual's social networks*	- 15 households