Effectiveness and impacts of community-based action on household energy reductions

ECEEE Summer Study

Hyères, France, 1-6 June 2015

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Structure of the presentation

- Context
- Overview of EVALOC project
  - Methodology
  - Case study households
- Effectiveness and impacts
  - Wider local area energy reductions
  - Local neighbourhood energy reductions
  - Case study household energy reductions
- Role of low carbon community organisations

EVALOC
EVALUATING LOW CARBON COMMUNITIES

What is the context of the research?

- DECC's Low Carbon Transition Plan, 2009: **Collective action** over **individual action**

  We often achieve more acting together than as individuals.

- First ever **Community Energy**

BUT…lack of robust evidence-based M&E about the outcomes, impacts and added benefits of LCC action

achieving local energy reductions

- **Trusted messengers**
- Combine behaviour initiatives with energy efficiency measures, micro-generation with empowering and enabling change.
- More **familiar** with **contextual factors** that shape individual behaviours

What is EVALOC?

- 4.5 year research project (2011-2015) funded under the **ESRC-EPSRC Energy and Communities programme.** £1.14million.
- Oxford Brookes University and University of Oxford.
- **Interdisciplinary evaluation of six selected low carbon communities (LCCs)** funded under the DECC's **Low Carbon Communities Challenge** in terms of their:
  - **IMPACTS** (on changing individual and community energy behaviours)
  - **EFFECTIVENESS** (on achieving real-savings in energy use CO_2 emissions)
  - **SUCCESS** (in bringing about sustained and systemic change).
- Assess changes in energy use in participating LCCs at the **community** and **household** level.

EVALOC
EVALUATING LOW CARBON COMMUNITIES

Low Carbon Communities Challenge

- **Six case study low carbon communities**

Sustainable Blacon
Community-led, suburban
disadvantag
- Fabric mea
- Technical
- Behaviour
energy fee
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- Communit
- Behaviour
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- Communit
- Low/zero c
renewables (households)
- Fabric measures
- Technical measures
- Behaviour change interventions: action and group learning

Eco-Easterside
Partnership, suburban, disadvantaged
- Community renewables
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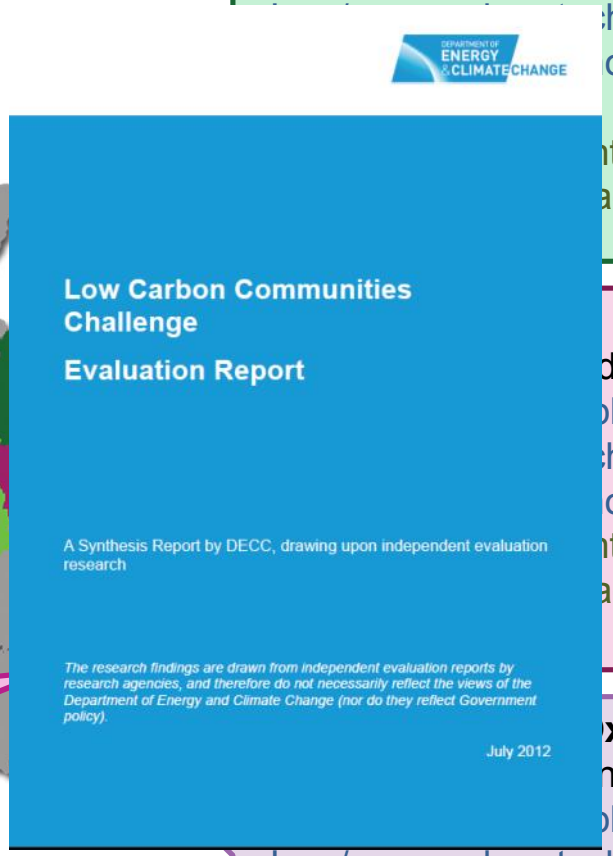
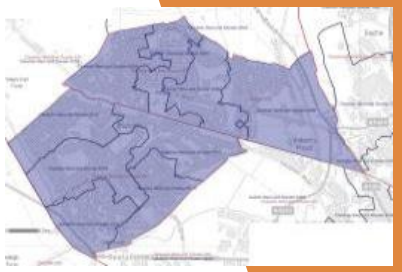
- Low/zero carbon technologies & renewables (households)
- Behaviour change interventions: energy feedback & action and group learning



Methodology

- **Graduated approach** to assessing **changes in household energy use**
- Mixed methods approach using **qualitative** and **quantitative** methods



Wider local area (1,000-5,000 households per community)
Aggregated energy meter data of households (2008-2012)
Method: Lower Layer Super Output Data (LSOA), (DECC)

Local neighbourhood area (1,659 households in total)
Carbon mapping *before* and *after* LCC interventions
Method: DECoRuM carbon mapping model

Individual households (88 households in total)

- Methods: Longitudinal annual gas and electricity meter data (2008-2012)
- Household surveys and occupant interviews (88)
- Thermal imaging surveys (88)
- Monitoring of energy use, indoor environment & LZTs (60)

Findings: Effectiveness & impacts on energy reductions

Local area level: domestic gas use (2008-2012)

Community	LCC interventions (household level)	Household sample no (approx)	2008 average household gas use (baseline in kWh)	Percentage change in gas use (2008-2012)
National figures	-		**16,906**	**-17%**
Awel Aman Tawe	Behaviour change (group-based learning)	n/a	**n/a**	**n/a**
Sustainable Blacon	Physical & technical; behaviour change (energy feedback & group-based learning)	5,590	**13,613**	**-21%**
Eco Easterside	Physical & technical incl. LZTs; behaviour change (energy feedback & group-based learning)	1,160	**15,407**	**-15%**
Hook Norton Low Carbon	Physical & technical incl. LZTs; behaviour change (group-based learning)	n/a	**n/a**	**n/a**
Kirklees-Hillhouse	LZTs; behaviour change (energy feedback)	2,235	**16,020**	**-17%**
Low Carbon West Oxford	LZTs; behaviour change (energy feedback & group-based learning)	1,540	**16,057**	**-15%**

Focus on energy management & physical fabric/heating improvements **(demand)**

Council-led fuel poverty campaigns

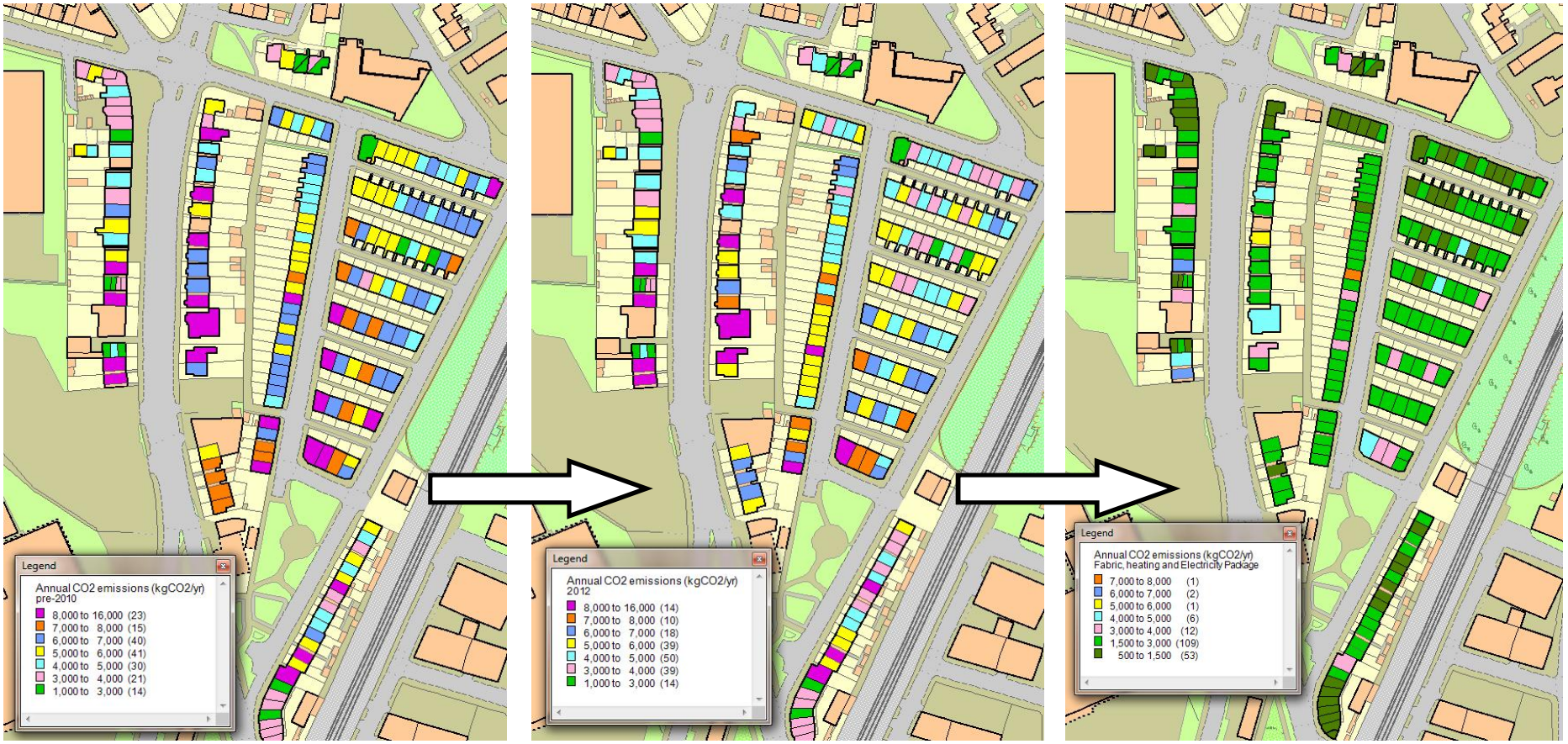
Local area: domestic electricity use (2008-2012)

Community	LCCC interventions (household level)	Household sample no (approx)	2008 average household electricity use (baseline in kWh)	Percentage change in electricity use (2008-2012)
National figures	-		**4,198**	**-4%**
Awel Aman Tawe	Behaviour change (group-based learning)	1,175	**4,987**	**+1%**
Sustainable Blacon	Physical & technical; behaviour change (energy feedback & group-based learning)	5,590	**3,765**	**-4%**
Eco Easterside	Physical & technical incl. LZTs; behaviour change (energy feedback & group-based learning)	1,160	**3,368**	**-6%**
Hook Norton Low Carbon	Physical & technical incl. LZTs; behaviour change (group-based learning)	1,070	**6,949**	**-3%**
Kirklees-Hillhouse	LZTs; behaviour change (energy feedback)	2,235	**3,660**	**-12%**
Low Carbon West Oxford	LZTs; behaviour change (energy feedback & group-based learning)	1,540	**3,658**	**-5%**

Communities with focus on **supply** (low-zero carbon technologies e.g. solar PVs)

Carbon emissions: *baseline, existing, future*

Quantifying energy and carbon savings achieved from the implemented domestic carbon reduction measures



Baseline
(2008)

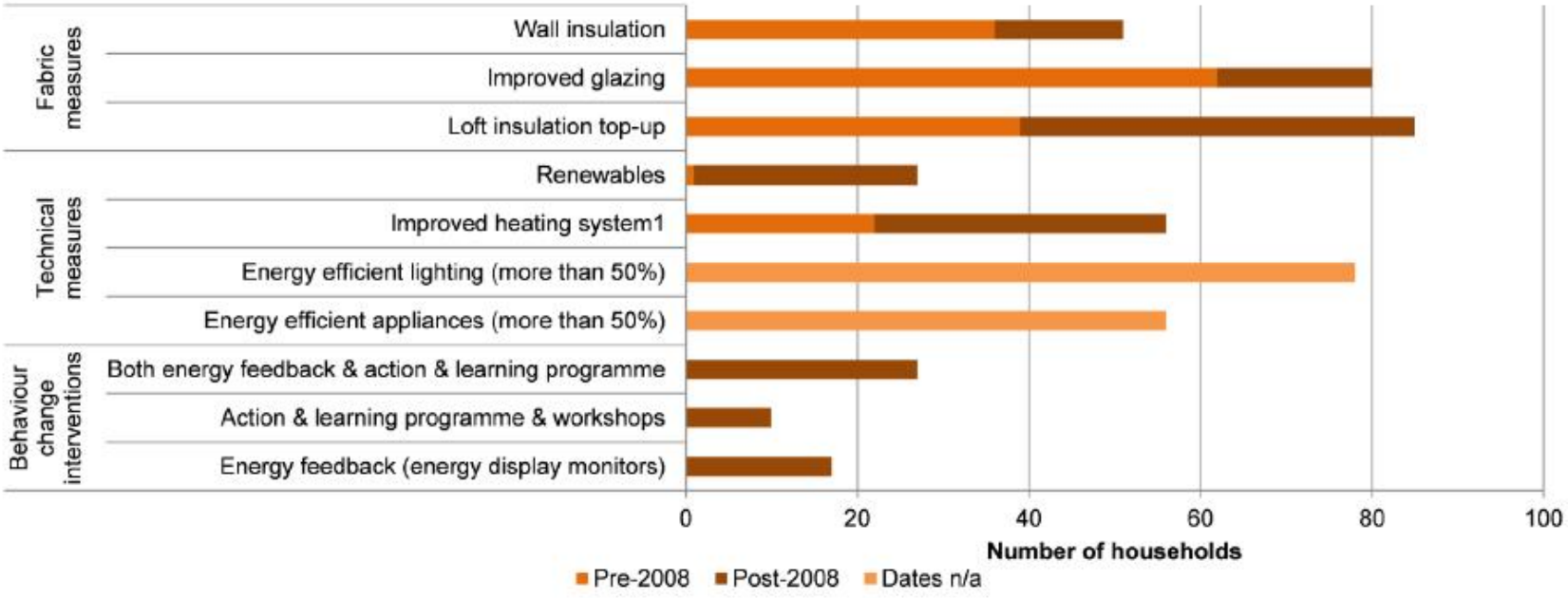
Existing
(2012)

Future
(deep retrofit package)

Individual households

Varied dwelling type, ages, occupancy

Interventions within case study households



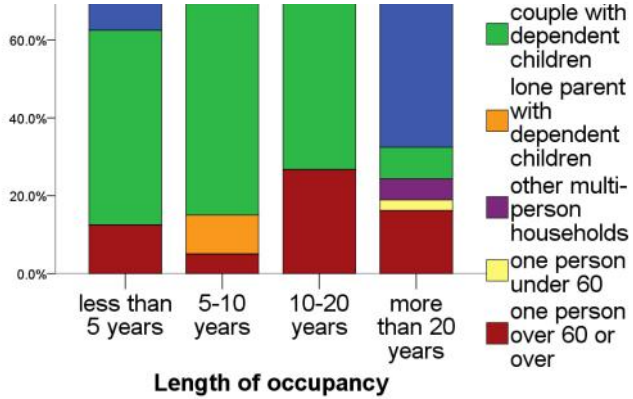
insulation)

LZTs:

21 Solar PV systems

6 Solar thermal systems

5 ASHP systems



Longitudinal changes in electricity use (2008-2012)

Households with physical & behaviour change (n:37)

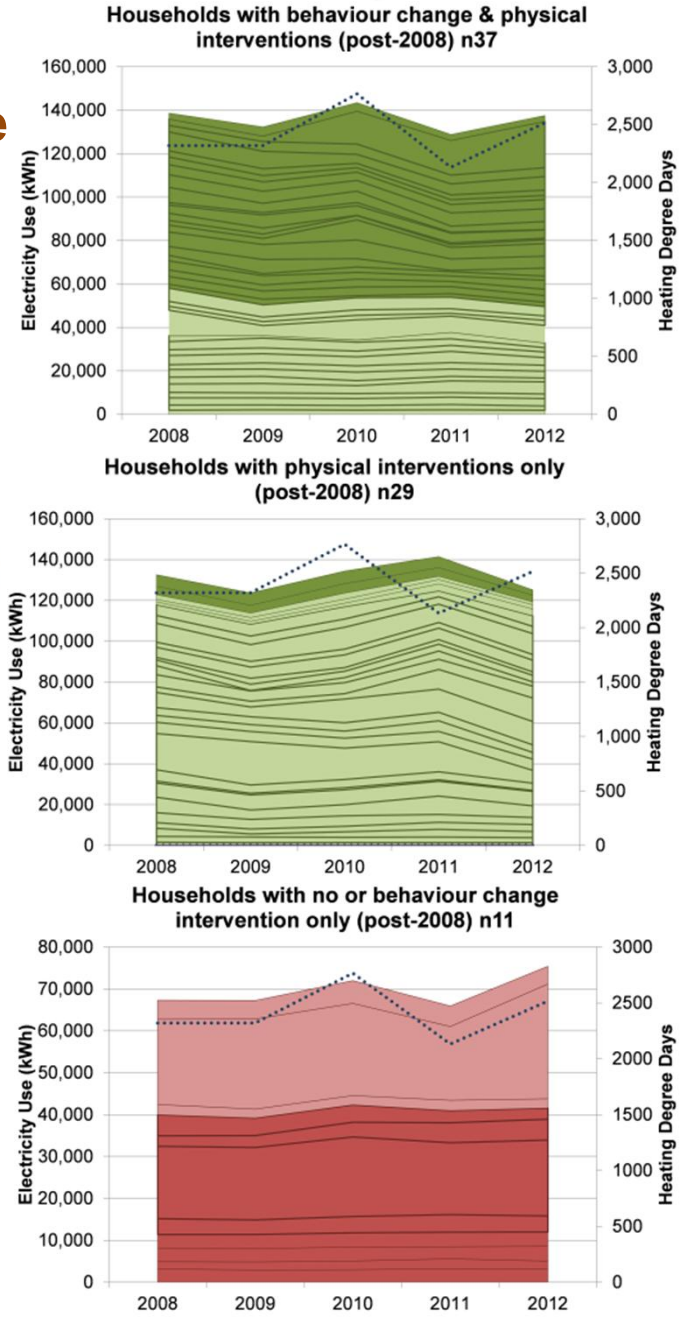
- 25 experienced reductions (**68% of total**)
- Mean change: 6% increase
- **Median change: 12% reduction**

Households with physical interventions (n:29)

- 16 experienced reductions (**55% of total**)
- Mean change: 9% increase
- **Median change: 3% reduction**

Households with no interventions (n:11)

- 3 experienced reductions (**27% of total**)
- Mean change: 9% increase
- **Median change: 5% increase**



Longitudinal changes in gas use (2008-2012)

Households with physical & behaviour change interventions (n: 31)

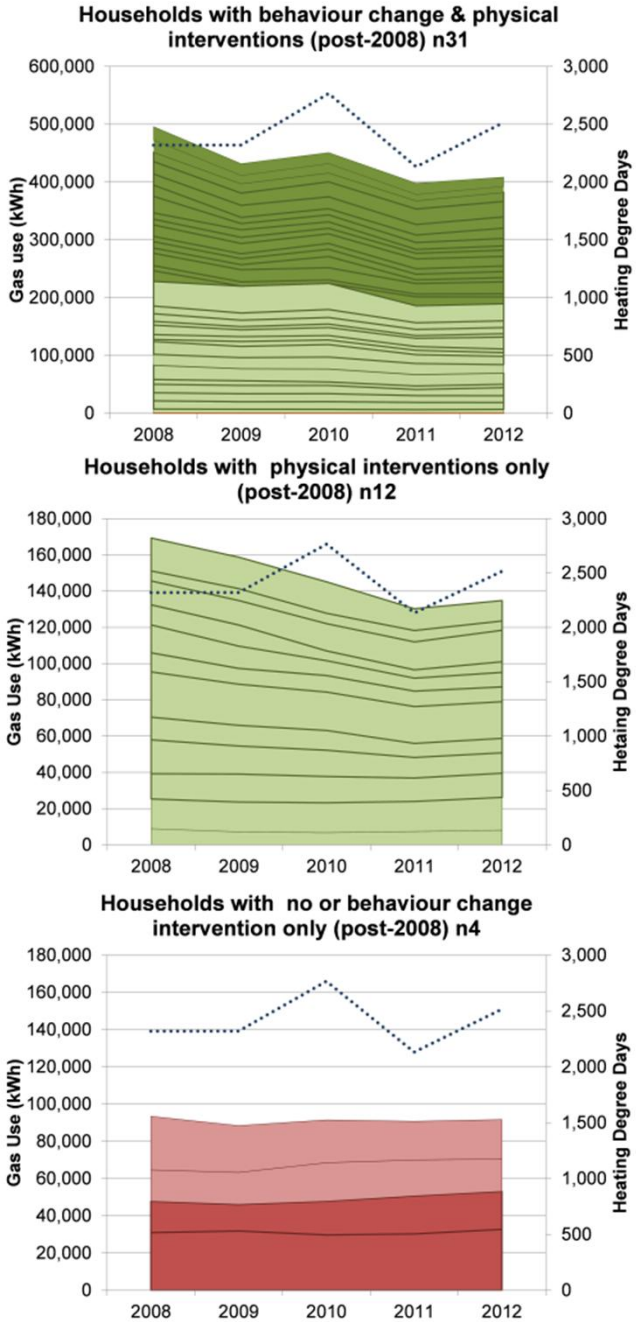
- 25 reductions (**81% of total**)
- Mean change: 13% reduction
- **Median change: 16% reduction**

Households with physical interventions (n: 12)

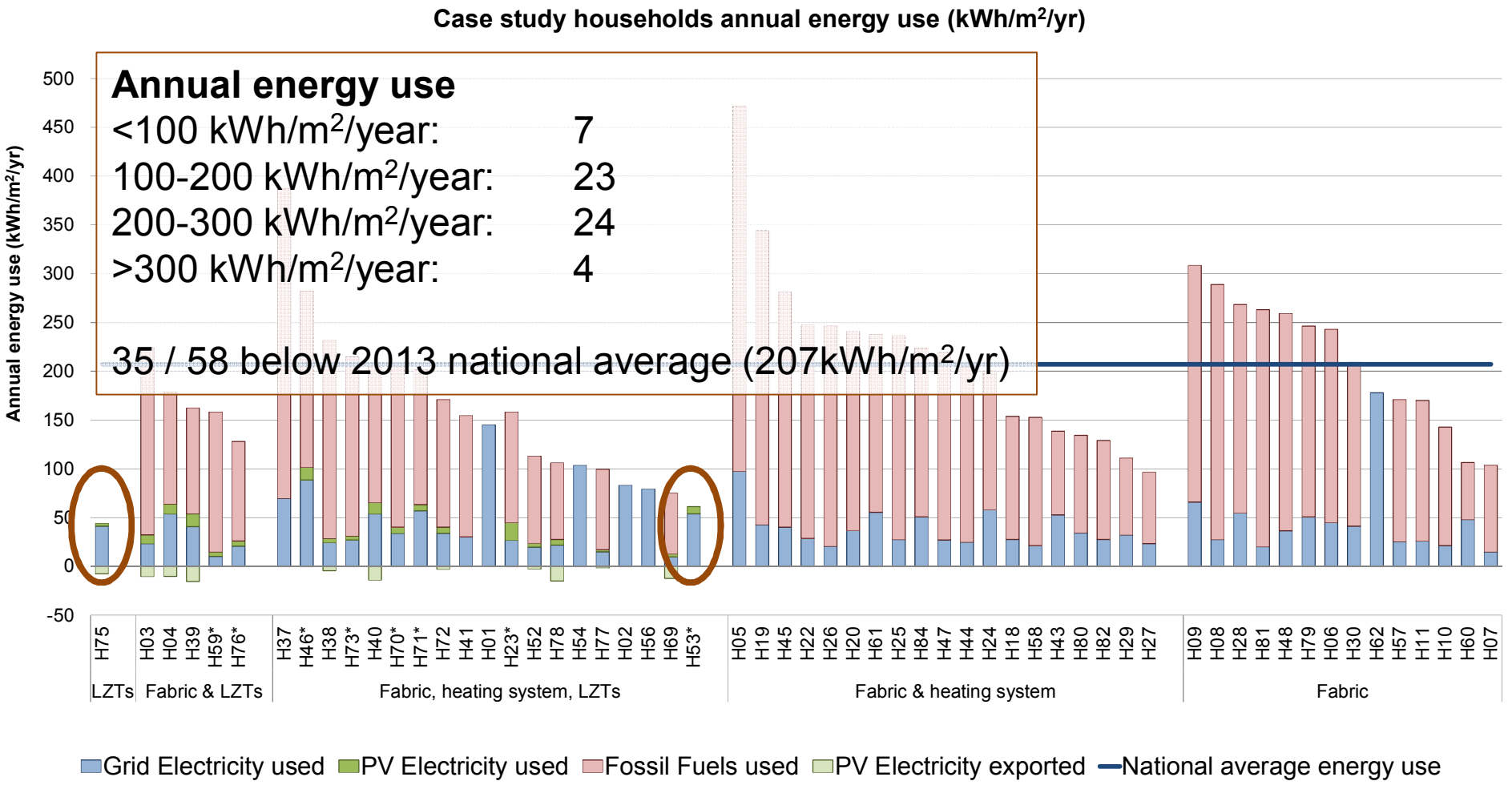
- 10 experienced reductions (**83% of total**)
- Mean change: 19% reduction
- **Median change: 21% reduction**

Households with no interventions (n:4)

- One experienced reductions (**25% of total**)
- Mean change: 1% increase
- **Median change: 5% increase**

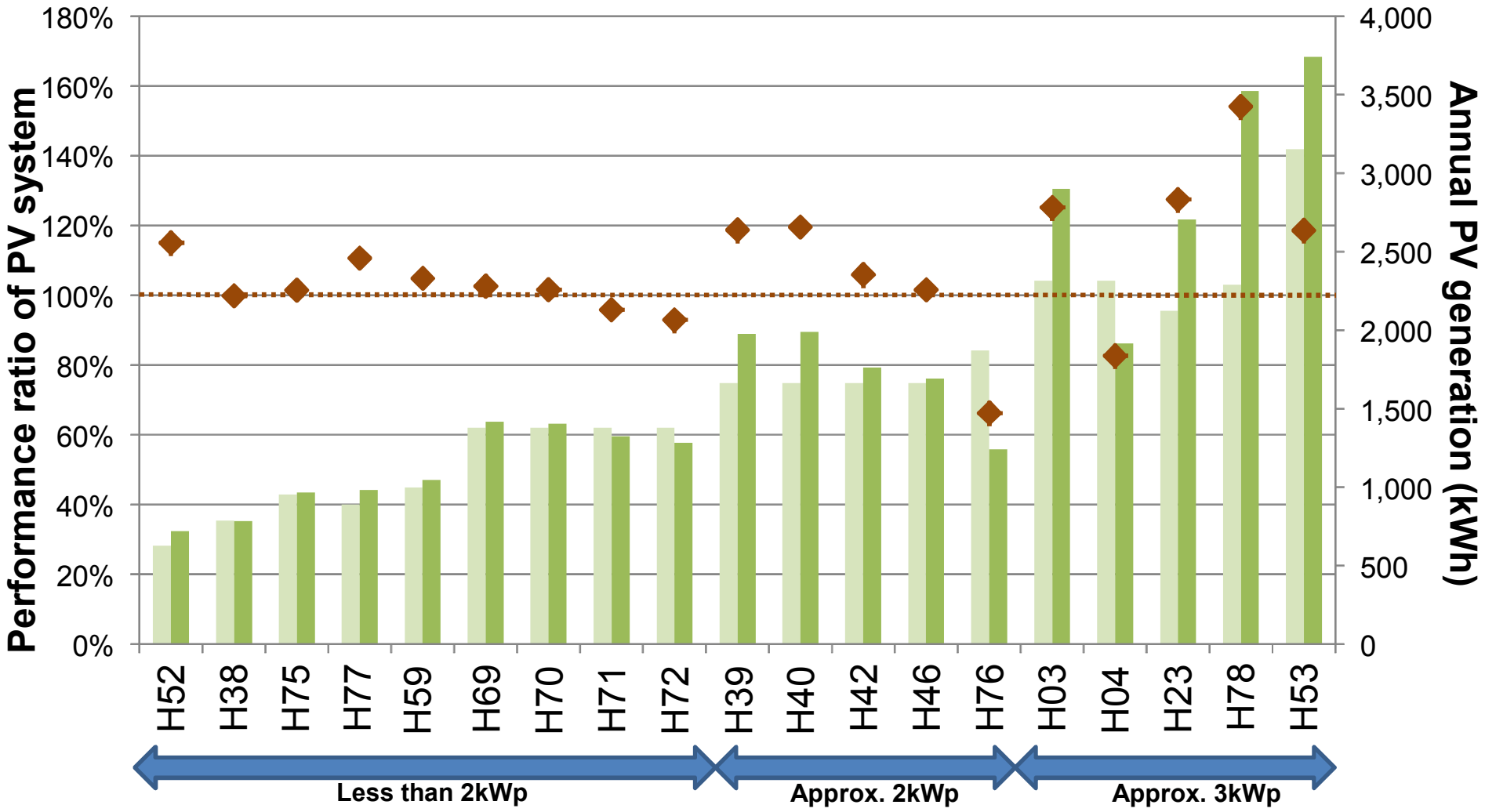


Annual energy use in EVALOC households in 2013



- Highest user **472 kWh/m² year**; Lowest user **44 kWh/m² year**
  - Difference of **428 kWh/m² year**
- **189 kWh/m² year** EVALOC mean energy use

Performance of Solar PVs (n: 19)



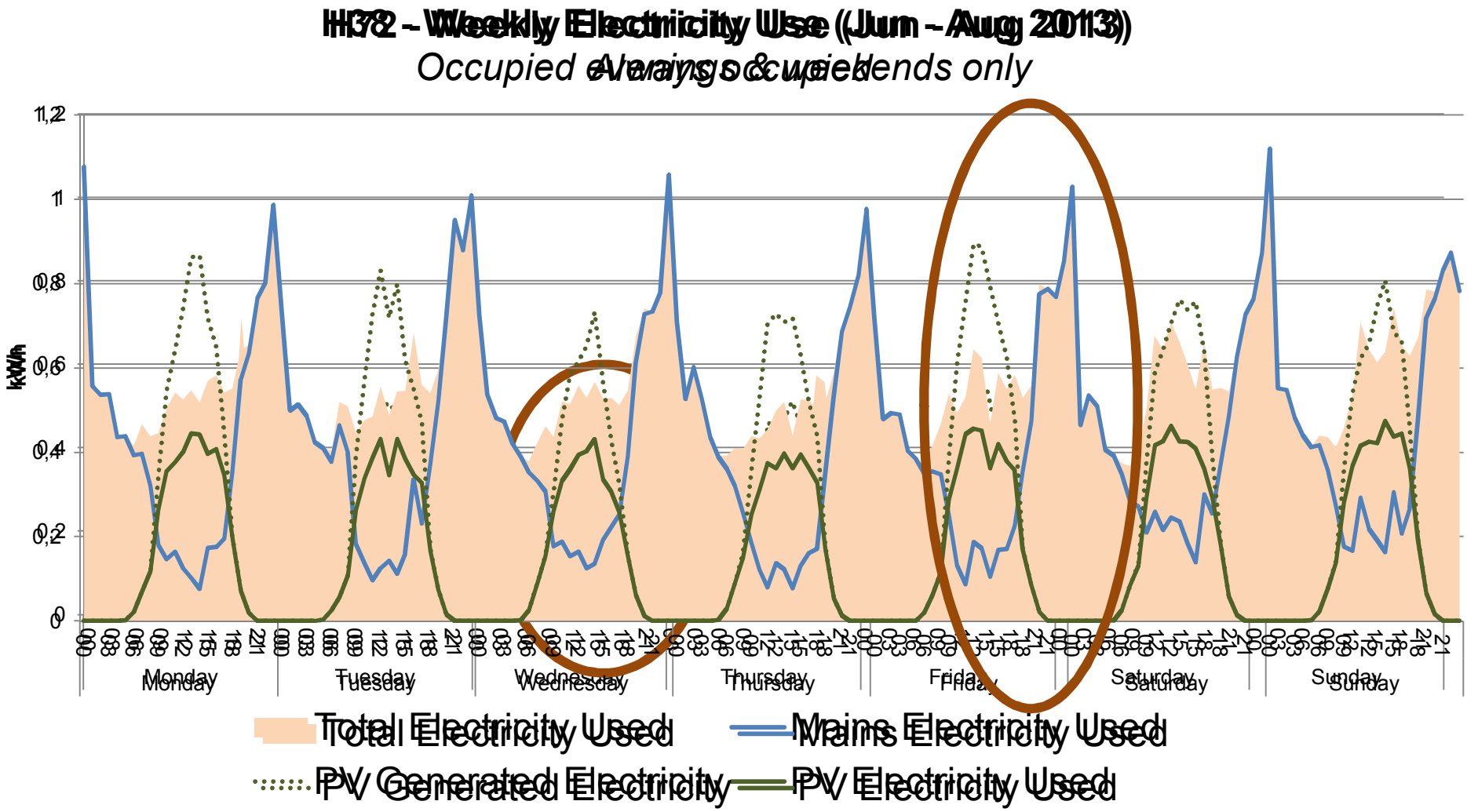
Changes in electricity use in PV households

- Longitudinal grid electricity data available for 19 households with PV
  - **13 saw reductions in their grid electricity use (2008-2012)**
- PV generated electricity used available for 10 households
  - **Three** have significantly reduced their **total** electricity use post PV installation
  - **Four** are using similar amounts of electricity
  - **Three** are using significantly more **total** electricity use post PV installation

Hsd ID	PV system installed (year)	Grid electricity use only (kWh)						Total electricity use (kWh)
		2008	2009	2010	2011	2012	2013	2013
H03	mid 2011	5,680	6,088	6,165	5,382	2,591	3,355	4,722
H04	mid 2012	4,081	3,774	4,629	4,213	3,277	5,722	6,686
H38	mid 2011	3,583	3,744	4,053	3,261	3,054	2,150	2,525
H39	mid 2011	3,050	2,802	3,599	2,394	2,933	2,883	3,780
H40	mid 2011	4,140	4,251	3,110	2,500	4,146	4,174	5,087
H52	mid 2011	2,665	4,143	3,831	2,652	2,620	2,593	3,018
H72	mid 2011	4,068	6,534	3,840	-	3,701	4,423	5,302
H75	mid 2011	6,677	6,890	8,598	5,238	5,494	3,764	4,045
H77	mid 2011	7,021	4,315	5,244	2,800	3,696	4,066	4,634
H78	mid 2011	2,999	4,487	4,739	4,047	4,076	3,611	4,655

Use of PV Electricity: Peak demand vs peak generation

- Use of PV electricity by household (n=10) ranges from **15% - 68%** **(Average: 45%)**



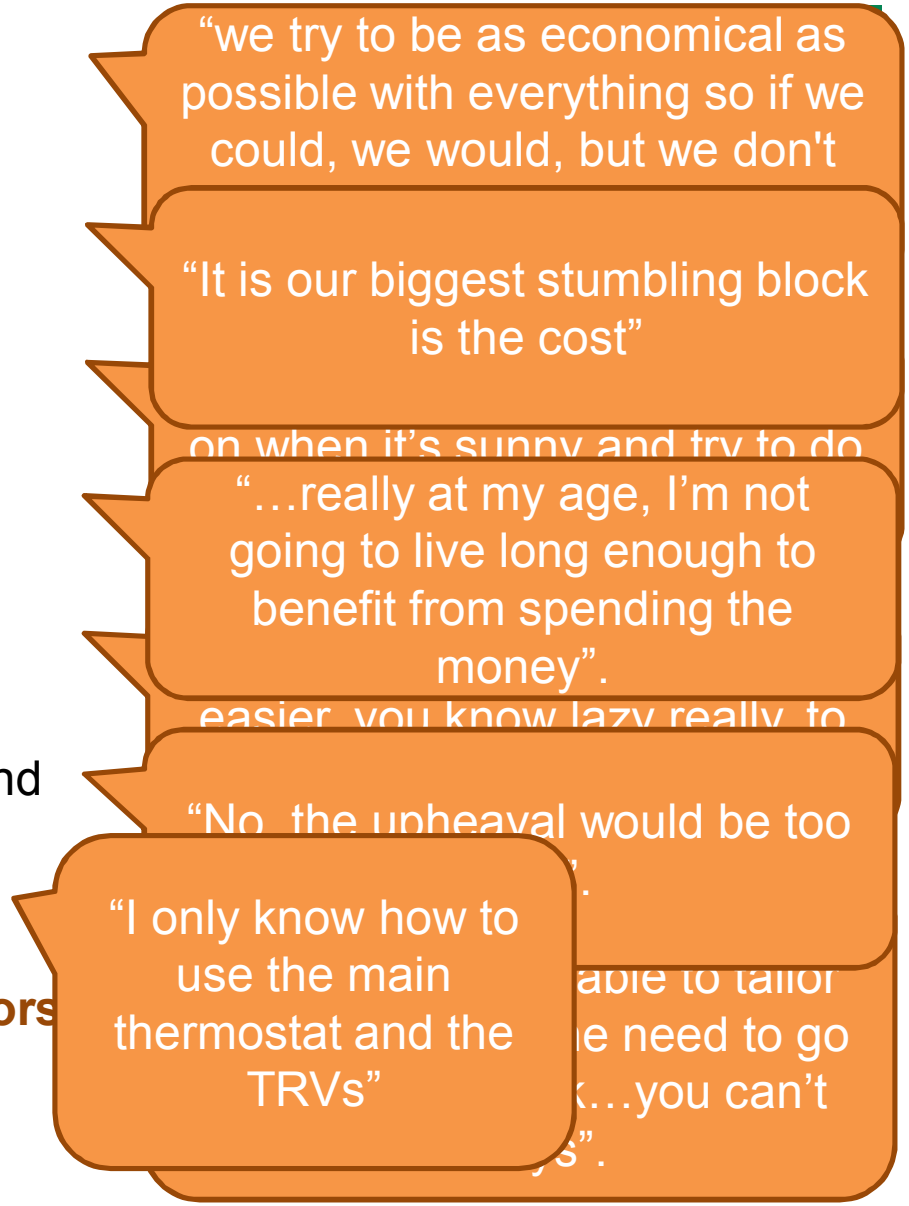
Influencing factors on household energy reductions

Physical environment and technical innovations
- Appropriateness of physical interventions
- Installation & commissioning issues

Control and management of technologies and physical environment
- 'Old' habits, 'new' technologies
- Need for localised control

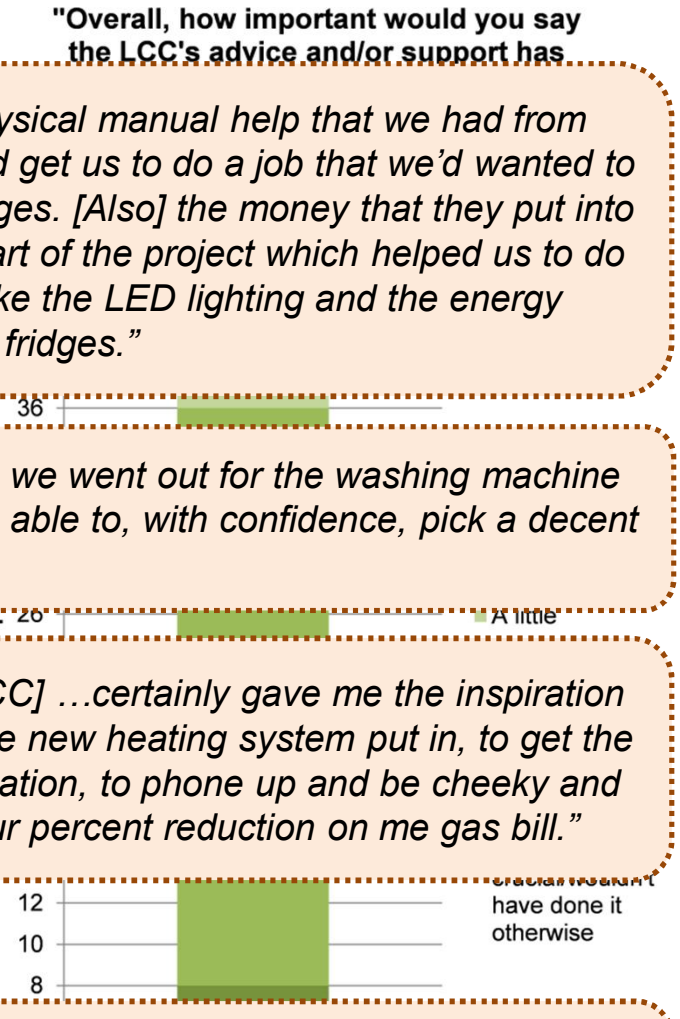
Occupant related factors
- Agency and knowledge
- Attitudes & interaction with environment and technologies
- Habits, occupancy patterns and lifestyles

Wider social, economic and practical factors
- Actual cost and cost-benefit ratio
- Impact of physical measures on space
- 'Hassle' factor



Role of LCCs in reducing household energy use

- 43/48 (90%) felt that the support and/or advice from the local LCC had helped them reduce their energy use
- LCCs enabled householders to undertake action and/or change behaviours through:
  - Facilitating installation of physical interventions
  - Increased knowledge and awareness
  - Increased motivation and agency to undertake further improvements



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

"…when we went out for the washing machine we were able to, with confidence, pick a decent one."

"[The LCC] …certainly gave me the inspiration to get the new heating system put in, to get the loft insulation, to phone up and be cheeky and get a four percent reduction on me gas bill."

"I think I probably would have done it all anyway but maybe not as quick and maybe not as effectively with the extra things that I learned."

Implications of findings for policy and practice

- LCCs can be more effective than other actors (such as national government, energy suppliers and private sector organisations) in engaging and motivating local communities
- However LCCs should be viewed as an important complement to business and government, not a substitute for them.
- Future energy and carbon reduction policies need to make more use of the power of more locally engaged actors.
- Effective support from local government is always helpful and probably essential to the operation of LCCs in disadvantaged communities.
- Retrofitting monitoring kit not easy or cheap but necessary to both monitor performance and optimise use and maximise cost and carbon savings.
- Case study based M&E approach more appropriate as household energy use is complex and dependent on many contextual variables. Case studies also provide an active learning process.

Concluding thoughts…

Impacts of community-based domestic energy projects

- **Overall positive energy reduction trends in wider community**
- **Mixed effectiveness** in terms of reducing actual energy use (long-term) in individual households.
- Many influential and **dominating factors** on energy use and behaviours including *knowledge and awareness; agency; intra-household dynamics; comfort; health; financial.*
- **Behaviour change** and **physical interventions** can:
  - **Shift** and **change energy demand** in individual households,
  - Lead to **increase** in **knowledge, awareness** and **motivation**
  - **BUT dependent on localised factors.**

EVALOC energy and communities toolkit (ENACT)

- ENACT is an **interactive open source** web-based energy and communities resource to **share knowledge and findings** from EVALOC.

www.evaloc.org.uk

Theme 1: Community projects: roles & strategies

Theme 2: Community engagement

Theme 3: Understanding energy behaviours

Theme 4: Home energy improvements

Theme 5: Energy feedback approaches

Theme 6: Monitoring & evaluation (M&E)

Thank you!

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