An Approach to (Sustainable) Design Research

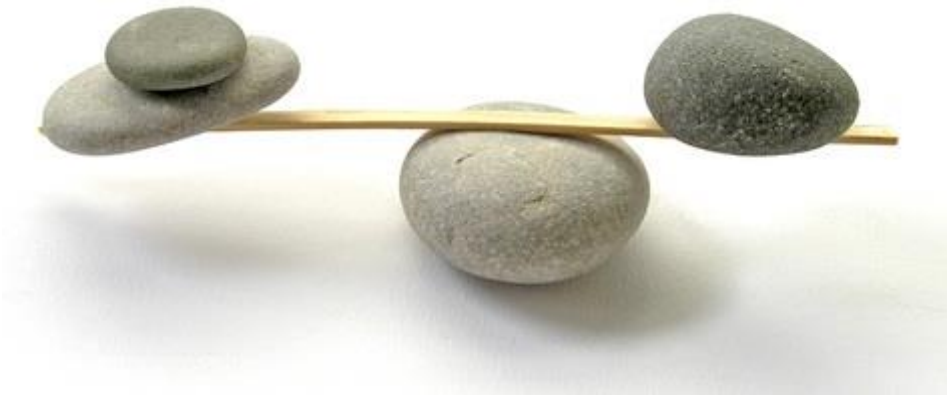
Loughborough University

Professor Tracy Bhamra

Loughborough University

Overview

- Sustainable Design Research Context
- Case Studies – Design for Sustainable Behaviour
- Lessons for Design Research
- Design Research Challenges



Rationale for Research into Sustainable Design

Designers have a responsibility to think about the impact on the environment and society of the products they design.

Only careful consideration can make sure that negative effects of the design are excluded and positive features included.

From an industry perspective trying to ‘retro fit’ more sustainable solutions is costly.

Product Life Cycle

Every product we create has environmental impacts:

- Uses resources & energy when raw materials extracted and when manufactured.
- Generates emissions when manufactured, transported and maybe even used.
- Uses energy when transported and when we use it.
- Creates waste & pollution at the end of it's life.

Different Products, Different Impacts

Furniture = raw materials & manufacture

Household appliances = raw materials, manufacture & use

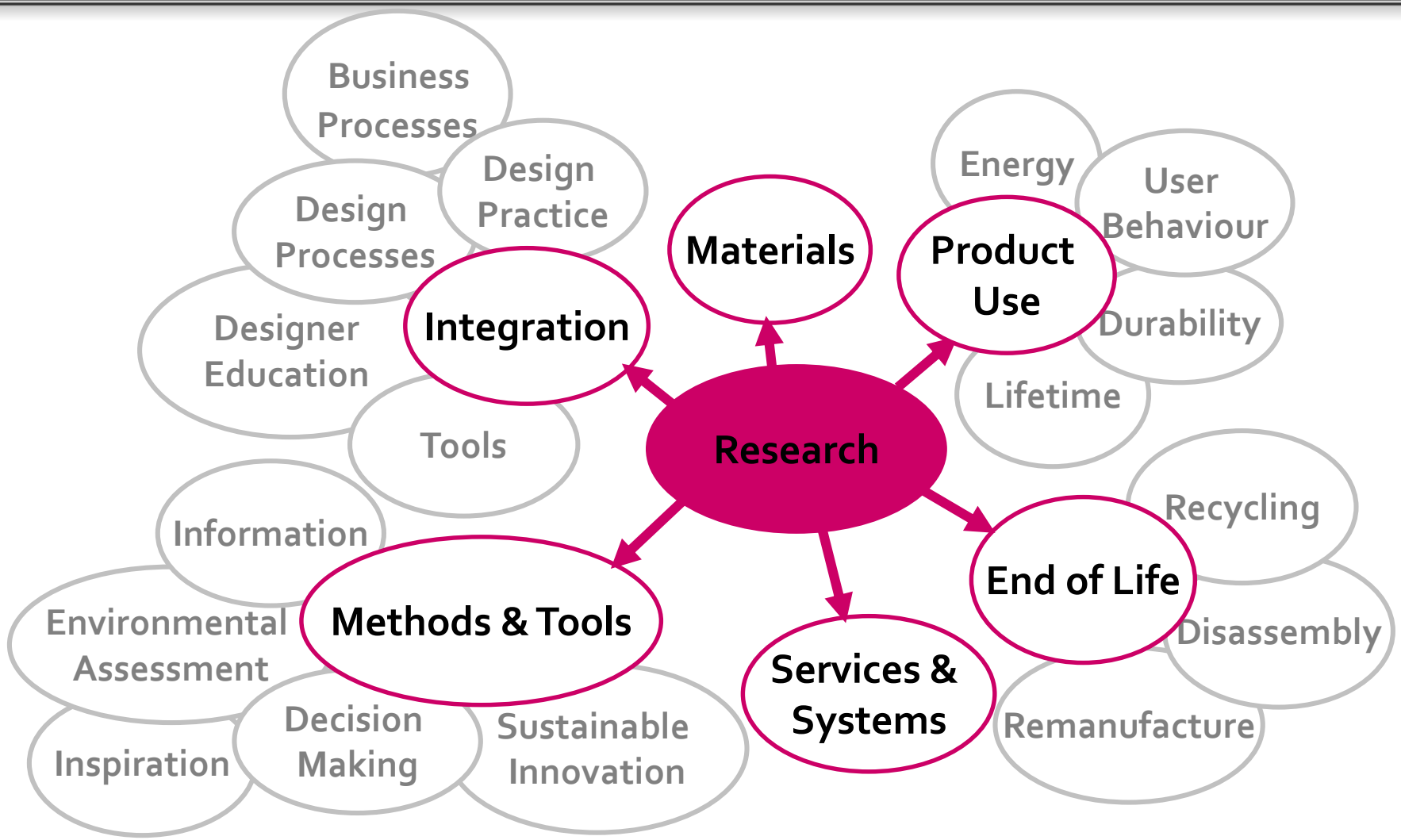
Sustainable Design Research

To date most research and industry practice in Sustainable Design focuses on Materials, Manufacturing & End-of-life. Often viewed as purely a technical problem to be overcome.

But often the biggest environmental impacts occur at the Use stage. This area has often been avoided by designers because it is viewed as complex.

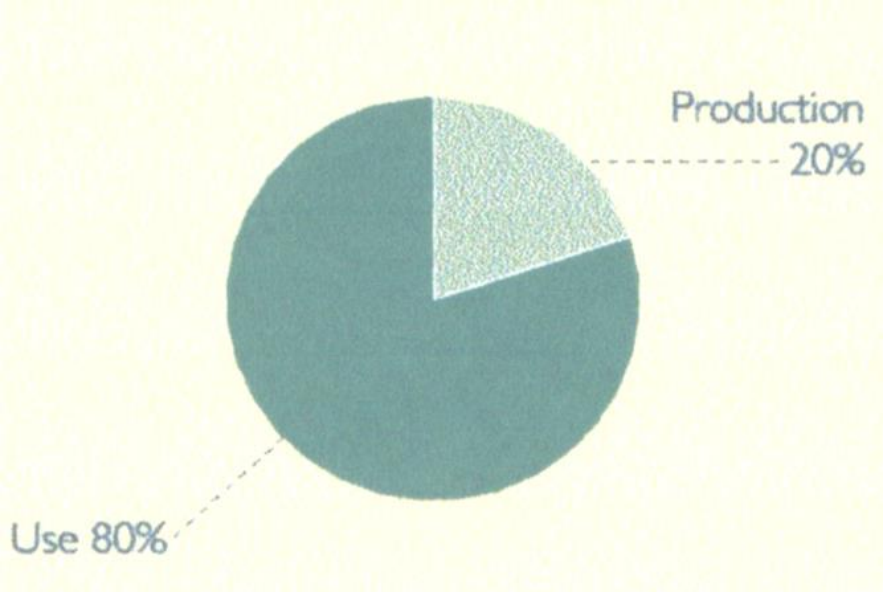
Loughborough University

Sustainable Design Research at Loughborough University since 2003



Loughborough University

What about Use?



People

How can design change behaviour so less energy and other scarce resources are used by the consumer?

Household Energy Use

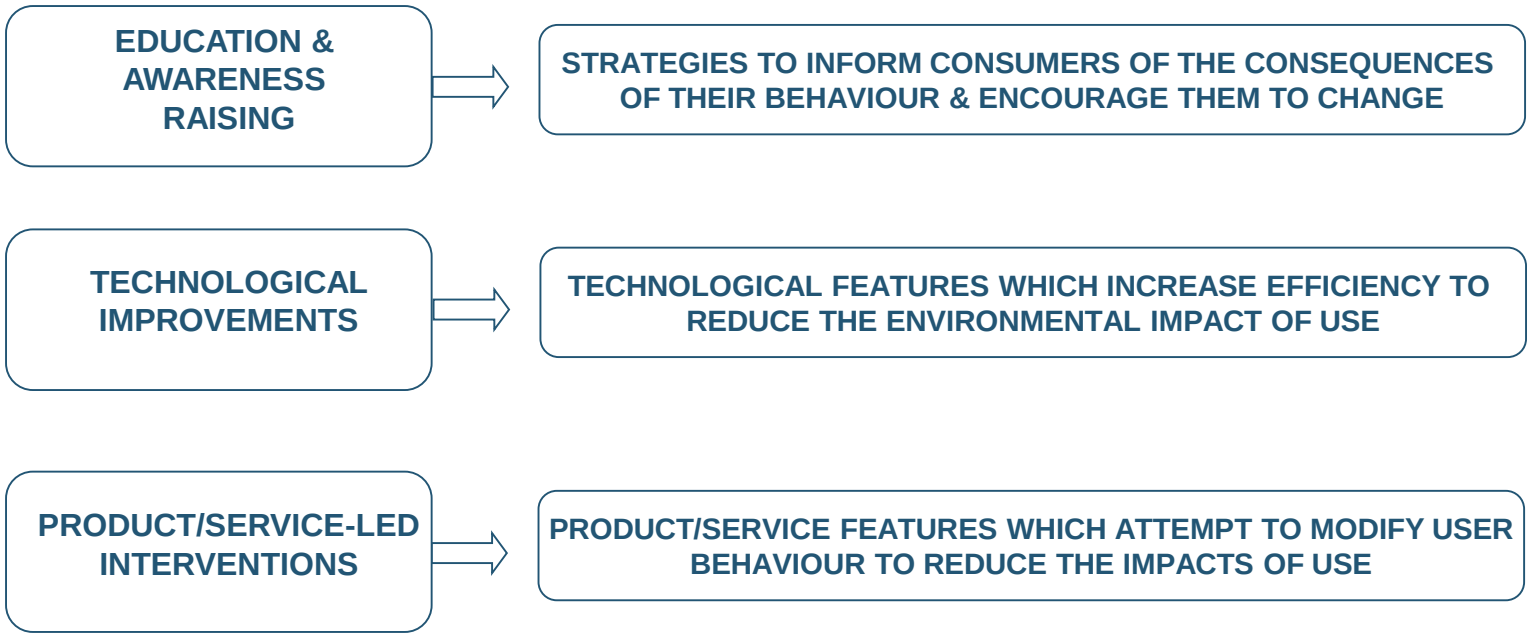
Since 1970

The efficiency of products and systems in the residential sector has improved by around 2% per year

The electricity use by domestic lights and appliances has increased by 70%

Improving the technical efficiency of appliances and manufacturing has not achieved a reduction in domestic energy consumption.

Changing Behaviour



Loughborough University

Carbon, Control & Comfort

‘Carbon, Control & Comfort’ a 3-year project funded by EPSRC & E.On collaboration with 7 other UK universities aimed to change control systems in social housing to enable users to create the comfort conditions that they want whilst reducing energy use for heating and cooling by 20%. Proposal was the outcome of an EPSRC sandpit.

Disciplines involved – architecture, civil engineering, energy systems engineering, building services engineering, electronic engineering, human geography and DESIGN.

EPSRC e·on

UCL · Cardiff University Prifysgol Caerdydd · Durham University · De Montfort University Leicester · The University of Greenwich · King's College London · Leeds Metropolitan University · Loughborough University

Loughborough University

Carbon, Control & Comfort – Design Research Questions

How do people use their heating systems?

What are the opportunities for design in reducing energy use for heating?

Can design interventions reduce energy use for heating?

EPSRC e·on

UCL Cardiff University Durham University De Montfort University Leicester the University of Greenwich King's College London leeds metropolitan university Loughborough University

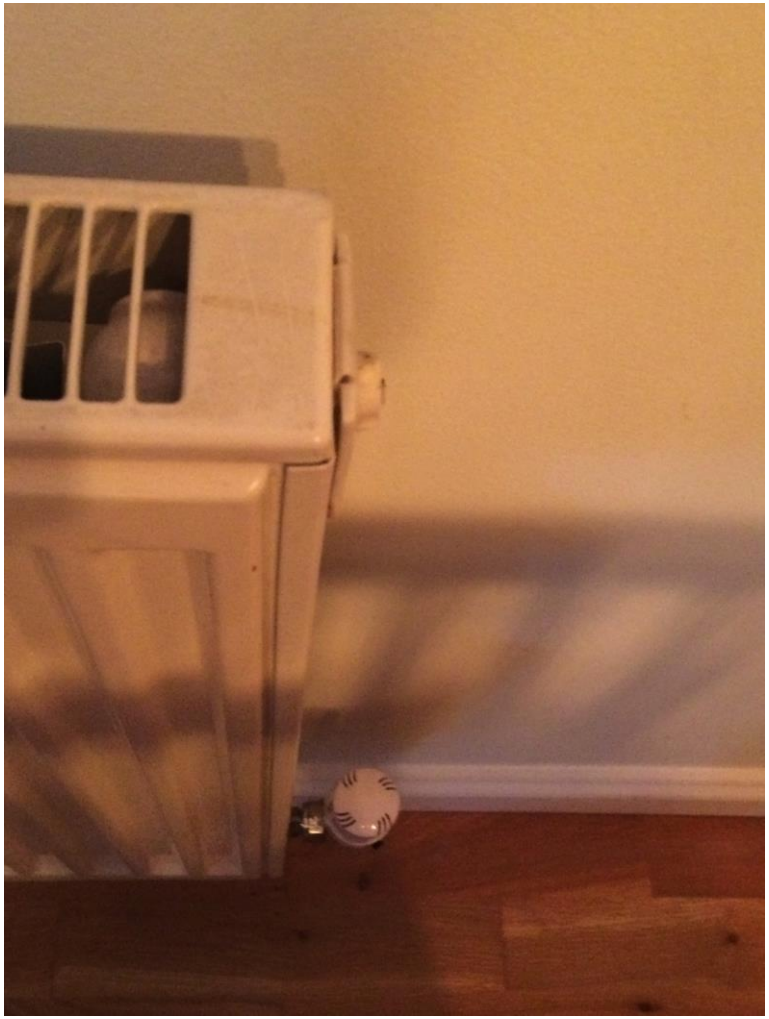
Carbon, Control & Comfort

Design and Human Geography researchers investigated real behaviour in the home using a range of methods.

Home diaries - limited success
Audio tours & interviews - very successful.

Findings used to design and test feedback interventions to help achieve energy reductions.

Contrasted these interventions with an automated system developed purely from a technical perspective by engineers on the project.



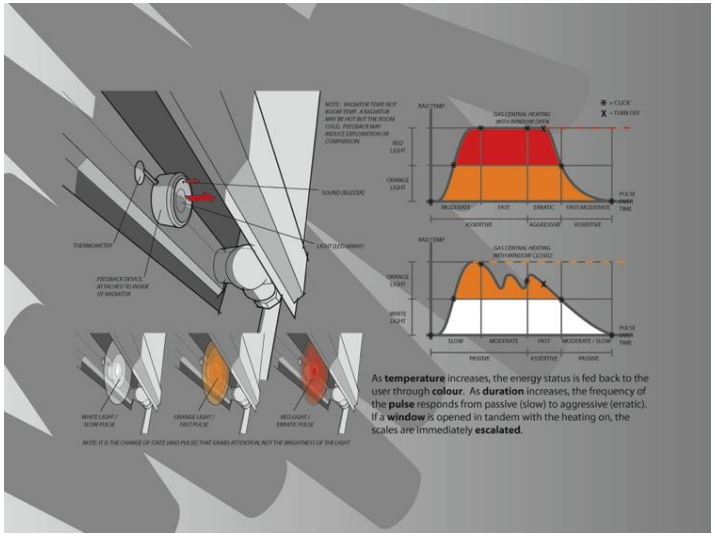
Carbon, Control & Comfort Findings

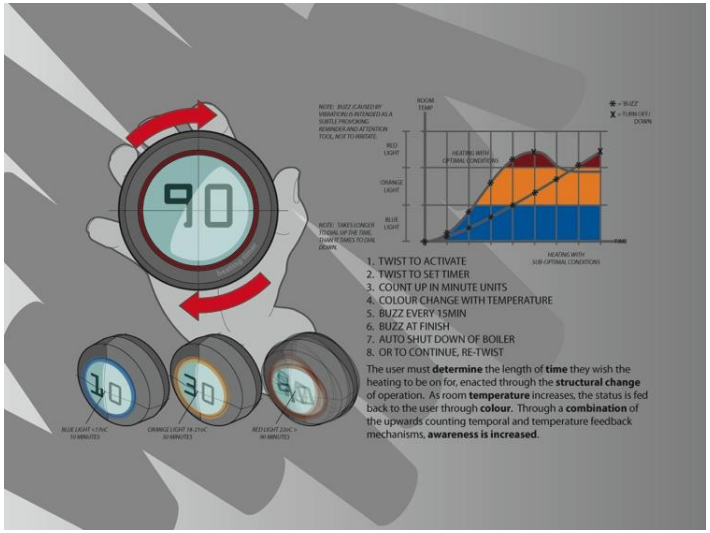
Engineering team undertook technical monitoring of 20 homes found a huge variation in energy use for heating even in very similar properties with similar households.

Detailed user studies in the same homes revealed:

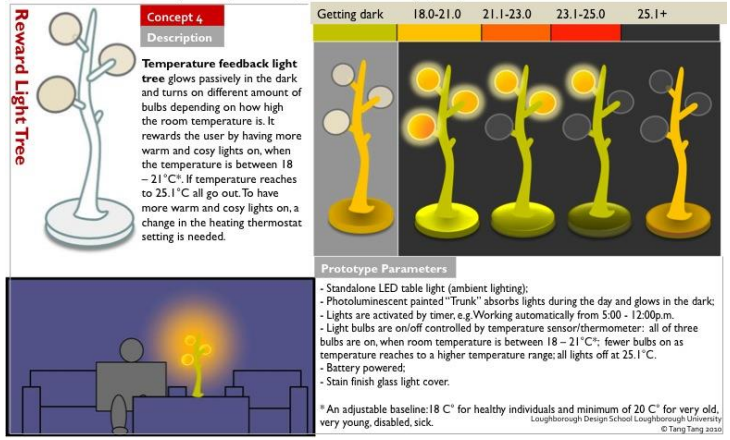
- Windows left open with heating on.
- Electric fires often used for light not heat.
- Timers often not used for setting heating.
- Thermostat use not understood.
- Large variation in thermostat settings.

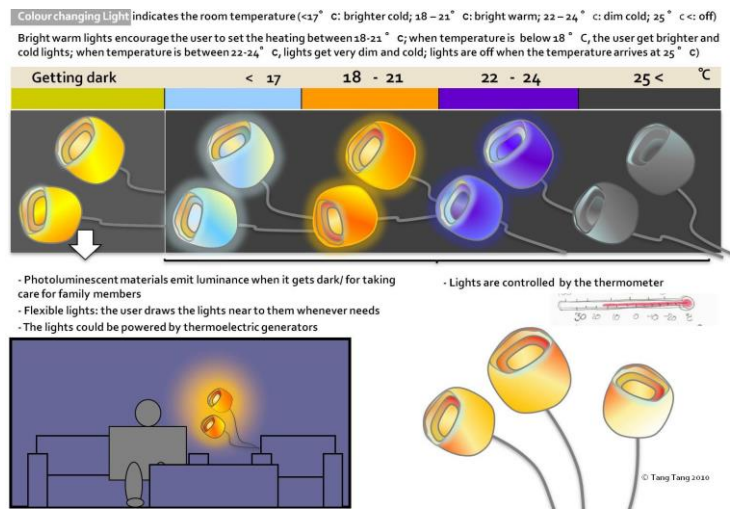
Carbon, Control & Comfort Design Concepts





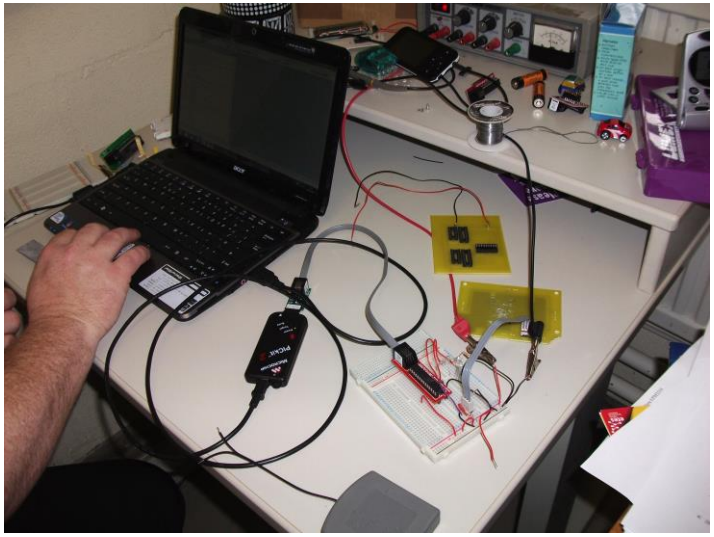
Objective:
The aim of the 'focal point light' (Concept 4 and Concept 5) is to help people save energy in both thermal and visual comfort. As a feedback mechanism, the light reacts to changes in room temperature and influences user's heating system control decisions by changing its colour. As a focal point in the living room, it emulates the function and cosiness provided by electric fire lights to shift the need of buying a fireplace.

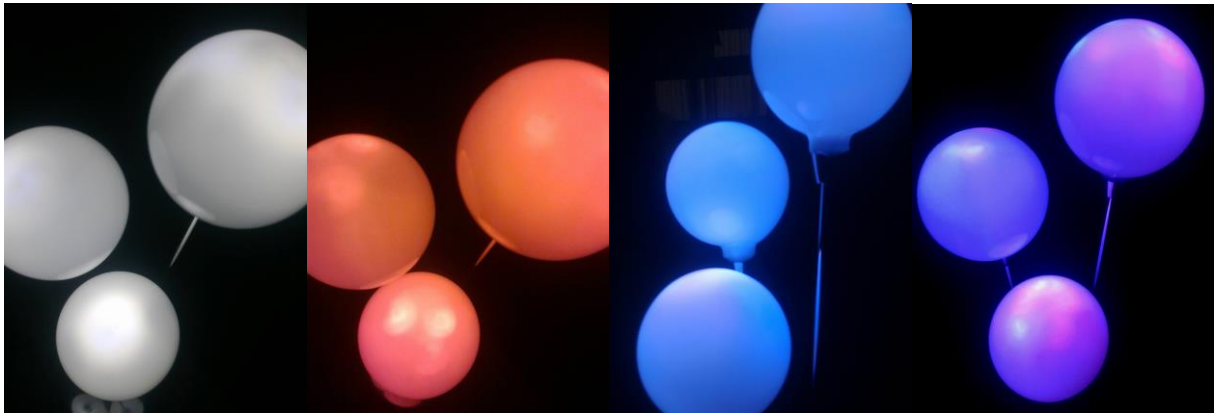




Loughborough University

Carbon, Control & Comfort Design Prototypes





Carbon, Control & Comfort Outcomes

Outputs: journal papers and book chapters.

Refined design for sustainable behaviour model that can be applied in design.

Impacts: informed government policy and increased industry understanding of home energy behaviours.

Loughborough University

Low Effort Energy Demand Reduction

‘Low Effort Energy Demand Reduction’ a 4-year multi-disciplinary project aimed to understand energy practices in the home and test innovative solutions to reduce energy demand. Funded by RCUK in collaboration with Eon, O2 and Alert Me.

Disciplines involved: civil engineering, systems engineering, computer science, energy systems engineering, anthropology and DESIGN. All at Loughborough University.

Research Councils UK Energy For a Low Carbon Future

Research Councils UK Digital Economy Transforming Business and Society

Loughborough University

Low Effort Energy Demand Reduction – Design Research Question

How do daily routines in the home influence energy use?

What are key opportunities in the home to reduce energy use?

Can design interventions in targeted areas in the home reduce energy use?

What are the lessons for designers and policy makers?

How can the results be used by designers and policy makers?

Research Councils UK Energy For a Low Carbon Future

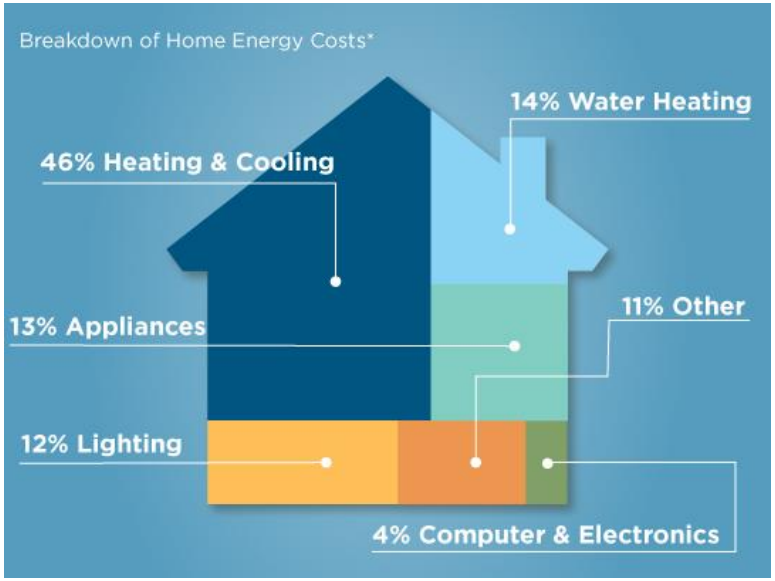
Research Councils UK Digital Economy Transforming Business and Society

Low Effort Energy Demand Reduction

Design researchers and anthropologists worked together to build a detailed picture of real energy use behaviour in the home.

Key research methods:
Detailed interactive interviews in the home and video ethnography

Detailed understanding of the activities and priorities of householders enabled development of set of personas used for designing interventions.



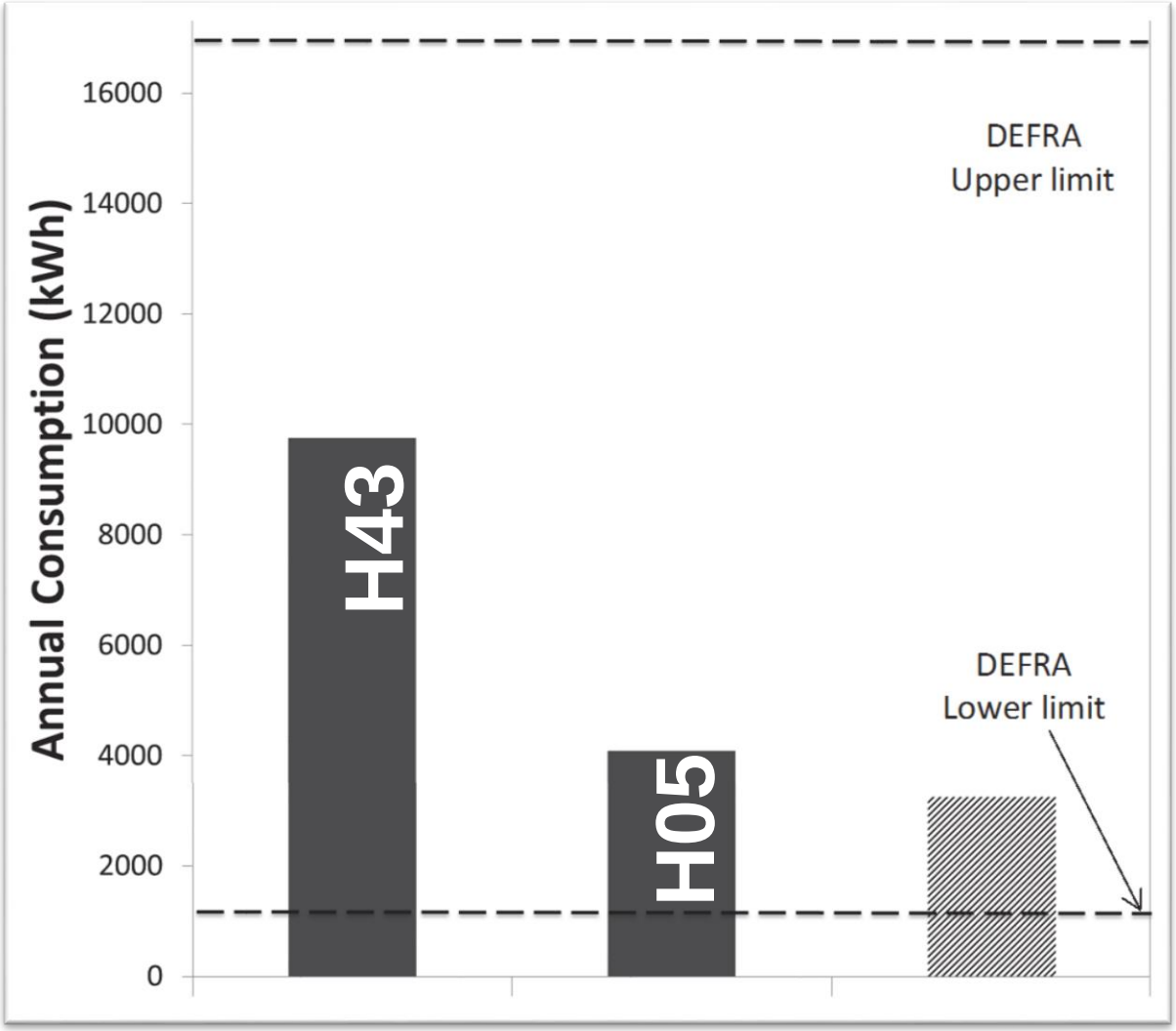
Loughborough University

Energy Monitoring

Engineering research monitored total electricity and gas usage as well as separate key appliances in 20 family homes (2 adults & 2 children) over three years.

Loughborough University

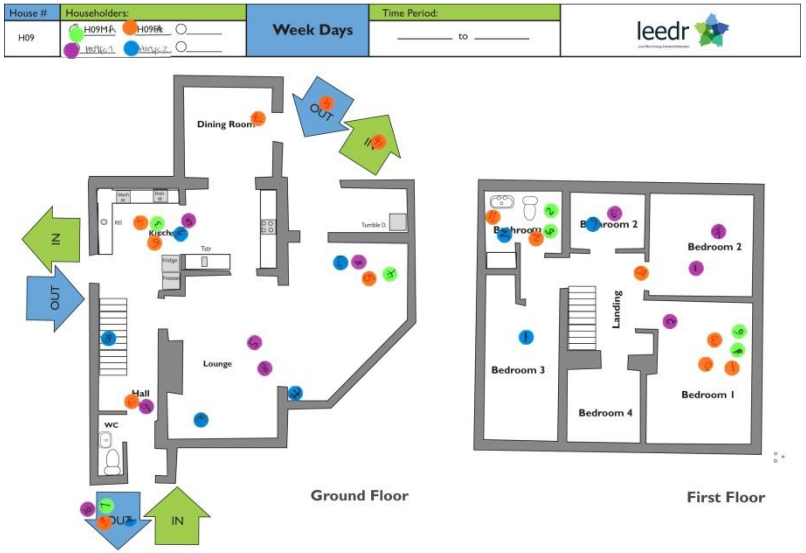
Energy Monitoring



Interactive Whole Family Interviews

Whole family involved in extended interview over an evening meal.

Understanding their motivation for energy saving, if any, their daily routines, energy using activities and their priorities in the home.



Video Ethnography

Collaboration with anthropologists brought video ethnography to design research.

Provided detailed first person accounts of research participants in their environments.

Three inter-related lenses were used through which to consider domestic life: Place, Movement & the Sensory Home

Place

Considers how people, things and resources relate to each other within ecologies of place.

- People – researchers and users
- Things – home technologies & prototypes
- Resources – energy and water

Considers the environments within which people move and live their everyday lives.

Movement

Using re-enactment we explored how people move in and as part of the home environment.

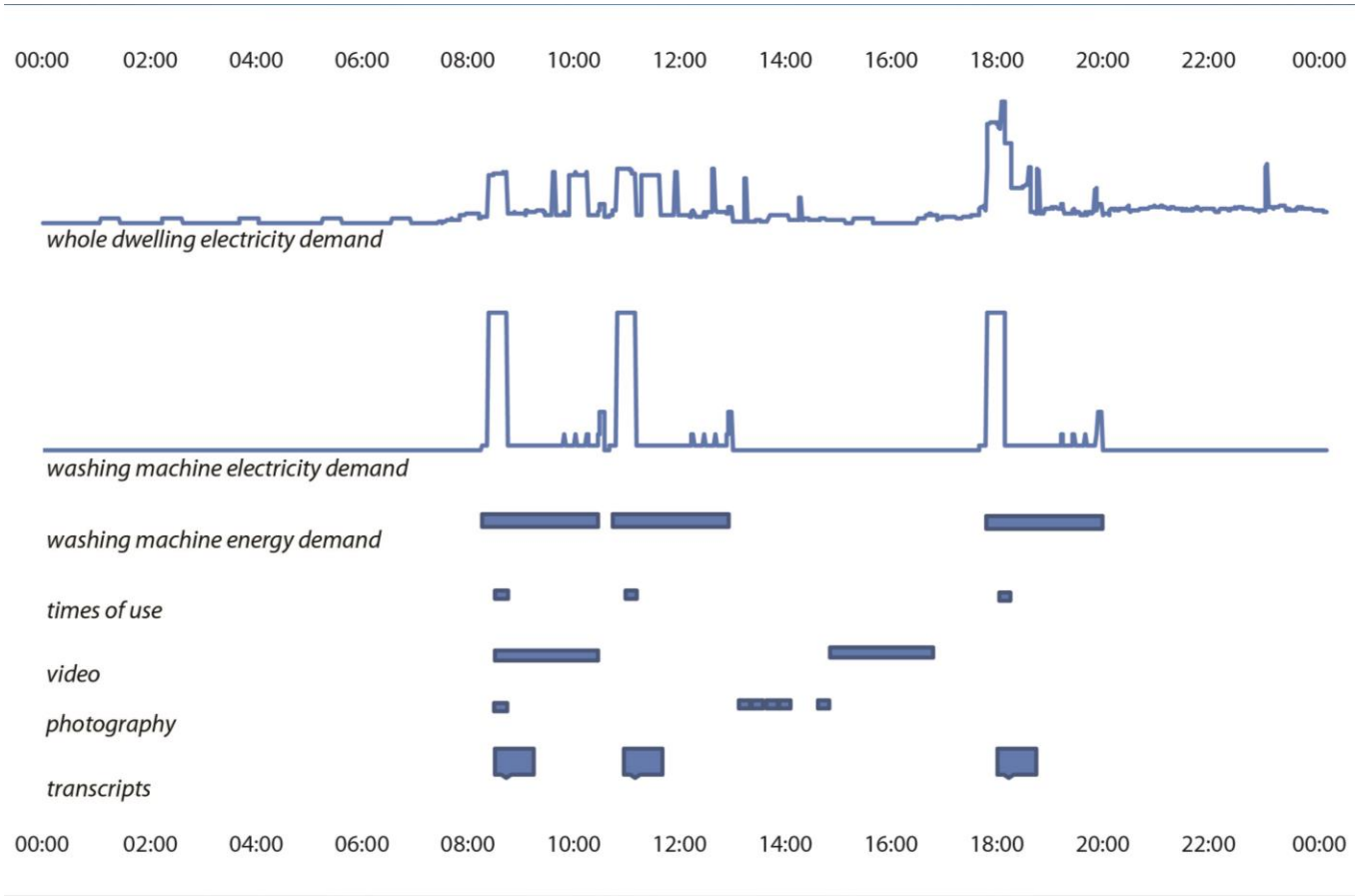
Re-enactment of familiar routines helped explore practices within the home.

The sensory home

Exploring perceptions of heat, air movement, sound & light and how they flow throughout the home.

Paying attention to the material and immaterial (less visible) elements of peoples homes.

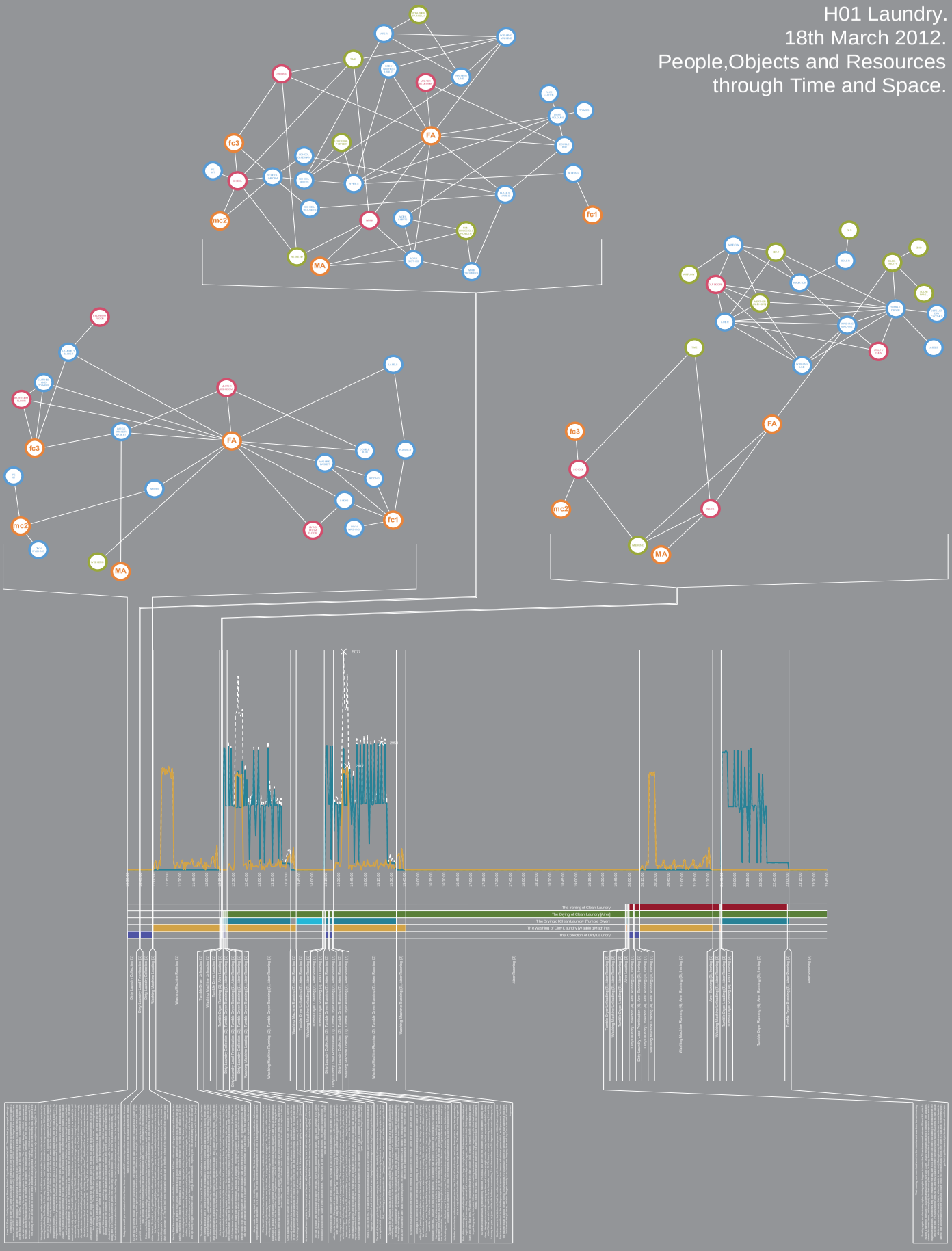
Data Mapping



Focused on laundry, entertainment & digital media and showering.

Mapped qualitative & quantitative data together to give insights into problems to be addressed

H01 Laundry.
18th March 2012.
People,Objects and Resources through Time and Space.



The Mature Good Lifers:

Jacqueline, Stephen, Hannah & Lauren.

Background
Jacqueline and Stephen, in their early fifties, are married and have two teenage children in secondary education, Hannah and Lauren. Both educated to a higher degree level, Jacqueline works as a manager of a local firm whilst Stephen works as an independent IT consultant.

The combined income for the household is around £105,000 p/a. The family would describe themselves as technophilic, stylish and enjoy a great standard of living.

Basic Human Goals:
- **To consume energy for the pleasure and work/education benefits it provides**
- **To be very active and sociable**
- **To be a stylish and proud family**

End Goals:
- **To maintain and enhance our high standard of living**
- **To reduce our energy waste**
- **To make the desired consequences of energy consumption more convenient to attain**

Experience Goals:
- **To feel unmitigated in consumption**
- **For individuals within the family to not feel inconvenienced through change**
- **For change to 'fit' within our flexible, relaxed nuclear family**

About the Family
- The entire family are confident and unmitigated consumers of technology and energy. They are very stylish, sociable, busy and active.
- As a family, they usually spread around the house, the teenagers wanting their own space. When together as a family, it is usually when watching TV or in the kitchen.
- Jacqueline and Stephen are lenient parents. The family are very flexible aside from Hannah and Lauren's extracurricular activities.
- There is usually somebody at home with Stephen working from home for two days of the week and they own a dog.
- The family has an open house attitude, with friends and visitors quite often letting themselves in.

...if I'm working from home, then the heating's on for the day, but it's not convenient to do it any other way. We have thermostatic radiators, but we never get anything sensible out of them...

'Home'
- In the years that the family have lived in their property they have had numerous extensions and changes to their home, creating a stylish open plan home in addition to the latest fixtures, such as windows. Because of all these changes, the whole family feel very much at home.
- As Jacqueline and Stephen get better at DIY, they would prefer to make changes themselves rather than employ a professional.
- Jacqueline and Stephen believe that they will probably move house once Hannah and Lauren go to university.

...we don't go without, I mean, I was always brought up with a family that did things to cut waste, but it's not like we are grandma's only doing it for money...

Sustainability and the Environment
- Jacqueline and Stephen have a deep understanding of climate change and sustainability, and are aware that their lifestyle has a negative impact despite growing their own vegetables, recycling, composting and baking.
- Although willing to make changes to become more environmentally friendly, their priority is to protect their lifestyle, including life aspirations, love of technology and comfort.
- Jacqueline and Stephen are aware that they are privileged and with a large disposable income they are not concerned with saving money but want to reduce waste.

...the dryer's on all the time but I'm willing to spend the money for a clean load that I don't need to iron. I'm aware it's not environmentally sound, but I want easy to fold dry clothes!...

Energy and Technology
- The family own state of the art energy related appliances and numerous digital media. They could be termed technophiles, although this is driven by Stephen who loves gadgets and works often from home.
- Jacqueline and Stephen both use smart technology for work, whilst the teenagers use mobile phones and other digital technologies for games and education.
- The family are very energy hungry, living in energy bliss. They have an idea of what they 'should' do, consuming as much as they like with no idea of how much they use or the cost; they pay no attention to it.
- Jacqueline and Stephen drive and take the train to work and long distances, and walk for shorter distances. This family cannot live without their car, depending on it for convenience.
- They take turns to walk the dog every day.

...we, like, buy a device that has an eco-button without necessarily knowing what on earth the eco-button did. Yeah, I suppose that's a good example of the sort of things we do...

Locations
- Certain visible marks, for Jacqueline and Stephen, are acceptable within the confines of the home or activities, such as painting, gardening or dog walking. Although Lauren tends to launder her own clothes, this tends to involve putting whatever is on her bedroom floor into the wash basket, whether 'dirty' or not. She has an abundance of clothes so isn't too fussed.

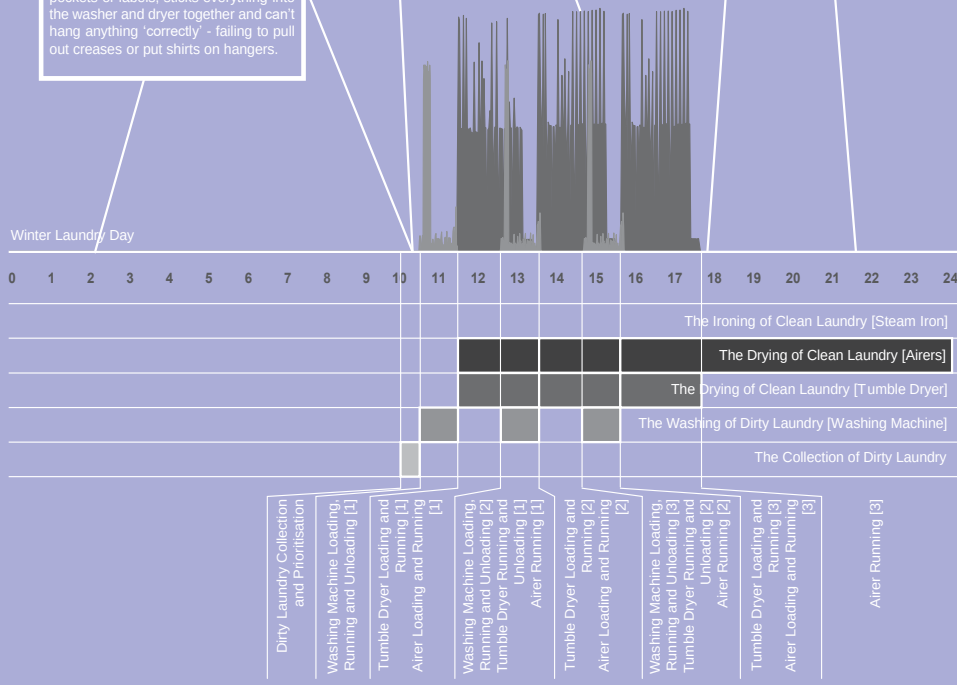
Limitations of Stuff
- Although Jacqueline heavily relies on the technology of the laundry process, she is very much aware of the limitations. Through experience, she has learnt to de-fluff the tumble dryer regularly and not to put certain articles in as they will shrink, and also that she cant put too many heavy items into the washing machine in one go as the machine will stop working.

Routines & Priorities
- Jacqueline usually orchestrates the laundry on Sundays with 2 to 3 loads (although Stephen will often do a load if working from home). Split by colour, wash loads are driven by and prioritised through key laundry items needed over the coming week, school uniforms first and then work shirts. Kitchen cloths and towels are exchanged daily to 'stay on top of things' hygienically.

Laundry Knowledge
- Jacqueline prefers to only use one or two settings on her washer, usually a 30 degree quick wash and then rammed into the tumble dryer (unless it can't be tumbled, then it's put on airers in the kitchen away from the dog). The dog's basket and towels get washed last on a higher temp' wash, sometimes with bleach when trying to remove the smell in the washer.

Laundry Services
- None of the family are enamoured with ironing, preferring the bought in, biweekly, service of a cleaning lady to tackle Stephen's work shirts whilst also cleaning the rest of the house. The rest of the family tend to wear clothes that don't need ironing. Usually, these clothes only need to be folded out the dryer and then distributed per person in baskets to be put away.

Social Stories
- Although Stephen sometimes attempts the laundry whilst working from home, Jacqueline would prefer him not to as he 'does it wrong'. Jacqueline claims that he never checks pockets or labels, sticks everything into the washer and dryer together and can't hang anything 'correctly' - failing to pull out creases or put shirts on hangers.



Bridging to design

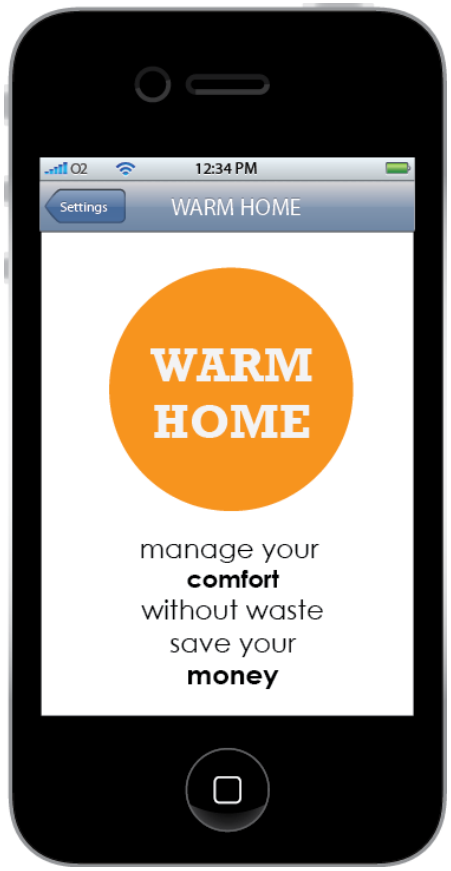
Personas helped us to make sense of the messy domestic reality.

Enabled us to identify design opportunities to develop concepts and prototypes.

This development enabled us to generate principles to guide conceptual design.

Main Findings - Informed the Design Brief

- Smart control and monitoring technologies offer great potential for domestic energy saving
- User needs must go beyond attractive aesthetics and usability
- Design of smart controls and energy feedback needs to take into account everyday routines and practices
- Need to design ‘with the grain’ of everyday life
- More targeted information and sophisticated control can lead to domestic energy savings as long as it fits into the rhythm and busyness of everyday life



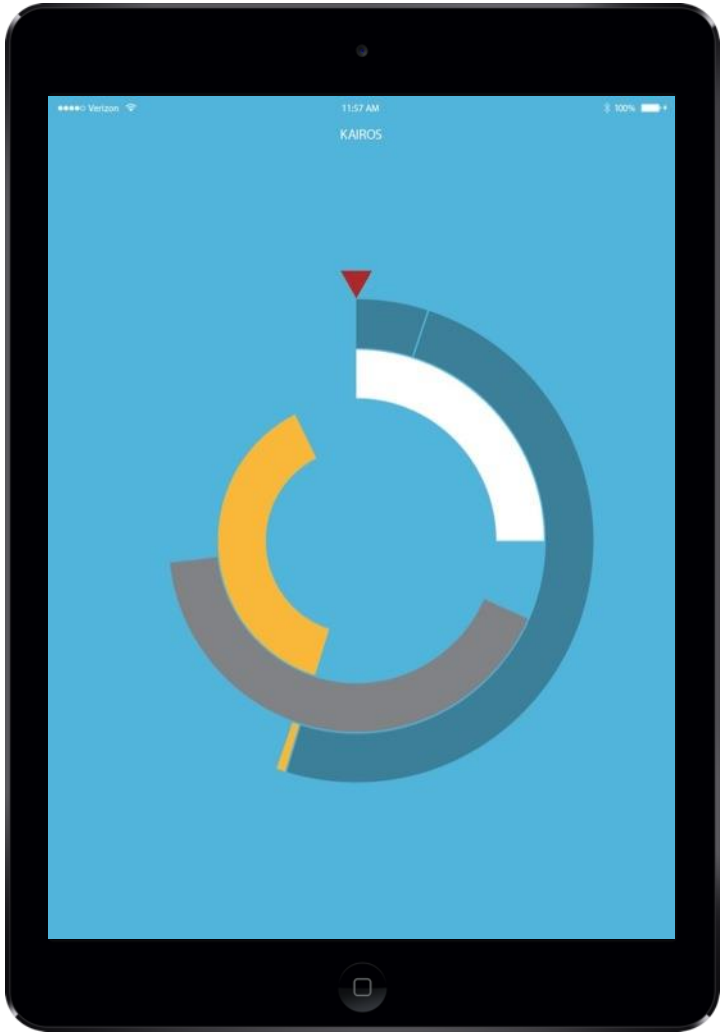

THE HOME IS
PROJECT
Design Challenge...
...how can we help reduce the domestic
energy consumption of householders
through 'low effort' digital intervention?
HMW...
TAKE 'UPGRADE'
WITH US?
HMW...
MAKE MICRO
GEN
DESIRABLE?
ENERGY IS
INTANGIBLE!
HMW
Make downshifting rather than
growth the aim
of family
living
HMW
Get households
to close internal
doors
HMW
Encourage new
appliance
acquisition
Values

Loughborough University

Kairos

Smart control of appliances and heating in relation to everyday events

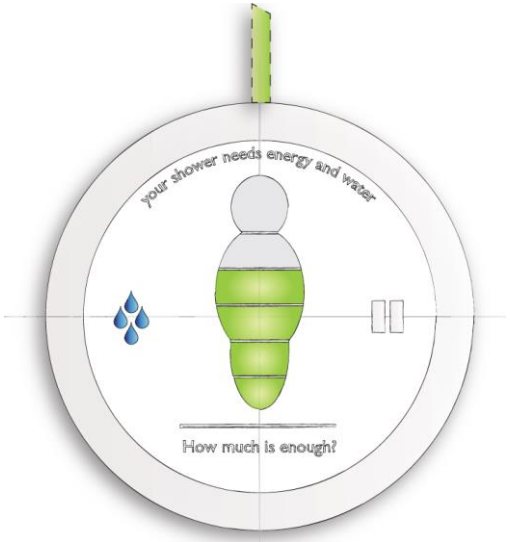
- ‘when baby stirs slow the washing machine spin cycle’
- ‘when I come in the door start the final rinse’



Enuf

Shower monitoring device to encourage all members of the household to reduce consumption. Used light and sound to provide feedback and incentives. Showering time and energy use indicated.

Encouraged competition between household members.

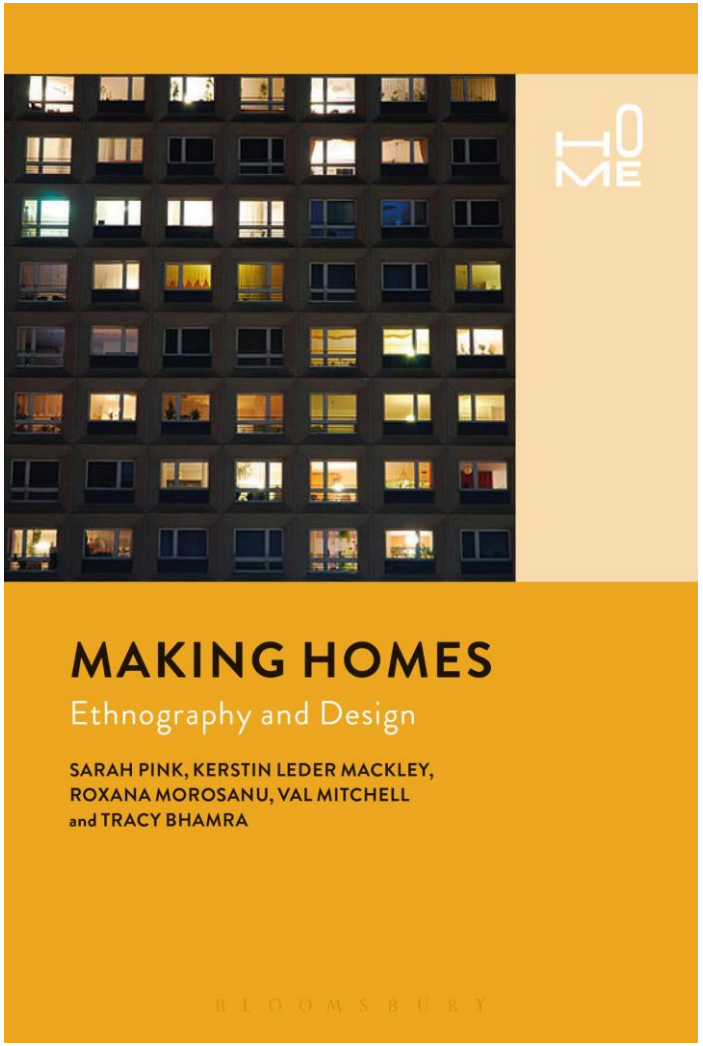


Low Effort Energy Demand Reduction Outcomes

Outputs: journal papers, book chapters and a book.

Design Guidance. Set of personas for design.

Impacts: informed government policy, increased industry understanding of home energy behaviours and informed the design of products and services.



Key Lessons for Design Research

Collaboration – multi-disciplinary projects seem to be well funded by EPSRC and you learn new things!

Design strengths are valued – aiding understanding and engaging research subjects (people), concept development and testing and making research results more accessible.

Practice – embedded as part of the research but not used as a research outcome.

Design Research Challenges

AHRC not funding design research – peer reviewers highly critical leading to low scores.

Design research has lost it's distinctiveness - often embedded in other projects but not obvious.

Confusion between design process and research process – they must be distinct and there must be a research question.

Everyone is a designer!

Loughborough University

Thank you for listening

Any Questions?

t.bhamra@lboro.ac.uk
Twitter: @tracybhamra