

low carbon housing for non-experts: usability in whole house retrofit

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URBED

Most low carbon
'retrofits' designed by,
and for, experts and
enthusiasts

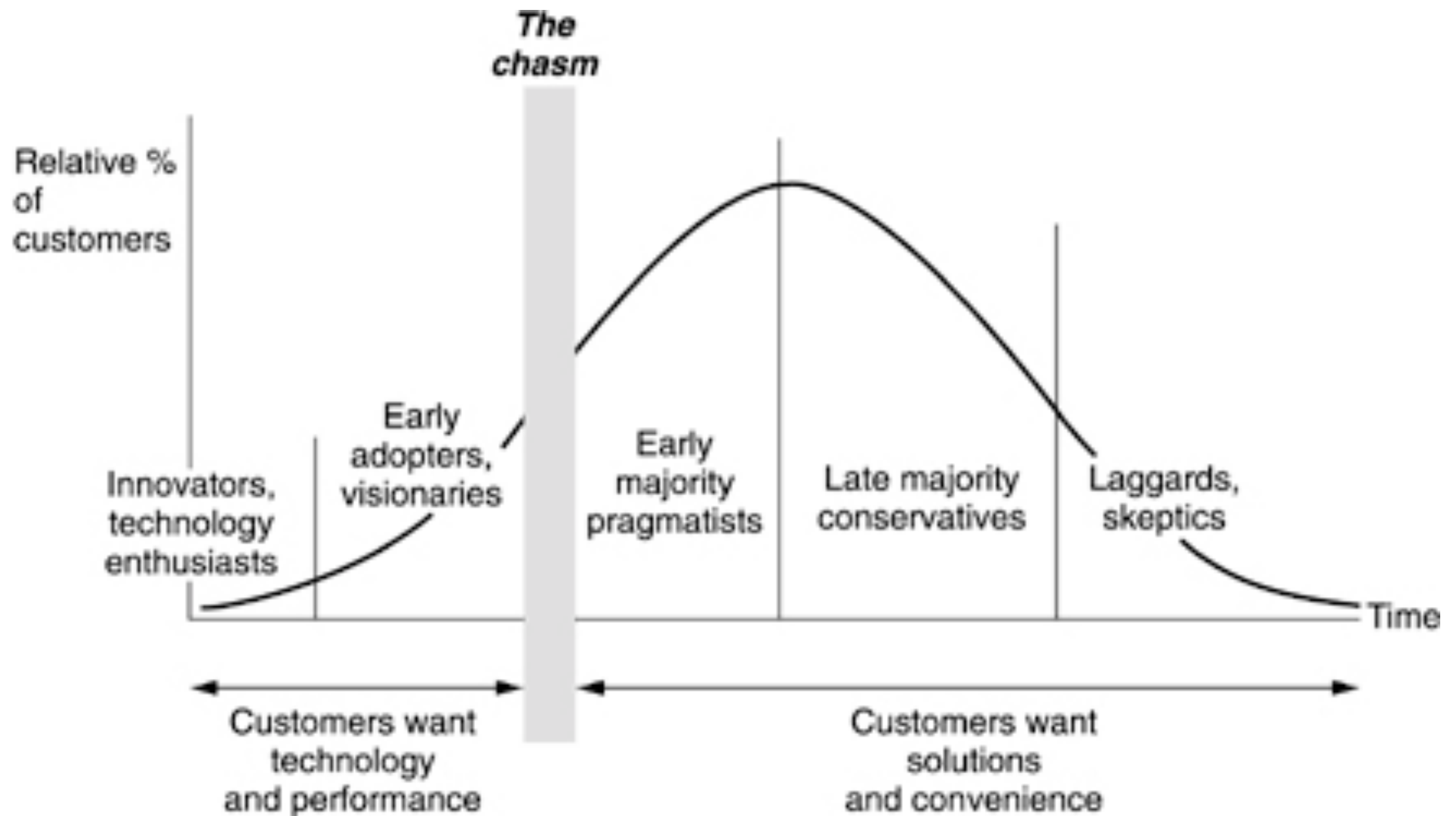


But we need to hit the mass-market to achieve carbon reduction targets....



...the equivalent of a city the size of Cambridge every month 'til 2050

Encouraging technology uptake..?



Potential pitfalls...

Building performance doesn't match design stage predictions:

- Due to build quality and changes during procurement?
- Due to inaccuracies/ false assumptions in modelling?
- ***Due to user behaviour?***

How can we convince people to opt for the measures if:

- It involves 'letting the builders in'?
- Their homes become less 'user-friendly'?
- The cost savings aren't guaranteed?



Significance of usability?

'The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use'

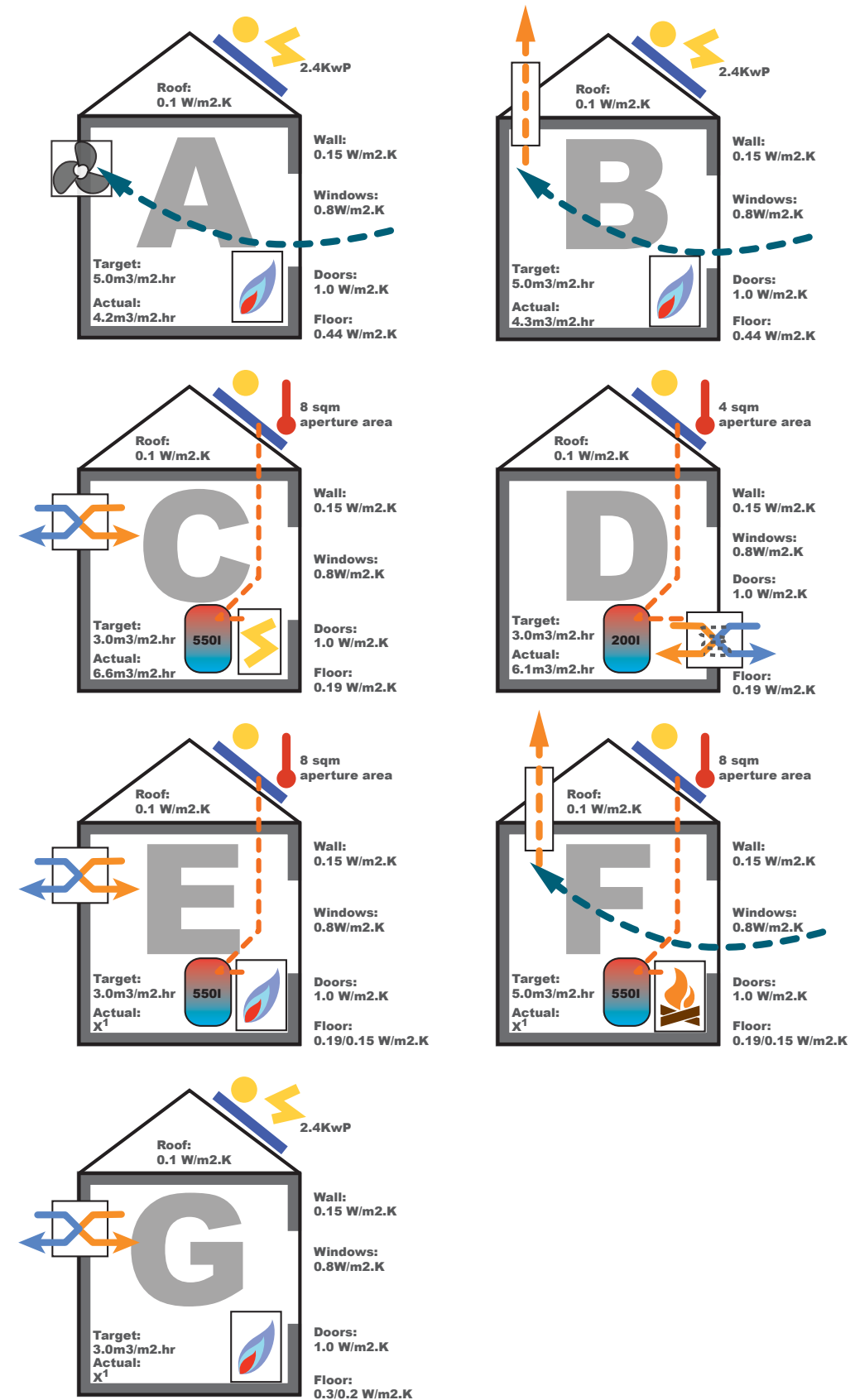
(ISO/TR 16982:2002)

Context

Measures were tailored to lifestyle and residents' tolerance of disruption...

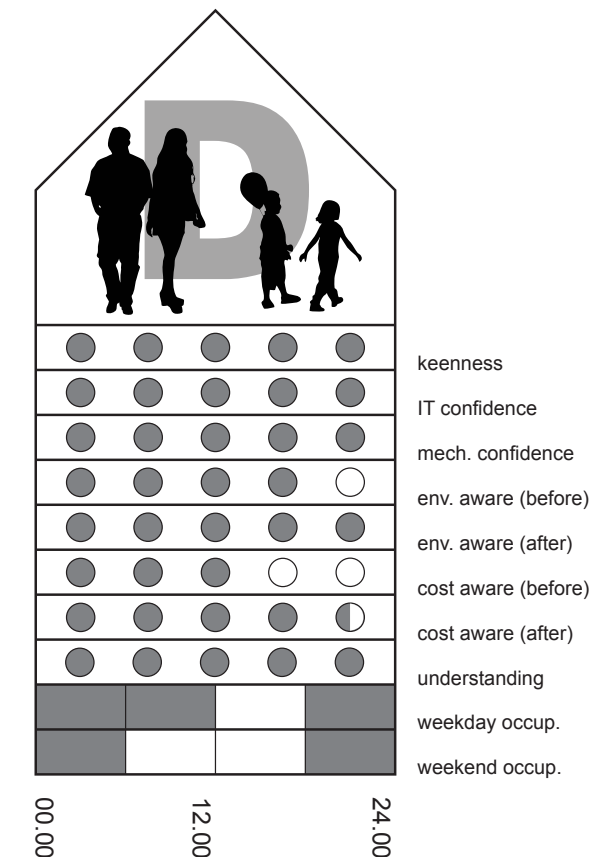
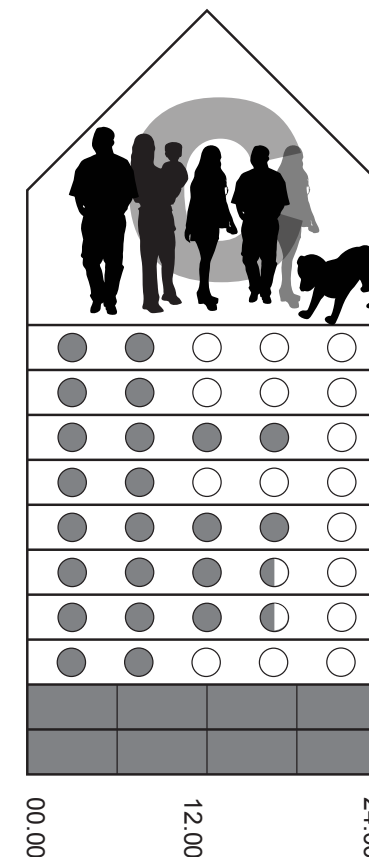
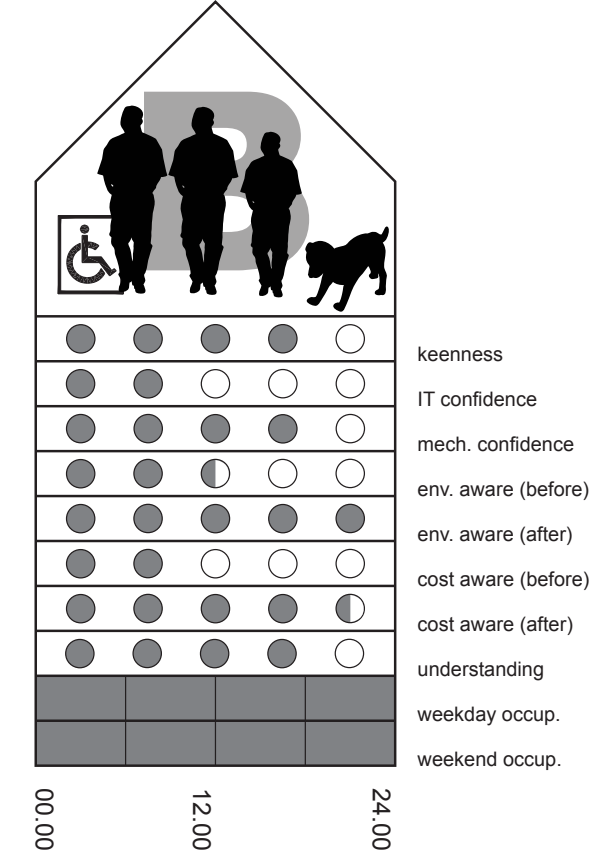
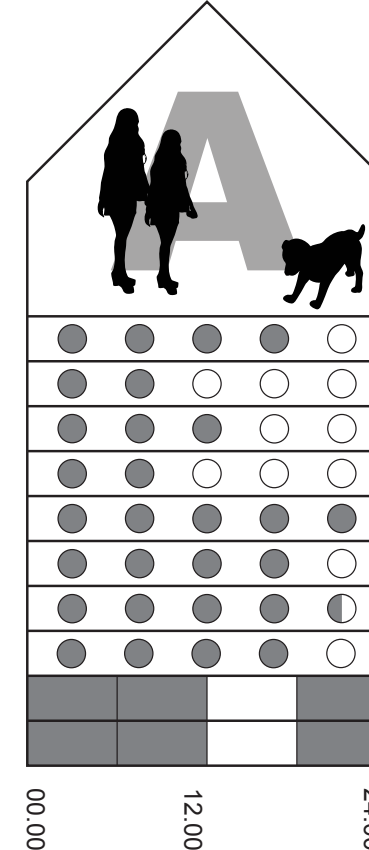
...but also a desire by design team to 'test' different measures

Different levels of
complication and different
fuel sources



Users

- Different levels of technical confidence and environmental awareness
- Seeing the construction process helped understanding
- Induction process...



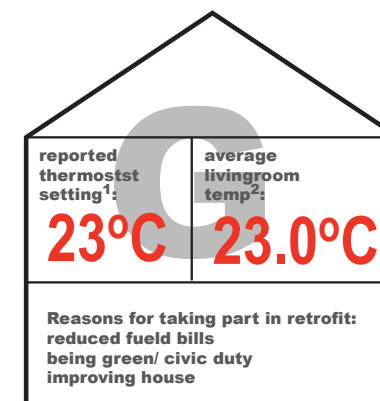
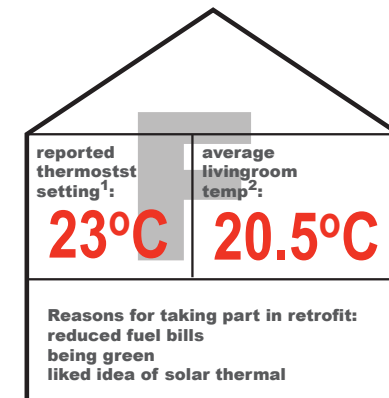
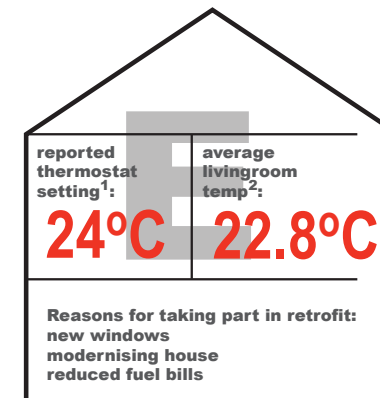
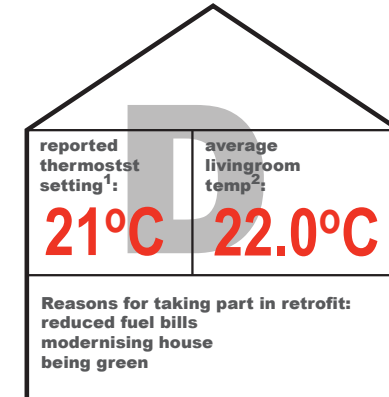
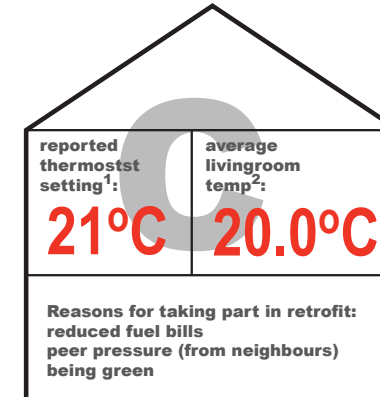
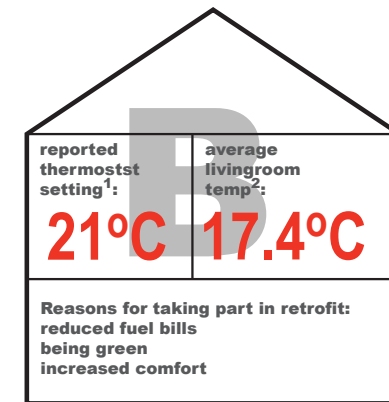
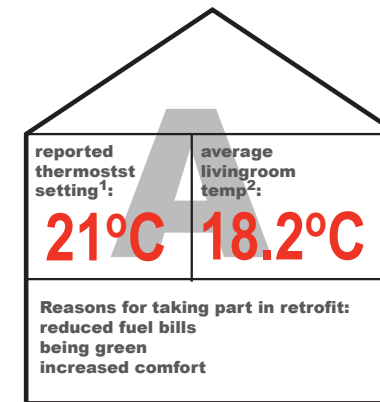
User's goals for retrofit

- **Reduced bills (6)**
- Interest in 'green issues' (2)
- Relative had solar panels and they wanted them too (1)
- Peer pressure (neighbours wanted their house 'done') (1)
- Doing their 'civic duty'(1)
- Work needed to be done to the house anyway (2)
- Wanted the house to be more 'modern' (1)
- "Just wanted new windows"(!) (1)





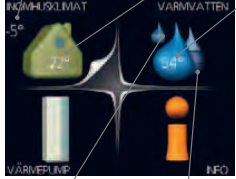
(of 7 households)

User's 'everyday' goals

- Wide range of comfort temperatures
- Different levels of washing, laundry etc
- Accommodating pets and 'everyday' habits



System Controls (effectiveness)

Control/Interface	Usability Rating	House	Comment on Resident Use
Central Heating Control  	clarity of purpose	1	A Residents don't use timer, just flick on and off as needed, using thermostat as a limit, but often switching off before this temp is reached.
	intuitive switching	1	
	usefulness of labelling	2	C
	ease of use	1	
	indication of system response/feedback	4	
	degree of fine control	4	
	Cover is fiddly to flip up to make adjustments, screen is not very clear or big. Symbols hard to understand. Small buttons.		G Use manual control and thermostat with thermostat as limit.
Control/Interface	Usability Rating	House	Comment on Resident Use
Central Heating/ Solar Control 	clarity of purpose	2	A
	intuitive switching	1	
	usefulness of labelling	1	C Understand some settings, but don't like not being able to switch 'off'.
	ease of use	1	
	indication of system response/feedback	2	E Understand some settings, but only use to adjust temp up and down a bit.
	degree of fine control	3	F Very good understanding of system, navigates menus to control as needed.
	Lots of digital menus and sub-menus to navigate. Labelling very abstract. Constant temperature read-out. Small backlit display.		G
Control/Interface	Usability Rating	House	Comment on Resident Use
Central Heating/ Heat Pump Control  	clarity of purpose	2	A
	intuitive switching	1	
	usefulness of labelling	2	C
	ease of use	1	
	indication of system response/feedback	2	D Very good understanding of system, including adjusting 'heatcurves' etc.
	degree of fine control	3	E
	Digital screen is hard to read in bright light and usually hidden. Symbols hard to understand without handbook.		F
			G

Fuel usage and costs (efficiency)

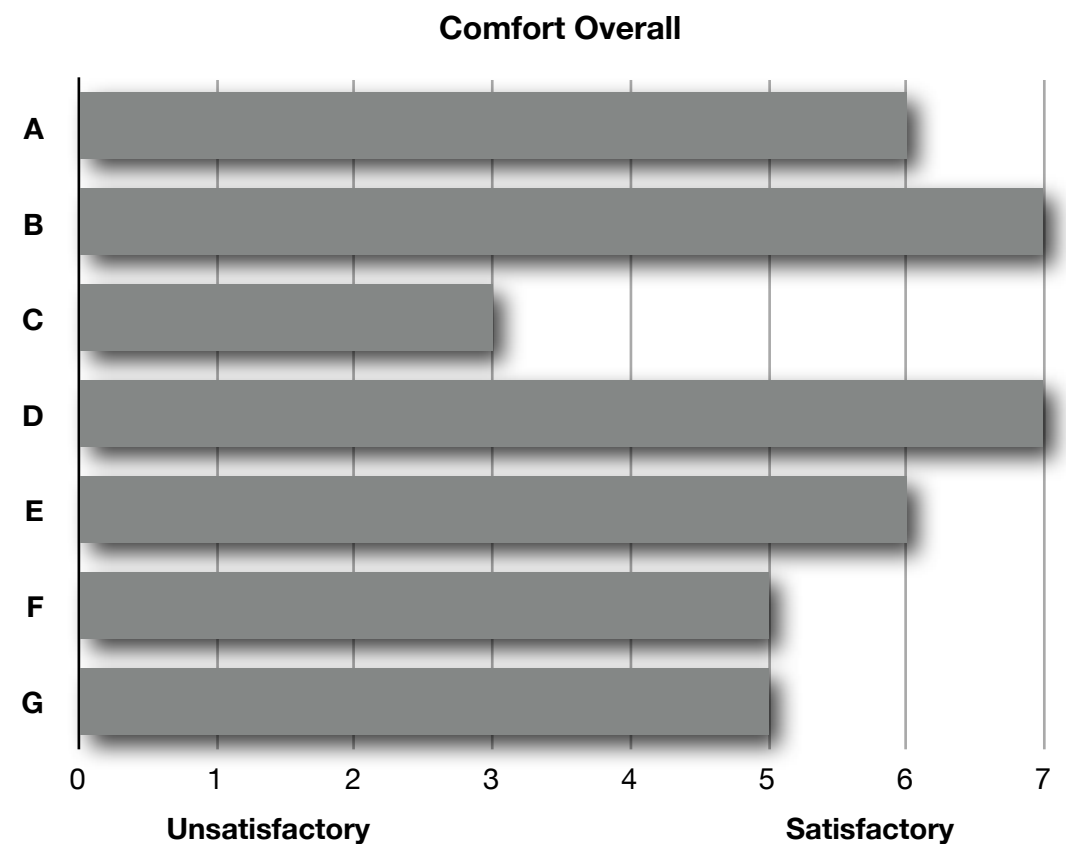
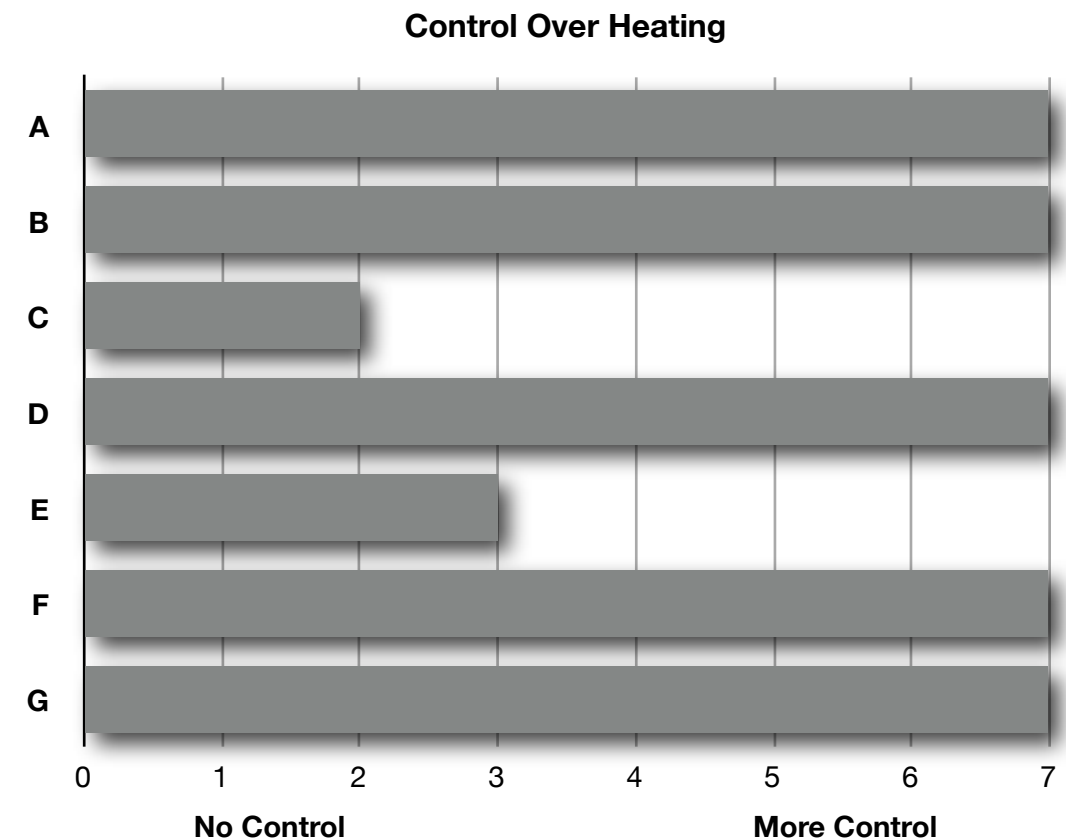
- Early results based on resident reporting.....not robust yet!
- Residents report cost savings - but these vary significantly
- Several residents report significant savings - and appear to be undershooting design targets for energy use and CO₂ emissions
- One resident reports small savings - but issues with thermostat setting and MVHR/window opening
- Will only be able to make a proper assessment once one year+ of data available

Comfort (satisfaction)

- Residents report increased thermal comfort:

“I don’t have to go to bed in thermals and a jumper anymore”

- Appears to be correlation between comfort, control and satisfaction - adaptive comfort (?)
- Noise from MVHR an issue



Other factors affecting satisfaction

- Stress of construction process
- Quality of finish
- Responsiveness of maintenance
- Quality of aftercare and support
- PV + behaviour change
- ‘Added bonus’ e.g. window cills, master-switch+parental control, reduced clothes washing
- Improved environmental awareness

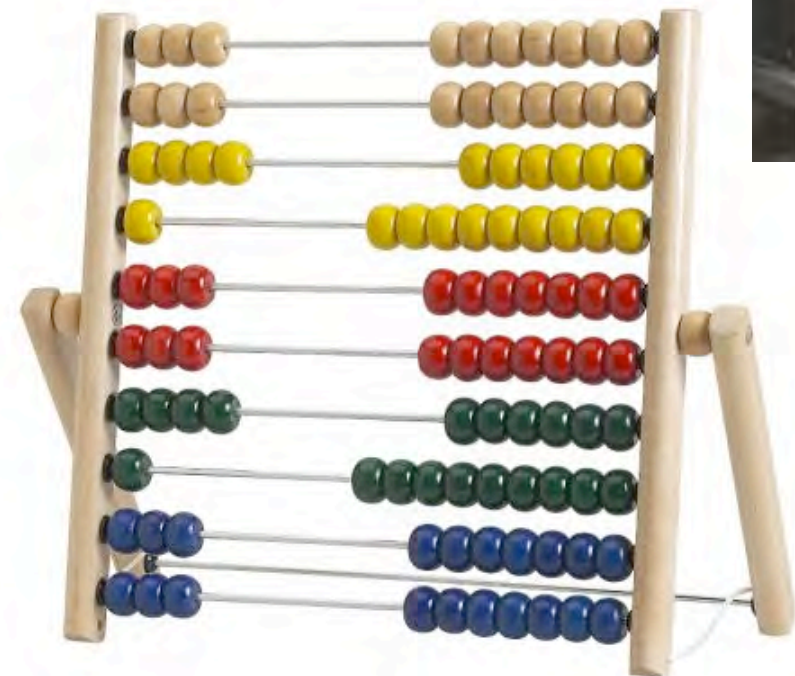
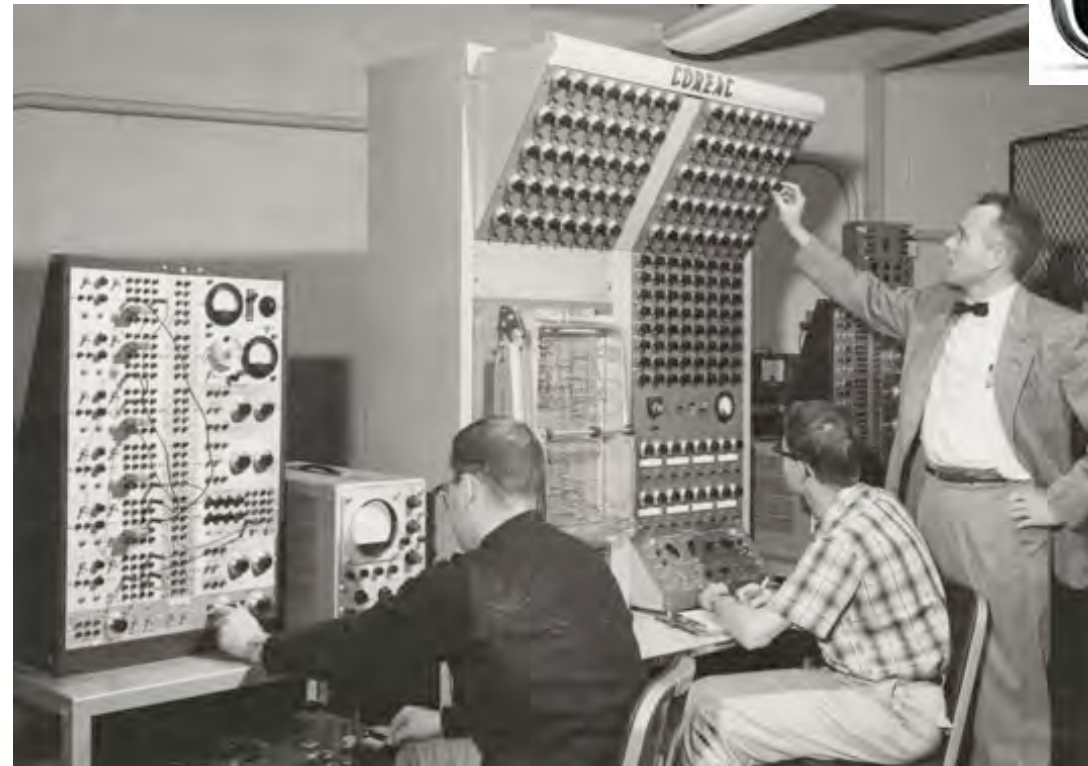


Initial conclusions and implications

- Cost savings of measures/households vary significantly -
 - a significant issue if cost is a major motivator?
 - implications for the 'Green Deal' and fuel poverty?
- Some approaches more 'fit and forget' than others - can't rely solely on 'techno-fix'
- Feeling of 'control' very important - related to satisfaction and usability
- Huge variations in ability to cope with change, level of interest and motivations among residents
- Residents want to be involved throughout the process and need support afterwards - customer care needs to be a priority
- Usability is key!

Evolution in design?

Computers have evolved...can retrofit?



....BUT Even iPhones aren't always 'useful'...

“I made up my mind . . . that I would never try to reform man—that’s much too difficult. What I would do was to try to modify the environment in such a way as to get man moving in preferred directions”

R. Buckminster Fuller