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for Climate Change Research

**Who *uses* smart home technologies?
Representations of users by the smart home industry**
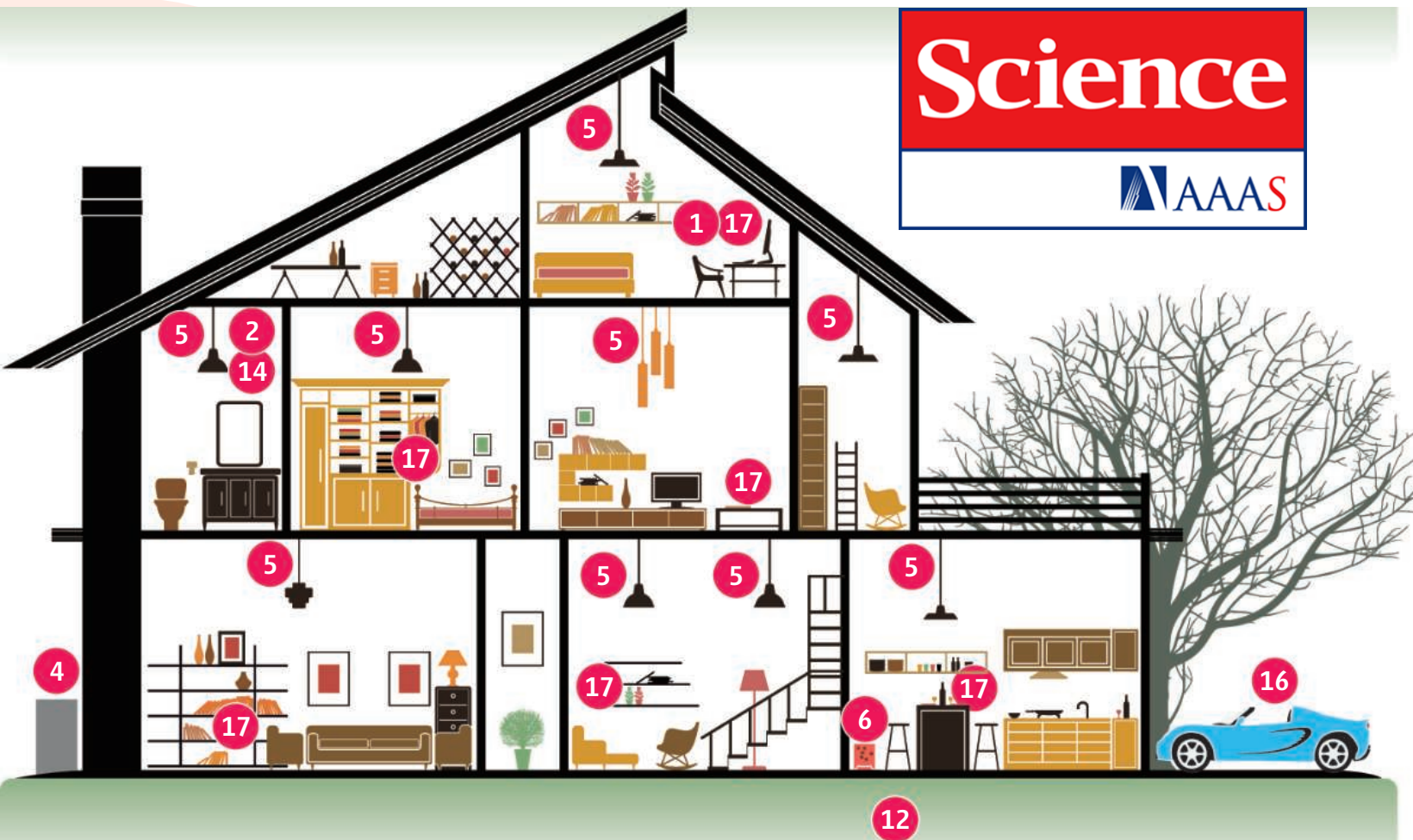
ECEEE, 7 June 2013

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Richard Hauxwell-Baldwin

University of East Anglia

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Loughborough University

Odd representation of a smart home?

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Science

AAAS

1	Ambient intelligent control	6	Automatic pet feeder	11	Security system	16	Ambient intelligent interface with car
2	Light sensor	7	Motorized drapes	12	Lawn moisture sensor	17	Ambient intelligent interface with smart phone
3	Windows and door control	8	Automatic watering	13	Face recognition sensor		
4	HVAC control	9	Mailbox sensor	14	Motion sensors		
5	Lighting control	10	Driveway sensor	15	Door sensors		

Coming soon to your home? In an ambient intelligent home, sensors collect information about the environment and the residents. An "intelligent agent" uses this information to decide whether actions need to be taken to adjust, e.g., temperature or lighting.

What are smart homes?

A *technological* vision: monitor, automate & control

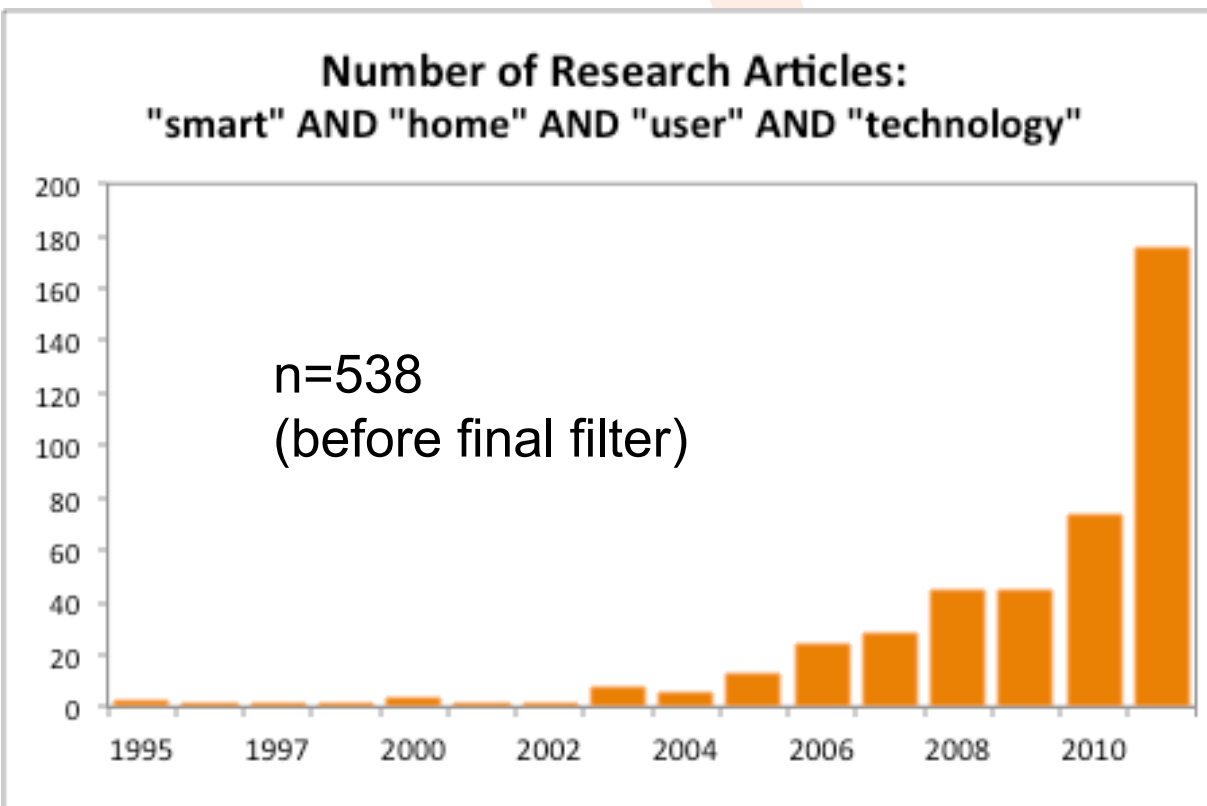An *energy efficient* vision: load management & energy citizenry

A *lifestyle* vision: ease & security

Core elements:
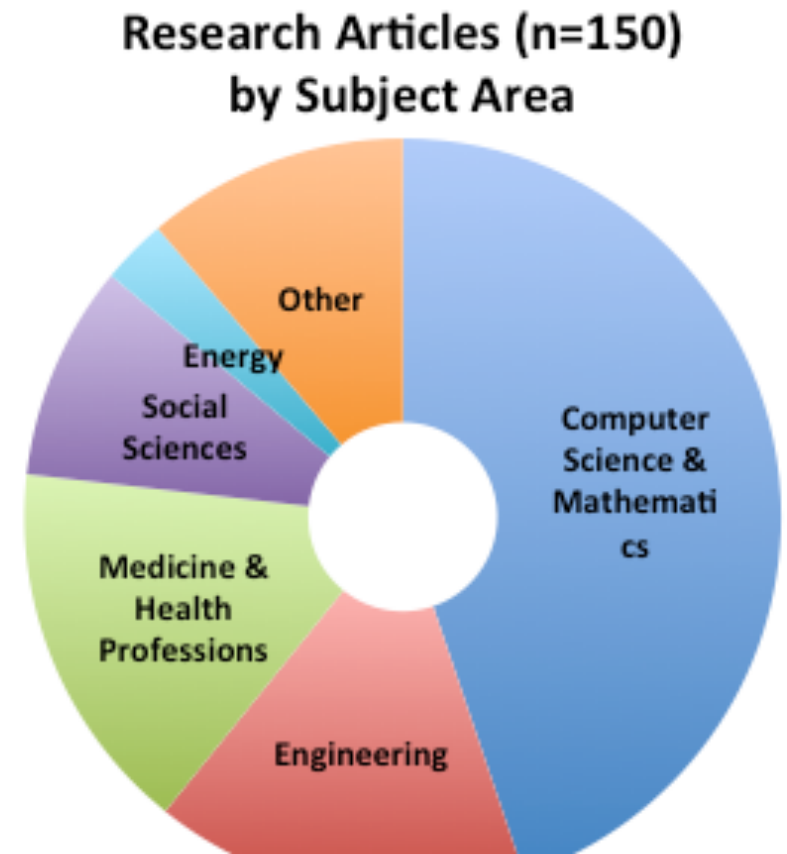(1) monitor
(2) control
(3) user interface

How are the users of smart homes represented and understood by researchers … and by industry service providers?

Method (6 steps)
1. Systematic literature review of research on smart homes *and* users
2. Identification of key themes in user representations (explicit & implicit)

Number of Research Articles:
"smart" AND "home" AND "user" AND "technology"

n=538
(before final filter)

**Research Articles (n=150)
by Subject Area**

Computer
Science &
Mathematics

Other

Energy

Social
Sciences

Medicine &
Health
Professions

Engineering

50 papers annotated so far

Three main research themes (made up of multiple categories)

TECHNOLOGY	**USERS**	**USE**
Technology Design	**Who Users Are**	**User-Tech Interaction**

related to other techs? — multiple users? — information flows

addition substitute	universal multiple	user<-tech user->tech
integrated		user<->tech

also   *also*   *also*

Purpose & Functionality	**What Users Are Doing**	**Interfaces**
Conspicuousness	**Types of User**	**Control & Automation**

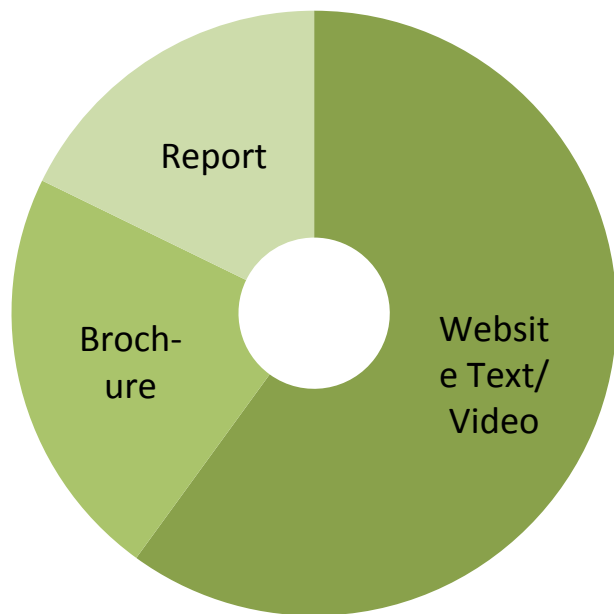*etc.*   *etc.*   *etc.*

How are the users of smart homes represented and understood by researchers … and by <u>industry service providers</u>?
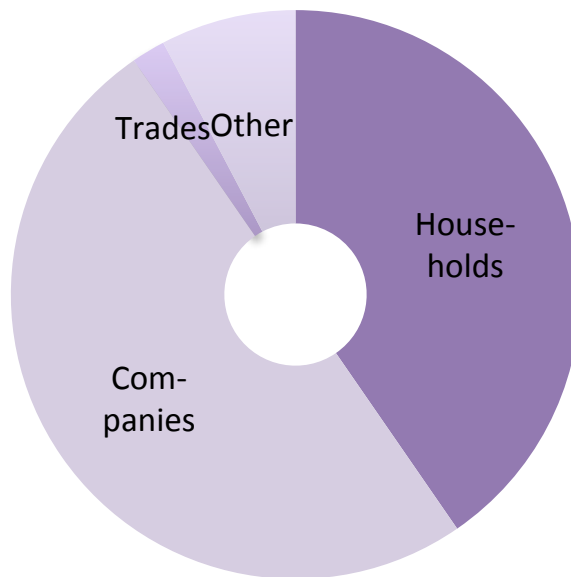
Method (6 steps)

1. Systematic literature review of research on smart homes *and* users
2. Identification of key themes in user representations (explicit & implicit)
3. Formalisation of themes in coding template (31 categories, 125 codes)
4. Content analysis of sample of industry publications (n=43)

Type of Material (n=43)

- Report
- Broch-ure
- Website Text/Video

Target Audience (n=43)

- Trades
- Other
- House-holds
- Com-panies

Type of Company (n=43)

- Other
- Manu-facturer
- Service Provider (B2B)
- Utility

Purpose of Material (n=43)

- Other
- Vision
- Sales pitch

were the publications selling a technological 'vision' of the future?

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Method (6 steps)

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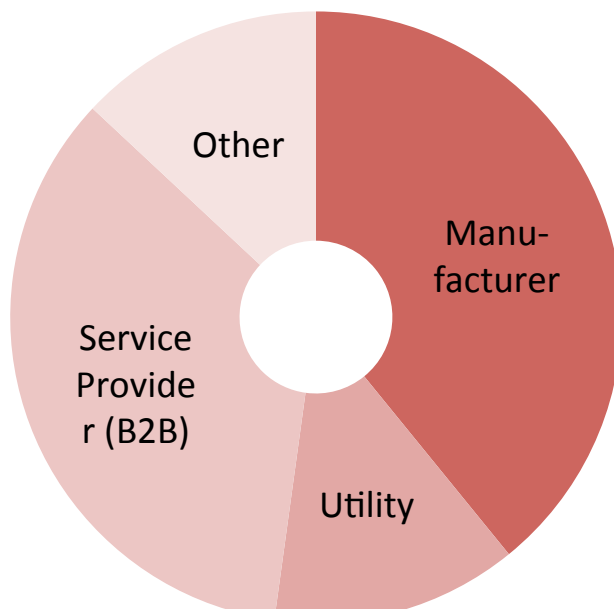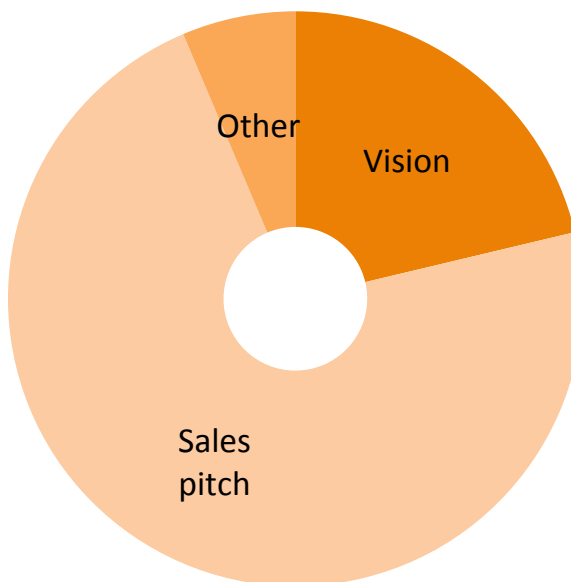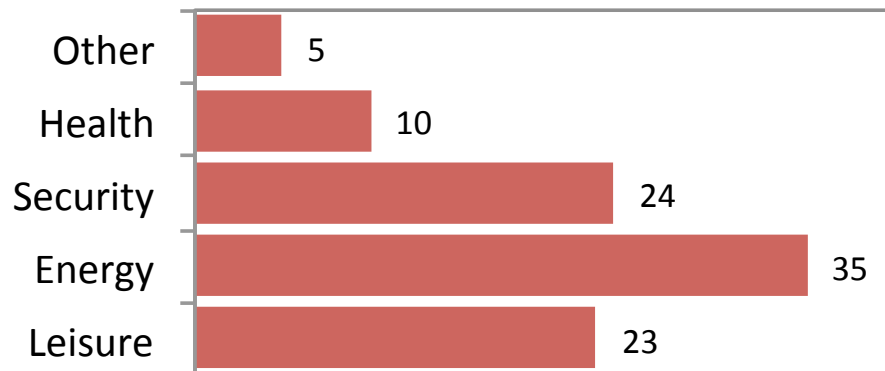4. Content analysis of sample of industry publications (n=43)
5. In depth characterisation of how smart home users are represented
6. Confirmatory interviews with industry stakeholders (IBM, Sentec, Geo)

emphasis in this paper:

areas of *convergence* and *divergence*

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Services provided *(non-exclusive counts)*

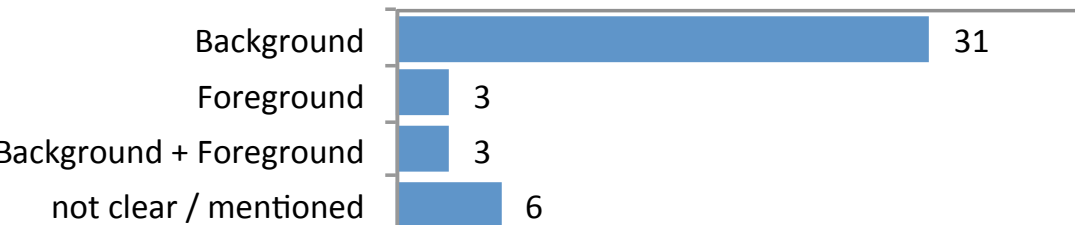| Service	Count
Other	5
Health	10
Security	24
Energy	35
Leisure	23

- Pre-set 'scenes' or routines, fixed in 'set-and-forget' mode

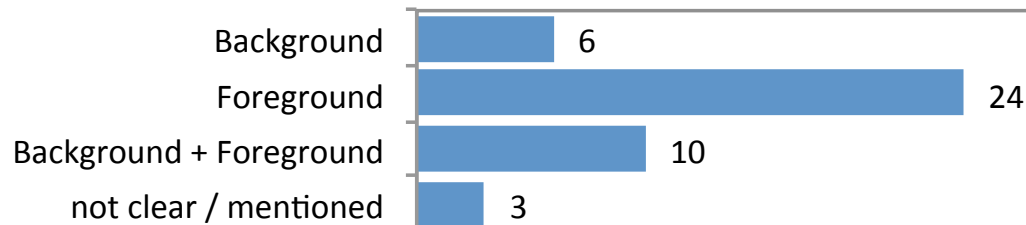 *"Set the rules once, and you're done!"* (Philips)

➤ **with** over-ride or exceptionality

- Either new, additional *or* integrated technologies.
- Modular, incremental roll-out in existing homes.

Conspicuousness of technology

	Count
Background	31
Foreground	3
Background + Foreground	3
not clear / mentioned	6

Conspicuousness of interfaces

	Count
Background	6
Foreground	24
Background + Foreground	10
not clear / mentioned	3

- Invisible technologies

  "no new wires and messy installation" (Z-Wave)

- Visible interfaces

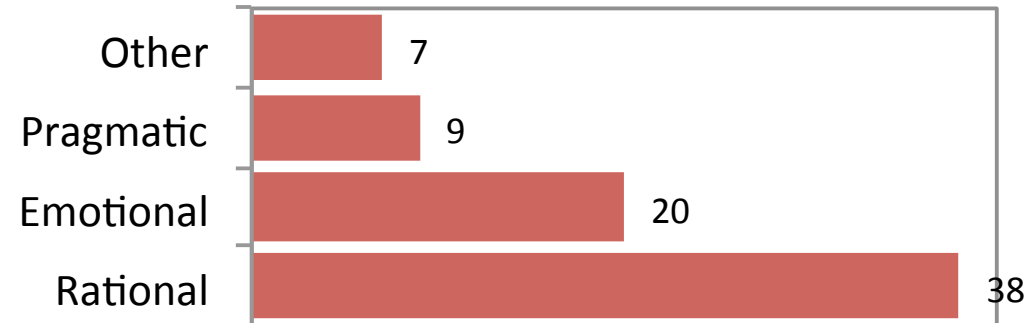 *"sleek user interfaces and compelling graphics"* (Intel)

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- 'All purpose' / general
  + some specific segments
  [*though not according to imagery!*]

- Multiple users,
  household dynamics?

Implied user decision-making
(non-exclusive counts)

Category	Count
Other	7
Pragmatic	9
Emotional	20
Rational	38

- Mainly informed decision making
  (+ some 'mood' setting)

- Value proposition: (1) save energy & money; (2) security; (3) save time

- Targeting: housework &/or leisure

Potential for multiple users

Category	Count
Universal	1
Multiple	3
Universal + Multiple	0
not clear / mentioned	39

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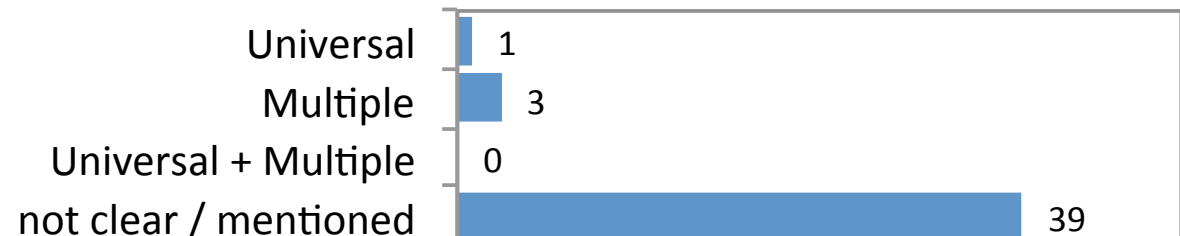
Ubiquitous, active control

"*Your home is as individual as you and the way you live should be determined by you, not the system.*" (Philips)

***but* with 'set and forget'**

User control of technology

User-Control	22
Automation	2
User-Control + Automation	14
not clear / mentioned	5
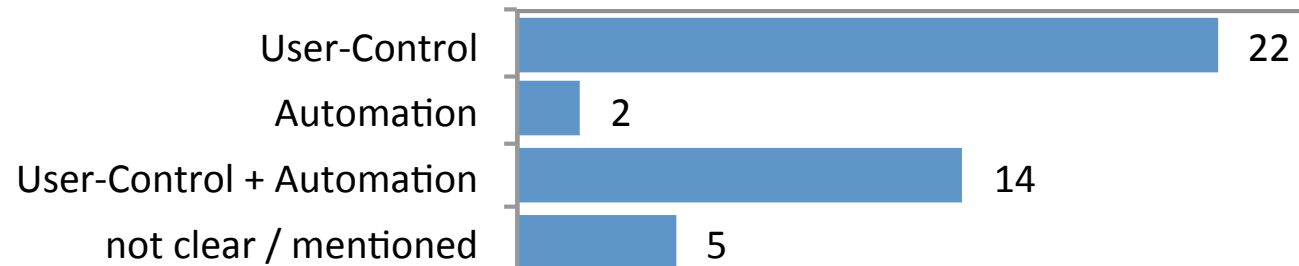
- Interfaces: multiple, mobile, familiar, intuitive

  "*ease of use, with interfaces similar to other popular consumer devices.*" (Intel)

Trustworthiness for user *(non-exclusive counts)*

Other	5
Credibility	11
Warranty	0
Privacy	2
Security	6
User-Control	22
Adaptable	22
Reliable	14
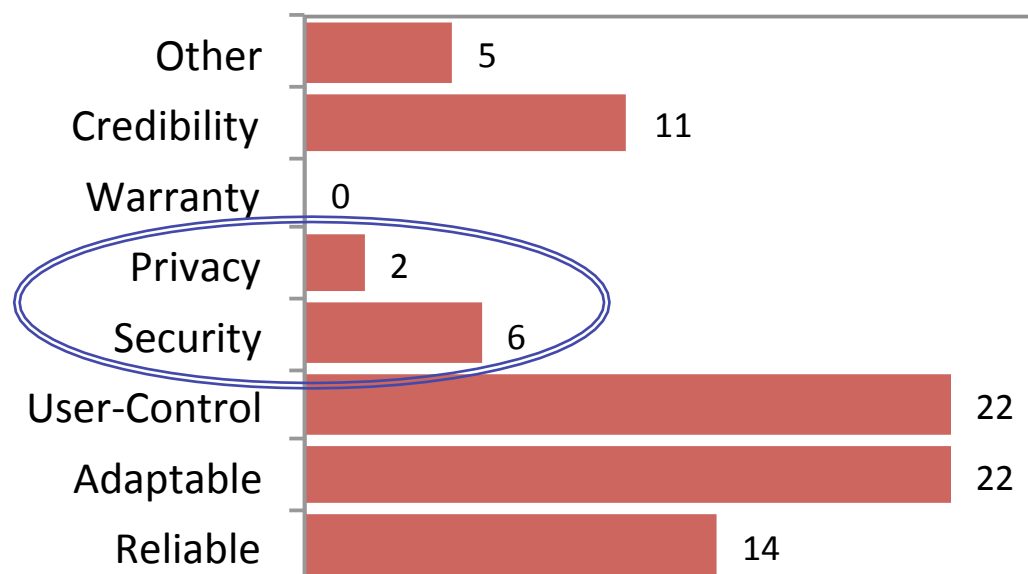
- Issues of trust, confidentiality largely side-stepped

Convergence

•Smart home <u>technologies</u>: modular, additional or integrated kit, introduced bit-by-bit into existing homes.

•Smart home <u>interfaces</u>: multiple, mobile, familiar and intuitive.

•Smart home <u>users</u>: anyone & everyone, for broadly 'rational' reasons to save energy, money, and time by helping with energy management, housework and relaxing.

> *"We create solutions that complement and enhance your lifestyle … it's about streamlining your life, not complicating it."* (Philips)

Divergence

•Smart home <u>use</u>: user-control, automation, over-rides.

•Smart home <u>practices</u>: regular routines (set and forget), variability and exceptionality (instant control).

•Smart home <u>design</u>: conspicuous (interfaces), invisible (sensors).