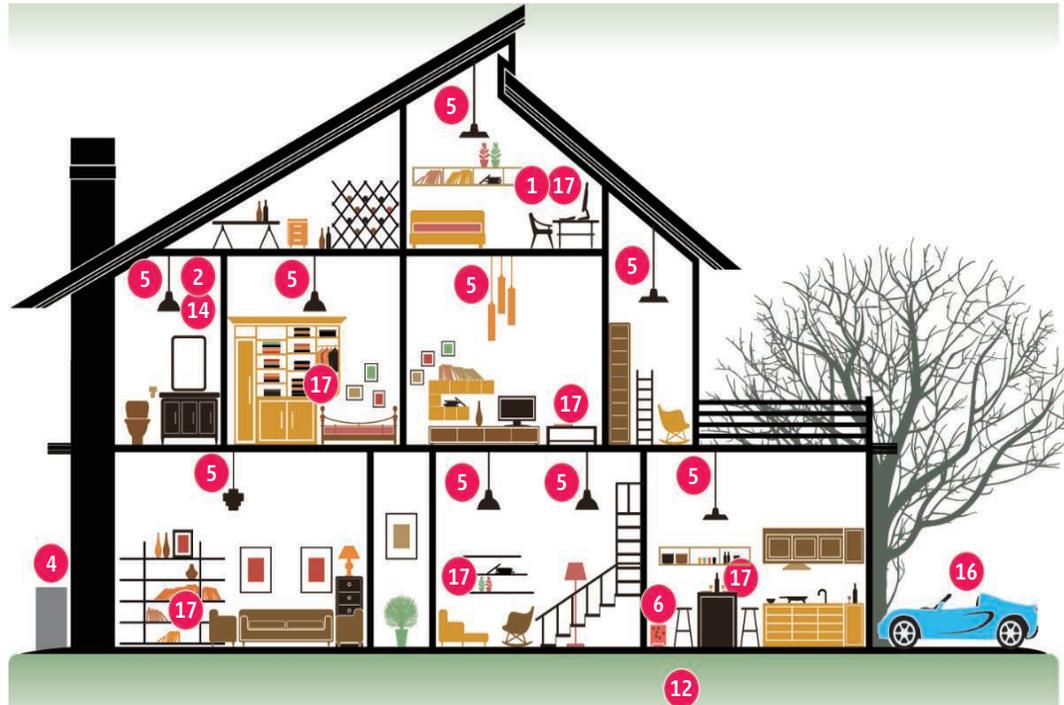


Smart homes, control and energy management

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What are 'smart homes'?



- | | | | |
|-------------------------------|------------------------|----------------------------|---|
| 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.

(Source: Cook 2012)

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3 core elements:

1. Context awareness
2. Feedback and user interfaces
3. 'Intelligent' control/automation

RWE Npower estimates 17-40% savings from its SmartHome system.

"Smart Home technology looks set to become a feature of people's lives, whether it is wanted or not." (Haines et al 2007; p358)

Control in the Smart Home

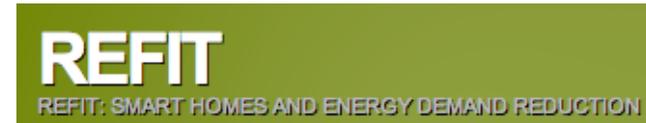


- ✧ Control over devices (ease of use/interoperability)
- ✧ External control (e.g. direct load control)
- ✧ Control over lives vs. control over devices
- ✧ Who's in control in the home (and over what)?
- ✧ Technology controlling society

The REFIT Project



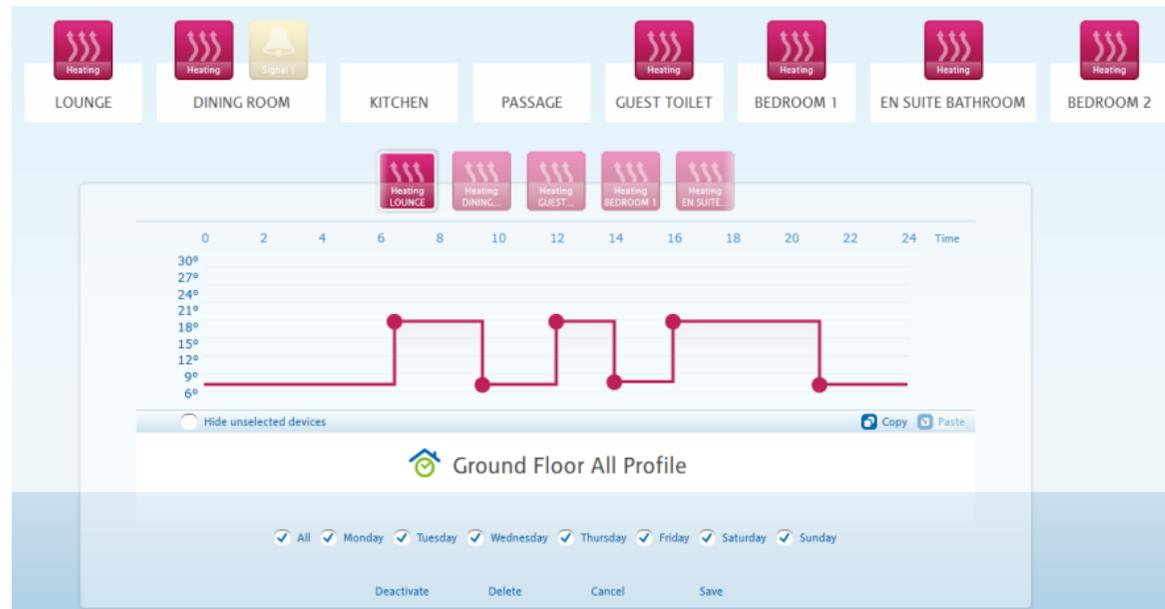
- ✧ Exploring the use of smart home technologies for retrofit decision support.
- ✧ Field trial of 20 'smart homes':
 - ✧ RWE SmartHome™ system (heating schedules etc.)
 - ✧ Vera Z-Wave System (remote control of devices via smart plugs)
- ✧ UEA aim:
 - ✧ How/will smart home technologies be integrated into everyday lives and with what impacts?



3 vignettes

House 3: John and Jane

- ✧ *“I expect to be able to control the heating in every room far more closely. I also expect to be able to pre-warm a room if I know there’s a guest coming. I expect to be able to do that quite comfortably, without any fuss or bother...I really expect, ultimately, to see less energy being used.”* (John)
- ✧ Set up 3 ‘time profiles’ and a ‘towel rails’ profile. Gradually amended these over time.
- ✧ Used Z-Wave system to establish ‘lounge’ and ‘passage’ security lighting.



House 3: John and Jane

- ✧ John interested in experimenting with the kit.
Compiled a list of things to trial and learn about.

- ✧ Jane:
 - ✧ *“It hasn’t infringed on my life in any way. John’s monitoring it obviously... For me, it’s just there and I’m getting on with my life”*
 - ✧ *but...*
 - ✧ *“If anything happened to John I would be in deep trouble...because I wouldn’t be able to control it I don’t think, it’s what troubles me.”*

- ✧ The system appears to have concentrated control in John’s hands whilst excluding others.



House 4: Henry and Louise

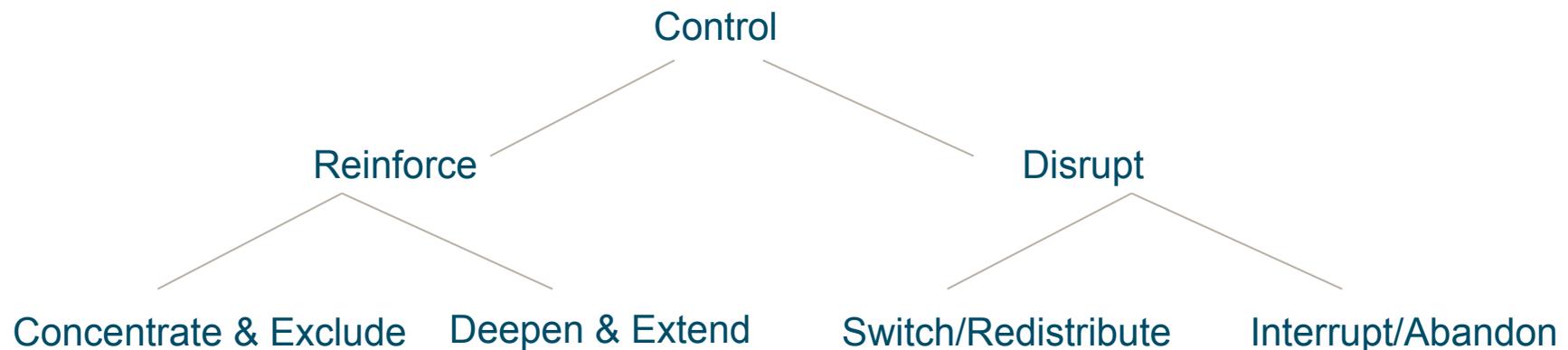
- ✧ Prior to installation, Louise very much 'in charge' of running the heating... *"[Henry] doesn't know how to use it."* (Louise)
- ✧ Henry established several 'zones' on the RWE kit during installation, but system little used. Z-Wave little used too.
- ✧ Henry suggested he found it annoying, non-intuitive and difficult.
- ✧ Disputes emerged after a few months:
 - ✧ *"We had an argument because I was saying: 'Look, I just want to be warm. I'm going to turn this thing up or down or whatever,' and he's saying: 'We should do it step by step, try one thing, see what happens...' and I'm saying: 'I'm cold, I want to turn the radiator up.'" (Louise)*
 - ✧ *"I feel I've lost control I suppose."* (Louise)
- ✧ The system appears to have disrupted control relationships to such an extent that it was ultimately abandoned.

House 19: Ingrid, David, Ben & Sam

- ✧ Ingrid has *“always been in control [of the heating].”* (David)
- ✧ 12 time profiles established to control different rooms and distinguish between weeks and weekends.
- ✧ Regular checking-up on the kids because their radiators would *“keep going high”* (Ingrid)
- ✧ Frequent ad hoc use of the Z-Wave system:
 - ✧ *“We vary when we go to bed so I’ve just been [changing the lights] manually rather than having it on the timer.”* (Ingrid)
 - ✧ *“I didn’t realise how much I would be looking at it...I’m quite surprised that everyday I look at...the temperature and turn the lights on...The more we have it the more I’ve done that.”* (Ingrid)
- ✧ The system appears to have given Ingrid finer-grained control, but is also making some demands on her.

Emerging conclusions...

- ✧ Not looked at control dynamics ‘beyond the home’ here...but
- ✧ Pre-existing control dynamics in the home shape how smart home technologies are used.
- ✧ These technologies can also come to disrupt or reinforce these pre-existing dynamics.



Thanks



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