Assisted Shifting of Electricity Use

A Long-Term Study of Managing Residential Heating

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User involvement in intelligent energy

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The Heat Pump Case

- **Motivation:** Heat pumps utilise a fair amount of electricity, but seen as a green alternative to heating houses.

- **Aim:** Explore how can we support users to intelligently ***shift*** heat pump consumption to times when the price is low or green (flexible energy)

- **Goal**: Develop an **interaction design** that engages users with intelligent and flexible energy.

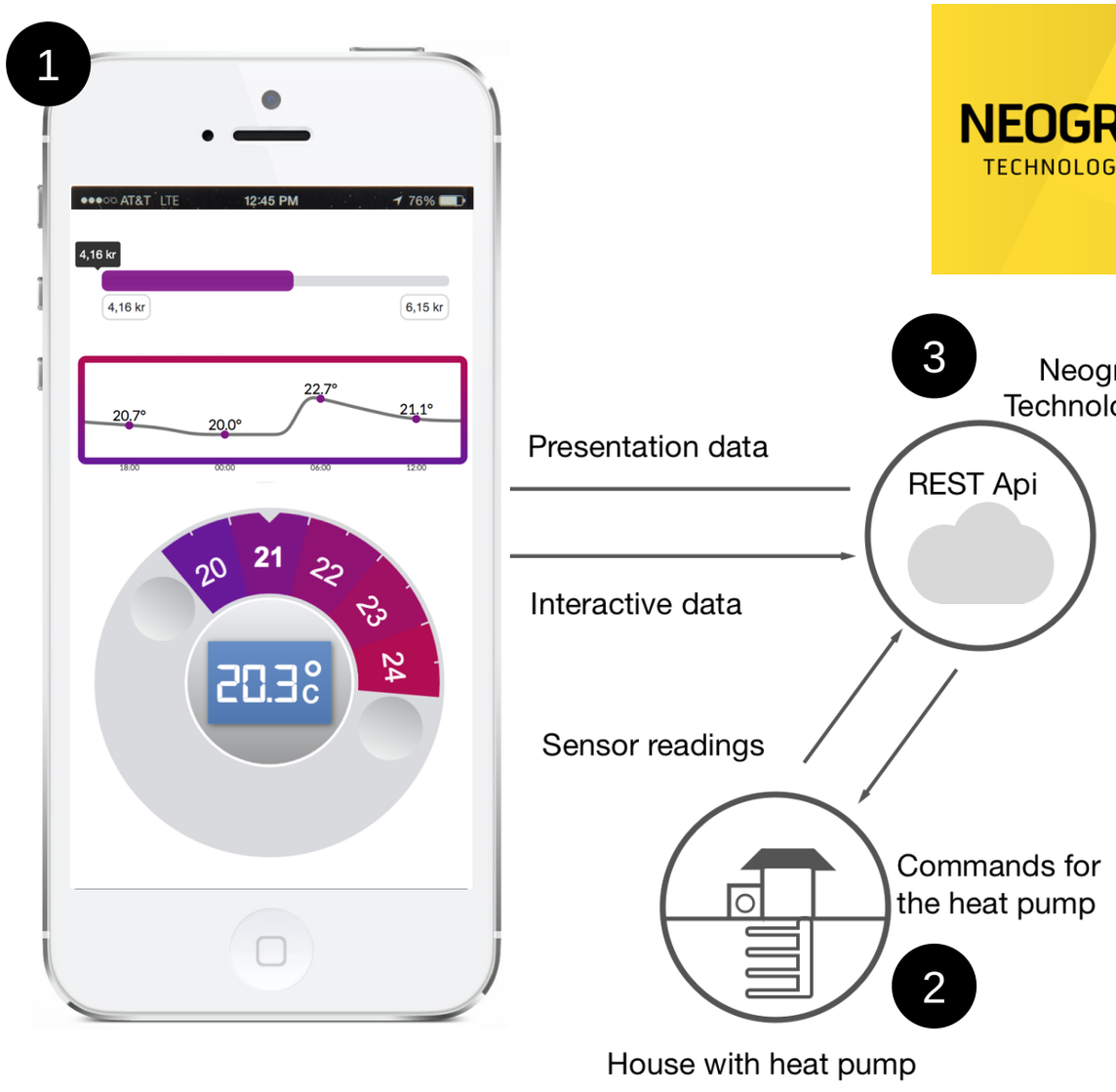
The HeatDial Prototype

1. An interactive web app.

2. Households with heat pumps.

3. A centralised intelligent scheduling system - automates running times based on;

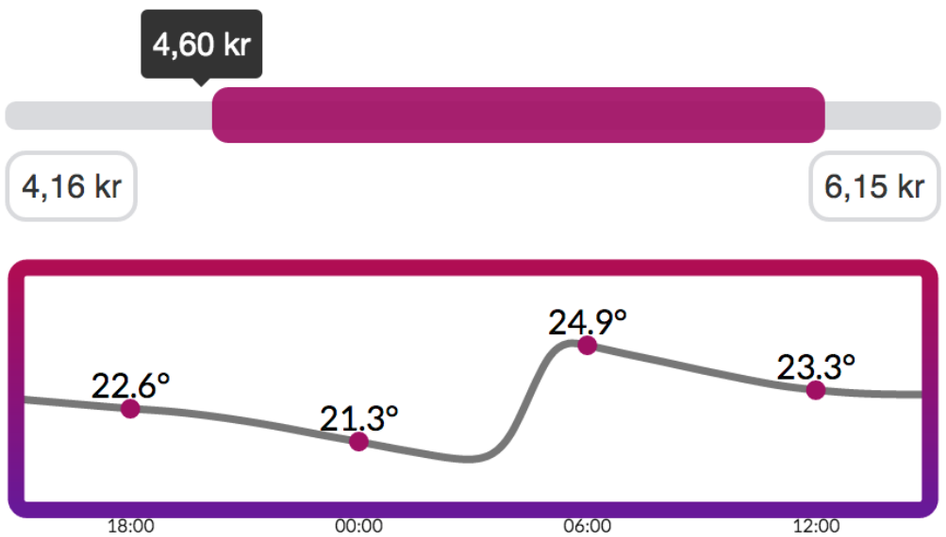
- User interactions
- Sensor readings
- Cheapest price

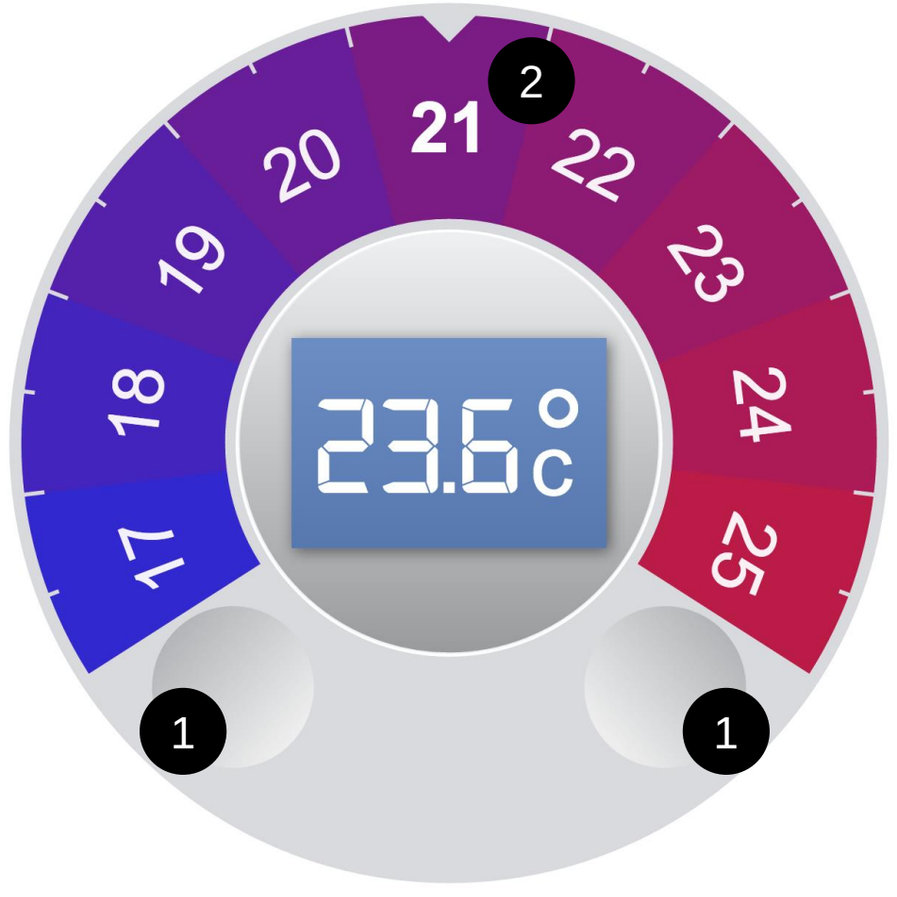


HeatDial Interaction Design

Design elements

- Simple interface (units of temperatures instead of kWh)
- New design convention:
    1. A comfort zone (17°- 25°)
    2. Set temperature (21°)
- Feedback on benefits and consequences the next 24 hours.





Example

A: High price savings at 5 AM.

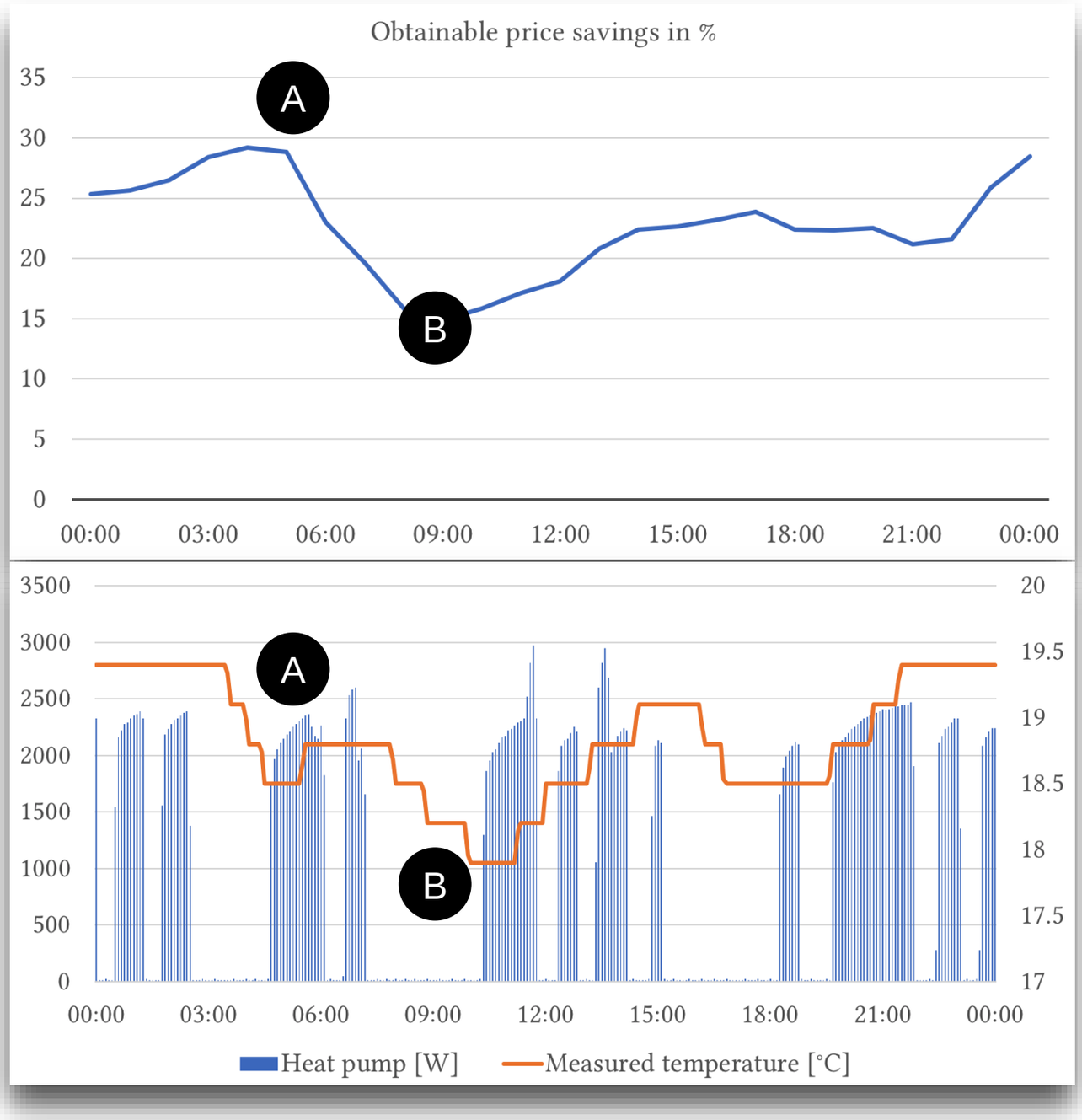
The heat pump waits to run at 5 (low price) and then runs for hours.

B: Low price savings at 9 AM.

The heat pump stops at 7.30 AM (higher price)

At 10.30 the temperature drops close to the lower comfort boundary

The heat pump starts to run as the price savings starts to raise.



Comfort zone (18°- 23°).
Set temperature (19°)

Household E on the 18th of April 2016.

User Study

How do users experience intelligent energy in real life?

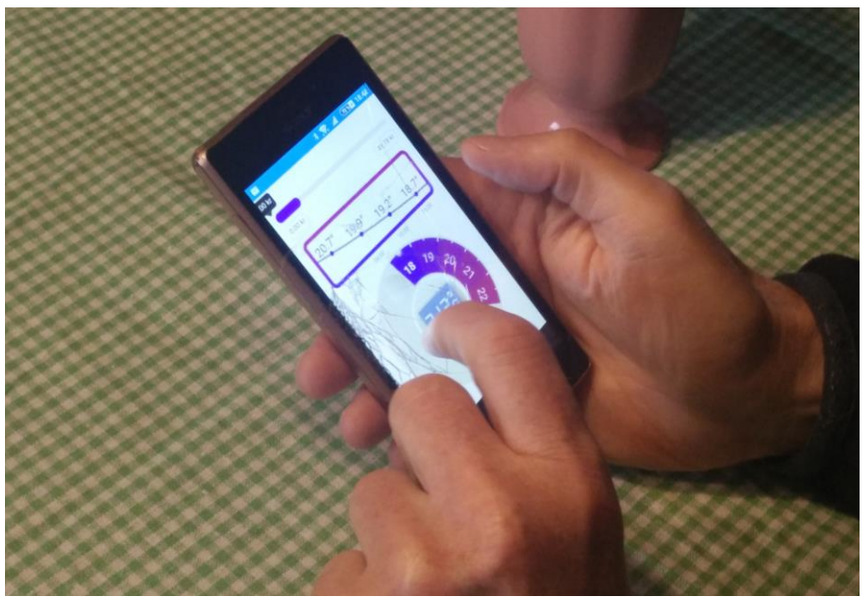
- Recruited 8 households - all heated using the HeatDial system
- Long-term (18-6 months)

Data Collection

- Logged interactions and performance records of the heat pump
- 20 interviews and technology tours
  - 3 with Household A-D
  - 2 with Household E-H

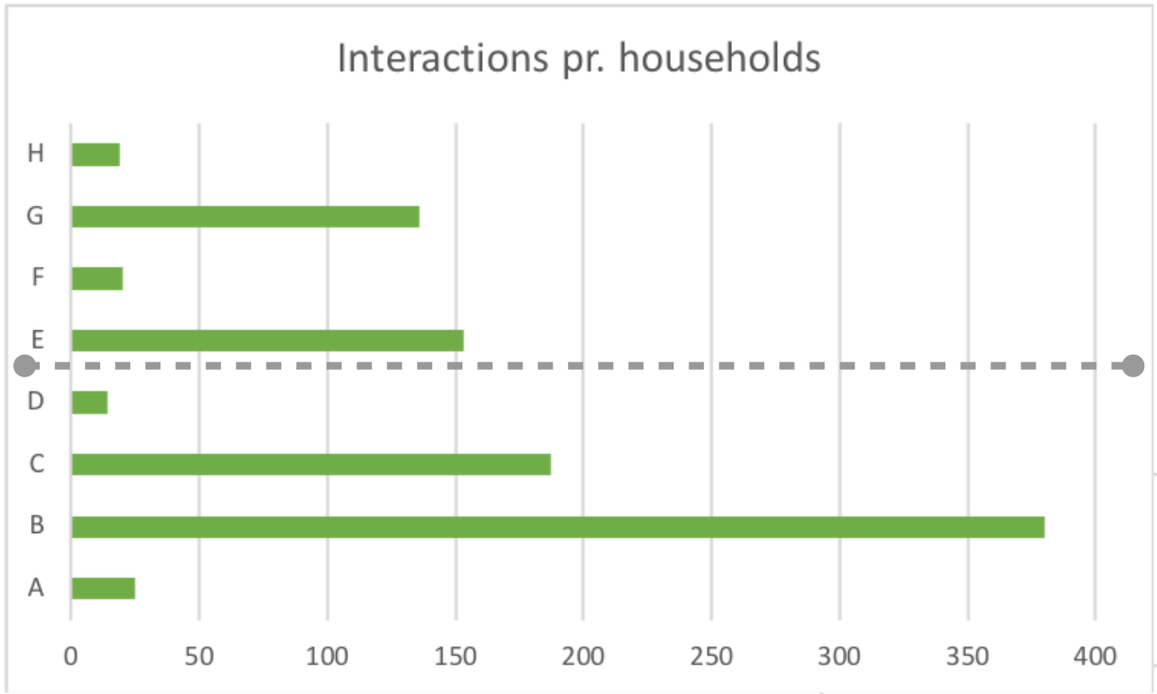
	# Children, # Adults	Age of Adults (F/M)	Occupation (F/M)	Location of floor heating	Wood burner	Solar panel	Awareness of heat pump behavior	Environmental motivation	#Winter seasons, #Months
Household A	(2,0)	(70, 69)	Both retired	Living room	Yes, regularly	No	Limited	Normal	18 (2)
Household B	(2,4)	(35, 34)	Project leader Mechanical engineer	Downstairs and upstairs bathroom	Yes, occasionally	Yes	High	Normal	18 (2)
Household C	(2,0)	(74, 69)	Both retired	Living rooms	Yes, occasionally	No	High	Normal	18 (2)
Household D	(2,3)	(47, 42)	Correspondent Bank specialist	Living rooms	No	No	Normal	High	18 (2)
Household E	(2,2)	(54, 53)	Health consultant Social educator	Basement	Yes, rarely	No	Limited	High	6 (1)
Household F	(2,0)	(68, 78)	Both retired	Living room	Yes, occasionally	Yes	High	Normal	6 (1)
Household G	(2,0)	(58, 62)	Nursing Project manager	Bathroom	No	Yes	High	Normal	6 (1)
Household H	(2,0)	(53, 57)	Nurse Sales director	Living room	Yes, occasionally	Yes	High	Normal	6 (1)

Participating households

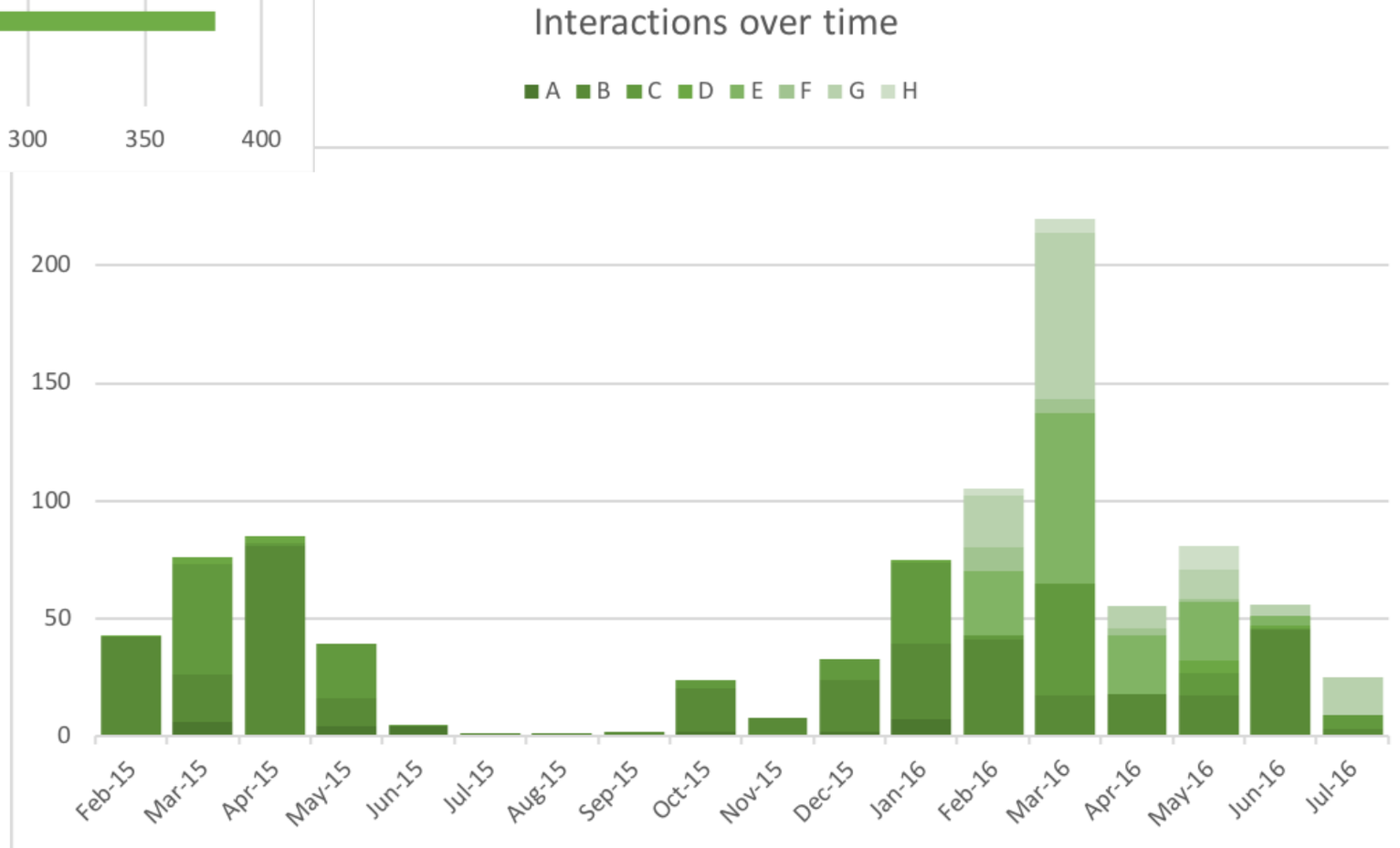


Technology tour

User Engagement



- Most interactions occurred just after being introduced to the system
- Half of the users interacted with the system regular
- Season depended

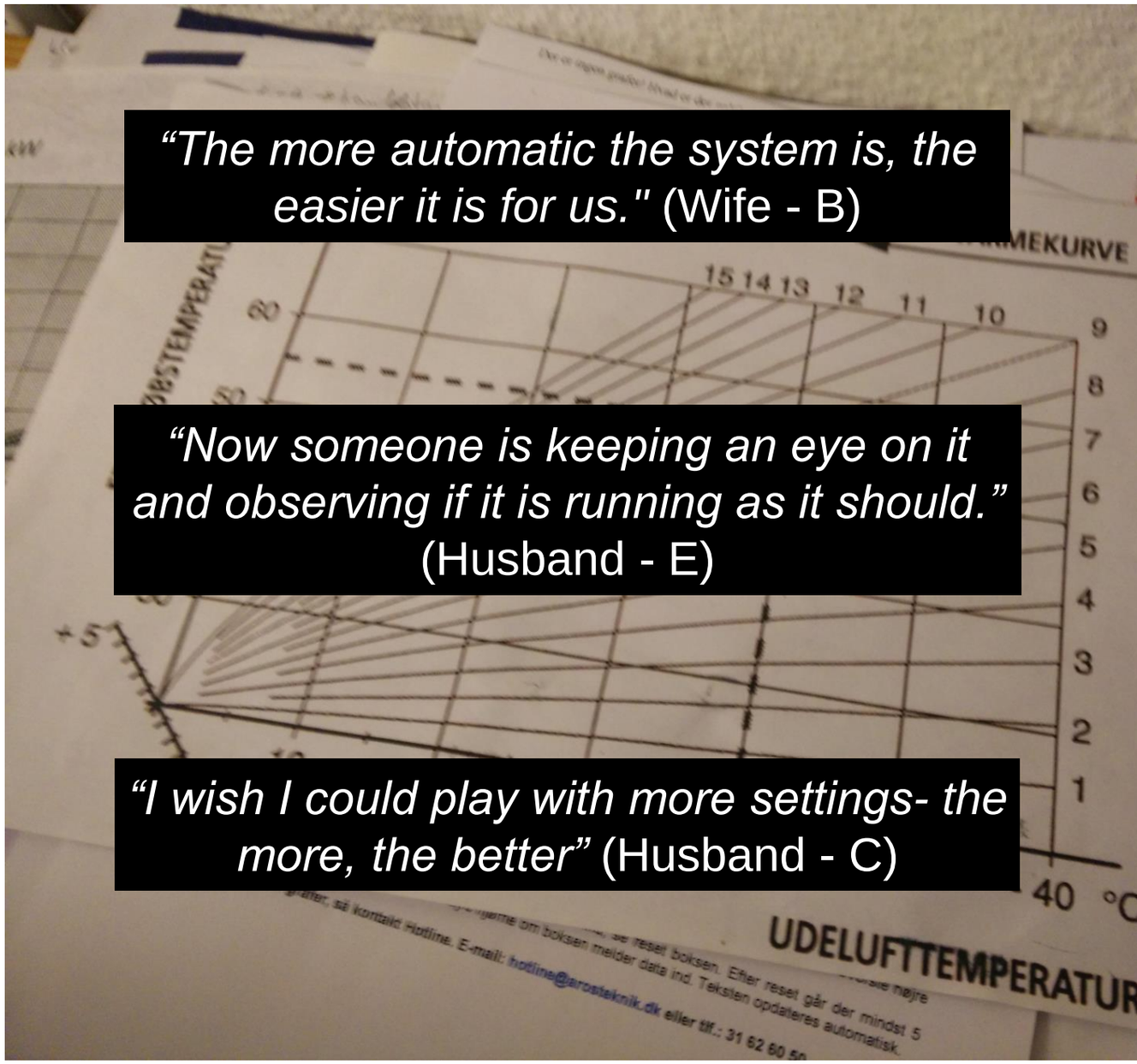


Opportunities

- **Automation** can be a **convenient** way to introduce flexible energy to users

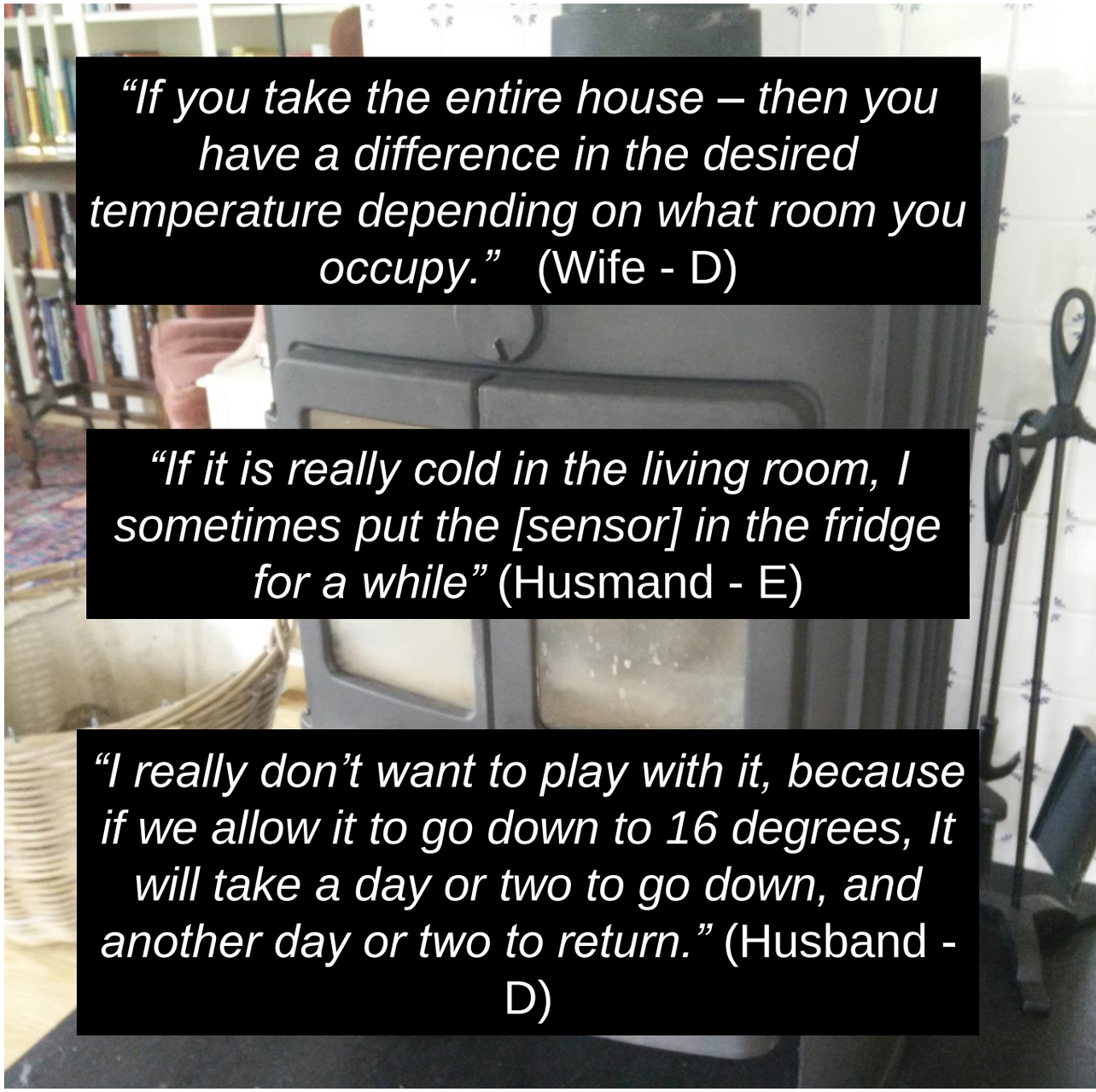
- **System intelligence** can help reduce complex concepts related to intelligent energy.

- **Easy user access** to the system can make some users feel **empowered** and in **control**



Challenges

- **Comfort** is experienced differently (different temperatures in rooms)
- **Rational** design conventions do not always capture **“irrational”** user actions (wood burners, open windows)
- Difficult to change **user understandings** with a rational system design (loss of engagement and control)



The End - Questions?