



Smart Energy & Consumer Behaviour

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Memorial Court, Clare College, CAMBRIDGE
16 MAY, 2014

Based on: M. Oseni, et al, 2013 EPRG Public Opinion Survey:
Smart Energy – Attitudes and Behaviours, EPRG WP1327

<http://www.cambridgeeprg.com/wp-content/uploads/2013/12/1327-PDF.pdf>

Outline

A. Background

- Previous literature on smart metering and consumer behaviour
- Some recent findings
- EPRG Surveys to date

B. EPRG Survey 2013: “**smart**” energy – attitudes and behaviours

- Meter readings and awareness of consumption
- Billing and consumption behaviour
- Concerns and new technology
- Remote controlled appliances and WTP

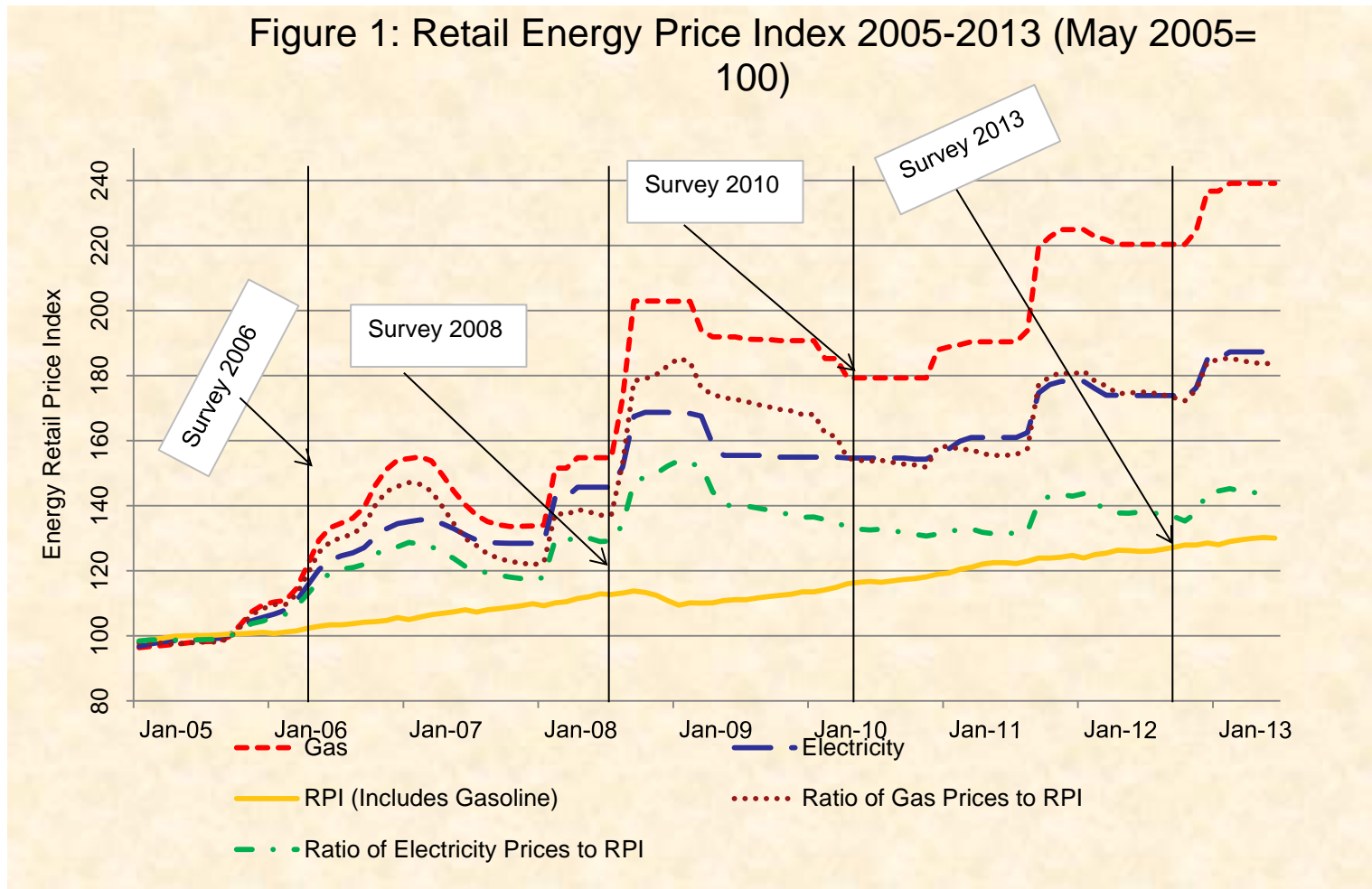
Previous literature: smart devices & consumer behaviour

- ❖ Smart devices need careful and customer group specific design
 - A one-size fits all approach cannot be justified
- ❖ Accompanying education and information is crucial
 - People should be frequently informed about consumption & different options of receiving feedback
- ❖ Impact of smart devices declines over time - habits are hard to break
 - Varying feedback and solutions like *plug & play* seem promising, but for effective design further research on habit formation and preference reversals is needed
- ❖ Money savings provide strong incentives for behaviour change
 - Time varying prices in combination with smart meters increase demand response
- ❖ Nudges (e.g. peer comparisons & goal setting) can have significant impact on consumer behaviour
 - Technologies like smart meters and network appliances which report energy use can make nudges more effective

Previous literature: smart devices & consumer behaviour

- Thus far, most econometric studies have used treatment-control approaches to analyse the impact of smart meters on energy consumption.
- Previous studies find significant impact of smart meters on energy consumption, but little econometric research on behavioural economic aspects e.g. peer effects.
- Nudges
 - Easiest nudges to implement are information based (e.g. conservation advice)
 - Peer comparisons seem most effective
 - Also promising: product-integrated feedback & energy conservation goals
 - But again: heterogeneous effect implies that targeting households whose observable characteristics predict larger treatment effects could substantially improve cost effectiveness
- **Technologies like smart meters and network appliances which report energy use can make nudges more effective**

EPRG Surveys to date



Source: Department of Energy and Climate Change (DECC), 2013

EPRG Survey 2013: “smart” energy – attitudes & behaviours

Aim of the survey:

- To gain insights into possible consumer response to smart meters and remote controlled appliances in particular

Focus:

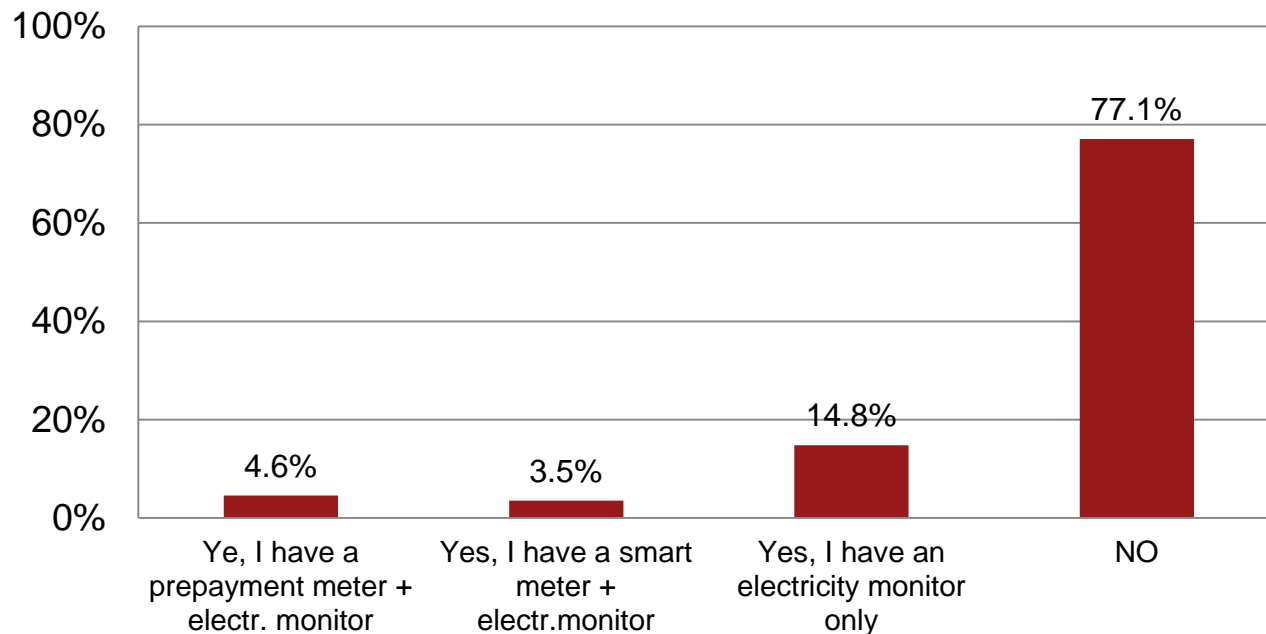
- meter readings and awareness of consumption
- billing and consumption behaviour
- payment type and frequency
- remote controlled appliances and willingness to pay
- concerns over technology
- switching behaviour

EPRG Survey 2013:

“smart” energy – attitudes & behaviours

- 1526 respondents (representative sample of UK population)
 - 22.94% (i.e. 350 respondents) had an in-house monitor of some kind in their home

Share (%) of Respondents by Ownership of In-house Electricity Monitors



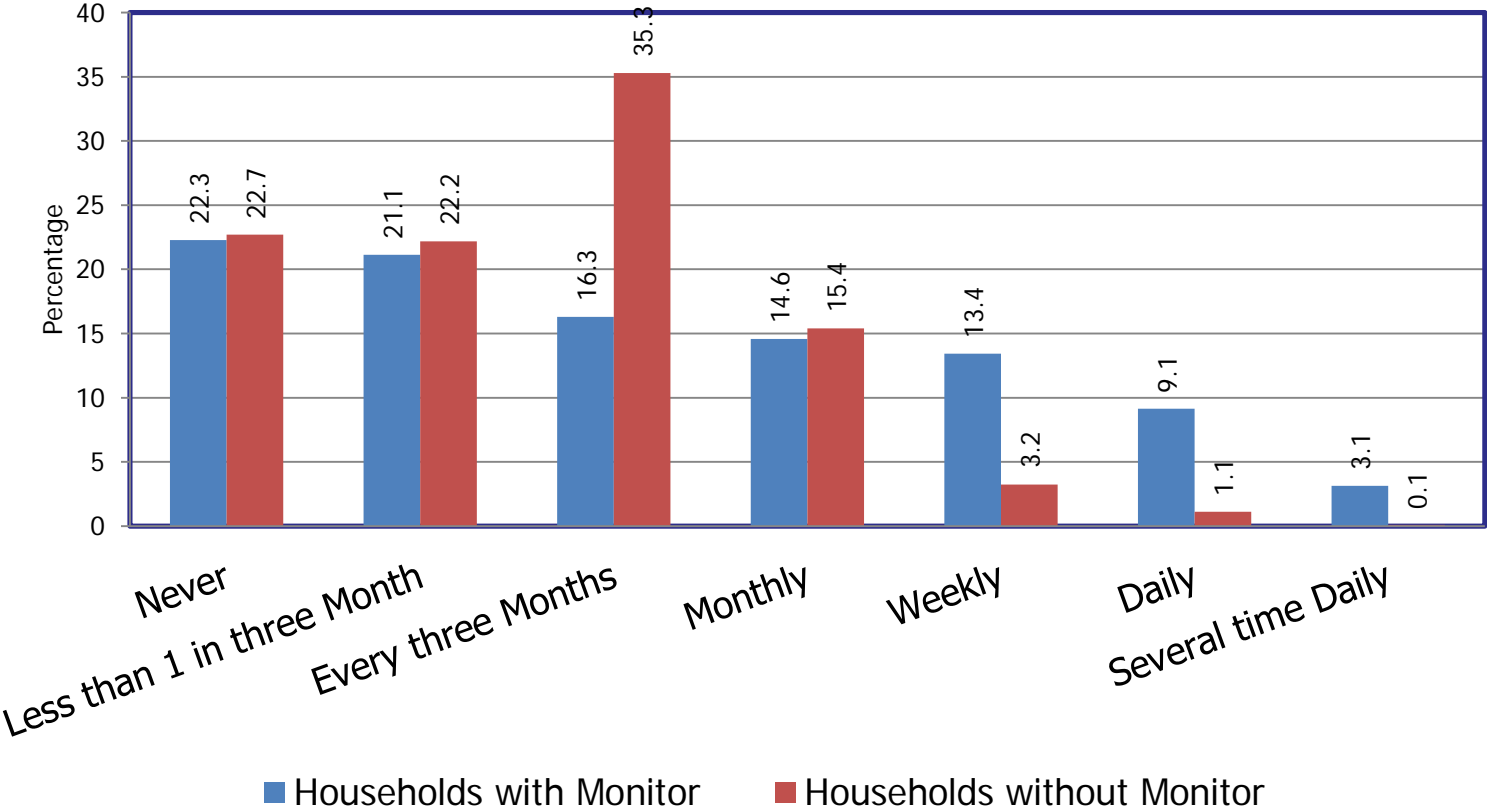
- prepayment meter with monitor (4.59%)
- smart meter with monitor (3.5%)
- only a monitor (14.8%)

Source: EPRG Survey of UK Households, 2013

EPRG Survey 2013: “smart” energy – attitudes & behaviours

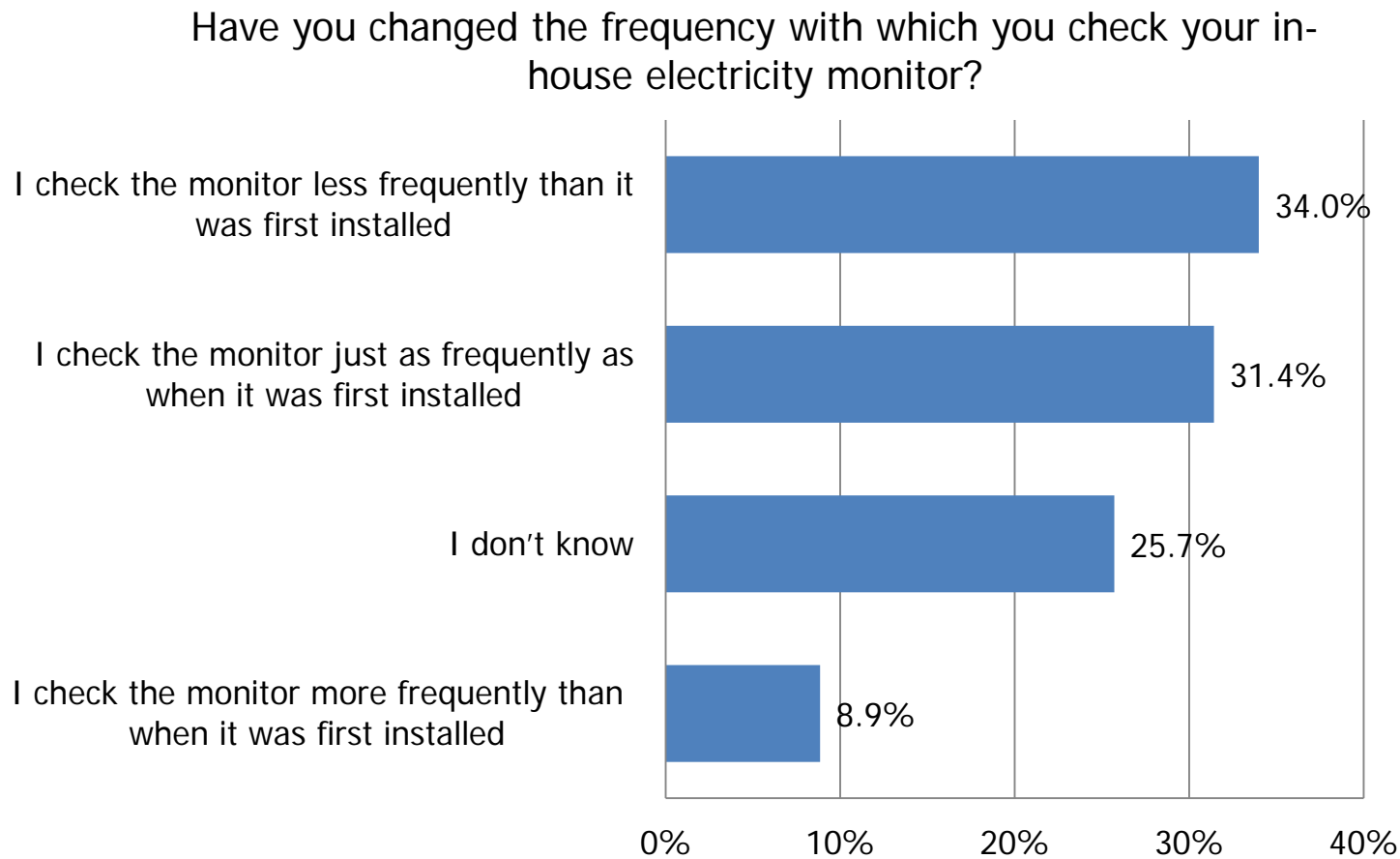
Monitor owners far more likely to read daily/weekly

Frequency Households Read Electricity Monitor or Meter



EPRG Survey 2013: “smart” energy – attitudes & behaviours

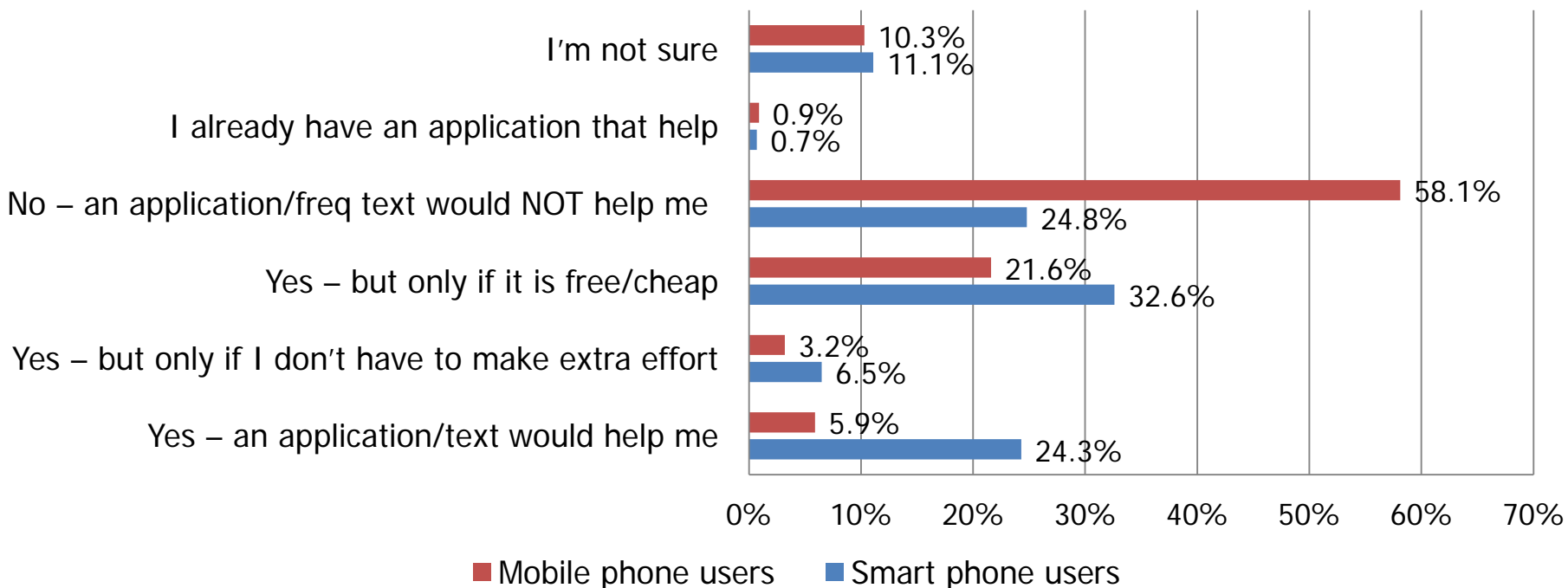
Many reduce frequency of checking since monitor first installed



EPRG Survey 2013: “smart” energy – attitudes & behaviours

Smart phone apps have potential to induce behaviour change

Do you think an application on your smart phone (or frequent text messages) would help you become more aware of your energy consumption?



- 56% of respondents have a smart phone
- 63% of smart phone owners state an app would help to become more aware of energy consumption

EPRG Survey 2013: “smart” energy – attitudes & behaviours

Education, age, homeownership increases behaviour change

Conscious Change in Energy Consumption Behaviour

	Share (%)	T-test
Change in consumption by:		
No bachelor degree	56.44	-3.154***
Bachelor degree or higher	64.56	
Male	58.55	-1.230
Female	61.71	
Age 18-49	56.61	-2.974***
Age 50 & over	64.25	
Rent	54.14	-2.929***
Own	62.98	
Not responsible for bill	39.23	-6.345***
Responsible for bill	63.56	
Setting thermostat at 20°C or less	65.64	3.526***
Setting thermostat at more than 20°C	59.92	
Doing cooking regularly	61.72	2.427**
Doing cooking occasionally or never	52.94	
Overall	60.18	

EPRG Survey 2013: “smart” energy – attitudes & behaviours

Economic reasons drive willingness to change consumption

Information provision:

40% of the respondents inform themselves online

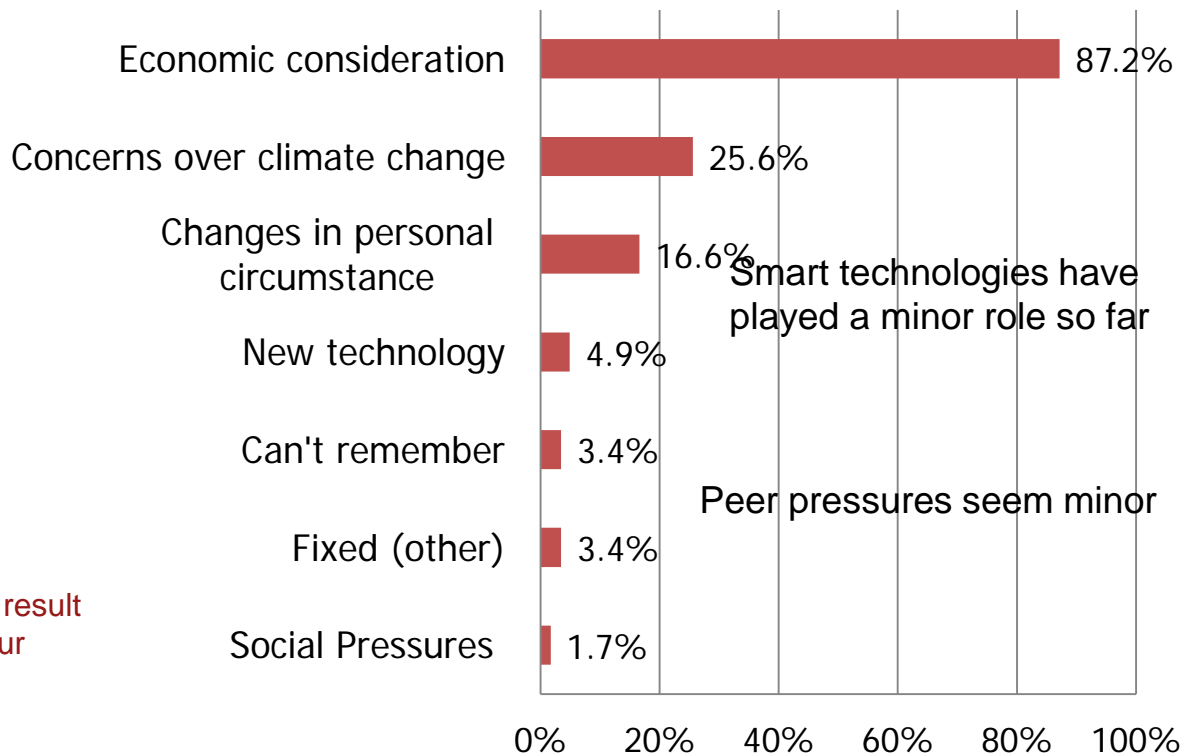
11% state they consult their supplier

10% talk with friends

2% ask neighbours for information

According to *stated* preferences, peer influences do not seem to matter much

Reason for changing consumption behaviour



Remark: no significant gender difference!

Remark: comparable result for switching behaviour

EPRG Survey 2013: “smart” energy – attitudes & behaviours

Consumers claim their behaviour is independent of peer actions

Further consideration of the role of peers

Question:

“Consider the following situation that might arise in a future electricity system with a large amount of renewable electricity sources (such as wind power). It is announced that in 3 days time, between 3pm and 8pm, there is a risk of power outages due to an expected combination of cold weather and low wind speeds. **All domestic electricity consumers are asked to voluntarily reduce their electricity consumption during this period.**”

Would you?

Significantly reduce domestic consumption, **but only if** most of your peers did. **3%**

Significantly reduce domestic consumption **regardless of** what your peers did. **31%**

Slightly reduce domestic consumption , **but only if** most of your peers did. **4%**

Slightly reduce domestic consumption **regardless of** what your peers did. **37%**

Not vary your consumption. 12%

Increase consumption. 1%

Don't know 12%

Again, consumers *state* that they do not condition their behaviour/decisions on their peers

→ *revealed* preferences might look different, though!

EPRG Survey 2013: “smart” energy – attitudes & behaviours

Technical & privacy concerns over remote controlled appliances

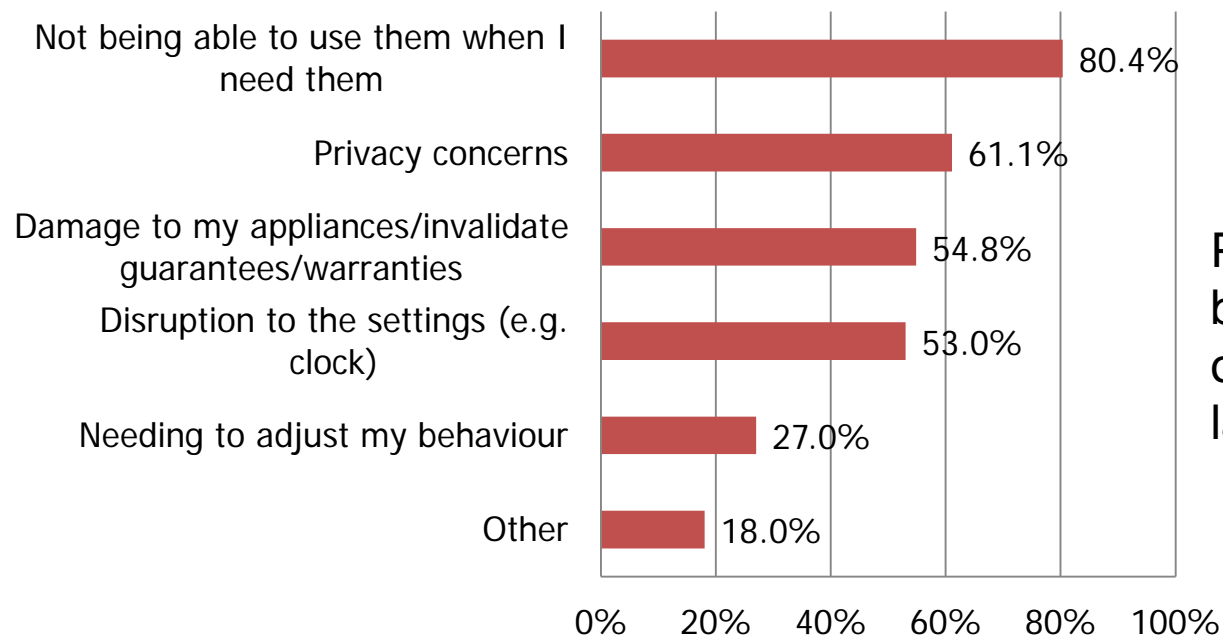
Concerns regarding new technologies:

53% state concerns regarding remote controlled appliances

24% are not sure

22% have no concerns

What are your major concerns regarding remote control of your appliances? tick all that apply to you



People are **not** afraid of behaviour change but rather of technical problems and lack of privacy

- Remote controlled appliances must not affect availability & functionality !
- Privacy concerns must be taken seriously!

EPRG Survey 2013: “smart” energy – attitudes & behaviours

Privacy concerns lower with age, homeownership, monitor, bill paymt

Shares of Respondents (%) That have Privacy Concerns, by Category

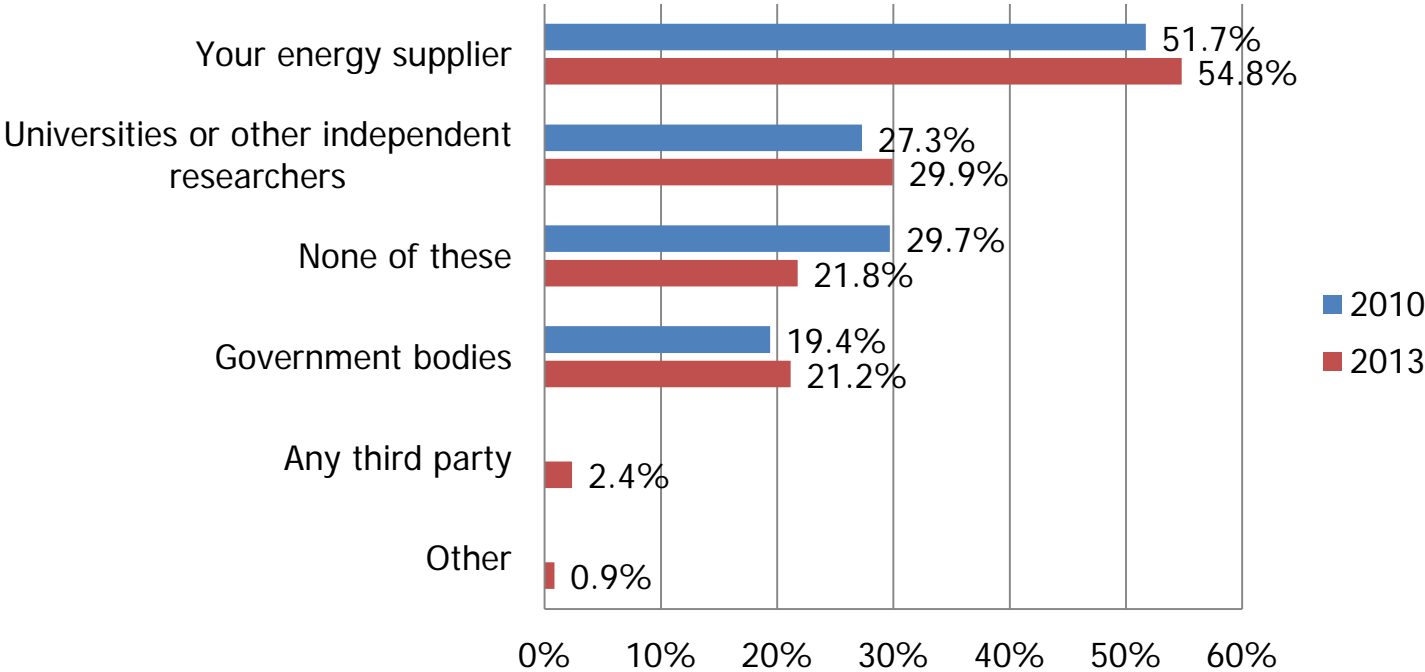
Category	Share (%)	T-test
No bachelor degree	60.48	-0.371
Bachelor degree or higher	61.75	
Age 18-49	68.2	4.245***
Age 50 & over	53.85	
Rent	67.76	2.404**
Own	57.74	
Did NOT have monitor	63.78	2.955***
Have a Monitor	61.67	
Not responsible for bill	72.16	2.431**
Responsible for bill	59.35	
Low technical job	60.91	0.031
High technical job	60.78	
Overall	61.10	

EPRG Survey 2013: “smart” energy – attitudes & behaviours

Sensitivities over sharing of consumption data

Majority of respondents want supplier to be the only body to access their data and over 1/5 want no one to access their data

Which of the following would you agree to share your energy consumption data with?



EPRG Survey 2013: “smart” energy – attitudes & behaviours

Concerns and New Technology

Shares of Respondents (%) That have Concerns, by Category

Category	Share (%)	T-test
Age 18-49	64.98	-4.627***
Age 50 & over	77.35	
Rent	65.12	-2.618**
Own	73.10	
Did NOT have monitor	71.51	1.287*
Have a Monitor	67.42	
Not responsible for bill	63.40	-2.093**
Responsible for bill	71.67	
Engage in low technical job	68.74	-2.494**
Engage in high technical job	76.69	
Not eager to try new product	73.60	5.011***
Always eager to try new product	52.67	
Overall	70.56	

EPRG Survey 2013: “smart” energy – attitudes & behaviours

Concerns and New Technology- Not want Data Recorded

Share (%) of Respondents That Would Not Want Their Consumption Data Recorded

Male	23.26	1.361*
Female	20.38	
Age 18-49	19.81	-2.024**
Age 50 & over	24.10	
Mention Privacy as Concern	31.53	6.523***
Did NOT mention privacy as concern	17.02	
Not responsible for bill	32.52	3.958***
Responsible for bill	20.29	
Income per capita £7500 or less	22.05	1.719*
Income per capita £24000 or more	15.76	
Not eager to try new product	22.94	3.333***
Always eager to try new product	11.76	
Overall	21.75	

EPRG Survey 2013: “smart” energy – attitudes & behaviours

Interrupting Cold Appliances and WTA

Load interruption of cold appliances (1-3 min per day)

If your annual electricity bill was reduced by X pounds per year, would you accept your cold appliances (e.g. fridges and freezers) *being interrupted* for short periods of 1-3 minutes over the course of the day?

Initial amount offered (10-50 pounds p.a.) was randomly drawn

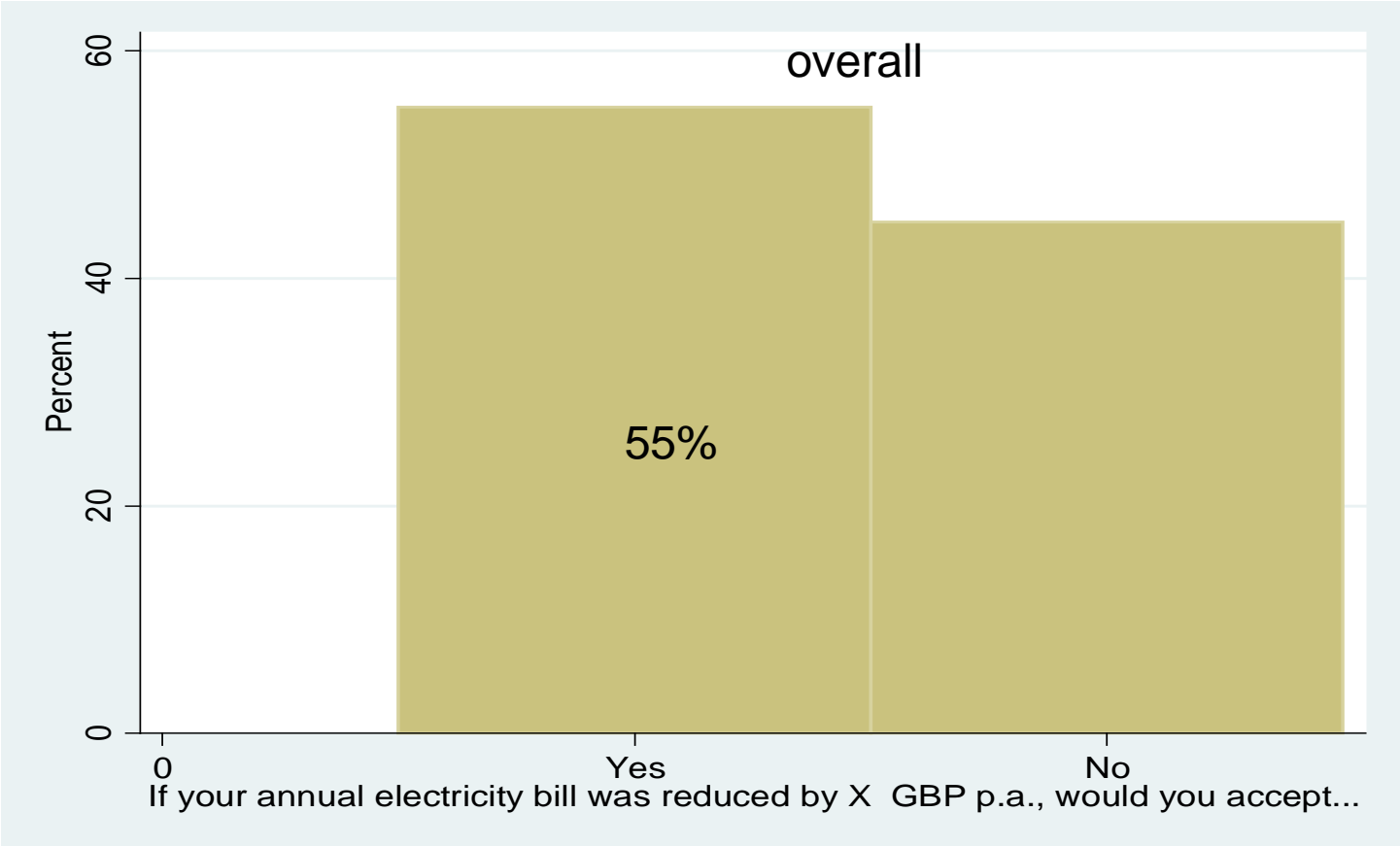
Depending on whether agent accepted/didn't accept, value decreased/increased by 10 GBP

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Interrupting Cold Appliances and WTA

Load interruption of cold appliances (1-3 minutes per day)
1st round

Based on the initial offer, overall 55% are willing to accept

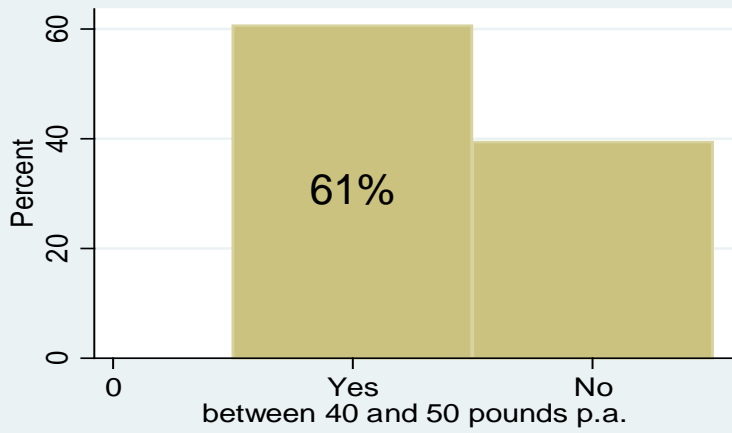
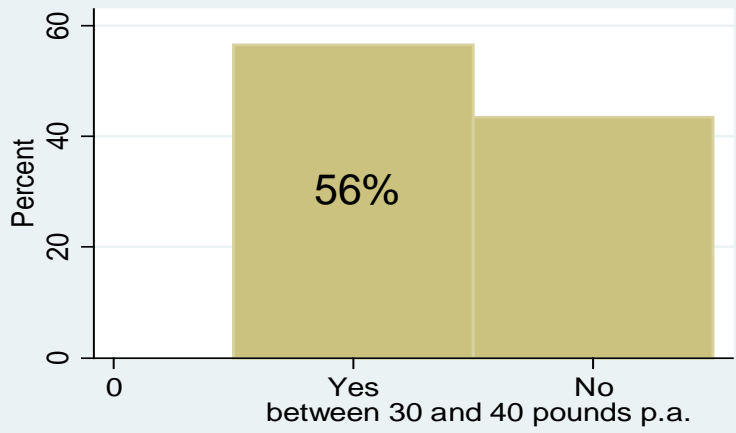
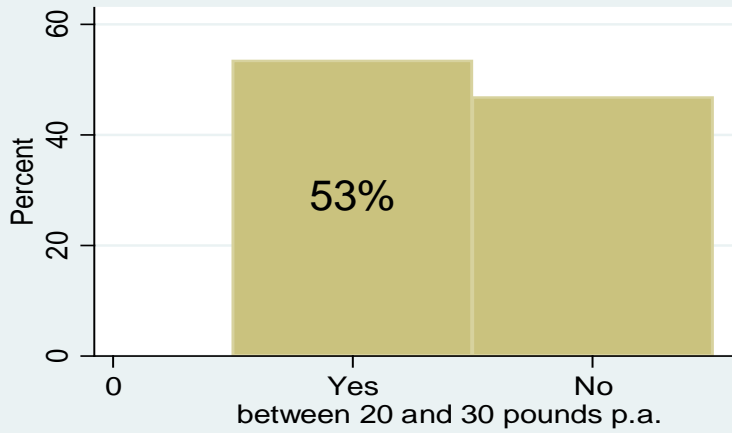
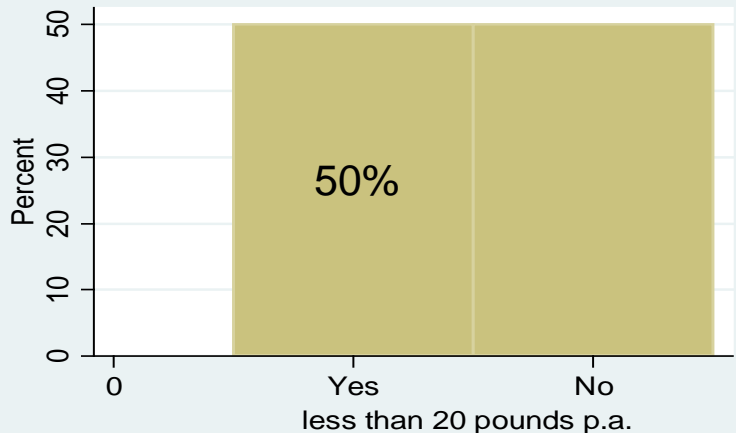


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Load interruption of cold appliances (1-3 minutes per day) by Value Offered

Share of respondents that is willing to accept increases from 50 to 61% as value offered is increased

1st round



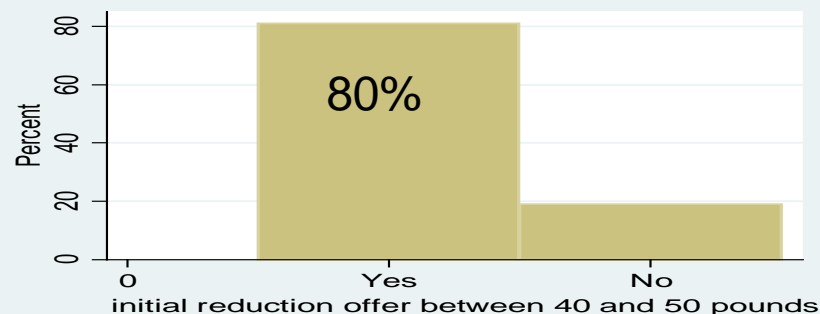
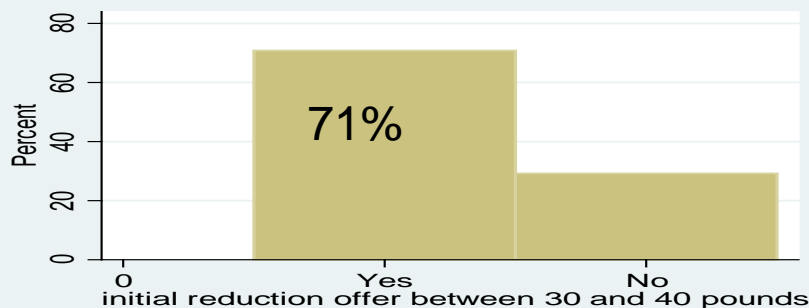
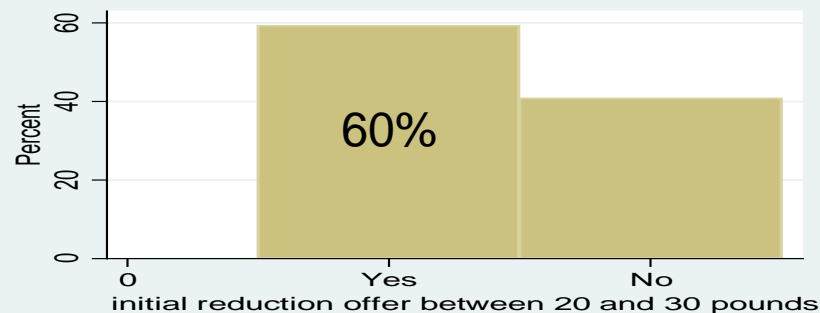
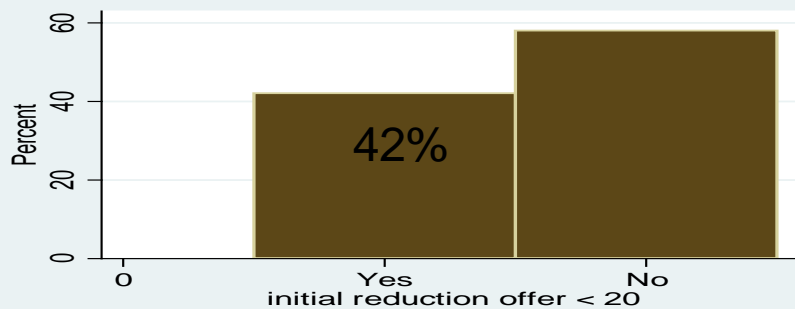
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Interrupting Cold Appliances and WTA

Load interruption of cold appliances (1-3 min per day)

2nd round: overall among those who accepted, 65% accept a lower amount
These are mainly those who had an initial value above 20 GBP.
For highest initial offers acceptance rate is 80%!

Those who accepted 2nd round



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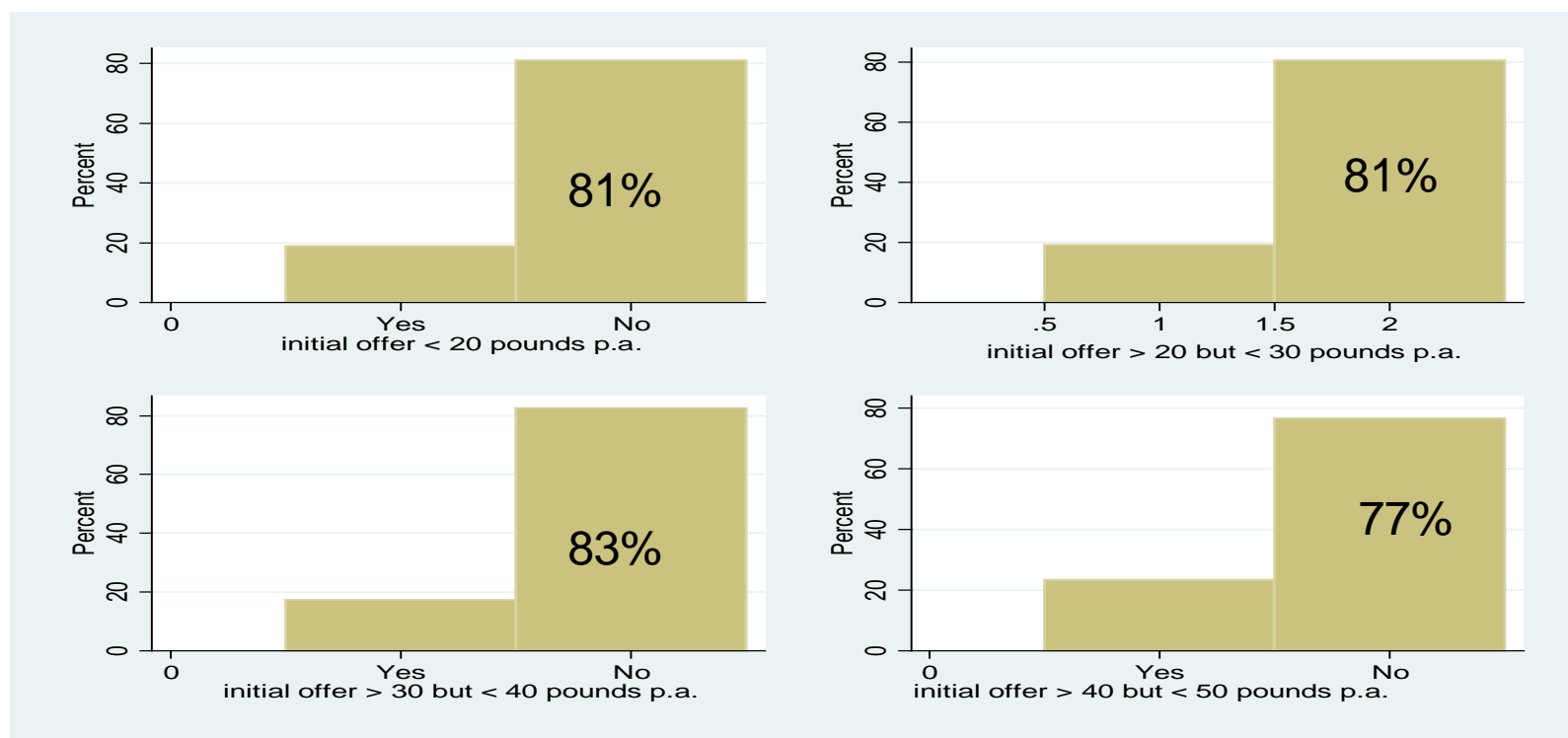
Interrupting Cold Appliances and WTA

Load interruption of cold appliances (1-3 min per day)

2nd round: overall, among those who did not accept the initial offer, 80% don't accept in 2nd round either

Independent of initial value, those who do *not* accept are likely to not accept higher values either.

Those who declined 2nd round



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Load Shifting Wet Appliances and WTA

Load shifting of wet appliances to preset time (9pm to 7am)

If your annual electricity bill was reduced X pounds per year, would you accept having your wet appliances (e.g. dishwashers, washing machines, tumble dryer) *preset* so that they only operate between 9pm and 7am?

Initial amount offered (10-50 pounds p.a.) was randomly drawn

Depending on whether agent accepted/didn't accept, value decreased/increased by 10 GBP

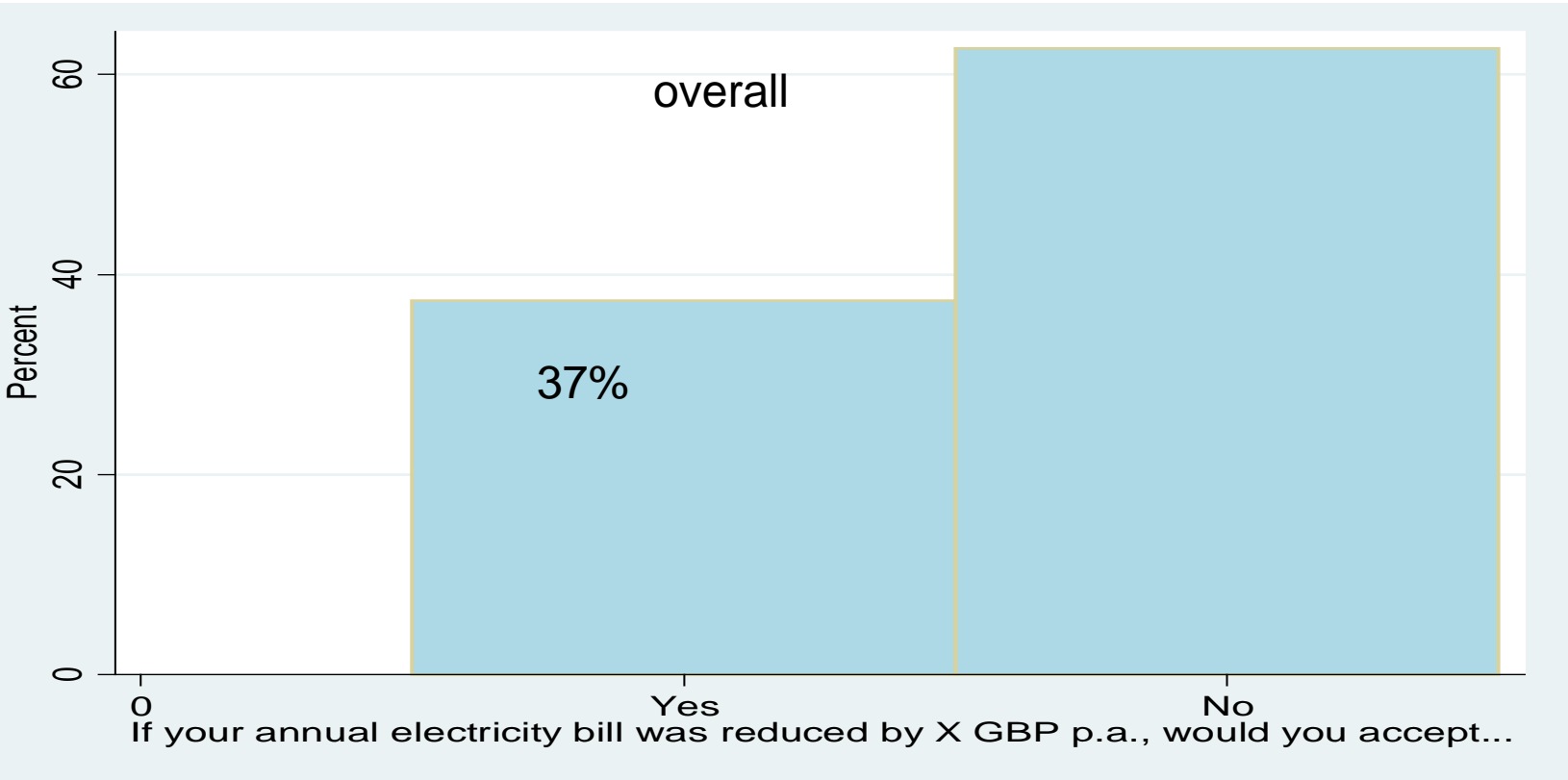
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Load Shifting Wet Appliances and WTA

Load shifting of wet appliances to preset time (9pm to 7am)

Only 37% are willing to accept

1st round



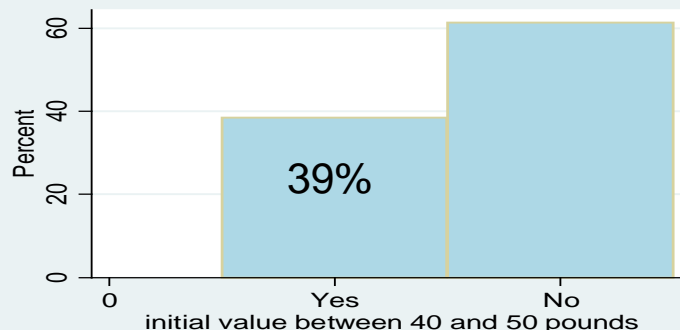
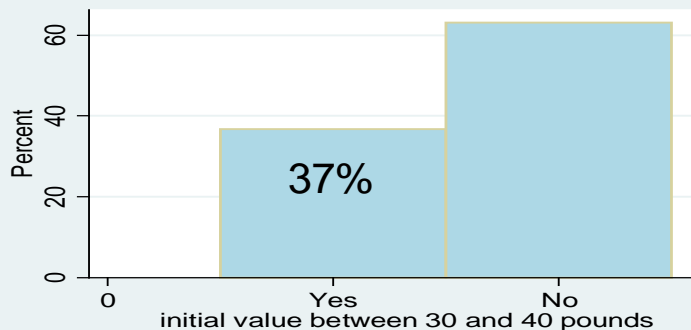
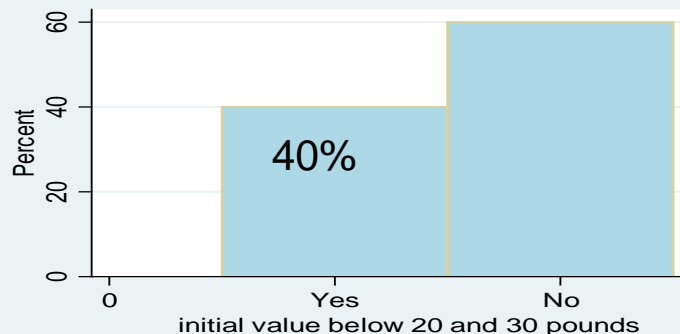
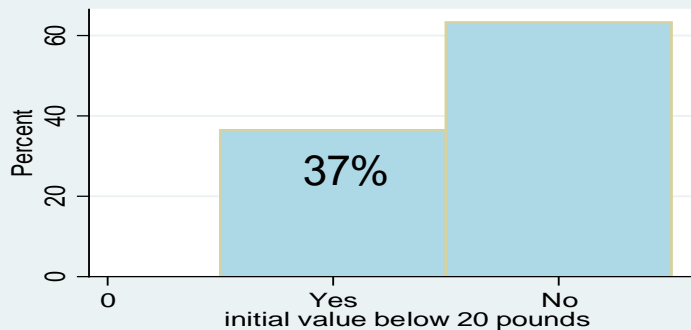
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Load Shifting Wet Appliances and WTA

Load shifting of wet appliances to preset time (9pm to 7am)

Share of respondents that is willing to accept preset time stays relatively constant in value offered: between 37 and 40%

1st round by value offered



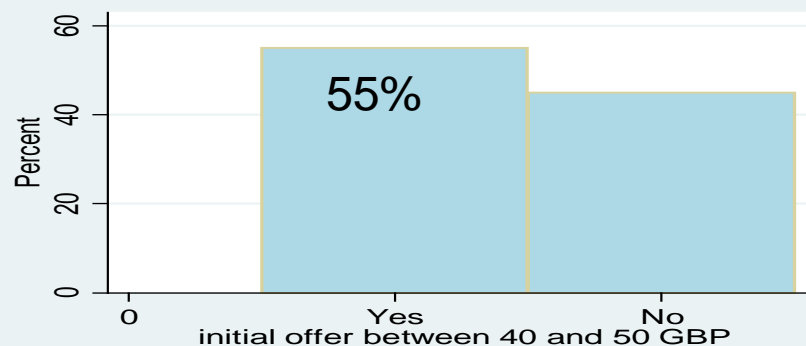
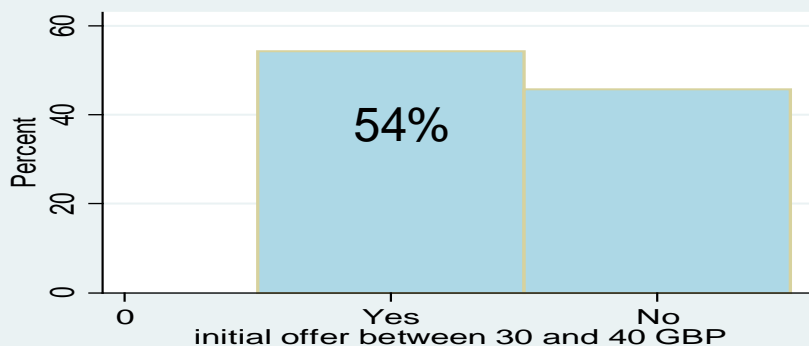
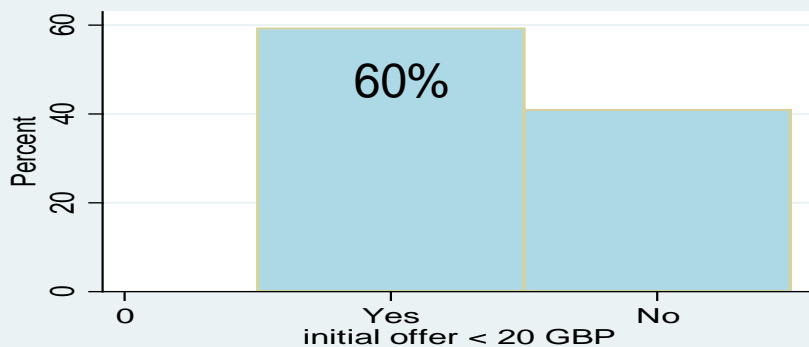
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Load Shifting Wet Appliances and WTA

Load shifting of wet appliances to preset time (9pm to 7am)

2nd round: overall among those who accepted, 57% accept a lower amount.
Counter intuitively, share decreases slightly with initial value to only 55%.

Those who accepted 2nd round



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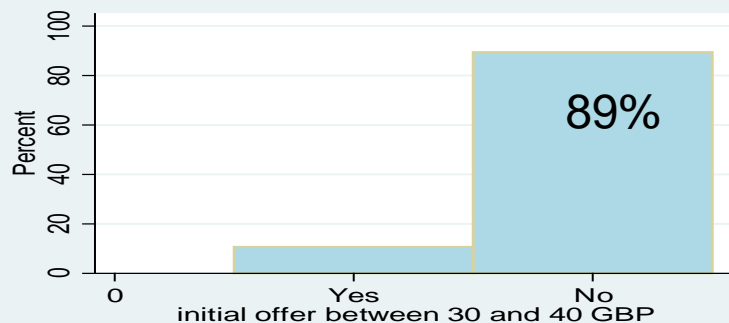
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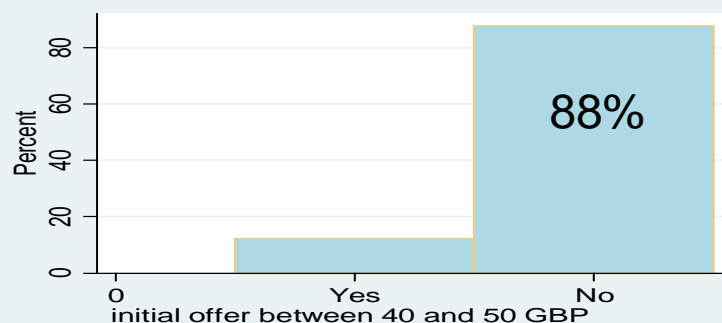
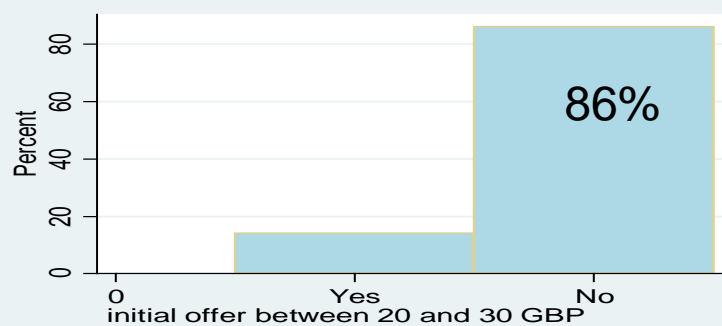
2nd round: overall, among those who did not accept, 89% don't accept in 2nd round either

Similar to case of load interruption, independent of initial value, those who do *not* accept, are likely to not accept higher savings either.

Those who declined



2nd round



EPRG Survey 2013: “smart” energy – attitudes & behaviours

Remote Controlled Appliances and WTA

Summary results remote control and willingness to accept:

- Load interruption cold appliances and WTA:
 - Share of people who are willing to accept load interruption increases with the money offered as compensation.
 - Compensation of at least 10 pounds per annum required to accept.
 - Independent of initial value, those who do not accept load interruption initially, are likely to not accept either when offered a higher compensation.
- Load shifting and WTA:
 - Share of respondents who accepts is lower than for load interruption
 - A decrease in the money value offered is more likely to lead to refusal.
 - Those who don't accept initially, don't accept higher value either.
- Time based interruption of hot appliances and WTA:
 - People seem least willing to shift hot appliance use
 - Decrease in compensating value lowers acceptance rate more than other cases
 - Those who do not accept initially, also don't accept higher compensation.

Summary

- Smart devices *have the potential* to lead to behavioural response
 - Challenge is to sustain this behaviour change over time
- Applications on smart phones are promising to raise awareness & induce behaviour change
- Economic reasons are main driver of behaviour change
 - Smart energy technologies must be well designed/incentive compatible
 - Peer pressures were not perceived as strong
- Remote controlled appliances must minimise impact on availability & functionality and privacy concerns must be taken seriously
- Questions over whether the sorts of values that individuals are willing to accept can be justified by the benefits derived from the ability to have remote controlled appliances

Thank you!

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