

UNIVERSITY OF
Southampton

The effects of LED light bulb installation on electricity demand in UK households

Results of a large-n randomised control trial

11th March 2021

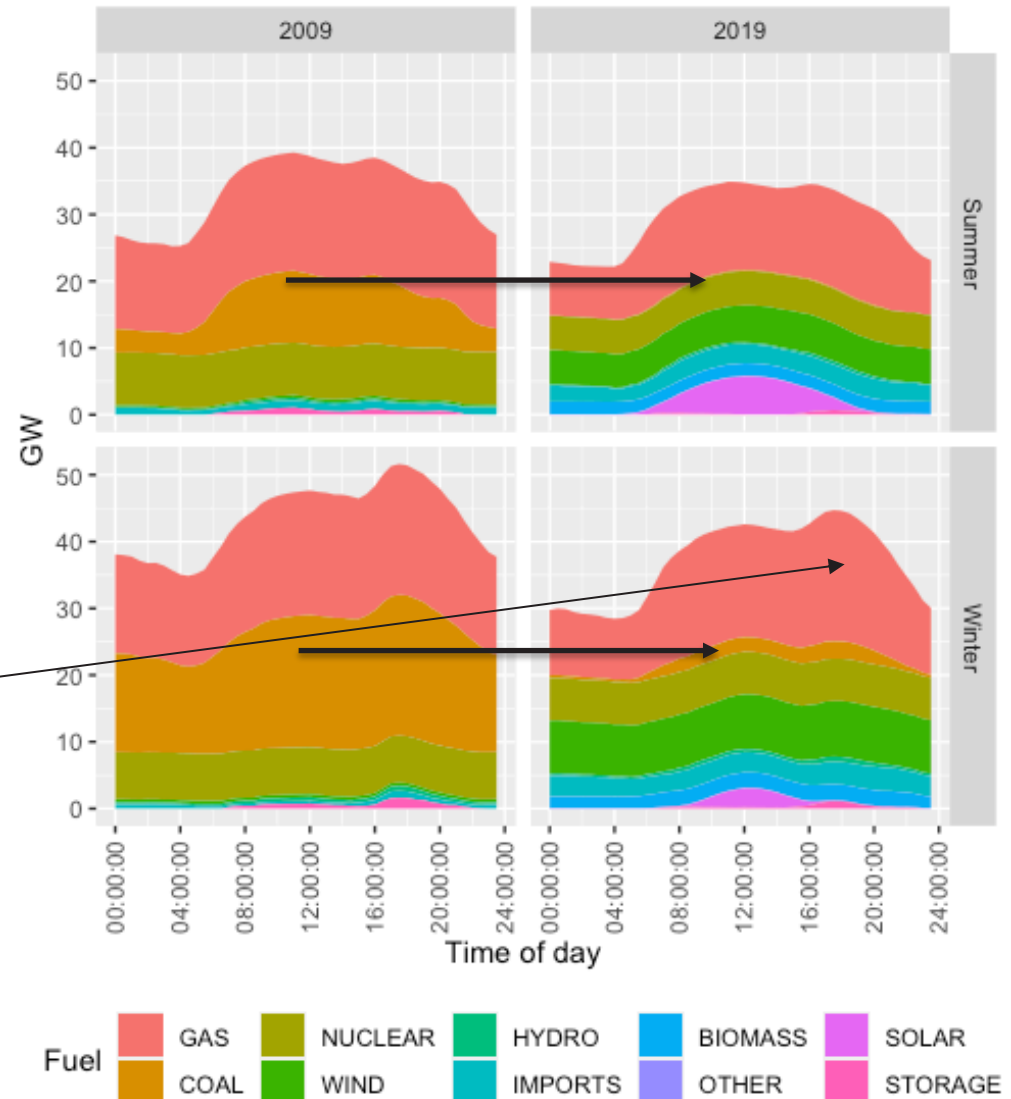
Ben Anderson
@dataknut

The Menu

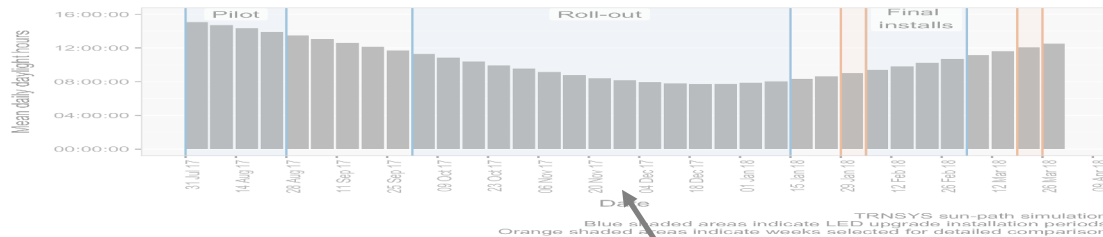
- The problem
 - Peak electricity demand
- The solution
 - Reducing & shifting demand
- Seeing the light
 - Large n LED light bulb trial
- Did it work?

Despite this...

- UK Generation
 - 2009 – 2019
- The peak is still
 - Peaky
 - Expensive
 - Carbon intense
- What to do?
 - Reduce it
 - Shift it



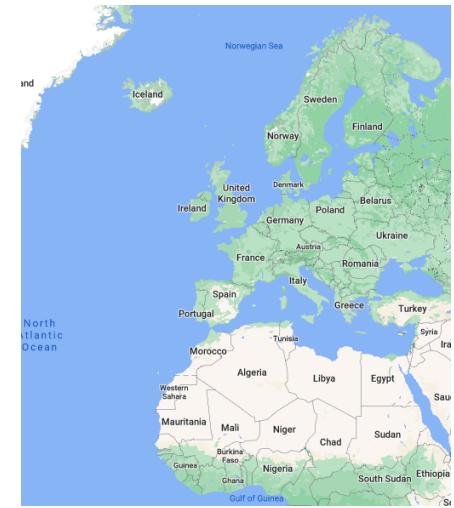
Can LED lights help?



Hours of daylight

- South East England
 - Stratified random sample
 - $N \approx 4000$ households (representative)
 - Randomly allocated to 4 trial groups ($n \sim 1,000$)

LED trial was one of these



Can LED lights help?

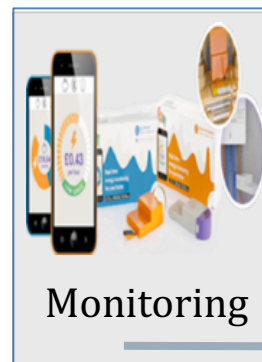
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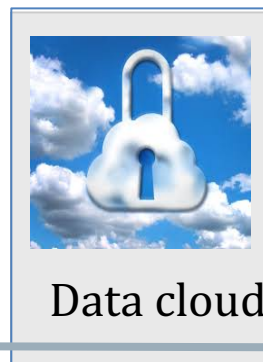
- Data

LED trial was one of these

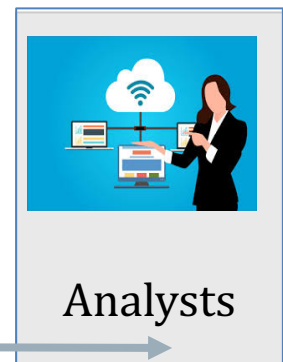
- <http://www.energy.soton.ac.uk/save-data-sources/>
- W every 10 seconds
- Wh every 15 minutes
- Household surveys



Monitoring

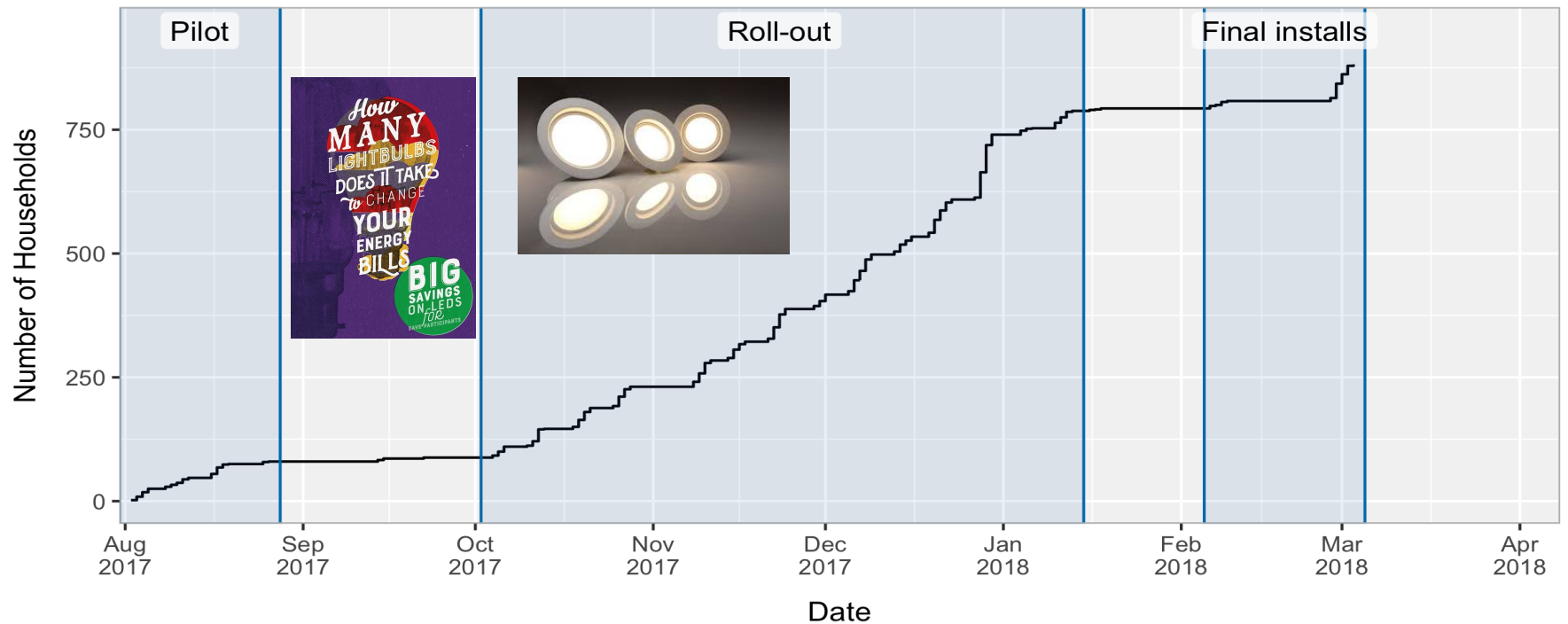


Data cloud



Analysts

Implementation

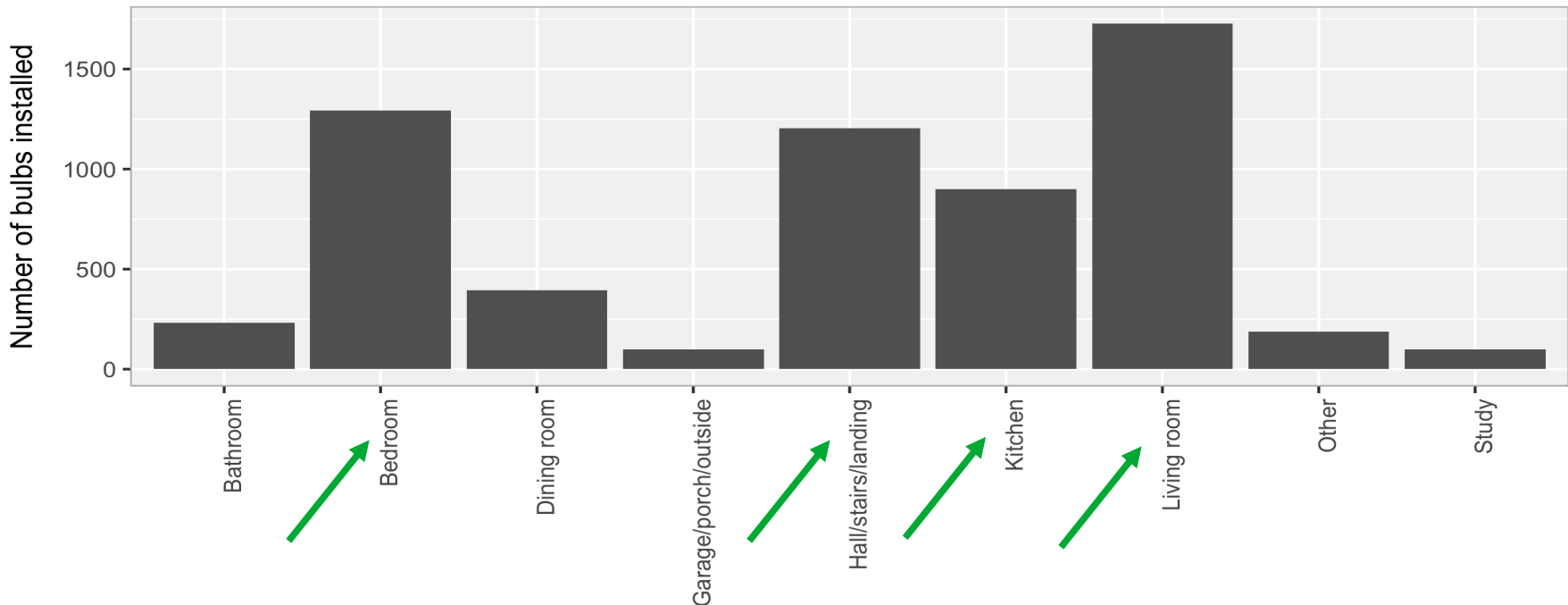


- Install: Up to 10 LED bulbs for free
- 76% (882) agreed

Cumulative total of LED lightbulb installations
Shaded area denotes Trial Period 2

Where were they put?

60% already had 1 or more



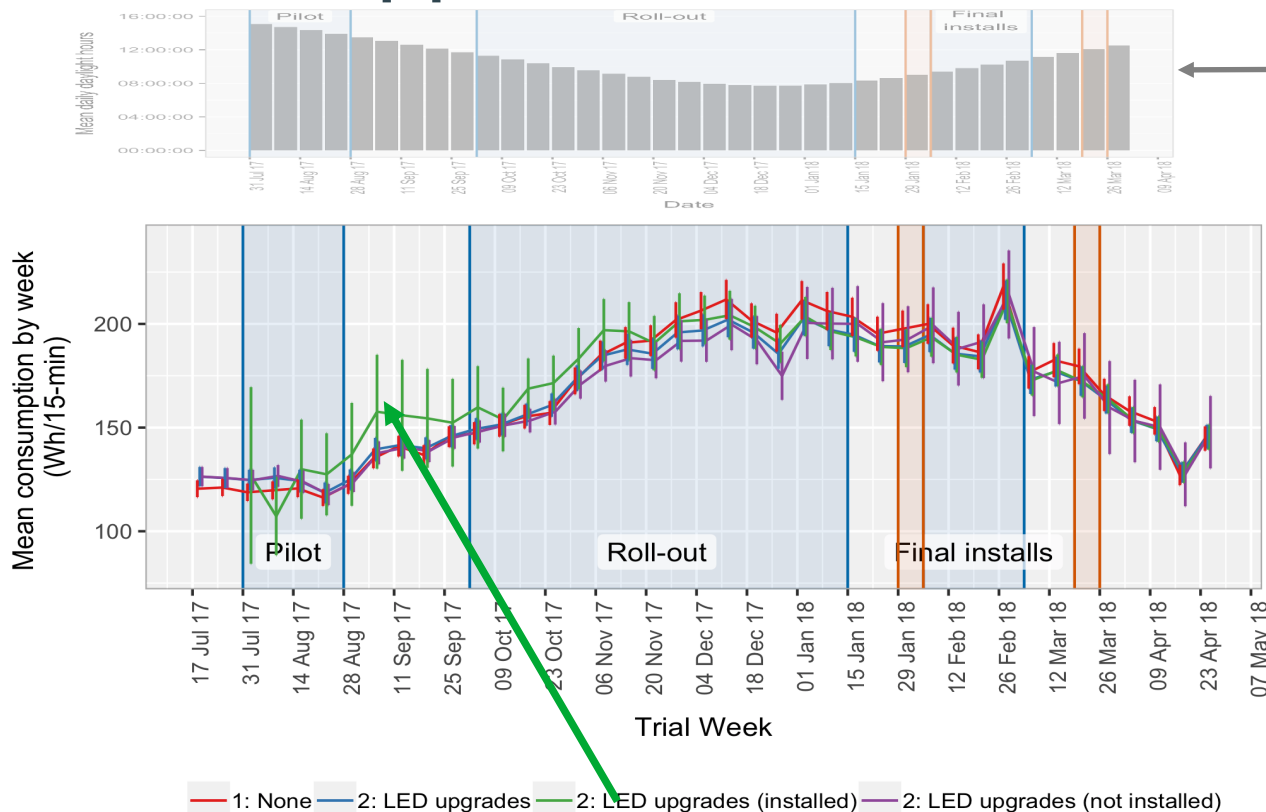
Upgraded bulb location

Source: BMG LED lightbulb installation data

- Maximum theoretical total installed saving = 155 kW across group
- Actual total installed = 124 kW

Mean: 176W per household

What happened?



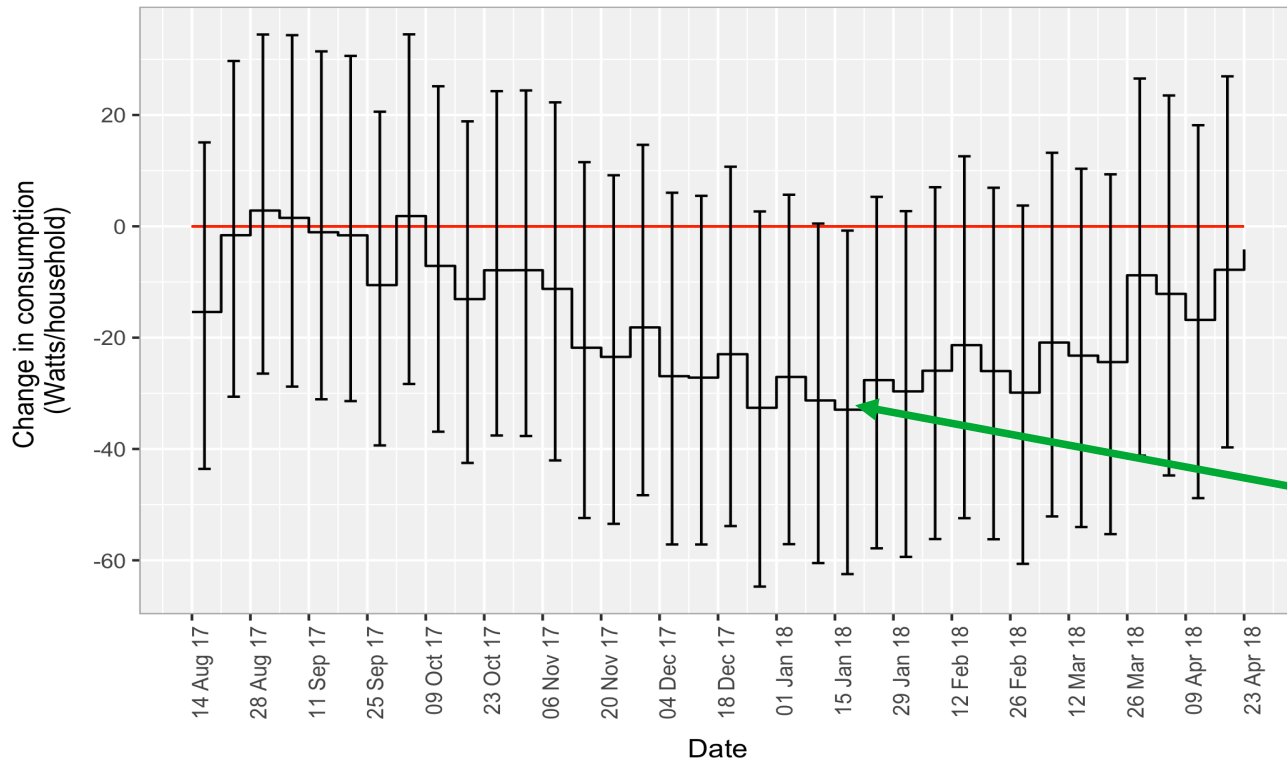
Hours of daylight

- Mean Wh
- 16:00 – 20:00

15 minute Wh consumption - weekly mean 16:00 – 20:00
 Error bars: 90% CI. Data from 2,021 households
 Blue shaded areas indicate installation periods
 Orange shaded areas indicate weeks selected for detailed comparison

We need a **difference in difference model!**

What happened?

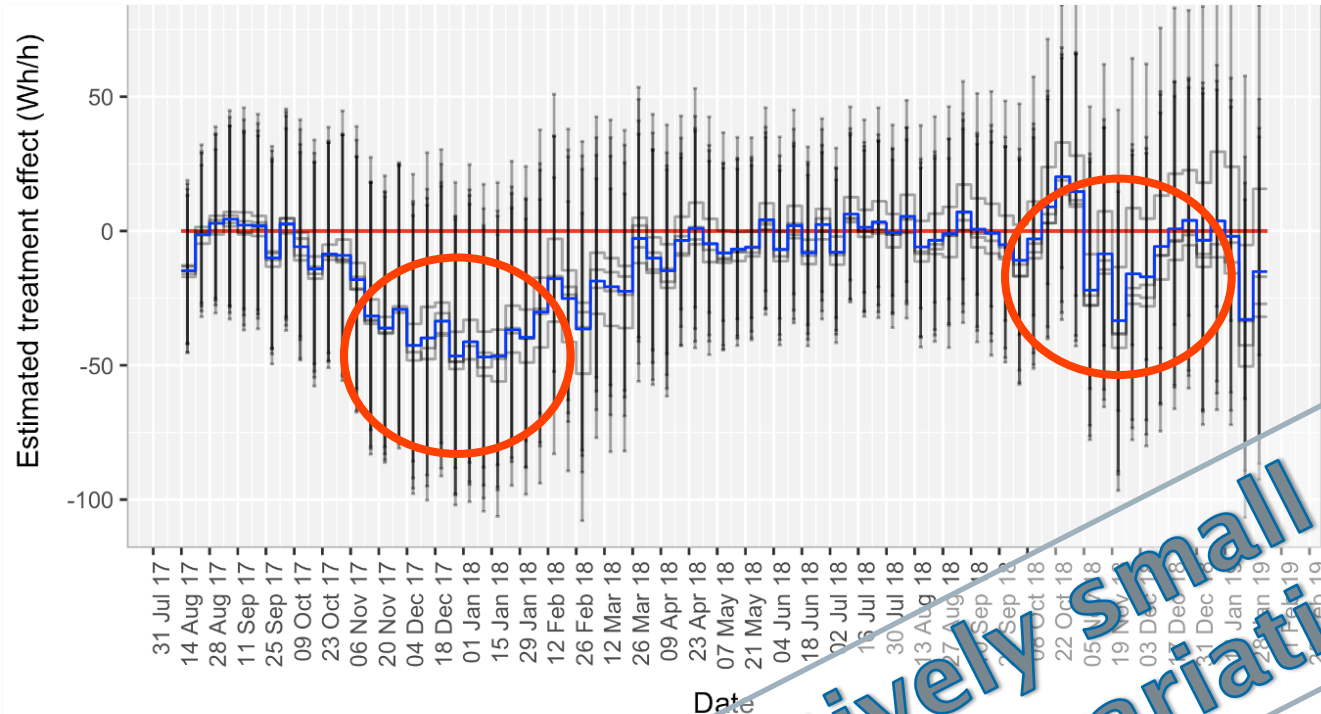


Error bars: 90% confidence interval for the estimates
Intercept omitted for clarity

- *Difference in difference model*
- 16:00 – 20:00 only

- Lack of precision – see 90% confidence intervals
- Relatively small effect
- Big inter-household variation

What happened (long term)?



Grey lines indicate effect estimates. Error bars: 90% confidence interval for the estimates
Contrast week, blue line shows mean of estimates

- 16:00 – 20:00
- Difference in difference model

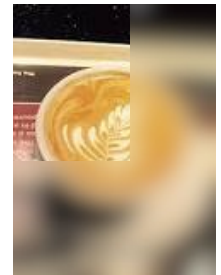
Relatively small effect
& big variation...

- Effect persisted to winter 2018

Was it worth it?

- ‘Biggest’ week (mid-winter):
 - Max peak-hours reduction: 47W (8%) in w/c 1 January 2018
 - Median: -31W in peak per household
 - Median: -3.9 kWh per household per week
 - ~£0.70/week!

176W installed



- Modelled 500 customer substitution:
 - ~24 kW peak load reduction (~ 3 EVs)
 - ~90kWh annual per customer (£16.00)
- Sometimes cost effective

It depends...

Deployment costs per 100 customers	Average peak load reduction per customer (kW)	Load reduction per 100 customers (kW)	Price per kW of peak reduction
£12,000	0.047	4.70	£2,600

- <https://save-project.co.uk/energy-efficiency/>

YOUR QUESTIONS

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