

**SMART ENERGY
RESEARCH LAB**

UNIVERSITY RESEARCH FOR PUBLIC GOOD

Smart Energy Research Lab (SERL)
webinar

Welcome & housekeeping

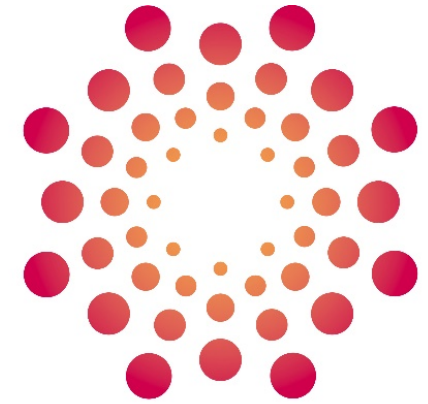
- Please note that the webinar is being recorded
- Attendees video/microphones and chat function are off
- Please use Q&A for questions – you can like existing Qs to upvote if similar to what you want to ask
- We will answer questions as we go along and at the end
- You can also contact info@serl.ac.uk if we are not able to answer all the questions during the session.

Agenda

- Overview of Smart Energy Research Lab (SERL) project
- SERL data
- SERL Research
 - SERL research programme – example projects
 - SERL Observatory – initial analysis
 - Covid19 project
- Data Governance
- Current state of play
- Q & A

SERL Project Overview

- 5-year project funded by UKRI until August 2022
- Consortium of 8 partners led by UCL
- Aim: provide an energy data resource for the UK research community
 - High-resolution smart meter data
 - Linked contextual data
 - Facilitate innovative research
- Recruit and collect data for 10,000 GB households
 - With informed consent
 - Exceeded target and recruited over 13,000 GB hholds
- SERL Research Programme – research utilising SERL data



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Why do we need SERL?

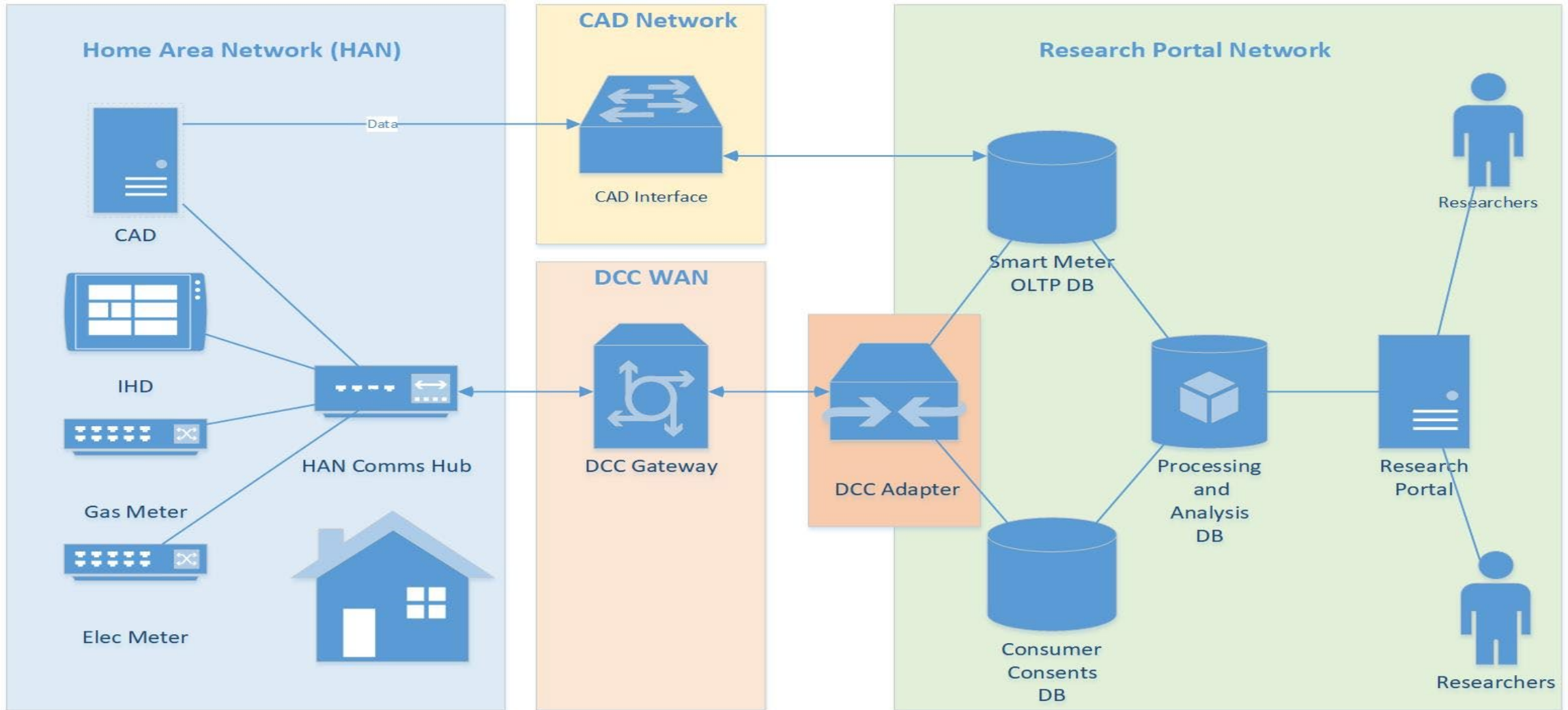
- Historically, and currently, very difficult for researchers to access good quality demand-side energy data in the UK
- Smart meter data could be a game-changer – high resolution (HH) data
- However substantial barriers to accessing smart meter data
 - Technical
 - Legal
 - Financial
- Hence SERL funded to be a **central resource** for the UK research community
- SERL's focus is on enabling research investigating energy demand/consumption etc in domestic buildings
 - Particularly research that requires use of granular, household level energy data

Goals of the research portal

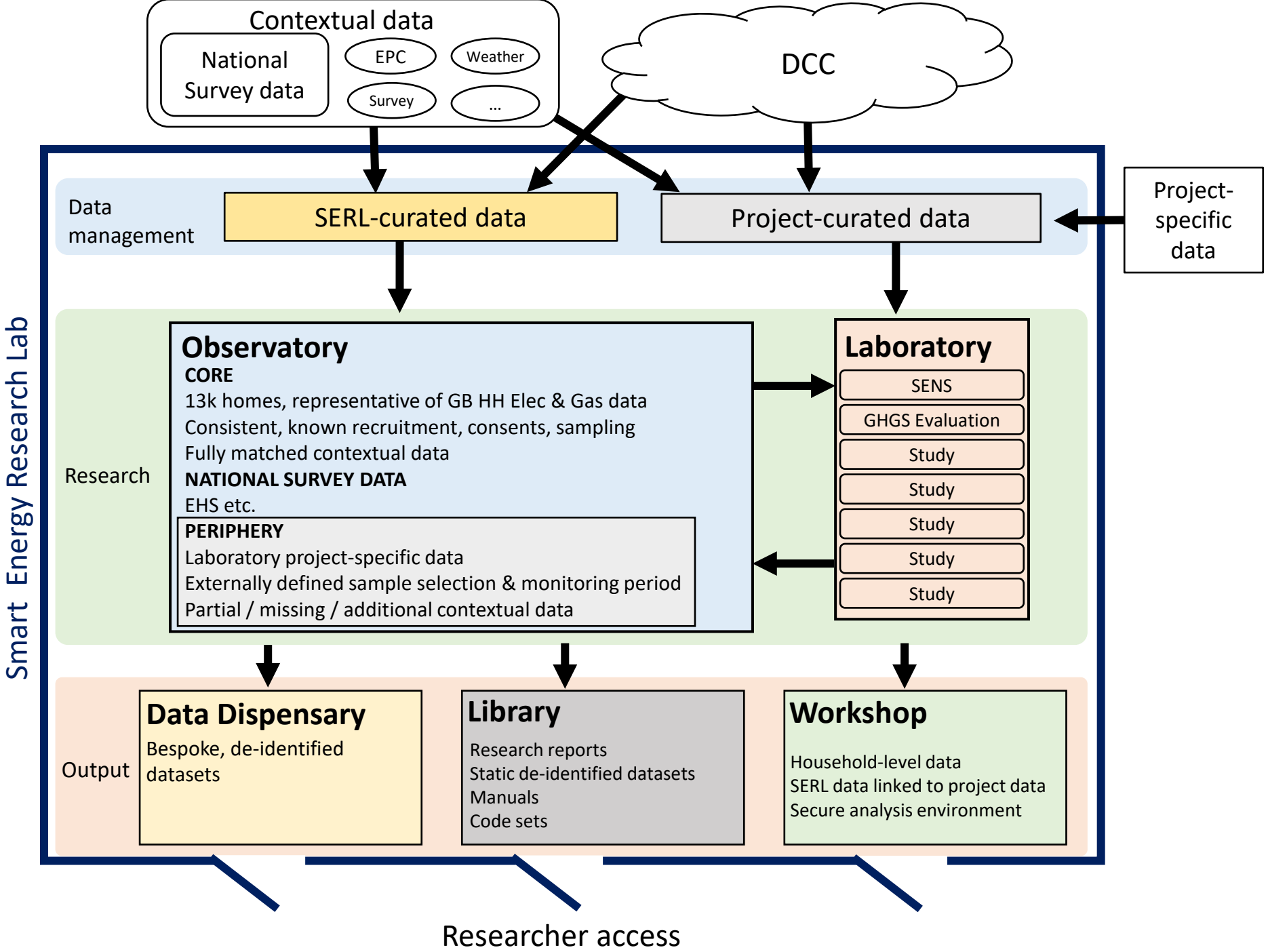
- **A trusted data resource** for researchers to utilize large-scale, **high-resolution energy data**
- An effective mechanism for linking energy data with other **contextual data**:
 - from surveys (e.g. SERL survey, EHS)
 - administrative data (e.g. EPCs)
 - individual research projects (e.g. heat pumps, PV, EV etc)
- **Rigorous data management** to ensure fit-for-purpose data provisioned to researchers



SERL System Diagram



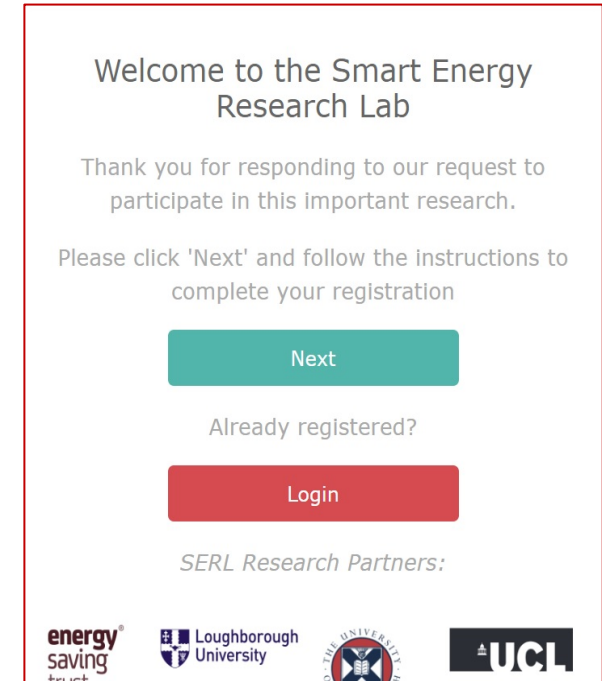
SERL Research Design Framework



Participant Recruitment

Observatory

- Initial target to recruit 10k households to our core Observatory panel
 - Representative of GB households
 - Cold mailing (no names) to households with SMETS2 meters
 - Participants signed up online or by post
 - Actually **recruited over 13k participants**
- Wave 1 (Pilot Phase): Aug-Sept 2019
 - 1700 households recruited. Response rate ~9%
- Wave 2: Aug-Sept 2020
 - 3k participants recruited. Response rate ~6%
- Wave 3: Jan-March 2021
 - 8k participants recruited. Response rate ~9%



Laboratory

- Laboratory projects recruit their own participants and include consent for SERL to collect data

Electricity data

Daily, Half-hourly
All participants (in theory)
Up to 12 months before consent,
ongoing collection

Gas data

Daily, Half-hourly
All participants with a SMETS2 mains gas meter (~70%)
Up to 12 months before consent, ongoing collection

Weather data

ECMWF ERA5 reanalysis data
Hourly, 30km resolution
20+ variables

SERL Survey

~40 questions on the dwelling, and
hhhold. One-off collection on sign-up

SERL Observatory Dataset

Energy Performance Certificate (EPC)

~50% of participants
Sourced from EPC Register

Wave 1 participants (~1700)

- Recruited Aug-Sept 2019
- Data from Aug 2018

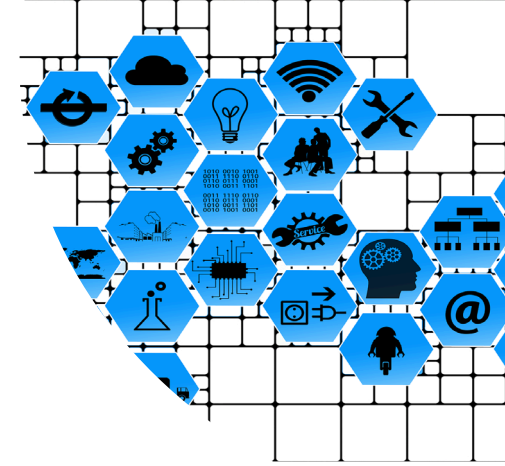
Wave 2 participants (~3100)

- Recruited Aug-Sept 2020
- Data from Aug 2019

Wave 3 participants (~8400)

- Recruited Jan-Mar 2021
- Data from Jan 2020

SERL Data Provisioning



Researcher datasets

- Regular updates (3-6 months)
- Robust data Quality Assurance before release
 - Data QA report, data quality flags/scores, data cleaning processes, derived variables

Observatory dataset: available via UKDS – SN 8666

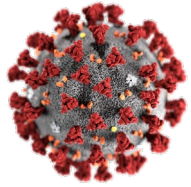
- First edition – released August 2020
 - Wave 1 participants
 - Smart meter data (Aug 2018 to July 2020)
 - Linked to contextual data: SERL survey, EPC, weather (1 variable)
- Second edition – released April 2021
 - Wave 1 & 2 participants
 - Smart meter data (Aug 2018 to Oct 2020)
 - Linked to contextual data: SERL survey, EPC, weather (20+ variables)

SERL Secure Lab environments

- UKDS Secure Lab
- SERL Research Portal (AWS hosted at UKDS)

Example SERL projects

Covid-19 impact on energy consumption



'Smart' EPCs



Annual report



Linking SERL and the English Housing Survey

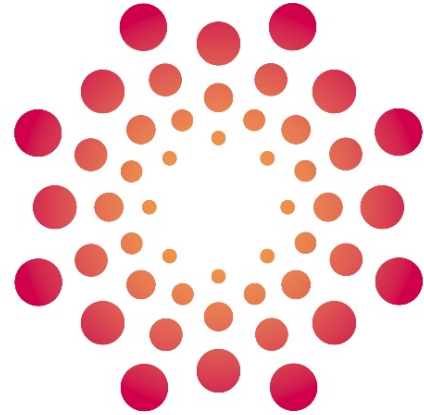


Identifying wintertime comfort in UK Homes (Leeds-Beckett)



Understanding habitual energy consumption (Southampton)

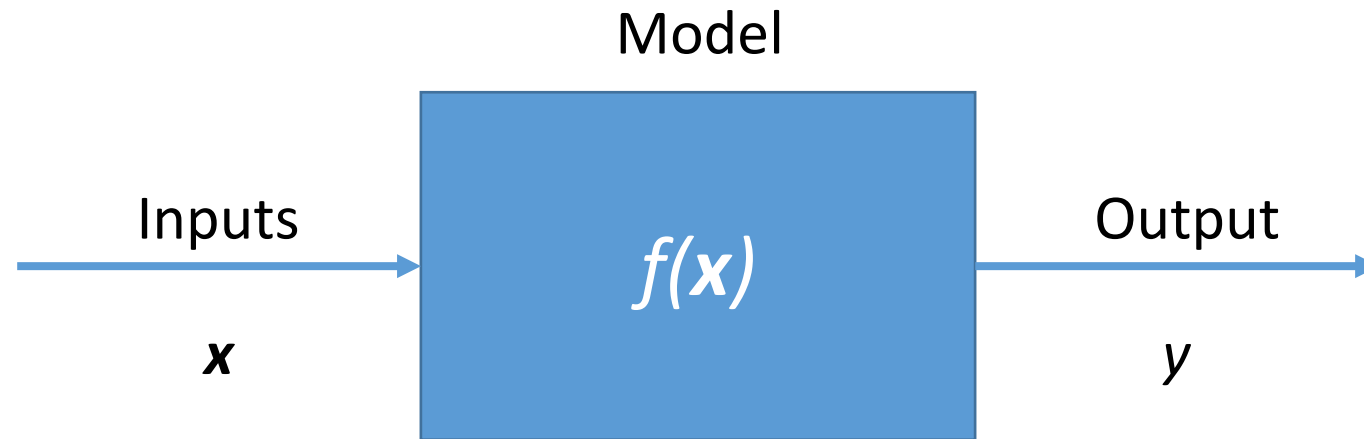




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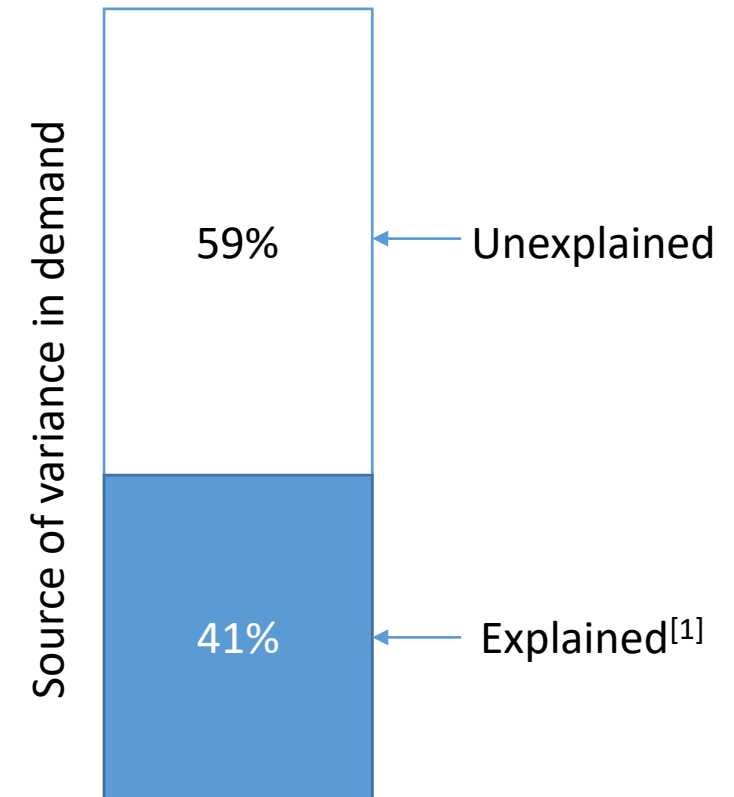
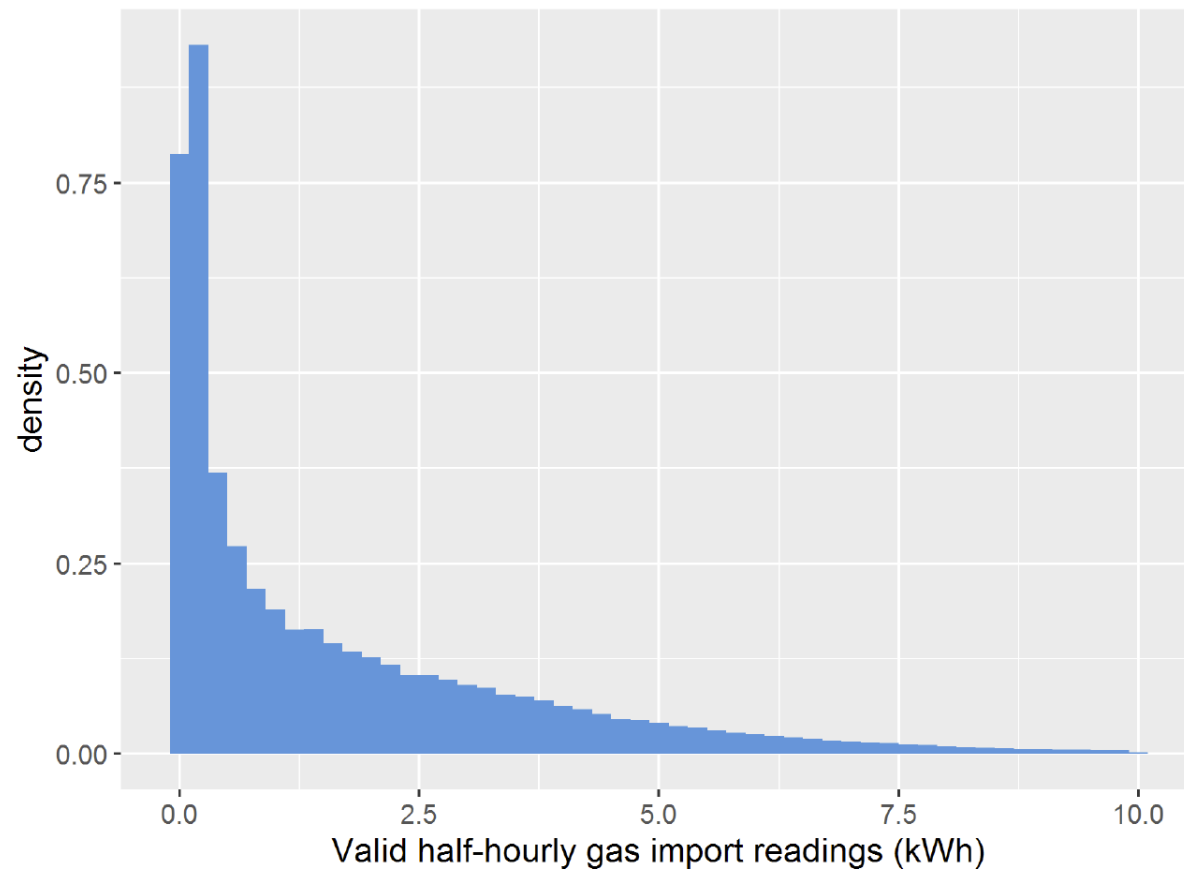
SERL Observatory - Early research findings

Need for characterizations of energy demand in buildings



Importance of (accurate) models

Figure 6: Histogram of half-hourly gas import readings, excluding those flagged as errors. Restricted to readings under 10 kWh but strictly greater than 0, bin width = 0.2 kWh.



[1] Department for Business Energy & Industrial Strategy, NEED Annex C: Predicting gas consumption, 2016. <https://www.gov.uk/government/statistics/national-energy-efficiency-data-framework-need-report-summary-of-analysis-2016>.

Approaches to characterizing energy demand

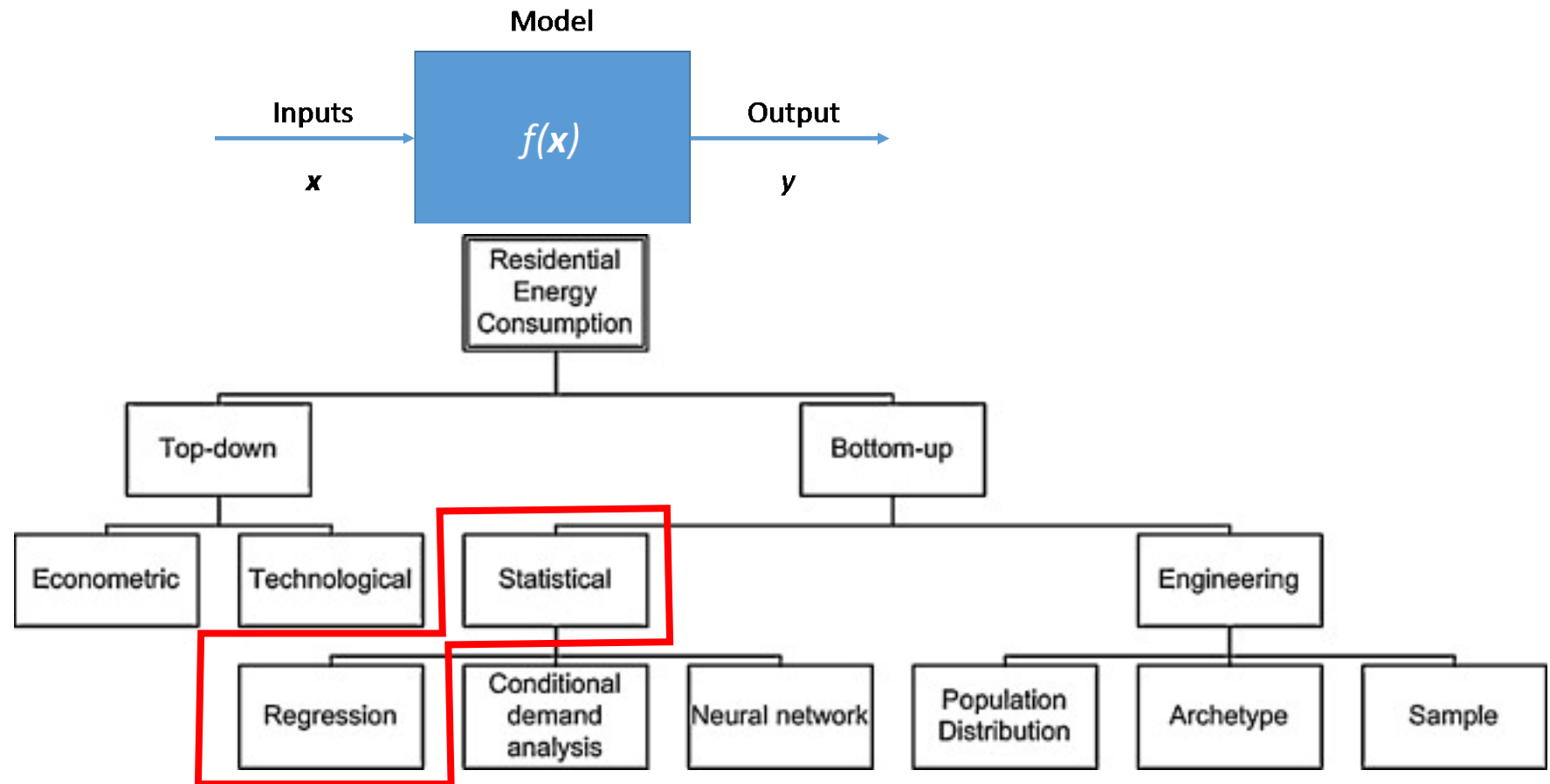
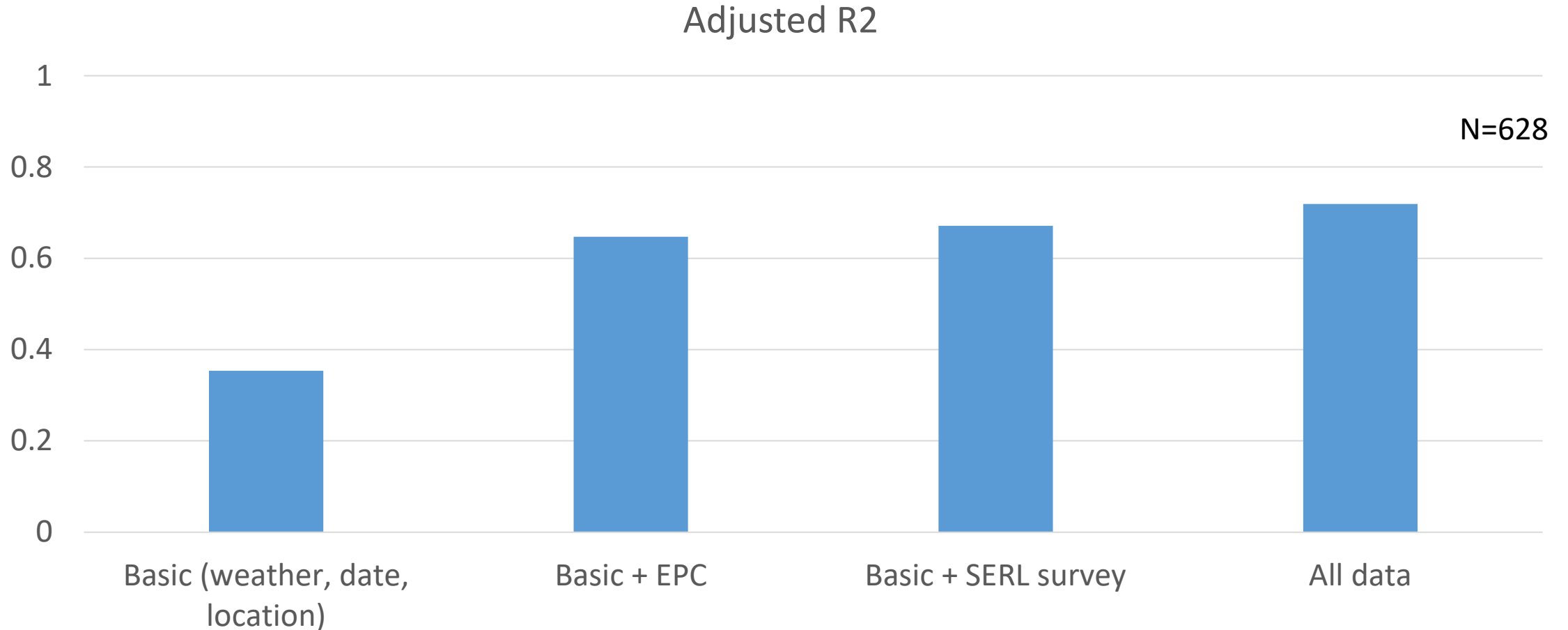


Figure from: Swan, Lukas G., and V. Ismet Ugursal. "Modeling of end-use energy consumption in the residential sector: A review of modeling techniques." *Renewable and sustainable energy reviews* 13.8 (2009): 1819-1835.

Results: explaining energy demand in SERL data



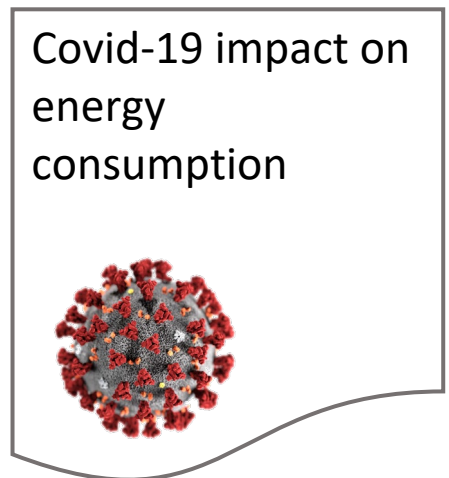
Preliminary analysis – Results are subject to change!

Discussion

- Some caveats
- Explaining over 70% of energy consumption compares very well to previous studies
 - Direct comparisons are difficult as SERL is a unique resource
- Value of bringing together SERL contextual data
- Projects harmonizing with SERL survey in future
- Sources of remaining variability?
- Next steps: advance method, covid-19, wave 3, half-hourly data, tariff, etc.
- Come and contribute to research!

Covid19 Project: short and long term impact of the coronavirus pandemic on domestic energy consumption (GB)

- Collaborative project with CREDS
- Following slides utilise a covid19 survey sent to SERL Observatory wave 1 participants
 - Survey data will be released in a future edition of the Observatory dataset for use in approved projects
- Analysis combining survey data and smart meter data is currently in progress



Covid Research: Working from home – before vs. during lockdown

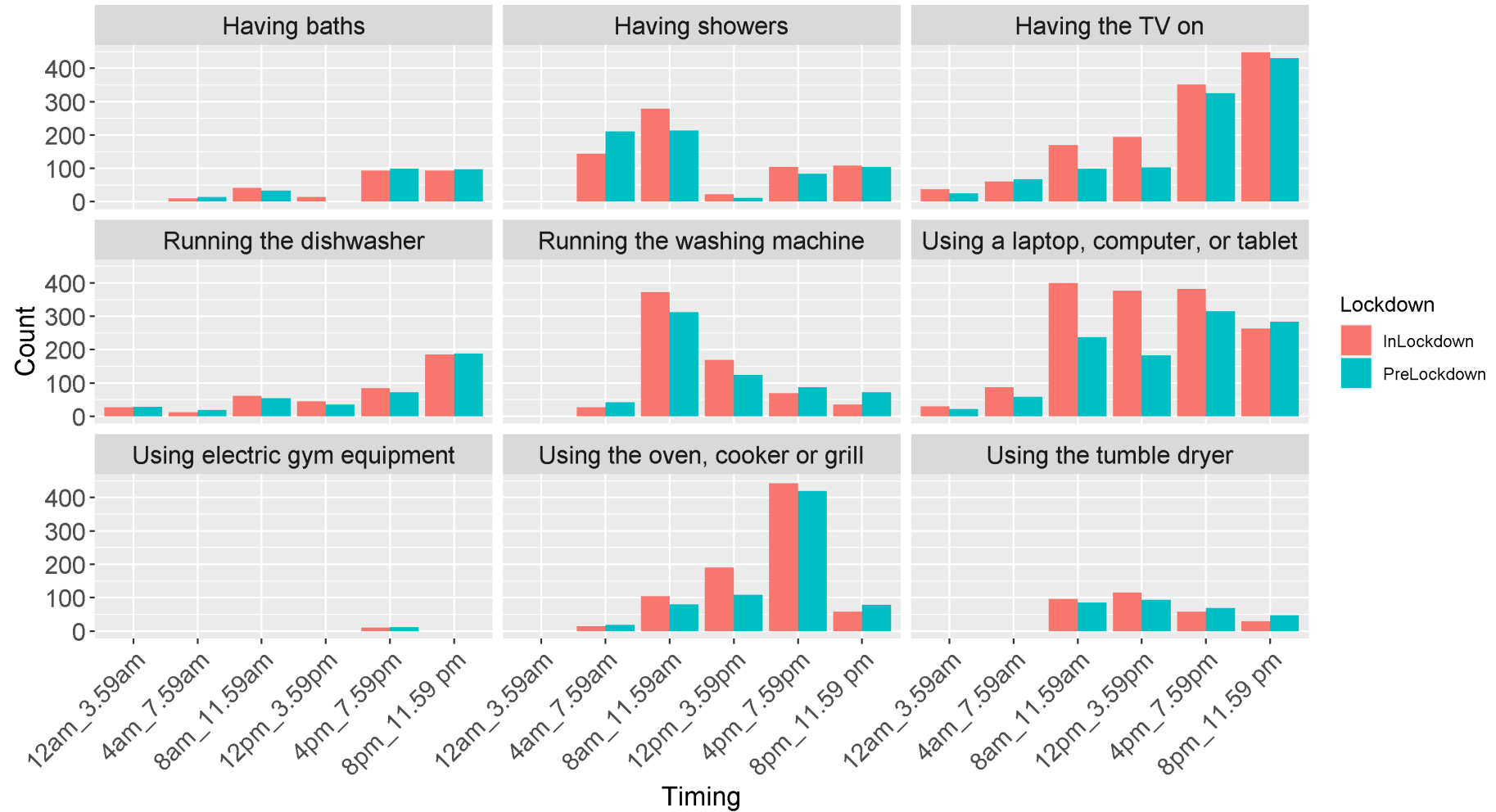


Substantial increase in those always working from home in lockdown.

Preliminary analysis – Results are subject to change!

Covid Research: Timing of Activities

Timing of activities in and before lockdown



Preliminary analysis – Results are subject to change!

Data Governance

Robust Data Governance is absolutely fundamental to the development and operation of the SERL research portal

- **Inbound governance** - Data collected by SERL via informed consent from participants (GB households). Full compliance with GDPR, the Smart Energy Code (SEC) and UCL Research Ethics.
- **Outbound governance** - ensures that only projects approved by SERL's Data Governance Board can access data via a Secure Lab using "5 Safes" protocols.



Accessing SERL data – 5 Safes

Accessing SERL data via a Secure Lab environment:

- **safe people** - all researchers must obtain ONS Accredited Researcher status
- **safe projects** – all projects must be approved by SERL DGB
- **safe settings** – UKDS Secure Lab / SERL research portal
- **safe data** – appropriate for secure lab environment e.g. pseudo-anonymised
- **safe outputs** – via Statistical Disclosure Control



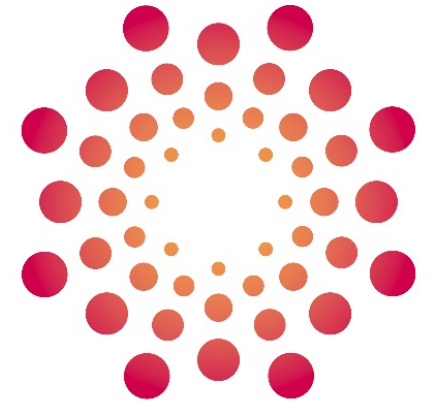
Where are we now (Q2 2021)?

- **SERL is fully operational**
 - Technical infrastructure
 - Collecting and managing data from over 13,000 hholds
 - Observatory dataset available via a secure lab environment
 - Independent Data Governance Board
 - SERL research programme – 8 projects commissioned
 - Initial analysis of the SERL Observatory dataset suggests it is a **valuable evidence-base for research** related to domestic energy consumption
- Next steps
 - Research Portal – ongoing development
 - SERL research programme – ongoing research
 - **SERL DGB – ongoing review of projects applying to access SERL data**
 - Several projects currently in the review pipeline with many more to follow
 - **Additional research project applications encouraged**



Contact information:

- Email - info@serl.ac.uk
- Website - www.serl.ac.uk
- Research and accessing SERL data - www.serl.ac.uk/researchers
- Newsletter - <https://tinyurl.com/SERLUpdate>
- UKDS Study Number 8666 - www.ukdataservice.ac.uk



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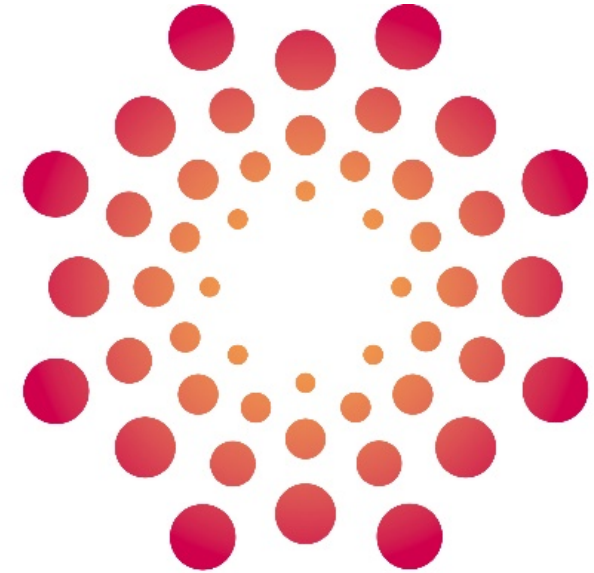
Questions

- Please type your questions into the Q&A area and we will read them out and respond



Acknowledgements

- All work to develop the Smart Energy Research Lab, including this presentation, is supported by an **Engineering and Physical Sciences Research Council (EPSRC) grant - EP/P032761/1**
- There are over 30 members of the SERL Consortium across 8 organisations who have contributed to the development of SERL and thus the content of this presentation



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