



# Using smart meter data to enable energy demand research



## The challenge

Access to high quality, high resolution energy data is critical for research, especially into demand for energy – yet the sector has a severe lack of collected, curated and shared data. Smart meters can fill this gap with high quality, high resolution information about energy consumption which has never existed before on a national scale. Such data will make it possible to carry out better research to support government policy, and to help find answers to the energy ‘trilemma’ – security, affordability and sustainability – and facilitate the transition to a smart energy system in the UK.

## Research examples

The domestic sector accounts for about 30% of total energy demand in the UK, so research into End Use Energy Demand (EUED) in domestic properties is vital for developing robust energy strategies to cover the next few decades. The installation of smart meters into 27 million homes by 2020 will provide data streams that allows researchers and government to identify households in fuel poverty, to find new ways of providing energy advice, to enable accurate characterisation of the energy performance of domestic buildings, and develop new ways of managing energy in the home.

Smart meter data will allow researchers to ask:

- to what extent can smart meter data break down our understanding of end-use energy consumption?
- how much do a building’s fabric and its services affect hourly and daily patterns of demand?
- how do different energy markets affect energy demand?
- how do socio-demographic factors affect demand, and how reliable are models which predict energy demand for different sections of society?

- what effect do smart home technologies such as home energy management systems or smart heating controls have?

Smart meters could also help us move to low carbon, low cost energy systems with improved security. Although this transition will be primarily delivered by government and industry, research with smart meter data can help in developing new ideas, products and services, such as:

- evaluating new tariff structures to assess their impact across different groups of consumers
- analysing the effect of switching suppliers/ tariffs on bills and energy consumption
- the effect of smart energy systems on the health, well-being and comfort of occupants
- optimising demand side response (where customers get financial incentives to lower or shift their electricity use at peak times)



Our vision is to deliver a world leading multi-disciplinary research programme, facilitated by a smart meter data portal. The portal will transform UK energy research through the long-term provision of high quality, high-resolution energy data.

Simon Elam, CEE, UCL on SMRP





## Data and data issues

Smart meters can provide electricity and gas consumption data for individual homes every half hour via the UK's DCC Gateway, and every 10 seconds for electricity via Consumer Access Devices (CAD), such as a display or home energy management system. Other variables, such as tariff and electricity export (e.g. for solar panels) information are also available.

Smart meter data can provide accurate information on consumption recorded by the meter, which will overcome many of the limitations of existing UK energy datasets:

- often only available at aggregated levels, such as geographically to local authority, or temporally, as an annual total. This disguises the diversity of individual energy consumption profiles
- often based on estimated readings
- often processed by data providers in ways that cannot be replicated
- not available in a form that can link energy data to other contextual variables at a household level.

The ability to conduct innovative research is greatly enhanced when energy consumption data can be linked to contextual data from a variety of sources, such as:

- Energy Performance Certificate data, which provides information about property type, size and insulation measures
- the English Housing Survey, which provides information on socio-demographics and a household's energy behaviour
- smart or connected devices that allow remote control and monitoring, such as smart appliances, home energy management systems and other data from the 'internet of things'

### Confidentiality and security

Despite the many potential benefits of using smart meter data, these benefits must be balanced with the need to respect households' data privacy. In the UK, smart meter data is protected by a robust Data Access and Privacy Framework incorporated into legislation via the Smart Energy Code. This means that, beyond monthly data for billing, smart meter data can only be used with the informed consent of the energy consumer.

### See our case studies on:

- Scaling up: digital data services for the social sciences
- Research with household energy data at scale
- Researching the thermal character of UK dwellings

## Our solutions

### Knowledge exchange

From 2015-17, the Smarter Energy Data project funded three workshops in the UK to address the usefulness of smart meter data as well as challenges such as data quality, security and privacy. These were attended by expert practitioners and major stakeholders in academia, government and other sectors. The workshops led to the creation of a UK smart meter data working group to facilitate knowledge sharing and the development of standards, best practices, and other resources related to the use of smart meter data.

Alongside these, University College London (UCL), Essex and five other universities have embarked on an Engineering and Physical Sciences Research Council-funded project to create a [Smart Meter Research Portal](#) (SMRP) to use smart meter data for research.

### Maintaining data privacy

One of SMRP's main priorities is to maintain households' data privacy, so the research portal makes sure:

- data is collected voluntarily - only with the explicit consent of households who have agreed to provide their smart meter data for research
- only accredited researchers will have access to anonymised data using our established 'Five Safes' protocols: safe data, safe projects, safe people, safe settings, safe outputs

### Size matters: handling data at scale

Once smart meters have been installed in all UK homes, they have the potential to generate over a trillion records per year. So, data collection, management and analytical processes must be scalable to meet the challenges of working with data of this magnitude. The UK Data Service's Big Data Hadoop platform provides fast and efficient tools for data exploration, transformation, aggregation and visualisation at scale. The solution offers a flexible and cost-effective infrastructure that links data on physical servers and cloud-based storage. This 'hybrid model' brings robust security but also provides authorised users with a seamless way of accessing data.

Analytical tools integrated into the Hadoop system support multiple querying with R, Python, Scala, and Structured Query Language (SQL), and provide powerful visualisation tools through a standard web browser. For example, Spark provides the engine that uses Map-Reduce technology to process billions of records at speeds unachievable in most alternative computing environments, while complex statistical analysis can be performed using R, SQL-like querying with Hive, and geo-spatial visualisations can be produced with Leaflet.

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