



Expert Workshop

9 December 2015

What can we learn from time-use data in energy research?

This document contains:

- 1) Agenda
- 2) Group work
- 3) Aims of the workshop
- 4) About METER
- 5) Attendees



Agenda

11:00 COFFEE

11:30 WELCOME AND INTRODUCTIONS

Brief introductions all

Introduction to METER Phil Grunewald (ECI)

Balancing and demand modelling challenges Russell Fowler (National Grid)

Policy evidence requirements Michael Harrison (DECC)

12:30 OPEN DISCUSSION

Chair: Judith Ward

What are the main gaps in knowledge on electricity use?

Introduction of Group Work 1

13:00 Lunch

13:30 GROUP WORK 1

Top priorities for time-use data in energy research (see p.4)

Walk in the park (optional)

Feedback

15:00 Tea

15:30 DISCUSSION

Chair: Joanne Wade

“Examples of current ‘Big Data’ usage” David Wallom (OeRC)

“Are we clear on the meaning of these data?” David Shipworth (UCL)

16:30 GROUP WORK 2

How to address the top research priorities with new data (see p.5)

Feedback

17:30 CLOSING REMARKS AND DRINKS

18:00 DINNER

Turl Street Kitchen, 16 Turl St, Oxford OX1 3DH

Attendees



Adam Cooper	UCL
Ben Anderson	Southampton
Catherine Bottrill	Pilio
Charlie Wilson	UEA
David Wallom	OeRC, Oxford
David Shipworth	UCL
Davide Zilli	Engineering, Oxford
Eoghan McKenna	Loughborough
Freya Stanley Price	Energy Network, Oxford
Jacopo Torriti	Reading
Jason Palmer	CAR
Jim Watson	UKERC
Joanne Wade	ACE
Judith Ward	Sustainability First
Lewis Knight	Bioregional
Lina Stankovic	Strathclyde
Matthew Leach	Surrey
Michael Fell	UCL
Michael Harrison	DECC
Mim Saxl	AgileOx, Oxford
Murray Thomson	Loughborough
Nick Eyre	ECI, Oxford
Phil Grunewald	ECI, Oxford
Rob Gross	Imperial College
Robin Morris	LCEO
Russell Fowler	National Grid
Russell Layberry	ECI, Oxford
Sam Hampton	ECI, Oxford
Sarah Higginson	ECI, Oxford
Stella Chatzitheochari	Warwick



Top priorities for time-use data in energy research

GROUP WORK 1

High level group discussion of where the combination of time-use and energy consumption research could have impact.

Themed tables provide some guidance for possible topics. You are free to move between tables during the session. The topics are merely a starting point and should not be seen as restrictive to the conversation.

Each table is invited to explore the top research priorities from one of these perspectives:

1) ENERGY SYSTEMS

Relationship of DSR with other sources of flexibility, like storage.
Efficiency vs. flexibility?
Peak demand, capacity margins and long term planning.
Importance of heat / transport
Markets, business models, regulation

2) SOCIETAL

Understanding fuel poverty.
Trends in energy use, emergence and impact of new practices.
Origins of and limits to flexibility.
Relationship between health and energy use.

3) ACADEMIC

What advanced are possible for sociology / time-use research?
Where can energy research agenda be advanced?
Are there other disciplines that should be involved?

4) OTHER

Don't agree with the other themes?
Make up your own.

The 'walk in the park' isn't really optional, but highly encouraged. As soon as you identified a topic to 'run with', please leave the building and go exploring in small groups. Each group should give a brief summary of their discussion on their return.

How to address the top research priorities with new data



GROUP WORK 2

This is a more 'hands on' session than the high level discussion in Group Work 1. Again, we will split onto tables with the option to move between tables at any point.

Bearing in mind the 'top-priorities' you discussed in the first group session, what needs to be done in practical terms to address them?

Each table has a theme and could address some of the following issues:

1) DATA

Draw your dream graph. What data does it require?

How do the data need to be structured to suit your needs?

What mustn't be missing?

2) DEMOGRAPHICS

Who should be in the sample?

How best to find/incentivise them?

What to ask them (to make sure we found them)?

3) APP DEVELOPMENT

No coding skills required!

Try out app prototypes on paper.

Draw your own screen interfaces.

What would you ask, how and when?

4) OTHER

There is always an 'other'. Has something come up during the day that you have an urge to follow up on? Do it at this table. You can also withdraw to other rooms.

Please help our facilitators by leaving plenty of notes on the sheets of paper on each table, to capture your ideas and discussion points.



About METER

Measuring and Evaluating Time- and Energy-use Relationships (METER) is a new five year EPSRC fellowship with the aim to better understand electricity use in UK households.

The proposed approach is to collect time-use information from household members, while taking readings from the mains electricity meter every second.

Innovative features of this approach include:

Scale - Thousands of households will be captured. This is an order of magnitude more than previous studies of this kind. The scale allows for statistically robust analysis to inform policy.

Technology - Smart Phones make data collection at this scale possible. Participation is less burdensome, more targeted and significantly cheaper than conventional instrumentation methods.

Perspective - Activities are a new lens through which to observe electricity use. While 'appliances' are commonly seen as the locus of electricity consumption, focussing on activities could provide a richer understanding of energy services and their shifting potential.

METER seeks to develop a robust evidence base for the relationship between household activities and electricity use, especially during peak demand periods.

Workshop Aims



1. Develop a shared understanding of the gaps in knowledge on household electricity use
2. Identify and discuss opportunities for using METER data
3. Ensure METER data is collected in accordance with the best available knowledge and for the benefit of a wide group of stakeholders

POSSIBLE DISCUSSION POINTS

Additional data: METER will collect electricity, activity and socio-demographic information at household and individual level. What additional information should be collected or measured? (e.g. attitudes, temperature, light level, GPS....)?

Validation: Self reported activities are prone to numerous errors and systematic biases. How should these be dealt with?

Related Research: A better understanding of household activities in relation to energy could be relevant to many other disciplines, including health, social or architecture. What considerations should be taken to make the data widely useful?

One day sampling: Time-use surveys traditionally only collect one day of diary information. This keeps participant burden and fatigue low. However, events with frequencies of less than one day can be systematically missed, regardless of sample size. These could include washing, laundry, shopping and many other important activities. Should sampling be extended beyond one day?

Practices: The process is intended to be 'light touch' and therefore different from in-depth studies required to understand the practices involved. Could appropriate contextual questions provide useful information on social practices?



The Process

REGISTRATION

Prospective participants register with their email address at energy-use.org. For prioritisation purposes they can declare ownership of PV, EV, electric heating and other appliances that could make them high peak-time users.

HOUSEHOLD INFORMATION

A few weeks before the diary day the registered contact person for each household receives an email to complete an online form, providing information on behalf of the household on

- Household size and composition
- Information about the building
- Appliance itinerary
- Electricity use habits (e.g. dishwasher runs per week)

Take part | Energy Use
www.energy-use.org

METER
Energy-use.org

TAKE PART

First name:

Surname:

Email:

Do you have any of the following?

Electric Vehicle (with home charging)

Photovoltaic panels

Power shower (electric shower)

Heat pump (air source)

Heat pump (ground source)

Electric storage heaters

REGISTER

Online Registration

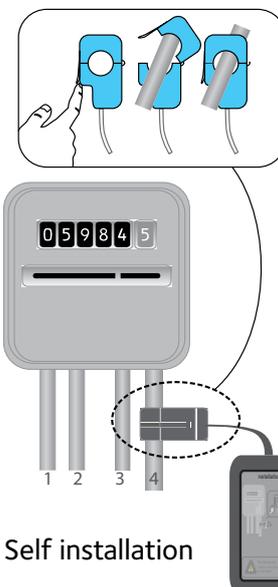
MEASUREMENT EQUIPMENT

A few days before the diary day, participants receive a parcel with an electricity recorder (eMeter) and electronic diaries (eDiary) for each household member.

The eMeter can be self-installed under the mains electricity meter, and will automatically take readings on the diary day only. The user does not have to interact with the device. It contains no buttons or displays, and requires no set-up.



eMeter



Self installation

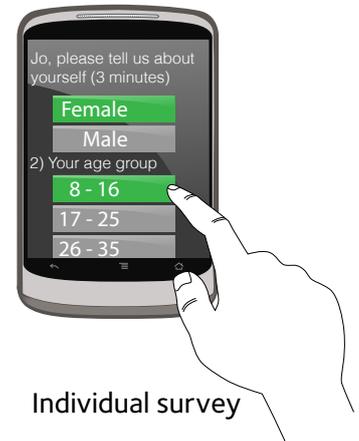
The Diary



INDIVIDUAL INFORMATION

On start-up the eDiary displays an introduction screen with optional tutorial videos. Before the user can start the diary a consent screen has to be accepted. Questions about gender, age, occupation, working habits, and their most commonly used appliances pop up during the day.

QUESTION: Should attitude questions be included?



Individual survey

DIARY COLLECTION

On the diary day the eDiary poses the question “What are you currently doing” based on the following trigger conditions:

- random timing while participant is active
- participant is at home (in range of the eMeter)
- eMeter detects high or characteristic load profile
- national load is high (e.g. 5-7pm on winter weekday)

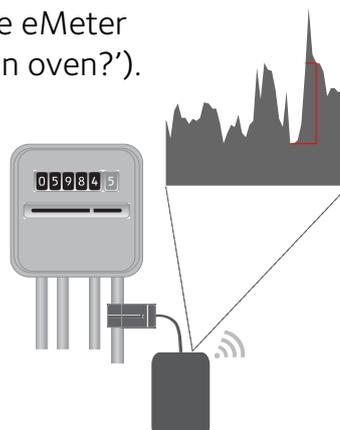
If participants aren't able to respond at the time, the query is held: “What were you doing XX minutes ago”.

To allow for response with minimum effort, a short-list of the most probably activities is presented, as well as a ‘free text’ field. Activity probabilities consider

- activity distribution in the 2015 time-use survey,
- sequence probability based on recent entries (e.g. ‘eating’ follows ‘meal preparation’),
- idiosyncratic activities based on the individuals information (e.g. occupation), and
- load type disaggregation at the eMeter (e.g. ‘Are you currently using an oven?’).



Activity collection



Appliance check



Additional information

SUB-QUERIES AND INFERRED INFORMATION

Certain activity selections can trigger follow-ups. For instance, tapping 'meal preparation' will open a screen: 'With hob / microwave / kettle / other / no appliances'.

The devices allow for additional information to be inferred, such as

- eDiary acceleration sensor: 'being active'
- Signal strength between eMeter and eDiaries: 'being at home'
- Signal strength between eDiaries: 'being together'
- While making an entry, the camera can take light level / light temperature readings (differentiate natural / artificial lighting)
- GPS signal can be used for location and infer 'mode of travel'

Questions: Should more be done to justify inferences? Should GPS be recorded?

DEMAND RESPONSE EVALUATION

At a later stage during this project, when a sufficient baseline of activity based electricity use has been established, a randomised controlled experiment will be incorporated into the eDiary process.

Here participants will be asked to make changes to their 'normal' activities.

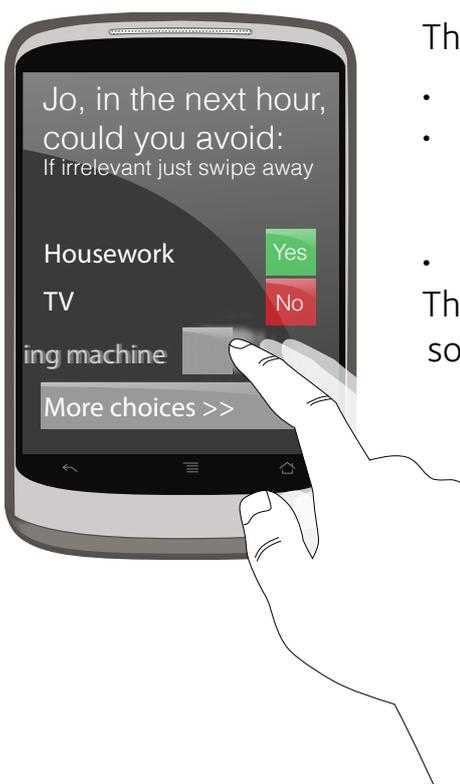
The change request can be based on

- Electricity: 'Try to use less electricity'
- Activity: 'Try to avoid doing X'
'X' can be informed by their own inputs, or
'Could you take a break at this point?'
- Practices: 'Could you avoid food preparation/housework...'

The requests can ask for an immediate response, or give some warning (1/4/24 hours or even days ahead).

The following 'incentive' types could be tested:

- financial incentive:
'Earn/win a £2/£20 Highstreet voucher'
- social nudge:
'80% of our participants were able to do it'
- plea:
'We are experiencing an exceptional situation'



Participant feedback



RETURNING DEVICES

After the collection day the devices are returned in a pre-paid envelop. Data is stored locally on the devices and extracted on return, before recharging and re-deploying the device.

FEEDBACK FOR PARTICIPANTS

Participants receive their personal annotated load profile for the day, highlighting some of their reported activities and periods of occupancy.





Key Questions

The combination of household, individual, socio-demographic, activity and electricity use data enables a range of analytical work. However, by formulating some specific research questions this workshop will help to ensure that the data is collected in the appropriate manner.

Key questions could include:

- What is the distribution of activities during peak demand periods and how do they correspond to electricity consumption?
- Can existing attempts to cluster socio-demographic electricity user types be confirmed or refined?
- What activity substitutions occur during demand response events?
- Do particular user types or activities lend themselves to load shifting?
- What mechanisms are most effective at delivering load shifting?

Questions:

Is the methodology fit to address these questions?

Are these the right questions?

STEERING GROUP

Russell Fowler, National Grid
Jim Watson, UKERC
Jacopo Torriti, University of Reading
Catherine Bottrill, Pilio
Chris Wright, Moixa Technology
Kajsa Ellegård, Linköping University
Lewis Knight, Bioregional
Sarah Darby, University of Oxford

FACILITATORS

Freya Stanley Price
Mim Saxl
Sam Hampton
Davide Zilli