Household Electricity Survey

Data Briefing

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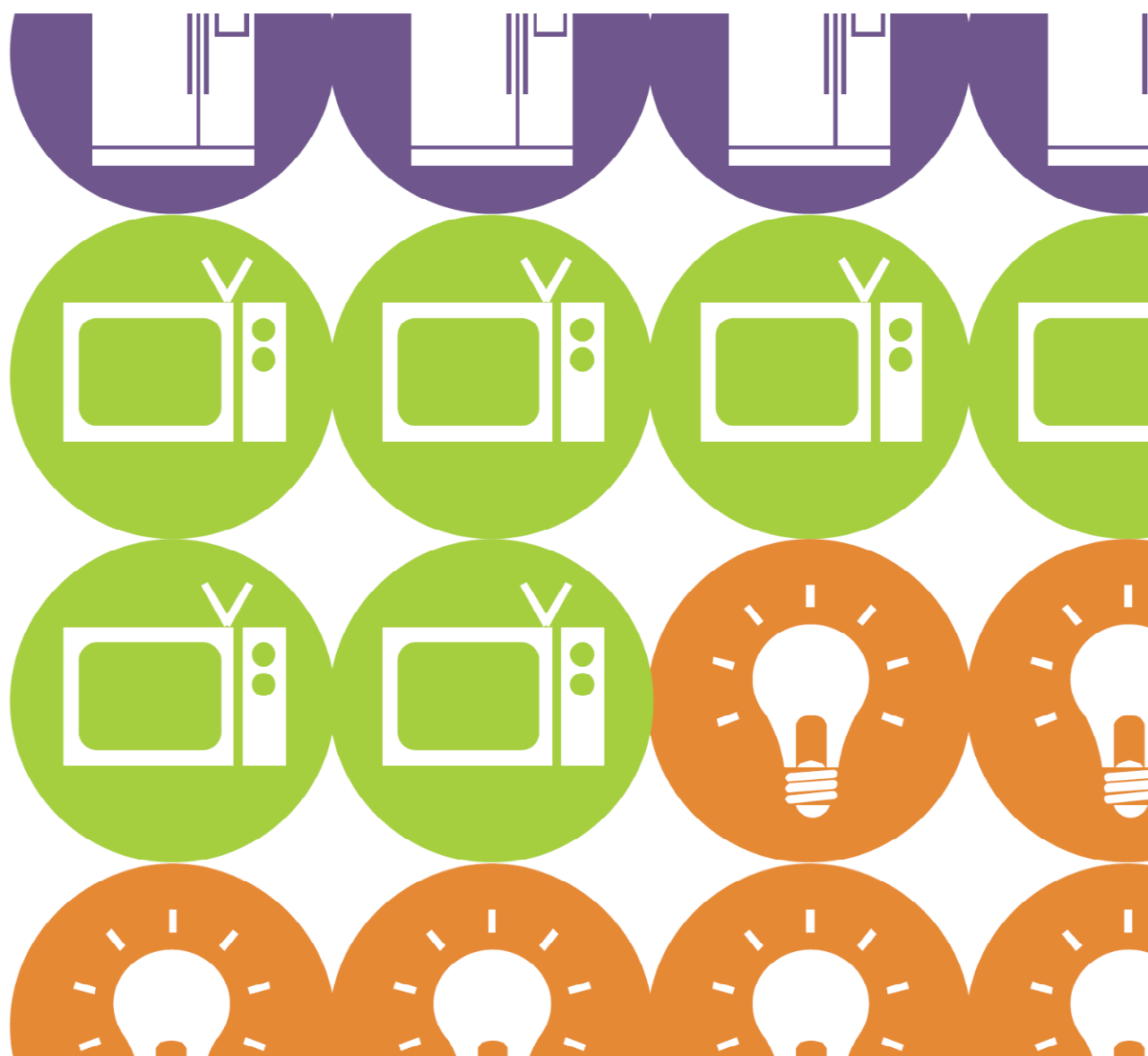
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Introduction

The Household Electricity Survey monitored a total of 250 owner-occupier households across England from 2010 to 2011. Twenty-six of these households were monitored for a full year. The remaining 224 were monitored for one month, on a rolling basis throughout the trial.

Participants kept detailed diaries of how they used certain appliances, which can be matched against actual energy use monitoring for their homes. They had between 13 and 85 appliances in their homes, with about a third of households owning between 30 and 40 appliances.

This data offers an unparalleled source of very detailed electricity profiles. It has already provided unmatched insights into the way electricity is used in English homes. However, there remains considerable potential for doing more with the data – which is why DEFRA and DECC are making it available to third parties for further research.

Cambridge Architectural Research was the first organisation independent from the data-collection team that tried to make use of the HES data to answer research questions. Our first report was published on DECC's website here (others will follow):

https://www.gov.uk/government/publications/early-findings-demand-side-management

This report summarises what we learnt about the data as we tried to get to grips with it. Our experience was that it was not structured to make life easy for third parties, and annotations and explanations could have been much better. This meant it was time-consuming to start understanding and using the data. This report should make it easier for others to follow in our footsteps.

The report is structured as a table, with the left-hand column giving the name of different files, and the right-hand column giving a description of each file. Important files are listed bold in the table.

Table listing HES files with a short description

File	Description
appliance_attributes.csv	This has two rows defining attribute names. It is unclear why this file is needed because the names seem to be unused elsewhere.
appliance_data.csv	This has details of some of the appliances which were monitored by household: energy rating, size, manufacturer and so on. There are about 4500 rows, but not all appliances are recorded. In some cases there are several appliances relating to the same energy use profile – such as for audio-visual sites and for computer sites. This is because there are several appliances plugged into he same socket and monitored together.
appliance_date_periods.csv	We inferred that this gives earliest and latest dates for when appliances were monitored – by appliance code (as in appliance_codes) rather than by household.
appliance_group_data.csv **(split into Agd-1a, Agd-1b, Agd-1c, Agd-1d, Agd-2, Agd-3)**	This massive (7.4 GB) file contains all the profile data – both for energy use and temperature. There are roughly 250 million data points. **IntervalId** is a code for 2/10 minute profiles– see interval_ids. **Household** is the household id **Appliance** is the appliance code (see appliance_codes) **DateRecorded** is a date. **TimeRecorded** is the time since midnight **Data** is the value (an integer). For energy profiles this is in tenths of a Watt-hour (Wh). For temperature profiles this is in tenths of a degree.
Appliance_groups.csv	This defines 56 codes for different appliance types. This is only needed to interpret ipsos_non_tabular.csv
appliance_codes.csv	This defines the codes used for different appliances. For example 0 is an upright freezer, 2 is a chest freezer. Since households often have more than one appliance of the same type – two chest freezers for example – there are several codes for chest freezer 1, chest freezer 2 etc. Note that 251 to 255 are temperatures, rather than energy profiles. Also sockets 1 to sockets 11 are circuits monitored at the consumer unit, which feed wall sockets around the dwelling. Main 1 and main 2 are mains readings. (Mains readings are not included for all households.)
appliance_type_codes.csv	This defines names for the appliance types: cold appliances, lighting, ICT etc. It maps the type code to the type name.
appliance_types.csv	This defines the mapping between appliance codes and appliance types.

File	Description
diary_hob.csv, diary_oven.csv, diary_tumble_dryer.csv, diary_washer_dryer.csv, diary_washing_machine.csv	These files have the diary data that was filled in for households' use of certain appliances. Most households completed diaries for two weeks.
interval_groups.csv	Defines codes used in appliance_group_data 1= 2 minutes for approximately one month (most households) 2 = 2 minutes for approximately two months (for the households which were monitored for a year, one month of that was in two-minute intervals). 3 = 10 minute-intervals (for the households which were monitored for year, this is the bulk of the data).
ipsos.csv	This has a large number of fields relating to demographic and household characteristics, including: • Flags for household type (so a household can technically have several types e.g. MultiplePensioner and MultiplePersonWithNoDependentChildren • Counts for various types of appliances • Household age • Working status • UKHES code • Answers to the environmental attitude questionnaire.
ipsos_non_tabular.csv	CAR has not used this so far in our analysis, but this seems to list how many appliances there were for each household/group combination.
monitored_appl.csv	CAR has not used this so far in our analysis, but this seems to list which appliances were monitored in each household: i.e. household/appliance/intervalid combinations also with group information.
monitored_appl_energy_efficiency_rating.csv	This defines the energy rating codes and the colours to draw them in.
rdsap_data.csv	This table has a large number of fields describing each dwelling, including the terrain type and heating type. It has the main inputs for carrying out a 'Reduced Data [calculation] for the Standard Assessment Procedure', which is used to estimate energy use of homes under standardised patterns of use.
rdsap_date_ranges.csv	Defines the codes for the household age in rdsap_data.
rdsap_dimensions.csv	We inferred this has area and height for each floor of each dwelling.
rdsap_energy_efficiency_rating.csv	Defines the energy ratings, as estimated in Reduced-data SAP.
rdsap_glazing_details.csv	We inferred this has details including area and glazing type of every window in each property.

File	Description
rdsap_glazing_types.csv	Defines codes for glazing type (not used in rdsap_glazing_details).
rdsap_insulation_thickness.csv	Defines codes for insulation thickness.
data_fixes.csv	This is a list of profile code changes which we applied to the original data to correct errors we discovered[1]. The 'Diagnose' field can be: • Profile: the profile data was not consistent with the original code, usually they were remapped to something less specific • Appdata: the code was inconsistent with the description in appliance_data.csv Also the To field was not always a code number. It can also be: • delete – profile deleted (not used or duplicate) • cap1000 – profile processed to remove spikes.
Total_profiles.csv	The profile data does not include mains profiles except for a very few households, and also there were distribution circuits that were not monitored. By analysing the known appliance use and comparing this to the sockets we determined as far as possible which appliances were not monitored at the circuit level. This file contains a list of profiles for each household which need to be added together to obtain total electricity consumption. (In some cases we disregarded mains or socket profiles because they appeared implausible.)
Seasonality_factors	We used the households monitored for a year to define 'seasonality factors' for each type of appliance – for example lighting is used more in the winter, and cold appliances use more energy in the summer. This file has a seasonality factor for each day and appliance type describing how to factor up or down the energy use from one month to other months of the year. We used this to estimate annual consumption for each appliance from the monthly households. Sum the energy use on each day and divide by the seasonality factor to get an adjusted day total, then the average of these x 365 gives a year's usage. The seasonality adjustment is subject to considerable uncertainty, and for this reason we recommend using the unadjusted monthly consumption data wherever possible.

Units

All measured electricity use data is presented in dWh, 'deci-Watt hours' over the interval, or 0.1 Wh. To convert to W, multiply by x 0.6 for 10-minute intervals, or by 3 for 2-minute profiles.

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[1] See CAR (2013) Household Electricity Survey: Cleaning the Data. Cambridge: Cambridge Architectural Research Ltd.