Sustainability *First*

GB Electricity Demand – *realising the resource*

DECC Electricity Demand Data Sources – Summary Note

by Richard Hoggett. Associate Research Fellow.
Energy Policy Group, University of Exeter.

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Preface

Paper 2 'GB Electricity Demand 2010 and 2025 - Initial Brattle Electricity Demand-Side Model : scope for demand reduction and flexible response'[1], was published by Sustainability First in February 2012, as a part of the ongoing work programme for the GB Electricity Demand project.

As background to the Brattle model, Sustainability First commissioned Richard Hoggett, Associate Research Fellow in the Energy Policy Group, University of Exeter, to produce a short overview of official UK electricity demand statistics.

Official statistics relating to UK electricity demand data draw on a number of different data sources: data on electricity actually supplied ; and electricity consumption data derived from models. In developing the Brattle model, we wished to be clear as to which model inputs derive from actual consumption data – and which from modelled data. Hence this Summary Note.

Other publications from the GB Electricity Demand project to date include:

- **GB Electricity Demand – Context and 2010 Baseline data** (October 2011)[2].
- **GB Electricity Demand – 2010 and 2025. Initial Brattle Demand-Side Model – Scope for Demand Reduction and Flexible Response** (February 2012).

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[1] 'GB Electricity Demand – 2010 and 2025. Initial Brattle Electricity Demand-Side Model - Scope for demand reduction and flexible response' (2012) Serena Hesmondhalgh, The Brattle Group. Available from: http://www.sustainabilityfirst.org.uk/gbelec_documents.html
[2] Available from http://www.sustainabilityfirst.org.uk/gbelec_documents.html

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Introduction

The following summary is based on information from DECC, BRE, Cambridge Architectural Research, Office of National Statistics and Defra's Market Transformation Programme. It is based on the notes used within the Digest of UK Energy Statistics (DUKES) and Energy Consumption within the UK (ECUK) and their supporting documents, as well as conversations with key staff from some of the organisations named above.

1. DECC Electricity Datasets

1.1 Publications

- Energy statistics are produced on a monthly, quarterly and annual basis, with demand reconciled with supply through the production of quarterly and annual energy balances.
- Annually the following publications are produced:
    - DUKES (and long term trends online only)
    - ECUK
    - Energy sector indicators
    - UK Energy in Brief
- Quarterly:
    - Energy Trends
- Monthly:
    - Energy Trends (online only)

Only DUKES and ECUK have been used for this briefing, as DECC state that monthly and quarterly data is ultimately reconciled against the annual data-sets.

1.2 Data Collection Sources

Detailed information on how DECC collect data is provided within the explanatory notes of DUKES[3] as well as an undated DECC publication 'Energy Statistics – data sources and methodologies'[4]. The following section summarises the data collection process.

On an annual basis DECC collect data (a year in arrears) via three electricity surveys:

- Major Power Producers (MPPs) Survey (all major companies whose prime purpose is the generation of electricity) – 35 in total (covering 90% of generation), includes fuel used, electricity generated, net electricity supplied to grid, own use of electricity, sales and capacity (broken down by fuel type);
- Electricity Suppliers Survey – 30[5] in total (covering 95% of electricity sales[6]), with data split by SIC[7] codes;
- Electricity Distributors Survey – 13 in total (excludes Scotland), recording quantity of electricity distributed and losses.

[3] DECC (2011) Digest of UK Energy Statistics, July 2011 – (paras 5.88 to 5.95)
[4] DECC (undated 1) Energy Statistics – data sources and methodologies.
[5] DUKES states the number is 30, although correspondence from DECC suggests it goes to 37 companies.
[6] A communication with DECC suggest the remaining 5% of sales is balancing adjustments.
[7] Standard Industrial Classification.

The annual data inquiries used by DECC include a range of questionnaires that are set to different companies, they are provided within the Annexes of DECC (undated 1). They are summarised in the table below.

Survey	**Annex in DECC (undated 1)**	**Sent to**
Annual Generation	Annex 1	MPPs[8]
Annual Fuel Used	Annex 2	MPPs
Annual Sales	Annex 3	Licensed Electricity Suppliers Companies (and MPPs if they sell electricity)
Annual Distribution	Annex 4	Electricity Distributors
Annual Capacity	Annex 5	MMPs

Additional annual data sources include:

- Autogenerators Survey – based on a sample of 100 (covering around 10% of generation) and including: fuel used; electricity generated; electricity transferred to grid; electricity consumed in generation; electricity consumption; and capacity (broken down by generation type/fuel and industrial sector)[9];
- Iron & Steel Statistics Bureau (ISSB) – sample size not stated, but covering electricity generated, consumed and lost by the iron and steel industry, blast furnaces and coke ovens[10];
- AEA Technology/RESTATS – renewable (inc co-firing);
- DECC annual internal analysis (calorific values and conversion factors);
- British Energy – average thermal efficiencies for nuclear electricity;
- National Grid – electricity imports/exports from/to France;
- Single Electricity Market Operator – electricity imports/export from/to the Republic of Ireland;
- Elexon – transmission losses and generation data for GB National Grid;
- Ofgem – distribution units and loss percentage summary.

The ISSB survey provides electricity consumption for the iron and steel sector and these figures are used for consumption within DUKES, rather than the information supplied by the electricity suppliers. DECC state that this is because electricity suppliers tend to over-estimate their sales to this sector by including some companies that use steel rather than manufacture it (the difference between the ISSB and electricity suppliers figures are re-allocated to other sectors).

For autogenerators[11] a sample survey is also carried out through a quarterly inquiry commissioned by DECC but carried out by the Office for National Statistics (ONS). Where

[8] Definition of MPPs was amended in 2008 to include major wind farm companies – applies to data from 2007 onwards – before this they were included as 'other generators'.

[9] Available in Annex 1 of http://www.decc.gov.uk/assets/decc/Statistics/source/electricity/371-other-electricity-statistics-methodology.pdf

[10] This is available from DECC on request.

[11] Companies who produce electricity as part of their manufacturing or other commercial activities, but whose main purpose is not electricity generation – classified as 'other generators' within DUKES tables (other generators also covers generation by energy service companies at power stations on an industrial or commercial site where the main purpose is the supply of electricity to that site, even if the ESCO is a subsidiary of an MPP).

autogenerators operate a combined heat and power (CHP) plant, this survey is supplemented (on an annual basis) by information from the CHP Quality Assessment scheme. There are two areas of autogeneration that are covered by direct data collection by DECC, mainly because the return contains additional energy – these include the Iron and Steel industry, and generation on behalf of London Underground.

DECC DUKES (2011) also indicate that a further means for checking electricity consumption data is now being employed on data for 2006 and subsequent years. This seeks to validate the consumption data using information on sectors from EU-ETS sources, although the figures are not used directly in the allocation because not all electricity use is recorded by the EU-ETS as some companies are not signed up to the scheme.

In addition to all the above sources, some administrative data is used for renewable generation and capacity in the hands of non MMPs, this includes data from the Renewables Obligation and Feed in Tariff schemes.

DECC also collect monthly and quarterly data for Energy Trends – this uses a similar approach to that set out above, although the monthly and quarterly surveys forms are much simpler than the annual inquiries. More information is available in DECC (undated 1)[12].

1.3 Annual Electricity Demand Calculations

Demand is split into that which is supplied via the PDS[13] and other generators, and includes final consumption by sector (industry, transport, domestic, commercial, agriculture, public administration and miscellaneous), as well as losses and energy industry use. The following process is used, based on DECC (undated 1):

PDS Sales (data from MPPs/electricity suppliers' survey)

- The survey collects data over 9 sectors with total of 33 subcategories based on SIC codes – industrial (16); commercial (5); transport; agriculture; public lighting; public administration; energy industries (5); domestic (5 – tariffs); other sectors (3).
- This sales data is checked against monthly returns, collated and then aggregated to sectors.
- For domestic sales the figures are broken down by tariff type, rather than by units consumed at peak/off-peak times.
- AN1 described in the footnotes of the survey (see Annex 3 in DECC's 'Energy Statistics – Data source and methodologies', undated 1) refers to a paper entitled 'narrative description of market sectors used on the annual electricity questionnaires'. This sets out for suppliers an overview of the headline SIC codes for each sector and subsector (worth clarification[14]). Further information on AN1 is provided under section 2.2.1 below.

[12] DECC (undated 1) Energy Statistics – data sources and methodologies.
[13] Public Distribution System.
[14] It would be worth clarifying with suppliers their knowledge of the SIC codes and how they allocate end use sales to the correct headline SIC code.

Other Generators' Consumption
- Electricity consumed by autogenerators for their own generation is compiled and aggregated for each sector (from autogenerators survey).
- This is currently only within the industrial and public administration sectors.

Iron and Steel
- ISSB survey gives electricity consumed from the grid.
- Differences between ISSB figures and the Electricity Sales survey is removed from/added to other industrial categories according to their share of overall consumption.
- For autogenerators, the total consumption figure for the iron & steel industry is taken from the autogenerators survey (less blast furnaces, coke ovens and losses).

Energy Industry Use
- Electricity consumed from the grid by coke ovens, petroleum refineries and in oil/gas extraction comes from the sales survey.
- For autogenerators, the ISSB data is used for consumption in coke ovens and blast furnaces.
- For petroleum refineries the autogenerator survey data is used.
- Electricity generation consumption includes electricity used on works by generators, plus pumped storage consumption.

Losses
- For the PDS this comprises transmission & distribution losses, plus theft.
- Annual transmission losses are obtained by aggregating the monthly Elexon loss returns.
- Distribution losses are based on the monthly distributor returns.
- Losses from autogenerators in iron and steel industries are reported in the ISSB survey and are reallocated from total PDS losses to the losses figure for other generators.

1.4 Balancing Supply and Demand

Energy Balances are the primary tool by which national energy statistics balance supply with demand. DECC state that they consider electricity supply data to be more accurate than demand data. Therefore, where any large[15] statistical differences exist between the two, changes are made to the demand data to close the deficit.

No changes are made to the data based on the ISSB survey, losses or energy industry use. Also DECC state that the annual domestic sales figures are considered to be accurate. Therefore if adjustments are required between supply and demand, they are made to the industrial and commercial sales figures, at an individual category level.

DECC state that any adjustments are carried out with consideration to the current economic and energy climate and past trends i.e. it is not based on a statistical methodology, although a more robust methodology is currently being developed (DECC undated).

[15] It has not been stated what is considered to be a 'large' statistical difference

1.5 Reconciling Annual/Quarterly/Monthly Data Sources

As DECC consider that annual data is of better quality, they aim to ensure that this is consistent with monthly and quarterly statistics. A reconciliation process is used that looks at annual survey forms to check against the sum of the monthly data previously received, with any large discrepancies investigated. Once DUKES is produced, a second phase of reconciliation is carried out; during this the previously published monthly and quarterly tables are re-published to be consistent with DUKES.

1.6 Statistical Differences

Statistical differences in DUKES arise because data collected on production and supply do not match exactly with data collected on sales or consumption – one reason is that some of the data are based on different calendars (DECC DUKES 2011: paras 5.82/5.83) – data on calendar years includes more electricity consumption than the slightly shorter statistical year of exactly 52 weeks.

DECC also highlight the need for care in interpreting the figures for individual industries in the commodity balance tables, as some companies move between suppliers and it is not possible to ensure consistent classification between and within industry sectors and across years. The breakdown of final consumption also includes some estimated data.

2. Sector Consumption Analysis

2.1 Domestic Data Sources

Data on electricity consumption within the domestic sector is set out within a range of DECC publications, across a range of tables; those of most relevance are highlighted in the table below.

Publication	Relevant Tables	Shows	Data sources
DUKES Annual and online tables of long term trends	• 5.1 Electricity Commodity Balances • 5.2 Electricity Supply and Consumption • 5.3 Electricity Commodity Balances • 1.1.5 Energy Consumption by Final User (energy supplies basis) - back to 1970 • 5.1.2 Electricity supply, availability and consumption - back to 1970	• 5.1 to 5.3 show total consumption for the domestic sector (GWh) • 5.3 includes additional information on consumption broken down by tariff type • 1.15 energy consumption by category of final user – shows trends in energy consumption by fuel (ttoe) • 5.1.2 total consumption within the domestic sector (TWh)	• The data within tables 5.1 to 5.3 is based on the annual sales survey – Annex 3 of DECC (undated 1) • As such, data in DUKES is based on actual sales • Table 5.3 includes more detailed information on both consumption and supply (showing consumption divided between electricity distributed over the PDS and electricity provided by other generators. It breakdowns domestic consumption by the following tariff types: standard, Economy 7 and other off peak, prepayment (standard), prepayment (off-peak), sales under any other agreement) • Total figures in Tables 1.1.5 and 5.1.2 are consistent with the data in Tables 5.1 to 5.3
Energy Consumption in the UK	• Table 3.1 Domestic energy consumption by fuel (1970 to 2010) • Table 3.7 Domestic energy consumption by end use and fuel (1990 to 2009) • Table 3.10 Total electricity consumption by appliance type (1970 to 2010)	• 3.1 gives total electricity consumption in the domestic sector (ttoe) • 3.7 gives a breakdown of total consumption by space heating, water, cooking, lights and appliances (ttoe) • 3.10 gives a detailed breakdown of electricity use for a wider range of lighting and appliance types (ttoe)	• 3.1 sourced from DUKES Long Term Trends table 1.1.5 (i.e. actual consumption) • 3.7 uses the total actual consumption figure from DUKES, but further analysis is modelled using BRE and CAR model (described below) • 3.10 is modelled from Defra's Market Transformation Programme (see below) and breakdowns lights and appliance consumption over a total of 27 different appliance/lighting types. The notes state that data within the table is modelled independently from other tables within ECUK. This explains why totals for consumption do not match earlier tables (i.e. those drawn from DUKES)

2.1.1 Domestic Data Sources Further Information

Actual Consumption

- Consumption data is derived from the annual survey that DECC carry out with Energy Suppliers – Annex 3 in DECC (undated 1)[16].
- This data feeds directly into DUKES – Tables 5.1 to 5.3 and the long term trends tables.
- The total consumption figures between all the DUKES tables are consistent with each other.
- This would also appear to be the basis for the total consumption figures with ECUK Tables 3.1 and 3.7.

Modelled Consumption

- Table 3.7 breaks the total consumption figures down across space heating, water, cooking and lights/appliances this data is modelled by BRE and CAR.
- Table 3.10 of ECUK is modelled on data from the Market Transformation Programme (MTP) – except for cooking, which is based on forecasts provided to DECC in 2008. The figures are based upon the MTP reference scenario.
- The outputs from the MTP model are set out within a number of Key Output papers from the MTP[17] showing total energy consumption (GWh) for a wide range of lights and appliances to 2030, these figures feed directly into table 3.10 at the annual update of ECUK.

BRE Modelling

BRE are referenced in ECUK against table 3.7 and a useful summary of the BRE Housing Model for Energy Studies (BREHOMES) is provided in Annex 3 of the GB Housing Energy Fact File[18]. This states that:

- The model uses a multiple dwellings approach for domestic energy consumption and is based upon a basic version of the single dwelling Building Research Establishment Domestic Energy Model (BREDEM), which calculates annual energy requirements of domestic buildings, and can be used to estimate savings resulting from energy conservation measures;
- BREHOMES assumes 1008 different categories of dwelling, based on tenure, house type, age, and the inclusion or exclusion of central heating;
- Primary data sources for BREHOMES includes information on household insulation measures and heating systems from the English Housing Survey (EHS), weather data, and estimates of electricity consumption from the Market Transformation Programme model;

[16] AN1 of Annex 3 in DECC (undated 1) 'Energy Statistics – data sources and methodologies' states that for the domestic sector this covers sales of electricity to households which by definition do not have an industrial classification code (although households with paid employees are classed to SIC 97).
[17] MTP model output for each sector is available from the 'Key Output' papers: http://efficient-products.defra.gov.uk/product-strategies/viewall/briefing-note#viewlist
[18] DECC (2011) Great Britain's Housing Energy Fact File 2011. URN 11D/866.

- BREHOMES calculates heat losses and energy consumption for each of the 1008 categories of dwelling, and then aggregates to give GB totals, based on the numbers of dwelling in each category and an extrapolation from the numbers of English to GB dwellings[19];
- Outputs from BREHOMES are estimates, and are unlikely to match the energy consumption figures published in DUKES exactly, so BREHOMES allows the user to reconcile calculated outputs with actual domestic energy totals from DUKES. The reconciliation process involves the user modifying assumptions within plausible boundaries and re-running the model (this is mainly done by altering the internal demand temperature). This process is repeated iteratively until the model and DUKES totals are in reasonable agreement. The reconciliation is intended to ensure that modelling assumptions are reasonable. This provides a more reliable basis for predicting future domestic energy consumption and possible savings from energy efficiency measures.

Cambridge Architectural Research - Cambridge Housing Model (CHM)

The Cambridge Housing Model is also referred to within the footnotes of ECUK Table 3.7. This model, based on Great Britain, uses data from the English Housing Survey (EHS) to carry out a series of calculations, based on SAP 2009, to estimate energy use and CO_2 emissions by use and by fuel type. As well as generating estimates of energy used for ECUK, it is also the model used for the new Housing Energy Fact File; it replaces the use of the BRE Housing Model in both these publications.

- Calculations in the CHM are principally based on the worksheet in SAP 2009 for energy rating of dwellings, plus Reduced Data SAP (RdSAP) for existing dwellings - Appendix S of SAP 2005. The SAP 2009 outputs for energy use and associated CO_2 emissions do not include cooking or electrical appliances. CAR has therefore included calculations for energy use for cooking and electrical appliances, and associated CO_2 emissions, based on the BRE's Domestic Energy Model (BREDEM 8) and SAP.
- The model is run for either a single dwelling type or the entire set of representative dwellings.
- The main source of input data for the CHM is the English Housing Survey (EHS), the data from which is prepared before use within the CHM. First it's "cleaned" to remove inconsistencies introduced when it was converted from the original SPSS files. Then it was run through CAR's Converter, which creates the dataset ready for use in the CHM.
- Further information on the data sources and assumptions made within the model are available from CAR[20].

[19] Presumably for ECUK, these figures are extrapolated for the whole of the UK in the same way.
[20] https://www.yousendit.com/sharedFolder?phi_action=app/orchestrateSharedFolder&id=yoztP438Ra-fjVwTVEhtK1nx6UGwpjDleJ63mmD0GU8. Accessed January 2012.

English Housing Condition Survey and English Housing Survey

The English Housing Condition Survey (EHCS) was run once every five years from 1971, up to and including 2001; and from April 2002 to March 2008 the EHCS was run on a continuous basis. In April 2008 it was merged with the Survey of English Housing to form the English Housing Survey (EHS). The EHCS covered all tenures and involved a household interview, a physical inspection and a market value survey of the property, to provide a picture of the type and condition of housing in England, the people living there, and their views on housing and their neighbourhoods. If the property was in the Private Rented Sector an interview was also sought with the landlord. The DCLG also collected detailed household information through its Survey of English Housing. The sample size appears to have been around 8000 (2007) DCLG (2012)[21].

The English Housing Survey (EHS) collects information about peoples' housing circumstances and the condition and energy efficiency of housing in England. It comprises two component surveys: a household interview, followed by a physical inspection of a sub sample of the properties; covering all housing tenures. The interview survey is conducted with all householders in the sample (around 13,300 households per year); and the physical survey involves a physical inspection by qualified surveyors of a subsample of around 6,200 properties per year. A periodic follow-up survey with private landlords is also undertaken to collect information on landlord experiences and attitudes, what type of landlord they are and why and how they became landlords (DCLG 2012)[22].

The CHM model used data from the EHS data based on a sample of 16,150 representative English dwellings to provide data for ECUK (Table 3.7). Each of these 16,150 cases represents a quantity of dwellings in England - that is a weighting, such that their sum is equal to the total number of dwellings in England (22.3 million). The CHM reads in the EHS dwelling data for each case (representative dwelling) and performs building physics calculations on them to determine energy consumption and associated CO_2 emissions, by use and by fuel type. Multiplying the energy use and CO_2 emissions by the associated weighting and summing across all cases gives total values for England. Using appropriate England–to–Great Britain and Great Britain-to-United Kingdom scaling factors, based on the number of dwellings in England, GB and the UK, the approximate GB and UK energy use and CO_2 emission totals can be calculated.

[21] DCLG (2012) – the information on the EHCS was taken from across a range of DGCL web pages in January 2012: http://www.communities.gov.uk/housing/housingresearch/housingsurveys/englishhousecondition/
[22] DCLG (2012) English Housing Survey. Accessed January 2012: http://www.communities.gov.uk/housing/housingresearch/housingsurveys/englishhousingsurvey/

Market Transformation Programme (MTP)

Defra (2012)[23] state that the MTP supports UK Government Policy on sustainable products, by:

- Developing and maintaining a robust evidence base on impacts and trends arising from products across their life-cycles;
- Ensuring reliable product information is available and is used to inform policy decisions, consumer choices and instruments like public procurement;
- Working with stakeholders to harness their expertise to develop a robust evidence base for effective standards across product life-cycles and outcomes which stimulate innovation and ecodesign.

The MTP covers all products that fall under the EU Ecodesign Directive, which sets minimum environmental performance standards, across the EU for energy related products. The products covered by the Ecodesign regulations and the MTP include energy-using products, which use, generate, transfer or measure energy (electricity, gas, fossil fuel), such as boilers, computers, televisions, transformers, industrial fans and industrial furnaces.

Within their main report Defra (2010)[24] state that existing evidence and information on the ownership and usage of many domestic products has recently been added to by data collected through the online survey on the Act on CO_2 website between 2007 and 2009. Over 100,000 surveys were completed by UK citizens and MTP has worked to analyse these to verify the conclusions of existing sources of evidence.

In terms of product areas covered, these are set out in section three of Defra (2010: 16-17), for the domestic sector this includes:

- Consumer Electronics: Televisions; Power Supply Units; Set top boxes; Video players and recorders; and Games Consoles;
- Domestic Appliances: Domestic Cold Appliances (refrigerators, fridge-freezers, upright freezers and chest freezers); Domestic Laundry (washing machines, tumble driers and washer-driers); and Domestic Dishwashers;
- Domestic Heating: Gas Boilers; Oil Boilers; Alternative electric systems (heat pumps); Alternative gas systems; Alternative biomass systems; Electric water heaters; and Heating system controls (e.g. thermostats and radiator valves);
- Domestic Lighting: Internal & external domestic lighting.

Annex 1 in Defra (2010) introduces the product area annexes setting out what each contains, this is based on a range of standard headings that includes ‘key trends and assumptions’ which describes the sales, stock and usage trends, which already have, or are expected to

[23] Defra (2012) Welcome to the Market Transformation Programme. Accessed January 2012: http://efficient-products.defra.gov.uk/

[24] Defra (2010) Saving Energy Through Better Products and Appliances: A report on analysis, aims and indicative standards for energy efficient products 2009-2030. December 2009?

have, an impact on the main products, with further information provided on life expectancy. The approach to modelling data is based on a series of models developed and maintained by the MTP, this is based on a stock turnover approach, where the number of products in use, expected growth or decline of that number in future years and product lifetime form the basis for calculating how the installed stock in any one year is composed of products sold in current and previous years.

Annex 2 in Defra (2010) provides an overview of consumer electronic products that show a range of data, for example for TVs, the number per household is highlighted, along with average daily use, etc. This is used to summarise the inputs into their model for 2009 and projected to 2020, including inputs for: total stock; sales; average life expectancy; and energy usage in hours per year. A further table on impacts shows how this relates to energy usage (GWh) and emissions.

Further information on the data sources, assumptions and confidence for these different areas is provided separately across a range of Government Standards Briefing Notes (GSBNs) for different products (around 175 GSBNs exist).

In respect to energy consumption, the energy efficiency of new appliances is extracted from the analysis of sales data, which provides an average kWh per year consumption based on Energy Label class. The model combines this data with other key inputs (stock, sales, usage, lifespan, etc) to estimate the total consumption of the various products covered under the MTP; as these variables vary with each MTP scenario, so do the energy consumption figures. In respect to the ECUK statistics, data is primarily drawn from the MTP reference scenario.

2.2 Service Sector

Data on electricity consumption within the service sector (public administration; commercial, agriculture and miscellaneous) is set out within a range of DECC publications, across a range of tables; those of most relevance are highlighted in the table below.

Publication	Relevant Tables	Shows	Data sources
DUKES Annual and online tables of long term trends	• 5.1 Electricity Commodity Balances • 5.2 Electricity Supply and Consumption • 5.3 Electricity Commodity Balances • 1.1.5 Energy Consumption by Final User (energy supplies basis) - back to 1970 • 5.1.2 Electricity supply, availability and consumption - back to 1970	• 5.1 to 5.3 show total consumption for each category within the service sector (public administration, commercial, agriculture and miscellaneous) (GWh) • 5.3 also includes sub-categories for public lighting, shops, offices, hotels, combined domestic/commercial premises, post and telecommunications, unclassified, and transport services (GWh) • 1.15 energy consumption by category of final user – service sectors are described under 'other final users' (ttoe) • 5.1.2 total consumption within the service sector under 'other' which also includes transport (TWh)	• The data within tables 5.1 to 5.3 is based upon Annex 3 of DECC (undated 1) • Table 5.3 includes an unclassified category which picks up any large figures that are not classified to other sectors (1.9.3 in AN1) • 1.1.5 and 5.1.2 data totals can also be related back to earlier DUKES tables – although they have also included transport (up to 1990 in 1.1.5 and ongoing in 5.1.2)
Energy Consumption in the UK	• Table 5.1 Service Sector Energy Consumption by fuel 1970 to 2010 • Tables 5.1a to 5.1c Consumption by Fuel for public administration, commercial and agriculture, respectively • Table 5.6 Service Sector Final Energy Consumption by sub-sector and end use by fuel 2009 (excluding agri.)	• 5.1 shows total electricity consumption in the service sector (administration, commercial, agriculture and miscellaneous) (ttoe) • 5.1a to 5.1c show total energy consumption 1999 to 2010 by fuel (ttoe) • 5.6 gives total energy consumption across: commercial offices; communication & transport; education; government; health; hotel and catering; other; retail; sport and leisure; and warehouses (ttoe) based on a number of different end uses: catering; computing; cooling ventilation; hot water; heating; lighting; and other.	• 5.1. is sourced from DUKES long term trends table 1.1.5 • 5.1a to 5.1c sourced from DUKES tables 1.1 to 1.3 and earlier energy balance tables. • 5.6 uses the total consumption figure from DUKES for each sector, but secondary analysis is carried out by DECC and BRE – it has not been possible to clarify the basis of this modelling with either DECC or BRE.

2.2.1 Service Data Sources Further Information

Actual Consumption

- Consumption data is derived from the annual surveys that DECC carry out with Energy Suppliers – provided in the Annex 3 of DECC (undated 1).
- This data feeds directly into all the DUKES tables, with the totals being consistent across the various tables.
- It is also the basis for the total consumption figures with ECUK Tables.
- ECUK Tables 5.1a to 5.1c use the 2007 SIC classifications which are shown in the footnotes for each table as:
    - 5.1a based on SIC2007 codes: 84 Public administration and defence; 85 Education; 86 Human health activities; 87 Residential care activities; and 88 Social work activities without accommodation;
    - 5.1b based on SIC2007 codes: 45-47 Wholesale and Retail; 52 Warehousing and support activities for transportation; 53 Postal and courier activities; 55-56 Accommodation and Food Service Activities; 55-56 Accommodation and Food Service Activities; 58-63 Information and Communication; 64-66 Financial and Insurance Activities; 68 Real Estate Activities; 69-75 Professional, Scientific and Technical Activities; and 77-82 Administrative and Support Service Activities;
    - 5.1c based on SIC2007 codes: 01 Crop and animal production, hunting and related service activities; 02 Forestry and logging; and 03 Fishing and aquaculture.
- DECC state that the consistency of the SIC codes across different commodities cannot be guaranteed because the figures reported are dependent on what the data suppliers can provide (DECC undated 2)[25].

Modelled Consumption

- Table 5.6 in ECUK is modelled to show how total consumption is broken down by end use.
- The classifications of different sub-sectors within ECUK Table 5.6, do not match exactly the classifications used within DUKES or Annex 3 (DECC undated 1). Note 3 within table 5.6 states that 'aggregated energy use in the service sub-sectors Education, Government and Health have been scaled to the figure for Public Administration energy use as published in DUKES'. There are some uncertainties regarding the basis of the modelling. For example, the modelling of fuel use, by end use, in Table 5.6 is based on secondary analysis of data from DUKES and BRE, but we have been unable to determine the methodology used for this – see paragraph on BRE Modelling below.

[25] DECC (undated 2) *Methodology notes for the energy balance* URN 10D793.

UK Standard Industrial Classification (UK SIC)

The following summary is taken from ONS (2009)[26]. A Standard Industrial Classification (SIC) was first introduced into the UK in 1948 for use in classifying business establishments and other statistical units by the type of economic activity in which they are engaged. The classification provides a framework for the collection, tabulation, presentation and analysis of data, and its use promotes uniformity. In addition, it can be used for administrative purposes and by non-government bodies as a convenient way of classifying industrial activities into a common structure.

Since 1948 the classification has been revised in 1958, 1968, 1980, 1992, 1997, and 2003 to take account of new products and new industries that emerge, as well as shifts of emphasis in existing industries. It is not always possible for the system to accommodate such developments and, after a period of time, updating the classification is the most sensible action. The 1997 and 2003 changes were not full-scale revisions but responses to user demand for additional detail at the subclass level together with some minor renumbering and revisions. This latest publication is a major revision reflecting contemporaneous changes in the EU's industrial classification system (NACE[27]).

From the outset, the UK SIC followed the same broad principles as the relevant international systems. Nevertheless, there were differences in detail between the two as ISIC reflected the structure of economic activity in the world as a whole rather than that in one particular country. In 1980, one of the principal objectives of the revision of the SIC was to examine and eliminate differences from the activity classification issued by Eurostat. The UK SIC is based exactly on NACE but, where it was thought necessary or helpful, a fifth digit has been added to form subclasses of the NACE four digit classes. Thus, the UK SIC is a hierarchical five digit system.

UK SIC (2007) is divided into 21 sections, each denoted by a single letter from A to U. The letters of the sections can be uniquely defined by the next breakdown, the divisions (denoted by two digits). The divisions are then broken down into groups (three digits), then into classes (four digits) and, in several cases, again into subclasses (five digits). So for example:

- section C Manufacturing (comprising divisions 10 to 33);
- division 13 Manufacture of textiles;
- group 13.9 Manufacture of other textiles;
- class 13.93 Manufacture of carpets and rugs;
- subclass 13.93/1 Manufacture of woven or tufted carpets and rugs.

In all there are 21 sections, 88 divisions, 272 groups, 615 classes and 191 subclasses. The full structure of UK SIC (2007) is shown on pages 27 to 53 of ONS (2009).

[26] ONS (2009) UK Standard Industrial Classification of Economic Activities 2007 (SIC 2007) - structure and explanatory notes.

[27] NACE – Nomenclature générale des activités économiques dans les Communautés européennes.

In terms of the data used in compiling DUKES, consumers are classified by their main business; as far as reasonably practicable based on SIC 2007 (DECC undated 2). Information on the allocation of SIC codes within the annual return from energy suppliers (Annex 3 in DECC undated 1) is provided in an information note – AN1. This sets out the following SIC headline codes for the service sector (sub-categories within these are shown within AN1, but are not recorded by the Annex 3 return):

- Wholesale and retail distribution (SIC codes 45 to 47);
- Insurance, banks, offices (SIC codes 62; 64 to 66; 68 to 70; 72; 73; 77; 78; 82);
- Hotels and restaurants (SIC codes 55 to 56);
- Combined domestic and commercial premises[28] ;
- Post and telecommunications (SIC code 53; 58 to 59; 61; 63).

Other SIC codes of relevance to the service sector in AN1 appear to include:

- Agriculture (SIC codes 01 to 03);
- Public lighting sector (THIS HAS NO CORRESPONDING SIC CODE)[29];
- Public administration (SIC codes 84 to 88; 91.01, 71.2);
- Other sectors - Construction (SIC codes 41 to 43, 80.2); Other services (SIC codes 37; 38.1-2; 39; 60; 71.1; 74; 75; 79.9; 80.1; 80.3; 81.2-3, 90.01-04; 91.02-04; 92-93; 94; 96; 99); Unclassified[30]

BRE Modelling

Unfortunately we were not able to clarify with BRE the basis of the modelling which they carry out for DECC in regards to ECUK Table 5.6. It would nevertheless be useful to understand the basis of, and methodology for, how total consumption is split across sectors and end uses. It would appear that the total consumption figure used within table 5.6 is based upon the total energy consumption figure from DUKES tables. However, how this is then separated by the different service sectors (commercial offices; communication & transport; education; government; health; hotel and catering; other; retail; sport and leisure; and warehouses) and the different end uses (catering; computing; cooling ventilation; hot water; heating; lighting; and other) is not clear. The basis for the underlying data for this modelling is not specified, including the sample size and date of any such sampling, and ultimately therefore how reflective the modelling may be of recent changes to energy demand and end uses within the service sector.

[28] This has no corresponding SIC code – AN1 stated that "*These are premises that have a special contract or tariff because of their combined use. If such contracts or tariffs no longer operate the premises should be included either in domestic (1.8) or under the appropriate industrial or commercial activity*".

[29] Correspondence from DECC in regard to DUKES Table 5.3 suggests that sales for public lighting purposes are increasingly covered by wider contracts that cannot distinguish the public lighting element.

[30] Unclassified data includes any large figures which have not been classified to any of the other sectors.

2.3 Industrial Data

Data on electricity consumption within the industrial sector is set out within a range of DECC publications across a range of tables; those of most relevance are highlighted in the table below.

Publication	Relevant Tables	Shows	Data sources
DUKES Annual and online tables of long term trends	• 5.1 Electricity Commodity Balances • 5.2 Electricity Supply and Consumption • 5.3 Electricity Commodity Balances • 1.1.5 Energy Consumption by Final User (energy supplies basis) - back to 1970 • 5.1.2 Electricity supply, availability and consumption (back to 1970)	• 5.1 and 5.3 show total consumption (GWh) for energy used within the 8 energy industry categories and 13 other industry categories (including 'unclassified') • 1.15 energy consumption by category of final user - shows trends in total energy consumption by fuel (ttoe) • 5.1.2 total consumption within the industrial and fuel industries sectors (TWh)	• The data within tables 5.1 to 5.3 in regard to industry (i.e. 12 categories) is based upon Annex 3 of DECC (undated 1). Data on consumption within the Energy Industry is drawn from a number of sources – see section 1.3 for detail (includes Annex 3, autogenerators survey, and ISSB survey) • Tables 1.1.5 and 5.1.2 appear to link to the above data sources, as figures are consistent
Energy Consumption in the UK	• Table 4.1 Industrial energy consumption by fuel use 1970 to 2010 • Table 4.6 Detailed Industrial energy consumption by fuel 2007[31] • Table 4.6c Industrial Energy Consumption at 2-digit SIC level by fuel type 2010 • Table 4.7 Industrial Consumption by end use 2009	• 4.1 gives total electricity consumption in the industrial sector (ttoe) • 4.6 based on 257 SIC classifications for industry (4 digit codes – SIC 2003) • 4.6c electricity consumption (ttoe) for 26 Industrial areas (plus an unclassified field), based on 2 digit SIC codes[32] • 4.7 total consumption (ttoe) by fuel type for 9 different processes	• 4.1. Source: DUKES Long Term Trends, Table 1.1.5 • 4.6 DECC with secondary analysis from ONS PI (Purchases Inquiry) – see below. It is highlighted that data within this table have not been revised, even if they have subsequently been changed within DUKES. • 4.6c uses DECC secondary analysis of DUKES and historic data from ONS PI – see below. • 4.7 DECC secondary analysis from ONS and BRE. It has not been possible to clarify the basis of this modelling with either DECC or BRE.

[31] Includes consumption for companies manufacturing coke, refinery petroleum products and nuclear fuel – SIC starting 23 (excluded from table 4.1)
[32] Includes total with and without SIC 23 i.e. above footnote

2.3.1 Industrial Data Sources Further Information

Actual Consumption

- Consumption data from DUKES is derived from the annual surveys that DECC carry out with the MMPs, Energy Suppliers, autogenerators, and ISSB data (see section 1.3 above).
- This data feeds directly into all the DUKES tables, with the totals across the various tables highlighted above being consistent with each other.
- For tables 1.1.5, data includes iron and steel industry, but from 1994 onwards excludes iron and steel use of fuels for transformation and energy industry own use (footnote 2 in table 1.1.5). Also the total consumption by industry includes an additional footnote (3), stating: blast furnace gas is included in coke and breeze up to 1995 and covers electricity transformation, use by ovens and losses; from 1996 onwards blast furnace gas is included in the total and covers just coke ovens and losses, which is consistent with the methodology used for compiling the energy balances.
- The Industry classification used within the DUKES tables includes:
    - for Energy Industry use: electricity generation; oil & gas extraction; petroleum refineries; coal extraction and coke manufacture; blast furnaces; patent fuel manufacture; pumped storage; and other;
    - for Industry, the follow categories are used: unclassified; iron and steel; non-ferrous metals; mineral products; chemicals; mechanical engineering, etc; electrical engineering, etc; vehicles; food, beverages, etc; textile, leather, etc; paper, printing, etc; other industries; and construction.
- For DUKES 5.1.2 and ECUK there is note on a discontinuity in the data pre-1986. Prior to this point MMPs, transport undertakings and hydro and nuclear stations were reported only, it now includes data for all generators.
- The notes for ECUK Table 4.1 states that energy use for transformation activities is excluded within the table since 1996.

Modelled Consumption

- ECUK 4.6 contains both actual and modelled data, in that secondary analysis has been carried out using the ONS Purchases Inquiry (PI) (see below). Some SICs are shown not to have consumed any energy (due to the sampling frame used in the PI). The PI was last carried out in 2006. For 2007, DUKES used the energy spend proportions from the 2006 PI together with the DUKES 2007 totals to show energy consumption at the four digit SIC level. Since 2007, in lieu of this, ECUK have produced tables 4.6a to 4.6c showing energy consumption at a two digit SIC level for 2008 to 2010.
- ECUK 6.6c is based on 26 SIC two-digit codes and the total (without SIC 23) matches the DUKES 1.1.5 total consumption, however the breakdown of consumption by SIC code is based on secondary analysis by DECC using historic data from the ONS PI.
- ECUK Table 4.7
    - This is based on DUKES data for total consumption, but splits it out by end use and fuel for 25 different SIC levels. The total consumption figure for electricity is very close to the total given in DUKES Tables 1.1.5 and 5.1.2, but end use is modelled, and based on end uses originating from historic survey information.

DECC state that as different definitions were used in the surveys, and different end uses dominate particular industrial sectors, some sectors show no energy use for certain processes; and that all end use information should be considered approximate.

- The user guide for ECUK states that table 4.7 sets out the following categories for energy use:
  - high temperature processes;
  - low temperature processes;
  - drying/separation;
  - motors;
  - compressed air;
  - lighting;
  - refrigeration;
  - space heating;
  - other.
- As examples of the above categories, the ECUK user guide includes: High temperature processes (Coke ovens, blast furnaces and other furnaces, kilns and glass tanks); Low temperature processes (Process heating and distillation in the chemicals sector; baking and separation processes in food and drink; pressing and drying processes in paper manufacture; and washing, scouring, dyeing and drying in the textiles industry); and Motors (Pumping, fans, machinery drives).

- Table 4.7 excludes mining of metal ores, electricity and gas manufacture & distribution, construction and unclassified. It also excludes heat sold, blast furnace gas, coke oven gas or non-electricity renewables and waste.

ONS Purchasing Inquiry

ECUK user guide (DECC undated 3)[33] states that the data in table 4.6 is based upon the Purchase Inquiry (PI), which is a sub-survey of the ONS Annual Business Inquiry. The Purchase Inquiry asks a sample of around 6,000 firms for the amount that they have spent on various items, including questions based on how much they have spent on various types of fuel. The data from the sample is then simply re-scaled to reflect estimated levels of expenditure on energy at the UK level by re-weighting the sample by the number of enterprises operating within each of the relevant SIC sectors. The expenditure data are then brought together with data on energy prices, overall consumption, and calorific values in order to convert expenditure by SIC code into consumption by SIC code. In other words, the expenditure on fuel figures are deflated by average prices and then scaled within each sector so that the totals match with the data in the DUKES.

It also states that the last set of PI data provided by the ONS related to 2006 and therefore 2006 expenditure data has been used with 2007 overall data in the latest update to the table (July 2009). Since then the PI has been suspended and is currently under review. There are no plans to collect data for at least 2007 to 2009.

[33] DECC (undated 3) Energy Consumption in the UK – A User Guide. URN 10D/754.

Industry SIC codes

In terms of the data used in compiling DUKES, consumers are classified by their main business; as far as reasonably practicable based on SIC 2007 (DECC undated 2). Information on the allocation of SIC codes within the annual return from energy suppliers (Annex 3 in DECC undated 1) is provided in an information note – AN1. This sets out the following SIC headline codes for the industrial sector (sub-categories within these are shown within AN1, but are not recorded by the Annex 3 return):

Industry:

- Iron and Steel (SIC code 24 excluding 24.4; 24.53; 24.54);
- Non-ferrous metals (SIC codes 24.4 excluding 24.46; 24.53; 24.54);
- Mineral products (SIC codes 08 and 23);
- Manufacture of chemicals and chemical products (SIC 20-21);
- Mechanical engineering and metal products (SIC codes 25; 28; 33.11; 33.12; 33.2);
- Electrical and instrument engineering (SIC codes 26 to 27);
- Vehicles (SIC codes 29 and 30);
- Food, beverages and tobacco (SIC codes 10 to 12);
- Manufacture of textiles, clothes, leather and leather products (SIC codes 13 to 15);
- Manufacture of pulp, paper, paper products, and the printing industries (including recorded media) (SIC codes 17, 18) – note publishing is now included in post & telecoms;
- Other industries (SIC codes 7, 16, 22, 31, 32, 33.19, 36, 38.3).

Energy Industries:

- Coal and coke (SIC codes 05; 09.9; 19.1);
- Extraction of oil and gas and services related to this activity (SIC code 06 and 09.1);
- Petroleum refiners (SIC code 19.2);
- Nuclear fuel production (SIC codes 24.46; 7.21; 9.9);
- Gas and electricity supply (SIC code 35).

BRE Modelling

The footnotes for ECUK Table 4.7 indicate that secondary analysis includes both the use of data from the ONS and BRE. Unfortunately we were not able to clarify with BRE the basis of the modelling that they carry out for DECC in regard to ECUK Table 4.7. As such, it remains unclear on what basis total consumption within the industrial sector is broken down by SIC code or end use. It is also apparent from note 2 under this table that it draws on historic survey information, but it remains unclear what the origin is of this historic information: how old it is, who collected it and how this feeds into the modelling. As such, and as with the service sector, how reflective the figures may therefore be of recent changes to energy demand and end uses within the industrial sector is not clear. It would nevertheless be useful to understand the basis of, and methodology for, how total industry consumption is split across sub-sectors and end uses.

Sustainability *First*

Sustainability First was set up to develop new approaches to sustainability. Its primary focus is on policy and solutions within the UK, but draws on experiences and initiatives both within and outside the UK.

Sustainability First develops implementable ideas in a number of key policy areas – notably, energy, water and waste - where it can make a difference. It undertakes research; publishes policy and discussion papers; organises high level seminars and other events. Sustainability First is a registered charity.

Sustainability First's trustees are: Ted Cantle (Chair); Phil Barton (Secretary); Trevor Pugh (Treasurer); John Hobson; Derek Osborn; David Sigsworth. It's projects are developed by the trustees and a number of associates and consultants.

Sustainability First's associates are: Gill Owen and Judith Ward. Maria Pooley is Sustainability First's research officer.

Sustainability First is a registered charity number 107899.

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Sustainability *First*