Methodology changes: Oil, Gas and Electricity

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Key headlines

This article explains methodology changes that we intend to make to the oil, gas and electricity balances in the July edition of the Digest of UK Energy Statistics (DUKES), to be published on Tuesday 30 July 2024.

Demand estimates for oil by types of final consumers will likely be revised following a new survey of oil wholesalers and more detailed analysis of existing administrative datasets. Consumption estimates for gas will also be reviewed to reflect improved data quality following an update to our surveys, and increased work with data suppliers.

For electricity improvements have been made to the calculation of electricity used in the process of generation. This change makes better use of available data but does not have a large impact on previously published data. Data on grid scale battery storage has also been added to the electricity tables covering electricity input to batteries, output from batteries, and their capacity.

Update on improving sector demand estimates for oil products

Difficulty with determining end users of oil products sold

The Department publishes oil supply and demand in Energy Trends and the Digest of UK Energy Statistics (DUKES)[1]. The data is based on our monthly survey of oil majors, which is a census of every company that supplies at least 50 thousand tonnes of key oils to the UK in a 12-month period[2]. Combined with other data sources, evidence indicates that over two-thirds of oil is consumed for transport purposes, seven per cent as feedstock for petrochemical plants and a further six per cent by the energy industry (Energy Trends Table 3.2, March 2024[1]). These sectoral estimates are based on sound data.

It is more complex to estimate the many different users of commercial fuels (gas oil, fuel oil and other kerosene). The supply chain is complex, passing between producers, importers and wholesalers before reaching the various relatively small, but high number, of end users, making a direct survey of consumers disproportionately burdensome. We exploit existing and alternative data sources to better understand sector demand (see Annex A), but we needed to find an alternate way to identify end users of the roughly eight million tonnes of oil a year that is delivered to final consumers, which is not directly captured in our current data framework.

In 2019 we ran a pilot survey of oil wholesalers to improve sector data and published results in the June and July 2019 editions of Energy Trends and DUKES[3]. We were able to re-allocate around a million tonnes of oil a year from industry (unclassified) to the commercial, public administration and agricultural sectors. This reduced the three to four million tonnes reported as ‘unclassified’ each year to around two million tonnes but introduced a discontinuity in the time series for some industrial sectors between 2015 and 2016.

Recent improvements to the evidence base

The 2020 COVID-19 pandemic substantially disrupted oil demand patterns, pausing further development work in this area, but trends have appeared to be stable since the start of 2022. We decided to expand on the results of the 2019 pilot and ran a survey of oil wholesalers in 2024, capturing data from pre-pandemic 2019 through to the end of 2023. As with all new surveys, data completeness and quality will need to be improved, but we feel that even in this first year of the survey there is sufficiently sound evidence to show sector demand

[1] Oil statistics collection: https://www.gov.uk/government/collections/oil-statistics

[2] Substantial suppliers are obligated to hold emergency reserves of oil in case of a supply disruption. Further information and a template DORS form can be found here: https://www.gov.uk/government/publications/emergency-oil-stocking-international-obligations

[3] Energy Trends: June 2019 - Change to method of estimating sector demand for oil products: https://www.gov.uk/government/publications/energy-trends-june-2019-special-feature-article-change-to-method-of-estimating-sector-demand-for-oil-products

from before the pandemic, throughout the period of lockdowns, and for demand that has been typical since the start of 2022.

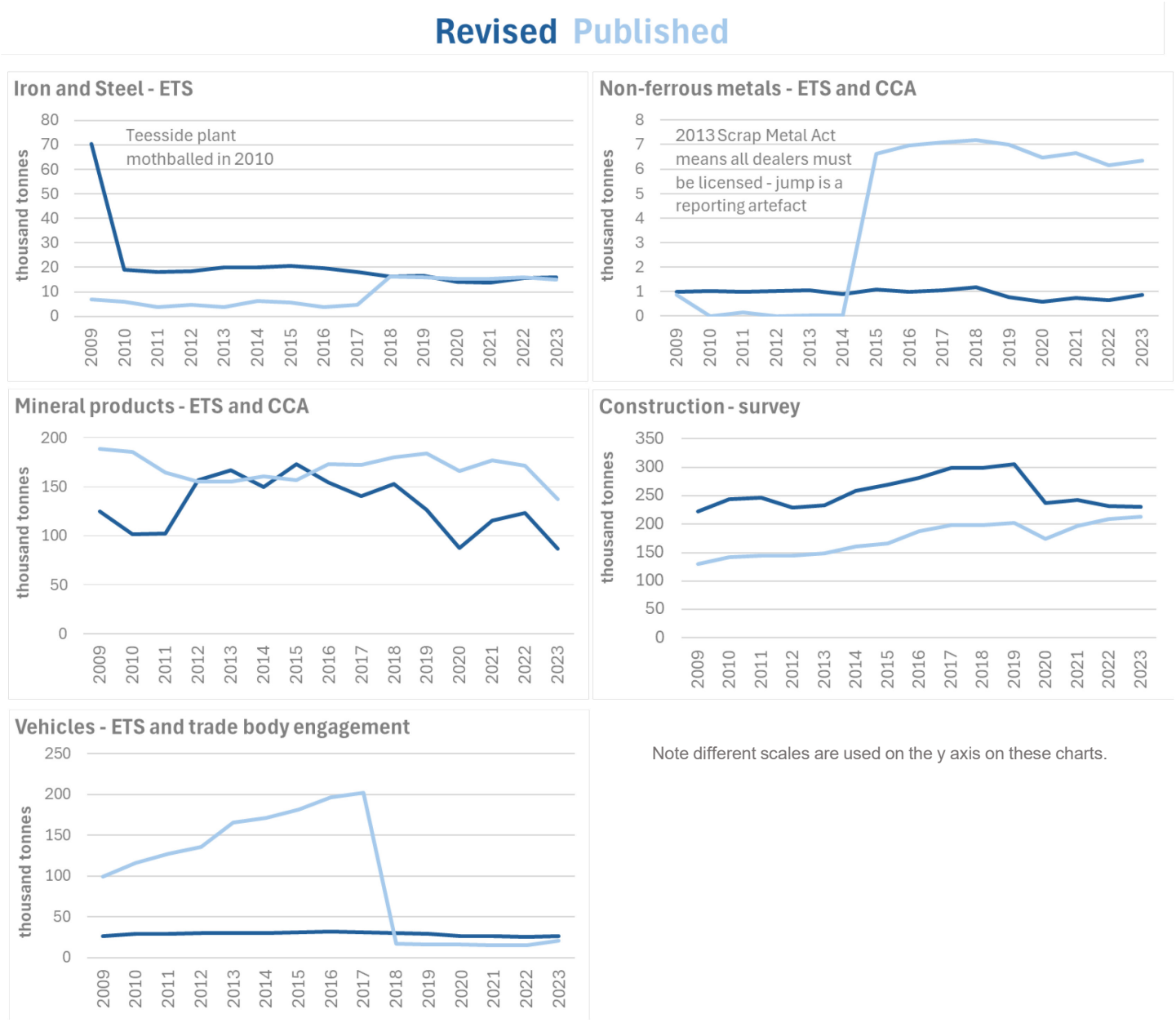
We use data from the EU (now UK) Emissions Trading Scheme (ETS), and Climate Change Agreements (CCA) to cross-reference our demand estimates. We have now analysed this data in more depth and have been able to use results to supplement survey results and improve some industrial subsector demand estimates.

Impact on oil sector demand estimates

Different key benefits have been brought by the new survey and more extensive analysis of the ETS and CCA data. A key change has been to further reduce the amount of oil reported in industry (unclassified) – we intend to re-allocate between 300 to 500 thousand tonnes a year out of unclassified to other industrial subsectors, and in some cases to non-industrial users as per the detail below.

Broadly the re-allocation of demand for oil across industry subsectors does not materially affect industry total demand of around 2.5 million tonnes per year. The panel of charts for the industrial subsectors shows the likely revisions that will be made to Iron and Steel, Mineral products, Non-ferrous metals, Construction and Vehicles sectors. Scales of revisions vary across sub-sectors because the demand for oil varies from around one thousand tonnes (1kt) for Non-ferrous metal to a high of 300kt for Construction. The data used to revise demand is shown in each chart title.

Impacts on industry subsectors



All Iron and Steel manufacturers are in the ETS meaning this is a census of the sector. We previously revised Iron and Steel and Vehicles back to 2018 using this data and are now extending the revisions to 2009.

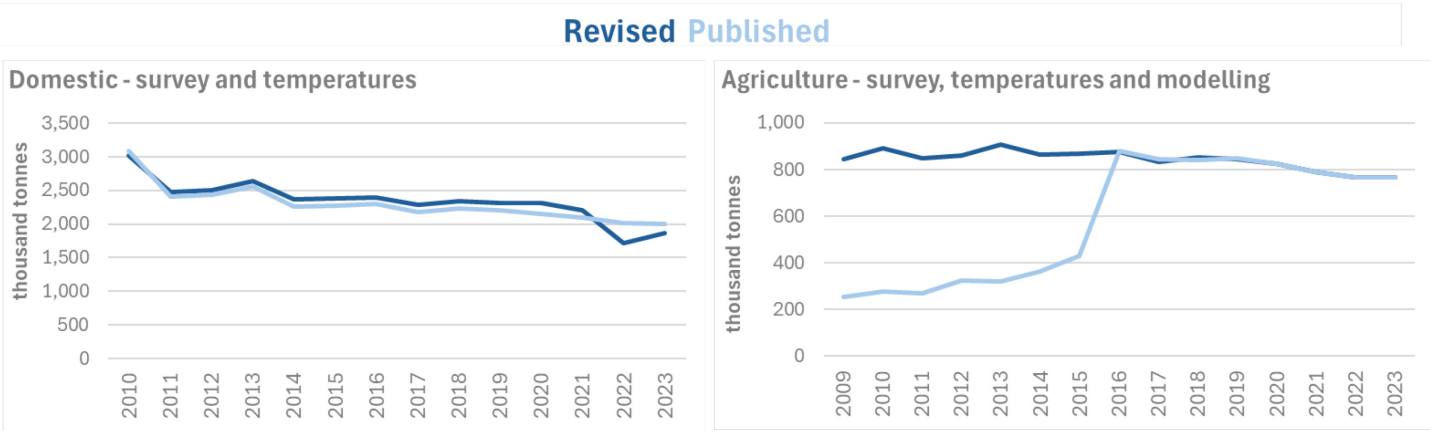
Revisions to Mineral Products show a pronounced drop in energy demand from 170kt in 2015 to less than 100kt in 2023 resulting from factors such as sales of assets, mergers and fuel switching. The non-ferrous metals data shows that energy balances have been overestimating demand for oil since 2015 (it has more likely been roughly stable at around 1kt each year) and that the sudden jump in demand in published 2014 data is likely a reporting artefact following the introduction of the Scrap Metal Act 2013 that required all metal dealers to be licenced.

The construction industry does not have good representation in either the ETS or CCA data, likely because of the very high number of relatively smaller businesses meaning it is not economical to join either scheme. However, the wholesalers survey data identified a new floor for construction demand of around 240kt in recent years and 300kt in 2018 and 2019 pre-pandemic. We have used reported demand from the survey (demand is likely higher but we do not yet have evidence to scale our sample) and revised back to 2009 using trends in output from the Index of Construction published by the Office for National Statistics.

Impacts on other users

The two other key areas that will be revised are the domestic – or residential – and agricultural sectors. Again, please note the different scales in demand from between 1.6 to 3 million tonnes for the domestic sector to around 800kt for agriculture.

The wholesaler survey showed a sharper drop in 2022 than we have previously indicated, and this revision represents the biggest departure from the currently published series. The survey provided a new basis to calculate annual litres of oil used per household. The 2022 drop was seen in this surveyed data and was not because of lower customer numbers. To obtain UK demand we combined the types of fuels used by households with estimates of the number of households in the UK that use oil for heating to give total UK domestic demand and combined with temperature data to give a revised back series (see crude oil and petroleum products: methodology note[4]).



We previously revised demand in agriculture back to 2016 using data from an earlier analysis of the CCA data. We have kept the higher amount of oil derived from this analysis post 2016 but used modelling to extend revisions to 2009 to give a consistent time series. We used survey data to more accurately identify breakdowns of oil types used in the sector, and to achieve quarterly seasonality we accounted for the proportion of types of farming in the UK, fuel required for each main farming activity, and the pattern of activities across the seasons.

Next steps for oil sector demand estimates

The revisions to sector estimates described in this article are indicative only as we continue to develop the analysis before publication of DUKES on 30 July 2024. Going forward, we will continue to consider further analysis to continue improving sector demand estimates, which will remain subject to further revision because they are based on new and developing data collections. We will be working closely with wholesalers and continue to engage with industry and trade bodies as we move forward in this iterative process. Another area under consideration is the use of oil products in the petrochemical sector. We have again looked at this in the ETS and CCA data, and conducted a survey of petrochemical plants in the UK and hope to implement the results of this work when we are confident in any revisions.

[4] Crude oil and petroleum products: methodology note: https://www.gov.uk/government/publications/crude-oil-and-petroleum-products-methodology-note

Our intention with the evidence that is currently available is to provide greater confidence in sector demand estimates and a consistent back-series in DUKES 2024, and to consider further revisions as new data come to light.

As ever, we welcome comments on these changes.

Update on improving sector consumption estimates for natural gas

Recent improvements to evidence base

The Department uses a variety of data sources to estimate gas use in the UK, including data from two administrative schemes, the Emissions Trading Scheme and the Climate Change Agreement scheme. It also conducts its own survey of energy suppliers.

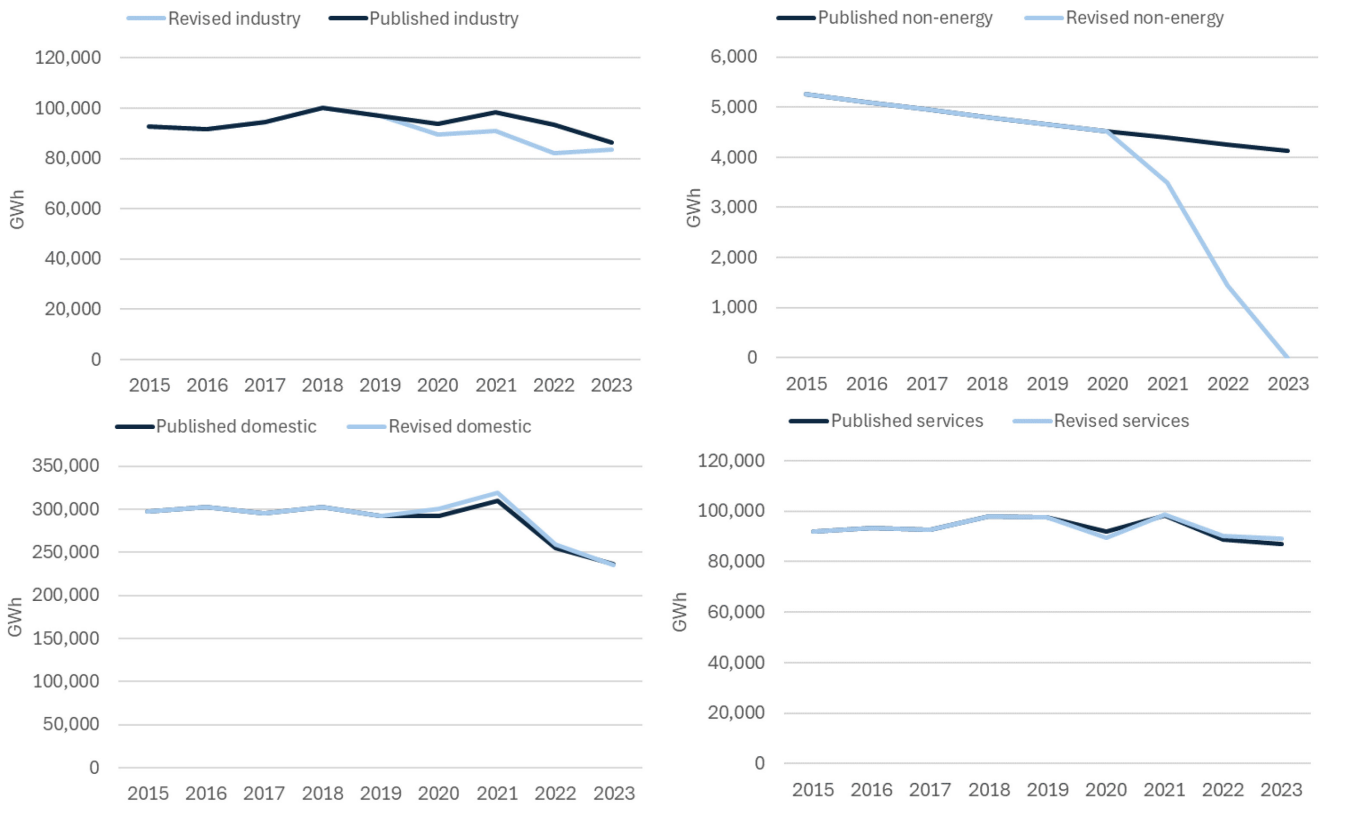
In 2023 the Department increased the frequency of its principal data collection of large[5] gas suppliers and prioritised working with data suppliers to improve data quality in this area (for more information see Natural gas statistics: data sources and methodologies). As part of this ongoing work, we held discussions with energy suppliers on end use data. As per oil and other fuels, data on gas end use is collected using Standard Industrial Classification (SIC) codes but providing accurate data is challenging, especially for those customers who are not charged the domestic rate of value added tax.

Impact on gas sector consumption estimates

The Gas Statistics Team have worked with data suppliers to improve the quality of survey data and improved analytical processes resulting in more accurate sectoral consumption estimates. These improvements will result in revisions to the sectoral consumption data published in balances as part of DUKES and Energy Trends publications from July 2024.

Of note these revisions are likely to include a reduction of gas consumed by industry with gas reallocated between other sectors from 2020. For industry this will result in revisions of up to minus ~10 per cent annually with a knock-on effect of revisions of less than ~5 per cent for domestic and services sectors.

Additionally, non-energy use of gas, which is currently considered as ammonia production only, has been reduced to reflect (to the best of our current knowledge) the closure of all large ammonia production sites in the UK in 2023. The charts below reflect our current estimates, but these are not in their final form and further work will be required in the run-up to the DUKES publication at the end of July.



Note different scales are used on the y axis on these charts.

[5] Supply >1,750 GWh per year

Next steps for gas sector demand estimates

In the coming year the Gas Statistics Team will continue to work with data suppliers to improve our understanding of the quality of survey data. This will include broadening the scope of sectors to include energy industry and losses as well as continuing work to improve the quality of consumption estimates. Furthermore, the team will consider whether the current definition of non-energy use accurately represents this sector whilst a hydrogen economy expands in the UK.

Methodology changes in electricity own use

The Department have made changes to the way in which we calculate and report electricity used in the process of generation (called 'own use' in some tables). The changes have been introduced as part of the production process for DUKES 2024 and have been applied to all data from the start of 2020.

For all fuels and technologies, these changes mean that we report electricity used in the process of generation from survey returns where available and model it where data are not available. We will also report this for wind and solar generators for the first time. This reflects our analysis of the data given in returns as well as consultation with sector experts.

We have also updated the way we report on plants who have used more than they have generated in a particular time period. Previously this would give a negative supply as these plants drew electricity from the grid, where the new method sets supply to zero and counts all the electricity used but not generated on site as 'own use' in the tables.

These changes reflect better use of available data and system improvements but do not have a material impact on the reported data. The new methodology increases reported generation and supply by less than 1 per cent and each separate fuel/technology by less than 0.5 per cent. Similarly, the new methodology changes the shares of generation by fuel by less than 0.2 percentage points.

Background and key terms

The electricity tables make a distinction between 'generation' and 'supply'. Generation refers to all the electricity generated by a power plant or turbine where supply is the amount of electricity that was supplied to the grid or available for use. The difference between these is the plant/turbine's 'own use' i.e. electricity that was consumed on site as part of the process of generation.

The changes to methodology mainly affect the data for Major Power Producers (MPPs). Previously, only the electricity supplied value was taken from the MPP survey. This was scaled up using standard factors to give calculated generation for that company and the difference between these was reported as calculated own use. There were specific factors for each fuel and for different generator types, but no own use reported for wind or solar generators. For all other forms of generation, an average scaling factor was used. The aggregation was done at a company level across all the company's sites. This approach had several issues:

- Single factor for each fuel/technology did not reflect diversity of sites in the sample
- No own use counted for wind or solar did not fully reflect how these technologies operate
- Factors had been kept consistent over time but then did not reflect improvements in technology
- Not making best use of data we had available from survey respondents

New approach

Where any site (including wind and solar) has generation, own use and supply data in their return, we will use that data. We will also use that data to calculate scaling factors each month which will then be applied to the MPP sites who do not give the data. The biggest impact of this will be to report own use data for solar and wind sites. There will be smaller changes for other fuels and technologies where own use data is already reported, but the new method will improve the way in which this is calculated.

MPP sites will be included in the calculation if they have generation and own use data and have supplied electricity to the grid in that month. A separate factor is calculated for each fuel/technology and each year (e.g. solar in 2023) and then applied to all sites of that type in that year who have only reported supply data. The factors will be revised every month when the MPP process is run to take account of any revisions to these data, but we will use the factor from the most recent complete year to prevent variability in the early parts of the year where there is not as much data. The only exception to this is pumped storage sites, where own use will continue to be taken from their returns, to accurately report on the amount of electricity used in pumping.

For sites that are not part of the MPP sample, there will be no change to own use for most fuels and technologies. Because own use and supply is not collected for these sites, these are estimated using standard scaling factors for each fuel and technology, as detailed in the methodology document for electricity statistics. As part of this methodology change, we have added an estimated scaling factor of 0.5 per cent own use for wind and solar sites. This is in line with the analysis of MPP data above and means that wind and solar is consistently handled for both MPP and non-MPP sites.

Negative supply (MPP only)

Within the MPP survey, a site's supply could be recorded as a negative value if it had little or no generation but had still reported own use. The electricity used would most likely have come from another generator via the National Grid so it did not make sense for this to be recorded as part of the MPP data. Under the new methodology, if MPP supply is negative for a site, this will be counted as 0 for the purposes of reporting. This will mean than negative supply does not affect the total supply reported by MPPs. Own use by that site will still be counted as this is included under 'energy industry use' in the electricity balances. Similarly, if a site has generated less than the amount reported as own use, the difference between the two will be the amount that the site has consumed from the National Grid and will be counted under 'energy industry use'. Negative supply generally only occurs when a site is on outage and excluding it increases reported supply by less than 0.5 TWh.

Addition of battery storage to the electricity balances

Background

Grid-scale battery storage sites provide short-term energy storage for the grid. Over the last decade the UK battery market has grown rapidly, with the total annual electricity output from batteries going from approximately 0.5 GWh in 2017 to approximately 1000 GWh in 2023 – now approaching electricity from pumped storage, which in 2023 was approximately 1800 GWh.

In July 2024, figures on battery storage will be published for the first time in DUKES with data back to 2017. This note outlines the methodology used to produce these figures.

Users of the data described in this article should note these data are under development and will be subject to revision as the methodology and data sources improve.

Methodology

Input and output electricity

Data on the electricity input to and output from batteries comes from Elexon's BM Unit Aggregation Report, which quantifies the volume of electricity input/output to GB's Balancing Mechanism by all Balancing Mechanism Units (BMUs). A list of the Balancing Mechanism Unit IDs of batteries has been produced using data provided to the Department by Elexon on the primary fuel type of each unit, alongside supplementary research. Note that batteries co-located with generation sites were excluded from this list to prevent double counting of generation. Using this list of IDs, data referring to only batteries is extracted from the BM Unit Aggregation Report. The data is then aggregated by year, giving the total electricity input from and output to the balancing mechanism to/from batteries in each year. Where multiple settlement runs were available for a given day, the most recently published run is used.

Using the total electricity output to the GB balancing mechanism from batteries, we can estimate the total electricity input to/output from batteries to all markets in the UK. We estimated that half of battery output electricity is attributed to the Balancing Mechanism, with the rest attributed to other markets. Taking the contribution from Northern Ireland batteries to be small relative to the GB total, we estimate the total UK battery input and output electricity to be double the total battery input and output electricity from/to the balancing mechanism. Work is ongoing to identify suitable sources of data for volumes provided to/from each of the other markets to allow us to improve this methodology.

Capacity

Batteries have two forms of capacity: power capacity and energy capacity. Power capacity measures the rate of electricity input/output and is commonly measured in units of MW. Energy capacity measures the amount of electricity stored by a battery and is commonly measured in units of MWh.

Data on the power capacity of batteries is sourced from Elexon's list of registered BM units, available daily via their data portal. Batteries are identified in this file using the same list of IDs compiled for the input/output of electricity. The power capacity of a battery is taken to be the generation capacity in this file. As the majority of battery sites are registered with the balancing mechanism, capacity data is not scaled up to account for the other markets.

No suitable data source has yet been identified which can provide energy capacity figures. Work is ongoing to identify a data source.

Changes to DUKES tables

Adding battery storage data to DUKES requires the modification of existing tables, alongside the introduction of a new table which summarises data on all forms of energy storage sites. In existing tables, rows referring to pumped storage will be changed to 'energy storage', and figures will be the sum of all forms of grid-scale energy storage. Rows referring to the electricity output from 'other sources' will now include battery storage. A full list of changes made to existing tables are described in Table 1.

DUKES 5.16 is a new set of three tables which brings together all data on energy storage, broken down by storage type. 5.16A shows the quantity of electricity output by these sites, while 5.16B shows the electricity input to them. 5.16C lists the total power capacity of all sites operational at the end of May in each year.

In addition to the changes to DUKES, equivalent changes will be made to the tables published in Energy Trends.

Table 1: Details of changes to each table

DUKES table	Changes
5.1	• 'Other sources' (row 7) now includes electricity output from batteries. • 'Pumped storage' (row 24) renamed to 'Energy storage', and now includes energy input to batteries/
5.2	• 'Other sources' (row 8) now includes electricity output from batteries. • 'Pumped storage' (row 22) renamed to 'Energy storage', and now includes energy input to batteries.
5.5	• 'Pumped storage' (rows 10 and 16) renamed to 'Energy storage', and now includes energy input to batteries.
5.6	• New 'Battery storage' rows added below each MPP 'Pumped storage' row (rows 18, 39, 58, 85, and 179),
5.11	• 5.11 summary: new 'Battery storage' row added below MPP 'Pumped storage' (row 17) • 5.11 Full list: battery storage sites added
5.1.2	• Electricity output from batteries added to 'Electricity Available' column
5.1.3	• New 'Electricity supplied (gross) from battery storage (major power producers)' and 'Electricity supplied (gross) from battery storage (all generators)' columns added.

Impacts on the electricity balances

Adding battery data to the electricity balance causes previously published total supply and demand figures to increase. The increases in supply range from approximately 0.5 GWh in 2017 to approximately 1000 GWh in 2023. As batteries are on average approximately 70-80% efficient, the increases to demand are slightly higher at approximately 1 GWh in 2017 and approximately 1300 GWh in 2023. Due to the electricity lost to efficiency, the net effect of adding battery data to the electricity balance is additional demand ranging from approximately 0.5 GWh in 2017 to approximately 100 GWh in 2023.

Annex A: Basis for previous sector oil demand estimates

The main survey that underpins estimates of oil demand by sector is the Downstream Oil Reporting System, the monthly survey of all substantial suppliers of oil to the UK (defined as supplying at least 50 thousand tonnes of key fuels to the UK in a 12-month period[2]). This includes all refiners and major importers, covering more than 97 per cent of UK supply of oil. However, these major suppliers do not tend to sell direct to the end user. Instead, around 80 per cent of deliveries are to wholesalers who resell the oil, making it difficult for substantial suppliers and the Department to identify the end users of commercial fuels.

Historically we have taken steps to identify alternative sources of data to inform estimates of demand for each sector. These have included:

- Working with trade bodies of industry sectors that use commercial fuels such as the Food and Drinks Association and the Society of Motor Manufacturers and Traders.
- We collaborated with Liquid Gas UK trade body members to develop a direct survey of sales to better understand demand by user type for Liquefied Petroleum Gas.
- Working with petrochemical companies to better understand supply and demand in that sector.
- Cross-referencing our estimates with administrative data such as from the EU (now UK) Emissions Trading Scheme[6] and Climate Change Agreements[7].
- More recently, the Office for National Statistics (ONS) re-started the Annual Purchasers' Survey to identify where businesses spend money, including for energy, and we worked closely with ONS to quality assure and improve this data source.
- Benchmarking against datasets including:
    - His Majesty's Revenue and Customs excise data for road fuels
    - Weekly sales of road fuels that are published by the Department using data from forecourt wetstock management data
    - Civil Aviation Authority data on aircraft movements across the country for jet fuel demand
    - Indices of Production, Services and Construction published by ONS to align time series trends with output
    - Weather data to calibrate estimates of oil used for heating such as kerosene in the domestic and public administration sectors.

To further improve sector estimates, in 2016, 2017, and 2018 the Department ran a survey of all substantial suppliers to construct a full customer base and used that data to correctly classify the ~20 per cent of deliveries from substantial suppliers that are delivered direct to the end user. This survey also identified the larger oil wholesalers who sell to end users in the UK, and we ran an initial pilot data collection of the largest resellers in 2019.

As a result of this new evidence we were able to improve our sector estimates and re-apportion volumes, mainly of other kerosene (or burning oil), from industry (unclassified) to the commercial, public administration and agricultural sectors. This reduced the three to four million tonnes reported as 'unclassified' to around two million tonnes, as described in a special article in Energy Trends June 2019[3]. We revised sector demand back to 2016 and published new estimates in the June 2019 edition of Energy Trends and July 2019 edition of DUKES.

[6] Participating in the UK ETS: https://www.gov.uk/government/publications/participating-in-the-uk-ets/participating-in-the-uk-ets

[7] Climate change agreements: https://www.gov.uk/guidance/climate-change-agreements--2

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