



Crude oil and petroleum products –methodology note

Crude Oil and Petroleum Products

Scope

1. These notes cover data produced on a monthly basis (internet only tables), quarterly basis (Energy Trends) and annual basis (the Digest of United Kingdom Energy Statistics, DUKES). The complete range of information is published at:

<https://www.gov.uk/government/collections/oil-statistics>

2. This note covers

- 'Upstream oil'. This is the production of crude oil and Natural Gas Liquids (NGLs);
- 'Downstream oil'. The refining of crude oil into petroleum products and the distribution of those products;
- Oil stocks. The stock held in the UK to respond to national and international emergencies;
- Trade data. Refers to the imports and exports of crude oil and petroleum products

3. Not all of the data shown in the annual publication are reflected in the quarterly and monthly publications. The annual publication contains the highest level of detail and is represents the final data for the year.

Data collection instruments

4. The data are collected via the following instruments

Primary collections

- The Petroleum Production Reporting System (PPRS). PPRS is an administrative data collection system that requires licensees operating on the UK Continental Shelf to submit monthly details of their hydrocarbon (both oil and gas) production to the Department. PPRS is used to report flows, stocks and of crude oils and Natural Gas Liquids from field level through to final disposal. It is a condition of operation on the UKCS that companies submit monthly returns to government.
- Downstream oil information, including information on the transformation of crude oil into petroleum products at refineries, imports and exports of petroleum products, and the delivery of these products into consumption by various users, is collected through the Downstream Oil Reporting System (DORS). DORS was developed in cooperation with industry.

Secondary collections and other data sources

- HMRC data are used to supplement information obtained from PPRS and DORS, and as a quality control mechanism.
- Ad hoc returns. These smaller returns include a survey of hypermarkets and suppliers of Liquid Petroleum Gas. The hypermarket survey allows for the calculation of the shares of motor spirit and DERV sold through hypermarket retailers and published on a quarterly basis. The LPG return allows the apportionment of sales of propane and butane to the sectoral breakdowns of industry, transport, and other.
- Estimates from Ricardo of fuel use by mode of transport are produced as part of their work to compile the UK Greenhouse Gas Inventory, and reproduced in the annual statistical digest (DUKES).
- Survey of major power producers. The amount of fuel used for electricity is sourced from BEIS's survey of major power producers.
- Data from the Iron and Steel Statistics Bureau for deliveries of petroleum products to steel works and iron foundries.
- Environmental Emissions Monitoring System (EEMS) is a system used by BEIS to collect information on emissions from offshore installations and associated terminals for oil and gas extraction.

Data coverage

5. PPRS and DORS operate as a census and cover all companies involved in extracting and refining oil. In 2015 the DORS reporting framework was extended to also capture data from major suppliers of oil products (over 50kt in a 12 month period) to the UK market.

Geographical coverage

6. United Kingdom.

Data frequency

7. The principal data systems operate on a monthly basis. Hypermarket returns are monthly and the LPGA return is quarterly. Ricardo estimates of fuel use are provided on an annual basis. Data from the Iron and Steel Statistics Bureau are provided on an annual basis.

Data Quality

8. Data are in provisional form until the publication of the annual Digest of UK Energy Statistics.

9. As oil and oil products are valuable, the companies involved are subject to high degree of financial regulation and independent auditing to ensure that what is produced, refined and delivered is accurately reported. As both PPRS and DORS are sourced from company accounts, the high levels of auditing provide good levels of quality assurance.

10. Additionally the Department makes significant efforts to ensure that the data provided are fit for purpose. On the downstream side, reporting companies are subject to a light touch audit by BEIS Statisticians on an annual basis to assess whether data systems are robust. The PPRS system is used to monitor field production by BEIS engineers and policy makers, and data from the system forms the backdrop to discussions on field by field production. Its use as an ongoing source of information provides good assurance of quality.

11. Whilst data providers and the Department make these efforts to assure data quality, the following two items should be noted.

12. Firstly, the sectoral breakdown for non-road use of gas oil and fuel oil is based on the

reporting companies' understanding of the primary business of the companies they deliver to. It is difficult to know with certainty in all cases what the primary business of receiving companies is. In particular, given that some receiving companies sell products on to third parties, it becomes difficult for the refiners to trace through to final delivery. Whilst the consumption of non-transport uses of gas oil and fuel oil is a relatively small proportion of the total final consumption (less than 10 per cent), improvements in 2015 and 2016 by the Department and reporting companies have developed the understanding and reporting of sectoral splits.

13. Secondly, the transfers heading in the commodity balances in the commodity balances reflect the outcome of complex refinery processes. Transfers can include:

- Reclassification of products within refineries. For instance, butane or naphtha can be added to motor spirit to improve the octane rating, or aviation turbine fuel could be reclassified as domestic kerosene if its quality deteriorates;
- Differences in product use between refineries. For instance, a company might deliver fuel oil to another company and that company might then report receipt of a feedstock;
- Backflows of products from petrochemical plants that are often very closely integrated with refineries. Volumes of backflows are reported in all publications as production of feedstocks. Deliveries to petrochemical processing plants are shown in annual table 3.2-3.4 under Other Transformation. Whilst the amount varies, the scale of these backflows is relatively small.

14. There is scope for error in the recording these processes because refineries use volumes rather than masses during the conversions and different factors apply for each product when converting from a volume to mass basis. These can differ between refineries and between the aggregated figures used with the Department for mass conversion.

15. Transfers can be more common with the heavier fuel oils, but in the majority of cases they do not impact on the product balance. In total, around 2% of the supply balance is composed of transfers.

Statistical Differences

16. Given the complexity of reporting systems and the number of parties involved, the tables show 'statistical differences' where appropriate. Statistical differences reflect reporting differences between the data systems and allow the Department to spot mismatches between the supply and demand of oil and oil products.

17. Statistical differences can arise from:

- inaccuracies in metering devices;
- measurements taken at different temperatures and pressures;
- timing differences, particularly with shipping movements;
- contamination with water or other products;
- leakage;
- clerical errors between the various parts of the business (refiners, oil traders, marketing departments, accounting departments).

18. The following paragraphs provide more detail on statistical differences, for both the upstream and the downstream sector.

19. The statistical differences headings listed in the primary oil commodity balances are differences between the separately observed and reported figures for production from onshore or offshore fields and supply to the UK market that cannot be accounted for by any specific factors. Primarily they result from inaccuracies in the meters at various points along

offshore pipelines. These meters vary slightly in their accuracy within accepted tolerances, giving rise to both losses and gains when the volumes of oil flowing are measured. Errors may also occur when non-standard conditions are used to meter the oil flow.

20. The statistical difference for primary oils in the table includes own use in onshore terminals and gas separation plants, losses, platform and other field stock changes. Another factor is the time lag that can exist between production and loading onto tankers being reported at an offshore field and the arrival of these tankers at onshore refineries and oil terminals. This gap is usually minimal and works such that any effect of this at the start of a month is balanced by a similar counterpart effect at the end of a month. However, there can be instances where the length of this interval is considerable and, if it happens at the end of a year, there can be significant effects on the statistical differences seen for the years involved.

21. Another technical factor that can contribute to the statistical differences relates to the recording of quantities at the producing field (which is the input for the production data) and at oil terminals and refineries, since they are in effect measuring different types of oil. Terminals and refineries measure a standardised, stabilised crude oil, that is, with its water content and content of NGLs at a standard level and with the amounts being measured at standard conditions. However, at the producing field they are dealing with a “live” crude oil that can have a varying level of water and NGLs within it. While offshore companies report live crude at field, the disposals from oil terminals and offshore loading fields are reported as stabilised crude oil. This effectively assumes that terminal disposals are stabilised crude production figures. These changes were introduced in the 2002 edition of this Digest.

22. Part of the overall statistical difference may also be due to problems with the correct reporting of individual NGLs at the production site and at terminals and refineries. It is known that there is some mixing of condensate and other NGLs in with what might otherwise be stabilised crude oil before it enters the pipeline. This mixing occurs as it removes the need for separate pipeline systems for transporting the NGLs and it also allows the viscosity of the oil passing down the pipeline to be varied as necessary. While the quantity figures recorded by terminals are in terms of stabilised crude oil, with the NGL component removed, there may be situations where what is being reported does not comply with this requirement.

23. With the downstream sector, the statistical differences can similarly be used to assess the validity and consistency of the data. From the tables, these differences are generally a small proportion of the totals involved

24. Refinery data are collated from details of individual shipments received and made by each refinery and terminal operating company. Each year there are thousands of such shipments, which may be reported separately by two or three different companies involved in the movement. While intensive work is carried out to check these returns, it is possible that some double counting of receipts may occur.

25. Temperature, pressure and natural leakage also contribute to the statistical differences. In addition, small discrepancies can occur between the estimated calorific values used at the field and the more accurate values measured at the onshore terminal where data are shown on an energy basis. The statistical differences can also be affected by rounding, clerical errors or unrecorded losses, such as leakage. Other contributory factors are inaccuracies in the reporting of the amounts being disposed of to the various activities listed, including differences between the quantities reported as going to refineries and the actual amounts passing through refineries.

26. Similarly, the data under the statistical difference headings in Tables 3.2 to 3.4 are the differences between the deliveries of petroleum products to the inland UK market reported by the supplying companies and estimates for such deliveries. These estimates are calculated by taking the output of products reported by refineries and then adjusting it by the relevant factors (such as imports and exports of the products, changes in the levels of stocks etc.).

27. It may be thought that such differences should not exist as the data underlying both the observed deliveries into the UK market and the individual components of the estimates (i.e.

production, imports, exports, stocks) come from the same source (the oil companies). While it is true that each oil company provides data on its own activities in each area, there are separate areas of operation within the companies that report their own part of the overall data. The table below illustrates this

Sources of data within oil companies	
Area covered	Source
Refinery production	Refinery
Imports and exports	Refinery, logistics departments, oil traders
Stocks	Refinery, crude and product terminals, major storage and distribution sites
Final deliveries	Sales, marketing and accounts departments

28. Each individual reporting source will have direct knowledge of its own data. For example, refineries will know what they produce and how much leaves the refinery gate as part of routine monitoring of the refinery operations. Similarly other data such as sales to final consumers or imports and exports will be closely monitored. Companies will ensure that each component set of data reported is as accurate as possible but their reporting systems may not be integrated, meaning that internal consistency checks across all reported data cannot be made. Each part of a company may also work to different timings as well, which may further add to the degree of differences seen.

29. The Department uses statistical differences as a quality assurance tool. Large statistical differences are investigated for data input and other quality issues and referred back to reporting companies where appropriate. The Department has a tolerance of 0.5% for its annual statistical balance.

Revisions.

30. Revisions can occur through either re-submitted data from companies, or through clerical errors within the Department. Where these occur, data are revised as soon as possible, usually for the following month's publication.

Adjustments

31. The data supplied by oil companies are the primary source of data, but individual company returns are adjusted in certain circumstances. Circumstances include:

- Missing data. Where a company has experienced difficulty with data supply in a given month, estimates are used. These estimates will be based on previous data and general market trends and revisions will be published as soon as practicable, usually for the following month;
- Erroneous data. Where a company's return is clearly erroneous and there is insufficient time to resolve, estimates are used. These estimates will be based on previous data and general market trends and revisions will be published as soon as practicable, usually for the following month;
- Use of HMRC data. The vast bulk of data is from the PPRS and DORS returns. However, motor spirit, DERV and gas oil deliveries are adjusted in line with revenue data from HMRC. HMRC data reports volumes released for consumption rather than deliveries to re-sellers.

32. Wherever possible, estimates are based on established statistical methodologies to deliver average values. Adjustments are carried out with consideration of the current economic and energy climate, and past trends of the individual time-series. When considering the past time-series, it may also be necessary to redistribute consumption from one category to another.

Main classes of supply

33. The supply of crude oil and NGLs is derived from:

- **Production** – This can relate to oil or products from the United Kingdom’s Continental Shelf (UKCS) or the petroleum products from UK refineries;
- **Imports** – Imports of oil or oil products from within or outside of the EU increase the supply of oil and oil products within the UK and show as a positive number in the commodity balances;
- **Exports** – Exports of oil or oil products to the EU or elsewhere decrease the total supply and are shown with a negative number;
- **Marine Bunkers** – UK supply is reduced through deliveries to Marine bunkers which are shown in the balances as a negative number. This covers deliveries to ocean going and coastal vessels under international bunker contracts while deliveries to fishing, coastal and inland vessels are excluded;
- **Other Sources** – Upstream oil operations generate a significant amount of Natural Gas Liquids (Ethane, Propane, Butane and Condensate). As these are finished products they are shown as a negative in the upstream balance (under transfers) and a positive in the downstream balance;
- **Stock change** – The total amount of supply will also be moderated by changes in the stock held by refineries, though stock changes represent relatively small amounts in the context of the UK supply. Positive numbers indicate a stock fall (increasing the amount of supply available as stock is drawn down) and negative numbers indicate that product is being withdrawn from supply into storage.

Main classes of demand

34. Demand is divided between

- **Transformation**– This is the use of oil products for electricity or heat generation. The primary demand here is for **Electricity generators**. This includes petroleum products used to generate electricity at oil refineries.
- **Energy Industry Use** – This is the product used to operate petroleum refineries. Typically, these are petroleum coke, natural gas, fuel oil and a small amount of gas oil.
- **Final consumption** – which is further subdivided into industry use, transport use, and other use.

35. DORS reports deliveries into consumption, as opposed actual consumption or use. Inland deliveries will not necessarily be consumed in the United Kingdom (e.g. aviation fuels).

Main classes of consumer

36. Within the main classes of demand, various breakdowns are available. These are more detailed in the annual tables than the monthly and quarterly tables.

- **Agriculture** - Deliveries of fuel oil and gas oil/diesel for use in agricultural power units, dryers and heaters. Burning oil for farm use.
- **Iron and steel** - Deliveries of petroleum products to steel works and iron foundries. This is based on information from the Iron and Steel Statistics Bureau.
- **Other industries** - The industries covered correspond to the industrial groups shown in Table 1E of DUKES excluding Iron and Steel of Chapter 1.

- **National navigation** - Fuel oil and gas/diesel oil delivered, other than under international bunker contracts, for fishing vessels, UK oil and gas exploration and production, coastal and inland shipping and for use in ports and harbours.
- **Railways** - Deliveries of gas/diesel oil to railways are based on estimates produced by AEA Energy and Environment as part of their work to compile the UK Greenhouse Gas Inventory(year - 2 basis). A year – 1 estimate is produced based on passenger number and freight volumes from the Office of Rail Regulation (ORR). See Energy Trends article in the June 2011 edition at:
http://webarchive.nationalarchives.gov.uk/20130103053406/http://www.decc.gov.uk/en/content/cms/statistics/publications/trends/articles_issue/articles_issue.aspx
- **Air transport** - Total inland deliveries of aviation turbine fuel and aviation spirit. The figures cover deliveries of aviation fuels in the United Kingdom to international and other airlines, British and foreign Governments (including armed services) and for private flying.
- **Road transport** - Deliveries of motor spirit and DERV fuel for use in road vehicles of all kinds.
- **Domestic** - Fuel oil and gas oil delivered for central heating of private houses and other dwellings and deliveries of kerosene (burning oil) and liquefied petroleum gases for domestic purposes
- **Public services** - Deliveries to national and local Government premises (including educational, medical and welfare establishments and British and foreign armed forces) of fuel oil and gas oil for central heating and of kerosene (burning oil).
- **Miscellaneous** - Deliveries of fuel oil and gas oil for central heating in premises other than those classified as domestic or public.

Product definitions – energy use

37. Around 90% of oil and oil products are used for energy. DUKES reports on each of these categories listed below. Quarterly and monthly tables are presented at a higher level of aggregation.

- **Refinery fuel** - Petroleum products used as fuel at refineries. Typically, these are petroleum coke, natural gas, fuel oil and small amount of gas oil.
- **Ethane** – A naturally gaseous straight-chain hydrocarbon (C₂H₆) in natural gas and refinery gas streams. Primarily used, or intended to be used, as a chemical feedstock.
- **Propane** - Hydrocarbon containing three carbon atoms(C₃H₈), gaseous at normal temperature but generally stored and transported under pressure as a liquid. Used mainly for industrial purposes, but also as transport LPG, and some domestic heating and cooking.
- **Butane** - Hydrocarbon containing four carbon atoms(C₄H₁₀), otherwise as for propane. Additionally used as a constituent of motor spirit to increase vapour pressure and as a chemical feedstock.
- **Naphtha** (Light distillate feedstock) - Petroleum distillate boiling predominantly below 200 °C.
- **Aviation spirit** - All light hydrocarbon oils intended for use in aviation piston-engine power units, including bench testing of aircraft engines.
- **Motor spirit** - Blended light petroleum components used as fuel for spark-ignition

internal-combustion engines other than aircraft engines:

- (i) Premium unleaded grade - all finished motor spirit, with an octane number (research method) not less than 95.
- (ii) Lead Replacement petrol / Super premium unleaded grade - finished motor spirit, with an octane number (research method) not less than 97.
- **Aviation turbine fuel (ATF)** - All other turbine fuel intended for use in aviation gas-turbine power units and including bench testing of aircraft engines.
- **Burning oil** (kerosene or "paraffin") - Refined petroleum fuel, intermediate in volatility between motor spirit and gas oil, used primarily for heating. White spirit and kerosene used for lubricant blends are excluded.
- **Gas/diesel oil** - Petroleum fuel having a distillation range immediately between kerosene and light-lubricating oil:
 - (i) **DERV (Diesel Engined Road Vehicle) fuel** - automotive diesel fuel for use in high speed, compression ignition engines in vehicles subject to Vehicle Excise Duty. DERV is now shown as separate column in Table 3.2. An article discussing this, and changes to the monthly and quarterly tables, can be found in March 2011's edition of Energy Trends at:
http://webarchive.nationalarchives.gov.uk/20130103053406/http://www.decc.gov.uk/en/content/cms/statistics/publications/trends/articles_issue/articles_issue.aspx
 - (ii) **Gas oil** - used as a burner fuel in heating installations, for industrial gas turbines and as for DERV (but in vehicles not subject to Vehicle Excise Duty e.g. Agriculture vehicles, fishing vessels, construction equipment).
 - (iii) **Marine diesel oil** - heavier type of gas oil suitable for heavy industrial and marine compression-ignition engines.
- **Fuel oil** - Heavy petroleum residue blends used in atomising burners and for heavy-duty marine engines (marine bunkers, etc.) with heavier grades requiring pre-heating before combustion. Excludes fuel oil for grease making or lubricating oil and fuel oil sold as such for road making.

Product definitions – non energy use

38. Oil products are used for several non-energy uses and comprise around 10% of the UK's demand. DUKES reports on each of these categories listed below. Quarterly and monthly tables are presented at a higher level of aggregation.

- **Feedstock for petroleum chemical plants** - All petroleum products intended for use in the manufacture of petroleum chemicals. This includes middle distillate feedstock of which there are several grades depending on viscosity. The boiling point ranges between 200°C and 400°C.
- **White spirit and specific boiling point (SBP) spirits** – These are refined distillate intermediates with a distillation in the naphtha / kerosene range. White spirit has a boiling range of about 150°C to 200°C and is used as a paint or commercial solvent. SBP spirit is also known as Industrial spirit and has a wider boiling range that varies up to 200°C dependent upon its eventual use. It has a variety of uses that vary from use in seed extraction, rubber solvents and perfume.
- **Lubricating oils (and grease)** - Refined heavy distillates obtained from the vacuum distillation of petroleum residues. Includes liquid and solid hydrocarbons sold by the lubricating oil trade, either alone or blended with fixed oils, metallic soaps and other organic and/or inorganic bodies.

- **Bitumen** - The residue left after the production of lubricating oil distillates and vacuum gas oil for upgrading plant feedstock. Used mainly for road making and building construction purposes. Includes other petroleum products such as creosote and tar mixed with bitumen for these purposes and fuel oil sold specifically for road making.
- **Petroleum wax** - Includes paraffin wax, which is a white crystalline hydrocarbon material of low oil content normally obtained during the refining of lubricating oil distillate, paraffin scale, slack wax, microcrystalline wax and wax emulsions. Used for candle manufacture, polishes, food containers, wrappings etc.
- **Petroleum cokes** - Carbonaceous material derived from hydrocarbon oils, uses for which include metallurgical electrode manufacture. Quantities of imports of this product are used as a fuel.
- **Miscellaneous products** - Includes aromatic extracts, defoamant solvents and other minor miscellaneous products

Uses of the data

39. BEIS itself is one of the main users of the Oil and oil product statistics as these figures are included monthly, quarterly (Energy Tables) and annual (DUKES) statistics to help provide the complete energy picture.

40. In addition, the figures are also used when BEIS makes projections of energy demand, fuel mix and resulting CO₂ emissions. Outside of BEIS, the statistics are also used by HM Treasury (for example to feed in to budget advice), the Department for Transport, the oil industry and others. There is also an international interest in these statistics as we are required to submit oil information to the IEA and Eurostat on a monthly and annual basis.