Office for National Statistics

Low Carbon and Renewable Energy Economy (LCREE) Survey: indirect estimates methodology

Information on the methods used to calculate indirect estimates from the Low Carbon and Renewable Energy Economy (LCREE) Survey.

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Notice

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Statistics and analysis relating to 2023 indirect estimates using this dataset were previously published in our main Low carbon and renewable energy economy, UK bulletin series. Information relating to indirect estimates will now be released as a separate Low Carbon and Renewable Energy Economy (LCREE) Survey indirect estimates, UK bulletin series. Indirect estimates data is still published separately in our Low carbon and renewable energy economy indirect estimates dataset.

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1 . Overview of the Low Carbon and Renewable Energy Economy Survey

The Low Carbon and Renewable Energy Economy (LCREE) Survey is the primary source of official information on LCREE activity in the UK. The survey was designed and developed in consultation with stakeholders from government departments and devolved administrations, who are the primary users of the data, following demand for LCREE official statistics.

We consider businesses to be operating within the LCREE if they provide information on economic activity within 17 predefined sectors. These sectors are listed in the "Low carbon and renewable energy sectors" section of the Glossary in our LCREE Survey bulletin. These sectors do not need to represent the main activity of a business to be counted.

Businesses in the survey are selected using the Standard Industrial Classification (SIC) 2007. This groups businesses into industries based on the type of economic activity in which they are engaged. The selection is done using the Inter-Departmental Business Register (IDBR) as a sampling frame. The LCREE Survey samples around 25,000 businesses annually from SIC codes we consider likely to contain relevant activity.

The survey provides estimates at the UK and four-nation level for:

- turnover
- number of businesses
- imports
- exports
- employees (in full-time equivalents)
- capital investment

All the estimates are in current prices as provided by the survey respondents; no inflation adjustments are made.

However, the survey does not collect data on additional activity in the economy that is generated because of the demand for the inputs used by businesses active in the LCREE directly; this additional activity is referred to as "indirect LCREE activity".

We have improved our methods to calculate indirect LCREE estimates. However, further work is required to address areas where there may be some remaining double counting, resulting in a bias towards overestimation of the total (direct plus indirect) LCREE estimates. While these methodological limitations remain, these estimates will continue to be classed as official statistics in development.

More information on LCREE Survey results and methodology can be found in our latest LCREE Survey bulletin and Quality and methodology information (QMI) report.

Concepts and definitions

The creation of any product to satisfy final demand has a wider impact on the economy than just the monetary value of that sale. The following definitions explain the use of goods and services within an economy.

Final use

Final consumption expenditure, which is the consumption of products that do not contribute further to the creation of other products.

Intermediate use

The consumption of products that are used up or transformed to create other products.

Changes to final use of goods and services in the economy can have wider effects than their direct output and consumption, and can lead to other economic effects. The following definitions explain these different economic effects.

Direct effect

The immediate effect caused directly by a change in final use.

Indirect effect

The subsequent effect caused by the consequent changes in intermediate use.

For more information on direct and indirect effects, see our UK Input-Output Analytical Tables, 2010 (PDF, 508KB)
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Indirect and total activity in the LCREE

We produce indirect estimates to gain a more comprehensive understanding of the impact that the LCREE has on the wider economy. These provide a better indication of the effect caused by intermediate use within the LCREE production process.

This is because producers in the LCREE will require the input of other goods and services to carry out this activity. These inputs to the LCREE production process will in turn require other goods and services to produce them, therefore creating an indirect effect in the supply chain and demand in other products across the economy.

Total LCREE estimates can be generated by summing direct and indirect LCREE effects together:
$$Direct\ LCREE\ effect + Indirect\ LCREE\ effect = Total\ LCREE\ effect$$

Both total and indirect LCREE estimates are classed as official statistics in development.

2 . Previous methodology

Previously, we used a multiplier method to estimate indirect activity for turnover and employment generated by the Low Carbon and Renewable Energy Economy (LCREE).

These multipliers were calculated by adjusting values from our Employment multipliers and effects in the UK dataset. This provides a list of employment multipliers for UK Standard Industrial Classification (SIC) codes (more information is available in Section 1: Overview of the LCREE Survey).

These multipliers measure the ratio between direct and total (direct plus indirect) economic impact caused by a change in final use. We adjusted these multipliers (for both turnover and employment) to generate new bespoke multipliers for each LCREE sector. This was done by applying the proportion each industry was contributing to overall turnover and employment within each LCREE sector and then adding up all the contributing industries.

However, applying these by-sector multipliers to calculate LCREE indirect estimates presented two issues. Firstly, each LCREE sector is made up of activity in several industries in varying proportions. Therefore, generic multipliers for a given LCREE sector were not appropriate for fully capturing the interactions between different SIC industries.

Secondly, these multipliers can be applied to direct effect data to calculate total economic effect. The LCREE Survey estimates were used to represent the direct effect required for this calculation. However, this was not an accurate representation because the survey questionnaire does not distinguish between final and intermediate use. This means LCREE-related intermediate use (and therefore some indirect activity) is included in the multiplication. This double counting lead to an overestimate of indirect activity.

See our Input-output analytical tables: guidance for use article for more information on employment multipliers and their use.

3 . Improved methodology

We have reviewed and updated our methodology for producing low carbon and renewable energy (LCREE) indirect estimates. This method uses the UK industry-by-industry input-output analytical tables (IOTs) in its calculations.

What are UK input-output tables (IOTs)

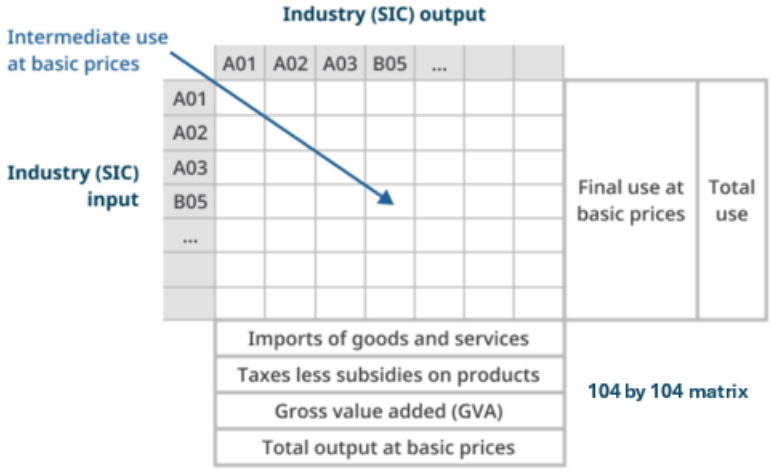
IOTs play an important role in understanding the structure of the economy, they are derived from the information provided in our Supply and Use Tables (SUTs). These SUTs show the product inputs to the production of an industry. The two types of IOT that can be derived from the SUTs are:

- product-by-product IOTs: which describe how products (and primary inputs) are used to produce further products and to satisfy final use
- Industry-by-industry IOTs: these describe the input-output interdependencies between different Standard Industrial Classification (SIC) codes (see Section 1: Overview of the LCREE Survey) in the economy

As the LCREE Survey sample is constructed using industry SIC codes, the industry-by-industry IOTs can be used to produce indirect LCREE estimates.

The Office for National Statistics (ONS) produces industry-by-industry IOTs, which are kept under continual review. These are currently published as a 104 by 104 SIC code matrix. Within this matrix, each row represents the amount of financial input that an industry provides to the various by-industry columns. The columns represent the amount of output each industry generates from each individual row. Figure 1 shows the industry-by-industry structure of the IOT:

Figure 1: Structure of our industry-by-industry input-output tables (IOTs)



Source: Low Carbon and Renewable Energy Economy (LCREE) Survey methodology from the Office for National Statistics

More information on the IOTs can be found in our Input-output analytical tables: guidance for use article.

Producing LCREE indirect estimates using IOTs

To produce estimates of indirect activity in the LCREE, we use matrix manipulation to transform the original industry-by-industry IOTs so that the by-industry output columns are replaced with LCREE sectors. This is done initially using LCREE turnover data to produce indirect turnover estimates. These are then converted to indirect employment estimates using multipliers. These multipliers are the same as those used for the method described in Section 2: Previous methodology. However, in our new method, we use them much later in the process.

The first step in this process is to aggregate the original 104 by 104 rows and columns in the industry-by-industry IOTs to produce a new 52 by 52 matrix (an aggregated IOT) that aligns with the LCREE Survey.

The following subsections give an example from the LCREE low emission vehicles and infrastructure sector to illustrate this approach (sector descriptions are available in Section 1: Overview of the LCREE Survey).

A-matrix (or matrix of coefficients) – 52 by 52

To calculate the A-matrix, the individual cell values of intermediate use are divided by total output at basic prices. In other words, all cell values in the aggregated IOT are divided by their column totals so that the total of each column is equal to one.

This matrix provides coefficients for calculating input requirements (rows) per unit of output (columns). For example, generating an additional £1 million of electric vehicle turnover for the low emission vehicles and infrastructure sector requires various products as inputs to produce electric vehicles for final use. The A-matrix provides coefficients able to quantify the value of this requirement for a change in final output.

Unit matrix (or I matrix) – 52 by 52

In a unit matrix, all off-diagonal cells have a value of zero and all diagonal cells have a value of one. A 52 by 52 unit matrix is constructed for this analysis.

Leontief matrix (L) – 52 by 52

This is calculated as the inverse of the difference between the unit matrix (I) and the A-matrix:
$L = (I - A)^{-1}$

Whereas the A-matrix helps analyse direct relationships within the economy, the Leontief inverse begins to take supply chains into account and is central to our method.

For the example of generating £1 million of extra electric vehicle turnover, there would be a certain value of output generated by UK industries to satisfy supply chains; for example, manufacture of tyres, electric motors, plastic products and other components. This turnover would be additional to the £1 million generated by the low emission vehicles, and by the infrastructure sector itself; it could also be seen across many other industries. The Leontief inverse provides coefficients able to quantify this additional turnover.

Effects matrix – 52 by 52

This is calculated by multiplying the A-matrix by the Leontief inverse:
$\mathrm{Effects} = \mathrm{A} - \mathrm{matrix\ X\ Leontief\ inverse}$

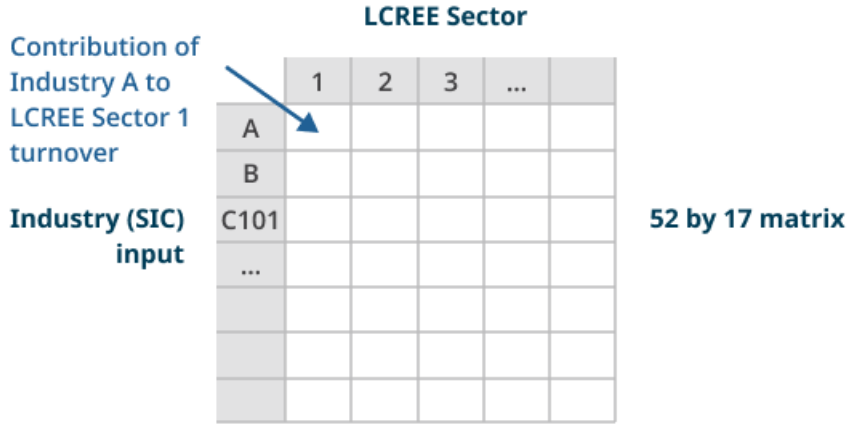
The effects matrix shows the total gross value added (GVA) that is attributable to all the intermediate use following a change in final use. In the electric vehicle example, the effects matrix would provide coefficients that combine final product-related business-to-business interactions (captured by the A-matrix) with interactions required to satisfy supply chains (captured by the Leontief inverse). The effects matrix provides coefficients able to quantify this effect on the whole economy for a change in final output.

LCREE Survey turnover vector – 52 by 17

The A-matrix, Leontief inverse, and effects matrix are all derived directly from the UK industry-by-industry input-output tables. They provide coefficients that can quantify the effect that a change in final output within a given industry will have across the whole economy.

Generating the LCREE Survey turnover vector is the point in the process where data collected by the LCREE Survey are inputted into the calculations. LCREE turnover data from the survey can be divided up into a 52 by 17 grid of turnover by SIC code (rows) and LCREE Sector (columns):

Figure 2: Structure of our LCREE Survey turnover vector



Source: Low Carbon and Renewable Energy Economy (LCREE) Survey methodology from the Office for National Statistics

Final use vector – 52 by 17

The LCREE Survey turnover vector contains turnover data in different industries as collected by the LCREE Survey. However, as discussed in Section 2: Previous methodology, the LCREE Survey does not specify between intermediate and final use. This means some intermediate use data are contained within the LCREE Survey turnover vector that need removing before indirect effect calculations can be carried out.

This can be done by multiplying each cell in the LCREE Survey turnover vector by the ratio between final use and total use for that industry (taken from the aggregated IOT):

$$\text{Final use} = \text{LCREE Survey turnover X } \frac{\text{final use by industry (from IOT)}}{\text{total use by industry (from IOT)}}$$

The resulting vector represents the level of final use captured by the LCREE Survey, with intermediate use now removed.

Monetary impact matrix (indirect LCREE turnover) – 52 by 17

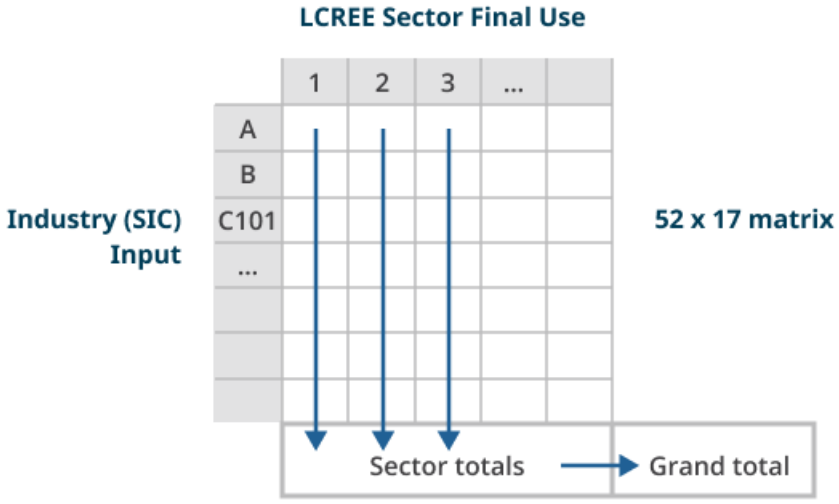
The monetary impact matrix is calculated by multiplying the effects matrix by the final use vector from the LCREE:

$$\text{Monetary impact matrix} = \text{effects matrix X final use}$$

In this stage, we combine the IOT matrix development with LCREE turnover recorded by the survey. Multiplying LCREE final use by the effects matrix calculates the total amount of intermediate use needed to satisfy LCREE final use (or the effect of this final use on the rest of the economy).

This monetary impact matrix has the desired structure for calculating indirect LCREE effect, as the input rows by SIC industry now feed into output columns that are represented by LCREE sectors. This matrix can therefore be used to generate indirect turnover estimates. The structure of this impact matrix is shown in Figure 3.

Figure 3: Structure of our LCREE monetary impact matrix



Source: Low Carbon and Renewable Energy Economy (LCREE) Survey methodology from the Office for National Statistics

Figure 3 shows that the column totals of this monetary impact matrix provide by-sector estimates of indirect LCREE turnover. Adding all 17 column totals together provides an estimate of total UK indirect turnover.

Employment impact matrix (indirect LCREE employment) – 52 by 17

This stage of the process uses our Employment multipliers and effects in the UK dataset to convert indirect turnover to indirect employment.

Contained within this dataset is a "Full Time Equivalents (FTEs) per £ million (£m)" column. This provides a ratio between employment and turnover for the 104 UK Standard Industrial Classification (SIC) codes (see Section 1: Overview of the LCREE Survey).

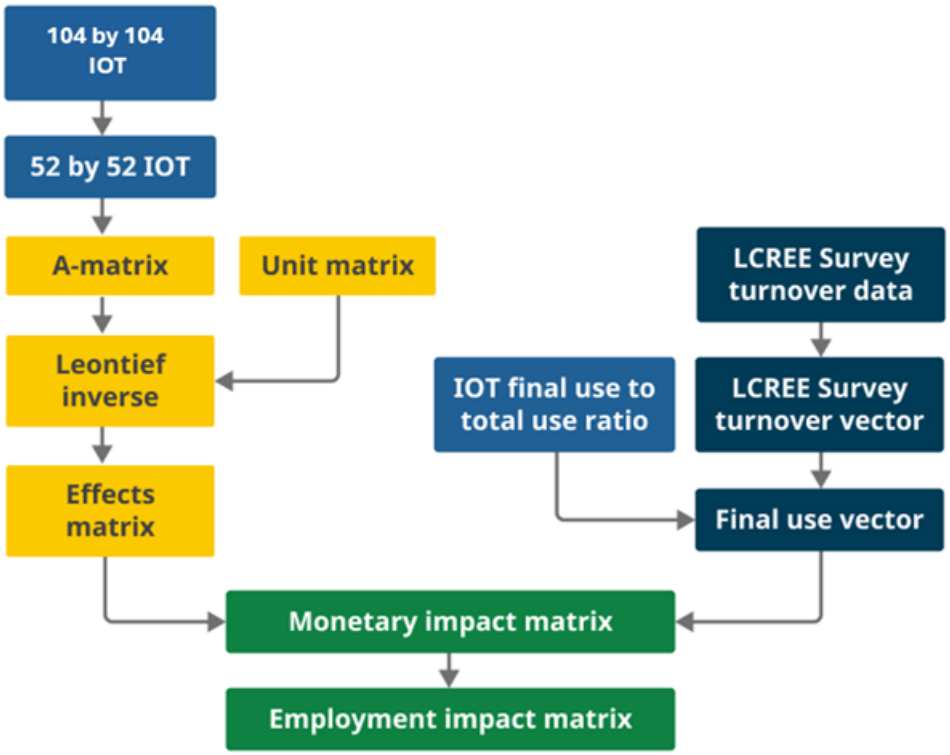
Once these data have been aggregated to match the 52-row structure of the industries in the monetary impact matrix, the "FTE per £m" numbers can be used to convert monetary impact into employment impact (in FTEs), using the same structure as shown in Figure 3.

Like the monetary version, the column totals of the employment impact matrix provide by-sector estimates of indirect LCREE employment. Adding all 17 column totals together provides an estimate of total UK indirect employment.

Process overview

An overview of the steps outlined in the previous sections is shown in Figure 4.

Figure 4: Overview of our revised LCREE indirect estimates methodology



Source: Low Carbon and Renewable Energy Economy (LCREE) Survey methodology from the Office for National Statistics

For more details on the A-matrix, Leontief inverse, effects and multipliers see our Input-output analytical tables: guidance for use article.

4 . Quality Information

Assumptions

Combining Low Carbon and Renewable Energy Economy (LCREE) Survey data with UK input-output tables (IOTs) to generate indirect LCREE estimates, requires the broad assumption that the LCREE sectors follow the same input-output structure as industries in the UK economy as a whole. This is a necessary assumption given the availability of current data.

The main assumptions made during our new methodological process are that:

- the relationship between total and final use is the same for a LCREE sector as it is for the industry as a whole
- the distribution of sales of each industry's LCREE portion will be the same as the industry as a whole
- the LCREE part of each industry shares the wider industry's input structure
- the employment multipliers used to transform monetary impact into employment impact are representative of the LCREE portion of each industry

Limitations

Overestimation of total LCREE effect

As outlined in Section 2: Previous methodology, the multiplier method we previously used lacked industry input-output detail. Additionally, double counting led to overestimated indirect estimates.

Our new method removes intermediate use from the LCREE Survey data in its calculations of the indirect LCREE effect. This resolves our previous method's issues with double counting during the production of indirect LCREE estimates.

However, some limitations remain when these indirect numbers are used to calculate total LCREE effect, as Figures 5 and 6 demonstrate.

A visual demonstration of our previous method is shown in Figure 5.

Figure 5: Overview of our previous LCREE indirect estimates methodology

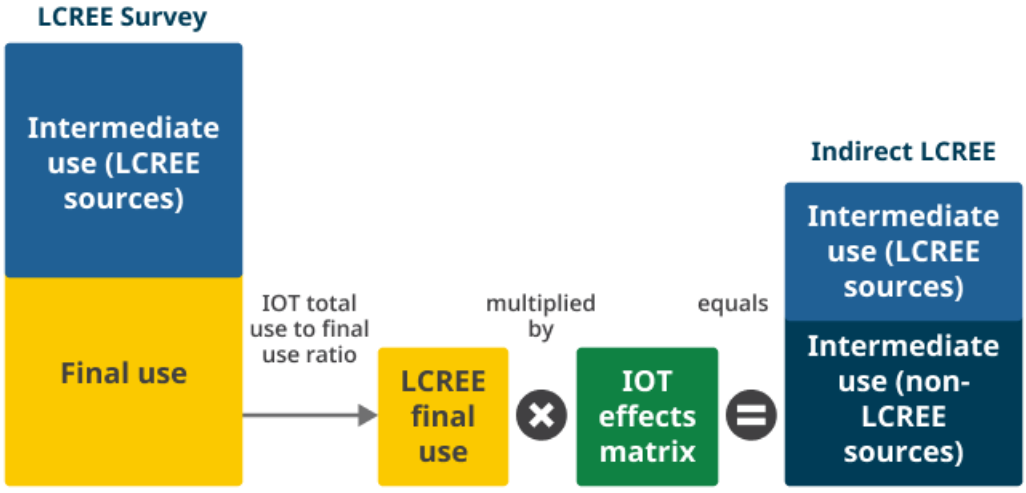
Source: Low Carbon and Renewable Energy Economy (LCREE) Survey methodology from the Office for National Statistics

Notes:

1. This diagram is not to scale, it is for illustrative purposes only.

A visual demonstration of our new method is shown in Figure 6.

Figure 6: Overview of our new LCREE indirect estimates methodology



Source: Low Carbon and Renewable Energy Economy (LCREE) Survey methodology from the Office for National Statistics

Notes

1. This diagram is not to scale, it is for illustrative purposes only.

The LCREE Survey does not distinguish between final and intermediate use. For example, in the sale of an electric vehicle, the LCREE Survey may pick up the car company selling the vehicle to the consumer, but it may also pick up, for example, the company that builds the electric motor that was sold to that car company. We consider both the car company and the company that sells the motor to be active in the LCREE.

Adding LCREE indirect effect to direct LCREE effect gives total LCREE effect (as described in the equation in Section 1: Overview of the LCREE Survey). However, the LCREE Survey data are currently being used to represent direct effect. This is not completely accurate because the LCREE Survey data contain some intermediate use (and therefore some indirect activity) from LCREE sources (as shown in Figure 4). This therefore leads to some double counting when calculating the total LCREE effect.

Our indirect estimates, calculated using the new method, factor in intermediate use from both LCREE and non-LCREE sources. Providing a more accurate representation of total LCREE effect would require separating out these two sources. However, this is not currently possible with the available data.

Indirect turnover and wider economic output

In this methodology, we have used the column totals of the monetary impact matrix as by-sector estimates of indirect turnover (see Section 3: Improved methodology). However, combining the LCREE final use vector with the effects matrix calculates an indirect effect that contains more than turnover collected from sales. These values are better represented as an economic output that, in addition to turnover, factor in activity including:

- work still in progress
- unsold goods
- products that are free at the point of consumption

In the production of these statistics, we are using turnover as a proxy for output.

Future developments and user feedback

Until the limitations outlined in this section have been addressed, these estimates will continue to be classed as official statistics in development. We would welcome any feedback from our user community about our estimates and methods. Any future development work that takes place will be discussed in our annual LCREE Survey bulletin.

Estimates for 2014

The LCREE Survey was conducted for the first time in 2015, collecting data for the calendar year 2014. The sampling methodology and the method used to calculate business counts for sectors within the LCREE was changed following the publication of 2014 final estimates in May 2016. Comparing estimates from 2014 with estimates from later years of the survey is not advised because of changes in the methodology that were implemented in 2015. For this reason, we have not included 2014 indirect estimates.

More information on the LCREE Survey sampling methodology can be found in our LCREE Survey QMI.

Indirect estimates for 2015 to 2016

The methodology used to generate UK IOTs is constantly under review, which means the number of rows or columns may change over time. In 2017 a major piece of development work was undertaken that resulted in industry-by-industry IOTs being generated for the first time. Only product-by-product tables had been produced previously (more details are available in Section 3: Improved methodology).

This means the new methodology for calculating LCREE indirect estimates, is only applicable to 2017 data onwards. This presented a challenge for data published before 2017. After assessing different options, we decided to apply 2017 IOTs to the 2015 and 2016 LCREE data to produce indirect estimates for these years.

Other options included attempting to adjust the product-by-product IOTs for these two years, however our chosen method was found to provide more stability in the estimates. We consider it reasonable to assume the 2017 structural analysis of the UK economy can be applied to 2015 and 2016.

Timeliness

The latest version of our UK IOTs is available in our 2023 dataset. This is one year behind our LCREE publication, for which data is available up to 2024.

We have decided to use provisional estimates to account for this lag and provide data in the timeliest possible manner to users. For any year of LCREE data where IOTs are not yet available, we will use IOTs from the most up-to-date year to produce provisional indirect estimates.

These provisional estimates will be provided until an IOT is produced that aligns to the LCREE year in question, at which point these estimates will be updated.

5 . Related links

Low carbon and renewable energy economy, UK: 2024
Bulletin | Released 25 February 2026
Estimates of the size of the UK's low carbon and renewable energy economy, including turnover and employment.

Low Carbon and Renewable Energy Economy (LCREE) Survey QMI
Methodology | Released 25 February 2026
Quality and methodology information for the Low Carbon and Renewable Energy Economy (LCREE) Survey, detailing methods used, data it provides, and strengths and limitations.

UK inputoutput analytical tables: industry by industry
Dataset | Released 11 December 2025
Industry by industry and further analysis tables derived from the annual Supply and Use Tables (SUTs) for 2023.

Employment multipliers and effects in the UK
Dataset | Released 19 December 2025
Estimates of full-time equivalent (FTE) employment per £m, type 1 FTE employment effects, and type 1 FTE employment multipliers across 104 industries. These are official statistics in development.

Input-output analytical tables: guidance for use
Article | Released 1 April 2022
This is a guide for the use of input-output analytical tables (IOATs). It provides insights on how to interpret them and is aimed at users looking to familiarise themselves with IOATs.

6 . Cite this methodology

Office for National Statistics (ONS), released 25 February 2026, ONS website, methodology,Low Carbon and Renewable Energy Economy (LCREE) Survey: Indirect estimates methodology