

Low Carbon and Renewable Energy Economy (LCREE) Survey QMI

Quality and Methodology Information for the Low Carbon and Renewable Energy Economy (LCREE) Survey, detailing the strengths and limitations of the data, methods used and data uses and users.

Contact:
David Ainslie or Kirsty Mackenzie
environment.accounts@ons.gov.
uk
+44 (0)1633 455847

Release date:
13 January 2020

Next release:
To be announced

Table of contents

1. [Output information](#)
2. [About this Quality and Methodology Information report](#)
3. [Important points](#)
4. [Quality summary](#)
5. [Quality characteristics of the Low Carbon and Renewable Energy Economy \(LCREE\) Survey data](#)
6. [Methods used to produce the Low Carbon and Renewable Energy Economy \(LCREE\) Survey data](#)
7. [Other information](#)
8. [Annex 1: Indirect activity in the LCREE](#)

1 . Output information

Designation	Official Statistics
Survey name	Low Carbon and Renewable Energy Economy (LCREE) Survey
Data collection	Sample 24,000 businesses
Frequency	Annual
How compiled	Sample-based survey
Geographic coverage	UK
Related publications	Low carbon and renewable energy economy, UK
Last revised	2 October 2019

2 . About this Quality and Methodology Information report

This quality and methodology report contains information on the quality characteristics of the data (including the [European Statistical System five dimensions of quality \(PDF, 1.19MB\)](#)) as well as the methods used to create them.

The information in this report will help you to:

- understand the strengths and limitations of the data
- learn about the existing uses and users of the data
- understand the methods used to create the data
- help you to decide suitable uses for the data
- reduce the risk of misusing data

3 . Important points

- The Low Carbon and Renewable Energy Economy (LCREE) Survey is the primary source of official information on LCREE activity in the UK.
- Estimates are available at the UK and UK country level of turnover, number of businesses, imports, exports, employees (in full-time equivalents) and capital investment.
- Estimates of the accuracy associated with LCREE Survey-based estimates are provided along with the estimates; for lower-level disaggregations of the survey data, for example, country and specific LCREE sector, the accuracy of estimates can be low, limiting the use of the data.
- The survey only collects data on direct LCREE activity and not indirect activity (that is, the additional activity in the economy generated because of demand for the products of LCREE-active firms, the wages they pay to employees, or the increase in demand for the inputs used by businesses directly active in the LCREE).
- LCREE activity does not have to be the main activity of a business for a business to be counted as active in the LCREE economy.

4 . Quality summary

Overview

The Low Carbon and Renewable Energy Economy (LCREE) Survey was designed to provide estimates of the LCREE in the UK, following demand for official statistics on this topic. The survey was conducted for the first time in 2015, for the reporting year 2014.

[Results from the survey](#) can be used to provide estimates of activity in 17 LCREE sectors as outlined in the [questionnaire \(PDF, 212KB\)](#). Estimates of turnover, number of businesses, imports, exports, employment and capital assets are available at the UK and UK-country level.

The LCREE Survey currently samples approximately 24,000 UK businesses using the [Inter-Departmental Business Register](#) (IDBR) as the sampling frame. The design is a stratified single-stage simple random sample with the target population being stratified by industry, employment size and UK country. Sample selection occurs independently within each stratum.

Sample respondents are weighted to represent a number of non-sampled businesses within the same stratum. As many nil returns are received, estimates are calculated using a two-stage process in combination with Winsorisation, to improve the quality of results. Standard errors are calculated assuming that the estimator of the population total is a product of independent random variables and takes into account both the variability in the estimate of the proportion of non-zero LCREE activity and the variability of the estimate of the population total assuming all non-zero response.

Results with associated measures of their accuracy are published approximately 12 months after the reference period. The data published are estimates for the calendar year, January to December.

Uses and users

Estimates from the LCREE Survey are currently used by international organisations, UK and devolved governments and the wider research community. They can be used to help assess and develop policies in areas such as green job creation, investment in the LCREE economy or the trade of LCREE products.

Some examples of users and uses include:

- the Department for Business, Energy and Industrial Strategy (BEIS) uses estimates from the LCREE Survey as an informative framework for the development of cross-cutting and sector-level policies across the clean growth and climate change areas.
- LCREE Survey estimates are published in the new [ACSES](#) (Annual Compendium of Scottish Energy Statistics) publication and the [Energy Statistics Database](#); the data are used to track Scotland's renewable and low-carbon ambitions as lined in [Scotland's Energy Strategy](#)
- LCREE Survey estimates are published in the biennial [Energy in Northern Ireland](#) compendium publication; the data are used in briefing to policy colleagues regarding the size of the low-carbon economy in Northern Ireland and will be used in any review of the Northern Ireland Strategic Energy Framework
- several government departments regularly use LCREE data for general briefing to ministers and to inform responses to Parliamentary Questions that are received regarding the size of the low-carbon economy
- estimates from the LCREE Survey may be used to contribute to international monitoring and regulation; for example, they are used to help fulfil regulatory required statistics such as estimates of the [Environmental Goods and Services Sector](#) produced under the [UN System of Environmental Economic Accounting \(UN SEEA\)](#) framework and to contribute to Sustainable Development Goal (SDG) indicators such as [Indicator 7.b.1: Investment in Energy Efficiency as a proportion of GDP](#)
- estimates from the LCREE Survey are used in combination with national accounts information to help provide an indication of the indirect economic impacts of activity in the LCREE (see Annex 1)

Strengths and limitations

The main strengths of the LCREE Survey include:

- the LCREE response rate is consistently above 80% at the publication of results
- the LCREE questionnaire collects activity by sector, which allows users to gain a thorough insight into the type of activities operating in the low-carbon economy within the UK

The main limitations of the survey include:

- the final and only estimates are published around 12 months (January) after the period to which the data relate, because of the size and complexity of the survey
- the accuracy of survey-based estimates for smaller LCREE sectors and country-level disaggregations, which is highlighted by 95% confidence intervals and coefficients of variation (CV) published together with the [estimates](#), can be variable, which limits the use of some of the data; sample optimisation as the survey continues each year should improve the ability to target LCREE businesses, improving the accuracy of estimates for smaller sectors

Recent improvements

LCREE government user group meetings are held quarterly to give an opportunity for any changes or developments to the LCREE Survey to be discussed directly with the survey's main users (Department for Business, Energy and Industrial Strategy, Welsh Government Environment, Energy and Rural Affairs, Northern Ireland Department for the Economy, Scottish Government Energy and Climate Change Directorate) to ensure the survey continues to meet policy requirements.

For example, following feedback, the LCREE Survey for the 2018 reporting period now enables turnover from the Government Feed-in Tariff Scheme to be captured separately from total turnover. This change ensures the survey is useful for helping assess the impact of a relevant government policy.

From the 2018 reporting period onwards, following user request, associated 95% confidence intervals of all survey-based estimates will be provided to aid user interpretation of the accuracy of LCREE estimates.

5 . Quality characteristics of the Low Carbon and Renewable Energy Economy (LCREE) Survey data

This report provides a range of information that describes the quality of the output and details any points that should be noted when using the output.

We have developed [Guidelines for Measuring Statistical Quality \(PDF, 1.19MB\)](#); these are based upon the five European Statistical System (ESS) quality dimensions. This report addresses these quality dimensions and other important quality characteristics, which are:

- relevance
- timeliness and punctuality
- coherence and comparability
- accuracy and reliability
- accessibility and clarity

More information is provided about these quality dimensions in the following sections.

Relevance

Relevance is the degree to which the statistical product meets user needs for both coverage and content.

The Low Carbon and Renewable Energy Economy (LCREE) Survey has been developed in consultation with stakeholders from government departments, who are the primary users of the data, following demand for LCREE official statistics.

A stakeholder group was set up that includes representatives from the Department for Business, Energy and Industrial Strategy, Welsh Government, Scottish Government and Northern Ireland Department for the Economy. Workshops were organised during the start-up phase of the survey to ensure the questionnaire and sample selection met requirements. This included developing a list of 17 LCREE sectors for which statistics on activity were required as outlined in the [LCREE Survey Guidance](#). Stakeholders are consulted before any questionnaire changes are made.

The LCREE Survey is the primary source of official information on LCREE activity and has been designed to meet the needs of users. For example, devolved administrations required regional information, at the UK country level, on LCREE activity. Many businesses may have their reporting office in a different location to where the LCREE activity takes place. The LCREE Survey asks respondents to proportion their LCREE activity between UK regions to overcome this problem and produce robust regional statistics.

Timeliness and punctuality

Timeliness refers to the lapse of time between publication and the period to which the data refer. Punctuality refers to the time lag between the actual and planned dates of publication.

A statistical bulletin is published annually around 12 months after the period to which the data refer and includes all headline estimates of UK and country-level turnover, employment, number of businesses, imports, exports, acquisitions and disposals and, in addition, group, sector and industry breakdowns of these estimates.

All publications are pre-announced on the [Office for National Statistics \(ONS\) release calendar](#) at least four weeks in advance. If there are any changes to the pre-announced release schedule, public attention will be drawn to the change and the reasons for the change will be explained fully at the same time, as set out in the [Code of Practice for Statistics](#).

The time lag between the collection and publication of LCREE estimates reflects the size and complexity of the survey. Detailed breakdowns between low-carbon sectors and geography require detailed responses from a large number of businesses.

Coherence and comparability

Coherence is the degree to which data that are derived from different sources or methods, but refer to the same topic, are similar. Comparability is the degree to which data can be compared over time and domain, for example, geographic level.

Limited comparator data are available. Information is available on some individual LCREE sectors. However, differences in scope limit comparability. Some examples follow.

Department for Business, Energy and Industrial Strategy (BEIS) publish statistics on all renewable energy sources in the UK in the [Digest of United Kingdom Energy Statistics \(DUKES\): Chapter 6, Renewable Sources](#). These statistics cover the production of electricity and renewable electricity capacity. Statistics produced from the LCREE Survey cover all sector activity, including design, installation and maintenance in addition to the production of electricity.

Data on activity in the UK low-carbon economy between 2010 and 2013 are available from the [BEIS Low Carbon Report](#). The differences in definitions and methodology mean that the results are not directly comparable with the LCREE Survey. One significant difference is that the BEIS report used a combination of a small survey and existing data. Another important difference is that the BEIS study included the supply chain; hence the headline figures quoted by the BEIS report are far higher.

The LCREE Survey was conducted for the first time in 2015 collecting data for the calendar year 2014. This was the first survey of this kind following demand for official LCREE statistics. Continuity between the now four years of the survey has been ensured with minimal changes made to the questionnaire. Any changes made have provided further information to respondents to minimise the risk of error, following feedback from respondents. Year-on-year comparisons are now available up to and including estimates from the calendar year 2017.

Accessibility and clarity

Accessibility is the ease with which users are able to access the data, also reflecting the format in which the data are available and the availability of supporting information. Clarity refers to the quality and sufficiency of the release details, illustrations and accompanying advice.

The Low Carbon and Renewable Energy Economy (LCREE) data are made available via the [Secure Research Service](#). This provides the opportunity for approved researchers to access detailed microdata in a controlled environment.

Our recommended format for accessible content is a combination of HTML web pages for narrative, charts and graphs, with data being provided in usable formats such as CSV and Excel. Our website also offers users the option to download the narrative in PDF format. In some instances other software may be used, or may be available on request. Available formats for content published online but not produced by us, or referenced on our website but stored elsewhere, may vary. For further information please refer to the contact details at the beginning of this report.

Why you can trust our data

The Office for National Statistics (ONS) is the UK's largest producer of statistics and is its national statistics institute. [The Data Policies and Information Charter](#), available on the ONS website, details how the data are collected, secured and used in the publication of statistics. We treat the data we hold with respect, keeping them secure and confidential, and we use statistical methods that are professional, ethical and transparent.

6 . Methods used to produce the Low Carbon and Renewable Energy Economy (LCREE) Survey data

How we collect the data, main data sources and accuracy

Coverage

When the LCREE Survey was first designed, instead of sending questionnaires to all industry sectors in the economy, a target population of industries likely to have LCREE activity was developed based on four sources of evidence: evidence from the [Annual Business Survey](#), guidance from Eurostat, the target population of similar surveys administered by other national statistical institutes (NSIs) and Office for National Statistics (ONS) expert judgement. UK government stakeholders were consulted and the proposed target population of 71 two-digit [Standard Industrial Classifications \(SICs\)](#) was agreed upon.

The following industries (divisions) were excluded:

- information service industries (63¹)
- financial and insurance activities (64, 65, 66)
- public administration and defence; compulsory social security (84)
- human health and social care activities (86, 87, 88)
- arts, entertainment and recreation (90, 91, 92, 93)
- repair of computers and personal and household goods (95)
- activities of households as employers; undifferentiated goods – and services – producing activities of households for own use (97, 98)
- activities of extraterritorial organisations and bodies (99)

Following review of the data collected in the first two years of the survey, 27 industry divisions (see Table 1) were identified as not within the target population of interest and were excluded from the sample frame for the 2016 reporting period onwards. Revisions were made to previously published 2014 and 2015 estimates to account for this change.

Table 1: 27 divisions excluded from 2016 reporting period and future selections

Description	Division
Fishing	03
Extraction of oil/gas	06
Mining support services	09
Manufacture of food	10
Manufacture of beverages	11
Manufacture of textiles	13
Manufacture of clothes	14
Manufacture of leather	15
Manufacture of wood products	16
Printing/reproduction of media	18
Manufacture of coke/refined products	19
Manufacture of pharmaceuticals	21
Manufacture of furniture	31
Repair/installations of machinery	33
Retail	47
Water transport	50
Air transport	51
Accommodation	55
Food and beverage services	56
Publishing	58
Motion picture/tv etc	59
Programming/broadcasting	60
Telecommunications	61
Advertising	73
Veterinary	75
Travel agents/tours etc	79
Security	80

Source: Office for National Statistics

Concepts and definitions

Concepts and definitions describe the legislation governing the output, and a description of the classifications used in the output.

Sectors

The LCREE Survey asks respondents to report their activity in 17 LCREE sectors as reported in Table 2. These sectors were developed in consultation with LCREE experts from various government departments, who are also data users.

Groups

Experts were further consulted regarding aggregating these sectors into groups of similar activity. These six groups are reported in Table 3.

Standard Industrial Classification

Estimates are presented at an industry level using the [Standard Industrial Classification: SIC 2007](#). This is the UK standard industrial classification of economic activities.

Output objectives

The LCREE Survey was designed to provide greater detail on the low-carbon and renewable energy economy in the UK.

Data collection

The survey questionnaire was designed using our standard four-stage process:

- specialist review
- feasibility testing
- cognitive testing
- final reporting

Read the [2018 Low Carbon and Renewable Energy Economy questionnaire](#), along with guidance for survey respondents.

Paper questionnaires are sent to the selected businesses. Respondents are asked if the business operates in any of the 17 LCREE sectors in Table 2. Respondents are then asked to report the turnover, imports, exports, employment, and capital assets for any of the LCREE sectors they have operated in during the reference period. Where businesses are active in multiple LCREE sectors, respondents are asked to report the information separately for each sector.

Table 2: LCREE sectors and descriptions of activity

Sector	Description
Offshore wind	The production of electricity and the design, production, and installation of infrastructure for this purpose, including operations and maintenance.
Onshore wind	
Solar photovoltaic	
Hydropower	
Other renewable electricity	The production of electricity from wave and/or tidal and /or geothermal renewable sources and the design, production, and installation of infrastructure for this purpose, including operations and maintenance.
Bioenergy	<p>The production of energy (electricity and heat) and the design, production, and installation of infrastructure for this purpose, including operations and maintenance.</p> <p>Bioenergy is liquid biofuels, solid biomass and biogas, for example, bio methane, vegetable oil, peanut oil and energy crops. This sector includes gasification and anaerobic digestion.</p>
Alternative fuels	The production of fuels for low-carbon and renewable energy use, which is not classified as bioenergy. Including hydrogen. Excluding compressed natural gas and liquefied petroleum gas.
Renewable heat	The design, production, and installation of infrastructure for generating heat directly through solar, thermal, geothermal or other means. Including operations and maintenance. Including ground source and air source heat pumps. Excluding generating electricity, which is then used to generate heat. Excluding heat from biomass, which is classified under bioenergy.
Renewable combined heat and power	The design, production and installation of infrastructure for generating heat directly through solar, thermal, geothermal or other means where the renewable sources both generate direct heat and electricity. Including operations and maintenance. Excluding heat and power from biomass, which is classified under bioenergy.
Energy-efficient lighting	The design, manufacture and installation of energy-efficient bulbs, tubes, fittings and so on, designed to use less energy to produce the same or greater amount of light.
Energy-efficient products	<p>The design, manufacture and installation of energy-efficient products. Examples include:</p> <ul style="list-style-type: none"> • energy-efficient doors and windows • heating and ventilation, such as condensing boilers, ventilation and heating recovery • insulation such as loft, external wall, roof insulation, reducing energy consumption for heat or air conditioning by minimising “leakage” of heat • energy-efficient building materials or technologies • sustainable buildings and architecture • materials with greater insulation properties or durability properties or those requiring significantly less

	carbon emission in their manufacture or recycling waste materials in their manufacture
	Exclude: "Smart" goods such as TVs and freezers.
Energy monitoring, saving or control systems	<p>The design, manufacture and installation of systems that reduce energy consumption through effective heat or energy management. Include equipment and related systems for doing this.</p> <p>Examples include:</p> <ul style="list-style-type: none"> • smart heating controls • condensation control • control system components • energy management systems • energy management software
Low-carbon financial and advisory services	<p>Expert advice and education on: reducing carbon consumption, engaging in low-carbon industrial activities, carbon credits and funding systems for low-carbon activities and services.</p> <p>Include: environmental and/or energy consultants.</p>
Low-emission vehicles and infrastructure	<p>Design and manufacture of vehicles with specific technology to significantly reduce or remove emissions.</p> <p>Include: hybrid vehicles, electric vehicles, fuel cell vehicles or other technologies.</p> <p>Include installation of infrastructure to support these vehicles.</p> <p>Exclude: small efficiency improvements such as lighter bodywork or aerodynamics. Fuel-efficient, conventional vehicles are also excluded.</p>
Carbon capture and storage	<p>Capturing waste CO₂ at point of emission and depositing it where it will not enter the atmosphere. Activity of doing this and the design, manufacture and installation of infrastructure for this purpose.</p>
Nuclear power	<p>The production of electricity from nuclear power and the design, production and installation of infrastructure for this purpose. Including operations and maintenance. Decommissioning and waste processing activities are excluded.</p>
Fuel cells and energy storage systems	<p>The design, manufacture and installation of energy storage systems, flywheel energy storage, fuel cells, batteries and any other form of energy storage system.</p>

Source: Office for National Statistics

These 17 LCREE sectors are also aggregated into groups for results publication (see Table 3). Estimates at sector level that are considered disclosive are suppressed (see section on "Disclosure control" for more details).

Table 3: LCREE groups and description of activity

Group	Description
Low- carbon electricity	Offshore wind, onshore wind, solar photovoltaic, hydropower, other renewable electricity, nuclear power, carbon capture and storage
Low- carbon heat	Renewable heat, renewable combined heat and power
Energy from waste and biomass	Bioenergy, alternative fuels
Energy-efficient products	Energy-efficient products, energy-efficient lighting, energy monitoring, saving or control systems
Low-carbon services	Low-carbon financial and advisory services
Low-emission vehicles and infrastructure	Low-emission vehicles and infrastructure, fuel cells and energy storage systems

Source: Office for National Statistics

Sample design

The LCREE Survey samples approximately 24,000 UK businesses using the [Inter-Departmental Business Register](#) (IDBR) as the sampling frame. Sample selection is carried out using a stratified single-stage simple random sample with a target population stratified by different cells. Groups of businesses (called cells) are defined by three criteria:

- employment size-band
- industry (Standard Industrial Classification: SIC 2007)
- UK country of business registration (as per the IDBR)

There are around 900 of these cells in LCREE design. Sample selection occurs independently for each cell.

All businesses with 250 or more employees are selected, together with a random sample of businesses from each of the other strata, defined by two-digit SIC 2007 industry, country and employment size-band. Businesses that are randomly sampled are generally expected to remain in the sample for two years. The sample is supplemented with a small number of businesses that are known to be highly active in one or more of the LCREE sectors but do not have large enough employment to be selected as part of the census strata. These businesses are allocated to a reference list and will remain on the list each year as their returns are “unique” and therefore need to be added to their own cell.

The total sample is allocated between strata in order to try and minimise the variance of the estimates of total LCREE turnover at the UK, country and LCREE group-level as far as is possible.

The sample will be re-optimised to improve the efficiency of sample estimation as more data from the survey become available.

How we process the data

Editing and validation

All responses are put through validation checks and any that fail are investigated and queried with the respondent to obtain explanations for data anomalies. Sources such as the Inter-Departmental Business Register (IDBR) and business websites are also used to investigate data.

Various quality assurance exercises, such as validating nil returns, are also carried out. As a large number of nil returns are received (roughly 80% of the returns), a range of methods are employed to identify businesses for which activity is expected. These include:

- cross-checks against lists of businesses known to be transacting in the low-carbon industries
- searches for specific key words within the name such as “solar”, “wind”, “energy” and “glazing”
- sector specific checks – for example, businesses in SIC 43.2 “Electrical, plumbing and other construction installation activities”
- within the construction industries businesses are contacted to establish if they carry out installation activities for energy-efficient products

Imputation

Imputation techniques are used to estimate the value of the missing data caused by non-response.

Non-response can lead to a reduction in the precision of estimates and undermine the data's utility for users. For the LCREE Survey there are two types of imputation processes:

- item non-response imputation, which refers to incomplete responses
- unit non-response imputation, which refers to businesses that did not respond to the survey

Item non-response

Imputation methods for item non-response are based fundamentally on other survey variables that serve to predict the values or distribution of plausible values of the target variable(s) being imputed (the imputation classifications). Typically, the imputation classifications will consist of other variables from the survey that have two fundamental properties:

- they should account for any non-response bias identified in the data
- they should be good predictors of the target variable(s)

Poorly specified classifications will lead to error or bias in survey estimates.

Businesses that have provided valid responses are divided into imputation classes and the median value for the class is calculated. Item non-response replaces missing items with the median of the values returned by the other responders in the imputation class. All incomplete responses are treated for item non-response. It is important that the imputation class has enough responders to enable the imputation calculations to give a fair result. Otherwise, one very large or small response could have a large impact on the quality of the imputed values. An imputation class has to hold at least 10 responders providing complete response. Where this is not the case the next priority order imputation class would be applied.

Imputation classification order:

1. SIC 2007 section and LCREE Sector
2. SIC 2007 section and LCREE Group
3. Collapsed SIC 2007 section (A, D, F, G, M separately, all other sections combined) and LCREE Group
4. LCREE Group only

Unit non-response

When the survey was initially set up, there was no way to impute for unit non-response as there were no previous data and so all missing whole returns were dealt with through weighting to account for non-response. Once previous survey data were available, unit non-response imputation was designed for larger businesses (250 or more employees) and reference list businesses to impute the non-responders in that group with their previous data, upscaled with a growth factor. The rest of the sample non-responders are accounted for by increasing the weight for their cells (that is, as if they were not selected).

Weighting and estimation

Sample respondents are weighted to represent a number of non-sampled businesses within the same stratum. As many nil returns are received, estimates are calculated using a two-stage process, to improve the quality of results.

First, the proportion of businesses reporting any LCREE activity within a stratum is estimated. Second, a weighted aggregate of LCREE activity is calculated from those businesses reporting activity. This is achieved by removing those businesses that do not report LCREE activity and adjusting the weights of the remaining businesses to ensure they represent the non-sampled businesses appropriately. The resulting weighted responses are then aggregated. The final stage of the process is to multiply the estimate of the proportion by the weighted aggregate to estimate the population total in each stratum.

All businesses in the census strata (250 or more employees) and those from the reference list will have (ideally²) a weight of one or close to one as they represent themselves. In the first year of the survey (reporting period 2014), no reference list existed as LCREE activity was unknown. A reference list was introduced for the 2015 survey period. For businesses that had identified LCREE activity in 2014 and were then added to the reference list in 2015, this will have resulted in a reduction in their weighting.

Business counts are estimated as the weighted aggregate of the proportion of activity reported in each sector and region for each business. These count estimates are consistent across groups, regions and the whole economy.

Businesses with extreme or atypical main variable returns are automatically detected and treated using a method known as one-sided Winsorisation. The detection threshold is set to minimise the mean squared error, with those businesses identified as outliers having their values reduced towards the threshold so they do not represent as many unsampled businesses as their initial weight would imply. The parameters used to set the detection threshold are reviewed on a regular basis. It is the treated values that are used in the estimator.

In addition, some returns, with values that are atypical when compared with similar businesses and also have a large impact on estimated totals, are treated as outliers with post-stratification, that is, they are removed from their original cells and assigned to unique new ones, reducing their weights to one, so that they do not have a large distorting effect on the estimates. The weights of other businesses in the original cell as the outlier are then recalculated.

Standard errors are calculated assuming that the estimator of the population total is a product of independent random variables and takes into account both the variability in the estimate of the proportion of non-zero LCRE activity and the variability of the estimate of the population total assuming all non-zero response.

Confidentiality

The [Code of Practice for Statistics](#) guarantees confidentiality to those who provide private information for the production of Official Statistics. Principle T6.4 of the Code states: "...Personal information should be kept safe and secure, applying relevant security standards and keeping pace with changing circumstances such as advances in technology."

Furthermore, our surveys are conducted on behalf of the UK Statistics Authority and all outputs are subject to Section 39 of the [Statistics and Registration Service Act \(2007\)](#).

Business surveys operating within the UK are governed under the [Statistics of Trade Act \(1947\)](#). This states that tables should not be published that would disclose any information relating to an individual business, unless there is expressed consent in writing from that business.

Our confidentiality pledge assures confidentiality given to respondents:

"All the information you provide is kept strictly confidential. It is illegal for us to reveal your data or identify your business to unauthorised persons".

Statistical disclosure

Statistical disclosure control methodology is applied to LCRE data. This is to make sure that information attributable to an individual or individual organisation is not identifiable in any published outputs.

The [Statistical Disclosure Control Policy](#) sets out the standards for safeguarding the information provided in confidence to us. "Disclosure control" refers to the methods that reduce the risk that confidential information is published in any official statistics. These methods are applied if ethical, practical or legal considerations require the data to be protected. Disclosure control involves modifying data so that the risk of identifying individuals is reduced, but at the same time attempts to find a balance between improving confidentiality protection and maintaining an acceptable level of quality in the published data.

How we quality assure and validate the data

Accuracy

The degree of closeness between an estimate and the true value.

Figures from the LCREE are survey-based estimates. Surveys gather information from a sample rather than from the whole population. The sample is designed to allow for this, and to be as accurate as possible given practical limitations such as time and cost constraints, but results from sample surveys are always estimates and not precise figures. This means that they are subject to some uncertainty. This can have an effect on how changes in the estimates should be interpreted. Estimates of the level of uncertainty associated with all figures (coefficients of variation (CV)) reported are presented in the datasets to aid interpretation.

In general, changes in the estimates reported between each year are not usually greater than the level that is explainable by sampling variability. This means movements in the estimates should be treated as indicative only.

As in all surveys, the estimates in the Low Carbon and Renewable Energy Economy (LCREE) Survey are subject to various sources of error. The total error in a survey estimate is the difference between the estimate derived from the data collected and the true (unknown) value for the population. The total error consists of two main elements: the sampling error and the non-sampling error. The LCREE Survey was designed to minimise both these errors.

Sampling error

This occurs because estimates are based on a sample rather than a census of the population. The results obtained for any single sample may, by chance, vary from the true values of the population but the variation would be expected to be zero on average over a number of repeats of the survey. Sampling error is minimised through the use of a stratified random sample.

Sampling error is continually monitored with CV calculated for each output measure. The CV is the standard error of a variable divided by the survey estimate and it is used to compare the relative precision across surveys or variables. The closer the CV is to zero, the more accurate the estimate in percentage terms. A rough guide to CVs is: 5% is very good, 10% is good, 20% is acceptable, over 20% should be used with caution.

Confidence intervals of 95%, the range within which the true population would fall for 95% of the times the survey was repeated, will be provided from the publication of 2018 data onwards following user feedback. This is another standard way of expressing the statistical accuracy of a survey-based estimate. If an estimate has a high error level and CV, the corresponding confidence interval will be very wide.

Non-sampling error

There is potential for non-sampling error, which cannot be easily quantified. These can be caused by coverage issues, measurement and non-response. A number of steps are taken to minimise non-sampling error and are listed in this section.

Validation checks

Returned information is run through a series of validation checks to identify any errors. Data that fail the validation checks are queried with respondents to confirm or correct the original data.

Responses are further quality-assured using a number of resources. For example, keyword searches are undertaken on company names. Information from trade membership organisations is also used.

Response accuracy

Following dispatch of the questionnaire, up to two reminders are sent to businesses that have not responded. Response-chasing exercises are also carried out, targeting large businesses in important industries that are likely to be operating in the LCREE sectors. The LCREE Survey consistently achieves a response rate of over 80% by publication release.

In addition, LCREE has a rolling programme of questionnaire reviews where stakeholders are consulted on any changes that may be implemented to improve and clarify the survey questions and supporting notes, and hence help respondents complete the survey more accurately.

LCREE calendar year results

LCREE estimates are published for calendar years. However, in order to reduce the burden on respondents, businesses have, and some use, the option to return data for their business year-end, covering any 12-month period up to and including the end of the financial year that follows the end of the calendar year. It is possible that, particularly if the economy is undergoing a period of rapid change such as during an economic downturn, the different reporting periods could introduce some bias.

Regional apportionment

Estimates are calculated on regional LCREE activity at the UK country level. For businesses with multiple sites, using the country recorded on our business register was likely to result in assigning the LCREE activities to the country where the reporting head office was located. A question was therefore tested and added to ask respondents to proportion their LCREE activity between UK countries to enable accurate regional estimates to be produced.

Industry classification in the Inter-Departmental Business Register

Industry re-classification of a business can occur because of a relatively small change to the nature of its operation and this can have a significant effect on LCREE estimates by industry. In addition, the correction of misclassification of businesses can lead to bias, particularly where there is systematic movement from one industry to another. This is because, where classification updates are identified via survey returns, it is only units in the survey sample that are updated.

Where a survey does not cover the whole business population, such as the LCREE, re-classification can lead to units moving out of the sample, but never into it. In the LCREE, this effect is likely to be small and is corrected for by adjusting the weights of the businesses that remain in the sample.

How we review and maintain data processes

Revisions

Revisions are not unusual, especially in the first few years of a new survey and result from a variety of factors, including:

- the incorporation of additional data received from businesses that have been sampled in multiple years of the survey
- changes to data as a result of businesses revising their previous submissions
- developments in methodology

Revisions are a standard practice when producing official statistics and over time, as more information becomes available, estimates can be revised to improve the quality and accuracy, which will provide a better picture of that being measured.

If revisions arising through improvements to methodology or changes to data are found to be insignificant, they will be introduced in the next planned final estimates bulletin. For the LCREE Survey, revisions to previous estimates are only typically collated for the last two reporting periods.

Assessment of user needs and perceptions

The processes for finding out about uses and users, and their views on the statistical products.

The survey has been developed in consultation with stakeholders from government departments, who will be the main users of the data. A stakeholder group was set up that includes representatives from the Department for Business, Energy and Industrial Strategy (BEIS), Welsh Government, Scottish Government and Northern Ireland Department for the Economy.

Workshops with a wide variety of users were organised during the start-up phase of the survey to ensure the questionnaire and sample selection met user requirements. Following dispatch, monthly highlight reports are provided to the stakeholder group to update on progress. Regular additional workshops are also organised at important points in the survey cycle to update stakeholders further and discuss any developments in detail.

Notes for: Methods used to produce the Low Carbon and Renewable Energy Economy (LCREE) Survey data

1. Standard Industrial Classification (SIC) of Economic Activities system, 2007.
2. The census strata are supposed to have selected and collected the responses of all of the businesses we know about. But not all of them respond, and if they never responded to the LCREE Survey, there are no data for them to construct their response, so the weights for those from the census strata are adjusted to compensate for the non-responders.

7 . Other information

More information on the Low Carbon and Renewable Energy Economy Survey and other topics related to the UK Environmental Accounts are available:

- [UK Environmental Accounts](#)
- [Low Carbon and Renewable Energy Economy survey: statistical bulletin](#)
- [Low Carbon and Renewable Energy Economy survey: information for businesses taking part in the survey](#)

8 . Annex 1: Indirect activity in the LCREE

Most economic transactions increase economic activity by a larger amount than their size – this is because any transaction results in an increase in another economic actor's income or demand for an input, which in turn results in an increase in their spending, or investment.

Multipliers can be used to estimate the indirect effect an economic activity has on the wider economy, such as additional activity due to demand generated for the products of other firms by the wages paid to employees, or the increase in demand for the inputs used. A multiplier effect is the impact an economic transaction has on the wider economy; the multiplier measures the overall increase in economic activity resulting from the transaction, proportional to its size.

Total activity estimates for the Low Carbon and Renewable Energy Economy (LCREE) Survey (that is, direct activity captured by the survey plus indirect activity captured by using multipliers) can be calculated by applying multipliers to the survey estimates.

Multipliers for output, employment and other aspects of economic activity are estimated regularly by the Office for National Statistics (ONS) for each industry per Standard Industrial Classification: SIC 2007. However, these cannot be readily applied to the LCREE Survey estimates, because each LCREE sector is made up of activity in several different industries and in different proportions. Therefore to be used with the LCREE Survey data, these multipliers need to be adjusted on the basis of each industry's proportional share in a LCREE sector and country.

Estimates of indirect and total activity LCREE estimates derived in this manner are published within the LCREE Survey statistical bulletin and are currently classified as [experimental](#).

The methodology used to produce them is currently being reviewed in collaboration with external stakeholders such as BEIS, Welsh Government, Scottish Government and Northern Ireland Department for the Economy. Noted limitations of the current methodology are the current application of only UK-level multipliers to sub-UK level estimates and the potential for double-counting direct and indirect activity, if the LCREE Survey captures some aspects of LCREE activity that might be considered indirect.

The results of this work will be made available with the next LCREE statistical bulletin in early 2020.