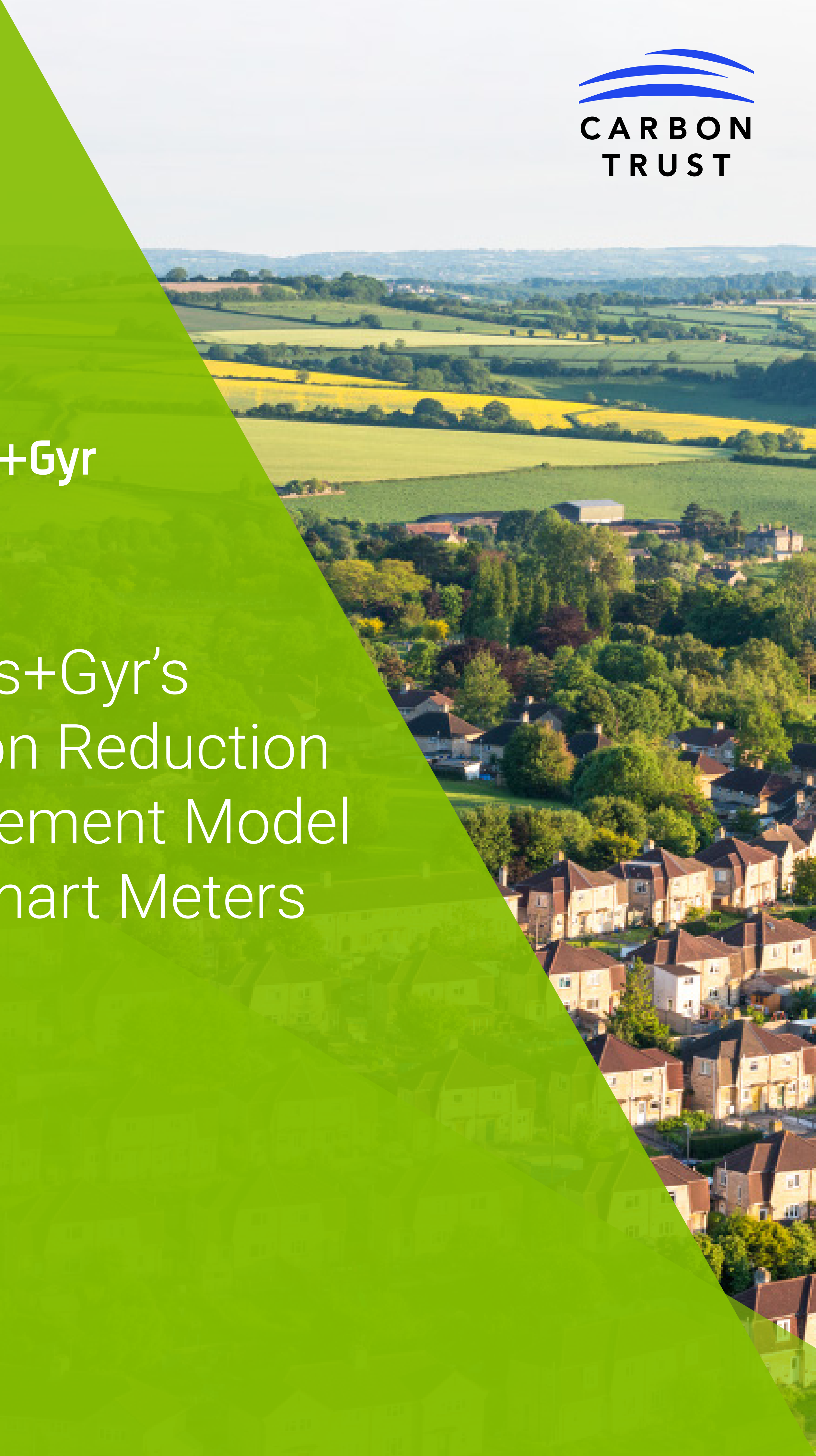
CARBON TRUST

Landis+Gyr

Landis+Gyr's Carbon Reduction Enablement Model for Smart Meters



About the Carbon Trust

The Carbon Trust is a global climate consultancy driven by the mission to accelerate the move to a decarbonised future. Climate pioneers for over 20 years, it partners with businesses, governments and financial institutions to drive positive climate action.

From strategic planning and target setting to implementation and communication, the Carbon Trust turns ambition into impact. To date, its 400 experts have helped set over 200 science-based targets and guided more than 3,000 organisations and cities across five continents on their route to Net Zero.

About Landis+Gyr

Landis+Gyr is a leading global provider of integrated energy management solutions. We measure and analyze energy utilization to generate empowering analytics for smart grid and infrastructure management, enabling utilities and consumers to reduce energy consumption. Our innovative and proven portfolio of software, services and intelligent sensor technology is a key driver to decarbonize the grid. Landis+Gyr manages energy better – since 1896. With sales of USD 1.7 billion in FY 2022, Landis+Gyr employs around 7,800 talented people across five continents. For more information, please visit our website www.landisgyr.com.

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Aim

Landis+Gyr provides tools to manage energy more efficiently and thereby helps customers to reduce energy consumption. One such tool is Landis+Gyr's smart meters, which enable energy consumption reductions by influencing the behavior of customers. Meters facilitate higher awareness and monitoring of consumption by providing detailed information on energy use, and various studies have demonstrated the energy saving impact of smart meter installation.

In 2019 the company wanted to understand the positive impact of its smart meter products and decided therefore to build a model to estimate it. Since it was the benefit provided to the environment that should be analyzed, it was clear that the impact should express greenhouse gas (GHG) savings enabled by Landis+Gyr's smart meter products, in terms of carbon dioxide equivalent (CO_2e).

History

Landis+Gyr created a model that calculates the benefit created by its smart meters deployed worldwide and expresses the benefit in CO_2e savings enabled. This type of model is often called a "carbon enablement model", which quantifies avoided emissions due to a specific product or service.

The approach to quantifying savings is to assess the existing situation, or baseline, and compare it with the situation after the installation of Landis+Gyr's smart meters.

To be able to express the savings for the worldwide infrastructure of smart electricity meters deployed, the calculation was performed on a country-by-country basis to reflect country specific characteristics and deployment volumes.

The calculation is based on the electricity consumption reduction enabled by Landis+Gyr's smart electricity devices. Such a reduction is achieved by better informing energy users of their energy consumption, which leads to a behavioral change. The installed smart meter communicates detailed information about energy consumption frequently and regularly, thereby providing the foundation for consumers to be well educated on their energy consumption and consequently motivated to act upon and reduce their consumption.

Historic Model Set-up and Sources

The expected or realized reduction in energy use had to be attributed to the households served by a Landis+Gyr smart meter point. Hence, we looked for the average electricity consumption per household in the market served. The average consumption was then applied to the number of households served by Landis+Gyr's smart meter points. Then, the total energy consumption in each market was multiplied by the percentage savings expected in that market, which, if available, were obtained from publicly available studies via desk-based research. The resulting estimate of energy savings in each market was translated into CO_2e by applying the electricity grid emission factor for the respective market.

SOURCES:

Electricity grid emission factors: IEA
Average electricity consumption per household: Statistical Office of the respective market
Installed base: Landis+Gyr statistics
Energy reduction expected or realized: Different scientific publications for the respective market, including Cost Benefit Analysis (CBA) calculation for smart meter roll-out in the specific country

After several years of calculating the CO_2e reduction enabled by the Landis+Gyr smart meter installed base with the above-described model, the company wanted to explore updating the model considering the latest research on the topic.
For that aim Landis+Gyr engaged in a project with the Carbon Trust.

Model Update Supported by the Carbon Trust

In collaboration with the Carbon Trust, we quickly understood that the fundamental approach chosen for the original model was still best practice. However, for some of the calculation variables, newer or more accurate data had become available. Below is a technical summary of the modelling approach taken, assumptions made, data sources and the frameworks/standards that have informed the approach.

OVERVIEW OF AVOIDED EMISSIONS METHODOLOGY AND APPROACH

Avoided emissions is the measurement of carbon savings resulting from the use of products and services. The measurement of savings is against a "business as usual" baseline of greenhouse gas emissions that would have otherwise occurred. In this case, "business as usual" is defined as a household not being served by a smart meter.

The calculation approach is for a quantity (unit of measure) to be multiplied by a carbon savings factor per unit of quantity.

CARBON SAVINGS MECHANISM

Smart metering is the installation of energy meters, which have the capability of remote connectivity and communication. They record the consumption of energy (gas or electricity) on frequent regular intervals (typically at least once per hour) and communicate the information back to the energy utility company at least daily to allow remote reporting. They also allow two-way communication so that the utility company can perform remote functions like remote re-connection, disconnection, and load reduction.

The reporting from the smart meters is also available to the energy consumer, and this feedback provides a mechanism for reduction in energy use through behavioral change.

Smart meters are seen as an important tool to reduce domestic energy demand and manage energy networks more efficiently. Various studies have demonstrated that the installation of smart meters and associated initiatives have resulted in energy consumption reductions.

CALCULATION AND ASSUMPTIONS

The scope of the model includes both smart electricity and smart gas meters, and the calculation approach can be seen in the equation below. For each geography, the annual avoided emissions in tons of CO_2e are found by multiplying together the average annual household consumption (in kWh) for either electricity or natural gas, the annual savings % per smart metered household (electricity or natural gas), the relevant emission factor and the number of smart meters.

Annual avoided emissions (tCO_2e) = *Country specific average annual household electricity/gas consumption (kWh)* X *Annual electricity/gas savings per smart metered household (%)* X *Natural gas/electricity emission factor (CO_2e / kWh)* X *No. smart meters in the market*

Annual percentage savings per smart meter for both the electricity and natural gas smart meters are also found in literature. Literature values were taken preferably from case studies that were conducted and showed actual savings as well as from the European Commission's savings estimates for the report 'Benchmarking smart metering deployment in the EU'. For geographies for which a specific savings figure was not found, an average value from all other geographies was used.

The natural gas lifecycle emission factor was taken from BEIS 2021 and was assumed to be the same for all countries and across all years.

The electricity lifecycle emission factor is made up of five components: generation, trade adjustment, transmission and distribution (T&D) losses, well-to-tank for generation, and well-to-tank for transmission and distribution. Generation, trade adjustment and transmission and distribution loss emission factors are taken from the IEA and are country specific. The well-to-tank (WTT) factors for generation and T&D losses are taken from BEIS 2021 which uses UK-specific values as a basis for approximation due to a lack of country-specific data.

The volume data is the number of active smart meters in each market. It is assumed that the lifetime of a smart meter is 15 years and that all shipped smart meters are installed. Using the data of shipped smart meters by Landis+Gyr, the number of active smart meters is calculated in a given year by considering the lifetime.

ASSUMPTIONS

- The lifetime of a smart meter is 15 years (assumption provided by Landis+Gyr).
- Every residential household has one electricity M2M connection.
- Residential households with gas smart meters only have one M2M connection per household.
- The annual average electricity and gas consumption per household is the same for all years.
- The natural gas emission factor is the same for all markets across all years.
- All shipped smart meters are installed and used for their full lifetime.
- Smart meter sales are assumed to be made to customers with no smart meter installed.
- Assume that the behavioral change associated with smart meters persists over the full lifetime of the smart meter at the same savings percentage.
- The model does not consider potential impacts of behavioral effects such as the Hawthorne effect (results of an experiment are due to subjects being aware of participating in an experiment) or drawback effect (that reaction diminishes as the newness wears off).
- For markets where no specific % savings figure was found from a reputable source, the average from the rest of the markets was used.
- Secondary enabling effects and rebound effects are not considered.

DATA SOURCES

Electricity – average annual household consumption (kWh)

Australia:	Residential energy consumption benchmarks - 9 December 2020_0.pdf (aer.gov.au)
Austria:	Electricity consumption per dwelling | Electricity dwelling | ODYSSEE-MURE
Canada:	Household energy consumption, by type of dwelling, Canada and provinces (statcan.gc.ca)
Denmark:	Electricity consumption per dwelling | Electricity dwelling | ODYSSEE-MURE
Finland:	Electricity consumption per dwelling | Electricity dwelling | ODYSSEE-MURE
France:	Electricity consumption per dwelling | Electricity dwelling | ODYSSEE-MURE
Germany:	Electricity consumption per dwelling | Electricity dwelling | ODYSSEE-MURE
Italy:	Electricity consumption per dwelling | Electricity dwelling | ODYSSEE-MURE
Japan:	Average Household Electricity Consumption - 2023 - Shrink That Footprint
Netherlands:	Electricity consumption per dwelling | Electricity dwelling | ODYSSEE-MURE
New Zealand:	Electricity Authority - EMI (market statistics and tools) (ea.govt.nz)
Slovenia:	Electricity consumption per dwelling | Electricity dwelling | ODYSSEE-MURE
South Africa:	https://www.enerdata.net/estore/energy-market/south-africa/
Spain:	Electricity consumption per dwelling | Electricity dwelling | ODYSSEE-MURE
Sweden:	Electricity consumption per dwelling | Electricity dwelling | ODYSSEE-MURE
Switzerland:	Electricity consumption per dwelling | Electricity dwelling | ODYSSEE-MURE
UK:	https://www.gov.uk/government/statistics/energy-consumption-in-the-uk-2020
USA:	https://www.eia.gov/tools/faqs/faq.php?id=97&t=3#:~:text=How%20much%20electricity%20does%20an,about%20893%20kWh%20per%20month.

Electricity – average annual electricity savings per smart meter (%)

Australia: https://unfccc.int/climate-action/momentum-for-change/activity-database/momentum-for-change-smart-metering-for-electricity-distribution-automation-and-home-energy-management

Austria: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014SC0188&from=EN

Canada: https://nsuarb.novascotia.ca/sites/default/files/M08349%20Decision.pdf

Denmark: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014SC0188&from=EN

Finland: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014SC0188&from=EN

France: https://eu.landisgyr.com/blog/erdf-calls-for-bids-for-second-wave-of-linky-smart-meter

Germany: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014SC0189&from=EN

Italy: https://erranet.org/wp-content/uploads/2017/09/Highly-Acknowledged-Paper_PitiTeam_Paper_Award_2017.pdf

Netherlands: Dutch Smart Meter Energy savings Monitor final version (smart-energy.com)

New Zealand: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014SC0188&from=EN

Slovenia: https://www.ecoplan.ch/download/smmu_sb_de.pdf

South Africa: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/276656/smart_meter_roll_out_for_the_domestic_and_small_and_medium_and_non_domestic_sectors.pdf

Spain: https://www.energy.gov/sites/default/files/2021-07/insights-smart-meters-final-report.pdf

Natural gas – average annual household consumption (kWh)

Netherlands: https://www.odyssee-mure.eu/publications/efficiency-bysector/households/average-energy-consumption-dwelling.html

UK: https://www.gov.uk/government/statistics/energy-consumption-in-the-uk-2020

USA: https://www.eia.gov/consumption/residential/data/2015/c&e/pdf/ce2.1.pdf

Natural gas – average annual savings per smart meter (%)

Netherlands: Dutch Smart Meter Energy savings Monitor final version (smart-energy.com)

UK: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/276656/smart_meter_roll_out_for_the_domestic_and_small_and_medium_and_non_domestic_sectors.pdf

- Conversion factors: https://www.iea.org/data-and-statistics/data-tools/unit-converter
- Emission factors for Generation, trade adjustment, T&D losses emission factors: IEA 2006 - 2021
- Emission factors for WTT for generation and T&D losses emission factors: BEIS 2006 – 2021-https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting
- Emission factors for Quebec electricity generation:
  - 2020 - 2014: https://publications.gc.ca/collections/collection_2022/eccc/En81-4-2020-3-eng.pdf
  - 2009 - 2013: https://publications.gc.ca/collections/collection_2016/eccc/En81-4-2013-3-eng.pdf
  - 2006 - 2009: https://publications.gc.ca/collections/collection_2010/ec/En81-4-2008-3-eng.pdf
- Natural gas emission factor: BEIS 2021 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1049333/conversion-factors-2021-full-set-advanced-users.xlsm

Standards and Reviewed Documents

While there are no published standards that comprehensively cover the calculation of avoided emissions, the following reference documents provide related coverage of the topic. All documents reviewed here are specific to ICT, but are based on more generic ISO standards, the GHG Protocol standard and the Avoided Emissions Framework developed by the Net Zero Compatible Innovations Initiative (NZCII). The following documents are of relevance:

- Mission Innovation's Net-Zero Compatible Innovations Initiative features "The Avoided Emissions Framework (AEF)", published in 2020, which provides guidance for how avoided emissions can be assessed. This framework provides guidance and a step-by-step approach to assessing avoided emissions and includes a comprehensive list of references to related initiatives and methodologies. The Avoided Emissions Framework is the leading methodology document.
- ETSI TS 203 199: Methodology for environmental Life Cycle Assessment (LCA) of Information and Communication Technology (ICT) goods, networks and services is a document developed by the European Telecommunications Standards Institute (ETSI) which superseded the ETSI TS 103 199 report. It is technically equivalent to ITU-T L.1410
- GeSI Digital with Purpose: Delivering a SMARTer2030, identifies and quantifies how digital technologies can help governments, businesses, and philanthropic organizations accelerate their efforts to achieve each SDGs. The report considers seven digital technologies which have been chosen as broadly representative of the way digital capability will evolve in the medium term and for their critical influence on the world. These technologies include: digital access, faster internet, cloud, the internet of things (IoT), cognitive, digital reality, and blockchain. Of the 169 SDG targets, 103 are directly influenced by these technologies.
- ICT Enablement Methodology: Building on existing assessment standards and proposed methodological approaches, as well as the commitment of industry leaders

and researchers, GeSI has developed a methodology tailored to the needs of the ICT industry and its customers, with a focus on ease of assessment where possible.

- GeSI ICT Handbook: This handbook is a report providing practical support to practitioners who are calculating avoided emissions from ICT. This handbook includes a summary of existing methodologies, examples of calculations, and a set of carbon abatement factors.
- GeSI Mobile Carbon Impact Report: This study commissioned by the Global e-Sustainability Initiative (GeSI) aims to identify how mobile communication technology is enabling sustainable development. The report assessed the avoided emissions that are enabled by this technology in different sectors and industries.
- GSMA, The Enablement Effect: This report assesses the avoided emissions enabled by mobile telecommunications technologies at a global scale, using representative countries, covering an extensive range of technology use-cases. The calculation methodology used is consistent with the methodology described in the Avoided Emissions Framework.
- The report "Evaluating the carbon-reducing impacts of ICT", published by GeSI in 2010, provides an assessment methodology for calculating the carbon savings related to the enabling effect of ICT
- ITU-T L.1410 - "Methodology for environmental impacts assessment of information and communication technologies (ICT) goods, networks and services". Part II of this ITU recommendation provides a framework and guidance for the 'comparative analysis between ICT and a reference product system'
- ITU-T L.1430 – "Methodology for assessment of the environmental impact of information and communication technology greenhouse gas and energy projects" published in 2013
- International Electrotechnical Commission IEC TR 62726:2014 and 62725:2013 – "Guidance on quantifying greenhouse gas emission reductions from the baseline for electrical and electronic products and systems"
- Forum for the Future's report "Measuring your way to Net Positive"

The Carbon Trust is a company limited by guarantee and registered in England and Wales under Company number 04190230 with its Registered Office at: Level 5, Arbor, 255 Blackfriars Road, London SE1 9AX, UK.

Published in the UK: 2023.