Methodology paper - albert carbon calculator

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ALBERT

Contents

Introduction

albert is the screen industry authority on environmental sustainability. Founded in 2011, the project supports the industry in eliminating its environmental impact as well as developing on-screen content that is compatible with a sustainable climate.

At the heart of albert's offer to the industry lies its bespoke carbon calculator which has been designed expressly for the production community to understand the carbon footprint of making a film or TV show, and where their emissions are coming from.

This paper details the methodology behind the latest updates to the albert calculator. This is the fourth iteration of the albert calculator, released in October 2022.

The recent updates have been the most comprehensive to date making the albert calculator arguably the most specific and accurate carbon calculator tool available to the screen production industry.

The albert calculator is available for use across the globe and as such contains emission factors from a variety of sources. For example; any measurement in the UK will be calculated using the Department for Environment, Food and Rural Affairs (DEFRA) data, for other countries the calculator uses the most reliable and accurate sources available. The calculator has a database of 309 electricity emission factors (Appendix, table 1) for different countries and states.

The emission factors, benchmarks and activities recorded will be subject to an annual audit and review internally in consultation with the albert Directorate and Consortium, as well as third parties where appropriate. This is to ensure that the calculator continues to follow the most accurate and up to date global guidelines on emissions reporting and can continue to serve the screen industry.

Emission factors

The emission factors used for the United Kingdom have been provided by DEFRA. The current iteration of the calculator uses DEFRA factors published on 22 June 2022. Updated factors are published annually in July, the calculator will therefore be updated accordingly.

For international countries, albert collaborated with the sustainability consultants at Building Research Solutions Ltd, who provided electricity and rail emission factors for countries outside the UK - (Appendix, table 1).

For any unit conversions of activity data (km to miles, litres to US gallons, etc.) standard unit conversions have been used. Details can be found in the appendix (tables 2:5).

Which gases does albert report on?

Emission outputs from the calculator will be given in the unit tonnes of carbon dioxide equivalent (tCO_2e). This is a universal unit of measurement to indicate the global warming potential (GWP) of greenhouse gases (GHGs). tCO_2e incorporates the emissions associated with the seven main GHGs that contribute to climate change covered by the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3).

When reporting emission intensity, the unit emission per hour of broadcast has been used (tCO_2e/hr) as this unit provides the best representation for all TV and film regardless of genre and production method.

Reporting Scopes

All emission factors used cover scope 1, 2 and 3 emission reporting where possible. The definitions of the scopes are:

Scope 1 (direct emissions) emissions are those from activities owned or controlled by your organisation. Examples of Scope 1 emissions include emissions from the combustion of owned or controlled boilers, vehicles, etc. as well as the leakage of refrigerant gases used in air-conditioning units in company-owned or controlled buildings and spaces.

Scope 2 (energy indirect) emissions are those released into the atmosphere that are associated with your consumption of purchased electricity, heat, steam and cooling. These indirect emissions are a consequence of your organisation's energy use, but occur at sources you do not own or control.

Scope 3 (other indirect) emissions are a consequence of your actions that occur at sources you do not own or control and are not classed as Scope 2 emissions. Examples of Scope 3 emissions are business travel by means not owned or controlled by your organisation, water, waste disposal, and materials or fuels your organisation purchases.

This year, Outside of Scope emissions have been removed from the emissions factor associated with burning biomass and biofuels. This had previously been included to account for the direct carbon dioxide (CO_2) impact of burning biomass and biofuels, but falls outside of Scope 1,2,3 emissions. The emissions are labelled 'outside of scope' because the Scope 1 impact of these fuels has been determined to be a net '0' (since the fuel source itself absorbs an equivalent amount of CO_2 during the growth phase as the amount of CO_2 is released through combustion).

Certified Renewable Energy

In order to affect the greatest behavioural change of those using the calculator, an emission factor of 0 $kgCO_2e/kWh$ of electricity from Certified Renewable Energy has been used, to amplify the potential environmental impact of making this switch.

How the emissions are calculated

Production users input raw data into the tool (e.g., kWh usage in studio) which is multiplied by the relevant emission factors to quantify the GHG emissions associated with that activity.

GHG emissions = activity data x emission factor

Currency and exchange rates

When given the option to measure activity by spend, the calculator provides the option to input data in British pound sterling (GBP) as this is the most common currency in the data sets used to create the benchmarks.

For fuel spend, a data set (Global Petrol Prices) with different currencies has been used, to prevent the need for currency exchange.

The option to build a live exchange calculator into the tool (EX.com) is being explored, to allow productions to use their local currency for every possible entry.

Non-filming and filming spaces

Electricity, gas and heat & steam

All UK electricity factors are taken from DEFRA. For countries outside the UK, a variety of open sources have been used (please refer to the table in the appendix.).

All heat and steam (domestic) heating factors applied in the carbon calculator are taken from DEFRA.

Natural gas from the grid that is used for heating in buildings uses emission factors from DEFRA. The units used for measuring grid gas consumption vary geographically, with this in mind the albert calculator tool offers measurements in kilowatt hours (kWh), gigajoules (Gj) and cubic meters (m^3). Conversion of the DEFRA emission factor from kWh to Gj and m^3 has been calculated using conversion factors and fuel properties listed in the DEFRA emission conversion factor document.

Fuels

Generators:

The albert calculator is using DEFRA emission factors for its fuel options in the calculator. When using biofuels, the emission factors were calculated by using DEFRA's suggested calculations. 'Outside of Scope' figures for fuels that have a biogenic source, e.g. biofuels, pump diesel and petrol have not been included.

To calculate the emission factors for biofuels (biodiesel and bioethanol) the below formula was used:

Emissions Factor Generation for biodiesel % blend, example – 20%

[0.2 x (emission factor of biodiesel + WTT)] + [(1-0.2) x (emission factor of 100% mineral diesel + WTT)]

Where: WTT = well-to-tank, i.e., emissions associated with production of a fuel, including resource extraction, initial processing, transport, fuel production, distribution and marketing, and delivery.

Data used to calculate the carbon emissions by giving the fuel spend data have been taken from the global petrol prices site. The fuel price data provided is country specific and provided in the currency of use in the respective country.

To reflect an increase in the production and use of hydrogen fuel in the industry, we have now included this as an option for generators. DEFRA do not currently list an emission factor for this fuel type. albert uses two conversion factors: one for green hydrogen (average of wind and solar) and one for brown hydrogen, which have been derived from Parkinson et al. (2019) and Ajanovic et al. (2022) academic sources.

Heaters, special effects, cooking and other:

A number of location crews, industry caterers and SFX companies were consulted with, to make sure all the most commonly used fuels are included in the albert calculator.

As isobutane and propane are in the refrigerants section of the DEFRA emissions factor tables, the assumption has been made that they will have the same or similar WTT figures as LPG.

Fuel List: Below is the list of fuel options for generators, heaters, special effects, cooking and other (where relevant).

Gas	Biodiesel (B20)	Propane
Petrol (average biofuel blend)	Biodiesel (B40)	Butane
Diesel (average biofuel blend)	Biodiesel (B99)	Burning Fuel
LPG	CNG	Heating Oil

Diesel (100% mineral)	Aviation Turbine Fuel	Kerosene
Biodiesel (B100)	Jet Fuel	Aviation Gasoline
Biodiesel (B5)	LNG	HVO waste fuel
Biodiesel (B7)	Natural Gas (100% mineral)	Fuel Oil
Hydrogen (green)	Bioethanol (E100)	Bioethanol (E10)
Renewable petrol waste	Hydrogen (other)	

Non-filming

Benchmarks

Production office:

The calculator uses the Chartered Institution of Building Services Engineers (CIBSE) benchmarking tool and Guide F to calculate benchmarks (having taken an average of good practice and typical energy consumption) for the office types below, provided by CIBSE.

- Individual offices (no air-con)
- Open plan (no air-con)
- Air-conditioned (standard)
- Air-conditioned (prestige/HQ)

It was assumed that the offices have 11 m^2 per person (Government Office Health and Safety on Space) and the data is taken for a calendar year rather than a working year, according to the CIBSE guidance. This is then multiplied by the relevant emission factors (depending on the country) for electricity and/or gas where necessary; the calculator uses the following formula:

Emissions associated with Production Office (tCO2e) = [(Benchmark x #full time employees x #number of days) x emissions factor for electricity and gas] / 1000

Working from home:

The working from home benchmark is taken from EcoAct's working from home benchmarking methodology. This benchmark looks at three main areas, office equipment, heating energy and cooling energy (where relevant), and assumes 240 working days per year based on 28 days annual leave and a 40- hour working week. Other assumptions are listed in the EcoAct methodology which is provided in the reference section below. As per DEFRA recommendations and various academic sources, the homeworking benchmark is now weighted 91% gas and 9% electricity.

All entries that select a "certified green energy" tariff are still calculated, however the emissions associated with electricity consumption are zero. This option should only be selected if the electricity used in the house is meeting with the 100% renewable energy certification required.

Water

The albert calculator has been updated to include the emissions associated with the supply and treatment of water. The calculator uses water emission factors taken from DEFRA (2021). This emission factor measures water in cubic meters (m^3). To increase usability, the tool also enables productions to measure in Litres (L).

An office water benchmark is also available based on the average water consumption within office facilities. This includes water used in office facilities.

50 Litres/ employee/ day (South Staffordshire Water, 2012)

Filming Spaces

Benchmarks:

albert has created energy consumption benchmarks for studios. There are two energy options for the benchmarks: “electricity + heat & steam” and “electricity + gas”.

Additional studio benchmarks have been built based on annual utilities usage (electricity, gas, heat & steam where appropriate) and stage sizes (in m^2) data which has been provided by 7 TV and film studio facilities in the UK and Ireland, thus allowing for studio benchmarks per square meter per day to be created. These benchmarks will be updated and reviewed as data from studios is received.

Future iterations of the calculator can benefit from the information productions provide us. For example, productions input data on studio floor space, LED use, air con and galleries. This is audited by albert and will inform future benchmark figures.

The formula below has been used to calculate the carbon emissions associated with studios when using the albert benchmarks:

Emissions associated with studio (tCO2e) = [(Studio benchmark x number of days in the studio) x emissions factor] / 1000

Feedback from the industry has called for the inclusion of a separate section to report on a production’s use of galleries. The albert toolkit enables productions to measure the emissions associated with this space from meter/clamp/sub meter readings.

This will provide albert with data which can be used to create new benchmarks in future thus increasing usability of the tool.

Travel and Transport

All emission factors for travel and transport have been taken from the DEFRA database.

Air travel

Commercial Air Travel:

DEFRA emission factors have been used for all air travel emissions. Radiative forcing factors have not been included as the DEFRA methodology highlights the high uncertainty of this multiplier and is not utilised in many academic sources.

Following DBEI’s emissions factor methodology report, distance and travel categories have been classified as follows:

Type of flight	Distance (km)
Short haul	<800
Medium haul	800-3700
Long haul	>3700

For ease of use, a flight distance calculator is included, based on airport codes which enables the user to enter 3 figure IATA airport codes for 5,200 medium – large airports around the world. The albert toolkit uses the airmilescalculator.com (2021) data set.

Chartered Planes and Helicopters:

Fuel consumption for the following aircrafts have been taken from a variety of sources specific to the aircraft from manufacturers and the European Energy Agency (EEA) and US Department of Agriculture (USDA).

These fuel consumption benchmarks are for aviation gasoline for helicopters and jet fuel for chartered planes.

To calculate the emissions using specific fuel consumption (L/hr or kg/hr, where relevant), the assumption has been made that all helicopters will be fuelled by aviation gasoline and that chartered planes are fuelled by aviation turbine fuel (jet fuel) (Gunston) using the appropriate DEFRA emission factors for these fuel types.

List of Helicopters and Chartered Planes:

Helicopters	Chartered Planes
Aerospatiale SA-315B	Boeing 737-800
Augustawestland AW139	Cessna C152, C172, C182 (single engine)
Augustawestland AW139 Koala	Cessna 50XL Citation
Augustawestland EH101	Cessna 337
Bell 206 LR	Cessna II Citation
Eurocopter AS350 B3e	Cessna Excel Citation
Eurocopter AS355	Dassault Falcon 2000
Mil Mi-17	Gulfstream G550
Augustawestland Sea King	MD-80
Bell B212	Robin (French aircraft) (single engine)
Bell 206 (Jet Ranger)	Gulfstream GIV

Source: USDA, EEA, specific manufacturers

Air travel - Benchmark:

Spend benchmarks for air travel are included. Data used to create these benchmarks was provided by the travel and accommodation comparison site, KAYAK. This was given in the form of a random selection of around 1200 flights with the associated distance travelled and cost. This data was validated by spend and distance data provided by companies in the tv industry.

The benchmarks created have been combined with up-to-date data provided by a group of albert Consortium members who report on their air travel spend by distance.

Road travel

The albert calculator uses DEFRA emission factors for all fuels listed on road travel.

Below are the different road travel options included in the albert calculator, with the option of Biodiesel HGV and Electric Bus being added as options for this iteration of the calculator:

Car - Small	Motorcycle
Car - Medium	Truck/Van (<3.5 tonnes)
Car - Large	HGV (>3.5 tonnes)

Car - unknown	Taxi – regular
Coach/Minibus	Taxi – black cab
Local bus	HGV (>17 tonne)
Biodiesel HGV	Electric Bus

The following fuel source type options are listed for all road travel (when relevant):

Gasoline/Petrol	Biodiesel (B5, B7, B20, B40, B99, B100)
Diesel	LPG
Electric	CNG
Hybrid electric	

Road travel – benchmark

Data used to calculate the carbon emissions based on fuel spend data have been taken from the global petrol prices site. The fuel price data provided is country specific and provided in the currency of use in the respective country.

Taxi Travel

DEFRA provide emission factors for 'Taxi -– black cab' and 'Taxi – regular'. There is currently only one fuel type associated with 'regular taxis' through DEFRA so an additional emission factor for other fuel types has been calculated through consulting the DBEI emission factor methodology; this states that the emission factor for regular taxis was calculated using the average emission factor for medium and large cars (average fuel type) whilst also factoring in which taxis travel and fuel efficiency through an "uplift factor" of 40% (*1.4), as recommended by Transport for London (TfL).

Specific Fuel Type Regular taxi emission factor (kgCO2e/ km or mile) = average car (large/ medium) specific to fuel type emission factor x 1.4 (Uplift factor)

Taxi travel

Taxi Travel - Benchmark

The taxi spend benchmark was calculated with data from TfL (taxis) and Gett taxis based on their fares, which are calculated per mile travelled on top of a baseline fare. An average fare price was taken based on iterating the fare prices for distances up to 200 miles. This spend benchmark is then used along with DEFRA emission factors for taxis to calculate the emissions associated with taxi travel.

Spend option can be used for the following taxi fuel types for regular and black taxis.

Regular - Diesel	Regular - Electric	Regular - Hybrid	Regular – Petrol
Regular – unknown (average)	Black cab - Diesel	Black cab – Electric	

This benchmark option is only available for productions in the UK. Future iterations of the calculator will include benchmarks for each country, subject to getting the relevant and accurate data.

Rail Travel

Following the DEFRA emissions factor methodology report, rail categories in the UK have been classified as: 'National Rail', 'International Rail' (Eurostar), 'Light Rail and Tram' and 'Underground/Subway' based on the train type. The metric for reporting emissions from rail travel is $kgCO_2e$ per passenger kilometre ($kgCO_2e$/pkm), i.e., the emissions associated with one per travelling 1 km.

In due course, the calculator will offer new rail travel categories and emission factors for 52 countries offering 181 factors, associated with different rail types (light, high speed, etc.). Emission factors for the UK, i.e. from DEFRA, could not be used for all countries for several reasons: the differing fuel types used to power the trains, the different carbon intensities across countries (in the case of electric-powered trains), the passenger kilometres travelled per country (if more people use trains, more passengers are travelling per km, so the carbon intensity will be lower).

Rail travel – benchmark

The spend benchmark for rail travel was provided by the Office for Rail and Road (ORR) who release quarterly updates on fare prices per km of distance travelled. These figures will be reviewed annually.

Boat Travel

Boat travel emissions are calculated for the following types: ferry (passenger only), ferry (passengers with car), unknown ferry (average) and speed boat/small boat (other boats).

For ferry activity, the emissions are calculated using distance activity data and DEFRA emission factors which align with the ferry categories above. For speed boat/small boat the activity emissions are calculated using fuel consumption data and DEFRA emission factors for the following fuels.

Biodiesel (B5, B7, B20, B40, B99 and B100)	Marine Gas Oil (MGO) Diesel Fuel	Marine Diesel Oil (MDO) Gasoline/Petrol
Renewable Diesel	Jet Fuel	

Couriers and Excess Baggage

Courier and Excess Baggage emissions are calculated for the following types: air consignment, motorcycle courier, truck/van courier. The albert calculator collects data in relation to the package/baggage weight and distance travelled.

DEFRA emission factors are provided for activity data given in tonne/km. To improve the usability of the calculator tool standard conversion unit factors have been used (listed in the appendix – tables 1, 2, 3) to enable productions to enter courier and excess baggage data in a variety of weights (kg, lb, ton (US), tonne) and distance (km and mile) units.

Air Consignment

Air consignment emissions are broken down into travel distance (short, medium, and long haul), aligning with the DEFRA emission factors. Distance categories are in the "Commercial Air Travel" section.

Truck/Van Courier

To enable high levels of accuracy there is the option to choose from a range of fuel types that truck/van couriers can use:

Diesel Fuel	Battery Electric	LPG
CNG	Petrol/Gasoline	Unknown (average)

Motorcycle Courier

DEFRA do not provide a weight option for this courier activity, so the emissions are therefore associated with the distance travelled by a motorcycle courier and it is assumed that the motorcycle is fuelled by diesel fuel.

Freight

Freight emissions are calculated for the following types: train consignment, sea tanker and cargo ship using weight and distance data and DEFRA emission factors.

As with 'couriers and excess baggage', DEFRA emission factors are provided for activity data given in tonne/km. To improve the usability of the calculator tool standard conversion unit factors have been used (listed in the appendix) to enable productions to enter data in a variety of weight (kg, lb, ton (US), tonne) and distance (km and mile) units.

Accommodation

Accommodation emissions for hotels/apartments/houses are calculated using the average energy consumption given by the Energy Star site. The albert calculator uses these energy consumption benchmarks based on accommodation type supplemented with the Cornell Hotel Sustainability Benchmarking Index and multiplies them by the relevant electricity carbon factor for each country.

For hotels that are supplied by a certified renewable energy tariff, the emissions factor is zero. Users have the option to select this in the albert toolkit.

Accommodation Type	kWh/day
Economy Hotel	15.11
Midscale Hotel	29.78
Upscale Hotel	34.51
Luxury Hotel	45.08
Apartment /Condo/Flat	31.01
Average House	17.47
Large House	47.94

Materials

DEFRA guidance has been followed when building the carbon factors for all the materials included in the albert carbon calculator.

The DEFRA factors consist of two parts: the consumption of using the material depending on how it has been made (e.g., recycled content) and the disposal factor depending on the material and disposal method. As it is not easy to get the information on how a product has been made, it is assumed that the product is a 'new product' unless stated in the following material sections.

It is assumed that not all materials purchased for productions will be disposed of, to account for this, the calculator breaks this into a two-part process: 'material' and 'disposal'. This also enables albert and the rest of the industry to encourage the re-use of products. The materials options offered in the calculator are below:

Paint

Emission factors for the following paint types have been derived from multiple different open-sources, including Berger Paints and Dulux. With help from Graphenstone UK and consultants at BRS, the paint emission factors have been newly split into: the type of paint (water and solvent-based) then into different types of paint finishes (matt, gloss, undercoat/primer).

Paper

The following paper sizes have been included in the calculator and the associated weights of a ream (the assumption is that a ream will be 500 sheets for all paper sizes).

Paper Size (gsm)	Weight of a ream (kg)
A0 (100)	50
A1 (80)	20
A2 (80)	10
A3 (80)	5
A4 (80)	2.5
A5 (80)	1.25
Legal A4 (120)	3.75
Letter (100)	1.875

Source: Paper Sizes.

There is a 'paper from recycled content' option in this iteration of the calculator to acknowledge that 30% of paper produced globally is made from recycled content.

Cardboard

Cardboard can be recorded by weight or by its dimensions. When recording cardboard emissions by weight, this can be done using a variety of units (kg, lb, US ton, tonne). When recording by dimensions of a flat box assuming the depth or thickness of the cardboard an average density of cardboard of 0.689 tonnes/m3 has been assumed (source: aqua-calc).

Timber

Average prices for timber have been taken from B&Q and Jewson as this provides a good breakdown of pricing. There is a data set of 700 timber prices and weights included in the calculator. This data is used to create a cost-weight coefficient and is combined with the DEFRA emission factor for timber (tonnes).

Cost to weight coefficient = 2412.609 (£/tonne) (source: B&Q, Jewson).

When entering timber consumption by dimensions, the calculator asks for the length, width and depth of timber and assumes an average density of the timber.

Assumed density of timber = 0.63 (tonne/m3) (source: B&Q, Jewson).

For timber the option to account for materials that are made from recycled content has been added.

Textiles

Emissions associated with the use of textiles can be recorded by weight or dimensions. The calculator has the added option to record textiles made from recycled content as the assumption is made that 96% of clothing is made from virgin stock (Ellen MacArthur Foundation) and therefore wants to acknowledge those sourcing their clothing from 100% recycled content. These factors have been extracted from SimaPro with help from consultants from Building Research Solutions Ltd, with the exception of leather, which was derived from Chen et al. (2014).

When recording dimensions, the calculator asks for width and length of textiles and the density (kg/m^2) from the user filling in the calculator tool.

Food

Emission factors for different food types have been produced using information from a wide range of food LCAs from food suppliers, consultancy firms (Small World Consultancy, Carbon Smart) and food emissions resources (Our World in Data). This information was incorporated with research on human food behaviour as well as recommended daily intake. Average portion consumption was taken from National Diet and Nutrition Survey for 16-64 year old adults. The meal benchmarks assume a 2,500-calorie diet made up of the representative food groups assuming calorie intake is such that it is sufficient for maintaining weight. In order to adjust calories to portions, the benchmarks uses McCance and Widdowson so that the benchmark is associated per gram per food group based on average UK consumption.

Vegetarian excludes all meat and fish but includes dairy, the Vegan option excludes dairy as well.

Meal Type	Benchmark (kgCO_2e/meal)
Vegetarian	0.76076
Vegan	0.52786
Fish	2.4897
Meat - Chicken	2.8797
Meat - Pork	3.1397
Meat - Lamb	5.2197
Meat - Beef	9.8997

Source: LCAs, NDNS, McCance and Widdowson and Poore and Nemecek nutritional guidelines and human behaviour average consumption

Emissions related to food are based on assumptions but aim to show the difference that diet can make and acknowledge the lifestyle recommendations to achieve a low-carbon lifestyle from the UN.

Plastics

DEFRA emission factors for average plastics are used to provide a simple value to the end user that maintains usability and comprehension within the toolkit. For plastics there is also an option to account for materials that are made from recycled content.

Users can also record emissions associated with plastic products by quantity, as the calculator takes in to account the weights of a single unit of the following commonly used products:

Product	Weight (g)
Bottle	60
Plate	60
Cup	20
Cutlery	7

Sources: BAFTA, method of process can be found in the appendix.

Metals

The albert calculator uses DEFRA emission factors for average metals, to provide a simple yet complete footprint while maintaining usability. A user can now account for materials that are made from recycled content.

Users can also record emissions associated with metal products by quantity, as the calculator takes in to account the weights of a single unit of the following commonly used products:

Product	Weight (g)
Drinks Can	14
Tin Can	20

Source: BAFTA, method of process can be found in the appendix.

Batteries

The albert calculator uses DEFRA emission factors for batteries, to provide a simple yet complete footprint while maintaining useability. Users can also record emissions associated with battery products by quantity, as the calculator takes in to account the weights of a single unit of the following commonly used products:

Productions can record emissions by quantity of product, as the tool recognises the weights of a single unit of the following commonly used batteries.

The list of battery sizes will be reviewed regularly, using feedback from users.

Size	Weight (grams)
AAAA	6.5
AAA	11.5
AA	25
9V	45
C	65
4.5V	110
D	165
6V	600
18V	605

Source :BAFTA, method of process can be found in the appendix.

The most recent update of DEFRA and DBEIS emission factors has included new ways in which companies can report on their battery use. There are three new options:

- Alkaline
- Lithium ion (Li-ion)
- Nickle Metal hydride (NiMh)

Glass

The albert calculator assigns an average emission factor for glass from DEFRA, and enables productions to record emissions associated with glass products by quantity of product. The tool recognises the weights of a single unit of the following:

Product Type	Weight (grams)
Bottle (wine)	70
Bottle (soda)	19.2

Source: BAFTA, method of process can be found in the appendix.

There is now the option to account for materials that are made from recycled content

Disposal

Disposal is calculated by weight and by container size. Emission factors from DEFRA have been used for calculating the emissions associated with disposal activity. The EPA waste emission factors enable users to estimate a reduction in waste emissions depending on the treatment type rather than calculating the emissions associated with material consumption and waste disposal as these factors are frequently negative. At this time, DEFRA emission factors are being used for all countries but country specific disposal emission factors will be included in further iterations as albert recognises that these emission factors are dependent on the energy of waste management activities, fuel types used (thus carbon intensity) and efficiency of waste management practices, e.g., energy from waste, landfill gas utilisation, etc.

albert actively encourages productions to calculate emissions based on weight of disposal however to improve usability and encourage the general use of the calculator option to measure emissions associated with disposal through number of containers has also been included.

When recording the emissions associated with disposal through number of containers, the following formula has been used:

Emissions associated with disposal containers (tCO2e) =(size of container x cubic meter conversion x weight of waste conversion x emission factor (material and treatment specific as listed below)

Where:

Cubic meter conversion = appendix, table 8

Weight of waste conversion = 0.1348 tonnes/ m^3 (source: BAFTA, method can be found in the appendix)

Albert Material Type	Albert Disposal Type	DEFRA Material Type	DEFRA Treatment Type
Construction	Donated	Construction (Mixed)	Re-use
Construction	Landfill/Unknown	Construction (Mixed)	Unknown
Construction	Recycled	Construction (Mixed)	Recycling (Closed Loop)
Electronic waste	Incinerated/Energy recovery	WEEE* (Mixed)	Energy (Combustion)
Electronic waste	Landfill/Unknown	WEEE (Mixed)	Landfill
Electronic waste	Recycled	WEEE (Mixed)	Recycling (Closed Loop)
Electronic waste	Donated	0	
Food/Compostable	Composting	Food and Drink	Composting
Food/Compostable	Donated	0	
Food/Compostable	Incinerated/Energy recovery	Food and Drink	Energy (Combustion)
Food/Compostable	Landfill/Unknown	Food and Drink	Landfill
Food/Compostable	Anaerobic Digestion	Food and Drink	Anaerobic Digestion
General/Mixed	Incinerated/Energy recovery	Household Residual Waste	Energy (Combustion)

General/Mixed	Landfill/Unknown	Household Residual Waste	Landfill
General/Mixed	Anaerobic Digestion	Household Residual Waste	Anaerobic Digestion
Paper/Cardboard	Composted	Paper and Cardboard (Mixed)	Composted
Paper/Cardboard	Incinerated/Energy recovery	Paper and Cardboard (Mixed)	Energy (Combustion)
Paper/Cardboard	Landfill/Unknown	Paper and Cardboard (Mixed)	Landfill
Paper/Cardboard	Recycled	Paper and Cardboard (Mixed)	Recycling (Closed Loop)
Plastic	Incinerated/Energy recovery	Plastic: Average plastics	Energy (Combustion)
Plastic	Landfill/Unknown	Plastic: Average plastics	Landfill
Plastic	Recycled	Plastic: Average plastics	Recycling (Closed Loop)
Textiles	Donated	0	
Textiles	Incinerated /Energy recovery	Clothing	Energy (Combustion)
Textiles	Landfill /Unknown	Clothing	Landfill
Textiles	Recycled	Clothing	Recycling (Closed Loop)
Timber	Donated	0	
Timber	Incinerated/Energy recovery	Wood	Energy (Combustion)
Timber	Landfill/Unknown	Wood	Landfill
Timber	Recycled	Wood	Recycling (Closed Loop)
Timber	Composting	Wood	Composting
Batteries	Landfill/unknown	Batteries	Landfill/unknown
Metal	Incinerated/Energy recovery	Metals	Energy (combustion)
Metal	Landfill/unknown	Metals	Landfill
Metal	Recycled	Metals	Recycling (closed loop)

Metal	Donated	0	

*WEEE – Waste Electrical and Electronic Equipment

Postproduction

Edit suite calculation:

Emissions associated with edit suite (tCO2e) = 2.99… x hours per day x number of days x electricity emission factors (based on country and region)

Benchmark source	Benchmark (average kWh)
Sub-metered edit suite	2.999

Source: BAFTA, Method can be found in appendix.

Appendix

Global Emission Factors Source list

Table 1: Global Emission Factors in including the source and the countries and regions that they apply.

Scope	Source	Region or state
Scope 2	DEFRA	UK
Scope 2+3	Australian Government 2021	Western Australia, New South Wales, Northern Territory, Queensland, South Australia, Tasmania, Victoria
Scope 2+3	CarbonFootprint 2022	Argentina, Austria, Belgium, Brazil, Bulgaria, Canada, Alberta (AB), British Columbia (BC), Manitoba (MT), New Brunswick (NB), Newfoundland and Labrador (NL), Nova Scotia (NS), Northwest Territories (NT), Nunavut (NU), Ontario (OB), Prince Edward Island (PE), Quebec (QC), Saskatchewan (SK), Yukon Territory (YT), Denmark, Estonia, Finland, France, Greece, Hong Kong (China), Hong Kong (CLP group), Iceland, New Zealand, Norway, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Thailand, United States, Alaska (AK), Alabama (AL), Arkansas (AR), Arizona (AZ), California (CA), Colorado (CO), Connecticut (CT), Washington DC (DC), Delaware (DE), Florida (FL), Georgia (GA), Hawaii (HI), Iowa (IA), Idaho (ID), Illinois (IL), Indiana (IN), Kansas (KS), Kentucky (KY), Louisiana (LA), Massachusetts (MA), Maryland (MD), Maine (ME), Michigan (MI), Minnesota (MN), Missouri (MO), Mississippi (MS), Montana (MT), North Carolina (NC), North Dakota (ND), Nebraska (NE), New Hampshire (NH), New Jersey (NJ), New Mexico (NM), Nevada (NV), New York (NY), Ohio (OH), Oklahoma (OK), Oregon (OR), Pennsylvania (PA), Rhode Island (RI), South Carolina (SC), South Dakota (SD), Tennessee (TN), Texas (TX), Utah (UT), Virginia (VA), Vermont (VT), Washington (WA), Wisconsin (WI), West Virginia (WV), Wyoming (WY)

Scope 2 + 3	EIB 2022	Afghanistan, Algeria, American Samoa (U.S.), Andorra, Anguilla (U.K.), Antigua and Barbuda, Aruba, Azerbaijan, Azores (Portugal), Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belize, Benin, Bermuda (U.K.), Bhutan, Bosnia and Herzegovina, Botswana, British Virgin Islands (U.K.), Brunei, Burkina Faso, Burundi, Cambodia, Cameroon, Canary Islands (Spain), Cape Verde, Cayman Islands, Central African Republic, Chad, Channel Islands, Chile, China (P.R. China & Hong Kong), Taipei (Chinese), Colombia, Comoros, Congo, Republic of, Costa Rica, Côte d'Ivoire, Croatia, Cuba, Curaçao (Netherlands), Cyprus, Czech Republic, Congo, Democratic Republic of, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Falkland Islands (U.K.), Faroe Islands (Denmark), Fiji, French Guiana, French Polynesia, Gabon, Gambia, Georgia, Germany, Ghana, Gibraltar (U.K.), Greenland, Grenada, Guadeloupe (France), Guam, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Hungary, India, Indonesia, Iran, Iraq, Isle of Man, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kiribati, Korea (South), Republic of, Korea (North), Dem. People's Rep. of, Kosovo, Kuwait, Kyrgyzstan, Laos, Latvia, Lebanon, Liberia, Libya, Liechtenstein, Lithuania, Luxembourg, Macao (China), Macedonia, North, Madagascar, Madeira (Portugal), Malawi, Maldives, Mali, Malta, Marshall Islands, Martinique (France), Mauritania, Mayotte (France), Mexico, Micronesia, Moldova, Monaco, Mongolia, Montenegro, Montserrat, Mozambique, Myanmar, Nauru, Nepal, Netherlands, Netherlands Antilles, New Caledonia (France), Nigeria, Niue, Northern Mariana Islands (U.S.), North Macedonia, Oman, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Philippines, Poland, Puerto Rico (U.S.), Reunion (France), Romania, Russian Federation, Rwanda, Saint Helena (U.K.), Saint Kitts and Nevis, Saint Lucia, Saint Martin (France), Saint Pierre and Miquelon (France), Saint Vincent and Grenadines, Samoa, San Marino, Sao Tomé & Principe, Serbia, Seychelles, Sierra Leone, Singapore, Sint Martin (Netherlands), Solomon Islands, Somalia, South Africa, South Sudan, Sri Lanka, Sudan, Suriname, Switzerland, Syrian Arab Republic, Tajikistan, Tanzania, Timor-Leste, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Turks and Caicos Islands (U.K.), Tuvalu, Uganda, Ukraine, United Arab Emirates, Uruguay, Uzbekistan, Vanatu, Venezuela, Vietnam, Virgin Islands (U.S.), West Bank and Gaza, Yemen, Zambia, Zanzibar (Tanzania), Zimbabwe
Scope 2	IEA 2019 - Open source	Albania, Armenia
Scope 2	SEAI - (kgCO_2/kWh)	Ireland
Scope 2	Electricity Maps	Peru
Scope 2	IRENA 2022	Eswatini, Kenya, Lesotho, Malaysia, Mauritius, Morocco, Namibia, Nicaragua, Niger, Qatar, Saudi Arabia, Senegal
Scope 3	Australian Government, 2021	New South Wales, Northern Territory, Queensland, South Australia, Tasmania, Victoria, Western Australia
Scope 3	DEFRA	All Countries

Studios – benchmark

Studios provided annual stage energy consumption data (kWh) broken down into the energy source (Electricity, Gas, Heat & Steam) alongside the size of each of the stages. This data was then used to calculate a benchmark with the unit kWh/ m2/ day. It is acknowledged that the energy sources are dependent on one another e.g. electricity and gas, and electricity and heat & steam so two benchmarks have therefore been provided.

Standard Unit Conversion

Table 2: Volume conversion units

Volume		L	m³	US gallon
	Litres, L		0.001	0.264172
	Cubic meters, m³	1000		264.1721
	US gallon	3.785412	0.003785	

Table 3: Mass Conversion units

Mass		kg	Tonne	Ton (US)	Lb
	Kilogram, kg		0.001	0.001102	2.204624
	Tonne, t (metric tonne)	1000		1.102311	2204.624
	Ton (US, short ton)	907.185	0.907185		2000.002
	Pound, lb	0.453592	0.000454	0.0005	

Table 4: Distance conversion units

Distance/ Length		m	ft	mi	Km
	Meter, m		3.28084	0.000621	0.001
	Feet, ft	0.3048		0.000189	0.000305
	Miles, mi	1609.344	5280		1.609344
	Kilometres, km	1000	3280.84	0.621371	

Table 5: Distance conversion units

Distance/ Length		m	ft	in	Cm
	Meter, m		3.280804	39.37008	100
	Feet, ft	0.3048		12	30.48
	Inch, in	0.0254	0.083333		2.54
	Centimeter, cm	0.01	0.032808	0.393701	

Fuel consumption of helicopters and chartered flights taken from multiple sources (USDA, EEA, Open Sources) were often provided in litres per hour of flight. To standardise the following conversion factors were used so that all fuel consumption was in kg/hr .

Table 6: Chartered and Helicopter fuel densities

Fuel Type	Density (kg/l)
Jet Fuel	0.79
Aviation Gasoline	0.7185

Table 7: Gas Fuel densities

Gas Type	Density (kg/m³)
Propane	493
Butane	573

Table 8: Container Sizes and conversions to cubic meters

Container Size	Convert to cubic metres
Bag of rubbish/trash (20 litre)	0.02
Bin (1100 litre)	1.1
Bin (660 litre)	0.66
Bin (770 litre)	0.77
Container (1 meter)	1
Container (1 yard)	0.764555
Container (1/2 meter)	0.5
Container (1/2 yard)	0.3822775
Container (10 meter)	10
Container (10 yard)	7.64555
Container (15 meter)	15
Container (15 yard)	11.468325
Container (2 meter)	2
Container (2 yard)	1.52911
Container (20 meter)	20
Container (20 yard)	15.2911
Container (3 meter)	3
Container (3 yard)	2.293665
Container (30 meter)	30
Container (30 yard)	22.93665
Container (35 US gallon)	0.13248935
Container (4 meter)	4
Container (4 yard)	3.05822
Container (40 meter)	40
Container (40 US gallon)	0.1514164
Container (40 yard)	30.5822
Container (5 meter)	5
Container (5 yard)	3.822775
Container (6 meter)	6
Container (6 yard)	4.58733

Container (68 US gallon)	0.25740788
Container (8 meter)	8
Container (8 yard)	6.11644
Container (98 US gallon)	0.37097018
Wheelie bin (large - 360 litre)	0.36
Wheelie bin (medium - 240 litre)	0.24
Wheelie bin (small - 140 litre)	0.14

Source: simple skip hire.

Table 9: Hydrogen emission factors

Method name	Emission Factor (kgCO2e/ kg)	Method
Green	1.55	Average of electrolysis wind and solar H2
Brown	19.78	Coal Black/Brown H2

Source: Parkinson et al. (2019) and Ajanovic et al. (2022)

Materials

To account for mechanical error five kitchen scales were used to measure the products (listed in the materials section of the methodology). Although object mass was provided to 2 decimal places these figures were rounded to the nearest gram to mitigate for mechanical error. The sample size for each product was five, the final figure used was an average of these weights.

Disposal

Mass of waste was measured using a number of different scales dependent on the waste.

Electronic waste, Food/ Compost, General/ Mixed, Paper/ Cardboard, Textiles, Batteries, Metals were all measured using 3 different household human scales (accounting for mechanical error) having first weighed the container (a UK council waste bin = 0.448 m3) and then added the faux/ waste materials (separated by material type). Having measured the waste for each material type the mass of the container was deducted to calculate the final mass of the waste.

Construction waste was measured at a recycling centre through first measuring the weight of a vehicle and then adding the construction waste (in containers – the mass of these were known previously) and re-weighing.

The densities of these materials were then calculated mass (kg)/ m3 and the average taken.

albert acknowledges that this process results in a low accuracy density however albert actively encourages users to make use of the weight measurement option in order to increase accuracy of measurement. albert offers this option to enable usability and enable productions to gain a more complete understanding of their emissions.

Post Production

Submeters were attached downstream from the main office electricity meter to measure the energy (kWh) associated with individual edit suites. This process was repeated for a sample of 5 edits suites. The figures were then averaged. To validate these figures the energy consumption of all equipment and kit in each suite was totalled.

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Budget Hotel /Lodge: 12.25 kg

Mid Range Hotel: 28.45 kg

Country House: 33.55 kg

Deluxe Hotel 30.90 kg

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