bp Target Neutral
Global online travel calculator:
Method for calculating greenhouse gas emissions

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1.1 EXECUTIVE SUMMARY

bp Target Neutral has committed to help individuals tackle their personal carbon footprint from their daily journeys.

This methodology statement was formulated as part of ERM's ongoing support with the development of bp Target Neutral's global online carbon offsetting calculator, hereafter referred to as the 'online calculator', to be rolled out across a number of markets.

This paper sets out the overarching approach for calculating greenhouse gas (GHG) emissions associated with driving and flying, and presents the rationale behind the method adopted for these different markets.

1.2 MARKETS

The methodology developed is tailored to the following key markets:
UK, USA, Germany, Australia, New Zealand, China, Mexico, Netherlands, Luxembourg, Switzerland, Austria, Poland, Turkey, Spain, Portugal, South Africa, Mozambique, and Indonesia. The methodology has also been extended to other markets as demonstrated in table 1 below.

1.3 TRANSPORT MODES

bp Target Neutral's global online carbon offsetting calculator focuses on the following modes of transport:

- Flights (domestic, short-haul and long-haul)
- Cars
- Vans & Trucks
- Motorbikes

1.4 EMISSION FACTORS

The methodology developed is aligned with the WRI/WBCSD GHG Protocol[1] and makes use of publicly available, nationally relevant and regularly updated (ideally on an annual basis) emission factors from reputable and recognised sources.

A tiered approach is applied to the selection of emission factors for each market.

(1) Where nationally relevant emission factors are available for a market from a government source, the latest version of the dataset is applied.

(2) Where a specific government source is **not** available for a market, the next category of emission factors selected is the latest National Inventory Submission for that market, as published by the United Nations Framework Convention on Climate Change (UNFCCC).
(3) Finally, where neither of the above are available, the emission factor database supplied by the Intergovernmental Panel on Climate Change (IPCC) is used.

Table 1 below outlines the emission factor database used for each market.

Table 1. Emission factor database used for each market

Market	Emission Factor Database
United Kingdom	2020 UK Government Greenhouse Gas (GHG) Conversion Factors for Company Reporting[2]
United States	2020 US Environmental Protection Agency Emission Factors for Greenhouse Gas Inventories[3]
Germany	2020 UNFCCC National Inventory Submissions[4], Germany Common Reporting Format
Australia	2020 Australian National Greenhouse Accounts[5]
New Zealand	2016 New Zealand Ministry for the Environment, Greenhouse Gas Voluntary Guidance[6]
China	2006 IPCC Emissions Factor Database[7]
Mexico	2014 INECC, Emission factors for the different types of fossil and alternative fuels consumed in Mexico[8]
Netherlands	2020 The Netherlands: list of fuels and standard CO_2 emission factors[9]
Luxembourg	2020 UNFCCC National Inventory Submissions, Luxembourg Common Reporting Format
Switzerland	2020 UNFCCC National Inventory Submissions, Switzerland Common Reporting Format
Austria	2020 UNFCCC National Inventory Submissions, Austria Common Reporting Format
Poland	2020 UNFCCC National Inventory Submissions, Poland Common Reporting Format
Turkey	2020 UNFCCC National Inventory Submissions, Turkey Common Reporting Format
Spain	2020 UNFCCC National Inventory Submissions, Spain Common Reporting Format
Portugal	2020 UNFCCC National Inventory Submissions, Portugal Common Reporting Format
South Africa	2017 South African National GHG Emission Reporting Regulations[10]
Mozambique	2006 IPCC Emissions Factor Database
Indonesia	2017 Indonesian Ministry of Energy and Mineral Resources[11]
Other Markets	2006 IPCC Emissions Factor Database

1.4.1 Net Calorific Values and Fuel Density

The calorific value of a fuel is the quantity of heat produced by its combustion at constant pressure and under standard conditions.

For markets using energy-based factors, e.g. tonnes of CO_2e per terajoule of fuel (tCO_2e/TJ) or kilogramme of CO_2e per gigajoule of fuel ($kgCO_2e/GJ$), default UK GHG DEFRA Fuel Density Values and market-specific Net Calorific Values (NCV) and are applied where available to convert the emission factors from CO_2e per unit of energy to CO_2e per litre of fuel.

Market-specific NCVs are thus applied for Australia, New Zealand, Mexico, Netherlands, Switzerland and South Africa.

Where the market-specific NCVs are however not available, NCVs derived from the IPCC (2006) are applied as default. This applies to Germany, China, Luxembourg, Austria, Poland, Turkey, Spain, Portugal, Mozambique, Indonesia and other markets.

Table 2. Example calculation for Germany market: conversion of energy based emission factors to volume based emission factors

Vehicle Type	Fuel Type	Net Calorific Value (TJ/Tonne) A	Energy based Emission Factor (tCO2e/TJ) B	Fuel Density (Tonne/l) C	Volume based Emission Factor (kgCO2e/l) A X (B X 1000) X C
Motorcycle	Petrol	0.0443	78.92	0.000737	2.57645
Car	Petrol	0.0443	75.56	0.000737	2.46651
	Diesel	0.0430	75.16	0.000841	2.71685
	LPG	0.0473	66.76	0.000529	1.67122
Light Duty Trucks	Petrol	0.0443	75.98	0.000737	2.48050
	Diesel	0.0430	74.76	0.000841	2.70230

1.4.2 Fuel Efficiency

To make the emissions results more nationally relevant, fuel efficiency (also frequently termed as 'fuel economy') is applied in the online calculator so that emissions are calculated on the basis of fuel efficiency unique to the type and model of the vehicle.

It is possible for the user to enter the fuel efficiency of the vehicle, following the format of the current online calculator.

However, where a user does not know the fuel efficiency value for their vehicle, a proxy fuel efficiency value is made available in each market-specific version of the tool as a default, in order to be able to convert emission factors from CO_2e per litre of fuel to CO2e per distance travelled.

The most recent fuel efficiency value is provided where market-specific fuel efficiency datasets are available, i.e. the UK, US, Australia, New Zealand and Switzerland. Where these are not

available for a market, default values are set as being those from UK Department for Transport Statistics[12] (Petrol and Diesel), and from IPCC (LPG).

Table 3. Example calculation for Germany market: conversion of volume based emission factors to distance based emission factors for when the end user does not know the fuel efficiency value for their vehicle

Vehicle Type	Fuel Type	Volume based Emission Factor (kgCO2e/l) A	Fuel Economy (l/km) B	Distance based Emission Factor (kgCO2e/km) A X B
Motorcycle	Petrol	2.57645	0.05740	0.14789
Car	Petrol	2.46651	0.05740	0.14158
	Diesel	2.71685	0.05100	0.13856
	LPG	1.67122	0.11200	0.18718
Light Duty Trucks	Petrol	2.48050	0.05740	0.14238
	Diesel	2.70230	0.05100	0.13782

1.4.3 Well-to-tank factors

When calculating emissions, not only are direct emissions of CO_2, CH_4 and N_2O from the combustion of fuel accounted for, but the indirect emissions associated with the extraction and transport of primary fuels as well as the refining, distribution, storage and retail of finished fuels, also known as the 'well-to-tank' emissions are also taken into consideration.

The applicable 'well-to-tank' emissions, whether relating to fuels or different travel modes, are used from the specific '*WTT*' table in the UK GHG Conversion Factors for Company Reporting document and added to the relevant conversion factor.

As none of the other nationally relevant or default emission factor databases contain a 'well-to-tank' component, the relevant WTT emissions are taken as default from the UK GHG Conversion Factors for Company Reporting document across all other markets. Since UK produces distance based WTT factors only, default fuel economies (as referenced in section 1.4.2) are used to generate volume based WTT factors for use across all markets for consistency. For illustration, Table 4 below shows a small sample of Australia emission factors used in the online calculator.

Table 4. Example emission factors used for the Australia market

Vehicle Type	Fuel Type	Emission Factor	WTT Factor	Final Emission Factor	Unit
Motorcycle	Petrol	2.3872	0.5331	2.9203	$kgCO_2e$/litre
Car	Petrol	2.3126	0.8329	3.1455	$kgCO_2e$/litre
	Diesel	2.7178	0.7939	3.5117	$kgCO_2e$/litre
	LPG	1.5982	0.2154	1.8136	$kgCO_2e$/litre
Van	Petrol	0.2530	0.0603	0.3133	$kgCO_2e$/km
	Diesel	0.2717	0.0596	0.3313	$kgCO_2e$/km
	LPG	0.1789	0.0332	0.2120	$kgCO_2e$/km

It is recommended that any updates to the above mentioned Emission Factor, NCV, Fuel economy databases etc. are reviewed and that the online travel calculator is updated on an annual basis to reflect the latest available set of factors from selected sources.

1.5 EXAMPLE CALCULATIONS

Vehicle travel

a. Vehicle registration number

In all markets, the user has the option of entering the vehicle registration number. The car type is automatically looked up in the relevant database (if available), and the emissions are calculated depending on the annual distance travelled entered by the user.

b. Fuel Efficiency input

When vehicle registration number is not available, the user is asked to input the annual distance travelled in miles or km, type of fuel and vehicle type. It is then possible for a user to enter the vehicle's fuel efficiency value in either 'miles per gallon' (mpg) or 'litres per 100 km' (l/100km), or if known, the vehicle emissions value in gCO_2/km.

Where fuel efficiency is provided, emissions are calculated on the basis of fuel usage and the fuel-specific volume based conversion factor, as in the examples below:

Emissions for 10,000 miles travelled in a petrol-fuelled car with 'mpg' value of 36
= fuel usage in litres x volume based emission factor
= [(mileage/fuel efficiency) x conversion to litres] x emission factor
= [(10,000 miles/36 mpg) x 4.5461] x 3.8695 $kgCO_2e$/litre
= **4,886.4** $kgCO_2e$

Emissions for 10,000 miles in a diesel-fuelled van with 'l/100km' value of 34
= fuel usage in litres x volume based emission factor
= [(fuel efficiency) x (distance in miles x conversion to km)] x emission factor
= [(34/100) x (10,000 miles x 1.6093 km/mile] x 6.0137 $kgCO_2e$/litre
= **32,905.7** $kgCO_2e$

In instances where the user enters the car emissions value in gCO_2/km, this is uplifted by 22.9% to account for CH_4 and N_2O emissions as well as indirect 'WTT' emissions, and total emissions are generated as such:

Emissions for 10,000 miles travelled in a motorcycle emitting 250 gCO_2/km
= [(emissions value x 1.229) x (distance in miles x conversion to km)]/ 1,000
= [(250 gCO_2/km x 1.229) x (10,000 miles x 1.6093 km/mile)]/ 1,000
= **4,994.7** $kgCO_2e$

c. Programmed Fuel Efficiency

Alternatively, once the end user has inputted annual distance travelled in miles or km, type of fuel and vehicle type, and depending on the market, it is possible for users to select the type/size of vehicle that closely matches their own. Under this option, fuel economies are programmed in to the calculator, as described in section 1.4.2.

For instance, if a UK user were to enter an annual mileage of 10,000, and opt for a small petrol car, emissions generated
= distance in km x distance based emission factor
= (distance in miles x conversion to km) x distance based emission factor
= (10,000 miles x 1.6093 km/mile) x 0.18902 $kgCO_2e/km$
= **3,041.9** $kgCO_2e$

Air travel

Two key elements form the basis of air travel emissions calculations:

(1) an uplift factor of 8% applied to the flight distance to factor in sub-optimal routing and stacking at airports during periods of heavy congestion; and

(2) the Radiative Forcing Index (RFI) of 1.9 applied to the CO_2 emissions factor of any given flight type to account for non-CO_2 climate change effects of aviation, for example, those associated with vapour trails or NO_x emissions.

These two factors have already been incorporated into the government GHG conversion factors – these factors are applied for all markets. As mentioned in Section 1.4.3, 'WTT' emissions have been included in the relevant emission factors.

Flight distances are calculated using the Great Circle Flight methodology to account for the curvature of the Earth.

Emission factors are applied according to the route length, e.g. domestic, short-haul international or long-haul international. Band distances are used to determine the flight type[13].

Table 5 below outlines the band start point for each flight type as well as the associated emission factor.

Table 5. Flight type band start points and emission factors

Flight type	Band start (km)	Grand Total GHG ($kgCO_2e$/pkm)
Domestic	0	0.27104
Short-haul international	400	0.17256
Long-haul international	3700	0.21175

Class information is not taken into consideration, i.e. the average conversion factor, instead of factors specific to economy, business or first class travel, is used for each flight type. Furthermore, a fourth category of route length called 'International, to/from non-UK' is not taken into consideration as each of the above categories i.e. domestic, short-haul international and long-haul international will be applied to all markets.

As an example: emissions for a person making four return trips from San Francisco to London Heathrow
= 2 x (distance x long-haul international average emission factor x number of trips)
= 2 x (8615 km x 0.21175 $kgCO_2e$/pkm x 4)
= **14,593.8** $kgCO_2e$

[1] WRI/WBCSD The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard
Available online at:
https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf

[2] 2020 UK Government GHG Conversion Factors for Company Reporting.
Available online at:
https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2020

[3] 2020 US EPA Emission Factors for Greenhouse Gas Inventories.
Available online at:
https://www.epa.gov/sites/production/files/2021-04/documents/emission-factors_mar2020.pdf
[4] 2020 UNFCCC National Inventory Submissions.
Available online at:
https://unfccc.int/ghg-inventories-annex-i-parties/2020

[5] 2020 Australian Government, Department of the Industry, Science, Energy and Resources National Greenhouse Accounts Factors
Available online at:
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[6] 2016 New Zealand, Ministry for the Environment, Greenhouse Gas Voluntary Guidance.
Available online at:
https://environment.govt.nz/facts-and-science/climate-change/measuring-greenhouse-gas-emissions/about-new-zealands-greenhouse-gas-inventory/

[7] 2006 IPCC Emissions Factor Database.
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https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf

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[9] 2020 Netherlands Enterprise Agency (NEA), The Netherlands: list of fuels and standard CO2 emission factors.
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[11] 2017 Indonesian Ministry of Energy and Mineral Resources, Energy and Mineral Resources, Data and Information Technology, Usage Study Local Emission Factor (Tier 2) inside Energy Sector GHG Inventory
Available online at:
https://www.esdm.go.id/assets/media/content/content-kajian-emisi-gas-rumah-kaca-2017.pdf

[12] UK Department for Transport Statistics, Energy and Environment Data Tables (ENV0103).
Available online at:
https://www.gov.uk/government/statistical-data-sets/energy-and-environment-data-tables-env

[13] GHG Emissions Resulting from Aircraft Travel, Carbon Planet, 2009
Available online at:
http://www.trpa.org/documents/reisc/5_Comment%20References/LTSLT_FOWS_TASC_references/Airport/Flight_Calculator_Information_v9.2.pdf