Carbon Savings Calculation Methodology

1. Introduction

Carbon Wallet aims to make green lifestyle count. It empowers users to track their Carbon Savings based on their green actions in three areas **namely recycling, green dining and plant milk.**

To ensure robustness, an independent consultant, RESET Carbon, has been appointed to develop the calculation methodology of Carbon Savings based on scientific research studies and their professional expertise.

This document provides the methodology and references for the calculation of the Carbon Savings for items covered in the Carbon Wallet App.

2. Definition of Carbon Savings

Carbon Savings represent carbon emissions avoided by practicing a green action when compared with its baseline action (e.g., consume a vegetarian meal vs a non-vegetarian meal, recycle a plastic bottle vs disposal at landfill).

Carbon Savings are calculated by comparing carbon emissions of a green action with its respective baseline action:

$$Carbon\ Savings = Carbon\ Emissions_{\ Baseline} - Carbon\ Emissions_{\ Green\ Action}$$

3. Design Considerations and Limitations of the Methodology

3.1 Design Considerations

There are two key considerations when developing the calculation methodology:

- Accuracy – accurate measurement of Carbon Savings from practising green actions; and
- User-friendliness – ease of use and granularity of data input by users.

There is a potential trade-off between the two considerations – while the methodology aims to accurately capture carbon emissions from green actions, there are limitations to the granularity of data input. For example, it is not feasible for user to record every ingredient that was consumed in a meal, or the volume of each recycled container.

Version 2.0 - last updated on 21 July 2023

In order to strike a balance between the two considerations, appropriate assumptions are made when developing the calculation methodology.

3.2 Limitations

3.2.1 Use of Life Cycle Assessment

Life cycle assessment (LCA) is typically used to estimate the total environmental impact of a product. It may involve a range of assumptions (e.g., energy input, geographic location) in the assessment, which could vary amongst studies performed by different parties, leading to a different result.

3.2.2 Data Availability

There is currently a lack of comprehensive studies on lifecycle carbon emissions for most of the products. This limits the availability of data that are specific to the items covered in the calculation methodology.

3.2.3 Data Locality

Data from local academic studies or government publications are prioritised to estimate carbon emissions specific to local context in the calculation. If only international sources are available, sense-check and assumption reviews are performed to ensure the data applicability prior to adopting in the methodology.

4. Calculation Methodology

4.1 Overview

The following table presents the Green and Baseline Actions for respective areas based on which Carbon Savings are calculated.

Areas	Green Actions	Baseline Actions
Recycling	Recycling of beverage plastic bottle	Disposal at landfill
	Recycling of personal care plastic bottle	
	Recycling of aluminium can	
	Recycling of beverage carton	
	Recycling of glass bottle	
	Recycling of takeaway container	
Green Dining	Consuming a vegetarian meal	Consuming a non-vegetarian meal
Plant Milk	Consuming plant milk alternatives in coffee	Consuming dairy milk in coffee

4.2 Recycling

Carbon Savings are calculated by comparing the emissions associated with the green action of recycling an item against the baseline action of disposing of it at landfill. The emission factors of both actions per item are determined with reference to different studies and databases.

Recyclable	Reference/ Remarks of Emission Factors
Beverage plastic bottle	Lifecycle environmental inventory of beverage packaging is commonly available in Spain, taking into account the full lifecycle impacts from beverage production, transport, and end-of-life disposal [1,2].
Aluminium can	
Beverage carton	
Glass bottle	
Personal care plastic bottle	It consists of a mix of plastic types including PET, HDPE, LDPE and PP, and references the studies mentioned above [1,2], another study on upstream emissions of materials which consolidated results from European countries and the United States [3], and United Kingdoms-based DEFRA database for end-of-life disposal [4].
Takeaway container	A United Kingdom study on GHG emission factors for recycling [5].

Carbon Savings for recycling are calculated on a per-unit basis. A standard volume has been selected as the "representative volume" for each item for the calculation. For personal care plastic bottle, the representative volume and weight are estimated based on sampling of Carbon Wallet users' submissions. As for other recyclables, the selection is based on reviewing local usage statistics and research.

Recyclable (material)	Representative Volume (mL)
Beverage plastic bottle (PET)	500
Personal care plastic bottle	496
Aluminium can	330
Beverage carton	250
Glass bottle	330
Takeaway container (PP)	670

4.3 Green Dining

Carbon Savings are calculated by comparing the carbon emissions associated with the green action of having a vegetarian meal [6,7,8,9] to the baseline action of having an average non-vegetarian meal. The calculation follows an ingredient composition defined by a study conducted by The University of Hong Kong [10].

Carbon emissions of different meals are derived from the summation of carbon emissions of all ingredients according to the composition of the respective meal types. For a vegetarian meal, meat is replaced by other ingredients such as grains, vegetables and fruits.

4.4 Plant Milk

The emission factors of both green action and baseline action are referenced from agribalyse [11], a French LCA database developed by The French Agency for Ecological Transition (ADEME) for the agriculture and food sector. The average milk content per coffee is determined as 149mL based on the global typical milk portion of 5 common milk coffee (i.e., latte, cappuccino, flat white, mocha & dirty). The emission difference between using dairy milk and plant milk (i.e., soy and oat milk) at this volume is then the carbon savings per coffee.

5. Carbon Savings Equivalencies

On the homepage of the Carbon Wallet App, users' Carbon Savings are illustrated by linking with different activities (or "equivalencies") to help them easily understand their contribution to reducing their carbon footprint. The table below presents the carbon emissions associated with these equivalencies.

Carbon Savings Equivalencies	Definitions	Carbon Emissions ($kgCO_2e$)
Per smartphone charged	Carbon emissions generated per smartphone charged	0.0059
Per km travelled by private car	Carbon emissions generated per kilometre travelled by a private car	0.2736
Per serving of an 8oz steak	Carbon emissions generated per serving of an 8oz steak	4.84
Emissions absorbed by a tree per year	Carbon emissions absorbed by a tree per year	23
Per one-way flight between Hong Kong and Taipei	Carbon emissions generated per one-way flight between Hong Kong and Taipei	70
Per one-way flight between Hong Kong and Tokyo	Carbon emissions generated per one-way flight between Hong Kong and Tokyo	270
Household electricity usage per month	Carbon emissions generated per a 3-person household electricity usage per month	210
Per one-way flight between Hong Kong and New York	Carbon emissions generated per one-way flight between Hong Kong and New York	1,120

6. Glossary of Key Terms

Greenhouse gases: Gases in the Earth's atmosphere that trap heat and contribute to the greenhouse effect. These include, for example, carbon dioxide, methane and nitrous oxide, and fluorinated gases. [12]

Carbon dioxide equivalent (CO_2e): A measure for comparing or consolidating emissions of various greenhouse gases on the basis of their global warming potential (GWP), by converting amounts of other gases to the equivalent amount of carbon dioxide with the same global warming potential. [13]

Global warming potential: The relative potency of a greenhouse gas in the atmosphere as compared to the impact of carbon dioxide over a 100-year period. [14]

Life Cycle Assessment: Life cycle assessment (LCA) is a systematic method used to evaluate the environmental impact of a product or activity throughout its entire life cycle, covering material acquisition, production, transportation, operation, and finally end-of-life disposal. [15]

7. Key References

1. The Carbon Footprint and Energy Consumption of Beverage Packaging Selection and Disposal. https://www.sciencedirect.com/science/article/abs/pii/S026087741000542X
2. The Global Warming Potential Analysis of Beverage: Which is the Best Option? http://www.lcm2011.org/papers.html?file=tl_files/pdf/paper/8_Session_LCM_of_Packaging_Sustainability/6_Meneses-The_Global_Warming_Potential_analysis_of_beverage-588_ax.pdf
3. Evaluation of life cycle inventory data for recycling systems https://backend.orbit.dtu.dk/ws/portalfiles/portal/119496498/2014_Brogaard_et_Evaluation_of_life_cycle_inventory_data_for_recycling_systems_Postprint.pdf
4. Defra 2022- Waste Disposal
5. Greenhouse Gas Emission Factors for Recycling of Source-Segregated Waste Materials. https://www.sciencedirect.com/science/article/pii/S0921344915301245
6. Dietary Greenhouse Gas Emissions of Meat-Eaters, Fish Eaters, Vegetarians and Vegans in the UK. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4372775/
7. Which Diet Has the Least Environmental Impact on the Planet? A Systematic Review of Vegan, Vegetarian and Omnivorous Diets. https://www.mdpi.com/2071-1050/11/15/4110/pdf
8. Food in a Warming World. https://www.wwf.org.uk/sites/default/files/2018-03/Food_in_a_warming_world_repor t.PDF
9. Environmental Impact of Omnivorous, Ovo-Lacto-Vegetarian and Vegan Diet. https://www.nature.com/articles/s41598-017-06466-8

10. Environmental Impact of the Average Hong Kong Diet: A Case for Adopting Sustainable Diets in Urban Centers. https://www.mdpi.com/2078-1547/10/2/5/htm
11. Agribalyse https://doc.agribalyse.fr/documentation-en/
12. GHG Protocol Corporate Accounting and Reporting Standard. https://ghgprotocol.org/corporate-standard
13. Euro Statistics Glossary. Glossary:Carbon dioxide equivalent - Statistics Explained (europa.eu)
14. US EPA Understanding Global Warming Potentials. https://www.epa.gov/ghgemissions/understanding-global-warming-potentials
15. ISO 14040.2 Draft: Life Cycle Assessment - Principles and Guidelines. https://www.iso.org/standard/37456.html