Carbon Reduction Opportunities Calculator Methodology

1. Diet Change for a Sustainable Future

Climate scientists have warned that if we don't change our current lifestyle and reduce greenhouse gas emissions, by the year of 2030 our planet might go down the path of irreversible destruction.

Numerous studies have suggested that "Consumption of healthy and sustainable diets presents major opportunities for reducing GHG emissions from food systems and improving health outcomes" (IPCC, 2019). The environmental stress created by a meat-centric diet and industrial livestock farming is reported by a number of credible sources. According to the report "Tackling Climate Change Through Livestock", total emissions from global livestock represent 14.5 percent of all anthropogenic GHG emissions (UNFAO, 2013). The impacts of animal products can markedly exceed those of vegetable substitutes, to such a degree that meat, aquaculture, eggs, and dairy use ~83% of the world's farmland and contribute 56%-58% of food's different emissions, despite providing only 37% of our protein and 18% of our calories (Poore, 2019).

Green Monday Group is the pioneer in Asia to launch a large-scale plant-based movement by advocating a flexitarian lifestyle. The Group accelerates the diet change movement by innovating plant-based solutions and partnering with F&B partners to co-create more sustainable meal options internationally.

2. Purpose and Significance

Given that food is closely associated with the well-being of employees and, at a macro level, with climate mitigation, companies that incorporate sustainable food policies, such as promoting plant-based options through their HR program, are advancing a positive ESG practice that should be encouraged.

While an international framework of quantifying food purchasing and consumption activities in terms of associated GHG emissions and various indicators is not yet in place, this Carbon Reduction Opportunities Calculator aims at generating an indicative figure to demonstrate the positive impact due to diet change.

The figures generated by this calculator, bound by the boundary and assumptions, intend to motivate individuals and corporates to create more ideas for change but not for any statutory reporting purpose.

3. Definition of Carbon Reduction Opportunities

Carbon Reduction Opportunities is calculated by comparing the carbon emissions of a plant-based diet with its baseline:

Carbon Reduction Opportunities = Carbon Emissions $_{Baseline}$ *- Carbon Emissions* $_{Plant\text{-}based\ Diet}$

Carbon Reduction Opportunities is reported in kilograms of CO2 equivalent per meal reduced (kg CO2e / meal reduced).

Plant-based diet is classified as either vegan (no animal products) or vegetarian (with eggs and certain animal-based proteins). Detailed definition and boundary are referenced from the methodology of the cited research.

Figures are directly cited from published research papers and guided by the author(s). If location-specific data is not available, global average is used.

4. Consideration and limitation

a) In order to strive for a balance between user-friendliness and accuracy, this calculator adopts the “Preset” format in which impact metrics of certain preset diet scenarios are cited from references directly. This avoids granularity of data collection and input of every meal’s ingredient and weight, which is normally not feasible.

b) The methodology used and assumptions entailed by this calculator will be constantly reviewed and updated when more up-to-date data are available and advice from experts received.

c) Comparison between different calculators should be made with care due to the possible difference in scope and underlying assumptions. The comparison can be inaccurate and deceptive unless dissimilarities can be clearly stated or resolved.

5.1. Metrics and Assumptions (Hong Kong scenario)

Hong Kong's per capita meat consumption ranks top among some of the world's developed cities. As Hong Kong is a net importer of goods and GHG emissions, researchers from the HKU Department of Earth Sciences reported a Hong Kong specific GHG emissions by the "consumption-based accounting method" which better reflects the actual scenario observed in Hong Kong (YY Yau et al, 2018). The research, led by Dr Christelle Not, was published in *Environmental Research Letters* 2018 and estimated the GHG reductions by different diet scenarios.

The research focused on 8 diet groups which are generally reported as having high environmental impact. They included ruminants, monogastrics, eggs and dairy products. By extracting from the HK Gov's trade data and authorities' local production data, the net volume consumed (2016) by the Hong Kong population was obtained. Hong Kong specific emission factors were calculated by taking into account the data of international trades.

Data of fish, crustaceans, vegetables, legumes, grains and their products, soymilk and fruits were added to create a more complete "baseline diet" observed in the typical Hong Kong population.

Baseline diet [(1)(2)]

A mix of 18 food groups including ruminants and monogastrics (Beef, Sheep, Pork, Poultry), eggs and dairy products (Eggs, Milk, Cheese, Yogurt), Fish (farmed) and Crustaceans (farmed)[(3)], vegetables/legumes/Grains (Tofu, Root vegetables, Brassica, Rice, Peas/Legumes/Soy, Bread/Wheat), Soy Milk[(4)] and Fruits.

Vegan diet [(5)(6)(7)]

Removing all animal products from the baseline diet including Beef, Sheep, Pork, Poultry, Eggs, Milk, Cheese, Yogurt, Fish (farmed) and Crustaceans (farmed), accounting for a daily intake of 60g protein with new mix of protein sources.

Vegetarian diet

Removing all animal products from the baseline diet except eggs and dairy products, accounting for a daily intake of 60g protein with a new mix of protein sources.

Vegan Carbon Reduction Opportunities [(8)]
= GHG emiss.(baseline - vegan)/ per meal convertor
= (18.93-2.78)/3
= 5.38 kg CO2e / meal reduced

Vegetarian Carbon Reduction Opportunities
= GHG emiss.(baseline - vegetarian)/ per meal convertor
= (18.93-3.79)/3
= 5.05 kg CO2e / meal reduced

	Carbon Intensity (Tonnes/kg)	Baseline consumption per day (kg/capita)	Carbon Emission per day (kg CO2e)	Vegetarian consumption per day (kg/capita)	Carbon Emission per day (kg CO2e)	Vegan consumption per day (kg/capita)	Carbon Emission per day (kg CO2e)
Ruminants							
Beef	0.0500	0.2300	11.5000	0	0	0	0
Sheep	0.0300	0.0020	0.0600	0	0	0	0
Monogastrics							
Pork	0.0090	0.2730	2.4570	0	0	0	0
Poultry	0.0080	0.1300	1.0400	0	0	0	0
Seafood							
Fish (farmed)	0.0050	0.0440	0.2200	0	0	0	0
Crustaceans (farmed)	0.0120	0.0060	0.0720	0	0	0	0
Eggs and Dairy products							
Cheese	0.0160	0.1180	1.8880	0.0300	0.4800	0	0
Yogurt	0.0060	0.0020	0.0120	0.0030	0.0180	0	0
Egg	0.0050	0.0470	0.2350	0.1050	0.5250	0	0
Milk	0.0020	0.0780	0.1560	0.2400	0.4800	0	0
Vegetables / Legumes / Grains							
Tofu	0.0016	0.0080	0.0128	0.3080	0.4928	0.3080	0.4928
Root vegetables	0.0004	0.0200	0.0080	0.0310	0.0124	0.0620	0.0248
Brassica (leafy vegetables)	0.0004	0.1120	0.0448	0.1760	0.0704	0.3000	0.1200
Rice	0.0038	0.2420	0.9196	0.3100	1.1780	0.3100	1.1780
Peas/Legumes/ Soy	0.0009	0.0050	0.0045	0.0140	0.0126	0.0400	0.0360
Bread/wheat	0.0014	0.1230	0.1722	0.2170	0.3038	0.2170	0.3038
Fruits and Plant based drink							
Soy milk	0.0009	0.0300	0.0270	0.0300	0.0270	0.4800	0.4320
Fruits	0.0008	0.1200	0.0963	0.2340	0.1878	0.2340	0.1878
Total emissions per day			**18.9252**		**3.7878**		**2.7752**
Reduction per day (kg CO2e reduced)					**15.1374**		**16.1500**
Reduction per meal (kg CO2e reduced)					**5.0458**		**5.3833**

Assumptions:

1. Per meal. Convertor assumes three meals a day with environmental impact evenly distributed.

2. Daily consumption of ruminants, monogastrics, eggs and dairy products are obtained from YY Yau et al (2018). All food intake and wastage are regarded as consumption (and contribute to GHG emissions in this sense) [reference].

3. Daily consumption of “Seafood”, “Vegetables/Legumes/Grains” and fruits are obtained from the Centre for Food Safety’s Report of the Second Hong Kong Population-Based Food Consumption Survey (2018-2020 average) [reference]. All seafood are assumed to be farm produced.

4. Daily consumption of Soymilk is obtained from China's Soy Milk Market Prospects Research Report 2018 (AskCI Consulting, 2018) [reference]. Carbon intensity of “Fruits” is the average of that of the 4 fruit groups (citrus-oranges, pome-apples, tropical-bananas, berries) provided by Poore (2018) [reference].

5. The vegan and vegetarian diet scenarios are designed referencing the research result conducted by Dooren (2014) [reference], followed by verification conducted by Green Monday Group’s in-house nutritionist.

6. Protein mix of Eggs and Dairy products, Tofu, Peas/Legumes/ Soy and Soy milk in vegan and vegetarian scenarios are adjusted to 60g/day according to nutritionist guideline referencing USDA (2020) [reference].

7. Total daily consumption of leafy vegetables, root vegetables and fruits are adjusted to at least 400g based on WHO guideline (2020) [reference].

8. Alternative proteins - While alternative protein products could be highly processed, the key environmental impact (including carbon emission during production and land-use change) is closely linked to its primary ingredients. “The farm stage dominates, representing 61% of food’s GHG emissions (81% including deforestation) (Poore, 2018). Waite (2019, World Resources Institute) suggested classification of alternative proteins can be done according to their main ingredients, such as soy, pea and wheat, and the corresponding environmental footprint could be double (2X) that of the main ingredients. Therefore the environmental footprints of alternative proteins are not exhaustively accounted for. Taking pea as an example, the GHG emission per 100g pea protein is 0.4 kgCO2e, which is only 0.8% of that of beef (beef herd) (Poore, 2018).

6. References

1. AskCI Consulting (2018). China's Soy Milk Market Prospects Research Report 2018. [reference]
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7. United States Department of Agriculture (2018). Abridged List Ordered by Nutrient Content in Household Measure. [reference]
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