Methodology used for the GoClimate Lifestyle Footprint Calculator

2020-04-22
Version 1.0

1. Introduction

As a part of our mission to stop climate change, we believe that it is essential that individuals, as part of the society, understand and take responsibility for their carbon footprint. In becoming more informed and holding ourselves accountable, we can both reduce our own footprint as well as collectively exert pressure on politicians, companies and others whose emissions we cannot affect alone.

This footprint calculator has been elaborated to give individuals an estimation of the climate impact of their lifestyle with a few simple questions. Our goal is to provide a tool that is incredibly easy to use, but by asking the right questions can still give a good approximation of the carbon footprint. Instead of striving for a very precise answer, which would require asking for a lot of details that one might have to recall or look up, the calculator is formulated so that anyone can answer effortlessly and get a fairly accurate idea of their impact.

At the point in time when this product was developed, we saw that few people knew much about their carbon footprint. This tool therefore helps users understand how many tonnes of carbon dioxide they are responsible for, where they come from and thus how they can be reduced. By asking only the most important questions, our user's attention will be drawn to the sections where they should start their efforts to reduce their impact. Our time and energy is limited, so to do the most good for the climate, efforts should be made based on their impact and not confused with symbolic actions that might feel good but distract us from what is most important.

This document describes the methodology behind the GCN Lifestyle Footprint Calculator, starting with the fundamental principles considered, followed by the decisions made for data input in terms both of data sources as well as actual values. Considering that research continually provides better data, and that changes occur in society both regarding our behaviour and the technologies we use, this methodology will develop with time as the input becomes more precise and our understanding of the data becomes even better. Hence, this is not a claim to absolute truth, but a tool to help us on the long road towards a carbon neutral society.

2. Principles

These are the fundamental principles we are guided by in the design and development of the calculator and in compiling the underlying data.

2.1. Science based

We always consider more than one study or data source to get a deep understanding of what is most appropriate use of data for this purpose. In the cases where there is national data available, we use that. Most often we do so if there is official government data from the Environmental Protection Agency (EPA) or equivalent. To the largest possible extent we try to rely on official data, or peer reviewed scientific articles. However, this is not always available and then we use the most legitimate data we can find. As the field of carbon footprinting and GHG accounting is expanding and factors are changing, we continuously review and update the data. This means that the user could retake the calculator and possibly get a different result in the future. This is something we should all be happy about because it means we are improving our accuracy and understanding of the emissions.

2.2. Simplicity

The purpose of our calculator is to allow people to get an overview of their carbon footprint in just a few minutes. We believe that we are asking the most relevant questions to get an individual footprint, and nothing more. There are many tools out there for the person who wants to make a more detailed analysis of their emissions, but for our purpose we value simplicity over details. Moreover, we believe that by focusing on the major categories, we help our uses understand where the majority of their emissions come from, and where they can have the largest impact when they work on reducing their emissions. The simplicity helps us focus on what is really important and to spend our energy on the right things.

2.3. Default data

Noting that the answers aim to provide a general idea of the climate impact of a lifestyle, and not a perfect individual analysis, we are using generic data and averages. We do provide national average data for some countries in this version, but many countries will use default data that are to a large extent based on EU averages. If the result seems too low or too high compared to other numbers that are out there, this is the perspective to keep in mind. The design is meant to be as global and general as possible, which comes with certain limitations. We are catering to the 80%, so if you have a special situation, this can be hard for us to account for. If you know that your footprint is different from what our calculator shows, feel free to compensate for more or less than what is suggested. We do not claim absolute truth.

2.4. Consumption vs production based

There are several ways to calculate carbon footprints. In statistics from the World Bank and others on CO2 emissions per capita, this is based on the production of CO2 emissions in that country. For the purpose of this calculator, this is highly unhelpful as we want the user to be able to understand and take responsibility for their full emissions. This includes emissions from flights, which take place on international territory, and the use of products that are produced overseas. In a production based calculation, the producer carries the responsibility whereas we are interested in the emissions related to the consumption, which is where we believe that we have the power to change and make a difference as a community.

2.5. Approximately right vs. exactly wrong

We prefer to be approximately right rather than exactly wrong. This means that we prefer to use averages and more all-encompassing numbers, than go into too much detail. The reason for that being, that it is impossible to ask all the right questions. On the one hand, it is very hard to estimate your exact behaviour and consumption because life is not a perfect routine, and it is often the outliers that have a significant impact. On the other hand, we would end up asking a lot of questions that would not be all that relevant to the bigger picture, and lose focus on the most important factors. By only asking questions about the main sources of emissions, we maintain focus on what is really important. In order to change society, we need to see the bigger picture and not get lost in the details. Therefore, we do not ask about how you sort your waste as this has very low impact on your emissions, but tend to steal the attention and energy of many people.

3. Versions of the calculator

The first version of the calculator was based on values for Sweden. For the second version, we are expanding the calculator to contain slightly different calculators for different countries, and have an international version for the rest of the world. The selection of countries was based on the countries where we have seen an interest from users, and we therefore start by launching separate calculators for Germany, the UK, the USA and (an improved version for) Sweden. The international version is largely based on average EU values, as that is where we have users today. It is also worth keeping in mind that a main determining factor for lifestyle carbon footprint is income level. So if we were to assume that our users have roughly the same income level, that would make their lifestyle and choices relatively similar, even though they might live in very different parts of the world. People with a high income living in low income countries are more likely to have a footprint comparable to that of an average EU citizen, rather than to their national average.

4. Footprint Categories

The lifestyle footprint is split into the different categories listed below.

4.1. Food

For this version of the calculator, we have used the same values for food for all countries.

It is known from research that we tend to report our diets inaccurately. Therefore, we believe it is better to present general dietary profiles rather than ask the user to recall how many grams of each product is consumed per week. Naturally, there is variability within these diets (some sources show vegan diets as low as 0,5 tonnes per year, others show 3,3 tonnes for a meat lover), but this gives a good approximation of an average person's impact.

We have based the categories and values in the calculator on data from a study by Scarborough et al (2014). These are the categories and values we use:

Vegan	1,054 t/yr	2,89 kg/day
Vegetarian	1,390	3,81
Pescetarian	1,427	3,91
Some meat	1,704	4,67
Regular meat	2,054	5,63
Heavy meat	2,624	7,19

Noting that these diets are adjusted to 2000 kcal, and they do not account for food waste.

The choice to use this study was based on the fact that it is one of very few studies that compare actual and not hypothetical data. When looking at theoretical data, the values tend to be lower than in this kind of studies, because when we imagine a diet we can be quite idealistic. The study was performed in the UK, but we have been in touch with Swedish researchers who indicate similar numbers for Sweden. The diet as well as the caloric intake varies greatly between countries as well as for individuals, where men generally eat more than women and wealthier people eat more than poorer, but we consider this to be the best study that in this version of the calculator best represents the profiles of our users.

4.2. Car

The data is adjusted for country averages, as the car fleet varies from country to country. For example, in Sweden, the turnover rate of cars is quite low, which means that there are many older cars still in use and their emission factors are higher than for the newer cars. Hence, the values are higher for the average car on the road than it is for new cars. The EU has set standards for emission factors for new cars which are significantly lower than the values we use for average cars, which is a great policy. The New Car Report 2017 from the Society of Motor Manufacturers and Traders (UK) indicates that a new car is more than 20% more efficient than the average car in use. For this calculator we still use the data for average cars, and not for new cars. Another illustrating example of how much it can vary from one place to another is that the emission factor for new passenger vehicles in Australia is 45% higher than in Europe. The Australian National Transport Commission explains that this depends on Australians' preference for heavier vehicles with larger and more powerful engines, a lower proportion of diesel-powered engines, has fewer government incentives for lower emissions vehicles, and relatively lower fuel prices in Australia compared with Europe. These factors could presumably also be true for the USA where the emission factor for average cars is also higher than in Europe.

These are the values (and sources) we use:

EU/international and Germany (EEA 2019, National Transport Commission 2019, Energimyndigheten 2018):

Gasoline	148 g CO2/km (adding 20% to the average for new cars)
Diesel	146 g CO2/km (adding 20% to the average for new cars)
Plug-in Hybrid Electric	49 g CO2/km
Electric	5 g CO2/km

Sweden (Energimyndigheten 2018):

Electric car or HVO	5 g CO2/km
Vehicle gas (CNG)	39 g CO2/km
Ethanol (E85)	113 g CO2/km
Diesel	147 g CO2/km
Gasoline	186 g CO2/km

UK (Department for Business Energy & Industrial Strategy 2018, National Transport Commission 2019, Energimyndigheten 2018):

Diesel	140 g CO2/km (248 g CO2/mile)
Petrol	154 g CO2/km (225 g CO2/mile)
Plug-in Hybrid Electric	49 g CO2/km (79 g CO2/mile)
Electric	5 g CO2/km (8 g CO2/mile)

USA (US Environmental Protection Agency 2018, National Transport Commission 2019, Energimyndigheten 2018):

Gasoline	252,5 g CO2/km (404 g CO2/mile)
Plug-in Hybrid Electric	49 g CO2/km (79 g CO2/mile)
Electric	5 g CO2/km (8 g CO2/mile)

Australia (National Transport Commission 2019):

Gasoline	200 g CO2/km (20% higher than the new car average)
Diesel	250 g CO2/km (20% higher than the new car average)
Plug-in Hybrid Electric	49 g CO2/km

For electric vehicles we use the emission factors as provided by the Swedish Energy Agency (Energimyndigheten) and for hybrids the value provided by the Australian National Transport Commission were used throughout the calculator, as there are still few cars and brands on the market, making the factors homogeneous.

4.3. Flight

We have built an API for calculating flight emissions. The calculations are explained in more detail here. In the model we differentiate between short, medium and long haul flights. Flight emissions can differ a lot depending on several factors, among them the airplane model, the amount of fuel, luggage, freight and passengers loaded, the holding patterns and air waiting time and the direction and strength of the wind. However correct you get some of the factors, you will almost always be a bit off.

In this lifestyle calculator we also mix short, medium and long haul flights and sum them up into a number of flight hours It therefore does not make much sense to try to guess what kind of flights the sum consists of.

Therefore we decided to use a simpler factor in this lifestyle calculator. We compared different ways of calculating the emissions of the sum of hours and with a radiative forcing index (RFI) of 2, which is considered best practice according to recent studies. We ended up with an emission factor of 200 kg CO2e / hour.

4.4. Housing

The housing calculations differ significantly from country to country, which depends on several factors, including local climate and need for heating/cooling, available energy sources and options, but also data availability and format. There is an option to choose "unknown", which gives an average value. This is to be used in the case where the user is not sure of the energy consumption, or if their specific method for energy consumption used in their home should not be available.

4.4.1. EU (international)

A straightforward way of calculating household energy consumption on a general level that can be applied in varying contexts, is to multiply the kWh consumption per m2 with the living space per person. Although the energy consumption varies depending on the country and local conditions, such as weather and insulation standards, we use the EU average of 170 kWh per m2 (ECSO 2018). We provide alternatives to account for living area per person, indicating that the EU average is 42 m2 per person (DG Energy 2011) but allowing the user to adjust this for higher accuracy. 80% of the energy consumption is then multiplied by the emission factor for the chosen heating source, and 20% by the emission factor for electricity, as this is roughly the average distribution of energy consumption per usage - heating and household electricity for appliances and lighting (Eurostat 2019). The emission factors are provided by the Joint Research Centre of the European Commission (2017) and Institut Wohnen und Umwelt (2020). The answer "don't know" defaults to natural gas as heating source.

4.4.2. Germany

The alternative sources for home energy in Germany are many, and vary depending on where in the country you live. There is also significant variation in how energy-efficient the homes are, as older homes are not conserving heat as well as new ones. There are government programmes aiming to improve older buildings, making them more efficient through insulation refurbishments. We currently do not take this into consideration, in order to still keep the calculator as simple as possible.

From Statistisches Bundesamt (2018), we use the average kWh consumption per household, divided by average number of persons per household to get an individual answer. This data is disaggregated into heating and water, and general household electricity use. The value is then multiplied by the emission factor for the selected energy source for the heating and water, and for the average German electricity factor for the household general consumption. The emission factors are provided by Institut Wohnen und Umwelt (2020).

4.4.3. Sweden

In Sweden, the major factors influencing your electricity and heating consumption and the associated carbon footprint is whether you live in an apartment or a house, and how you heat your home. Most common methods for heating are district heating and direct electricity. In our calculations for heating, we have used data from Statistics Sweden (2018a) considered average living area per person, which differs from apartments and houses. Then we multiply that by average heating consumption per m2 for the house type, as indicated by the Swedish Energy Agency (2019a, 2019b), and by the emission factor (co2e) for the type of energy input (data for district heating from Swedenergy (2020) and data for electricity from the Swedish Energy Markets Directorate (2018)). It should be emphasized, however, that the emission factor for district heating varies greatly within Sweden. There are many providers and for some the emission factor is close to 0 because they use clean energy, for others the emission factor is much higher. We therefore encourage everyone who is interested to look up the specific emission factor for their area and provider, which is published annually at Swedenergy.

For those who use a geothermal heating pump, we assume a 70% reduction in energy consumption. It can be up to 80% according to Vattenfall (2020a), so we have a little buffer there. Same goes for air heat pumps, where Vattenfall (2020b) estimates that the reduction in heating costs (excluding heating of water) can be up to 55%, where we assume 50%.

For household electricity consumption, we consider average consumption per household as provided by the Swedish Consumer Energy Markets Bureau (2020) divided by the average number of persons per household as provided by Statistics Sweden (2018b), differentiated for apartments and houses.

4.4.4. United Kingdom

In the UK, 75% of homes are heated with natural gas. About 11% are heated with electricity, 8% with oil and the rest use other sources. The calculator therefore considers Gas or Electricity as options for heating sources, as it applies to the large majority of the population. To the heating consumption, general household electricity consumption (lighting, kitchen appliances, washing machines etc) is added. “Unknown” option for the UK is therefore a medium consumption of gas for heating, and a medium consumption of household electricity.

The numbers for average household energy consumption comes from UK Power (2019). These values are multiplied by the emission factors for gas and electricity, which are provided by the Department for Business Energy & Industrial Strategy (2019). In the case

where the home is heated with electricity, the same consumption as for gas is assumed and the emission factor for electricity is used. The result is divided by average number of individuals per household as provided by the Office for National Statistics (2017), to give a footprint per person.

4.4.5. USA

Considering the great diversity in home energy usage in the USA, we have chosen to base our calculations on which type of fuel is used to power the home, and then used regional averages for the quantity consumed. This data comes from US Energy Information Administration (2015) Residential Energy Consumption Survey (RECS). The emission factors come from the US Environmental Protection Agency's Center for Corporate Climate Leadership (2016).

Assessing the energy consumption data disaggregated for household use from the RECS, we isolated the water as a separate factor, to assume that the water was heated natural gas. We then isolated the electricity use from general household appliances, and added the emissions from this usage as household electricity to the main energy source for heating and/or cooling. The emissions per household is then divided by 2,63 which is the average number of individuals per household in the US, according to the US Census Bureau (2020).

4.5. Electricity

In case green electricity (disclosed electricity/guarantees of origin or if you are self-sustaining with e.g. solar panels) is chosen, the emission factor for electricity is set to 10 g CO2e/kWh. The value is based on the wind emission factor as provided by the Joint Research Centre of the European Commission (2017), which is slightly higher than the emission factor for hydropower but lower then for solar panels. Noting that hydropower is the most common source of renewable energy, using the slightly higher factor for wind power leaves us a slight safety margin for errors. This is applied to the household electricity consumption, and in case electricity is used for heating/cooling, is applied to that correspondingly.

4.6. Other consumption

There are some emissions that are not covered by the questions in the calculator. We have not included questions about leisure activities or personal shopping, instead we have opted to use an average value. This is because we would have to ask too many questions to get a reasonable answer, and even so, it is very hard to get a good value. This is both because it is hard to ask the right questions, but also because it is hard to answer accurately on this level of detail. Again, the purpose of this calculator is to give a good approximation, not the perfect truth.

These are the values (and sources) we use:

EU/International (Ivanova et al 2016): 2,955 t/yr (average excluding Germany and UK)
Germany (Ivanova et al 2016): 3,6 t/yr
Sweden (Swedish National Environmental Protection Agency 2020): 1,01 t/yr
UK (Ivanova et al 2016): 5,1 t/yr
USA (CoolClimate Network 2020): 5,124 t/yr

The study by Ivanova et al (2016) was chosen for the relatively high level of detail provided for a large number of European countries, where the data comes from the same set. This makes the values fair and comparable from one country to another, which would have been incredibly hard to accomplish using different data from varying sources, as the methodology and assumptions chosen for different studies vary greatly.

4.7. What is the rest of my footprint?

There are also some emissions that you cannot avoid, from public goods and investments. These include materials used in hospitals, the construction of roads, education etc. It is important that these are accounted for in this calculator, as it is a service provided to you that you take advantage of either directly or indirectly. In order to account for this, we add a standard value to the result, which is a rough estimation of these emissions.

For the EU/international version, as well as for the German, UK and US version, we use data provided by the German Umweltbundesamt (2007) which estimate 1,24 tonnes per person per year.

For Sweden, we have used the consumption-based emissions per person as provided by Naturvårdsverket (2017), which indicate a value of 0,98 tonnes per person for public consumption and 2,6 tonnes from public investments.

5. Average footprint

In order to compare your footprint to something and put it into perspective, national averages are provided, as well as the goal for where we need to be in 2030 to be in line with the Paris agreement. The national averages that we use, and the sources, are:

EU/International (Ivanova et al 2016): 11,3 t/yr (average excluding Germany and UK)
Germany (Ivanova et al 2016): 13 t/yr
Sweden (Swedish National Environmental Protection Agency 2020): 8,87 t/yr
UK (Ivanova et al 2016): 15,3 t/yr
USA (CoolClimate Network 2020): 19,2 t/yr

World (World Bank 2020): 5 t/yr

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