Calculations in the GoClimate Business Footprint Calculator

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1. Introduction

The GoClimate Business Footprint Calculator calculates an approximation of the amount of CO_2-equivalents a business emits during a specified time period. The purpose of the GoClimate Business Footprint Calculator is to educate on the amount of emissions a business has, and what the distribution are between different sources of emissions. This will in turn give businesses data that hopefully will make it easier for them to reduce emissions where it has biggest effect.

1.1. Climate Change and businesses

Climate change is real and the time to drastically lower our total Greenhouse Gas emissions is now. Businesses have a big responsibility in leading this change and set up emission reduction goals in line with the Paris Agreement.

We believe that future laws and regulations will make all kinds of businesses pay for their emissions, and we hope to be a part of preparing businesses for this - which will also hopefully speed up the process on getting the laws and regulations in place.

1.2. Precision of Calculations

Our calculation is as almost all GHG-calculations an estimation of the real emissions. It is complex and time consuming to calculate a business exact emissions - if even possible - due to several reasons:

- Data available - not all data is always easily available. Does the electricity our office consumes get measured? For smaller companies using only part of a floor, or working in a co-working space in a building, this is sometimes not measured.
- Time available - even if the data can be obtained, is it feasible to make all employees report every exact commute to work? Or every lunch they buy to potential customers and if the lunch contained meat or not?

Calculations on the climate impact of most business needs to be based on some assumptions - each assumption with different drawbacks. In this document we try to explain the reasoning behind the assumptions we have made.

For some companies (small service companies in Sweden) the calculator will be a very good and accurate estimate, even GHG-protocol compliant, but for most more complicated

companies a more detailed analysis with tailored emission factors is needed to become GHG-compliant or similar.

1.3. CO2e unit

In our calculator we have tried to simplify the technical language we use, since many people using the calculator are not full time sustainability-professionals.

One choice we have made is to use the term carbon dioxide (sv: koldioxid) when talking about carbon dioxide equivalents (CO2e). This decision was made after our user tests revealed that many people find the words CO2, CO2e or carbon dioxide equivalents confusing. So every time we mention carbon dioxide in the calculator, we are talking about carbon dioxide equivalents.

2. Objective

The objective of the GoClimate.com Business Footprint Calculator is to shed light on the emissions caused by a business and visualize how they are distributed among different emission sources. This will provide a good source of information for enabling businesses to reduce their emissions where it has the biggest positive effect for the climate.

3. Principles

Since there are many ways of reasoning about the assumptions needed to be done, we have chosen a few principles to guide us.

3.1. Underestimation vs. Overestimation

We don’t want to underestimate emissions and thereby risk guiding businesses to make the wrong decisions. But we also don’t want to overestimate, giving the businesses the wrong impression of the actual emissions.

Two other factors can be taken into account here. Firstly, from a communications perspective it is can feel safer to slightly overestimate the emissions, especially if you offset the emissions and want to feel safe that you have offset enough emissions. Secondly, it is also nicer to see that the more accurate a calculation it becomes, the emissions calculated becomes lower and not higher, thus intecivicing an as accurate calculation as possible.

A balance between underestimation and overestimation is important - trying to aim for as accurate calculations as possible. But if we are in doubt, we lean towards a slight overestimation for the reasons stated above.

3.2. Approximately right vs. exactly wrong

We prefer to be approximately right than exactly wrong. This means that we rather answer with less significant digits in our response than too many significant digits. It also means that we focus on the emissions that really matter, and don’t spend time on those that are insignificant or very hard to measure correctly.

3.3. Assumptions

A few assumptions needs to be made for a consistent calculation:

- **Businesses using the calculator** - The calculator is developed for service companies, with no own production (specifying the emissions from the production in the open “other” category in the form is possible). So far we only support Swedish and UK based companies, and we assume most are tech companies based in Stockholm or London, even though we support the entire countries.

- **Employee commuting** - Employees commuting with public transport or bike is excluded in this calculation since this is such a small factor - often below 0.1% - of the company's total emissions. We assume most employees are not driving or flying long distances to work every day. If some employees are, this should be entered in the “other” category in the form.
- **Average sqm per person** - To make averages usable for per sqm factors, we need to make certain assumptions. We assume that offices are a mix between open space offices and activity based offices. This number is only used if the user does not enter the m2 of the office in the form themselves.
  Factor: 15 sqm / person
  Source:
  https://yta.se/blogg/kvadratmeter-per-anstalld-for-kontor/
  https://objektvision.se/Artiklar/Kontorsyta

4. Calculations

The different calculations made are in the areas energy, business trips, food and material.

4.1. Energy

There are several ways to calculate the climate impact of the energy use from a business. The GHG-protocol Scope 2 guidance suggests using both a market based calculation (calculating different climate impacts for businesses having green power programs and those who not), and a location based calculation. We have decided using the market based calculation when summing up a business total emissions.

4.1.1. Electricity

We have chosen to calculate with zero emissions if the business has a 100% renewable power program or uses nuclear power. We have chosen Nordisk residualmix as a basis for our calculations if the business does not have a green power program.

Factor: The factor used depends on if the electricity is from a 100% renewable power program or not, according to the market based-method.

Green factor: 0,006 kg CO2e / kWh
Non-green factor: 0,329 kg CO2e / kWh
Source: https://ei.se/sv/for-energiforetag/el/ursprungsmarkning-av-el/
https://www.vattenfall.se/elavtal/energikallor/elens-ursprung/

Average per m2 if exact electricity is not known: 122 kWh / m2 / year
Source:
https://www.energimyndigheten.se/statistik/den-officiella-statistiken/alla-statistikprodukter/ - Energistatistik för lokaler 2017 - Tabell 3.16 Energianvändning (exklusive fjärrkyla och el för komfortkyla) per kvadratmeter uppvärmd area i lokaler år 2017, fördelad efter byggår, ägarkategori och län, kWh/m2 - total, alla län

4.1.2. District heating and cooling

90% of the offices in Sweden has district heating as primary source of heating for a building and its tap water. If not specified, we assume the office has district heating.

Factor: 0,06592 kg CO2e / kWh
Source: Average of Swedish district heating providers. Sthlm Exergi were many of our users are has 0,071 kg co2e / kWh.

Average per m2 if district heating is not known: 117 kWh / m2 / year
Source:
https://www.energimyndigheten.se/statistik/den-officiella-statistiken/alla-statistikprodukter/ - Tabell 2.4 Faktisk och temperaturkorrigerad fjärrvärmeanvändning per kvadratmeter i lokaler endast uppvärmda med fjärrvärme år 2002-2017, efter byggår, kWh per m2

4.1.3. Servers

Servers can be a large source of emissions, and can differ quite a lot depending on if the server is in the cloud or on premise and if the electricity used by the server is 100% renewable or not.

Data for the emissions from production of a server and the energy consumption of servers that result in the emissions are taken from a standard 2019 R640 Dell server. This is deemed as a top of the line but not unusual server being bought 2019.

If the servers are running in a data center that runs on a 100% renewable power program, the emissions only include the emissions from the production of servers. If not, the calculation assumes the Nordic residual mix multiplied by a cloud effectiveness factor.

The cloud effectiveness factor is taken into account since cloud data centers can be a lot more energy efficient than ordinary data centers or self managed on premise servers. AWS claims that 88% less power is used for servers in the cloud. A large number makes sense since cloud

providers have a much better possibility of using the resources available in a smarter way, and has much larger incentives to lowering their electricity usage. We use a conservative number of 50% since numbers from other cloud providers are not available.

A four year lifetime of a server is assumed.

Emissions from production of servers on premise: 320 kg CO2e/year
Emissions from production of servers in cloud (since 50% is needed in cloud): 160 kg CO2e/year

Emissions from green power consumption: 0 kg CO2e/year
Emissions from non-green consumption for premise power or self managed servers : 1760.3 kWh / year * 0,329 CO2e / kWh = 579 kg CO2e
From non-green cloud power consumption : 1760.3 kWh / year * 0,329 CO2e / kWh * 0,5 = 290 kg CO2e

This results in:

Factors:
Server on premise with green power consumption: 320 kg CO2e / year and server
Server on premise with non-green power consumption: 899 kg CO2e / year and server

Server in cloud with green power consumption: 160 kg CO2e / year and server
Server in cloud with non-green power consumption: 450 kg CO2e / year and server

Sources:
https://i.dell.com/sites/csdocuments/CorpComm_Docs/en/carbon-footprint-poweredge-r640.pdf
https://ei.se/sv/for-energiforetag/el/ursprungsmarkning-av-el/
https://aws.amazon.com/blogs/aws/cloud-computing-server-utilization-the-environment/
https://docs.google.com/document/d/1eCCb3rgqtQxcRwLdTr0P_hCK_drIZrm1Dpb4dlPeG6M/edit

More reading on this topic can be found here:
https://www.GoClimate.com/blog/the-carbon-footprint-of-servers/

4.2. Business trips

Business trips are a large source of most service businesses carbon footprint, mainly coming from flights.

4.2.1. Flights

We have chosen to calculate the flight emissions from flight hours rather than actual trips after our user tests have shown that a significantly higher amount of users can estimate the number of flight hours rather than specifying every single trip made.

Factor: 200 kg CO2e / hour
Source: Our own calculations based on our research for the GoClimate Flight Emissions API: https://api.GoClimate.com/docs

4.2.2. Car & taxi

This number is excluding the distance driven in electrical vehicles.

Factor: 0,122 kg CO2e / km
Source: Genomsnittligt koldioxidutsläpp nya personbilar under 2017 samt 2018. Siffran inkluderar de utsläpp som uppstår när bränslet produceras, distribueras samt vid förbränning i motorerna. Siffran innefattar inte de utsläpp som orsakas vid tillverkning av bilen. https://www.trafikverket.se/for-dig-i-branschen/miljo---for-dig-i-branschen/energi-och-klimat/Klimatbarometer/

Source: https://www.miljofordon.se/bilar/soek-bil/

Future possible improvement:

- We could divide taxi and car, since taxi is often traveling unused, a 20% extra consumption is fair to add
- We could divide tjänstebil and rental car since it's different scopes
- Add option if the company has a environment taxi policy

4.2.3. Hotel nights

We have divided the hotel nights into two categories, in the Nordics and in other parts of the world. This due to us initially focusing on Swedish businesses and that the difference between emissions between the two categories is quite large.

Factor:
Nordics: 5 kg CO2e per night
Other: 20 kg CO2e per night
Source:
https://www.klimatsmartsemester.se/sites/default/files/metodrapport-klimatsmart-semester-version-1.pdf

4.3. Food

The meal is representing an average meal. The coffee includes emissions from dairy product used in coffee.

Factors:
Average meal: 2,1 kg CO2e / meal

Average vegetarian meal: 0,7 kg CO2e / meal

Coffee: 0,032 kg CO2e / cup inc milk
(3 per dag, 220 arbetsdagar. 1 kaffe (8g bönor kaffe/kopp) = 24g CO2 + 8 cl mjölk (8 g CO2) = 32g CO2/kopp = 96 g/dag = 21,12 kg/år/anställd

Sources: https://pub.epsilon.slu.se/8710/1/roos_e_120413.pdf
https://www.wwf.se/mat-och-jordbruk/matkalkylator/

4.4. Material

We only count electronics in this category since they are most often the biggest sources of emissions for tech service companies. Emissions from other material that is significant can be entered in the “other” category in the form. Examples of large sources of emissions that are not electronice could be furnitures if the business has changed premises lately.

Factors:

Average laptop: 350 kg CO2e / unit
Phone : 70 kg CO2e / unit
Monitor: 500 kg CO2e / unit

Sources:
https://www.lenovo.com/us/en/social_responsibility/datasheets_notebooks/
https://www.apple.com/environment/
https://www.dell.com/learn/us/en/uscorp1/corp-comm/environment_carbon_footprint_products