



Carbon Footprint 2021 Calculator

PHI Impact Calculator

**Erasmus
University
Rotterdam**



16-08-2022

EXECUTIVE SUMMARY

Erasmus University (EUR) is working towards a more sustainable campus and a lower carbon footprint. To measure the effectiveness of the current strategies and to detect new opportunities, the EUR calculates its yearly footprint. This report explores the results of the 2021 impact calculator. It builds on the previous yearly carbon footprint calculators and expands the scope in several areas.

Based on the mapped data, the carbon footprint for Erasmus University in 2021 is

8.800 Tons of CO₂e

This footprint has been calculated in accordance with the guidelines of the 'Greenhouse Gas Protocol'

A distinction has been used between:

- Scope 1: Direct emissions. These are produced from sources in the organization, such as the fuel consumption by the university's owned vehicles.
- Scope 2: Indirect emissions that can be directly linked to the organization. Such as the produced energy and heat consumed.
- Scope 3: Indirect emissions along the supply chain. These are the embodied carbons that are released during the production of the goods and materials used by the organization.

In 2020, the total emissions were 5.866 tons of CO₂e. In the following table and figure 2 the differences per scope are highlighted.

Tons CO ₂ e	2019	2020	2021
Scope 1	224 ton	96 ton	12 ton
Scope 2	1.025 ton	947 ton	904 ton
Scope 3	13.868 ton	4.823 ton	7.884 ton

The difference in scope 3 emissions between 2020 and 2021 can be explained by the expanded scope. The MFO II building, indirect emissions from electricity, work environment and the ICT have been added in the 2021 carbon footprint.

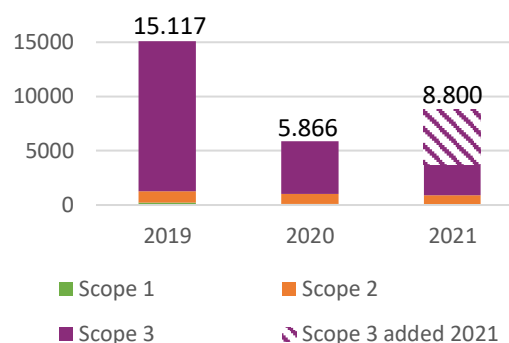


Figure 2: Total emissions per scope

The largest impact categories for 2021 are:

- The MFO II building with 4.348,9 tons
- The mobility (which includes the student & employee commute, and the business travel) with 2.231,5 tons
- The heat consumption with 1.036,8 tons

See following page and appendix 1 for total impact per category.

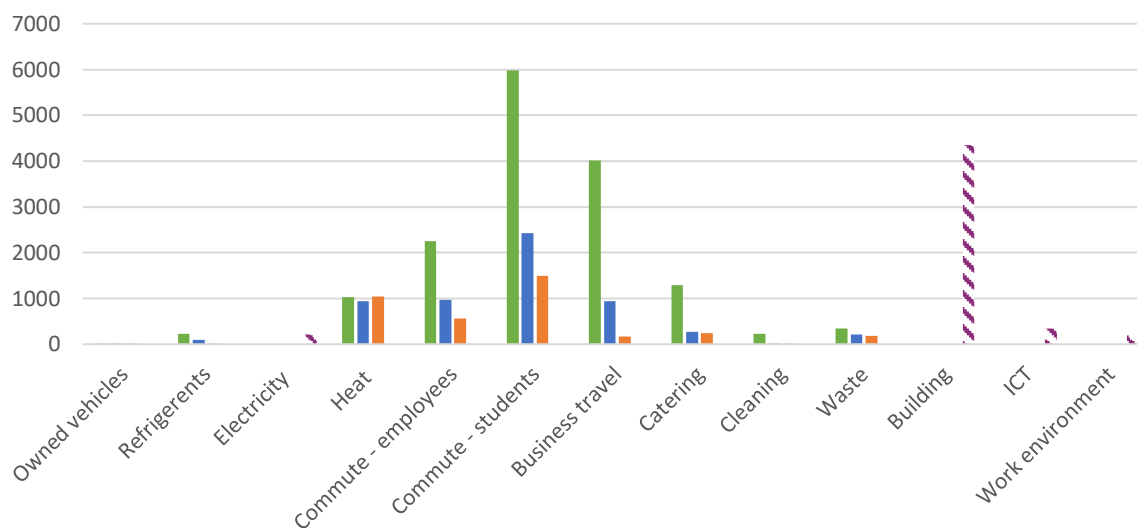


Figure 1: Total emissions per impact category

■ 2019 ■ 2020 ■ 2021 ■ 2021 added scope

Year	2019	2020	2021
Direct emissions (scope 1)	223,4	95,5	12,3
Natural gas consumption	x	x	x
Fuel consumption university-owned vehicles	1,5	1,4	0,9
Refrigerents	221,9	94,1	11,4
Indirect emission (scope 2)	1.024,9	947,2	903,9
Electricity consumption	-	-	-
Heat consumption	1.024,90	947,2	903,9
Other indirect emissions (scope 3)	13.868,3	4.823,8	7.883,7
Heat consumption - embodied carbon	-	-	132,9
Fuel consumption university-owned vehicles - embodied	-	-	0,3
Commuting - employees	2.317,4	964,9	563,0
Commuting - students	5.908,6	2.426,0	1.493,8
Fuel consumption business travel - car	74,8	25,6	17,2
Fuel consumption business travel - airplane	3.903,6	913,6	156,3
Fuel consumption business travel - train	13,6	3,7	0,1
Fuel consumption business travel - public transport (other than train)	23,7	8,0	1,1
Waste production	342,9	213,2	181,3
Catering	1.283,2	268,4	237,0
Cleaning detergent	0,4	0,4	0,3
Work environment	-	-	198,6
ICT	-	-	337,7
Building	-	-	4.348,9
Embodied carbon renewable electricity			215,2
Total (students & employees)	15.116,6	5.866,5	8.799,8

Figure 3: Total tons of CO_{2e} per category

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1. INTRODUCTION

Organization's business operations emit a large amount of carbon emissions. Obvious examples are the energy consumption within the building and the fuel emissions for the transportation of employees and goods. However, that is not all. Organizations have a bigger influence on the global carbon emissions than is believed: with all materials that are being used in and around their business operations. The sum of all the greenhouse gas emissions caused throughout the whole life cycle of a product is called embodied energy. This includes the extraction of raw materials, productions, transport, use of the product and what happens at the end of the lifecycle of a product.

To give more insight into this impact, PHI Factory has developed an instrument: the PHI Impact Calculator. It uses carefully selected standards and emission factors (based on scientific data and life cycle analyses of materials) to calculate the embodied energy of the building, the work environment, facility services, ICT and more.

Assignment

Erasmus University Rotterdam (EUR) has been calculating its emissions since 2011. It started implementing a standardized methodology in 2015, which has therefore been used as the starting year. For 2021, the EUR wants to improve their methodology, in order to have a more in depth and complete overview of the direct and indirect emitted carbon. PHI Factory has been asked to aid in this process of having a more standardized process that can be repeated every year.

This aligns with the broader sustainability goals of the EUR, which aims to reduce their direct (scope 1 and 2) emissions by 2024. They are also in the process of formulating the ambition for indirect (scope 3) emission reduction. The results of this report can be used to aid in this ambition. This report will compare the results of 2021 with the previous years, to determine whether current strategies are effective and what type of future strategies are required to reduce the carbon footprint.

Additionally, the 2021 CO₂-calculation process will be used to identify how data collection and calculation can be improved moving forward. The results on how this process can be improved and embedded in the organization are included in an additional report.

Scope

For the calculation of the carbon footprint of 2021, the scope has been changed to include additional impact categories. However, the figures are presented in a transparent manner which enables a comparison with the results of previous years.

The impact categories are as follows:

- Energy consumption consisting of:
 - Electricity for buildings (indirect emissions have been added for 2021)
 - Heat for buildings
 - Refrigerants
- Mobility consisting of:
 - Commute – students
 - Commute – employees
 - Business travel (all types of transport)
 - Fuel consumption by university owned vehicles
- Catering & hot drinks (excluding external partners such as the Foodplaza restaurants)
- Cleaning (detergents)
- Buildings (focus on the newly constructed MFO II building)
- ICT (new for 2021)
- Work environment (new for 2021)
- Waste production and treatment

This footprint includes all locations of Erasmus University Rotterdam, except the Hatta housing complex. The location included are:

- Woudestein
- ISS International Institute of Social Studies
- EUC Erasmus University College

Application of results

The footprint of the EUR has been calculated for the year 2021 in order to measure the impact of the yearly carbon, the consequences due to the COVID-19 pandemic and other sustainable initiatives that were implemented. In order to do this, the results are compared to the outcomes of the previous calculations. In addition, the impact of the construction of the MFO II building has also been calculated.

Additionally, the results of this study can inform stakeholders and guide future decision making and implementation of new sustainable initiatives for the EUR.

2. CALCULATION METHOD

For the measurement of the carbon footprint of Erasmus University (EUR), the GHG Protocol guidelines were followed (see appendix 2). The GHG Protocol distinguishes three different scopes of carbon emissions:

- Scope 1: Direct carbon emissions. These are caused by sources that are owned and managed by the organization, for example the combustion of gas and or spillage of refrigerants when using the building.
- Scope 2: Indirect carbon emissions. This scope includes purchased electricity and heat. These emissions take place outside the organization but can be directly assigned to the organization.
- Scope 3: Indirect carbon emissions of materials and products, also called embodied energy. Emissions caused during the entire life cycle of all products used in business operations, such as the extraction of raw materials, production, transport, use and processing after use.

All three scopes are relevant for the business operations of the EUR. For scope 1, think of the fuel emissions of cars, but also the coolants of the air conditioning. Scope 2 covers the heat that is used by Erasmus University and scope 3 includes a wide range of products, from the sandwiches during lunch, to the electronic devices that are being used.

In order to calculate the carbon footprint of Erasmus University's business operations in these three scopes, insight is needed into the different products and services that the EUR uses. For all relevant sources of GHG emissions, we have collected data on the number of products, their lifespan (for long-cycle products), distance traveled or other factors that provided an insight. For an inventory of products that are used for several years, the lifespan is crucial for determining their yearly impact. As a product is only purchased by Erasmus University once and used for several years, the impact of the product is spread out over its total lifespan. Therefore, doubling the lifespan of a product results in a 50% reduction of the carbon yearly footprint.

Since carbon dioxide (CO₂) is not the only greenhouse gas that causes global warming, CO₂ equivalents are used in this study as the unit of measurement. The impact of other greenhouse gasses, such as methane, is expressed in CO₂ equivalents (CO₂e) to show their global warming

potential relative to carbon dioxide. By doing this, the total global warming potential of different greenhouse gasses can be expressed in the same way (see appendix 2).

CO₂-equivalents are measured by their weight. In this study, emissions will be expressed in kg or tons of CO₂ equivalents. One ton is a thousand kg of CO₂ equivalents and:

- is the amount of CO₂ 50 full-grown trees take up within one year;
- is emitted during 7 flights to Paris;
- and looks like a balloon of 500 m³, filled with CO₂.



Figure 4: 1 ton of CO₂

For all categories, CO₂ equivalent emissions have been assigned to the product data, using the PHI Impact Calculator, see Appendix 3. This database contains a wide range of global warming potential (GWP) factors, based on a product's life cycle: extraction of the necessary raw materials, manufacturing, transport, use and end-of-use.

These standards are based on scientific data in relation to the product, according to the GHG Protocol. An example of the scientific sources which are used are the International EPD System and the Idemat instrument, created by the TU Delft. For more information about this methodology and a list of GHG emission factor sources, see Appendix 3.

When GWP data on a specific product from the EUR was missing in the database, or when product data was unavailable, a new GWP factor was researched, or calculated based on similar products or more general data.

By using product specific GWP data, the total impact per impact category was determined, providing the results that are described in the next part of this report.

3. CARBON FOOTPRINT

The results in this chapter present an overview of the CO₂ footprint of Erasmus University for the year 2021. This study:

- identifies the carbon drivers and impact areas of Erasmus University in the year 2021 per scope;
- measures the progress on carbon reduction compared to the 2020 calculation;
- enables data-driven decision-making towards effective reduction strategies.

Firstly, an overview is presented of the total carbon emissions of the EUR in the year 2021, followed by a comparison with the footprint of the year 2020. Each impact category per scope will then be discussed in further detail. As can be seen in figure 4, some impact categories have an impact on multiple scopes. Finally, a conclusion is given on Erasmus University's emissions and how this relates to Erasmus University's sustainability goals.

Total emissions

The total reported carbon footprint of Erasmus University in 2021 was 8.800 tons of CO₂e. This number includes the added categories. To put this in perspective, this is:

- 439.990 trees that grow for a full year
- 61.599 flights to Paris

And looks like:

- 8.800 balloons of 500 m³

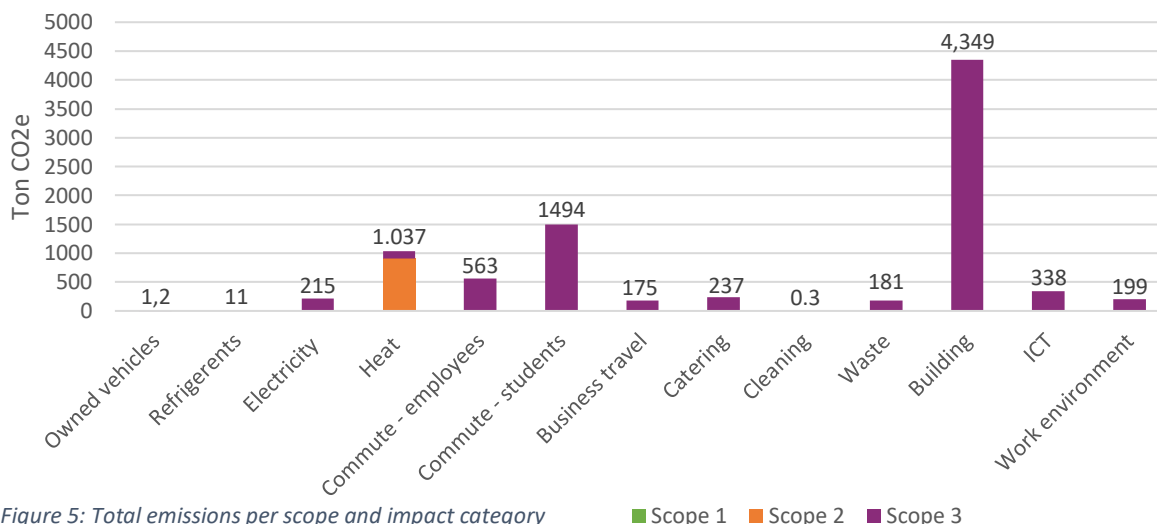


Figure 5: Total emissions per scope and impact category

Of the total emissions:

- 12,3 tons were scope 1 (0,1%),
- 903,9 tons were scope 2 (10,3%),
- 7.883,6 tons were scope 3 (89,6%)

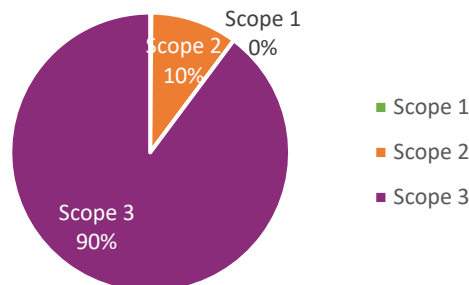


Figure 6: Total emissions per scope

Scope 3 has the largest impact. Categories such as the building, with 4.531,4 tons of CO₂e and the commuting of students, with 1.493,8 tons, have the highest footprint. Other mobility categories are also carbon intensive with employee commute, 563 tons of CO₂e, and business travel, with 174,7 tons. Scope 2, which is responsible for 10% of the total footprint, consists solely of the heat consumption. It is responsible for 903,9 tons of CO₂e which the EUR compensate by buying carbon credits.

It must be taken into consideration that the COVID-19 pandemic has had a considerable impact on the outcome of this year's carbon footprint. The results for some categories can therefore be lower than expected. However, the increased scope, with the MFO II building, the working environment, ICT, and the indirect emissions from consumed electricity, add to the total carbon footprint.

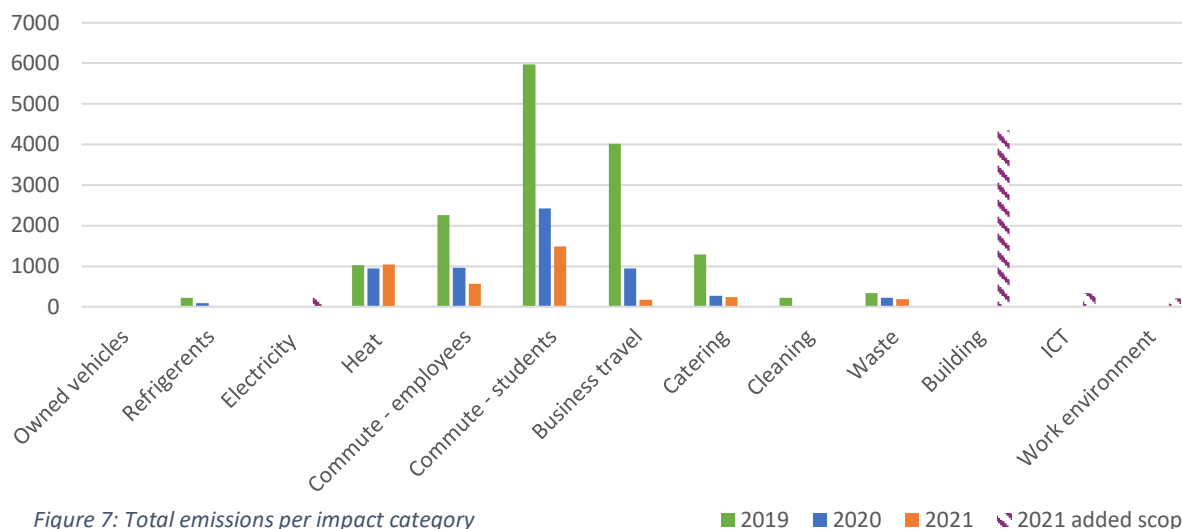


Figure 7: Total emissions per impact category

Comparing 2019, 2020 and 2021

For 2019, the total carbon footprint was 15.117 tons of CO₂e. For 2020 this was 5.866 tons of CO₂e. The reported CO₂ emissions have therefore increased by 53%. This is due to the increased scope of the impact calculator for 2021. If we use the same scope of 2020 (and exclude the building, ICT and work environment), the total footprint of 2021 is 3.914,6 tons. This is a reduction of 33%. Compared to 2019, there is a reduction of over 71%.

Tons CO ₂ e	2019	2020	2021
Scope 1	224 ton	96 ton	12 ton
Scope 2	1.025 ton	947 ton	904 ton
Scope 3	13.868 ton	4.823 ton	2.783 ton
Scope 3 added 2021	x	x	5.100 ton

The mobility categories have been reduced the most. The total impact of mobility for 2020 was 4.334 tons, whereas in 2021 this has been reduced to 2.231. This is a reduction of almost 49%. This reduction is caused by the limited occupancy of the university and the focus on hybrid work and classes.

These differences will be further explained in the following chapter. Each impact category will be examined compared to the previous year.

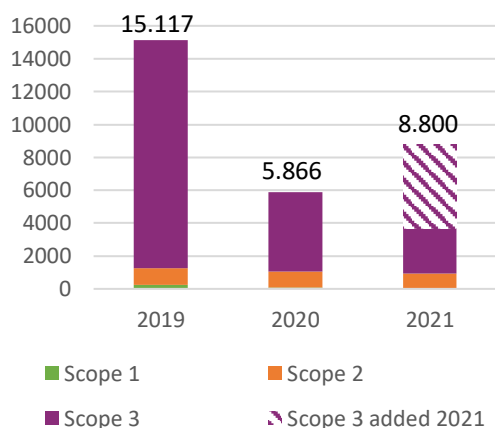


Figure 8: Total emissions per scope

3.1 Scope 1

The total impact of scope 1 for 2021 was 12,3 tons of CO₂e. For EUR, this category consists of refrigerants and the direct emissions from the fuel consumptions of the university's owned vehicles.

3.1.1 Refrigerants

The impact of the *refrigerants* for 2021 was 11,4 tons of CO₂e. In 2020 this was 94,1 tons. This is a reduction of 88%. Refrigerants have a very powerful global warming potential if they are released. However, if these refrigerants are not leaked but merely replaced and effectively processed, they are not emitted, and the impact is minimalized.

3.1.2 Fuel consumption owned vehicles

The fuel consumption of the university owned vehicles is 372 liters of diesel, which is responsible 1,2 tons of CO₂e. 919 kilograms of CO₂e are scope 1 emissions produced whilst the fuel is consumed. 293 kilograms of CO₂e are scope 3 emitted in the transportation and production of the fuel.

In 2020 this category was responsible for 1.4 tons of CO₂e. The impact has been reduced by 15%.

3.2 Scope 2

The total impact of scope 2 for 2021 is 903,9 tons of CO₂e. This solely consists of the emissions caused by heating. Emissions caused by electricity use produced by grey power would also be included in this scope, however, emissions caused by green energy are included in scope 3.

3.2.1 Heating

The *heat consumption* in 2021 was 48.858 gigajoules which is responsible for a carbon footprint of 1.037 tons CO₂e. 904 tons falls under scope 2 which is emitted at the energy plant and 133 belongs to scope 3 which is a result of the production of the equipment and the production and transportation of the fuels used for heat generation.

In 2020 the heat consumption was 43.055 gigajoules which was responsible for 947 tons of CO₂e. For the calculation of 2021, updated emissions factors have been used. If we apply these factors on the heat consumption of 2020 (and create a 2020b scenario) the total carbon footprint would have been 914 tons of CO₂e. 797 tons belong to scope 2 and 117 in scope 3.

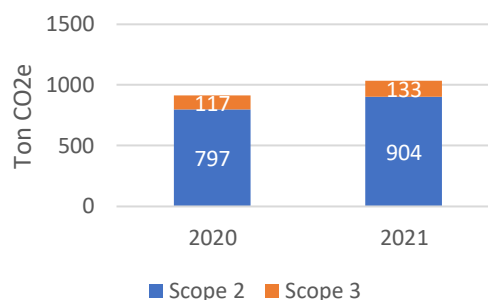


Figure 9: Emissions caused by heat consumption

There is an overall increase of 12% in both gigajoules use and the impact (based on the 2020b scenario). In 2020, the gigajoules consumption was 43.055.

3.3. Scope 3

The total impact of scope 3 for 2021 is 7.883,7 tons of CO₂e. It consists of emissions caused by the electricity consumption, mobility (commuting and business travel), catering and hot drinks, working environment, ICT, cleaning detergents, waste, and building.

3.3.1 Electricity consumption

15.370.518 kWh with Dutch wind energy guarantee of origin certificates. Because this is renewable energy, the generation of electricity does not result in a carbon footprint, which would be accounted for in scope 2. However, renewable energy still has embodied carbon which is emitted during the production and transportation phase of the wind turbines. Therefore, the electricity consumption of the EUR is responsible for 215 tons of CO₂-emissions, which fall under scope 3 of the GHG Protocol. This has been added in the scope of 2021 and was not included in previous carbon footprint calculations.

In 2020, these indirect emissions were not calculated as the focus was only on the direct emissions for this category. The electricity consumption in 2020 was 14.300.684 kWh which would have resulted in an emission of 200 ton CO₂e.

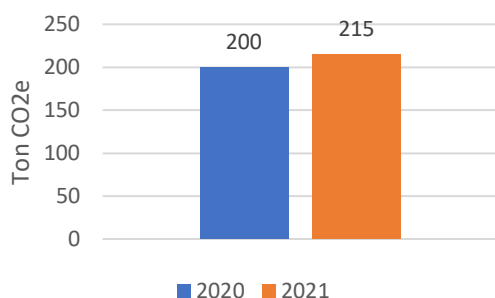


Figure 10: Emissions caused by electricity use

The electricity consumption and the impact that it has increased with 7%. Even with renewable energy, it is still better to reduce consumption. This is further expanded on in appendix 4. The EUR has created a reduction strategy, the Roadmap Energy Transition, in order to drive down the energy consumption.

3.3.2 Mobility

Mobility is an important category for the EUR because it has been the largest impact category in previous years. This category includes the commute for both students and employees and business travel of employees (private car, train, and plane).

For the *commute of both students and employees* a similar methodology has been applied as in 2020. Normally, a mobility survey is conducted every 2 to 3 years. Due to the COVID-19 pandemic, this has not happened since 2016. Therefore, the data from this survey has been used and was extrapolated to the current number of students and employees. The current number of students (31st of December 2021) is 36.906. The number of employees is 3.885. An estimation of the occupancy rate was made based on the government COVID-19 restrictions for higher education and the EUR's own policies and private discussions with EUR staff on the closure of the university during the pandemic. It was calculated that the occupancy rate for 2021 was 20%. This is based on the assumption that due to covid restrictions and holidays, there was no occupancy for 31 weeks. During the 21 weeks which the EUR was open, the occupancy is estimated to be 50%.

The impact of the student commute is 1.493,8 tons of CO₂e. It is recommended to gather new insights on student travel behavior for future carbon footprint calculations, as this behavior has most likely changed since the COVID-19 pandemic. For now, the distribution of the mode of transportation used is therefore the same as the previous years.

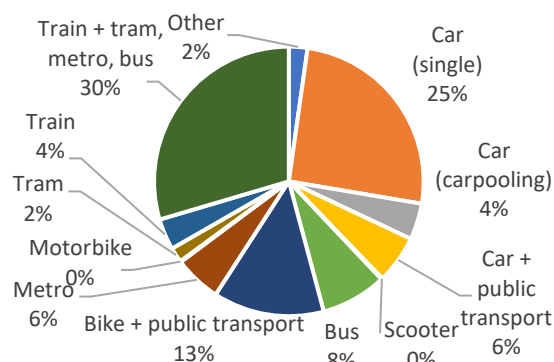


Figure 11: Percentage of total impact per mode of transportation - students

The impact for the student commute in 2020 was 2.426 tons of CO₂e. The main reason for the estimated reduction is due to the COVID-19 restrictions and the limited occupancy.

The impact of employee commute for 2021 is 561 tons of CO₂e. Similar to the commute of students, this is based on the survey from 2016. The overall distribution for means of transportation has therefore not changed, whilst in reality, it most likely has.

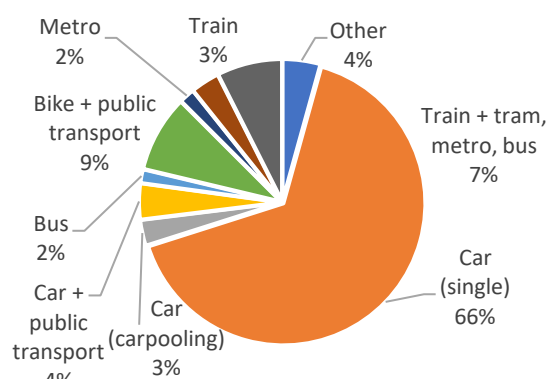


Figure 12: Percentage of total impact per mode of transportation - employees

The impact for the commute in 2020 was 964,9 tons of CO₂e. The reduction can also be explained due to the COVID-19 and the limited occupancy, reducing overall commute.

The *business travel by private car, train and plane* is responsible for 174,7 tons of CO₂e. To calculate this impact, the employee expense claims have been used.

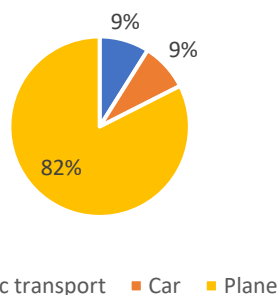


Figure 13: Percentage of traveled km per mode of transportation

Over 1.012.295 km have been flown in 2021, which is 82% of the total km conducted for business travel. Car travel consists of 105.551 km and public transport is good for 109.698 km.

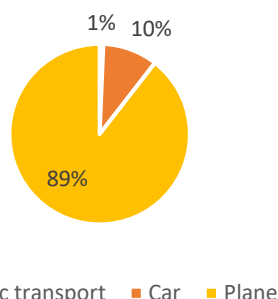


Figure 14: Percentage of total impact per mode of transportation

However, plane travel is responsible for 89% (156,3 tons) of the CO₂-impact of business travel. Car travel produced 10% and public transport only represents 1% of the total impact for business travel.

The university has implemented a rule to replace flights of less than 700 km with train travel. Over 137.000 km of plane travel is caused by flights shorter than 700 km. This is responsible for 27,7 tons of CO₂e, which is 18% of the total carbon impact produced by plane travel.

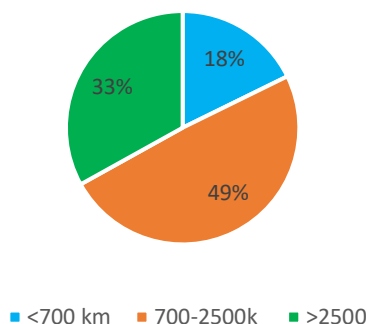


Figure 15: Percentage of total impact caused by plane travel per travel distance group

In 2020, the total impact of business travel was 943 tons CO₂e. In 2021 a reduction of 81% was realized. This is most likely largely due the COVID-19 pandemic. In 2019 the total impact of flying alone was 3.903,6 tons of CO₂e. The reduction of business travel is a very important measure to reduce the total carbon footprint.

3.3.3 Catering & hot drinks

This category was responsible for 237 tons of CO₂e. It is based on the provided data of purchased goods from food suppliers (Vitam and Sligro) and hot drinks suppliers (MAAS & JDE). In 2020, the impact of the reported catering & hot drinks was 268,4 tons. The total impact of the category was reduced by 12%.

The catering of the food suppliers had an embodied carbon of 107,4 tons of CO₂e. This includes the general catering (Vitam) and for the sport facilities (Sligro). It does not include external restaurants that are active on the campus grounds, as it was not possible to receive the required data.

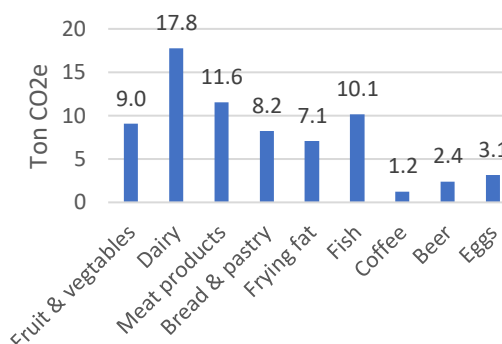


Figure 16: Emissions per product category

Of all the product categories, dairy has the highest carbon impact with 17,8 tons of CO₂e. This is followed by the meat products with 11,6 tons and fish products with 10,1 tons of CO₂e.

In 2020, the impact for catering was 250 tons. This means that the impact for 2021 was reduced by nearly 57%. This can mainly be attributed to the COVID-19 pandemic.

The hot drinks are responsible for 129,7 tons of CO₂e. This impact is based on the data provided by the suppliers of hot drinks and the machines (MAAS & JDE). This encompasses all the warm drinks that are provided by the machines on the campus.

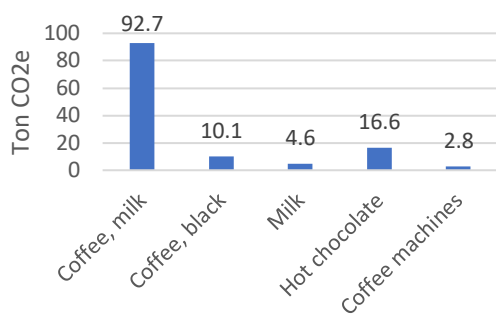


Figure 17: Emissions per product category

The drinks are grouped in several categories. Of these product categories, coffee with milk is the largest with 92,7 tons of CO₂e. These were the most ordered drinks, with over 206 thousand consumptions, and have a higher emission factor due to the added dairy consumption.

In 2020 the impact of hot drinks was 18 tons of CO₂e. This means there is a reported reduction of 86%. However, this is also due to updated emission factors that have been applied in 2021 and the improved data collection.

3.3.4 Working environment

The working environment is another category which has been included for the 2021 carbon calculator. This category includes the furniture, such as desks, chairs and other materials used for workspaces. There are two ways in which this has been calculated. The inventory scan and the procurement scan. For the total carbon footprint, it has been decided to include the inventory scan, as this shows an overview of everything currently in use. For future years, it can be beneficial to focus on procurement scans, as these allow for decision making whilst products are being purchased.

The first is based on an inventory scan, which includes all product present at the EUR and calculates a yearly footprint for each product category. This is based on several assumptions based on the total capacity of workspaces and the average articles used per workspace. Nevertheless, it does provide a useful insight in the embodied carbon of this category. The total footprint of this inventory is 198,6 tons of CO₂e.

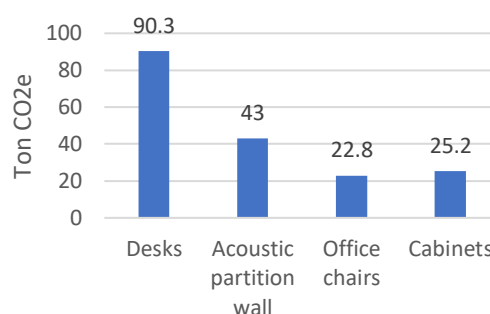


Figure 18: Emissions per product category for the inventory scan

The desks have the highest impact, with 90,3 tons of CO₂e. The acoustic division walls between workspaces also have a rather high impact, with 43 tons.

The second way to look at the category of the working environment, is based on a procurement scan. This can be done by looking at what has been purchased during the year 2021. For the inventory scan, the lifespan of a product is taken into consideration, for a procurement scan, the full embodied carbon of the production is used.

The total embodied carbon of all the purchases in the work environment is 101,9 tons of CO₂e.

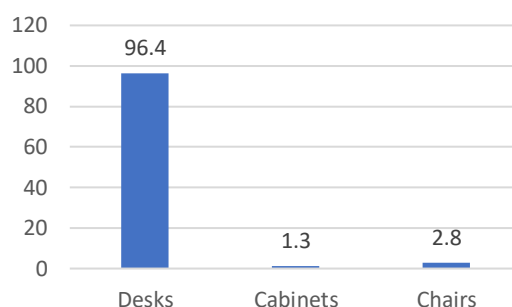


Figure 19: Emissions per product category for the procurement

Of the provided data, the desks (mostly the electrically adjustable versions) also have the highest impact for this scenario. A procurement scan is useful, as this is the moment when the carbon impact is made and when low carbon alternatives can be considered. By extending the lifespan of products, the amount of products that have to be purchased is reduced, which lowers the carbon footprint of the procurement scan.

3.3.5 ICT

Another category which has been added for the impact calculator of 2021 is ICT. The total embodied carbon for this category is 337,7 tons of CO₂e. This is based on an inventory scan provided by the responsible departments. It includes all the workspaces, IT used by employees, AV and the servers in use in 2021. It is a total carbon footprint of all the ICT-equipment used by and for employees divided by the estimated lifespan. This does not include the ICT used by students.

The lifespan of the products is based on when they are replaced. The carbon footprint of ICT does not take the carbon emissions during the use stage into consideration as this is covered under energy consumption.

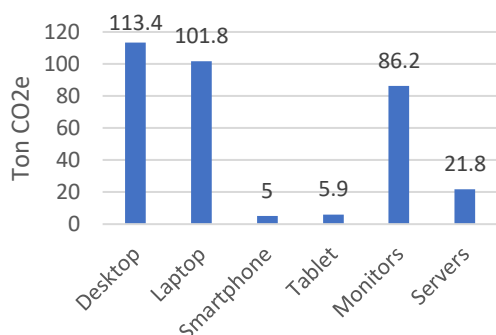


Figure 20: Emissions per product category

The 2.732 desktops are responsible for the highest impact with a footprint of 113,4 tons of CO₂e. The 4.474 laptops have an embodied carbon of 101,8 tons and the 3.639 monitors are responsible for 86,2 tons of CO₂e.

3.3.6 Cleaning

For this category, the scope remains the same as previous years and focuses on the cleaning detergents. The impact of this category 277 kg of CO₂e. In 2020 this was responsible for 411 kg, which means there has been a reduction of 33%.

The scope of this category is limited. For future carbon calculations it is advised to broaden it further to include additional cleaning supplies and the mobility of the cleaning personnel

3.3.7 Waste

The university monitors their waste streams. The total impact of waste treatment for 2021 was 181,3 tons of CO₂e. This was caused by over 313 thousand kilograms of waste.

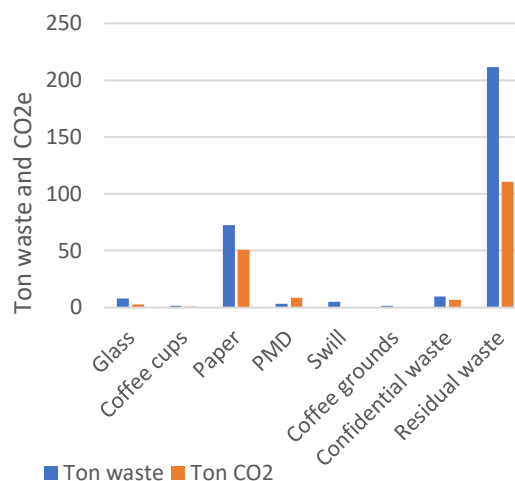


Figure 21: Amount of waste and emissions per waste category

Both in the amount of waste and the impact made, residual waste is the largest category. Separating waste will allow for recycling and more efficient waste treatment which will result in a lower impact.

In 2020 the total amount of waste collected was over 370 thousand kilos which was responsible for 213,2 tons of CO₂e emissions. This means that there has been a significant reduction in both the CO₂-footprint as well as the overall weight of the waste produced in 2021.

3.3.8 Building

When talking about the sustainability of buildings, operational energy usage is often the main factor that is taken into account. However, the materials of a building are responsible for a lot of embodied carbon. Especially because of the large amount of material that's being used in a building. Therefore, it was decided to also include the embodied carbon of buildings in this report.

Because the construction of the MFO II building started in 2021 and the data on the materials used were available to conduct an impact calculation, this building was taken as an example to show the material impact of buildings. The MFO II building was designed to be energy efficient and uses circular or bio-based materials. According to our calculations, the total impact of all materials used in MFO II was 4.349 tons of CO₂e.

In order to put this number into perspective, the embodied carbon of the EUR library building was calculated as well: 5.302 tons of CO₂e. This is based on the post-renovation materialization of the library. When calculating per square meter of

building, the two buildings are strikingly similar: 594 kg CO₂e/m² for MFO II and 591 for the library building. The MFO II building has a lower carbon footprint when it comes to its partitions and finishings. However, more materials have been used to ensure the energy efficiency of the building. An example of this are the triple glazing windows that have been used. In figure 20, an overview is given of the footprint of the MFO II building.

has been used. By using FSC-wood, carbon is stored within the wood that is used and will only be released to the air again at the end of the lifecycle. In this way, the MFO II building stores 117 tons of CO₂e in the form of bio-based construction elements. Because this carbon will eventually be released to the air again it cannot be credited to the total carbon footprint, according to the Green House Gas Protocol, and therefore does not influence the total carbon footprint of the EUR.

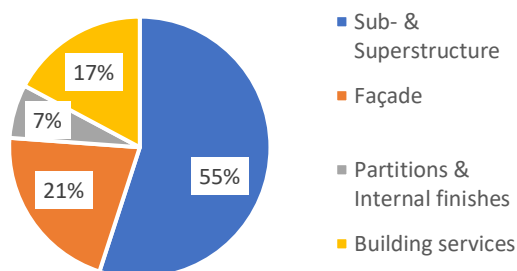


Figure 22: Percentage of the total impact per category

The sub- and superstructure category includes the foundations and the above ground weightbearing structures (mostly steel and concrete). The façade includes the external walls and finishes (glass, aluminum and wood). Partitions and internal finished include the separations walls and doorways within the building. Building services include the installations such as climate control.

Important to note is the necessity to replace certain parts of buildings during its lifespan. Therefore, the library building has caused more embodied carbon emissions during its lifespan. The current footprint of the library is based on the post-renovation materialization. It therefore does not include the exact materials from the original construction, but rather what materials the building consist of in 2021. If the data from all the materials used in the total lifespan of the library would have been available, the total footprint would be higher.

The total footprint for the MFO II building will also increase during its lifespan, as future renovations will take place. Because the MFO II building is energy neutral, its carbon footprint over its whole lifespan will be much lower than that of the library.

Part of the MFO II building was constructed from FSC-certified wood. This was done in order to reduce the carbon footprint. FSC-certified wood is grown in a sustainable way, so it is replaced after it

4. TOWARDS THE REDUCTION GOALS OF ERASMUS UNIVERSITY

Erasmus University has committed to reduce its carbon emissions significantly by 2024. In order to achieve the reduction goals, this chapter provides various strategies per impact category.

There are a few general strategies which can be applied for almost every category.



Buy less: reduce overall products owned and purchased.



Use longer: increase the lifespan of products which are used. Repair instead of replace.



Buy alternatives: if it is necessary to buy goods, make sure they have a low CO₂-emission. For example, buy locally produced goods or product which use a low carbon or recycled material.



Reuse or recycle: when a product is written off, find another use for it or try to ensure high-quality recycling.

4.1 refrigerants

For *refrigerants* there are a few strategies that can be implemented:

- Use compounds that have a lower global warming potential.
- When installations need to be replaced, look for alternatives which do not use chemical refrigerants, but provide mechanical or natural cooling instead. The MFO II building on campus is a good example for this type of installations.

4.2 Fuel consumption owned vehicles

For the *fuel consumption by university owned vehicles*, there will be a switch towards an electric vehicle in the near future. This will further reduce the direct scope 1 emissions of the EUR. It would be beneficial if this electric vehicle will be charged on locally produced green energy.

4.3 Heating consumption

For the *heat consumption*, even though the impact is lower compared to gas consumption, it is also

desirable to reduce the gigajoules utilized.

Strategies which can be used are:

- Reduce the heating by 1 or more degrees and make sure areas which are not being used are not heated.
- Improve isolation for older buildings.

4.4 Electricity consumption

For the *electricity consumption*, guarantees of origin certificates are a good addition for additional investments in green energy and the increase of green energy supply in the Netherlands. However, as long as the energy net in the Netherlands is not fully green, anyone using the energy will still contribute to the use of fossil fuels for electricity generation. This is further described in appendix 4.

Therefore, it is still imperative that the EUR reduces its overall energy consumption. This will also help in reducing the 215 tons of CO₂e which are indirectly emitted with the green energy production. The EUR already has an energy reduction plan describing the actions to achieve the ambitions.

4.5 Mobility

Mobility is the largest impact category for the EUR. It has been reduced for the last two years because of the COVID-19 pandemic. One thing which this period has shown, is what type of CO₂-reduction is possible when mobility is reduced. It is necessary, that the impact does not return to pre-pandemic heights.

For the *commute of students and employees*, the following general strategies can be utilized:

- Less commuting, for example by stimulating working from home, carpooling or offering courses online.
- More sustainable travel, for example by bicycle or public transport. Since 2018, all trains within the Netherlands run on renewable energy, minimizing their emissions. The NS-business card which is provided to EUR-employees can help, as long as this is properly embedded in the organization through behavioral change.
- Promote carsharing over individually owned cars.
- Provide infrastructure for cars with alternative motors (i.e., charging ports for electric cars).

For business travel the following strategies can be implemented:

- Ensure that journeys below 700km are taken by alternative transportation such as trains instead of a plane.
- Implement a carbon budget for faculties or research projects that caps the amount of travel allowed.
- Communicate on the impact that individual trips make when they are being booked. This can be accomplished in partnership with the travel agency the EUR plans on working with.

4.6 Catering & hot drinks

During the height of the pandemic, these categories were lower than during the pre-pandemic era. It is expected that for 2022 this impact category will be higher than 2020 and 2021. Therefore, it is important to have some strategies in place to keep the CO₂-impact to a minimum.

For catering, the following strategies are possible:

- Buy locally produced and in season fruits and vegetables. If this is not possible, try to buy foods that are not transported by plane.
- Replace meat or fish by vegetarian or vegan alternatives. The biggest impact can be realized by replacing meat from ruminants, such as cows.
- Replace dairy products with plant-based alternatives.
- For cheese, it is good to know that fresher/younger cheese has a lower carbon footprint compared to aged products.
- Push for sustainable logistics with the catering suppliers.
- Cooperate with innovative companies such as Toogood Togo, Orbisk and/or Bestelbewuster.

For *hot drinks*:

- Tea is better than coffee, coffee without milk is better than coffee with milk.
- Collect coffee grounds separately from residual waste. Try to upcycle these as high-quality as possible. For example, it can be used to produce oils and bioplastics.
- Work with suppliers that have a proven track-record for sustainable production and transport.
- Reduce disposable cups and implement a system which facilitates the use of reusable variants.

4.7 Working environment

Strategies that could lower emissions in this category include:

- Extend the lifetime of products by repairing them.
- When it does not meet your quality standards, giving furniture a new life is better than recycling.
- When a new lifecycle is not possible, make sure the materials are recycled, especially those with a high footprint, such as metal.
- When new furniture is purchased, try to choose 2nd-hand or refurbished products or products containing recycled or sustainable bio-based materials.

4.8 ICT

There is a high number of electronics that are being used by the EUR. Here are some strategies which can be implemented:

- Try to repair or refurbish products instead of replacing them. Do not use a financial depreciation framework but repair products as long as possible.
- When new products are purchased, try to buy equipment with recycled materials.
- Reduce data usage, for example by shutting off the camera during online video calls and investigate data usage of students and employees.
- For external server storage, attempt to select providers who run their servers on renewable energy.

4.9 Cleaning

Due to the smaller scope of this category, the overall impact is already rather low. The following strategies can also reduce the impact of the detergent use, which is currently the scope, but also include general strategies to reduce the impact of cleaning services:

- Minimizing the use of water and cleaning products. The cleaning frequency could be reduced.
- Using dispensers and other durable products for as long as possible, repairing the products when needed.
- Stimulate carpooling in the cleaning staff department and/or the usage of public transport for transportation.

4.10 Waste

There is large carbon footprint linked to the waste treatment of the EUR. There are several strategies to reduce this impact:

- Aim to reduce the overall purchasing of goods and increase the life expectancy of products to limit the total output of waste.
- Reduce the percentage of residual waste. By collecting different waste streams, it is possible to reduce the carbon intensity of its treatment. Currently, over 67% of all the collected waste consists of residual waste. This is an indicator that there is potential for further waste separation.
- Monitor different streams of waste and implement waste reductions strategies.
- Cooperate with start- and scale-ups that specialize in using different types of waste as raw materials.

4.11 Building

The MFO II building has already been realized with sustainability as a key aspect of its conception. For the future, there are a number of strategies that can be implemented for the current buildings and when considering to construct a new building.

- Use the building and the elements in the building for as long as possible. If a building has already been built, preserving and preventing demolition has a very big impact on reducing emissions.
- Use existing buildings as good as possible in order to prevent a new building from having to be built. Make sure these buildings are renovated so they are (more) energy efficient.
- Consider the possibility of disassembling components. This is an important aspect of a sustainable building. If building materials are attached with screws (instead of glue), they can be replaced again to extend the life. When they are written off, these materials can be separated and processed as separate waste streams. Glass, plastic and metals can only be recycled if they can be separated and cleaned.
- Use more wooden or other bio-based products, in them CO₂ is stored which can reduce the CO₂ footprint of the building materials.
- Using bricks and natural stone, these can be reused indefinitely, allowing the ecological footprint to be fully amortized for the next user. For concrete, on the other hand,

besides a low-grade aggregate, there are no recycling options.

- In future building-related projects, make the choice to reuse elements and sustainable materials. This can make the difference on the CO₂ footprint of the building. When elements and materials are reused, this has a positive impact on the total CO₂ footprint.

5. CONCLUSION

Erasmus University Rotterdam (EUR) is continuously trying to reduce its carbon footprint and improve the calculation process. This year's expanded scope has increased the overall footprint to create a more accurate representation of the actual emitted carbon. Of the total footprint, the scope 1 and 2 emissions consist of 10,4%. Most of the total footprint, with 89,6%, are scope 3 emissions.

The largest impact categories for 2021 are:

- The MFO II building with 4.349 tons
- The mobility (which includes the student & employee commute, and business travel) with 2.231,5 tons
- The heat consumption with 1.036,8 tons

In the future, it is possible to expand the scope of the impact calculation further. For example, currently the footprint does not include other buildings in use by the EUR and focuses on the MFO II construction. It is also possible to improve the data collection for current impact categories. These actions will continue to improve the accuracy of the carbon footprint. Advice to improve this calculation process has been added in an additional report for internal use.

If the strategies in this report are implemented, the overall carbon footprint for the EUR can be reduced. This is in line with the ambitions which the university has set for itself.

APPENDIX 1: ADDITIONAL GRAPHS

For readability, additional graphs showing the total carbon footprint per impact category have been included.

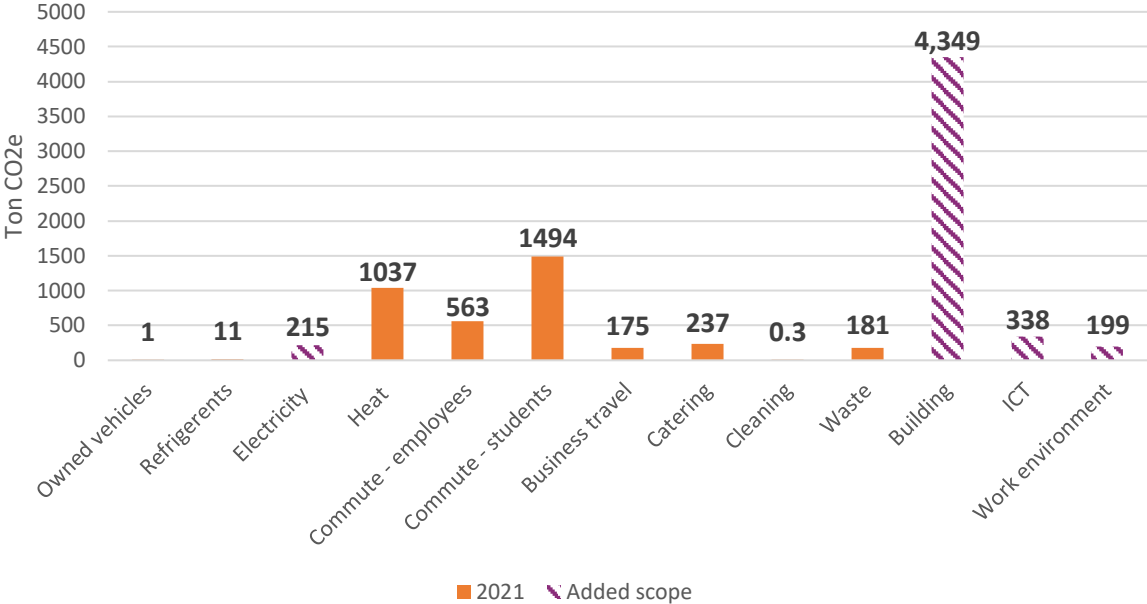


Figure 23: Total emissions per impact category

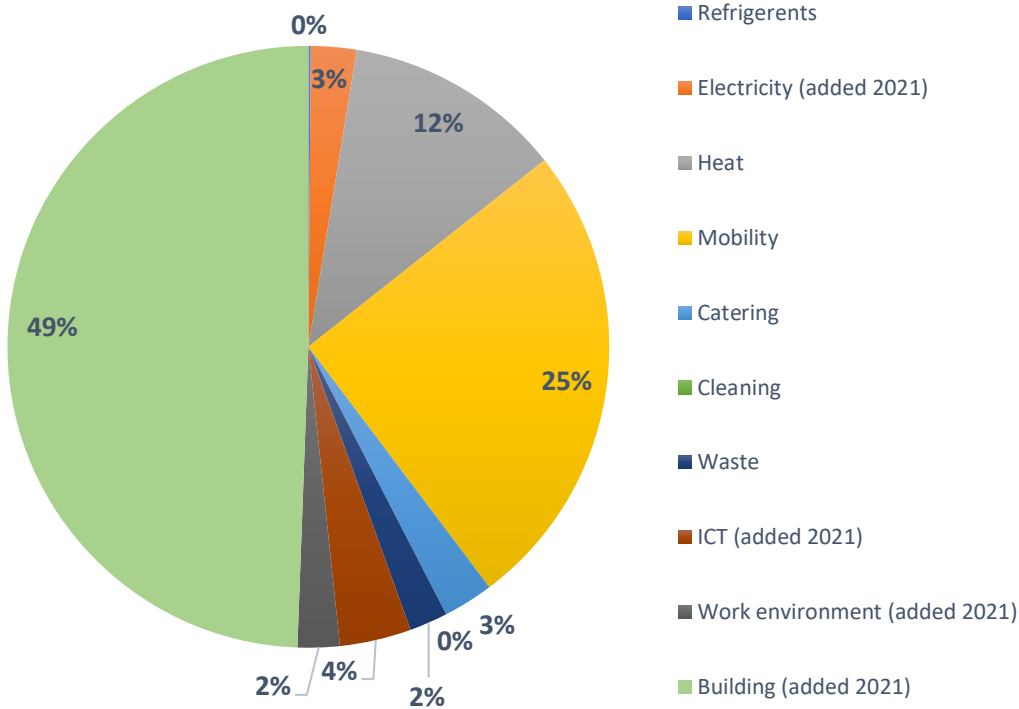


Figure 24: Total percentage of the total footprint per impact category (including MFO II building)

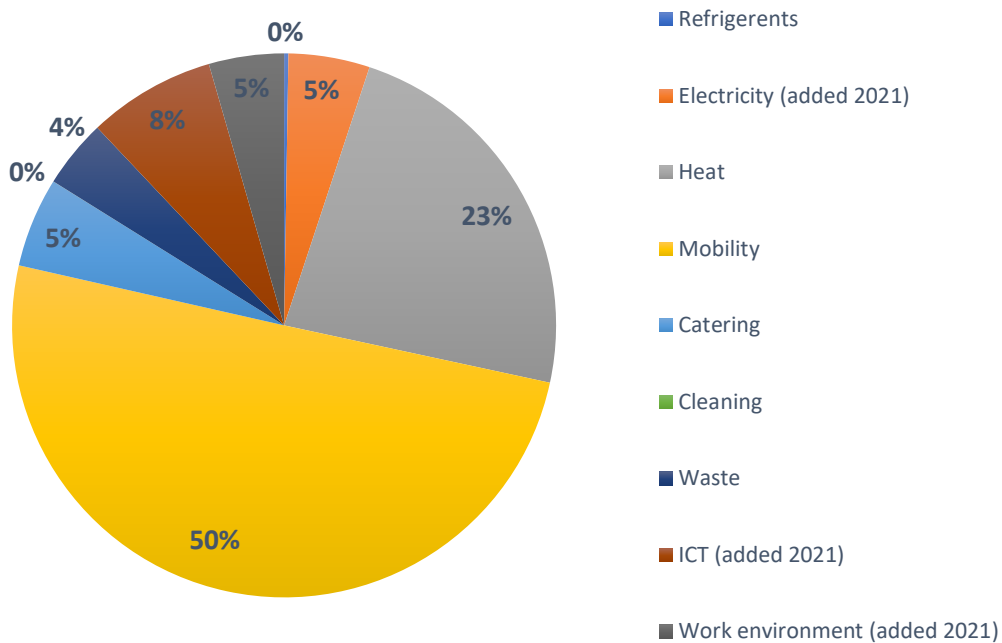


Figure 25: Total percentage of total carbon footprint per impact category (excluding FMO II building)

APPENDIX 2: GHG PROTOCOL SCOPES

Scope 1 emissions: direct greenhouse gas emissions of sources that are owned by or are under the control of the organization. Examples include:

- Generation of electricity, heat or steam. These emissions result from combustion of fuels in stationary sources, e.g. boilers, furnaces and turbines.
- Physical or chemical processing. Most of these emissions result from manufacture or processing of chemicals and materials, e.g., cement, aluminium, adipic acid, ammonia manufacture, and waste processing.
- Transportation of materials, products, waste, and employees. These emissions result from the combustion of fuels in company owned/controlled mobile combustion sources (e.g., trucks, trains, ships, airplanes, buses, and cars).
- Fugitive emissions. These emissions result from intentional or unintentional releases, e.g., equipment leaks from joints, seals, packing, and gaskets; methane emissions from coal mines and venting; hydrofluorocarbon (HFC) emissions during the use of refrigeration and air conditioning equipment; and methane leakages from gas transport.

Scope 2 emissions: GHG emissions from the generation of purchased electricity consumed by the company.

- Purchased electricity, defined as electricity that is purchased or otherwise brought into the organizational boundary of the company. Scope 2 emissions physically occur at the facility where electricity is generated.

Scope 3 emissions: GHG emissions that are a consequence of the activities of the company, but occur from sources not owned or controlled by the company. To determine if an activity falls within scope 1 or scope 3, the company should refer to the selected consolidation approach (equity or control) used in setting its organizational boundaries.

- Extraction, production, transportation and disposal of purchased materials and fuels
- Employee business travel
- Transportation, use and disposal of sold products and services
- Transportation and disposal of waste generated in operations
- Leased assets, franchises, and outsourced activities

At times there is confusion in the reporting of emissions related to vehicles. Transport emissions from vehicles owned by or under control of the company are reported in Scope 1. Manufacturing emissions from vehicles owned by the company, and transport emissions from vehicles used by the company are reported in Scope 3.

Some products have a negative GWP factor. This applies to products made of vegetable materials, such as paper and wood. Wood absorbs CO₂ when it grows. In the production process, carbon emissions are generated, but may not be enough to undo the carbon “credit” that was built up during the lifetime of the material. This results in a factor for the upstream and use process that is negative. When at the end of the product lifecycle the product gets burned, the captured CO₂ is re-emitted. As long as this is not the case (or partly when the energy is captured), the net carbon emissions of vegetable products can be negative. Therefore, purchasing wooden products can have a negative impact. Important to note is that these vegetable materials should be grown sustainably, meaning the tree should be replaced by a new one. FSC certification for products guarantees sustainable forest management of the materials of those products.

The GHG Protocol includes accountancy and reporting for the six greenhouse gasses that fall under the Kyoto protocol: Carbon Dioxide (CO₂), Methane (CH₄), Nitrous Gas (N₂O), Hydrofluorocarbons (HFK's), Perfluorocarbons (PFK's) and Sulfur Hexafluoride (SF₆)

APPENDIX 3: METHODOLOGY AND GHG EMISSION FACTORS

This report is based on the results of the PHI Impact Calculator, developed by PHI Factory. The PHI Impact Calculator is developed according to the guidelines of the [GHG Protocol Corporate Accounting and Reporting Standard](#) created by the Greenhouse Gas Protocol Initiative, a partnership of multiple stakeholders brought together by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD).

In this report, we work with net carbon emissions. This means that in scope 3, both upstream and downstream activities are included. This means that the whole life cycle of a product is taken into account: the extraction of raw materials, productions, transport, use stage and what happens at the end of its lifecycle

We select GHG emission factors for components or materials from selected databases or scientific publications that use a LCA calculation methodology performed according to the guidelines of ISO 14040/44 and EN 15804. Where aggregated data is not available, we either reparametrize existing data for similar products based on functional units or perform own LCA calculation using raw data from <http://idematapp.com/>. All sources follow ISO 14040/44 and EN 15804 guidelines.

For scope 1 and 2 categories, as well as for the transport category of scope 3, greenhouse gas emission factors come from <https://www.CO2emissiefactoren.nl/>. This list is updated annually by a broad panel of experts based on the most recent insights.

For GHG emission factors of scope 3 categories, we used a mix of databases and other sources:

- International EPD® System. Available via: <https://www.environdec.com/>
- Ecodesign and Labeling. Available via: <https://www.eceee.org/ecodesign/>
- Eaternity Database (EDB) <https://eaternity.org/foodprint/database>
- Open LCA database for WARM, version 15. Available via: <https://www.epa.gov/warm/versions-waste-reduction-model-warm#15>
- CE Delft. Available via: www.ce.nl
- Idemat database for material data. Available via: <https://idematapp.com>
- National Institute for Public Health and the Environment (RIVM). <https://www.rivm.nl/voedsel-en-voeding/duurzaam-voedsel/database-milieubelasting-voedingsmiddelen>
- Malmodin & Lundén, 2018. *The energy and carbon footprint of the global ICT and E&M sectors 2010–2015*
- Transport & Environment, 2020. *How clean are electric cars? T&E's analysis of electric car lifecycle CO₂ emissions.*
- Homeworking emissions whitepaper. Available via: <https://info.eco-act.com/>
- Quantis, 2018. *Life Cycle Assessment (LCA) of a lungo cup of coffee made from a nespresso original capsule compared with other coffee systems in Switzerland.*
- Wageningen University, 2020. *CO₂ footprint WUR 2018*; <https://www.wur.nl/nl/show/CO2-footprint-WUR-2018.htm>

For more information on the used methodology, please contact PHI Factory.

APPENDIX 4: ELECTRICITY

Most of the greenhouse gases caused by humans come from energy consumption, both directly through burning fossil fuels (for example, in a car) and in the form of electricity.

The EUR has a high level of electricity consumption. Indirectly, the use of electricity causes CO₂-emissions. A distinction is made between grey and green electricity. Grey electricity is electricity that is generated from fossil sources, such as coal or gas. One kWh of grey electricity causes about half a kilogram of CO₂-emissions at the power plant and another 80 grams of indirect CO₂-emissions for the extraction and transport of the fossil fuels. Green electricity is generated from a renewable source, so the emissions are quite a bit lower. Only a small amount of indirect CO₂-emissions result from this. These emissions are created during the construction of wind turbines and solar panels and are attributed to the electricity generated. For Dutch wind power, an emission factor of 0,014 kg of CO₂e can be calculated per kWh.

The EUR purchases green electricity (Dutch Wind Energy) through Guarantees of Origin (GoOs). These link the generation of green electricity by solar panels and wind turbines to an end user (see Figure 21).

Purchasing only green electricity, however, does not mean that electricity use no longer causes CO₂-emissions. Because all electricity in the Netherlands is transported through the same network, there is no difference between the electricity that comes out of the wall socket at buyers of green or grey electricity. All generated electricity is, as it were, lumped together, which customers then draw from.

Until 100% of the Dutch electricity is generated sustainably, all additional electricity that is being used will come from fossil sources. This means that (green) energy savings at the EUR will ensure that less grey electricity is used in total. This, however, does not mean that buying green electricity is pointless. By purchasing Dutch green electricity, you will stimulate the construction of new sustainable energy sources in the Netherlands, which will enable society to run more quickly on entirely green electricity.

The GHG Protocol distinguishes 2 methods to report the impact electricity from electricity:

- *Market-based*: this method takes into account the purchase of green or grey electricity.
- *Location-based*: this method calculates with the average electricity mix of the location (country) where the electricity is consumed.

For this calculation, the market-based method was chosen to properly reflect the indirect impact of the university's (green) electricity

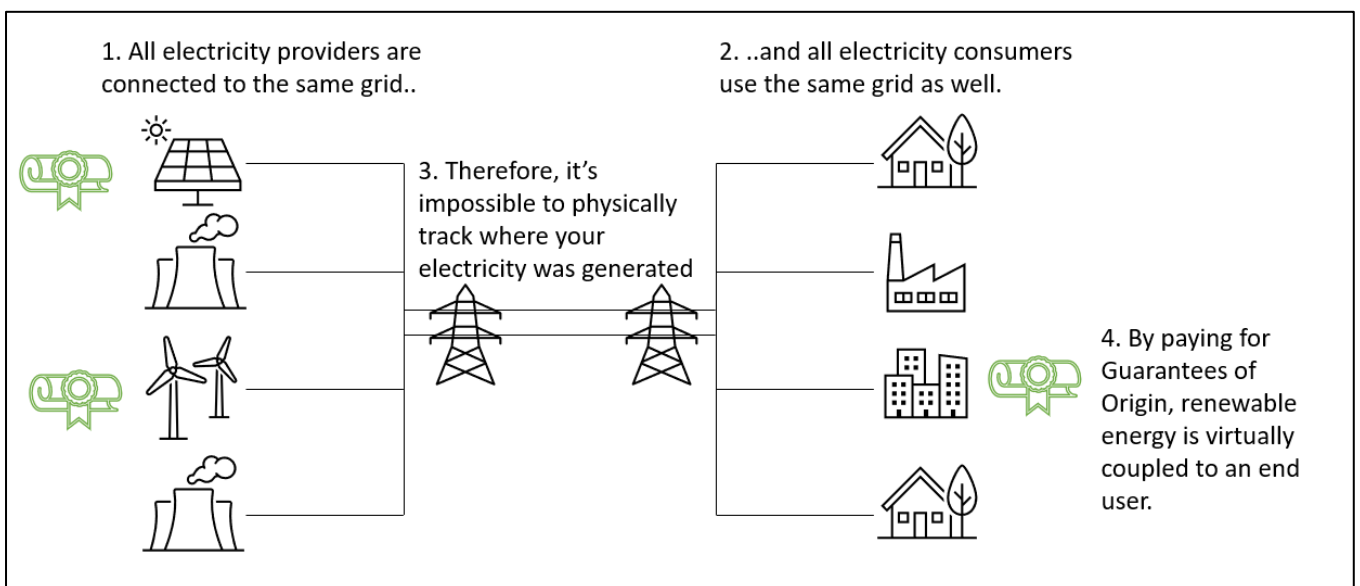


Figure 26: how Guarantees of Origin help organization purchase green electricity.

