# CARBON FOOTPRINT 2016

## Erasmus University Rotterdam

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# Contact

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# CONTENTS

# 1 INTRODUCTION

Erasmus University Rotterdam (EUR) asked Arcadis to calculate the carbon footprint for the complete university over 2016 in a uniform way to gain insight in energy consumption, material use and waste production. EUR gathered the necessary data for the underlying calculations. In this report the results are shown as well as advices for further improvement of the available data.

The results will be compared to the analysis of the footprint 2015.

Deliverables

The deliverables encompass not only this report but also an excel sheet containing calculations, sources, assumptions and estimations.

# 2 STARTING POINTS

In this chapter, we briefly describe how the data for the carbon footprint has been obtained, analyzed and categorized and what principles are used along the way.
Detailed information on the conversion factors can be found in appendix I. Appendix II presents the calculation sheet (available as separate document).

## 2.1 Method

This carbon footprint is written in accordance with the NEN-ISO 14064 norm. The structure of the carbon footprint is based on methods from the Greenhouse Gas Protocol (GHG Protocol). This protocol discussed three scopes. The figure below shows the scopes and the associated emissions.

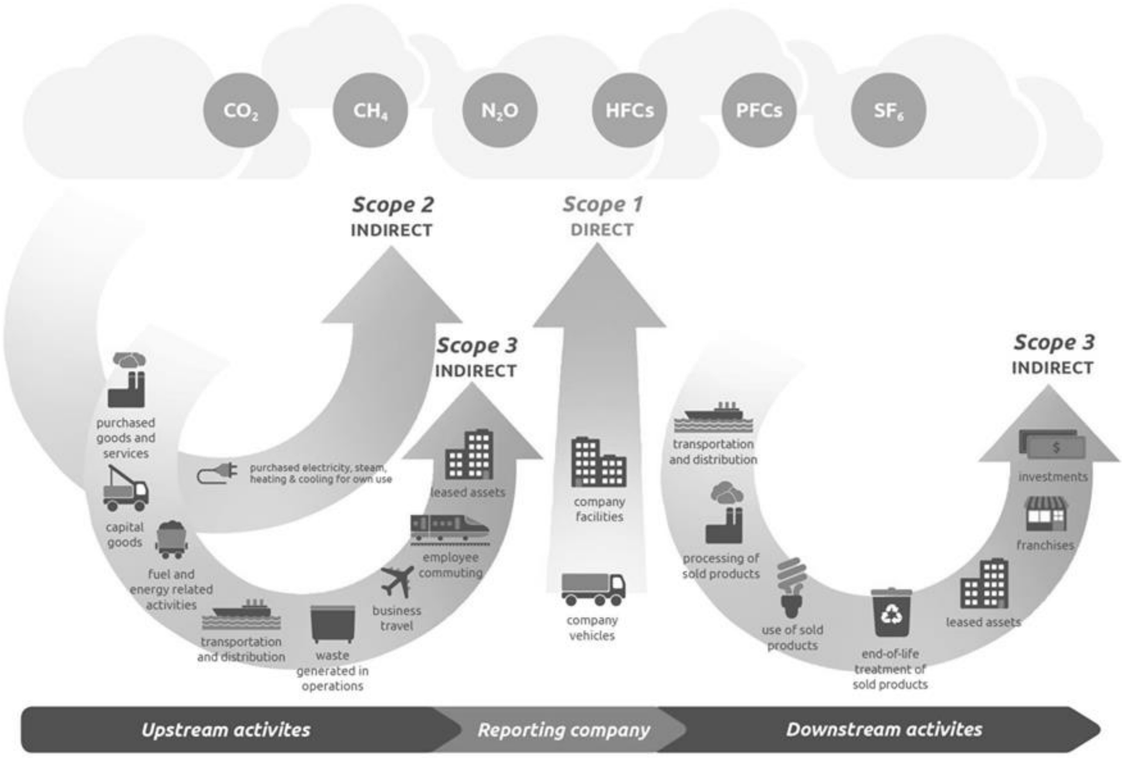


*Figure 1: Definition of the scopes according to the GHG Protocol*

These scopes are based on the extent to which the organization can influence the emissions in each scope.

The scope 1, 2 and 3 emissions mentioned below are included in the $CO_2$ footprint:

1. Scope 1: The university is able to directly influence the $CO_2$-emissions.
    - Natural gas consumption.
    - Fuel consumption university-owned vehicles/ machines.
    - Refrigerants.
    - Cleaning detergence.

2. Scope 2: Emissions of $CO_2$ originating from power generation. The university is able to directly influence the emissions, but these emissions are emitted outside of the organizational boundary, for example at a power generation facility.
    - Electricity for buildings.
    - Heat for buildings.
3. Scope 3: The university is able to indirectly influence these emissions of $CO_2$ on a limited basis.
    - Fuel use commuting - public transport (various modalities).
    - Fuel use commuting - private cars, motorbikes, scooters and electric bikes.
    - Fuel use business travel - private cars.
    - Fuel use business travel - flight travel.
    - Fuel use business travel - train.
    - Emissions from waste production (residual waste, paper, cardboard, organic waste, plastic, glass, swill).

**Emissions of the students**

Students have a major impact on the total $CO_2$ emissions of EUR. Not only in the use of the buildings and facilities attached thereto. Students travelling to and from the university generate a significant amount of $CO_2$-emissions. Because these emissions are indirectly caused by EUR itself, it has been decided to include the emission of the students in the carbon footprint.

Located on the campus is a student apartment complex (Hatta complex). This part of the campus is excluded from the $CO_2$ footprint because the Hatta complex is not owned by EUR and therefor the emissions are not part of the footprint.

**Fuel consumption business travel – private car**

This year for the first time the emission regarding the fuel consumption for business travels made by private car have been added. Therefore, the invoices of the employees (€ 0,19/ kilometer) have been used.

## 2.2 Boundaries

This footprint includes all locations of Erasmus University Rotterdam, except the Hatta complex:

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

During the analysis of the energy consumption data, the following number of students and employees have been taken into account (1st of October/ 31st of December 2015):

- 2.734 employees (fte);
- 25.784 students.

## 2.3 Starting year

In 2011, the university has analyzed their $CO_2$ footprint for the first time. This footprint is the basis of the footprint for 2015. However, standardized methods, internal processes and conversion factors have changed throughout the past few years. Therefore, the starting year is chosen to be 2015.

# 3 CARBON FOOTPRINT 2016

## 3.1 Results

The total $CO_2$-emission of the university for 2016 is 11.491 ton $CO_2$. This equals an emission of 44,57 ton $CO_2$ per 100 students. The figure below shows the distribution of the different emissions.

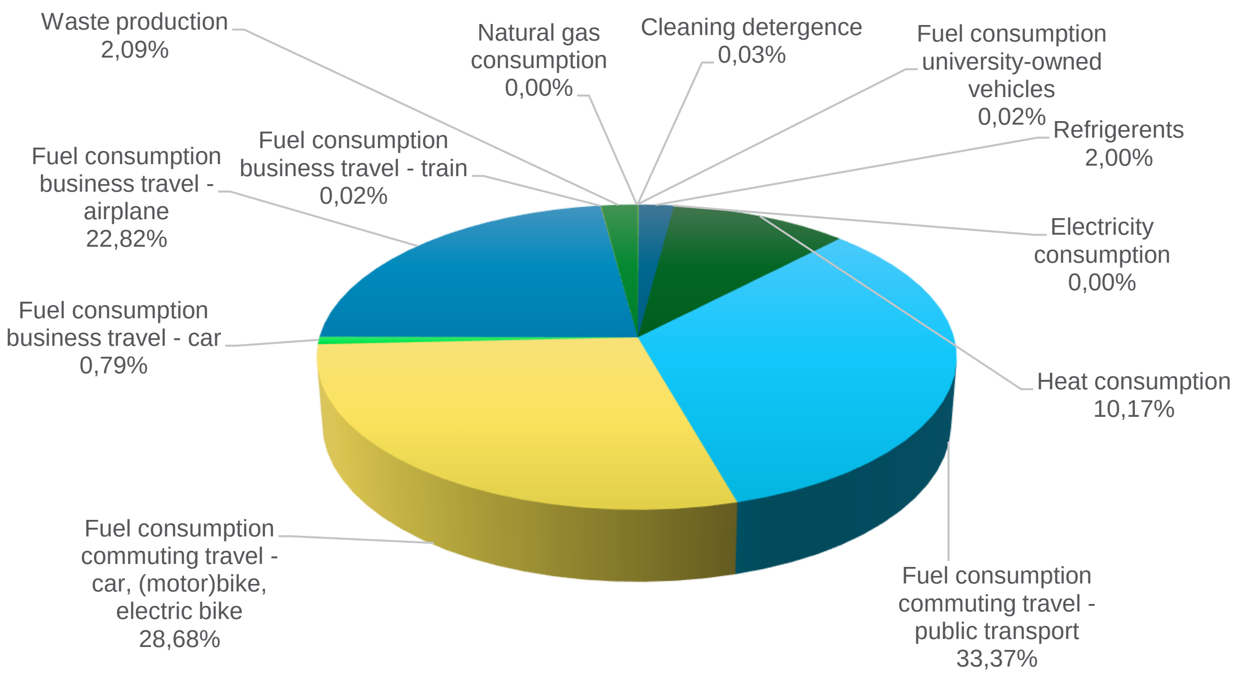


*Figure 2: $CO_2$-footprint Erasmus University Rotterdam 2016*

A substantial part of the emissions is caused by the fuel consumption for commuting travel by public transport (33,37%), followed by the fuel consumption for commuting travel by car, motorbike, scooter and electric bike (28,68%). Next in line is the fuel consumption for business travel by plane (22,82%). That means that the largest part of the $CO_2$-emissions is caused by scope 3 emissions regarding mobility with nearly 86% of the whole footprint.

EUR exclusively purchases renewable electricity since 2015. According to the most recent conversion factors for greenhouse gas reporting[1], renewable electricity is free of $CO_2$-emissions. Therefore, electricity is not present in the figure above.

In 2016 the university stopped renting 3 apartments for employees at location Woudestein. Therefore, no more natural gas is used (other locations are supplied with heat).

Also shown in the figure above are the percentages of the total for the emissions of fuel consumption of the university-owned vehicles, fuel consumption for business travel by private car, cleaning detergence and fuel consumption of business travel by train. These emissions are neglectable (the highest one shows a percentage of the total of 0,79%).

Compared to the emissions of the footprint 2015, slight changes are visible. The overall footprint is reduced by 22%, even though an additional emission category of scope 1 has been added (fuel consumption of the business travels made by private car). The $CO_2$-emission is reduced from ***14.671*** ton $CO_2$ in 2015 to ***11.491*** ton $CO_2$ in 2016.

The table below shows the $CO_2$-emissions of the university per scope and type of emission. The emissions are related to the number of students and employees and to the gross floor area. This is done because the

[1] www.co2emissiefactoren.nl

universities energy consumption is affected by these parameters. It is obvious that the total $CO_2$-emission of one student is way lower (0,44 ton $CO_2$) than the total emission of one FTE employee (4,2 ton $CO_2$).

| Types of emission per scope | | Total [ton/year] | Per student [ton/100] | Per fte [ton/ fte] | Per GFA [ton/100m²] |
|---|---|---|---|---|---|
| Direct emissions | | | | | |
| Natural gas consumption | Scope 1 | - | 0,000 | 0,000 | 0,000 |
| Fuel consumption university-owned vehicles | Scope 1 | 2,9 | 0,011 | 0,001 | |
| Cleaning detergence | Scope 1 | 3,2 | 0,012 | 0,001 | 0,001 |
| Refrigerents | Scope 1 | 229,7 | 0,891 | 0,084 | 0,103 |
| Indirect emission | | | | | |
| Electricity consumption | Scope 2 | - | 0,000 | 0,000 | 0,000 |
| Heat consumption | Scope 2 | 1.168,3 | 4,531 | 0,427 | 0,522 |
| Other indirect emissions | | | | | |
| Fuel consumption commuting travel - public transport | Scope 3 | 3.834,5 | 14,871 | 1,403 | |
| Fuel consumption commuting travel - car, (motor)bike, electric bike | Scope 3 | 3.296,1 | 12,783 | 1,206 | |
| Fuel consumption business travel - airplane | Scope 3 | 2.622,2 | 10,170 | 0,959 | |
| Fuel consumption business travel - train | Scope 3 | 2,6 | 0,010 | 0,001 | |
| Fuel consumption business travel - car | Scope 3 | 91,1 | 0,353 | 0,033 | |
| Waste production | Scope 3 | 240,4 | 0,932 | 0,088 | 0,107 |
| Catering | Scope 3 | | - | - | 0,000 |
| Total (students & employees) | | 11.491,0 | 44,566 | 4,203 | 0,733 |

*Table 1: $CO_2$-emissions Erasmus University Rotterdam 2016*

Figure 3 shows the distribution of emissions per scope. Nearly 88% of the total emission derives from the emissions of scope 3. As waste production only makes up for 2 percent of the total percentage of scope 3, mobility is responsible for nearly all $CO_2$-emissions of the university.

Compared to the emission per scope in 2015, the emissions of scope 1 slightly increased as well as the emission of scope 2. Scope 3 on the other hand, mainly consisting of mobility, decreased from 91% (13.375 ton $CO_2$) of the total footprint to 88% (10.087 ton $CO_2$) of the total footprint. Further below, the various emissions and the changes during 2016 are described in more detail.

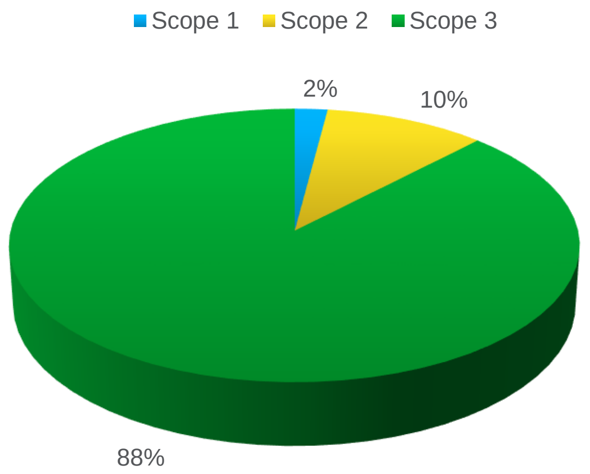


*Figure 3: $CO_2$-emissions per scope*

## 3.2 Results per source of $CO_2$-emission

### 3.2.1 Direct emissions

The diagram below shows the impact of the various emissions of scope 1.

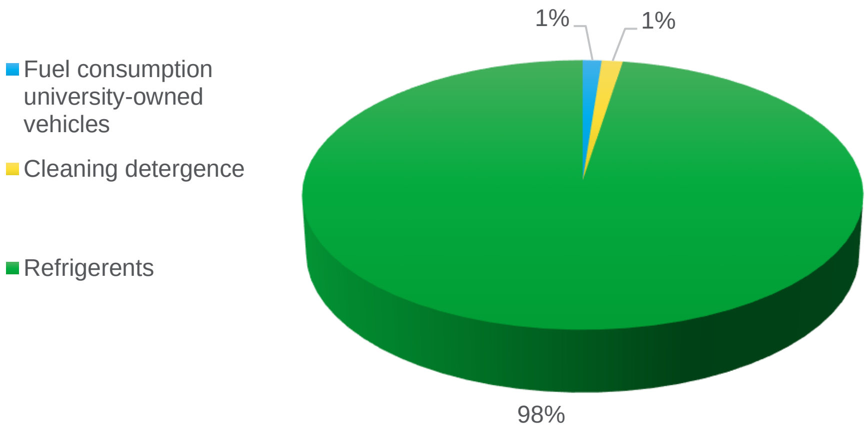


*Figure 4: Emissions scope 1*

*Natural gas - Energy data buildings*

In 2015 the natural gas consumption is responsible for 4,1 ton $CO_2$ (0,03% of the total footprint of 2015). The natural gas was used for the heating of the staff accommodation. Those apartments are no longer in use, therefore no natural gas has been used in 2016.

*University-owned vehicles*

The total costs for fuel (diesel) for university-owned vehicles is € 1.002,- for the year 2016. Using data from Statistics Netherlands[2], a translation from costs into used liters diesel is done. The average price for diesel is € 1,134/ liter, according to Statistics Netherlands (2016). The university used one vehicle during 2016.

In 2016 the university-owned vehicles are responsible for 2,9 ton $CO_2$ (0,02%).

Compared to 2015 (3,9 ton $CO_2$), this is a reduction based on the downsizing from three cars to one.

*Refrigerants*

Refilling of the refrigerants is done by a third party. They maintain a list of refrigerants that have been refilled/ drained. Unfortunately, it was impossible to retain this list from the contracted party. Therefore, the data of 2015 has been used. The emissions are unchanged.

In 2016 the use of refrigerants is responsible for 229,7 ton $CO_2$ (2,0%).

*Cleaning detergence*

In 2016 the use of cleaning detergence is close to zero, mainly because of a lack of valid data. The data for cleaning detergence is not complete.

[2] www.cbs.nl

### 3.2.2 Indirect emissions

*Electricity - Energy data buildings*

The energy data of the buildings are based on measurement data from invoices or manual readings of the electricity meters. The university only purchases renewable electricity. The electric cars are also charged with renewable electricity. Therefore, there is no $CO_2$-emission deriving from the use of electricity.

*Heat consumption - Energy data buildings*

The energy data of the buildings are based on measurement data from invoices (Eneco).

In 2016 the heat consumption is responsible for 1.168,3 ton $CO_2$ (10,17%).

Compared to 2015 (1.058,6 ton $CO_2$), a slight increase of nearly 3% of the total footprint is visible. This is mainly based on the colder winter months (2672 degree days in 2015 vs. 2757 degree days in 2016).

### 3.2.3 Further indirect emissions

The diagram below shows the impact of the various emissions of scope 3.

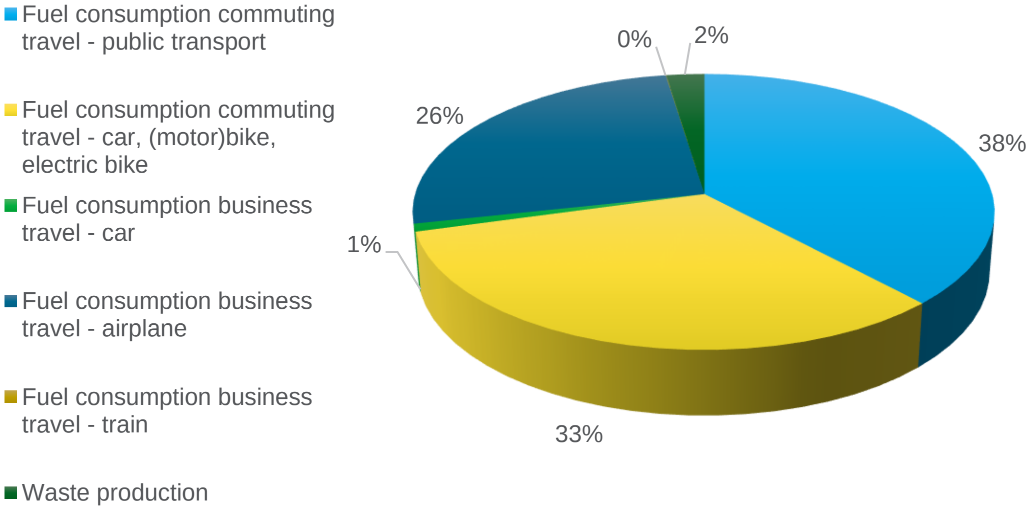


*Figure 6: Emissions scope 3*

*Commuting travel*

Once every two or three years, the university conducts a mobility survey on the travel behavior of employees and students[3]. The upcoming survey is planned to be conducted in 2018. Based on the results of the data of the last survey, the number of kilometers travelled by various modalities has been extrapolated for the total amount of students. The results of the survey of 2014 are used for the data of 2015 and 2016 for employees and for students.

In 2016, the commuting travel by public transport is responsible for 3.834,5 ton $CO_2$ (33,37%). The commuting travel by car, motorbike, scooter and electrical bike is responsible for 3.296,1 ton $CO_2$ (28,68%).

In 2015, the commuting travel by public transport was responsible for 4.783,5 ton $CO_2$ and the commuting travel by car, motorbike, scooter and electrical bike was responsible for 4.607,7 ton $CO_2$. This remarkable reduction in both categories is mainly based on a statistical effect (lower response rates). No additional measures have been implemented.

[3] Voortgangsrapportage Mobiliteitsbeleid; June 11$^{th}$, 2015

*Business travel by private car, train and plane*

This year for the first time the emissions regarding the fuel consumption for business travels made by private car have been added. Therefore, a comparison to the emissions of 2015 is not possible. The invoices of the employees (€ 0,19/ kilometer) have been used to calculate the result.

In 2016 the business travel by private car is responsible for 91,1 ton $CO_2$ (0,79%).

A number of employees is using their NS-business card for national train travels. Accurate data is derived from the business card overview. The invoices handed in manually are added to the overall data.

In 2016 the business travel by train is responsible for 2,6 ton $CO_2$ (0,02%).

A comparison to the emission of 2015 is not useful, given the fact that data of only two months has been available in 2015.

The business travel made by plane is determined based on the destination of the flights and possible stop-overs. For the major part of the flights, the destination is known. For a certain amount of flights (5%) an assumption had to be made regarding the destination airport. It has been assumed that the departure airport is solely Schiphol Airport, due to missing data on the departure airport. Above described uncertainty factors result in an inaccuracy of the assigned emission which in reality may even be higher.

The distance (flight kilometers) is determined using the website http://www.travelmath.com/flight-distance/. According to the distances (national, European and intercontinental) the emissions are calculated.

In 2016 the business travel by plane is responsible for 2.622,2 ton $CO_2$ (22,82%).

Compared to 2015 (3.745,3 ton $CO_2$), a reduction is visible. This is partly based on a more thorough investigation of the flight kilometers and a more detailed way of calculating the final emissions.

*Waste production*

The university monitors different waste streams. This list of registered waste volumes serves as an input for calculating the carbon footprint. In this footprint seven waste streams will be included:

- Residual waste.
- Paper and cardboard waste.
- Vegetable, fruit and garden waste.
- Plastic.
- Glass.
- Swill.
- (Domestic) electrical appliances.

Assumptions:

- Confidential waste is classified as paper waste.
- (Domestic) electrical appliances are seen as refrigerators (mostly used at the university). Assumptions have been made about the materials of which a refrigerator consists of (10% plastic, 20% glass, 70% iron).

In 2016 the waste production is responsible for 240,4 ton $CO_2$ (2,09%). The amount recorded for the Hatta complex is based on an estimation.

Compared to 2015 (237,8 ton $CO_2$) a neglectable increase is shown, possibly based on the increase of the amount of students.

## 3.3 Preview

Sustainability is one of the main strategic research topics on which the university wants to focus during the upcoming years. In the field of education, sustainability is playing a major role since a couple of years. The topic is no less relevant to the management of a business. During the last couple of years, the university has been eager to further improve the sustainability of the management. The focus has been on housing, mobility, energy and sustainable procurement.

The university therefore aims to improve the $CO_2$ footprint constantly. Attention is paid on the reliability and accuracy of the used data.

It mainly concerns the following aspects:

1. Data on catering.
2. Data on transport.
3. Data on cleaning detergence.
4. Data on refrigerants.

**Catering**

Part of scope 3 are emissions concerning the catering. For 2015 and 2016, these emissions are not yet identified and calculated. Erasmus University Rotterdam pays additional attention to the $CO_2$ supply chain emissions. The university is committed to lower their emissions in the supply chain. Furthermore, students are regularly inquiring about the products available in the canteens.

While scope 1 and 2 cover direct emissions sources (e.g., fuel used in company vehicles and purchased electricity), scope 3 emissions cover all indirect emissions due to the activities of an organization. These include emissions from both suppliers and consumers. A complete chain analysis starts at the raw materials purchased and ends with the treatment of the waste at the end of the lifetime of the product delivered.

For this, the university's catering data will be gathered and analyzed the upcoming year.

**Transport**

An important part of the footprint are the emissions originating from transport. Various aspects are part of the analysis:

- Commuting travel students and employees
- Business travel employees

The commuting travel of the students and the employees is currently based on a mobility survey originating from 2014. The data gathering process can be improved in the upcoming years, especially the response to the survey can be stimulated to strengthen the analysis (> 40% response). A standardized way of monitoring the necessary data will enhance the accuracy of the data. As long as there is no overall monitoring system, a regular update of the survey can provide the university of a reliable dataset. The upcoming survey is planned to be conducted in 2018.

The business travel made by plane is determined based on the destination of the flights. For the major part of the flights, the destination is known. For a certain amount of flights an assumption had to be made. It also has been assumed that the departure airport is solely Schiphol Airport, due to missing data on the departure airport. By making certain assumptions, the university has elaborated their analysis, separating the different flight distances.

Nevertheless, further improvement is possible. Exact flight data can be recorded on a faculty level so it can be monitored and benchmarked. Usually a contract with a travel agency should provide this possibility if everyone books their trips through this agency. The latter is improved when non-agency declarations will not be honored. In the upcoming years, further steps will be taken to strengthen the analysis.

The distance travelled and the modality used for business travel should be recorded in declaration forms. If this is not possible, the focus should be shifted to flights only. That because international train travel and international car travel will be only a small fraction of the emissions.

Also goods transport to the university (suppliers of the university and catering) has not been included in the analysis. The university is intending to include this emission stream and will collect the relevant data.

**Cleaning detergence**

More exact and complete data on the ingredients of used cleaning detergence can be gathered during the next period. A detailed list of ingredients will make the footprint more accurate due to the more accurate data on which calculations of emissions will be based.

**Refrigerents**

Unfortunately, no actual data for 2016 has been available (therefore, the data of 2015 has been used as estimation). The university is keen to improve the overall accuracy of providing the necessary data on time to calculate the footprint.

ARCADIS

# APPENDIX I - CONVERSION FACTORS

## Variables

| | | | | |
|---|---|---|---|---|
| Year | 2016 | | | |
| Owner | Jan-Cees Jol | | | |
| Students | 25.784 | students | 257,84 | 100 students |
| Employees | 2.734 | employees | | |
| GFA | 223.998 | m² | 2.240 | 100 m² |

| Locatie | Woudestein | EUC | ISS |
|---|---|---|---|
| GFA (m²) | 202.585 | 5.727 | 15.685 |

$CO_2$-conversion factors — Most recent update: November 11th, 2017 — according to: http://co2emissiefactoren.nl/

| | | | |
|---|---|---|---|
| **Scope 1** | | | |
| Natural gas | 1,884 | kg $CO_2$/ Nm³ | |
| Gasoline | 2,740 | kg $CO_2$/ liter | * E95 NL |
| Diesel | 3,230 | kg $CO_2$/ liter | * NL |
| R22T | 1.810 | kg $CO_2$/ kg | |
| R134a | 1.430 | kg $CO_2$/ kg | |
| R407c | 1.774 | kg $CO_2$/ kg | |
| R410a | 2.088 | kg $CO_2$/ kg | |
| R507 | 3.985 | kg $CO_2$/ kg | |
| **Scope 2** | | | |
| Electricity grey | 0,526 | kg $CO_2$/ kWh | |
| Electricity green | - | kg $CO_2$/ kWh | * Wind, water, zonne |
| Heat STEG | 22,000 | kg $CO_2$/ GJ | * Cijfers conform hopgave Eneco |
| **Scope 3** | | | |
| Public transport (average) | 0,061 | kg CO2/ km | |
| Train (average) | 0,039 | kg CO2/ km | |
| Car (average) | 0,220 | kg $CO_2$/ km | |
| Residual waste | 0,527 | kg CO2/ kg | * Municipal solid waste {NL}\| treatment of, incineration \| Alloc Def, S |
| Paper waste | - | kg CO2/ kg | * The recylce process of paper and comparable materials generates energy to be used in the production process of new paper. For that the emission regarding paper and comparable materials is set to '0' due to the recycling step. |
| Fruit, vegetables, garden | 0,0001 | kg CO2/ kg | * Biogas {GLO}\| market for \| Alloc Def, S \|\| Soortelijk gewicht: 400 kg/m³ |
| Plastic | - | kg CO2/ kg | * The recylce process of plastic generates energy to be used in the production process of new plastic. For that the emission regarding plastic is set to '0' due to the recycling step. |
| Glass | - | kg CO2/ kg | * The recylce process of glass generates energy to be used in the production process of new glass. For that the emission regarding glass is set to '0' due to the recycling step. |
| Swill | 0,0001 | kg CO2/ kg | * Biogas {GLO}\| market for \| Alloc Def, S \|\| Density: 400 kg/m³ |
| Appliances | 2,0300 | kg CO2/ kg | * Cast iron {GLO}\| market for \| Alloc Def, S |
| Asito Element | 1,2700 | kg CO2/ kg | * Important ingredient: hydrogen peroxide, dilluted (1%): Hydrogen peroxide, without water, in 50% solution state {GLO}\| market for \| Alloc Def, S |
| Decalcifier | 8,7000 | kg CO2/ kg | * Mainly consists of citric acid: Citric acid {GLO}\| market for \| Alloc Def, S |
| Hand soap | 1,3400 | kg CO2/ kg | * Mainly consists of fat and sodium hydroxide (estimation: 50%) Sodium hydroxide, without water, in 50% solution state {GLO}\| market for \| Alloc Def, S |
| Carpet cleaner | | kg CO2/ kg | |
| Airplane < 700km | 0,2970 | kg CO2/ km | |
| Airplane EU 700-2500 km | 0,2000 | kg CO2/ km | |
| Airplane Interco > 2500 km | 0,1470 | kg CO2/ km | |
| Airplane (average) | 0,2140 | kg CO2/ km | |
| Bread | 0,6570 | kg CO2/ kg | *Wheat grain {GLO}\| market for \| Alloc Def, S |
| Salade | 3,0100 | kg CO2/ kg | *Lettuce {GLO}\| market for \| Alloc Def, S |
| Meat | 7,5000 | kg CO2/ kg | *Red meat, live weight {GLO}\| market for \| Alloc Def, S |
| Dairy | 234,0000 | kg CO2/ m³ | * Dairy {GLO}\| market for \| Alloc Def, S; assumption: 10 liter milk= 1 kg chees |
| Apple | 0,3210 | kg CO2/ kg | * Apple {GLO}\| market for \| Alloc Def, S |
| Banana | 0,2190 | kg CO2/ kg | * Banana {GLO}\| market for \| Alloc Def, S |

EUR Commuting

| | | | |
|---|---|---|---|
| Other | 0,0610 | kg $CO_2$/pkm | |
| Car (single passenger) | 0,2200 | kg $CO_2$/pkm | |
| Car (carpooling) | 0,2200 | kg $CO_2$/pkm | |
| Car + public transport | 0,2200 | kg $CO_2$/pkm | |
| Scooter | 0,0590 | kg $CO_2$/pkm | *Afstudeerscriptie mobiliteit |
| Bus | 0,1400 | kg $CO_2$/pkm | |
| Bike electric | 0,0070 | kg $CO_2$/pkm | |
| Bike | - | kg $CO_2$/pkm | |
| Bike + public transport | 0,0610 | kg $CO_2$/pkm | |
| Metro | 0,0950 | kg $CO_2$/pkm | |
| Motorbike | 0,1360 | kg $CO_2$/pkm | *Afstudeerscriptie mobiliteit |
| Walking | - | kg $CO_2$/pkm | |
| Tram | 0,0840 | kg $CO_2$/pkm | |
| Train | 0,0390 | kg $CO_2$/pkm | |
| Train+ Tram/Bus/Metro | 0,0610 | kg $CO_2$/pkm | |

# APPENDIX II – CALCULATION SHEET

(available as seperate document)

# COLOPHON

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OUR REFERENCE

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