ARCADIS Design & Consultancy for natural and built assets

CARBON FOOTPRINT 2017

Erasmus University Rotterdam

16 JANUARY 2019

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CONTENTS

1 INTRODUCTION

Erasmus University Rotterdam (EUR) asked Arcadis to calculate the carbon footprint for the complete university over 2017 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 2016.

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.

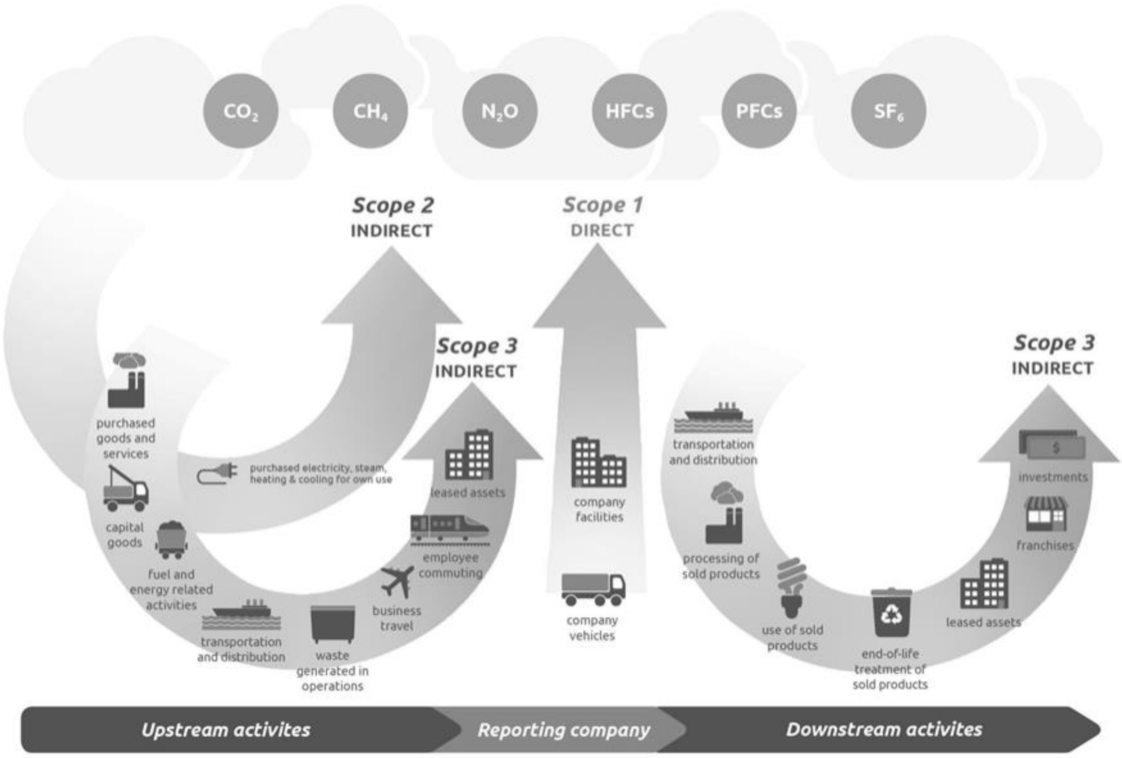

Figure 1: Definition of the scopes according to the GHG Protocol

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.
    - Fuel use business travel – public transport (other than train)
    - Emissions from waste production (residual waste, paper, cardboard, organic waste, plastic, glass, swill).
    - Catering.

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, but by travelling to and from the university students also 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.

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 2017/ 31st of December 2016):

- 2.932 employees;
- 27.289 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.

2.4 Additional information

The used amount of square meters has increased slightly by 5% (location Woudestein) which has to be taken into account while analyzing the energy consumption in 2017 and the total increase compared to 2016.

3 CARBON FOOTPRINT 2017

3.1 Results

The total CO_2-emission of the university for 2017 is 11.937,80 ton CO_2. This equals an emission of 43,75 ton CO_2 per 100 students. The figure below shows the distribution of the different emissions.

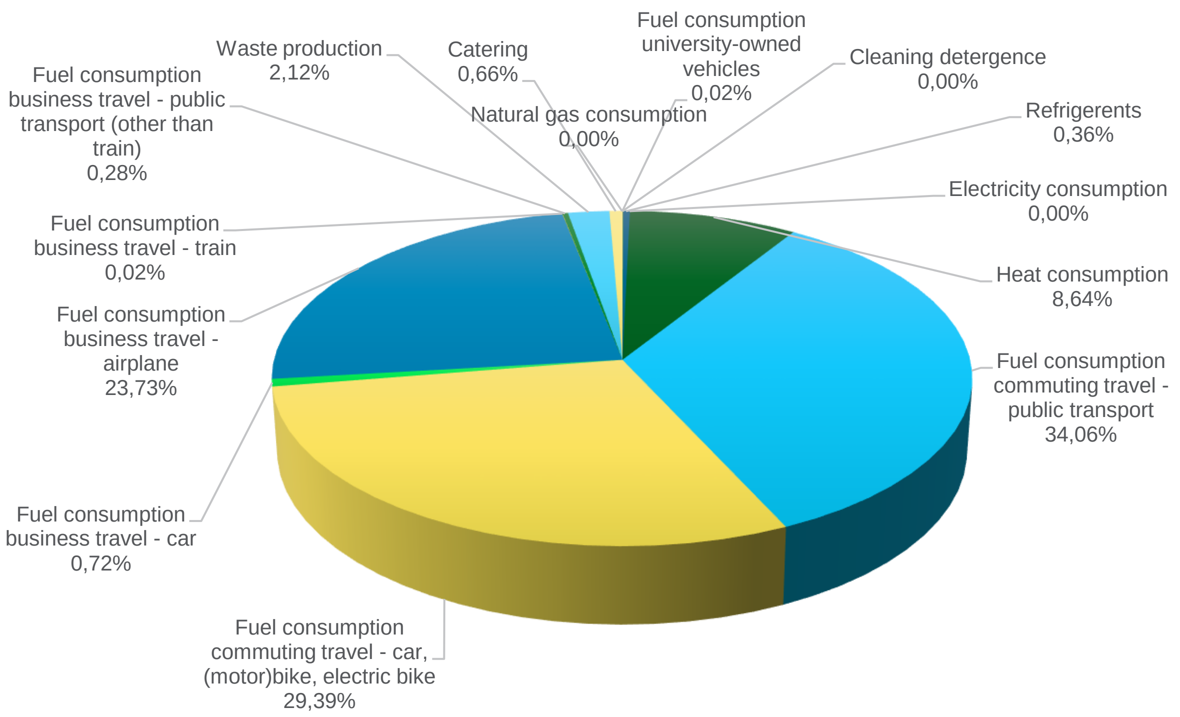

Figure 2: CO_2-footprint Erasmus University Rotterdam 2017

A substantial part of the emissions is caused by the fuel consumption for commuting travel by public transport (34,06%), followed by the fuel consumption for commuting travel by car, motorbike, scooter and electric bike (29,39%). Next in line is the fuel consumption for business travel by plane (23,73%). That means that the largest part of the CO_2 footprint is caused by scope 3 emissions regarding mobility with 88% 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 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 0,72%).

Catering has been added for the first time in the carbon footprint of 2017. The university was able to retrieve information regarding the coffee consumption (kg/year) of the university. This results in an additional emission of 79,3 ton CO_2 (0,66%). Also for the first time the data regarding the fuel consumption for business travel with public transport and the real life data for the refrigerants were added.

[1] www.co2emissiefactoren.nl

Comparing this footprint to the footprint of 2016, some changes are visible. The overall footprint increased by nearly 4%.The CO_2-emission has increased from ***11.491*** ton CO_2 in 2016 to ***11.938*** ton CO_2 in 2017, mainly due to an increase of students and employees.

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 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 employee (4,07 ton CO_2).

Types of emission per scope		Total [ton/year]	Per student [ton/100]	Per employee [ton/ emp]	Per GFA [ton/100m²]
Direct emissions					
Natural gas consumption	Scope 1	-	0,000	0,000	0,000
Fuel consumption university-owned vehicles	Scope 1	1,8	0,007	0,001	
Cleaning detergence	Scope 1	0,6	0,002	0,000	0,000
Refrigerents	Scope 1	42,9	0,157	0,015	0,018
Indirect emission					
Electricity consumption	Scope 2	-	0,000	0,000	0,000
Heat consumption	Scope 2	1.031,0	3,778	0,352	0,439
Other indirect emissions					
Fuel consumption commuting travel - public transport	Scope 3	4.065,5	14,898	1,387	
Fuel consumption commuting travel - car, (motor)bike, electric bike	Scope 3	3.508,8	12,858	1,197	
Fuel consumption business travel - car	Scope 3	86,2	0,316	0,029	
Fuel consumption business travel - airplane	Scope 3	2.833,2	10,382	0,966	
Fuel consumption business travel - train	Scope 3	2,4	0,009	0,001	
Fuel consumption business travel – public transport (other than train)	Scope 3	33,4	0,122	0,011	
Waste production	Scope 3	252,7	0,926	0,086	0,108
Catering	Scope 3	79,3	0,291	0,027	0,034
Total (students & employees)		11.937,8	43,746	4,072	0,599

Table 1: CO_2-emissions Erasmus University Rotterdam 2017

Figure 3 shows the distribution of emissions per scope. Approximately 91% of the total emission derives from the emissions of scope 3. As waste production only makes up for 2 percent and catering only makes up for 0,66% 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 2016, the emissions of scope 1 slightly decreased as well as the emission of scope 2. Scope 3 on the other hand, mainly consisting of mobility, increased from 88% (10.087 ton CO_2) of the total footprint to nearly 91% (10.862 ton CO_2) of the total footprint. Further below, the various emissions and the changes during 2017 are described in more detail.

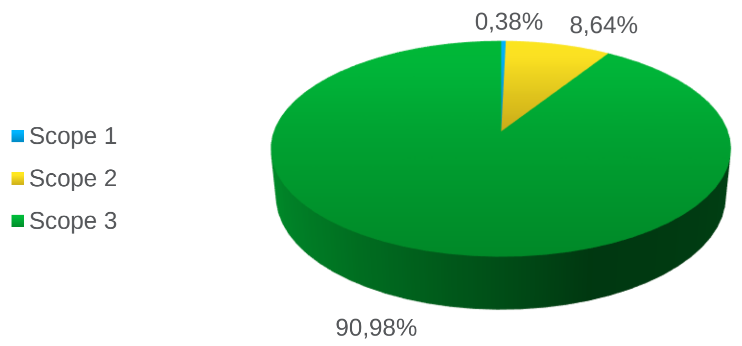

Figure 3: CO_2-emissions per scope

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.

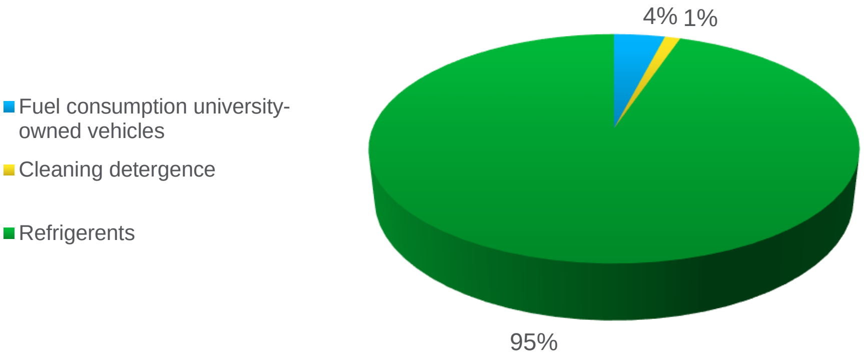

Figure 4: Emissions scope 1

Natural gas - Energy data buildings

In 2015 the natural gas consumption was 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 and 2017.

University-owned vehicles

The total costs for fuel (diesel) for university-owned vehicles is € 684,- for the year 2017. Using data from Statistics Netherlands[2], a translation from costs into used liters diesel is done. The average price for diesel over 2017 is € 1,22/ liter. The university used one vehicle during 2017.

In 2017 the university-owned vehicles are responsible for 1,8 ton CO_2 (0,02% of total footprint). Compared to 2016 (2,9 ton CO_2), this is a further reduction.

Refrigerants

Refilling of the refrigerants is done by a third party. They maintain a list of refrigerants that have been refilled/ drained. This year it was for the first time possible to retain this list from the contracted party (emissions from earlier years were based on an estimation).

In 2017 the use of refrigerants is responsible for 42,9 ton CO_2 (0,36% of total footprint). Due to the fact that estimations have been made in earlier years, a comparison of the emissions has no added value (nevertheless, due to validated numbers, a decrease is visible).

Cleaning detergence

For the year of 2017 valid data on cleaning detergence use is available. In earlier years the data regarding cleaning detergents has been incomplete. A comparison to former years is therefore not useful.

In 2017 cleaning detergents were responsible for an emission of 0,6 ton CO_2. (0,001% of total footprint).

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[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 2017 the heat consumption is responsible for 1.031 ton CO_2 (8,64% of total footprint).

Compared to 2016 (1.168,3 ton CO_2), a decrease of nearly 12% is visible. This is mainly due to the warmer winter months (2.757 degree days in 2016 vs. 2.587 degree days in 2017).

Since 2017, the university is compensating its emissions deriving from their heat consumption and has offset 1.031 tons of CO2 equivalents in the year 2017 with GS cookstoves for Kenia, Tanzania and Uganda. Climate Neutral Group invests in emission reduction projects which combine energy, environment and developmental solutions into sustainable business opportunities in developing countries.

3.2.3 Further indirect emissions

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

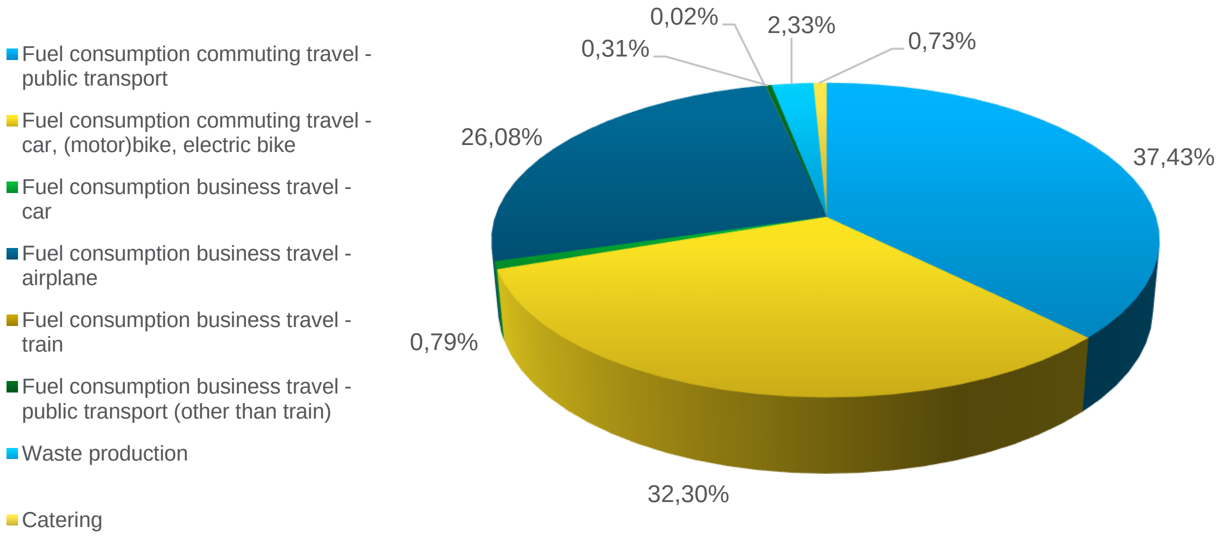

Figure 6: Emissions scope 3

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 2019. 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 and employees. The results of the survey of 2014 are used for the data of the footprints of 2015, 2016 and 2017.
In 2017, commuting travel by public transport is responsible for 4.065,5 ton CO_2 (34,06% of total footprint). Commuting travel by car, motorbike, scooter and electrical bike is responsible for 3.508,8 ton CO_2 (29,39% of total footprint).

In 2016, commuting travel by public transport was responsible for 3.834,5 ton CO_2 and commuting travel by car, motorbike, scooter and electrical bike was responsible for 3.296,1 ton CO_2. This increase in both

[3] Voortgangsrapportage Mobiliteitsbeleid; June 11th, 2015

categories is mainly due to the increase of the amount of students (5,8% increase) and employees (7,2% increase). No additional measures have been implemented.

Business travel by private car, train and plane

To be able to analyse the emissions for business travel, the invoices of the employees (€ 0,19/ kilometer) have been used to calculate the result. In 2017 business travel by private car is responsible for 86,2 ton CO_2 (0,72% of total footprint). Compared to the emissions in 2016, a slight reduction is visible (5,3%).

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 2017 business travel by train is responsible for 2,4 ton CO_2 (0,02% of total footprint). Compared to the emissions in 2016, a reduction is visible (7,7%).

Business travel 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 2017 business travel by plane is responsible for 2.833,2 ton CO_2 (23,73% of total footprint).

Compared to 2016 (2.622,2 ton CO_2), an increase is visible.

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 are included:

- Residual waste.
- Paper and cardboard 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 2017 the waste production is responsible for 252,7 ton CO_2 (2,12% of total footprint). The amount recorded for the Hatta complex is based on an estimation. Compared to 2016 (240,4 ton CO_2) an increase of 5% is shown, possibly due to the increase of the amount of students and employees.

Catering - coffee

This category has been added to the carbon footprint of the university for the first time. The university was able to retrieve the data regarding coffee beans used in 2017, which was 7.312 kg. Using the conversion factor of Wuppertal Institute in Germany (one of the few public available conversion factors) of 10,85 kg CO_2/kg coffee, the use of coffee results in 79,3 ton CO_2 (0,66% of total footprint).

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 and research, 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, waste management, catering 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.

This mainly concerns the following aspects:

1. Data on catering.
2. Data on transport.

Catering

Part of scope 3 are emissions concerning the catering. For 2015 and 2016, these emissions were not identified because there was no data available. 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.

Also a few sustainable initiatives have been set up, e.g.:

- During the Sustainability conference, a vegan lunch has been served. Of each product used, a carbon footprint was available.
- The Erasmus Food Lab offers a vegan cooking workshop to everyone interested.

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. Right now, the university was able to retrieve information on the amount of coffee beans used. A first step in the right direction to calculate the emissions of the catering in total. Also a new contract with the catering company is due to be set up, a perfect opportunity to regularly include a list of inventory with the bill.

Transport

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

- Commuting travel of students and employees
- Business travel of 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 with a reliable dataset. The upcoming survey is planned to be conducted in 2019.

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 this aspect of 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 is because international train travel and international car travel will be only a small fraction of the emissions.

Also transport of products 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.

The university has planned to set up a new mobility policy upcoming year, focusing on reducing travel by car and stimulating public transport.

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APPENDIX I - CONVERSION FACTORS

Variables

Year	2017			
Owner	Jan-Cees Jol			
Students	27.289	students	272,89	100 students
Employees	2.932	employees		
GFA	234.676	m²	2.347	100 m²
Peildatum stud. 1 okt 2017 / medewerkers 31 dec 2016 natuurlijke personen				

Locatie	Woudestein	EUC	ISS
GFA (m²)	213.263	5.727	15.685

CO_2-conversion factors

Most recent update: December 11th, 2018 according to: http://co2emissiefactoren.nl/

Scope 1			
Natural gas	1,890	kg CO_2/ Nm³	1,884 2016
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
Coffee	10,8500	kg CO2/ kg	* Wuppertal Institute
Asito Waspoeder	1,7800	kg CO2/ kg	* Main ingredient: sodium carbonate (30%), similar to Sodium percarbonate, powder {GLO}| market for | Alloc Def, S
Asito linostripper	4,2500	kg CO2/ kg	* Main ingredient not available. 2nd benzyl alcohol (30%): Benzyl alcohol {GLO}| market for | Alloc Def, S

EUR Commuting

Other	0,0610	kg CO2/pkm	
Car (single passenger)	0,2200	kg CO2/pkm	
Car (carpooling)	0,2200	kg CO2/pkm	
Car + public transport	0,2200	kg CO2/pkm	
Scooter	0,0590	kg CO2/pkm	*Afstudeerscriptie mobiliteit
Bus	0,1400	kg CO2/pkm	
Bike electric	0,0070	kg CO2/pkm	
Bike	-	kg CO2/pkm	
Bike + public transport	0,0610	kg CO2/pkm	
Metro	0,0950	kg CO2/pkm	
Motorbike	0,1360	kg CO2/pkm	*Afstudeerscriptie mobiliteit
Walking	-	kg CO2/pkm	
Tram	0,0840	kg CO2/pkm	
Train	0,0390	kg CO2/pkm	
Train+ Tram/Bus/Metro	0,0610	kg CO2/pkm	

APPENDIX II – CALCULATION SHEET

COLOPHON

CARBON FOOTPRINT 2017
ERASMUS UNIVERSITY ROTTERDAM

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OUR REFERENCE

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16 January 2019

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