



## Carbon footprint of SURFnet 2014

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## Nederlandse samenvatting

Dit rapport beschrijft het energiegebruik en daarmee de CO<sub>2</sub>-uitstoot van SURFnet en laat zien hoe deze getallen berekend zijn. Deze manier van rapporteren voldoet aan de ISO14064-standaard, een algemeen gebruikte standaard voor soortgelijke rapportages. Dit rapport verschijnt nu voor het vierde jaar. Dit rapport is niet gevalideerd door een externe partij.

De totale CO<sub>2</sub>-eq uitstoot van SURFnet en haar diensten in 2014 is 1313,8 ton CO<sub>2</sub>-eq.

## English summary

SURFnet wants to account for its energy consumption in a way that it can compare itself to other National Research and Education Networks (NRENs) in Europe. To that end, an assessment was held to account for the Green House Gas (GHG) emission in 2014, according to the ISO 14064:2006 part 1 standard. SURFnet starting reporting on GHG emissions in 2010.

The quantitative assessment is limited to Scope 1 (direct emissions) and Scope 2 (indirect emissions related to bought energy) and certain parts of Scope 3 emissions (e.g. emissions related to the production of bought products, travel, waste). The total GHG emission under Scope 1, Scope 2, and Scope 3 accounted for by SURFnet in 2014 is equal 1313,8 ton CO<sub>2</sub>-eq.

This report was not submitted for independent validation by a third party.

# 1 Introduction

## 1.1 Background

Starting in 2009 SURFnet started an investigation to get more insight in the energy consumption of the SURFnet network and the energy consumption of its customers. This investigation, targeted at electrical energy consumption of the SURFnet network, resulted in a report 'Energy consumption of the SURFnet network'.

SURFnet has the ambition to report on its energy consumption in the annual reports and to lower the carbon dioxide emission and the environmental footprint. SURFnet has also committed itself to the [environmental sustainability policy](#) as made by GEANT. SURFnet considers it valuable to be able to compare itself to other NRENs using similar methods.

## 1.2 Scope

The primary goal of this assessment is to account for the Green House Gas (GHG) emission according to the ISO 14064:2006 part 1 standard. This means that Scope 1 (direct emissions), Scope 2 (indirect emissions related to bought energy), and Scope 3 emissions (e.g. emissions related to the production of bought products, travel, waste) are all included in this assessment where data is available. Where data is not available this will be mentioned in the corresponding sections of this report.

## 1.3 Purpose and Profile

SURFnet has four goals with respect to reporting on carbon dioxide emission footprint.

- Accountability with respect to the stakeholders of SURFnet. SURFnet has set the ambition to report henceforth on its energy consumption and to lower carbon dioxide emissions and environmental footprint.
- Creating awareness at the institutions that use the SURFnet network.
- Achieving the same level of accountability and comparing carbon dioxide emission levels to other research networks in Europe. Other European Research network providers (NRENs) have started to report carbon dioxide emissions and it's important to being able to learn from each other, finding good-practices from organisations similar to SURFnet.
- Achieving the same level of accountability and comparing carbon dioxide emission between SURFnet, SURFmarket, SURFsara, the three organizations under the SURF foundation.

## 2 Inventory Design and Development

### 2.1 Organisational boundaries

SURFnet is responsible for the connectivity services of higher education and research institutions of the Netherlands. To deliver these connectivity services, network equipment is installed and used in a variety of locations. Some of these locations are solely used by SURFnet, some are shared.

The 'operational boundaries' of SURFnet include the office located in Utrecht, and the backbone, which is the SURFnet computer network. The computer network consists of

- network equipment like switches, routers and optical network equipment.
- Computer servers and other equipment owned by SURFnet

The GHG emissions of SURFnet are consolidated into three categories (the office, services and the network), and each is measured in a controlled and documented manner. In this way, SURFnet will account for all GHG emissions and removals from facilities over which it has financial and operational control, and of which is reasonably possible to acquire the data.

### 2.2 Responsible Party

This inventory report was prepared by SURFnet. Primary contact is Lex Sietses, email: [lex.sietses@surfnet.nl](mailto:lex.sietses@surfnet.nl)

### 2.3 Reporting Period Covered

The period covered by this inventory is the year from January 2014 to December 2014, both inclusive.

### 2.4 Base Years

The first GHG inventory for SURFnet, covering the year January 2010 to December 2010 serves as historical base year as well as base year for this inventory.

### 2.5 Base Year Changes and Recalculations

In scope of this GHG emission assessment of SURFnet are the SURFnet computer network, SURFnet computer equipment, the office located in Utrecht and transport.

The most relevant changes are to be expected from the growth of the SURFnet network itself, or the services it offers. It is very unlikely SURFnet will change its type of business, and start other types of services. Since 2010, SURFnet owns an asset database in which all SURFnet network equipment is registered. This asset database gives details of each item of equipment, including its type, its manufacturer, model number, physical location etc. The purpose of the asset database, besides serving as an authoritative source of information for the GHG emissions report, is to be the central repository to record company assets. It is the ambition of SURFnet and their company policy to keep the database updated with new acquisitions, disposals and movement of equipment. By having this company policy in relation to the asset database, the accuracy of the information used for the purpose of the GHG emission report is ensured.

## 2.6 Impact of Uncertainties on the Accuracy of the Data

This section describes the impact of uncertainties on the accuracy of the GHG emissions and removals data. SURFnet has started, in 2010, to measure and report on GHG emissions. The approach is to begin with the simplest methods available, which include invoiced amounts of power consumed, systematic sampling and projection of equipment power consumption. Having reported through this baseline inventory and having engaged senior management in the process of implementing the environmental policy of the organisation, more accurate procedures and systems to measure energy consumed can be used. This will only be done if this benefits the goals (see section 1.3) with this GHG emission report in a way that is economically sensible.

Nonetheless, the methodologies used in conducting this inventory have been discussed and agreed by the team responsible. We believe that they give a reasonably accurate indication of the level of GHG emissions by the organisation in the reporting period.

At more detailed level, uncertainties in data could be caused by several factors. The following paragraphs describe these factors.

*Incorrect network/computer asset (device type) count:* Starting in 2010 SURFnet owns and uses an asset management system, which contains accurate information on the installed base of network equipment. For this assessment, this asset database was used to provide equipment type counts. In the past years several sites have been visited to check for deviations from this database, which were minimal. Therefore we expect deviations in network equipment counts to be minimal (less than ten devices). SURFnet does not have an asset management system for their computer systems, used to deliver services over the network.

*Deviations in Operational boundaries:* As mentioned in the previous paragraph, SURFnet owns an asset management system. In this system the location of network equipment is included in this database. A change in the number of locations is tracked in this system. For computer systems SURFnet does not own an asset management system.

*Power measurement instead of consumption counts:* The energy consumption of the SURFnet network is based on a report from Joulex, the energy management tool used to monitor the SURFnet network. Some hardware is not capable of providing real-time data for energy usage. In these cases we have done several measurements during 2014. There are also a handful of devices for which we do not have measurements and cannot provide real-time data. For measured data the effect in accuracy is roughly 5% and the power use for devices not taken into account (due to no data) is negligible.

*Uncertainties related to the office:* The amount of GHG emissions related to services, heating, cooling the SURFnet office in Utrecht are a source of inaccuracy since no power or energy measurement devices are available for heating, cooling and servicing (lifts, security, lighting corridors in the complex) the office. Correct measurements are only available for the electricity meter of the office itself. Due to a lack of measurements, the GHG emissions are derived from the service costs in relation to the total GHG emission of the building complex (Hoog Catharijne). The impact of deviations in this area is minor due to the fact that the size of emissions is small compared to emissions related to the SURFnet network.

*Uncertainties related to transport:* The amount of GHG emissions related to transport: commuting, and on-mission travel are a source of inaccuracy since a travel log is not available for all types of transport. Only plane flights booked via our booking office provide an accurate data source for GHG emissions. Based on logs provided by the HR department we know about half the flights are booked via the booking office, so the known GHG emissions for the booking office are doubled for this report. For regular transport via train, we have used information from HR including place of residence, amount of workdays per employee, days each employee works at home and average sick days per year. Based on this we calculate per employee which distance they roughly travel per year.

The impact of deviations in this area is expected to be small, due to the fact that size of emissions is relatively small compared to that of the SURFnet network. It should also be noted that the SURFnet office is located at the railway station in Utrecht and that all employees do their daily commuting to SURFnet by train. In this case, travel distance can be estimated with little error.

## **2.7 Compliance Statement**

This section confirms that the GHG report has been prepared in accordance with the appropriate part of ISO-14064. This GHG inventory has been prepared in accordance with ISO 14064-1.

## **2.8 Verification Statement**

This section describes whether the GHG inventory, report or assertion has been verified, including the type.

This report was not submitted for independent validation to assure that the report is in accordance with ISO 14064.

### 3 Calculating GHG emissions

#### Green house gasses and CO<sub>2</sub>-eq definition

The green house gasses (GHGs) are:

- Carbon dioxide (CO<sub>2</sub>).
- Methane (CH<sub>4</sub>).
- Nitrous Oxide (N<sub>2</sub>O).
- Hydrofluorocarbons (HFCs).
- Perfluorocarbons (PFCs).
- Sulphur Hexafluoride (SF<sub>6</sub>).

When GHG emissions are calculated, the impact of each GHG is transformed to a CO<sub>2</sub> equivalent. This is done by multiplying the emissions of a GHG by a factor that represents the effect of the GHG on climate change. These effects are based on the IPCC GWP100 factors. The effect of CO<sub>2</sub> is 1, since by definition effect of CO<sub>2</sub> is 1 CO<sub>2</sub>-eq.

#### 3.1 Data used for calculating GHG emissions

In order to calculate the GHG emissions, different data sources are used. For the GHG emission of heating with a natural gas boiler, ecoinvent unit process data has been used. The emission of 1 MJ "Natural gas, burned in boiler modulating <100kW/RER U" is 0,0734 kg CO<sub>2</sub>-eq.

Based on the "achtergrondgegevens stroometikettering 2013" (backgrounddata energy labelling 2013) published by CE Delft, the average CO<sub>2</sub>-eq caused by 1 kWh of electricity in the Netherlands is 300g CO<sub>2</sub>-eq in 2013. This applies for the total energy demand in the Netherlands. The data for 2014 are not known, therefore this data is the most actual and hereby used.

The CO<sub>2</sub>-eq emissions related to travelling between train station and home/office is taken as the average of CO<sub>2</sub>-eq emissions for each car type of car, of which we use 75% and assume the rest is bike travel (based on <http://www.milieucentraal.nl/themas/schoon-en-zuinig-op-weg/auto-ov-of-fiets>). This is a very rough estimation based on national averages. Not known is the amount of people who use an electric car or even who use a car at all for this transportation. That leaves a large margin of error but based on this method, the average CO<sub>2</sub>-eq emission of 1km travel between train station and home/office that we use in our calculations is 128 g/km.

The CO<sub>2</sub>-eq emissions related to travelling by plane is reported by our booking office. They supply the CO<sub>2</sub>-eq emission for each ticket booked by us. We use the average per flight from our booking office to determine the CO<sub>2</sub>-eq emissions per flight booked directly (as not all employees book via the booking office). We multiply this CO<sub>2</sub>-eq emission by the amount of people who book their flight themselves, for which we got data from a questionnaire.

## 4 Scope 1: Direct GHG Emissions

Direct (Scope 1) GHG emissions are defined as emissions caused by the combustion of fuels by SURFnet or direct emissions of GHGs. These emissions are characterized as Scope 1 according to ISO 14064. SURFnet does not directly burn any fuels. Previous years the power, gas and heating for our office was reported in this section, but this year it's reported under scope 2. The underlying reason for this is that we rent our offices in a multi-tenant building (Hoog Catharijne) with a central heating system. This is owned by a different entity so it's more correct to present the CO<sub>2</sub>-eq emissions as scope 2.

- SURFnet does not own any car or other form of motorised transport which causes direct or combustion related emissions of the GHGs listed.
- SURFnet makes use of approximately 290 locations varying in size from a small computer room (a few square meters) to locations with more than 100 square meters. Typically the larger datacentres make use of diesel powered generators as a backup for mains electricity. The use of those diesel powered generators is generally restricted to outages and interruptions of mains electricity and periodic operational testing. Therefore it was decided to not take into account the emissions related to the use of these generators.

### 4.1.1 GHG Removals

SURFnet is not responsible for any GHG removals.

### 4.1.2 Exclusions

As is described in the introduction of this section, the diesel powered backup generators are excluded from this inventory. The underlying reason is that use of these generators is restricted to outages and interruptions of mains electricity and operational testing.

### 4.1.3 Direct CO<sub>2</sub> Emissions from the Combustion of Biomass

SURFnet is not responsible for any combustion of biomass.

### 4.1.4 Total CO<sub>2</sub>-eq under Scope 1

The total Scope 1 CO<sub>2</sub>-eq emission is 0 tons.

## 5 Scope 2: Indirect GHG Emissions

This section covers the methodology use to quantify energy-indirect GHG emissions, by sector, within SURFnet boundaries. Indirect GHG emissions are caused by using energy produced by others (e.g. electricity or heat).

This section provides the Scope 2 GHG emissions for the SURFnet office (section 5.2), the SURFnet network (5.3), and the SURFnet services (5.4).

### 5.1 Quantification Methodologies

In this inventory, only recurrent emissions are considered. The embedded energy and consequent GHG emissions from building and production of facilities and equipment are not included. SURFnet does not produce any GHGs by direct emission (see previous chapter). Indirect emissions are calculated from activities in two areas:

**The office:** the SURFnet office at Radboudkwartier 273, 3511 CK, Utrecht which serves as the company's sole premises and where all staff are employed. Indirect emissions in this area originate from:

- The SURFnet office (Radboudkwartier 273, 3511 CK, Utrecht) is located in a multi-tenant building (Hoog Catharijne) with a central heating system (powered by natural gas) used for heating the offices located in the building. Since no data for 2014 are available, direct emissions were derived from the estimation for 2014 provided in 2013. The proportional GHG emission was related to the SURFnet office based on the service costs. The calculation available in appended file B3 estimates that 553GJ should be attributed to SURFnet. For calculation this is first calculated into m<sup>3</sup> natural gas and based on the "lijst emissiefactoren" van Mileubarometer each M3 equals 1825g CO<sub>2</sub>-eq. This makes the emission impact for natural gas for SURFnet equal to 26,38 tons CO<sub>2</sub>-eq.
- Electricity used by Hoog Catharijne, the GHG impact for this is calculated the same way as the gas consumption in scope 1. See appendix B3 for more details.
- Electricity usage for the office itself. Electricity is used for lighting, desktop/laptop computers (not the SURFnet network), coffee machines, displays, beamers, etc. The data for this is taken from two separate energy bills.
- Electricity for building services. The SURFnet office is located in a multi-tenant building. Outside the office energy is spent in lifts, lighting and security. The data for this is taken from Appendix B1, see B3 for summary.
- Electricity for cooling the building and offices (also SURFnet) in the form of air-conditioning and ventilation. See appendix B1 and B3 for this again.
- The SURFnet office hosts a small part, eight network components plus an air-conditioning, of the SURFnet computer network (Ut002A). Six of these eight network components are passive and do not consume electrical energy. In order to avoid double counting of energy consumption, the consumed energy of this small part of the network is subtracted from the office electricity usage. This is corrected under exclusions.



**The Network:** the network (or backbone) comprising all facilities, PoPs (points of presence) where network equipment, owned by SURFnet is located. Equipment that is included in the network is:

- The IP routers (located at two PoP sites in Amsterdam)
- The “photonic layer” which is the optical network consisting of optical amplifiers, (de)multiplex devices, wavelength switches, optical controllers and DWDM equipment
- Edge network equipment like switches
- A limited number (smaller than ten) utility server systems all located in the Amsterdam (Asd001A) datacentre. These systems are installed for various purposes: network management, testing, probing, time service (NTP), and troubleshooting.

The energy consumption of the SURFnet network is based on a report from Joulex, the energy management tool used to monitor the SURFnet network. Some hardware is not capable of providing real-time data for energy usage. In these cases we have done several measurements during 2014. There are also a handful of devices for which we do not have measurements and cannot provide real-time data. For measured data the effect in accuracy is roughly 5% and the power use for devices not taken into account (due to no data) is negligible.

**The Services:** the services comprising all facilities, PoPs (points of presence) where computer equipment, owned by SURFnet is located. Equipment that is included in this category are: webservers, storage systems, local network switches.

## 5.2 The Office

### 5.2.1 Facilities

The only office facility accounted for is the office in Utrecht (Radboudkwartier 273, 3511 CK, Utrecht), the electricity used by the office is accounted for as well as the proportional amount of electricity used for building services inside and outside the office itself (lifts, security, lighting) and cooling (air conditioning, ventilation).

### 5.2.2 Exclusions

A small part of electricity consumption in the office is excluded. This is done in order to avoid double counting. This is a small part of the SURFnet computer network accounted for in section 5.3. The excluded parts are eight network components plus an air-conditioning system. Six of these eight network components do not consume any energy (passive optical equipment) and two systems do consume electrical energy (UT002A\_O5 and UT002A\_OME01). The estimated energy consumption of these systems including air conditioning is 6805,536 kWh. The detailed calculation is included in appended file B4. As can be seen there are only records for the first five months of 2014, after that there is no automated data available. For this reason the average of the first five months is used to calculate the total usage for 2014.

### 5.2.3 Sample

The two electricity bills for the year 2014 received from the electricity company Eneco (Eneco, PO Box 666 3000 AR, Rotterdam, The Netherlands) are available in appended file B2a and B2b. An overview of the energy spent in building services, heating and cooling is available in appended file B1.

## 5.2.4 Measurement Method

In 2014 SURFnet had two separate energy contracts for its office. One with Eneco MKB and the other with Eneco Grootzakelijk. We have 'ecostroom', meaning renewable energy with Eneco MKB, but not with Grootzakelijk. The bill for Eneco MKB (appendix B2a) shows 113522 KWh used, resulting in 0 tons CO<sub>2</sub>-eq according to the Eneco website<sup>1 2</sup>. The bill for Eneco Grootzakelijk (appendix B2b) shows a use of 66236 KWh and as this is regular grey energy appendix B2c shows this equals 354gr CO<sub>2</sub> per kwh, totaling 23,45 tons CO<sub>2</sub>-eq.

The SURFnet office hosts a small part of the SURFnet computer network (The office is identified by Ut002A in appended file B4).

Appended file B1 provides an overview of the energy consumption needed for cooling and building services (lifts, security, lighting) of the 'Hoog Catharijne' complex where the SURFnet office is located. The proportional energy consumption was related to the SURFnet office based on service costs. The calculation available in appended file B3 estimates that 110804 kWh should be attributed to SURFnet for services, and that 3556 kWh should be attributed to SURFnet for cooling. These amounts are multiplied by the Dutch average CO<sub>2</sub>-eq for 1 kWh (300g per kWh), which results in an emission of 33,24 tons and 1,07 kg CO<sub>2</sub>-eq. respectively. For heating we should contribute 553 GJ which results in an emission of 26,38.

In section 5.2.2 the SURFnet office hosts a small part of the SURFnet network. In order to avoid double counting (the network is accounted for in 5.3), the emissions of this part of the network are **-2** ton CO<sub>2</sub>-eq.

## 5.3 The SURFnet network

### 5.3.1 Facilities

SURFnet makes use of approximately 290 locations that vary in size. Each location houses a part of the SURFnet network in the form of computer network equipment (switches, optical network equipment, etc.).

- Most locations are small (a few square meters) computer rooms located at customer-premises: office buildings or universities.
- A few locations are larger computer rooms or part of a data centre. Size is up to 100 square meters.
- All locations provide a housing service to SURFnet. At each location, network equipment owned by SURFnet is installed. The housing service provides energy in the form of electricity needed to power all systems, and cooling to condition the environment of installed devices.

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<sup>1</sup> <https://www.eneco.nl/stroometiket/>

<sup>2</sup> This does need a comment. It's unlikely that this energy really does not provide any CO<sub>2</sub>eq because research has shown even wind energy is responsible for (some) CO<sub>2</sub> emission. However, we have to base our calculations on information provided by Eneco in this case.

Energy consumption and GHG emissions of the SURFnet network is influenced by the following factors:

- *Energy consumption of installed network equipment:* The installed base of network equipment per location, and their corresponding electrical energy consumption over the measurement period.
- *Energy consumption of the facility:* Additional energy consumption of the facility required for the housed network equipment. Energy consumption is predominantly caused by cooling systems, but also the power distribution network, and additional services (security, lighting).
- *Energy source:* The type of energy source per facility: renewable or non-renewable. Facility owners can choose to select a 'green' electrical energy contract, which corresponds to electrical energy generated by renewable sources only.

### 5.3.2 Exclusions

Network and server equipment not owned by SURFnet is excluded from this report.

### 5.3.3 Sample

It is not possible to track down all energy suppliers for each location used by SURFnet. This is caused by the large number of locations, each with the freedom to choose their own supplier, which makes it a complex task to retrieve all energy suppliers and the corresponding energy contract type (based on renewable or non-renewable energy). For this reason we use the Dutch average of 300g per kWh in CO<sub>2</sub>-eq emissions.

### 5.3.4 Measurement Method

The energy consumption of the SURFnet network is based on a report from Joulex, the energy management tool used to monitor the SURFnet network. Some hardware is not capable of providing real-time data for energy usage. In these cases we have done several measurements during 2014. There are also a handful of devices for which we do not have measurements and cannot provide real-time data. For measured data the effect in accuracy is roughly 5% and the power use for devices not taken into account (due to no data) is negligible.

We do not have data on the Power Usage Effectiveness (PUE) of all locations used by our equipment. We do know that the average in 2014 was 1.7<sup>3</sup> but also that our equipment is often located in small rooms with less focus on effective power usages that big datacentres. We have decided to be on the safe side and use a PUE of 2, which means we double the power usage for the network to account for all overhead.

### 5.3.5 GHG emission of the SURFnet network

Details of the calculation of kWh used by the network is provided in a separate excel sheet available in appended file B4.

The total energy consumption of the SURFnet network, including the overhead of all facilities, is 3.019.473 kWh in 2014. This amount is multiplied by the GHG emission factor (300 g/kWh) and corresponds to 905,84 tons CO<sub>2</sub>-eq.

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<sup>3</sup> <http://www.datacenterknowledge.com/archives/2014/06/02/survey-industry-average-data-center-pue-stays-nearly-flat-four-years/>

## 5.4 SURFnet services

### 5.4.1 Facilities

SURFnet makes use of approximately 290 locations varying in size. Four of these locations house computer systems used to deliver services over the SURFnet network.

These locations provide a housing service to SURFnet computer equipment. At each location, computer equipment owned by SURFnet is installed in rack cabinets. The housing service provides energy in the form of electricity needed to power all systems, and cooling condition the environment of installed devices.

Energy consumption and GHG emissions of the SURFnet network is influenced by the following factors:

- *Energy consumption of installed computer equipment:* The installed base of computer equipment per location, and their corresponding electrical energy consumption over the measurement period.
- *Energy consumption of the facility:* Additional energy consumption of the facility required for the housed computer equipment. Energy consumption is predominantly caused by cooling systems, but also the power distribution network, and additional services (security, lighting).
- *Energy source:* The type of energy source per facility: renewable or non-renewable. Facility owners can choose to select a 'green' electrical energy contract, which corresponds to electrical energy generated by renewable sources only.

### 5.4.2 Exclusions

Network and server equipment not owned by SURFnet is excluded from this report.

### 5.4.3 Sample and Measurement Method

Included in appended file B6 is an excel sheet containing the measurement results of the four locations where computer equipment owned by SURFnet is installed. These locations are NIKHEF (Amsterdam), SURFsara / Vancis (Amsterdam), UvT (Twente) and UMCU (Utrecht). Energy consumption is calculated per rack cabinet containing computer equipment. The rack cabinets at Vancis (Amsterdam) are equipped with energy consumption counters. For the equipment at the UMCU we have monitoring software in place. For the other two locations we do not have measurements but we know which equipment is setup. As we also know how much the same equipment uses at Vancis (and load balancing ensures same usages per location) we can estimate the power usage for both UvT and NIKHEF. All measurement data is available in the worksheet measurements of B6.

It is not possible to track down all energy suppliers for each location used by SURFnet. This is caused by the large number of locations, each with the freedom to choose their own supplier, which makes it a complex task to retrieve all energy suppliers and the corresponding energy contract type (based on renewable or non-renewable energy).

### 5.4.4 GHG emission of the SURFnet services

Details of the calculation of CO<sub>2</sub>-eq are provided in a separate excel sheet available in appended file B6. The total energy consumption of the SURFnet computer systems, including the overhead of all facilities, is 336.038 kWh in 2014. Of this we know 68.501 is green energy, the rest is unknown and

thus classified as non-renewable energy. This amount is multiplied by the GHG emission factor (300 g/kWh) and corresponds to **80,26** tons CO<sub>2</sub>-eq.

### **5.5 Total CO<sub>2</sub>-eq under Scope 2**

The total GHG emission under Scope 2 is the sum of 82,14 (total for the office), 905,84 ton (for the network) and 80,26 ton (for the service) CO<sub>2</sub>-eq, which is equal to 1068,24 ton CO<sub>2</sub>-eq.

## 6 Scope 3: Other indirect GHG emissions

Indirect GHG emissions in Scope 3 are emissions of GHGs caused by transport (commuting and on mission using other than own transport vehicles), waste and network operations.

In Scope 3 GHG emissions for SURFnet are caused by: Transport (commuting by predominantly train, train trips and airplane flights on mission) and Network operations.

The sources of these emissions related to transport arise from the following sources:

- Gasoline and diesel fuel: used by private cars, motorbikes, taxis, buses, and trains
- Aviation fuel: used by aircraft for air travel
- Electricity: used by trains, trams, and metros

### 6.1 Transport

#### 6.1.1 Scope

In this section, GHG emissions due to forms of transport are considered in two categories, concerning all employees of SURFnet: commuting to and from work, and travel “on mission” as part of one’s duties to SURFnet

#### 6.1.2 Exclusions

There are no exclusions from either category of transport. For waste we are only able to have accurate data on paper waste, as the regular waste is not measured. For this reason, only paper is included into this report, all other forms of waste are excluded.

#### 6.1.3 Sample

Appended to this report is the excel document ‘B8 - Transport.xlsx’ which includes an export from the travel agency (in worksheet ‘on mission – air travel’) an export from the SURFnet employee database was inserted in worksheet ‘commuting’.

#### 6.1.4 Measurement method

The SURFnet office is located very close to the railway station in Utrecht. This means that all employees commute by train (if not traveling from Utrecht itself). Worksheet ‘commuting’ in B8 contains a list of all employees, their place of residence and the corresponding round-trip distance by train to the Utrecht railway station, as well as the round-trip reference travel distance of 5km (based on the average of 5.1km for the Netherlands in 2008, from compendium voor de leefomgeving, <http://www.compendiumvoordeleefomgeving.nl/indicatoren/nl2092-Woonafstand-tot-treinstation.html?i=38-187>).

The financial / HR department has a log of days that employees will work at home. This is used to determine the days that these specific employees do not travel to work. It’s know this administration is not perfect, some employees do not have an official day they work from home but still do so in practice. There has been a questionnaire like previous years too, asking employees when they work at home. Our impression however is that the new method (using the financial department) is more accurate. This is especially the case as only 40% of the employees responded to the questionnaire and with the limited number of employees, the effect of a few answers is too big.

The same questionnaire was used to get insight in the amount of on-mission travelling (Question 2: “how many trips per month?”). Based on the answers to this question a total number of 2796 trips was calculated. The average trip distance was derived from the list of institutions (clients) connected to SURFnet and their travel distance (by train to Utrecht). Also each on mission trip includes 5,1 km traveling on location (based on the average of 5.1km for the Netherlands in 2008, from compendium voor de leefomgeving). We have assumed most trips to customers start or end in Utrecht and thus have no travel (relevant) time to SURFnet itself.

Data for air traveling was supplied by the travel agency, which is supposed to arrange all air traveling trips. A list of trips, and their corresponding emission is listed in B5 (worksheet ‘on mission – air travel’). In order to correct for the (in)completeness of this list a third question was added to the questionnaire (Wie boekt de vliegtrip?). Based on the answers to this question it was estimated that the amount of air trips should be increased by 47%.

The amount of paper waste is provided by our processor (G. van Doorn, Papier Recycling Utrecht B.V). In 2014 they have collected 8.400kg of paper waste from our offices. According to [www.carbonmanager.nl](http://www.carbonmanager.nl) this equals 5,9 tons of CO<sub>2</sub>-eq.

## 6.2 Network operations

The activity of network operations (daily management of the SURFnet network) is outsourced to another organization: Telindus-ISIT. The sources of the emissions related to network operations are expected to arise from various sources. We expect the most important emission sources are:

- Gasoline and diesel fuel: used by cars for transport of network equipment and engineers.
- Natural gas: used for heating Telindus-ISIT offices.
- Electricity: used by network management equipment and for the Telindus offices (cooling, lighting)

SURFnet asked Telindus-ISIT to report on their energy consumption/GHG emissions. At this moment no data has been received, so that it cannot be included in this scope.

## 6.3 Total CO<sub>2</sub>-eq under Scope 3

The total GHG emission under Scope 3 is the sum of 32,75+9,08 (for commuting), 15,40+1,79 (for on-mission travel) and 178.68 (for air-travel) ton CO<sub>2</sub>-eq, which is equal to **237,70** ton CO<sub>2</sub>-eq.

## 7 Summary of GHG Emissions

The total GHG emission under Scope 1, Scope 2, and Scope 3 accounted for by SURFnet in 2014 is equal 1313,8 ton CO<sub>2</sub>-eq.

Item	Energy Source	Energy consumption	Appendix	CO2 Factor	Total (tons CO2)
<b>Scope 1</b>					
N/A	N/A	N/A		N/A	N/A
<b>Scope 2</b>					
Office – electricity (renewable)	Electricity	113.522 kWh	B2a	0 g/kWh	0,00
Office – electricity (non-renewable)	Electricity	66.236 kWh	B2b & B2c	354 g/kWh	23,45
Network excluded in the Office	Electricity	6.805,54 kWh	B4	300 g/kWh	-2,04
Office – Heating	Natural gas	14.452,81 M <sup>3</sup>	B1 & B3	1825 g/M <sup>3</sup>	26,38
Office – cooling	Electricity	220 kWh	B1 & B3	300 g/kWh	1,07
Office – service	Electricity	110.804 kWh	B1 & B3	300 g/kWh	33,24
Network	Electricity	3.019.473,16 kWh	B7	300 g/kWh	905,84
Services	Electricity	355.366,67 kWh	B6	300 g/kWh	80,26
<b>Scope 3</b>					
Transport – Commuting (trains)	Passenger km	861.947 km	B5	38 g/km	33,75
Transport – Commuting (...)	Passenger km	70.920 km	B5	128 g/km	9,08
Transport – On mission (trains)	Passenger km	394.795,2 km	B5	38 g/km	15,40
Transport – On mission (...)	Passenger km	13.980 km	B5	128 g/km	1,79
Transport – On mission (flight)	Passenger km	1.458.806 km	B5	-	179,68
Waste (paper)	Waste	8.400kg		-	5,90
Network Operations	Mixed	-		-	-
<b>Totals</b>					
					<b>1313,80</b>

## 8 Appendices

This section provides an overview of the files appended to this report with detail information like: measurements, calculations, sample bills, etc. In this report each file is referred to by an identifier. The corresponding filename and a brief description of the contents is listed in the following table:

Identifier	Filename	Description
B1	B1 – Specification Corio costs 2013	This is a scan from a report that contains energy usage numbers received from the owner of the whole complex “Hoog Catharijne”, including the SURFnet office.
B2a	B2a - Year summary Eneco MKB	Scan of the electricity bill of the SURFnet office.
B2b	B2b - Year summary Eneco Grootzakelijk	
B2c	B2c - EnecoZakelijk_Stroometiket_2014	
B3	B3 – Office Services	Excel sheet containing the calculation of converting service costs into GHG emission.
B4	B4 – Energy consumption UT002A-2014	Excel sheet containing the calculation of energy consumption of the SURFnet network which is located in the SURFnet office.
B5	B5 – Transport	Excel sheet containing the data and calculations of transport, commuting and on mission.
B6	B6 – Summary power usages Vancis - UvT and NIKHEF	Excel sheet containing the calculations of the energy consumption of the SURFnet services, and measurement data.
B7	B7 - Energy-Consumption SURFnet network	Excel sheet containing the energy consumption for SURFnet network.
B8	B8 – Questionnaire	Results of a questionnaire held among SURFnet employees in order to gather information about their traveling behaviour.

Because of privacy issue these appendices are not published on the internet.