CBS Environmental Report 2012

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Preface

The purpose of this report is to ascertain CBS' impact on the environment and especially the CO_2 emissions by CBS. The report is produced in the beginning of 2012 and is looking back at the years 2008 to 2011. The report should portray a clear picture of the energy use, waste impact, water use, transportation use and CO_2 emissions at CBS, from 2008 to 2011. It is the goal that the reader of the report should gain an elaborate understanding of the changes in, as well as the current use of, these different impacts on the environment caused by CBS. The report has a critical take on the facts and figures being analyzed and evaluates and questions the results. This should all together lead to the report being a contributing factor in CBS Goes Green's main goal of reducing CO_2 caused by CBS with 40% in the year 2020, with a baseline year in 2008. As this is the first report of its kind it should provide a status on how far we are in process of reaching the 2020 goal and how far there still is to go. The goal is to create a new report every year, that way being able to continuously track the progress of reducing CBS' CO_2 emissions and impact on the environment.

A special thanks to the following institutions in helping to make this report a reality:

Business Intelligence for providing numbers on CBS' energy use and water use from 2008 to 2011.

Campus Services for providing numbers on CBS' waste impact and internal transport from 2008 to 2011.

Via Travel for providing numbers on CBS' Air transport impact use for 2010 and 2011.

The accounting department for providing numbers on CBS' use of taxis and reimbursement for use of private vehicles in work related matters.

Index

Executive summary

During the spring of 2012 CBS Goes Green has conducted this elaborate report with calculations on CBS' energy use, waste impact, water use, transportation use and CO_2 emissions. With help from Business Intelligence CBS and Campus Services we have collected data and analyzed CBS' CO_2 Footprint for this extensive report.

The goal of this project is to assess the impact of CBS on the environment, and ultimately to calculate CBS' CO_2 emissions. Through our research we have uncovered an impressive 20% decrease in CO_2 emissions in only four years, which is halfway to the goal of 40% in 2020.

For our future work our goal is to expand the project by converting the energy use, water use, waste and transportation into a business case. This conversion would give an overview of how much is actually spent on these activities in monetary terms, which might be more understandable than ton CO_2, KWh, MWh etc. for students and employees. Furthermore, we are looking to expand the project with a seminar and paper series to further engage people on campus and external stakeholders.

We are currently investigating the possibility of creating a comparable analysis of CBS' CO_2 emissions through a benchmarking analysis of different other business schools and universities, including Harvard in USA, BI in Norway, WU in Vienna and KU in Copenhagen. This is a highly ambitious project which will contribute to setting a standard for measuring CO_2 footprints in higher education institutions.

To reach our goal of a 40% decrease it is vital for us to engage both students and staff at CBS, as well as CBS as an organization. The students and staff should be encouraged to behave in a sustainable matters, for instance remembering to turn of lights lower the thermostat settings, turn off unused computer screens, etc.
When it comes to CBS as an organization, we will encourage green initiatives, such as an investment in solar cells, the purchase of solar screens for windows which absorbs up to 90% heat in the summer time, the replacement of light bulbs to LED lighting etc.

We will create a new report every following year in order to track the progress of reducing the impact on the environment by CBS and the possible implementations of green initiatives at CBS.

Table of content

1.0 CBS' goals

Main goal: To reduce CO2 by 40% by 2020

First order effects:

- Reducing energy and water consumption
- Increasing recycling and reducing waste
- Reducing non-green on-campus transportation
- Increasing responsible purchasing
- Developing carbon-neutral meetings and conferences
- Reducing paper consumption

Second order effect:

- Acting as a role model

2.0 Projects

2.1 Research

With more than 19.000 students and 2000 staff members and a campus covering a gross area of 118.306 square meters, CBS is a business university that uses a great amount of resources. With the research project we aim to obtain a clear picture of CBS' yearly consumption of resources and CO2 emissions.

The overall goal for CBS is to reduce CO2 by 40% in 2020 with a baseline year in 2008. In order to give a clearer picture of the emissions, the numbers will be calculated in accordance to yearly consumption, consumption per student, consumption per staff member and emissions in CO2.

2.1.1 Strategy

1) Analysis: Identify sources of CO_2 emissions.
2) Targets: Priorities in projects.
3) Action plan: Communicate how reductions can be achieved in understandable terms and make reduction relevant to students and staff.
4) Implement: Projects to reduce CO_2.
5) Evaluate: Follow up and carry out continuous monitoring.

2.1.2 Research Partners

1) Campus Services: Provide numbers on waste and internal transportation.
2) Business Intelligence: Provide numbers on water, heat and electricity consumption.
3) Via Travel: Provide numbers on CBS' air travels.

4) Others: Employees at CBS have been contacted, for instance in order to obtain numbers on taxi transportation and work related travel in private vehicle.

2.1.3 About CBS

CBS has 4 main buildings with student activity, covering a gross area of 118,306 square meters. In 2011 the number of staff members had increased from 2218 in 2008 to 2360. The number of students had in 2011 increased to 19.264 from 16.359 in 2008. CBS production is a mixture of out-sourcing and in-house campus operations.
Some of the buildings are owned by CBS, and some are rented. The buildings that are owned by CBS are Solbjerg Plads, Kilen, Howitzvej 11-13 & 60. The rented buildings are Porcelænshaven, Dalgas Have, Grundtvigsvej and Solvej.

Most of the buildings have energy measuring devices, although there are a few without (eg. Grundtvigsvej, Solvej). However, these are very small units and are not used by students. As far as we are informed, there are no measuring devices in the server rooms, which often account for a fair amount of energy use.

CBS has the last couple of years experienced an increase in students, and in 2011 the number reached more than 19,000. The two following graphs show the numbers of students and staff at CBS from 2008-2011.

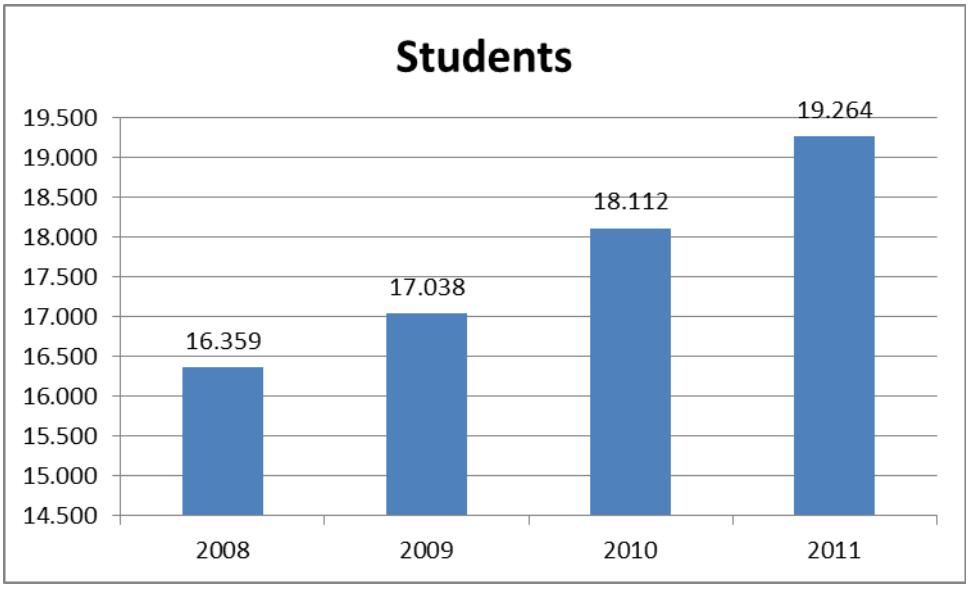


Figure 2.1

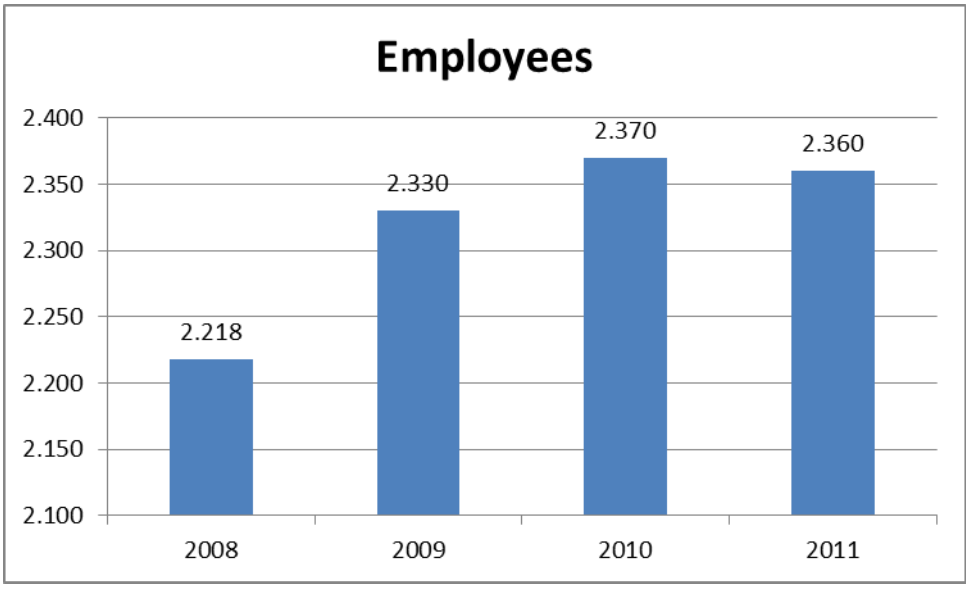


Figure 2.2

2.1.4 Steps towards the goal

1) Present the numbers for consumption of water, heat, electricity, waste and transportation for the period of 2008-2011.
2) Calculate the heat, electricity, waste and transportation into CO_2 emission for the period of 2008-2011.
3) Identify what CBS has already done in this area, and what more can be done.
4) Implement changes at CBS that help reduce the CO_2 emissions.

2.1.5 Scopes

According to GHG Protocol, the emissions of CO_2 shall be divided into three scopes:
Scope 1: Direct emissions of CO_2 from CBS.
Scope 2: Indirect emissions of CO_2 from energy purchased (electricity and heating).
Scope 3: Other emissions of CO_2. Such as suppliers, procurement, students and staff transportation to/from university/work etc.

Source: The Green House Gas Protocol (GHG Protocol) by World Business Council for Sustainable Development and World Resources Institute www.ghgprotocol.org.

We have chosen in 2012 to focus on scopes 1 & 2 for CBS. Therefore, the contents of the research will be: Scope 1 & 2: Electricity, Heating, Water, Waste and Transportation.

2.1.6 Methods and standards

There are no universal standards or even a Danish required method or standard for calculating CO_2 emissions.

To calculate the CO_2 emissions from electricity use, we have used CO_2 factors (gram CO_2 emitted per KWh used) provided by www.energinet.dk. The CO_2 factor changes from year to year, as the contribution of fossil fuels and renewable energy sources to the provision of 1 KWh changes from year to year. Furthermore, Denmark also imports and exports electricity. The volume of the imported and exported electricity, combined with the sources from which the imported/exported electricity is generated, also affects the CO_2 factor. The following factors are adjusted for the amount of imported/exported electricity in given years:

CO2-factor for Electricity						
g/KWh	2006	2007	2008	2009	2010	2011
CO2-factor	629,1	588,5	474,9	511,7	477,0	404,9
Rolling average	N/A	N/A	564,18	525,04	487,88	464,53

Table 3.1

The factors from 2006 to 2009 are specific, for electricity provided to eastern Denmark, which includes Zealand, Lolland Falster, Bornholm and the surrounding islands. From 2010 and onwards, there is only one CO_2 factor for all of Denmark. This is because of the established direct current connection across Storebælt in 2010.

When receiving electricity from a provider, some distribution losses will occur; these should not be included when calculating the CO_2 emissions. The distribution losses vary according to geographic location, and should be obtained by the specific provider. However, as this has not been possible, we have in this report used an average of a 5% distribution loss. The average of 5% is based on Energinet's advice, who argues that the average can be used when it is not possible, to obtain the accurate distribution loss percentage. The 5% is, therefore, a good estimation of the distribution loss.

After regulating for the distribution loss, the factors are as follows:

CO2-factor for Electricity (incl. 5% distribution loss)						
g/KWh	2006	2007	2008	2009	2010	2011
CO2-factor	597,7	559,1	451,2	486,1	453,2	384,6
Rolling average	N/A	N/A	535,97	498,79	463,49	441,31

Table 3.2

When calculating the CO_2 emissions from heating, we have used CO_2 factors (gram CO_2 emitted per KWh used) provided by www.ctr.dk. The CO_2 factors are specific to the district heating in Frederiksberg, provided by "Frederiksberg Forsyning", which is where CBS gets their heating from.

The factors are as follows:

CO2-factor for Heat (Frederiksberg)						
g/KWh	2006	2007	2008	2009	2010	2011
CO2-factor	124,2	123,5	124,7	126,1	110,4	100,1
Rolling average	N/A	N/A	124,16	124,78	120,41	112,20

Table 3.3

The calculation of both electricity and heating is based on their respective rolling averages, so as to smooth out eventual extreme numbers in the different years. This is done, because we mainly are interested in the reduction of CO_2,that is caused by changes at CBS and not by the changes in the composition of energy sources used to produce 1 KWh. However, it should be noted that the reduction of the CO_2 factor and the increasing contribution of renewable energy sources to the total composition, has a positive impact and it contributes to a reduction of CO_2 emissions from CBS. The rolling averages are calculated by taking the average of the two previous years and the current year. So for 2008, the rolling average is calculated by taking the average of the numbers from 2006, 2007 and 2008.

The CO_2 factors for electricity and heating are calculated by the providers of these factors. There are several different ways of calculating the CO_2 factors, the most common being, what is called, the 125% method and the 200% method. When calculating CO_2 factors for electricity and heating, it is necessary to divide fuel use and emissions from CHP plants (Combined Heat and Power plants) between electricity and heating, as heating is a bi-product of the production of electricity. This is actually an impossible task, and the use of a method on how the allocation of the effect on the environment between electricity and heating is, must be chosen. Both the 125% method and the 200% method have their distinct strengths and weaknesses.

The CO_2 factors in this report for both electricity and heating are based on the so called 200% method. Energistyrelsen (The Danish Energy Agency) in Denmark recommends that the 125% method is used. However, as the provided CO_2 factors for heating are based on the 200% method, it is necessary to be consistent, which is why the CO_2 factors for electricity, based on the 200% method, are used in this report.

Source: www.energinet.dk: methods and data basis for environmental report 2011. PDF: http://energinet.dk/SiteCollectionDocuments/Danske%20dokumenter/Klimaogmiljo/Metoder%20og%20datagrundlag%20til%20Miljørapport%202011.pdf (in danish)

Note that electricity, on average, emits four times as much CO_2 per KWh than heating. This is important to keep in mind, when choosing which areas to focus on, when trying to reduce CO_2 emissions at CBS.

The contributions of emitted CO_2 from air travels are calculated by Via Travel, which is the travel agency the staff at CBS use.

In addition, we have chosen to use some of Energistyrelsen's tools, for instance when dealing with day-regulation of the heat consumption.

Because of variations in the temperature over different years, and the consequent variation in the heat consumption, so called "degree-days" are used to normalize data, in order to be able to compare data from year to year. Degree-days measure how cold/hot a specific year has been and by comparing these degree-days to a "normal" year's degree-days, an adjustment can be made, so the data are comparable. A "normal" year's degree-days are defined as the average degree-days of the past 40 years, and are updated every 40 years. In this report, a "normal" year's degree-days are the average of the degree-days from 1941 to 1980.

Source: www.teknologisk.dk

The reason for regulating with degree-days is, that people cannot control how cold/hot a year is, and in order to make the comparison between different years "fair", an adjustment to a "normal" year is necessary. However, not all of the heat consumption should be regulated. The heating used to heat water, is not affected by the temperature and should, therefore, be excluded from degree-day regulation. "Energistyrelsen" in Denmark has set the DUC (degree-day unaffected consumption) at universities, to be approximately 19% of the total heat consumption. The DAC (degree-day affected consumption) of 81% has been regulated, and the unregulated 19% has then been added in the end to achieve the correct degree-day regulated heat consumption. To view a bar chart of CBS' degree-day regulated heat consumption, see section 4.2.1.

The degree-day regulation is calculated as follows: $DUC_{Current\ year}$ + ($DAC_{current\ year}$ * Degree-$days_{normal\ year}$/Degree $days_{current\ year}$).

Source: Energistyrelsen

3.0 Research results

3.1 Energy Consumption

3.1.1 Facts and figures for CBS - total and per student

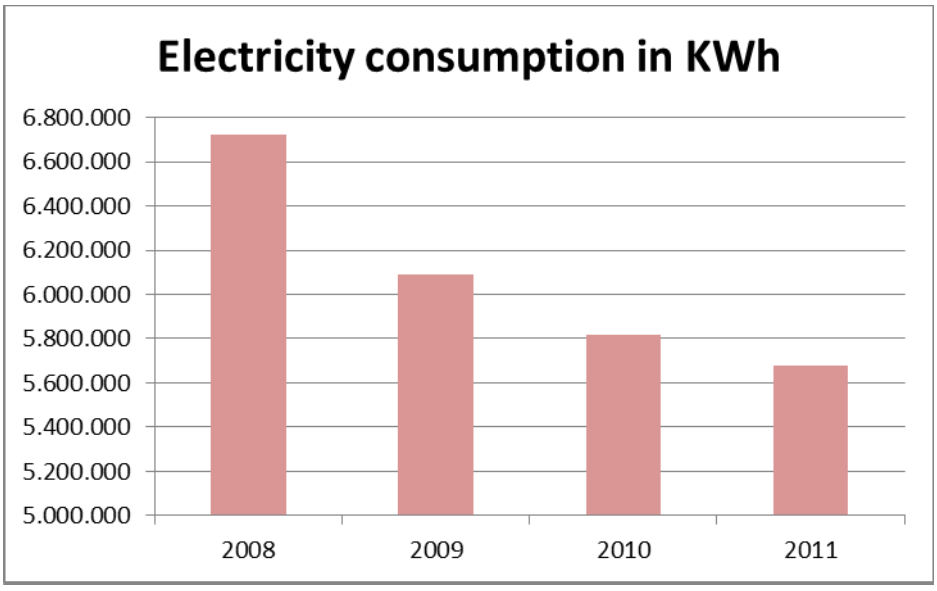


Figure 3.1

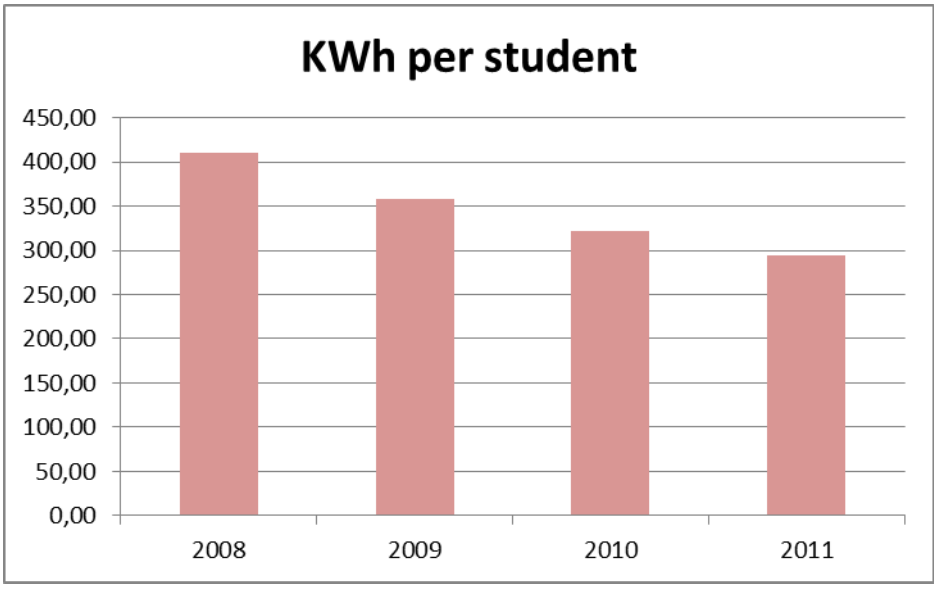


Figure 3.2

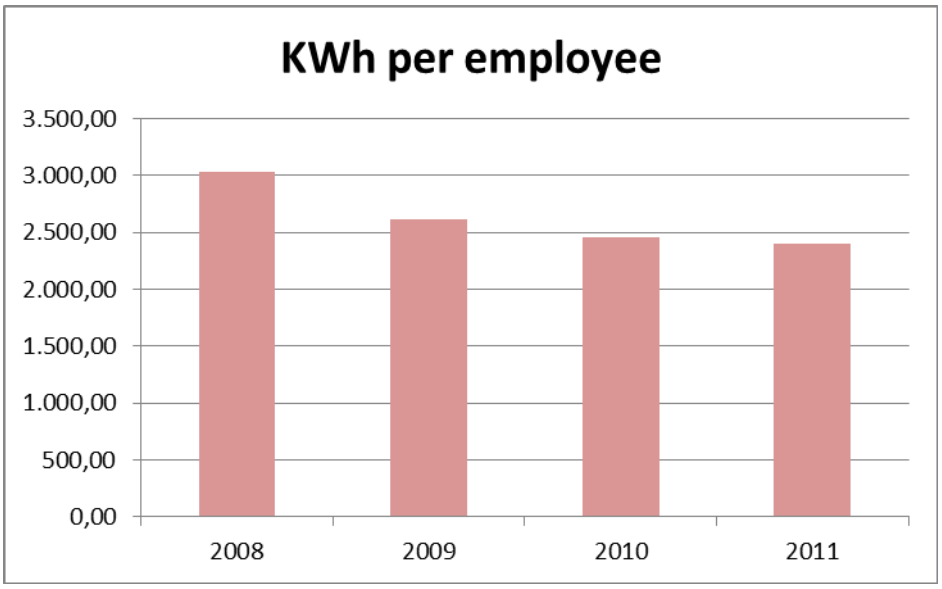


Figure 3.3

When looking at the the energy use from 2008 to 2011 (figure 3.1) it is noticable, that the energy use has decreased a lot, 15.5% to be precise, and several factors can contribute to explain this decrease. First of all, about 1000 light bulbs have been switched to electricity saving lighting (LED-lighting) in many buildings. Furthermore, the effectiveness of the ventilation system on CBS has been greatly increased, which has a big impact on the energy use. Last but not least, CBS has in recent years become more aware of being green and saving energy.

The decrease from 2008 to 2009 is especially large, amounting to 60.41% of the total decrease and may seem to be unrealistic. However, 2008 was the year when there was a technical analysis of CBS buildings and many energy saving activities were put in place. This fact and the increased awareness of energy use at CBS can explain the large decrease. However, it is important to

emphasize the importance of accurate data collection in future monitoring and benchmarking activities. It is important to question numbers that seem to deviate a lot from previous years, while having no explanation of the decrease.

The decrease in the energy use from 2009 to 2011 also seems plausible considering the aforementioned actions that CBS has put in place to save energy.

3.1.2 Tips

You can reduce your consumption of electricity in two ways:

- By investing in more electricity-efficient technology, which often, especially in the light of the high oil prices, is repaid in a limited number of years.
- By changing student and employee behavior, in relation to equipment and machinery use, this does not necessarily cost anything or can be less costly than the introduction of new technology.

Note, however, that tip number two is not always where the largest impact comes from, as students only have limited access to the regulation of lighting and other electricity using activities at CBS. Nevertheless, students can affect electricity use in some situations, for instance, remembering to switch of the computer screens after using them.

3.2 Heat consumption

3.2.1 Facts and figures for CBS total and per student

Actual heat consumption

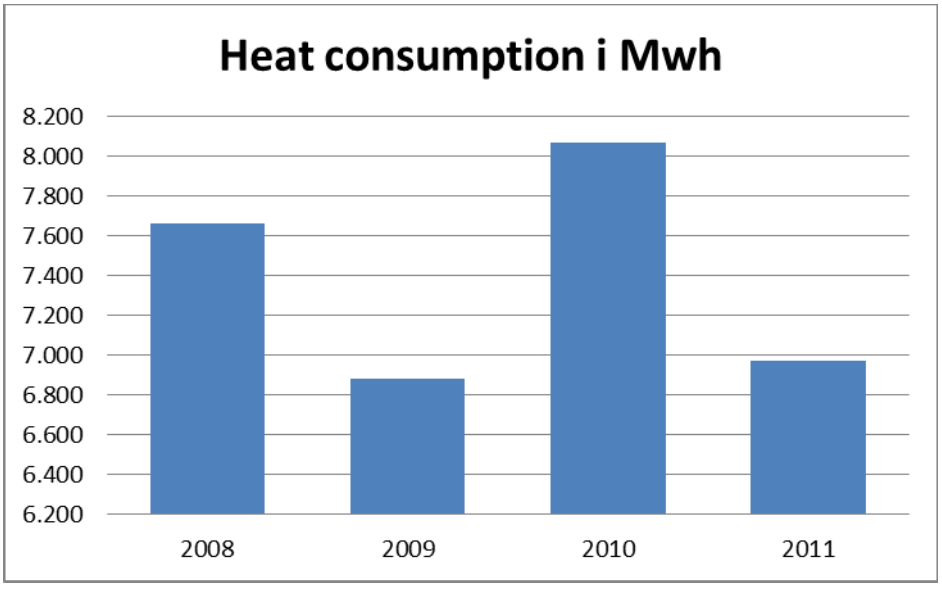


Figure 3.4

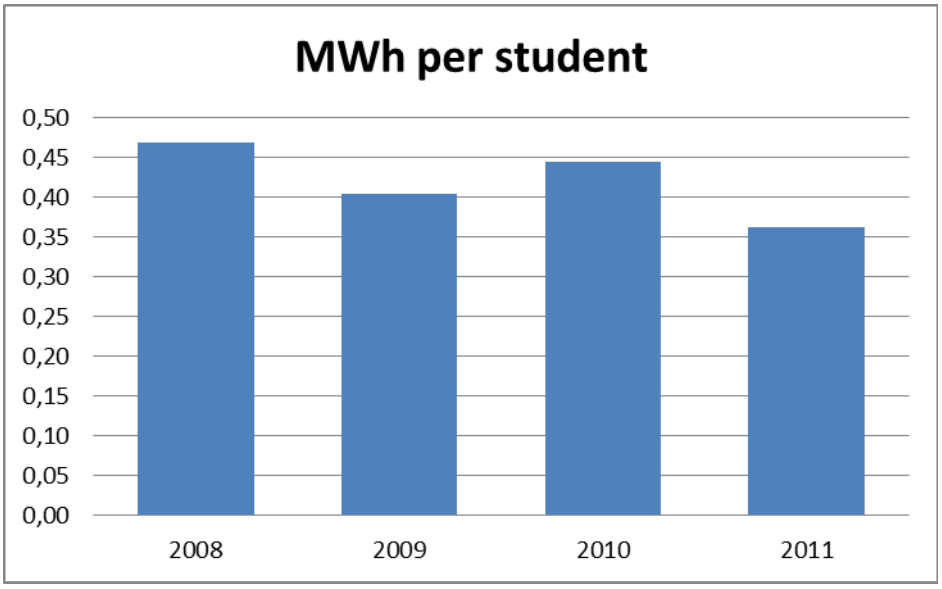


Figure 3.5

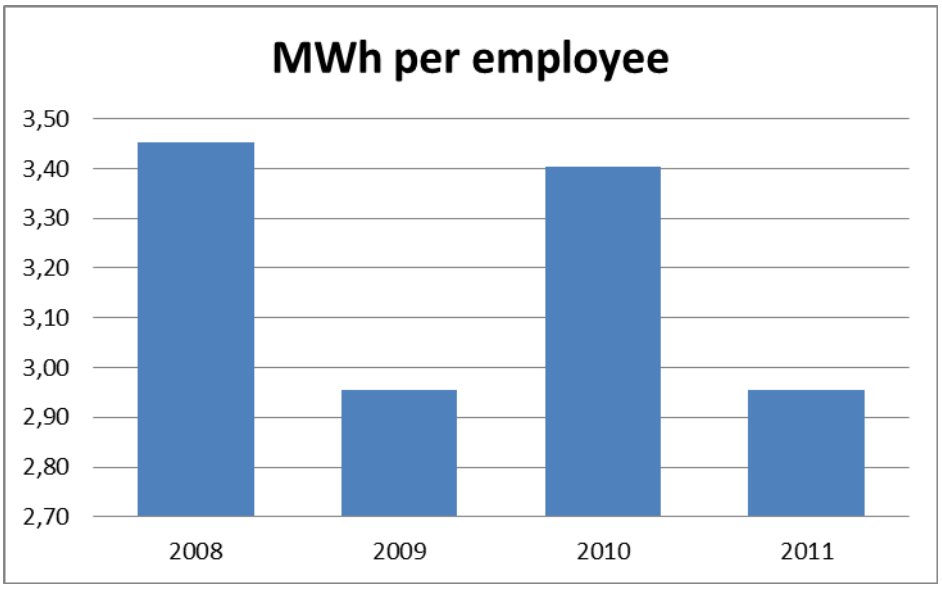


Figure 3.6

Degree-day regulated heat consumption (Information about degree-day regulation can be found in section 2.1.6)

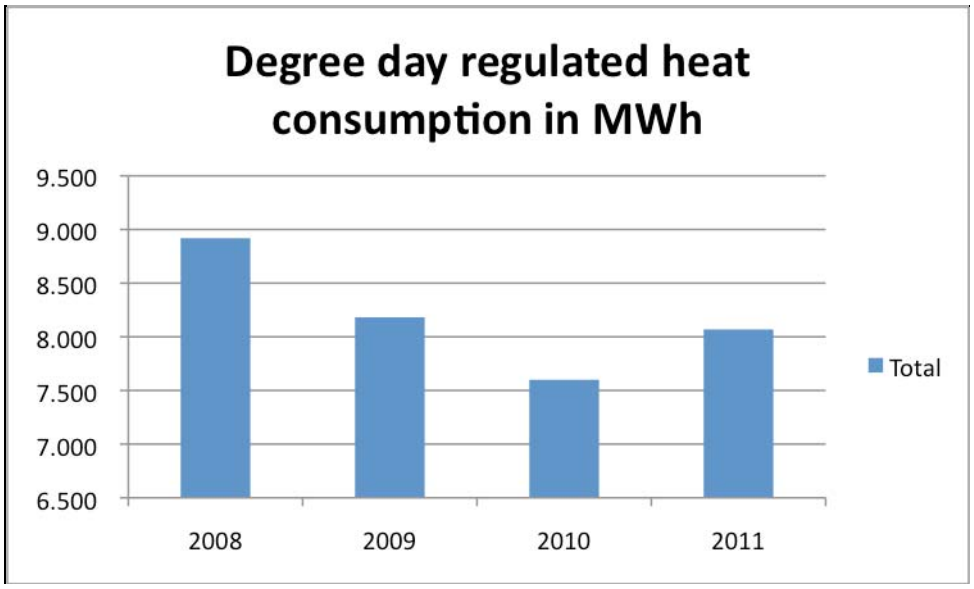


Figure 3.7

As can be seen in figure 3.4, the heat consumption in 2010 was especially high. This is almost certainly because of the very cold winter Denmark faced in that year and CBS, therefore, had to increase the heating of the university in order to make the temperature inside CBS tolerable. To regulate for warm and cold winters, we use the so called day-degree regulation. Basically, this method regulates the heat consumption of every year to how it would have been, had the temperature of the year been as in a normal year. The normal year is defined as the average number of degree-days in the last 40 years, in this case from 1941 – 1980. When the years have been degree-day regulated they are comparable as the temperature factor is no longer an influence on the heat consumption. For more information on degree-day regulation and how it is calculated, see section 3.1.6: “Methods and standards”, in this report.

The degree-day-regulated heat consumption in figure 3.7 shows that 2010 has gone from being the most consuming year to being the least consuming year after degree-day regulating. What this means is that, had all the years had the same temperature, there would have been consumed the least heat in 2010. Again, by looking at figure 3.7, it is noticeable that, even after degree-day regulation the year 2008 still had an extremely high heat consumption. As mentioned before there was a technical analysis of the building in that year and actions put in place because of this analysis, can explain this large decrease.

Again, it is necessary to emphasize the importance of accurate data collection in future monitoring and benchmarking activities. It is important to question numbers that seem to deviate a lot from previous years, while having no explanation of the decrease.

3.2.2 Tips

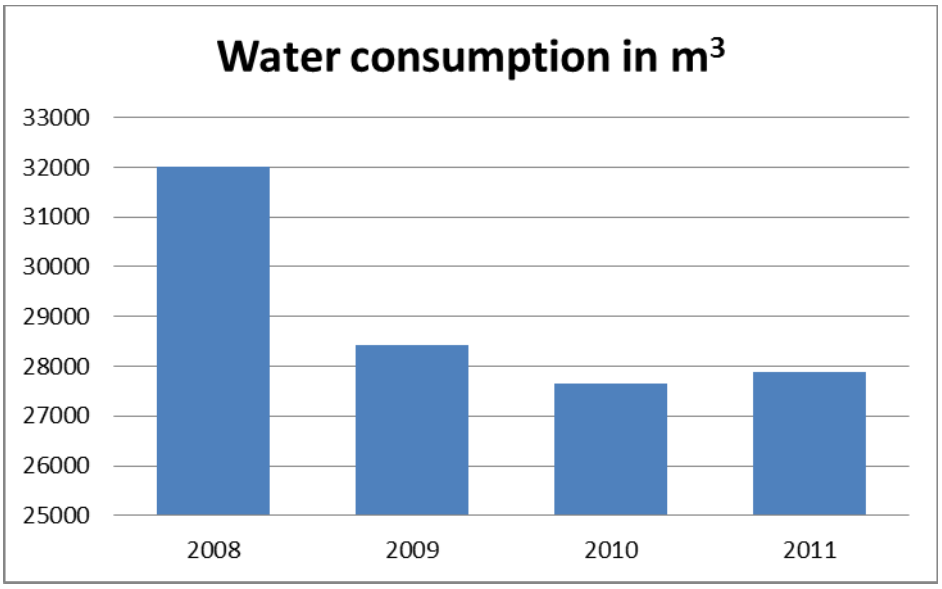
It is a difficult task to reduce CBS’ heat consumption by trying to change student and employee behavior, as it is limited how much control they have over the heating of CBS. However, some

places students can regulate the thermostats themselves and some employees have thermostats in their offices and the choice of opening/closing windows.

The most efficient way of decreasing the heat consumption at CBS is, however, to increase awareness of ways to maximize effectiveness of the heating system and decrease unnecessary heating, such as heating of unused rooms, excessive heating of areas in close proximity to outside areas, etc.

3.3 Water consumption

3.3.1 Facts and figures for CBS total and per student



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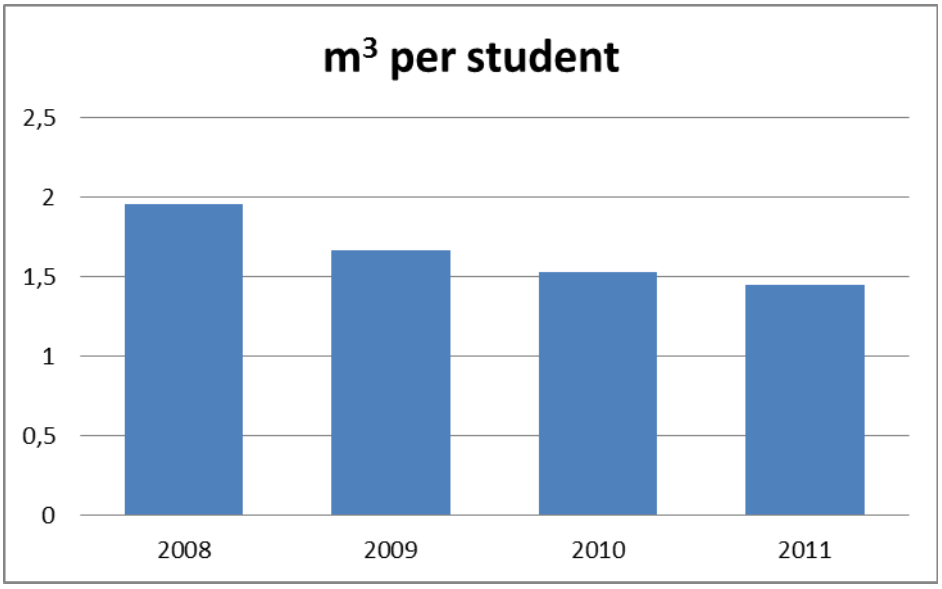

Figure 3.9

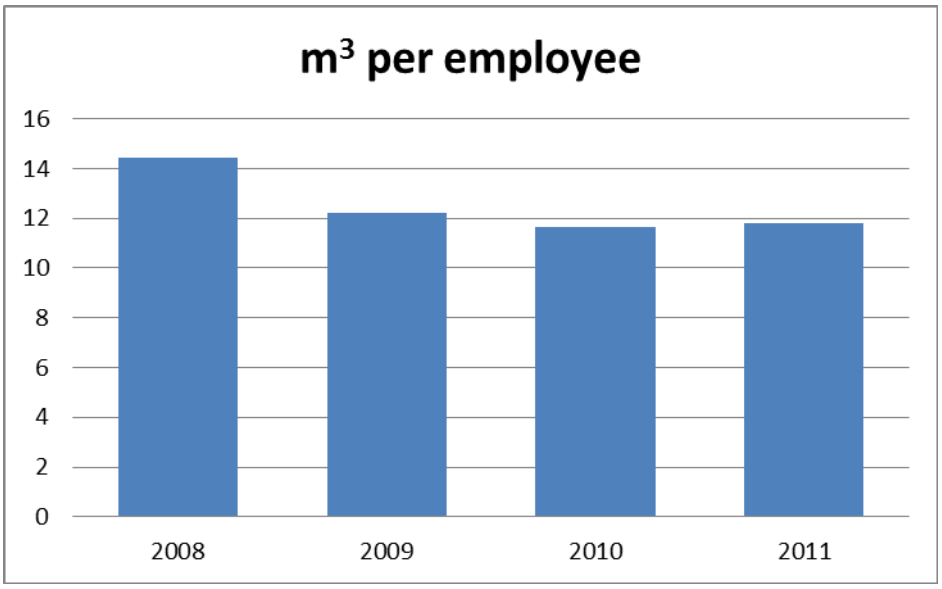

Figure 3.10

As it can be seen on the previous graphs of water use from 2008 to 2011, it can be concluded, that water use has decreased since 2008 interrupted by a small increase from 2010 to 2011. From 2008 to 2009 there was a very large decrease in the water use, which to some extent can be explained by the reparation of many running toilets, which use a lot of water. However, the number should be questioned as the decrease is very large and is perhaps not explainable, merely by the reparation of toilets and awareness of water use.

3.3.2 Tips

Water consumption for one person is on average 130 liters a day, which is 46 m^3 a year. However, this amount is not entirely consumed at CBS, as students and employees only spend a limited time at CBS.

Approximate use divided into the follow categories:	
Personal hygiene	44 liters a day
Toilet flush	33 liters a day
Washing of clothes	19 liters a day
Dishwashing/cleaning	17 liters a day
Food/beverages	9 liters a day
Other	8 liters a day

Table 3.1

3.3.3 Warm water

The energy use of water heating is determined by the amount of warm water being used.

	per person pr. year
Gas consumption to heat water	75 m3
District heating to heat water	750 kWh

Table 3.2

Whether the EWH (Electric Water Heater) is old or new has almost no significant impact on the use of electricity. What is paid for is the amount of warm water that is used.

A good approximation, however, is 850 KWh per Person, which means that a family of four people has an electricity use of between 3000 and 4000 KWh on warm water a year. The family uses 8-10 KWh a day on warm water.

Examples of water consumption when taking a shower or a bath (based on 40˚C water)

Examples	**Water use liter ca.**	**Electricity use kWh ca.**
Shower (5 min) with an energy saving shower	25	1
A bath	180	6,5

Table 3.3/Source: Dong Energy, 2012.

The following table shows the cost of warm water, depending on the energy source:

Heating source	The price of warm water
District heating	25-35 DKK/m^3
New gas furnace	35 DKK/m^3
New oil-fired boiler	40 DKK/m^3
Old gas furnace or oil-fired boiler	45-50 DKK/m^3
Electricity	70-75 DKK/m^3
Wood pellets	15-20 DKK/m^3
Solar heat	2 DKK/m^3

Table 3.4/Source: (DANVA Energitjenesten)

At CBS the heating source is district heating, which means that every m^3 of warm water costs 25 – 35 DKK. This is considerably less than when using some of the other heating sources, but it is still a high price to pay for washing your hands in warm water instead of cold water, which is just as hygienic.

3.4 Waste and recycling

3.4.1 Facts and figures for CBS total and per student.

CBS divides its waste into household waste and fragmented waste. Fragmented waste consists of paper, cardboard, large pieces of flammable waste, food/bio waste, electricity/IT waste, bottles/glass, batteries, iron/mercury, foil, other recyclable waste and landfill (noncombustible). The figures concerning waste are gathered from Campus Services. Unfortunately, the figures from 2008 and 2009 have been combined, which means that it is not possible to get the exact figures from these years. Consequently, these figures are obtained by dividing the overall figure from 2008/2009 in two. A degree of uncertainty in the figures is therefore to be expected. In the student areas, there is a waste sorting system consisting of four different waste bins, which are for Batteries, Plastic, Organic and Paper. In addition to these sorting bins, there are normal waste bins placed all over campus for all sorts of waste. For the staff at CBS there is only a system for collecting and recycling paper.

Household waste

At CBS there are a total of 19 containers for household waste that each can contain 600L/47 kg. In high season, these 19 containers get filled. However, in low season, such as the summer holiday, they do not. CBS pays for all the containers regardless of whether they are full or empty. Frederiksberg municipality collects the household waste. In 2011, the figure for household waste collected was 684,322 kg, which is a decrease of 157,178 kg since 2008, where the figure was

841,500 kg. There was a slight increase from 2010 to 2011, which could be due to an increase in students from 18,112 in 2010 to 19,264 in 2011. The fact that the figure from 2011 has decreased, compared to the figure from 2008, can indicate that CBS has become better at recycling the waste into fragmented waste.

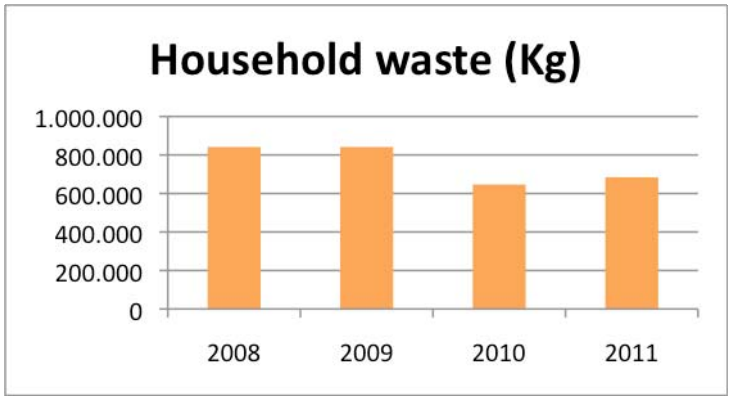

Figure 3.11

Paper

CBS gets 0.1 DKK, per kg paper that is collected for recycling. Shredded paper (confidential paper) gives less money than non-shredded paper. In 2011, the collected paper for recycling amounted to 103,025 kg and CBS earned approximately 10,300 DKK. Compared to 2008, CBS collected 12,525 kg more paper in 2011. As explained earlier, there have been different methods of calculating the waste and in which categories the materials were placed in. This could be a reason why it seems like the amount of recyclable paper has decreased in 2011 compared to 2010.

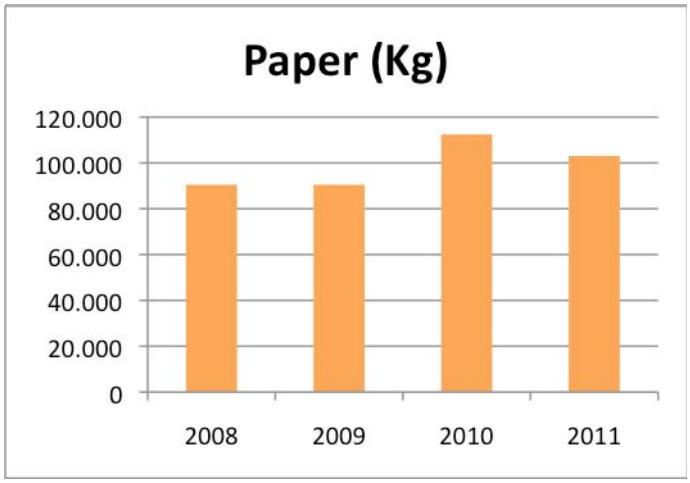

Figure 3.12

Cardboard

CBS recieves 0.3 DKK per kg cardboard that is collected for recycling. In 2011, the collected cardboard for recycling amounted to 18,535 kg and CBS earned approximately 5560 DKK. Compared to 2008, CBS collected 26,465 kg less cardboard in 2011. The decrease in cardboard from 2009 to 2010, seems incredibly large and the accuracy of the 2008/2009 numbers is to be questioned. We expect more accurate numbers in the future, as there has recently become a lot more focus on collection of these data.

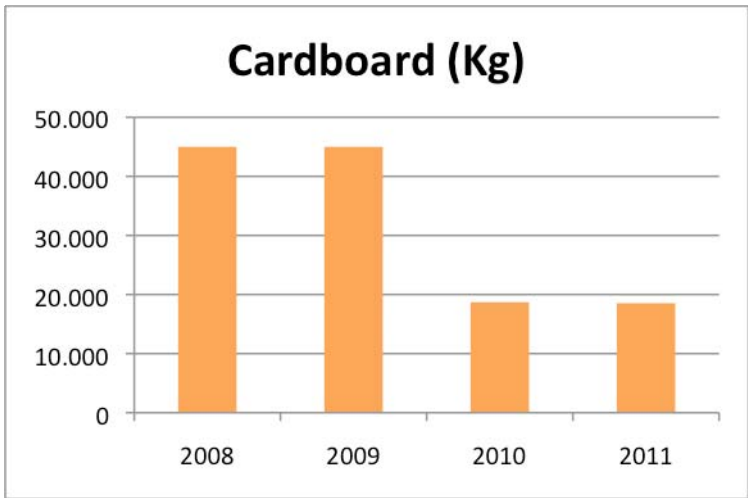

Figure 3.13

Large pieces of flammable waste

In 2011, CBS collected 26,421 kg of large pieces of flammable waste for recycling, which is a decrease of 16,579 kg compared to 2008, when the figure was 43,000 kg.

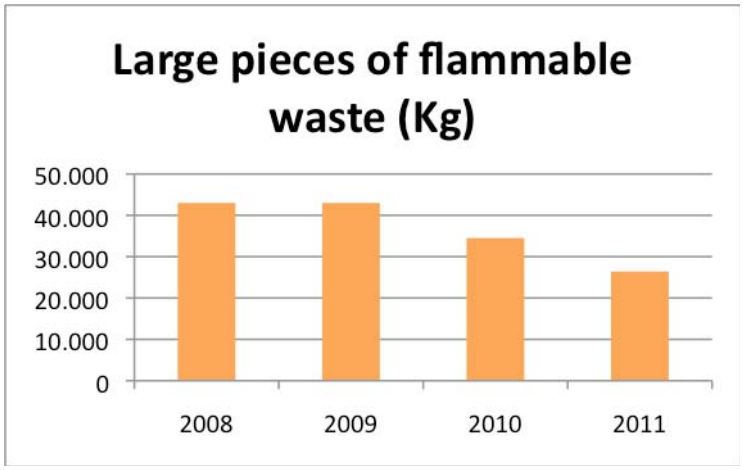

Figure 3.14

Food - bio waste

In 2010/2011, there are no figures regarding food (bio waste) due to the fact that the company collecting food has used a subcontractor, Marius Pedersen A/S.

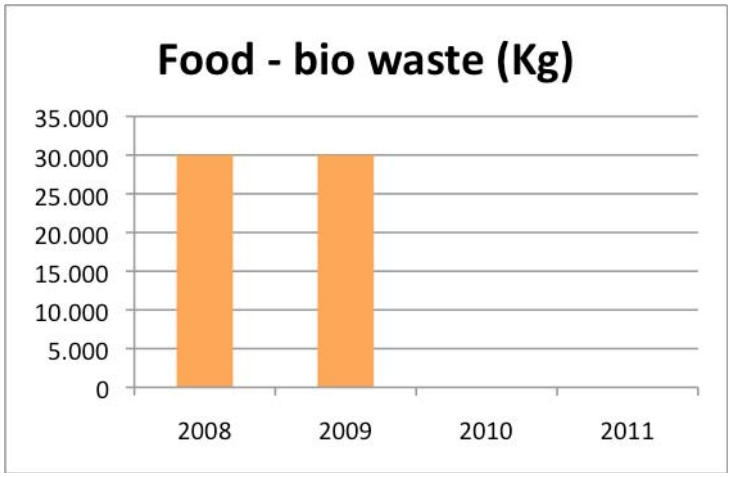

Figure 3.15

Electricity/IT waste

CBS gets 3000 DKK per ton electricity, and IT waste that is collected for recycling. In 2011 CBS collected 9774 kg/9.774 ton and CBS earned approximately 29,322 DKK. Compared to 2008 CBS collected 1726 kg less electricity/IT waste in 2011.

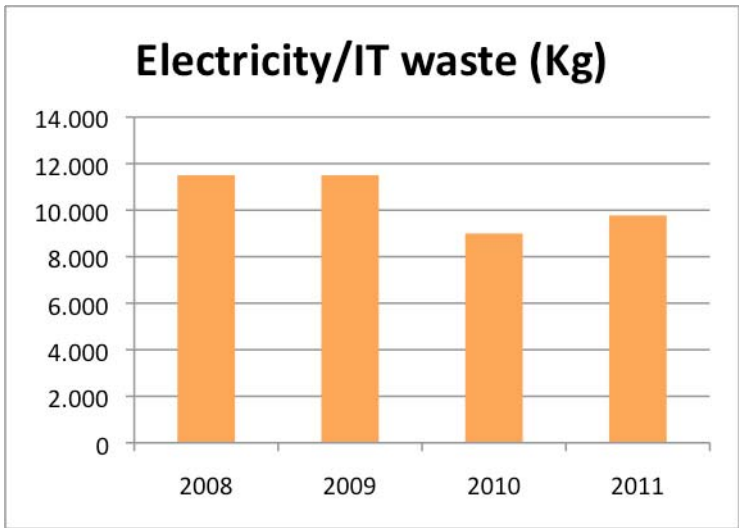

Figure 3.16

Bottles/glass

In 2011 CBS collected 4130 kg bottles/glass for recycling, which is an increase of 1630 kg compared to 2008, where the figure was 2500 kg.

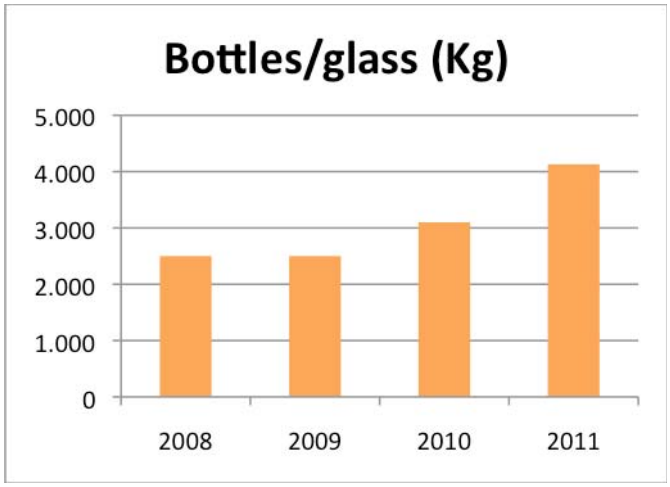

Figure 3.17

Batteries

In 2011 CBS collected 336 kg batteries for recycling, which is a decrease of 14 kg compared to 2008, where the figure was 350 kg. Campus Services who handles the waste, has informed that out of the four waste options the students have, the “batteries” option is the one, where the students have no problem handling correct recycling.

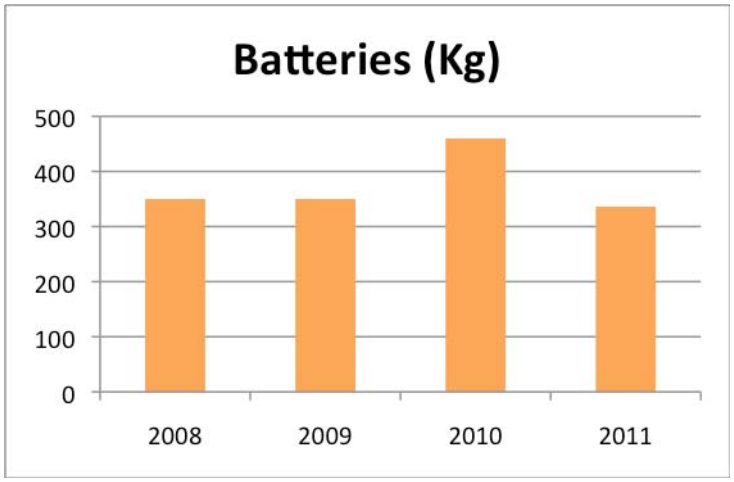

Figure 3.18

Iron/mercury

In 2011 CBS collected 351 kg of iron/mercury for recycling, which is an increase of 151 kg compared to 2008, where the figure was 200 kg.

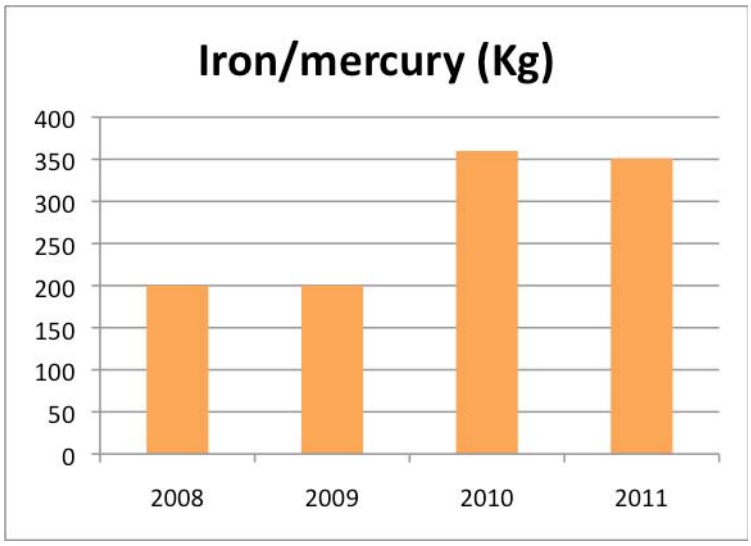

Figure 3.19

Foil

CBS gets 0.2 DKK per kg of foil that is collected for recycling. In 2011 the collected foil for recycling amounted to 923 kg and CBS earned approximately 184 DKK. Compared to 2008, CBS collected 873 kg more foil in 2011.

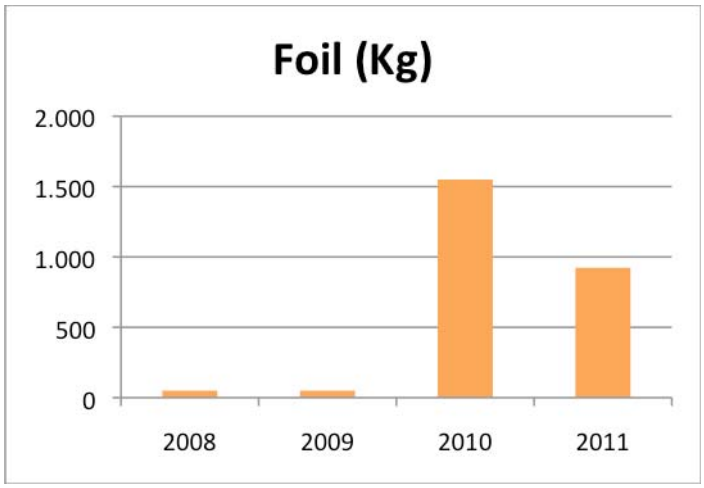

Figure 3.20

Landfill (noncombustible)

Landfill (noncombustible) only became a part of CBS's recycling system in 2011.

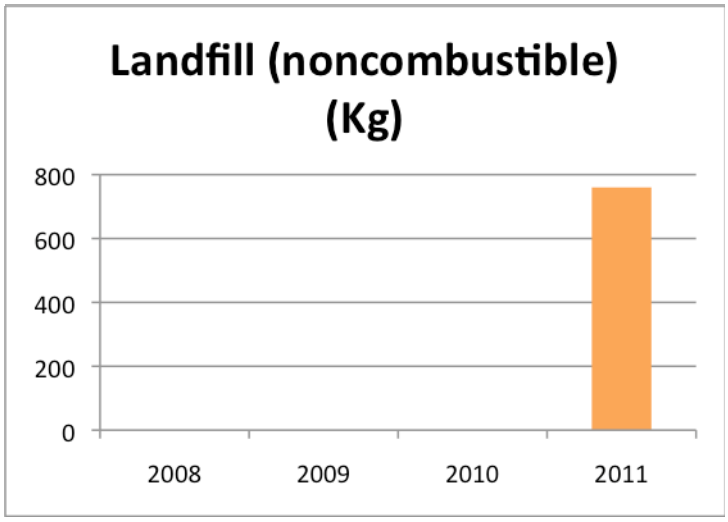

Figure 3.21

As it can be seen from this section, there are uncertainties in the waste data. Especially the fact that the numbers from 2008 and 2009 where combined, and not available as separate numbers, is a big issue. However, it is expected that we in the future, will receive more accurate data concerning waste as there is an increasing awareness of the waste system.

It should be noted that an increase in some of the waste groups, such as paper, cardboard, bottles, etc. is not necessarily a negative thing. If an increase in one of these groups is accompanied with a decrease in the number of the general waste, it suggests that the people at CBS have become better at sorting their waste. However, an increase in these groups without an accompanying decrease in general waste, suggests a higher overall use of resources, which is a negative development.

CBS is currently working on a new waste system, which hopefully will be introduced in the summer of 2012. The purpose of this system is to make it easier for students to sort their waste and thus, have an increase in sorted waste and a decrease in general waste.

The effects of the new sorting system will be concluded on in future reports, when an effect hopefully can be seen.

3.4.2 Tips

It is important for future calculations of waste that the numbers are recorded and done in the same way every year. A greater effort should be made to encourage the students to recycle correctly, because much of the paper from the sorting bins in the students' area cannot be recycled, as it is contaminated with organic waste (e.g. pizza trays, paper with leftovers of food etc.). The sorting systems should also be available to the staff, in order to make the most of the recycling of waste.

3.5 Transport

3.5.1 Facts and figures for CBS

Transportation in the CBS framework consists of the employees' transport use in connection with meetings and conferences i.e. official journeys. International flights are, by far, the most important source of CO_2 emissions in transport.

Air transport

The figures concerning CBS' use of air transport in 2010 and 2011 are compiled by Via Travel. Unfortunately, the figures from 2008 and 2009 were not available. These figures are consequently assumed by averaging the two figures from 2010 and 2011.
From 2008 to 2011 the CO_2 emissions from CBS's use of air transport have been equivalent to 20-25 percent of the total amount of CO_2 emitted by CBS. It is also interesting to notice that despite the fact that the number of staff was decreased from 2,370 in 2010 to 2,360 in 2011, there has been an increase in air transport indicating more or longer flights.

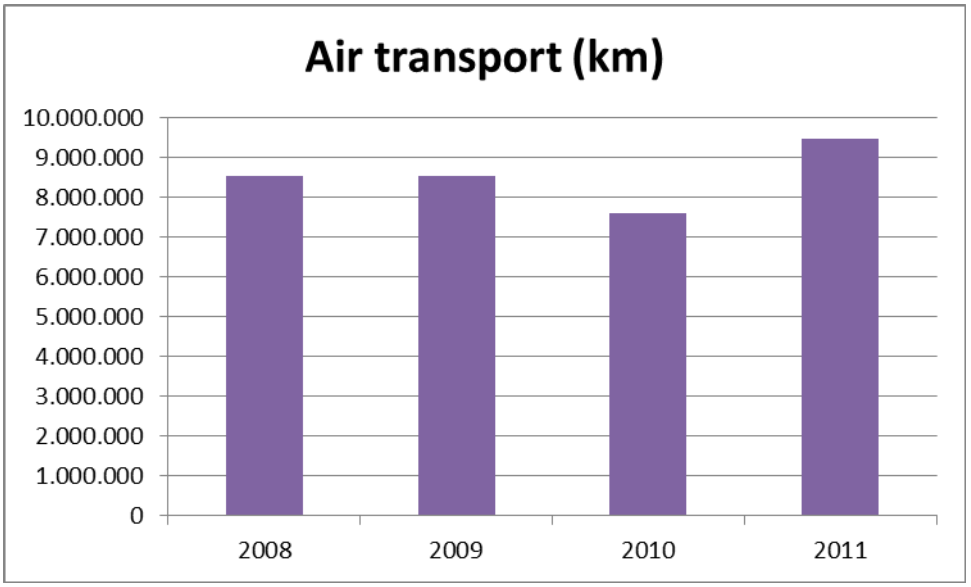

Figure 3.22

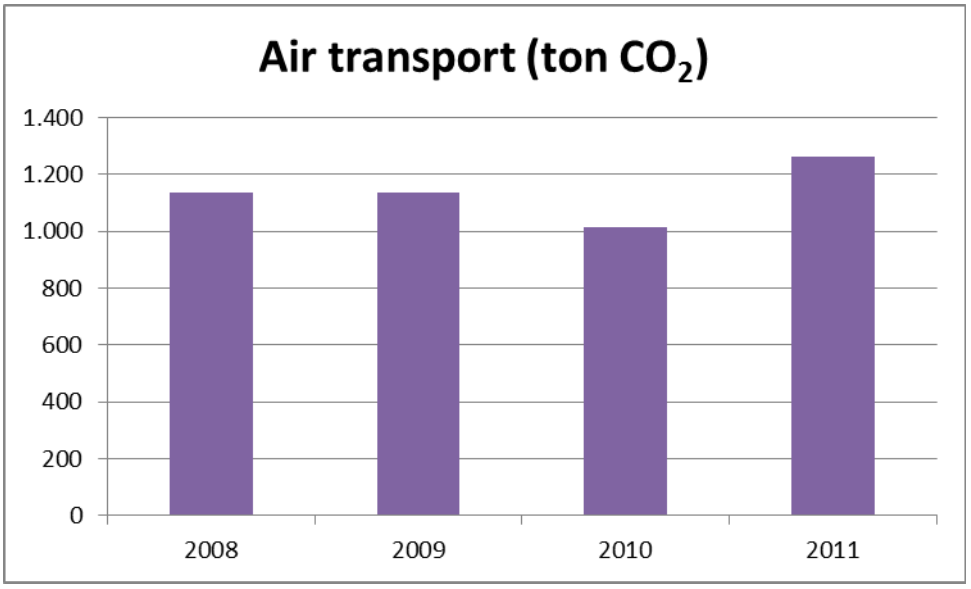

Figure 3.23

Internal transportation by car

CBS owns an old Fiat, which drives less than 10 km on a liter petrol. On average, the car has been driven approximately 8000 km pr. year since 2008. This results in a CO_2 emission of 2.36 ton per year.

CBS is in the process of buying an electric car, which will replace the old Fiat, thereby reducing the CO_2 emissions. The electric car should be recharged during the night, so that the electricity comes from renewable energy sources and not coal-fired power plants that emit CO_2.

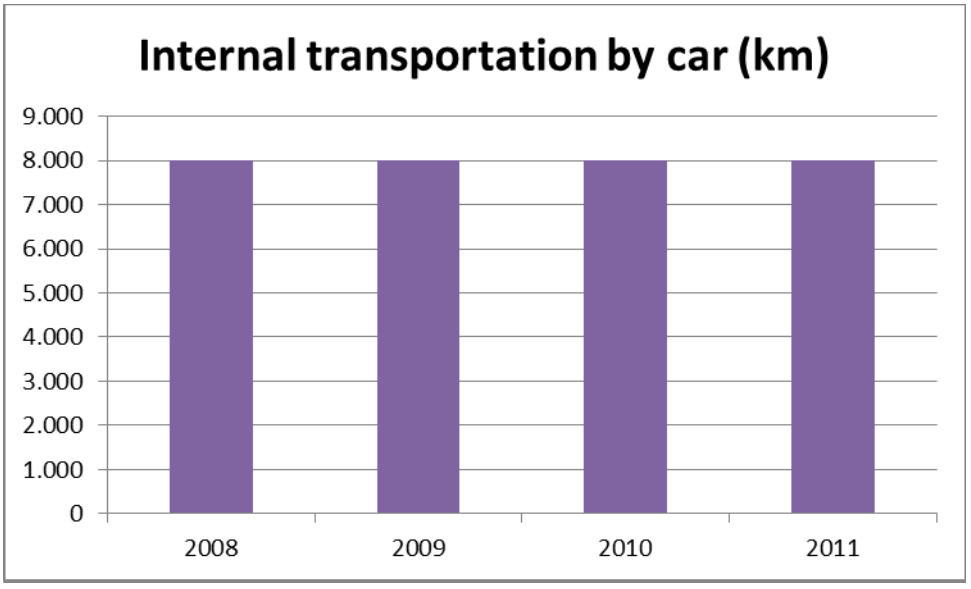

Figure 3.24

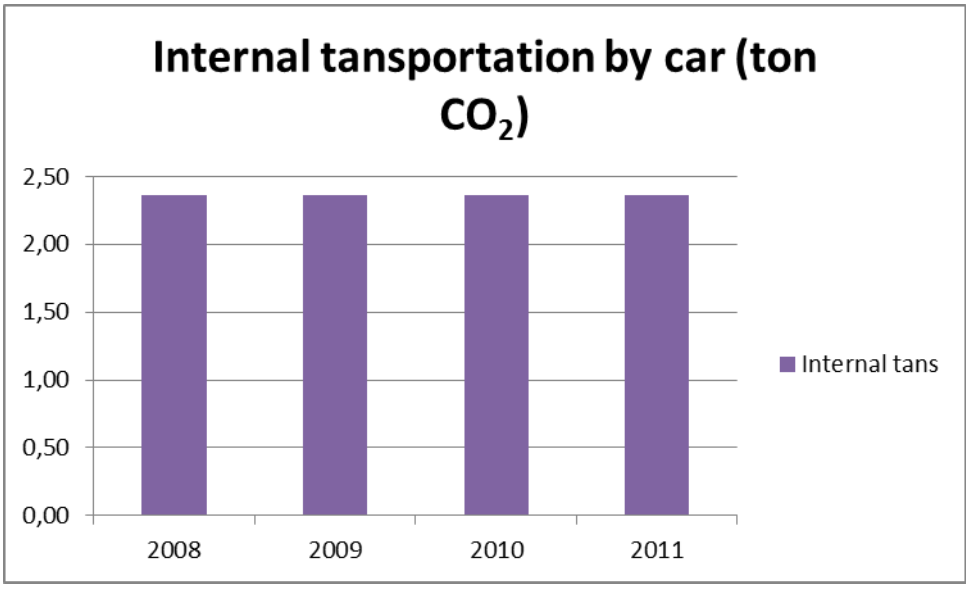

Figure 3.25

Taxi and private vehicle use for work related travel

The following table contains information about the use of taxis and work related travel in private cars in the period from 2008 to 2011:

	Taxi - 31415 (DKK)	Tranport reimbursement (DKK)	Km - rate (DKK per km)	Km
2008	533,616	349,988	1.90	184,204
2009	467,155	384,137	1.90	202,177
2010	483,270	395,339	1.90	208,073
2011	953,518	288,020	2.00	144,010

Table 3.5

It should be noted that it was not possible to obtain the rate of reimbursement per kilometer in 2008 and it was, therefore, set to be equal to the rate in 2009.

From table 3.5, it is noticeable that the use of taxis has increased considerably in the period from 2008 to 2011: 79%. Use of private cars in work-related activities has in the same period, however, decreased by 22%. The use of private cars is only calculated in kilometers as the DKK number varies, due to the variation in the rate of reimbursement per kilometer.

The figures in table 3.5 have not been converted to CO_2 emissions and are, thus not included in the CO_2 calculations. This is due to the fact of the different cars' mileage and the variation in the price

of taxis. The numbers have, therefore, not been converted to CO_2 emissions because it would provide too inaccurate numbers.

3.5.2 Tips

A way to reduce CO_2 emissions caused by air transport, is e.g. to increase focus on a possible availability and use of videoconferencing.

Furthermore, the use of taxis should be reduced and, as much as possible, be replaced by the use of bicycling and public transportation (bus, metro and train), which is quite well functioning in Denmark. Another possibility for CBS is to have "work bicycles" for the employees when they need to travel somewhere relatively close.

3.6 CO_2 emissions

The per capita emission of CO_2 in Denmark is about 10 tons per year. The six tons come from personal use of heat, electricity, transport and goods.

Source: Dong Energy, 2012

This section focuses on calculating both CBS' actual and degree-day regulated CO_2 emissions and will, ultimately, reveal the reduction in CBS' CO_2 emissions as of 2011 compared with the baseline year of 2008.

Water and waste figures are not included in the CO_2 emissions calculations in this report, as it is very difficult and time consuming to convert the contribution of these activities into accurate equivalent CO_2 emissions. Nevertheless, it is important that CBS continues to benchmark its activities in terms of both water and waste, as there is expected to be increased focus on responsible resource management in the coming years.

When concluding on CBS' improvements in cutting CO_2 emissions, degree-day regulated CO_2 emissions are to be used.

It is important to emphasize, however, that to see exactly how much CO_2 CBS emits only the numbers for "Actual CO_2 emissions" should be viewed.

3.6.1 Facts and figures for CBS

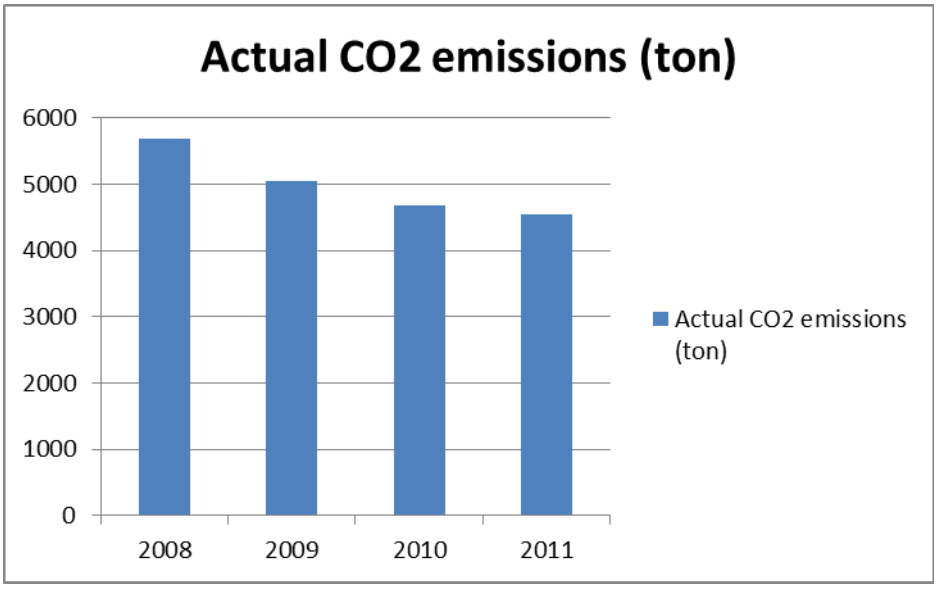

Figure 3.26

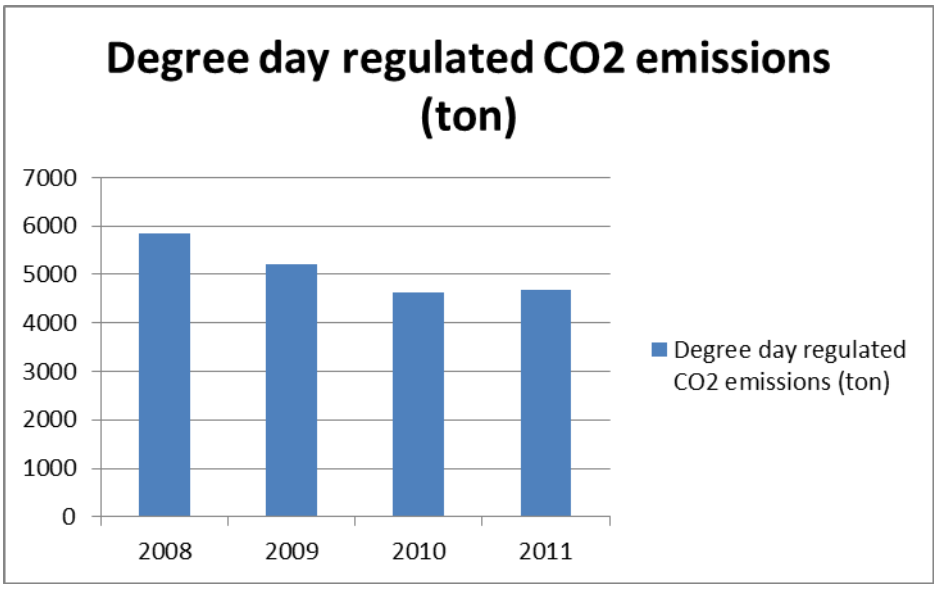

Figure 3.27

Actual CO_2 emissions:

2008:
Electricity: 6,720,429.478 KWh = 3601.93 ton CO_2
"Non-regulated" heat consumption: 7660.012 MWh = 951.07 ton CO_2
Car transport: An internal Diesel car that drives approximately 8000 km a year and around 9 km on a liter of diesel (under 10) = 2.36 ton CO_2
Air transport (estimated): 1137.043 ton CO_2
Total: 5692.403 ton CO_2

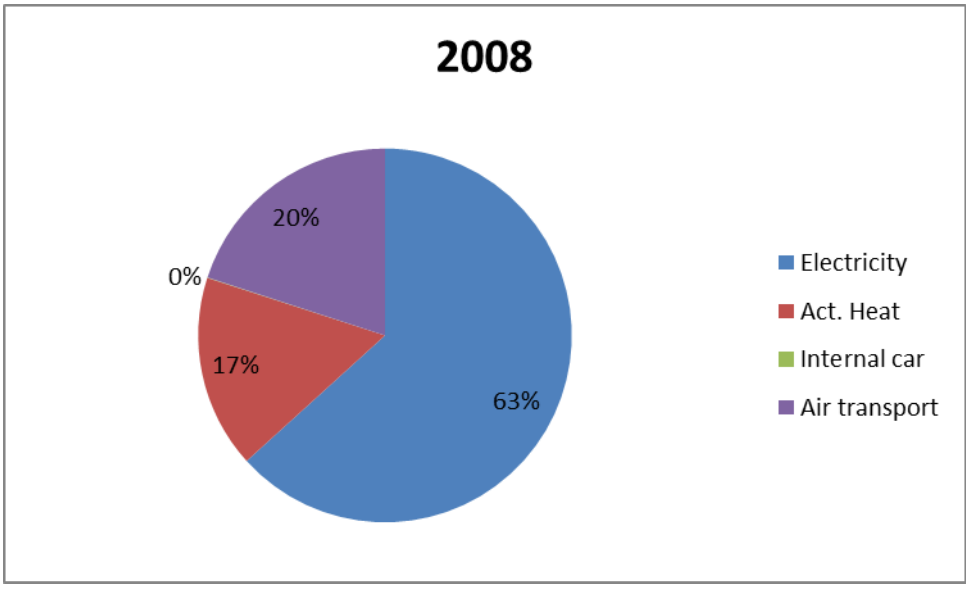

Figure 3.28

2009:

Electricity: 6,091,056.583 KWh = 3038.13 ton CO_2

"Non-regulated" heat consumption: 6884.603 MWh = 859.09 ton CO_2

Car transport: An internal Diesel car that drives approximately 8000 km a year and around 9 km on a liter of diesel (under 10) = 2.36 ton CO_2

Air transport (estimated): 1137.043 ton CO_2

Total: 5036.623 ton CO_2

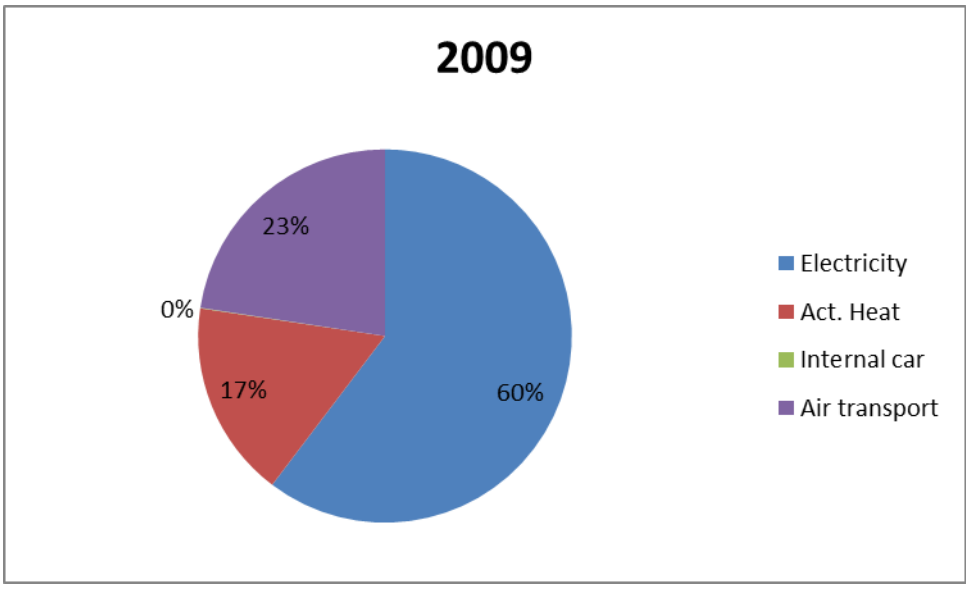

Figure 3.29

2010:

Electricity: 5,816,887.581 KWh = 2696.04 ton CO_2

”Non-regulated” heat consumption: 8067.333 MWh = 971.39ton CO_2
Car transport: An internal Diesel car that drives approximately 8000 km a year and around 9 km on a liter of diesel (under 10) = 2.36 ton CO_2
Air transport: 7,612,670 km = 1013.229 ton CO_2
Total: 4683.019 ton CO2

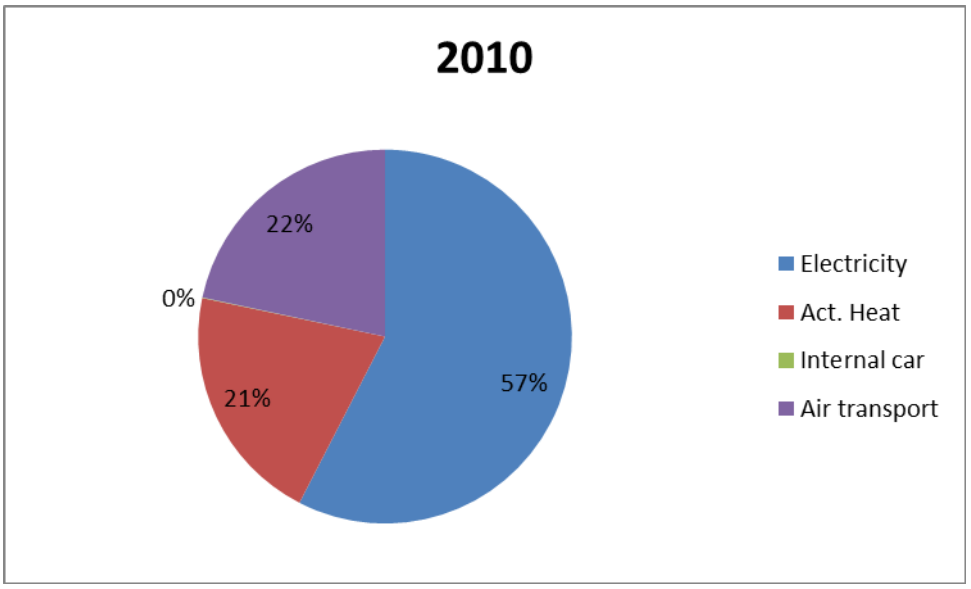

Figure 3.30

2011:
Electricity: 5,678,574.435 KWh = 2505.99 ton CO_2
”Non-regulated” heat consumption: 6973.728 MWh = 782.46 ton CO_2
Car transport: An internal Diesel car that drives approximately 8000 km a year and around 9 km on a liter of diesel (under 10) = 2.36 ton CO_2
Air transport: 9,488,728 km = 1260.857 ton CO_2
Total: 4551.667 ton CO_2

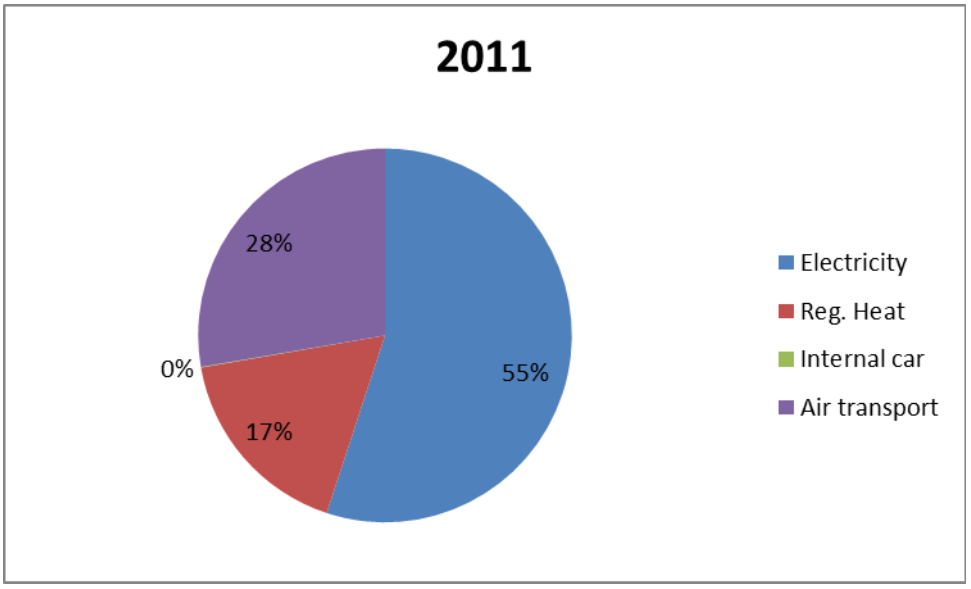

Figure 3.31

Degree-day regulated CO_2 emissions:

2008:

Electricity: 6,720,429.478 KWh = 3601.93 ton CO_2

Regulated heat consumption: 8919 MWh = 1107.41 ton CO_2

Car transport: An internal Diesel car that drives approximately 8000 km a year and around 9 km on a liter of diesel (under 10) = 2.36 ton CO_2

Air transport (estimated): 1137.043 ton CO_2

Total: 5848.743 ton CO_2

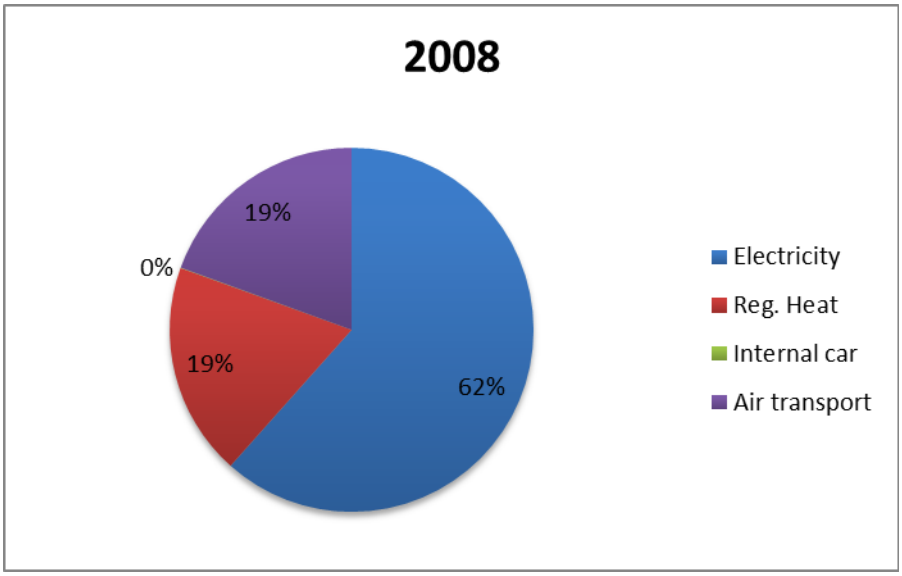

Figure 3.32

2009:

Electricity: 6,091,056.583 KWh = 3038.13 ton CO_2
Regulated heat consumption: 8181 MWh = 1020.92 ton CO_2
Car transport: An internal Diesel car that drives approximately 8000 km a year and around 9 km on a liter of diesel (under 10) = 2.36 ton CO_2
Air transport (estimated): 1137.043 ton CO_2
Total: 5198.453 ton CO_2

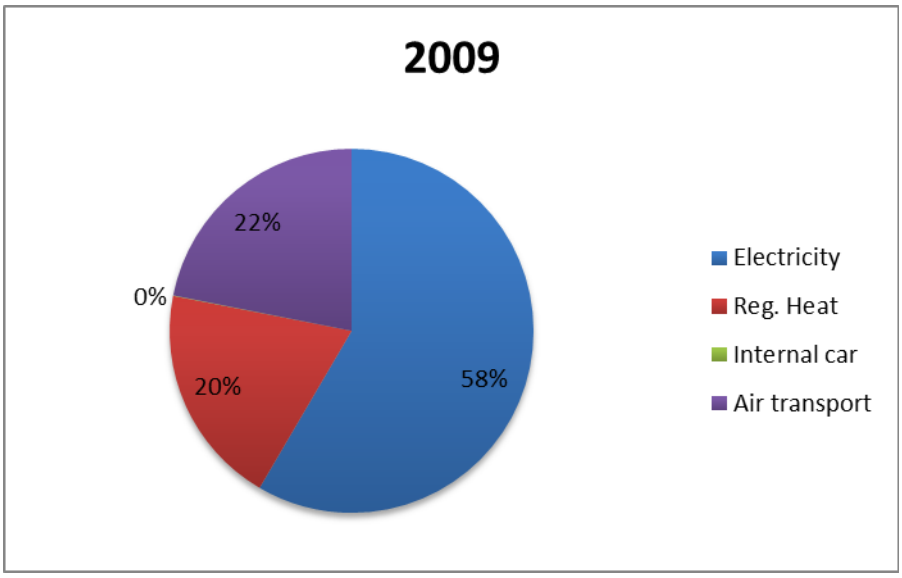

Figure 3.33

2010:
Electricity: 5,816,887.581 KWh = 2696.04 ton CO_2
Regulated heat consumption: 7600 MWh = 915.14 ton CO_2
Car transport: An internal Diesel car that drives approximately 8000 km a year and around 9 km on a liter of diesel (under 10) = 2.36 ton CO_2
Air transport: 7,612,670 km = 1013.229 ton CO_2
Total: 4626.769 ton CO_2

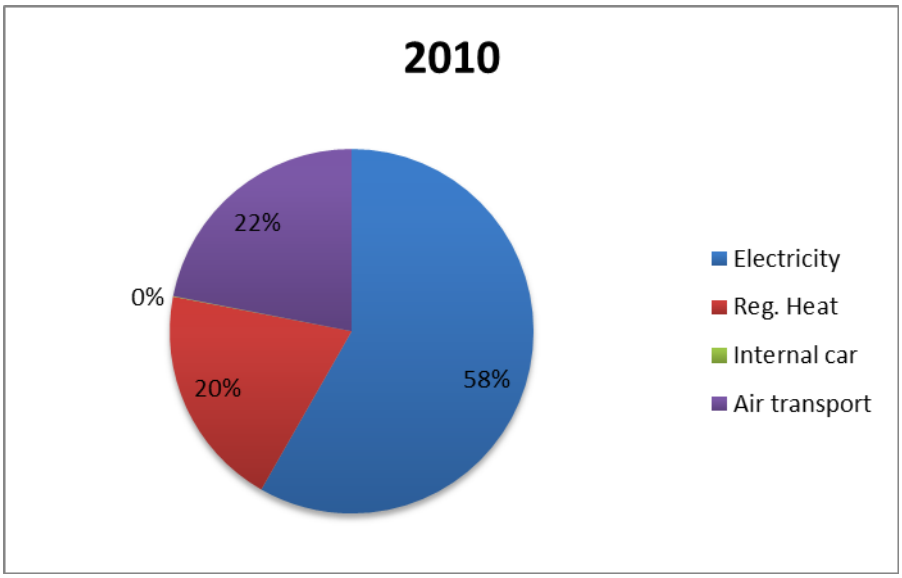

Figure 3.34

2011:
Electricity: 5,678,574.435 KWh = 2505.99 ton CO_2
Regulated heat consumption: 8069 MWh = 905.36 ton CO_2
Car transport: An internal Diesel car that drives approximately 8000 km a year and around 9 km on a liter of diesel (under 10) = 2.36 ton CO_2
Air transport: 9,488,728 km = 1260.857 ton CO_2
Total: 4674.567 ton CO_2

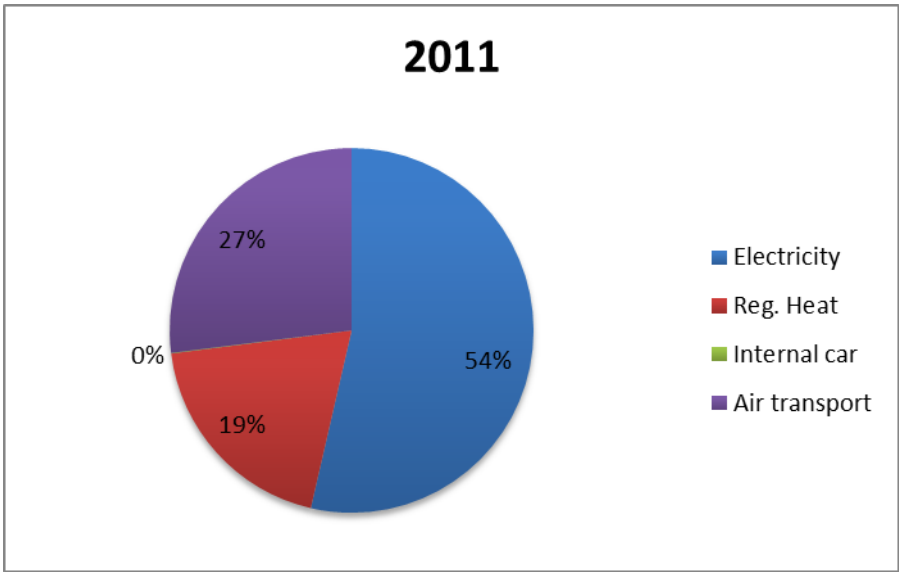

Figure 3.35

It can be noted that use of electricity is the largest single contributing factor to CO_2 emissions amounting on average to 59% of actual CO_2 emissions, followed by air transport amounting on average to 23% of actual CO_2 emissions. Especially the amount of CO_2 that air transport contributes to the total consumption is significant, as it is produced solely by the staff at CBS.

In working on reducing CO_2 emissions, air transport could be an interesting focus area, as there are some alternatives to CBS' excessive use of air travel, for instance videoconferencing.

Reduction in CO_2 emissions from 2008 to 2011 (actual) = 20.04%

Reduction in CO_2 emissions from 2008 to 2011 (degree day regulated) = 20.08%

As can be seen from the previous section, CBS has had a 20.08% decrease in degree-day regulated CO_2 emissions in the period from 2008 to 2011. This is a big step in the right direction and it shows that, during the past few years, CBS has been focusing on its carbon footprint by reducing consumption of the various contributors to CO_2 emissions. The reduction is half way to the goal reduction of a 40% decrease in CO_2 emissions, which is set to the year 2020. This is a significant reduction, especially keeping in mind that there are still 8 years until the year 2020. However, it is important to keep encouraging students, staff and CBS as a whole, to try to reduce CBS' CO_2 emissions. This can be done by engaging students in acting environmentally responsibly. However to reach the goal, it is vital to convince CBS' Board of Directors to invest in green initiatives. The use of a technical analyst has been selected to optimize the energy use at CBS, by optimizing the ventilation system, changing to LED-lighting etc. CBS could benefit from using a technical analyst to advise on the possibilities and advantages of other green initiatives, such as using solar panels for instance.
These are the challenges we will be facing at CBS Goes Green in the forthcoming period.

3.7 Consumption in DKK

Our goal is to convert the energy use, water use, waste and transportation into DKK. This gives an overview of how much is actually spent on these activities in monetary terms, which might be more understandable than ton CO_2, KWh, MWh etc.
However, due to challenges in acquiring data on the cost of the different activities, this has been postponed to future reports.

4.0 Conclusion

Throughout this report an elaborate calculation of CBS' energy use, waste impact, water use, transportation use and CO_2 emissions has been made. Numbers have been analyzed and concluded on, and a there has been a critical take on suspicious factors. The goal of the report was to assess the impact of CBS on the environment, and ultimately to calculate CBS' CO_2 emissions. It is very impressive to see the large decrease in CO_2 emissions by 20% in only four years, which is halfway to the goal of 40% in 2020. It should, however, be noted that CBS should only be accredited with a certain amount of this decrease, as the contribution of renewable energy sources to the provision of 1 KWh used has increased a lot, thus automatically decreasing CO_2 emissions.

5.0 Future steps

Our future goals are to be able to convert waste impact, water consumption and transportation as well as 3rd scope activities to CO_2 emissions, thus covering all of CBS' activities, however, in this report it has not been possible.
Furthermore, we wish to achieve an accurate benchmarking analysis in future reports.

5.1 Scope 3

In the future the goal is to be able to calculate the CO_2 emissions of 3rd scope activities. These activities include transport of students and employees to and from work, the effect of the disposal and recycling of waste, procurement, water usage and other possible 3rd scope activities.
These 3rd scope activities are not included in this report, as it currently is hard to assess accurately how much CO_2 these activities emit. It is our goal in the future to have measuring techniques that can assess these emissions accurately, as it would increase the precision of the report to cover CBS' entire CO_2 impact.

5.2 Benchmarking

We strive to create a comparable analysis of CBS' CO_2 emissions by benchmarking with other universities such as Harvard in USA, BI in Norway, WU in Vienna, KU in Copenhagen and UBC in Canada.
However, due to challenges in acquiring data from other universities, and lack of a method that can accurately compare the CO_2 emissions between the universities this is not included in this report. The goal is to include a section on benchmarking in future reports.

6.0 Areas of possible energy optimization:

- Air transportation
- Water
- Electricity
- Heat
- Ventilation
- Lightning
- Cooling
- Heating
- Maintenance
- Indoor climate
- Large areas in the buildings
- Other

Concrete suggestions for energy changes:

- Solar panels (capacity of approximately 95% in 25 years).
- Lighting (change to LED)
- Solar screens for windows (reduces heat absorption through windows by up to 90%, resulting in energy cost savings)
- Other