Environmental Statement 2016

of the University of Bremen

Universität Bremen

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Dear University Staff and Interested Persons,

This year, the University is already participating in its 13th EMAS environmental audit. Environmental protection has become routine within all operational processes. The social requirements are becoming bigger and bigger. Assessing the climate protection agreement of Paris, the earth should become climate-neutral by 2045/60. This goal can only be reached if all companies, public institutions, and citizen participate in the necessary actions. In the focus of reaching this goal, three main things are discussed: renewable energies, energy saving, and energy efficiency. All three topics have also been intensely discussed in the University. We have already processed two energy-saving campaigns, opened a Green IT Housing Center with efficient climate technology, and we have also changed all lighting materials within the university to LED lighting. All of this shows our work to fulfill our goals of climate protection.

But environmental protection within our university does not end at climate protection. The environmental protection of the university also shows in the environmentally- friendly handling of university waste, the safe handling of hazardous substances, water protection, and the conservation of biodiversity within the campus.

The employees of the University here have performed a great deal of work. They have managed to constantly improve the environmental benefits over the years. For that, I would like to give my sincere appreciation!

Dr. Martin Mehrtens
Chancellor of the University of Bremen

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One of Eleven Universities of Excellence

Roughly 23,000 individuals are currently active as students, teachers, researchers, or employees of the University of Bremen. It has become one of Germany`s top eleven universities of excellence. It is the science center of Northern Germany, renowned for its strengths in the sciences and engineering disciplines, as well as the humanities and the social sciences.

The work carried out by its researchers, many of whom of international repute, provide important stimuli for the development of innovative ideas and the resolution of problems facing society in general. Visiting guests from all over the world enrich campus life at the University of Bremen, which is well known in the student community as a cosmopolitan venue for study and research. Always open for new ideas and on the lookout for ways to adapt and improve, the university administration and academic staff have been interacting with the public and working with community groups for the past forty years.

The exceptional quality of research in Bremen is due, among other things, to the university's close collaboration with numerous independent research institutes, both on campus and around the region. Their competence and vitality have attracted more than four hundred research and business ventures to the technology parks around campus, creating a nationally recognized hub of high technology.

Strength in Research

For many years now, the University of Bremen has been among the top league of German universities in the area of research. Since June 2012, the University of Bremen is entitled "University of Excellence". The Excellence Initiative was passed for the first time in 2005 by the German federal and state governments. And the latest Förderatlas (funding atlas) published by the Deutsche Forschungsgemeinschaft (DFG) puts Bremen right at the top among German universities in several categories.

Research conducted at the University of Bremen is interdisciplinary. In other words: Bremen research transcends the borders of traditional disciplines and is embedded within six research concentrations, also known as high-profile areas:

- Ocean and Climate Research
- Materials Science
- Information-Cognition-Communication
- Social Sciences
- Health Sciences
- Logistics

The University of Bremen numbers among the most successful universities in Germany with regard to acquiring external funding for research projects. In 2010, the University's scholars and scientists acquired some 91 million euros of research funding – almost one third of the University's entire budget.

Focus on Teaching Excellence

Ever since it was founded, the University of Bremen has purposefully pursued a policy of creating close links between its teaching and research activities. A good example is its approach to studying in projects ("Bremen Model"), which fosters elements of independent research-based learning oriented to societal issues. Today, this is underscored in a number of study elements, the strong orientation to interdisciplinary studies, and the University's guiding principles. Various surveys, measures, and discussion processes illustrate and confirm that both teaching staff as well as students share a high level of willingness to participate in research-based learning: implementation is facilitated by this culture of internal consensus. Especially characteristic for its teaching profile is the University's focus on research-based learning at an early stage of studies, the anchoring of a comprehensive program of General Studies in the curriculum, and the supportive integration of e-learning components.

Intercultural and international

Wherever you look – the student body, research work, or life on campus – at the University of Bremen, there is truly an abundance of international and intercultural diversity. The University is particularly proud of the support it offers to its international members – whether temporary visitors, students, or permanent staff. About twenty thousand students from 120 different countries have chosen to study here. And, large numbers of young and renowned scholars and scientists have already come to Bremen to teach and carry out research. Following the University's success in the Excellence Initiative, this wel-


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come development will certainly now receive an additional boost.

Open for New Ideas

The young University of Bremen is always open to new developments. For example, within the context of support for young researchers, in 2001 it was the very first university in Germany to introduce a so-called tenure track for “junior professors” (assistant professors), which became known as the “Bremen Perspective”. Junior professors are sure in the knowledge that after six years they will be shortlisted with other external candidates for a full professorship.

Science and Research in the interest of society

Research and finding solutions to pressing social issues has a long tradition at the University of Bremen. This encompasses both fundamental as well as applied researches. The University meets its commitment to education and research in the interest of society by entering into close cooperation with public institutions and enterprise, as well as by offering a broad spectrum of services to the community. These open offers range from asthma training for children, through genetic advice, up to public access to its socio-political archives.

Open Access at the University of Bremen: Strategic Element of Communication in Academia

Open access still accounts for only a relatively small but stable share of the University of Bremen’s publications – with a rising tendency. The quality of professional open access publishers has no need to hide itself from the established channels of scientific publishing, and the University of Bremen’s management is convinced that open access will play an increasingly major role in the future, in communication between members of the scientific community. Since 2010, therefore, it assumes some of the costs of open access publications for its members within the context of a funding program offered by the Deutsche Forschungsgesellschaft [German Research Foundation].

Consolidating open access

In light of past experience and current developments, the time is right to strengthen the profile of open access support and adopt a more active stance. The aim, therefore, is to anchor open access more permanently within the University of Bremen – not only by means of funding, but also within the culture of the disciplines.

Whether open access can be established within a discipline depends to a large extent on the culture of the discipline in question – it is hardly a coincidence, then, that open access is a widespread practice in the University’s high-profile areas of environmental physics, marine research, the geosciences and the health sciences. The University intends to concentrate support for open access especially on these high-profile areas so that information and funding achieve maximum impact. The monitoring and evaluation of publications stemming from members of the University will therefore also be assessed in the future on the significance and development of open access.

Platform for young careers

The University of Bremen wants to offer young talented and outstanding young researchers a platform for their academic careers. In this respect, it provides

support for intellectual openness, critical reflection, and interdisciplinary communication. Future generations of scientists and scholars will perceive open access as a matter-of-fact aspect of academic exchange. Therefore, young researchers in particular are to be treated as a special target group for information about open access. This is not to mean, though, that evaluation of academic performance should rest on whether or not it is published in open access.

The University's regular financial support for open access publications will remain a pillar of policy. In this respect, the University management underscores the strategic importance of open access for future communications within and outside the University.

The University at a Glance

(rounded values)

Number of students: 20,000 (51% female)

Students per science field:

7,000 Natural science and engineering
6,000 Humanities
5,500 Jurisprudence, economics and social sciences
(Remainder: doctoral candidates and certificates)

Graduates: 3,500

1,900 Bachelors
1,400 Masters
130 Diplomas
90 State law examinations
340 Doctorates
7 Habilitations

Staff: 3,500

2,300 Research associates
1,200 Non-scholar staff

Budget (in Mio. Euros):

300 Total
Personal expenses: 216
Consumptive: 69
Investments: 15
100 third-party funds

Global Interdependence:

2,200 international students:
1,000 from Europe
700 from Asia
250 from Africa
170 from America

600 Partner universities

Environmental Management

The Environmental Management System was validated in May 2016 by the EMAS III – Regulation (Verordnung (EG) Nr. 1221/2009), which came into force on January 11, 2010 for the University of Bremen located at the Bibliotheksstraße 28359, Bremen. The EMAS – Regulation puts high value on data of the key sectors as energy efficiency, material efficiency, water, waste, biodiversity and emissions in form of standardized indicators, as long as these sections comply with the essential environmental aspects. In a broad discussion within the environmental committee of the University of Bremen, the key environmental sections were defined: energy efficiency, water, waste, and emission. In early 2016 “Biodiversity” was added as a further essential environmental aspect.

The Environmental Management System includes all facilities of the University of Bremen at the campus with a total area of 462,300 m². It includes small streets, parking spaces, greens and the sport facilities. Public streets are not included. The buildings of the University of Bremen have a total basement floor area of 136,800 m² and a main acreage with a total of 194,000 m². Organization of

University of Bremen

the Environmental Management System includes all scientific and non-scientific facilities of the University of Bremen. This especially includes the twelve departments, the central operational units, the central scientific facilities and the administration. Not included into the Environmental Management System are third party users. This includes facilities and organizational areas which do not directly belong to the University (e.g.: Studentenwerk with the canteens and student residences, the State and University library and the Bremer Bäder-Gesellschaft including their swimming pool). Also not included are companies and institutes at the campus which are strongly connected to the University but have their own management (e.g.: BIAS, Faserinstitut, BIBA, Falltrumgesellschaft, Mikrofab). The Faserinstitut has its own Environmental Management System, validated by EMAS.

Organization of Environmental Protection System

The University of Bremen has, based on the EMAS, a validated Environmental Management System since 2014. The organization of the environmental protection system at the University of Bremen is strongly connected with the whole management of the University. The environmental protection system is established within the administration, the scientific institutions, and at the departments. Also, there are qualified personnel within the different staff positions which are directly connected to the University Management. A central element of the Environmental Management System is an Environmental Committee that includes members from the departments, research and the staff council. The environmental committee meets regularly and discusses all matters of environmental protection and the Environmental Management System.

The organizational structure, including the clear responsibilities of the UMS (Umwelt Management System/ Environmental Management System), are allocated over the whole University of Bremen:

- Within the rectorate, whereby the chancellor is taking responsibility for the UMS;
- By the environmental officer of the chancellor, as also by the UMS-Coordinator, both of which are responsible for the operational development of the UMS;
- In the form of staff positions within occupational safety, health protection and environmental protection. These staff positions are located in the chancellor‘s office, the rectorate, and/or decentralized within the different departments;
- In the form of responsibilities, which each supervisor, especially the professors, have.
- In the form of responsibilities for operational tasks, which is divided between the administrations of the departments on the one hand and the scientific institutes on the other hand.

In the environmental manual, which is publicly accessible via the Internet at *www.ums.uni-bremen.de*, the different process sequences can be traced.

The environmental manual is dedicated to all employees and students: It is inviting to actively participate at the Environmental Management at the University and to contribute to the improvement of the environmental performance of the University. The continuous improvement process can only be conducted with everyone's active participation.

Environmental Policy

In early 2010, the University Management and the Academic Senate of the University of Bremen established a new environmental policy. The new environmental policy ("Nachhaltigkeits- und Umweltleitlinien") was compiled by the environmental committee, a working group for the creation of a sustainability report, which is managed by the deputy head, as well as interested university staff members. This new version of the environmental and sustainability guidelines resulted from the efforts to create a new environmental report, as well as the discussion of "Sustainable University of Bremen".

Members of the Enviromental Committee

Sustainability- and Environmental Guidelines of the University of Bremen

Social responsibility and beneficial actions towards the environment are some of the central goals of the University of Bremen. Therefore, they form a central component to all university interests of apprenticeship, research, and administration.
To practically implement these goals and encourage the continuous improvement, the University of Bremen commits itself to the following of sustainability- and environmental guidelines:

Assure productive efficiency
As a demanding educational institution, the University of Bremen sees as its social task to create and provide knowledge and abilities. To ensure long-term efficiency, the University of Bremen assumes a responsible cooperation between its members and the available resources.

Energy efficiency and acquaintance with natural resources
In the center of the sustainability- and environmental activities of the University of Bremen, the ambition is the reduced use of natural resources, as well as, the avoidance of operational damaging effects on the environment. The university strives to meet the challenge of climate neutrality and the increase of energy efficiency.

Health protection and education for members of the university
The University of Bremen takes measures regularly to support a healthy organization of work and study for all university members.
It actively conveys health-related, social, and cultural initiatives. Additionally, the university allows the continued advanced training and education of its members, in terms of a sustainable development.

Sustainability and environmental protection in research and apprenticeship
Questions in terms of sustainability and environmental protection, are important points of research and apprenticeship for the University of Bremen. In a large number of research projects and lectures, these subjects are taken up and worked on, delivering an important input for the scientific, social, and political dialogue. All students have the choice to pursue bachelor and/or master courses on the subject of education for a sustainable development.

Participation and transfer in the sustainability context
The University of Bremen is aware of its function as a role model. It also offers forums for exchange. With its scientific competence in research and apprenticeship, University of Bremen contributes to the protection of the natural environment and to the spreading of sustainability actions.

Institutionalization of sustainability and environmental protection
For the practical implementation of the sustainability- and environmental guidelines, the committees and facilities of the University of Bremen support the work in research, apprenticeship and administration, as well as in the student area. The University of Bremen provides a sustainability- and environmental program in which the purpose and measures are listed and discussed. This program serves as a basis for a continuous improvement of the sustainability- and environmental achievements of the University of Bremen.

The Environmental Program

The environmental program for 2016 was discussed within the environmental committee and different facilities of the University. External institutions were also partly involved.

Environmental Goals and Environmental Program 2016

Measures	Implementation Period	Those Responsible	State
Environmental objective: Improvement of the environmental friendly and safe handling of dangerous substances (1)			
Planning of a Hazardous Substance Day 2017	December 2016	Robert Crueger	Measures currently in planning
Examination of a web-based method for establishing a hazardous substance cadaster	December 2016	Referat 02, FB 2	Measures currently in planning
Determining the potential substitution of hazardous substances within non-scientific areas as at external companies	October 2015	UMS-Coordinator, Environmental Committee	Action completed
Environmental objective: Optimization of paper consumption (2)			
Production of notepads made of recycled paper from print media production	September 2016	Printing house	Measures currently in planning
Air dryers at the WC facilities: 3 washrooms from 3 buildings will be selected and equipped with air dryers	July 2017	Dezernat 4	Measures currently in planning
Environmental objective: Optimization of energy and water consumption (3)			
Development of the Klischko integrated climate protection concept (Promotion by Ministry for Environmental Protection)	July 2015	Environmental Committee	Action completed
Development of a CO_2-Footprint in the form of a Master thesis	August 2015	UMS-Coordinator	Action completed
Procurement of LED lighting	December 2015	Central warehouse	Action completed
Conversion of sanitary facilities within selected buildings to reduce water consumption	December 2016	Environmental Committee	Within some buildings, action was completed, more facilities are currently in planning
Conversion of the ventilation system within the UFT building, to a heat recovery ventilation system	September 2017	Dezernat 4	Measures currently in planning
Exchange of old refrigerators at the UFT and NW 2 buildings	October 2017	UFT-Management	Measures currently in planning

Measures	Implementation Period	Those Responsible	State
Upgrading the outdoor lightings to LED lighting	August 2016	Dezernat 4, EZ, Elektrowerkstatt	Measures started
Exchange of all lightings within the buildings to LED lightings	July 2017	Dez. 4, GBT	Measures started
Energy contracting UFT, Barkhof, NW 1	September 2017	Dezernat 4	Measures started
Testing the application of intelligent control ventilation system based on long term weather data at selected buildings	February 2017	Dezernat 4	Measures currently in planning
Conversion of the sanitary facilities within selected buildings to reduce the water consumption	Dezember 2016	Dezernat 4	Currently in progress
Environmental objective: Reduction of staff-related amount of waste (4)			
Employee training on correct waste-handling	December 2017	Waste Management	First training already begun
Development of posters about the environmental friendly waste-handling	January 2017	UMS-Coordinator	Measures currently being planned
Environmental objective: Further development of emergency planning and fire protection (5)			
Revision of fire protection concept in each building	November 2015	Referat 02, Dez. 4, Experts	Measures currently being planned
Development of a catalogue of measures with adjustment measures for certain floors of the buildings MZH, GW 1 – Block A, B, C	October 2016	Dezernat 4	Measures currently being planned
Environmental objective: Optimization of the transportation link at the campus (6)			
Examination of Car-Sharing-Offers	September 2017	Environmental Committee	Measures currently being planned
Development of an Internet platform for Car-Sharing	January 2017	Environmental Committees	Measures currently being planned
Further action for building a new tram station in the Technologiepark	December 2013	AG Mobilitätsmanagement	Action completed
Analysis of the staff business trips for within the scope of CO_2-Footprint	August 2015	UMS-Coordinator	Action completed
Environmental objective: Effective communication about occupational safety, health protection and environmental protection (7)			
Creation of an information flyer about the EMAS-System of the university	October 2016	Environmental Committee	Measures currently being planned
Planning and implementation of sustainability days within the scope of “Deutsche Aktiontage Nachhaltigekeit”	June 2016	Environmental Committee, Virtual Academy of Sustainability	Measures currently being planned

Measures	Implementation Period	Those Responsible	State
Development of a sustainability-report 2015	August 2016	UMS-Coordinator, Prof. Müller-Christ	To be published soon
Development of an obligatory training module for all trainees of the university in the field of environmental protection	December 2016	Referat 08, Educators, UMS-Coordinator	Measures currently being planned
Planning and implementation of an Information Day for Building Management Engineering	February 2018	Dez. 4, Environmental Coordinators	Measures currently being planned
Environmental objective:: Consideration of aspects on environmental protection during the planning (8)			
Planning of building a sustainable natural science building	Completion 2018	Dezernat 4, SfWG	Measures currently being planned
Development of an Energy-saving-Contracting procedure with the components: -Project development -Implementation of a tendering procedure	December 2017	Dezernat 4	Contract signed
Market analysis and basic evaluation for possible energy contracting projects	August 2015	Dezernat 4, Environmental Committee	Action completed
Environmental objective: Broad involvement of sustainability aspects in research and teaching (9)			
Implementation of an artec colloquium in the summer semester of 2016 linked to sustainability	August 2016	Artec – Forschungszentrum Nachhaltigkeit	First appointment times have taken place
Working sustainable: (NAGUT) – Sub-Project: Development and regional distribution of work ecological innovations	August 2016	Artec – Forschungszentrum Nachhaltigkeit	Research project has started
Continuation of training measures for women after family phase – FIT in MINT	April 2016	UFT, artec, FB 6, Akademie für Weiterbildung	Action completed
Implementation of two project tasks on the topic: Mobility in the scope of the master's course of industrial engineering	April 2016	UMS-Coordinator, Research Associates, FB 7	Action completed
Environmental objective: Conservation and promotion of biodiversity (10)			
Bee project with honey bees	December 2017	FB 3 Informatik AG Schill	The first beehives have been build
Completion of the roof-biotope	September 2016	Dezernat 4, UMS-Coordinator	Under construction

Environmental Performance and Environmental Impacts

The EMAS – Regulation requires from the institutions to identify the environmental impacts of their field of activity and to derive the direct and indirect environmental aspects. Within the Environmental Committee, the environmental impacts are regularly discussed and assessed. Energy, water consumption, waste generation, emissions, and material efficiency play a crucial role here. As indirect environmental aspects, mobility and research projects were identified. In early 2016, the environmental aspect biodiversity was included and assessed as a crucial aspect. As a further aspect, preservation and the promotion of biodiversity was identified.

Energy Efficiency

Energy supply and the provision of drinking water is managed by the Dezernat 4 (Technischer Betrieb/ Bauangelegenheit). The Dezernat 4 is responsible for technical operations of the university buildings, including construction issues at the campus. Divided into three departments, the following responsibilities are done by the university:

The operational issues of the campus buildings are done by the Gebäudebetriebstechnik (GBT), while the supply of the buildings with energy, water, heat, and further medias are managed by the Energiezentrale. The Energiezentrale is also responsible for the 24-hour emergency call center (Leitwarte), as for organization and control of the campus monitoring service. To assure an optimized, undisturbed, and resource-friendly operation of the technical facilities, the control and monitoring of the facilities is managed by the Zentrale Gebäudeleittechnik.

All building maintenance measures, such as service, repair, modification or restructuring, are done with the help of our own workshops and/or external companies. Also, cleaning services and the regular care of the outdoor facilities are a part of the responsibilities of the Baudezernat.

Another main responsibility lies in the planning and support of new construction projects and reconstruction measures. A digital documentation of the existing buildings is constantly being implemented.

Within all processes of the Dezernat 4, the department is in close contact to the users in order to uphold environmental aspects and to avoid direct or indirect environmental impacts as well as possible.

Technical operations and the further expansion of the university, is done with careful planning, safe and resource-friendly operations.

Definition of tasks in Dezernat 4:

Staff position – managerial accounting, contract management, environmental management, sewage matters

Referat 40 – building operation and maintenance, energy technology, energy supply, energy management, building control system, coordination of campus guarding, cleaning services

Referat 41 – building maintenance, servicing, materials management, vehicle fleet, specialist workshops

Referat 42 – planning and support of construction measures, building stock documentation, warranty management

Annual Total Consumption

The energy consumption of the University of Bremen in 2015 fell slightly in comparison to the five years before. The effective area of the University increased, and the amount of University staff also slightly increased. Also, a Green IT Housing Center was opened on the campus. The special feature here is that the Green IT Housing Center is collecting all computer capacity of the university and other buildings around the campus in one highly modern facility. This concentration of the computer infrastructure and a smart cooling technology has made it possible to save around 3,6 million kilowatt-hours annually and with this, an annual reduction of carbon dioxide emission of 2,000 tons was made possible.

Climate Protection initiative: Installation of High Efficiency LED-Lightings at the SuUB

Within the facilities of the State- and University Library (SuUB) is a main staircase from level 0 to level 4. This staircase is the main way of transportation for all visitors of the SuUB. In the entire main staircase, LED-Panels were installed. Through this new installation, the library is saving 70 % of their energy. Over the whole lifespan of the building, 170 tons of CO_2 can be saved.

On the basis of the resolution from the Deutsche Bundestag, the Ministry for Environment, Nature Conservation and Reactor Safety (BMU) promotes measures on climate protection technologies, which are able to reduce emissions in a short term and lead to a sustainable reduction of greenhouse gas emissions. Part of the promotion at the University was the installation of LED-Lightings and the use of control technology during the restructuring, with a potential CO_2 reduction of 50 %. The amount of the subsidy for the restructuring of the buildings was about 30 % of the total investment.

The promotion of this project was based on the directive of the promotion of climate protection projects in social, cultural, and public facilities in the scope of the Climate Protection Initiative. The main promoter was the Forschungszentrum Jülich GmbH.

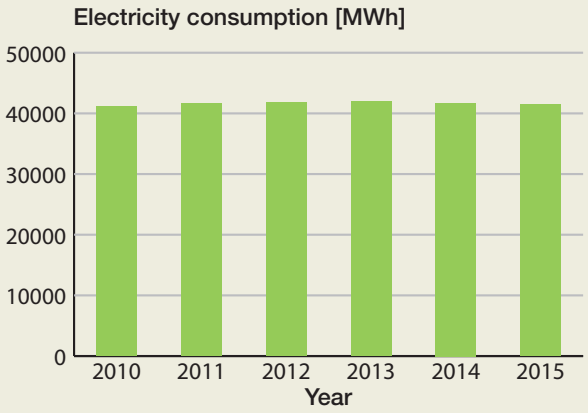
The project was concluded in September 2015.

Heating and Cooling

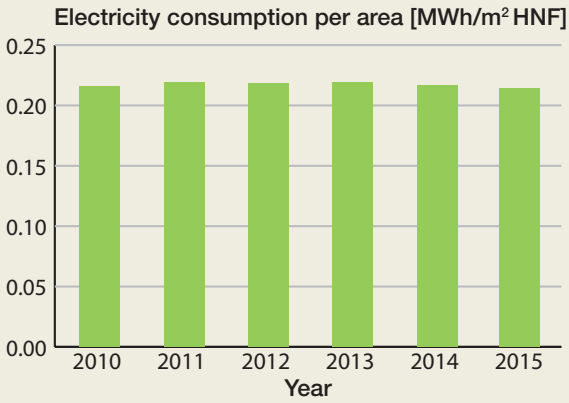
The University of Bremen receives its cooling and heating energy from the nearby waste-to-energy plant. It is using a modern absorption chiller to produce coldness. The method of the absorption refrigeration cycle is perhaps the oldest method for refrigeration.

At low temperatures, the refrigerant is absorbed in a solvent circulation, while at high temperatures, it gets desorbed. In this process, the temperature dependence of the physical solubility of two substances is used. This requires that both substances are soluble in each other at any of the used temperature intervals. Nowadays, almost all caravans are equipped with absorption refrigerators to be independent from electrical supply. These refrigerators get their required warming through the combustion of fuels, such as propane or butane.

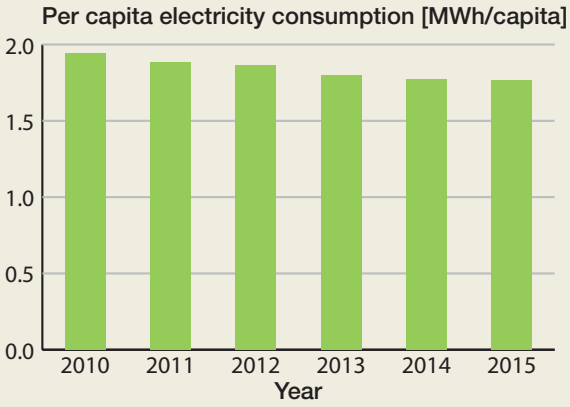
Energy



Electricity consumption (MWh) at the University of Bremen

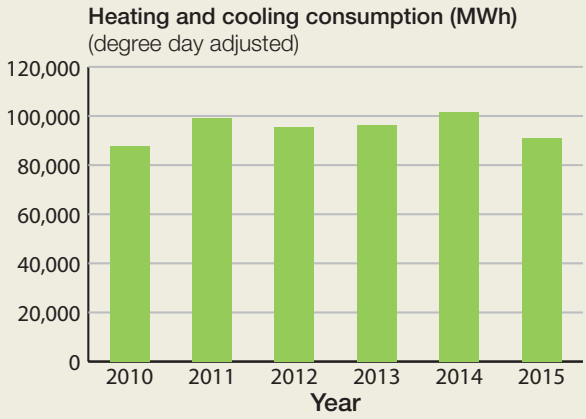


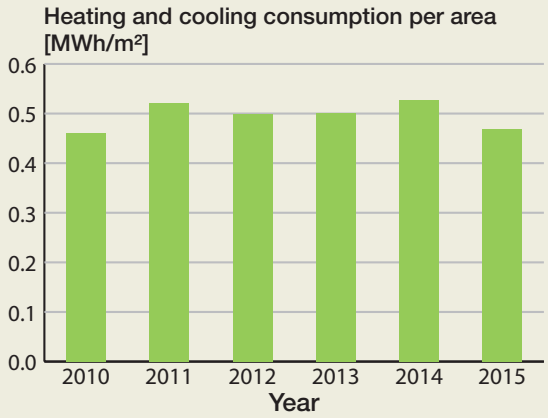
Electricity consumption per area (MWh/m²HNF),
HNF = Main usable area



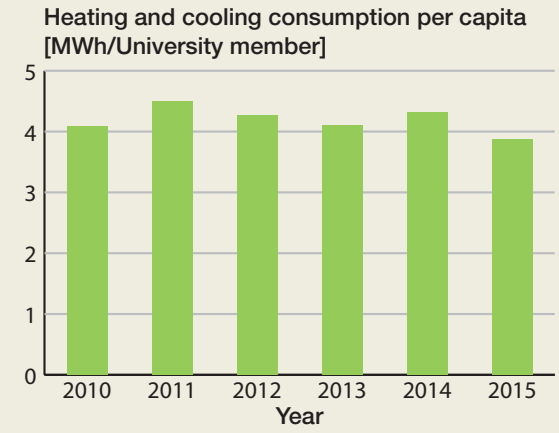
Per capita electricity consumption [MWh/capita]
MWh/ university member

Heating and Cooling





Spezifischer Wärmeverbrauch pro Hauptnutzfläche [HNF]

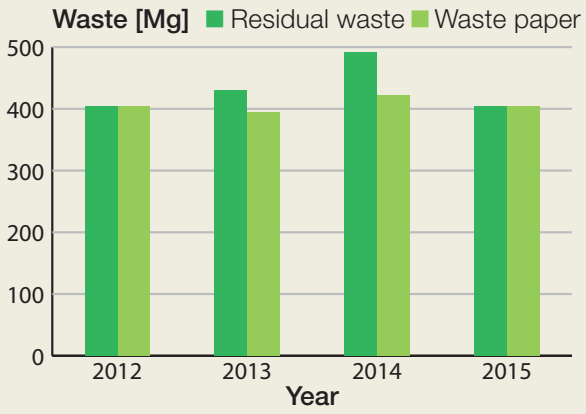


Waste

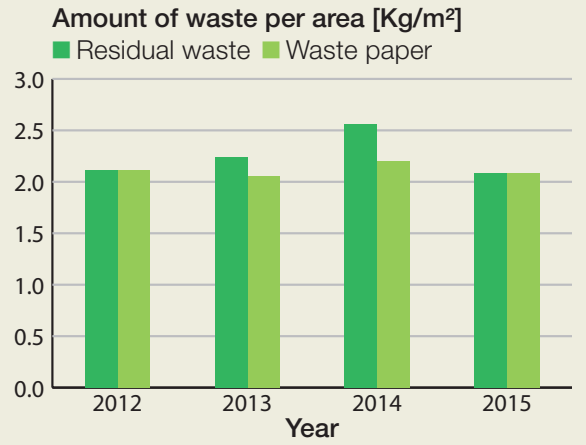
The central responsibility regarding collection, exploitation, and disposal of waste at the University of Bremen lies on the Waste Management Officer (Abfallbeauftragten). He is also the head of the certified waste management facility (Entsorgungsfachbetrieb) affiliated to the Referat 02 “Biologische Sicherheit, Gefahrstoffe, Strahlenschutz und Entsorgung”. Here, hazardous substances are collected, sorted, and properly disposed of. This service is also provided for external institutions. An appropriately equipped vehicle assures safe transportation.

The total amount of waste disposal at the University of Bremen in 2015 declined slightly, for residual waste at 405 tons[1] and for waste paper at 404 tons[1]. The central responsibility for the disposal of hazardous substances within the University of Bremen also lies on the Waste Management Officer, as at the ZVES (Zentrale Abfallentsorgung der Universität Bremen/ Central Waste Disposals of the University of Bremen). Currently, 50 different types of waste are managed. The Waste Management Officer is also responsible to create a waste balance, a waste-management concept, and to uphold legal regulations. The total amount of disposed hazardous substances in 2015 consisted of around 69 tons.

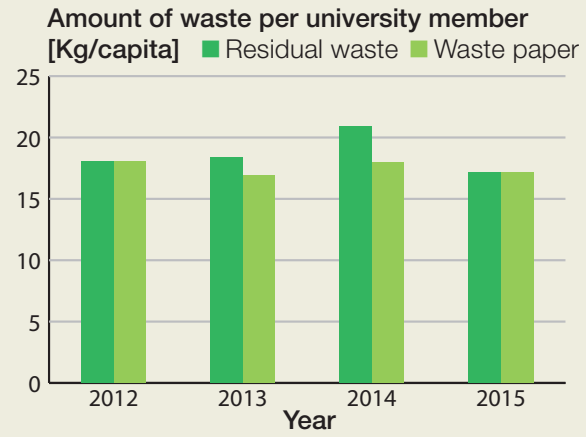
Information about the disposal of hazardous substances, including information about the disposal of regular waste, is accessible at www.abfall.uni-bremen.de, under the heading “Richtlienie zur Handhabung, Sammlung und Abgabe von Abfällen an der Unicersität Bremen”.



Amount of residual waste and waste paper at the University of Bremen



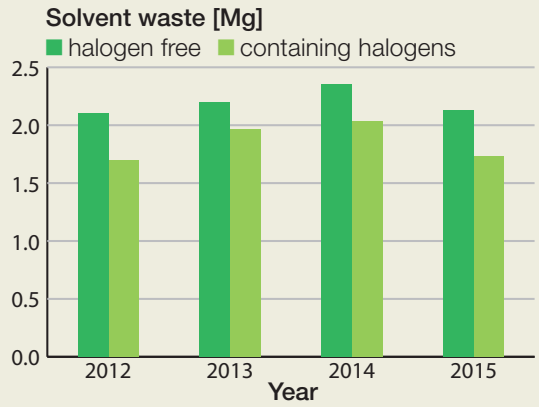
Total amount of waste per area at the University of Bremen



Total amount of waste per university member at the University of Bremen

[1] 1 Mg = Megagram (tons)

Amount of hazardous waste over time



Amount of solvent waste over time

© Mabel Baumgarten

Water

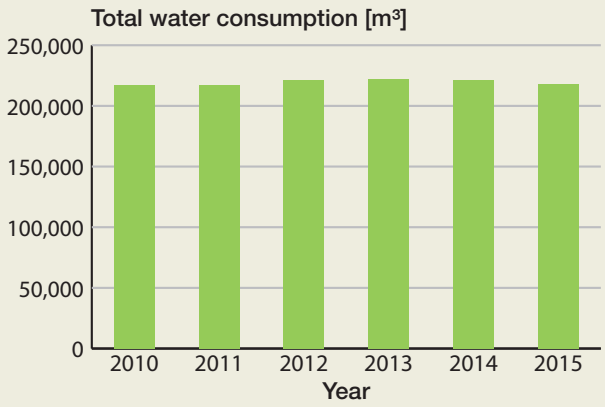
The swb Vertrieb GmBH is fully supplying the University of Bremen with water from groundwater sources. From their wells located in Blumenthal, Vegesack, Rönnebeck, Leherheide, Wulsdorf, Bexhövede, and Langen, the swb is collecting more than 15 million.

Material Efficiency

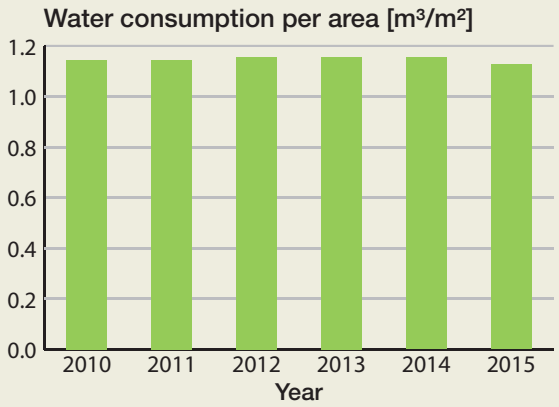
In recent years, the University of Bremen has made great efforts to increase its material efficiency. Various projects have had the objective to increase the material efficiency. The paper consumption of the University has stabilized between 2006 and 2015 at around 22 million pieces of paper per year.

Amount of Renewable Energy

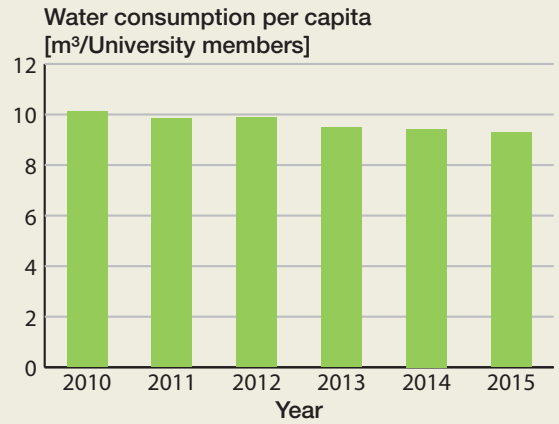
Since early 2009, the University of Bremen receives its energy from an electricity supplier, which receives its energy fully from regenerative energy sources, such as water, biomass, and sun or wind powers. The power quality is regularly certified by the TÜV Nord.



Water consumption at the University of Bremen over time



Specific water consumption per main usable area [HNF]



Specific water consumption per capita (stuff and students)

Emissions

The main source of emission from the University of Bremen is from energy consumption. Since the University of Bremen is consuming “NaturStrom” from the swb, and heating from the waste-to-energy plant, the University is not directly producing any CO_2-Emissions.

The district heat from the waste heating plant (MHW) Bremen is gained in the combined heat and power (CHP plant) from the steam after passing through the power turbine. The use of steam at MHW Bremen arises as a secondary process from the primary process of thermal treatment of waste.

ÖKOSTROM
ZERTIFIKAT

swb Vertrieb Bremen GmbH bestätigt der

Universität Bremen
Bibliothekstraße 1
28359 Bremen

dass sie vom 01. Januar 2016
bis 31. Dezember 2016
Ökostrom von swb bezieht.

Dieser Ökostrom wird zu 100 Prozent
aus regenerativen Energien erzeugt.
Bei der Produktion fallen weder CO_2-
Emissionen noch radioaktiver Abfall an.
Damit handelt das Unternehmen
nachhaltig für Klima und Umwelt.

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swb

Biodiversity

Biodiversity refers to the variety and variability of life on earth. One of the most widely used definitions of biodiversity describes it in terms of the variability within species, between species, and between ecosystems. In urban areas, biodiversity of flora and fauna have highly decreased. Buildings and sealed soils reduce the necessary semi-natural habitats and natural spheres. Intact soils, food, drinking water, and other ecological services are the foundations of human life and human well-being. For the sake of preserving biodiversity and the efficiency of the ecosystems, undeveloped areas are necessary. In May, the Environmental Committee of the University of Bremen decided to include the EMAS-Environmental biodiversity aspect as an important aspect in the environmental audit. As the new environmental objective, "preserving and maintaining of biodiversity" was stated and is now in the focus of the environmental management and measures will be taken to fulfill these goals. As a key indicator, referring to the EMAS III, the land use is prescribed in m². Environmental impacts by sealed soils include soil sealing, change of ecosystem, and loss of biodiversity. Most organizations use key figures to improve their environmental performance, even though other parameters seem more useful to give a qualitatively better picture of the open spaces with regard to biodiversity. In the future, these parameters shall be accommodated to improve within this field. The campus area is dominated by multi-leveled buildings and adjoining streets as well as parking spaces. Unsealed and planted areas are located in-between the buildings in the form of atriums and courtyards. The biggest green area in the campus is the Campus-Park, in addition to the Mensa-See. These areas are especially predisposed for biodiversity projects. All building maintenance-measures and prudent gardening of the outdoor facilities are the responsibilities of the Dezernat 4. The total area of the campus, excluding the Barkhof and Teerhof areas, is about 462.300 m². The key indicator "build-up areas in m²", as an absolute number, shows how strongly the environment is impacted by the organization. The University has built 136.800 m² of their base. Universities, schools, and public authorities usually use the amount of members they have as reference value.

The University of Bremen has 23.500 students and employees. Built-up area (m²) / members = 136.800 m² / 23.500 = 5,8 m² build-up area per university member.

Previous Actions

In recent years, there have already been several measures to improve the biodiversity at the campus. There are 140 nesting boxes located around the campus that are annually maintained and rebuild. Façade greening with wine or clematis provide food for insects and birds. The roof of the library was greened, also buckets and rockeries with sedum and buddleia were planted and placed along the University Boulevard. Since several years already, a sandy habitat for wild bees behind the SFG-Building was created. The Insect-Hotel was also created, and some deadwood which also provides habitat for a few species. In the scope of the "Bremen Summit" project, in which there were bee-friendly trees placed all around Bremen, the University also planted ten different fruit trees between the Sportturm and the Sportanlagen. These trees do not only provide habitat for bees, but also for birds and other mammals.









Mobility

In the previous winter semester of 2015/2016, students of the University of Bremen did a survey on the desires and needs of the users of the University of Bremen and the Technologiepark towards mobility behavior. The participants had eight weeks to answer on the survey‘s questions online. Meanwhile, the project of the students from the Fachbereich 7 was concluded and the results were published. The project team was able to reach a high respondent rate, with more than 2,400 participants. This shows that there was a great interest toward this issue. A positive result was that University employees favored a bicycle in comparison to other forms of transportation. For the students, public transportation such as bus and train were favored. The aspect of environmental friendliness was regarded as important, but also other aspects, such as weather and comfort, were also seen as important by the participants. This supported the suggestion to build a campus train station at the end of the Otto-Hahn-Allee. The participants supported this suggestion. With view on the motorized private transport, the survey suggested that a decrease of approximately 700 tons of CO_2 annually is possible through appropriate measures. The possibilities that result from changing driving behavior are enormous. The general emission of 8 t CO_2 annually shows the potential of an astonishing revised mobility management. The young researchers were able to state through their survey that there is a requirement for a constant mobility management and gave the recommendation to build a train station close to the campus and to expand the car-sharing offers.

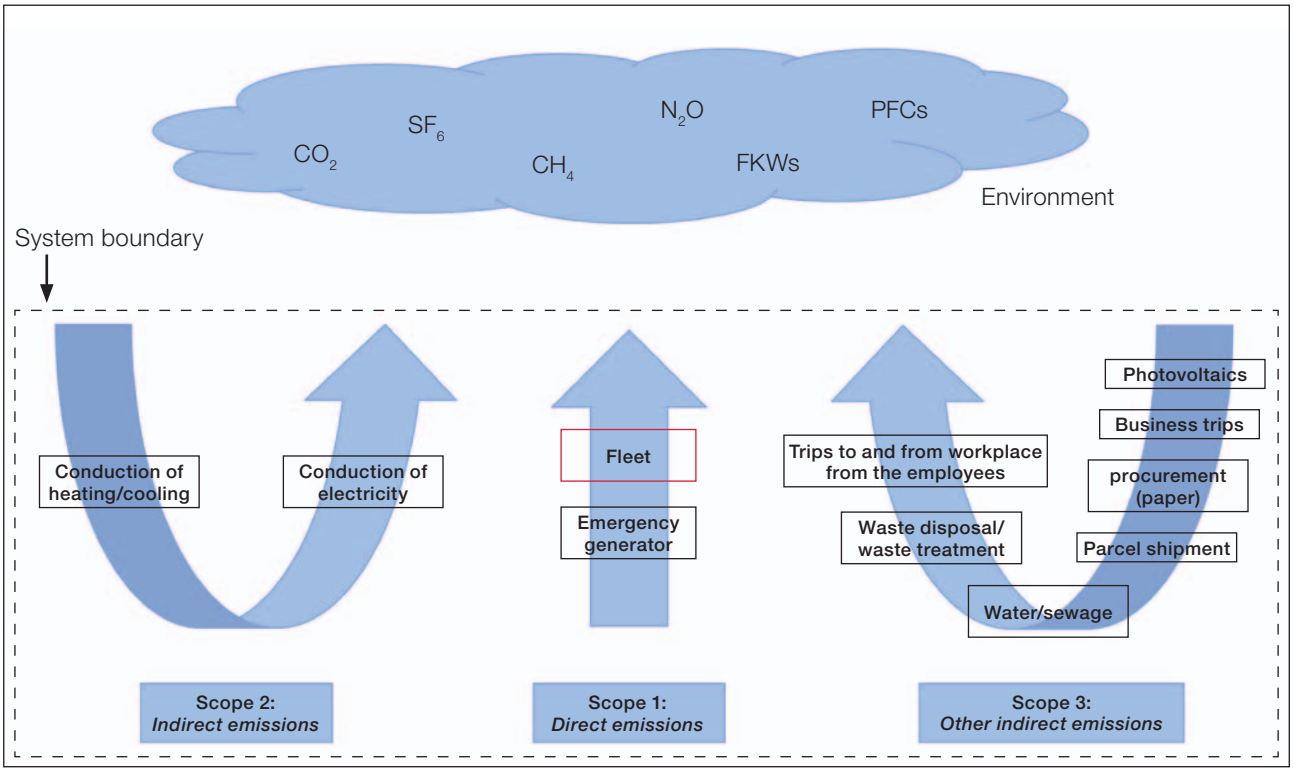
CO_2-Footprint of the University of Bremen

In the framework of a Master's thesis paper from 2015, the CO_2-Footprint of the University of Bremen was calculated. The primary objective of the paper was the political climate protection goals. In the scope of this master thesis, the relevant causes for greenhouse gas emissions at the University were identified, to show the saving potentials of the various emissions sources and to work out specific measures for reduction. The CO_2-Footprint serves primarily as a ground for comparability with other universities and institutions. Also, through an annual calculation of the University's footprint, the introduced measures can be tested, whether they are useful tools for reduction of greenhouse gas emission.

The CO_2-Footprint was calculated on the base of the Greenhouse Gas Protocol and the DIN EN ISO 14064-1. Fundamental principles of these standards were relevance, transparency, consistency, accuracy, and completeness of the collected data. The calculation occurred in five steps. First, a personal, spatial, and temporal system boundary had to be defined. In a later step, the relevant emission sources were identified within the system boundary and categorized as direct, indirect, or as another emission source. Then, the associated emission factors were determined and the CO_2-Footprint calculated.

The following illustration shows the relevant emission sources of the University of Bremen. The Fuhrpark is marked red because there is no data available.

The following table shows the emission values of the various emission sources. The values are indicated as CO_2-Equivalents (CO_2e), because not only the CO_2-Emission are shown, but also the greenhouse gas emissions, from which effects are converted into CO_2e.



The grafic shows for the calculation relevant emission sources at the University of Bremen. The fleet is marked red, because their are no availble data.

Emission Source	Greenhouse Gas Emissions [tCO_2e]
Scope 1	
Emergency Generator	62.42
Refrigeration	1.46
Scope 2	
Electric Energy	1,637.94
District Heating	619.14
Scope 3	
Photovoltaic	51.30
Paper	117.21
Trips to and from Workplace: Car Road/Rail	 1,793.52 732.40
Business Trip: Airplane · National · Europe · Intercontinental	 8.85 171.69 559.74
Business Trip: Deutsche Bahn	229.51
Waste Disposal	226.23
Water Supply/ Sewage Clarification	53.76
Total Greenhouse Gas Emissions	**6,265.17**
Greenhouse Gas Emission per Capita	**1.80**

The sum of greenhouse gas emissions have the same value with the CO_2-Footprint of the University. For the year 2013, the total amount was at 6,265.17 tCO_2e.

The energy supply of the University of Bremen is put together by electricity from hydroelectric power stations, from emergency generators, from solar energy, and heat from the waste incineration plant. In the following section, the emissions depending on the particular energy production are presented. The provision of power is the biggest cause for emissions. Although the University receives green energy, which does not generate emissions during production, emissions are caused during the construction of the facilities.

The consumption of district heating is also a cause for emissions, as well as the burning of fuel oil within the process of producing heating through waste.

In Scope 3, further indirect causes for greenhouse gas emissions are considered, which are not under the control of the University of Bremen. Trips to and from the workplace as well as business trips should be particularly considered.

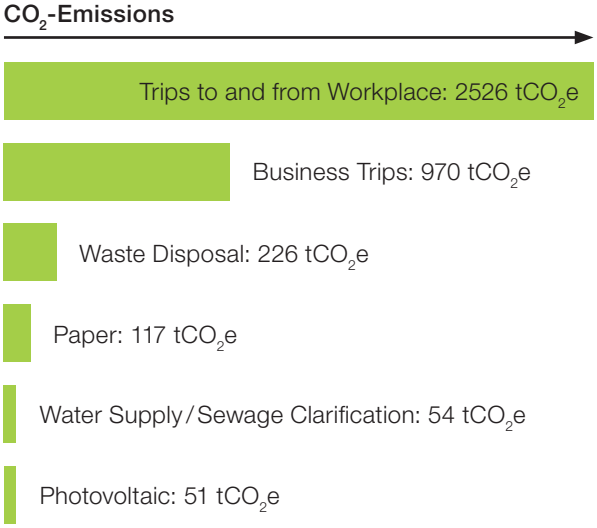
The following graphic shows the emissions sources included in Scope 3. It has been shown that travel to and from the workplace made by the employees from the University of Bremen is the biggest cause for greenhouse gas emissions.

CO_2-Footprint of the University of Bremen

6,265.17 tCO_2e

Regarding these results, we have to take into consideration that only buildings that could provide complete data are mentioned. Also, there was some data missing regarding the use of the Fuhrpark. In most of the cases, averaged values were calculated.

It can be said that in general, the CO_2-Footprint is relatively low. This is mostly due to the use of proNature power. Another very positive aspect was that 50 % of the employees decided to ride bicycles in the summer as a means of transportation. However, there is still potential for more savings regarding business trips.



Greenhouse Gas Emissions of the University Bremen in 2013 at the Scope 3

Integrated Climate Protection Concepts and their Reach

The University of Bremen is aware of its responsibility for climate protection as a profile-forming institution from the state of Bremen. As an institute for research and education, the University plays a crucial role in the achievement of national and international environmental goals.

The University of Bremen has built on previous actions and on the concrete requirements of the Bundesministerium für Umwelt, Naturschutz, und Reaktorsicherheit, a climate protection concept adapted to the organization of universities. For that, the University of Bremen has received subsidies, and, in cooperation with HIS-Hochschulentwicklung (HIS-HE), the university employed an external advisor with diverse experiences in the field of university specific consultancy in environmental issues. They are supervising the project management and the project execution.

The energy consumption of the University of Bremen is a significant part of the total energy consumption of the state of Bremen. Because of this, it is particularly important for the state of Bremen that the University of Bremen participates in the efforts of energy saving and the reduction of CO_2-Emissions. The university has around 19,000 students, more than 2,000 scientists, around 1,200 employees in the administration, approximately 80 buildings, and about 180,000 m² effective area. For this reason, the University of Bremen is one of the biggest universities in Germany.

Already since 2004, the University of Bremen had established a structure for environmental protection measures with the EMAS, and with many individual measures, quantitative and qualitative saving potentials were established. These will now be further developed in the field of energy efficiency.

This further development follows the objective of the previous actions of the University as well as the concrete requirements of the Bundesministerium für Umwelt, Naturschutz, und Reaktorsicherheit (Federal Ministry for the Environment, Nature Conservation, Buildingand Nuclear Savety). It has adapted to the organizations of universities to create a climate protection concept. Because of this, the University had applied for a subsidy, and in March 2014, commissioned HIS-HE with the project management and project execution staff.

The project includes the following components:

Energy Balance and CO_2-Balance

The energy- and CO_2-balance involves energy consumption and greenhouse gas emissions in all climate relevant fields and structure in polluter and energy sources. This assumes the determination and knowledge of the internal energy flow at the University and should be reproducible. For the University of Bremen, a detailed, updated balance of the energy consumption will be created. For that purpose, the current counting architecture from properties of the University of Bremen are being reviewed. The CO_2-balance includes an analysis of energy import, energy sources, and energy consumption. Further, it involves the aspects of mobility, procurement, and media supply.

Potential Analyses

The potential analyses are for the short and middle terms, technical and economical saving potentials, including the potential to increase the energy efficiency within the considered fields and for the use of renewable energies. The regulation of the final reduction and saving goals came up through the coordination between the parties involved.

Participation of Actors

For the successful implementation of the climate protection concept, the active involvement of relevant actors is necessary, because acceptance and identification are important conditions for a successful realization. Because of this, the affected administration units, departments, students, and external institutions were informed at an early stage, and are involved as much as possible. The level of involvement was dependent on the saving potentials, as in the willingness to participate. Through the intensive engagement with EMAS, a structural interconnectedness is already in existence.

Catalogue of Measures

The catalogue of measures contains an overview of the short-, middle-, and long-term climate protection measures. For the re-assessed measures, a short description with the following content was created:

- Description of the measure
- Expected total costs
- Statement to the expected energy consumption, energy costs, and CO_2-reduction potential
- Zeitraum für die Durchführung
- Actors – those responsible and target groups
- Priority of the measure
- Action steps and performance indicators
- Estimation on the effect to the outward (as regional value creation) through the proposed measure

The writing of the catalogue of measures was drawn on experiences from environmental management projects and research studies. Not all of the mentioned categories from the catalogue of measures could always been predicted.

Controlling-Concept

The controlling-concept shows the framework for recording and evaluation of the University's consumption and the CO_2-emissions. Also, it shows the framework for the review of the efficacy of the measures for the climate protection objectives. Statements about the involved persons, processes, and regulations, data collection and evaluations, were included. Key figures are essential for the Controlling-Concept, to make the wanted target orientation possible. It is important to ensure the data flow within the University.

Concept for Public Relations

Proposals towards public relations were already established during the concept development. This concept refers to the model, and compliments on already existing University measures aiming to stabilize the overall process. The concept for public relations is focused on University's external actors.

Textile equipped with DWR

Project “Grüne Outdoortextilien”

Dr. Stefan Stolte (Working Group Sustainability in Chemistry)

The Deutsche Bundestiftung Umwelt (DBU/German Federal Environmental Foundation) promotes the project “Outdoortextilien” (Outdoor textiles). According to the motto “Wasserdicht, atmungsaktiv und grün” (waterproof, breathable and green), the UFT (Center for Environmental Reseearch and Sustainable Technology), in cooperation with the Bundesverband der Deutschen Sportartikel-Industrie e.V. (BSI) and the Umweltbundesamt, are producing sustainable alternatives to fluorinated water, oil-, and dirt-repellent textile finishes.

DWR (“durable water repellent”) – coatings are used in the textile industry to improve products with a water-, oil-, and dirt-repellent features. For this, long chain per- and polyfluorinated alkyl compounds (PFASs) are usually used, the most known representatives being perfluorooctanoic (PFOA) and perfluorooctane (PFOS). You can find PFASs in many different industrial products, such as varnish, cosmetics, food packaging, lubricants, and in extinguishing foam. Through these applications and products, PFAS enter the environment. This can be proven within different environmental matrices and organisms, including humans. Even in secluded regions, such as the Arctic and Antarctic, it is possible to find PFASs. This proves the problematic potential of the global distribution of this substance class. In addition to the global distribution, PFASs has a high persistence in the environment. This shows how worrying this substance class is.

Because of these problematic areas, there is a requirement for substitution, especially for the long-chain PFASs, which are used as DWR-coatings within consumer-oriented products as in outdoor functional clothing or other outdoor products (as in tents, bags, etc.). These worrying characteristics of some of the long-chain PFASs and the regulatory activities lead the textile industry to use substitutes. Instead of the long-chain C8-chemistry (PFOA.), here they use especially short-

chain C6-homologous (like perfluorohexane) and their corresponding precursor. From the view of sustainability, there is also cause for concern about the short-chain, fluorinated homologues, because it is possible that above all persistence and accumulation, as ecotoxicological effects in the environment could also occur from the point of structural property relationships and studies. However, there is a lack of sufficient incriminating and exculpatory data. Furthermore, there are already existing alternatives for hydrophobic finishes of textile fibers, for example completely fluorine-free finishes as dendrimers, silicone polymers, polyurethane copolymers, paraffin or wax –based finishes, which are at least equal to the fluorine-containing finishes in their technical performance.

The objective of this project, within a case study about chosen textile finishing chemicals, is to determine the environmental risk potential of fluorine-containing and fluorine-free fiber equipment for outdoor-products. Through participating project partners, the expertise of the industry (BSI-Konsortium), regarding the technical performance on the selection of finishing chemicals, shall be used and combined with the expertise of the research (UFT), and of the regulatory (UBA), on risk and hazard potential analyses of substances. Through this cooperation, the lack of data shall be closed, and the uncertainties about the environmental risks shall be clarified. On the base of this data, a comparative hazard potential analysis of all chosen substances will be done. The data, which will be collected in this project regarding the hazard potential of the finishing chemicals, will be prepared in such a way that the users of the textile fibers could use this data even without any toxicological or ecotoxicological expertise. In this way, a sustainable range of products shall be established.

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Bundespräsident Joachim Gauck visiting the project exhibition at the week of environment (Woche der Umwelt).

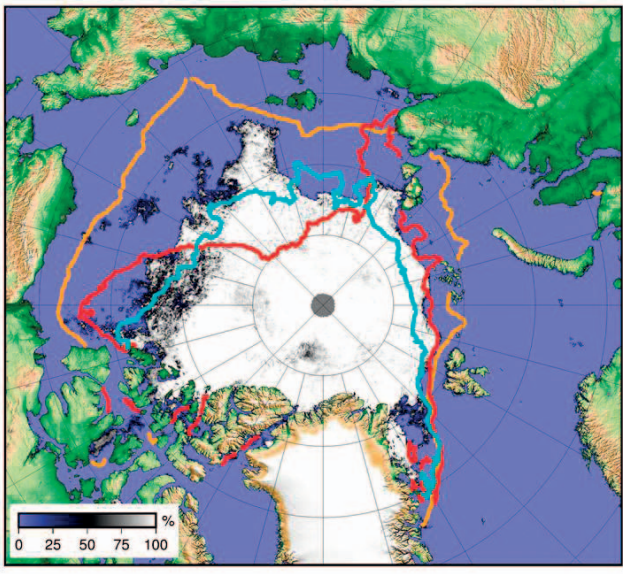
Sea Ice Research at the Institute for Environmental Physics

Gunnar Spreen (Working Group Fernerkundung, Prof. Dr. Nothold)

The air temperature in the Arctic has doubled in the past 100 years, compared to the rest of the world. The Arctic reacts very sensitively to climate change. One of the most visible changes is the decrease of the sea ice and its effect on the ecosystem. A polar bear on a melting ice floe has become a symbol for the Arctic climate change.

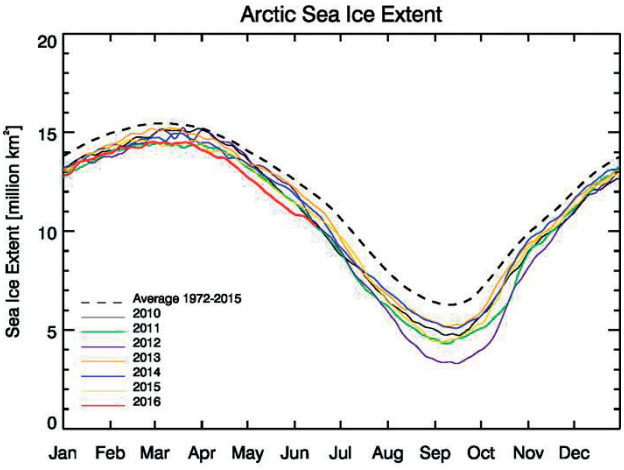
The knowledge that the Arctic summer sea ice surface is sinking at a rate of 10 % every decade is based on a 35 year old time series of satellite data. If the decrease of the Arctic sea ice surface continues, the Arctic Ocean will be ice-free in the course of this century.

The Institute for Environmental Physics at the University of Bremen has a long tradition of satellite remote sensing. Through this, they were able to contribute to this knowledge. Current satellite data is available for the public at *www.seaice.uni-bremen.de*.



Minimum of the arctic sea ice extent on the 6th of September 2015 (shaded white area). For comparison the contours of the minimal arctic sea ice extent in the year 2012 (turquoise), 2007 (red) and the average value for the years 1981–2010 (orange) are located. The years 2015 was the year fourth lowest ice extent.

The Arctic is known for its strong contrast of daylight between summer and winter and for its cloudiness. To observe the sea ice, regardless of daylight and cloudiness, satellite sensors are used. It works in the microwave range of the electromagnetic spectrum. Depending on the frequency and the size of the antenna on the satellite, different resolutions can be reached. The data calculated by the Institute for Environmental Physics from the sea ice surface has a resolution of 6 km, though usually 25 km resolutions are common. Procedures which will make the collected data even more precise and independent from the influence of the atmosphere are currently being developed.



Years transitional of the arctic sea ice extent for the past seven years. The lowest value was reached in 2012 (purple line). 2016 started with a very low sea ice extent in the summer (*seaice.uni-bremen.de*).

The past years are characterized by a particularly low rate of sea ice expanse. The past ten years are all below the long-term average. The absolute minimum was reached in the year 2012. Also in this year 2016, the sea ice expanse lies well below the average. The conditions for a new summer-minimum are given. It depends on the weather of the next months (storms, high temperature) whether a new minimum will be reached.

Besides the sea ice expanse, the thickness of the ice and the snow are also important aspects of Arctic climate change. The thickness of the ice and the snow, for example, determine how much energy is exchanged between the oceans and the atmosphere. Salty sea water freezes at -2° C. But compared to wintry air temperatures of -30 to -40° C, the sea water is quite warm. The sea ice lies like a cover between the ocean and the atmosphere and in a way, it decreases, the heat exchange. Melt ponds appear when the snow starts to melt on the sea ice. They are darker than snow and ice. This is why they absorb more sun energy and lead to an even faster melting rate. Procedures about these and further parameters were developed at the Institute for Environmental Physics and are accessible for the analysis of development and improvement of the understanding of the Arctic climate system.

Besides the sea ice in the Arctic, Satellite data is also analyzed on the Antarctica and on marginal seas, such as the Baltic Sea or the Sea of Okhotsk

“Hiverize – Bee-Project”

(Working Group Neuroinformatics, Prof. Schill)

In Spring 2016, a working group by Prof. Kerstin Schill started a research project on the multisensorial monitoring of honey-bee colonies. The idea for this project came from Thorsten Kluß and Carlolin Zschipping, who build up the project in front of the Cartesium building and continuously supervised it. The bee colonies are accommodated in sensor Langstroth beehives, which are each equipped with a measuring unit out of seven different sensor assemblies.

The objective of this project was to develop a smartphone/tablet/computer app, which provided data and information out of the beehive on a clear surface for the beekeepers. Through this, the beekeepers could immediately know, even without a minimally invasive operation, about their beehives, and were able to react fast on changes. Modern, bee-friendly operation modes, which used to be complex, uncomfortable, and risky, can now be practically realized through sensor support.

The measured values were being merged through cognitively motivated algorithms with further data sources (weather, location, epidemiological profile in the environment). Through the sensory fusion, information became visible, which would have been kept hidden in the single data channels. Measurements out of a single parameter are no guarantee for the internal state, but, through the fusion, these irritations are no longer a problem. Through this fusion, it is possible to recognize complex and abstract states, as for example, whether a hive is in the state of swarming or not. At a large scale use of the sensor Langstroth beehives, it is possible to form a comprehensive database which could support research in the analysis of the causes of the spread and course of diseases. The evaluation of the data was done with the data mining method, which promises the detection of new correlations that could then be used to develop new strategies on prevention and control of bee diseases. The focus of a disease could be identified by the beekeeper in an early stage even without disturbing the hive in an early stage, and could be cured quickly and efficiently.

Bees all over the world are dying in an unprecedented scale. This alarming message reached the focus of the media and sensitized the public towards the issue that bees are not just hard working honey suppliers, but also

play a crucial role in the ecosystem. Without the pollination of crop plants by bees, the food production would have significant struggles, and the consequences for biodiversity would be very serious. Fortunately, more and more people are motivated by environmental protection issues and are taking responsibility for bee colonies, even in cities, regardless of the epidemiological situation. Our project was also initiated because of this. The project will encourage people to reevaluate conventional practices for a change, and to improve for the sake of the bee and their potential function in urban areas.

The project is currently in its pilot stage, in which eight different building types of sensor Langstroth beehives

will be placed around the campus of the University of Bremen. For the sake of recognizing the influence of the different building types and operation modes, measures will be been taken from the beginning. The data collection will be done by a single-board computer, which shall perceptively manage all data processing. However, during the pilot stage the raw data will be transferred to a central server and evaluated offline. Measured are: temperature in the brood at every second honeycomb, the air humidity in the beehive, the airflow speed at the entrance hole, the airborne sound within the hive, the weight change of the bee colony, solar radiation, and, using a camera at the entrance hole, the amount of bees flying in and out. To keep the project practical, only generally available sensor technology was used.

The project is located in Bremen. For the research, honey-bees grown in Bremen are used. The cooperation with an institution from southern Germany and one from Switzerland has the potential to make the research project even more generally valid.

The research project is actively part of the teaching. Besides events from the FB 3, as “Ausgewählte Probleme der multisensorischen Kognition” (Selected Problems of Multisensory Cognition), it is also a part of the seminar “Bienen und Menschen” (Bees and Humans) from the FB 9. Guided tours through the research location at the Cartesium are offered for interested researchers. Currently, the project is also involved in the project week of the Gymnasium Lilienthal.

Determining the Emission-Sources and Sinks in Greenhouse Gases

Thorsten Warneke and Justus Notholt
(Working Group Remote Sensing)

In the past few decades, remote sensing was established as a useful measuring method within climate research. With the help of ground scanning, or measures by satellites, several trace gases in the atmosphere could be measured. Thereby, either direct or scattered sunlight or the emission of trace gases is used as a light source. Through this, you could not only get a concentration at the observation place, but also in the whole atmospheric column. Regarding the satellite measures, it is especially important to mention the SCIAMACHY instrument of the European Envisat satellite, which was developed by the IUP (Prof. Burrows). The ground scanning was internationally organized by two networks: the NDACC (Network for Detection of Atmospheric Composition Change) and the TCCON (Total Carbon Column Observation Network). We were a major player in the development of these networks, and we operate in the IUP station, as well as several NDACC and TCCON measuring stations worldwide, one of which is located in Bremen. In the astronomic dome of the NW1 building, a spectrometer is located, which measures the composition of the atmosphere. While the focus of research in the past was on the stratospheric ozone depletion, it is now focused on the long-lasting greenhouse gases, especially CO_2 and CH_4.

Since the beginning of industrialization, the global increase of temperature at ground level is, to a large extent, caused by the concentrated increase of the greenhouse gases CO_2 and CH_4 in the atmosphere. CO_2 is released by the burning of fossil fuel as well as land-use change. However, only half of the emitted CO_2 remains in the atmosphere. The other half is absorbed by the terrestrial biosphere and the oceans. The absorption through the biosphere is especially not understood positively. In the case of CH_4, the situation is even more complicated since it has several sources of mechanisms that are not well understood. One important objective of our research is to improve our understanding about the sources and sinks of greenhouse gases. This is essential for the prediction of the future climate and for political decisions that could counteract with appropriate measures.

Information about sources and sinks we received through two different approaches. The first was based on measures of the atmospheric concentration of CO_2 and CH_4. Here, through inverse modelling, the sources and sinks could be found. The second approach was based on the direct measurement of the exchange flow within different ecosystems. These measurements provided information about the contribution of processes of ecosystems, which could be extrapolated. In the past years, we have examined the emissions of CO_2 through direct solar radiation. This mechanism was identified as an important source of CO_2 in arid ecosystems (up to 20 % of CO_2-Emissions in this area). Our measures have also shown that the emission out of these sources was overestimated. Furthermore, we examined the emissions of CO_2 of peat water in Southeast Asia. Peat waters in Southeast Asia save massive amounts of carbon. This is why this region is so important for the global carbon cycle. In cooperation with the Leibniz Zentrum für Marine Tropenökologie, we were able to show that the CO_2-Emissions out of these waters are lower than expected.

Astronomical observatory at the NW1 Building. In the observatory is a sun seeker, which collects the sunlight and includes it into the spectrometer.

Validation

(Declaration of the environmental expert)

The Environmental Verifier
Dr.-Ing. Hans-Peter Wruk
Im Stook 12, 25421 Pinneberg

Registration Number DE-V-00051, accredited or authorized for (NACE-Code) 80.3

Has validated the environmental management system, environmental audit and its results, the environmental performance, and the environmental statement of the institution

Universität Bremen*

*EXZELLENT.

Located at Leobener Straße, 28359 Bremen

On the ground of the NACE Code 80.3 “Higher Education” in accordance with Regulation (EC) No. 1221/2009 from the European Parliament and of the Council from 25. November 2009, allowing voluntary participation by organizations in a Community eco-management and audit scheme (EMAS III).

On signing this declaration, it is confirmed that the appraisal and validation have been carried out in complete harmony with the Ordinance (EU) No. 1221 /2009; the results of the appraisal and validation confirms that there is no evidence of non-adherence to the applicable environmental regulations and that the data contained in the updated environmental statement provide a reliable, credible and truthful portrayal of all activities within the scope specified in the environmental statement.

The next consolidated environmental statement will be submitted for validation by 1. June 2016 at the latest. In 2017 and 2018, validated and updated environmental statements will be published.

Pinneberg, 31st of May 2016

Dr.-Ing Hans-Peter Wruk
Environmental Verifier
Registration No. DE-V-00051

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