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Universities as role models for sustainability: a case study on implementation of University of Gothenburg climate strategy, results and experiences from 2011 to 2015

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Abstract: This paper undertakes the concept of universities as role models for sustainability, regenerative sustainability and universities as living laboratories through a case study from University of Gothenburg and the implementation of the climate strategy. The climate strategy is a comprehensive university-wide strategy, including collaboration between faculty, administration and management, as well as with external stakeholders. With the support of its environmental management system (EMS), the University of Gothenburg manages climate action with a systematic approach, both in implementation and follow-up. This creates opportunities for technical solutions and social learning processes, and allows the University of Gothenburg to serve as a living laboratory and a role model for sustainability. The climate strategy was initiated 2011 and by the end of 2015 the target to reduce total carbon emissions by 20% was almost reached with a reduction of 18.5% compared with the baseline year 2008. The total energy use was reduced by 19%. These results were achieved even though the university revenues, staff/employees as well as students has increased from the year 2008 to 2015.

Keywords: EMS; environmental management system; climate strategy; living laboratory; interdependent approach.

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1 Introduction

The concept 'Sustainable development' was launched for the first time in the so-called Brundtland Commission's report 'Our Common future'. Sustainable development was defined as "development that meets today's needs without compromising the ability of future generations to meet their own needs" (WCED, 1987). Now that the research society is united in the conviction that human patterns of production and consumption causes effects on the Earth's climate system, there is an urgency to change technologies, social practices and social norms.

The UN and UNESCO have declared that education has a key role for a sustainable future that has been stated in the Millennium Development Goals and in the Decade of Education for Sustainable Development 2005–2014. The outcome of these processes

serves as input for the sustainable development goals (SDGs) that were established in November, 2015. This will be followed by the 2030 Agenda for Sustainable Development that will initiate in 2016 for the next 15 years. It includes the emphasis on: “By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development” (United Nations, 2015).

Chambers (2009) states that education has a key role for a sustainable future. Due to their high societal impact, universities are challenged to take a leadership role in sustainability issues. As universities educate the next generation of decision-makers and influencers, universities can have a vastly greater impact on sustainable development than any other single sector in society. Universities, therefore, have an important role in the strive to achieve the future SDGs.

On the national level, there was a change in the Act of Higher Education in Sweden in 2006 where it is stated that “Universities shall in their activities promote sustainable development so that present and future generations are assured a healthy and good environment, economic and social welfare and justice” (Ministry of Education and Research, 1992). This change clearly states and stresses the important role for universities in the process of sustainable development.

Universities are thus important in developing relevant skills among the leaders and citizens of tomorrow. Campus sustainability is an important avenue for raising awareness about sustainability. Universities have the opportunity to be role models for sustainability. At the same time, it is important to gain insight on the challenges and obstacles that universities are facing in such a process.

In this paper, the possibility for universities to be role models for sustainability is investigated, the analysis framework is also integrated with the concept of regenerative sustainability and universities as living laboratories. Robinson et al. (2013) express regenerative sustainability by asking the question “To what degree can human activity actually improve both environmental conditions and human quality of life?”. When the actions become regenerative the agenda shifts from constraints and limits to opportunities and achievement of net positive results (Robinson et al., 2013). König and Evans (2013) argue that initiatives that use university and city or parts of them as places to experiment with sustainable forms, technologies and lifestyles, so-called living laboratories, are becoming an increasingly popular model, because “they have the power to harness the academic capacity of universities to address the challenges of sustainable development”. Hua (2013) reflects on campuses being promising areas for living laboratories for development of solutions for low-carbon communities and sustainable cities. Hua states that experimentation could go beyond technological level, and expand to also include planning practices and societal issues (Hua, 2013).

Kilkis (2014) argues that universities have at least three key roles to play in; research, education and outreach. Kilkis is claiming that there is an emerging trend for a ‘fourth’ role, defined as the ability of universities to reduce resources usage and CO₂ emissions on their own campus, and to integrate sustainability into the academic curricula. From these perspectives, the implementation of the climate strategy at University of Gothenburg serves as an interesting and comprehensive case study.

2 Theoretical framework

2.1 A sustainable university

A sustainable university is defined by Velazquez (2006) as:

“A higher educational institution, as a whole or as a part, that addresses, involves and promotes, on a regional or a global level, the minimisation of negative environmental, economic, societal, and health effects generated in the use of their resources in order to fulfil its functions of teaching, research, outreach and partnership, and stewardship in ways to help society make the transition to sustainable lifestyles” (Velazquez, 2006).

Several authors argue that sustainable development, in order to be effective, must infiltrate all aspects of the university, including educational and operational elements. This is consistent with the findings of Cortese (2003) that a university system consists of four dimensions, namely Education, Research, University Operations and External Community, which often have been seen as separate, based on hierarchical and competitive structures. But in order to develop a vision for a sustainable campus, he argues that it is necessary to understand the interdependence among these dimensions and to increase the collaboration between them, “as all parts are critical for achieving a transformative change” (Cortese, 2003).

According to Velazquez (2006), the first three dimensions, namely education, research, and outreach and partnership, can be carried out inside or outside the campus while the fourth is aimed at implementing sustainability on the campus itself. Velazquez, as well as Alshuwaikait and Abubakar (2008), argues that there are two fundamental means to achieve these strategies. First to raise awareness among students, faculty and staff in order to develop new competences that lead to more sustainable practices, and finally, to a more sustainable society. Secondly, to reduce the universities’ environmental impact as operating institutions on local and global level (Velazquez, 2006; Alshuwaikait and Abubakar, 2008).

According to Disterheft et al. (2012), an environmental management system (EMS) can be seen as one tool in the overall process to enhance campus sustainability. A mix of top-down and participatory approaches is regarded to be most effective to accomplish the two-fold mission of a university as mentioned above:

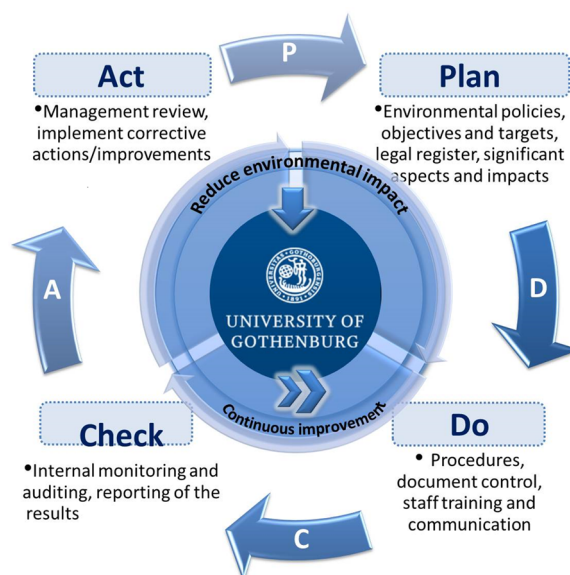
- to reduce the institutional environmental impact
- to carry out research and teaching, offering opportunities to develop competencies that lead to more sustainable practices.

Several case studies (e.g., Disterheft et al., 2012; Ferreira et al., 2006) show that EMS at the campus can be used in a broader sense beyond campus operations, including also the dimensions of education, research and outreach (Nicolaidis, 2006; Brorson and Sammalisto, 2008) as identified by Cortese (2003). The assumption that an EMS can enhance sustainable practices and participation was supported by Disterheft et al. (2012). EMS offers manifold possibilities to give students, faculty and staff the opportunity to put sustainability into practice (Disterheft et al., 2012).

2.2 Environmental management system (EMS) as a systematic platform

An EMS provides a systematic way of managing an organisations environmental issues and is based on a ‘plan-do-check-act’ (PDCA) model developed by Deming (1986). The EMS gives order and consistency for organisations to address environmental concerns through a systematic approach; the allocation of resources, assignment of responsibility and ongoing evaluation of practices, procedures and processes. The guiding principle of an EMS is ‘continual environmental improvement’ (International Organization for Standardisation, 2015) and the EMS serves as a tool to improve environmental performance (Omrcen et al., 2013). A schematic of the PDCA as applied by the case study of this paper is provided in Figure 1. The University is both EMAS registered (Eco Management and Audit Scheme) and certified in accordance with ISO 14001.

Figure 1 ‘Plan-do-check-act’ (PDCA) model (see online version for colours)



Source: University of Gothenburg, based on Almgren and Brorson (2007)

This is a management philosophy that seeks improvements as a never-ending process of achieving small improvements. It is always necessary to go through the cycle again for solving new challenges and problems. The implementation of the model must not be a static process for generating a particular initiative. Therefore, the four phases of the model are a series of iterations that are designed to continuously work to improve the sustainability of the institution (Velazquez, 2006).

Sammalisto (2007) states that an EMS can function as an effective means to integrate sustainable development in all university activities, including education. The regular audits required by a certified EMS keep the activities on the university agenda and provide opportunities for follow-up, for feedback and for further development.

In their study, Disterheft et al. (2012) shows that lack of awareness from students, faculty and staff is a frequently reported barrier to campus greening but by offering hands-on approaches to tackle complex problems, the situation can be reversed. With

regard to the global challenges and expected changes in the job markets, it is particularly essential to prepare the students in the best way for the needs society is confronted with and to involve them in establishing new sustainable strategies. EMS at the campus can help offering these practical learning experiences.

2.3 The concept of living laboratories

According to Dryzek (1997), experimentation has been recognised as a key requirement of sustainability. These experiments increasingly take place in bounded spaces in cities or on university campuses, termed ‘living laboratories’, which promise to generate knowledge that is applicable to real-world situations (König, 2013).

The purpose of living laboratories is not only to allow novel things to be tried that would not be possible in conventional urban settings, but also to carefully monitor their social and physical impacts in order to provide a robust knowledge base for learning. König (2013) states that “as such, living laboratories are a key mechanism through which universities are seeking to contribute to a wider societal transition to sustainability”.

The living laboratory provides a focal point around which stakeholders can work together, generating communities of interest that may well outlive and transcend the living laboratory itself. According to König (2013), living laboratories are an increasingly popular model through which universities and cities are engaging with each other to generate practical solutions to applied problems.

Also Evans and Karvonen (2011) express that living laboratories are distinctive because universities engage their research capacity and expertise to set up, monitor and evaluate real-life experiments. But, as Jasanoff (2004) states, the development of technological fixes alone is not the most effective way of achieving real transition, directing attention to the cognitive, material, social and normative ways in which lifestyles are constructed.

3 Methodology

3.1 Action research

In this study, the authors have been inspired to use the methodology of action research. Since the authors all take active part in the implementation of the university climate strategy, this could be seen as a natural choice. In using action research, the similarities with the EMS principles of the PDCA model (see Figure 1) were also observed. Already in the 1940s, it was stated that action research with its cyclic process of ‘plan-act-observe-reflect’ was a key process to solve-specific problems with a focus on continuous development. The researcher would always be observing the process and results, and through reflections, developing new research questions to be part of the ongoing research process (Rönnerman, 2012).

The authors have been taking part in the actual implementation, studying the processes, following up the results for each year, evaluating the process, experiences and lessons learned. Discussions and reflections has then been part of the process for each year. A continuous improvement of the strategy in itself has become a result.

To be an active part in the research process, it is of importance to be able to change roles being both an actor and an observer. Various activities, including documentation and continuous meeting with the 'climate working group' (CWG), has enabled the change roles in the process. Rönnerman (2012) states that action research is about development and change of task, process, problem, but also about gathering knowledge about the actual change process and what is going on during the work/process. The challenge is to develop a relation and cooperation between thinking, activity and reflections in practical work. It is important to ask the questions, plan for activity, initiate the action, observing the results and outcomes and then finally, reflect over both the results as well as the change process in itself.

The initiatives within the climate strategy follow the 'plan-act-observe-reflect' process. Plans, targets, ambitions that were formulated were changed depending on the outcomes and reflections were made during the process.

One critical part in the action research process, according to Rönnerman (2012), is the way the analysis is used and how new knowledge and insights are used in the practical work. If the participants, even with new knowledge, continue to work as always, then the action research is reduced only to be a technical method. But if the participants choose to change their practical work based on the analysis that has been done, then it is possible to see a new and deepened learning with changes that are based on research and proved experience. One clear example is the energy efficiency program that was initiated that had as a target to initiate 'energy-saving-campaigns' at every faculty. The program was evaluated and changed into a systematic work focusing on the operations and buildings that had the highest energy consumption.

The process of action research can be seen from a 'bottom-up' perspective where the actors in practice are the change agents. This is in comparison with a 'top-down' perspective when it is somebody from the outside that decides what should be developed and changed. In this case study, the authors can show and reflect on the combination of these two perspectives and how they are in some way integrated and intertwined.

3.2 *Description of the case study*

The site of the case study, the University of Gothenburg, is integrated in the city of Gothenburg, Sweden's second largest city. The university does not have a physical campus area, as it is integrated in the city as a 'city-campus'. The university does not own the buildings it is operating in. The organisation of the university is shown in Figure 2 and some information about the university are listed below (University of Gothenburg, 2016a):

- 37,000 students (full time students: 25,397).
- 5462 employees.
- *Premises*: 38,363 square metres.
- *Revenues*: 5963 Million Swedish Kronor (SEK).

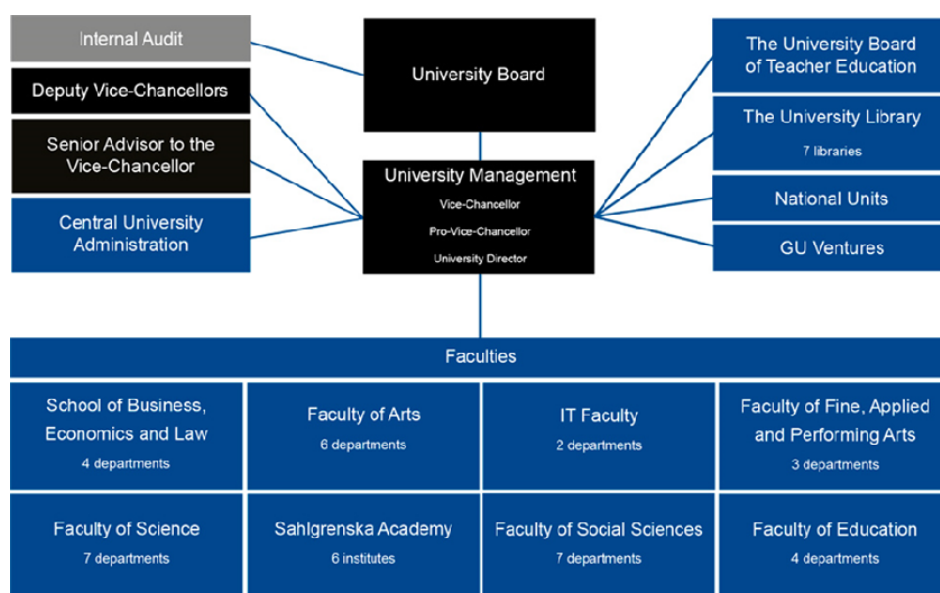
There are eight faculty areas:

- pharmacy, medicine, odontology and health care sciences
- natural sciences

- arts and humanities
- fine, applied and performing arts
- social sciences
- business, economics and law
- education
- information technology.

By the fall of 2009, the Vice-Chancellor of the University of Gothenburg assigned the environmental manager to develop a climate strategy. The University has an EMS that is both EMAS registered (Eco Management and Audit Scheme) and certified in accordance with ISO 14001. With its well-established EMS, the university held an excellent position to implement a climate strategy and carry out systematic monitoring of this.

Figure 2 Organisational chart University of Gothenburg in 2015 (see online version for colours)



Source: University of Gothenburg (2016b)

By having an ambitious objective, the challenge was to determine whether the University of Gothenburg could be able to take responsibility and set an example demonstrating the importance of the climate issue?

The research questions are “Is it possible for multi-site city universities, to address climate impact across several areas in an effective manner?”, and if so “In what areas could and should the main focus be?”

4 Results

4.1 *The background to the climate strategy*

The university abandoned the objective for reducing its climate impact and emissions from travelling and energy use. This initiated a process where the local media questioned the decision. The students as well as many researchers and staff were critical to the decision. The environmental manager then got the commission, from the Vice Chancellor, to investigate what the university could do when it came to reducing its climate impact, aiming at and discussing the following factors:

- negative results = increased CO₂ emissions
- revised targets in the action plan
- negative media attention
- new demands from the government
- national and international targets and agreements

The work process was led by the environmental manager and a workgroup consisting of personnel from the environmental unit and faculty of natural science and Sahlgrenska academy (Medicine, Odontology and Health) focused on the following areas:

- internal inventory – what do we already have?
- external inventory – what do others do? Including legal framework, targets, etc.
- suggestions for future goals and initiatives.

Several seminars were held with different researchers presenting different aspects of climate impact. A draft version of a ‘Climate initiative or strategy’ was developed which was discussed on several so-called hearings. It was also presented to the deans of all faculties.

The climate strategy was decided on in 2010 and implementation started in 2011 with the final year set to be 2015. The Environmental manager got the commission to implement the climate strategy and to reach the objective of 20% CO₂ reduction by 2015, compared with the base year 2008 emissions. The annual budget was 300 000 Euro and the results should be reported annually to the university management.

4.2 *Objective and action areas*

The main objective with the climate strategy was to reduce total carbon dioxide emissions by the year 2015 by at least 20% compared with 2008 levels. The University of Gothenburg also aimed to reduce total energy usage by 10% for the same period.

This was planned to be achieved mainly through:

- energy efficiency measures
- adapting business travel in line with climatic and environmental considerations.

Areas with an indirect positive or negative impact on the climate had also been identified to reinforce the University of Gothenburgs climate-related efforts. These include areas of research and education, cooperation and communication, coordination of purchasing and transport, computer use and food.

Carbon off-setting was made for all climate affecting emissions from air-travel, without it being calculated for in the objective follow-up. In contrast, the university has no stated ambition to become 'CO₂ neutral' or 'Climate neutral'.

The target fulfilment was monitored through emissions from travel and energy consumption. The target was set in absolute figures, giving that when the university grows in revenues, students and/or staff, it would not affect the target.

4.3 Organisational framework

In order to win support for the strategy and to drive its implementation forward, the University formed an internal Climate Committee consisting of nine eminent researchers within the climate field. Two of them, Ulf Molau, Professor in Environmental Sciences and Thomas Sterner, professor in Environmental Economics, are also lead authors in the UN IPCC. The task of the Climate Committee was to provide guidance and opinions on the university's climate-related work, and to assess the measures described in the strategy. At the University of Gothenburg, this is a unique way of gathering knowledge produced within the University for Application on its own operations.

The climate working group within the environmental unit played a key role in planning, coordinating, facilitating and monitoring the climate strategy. Together with the environmental coordinators on faculty and department level it became a strong support organisation (Figure 3). The EMS enabled a target-oriented and systematic approach to achieve the ambitions set forth in the climate strategy. The EMS also facilitated the management engagement necessary to implement the ambitions outlined in the climate strategy.

Swedish universities are according to legislation not able to buy or own real estate. The university hires thus all facilities from public and private corporations on contracts on up to a maximum of 10 years, which imposes a great challenge in terms of creating incentives for energy savings as well as campus development. An aspect that increases the complexity even more is that the University of Gothenburg does not have a physical campus area, it is a 'multi-site city university' integrated within the city of Gothenburg. One could state that the city is the 'University campus'.

In order to reduce climate impact, sustainability aspects has been integrated into the University policy for new construction and refurbishment. A sustainability group with representatives from the University Environmental Unit, Communication Unit and Property Unit was appointed with the mandate to ensure that sustainability issues are included and followed up in major new construction and renovation work planned at the University of Gothenburg. Naturally, this also implies an in-depth collaboration with the property owners.

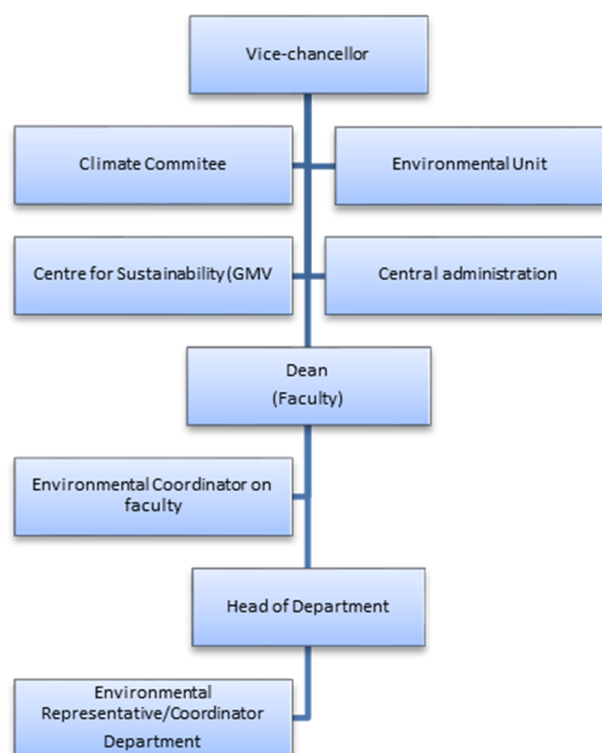
4.4 Successful initiatives

The climate strategy has been awarded the prestigious 'Excellence in Campus Award' by the network 'International Sustainable Campus Network' (ISCN). At Harvard in 2014 the University of Gothenburg was presented the award as "A success story on climate change

mitigation through transboundary collaboration in a complex academic environment”. The awards has made the climate strategy visible and reinforced the coming investment for the future.

Below some of the initiatives within the climate strategy clustered in ‘Awareness’, ‘Movement’ and ‘Investments and Infrastructure’ are presented. The results for some of the initiatives are discussed in the section on analysis and reflections.

Figure 3 Organisation for implementation of climate strategy at university of Gothenburg (see online version for colours)



4.4.1 Awareness

Students committed to climate

The student initiative Fossil Free University of Gothenburg argue that certain investments support fossil energy production that is immoral and financially short termed, and campaigns for divestment. The outcome was that the Vice Chancellor gave a commission to the fund Board to evaluate, and if necessary, change the criteria for the policy of financial investments made by the university. The Vice Chancellor decided therefore not to sign the ‘Fossil free’ campaign document, which made the students a bit disappointed.

Sahlgrenska Academy Students for Sustainability (SASS) and Handels Students for Sustainability (HaSS) actively promote engagement in and dispersion of knowledge about sustainable development.

In the current climate strategy several lunch restaurants at the University of Gothenburg introduced meat-free days, initiated by the SASS. SASS had the worldwide

public health campaign, Meat Free Mondays, as inspiration and beyond the public health perspective they highlighted the climate and environmental impact, from meat production as well as, ethical and global solidarity as arguments for a reduction in meat consumption. The Vice-Chancellor of University of Gothenburg supported the initiative, but the introduction of meat-free days was voluntary for restaurants and cafés, and no agreement was changed.

This initiative was hard to arrange and the campaign was named ‘meat-free onedays’ since different owners of the restaurants and cafés wanted to have their specific day if participating. Even then it was hard to make them implement the ‘meat-free oneday’ concept.

Mainly the students own initiatives are supported through simple gestures. That could include arranging meetings with the vice chancellor, offer a meeting room outside office hours or provide smaller economic support for certain projects.

University of Gothenburg is involved in the agreement students climate ambassadors, run by the University of Borås, and is part of Västra Götalands climate strategy smart energy. The goal of the agreement is to spread knowledge about sustainable lifestyles among young people, and to support the increased involvement of students for sustainable development. The exchange of experiences between the participants in the agreement allow for a more widespread impact. The agreement commits the University of Gothenburg to involve students in the design of the university’s future climate work.

Climate award ‘Klimat-Åskar’

Every year one of the departments or units at the University is awarded a ‘Climate Åskar’ (similar to the Hollywood Oscar Award). The winning department is the unit that excelled in lowering its energy consumption and business travels during one year. The award is distributed by the vice chancellor at a festive ceremony. This initiative encouraged a competition between the departments, and made the staff and management aware about the ‘climate impact’ of their operations. It also made the reporting and evaluation of results more visible, not only being in the annual sustainability report.

Climate seminars

The University gives a series of interdisciplinary climate seminars, aiming to highlight the importance of research dealing with climate change. Approximately five seminars have been held each year, of which some examples is mentioned here: ‘What impact does the media have on our view of the climate issue?’; ‘How is human health affected by climate change?’; ‘Fossil-free universities, fossil-free world?’; ‘Climate and gender’; ‘Do we become happier if we live more climate-smart?’

At each seminar there are researchers from different disciplines giving their reflections on a certain topic or issue in order to show the complexity of different climate issues. One interesting outcome from the seminars is that attending researchers, earlier not aware of each other’s areas of expertise, find possibilities of further exchange with peers.

The seminars have become very popular and gathers each time some 150–200 staff, students and other stakeholders, in total 750–1000 participants per year. The seminars are open to the public.

4.4.2 Movement

Travel and meeting policy

As part of the climate strategy the university revised its travel policy. A new policy was established in 2011 together with an instruction of implementation and use. One new and challenging aspects was that flights under 500 km was not recommended unless motivated and approved by your manager.

In the new policy for travelling and meetings the ‘non-travelling’ is a new element. This means that employees at each travel occasion are encouraged to investigate the possibility of replacing the trip with an audio, video or web-based meeting. To appear on the world scene in the science context is, however, of great importance to the university. To avoid getting into a conflict of interest the University of Gothenburg makes the necessary investments for a university shared infrastructure solution for video conferencing. The University also works to ensure that all employees should have access to good technical video and web-based conferencing equipment and that everyone should have adequate training in how to use the technology.

A part of the city

Together with the city of Gothenburg and Sahlgrenska university hospital, the university is setting up a ‘green itinerary’ for a well visited university area situated in the city, ‘campus medicinareberget’, aiming to develop an easy accessible campus without increasing motor traffic. The project is focusing on improved access for bikes and pedestrians as well as more frequent public transports. The city of Gothenburg is aiming for the ‘Green Itinerary’ to become a prerequisite for initiating any development program in the city.

The bicycle challenge

To promote health and lower climate impact, the university has encouraged its staff to participate in many different events arranged by the city; all in order to encourage walking or biking to work instead of using the car. The most popular event has been the ‘Bicycle challenge’ where the university has sponsored 300 entries for the staff. Another yearly event has been bicycle campaigns with free bicycle repairs arranged at several places at the university.

Purchase and transport coordination

By interaction and participation in tenders for ~~a~~ framework agreements the University aims to set environmental and climate requirements including transportation. In a contract for waste management that was carried out in 2014, demands were made to coordinate the transports in order to reduce the number of trips for collecting the waste. In 2014, the procurement of computers was carried out in cooperation with Chalmers University of Technology. High demands were set regarding environmental impact, sustainable development and social responsibility. In addition, the supplier was required to minimise transportation at delivery. A single supplier makes it easier for institutions shared by the University of Gothenburg and Chalmers University of Technology to purchase computers that meet the requirements of both universities.

4.4.3 Investments and infrastructure

Climate off-setting through gold standard CDM

In line with the University vision of increased internationalisation, carbon dioxide emissions from travels have increased by 20% since 2008. In order to balance these emissions, carbon offsetting is applied by investing in a gold standard clean development mechanism (CDM) project. The university has developed a system where every flight is added a 'climate fee'. From the beginning, it was differentiated according to climate impact, so that longer flights required a higher sum than a shorter flight. The principle used was 'the polluter pays principle' which means that the person who makes the travel has to pay the climate-fee.

The new climate fees were changed in 2014, to a fixed fee for every flight, which is 118 SEK or 12 EURO. Shorter flights are thereby subject to a relatively higher fee than longer flights. This is in line with the travel policy, that argues that short air flight should, if possible, be avoided.

Carbon offsetting is viewed as secondary to energy efficiency measures and sustainable travelling. The university do not use the offsetting to become 'climate neutral', nor is it used for reduction of climate impact/footprint in the annual report.

Internal climate fund

An internal climate fund, financed by part from climate off-setting fees, was launched in 2014. All university staff and students are able to apply for funding of projects that help reducing the university's carbon footprint. The first projects to be funded were:

- *Autonomous satellite transmissions replace diesel research in Antarctica*

Technology development and production of measurement buoys that will allow data collection remotely from research in Antarctica.

- *The student symposium EuroEnviro2015 catalysts of change*

Financial support for climate smart trips for participants during the symposium.

- *Electric car*

Partial funding for the purchase of an electric car that will replace the diesel minibus used today for passengers.

- *Minimising the carbon footprint of handling of chemicals*

Inventory of opportunities to take into account the carbon footprint of substitution and method development of chemical use.

- *Operation of a small boat with renewable energy*

Purchase of an electric engine for the operation of a small boat.

Energy efficiency program

In the initial part of the climate strategy, there was programs setup for energy savings at each faculty. Focus was on changing behaviour of staff and students. Campaign material was produced and kick-offs were initiated. The result varied.—Some faculties and departments worked very hard with the programs, others did not do so much or did not

participate at all. Though awareness was raised about the difference between infrastructure (mainly owned by the property owners) and individual challenges for reducing energy use in a building. After an evaluation of the programs it was decided that the focus should be on cooperation with the property owners in a structured form and with focus on buildings that are 'energy high consumers'.

Cutting energy at the laboratory for experimental biomedicine (EBM)

In a joint project, the Sahlgrenska Academy and the property owner Akademiska Hus, carried out several major energy efficiency measures in order to reduce use of fossil natural gas and total carbon dioxide emissions from EBM, the most energy consuming entity of the University. This project is unique because it saves energy and money and it improves the work environment and the animal welfare, at the same time.

For example, connecting the central ventilation directly to the animal racks is an innovation, developed by our technicians, and has not been done anywhere else to the best knowledge of the authors. After one year, adjustments and analyses was carried out in order to fulfil the first part of the project and to set up new goals for a second part.

The project at EBM has been awarded the prestigious 'Excellence in Building Award' by the network 'International Sustainable Campus Network' (ISCN), in 2013. Many other universities, with the similar research and facilities, have been very interested in the knowledge and experiences from the 'EBM project'.

Sustainable lease agreements

The university has a joint project on Sustainable lease agreements together with the university's second-largest property owner. The project is based on a number of identified energy measures in various properties the university rents and aims at a declaration to work in cooperation for reduced environmental impact in the real estate.

Planning for renewable energy

Students at the School of Business, Economics and Law were assigned to count on profitability and environmental benefits of installing a solar PV system on the school roof in order to provide recommendations to whether, and under what conditions, the school should agree to such an investment.

The assignment was carried out in collaboration with the property owner, Akademiska Hus, who now has made the installation of 200 square metres solar panels with a capacity of ~30 MWh. The concept will be used in several faculties across the University in order to implement energy efficiency measures that have been identified in a joint energy savings project with other property owners.

IT services and use of computers

The total annual consumption of electricity for IT (computers, computer monitors, printers, copy printers, and servers) was 2.4 GWh, in year 2015, which is equivalent to 7% of the university's total annual consumption of electricity. An estimate using the measurement standard Energy Star shows that IT electricity consumption at the university has been reduced by at least 40% from 2008. Thanks to a comprehensive optimisation projects the estimated numbers of printers and copy printers have decreased by 50% since 2008. The number of data centres and server rooms has been greatly reduced. Virtualisation of servers and effective coordination of the system has resulted in 75% fewer server rooms since in 2008. Almost half of the university's computers are

now available in the common computer workstation environment DAFGU. The IT unit has extended service for computers from three years for laptops and four years for desktops, to 4 and 5 years, respectively. This way the computer lifecycle is prolonged and the carbon footprint at the manufacturing level decreases.

Policy document for buildings and campuses

An example of a sustainable building project is the School of Sport Science at the Department of Food and Nutrition/Sport Science. The school is a national knowledge centre for development in sports performance and health promoting work. The house is 3600 m² and equipped for sport activities, test and research laboratories, dance studios and ordinary facilities, such as classrooms and offices. The house, which is owned by property owner HIGAB, was opened in the beginning of 2011 and is certified according to the environmentally classified building – gold class and green building (Swedish Standard). The environmental profile is visualised partly through minimised energy use, and use of renewable energy sources. It has a high flexible indoor environmental quality and climate (IEQ, IAQ) and no environmentally harmful materials or chemicals were used in the construction.

The knowledge and experiences from the sustainable building project at the School of Sport Science was used to develop a policy for new and renovated buildings. The policy was designed by a working group with representatives from three units at the central university administration; facilities, communication and environment. The policy states that in all construction projects, there should be possibilities to choose solutions that support good performance for sustainability. The aspects of environment, functionality, work environment and safety must always be considered. The aim and objective for new and renovated buildings is that they should be certified according to the environmentally classified building – gold class and green building (Swedish Standard). At the university, its buildings and surroundings shall visualise an, accessible, inviting, open and cohesive university. The university buildings should communicate openness, quality and community involvement.

4.5 Evaluation, reporting and communication

Every year the climate strategy was evaluated and the results of different events and projects were published in a 'climate report'. The award 'Climate Åskar' was delivered to the proper winner and the results were also published in the University Sustainability Report. The gathered knowledge produced within the university, in form of yearly results, were used for application on its own operations and also served as a base for future priorities.

The results were communicated through several different channels such as newsletters and on the internet. 'Grönheter' (Green News) is a monthly leaf letter of environmental news at the university that reported on coming events or results from recent events.

In 'Grönheter' the projects, initiatives and results from the climate strategy was continually presented, with the ambition to share knowledge with staff and students, but also other stakeholders. Some of the projects and results were also presented in the official university magazine 'GU-Journalen'.

A summary of all initiatives connected to the climate strategy is presented in Table 1.

Table 1 Summary of all initiatives connected to the climate strategy

<i>Initiative</i>	<i>Involved stakeholders</i>	<i>Measures</i>	<i>Results direct and indirect CO₂ emissions</i>	<i>Ongoing/unique</i>
'Meat-free Onedays' at the university cafés and restaurants	Students Management Staff	Student driven campaigns in cooperation with owners	Raising awareness	Has ended
Student initiative fossil free university	Restaurants Students Management Staff	Campaigns for divestment in fossil energy production	Raising awareness	Ongoing
Interdisciplinary climate seminars	Staff and students Other stakeholders	Seminar series open to the public. Five seminars per year are arranged	Investment Aiming to highlight the importance of research dealing with climate change	Has ended
Award 'Climate Askar'	Staff, management	Competition to lower energy consumption and business travels	Raising awareness Reducing CO ₂ Investments	Has ended
New policy for travelling and meetings the 'non-travelling' is a new element	Staff	Replacing their travel with an audio, video or web-based meeting.	Raising awareness Reducing CO ₂ Investments	Ongoing
Support for 'non-travelling' meetings	Staff	Shared infrastructure solution for video conferencing	Investments staff training Maybe reduction in CO ₂ emissions	Ongoing

Table 1 Summary of all initiatives connected to the climate strategy (continued)

<i>Initiative</i>	<i>Involved stakeholders</i>	<i>Measures</i>	<i>Results direct and indirect CO₂ emissions</i>	<i>Ongoing/unique</i>
Carbon off-setting for air travel	All staff Travel agency	Investing in a Gold Standard Clean Development Mechanism (CDM) project	Raising awareness	Has ended
Internal climate fund	Staff and students	Financed by climate off-setting fees, was launched in 2014	Investments Raising awareness Investments	Ongoing
‘Grönheter’/ Green News	Staff Management	Communication of initiatives and results	Movements Awareness and communication	Has ended
Annual “Climate Report”.	Staff Management	Communication of initiatives and results	Awareness and communication	Has ended
Environmentally classified building – gold class and green building	Staff Management	Policy documents	Raising awareness	Ongoing
Installing solar PV system	Property owners Akademiska Hus, Students at the School of Business, Economics and Law of installing	Case studies. Solar PV system	Investments Direct CO ₂ emissions	Has ended Ongoing on other buildings
Energy efficiency measures in order to reduce use of fossil natural gas and total carbon dioxide emissions from EBM	Sahlgrenska Academy and the property owner Akademiska Hus	Energy efficiency measures	Direct CO ₂ emissions	Ongoing

Table 1 Summary of all initiatives connected to the climate strategy (continued)

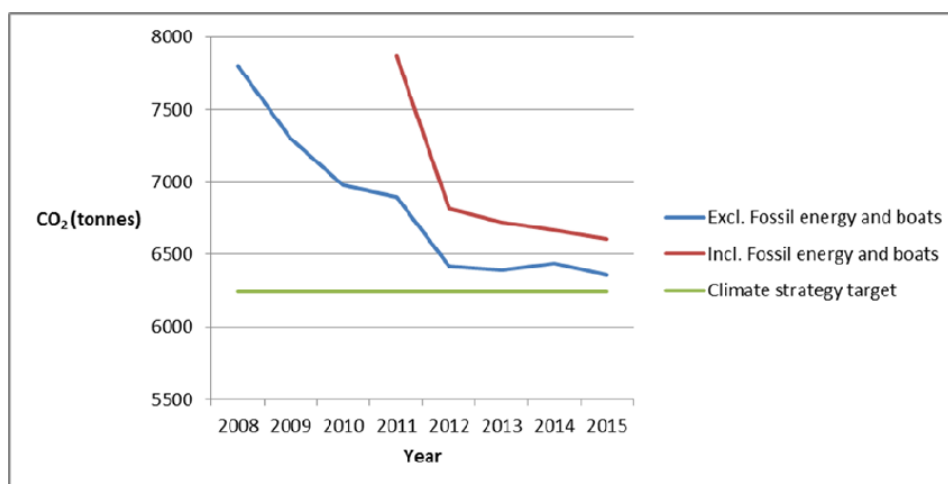
<i>Initiative</i>	<i>Involved stakeholders</i>	<i>Measures</i>	<i>Results direct and indirect CO₂ emissions</i>	<i>Ongoing/unique</i>
Yearly event has been bicycle campaigns	Staff	Free bicycle repairs arranged at several places at the University	Raising awareness Reducing CO ₂ Investments	Has ended
Events and initiatives to promote health and lower climate impact	Staff City	Promoting walking or biking to work instead of using a car	Raising awareness Reducing CO ₂ Investments	Has ended
'Green Itinerary' for, 'Campus Medicinareberget', developing campus areas without increasing motor traffic	City of Gothenburg and Sahlgrenska University Hospital, the university	Focusing on improved access for bikes and pedestrians and more frequent public transports	Awareness Investments Movements	Ongoing
IT services and computer use; optimisation projects; virtualisation of servers	Staff Students Management	Reducing printers, copy printers and server rooms	Raising awareness Reducing CO ₂ Investments	Ongoing

5 Analysis and reflections

5.1 Analysis of results and emissions

The implementation of the University climate strategy can be seen as an initiative in order to develop, not only a vision for a sustainable campus, but also to make it visible and concrete. Therefore, it is important to annually monitor and communicate the results to students, faculty and staff within the University, as well as to stakeholders outside the University. Figure 4 provides the results from the main areas of the climate strategy from year 2008 to 2015.

Figure 4 Carbon dioxide emissions from 2008–2015 in tonnes. The comparison with 2008 does not include emissions from boats or fossil energy (natural gas and oil), since these emission sources have only been measured since 2011 (see online version for colours)



By the end of 2015, the target of a 20% CO₂ reduction was almost reached with a reduction of total carbon emissions by 18.5% when compared with the baseline year 2008. The campus climate strategy aimed to limit CO₂ emissions at 6250 tonnes of CO₂ emissions, which represented a 20% reduction when compared with the CO₂ emissions of the year 2008 at 7812 tonnes of CO₂ emissions. Total energy use was reduced by 19%, from 251 kWh/m² to 204 kWh/m² exceeding the 10% goal. The savings in financial terms was equivalent to 19 million Swedish kronor (~2 million Euros).

The university's total carbon dioxide emissions from travel and energy in 2015 amounted to 6603 tonnes, which is shown in Figure 5.

Thirty-one percents of the University's total carbon dioxide emissions come from energy usage. In 2015, electricity usage and heating corrected for a normal year totalled 71000 MWh that corresponded to 1960 tons of CO₂ emissions. Per square metre of building area, this was 204 kWh/m². During the same year, the energy use decreased by 1% compared with 2014. Since 2008, the total energy use has decreased by 19%. Figure 6 provides the reduction in average energy use in kWh/m².

Figure 5 Distribution of total CO₂ emissions (tonnes), from energy use and business travels in 2015 (see online version for colours)

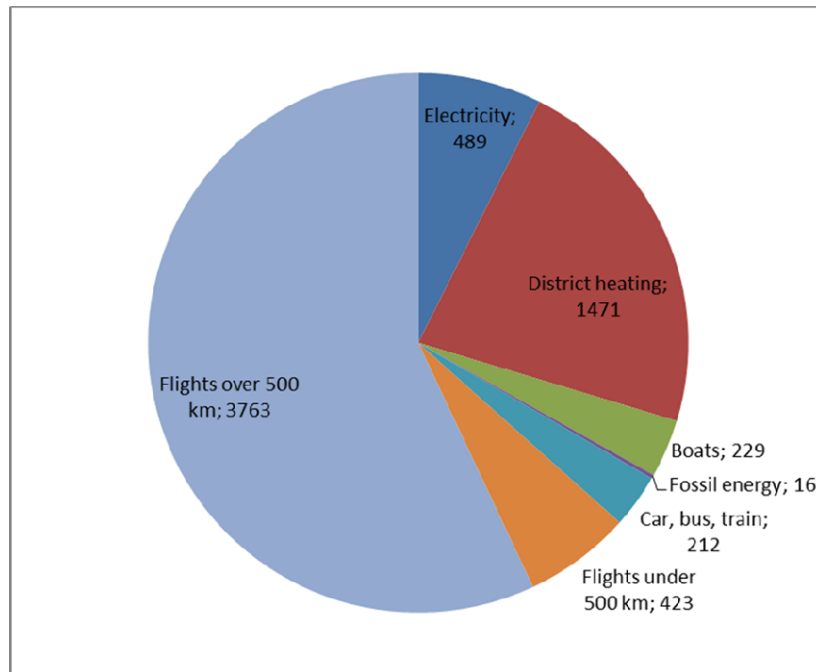
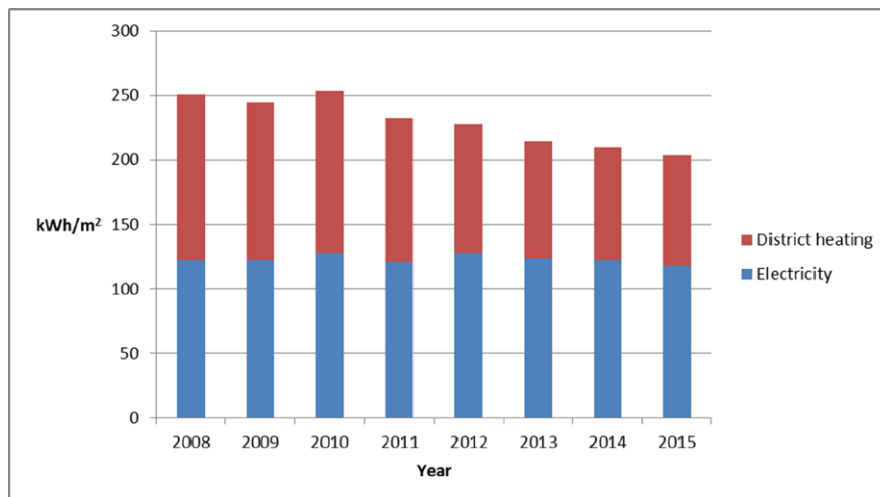


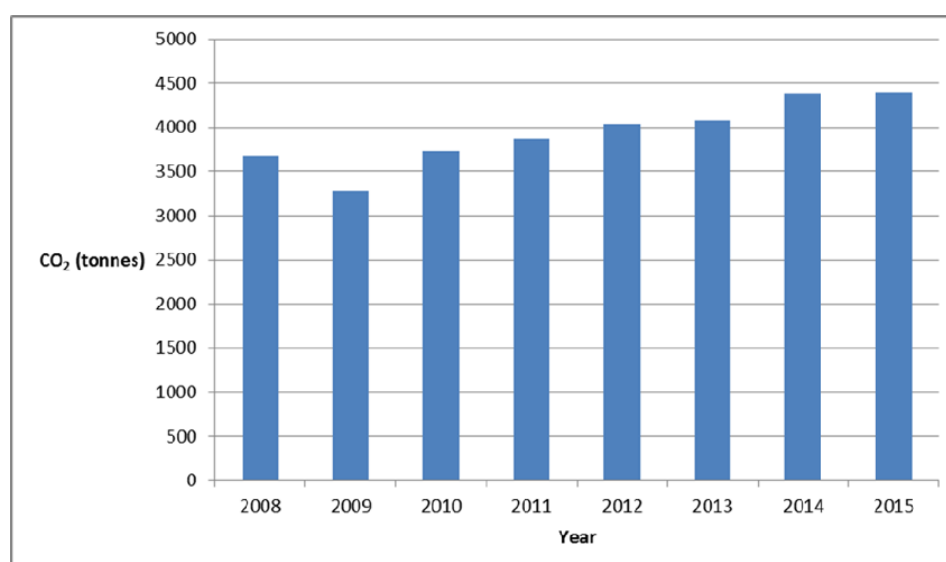
Figure 6 Average energy consumption kWh/m² 2008–2015 (see online version for colours)



One of the most successful energy projects was the joint project between the Sahlgrenska Academy and the property owner, Akademiska Hus, where several major energy efficiency measures were carried out. Energy consumption at the laboratory for experimental biomedicine (EBM) was reduced by 24% in three years, which corresponds to 375 000 USD per year. By removing the use of fossil natural gas, carbon dioxide emissions from EBM was reduced by just over 300 tons in one year.

Sixty-four percents of the university's total carbon dioxide emissions come from air travel. Due to this share, all flights are offset in UN-approved climate projects that meet the requirements of the gold standard quality label. The work to increase the knowledge and use of videoconferencing technology continued in 2015. The University registered 898 users of Jabber Video, which enables staff members to participate in videoconferencing from a computer, tablet or videoconferencing facility. University staff participated in a total of 8582 travel-free meeting hours. Travel-free meetings contribute to reduce environmental and climate impact, economic savings and more time for work, family and leisure. Despite this, the CO₂ emissions from travels continued to increase in 2015 which can be seen in Figure 7. One might say that this is a fundamental conflict of interest; the need to appear on the global scene in the science context is of great importance to the University as well as the importance of decreasing the climate impact.

Figure 7 Carbon dioxide emissions (tonnes) from business travels year 2008–2015 (see online version for colours)



5.2 Reflections on the results in an organisational context

The target, of a 20% reduction of CO₂ emissions was set in absolute figures, giving that if the university grows in revenues, students and/or staff, it would not affect the target. The target fulfilment was monitored through emissions from travel and energy consumption.

How has the university developed from 2008 to 2015? What changes can be seen when it comes to revenues, staff and students? In Table 2, the results are presented.

The results show that the university during 2008–2015:

- increased its revenues with 28%
- increased the amount of staff/employees (full time employee equivalent) with 15%
- increased the amount of students (full-time student equivalent) with 2%.

This sets the reduction of CO₂ emissions and reduction of kWh/m² in an interesting organisational context.

Table 2 University revenues, staff and students year 2008–2015

<i>Year</i>	<i>Revenues (millions SEK)</i>	<i>Staff/employees (full-time employee equivalent)</i>	<i>Students (full-time student equivalent)</i>
2008	4652	4750	24,910
2009	4997	4763	26,370
2010	5165	4978	27,411
2011	5317	5128	26,801
2012	5427	5158	25,956
2013	5609	5138	25,639
2014	5746	5188	25,001
2015	5963	5462	25,397

Source: University of Gothenburg (2016a)

5.3 *Reflections on university campuses as ‘living laboratories’*

The case study supports the statement of Dryzek (1997) that experimentation is to be seen as a key requirement of sustainability. The case study also supports that these experiments increasingly take place in bounded spaces in cities or on university campuses, termed ‘living laboratories’, which promise to generate knowledge that is applicable to real-world situations (König, 2013). The energy efficiency project at EBM and the student calculation on solar PV system at the School of Business, Economics, and Law can be seen as good examples of the concept ‘living laboratories’.

The case study also shows an example of Jasanoff’s (2004) statement that social norms and technologies are co-produced in an explicit manner. This is important, as attending to co-production also helps to sensitise participants to the fact that the development of technological fixes alone are not the most effective way of achieving real transition. The attention and importance of cognitive, social and normative development processes are of great value in the construction of sustainable campuses as well as sustainable lifestyles. The student activities and their commitment to climate initiatives can be seen as good examples.

Hua (2013) reflects on the Climate Action Plan developed and implemented at Cornell University, as a structured design thinking process. Hua states that campus climate action plans should be designed to be adaptable in order to integrate the latest research outcomes and advances in the social and natural sciences. Hua raises the importance, when establishing a living laboratory on campus, of integration of strategies for three strategic areas: data collection and monitoring; institutional change and innovation; knowledge co-creation and sharing. The implementation of the climate strategy at University of Gothenburg has, in our opinion, developed strategies for the three strategic areas, identified by Hua, that are of importance for a living laboratory on campus.

5.4 Reflections on 'transformative change'

The University of Gothenburg's climate strategy supports the view of Cortese (2003) who argues that it is necessary to understand the interdependence among the four dimensions Education, Research, University Operations and External Community and to increase the collaboration between them, "as all parts are critical to achieving a transformative change".

The climate strategy has indeed worked with all dimensions with a clear ambition to develop integration between them and to make a 'Holistic climate strategy'. An example of this is the series of climate seminars that is arranged as a part of the climate strategy. At the seminars, researchers from various disciplines at the University, and from other higher education institutions, share their views on the climate issue. The climate and the marine environment, global climate agreements, a fossil-free University, climate and health as well as how the media influences societal views of the climate problem were some of the topics addressed in 2014. The seminar series attracted a total of ~750–1000 participants per year.

Other examples are the launch of the internal climate fund that supports projects with the aim to reduce the university's carbon footprint. The policy document on travel and meetings, as well as the policy document for buildings and campuses can be seen as good examples on small steps in a change process towards a sustainable university.

5.5 Reflections on EMS and campus sustainability

According to Disterheft et al. (2012), an EMS can be seen as one tool in the overall process to enhance campus sustainability. A mix of top-down and participatory approaches is regarded to be most effective to accomplish the two-fold mission of a university as mentioned above. These are

- to reduce the institutional environmental impact
- to carry out research and teaching, offering opportunities to develop competencies that lead to more sustainable practices (Disterheft et al., 2012).

The climate strategy is unique at the University of Gothenburg as it is a university-wide strategy, including faculty, administration and management. With the support of the EMS, the University of Gothenburg manages climate action with a systematic approach, both in implementation and follow-up. The EMS has provided targets and tools for evaluation, measurement and reporting of the results from the climate strategy. With this systematic and target oriented support the climate strategy has become a concrete action plan and not just a 'piece of paper'.

The case study shows, coherent with Disterheft et al. (2012), that an EMS indeed can enhance sustainable practices and participation, as an EMS offers manifold possibilities to give students, faculty and staff the opportunity to put sustainability into practice. As well as reducing the universities' environmental impact as operating institutions on a local, and global, level. The CO₂ reduction and the reduction in energy use can be seen as good examples, as well as the initiation of the university Climate Committee and the internal climate fund.

5.6 Reflections on the university in the city context

According to Velazquez (2006), the first three dimensions; education, research, and outreach and partnership, can be carried out inside or outside the campus while the fourth is aimed at implementing sustainability in the campus operations. The case study shows that for a city university as University of Gothenburg, which is fully integrated with the city of Gothenburg as well as in other more regional parts (i.e., Tjörnö, Kristinberg, Steneby, Mariestad), some of the development and implementation process has to be done in cooperation with different stakeholders. The author's state that even when it comes to campus operations, the fourth dimension, there is a strong need for both inside and outside cooperation.

The university works closely together with the city regarding transportation and energy usage. According to Swedish legislation, universities are not allowed to own property, thus good relations with the property owners are needed, one major owner being the city itself. The university's climate strategy is well in line with the goals of the city and the results from our efforts are a contribution to reach common objectives.

Gothenburg's history has fostered a spirit of cooperation between the city government, the academia and the private sector in the city. Special platforms have been created to stimulate this and through cooperation with industry and universities, the city and the city owned companies are developing new technologies and methods to reduce the environmental impact. The City of Gothenburg has signed the Covenant of Mayors and therefore committed itself to go beyond the objectives of EU energy policy. The city has adopted a local environmental objective to reduce its carbon footprint. The aim is that by 2050, the city will have a sustainable and fair level of carbon dioxide emissions. The average level of CO₂ equivalent emission per person in Gothenburg will have to be reduced from the current level of about 10 tons per person to < 2 tons per person for the goal to be reached. The city has also adopted an interim target which states that by 2020, emission levels of CO₂ will be reduced by at least 30% compared with the levels in 1990.

The challenge for the future is how the University of Gothenburg can strengthen its cooperation with different stakeholders, such as the city of Gothenburg, the Västra Götalands region, the property owners and so forth. One might say that the university is included in the city centre; the whole city might therefore be seen as a campus and living laboratory.

6 Conclusion

Universities must be role models for sustainability. To achieve this, they must collaborate between different departments internally and reach out to the rest of society – the private sector, government, and civil society.

The climate strategy is a university-wide strategy, including collaboration between faculty, administration and management, as well as with external stakeholders, such as property owners, the city of Gothenburg. With the support of the environmental management system (EMS), the University of Gothenburg manages climate action with a systematic approach, both in planning, implementation and follow-up. This creates opportunities for technical solutions and social learning processes, and allows the University of Gothenburg to serve as a living laboratory and a role model for sustainability.

The University of Gothenburg's climate strategy shows that it is possible for multi-site city universities, not in possession of the buildings in which they operate, to address climate impact across all areas in an effective manner.

By having an ambitious objective, the University of Gothenburg was able to take responsibility and set an example demonstrating the importance of the climate issue, even though the university revenues, staff/employees as well as students has increased from the year 2008 to 2015.

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