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Realization of a low emission university campus through the implementation of a climate action plan

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Abstract

The Climate Action Plan (CAP) experience started a few years ago with the aim to manage carbon and energy more efficiently. CAP is a roadmap to get Universities to the goals of climate protection, defining a carbon footprint, identifying priority actions, milestones to measure progress and target dates, raising funding opportunities. The methodological approach for the realization of a Low Emission Campus through the implementation of a CAP at the South East European University (SEEU) in Tetovo (Macedonia) foresees the analysis of the current energy consumptions and Greenhouse Gas (GHG) emissions and the integrated planning for the implementation of carbon friendly measures. CAP provides the cost-benefit analysis of the most suitable projects and associated yearly and cumulative GHG reductions, and defines the schedule for their gradual implementation. The Climate Action Planning process represents a valuable learning opportunity for the whole SEEU campus community, especially for students, providing additional opportunities for educational and research activities.

Keywords: CAP, GHG, carbon footprint, Low emission campus, Teaching Sustainability Future

1. Introduction

The South East European University was established in 2001 and it is located in Tetovo, Macedonia. It covers an area of about 200,000 m² and hosts approximately 6,000 students. SEEU has succeeded in establishing itself as a quality-led, financially sustainable university, now regarded as a model for multi-ethnic, multi-lingual higher education in South East Europe. The SEEU Campus has started the path to sustainability a few years ago, with the aim to manage carbon and energy more efficiently. The realization of a Climate Action Plan constitutes a roadmap to get Universities to the goals of climate protection, defining a carbon footprint, identifying priority actions, milestones to measure progress and target dates, raising funding opportunities. The methodological approach for the realization of a Low Emission Campus through the implementation of a CAP at SEEU foresees the analysis of the current energy consumptions and GHG emissions and the integrated planning for the implementation of carbon-friendly measures. Following the realization of a GHG Inventory, the CAP represents a powerful tool to reduce

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SEEU's carbon footprint, aimed at delineating strategies and a timeline for reducing greenhouse gas emissions. Furthermore, it allows pursuing the goals of integrating sustainability and climate action in all aspects of teaching, research, and community outreach. Universities can provide both practical and moral leadership with regards to society's efforts to address climate change by taking steps to reduce their own emissions. The SEEU CAP is a 10-year strategic plan for how the campus will undertake the path to carbon neutrality. Given technological change, the global economy facts and the Campus growth ambitions over the coming decades, the CAP is conceived as a living document, to be regularly updated to reflect the state-of-the-art, as well as the state of the Campus. Each institution should conduct an inventory of its greenhouse gas emissions to determine the baseline from which progress will be measured [1]. In July 2010, the University released its first inventory of campus greenhouse gas emissions. The report, entitled "Greenhouse Gas Emissions at SEEU Campus, 2005-2009" was completed in July 2010 [2]. The CAP identifies the emission reductions of each project and sets an implementation schedule over the short, middle and long term that will ensure that the Campus can make steady progress toward its climate goals. The University commitment towards climate change and environment preservation flows into a sustainability-oriented institute, the Institute for Environment and Health (IEH). The mission of the Institute for Environment and Health at SEEU is to develop technical and scientific information related to environmental and energy topics, and also training of human resources in order to inform the society on environmental, energy and health thematic, in addition to providing support for decision making processes, encouragement of environmental protection, and promotion of sustainability during the utilization of natural resources. As an indicator for sustainability for the CAP concept, the building of the Institute of Environment and Health is used and it was transferred from a building with a standard construction to a Sustainable Energy building. This level of sustainability is reached with the implementation of technologies for the production and accumulation of energy from renewable resources, technologies for increased energy efficiency and a system for monitoring the production, accumulation and consumption of energy. Comparatively, for verification of sustainability, architectonically identical, another building with standard construction is being used for comparison. At the same time, the IEH building will serve as a real laboratory, where students in the process of education will have the possibility to conduct research and perceive the real effects from the influence of energy.

2. Climate action plan

The first necessary step for tailoring the sustainable interventions for the reduction of energy consumption and GHG emissions is the realization of a GHG inventory. An inventory quantifies where and how many emissions are generated within the spatial boundaries of the campus.

2.1 Methodological approach

2.1.1. Inventory methodology

The inventory is based on the CA-CP Campus Carbon Calculator [3, 4]. The CA-CP methodology follows guidelines outlined in the World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD) GHG Protocol Initiative. The CA-CP Campus Carbon Calculator is based on international recognized emission factors databases to convert the emission sources into carbon dioxide equivalent emissions. It adapted protocols established by the Intergovernmental Panel on Climate Change (IPCC) for national-level GHG accounting for use at academic institutions [5].

2.1.2. Calculation of GHG emissions

The inventory was prepared considering the GHG emissions source by source. The reference year for the GHG inventory is FY 2009. Detailed data collections were carried out for every potential source of emission. Activity data (i.e.: litres of fuel, kWh of electricity, commuter trips, miles of air travel) were converted into tons of equivalent carbon dioxide (tCO_{2e}) using the related emissions factor (e.g.: kg CO₂/kWh, kg CH₄/kg waste) [6, 7, 8]. The following diagram (Figure 1) illustrates the GHG emissions profile over the inventoried years.

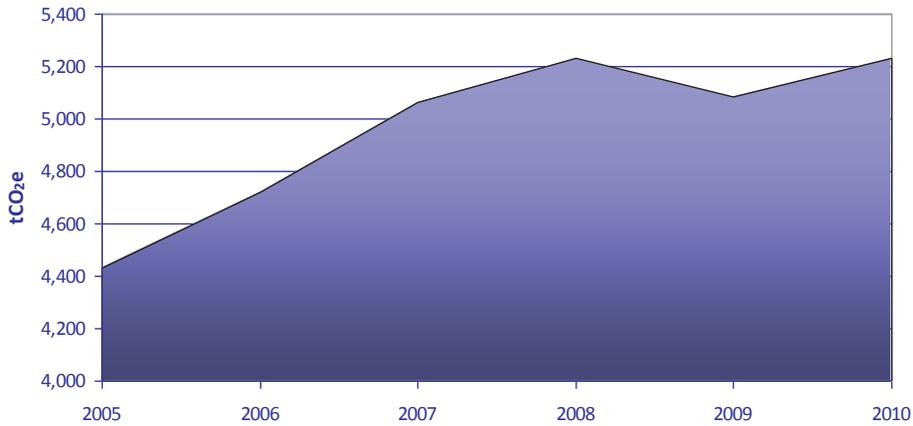


Figure 1: Total Campus Emissions

The GHG inventory revealed that the SEEU campus emitted approximately 5,100 tCO_{2e} in FY 2009. According to the figures of the diagrams, the overall GHG emissions, after an increasing trend in FY 2005-2008, registered a decrease in FY 2009, while for FY 2010 a new increase to the 2008's value is predicted. The rise in overall emissions in the first years can be attributed to the growth of the campus (population and surface) and the expanded facilities infrastructure required to support the growth. The decrease in FY 2009 is mainly due to the decrease in commuting in the year 2009, caused by a decrease in population. For the following year, the population remained constant, even though a slight increase in electricity consumption is expected, which could bring the overall emissions to the same values of year 2008. The following diagrams show the contribution of each inventoried sector to the GHG emissions. Figure 2 presents the contribution of each sector in percentage on the total emissions for FY 2009.

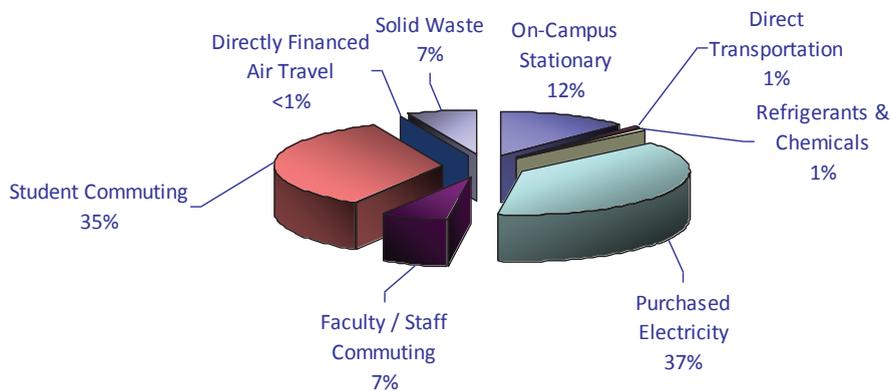


Figure 2: GHG Emissions by Sector – FY 2009

2.2. GHG reduction target strategy

SEEU has detected strengths in GHG emission reduction sectors of energy conservation and efficiency, green building design, alternative transportation and solid waste management and recycling. The strategies are categorized according to the GHG Emission Reduction Sectors.

According to the strategies outlined in this CAP and to the related calculations, the Campus emissions can be decreased by 34.8% by 2020, not including the carbon offset mechanism. The University management also aims at pursuing a 100% emission reduction, i.e. carbon neutrality, by 2030 as a challenging ambition.

2.2.1. Behaviour modification and occupation awareness

One of the most cost-effective ways to save energy and reduce GHG emissions is through changing energy-consuming habits and behaviours. The potential for paper and plastic collection is considerable in the SEEU Campus, especially because of books, sheets of paper, notebooks, etc. and plastic bottles. Due to the educational role of the university, SEEU will invest in awareness raising campaigns addressed to students and staff.

2.2.2. Carpool/public transport

The strategy of carpooling empowerment must be aimed at raising carpool share by 10%. A second sustainable measure is SEEU's promotion of public transport service at the municipal level and the promotion of service utilization.

2.2.3. Fuel switch

The use of alternative fuels is under assessment because it could result into fuel savings and, above all, notable emission reduction.

2.2.4. Foundations insulation

The insulation of building foundations can lead to 20% savings on the winter thermal demand.

2.2.5. Lamps replacement

Proved energy efficient light bulbs shall be provided to students living in the dorms, office administration and academic premises to be used in their task lighting.

2.2.6. Building

The current situation of SEEU structures is stable and no new buildings are foreseen in the short term period. In case of new construction works, the passive house system shall be followed, considering the pilot project as a valuable example of sustainable building.

2.2.7. Biomass

Biomass is under evaluation as a potential resource for fuel switch; this is a long term goal depending on the creation of a stable supply chain and local market.

2.2.8. Solar thermal

The installation of solar thermal collectors could help covering the domestic hot water needs of some buildings, thus replacing the electric boilers or reducing their load.

2.2.9. Solar photovoltaic

Summing up all the possible contributions for photovoltaic, the final goal for installation can be 500-510 kwp. And SEEU will be able to cover 28% of the current electricity demand.

2.2.10. Geothermal

An aquifer is available within a few meters below the Campus surface, thus allowing a possible exploitation of such energy source. Theoretically, geothermal could be designed for the whole Campus.

2.2.11. University fleet

SEEU may invest in low emission vehicles, such as hybrids, electrical and smaller vehicles.

2.2.12. Use of videoconference

SEEU will encourage the use of web conferencing technologies to minimize travel costs.

2.2.13. SEEU shuttles

The shuttles capacity and the rides frequency should be evaluated according to the initial forecasts, and periodically refined on the basis of the success of the initiative.

2.3. Project evaluation and ranking

Projects and policies have been ranked according to the following mechanism: the initial choice will fall on zero or low cost projects. Of course, the emission reduction targets can be only partially solved by means of these low cost projects. After this initial phase, therefore, priority will be given to actions with the best ratio between the economic viability and the emission reduction potential, reflecting the University's preference for mechanisms that guarantee a quick payback. Finally, the last mitigation strategy is represented by the purchase of carbon offsets. Once all the sustainable mechanisms have been exhausted, the University can meet all additional emissions reductions through the purchase of carbon offsets. Each action could be implemented according to the time frame presented in Table 3, where short, mid- and long-term strategies are detailed.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Baseline (tCO ₂ e)	5,085	5,23	5,191	5,242	5,295	5,348	5,401	5,455	5,51	5,565	5,621	5,677
CAP – subtotal (tCO ₂ e)	5,085	5,23	5,191	5,016	4,705	4,389	4,206	4,135	4	3,864	3,755	3,646
CAP implemented (tCO ₂ e)	5,085	5,23	5,016	4,705	4,389	4,206	4,135	4	3,864	3,755	3,646	3,42
Solar Thermal							33%	33%	34%			
Foundations Insulation								50%	50%			
Selective Collection						100%						
Lamps Replacement			50%	50%								
Photovoltaic				25%	25%					20%	20%	10%
SEEU Shuttles			50%	50%								
Videoconference			50%	50%								
Behavior Modification			50%	50%								
Carpool/Public Transport Policy					50%	50%						
Fuel Switch												100%
Cumulative Reduction			3%	10%	16%	19%	21%	23%	26%	28%	30%	35%
Annual Implementation Cost (€/y)			157 K€	720 K€	812 K€	258 K€	125 K€	850 K€	854 K€	450 K€	450 K€	395 K€
Cumulative Implementation Cost (M€)			0,15 M€	0,9 M€	1,7 M€	1,9 M€	2,1 M€	2,9 M€	3,8 M€	4,2 M€	4,7 M€	5,07 M€

Table 3: CAP Implementation Progress – Time Schedule

3. Teaching and research of sustainability future

The University target is to become a leader in the sustainability field and the strategies included in this plan will help further reduce the environmental impacts of the Campus; the University's commitment towards sustainability must be matched by its efforts to make its curriculum sustainable. Attention must be given to creating a learning environment that produces ecologically literate and socially responsible graduates, able to translate the lessons learnt at the University into concrete actions.

3.1. Background /mission

SEEU's mission is to share knowledge with students and place it in service of community and society. Therefore, in line with both the institutional mission and the climate neutrality goal, this plan identifies actions to promote investments devoted to energy, environment and climate and to further integrate sustainability in teaching and learning. This will not directly result into reductions in GHG emissions, but the promotion of cultural and behavioral changes will help achieving the climate neutrality goal. To a wider extent, SEEU aims at becoming an excellent example of a Green Campus for the Region, a living example of sustainability where new ideas and strategies to mitigate climate change could be developed, tested, and implemented. Ideally, the University itself can become a learning laboratory for the promotion of sustainability. It will be essential to underline that research and education become closely related to each other and placed in the larger regional and social context within which the University operates. SEEU's goals in the field of sustainability can be summarized as follows:

- To introduce sustainability and climate change topics in the University curriculum;
- To make the Institute for Environment and Health a center of academic excellence for the University;
- To institute and/or to strengthen partnerships with other universities, creating internships and study programs on sustainability and climate change;
- To make sustainability and climate change prominent features of events and programs that attract off-campus participants (public lectures, extracurricular activities, workshops, etc.);
- To develop new funding streams to support the initiatives outlined in this CAP.

3.2. Educational strategies

3.2.1. Teaching

SEEU has the opportunity to be a catalyst for regional and national efforts to mitigate global climate change. Its visibility and reputation will rise by demonstrating climate leadership and helping reduce the region's GHG emissions. The education strategies must focus on integrating sustainability in the curriculum so that all students have, at a minimum, a basic understanding of how to contribute to a sustainable society and those students interested in gaining deep knowledge of the issues are given the opportunities to do so. For students who want to pursue graduate studies and careers in sustainability, this plan recommends to develop new graduate degree programs in sustainability, along with increased support of student involvement in University research centers. SEEU offers several courses with an environmental, sustainability, and/or global climate change component, although these topics do not fall under a formally established minor.

3.2.2. Current Situation: Master Studies, Conferences, Lectures, Workshops

SEEU is currently committed to disseminating know-how and education on sustainability and environment preservation. From time to time, the campus hosts conferences and lectures open to students and staff. In the field of academic programs, MA Studies in the Institute for Environment and Health, in frame of SEEU, developed the Master Studies for "Management of Environment". It was one of the first master programs in the environmental sphere provided in the Republic of Macedonia and it has been attractive for new graduated students. The program includes a curriculum that fulfills the Bologna and European standards. The first generation started this program in the winter semester of 2007.

3.2.3. *New Courses in Sustainability and Climate Mitigation Planning*

The creation of a dedicated course on sustainability and/or climate mitigation planning represents a strong opportunity for SEEU in view of the realization of the main sustainability goals. The course should be focused on the interdisciplinary examination of climate change with a program oriented at educating students in the relevant areas of the climate change issue: science, society implications, and solutions. This will provide background and skills for students, developing a skilled labor pool for implementing GHG mitigation strategies on campus and for addressing the growing green economy.

3.2.4. *Climate Change Seminars/Events*

SEEU will develop seminars and workshops devoted to sustainability and global climate change. Hosting large, public sustainability-themed educational events is an excellent mechanism to engage the community and promote sustainability. Events may range from small internal workshops to large celebrations where to showcase the recent year's sustainability accomplishments and educate the audience. In addition to project-oriented off-campus volunteer efforts, SEEU will be engaged in creating collaboration with local schools for Climate Education to raise climate awareness.

3.2.5. *Study Programs*

As a long-term objective, SEEU aspires to become a Centre of Excellence on Energy and Environment for the whole Balkan region. Therefore, in parallel with the CAP implementation and short term workshops, it is planned to set the basis for the implementation of programs for formal education. To this goal, general principles and specific technical contents of a new post graduate study on energy and environment will be jointly defined, where a possible signing of a dedicated agreement with other universities providing know-how on the relevant educational sectors. The new formal educational program will be focused on environmental protection, sustainable development and climate change, from a multidisciplinary point of view. Legal, economic, social, scientific and engineering topics will be included in the comprehensive post graduate study, to be hopefully started within the academic year 2012.

3.2.6. *Research*

The Institute for Environment and Health (Sustainable Energy Building) in its strategic plan has four main goals:

- helping the Institute to clarify, focus and plan its development and prospects;
- providing a considered and logical framework within which the Institute can develop and pursue its strategies for achieving its goals over the forthcoming years;
- serving as a basis for discussion with third parties such as partner universities, funding agencies, the Government and Ministries, research collaborators and employer groups;
- offering a benchmark against which actual performance can be measured and reviewed.

The Strategic Plan is structured according to 4 Strategic Goals:

- Education: develop and organize program studies through a multi-disciplinary approach;
- Implementing science-research programs and projects;
- Increasing public awareness for developing health environment;
- Building partnerships and cooperation with national and international institutions.

From the aspect of research activities, the IEH possesses sufficient equipment to serve as a real laboratory. This is the unique object of this type in the environment and the same will be in disposal to students from the other universities. It all gives a dose of attractiveness and propaganda both for the Institute and for SEEU as a whole. The possibility for students to have practical approach in education opens opportunity to become professionals in the field and after graduation, to be included in real programmes and projects and to give their best contributions. This approach raises the added value of the students and makes them competitive in the labour market. The status of the laboratory as Sustainable Energy building is defined by technology that is implemented for optimal usage of energy. The generated amount of electricity from Photovoltaic panels is used to cover the immediate needs of the building. Over a period of surplus produced energy, it accumulates in batteries and used as needed. Energy for heating and cooling are generated from the ground, through a geothermal heat pump, while the sanitary hot water produced by

solar thermal collectors. Additional, insulation on the floor and ventilation system with heat recuperation is concentrated toward energy efficiency of the facility. An aspect of energy data collection is determined by installing a system for monitoring the physical and electrical quantities. All elements of the system are open and allow research in terms of simulations, forecasts of production and consumption, optimization, testing equipment, verification methodologies and approach. As a Case Study, an example research initiative is IEH of Sustainable energy building to move into a Self-sustainable energy building.

4. Conclusions

The CAP is a living document and is an ongoing, thorough effort to drive the SEEU Campus towards carbon neutrality and sustainability. Through the implementation of the initiatives described in the CAP, related to stationary, mobile, and behavioral fields, SEEU can reach the challenging target of 34.8% emission reduction by 2020. The CAP actual implementation will be periodically monitored and updates will be published accordingly. As technology develops, energy costs rise, and other factors change, changes are expected in the Campus projected emissions and targets for reduction. Confirming its commitment towards sustainability, SEEU completed its first GHG inventory in 2009. The inventory acted as a research project covering all sectors of the campus, including energy generation, electricity purchase, transportation, solid waste. Following the completion of the Climate Action Plan, an updated GHG inventory will be completed with significant participation of faculty and students. When the CAP process will be effectively implemented, SEEU will be a unique example in South Eastern Europe and, from the educational perspective, a research center for renewable energies and carbon emission reduction could be established with the support of other university institutions. The goal of the future laboratory will be the implementation of research activities on innovative technologies for the promotion and development of renewable energy sources, with a specific focus on solar and geothermal. The role of laboratories and research centers for the study of energy engineering problems is essential.

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