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SUSTAINABLE VISIONS FOR THE CAMPUS OF THE FUTURE

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Abstract
Since 2008 new long-term agreements on energy-efficiency have become effective in the Netherlands. Participating organisations of thirty-six sectors have agreed with the Dutch government to make efforts to realise energy-efficiency of 30 percent in the period 2005-2020 and 50 percent - as a guideline - before 2030. Higher education is represented among these sectors. To achieve the energy-efficiency objectives many sectors and associations of organisations have developed sustainable visions and road maps to implement these visions.
This paper will elaborate on the sustainable vision for the sector 'higher education', summarizing the results of a research project, which included an analysis of the higher education sector, scenario studies and strategic choices for the sustainable campus. In the process of developing sustainable campuses energy efficiency is not the only goal, setting a good example for visitors, employees and a new generation of students is another.
The research project consisted of three parts: (part I) the future of the campus, describing the higher education sector, (part II) collecting tools and measures for sustainable development and (part III) combining the components of part I and part II in future models for the sustainable campus. This paper describes the process of developing sustainable visions for the university and campus of the future.

Keywords: energy-efficiency, higher education, university, campus, sustainable development

INTRODUCTION

Background of this research

Research about the sustainable campus starts with more fundamental questions about the future of higher education and the current state of the university campus. The answers are the basis of models for a sustainable campus. Nonetheless, this research project was funded to answer a more practical question, supporting the long-term agreements on energy-efficiency: what measures can be and have already been implemented to achieve sustainability goals? The challenge for the research team was to combine these approaches.

During 2008 new long-term agreements on energy-efficiency have become effective in the Netherlands. These so-called MJA3 agreements replace earlier versions of MJA (an abbreviation for the Dutch "MeerJarenAfspraak"). The current MJA agreement is more

comprehensive than the previous versions and is connected to the Dutch governmental programme on sustainable development ("Schoon en Zuinig" in Dutch, which can be translated in "clean and efficient"). Agentschap NL – an agency of the Dutch Ministry of Economic Affairs and formerly known as SenterNovem – guides all sectors in the process of creating visions and implementing sustainable strategies. MJA agreements have been signed by thirty-six sectors. Higher education represents two of these sectors: universities (academic research institutions) and institutions for higher professional education ("hogescholen" in Dutch).

The participating sectors have agreed to make efforts to realise energy efficiency progress of an average of 30% in the period 2005-2020 and 50% before 2030. For higher education all fourteen (academic research) universities and a group of institutions of higher profession education have signed the agreement. In this paper the term 'university' will be used for all higher education institutions (HEIs) in this sector.

Objectives for higher education

The research team believes energy efficiency only makes sense when it is related to a sustainable development in general (as defined by the WCED – Our Common Future 1987). The term "sustainable campus" not only refers to the physical campus, but also to the overall strategy of a university and the individual users of the campus. Higher education is a sector with relatively many people involved: students, employees and visitors. A sustainable campus is dependent on the collaboration of these campus users: are they willing to change their behaviour to achieve energy efficiency goals? At the same time, sustainable solutions on campus can influence the behaviour of these users outside the campus, now and in the future. In time students will be decision-makers themselves, or policy makers on sustainable development. At least, users will take their experiences with sustainable solutions on campus and references of innovative technology to other – working, learning and living – environments. More importantly, many university employees are professors who conduct activities of exemplary nature, like lectures to students, professionals and academic colleagues and articles or interviews for different media. On top of that, visitors expect innovative solutions of universities with world-class reputations on subjects that are related to sustainability. This is all the more reason to aim at 'changing the mindset' of the campus users in the process of creating a more sustainable campus.

Changing the mindset of all user groups – students, employees, visitors – by implementing sustainable solutions or by setting a good (visible) example with innovative technology is an extra objective for the sector higher education, apart from the energy efficiency targets. Consequently, this research aimed at two targets: (1) supporting strategies for energy reduction and CO_2 reduction in line with the energy-efficiency goals for 2030 and (2) a mindset change for the users of the campus, both students and employees.

Research methodology in three parts

This research project was conducted in three parts: (part I) the future of the campus, describing the higher education sector, (part II) collecting tools and measures for sustainable development and (part III) combining the components of part I and II in future models for the sustainable campus. For each part a range of sources was used. Part I and II started with literature review and document analysis, exploring the future of higher education and (strategies for) the Dutch campus for part I and the existing sustainability tools and measures for part II. Furthermore, many workshops among campus managers, students and other experts on and user groups of the campus supplied additional ideas or validated the results.

Examples are workshops with campus managers and energy coordinators, online questionnaires among students and employees in higher education and workshops among students. The results of these workshops can be found throughout this paper. Figure 1 shows how all three parts of this research are connected in the research structure.

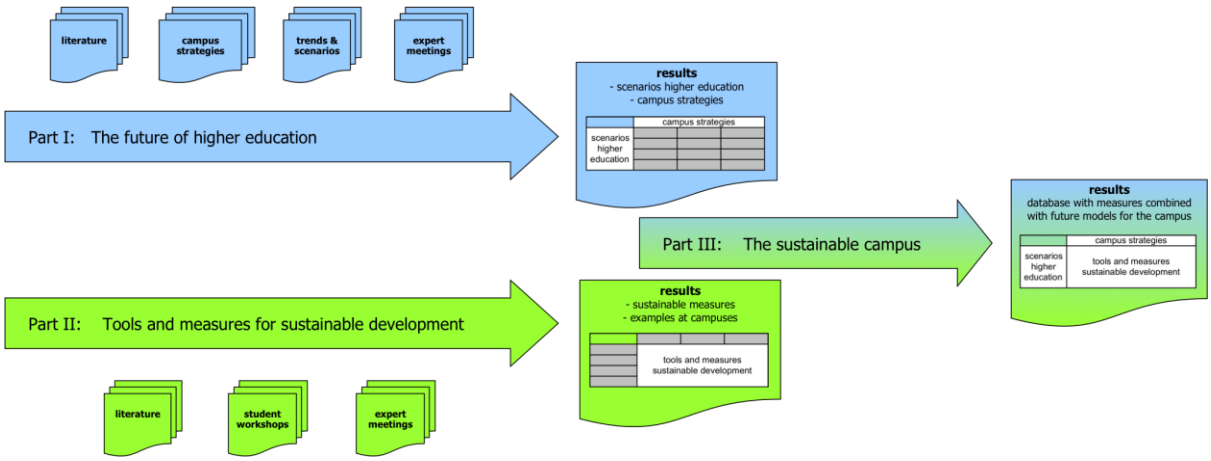


Figure 1: *The research structure in three parts*

The next sections will subsequently elaborate on (part I) the future of higher education, (part II) tools and measures for sustainable development and (part III) the sustainable campus.

PART I - FUTURE OF HIGHER EDUCATION

The future of the higher education sector can be composed by exploring the global developments that (can) influence the university and (can) shape the campus and strategic choices and policies of the universities. Both are described in part I of the research project. Yet, different generations on campus influence decision-making about future models and the support of sustainable solutions. These generations are described below.

Generations on campus

Most students in the higher education are young people in the age group of 18 to 24 years old. The employees, e.g. the scientific staff, the management staff and support services may be of other generations. It is good to realise that there is a visible generation gap between different generations. Generally the following generations are distinguished (e.g. Boschma & Groen 2006; SCUP 2009):

- The Baby Boom Generation follows World War II (1945 – 1955 up to app. 1964). The features are: a demographic bulge, a rejection or redefinition of traditional values, born in large families that they have outgrown, they are raised rigid and authoritarian; they hardly divorce and computers became familiar when they were older: they use them for finding information and surfing the Internet. They do not use chat services or social media.
- Generation X is the generation generally defined as those born after the baby boom ended (1960 - 1985). Children were part of small families - the first divorces also introduced broken families - and they were not raised very strict. As young adults they started to use computers for surfing and information and nowadays you will find them more often on chat services and social media.

- Generation Einstein (also Y or the Millennials) is brought up in the digital information society (1988 – 2000). Children of this generation want their own family, live in different structures and divorces are very common; 'love baby' is a keyword in family planning and upbringing is a matter of compromising. Children are raised with computers, which they use as a social machine, chat, self-publishing and sharing, you find them continuously on chat services. This is the current generation of students.
- The next generation Z or I (Internet generation) is characterised as digital natives. These are the students of the future.

Differences between these generations indicate that they will react differently on sustainable measures, also in terms of acceptance. Younger generations will be more inclined to share facilities with other user groups; older generations are used to "unlimited resources", private territory and exclusive use of facilities and will – for instance – not easily accept sharing a workplace with colleagues. The youngest generations have been taught about "the inconvenient truth" of the climate crisis and are more aware of the urge to reduce the footprint, also by sharing floor area and less frequently used facilities with other user groups. Differences between generations might require culture changes to implement some sustainable solutions on campus. For decision-makers it is important to acknowledge that. Nevertheless, the mix of generations at HEIs also offers a challenge to use each other's creativity and ideas and to learn from each other.

Decision-makers on the sustainable campus

While many generation types are present among the users of the campus, it is also important to acknowledge the age profile of decision makers. However relevant sustainability issues are in education and research, it is usually policy makers from the supporting staff that make the decisions on the campus. Facility managers decide on the ecological concepts in the catering and products in the restaurants, energy coordinators are discussing new technologies with their colleagues. Facility manager and campus managers do consult their superiors or colleagues, but they do rarely consult the academic staff about scientific knowledge about state-of-the-art, innovative or even experimental sustainable solutions. For the higher education sector this would be highly recommended, not just to improve the common knowledge about sustainable development, but also to improve the acceptance of sustainable solutions. Academics and students on sustainability could be proud ambassadors of "practicing what they preach" on campus. The age profile of the supporting staff differs from the age profile of the academic staff. Academic staff is relatively young, also because of the PhD students and young researchers. This could lead to a situation in which the traditional policies of a relatively older supporting workforce do not match with the ideas of the younger academic workforce and the students.

These are arguments for the proposition that sustainable campus strategies are most likely to be effective when prepared with members of each user group: students, academic staff and supporting staff. They are not only more likely to be innovative, but also more likely to be accepted on campus.

Scenarios for the future

In 2009 Agentschap NL published a document describing four different scenarios for the future in 2030. With "Agentschap NL" promoting sustainable development and innovation, these scenarios not only describe the future in terms of demography, economy, technology, culture, political choices and sociological developments, but also in terms of sustainability issues or – at least – influences on how sustainable the world will be in each of these futures.

Each of the four scenarios is characterised with many images and with descriptions of economic growth, consumer profiles, state of the world, societal values, population growth in the world (and in the Netherlands), the power of public authorities, the role of the European Union, (environmental) legislation, entrepreneurship, technological developments and innovation, available resources and available human resources.

The main scenario variables that distinguish the four scenarios are (I) globalisation versus regionalisation and (II) individualisation versus social integration. Combining these two variables results in the four scenarios (see Figure 2):

(1) Global market – combining globalisation with individualisation: the world as the playing field for competitive organisations and individuals;
(2) Global solidarity – combining globalisation with social integration: the world as the collective playing field to collaborate for mutual growth;
(3) Transatlantic region – combining regionalisation with individualisation: the region or own country as a habitat to compete with other;
(4) Regional community – combining regionalisation with social integration: the region as a community to collaborate for mutual growth.

Figure 2: *Agentschap NL scenarios (photo sources: Flick.com; Jason Kuffer, Amirjina, Paolo Màrgari and Stephen Poff)*

For higher education, the research team translated these scenarios in five main variables:
(a) The number of Higher Education Institutes, the size and their profile, compared to 2010;
(b) The funding of higher education, both private and public;
(c) The use of ICT, for education, research and valorisation of knowledge;
(d) The type of students;
(e) The type of scientists – professors and researchers.

1. Global market: knowledge for sale	2. Global solidarity: knowledge to share
(a) More universities and schools compete with each other; (b) More private funding, high student fees; (c) Greater use of ICT for distance learning and research; (d) Calculating students: investing in degrees and shopping for qualifications; (e) Competition between schools for the most talented student and professor, teacher and scientist.	(a) Fewer universities, better networks between universities and better cooperation to diversify the profiles; (b) Mix of public and private resources, but emphasis on (effective use of) public resources; (c) More ICT use to maintain the network and for open source knowledge sharing; (d) Travelling students with a home base; (e) Professors are academic gypsies loyal to their home base.
3. Transatlantic region: knowledge for yourself	4. Regional community: knowledge applied locally
(a) Institutions for specific target group, selection on culture, religion, world-view; education in local language; (b) Less public and more private funding from local business community that depend on local employees and regional economic growth; (c) ICT: closed network to use for individual growth; (d) Students: traditional and uniform, enrol at university close to home, majority still lives at home; (e) Academic staff: traditional, hierarchical – lifelong contracts.	(a) Universities focusing on regional economics / demands; (b) Education in local language, in close collaboration with professional and local economic partners; (c) Strong community with a lot of personal contact, mainly using ICT for file sharing; (d) Students: environmentally conscious, socially active, not necessarily born and raised in same community – feeling responsible for community wherever they study; (e) Academic staff: idealistic, maintaining good balance between work and home, feeling responsible for community.

Figure 3: *Table with scenarios for the higher education with different characteristics*

Additional aspects for each of the scenarios are the partners for collaboration, the changing in student population and community, the changing space demand, function mix and quality requirements, the increased demand for related university functions: residential, related businesses, retail & leisure and infrastructure, the feasibility of environmental goals and sustainable ambitions. Detailed information about all scenarios on all aspects can be found in the research reports (TU Delft 2010).

Opportunities and threats for higher education

All the mentioned developments require rethinking opportunities and threats to sustainable development on the campus of the future. Universities and colleges manage a total of approximately 7 million m^2 gross floor area and have considerable (re)investment programs, seizing opportunities for sustainable development or acting against a number of trends in sustainability under the influence of policy choices. The table (figure 4) below shows these opportunities and threats more explicitly.

Opportunities for sustainable development in higher education and on campus	Threats to sustainable development in higher education and on campus
- Smaller budgets (through public funding) provide more support for sharing facilities and services among managers and end users. - Emphasis on cooperation in education and research encourages shared use of facilities and reduces demand for private space by individuals, sections, departments and even colleges and universities (sharing laboratories that require a lot of energy and money). - Increasing student numbers provide opportunities to intensify usage of existing spaces. - ICT developments can partially replace space requirements with digital tools (instead of labs) or collegerama. - Cooperation with the city (council) in providing campus functions: intensification in usage of urban functions, more opportunities for reuse.	- National and international competition among institutions may lead to: → the same laboratories at every university - or even faculty → wanting to "hang on to" talented scientists and students with facilities, requiring (more) energy and money. - Increasing numbers of students may lead to building more m^2, as more intensive space usage may demand a large culture change for the organization or may not be consistent with policy. - ICT developments may reduce campus size, but increase demand for off-campus space and energy supply (more m^2 and higher energy usage working form home and other locations *). * Energy consumption by 300 college students watching online lectures on 300 different workstations compared to the energy consumption of the construction and maintenance of classrooms.

***Figure 4**: Opportunities and threats for higher education.*

Campus strategies

The three campus strategies are based on literature on the future of the campus (Chapman 2006) translated into similar issues - purpose, meters, users and funds - and used as a framework within real estate research strategies of the Dutch universities (Den Heijer 2007). In the table (figure 5) the characteristics of these strategies are illustrated in comparison.

Strategy A “Back to the Future” (traditional campus) is most similar to the present situation or to the past traditional, closed university model. A university wants to keep a relatively large portfolio of university buildings, most of which are exclusively used by the institution itself. The so-called “exclusive campus” can add to the image or identity of the university, but is also quite expensive and has a relatively large footprint per user. However, in this strategy, the campus is exclusively for the university.

Strategy B “Intellectual Agora” (network campus) represents an open market place for the creation and exchange of knowledge, with the campus as an integral component of the city, where many spaces are shared with other users. This strategy can be characterised as a network campus: the campus is shared with partners of the university.

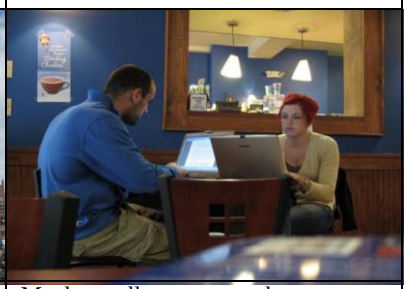
	Back to the Future (A) traditional campus	*Intellectual Agora (B) network campus*	*Clicks & Mortar (C) virtual campus*
			
Purpose	The campus does not change much in comparison with today's campus The physical campus is gradually adapted to new quality requirements	The campus operates as an open market place for the creation and exchange of knowledge The physical campus increasingly becomes part of the urban fabric, other users are welcome	Much smaller campus due to more working/ learning from home: 'clicks' replace some of the square meters (bricks) The physical campus is above all a meeting place: 'creative, stimulating and with a focus on intellectual and social exchange'
m^2	Same number of m^2	Same number of m^2 Higher occupancy & usage	Less m^2 Campus is partly virtual
Users	Largely exclusive use of buildings by their own users, also at faculty level	Knowledge institutions make use of each other's facilities and are no longer the exclusive users of their buildings	Students and lecturers spend less time at the campus, come to the campus to meet others
Euros	Same amount of resources available	More resources due to shared usage – external users pay	Same amount of resources available
Impact on quality	Same money for the same m^2 → Only enough money for "healthy and safe"	More money for the same m^2 → more quality differentiation possible → From "healthy and safe" to 'inspiring'	More money for fewer m^2 → higher quality per m^2 → up to "inspiring"

***Figure 5**: Strategies for the higher education*

Strategy C "Clicks & Mortar" (virtual campus) assumes there will be a much smaller campus with a great deal of inspiring space for social and intellectual encounters, an important trend in campus design. However, in this last strategy, students and employees will spend most of their time off-campus, while the campus does not supply a fulltime workplace for these user groups. The workplace can be anywhere, but consequently, the workforce is also spread around the world or region. This strategy is also referred at as a virtual campus: part of the university is virtual.

Strategic choices to make are: (1) what do we want to share with others and what do we want to exclusively use ourselves and (2) what part of the floor area can or do we want to we replace with virtual workspace? In essence, these choices have to be made in relation to the strategic vision of the university: what are the university values and how can the campus add to these? Combining these three strategies with the four scenarios creates twelve future models for HEIs, which are illustrated in next table (figure 6).

SCENARIOS STRATEGIES	Global market - Individualisation - Globalisation	Global solidarity - Social integration - Globalisation	Transatlantic region - Individualisation - Regionalisation	Regional community - Social integration - Regionalisation
	Knowledge for sale	Knowledge to share	Knowledge for yourself	Knowledge applied locally
A – "Back to the future" *exclusive campus* - exclusiveness, less sharing of facilities - many m^2 / student and employee - bigger selection, therefore smaller institution(s) - only affordable if higher tuition fees are common	Members Only	New network university	My gated community	Our village
B – "Intellectual agora" *network campus* - more cooperation with others - more frequent sharing facilities - more money / m^2 by renting out - campus = meeting place + workspace	Business & Science Park	Home base for academic gypsies	Campus to share in closed network	Our region
C - "clicks & mortar" *virtual campus* - less m^2 / student and employee - higher quality and more money / existing m^2 - campus only as meeting place - specific demands for workspace at home	Academic internet store	Open source campus	My closed virtual network	Our open virtual community

Figure 6: *Table with future models for HEIs: green indicates a logical scenario-strategy combination, orange is less realistic*

PART II - TOOLS AND MEASURES FOR SUSTAINABLE DEVELOPMENT

Many tools and measures are available to make implement sustainable strategies and to achieve sustainable objectives. In part II of this research project – parallel to part I – data was collected about these tools and measures.

Overview of tools

In the past years several tools have been developed in order (to try) to achieve sustainable ambitions. There are tools that focus on the development of an organisation, on the products or on the physical environment and tools that concentrate on testing the results. In this research the following classification used was: ambition tools, process tools, control tools, design tools, performance tools, prestige tools, user tools, support tools and testing tools. These tools can also be distinguished on the scale size they focus on, the time period during the building process they aim at, the achieved impact on the final results in practise and the effort they demand from the users in order to use the tools. The number of tools is enormous.

Depending on the specific situation, tools are more or less fit for the purpose. The overview of scenarios and strategies shows that the specific situation can differ significantly from campus to campus. This means that for the higher education sector there isn't just one advise on the usage of tools plausible. The right choice for tools depends on the ambitions, campus culture, the willingness of the users to adapt to measures, the goals and for instance the

current themes. Three general categories of tools exist and can be divided into twelve sub categories (see figure 7): development tools (focussing on organisation and process); development tools (focussing on hardware: the built environment) and testing tools.

In figure 7 the various tools are divided into five categories, also based on prior sustainability research (TU Delft 2010):

1. Achieving a ***sustainable working place / sustainable way of working*** (for both students and staff).
2. ***Make buildings sustainable*** as objects.
3. ***Make the campus sustainable*** as setting or organisation as a whole (including the relationship with external settings).
4. ***Sustainable business process***.
5. Working on a sustainable ***mindset*** (both student and employee) (also visible outside the setting of college or university).

	Development tools 1	Development tools 2	Testing tools
Sustainable workspace	Future studies Vision development System analysis	Ambition tools User tools	
Sustainable buildings		Ambition tools Process tools Design tools Support tools	Performance tools Prestige tools
Sustainable campus	Future studies Vision development System analysis	Ambition tools Process tolls Assessment methods Control tools	
Sustainable (operational) management	Future studies Vision development System analysis	Ambition tools Assessment methods Control tools	
Sustainable mindset	Future studies Vision development		

Figure 7*: Tools for the higher education*

Overview of measures collected by student workshops

To create an overview of possible measures groups of users were asked to give their opinion. Workshops with (international) students were organised to collect information. The students were asked to use the mind mapping method to create an extensive list of measures.

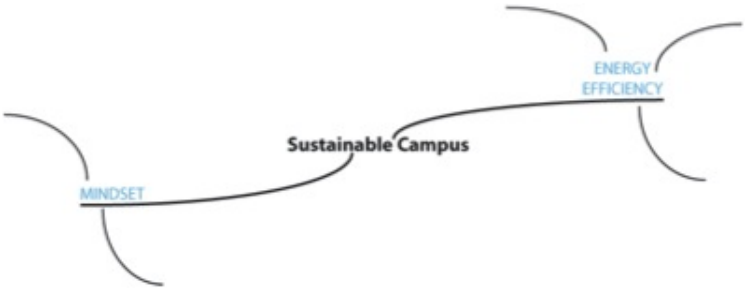


Figure 8: *Mind mapping, a technique used by students during the workshops*

***Figure 9**: Example of mind mapping result of student workshops*

***Figure 10**: Impression of a student workshop*

Notes on the results
The workshops encouraged students to think creatively. The results had some remarkable outcomes. As overall results the students' conclusions can be described as:

- Thinking in extreme situations in order to collect a range of measures;
- Ranking the scenarios Global Market or Regional community as their preferences;
- Having a positive approach;
- Thinking in goals and scenarios;
- Finding out that energy efficiency is possible in every scenario;
- Creating a change in mindset depends on the scenario.

The ideas of the students are summarised in a large collection of measurements. The most acceptable ones, that are the ones by the students marked as positive, are used in expert workshop to be ranked by the experts in part III of this research project.

PART III - THE SUSTAINABLE CAMPUS

In order to make future models for the sustainable campus the results of the first two parts of the research has to be combine; to validate the results these were presented for comment by

various groups of expert. These results were very useful to find a way to create a roadmap towards a sustainable campus.

Expert validation

Special expert workshops were organised. The participants were staff members of universities concerned with campus management. Measure lists created during the student workshops were used as input for the expert workshops. The experts were asked to indicate which measures are already being adopted at their organisation, which measures they missed on the list and which measures they did not find fit for their HEI. Through the Internet the questions asked during the workshop were presented in a questionnaire to staff members of other higher education organisations as well. Also members of the DHO platform were questioned: 78 questionnaires were filled out.

All experts during the workshop indicated in the matrix which scenario is the most likely for their specific higher educational organisation. They also indicated the most and least desirable scenario. The figure (11) shows the results of an expert workshop with campus managers and energy coordinators: most respondents expect globalisation; prefer social integration and fear individualization on both global and regional scale.

Figure 11*: Results of an expert workshop with campus managers and energy coordinators*

The questionnaires contained a long list of measures meant to indicate whether one would like to apply one of these measures or rather not. Also was inventoried which measures are already applied. Most wanted measures were: creating a cold-heat storage (heat pump); possibility to turn all devices off by default (1 button per building), a public display of energy consumption to increase awareness of energy use, more green on the campus, good public transport connections, the use of renewable energy sources, a visible application of sustainability, efficient use of space (more facility sharing), more awareness and applying insulation. Unpopular measures were: the use of greenhouses on buildings for heating, a car-free day, the production of food on the campus, sharing cars, incineration on the campus, a day without printing, the use of recycled toilet paper, fitness as a source of energy and less automatic arrangements.

The measures HEIs already apply are many solutions concerning the organisation and educational courses like competitions, pilot projects, education and symposia to improve awareness of sustainable development among students, staff and guests. Also efficient use of space; insulation; good public transport; separation of waste and turning off the lights (and

computers) at night are commonly use. More ambitious measures are applied, but are not yet common. Nobody applied a day without printing or fitness as a source for sustainable energy.

Conference

On April 27, 2010 sixty to seventy campus users (energy coordinators, campus managers, academics and students) attended a conference about the sustainable campus. However the first two were the largest groups in the audience, influencing the discussion about the propositions. The propositions were supporting by an electronic enquiry system to be able to discuss the collective opinion of the audience immediately and to enable to (anonymously) relate certain answers to the user group, the age or other characteristics of the respondent. Using this technique some of the research results were validated or tested. Some of the conclusions are summarized below.

Conclusions

The audience confirmed that the most probable scenarios are either "Global Market" or "Global solidarity", with the latter being the preferred scenario. The majority of the educational institutions already adopted the measures belonging to the scenarios Global Solidarity (mostly universities) and Regional Community (mostly institutions for higher professional educationally). If they did not adopt those measures yet, those were the most desirable measures. The measures belonging to Transatlantic Region are being judged as least desirable or even negative.

A clear difference is visible between the different goals. The mindset measures are mostly desired, while there is a big difference in the judgement of energy efficient measures.

The majority of the educational institutions will probably focus on the scenario Global Market or Global Solidarity, showing that globalisation is clearly visible in the higher education sector. The experts prefer to focus on social integration. Combining those will lead to Global Solidarity. Most educational institutions fear the Transatlantic Region scenario.

Most respondents are choosing "the network campus" (strategy B "Intellectual Agora") as a preferred strategy and "home base for academic gypsies" as a preferred future model – combining strategy B with scenario "Global Solidarity". However, the audience with mainly supporting staff did acknowledge that the opinions of academic staff could differ a lot.

With various generations in the audience – 67 percent older than 45 years and 33 percent younger – it became obvious that the decision-makers are indeed of a different generation than all students and a large group of academics. Discussions about a question like "Are you willing to share your workplace for a sustainable campus?" illustrated the culture change that such a measure to reduce the footprint would require.

Nonetheless, all respondents confirm that implementing the sustainable campus of the future is a collective task, which requires involving representatives of different target groups.

RESULTS - STARTING POINT FOR THE FUTURE ROADMAP

The research results are merged in a web based tool, which can be used by higher educational institutions in order to create their own future roadmap for 2030.

The vision on the future, based on the choice of strategy and scenario, determines the sustainability factor.

The possible measures are connected on this vision and the educational institution is free to choose a combination of measures to sustain their campus.

The twelve shown visions of the future – combinations of strategies and scenarios – are being arranged in terms of sustainability. Figure 12 shows which visions are most and least sustainable. Three considerations are at the basis:

1. The virtual campus of strategy B is more sustainable than the network campus of strategy B or the exclusive campus of strategy A.
2. Scenarios or strategies (scenario 2 and 4 and strategy B) using collective use of amenities and buildings are more sustainable than the exclusive models such as strategy A and scenario 1 or 3.
3. Due to the transportation aspects the global scenarios 1 en 2 are less sustainable than the regional scenarios 2 and 4. Scenario 2, with its global cooperation, might result in "academic gypsies", and might even result in more travelling in combination with strategy A or B than scenario 1.

A comment on strategy C virtual campus is that the space reduction on the campus will result in space use on other locations, for instance at the private homes of students, teaching staff, due to the fact that a larger workspace might be needed, which has to be heated or cooled down and demands printing facilities (space and energy demand).
Combined with scenario 2 and 4 the virtual campus might need a physical location to meet each other to meet the needs of the social interaction. Should those interactions take place on campus grounds or within the existing structure of the city? Figure 12 shows a sustainability ranking of all future campus models. Again, it should be noted that this is a ranking for the campus. Models C1, C2, C3 and C4 are relatively sustainable campus models, but might cause a larger footprint at the homes of all students and employees at the same time.

	1. Global Market	2. Global Solidarity	3. Transatlantic Region	4. Regional Community
	Knowledge for sale	Knowledge to share	Knowledge for yourself	Knowledge applied locally
A. Back to the future	Members Only	New network university	My gated community	Our village
B. Intellectual agora	Business & Science Park	Home base for academic gypsies	Campus to share in closed network	Our region
C. Clicks & mortar	Academic internet store	Open source campus	My closed virtual network	Our open virtual community

Figure 12: *Sustainable ranking of future models (green to red - from most to least sustainable)*

Web based tool

One of the research results is a web-based tool that combines these models with a database of sustainable measures. This tool is available on the Internet (www.duurzamecampus.nl - currently only in Dutch). With this tool HEIs can share knowledge and experience to work together towards a sustainable campus in 2030. With four scenarios and three campus models as a starting point, the tool leads to twelve possible future models. Based on these, an

impression is given which sustainable measures fit the specific situation of a HEI. While exploring various future models the users of this tool will gradually generate a customised, sustainable vision for their own campuses.

CONCLUSION - COLLECTIVELY CREATING THE SUSTAINABLE CAMPUS

Sustainable campus strategies are most likely to be effective when prepared with members of each user group: students, academic staff and supporting staff. They are more likely to be innovative because of the diversity of user groups on campus – representing different generations. But more importantly, they are also more likely to be accepted on campus, because users have been part of the process and academic staff members can be ambassadors of the practice that they preach. The scenarios, strategies and sustainable measures – also merged in the web-based tool – are a basis for this collective process to create the sustainable campus of the future.

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