TOWARDS A SUSTAINABLE CAMPUS

Visions for the future of higher education

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Abstract

Since 2008 long-term agreements on energy efficiency have become effective in the Netherlands. Participating organisations of forty-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 sectors and associations of organisations have developed a sustainable vision for the sector and road maps to implement this vision.

For the sector 'higher education' the Faculty of Architecture of Delft University of Technology has been involved in developing sustainable visions for the future campus. The resulting research project included an analysis of the higher education sector, scenario studies and strategic choices for the sustainable campus. The research contains 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.

Keywords

Energy agreements, energy-efficiency, campus, sustainable development, university, higher education

1. Introduction, research and methodology

1.1 Why this research?

What is the future of higher education? How can universities create a sustainable campus, now and in the future? What measures can be and have already been implemented to

achieve sustainability goals? During 2008 the so-called third long-term-agreements on energy efficiency have become effective in the Netherlands. These are the so-called third MJA agreements, following earlier versions of MJA, an abbreviation for the Dutch "MeerJarenAfspraak". The MJA agreements have been signed by forty-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 in this sector.

For the higher education sector the Faculty of Architecture of Delft University of Technology was involved to create models for the sustainable future of the university and the campus, based on four scenarios and three strategies. The client of this research was Agentschap NL (Dutch Ministry of Economic Affairs), which is guiding the processes of implementing the MJA agreements. Both the associations of universities – VSNU and HBO Raad – were represented in the advisory committee (see Acknowledgments). This paper illustrates some of the most important components and results of this research.

1.2 Focus on higher education

Agreements on energy efficiency in higher education go back to the mid-nineties. These multi-annual agreements were signed for the Ministry of Economic Affairs, represented by the agency "Agentschap NL" (previously known as SenterNovem). Agentschap NL guides all sectors in the process of creating visions and implementing sustainable strategies. 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").

The research team of TU Delft summarised the sustainable issues in higher education in the title "towards a sustainable campus", which 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 a lot of 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 – at home or at their other employer's offices – 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.

1.3 Sustainable development

Sustainable development is defined as: "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Our Common Future, 1987). Sustainable development focuses on "Now and Here", as well as on "There and Later".

1.4 Objectives

Towards a sustainable campus energy efficiency is just one goal, setting a good example for visitors, employees and a new generation of students is another. Consequently, this research aimed at two targets:

- Supporting (strategies for) energy reduction and CO_2 reduction in line with the energy efficiency goals for 2030.
- A mindset change for the users of the campus, both students and employees (directing the next generation towards sustainability).

Both objectives focus on "Now and Here", as well on "There and Later". Regarding the targets of this research, the CO_2-reduction more connects to "Now and Here", changing the mindset more fits "There and Later".

1.5 Research in three parts

This research product 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 the workshop with about forty campus managers and energy coordinators (October 30, 2009), the online questionnaire among students and employees in higher education, replied by roughly 70 respondents, through network DHO ("Sustainable Higher Education", 2009), workshops among students specialised in sustainability (October 12, 2009), Architecture students at Delft University of Technology (October 28, 2009) and students participating the minor course Ecology at Haagse Hogeschool (November 17, 2009). 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. Part I results in twelve future models, composed by combining four scenarios with three strategies. Part II results in a range of sustainable tools and measures. Part III combines these, also supported by a web-based tool to deal with the complexity of combining twelve future models with more than a hundred sustainable measures.

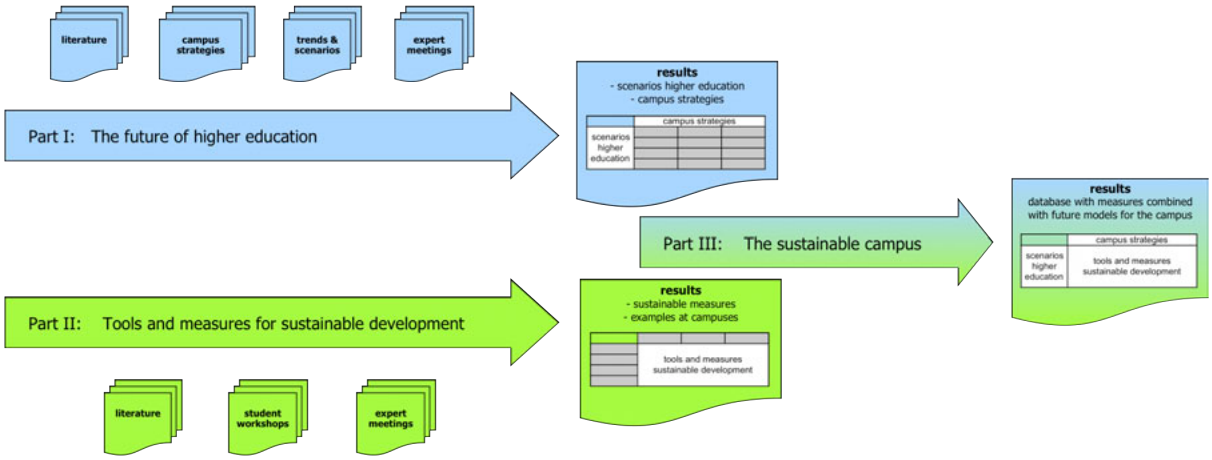


Figure 1: The research structure

2 Future of higher education (part I)

2.1 Four generations

Most students in the higher education are young people, just in the beginning of their career. 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 we distinguish next generations (Boschma & Groen (2006):

The Baby Boom Generation is the generation that was born following World War II (1945 – 1955 some literature give up to app. 1964). The boomers can be described as a demographic bulge. In general, baby boomers are associated with a rejection or redefinition of traditional values. They are born in large families where they were very much welcome. They want to become free of that family, they are raised rigid and authoritarian and they

hardly divorce. Computers became familiar when they were older; they use them for finding information and surfing the world-wide-web. They don not use chat services or social media.
Generation X is the generation generally defined as those born after the baby boom ended (1960 - 1985). Their features are: broken families, small families, the first divorces, they where not welcome as a child and their upbringing was not 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 is the generation that is raised in the digital information society (1988 – 2000). This generation is also known as Generation Y or the Millennials (SCUP 2009). They want their own family, live in different structures, to divorce is more the rule than the exception, love baby is a keyword, and raising is a matter of compromising. They are raised with computers, which they use as a social machine, chat, self-publishing and sharing, you find them continuously on chat services. People of this generation are nowadays students.
The next generation, you may call them the after Millennials also referred to as Generation Z or Generation I (Internet Generation) is characterised as digital natives. They will be the students of the future.
All differences between these generations of campus users indicate that they will react differently on sustainable measures, also in terms of acceptance. One generation will be more inclined to share facilities with other user groups, another generation is 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 taughts 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 higher education institutions (HEIs) also offers a challenge to use each other's creativity and ideas and to learn from each other.

2.2 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 sector higher education this would be very advisable, 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 "the practice of what they preach" on campus.

Table 1 shows that 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.

Table 1: Academic versus supporting staff at higher education institutions (HEIs)

Age profile personnel in higher education sector, 31 december 2008
in fte, academic versus supporting staff

	at universities (academic research institutions)				other HEIs
	academic staff	supporting staff	% academic	% supporting	HBO: all staff
<25	813	381	4%	2%	2%
25-29	6 069	1 193	28%	7%	7%
30-34	3 801	1 741	18%	10%	10%
35-39	2 243	2 049	11%	12%	12%
40-44	1 908	2 266	9%	13%	13%
45-49	1 813	2 671	9%	16%	16%
50-54	1 783	2 562	8%	15%	17%
55-59	1 599	2 590	7%	15%	16%
60+	1 291	1 346	6%	8%	7%

sources: VSNU, WOPI 2008, date 31 december 2008 — source: HBO-raad
excluding student assistants en Health (academic hospitals and medical schools) — figures 2008

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.

2.3 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.

Table 2: Scenarios for the higher education

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; 5) 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.

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).

As an example, the second scenario “Global solidarity – knowledge to share” is elaborated on in table 3 because it is considered the “trend scenario” by both researchers and campus planners. Many Dutch universities recognise their current context in scenario “global solidarity”. Workshops and questionnaires among Dutch campus representatives also showed that most universities expect a combination of scenario 1 and 2, which shows the globalisation trend is leading.

Table 3: Trend scenario (2) "global solidarity" and the possible effects on higher education institutions

Higher education scenario 2 – Global solidarity (trend scenario) “Knowledge to share”	
Number of institutions	Less than in 2009, more and better networks of institutions
Collaboration	With other (higher) education institutions – both horizontally (same level) and vertically (different levels but same profession or sector)
Resources	Combination of private and public, but focus on public
Role ICT	Open Source – sharing knowledge for mutual benefits
Type of student	Open, divers, loves to travel, but has a home base and is loyal to “alma mater”
Type of employee	Academic gypsy – like the student: uses the global network, but has a home base he is loyal to ‘alma mater’
Type of research	Collaborating within research network, collectively developing and managing expensive research facilities, also with related businesses
Space demand	Shared facilities, less need for individual territory, but need for physical home base: public spaces, places to meet, “a home away from home”, social meeting place and sharing workplace
Scope	Sharing facilities makes university more prepared for changes in enrolment and working force; employees have contracts but can freely move around in the network – wherever they are needed most
Feasibility of environmental goals	Willingness to share facilities reduces footprint and energy use of institutions
Demand for university related functions	Housing is important for university goals, responsibility of the university, increasing demand for international students (short stay students), visiting professors (short stay faculty housing), more attention for collective space to stimulate social integration, “home away from home”, part of the ‘learning experience’

2.4 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 below shows these opportunities and threats more explicitly.

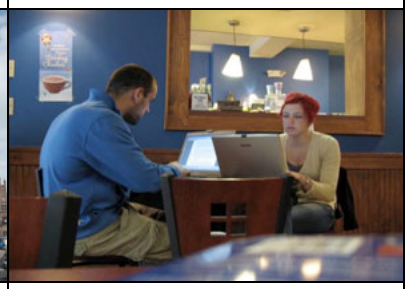
Table 4: Opportunities and threats for higher education.

Opportunities for sustainable development in higher education and on campus	Threats to sustainable development in higher education and on campus
- Less financial resources (through public funding) provide more support for sharing 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 an intensification of space usage may demand a large culture change for the organization or may not be not 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.

2.5 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 table 5 the characteristics of these strategies are illustrated in comparison.

Table 5: Strategies for the higher education

	Back to the Future (A)	*Intellectual Agora (B)*	*Clicks & Mortar (C)*
			
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 '"nspiring"

Strategy A "Back to the Future" 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" 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.

Strategy C “Clicks & Mortar” 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 higher education institutions, which are illustrated in table 6.

Table 6: Future models for higher education institutions:
green indicates a logical scenario-strategy combination, orange is less realistic

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* - excluseness, 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

3. Tools and measures for sustainable development (part II)

3.1 Overview of tools

Sustainability is a major topic, as it was in the nineties. In the past years several tools have been developed. Those tools were created in order (to try to) achieve the sustainability ambitions set. The tools can be divided by working method. A distinction can be drawn in tools that focus on the development of an organisation, the products or the physical environment and tools that concentrate on testing the results.

In this research the classification used was (see figure 3): 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. The next figure will show a few examples of several categories.

Sustainable Campus Sustainable Tools	scale					phase				impact / result			effort user				example (dutch)
	element	building	district	city	region +	initiative	design	execution	management / use	high	medium	low	high	medium	low		
ambition tools		x	x	x		x				x					x	3	DCBA-method
process tools		x	x	x	x	x	x	x		x				x		36	MER
control tools		x	x	x	x		x				x			x		17	EPC (housing, comercial/industrial)
design tools	x	x	x	x	x	(x)	x			x			x*			47	MMM: Milieu Maximalisatie Method
performance tools		x		(x)		x	x	x			x		x	x	x	24	GPR building
																25	GreenCalc 2.0+
prestige tools		x				(x)	x	x		x			x		x	11	Energielabel (State Energy Label)
																2	BREEAM NL
user tools	x	x							x			x			x	64	WoonWijzerWizard
support tools	x	x	x	x					x			x		x		42	Milieuparagraaf onderhoudsplan

Figure 3: Tools for sustainability

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 table 7):

1. Development tools (focussing on organisation and process)
2. Development tools (focussing on hardware: the build environment)
3. Testing tools

Table 7: Tools for the higher education

	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		

The measures to be addressed in the various tools can be divided into five categories:

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).

3.2 Student workshops

To create an overview of possible measures users were asked to give their opinion. Workshops with (international) students were held. The students were asked to use the mind mapping method to create an extensive list of measures. De measures on the list were evaluated.

Tony Buzan developed the used method of mind mapping (www.iMindMap.com). It should show the intriguing way of the function of the brains. Most of all it is an instrument that – by recording the associations – enlarges creativity and delivers original ideas.

The mind maps created for the sustainable campus all had the term sustainable campus as starting point. From this starting point associations were recorded, for instance associations related to scale sizes, themes and goals. After using the mind mapping method the associations were translated into concrete measures. Those measures were written on small memos and reorganised by scenario and strategy. For each measure organised by scenario was noted if the measure would be plausible within that specific scenario.

During the workshop the students came up with scale sizes from city, campus, building to workspace and building components end noted measures for the physical built environment and invented measures for sustainable process and management.

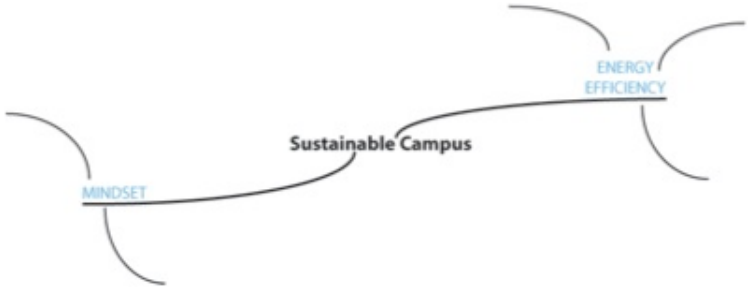


Figure 4: Mind mapping, starting point as given to the students during the workshops



Figure 5: Drawn mind mapping result of the student workshop

Towards a sustainable campus - a vision for the future of higher education

Name: .....

Institute:.....

	Make it so!	Yes, please!	NO
Open Course Ware	☐	☐	☐
Wind turbines on campus	☐	☐	☐
Reuse	☐	☐	☐
Renewable energy sources use	☐	☐	☐
Solar cells on campus	☐	☐	☐
Cold-heat storage (heat pump)	☐	☐	☐
All devices off by default (1 button per building)	☐	☐	☐
Advertising campaigns	☐	☐	☐
NUNA (and similar projects)	☐	☐	☐
Voluntary	☐	☐	☐
Challenges (competitions)	☐	☐	☐
Competitions between faculties on energy saving	☐	☐	☐
Public display of energy consumption	☐	☐	☐
Emails with sustainable tips	☐	☐	☐
Online and video lectures	☐	☐	☐
Run pilot projects	☐	☐	☐
Competition for Innovation	☐	☐	☐
Greenhouses for heating buildings	☐	☐	☐
Feedback on ideas	☐	☐	☐
Creating awareness	☐	☐	☐
Sustainability awards, points for services rendered	☐	☐	☐
Take action	☐	☐	☐
Defining sustainable development	☐	☐	☐
Efficient use of space	☐	☐	☐
Awareness of use	☐	☐	☐
Personal control over equipment	☐	☐	☐
Green on campus	☐	☐	☐
Free choice courses in sustainability	☐	☐	☐
Volunteering	☐	☐	☐
Small internships	☐	☐	☐
Sustainable development integrated in education	☐	☐	☐
Student competitions for solutions	☐	☐	☐
NUNA (and similar projects)	☐	☐	☐
Student involvement	☐	☐	☐
Biodiversity on campus	☐	☐	☐
Local energy	☐	☐	☐
Use recycled printer paper	☐	☐	☐
Cheap energy	☐	☐	☐
Discount for green action	☐	☐	☐
Competitions	☐	☐	☐
Car free Monday	☐	☐	☐
Workshop for mindset change	☐	☐	☐
Building and user interaction (flexibility)	☐	☐	☐
Sustainable housing (mixed use)	☐	☐	☐
Diversity in public on campus	☐	☐	☐
Good public transport connection	☐	☐	☐
Subsidies for student initiatives	☐	☐	☐
Travel less necessary by applying technologies	☐	☐	☐
Open Course Ware	☐	☐	☐
Sensors for equipment	☐	☐	☐
Encourage sustainable student projects	☐	☐	☐
Passive Building	☐	☐	☐
Interaction by public notices	☐	☐	☐
At night all the devices are off	☐	☐	☐
Smart systems	☐	☐	☐
Application of sustainable mobility	☐	☐	☐
Separating waste	☐	☐	☐
Green Awards	☐	☐	☐
Set specific demands on users	☐	☐	☐
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	Make it so!	Yes, please!	NO
Free public transport	☐	☐	☐
Inform about behavioral consequences	☐	☐	☐
Produce food on campus	☐	☐	☐
Harvesting and use of rainwater	☐	☐	☐
Increasing use digital / electronic publications	☐	☐	☐
Stimulation with rewards	☐	☐	☐
Good examples	☐	☐	☐
Renewable source for heating	☐	☐	☐
Market for secondhand books	☐	☐	☐
Lunch Lectures	☐	☐	☐
Symposia / Conferences	☐	☐	☐
Insulation	☐	☐	☐
Turn lights off at night	☐	☐	☐
Visible application of sustainability	☐	☐	☐
Efficient use of space	☐	☐	☐
Heat-cold storage	☐	☐	☐
Heat storage (buffering)	☐	☐	☐
Greywater system	☐	☐	☐
Geothermal	☐	☐	☐
Water efficiency	☐	☐	☐
Stimulation sustainable starters	☐	☐	☐
Free choice subjects in sustainability	☐	☐	☐
Living greenery in buildings	☐	☐	☐
Sustainable pavilion	☐	☐	☐
Green Awards for individuals	☐	☐	☐
Show energy usage	☐	☐	☐
Diversity	☐	☐	☐
Reuse	☐	☐	☐
Laboratories for pilot projects	☐	☐	☐
Sustainability Studies (1 ECTS, accessible)	☐	☐	☐
Shared Cars	☐	☐	☐
Free bikes on campus	☐	☐	☐
Display statistics of use of the building	☐	☐	☐
Student involvement	☐	☐	☐
Computers shut down (at the end of the day)	☐	☐	☐
Reward for energy saving	☐	☐	☐
Wind turbine on buildings	☐	☐	☐
Mix functions on campus	☐	☐	☐
Water management (wastewater)	☐	☐	☐
Organic food in canteens	☐	☐	☐
Incineration on campus	☐	☐	☐
Independent smart grid	☐	☐	☐
Local food production	☐	☐	☐
Collaboration between local authorities	☐	☐	☐
Day without printer	☐	☐	☐
Roof area used as outdoor space	☐	☐	☐
No paper or plastic cups	☐	☐	☐
Recycled toilet paper	☐	☐	☐
Motion sensors	☐	☐	☐
Fitness as source of energy	☐	☐	☐
Less automatic arrangements	☐	☐	☐
Management in sustainable cars	☐	☐	☐
Flowers and trees on campus	☐	☐	☐
Supermarket on campus	☐	☐	☐
Tours of sustainable projects	☐	☐	☐
Contests, projects on campus	☐	☐	☐
Flexspace, share facilities	☐	☐	☐
Visible green in the Faculty	☐	☐	☐
Central point of sustainability knowledge	☐	☐	☐
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J.D.M. van Hal, A.C. den Heijer, P.G. Teeuw, K.P,M. Aalbers, N. Stukje
30 oktober 2009 MJA-symposium

Figure 6: List of measures as a result of the student workshops

Notes on the results

The student workshop encouraged students to think out of the box. The results had some remarkable outcome. Striking measures per scenario are (e.g.) for the Global Market the implementation of Open Course Ware, stimulate working online, and launch competitions. Global Solidarity seems to fit with international chains and brands (Fair Trade), competitions like the Solar Challenge, but also with more local issues like volunteering and the use of local energy sources.

The Transatlantic Region scenario measures tend more to (financial) impulses connected to efforts and investmenst in visible measures.

Regional Community can be shaped by a mixture of functions and programs, a clear role of the teaching staff, local (simple) food production on faculty or campus ground and communal public transport.



Figure 7: impression of a student workshop

Remarkable findings

During the student workshop it was remarkable to see certain common similarities between the results. As overall result the students' features can be described as:

- Thinking in extreme situations in order to organise the noted measures;
- Having Global Market or Regional community as their favourite;
- Having a positive approach;
- Having difficulty to organise negative measures;
- 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 ranged by the experts. Figure 6 is an example of a questionnaire in which the mentioned measures results from the students' workshops. Almost invisible, the Co-ordinate system of the Agentschap NL scenarios is part of the list; the measures are ordered according to the scenarios - although ordered by how students indicated - these fit the scenarios.

4. Sustainable Campus development (part III)

4.1 Expert workshops

Special expert workshops were organised. The participants were staff members of universities concerned with campus management. The measure list 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 higher education institution. 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 questionaired, 78 questionnaires were filled in.

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. Figure 8 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 8: 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 higher education institutions 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.

4.2 Results of the conference

The conference on April 27, 2010 – hosted by Wageningen University & Research centre – was attended by sixty to seventy campus users: energy coordinators, campus managers, academics and students. 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.

4.3 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 “homebase 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.

5. Starting point for the future roadmap

The results are being shown in an Internet 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. The schedule 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? Table 8 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.

Table 8: Sustainable ranking of future models (green to red - from most to least sustainable)

	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

5.1 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 world wide web (duurzamecampus.plado.nl or www.duurzamecampus.nl - currently only in Dutch). With this tool - named “Towards a sustainable campus” - higher education institutions 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 a number of possible scenarios and campus models. Based on these, an impression is given which sustainable campus strategy fits the specific situation of an explicit higher educational institution. While visiting the various future scenarios, the visitors receive gradually opportunities that may fit their own situation so that a vision may be created on a sustainable future for their own campus.

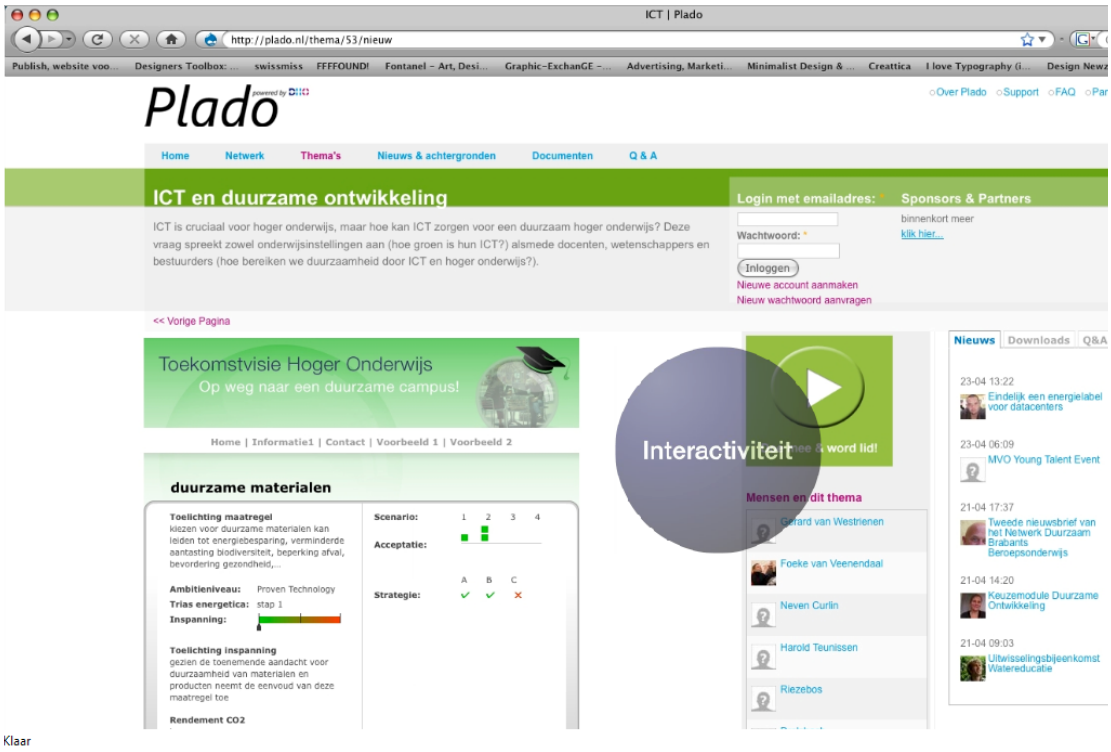

Figure 9: Impression of the web-based tool

5.2 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.

6 Acknowledgements

6.1 Research team

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6.2 Client and advisory committee

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Ir. Ad van der Have (WUR), representing the association of universities (VSNU)

Drs. Aldert Jonkman, HBO Raad, representing institutions for higher profession education

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www.hbo-raad.nl (for data on institutions for higher professional education)

www.agentschapnl.nl

www.tudelft.nl

www.osiris.tudelft.nl

www.iMindMap.com

Participants workshops / Respondents

Campus managers and energy coordinators (October 30, 2009)

Students and employees higher education, Network DHO (online questionnaire, 2009)

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Students minor course Ecology, Haagse Hogeschool (November 17, 2009)