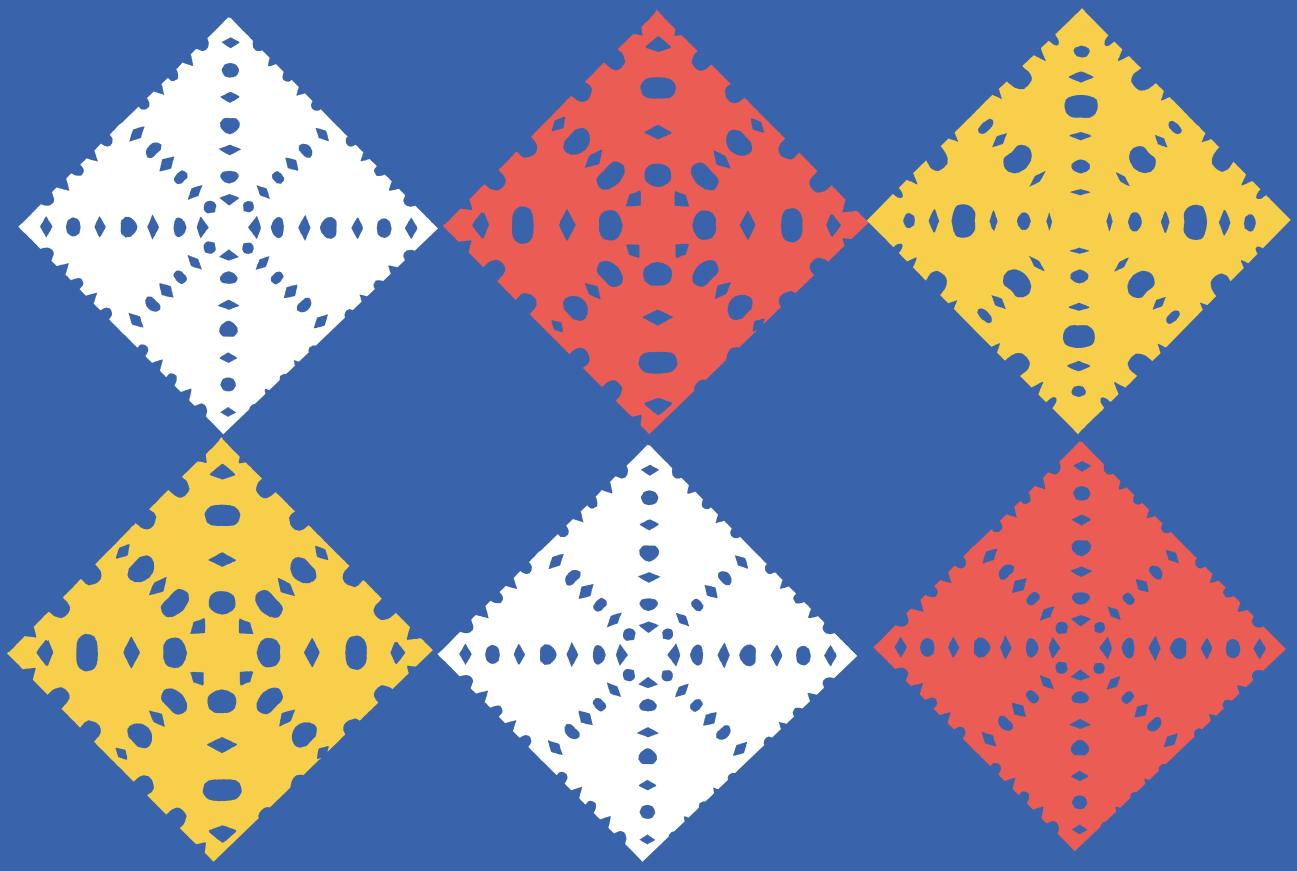

# SHORTCUTS TO SUSTAİNABLE NORDİC COMMUNİTİES

## Experiences from Nordic Climate Festival @Aalto

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Aalto University

NORDEN 2011

NORDİC CLİMATE FESTİVAL @Aalto

Aalto University,
Otaniemi, Espoo, Finland
30th August – 2nd September 2011

# Shortcuts to Sustainable Nordic Communities

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# Table of Contents

## Posters – New (and tried)Nordic ideas on…

# Foreword

Nordic Climate Festival @Aalto gathered some 90 Nordic Master's and PhD students to Helsinki and Espoo in late August 2011, to search for shortcuts to sustainable Nordic societies. The students worked in 7 workshop tracks, covering all key fields of sustainable societies, under the guidance of researchers from Aalto University.

The workshop turned out to be a success with enthusiastic contribution from dedicated students. The real value of the workshop lies not only in the results however, but also in new ways of thinking about sustainability – both for the students and Aalto staff. Most of all, the event helped to build individual connections and networks people engaged in the topic. In the end, the festival was much more than just a Nordic event; the participants represented over 30 countries in total. This can only be seen as a richness in ways of looking at climate change related challenges and especially solutions that, although always being operationalized on a local level and in a local context, in the end are common challenges to all countries in one form or another.

The core challenge in dealing with climate change, especially on mitigation, is time. As the level of global greenhouse gas emissions keeps on growing, we desperately need new policies and practices to turn this trend around. At the same time inertia both in natural phenomena and in changing our lifestyles means that global temperatures based on current emissions only will keep on rising for decades to come. This forces us to think of ways to adapt to unavoidable consequences of climate change and adaptation to them, despite the success of mitigation policies. Both aspects of managing climate change require forward oriented thinking already today, so that we can avoid being locked into unsustainable development pathways at the very least – a thing one might argue in many cases is already slowing mitigation efforts down.

Therefore the key question the workshop set to study was: can we find ways of speeding up societal change in some key sectors, in favor of sustainable solutions? The answer is not an easy one, nor one that could sufficiently be answered during a 4-day workshop. We did find many good solutions however and identified a number of bottlenecks – and ways to go around them. The workshop alone surely is a long way from bringing these ideas as a part of everyday life of Nordic citizens, but they do show that ideas and options related to sustainable lifestyles are ample within the Nordic countries.

In connection to the workshop we organized two open seminars with live webcasts and a hugely popular Climate Fair at Design Factory in Otaniemi on 1st of September. The Climate Fair invited companies, universities and other organizations working on sustainable solutions to present their current research initiatives and to promote their know-how and working opportunities related to climate change mitigation and adaptation. The fair was organized jointly with the Aalto University academic year opening, a big party for students and personnel. For a videojournal on the event by Helsinki Upper Secondary School of Visual Arts please visit ▶ ***www.climatefestival 2011.fi!***

In Espoo 4.11.2011
Simo Haanpää
Nordic Climate Festival @Aalto coordinator,
Researcher M.Sc., Aalto University, Centre for Urban and Regional Studies, YTK


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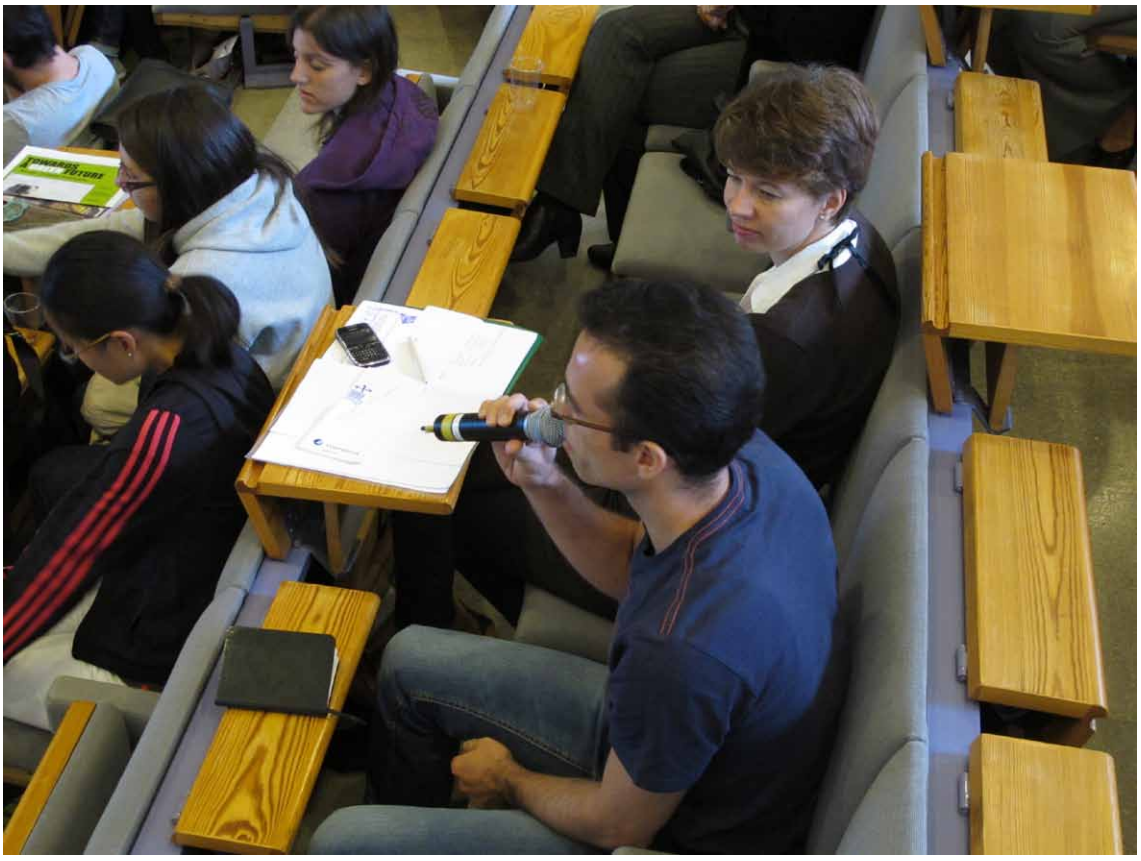


*As a basis for the Shortcuts to Sustainable Nordic Communities workshop an open seminar on fostering sustainable innovations was organized on 31.8.2011 at Dipoli in Otaniemi, Espoo. In the event we heard Nordic insights on topical climate change and sustainability issues from president of Aalto University Tuula Teeri, Minister for Foreign Affairs Erkki Tuomioja, Vice Director Lise Jørstad from Nordic Energy Research and from Environmental Counselor Antero Honkasalo from the Ministry of the Environment. Heikki Tuomenvirta from the Finnish Meteorological Institute FMI gave an introduction to climate change mitigation and adaptation challenges in the Nordic countries.*

*The presentations were followed by a panel discussion titled 'Shortcuts to Sustainable Nordic Communities: Facilitating Sustainable Innovation and Research in the Nordic Countries'. The panel was facilitated by Programme Manager on Sustainable Development Meri Löyttyniemi, Aalto University and journalist Kari Rissa. The panelists included Professor Peter Lund, Aalto University, School of Science, Department of Applied Physics; Director Jukka Noponen, Sitra, the Finnish Innovation Fund, Energy Programme; Energy Director Jari Suominen, St1, Renewable Energy; CEO Jaakko Särelä, ZenRobotics; Research Professor Antti Hautamäki, University of Jyväskylä, Agora Center; General Manager Jón Björn Skúlason, Icelandic New Energy and Researcher Aija Staffans, Aalto University, Department of Architecture.*

*The following introduction is an interpretation on the views presented in the opening seminar of the Nordic Climate Festival @Aalto. A webcast of the event can be found on the festival website* ▶ ***www.climatefestival 2011.fi*** *(until the end of December 2012).*

# INTRODUCTION: Facilitating Sustainable Innovations and Research in the Nordic Countries

*Simo Haanpää*
*Aalto University,*
*School of Engineering*
*Centre for Urban and Regional Studies, YTK*

As stated by president Tuula Teeri from Aalto University in her opening notes for the seminar, climate change is not only met by new technologies, but in battling it we actually develop a whole new mindset – including new design and new business models, as without a change of attitudes and values on consumption we risk losing any gain from new technologies. Put another way by Environmental Counselor Antero Honkasalo from the Ministry of the Environment, when we talk about eco innovations we can expand the range of our thinking from products to production, systemic level and social innovations – essentially into how to change organizations and lifestyles.

Indeed, an innovation is by no means merely an invention but essentially a way to spread and perhaps commercialize a novel practice or a technical solution. When we opened the call for the workshop, we asked for the applicants to submit a poster on a sustainable Nordic innovation related to their workshop track that the students felt could offer shortcuts to a sustainable Nordic future, whether it be a technical solution, practice or policy. The majority of these posters are now featured in this publication.

In practice it is difficult to categorize these approaches – we cannot consider technical innovations separate from their social use. In fact, many technologies now widely discussed in national, Nordic and EU scenarios (such as renewable energy sources, smart grids and innovations on energy efficiency) have been around for decades but are only now taken widely in use.

Antero Honkasalo reminded us that an 80% reduction in greenhouse gas emissions is a very ambitious target and that while national climate and energy strategies offer many different kinds of scenarios to reach it, all of them demand big changes especially in our energy use and in the transport sector. As stated by

Honkasalo, fulfilling our material basic needs such as housing and nutrition create the biggest climate impact, with the role of services growing. We also should not forget novel practices that actually serve a major role in mitigation; for example changes in consumption patterns are as important a means as changes in the energy sector.

In all, the production system we need to target covers cultures, production, trade and even health and environmental aspects. This view was shared by our panelists, too. The panel called for a systemic change in our society, covering a complex set of issues such as regulations, taxation and urban and regional planning.

These issues are especially prominent when we expand the understanding of climate change as being a problem essentially threatening global development goals and aims of social justice. Honkasalo stressed that solving issues of poverty is required to solve the climate crisis, making fairness an important part of global mitigation efforts. These questions arise in connection to issues such as energy-related climate policies and food production. However, the panel saw that new technologies can also help in smoothing the gap between people who have and who have not. For example, globally there are 2 billion people without sufficient energy services, and targeting local energy sources such as renewables could create both wealth and well-being. We should consider whether developing countries need to follow the same path we have taken, or could technologies and practices developed in the Nordic countries be used as shortcuts to a sustainable future in other parts of the world?

While our focus often lies in mitigation, Heikki Tuomenvirta from the Finnish meteorological institute reminded us that a strong understanding of socio-economic and policy processes is needed to create successful climate change adaptation policy and actions, too.

## Could the Nordic countries be sustainable innovation powerhouses?

The Nordic region has some advantages in dealing with climate challenge, such as high level of education, political will to act and high level of natural resources. As stated by Vice Director Lise Jørstad from Nordic Energy Research, we also have good starting points in some important fields contributing to sustainable development: Nordic countries are already world leaders in renewable energy systems, particularly in bioenergy (especially Finland and Sweden), hydropower (Norway, Iceland and Sweden) and windpower (Denmark).

To further back this up, the Nordic countries in 2008 opened the largest joint Nordic research and innovation initiative to date, the Top-level Research Initiative (TRI). Funding from the TFI program is already 90 million euros, and it has created thematic networks covering more than hundred Nordic universities, institutions and funding and business partners. Six Centres of Excellence focusing on climate change issues have also been created. In order to take the findings of the Nordic Climate Festival @Aalto to this important arena, in co-operation with the Nordic Investment Bank we chose one representative from each workshop group to join the TFI network annual meeting in Oslo on 18-19.11.2011 to present their groups' results and to further network with the Nordic research community.

In any case we cannot focus solely on the Nordic market. The panel noted that in the field of green economies new players are rising, most notably countries such as China and India and some African countries. These countries also create a huge new market, but we need to work on both international co-operation and fostering domestic production in order to enter them – both very strong professional knowledge and an ability to work together are needed. Fostering a technological change and creating domestic markets is an important step, as is seen in Germany. As stated by Jukka Noponen from Sitra, most cleantech companies

have a long background in research and they are easy to find and fund; however the domestic market often does not support their products, underlining the importance of the global market. This is nevertheless often hard to penetrate by small companies.

However, we already have working examples: General manager Jón Björn Skúlason from Icelandic New Energy stated that Iceland is these days exporting new geothermal energy knowhow worldwide, and in the same way they are ready to 'export' research on social aspects such as usage and acceptance of new technologies. Global problems such as waste management could be similar issues where we could export our knowhow, as illustrated by the construction waste sorting technology presented by CEO Jaakko Särelä from ZenRobotics.

## Large-scale co-operation and innovative financing for both research and commercialization: preconditions for success

The complexity of challenges posed by climate change calls for co-operation between various actors, which indeed was a key idea behind the festival; we aimed to provide young people a platform for the creation of fresh visions and concrete proposals for sustainable communities, while also fostering close partnership between the Nordic countries.

As stated by president Tuula Teeri from Aalto University at the very beginning of the seminar, research plays a big role in battling climate change. This view was backed by minister Tuomioja, who stated that the next industrial revolution will have to be a green one and that in order to achieve this we have to harness creativity and the force of innovation and in this the role of universities as well as R&D centers will be essential. This mindset is pursued in Aalto University, as in addition to offering a wide variety of technology development and embedding sustainability issues in business development, community planning and information communication, sustainability is to be part of the everyday life of Aalto's own experts, too.

While scientific collaboration is a key issue, co-creating solutions with municipalities, businesses and private citizens is crucial. The old-fashioned, exclusivist university system must be made obsolete. It was seen that this kind of Public-Private-Partnership model is actually a Nordic way of doing things, as governments readily acknowledge the importance of working together. Basically the only thing we need is more dialogue among various actors, which can be aided by social innovations.

Minister Tuomioja reminded us that in achieving emission reduction goals we should not overlook the role of the private sector; to make people understand the need for change in modes of production of goods and services, climate friendly solutions and services should be seen as a good business to invest in. We need businesses that think outside the box – innovative companies will pick the fruits in the long run.

Another key condition for the spread of sustainable innovation is the ability to quickly commercialize new innovations, as is done in the extremely dynamic ecosystems like that of Silicon Valley – an ecosystem that is of course extremely hard to re-create. Commercializing new innovations also calls for innovative financing, which is on the agenda of the Finnish government in international negotiations. It was seen that especially for 'out of box' types of new innovation it may be difficult to secure funding, especially if we are talking about multidisciplinary work that eludes current fields of funding. It was seen that venture capital is needed also for student driven innovations, as seed funding to test new innovations, an issue Sitra is already working on.

## Everyone has the power to facilitate sustainable innovations

The panel saw that market drivers are most important factors in fostering sustainable societies. This in the end requires political will, as it is the responsibility of politicians to create these drivers. Taxing is one key thing. For example the world forerunner tax on traffic and a mandate to use a small share of biofuels mixed in with gasoline already has had a direct market impact in FInland. However, a structural challenge persists: a change in energy paradigm easily takes decades, and it is very difficult to find a politician with enough stamina to put forward ideas or policies that only materialize long after they have retired from office.

The long time-spans of many technical solutions in use was also brought up as a reason why even companies such as St1, investing steadily in sustainable innovations, may still have one foot in traditional technologies – this is seen to be needed in order to fund their activities during the transitional period. Mobility is an interesting case in point in terms of the challenges in reorganizing our technological systems and thinking – mobility is a growing problem that electric cars are partially hoped to solve, but the question is, will they lock in a transport system based on private cars, to the expense of public transport?

Even slower is the transformation of urban structures – only 1% of buildings

are renewed each year. However, our living environment forms the setting in which we think of sustainability, and in any case, living and transport are the biggest sources of greenhouse gas emissions – not to mention emissions connected to our individual lifestyles.

In all, the call for a technological change comes from the grassroots level. In many cases the technology is already there – only demand from people is needed. Technologies have to be accepted by the citizens, otherwise they simply won't be used. Social innovation is a key issue in motivating people to work and live in a rational way and should be supported by motivation studies, cultural studies, sociology and anthropology. Changing mindsets will also feed into changing policies and vice versa.

It was seen that from the perspectives of both people and industries alike we need predictability of regulations, flexibility of their implementation, cost effectiveness, awareness raising, professional training and education, and easy access to information, contributing to credibility and acceptability of policies. Strict and clear targets are also needed for energy use and emissions, as these challenge existing innovations and create new markets – they only must be equal and fair to all. A global perspective to sustainability is indeed needed.

In the end whether we notice it or not, we are already living a systemic change; in the built environment the use of energy will drop to 20% of the present level according to current policies, and the years to come will likely see buildings feeding energy into the grid. The panel concluded that we shouldn't be too pessimistic – promoting sustainable innovations is largely a cost issue, and new technology is becoming increasingly cheaper. Our own choices can further facilitate this change already today.

*The following chapters present the results of the work done in the Shortcuts to Sustainable Nordic Communities workshop, together with a selection of posters on sustainable Nordic innovations as submitted by the workshop participants on themes related to their workshop tracks. For videos and ppt presentations of the workshop tracks please visit the festival website* ▶ ***www.climatefestival 2011.fi.***

## Shortcuts to Sustainable Nordic Communites Workshop for Nordic Master's and PhD students at Nordic Climate Festival @Aalto, Aalto University, Otaniemi Campus, Design Factory and Dipoli, 31 August–2 September 2011.

**Track 1) Vision for a Sustainable Urban Environment: identifying conflicts and synergies between adaptation and mitigation**
Track Chair: Sirkku Juhola, Aalto University School of Engineering, Centre for Urban and Regional Studies

**Track 2) Beyond Sustainable Transport: Electric Car Features and Services**
Track Chair: Pekka Malinen, Aalto University School of Science, BIT Research Centre, with Veikka Pirhonen and Raphael Giesecke, SIMBe.fi project

**Track 3) How to design and build affordable and sustainable near to zero energy dwellings in Nordic climates?**
Track Chair: Yrsa Cronhjort, Aalto University School of Engineering, Department of Architecture

**Track 4) Energy efficiency and renewable energy sources in Nordic homes**
Track Chair: Sampsa Hyysalo, Aalto University School of Economics, Department of Management and International Business with Eva Heiskanen and Jenny Rinkinen

**Track 5) Energy future 2050**
Track Chair: Sanna Syri, Aalto University School of Engineering, Department of Energy Technology

**Track 6) Design for Sustainability – Dematerialization by Design**
Track Chair: Tatu Marttila and Cindy Kohtala, Aalto University School of Art and Design, Department of Design

**Track 7) Universities, climate change and sustainability – case Aalto University, sustainable campus**
Track Chair: Meri Löyttyniemi, Aalto University, Sustainable Development, with Professor Raine Mäntysalo, Institute Director, Aalto University

# Track 1: Identifying conflicts and synergies between adaptation and mitigation

# Identifying conflicts and synergies between adaptation and mitigation

Sirkku Juhola, Aalto University School of Engineering,
Centre for Urban and Regional Studies YTK

## Cities at the forefront of climate change

The main topics of this track were the concepts of mitigation and adaptation, which are the two policy options for societies in response to climate change. The former aims to reduce the emission of greenhouse gases into the atmosphere by improving energy efficiency or by switching to renewable energy sources. The latter on the other hand focuses on measures with which societies can adapt to the inevitable impacts of climate change and to take advantage of them.

Cities are key players in both mitigation and adaptation as significant contributors of greenhouse gases as well as being large concentrations of people and economic assets. Decisions relating to mitigation and adaptation often become most prominent at the level of local decision-making where these policy goals are realised and here is where conflicts and synergies can be identified.

Adaptation or mitigation or both? The aim of this track was two-fold. Firstly, the aim was for the students to identify these potential conflicts and positive synergies in the urban space. For example, mitigation policies attempt to create a denser urban structure in order to reduce car and building energy use, whilst this can conflict with the aim of adaptation policies that aim to create open space for surface water runoff. Examples of synergies include, for instance, the planting of trees in urban areas can sequester carbon from the atmosphere whilst also cooling the city and reducing the possible heat island effect,

The second aim of the track was for the students to acknowledge that although political or technological means exist for mitigating greenhouse gas emissions and adapting to the impacts of climate change, these do not necessarily, and certainly not automatically, translate into action within cities. Decision-making is complex and involves a variety of views and agendas.

Games as way of facilitiating learningThe students were enrolled in a two-day workshop centered on three games, developed by the two researchers and co-

hosts of the track Pablo Suarez and Janot Mendler de Suarez, in collaboration with game design graduate students Mohini Dutta and Ben Norskov from the US.

During one of the games, the students were assigned the roles of construction firm owners and they had to make decisions regarding to what extent they should build housing that was energy efficient or resistant to flooding, all the while considering the tradeoffs between investing in protection from future climate changes and making the highest profit. In this way, the games illustrated the complexity of practical transition to a sustainable city.

Key messages

The key message that emerged from the workshop was the potential in illustrating complex social phenomenon through the medium of games. A group of people from very diverse backgrounds can be brought together to discuss a complex issue and develop a shared understanding through playing a game. This is particularly helpful in issues such as climate change where the debate can be polarised and dialogue can be hard to achieve through normal means. Games such as the ones played during the NCF can help people understand climate change

and facilitate informed decision- making in relation to the urban environment. For a short introductory to the game please visit ▶ *www.climatefestival 2011.fi!*

## Workshop Participants and Facilitators

**Track Chair:**

Sirkku Juhola, Aalto University School of Engineering, Centre for Urban and Regional Studies YTK

**Co-hosts:**

Pablo Suarez, Associate Director of Programs, Red Cross / Red Crescent Climate Centre
Janot Mendler de Suarez, Boston University Pardee Center for the Study of the Longer-Range Future, Games for a New Planet Task Force
Mohini Dutta and Ben Norskov

**Participants:**

| | |
|---|---|
| Arjun Basnet | (Nepal/NO) Norwegian University of Science and Technology |
| Chad Boda | (USA/SE) Lund University |
| Hildur Gunnlaugsdóttir | (IS) University of Iceland |
| Andreas Eggertsen | (SE/NO) Norwegian University of Science and Technology |
| Nazim Erdem | (Turkey/DK) Technical University of Denmark |
| Iida Huhtanen | (FI) University of Helsinki |
| Olli Jokinen | (FI) Aalto University |
| Kati Koponen | (FI) Aalto University |
| Freja Rasmussen | (DK) Technical University of Denmark |
| Keivan Saberi | (Iran/SE) Lund University |
| Linda Strandenhed | (SE) Swedish University of Agricultural Sciences |
| Ying Yin | (China/SE) Royal Institute of Technology |

*Issues related to climate change in the present context has much been debated and has been the whole world's concern. I first had some ideas related to this particular issue when I was one of the participants of Osaka Foundation of International Exchange (OFIX), a month long training program in architecture and arts where the topic of discussion was more focused on sustainability. It was a month long formal/informal discussions, symposiums and presentations on subjects relating directly/indirectly to climate change in Osaka Japan.*

*Receiving the invitation from NCF, I was really enthusiastic to participate. However, I was a bit taken aback by the standard of the participants the organisers wanted as I had just completed my 1st year of masters in Sustainable architecture. I took my time and applied at the 11th hour and was more than happy to get selected.*

*In the early morning of 30th of August, we in a group of participants from Norwegian Institute of Science and Technology (NTNU), Trondheim; headed for Helsinki. As we landed at Vantaa airport, all our fatigue disappeared due to the warm hospitality that we received from the organising side, Krista and her team.*

*The formal program began the same day in the afternoon after a break with coffee, tea and sandwiches. we were informed about the aim and objective of the workshop including other practical information of the festival. All the seven track co-ordinators introduced themselves and personally came into an interaction that we had communicated earlier through emails during the preparation of the posters. We grouped ourselves into respective tracks and introduced to the group. I was participating in track 1: Vision for Sustainable Urban Environment: Identifying conflicts and synergies between adaptation and mitigation; for which the track chair was Sirkku Juhola. She is a part of Centre for Urban and Regional Studies at Aalto University School of Engineering.*

*In the evening, a cruise trip to see some of the new residential waterfront areas in Helsinki was memorable indeed. Professor Trevor Harris from the department of Architecture in Aalto University was amazing as he described the area in a surprisingly astonishing fashion. We of course interacted with other participants while the cruise sailed by. After two hours of guided tour, we sailed back to Kauppatori at six in the evening and walked few meters to the Old City Hall for the evening reception organised by the city of Helsinki.*

*The next day, 31st of August; had an early morning breakfast at the Euro-hostel and headed towards Otaniemi campus at Dipoli. Formal program began at 9 in the morning with opening seminar where there were presentations, speeches and*

*discussions concerning sustainable Nordic communities from renowned personnel form the Nordic region.*

*After the lunch at around 12 in the afternoon, our group (track 1) headed towards the Venture Garage to start with the brain storming into the theme assigned. On the contrary, we did not go into any brain work in the beginning but started with playing games: feet games, hand games and body games. This gave us some time to further get going with the group and know one another. We were relaxed and ready for the brain storming session. Even the brain storming session was designed in the form of games which I really enjoyed. We started with the card game where we're given 3 cards of different colours each with different key words. The task was to make a statement keeping in mind the workshop theme, using those key words. In another similar session, we could also exchange the cards with other participants in case we'd make better statements and found something in common with fellow participant; obliged by the regulations of the game. This exercise gave us some idea about the content of the theme in general.*

*Another even more interesting exercise was the bidding game as part of the learning of climate change adaptation. The universal rule for bidding applied.*


*We're divided into 4 groups, discussed within the group about the issues of considerations for eg. Max. Bidding amount, investment in $co_2$ reduction and the profit made. However, while bidding, each of us applied individually. There was also a 'government body' (track co-ordinators) to check and form regulations. This exercise was basically to understand how development and construction work takes place and who should be responsible and the role of the responsible body in climate change adaptation. While getting involved in this exercise, we had a collective discussion on issues related to climate change adaptation, problems and possible solutions. With a short break in between, the workshop ended at 6 in the evening.*

*The next day, 1st September, all of us once again got together in the 2nd floor of the Dipoli campus to further get going with the workshop. Similar to the previous day, we started with feet, hand and body exercise and got into the third game "board game" this time, in understanding climate change mitigation. We were divided into three groups and each group had a similar piece of area to develop. Each one of us in the group had discussions collectively for mutual development, considering climate mitigation; however, decided individually while making development in one's own region as each one of us had a separate part to develop. In the process, there were suggestions and interventions from the 'government' (track leaders).*

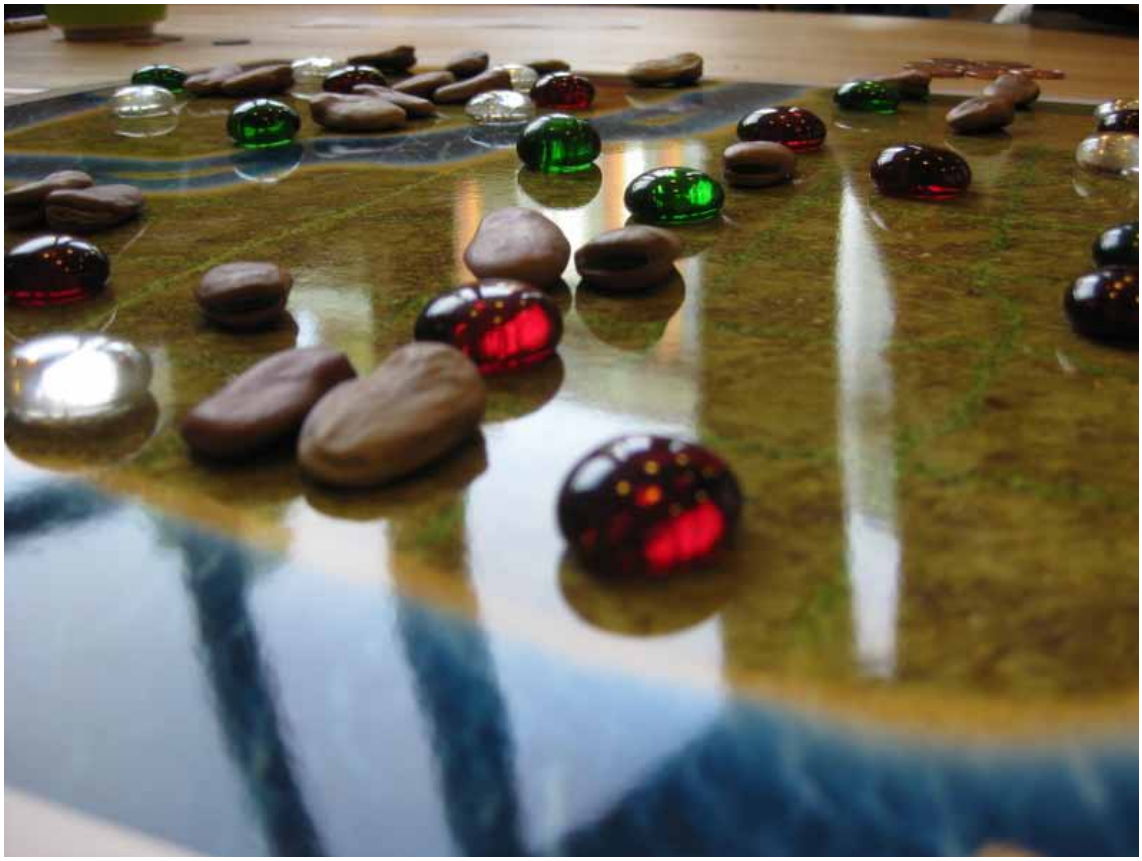
*As a conclusion after getting involved in these exercises, we were to invent our own game or improve on the games that we played to understand climate change*

*adaptation and mitigation; the synergies and conflict associated with these. As a result, for the next morning's presentation, we decided to show few slides to the audience and ask questions to see how well they know about climate change adaptation and mitigation; and conflicts and synergies associated. We found that the audience knew it very well as the questions asked were answered correctly by the majority of the audience in the closing ceremony.*

*On the final day 2nd September, each track-group made the presentations of the outcomes form the workshop which were quite unique. Among the seven tracks, I liked the presentations made by track 2 and track 6. Ours was equally good but could have been better. Finally, the program formally ended with a farewell lunch hosted by the city of Espoo.*

*I stayed a day more to go around the city of Helsinki and the surrounding places. The island Fortress of Suomenlinna, cultural and natural world heritage site and the Kiasma Museum of Contemporary Art designed by Steven Holl were the two sites that I had time to go around which I really enjoyed.*

*Returning back, I was contemplating on issues related to climate change and the consequences which have already been visible. In Nepal, where I come from,*



*melting of ice in the Himalayas, infrequent and delayed rainy season, draughts in some parts of the country have already been observed which have been said to be cause of climate change. It is the developing countries that are most likely to suffer for which they are not held responsible. So, it is the role of the developed part of the world to think and act sensibly. The role that is played by the Nordic region in climate change adaptation and mitigation in this regards is appreciable. I enhanced my knowledge in the field of climate change, possible innovation in tackling the consequences through adaptation and mitigation by participating in the four day long festival. I am very thankful to the organisers for providing me the opportunity of participation.* ■ **ARJUN BASNET**

*"I've taken part in the Track 1 Workshop: "Visions for a Sustainable Urban Environment: identifying conflicts and synergies between adaptation and mitigation". This was my first choice and I'm very happy that I got the chance to participate in the whole conference and in particularly this track as well. My academic background is social anthropology, development studies and quite a lot of environmental studies and sustainable development studies as well. I'm particularly interested in social and cultural aspects of environmental issues. During the last few years I've become more and more interested in issues of sustainable city development, in particular because I've spent half a year as an intern at the Swedish Embassy in Hanoi, Vietnam, where city development issues were a large part of the agenda. I would like to learn more about these issues and I feel I got some good points from the conference. I think that good climate change adaptation and mitigation work has to work with an eye out for both social and environmental long-term sustainability as well, and I was a bit worried from the information we got beforehand that the strict focus on climate change would lead to neglect discussing wider aspects of sustainability. I'm satisfied that this was not the case, and enjoyed complex discussions of different issues. As usual on conferences, I think the greatest part was getting to meet all the participants and to exchange opinions and experiences with a variety of people. Because of the different tracks, I was very satisfied with meeting students from all kinds of disciplines. That was useful and enjoyable as well.*

*I am very pleased with track 1. It was very interesting to hear about the other participant's posters and I also felt I got some new insights writing my own poster. I don't feel that I've learnt so much about the topic at hand, adaptation and mitigation synergies and trade-offs, as I had expected, but I do feel that I got a chance*


*to think more around those issues and I feel I learnt a lot about methodology and concrete methods around facilitation and working with groups. The idea of working with games was brilliant, and all the staff working with track one did a good job.*

*I was not very impressed with the literature which was given to us in beforehand. I felt most of the articles were quite tame and not really expanding on the topic in a way that was new and useful to me. Sometimes I felt they were stating the obvious 'There are synergies with some aspects of climate mitigation and adaptation, but sometimes there are trade-offs.' I would have preferred a wider discussion on 'visions for a sustainable urban environment' , some stirring and inspirational texts – maybe some provoking takes on it as well – just to get people thinking! - and then discussing what the place of climate change adaptation and mitigation has in the wider context of (ecologically, socially and economically) sustainable urban environments.*

*I feel this was a problem not only with the literature, but also during the whole track and the presentation, that we got a bit stuck on very technical issues instead of discussing wider impacts. That could still have been interesting, but I feel that a majority of us participants did not have that level of detailed, technical*

*knowledge that would make that kind of discussion useful. A wider discussion of sustainable city visions – and then looking at the role of cc mitigation and adaptation in those scenarios - I think would have been more meaningful and have led to more interesting results. Issues that are close to my heart – and which I thought were missing in the literature and during the workshop (though they came up in the discussion of some of the games) – are issues of environmental justice (that very easily is related to climate change mitigation and adaptation – who benefits and who bears the brunt of downsides?), what about gentrification or building for social equality, what about biodiversity in cities, what about centre - periphery relationships with urban – rural areas? I do understand that we had a very limited time to discuss the issues at hand, but I felt they were somewhat reduced to technical solutions that either work or doesn't, and that was a shame. I heard that some more 'adaptation and mitigation' lecturers were supposed to take part, but couldn't come, so I can understand that some aspects of these issues were missing because of that.*

*What we did get were smart, interactive and creative methods – and as I personally are quite interested in working with facilitation and helping groups develop ideas I was absolutely thrilled to learn more about how to work with games in this fashion. I found it brilliant that we got to take part in formulating and reworking the games themselves, and that we were invited in finding 'faults' and imagine alternative ways of doing them were a stroke of genius. I'm happy having seen these methods, and I think that might be useful for all of us, no matter that we all come from different backgrounds. I liked that the whole of the workshop was so interactive, I liked the use of games and discussion aids to really get people talking and playing. This was both fun and useful. I feel that some things, particularly the big game with the map, were a bit rushed, and they could have been used with more time to be able to get deeper into discussions on how the game relates to the real world and what actually can be learnt from it and how.*

*I am very happy with the track and I feel that I've brought a lot of new ideas and new contacts – as well as a brief but very satisfying break from everyday life - with me home.* ■ **LINDA STRANDENHED**

*"In the final session of the Nordic Climate Festival one of the organizers, Simo Haanpää, gave a talk about the organization process of the festival. In his talk he said, that he had participated to all this, to get his positivism back. This comment really stuck in my mind, and I could very well understand what he meant.*

*I have been working in a research group dealing with the issues related to climate change mitigation for over three years now. I guess that only three years is enough time to make you loose at least part of your positivism. Sometimes it is not so easy to stay positive, when you read all the time more negative news about the warming climate, rising emissions and the following natural catastrophes, and on the other hand about the stagnant climate politics. It doesn't make you feel positive, when you follow the politicians and decision makers going on and on with the economic growth, encouraging people to consume more and more money to things they really don't need. And when you follow the people around you demanding even higher living conditions even though they already have all they need. Most of the time the bad news and negative signals seem to arrive and the good ones seem to stay away.*

*Sometimes, your older colleagues don't help you to stay positive either, as they have fallen into very cynical thinking. They have seen how slow it is to try to change things, how little the politicians listen to them and how little one can do. Some of them don't believe that the system could be changed and even fewer of them think that the behavior of people could be changed. Some of them don't even see the need for a change.*

*Our research group assesses the climate impacts of evolving energy technologies, such as transportation biofuels, and often the results aren't so positive either. Often we have to tell, that a technology considered to solve some problems actually is not better than the current technology, from the point of view of climate impacts. Or that a regulation planned to ensure the sustainability of a new technology doesn't really ensure anything, as the impacts are very wide spread and difficult to control. That is not such a nice thing to do.*

*Even your own common sense tells you that things can't continue like this for a long time. If everything in our society is based on continuous economic growth, how could something grow forever? The resources are very limited, the population rate is rising, everybody wants to have the same living standards as the western people do, and the western people still aren't satisfied with what they already have. This seems like an impossible equation. No miraculous technology can solve the situation. And how to make the decision makers, the business people or consumers even to think about other options, such as the idea of degrowth?*

*So, how to stay positive after all that?*

*The Nordic Climate Festival really gave me back the little lost part of my positivism. It was great to see all the young people from various backgrounds but still interested in the same questions as you self. It was nice to feel the positive energy*

*that we had in our working group and in the common events, when people openly shared ideas and were open to new solutions and to everyone's opinions. Also the discussions made outside the official program, for example every evening, were very inspiring and showed me, that there are many other people also concerned about the same things as I am. For that, I really appreciated this occasion to see all these people and to participate to a very interesting seminar program during the week!*

*And then the big question: how to keep that positive energy and transform it into your own research work? I guess that you have to believe that every effort made is still worth something. You have to believe, that there are many enough of young (and for sure also older) people, who don't accept our society and our living manners as they are now and who want to change our way of living. And when these young people take their places in the working life, the political life and in business they can persuade the other people that a change is needed and possible.*

*In the working track one, we had a great example of positivism, as the co-facilitators Pablo and Janot were the most positive and energetic couple. Their energy really took over the whole group and they were able to create a very intensive and interesting working environment for us. They had developed a very inspiring method to deal with the climate change issues by using games. For me, this working method was the most interesting lesson learnt during our work. With some very simple games they could very efficiently show us the complexity of the decision making, when dealing with the climate change mitigation and adaptation. In my opinion, the games we played worked especially well as starting points for discussions and could be used for this in many occasions.*

*I think that the idea to use these kinds of games to make different stakeholder groups to discuss with each others could work in many situations. In a situation, where a decision would need to be made for example about city planning there are various stakeholder groups, such as city administration, constructors, the inhabitants, the architectures, various organizations etc., involved. By playing games, the roles of the stakeholder groups could be mixed and they could see things more clearly from the point of view of the other interest groups. This way they might be able to discuss and co-operate more efficiently and to better understand the drivers behind each other's targets.*

*Maybe some kinds of games could also be used, when presenting the results of research projects for example for public audience and politicians. The research concentrating on climate change mitigation is often very policy related, so the games could be about political decision making. Often the research results are*

*complex to understand and they should not be taken out of the context where the research is made. Maybe this could be better explained by visualizing and making the results more practical problems such as the decision making problems in games. Also some very simple games with audience could be used during scientific presentations, but this should be done very carefully. In any case, a little personality and variation in scientific presentations could be very refreshing!*

*Maybe this way, some little positivism could be transferred to the sometimes very negative research results. Anyhow, it is very clear that without positivism, no change can be made in people's minds. Only that fact is a very important reason and obligation to stay positive when continuing the work on climate change mitigation and adaptation!* ■ **KATI KOPONEN**

# Track 2: Beyond Sustainable Transport: Electric Car Features and Services

# Beyond SustainableTransport: Electric Car Features and Services

Pekka Malinen, Aalto University School of Science, BIT Research Centre, with Veikka Pirhonen and Raphael Giesecke, Aalto University School of Science (author)

## Introduction

The overall aim of the Finnish SIMBe project (**www.SIMBe.fi**) is to significantly accelerate the introduction of sustainable electric mobility in Finland. SIMBe stands for Smart Infrastructures for Electric Mobility in Built Environments. The fundamental assumption of the project is that electric (e-) mobility is inherently more sustainable than mobility based on fossil fuels. However, as has been widely recognized in the e-mobility field, the currently used batteries are expensive, often more expensive than the rest of the particular electric vehicle (EV) that they propel. There are two opposite schools of thought how to address this problem, which can be summarized as follows: a) *Leave the battery in peace, as it is precious*. Use it only to propel the EV of which it is an integral part. Use it instead of fuel, and do not use it for any other applications. The EV's sole purpose is that of a *transportation device*. b) Make *as much use of the battery as possible, as it is precious*. Involve vehicle to grid (V2G) or vehicle to house charging. Additionally, invent new features, meanings and services for the battery driven EV, which go *distinctively beyond transport*.

The SIMBe project decided to opt for school (b), based on the smart energy production and distribution scenario, in which electric and hybrid vehicles' batteries will deliver energy on demand to the grid. SIMBe aims to prepare key Finnish industrial players and consumers for the transition to this new energy-transportation paradigm. But how can we replace the conservative understanding of the "transport only" school by a holistic view of what features, meanings and services are actually possible by using a large scale fleet of "batteries on wheels"?

The Nordic Climate Festival @Aalto provided the unique opportunity to tap into the knowledge and creativity of students within the Nordic countries. Being properly prepared and facilitated, a workshop may provide some insights and

ideas. In scope of the workshop was the *individual electric car*, equipped with a *large scale electric battery*. EVs with range extenders were also in scope, plug-in hybrid electric vehicles were on the boundary.

## Objectives

The *direct* core objective of track 2 was to identify or invent additional features, meanings and services based on e-cars, which are impossible to be realised with internal combustion engine (ICE) cars. *Indirectly*, we intended to transform the participants of the workshop into "Ambassadors of E-mobility" – make them understand and promote actively sustainable e-mobility in their respective environments: professional and private. Also we wanted to embed sustainable e-mobility into the environmental and climate protection discourse in the Nordic countries, by starting with the Nordic Climate Festival @Aalto as a first major dissemination opportunity.

## Workshop Organisation

The participating students, most of them not yet working professionally in the field of e-mobility, were complemented with three SIMBe project researchers, one of them acting as the host, and – on the first day – an Icelandic new energies professional active in e-mobility. This set-up is not ideal but at least partially, in its diversity, close to the network of professions as suggested by Verganti (2009) for a design-driven approach. The workshop was professionally facilitated by Grape People Finland Ltd.

Phase one of the workshop – *Scoping & Informing* – started with a warm-up and with a keynote speech by the project manager of the Danish etrans project on "How might we create new opportunity spaces that use the benefits of the e-car?" The speech elaborated further on the results presented in Jensen et al. (2010), achieved by in-depth interviews combined with a set of joint workshops. The purpose of this first phase was to introduce e-mobility, the workshop goals and explicate the joint knowledge of the attendees.

The second phase of the workshop – *Diverging Beyond Transportation* – aimed to map existing ideas and the creation of a large amount of "wild", novel ideas about possible electric car features and services.

The third and final phase – *Converging and Closing* – involved the steps *selecting interesting ideas, developing ideas further, evaluating ideas according to potential impact and innovativeness* and *describing ideas*.

## Student Posters

Note that at least four student posters stood out in such positive way that a brief summary is given here.

### 1.1 Grid connection and use as an energy buffer (two posters)

EVs enable energy suppliers and distributors to regulate (keeping voltage and frequency stable) and they provide spinning reserves in case of sudden demands for power. Korompili (2011) distinguishes the following grid related features and services, which are in line with the findings of Romana (2011) and Giesecke et al (2010):

- Features creating functional framework for providing services to grid (Clement-Nyns et al. 2009, Green et al. 2010)
- Services provided to grid (Clement-Nyns et al. 2009, Green et al. 2010, White et al. 2010)

- Key-factors affecting benefits from provided services (Green et al. 2010, White et al. 2010, Andersson et al. 2010)

Remarkable is the idea of a Virtual Power Plant as described in the section "The power source" above. Obviously, EVs can also act as buffers for renewable energies, typically water-, wind- and solar power, as well as for nuclear power.

### 1.2 A future EV scenario – 2025 [or probably later]

The availability of electricity in the vehicle allows integration of equipment and appliances of the user's choice to the vehicle, whether it is an electric barbecue grill or a personal movie theatre. Users might actually have forgotten that the primary use for the vehicle was to move from A to B since it now very much acts as a mobile (and stationary) personal computer, wallet, phone, entertainment centre, a place to study and work and even as a replacement to summer cottage, hotel night or visit to the movies. Although, if one wants to, one can simply use the EV for going to the supermarket. Or maybe just send it there on its own to pick up the groceries.

### 1.3 The Interest of Insurance Companies in Sustainable Transportation

To realize sustainable transportation various players need to be mobilized. The insurance sector is one of the sectors able to influence a positive development. It is one of the biggest industries in the world (Bacani 2008), interacting with most parts of the economy (Jóhannsdóttir 2009). Insurers have vested interest in mitigating emissions causing climate change. They are exposed to population increase and concentration of wealth, driving disaster losses (Bouwer 2010). Climate change offers new opportunities to insurers as they can develop insurance products related to renewable energy technology. In addition, insurers are in a position to raise public awareness, focus on loss prevention and initiate behavioural changes through pricing policies.

When adding the insurance role and emphasis to the definition of a sustainable transportation system it becomes evident that the emphasis on the human dimension and actions should be strengthened. Technological solutions are not sufficient, behavioural changes are needed as well. Insurers can educate clients and use financial incentives. Sustainable transportation in itself is economically advantageous as it means less fuel consumption and less maintenance both for vehicles and infrastructure.

## Workshop Outcomes - New EV Features, Meanings and Services

Within the workshop a list of questions was created by the participants as stimuli for the later diversion phase. Although they were not meant to be an actual, final outcome of the workshop, they still can act as triggers for stakeholders who are interested to explore their own tacit ideas. Thus they will be listed in a structured way, with possible references to Maslow's (1943) Hierarchy of Needs, in a further SIMBe project essay. The stimulus questions triggered a lot of "wild" ideas around e-mobility, which were, in a last phase, filtered into final ideas, which were defined a little deeper. The filter criteria were the following: Idea needs to be inspiring, novel for e-car and have a large impact. Additionally, and this is the toughest criteria, the idea should not be applicable for ICE cars. The next sections are based on the actual workshop outcome, as photographed from the collated ideas, from student diaries and by applying some of the diversion ideas. Classification by the author.

### The power source

This meaning is closest to the initial battery on wheels idea. However, it is important to understand which needs are behind the various power source functions. Firstly, safety and security needs call for the use as a power back-up: a mobile energy buffer, which acts as an back-up during emergencies, such as earthquakes, storms or floods, in case the electrical grid (locally) collapses. It would also be an emergency power supply, for both home and outdoor use. The second use is that of a buffer, with which people can "do good" to the environment, live sustainable and express their green consciousness. This meaning is much closer to esteem needs and even allowing self-actualisation. The buffer should use excess energy from the grid or local production and be source of power when needed, allowing also sales of energy to the grid. It is a mobile, personal energy storage, which can be shared when and if needed. It is evident that EVs need to be able to charge electric devices both inside the vehicle and outside (home, cottage, other EVs etc.). For shared activities, EVs should also be able to be "stacked" (like battery racks).

A special application and meaning is the *virtual power plant*: an aggregator controls a fleet of EVs regarding charging and discharging according to (local) grid needs and user contracts and preferences. The meaning for the (traditional) energy producers and distributors is unchanged, which may reduce their initial fear to make use of EVs.

### The mobile multi-purpose shelter for individuals

This meaning of an EV addresses safety and security needs, but also esteem needs. It emphasises the EV as a shelter, a living and working room and a peaceful, protective environment. As no engine needs to run while being stationary and used, an EV has a much better capacity to be used as a mobile office and living room than an ICE driven vehicle. The mobile living room could come with computer and television, but also with kitchen elements, such as a fridge or outside grill. The usage is closer to a boat or caravan than a car. Still, it should promote Finnish EV values: fair, gender-equal, silent, robust.

### The iCar

Similar as an iPhone's main purpose isn't anymore the telephone voice communication, the meaning of an iCar, a term initially introduced by Jensen et al (2010), is mostly beyond transport, even if it still includes transport capability. The iCar needs to provide a *good fun* experience – involve gaming elements and artificial intelligence gadgets. The iCar needs to be a communication platform with internet that is voice driven; an organizer and planning platform, voice driven; a personal diary (e.g. after work), and finally, a personal coach which, as needed, relaxes or cheers up the users. It is obvious that the dashboard experience, touch screen, switches (e.g. volume, heat and/or indicators) should include loads of gadgets and be where the user wants them, following own needs and interests. Head Up displays could be used for, e.g. (dis-) charging opportunities and electricity market prices. While safety and security needs are still addressed, esteem needs, but also self-actualisation are in the focus of this idea.

### The community EV

This idea satisfies social needs and can be applied as an additional meaning to both the shelter meaning above, as well as the iCar. The EV as such needs to be a communication platform, but also promote the following values: share, not own; together, not alone; mobility as a service; networking; collaborative. It needs to integrate well into both interest driven and geo-local communities. It should be ideal for model villages and city-size demonstration sites. Integration capability into public- or on-demand transport systems is a must.

### The EV as a simple product, ideal for 3rd world countries

This meaning is basically the anti-thesis of the iCar, with some aspects of the mobile multi-purpose shelter, the community EV and the power source – targeted per target market. The *simple EV* needs to be easy and intuitive to use, simple

in its components and technology on system level, easy to repair (with the tools needed for a 1980's Lada) and its maintenance and usage costs need to be low. The core concept would be plug & play – in all meanings. Still, the battery power needs to be accessible as both buffer and emergency back-up. It needs to be a mobile energy storage answering the local needs in developing countries. Furthermore the EV needs to promote equality, help the poor and create local industries and jobs. In the final meaning, however, this kind of EV is certainly paving a way to increase the quality of life in developing countries towards western standards, while being environmental friendly and making most effective and sustainable use of global resources.

**Ubiquitous charging**

Charging starts with user-friendly electricity contracts allowing charging and discharging in various forms, e.g. prepaid, monthly, yearly, on-demand. A wide network of charging infrastructure reduces range anxiety – this does not need to be extraordinary costly, if individuals' charging points can be included on demand, as "public-individual roaming". All trains that carry cars, e.g. in the Eurotunnel, should offer charging. The long-term goal could be fully automated wireless (dis-) charging once the EV is stationary – on parking lots and in garages, but also while waiting in front of traffic lights. Within the EV and as smart phone application, there need to be electricity meters showing consumption and production of energy, both EV internal and towards the grid, community or house.

## Conclusions

As final element of the workshop, the students were provided with some ideas how to present, especially with the instruction to avoid text based Powerpoint slides. At that very moment, a last content analysis, as done by the author later, would have been a better closure in respect of the direct objective. However, the indirect objective, to embed sustainable e-mobility into the environmental and climate protection discourse by starting with the Nordic Climate Festival @Aalto was very well achieved by the students' team presentation. Embracing a typical day of an e-car owning family, using elements of (theatre-) play and visualisation up to real things, the students literally created a strong "drive" towards the audience, to engage with e-mobility. The SIMBe team is very grateful for this! Also the actual content, as described above, contains various features, meanings and services around a "battery on wheels", which go, at least partially, way beyond the idea of transport. A success.

## Workshop Participants and Facilitator

### Track Chair

Pekka Malinen, with Veikka Pirhonen and Raphael Giesecke, Aalto University School of Science, BIT Research Centre

### Keynote speaker, facilitator and guests

Mette Mikkelsen, Kolding School of Design, Denmark, etrans project (keynote speaker)
Piritta Kantojärvi, Grape People Finland Ltd (facilitator)
Jón Björn Skúlason, Icelandic New Energy Ltd, Iceland (guest, first day)

### Participants

| | |
|---|---|
| Heidi Auvinen | (FI) Aalto University / VTT |
| Bozena Guziana | (Poland/SE) Mälaradalen University |
| Lára Jóhannsdóttir | (IS) University of Iceland |
| Karl Martin Kjærheim | (NO/IS) University of Iceland |
| Asimenia Korompili | (Greece/DK) Technical University of Denmark |
| Anne Lorenz | (Germany/FI) University of Jyväskylä |
| Samantha Ratnayak | (Sri Lanka/SE) Umeå University |
| Dario Sacchetti | (Italy/DK) Technical University of Denmark |
| Nan Sun | (China/FI) Aalto University |
| Antti Teräsvirta | (FI) Aalto University |
| Konstatinous Vavatsoulas | (Greece/DK) Technical University of Denmark |
| Anna Veselkova | (Russia/IS) University of Iceland |

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*“I have chosen the track about electrical cars because I am involved in a project, where we work with scenarios for future development in the field waste-to-energy. The main substitute for fossil fuels and the possibilities of renewable energy export are basic elements that define scenarios in our project. As main substitutes for the fossil fuels, biofuels and electricity were identified. Scenarios Biofuels and Electrical vehicles relates to this substitution. As my knowledge about electrical vehicle was very limited I wanted to join the track 2 and get more insight.*

*I really enjoined the work in our track. The leader of workshop was very good and professional, the lecture was interesting. We have also got an interesting rapport about electrical cars. Still, I have to mentioned here, that the group work with presentation was in the beginning confusing, I was not sure we will manage to prepare a good presentation. But the result was fantastic; we have managed to deliver a presentation that was based on a story telling and drama. All in the group was really involved in the work with presentation. I was really impressed by the work of the members in my group, and also of the leader of our group.*

*The brainstorming and work with further development of our ideas has give me a lot of new insights and open my mind for electric cars. The idea about new concept of car was the one I find most interesting when we have had to select some ideas for further work. I have developed it further to the question: Why do I love my car? in one of discussion section. My own reflection about new concept of car has led me to think about my car as:*

- *My communication platform with internet that is voice driven*
- *My organizer and planning platform, voice driven*
- *My dairy, when I am going home after work*
- *My personal coach, I can select what I need, relax, cheering up*
- *My mobile private sphere, when I need to be on my own*

*In the group we have discussed the electrical car as a mobile living group; the electricity makes that you can have in the e-car computer, fridge and television. The electric car can also be an emergency help for example barbeque.*

*Our story was presented an ordinary day in a family with an electric car. The electric car is used as electricity storage equipment which is used by family instead of grid at peaks ours when electricity is expensive. There is also a possibility for the family for selling the electricity from the battery to the grid. The electric*

*cars can get energy from wireless PAD at the red lights. This demonstrates the variety of different use of electrical cars.*

*The idea of discussing electric cars in a broader perspective, as a new concept of solution in different areas, which was one of the focus in discussions in our track is in line with recommendation in Better Policies to Support Eco-innovation (OECD (2011) Better Policies to Support Eco-innovation. OECD Studies on Environmental Innovation.)*

> Electric vehicles should not be considered as a new version or new sub-branch of auto industry. One must think radically new demand, preferences and usages to imagine innovative offers and the potentially credible associated market. Otherwise electric vehicles are likely to remain a niche segment for a very long time, as the have been for more than a century. Only truly innovative and radically new design will support the effective diffusion of this technology on a large scale for a market that has still to be defined and characterized. (p.189)

*I will use these new insights about electrical vehicles in I my further work with the development of scenarios.* ■ **BOZENA GUZIANA**

# Track 3: How to Design and Build Affordable and Sustainable Near to Zero Energy Dwellings in Nordic Climates?

# How to Design and Build Affordable and Sustainable Near to Zero Energy Dwellings in Nordic Climates?

Yrsa Cronhjort, Simon le Roux, Ville Riikonen: Aalto University
School of Engineering, Department of Architecture

## Introduction

At the European level we are facing a challenge that all new buildings have to meet the requirements for near-zero energy building as from 2020 (Directive 2010/31/EU). The final definitions will be set on a national level aiming at cost optimal solutions and levels of energy efficiency. An additional goal is the environmental target of developing low carbon building as a part of the European environmental goal of 60-80% reduction of overall $CO_2$ emissions by 2050. In Europe, on average, buildings today are responsible for 40% of energy consumption and 36% of total $CO_2$ emissions. In Finland the respective numbers are 38% of total $CO_2$ emissions and 38% of energy consumption.

From a Nordic perspective the goals for our near future in building construction require a rapid development of energy efficient building solutions and building technology, the development of new methods for energy production and an increased utilization of renewable energy sources. We need new innovative approaches to building processes and energy efficient building.

## Track task

The task was for a proposal for a modular dwelling unit based on an integration of the students own research topics, with the goal to demonstrate a vision for sustainable living.

To make the task tangible and based on personal experience and sensory properties we chose future users that they can identify with – Aalto students 2020–2050, and a site adjacent to the workshop venue that could be observed and experienced.

The task was to visualize design concepts for the site, propose viable near-zero energy solutions for the proposal, and describe a vision for integrated sustainability and an innovative statement on low carbon design, with an emphasis on social and cultural sustainability.

We based the track on a charrette method - a collaborative session in which a group of designers drafts a solution to a design problem - with three teams, three task deliveries, and three feedback loops and three expert presentations. All students made opening presentations of their own specialist research topics with a commendable depth of knowledge.

To facilitate rapid networking and participation we had chosen 3 student teams in advance with cross-competencies in social planning, material life cycles, and renewable energy, which would allow them to make rapid design proposals informed by sustainability principles.

To raise the level of debate, we had three expert lectures on critical issues:
**Liisa Jokinen**: Technical systems in the prize winning Luukku house from the Solar Decathlon

**Kimmo Lylykangas:** Design for energy efficiency in Nordic Climates - experiences
**Yrsa Cronhjort**: Energy efficiency and low $CO_2$ in building modernization

## Experiences and reflections

Each team was comprised from a mix of different universities, and we measured our success by their good-spirited interaction. The most prized outcome of our track was the meeting of minds, new friendships, provocative and constructive criticism, and agreements on future collaboration, and the opportunity to present subjects which some students found beyond their own experience. It was our agenda to develop potential synergies and to debunk myths of professional barriers. Some students had just submitted their masters diplomas back home, and were glad to get collective feedback from a broad audience. The three feedback loop sessions were critical forums for open discussion and reflection, in which each team presented task solutions for review and debate. These session deliveries were the basis for the final presentation to the NCF closing session, which was a much condensed version of the broad material that the participants developed during the task.

The students surprised the hosts with their lack of preconceptions, positive attitudes, readiness to engage in an overambitious task description, showed a depth of expertise and grasp of broad spectrum of issues, personal commitment to hard work, inventiveness and great sense of humour. It was particularly fulfilling to experience their dedication and sincerity.

The Nordic Climate Festival was a unique forum and learning event for students and researchers from Nordic universities committed to the sharing of insight into the paradigm shift towards sustainable societies. We hope that the festival will become a recurring event.

**Track Chair:**
Yrsa Cronhjort, Aalto University School of Engineering,
Department of Architecture

**Co-hosts:**
Simon le Roux and Ville Riikonen, Aalto University School of Engineering,
Department of Architecture

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|---|---|
| Christina Beller | (Germany/DK) Technical University of Denmark |
| Amy Faramroze Baria | (Iran/SE) Royal Institute of Technology |
| Lin Du (China/NO) | Norwegian University of Science and Technology |
| Michael Gruner | (Germany/NO) Norwegian University of Science and Technology |
| Maxim Koltomov Sierra | (Spain/DK) Technical University of Denmark |
| Galina Medyna | (France/FI) Aalto University |
| Alise Plavina | (Latvia/NO) Norwegian University of Science and Technology |
| Kevin Smith | (Canada/DK) Technical University of Denmark |
| Maiju Suomi | (FI) Aalto University |
| Marie Louise Olin | (DK) Roskilde University |
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***Tuesday*** *The afternoon of arrival was filled with displays of warm welcoming and hospitality – inevitably formal, but evidently heartfelt.*

*Although a very entertaining and informative pastime the time of the boat trip on Tuesday might have been more useful for working in the workshops.*

***Wednesday*** *The introductory lectures outlined the scope where sustainability is researched, engineered, and thought. The field of sustainable appeared to be much vaster than the usual suspects. A personal insight was, that in fields where sustainability seems still questionable or where technology seem experimental for outsiders, there are solutions proposed or already developed and pending for implementation. To satisfy the curiosity it might be good not only to have workshops with experts among themselves but also to give the possibility to visit and listen for members of other tracks.*

*The final presentations could not work as such for they aim at persuading a audience. Innovations were widely elaborated on. The lecture of Eva Heiskanen showed very clearly how an iterative process of innovating can help to overcome difficulties in the implementation of new solution.*

*Another reoccurring theme was the demand on people to change lifestyles and behaviours, to cast off reluctance and act and adopt achievements. Maybe far-*

*fetched, but Bertolt Brecht's "The Solution" comes to mind as a tart comment.*

*Architecture is hereby rather a marginal field of innovations, since most technologies are mature since decades respectively traditional common practise is recognised and elevated again. The presentations of the track participants reflected the broadness of the track's theme from the detailed energetic aspects until the social dimension of dwelling in refurbished energy efficient housing. Time was unfortunately short, more space for discussion would have been desirable. Further input came from lectures by invited experts and the hosts giving insight in current research ongoing in the other institutions. A very interesting theme discussed was the local adoption of concepts like the "passive house" which will need further discussion. Nordic countries like Finland and Norway use the concept of the widely internationally known Swedish-German "Passivhaus" as starting point and change parameters and requirements to fit the local climate conditions. This might be confusing to clients when not clearly informed about the distinction between a "Passivhaus" or "passivhus" or "passiivitalo". A change of name might resolve further quarrel.*

***Thursday** The project task, a rapid design task to transform a parking lot into student housing, was in the focus this day. The usage of reused and salvaged mate-*

*rials was one of the focus issues which frequently popped up and was proposed by many groups. One problem which arose within this discussions and which need to be researched further is the availability of waste and ´worthless´ material. When seeming waste is considered a valuable source material and the disposable society turns into a recycling society then less and less material is available and the less material has higher value and looses its usability in the context of affordability.*

*The work track was split in smaller teams. The teams were a mix of different professions to practise the integrated design collaborative. But actually there is no need to evoke a ´clash´ of different professional backgrounds or to highlight possible prejudices about the different professions to build up stereotypes. Today's architects are (resp. should be) already conductors of the building process whose responsibility is stretching from the first scribbling to the key-hand-over to the new house owner (it might once stretch even further into facility management not to leave the client alone with his building). Therefore an architect must have basic knowledge in all participating disciplines and must have the social skills to empathise with them.*

*Collaboration is therefore very natural and does not have to be artificially created. Groups build of common skills and likings are more desirable. While the discussion within the small groups were then rather a question of personal affinity, most fruitful were the discussions on the results in the assembly of the whole track.*

***Friday** The tracks presented the results of the workshops to their fellow festival participants. In the foreground was rather the show than outcome. Some presentations were fairly populist, only few tracks presented ´dry´ results. Thus it was unfortunately not really possible to get insight in what other groups did.*

*As Virpi Mikkonen from "Tekes" revealed very precisely, many presented innovations may need to leave the aseptic academic conditions and may also need to include the many more circumstances (political, legal, economical, etc.) which they are faced in reality.*

*Despite all the critical tone in the before mentioned the Nordic Climate festival is a very good opportunity to meet and share knowledge and get to know what other institution in the exclusive Nordic circle are doing. It should be held annually or every second year to assure that always new ideas are presented.* ■ **Michael Gruner**

*“The crucial themes for this workshop were already coded in the question of the track – nearto zero energy, Nordic climate, design and build, sustainable, affordable.*

*In terms of energy, one of the cornerstones of sustainable development, a set of rather ambitious aims for the building industry have been set by EU and other developed nations. By asking how to build near to zero energy buildings, the question implies energy supply to buildings that is provided on-site or near to site. It also implies energy saving measures by well insulated building envelope, effcient home appliances and environment conscious user behaviour. As often correctly noted during this Climate Festival, the effcient technologies and high-tech materials are already available, but their application does not follow fast enough.*

*Nordic climate is a very relevant issue for sustainable solutions, since it questions the universality of application of different technologies. In terms of decentralized energy supply to dwellings one might ask if photovoltaics should be used for energy generation where the solar radiation levels are low like in Nordic countries. Questions like this undermine the on-site energy production possibilities and ask for a more broader and at the same more localized understanding of places, strong political will and well directed economic incentives.*

*For me, including the word sustainable in the agenda, always means returning to the core of why anything is done at all, questioning the motives and possible results, as well as defning clear reference systems. For example, in terms of buildings, energy can be seen not only as operational energy, but also that embodied in the materials, construction process and eventually in dismantling the building. This energy can be converted to carbon emissions to directly link buildings to climate change. However, this is only one cause-effect link. Others include transport, food production, water distribution etc. When discussing sustainable built environments, it eventually ends up being about everything we do.*

*Affordability is an aspect much overlooked by the building industry, since it is not only about simply building cheap, but more about economic and social sustainability. It requires rethinking the building practise in terms of reuse and recycling building materials, using renewable resources and low energy impact materials as well as ensuring affordability for state-of-the-art technologies. Some of these changes in building practise can only come through economic incentives or political decision-making.*

*How to design and build with such complex inputs is not easy to devise in a few day workshop. Multidisciplinary team could be part of the answer, but without clear reference system of aims and accounting systems (for emissions, energy consumption etc.), each project becomes a unique sequence of trial and error. Thus it is important to ask and continue asking the TRACK 3 question with all the inner contradictions – we should now know how to address all the mentioned aspects in connection and balance as soon as possible.*

**INPUTS**

*During the Climate Festival, a variety of different lectures, discussion panels and events provided a fertile soil for thought and later discussions within the track. While key-note presentations gave useful factual information and some inspirational statements, the open-format panel discussions and group work were more effcient in pinpointing critical aspects of the theme. The track-specifc lectures on Solar Decathlon competition, energy effciency in Nordic climates and refurbishments were informative and good at setting the background. However, there wasn't enough time to have a thorough and critical discussion afterwards, which was also the case with track participants' individual poster presentations.*

*The fnal presentations of all tracks were slightly disappointing, since only a few teams actually went beyond rhetorics and provided some useful insight in themes beyond my expertise. Also the strict time limit and "no questions" tactics did not seem to be justifed in this case, since the most surprising and inspiring ideas would have come in this fnal "brainstorm" with all the participants being saturated with the insights from their own tracks that could easily spill over to other tracks.*

**TASK**

*What initially seemed a rather random task, the design vision for the "sustainable living unit" for future Aalto students proved to be a very fruitful feld for action. While a student village can be seen as a very specifc kind of dwelling, student as a human being at a point in life of very rapid knowledge evolution, is a perfect "test rabbit" for future sustainable living.*

*Our micro-team was mainly concentrating of the idea of self-suffciency possibilities within the student village and introducing closed cycles for waste recycling, local food and energy production, as well as student active involvement in maintaining those cycles.*

*Unfortunately the time constraints did not allow us to go in too much detail,*

*so the result is a vision of rather general character. However, the mix of different technologies and everyday practises applied within the future student village was unique for me, since it came from teammates with different research backgrounds.*

**LESSONS LEARNED**

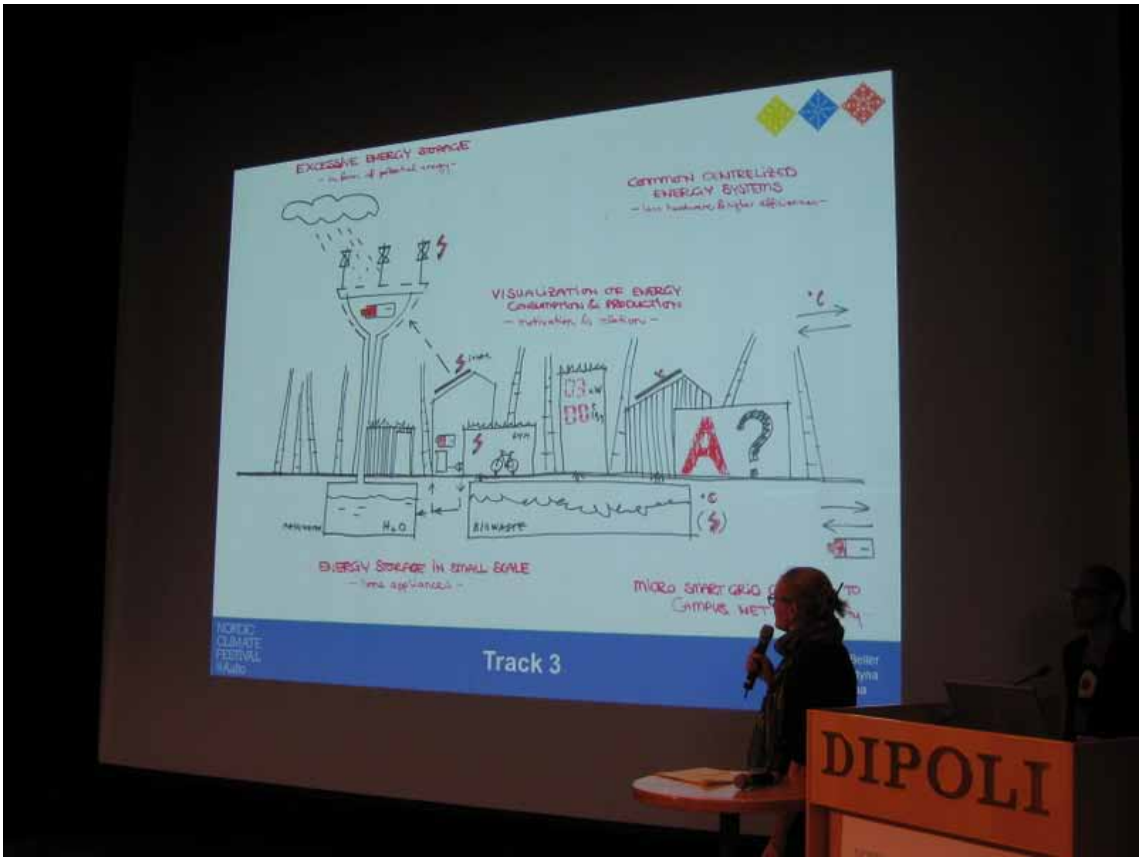
*While most of the information presented in the Nordic Climate Festival was not new to me, the introduction of interconnections between different themes and the urgency for action is something I will incorporate in my future activities.*

*Another important issue raised in the festival is the availability of technologies, but the reluctance to use them. For building specialists it means a closer dialogue with clients and that more explanatory work and user participation is necessary to create the demand for sustainable solutions.*

*TRACK 3 theme was inspirational and ambitious, since it included all possible aspects of the future building "philosophy". During my master degree studies of Sustainable Architecture, the main focus is set at energy effciency and energy supply systems in buildings, most often leaving out the considerations of how to make this kind of buildings affordable, accepted and commonplace. I agree with many of the Climate Festival speakers who urged for more political will and citizens demanding politicians to make "environmentally-oriented" decisions, but there also should be more to be done by industry professionals to strengthen the cause.*

**WAY FORWARD**

*The theme I presented in my poster about ecosystem services in small scale within built environment was used as a central approach for the student-village task, and with active involvement from my teammates got some new dimensions. Hopefully I can elaborate on the theme while working on my master thesis next semester, fnding and defning in more detail the services within built environment that can be provided within its local ecosystem, taking Northern Europe climate region as a reference. The Nordic Climate Festival was an inspirational "kick" to proceed within my chosen feld with more vigour and also act beyond the academic environment, involving more and spreading the word about sustainable everyday practises.* ■ **ALISE PLAVINA**




## An eye-opener

*During the four days I was in Helsinki I learned, that together with engineers, architects, social scientist etc. we will have a better chance of solving the problems of tomorrow. That might seem very overrated and naive, but I truly believe that it is possible. And how can it be possible? By working together as we did during the Nordic Climate Festival and making use of each others experience and expertise knowledge, I believe we can create the foundation of a more sustainable development.*

*A lot of the participants at the festival had different background both in terms of education and nationality. In that behalf a huge variety in opinions and different point of views was also added, wich I found very challenging and interesting. There is in my mind no doubt about the importance of learning from people with different experience.*

*Each student was very dedicated to his or her profession. They all cared very much for their discipline and had a huge knowledge in their field of expertise. That*

*also came to turn during discussions and even though we did not always agree, I still learned a lot from others points of views. This I found very satisfactory.*

*During the work in the group it was also possible to cover a broader spectrum of disciplines and by that the amount of information became greater and more differentiated. Thus being able to discuss with many people with different educational background and being able to learn from their experience and knowledge. Is the reason, why I find this kind of meetings very important*

**Student house on Aalto University**

*During our assignment we discussed how to build a student house, which could demonstrate sustainable living on campus. We had different views on, what sustainable living actually means and how to build in a sustainable way. Are you sustainable when you are living in a zero energy house, or are eating organic food or don´t drive a car? We agreed that the definition of sustainability is very broad and it is not possible to measure sustainability. In context with the assignment, we decided that sustainable should include reuse of local materials on campus. That could for example be expressed by reusing materials from the woodwork site or paper waste. Students participating in the Building Festival could also bring their own materials and together with the staff at campus, they would create the students new home.*

*The envelope and service for the house could be provided for the coming students. Together the students at each floor could discuss how much private space and social space they wanted. In that context the students would be forming their future home with the people, they were going to live and study with and at the same time creating their own interior.*

*Later when the students finished university, they would move out and clear the floor for new students, who could reuse materials, when they were building their new future home at another Building Festival.*

**Further use of my new learned experience**

*I have never before considered reusing materials in a context with new buildings or the interior. So in context with my own study, which is retrofitting for social houses, it would be very interesting looking into cases, that are retrofitting and on the same time are reusing materials. One advantage could be to keep the cost low? That would be a very good argument in context with social houses.*

*After coming home from The Nordic Climate Festival I felt very inspired to investigate more in the area of retrofitting. So when the semester started, I began*

*working on a new project about, how retrofitting are precursor for existing commercial buildings in the EU. At the moment the project design is focusing on how to make a manual for the landlords and tenants, presenting to them all the different opportunities, which are available to make energy efficient retrofits. The manual is supposed to be a walk through the process of energy renovation retrofits and financial schemes incl. subsidy programs. I also want to highlight what opportunities, there are available for the landlords and tenants individually or if they want to collaborate with another stakeholder. In this process I would also like to use the energy label system for houses as a tool to facilitate the outcome of successfully renovations being made. The main focus will be the EU and looking at the possibility of comparing different case studies from the EU countries. As one of the criteria for choosing the case studies would be that the retrofitting process used reused materials. I find it very interesting to investigate, if it is being done in the EU, and if the idea of reusing materials is at all being considered.*

*If I ever get the opportunity to participate in a festival like this again, I will certainly take it. Not only because of what I learned but also the given opportunity to create a network that reaches far beyond my own professional boundaries. My experience has also given me a desire to work at an international company, where there are a lot of opportunities to go abroad and cooperate with people with different backgrounds.* ■ **MARIE LOUSE OLIN**

# Track 4: Energy efficiency and renewable energy sources in Nordic homes

# Energy efficiency and renewable energy sources in Nordic homes

*Sampsa Hyysalo, Aalto University School of Economics, Department of Management and International Business*
*with Eva Heiskanen, National Consumer Research Centre*
*and Jenny Rinkinen Aalto University School of Economics, Department of Management and International Business*

## Introduction

The role of citizens as innovators, adaptors of existing technologies and diffusers of new climate-relevant innovations has been studied extensively in recent years. Since the late 1970s, sociological and demographic research on residential energy use has consistently found great variations in energy use among similar households. It has been suggested that these variations constitute a source of innovative low-carbon practices. Yet, while there are many generic technologies available for end-use efficiency and renewables, their slow rate of diffusion suggests that they are not as such applicable to local conditions. Citizens have a key role in their adoption and adaptation to local conditions, as well in their diffusion to other users. Against this backdrop, the track 4 of NCF called for poster presentations of innovative new products, modifications of existing products, news ways of make use of existing technologies as well as such living practices that reduce energy use or enable the utilization of renewable energy sources in domestic settings in the Nordic countries.

## Workshop organization

The track included three guest lecturers that opened the track themes for the students. First introductory talk was given by Samuli Rinne, Enespa Ltd. and addressed Global energy use and everyday life. It gave an overview of what energy needs and solutions there are globally and how these translate to technological options available in Nordic countries. Second talk was given Michael Ornetzeder, Institute for Technology Assessment addressed Sustainable technology, users and social learning, focusing on experiences with active citizen participation in low carbon technologies in Austria. The final talk was by Niels-Peter Skou,

Kolding School of Design and addressed Danish research at understanding the cultural role of energy in everyday life and Danish initiatives to make electricity more visible and paving the way to initiatives for various peak shaving and shifting options in high and low production periods.

These lectures were highly instrumental for setting the students for their independent group work in synthesizing and improving on their posters. The students in the track came from wide variety of educational and national backgrounds as well as had differing depth of knowledge related to energy technologies and domestic energy efficiency issues. Students' posters addressed a range of key energy technologies, including:

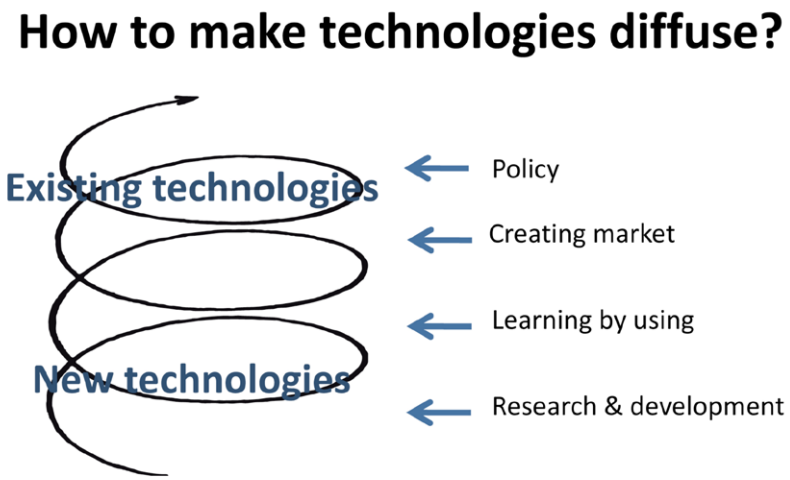
- Use of biomass in district heating
- Solar heating systems with PCM storage for low energy buildings
- Ground-air heat exchange systems
- Decision Making for Optimal Low-Emissions Cost-Effective Dwellings in Finland
- Biogas-based Fuel Cell system will promote the sustainability of Sweden
- Use of solar energy in Sweden
- Biomass for Energy: Energy alternative for Nordic Homes
- $Co_2$ pyramid for visualizing the climate impact of different foodstuffs to guide citizen choices.

The posters were presented and formed a basis for discussions between students and between tutors and students. The joint efforts of the participants were directed towards analysing presented solutions and considering potential ways of mobilising these solutions for wider use in the Nordic countries. In particular we focused on looking at the following issues: how universally applicable are the solutions? how adapted to local conditions are the solutions?, and how easy are the solutions for users to adopt? The student posters presented a good mix here, some solutions were completely new, some solutions already exist and some were not yet widely used. We also had discussions on old solutions that have been 'forgotten' and solutions from another country that could also work in a different environment.

In the final part of the track, the students then worked in two small groups to condense their insights into two joint posters, one related to solar technologies and other to the possibilities of biomass and biogas. These were then discussed between the groups and tutors and finally presented to the whole NCF audience.

In all, the experience was positive in sharing insights from so many backgrounds and angles and added to all participants awareness of the possible renewable and energy efficiency solutions there are to homes in Nordic homes as well as more globally.

To see the presentations of this group (as well as the others!)
please visit ***www.climatefestival2011.fi!***



**Track Chairs:**

Sampsa Hyysalo, Aalto University School of Economics, Department of Management and International Business
Eva Heiskanen, National Consumer Research Centre
Jenny Rinkinen, Aalto University School of Economics, Department of Management and International Business

**Co-hosts and guests:**

Michael Ornetzeder, Institute for Technology Assessment
Niels-Peter Skou, Kolding School of Design
Samuli Rinne, Enespa Ltd.

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| Malin Bäckman | (FI) Aalto University |
| Philip Giødesen Lund | (DK) Technical University of Denmark |
| Tingting Guan | (China/SE) Royal Institute of Technology |
| Mohamed Hassan | (Egypt/FI) Aalto University |
| Svenja Désirée Jaffari | (Germany/DK) University of Southern Denmark |
| Pavel Makhnatch | (Belarus/SE) Royal Institute of Technology |
| Anna Nikandrova | (Russia/SE) University of Gothenburg |
| Michela Pentericci | (Italy/DK) Technical University of Denmark |
| Mila Shrestha | (Nepal/NO) Norwegian University of Science and Technology |
| Katie Warren | (United Kingdom/FI) University of Jyväskylä |

*“As the title of track already suggests, track 4 on Nordic climate festival emphasized on the ideas of renewable energy usage and technology in Nordic homes. The idea was to suggest the innovative new technologies as well as to propose improved existing practices that help to reduce energy use and to also enable in the utilization of renewable energy sources appropriate in Nordic environment. The main theme of this track was to conceive different ideas for Nordic homes; it intended to put forward, the climate relevant innovations and users implication of those ideas.*

*The Nordic climate festival had brought together different peoples from different background and different interest to work together for the cause of environment and energy. During the four days of workshop, we were all participating in different activities that were both helpful to enhance my knowledge about energy efficiency and i could share my ideas about energy use efficiency and technologies. The initial idea in the track work was to come up with an innovative or existing ideas adapted by the users for the use of renewable energy use and energy efficiency. Each of us on the track had prepared a poster about the track title. The track co-ordinators were very kind, ready to help us with all kind of information regarding the track. I would personally like to thank  them all for their presence and all those informative talks on the related topic. The team of track leaders included Sampsa Hyysalo, Eva Heiskanen, Samuli Rinne, Michael Ornetzeder and Niels-Peter Skou. We are all very much thankful to you all for your precious time and all those knowledge's you shared with all of us during these four days.*

*On the very first day of the workshop, we heard few important facts about the energy challenges. Some of the important issues as need of food and water for human health and how the supply of them is being reduced in comparison to its demand, and what could be the consequences of this lag of supply and demand. Then we discussed about the carbon challenges, how essential is it to maintain the environmental cycle and how the carbon production can be effected by use and production of energy. Besides the carbon target, other important issues related to environment are limited availability of fossil fuel, nuclear problems are all directly related to energy use and user demand. These all emphasizes on the importance of renewable energy use for the fulfillment of human need of energy.*

*The solar energy use, passive housing technologies (reduced energy consumption), wind, biomass etc. were some of the major technologies that were figured out as the energy alternative to the non-renewable energy sources. On the second day of workshop we presented our ideas about the energy alternatives appropriate for Nordic climate that we had all prepared as the posters. Each of us had a unique idea that could fit into the Nordic homes in some ways. The ideas could more importantly presented as the more technical, using solar and wind energy to convert them into the useful electrical energy and the less technical method to collect methane from the biomass. Hence after looking into the poster of all, we divided ourselves into two groups where one worked more precisely on the solar energy use and other on technologies of biomass.*

*Thereafter we worked more in detail to figure out the technical details of the biomass and solar energy use, probable potential and problems in the use of these two energy technology. The solar technologies are more frequently in use on the homes but still it is possible to make them more efficient by implication of these technologies in ground heat exchange system, they could be pre heated or cooling systems to maintain the room temperatures as per the requirement. The idea of using phase change material is the innovative idea in solar technology. The technology uses solar thermal heat to change its stage from one phase o other and store heat. These system uses salt as the basic component that changes its phase and store energy. Another idea of energy use was to make use of biomass for production of energy. These uses different wastages from the environment to collect the useful methane gas and produce energy form them. Idea is to collect the decomposable wastages from the environment and make use of them to produce energy either by burning them or by collecting methane produced by them during decomposition. This energy can then be used for different household use or to operate different applications or to produce electricity.*

*We also discussed in detail about the possible problems in the production of energy and in the application of these technologies. And by the end of third day we have listed out some solutions that we presented on the fourth day for the above mentioned technology.*

*The workshop had been mere a good platform to learn a lots of technical things about the energy use and production. Beside the matters we discussed on our track, there were lots of thing to learn from the other tracks of the workshop. Most importantly it was a nice way to bring together the ideas and seek attention of the people and let them know about the energy uses and how they can play their role in energy efficiency.* ■ **MILA SHRESTHA**

# Track 5: Energy future 2050

# Energy future 2050

*Sanna Syri, Aalto University School of Engineering, Department of Energy Technology with Laura Kainiemi and Ville Riikonen*

## Introduction

The track was organized by the Department of Energy Technology, School of Engineering, at Aalto University.Energy future 2050 –track introduced participants to the global long-term challenges of achieving a sustainable energy supply. According to the Intergovernmental Panel on Climate Change (IPCC), effective climate change mitigation would require the global greenhouse gas emissions to be reduced by 50-85% from the present level by 2050. For industrialized countries, this would probably mean a practically carbon-neutral economy and energy supply, as developing countries need more possibilities for growth and probably enter stricter emission reduction commitments with some delay. In the beginning of the workshop, students were introduced to global energy scenarios and the challenge of climate change mitigation.

Students worked in three groups with the following topics:

- How to gain public acceptance of Carbon (dioxide) Capture and Storage (CCS) ?
- Personal emissions trading as a tool to achieve deep emission cuts
- How to get rid of fossil fuel subsidies? Nordic cases are peat use in Finland and Sweden.

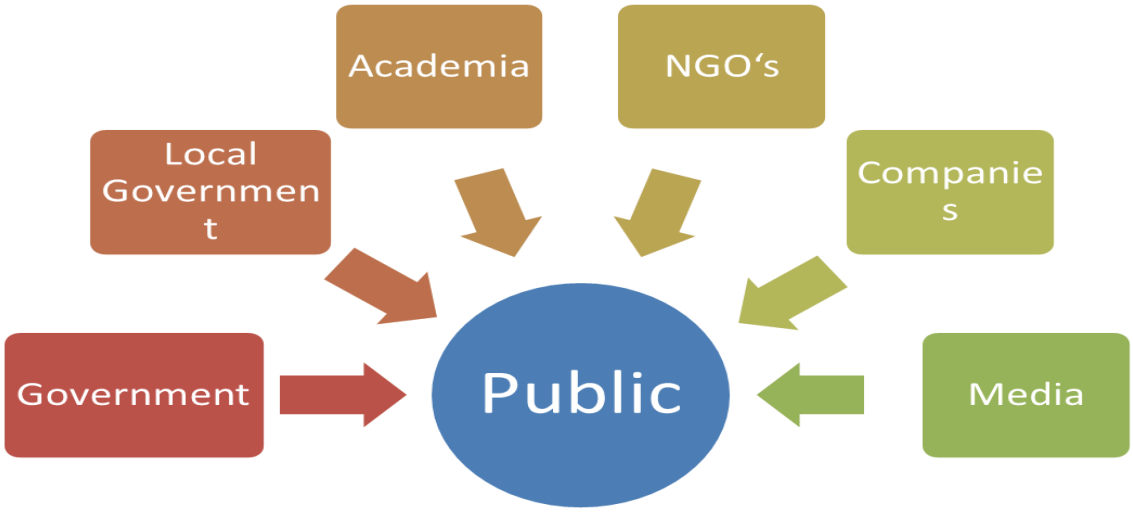
## Group work 1. How to gain public acceptance of CCS?

Carbon (dioxide) capture and storage (CCS) is a popular candidate for climate change mitigation. While certainly possible environmental risks caused by capture, transport or storage of $CO_2$ have to be recognized and solutions invented, there is another different kind of risk related to CCS: public acceptance. The first actual CCS installations in the EU, that of Spremberg in Germany and Barendrecht in the Netherlands, have faced strong opposition by either those living around the proposed storage sites or by national governments. CCS developers have been dumbfounded by the scepticism and criticism of local stakeholders. Scientists, on the other hand, argue that CCS poses no harm to human health

and that the public criticism is unwarranted. The groupwork created a mind map of CCS public acceptance and laid out practical action steps towards acceptance in Nordic conditions:

## Stakeholders influencing the public opinion

**Suggestions of the group:**




- Public involvement
- Alternative scenarios
- Show & Tell
- Political will for CCS
- Common legislation

**Opportunity for Nordic countries:**

- Infrastructure
- Early adapter
- Environmental awareness amongst public
- Long history of successful cooperation
- Applicable for renewable energy
- Possibility of carbon negative

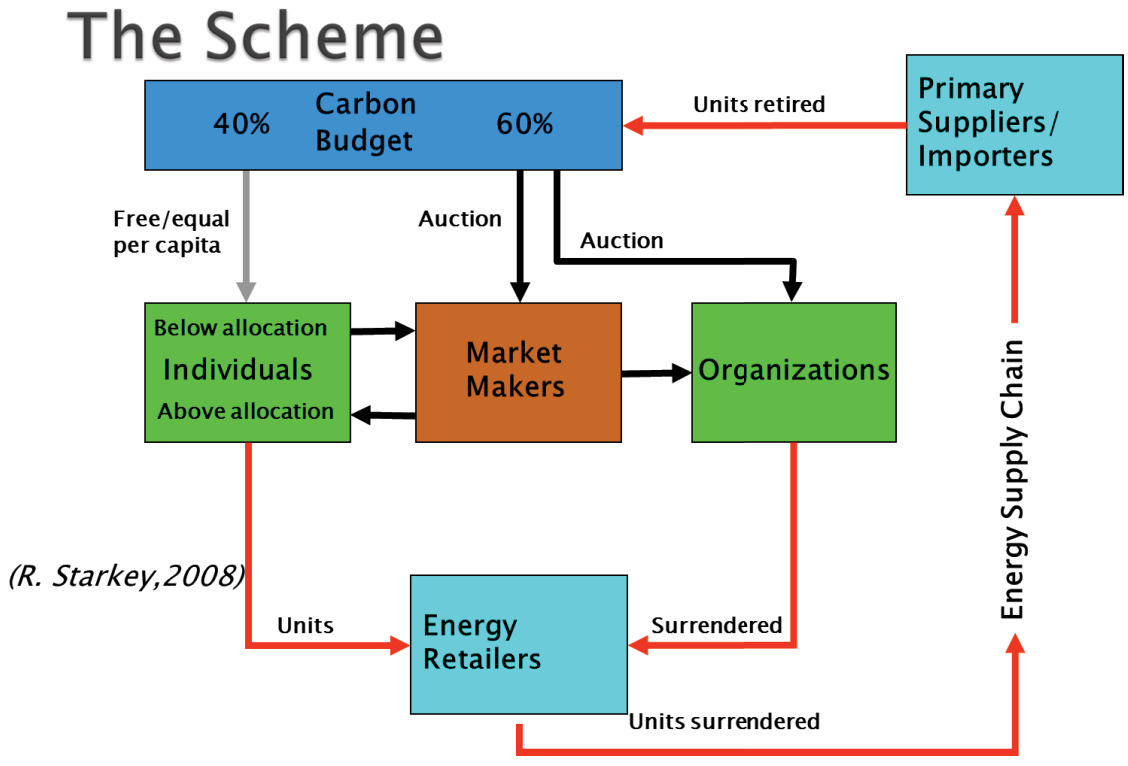
## Group work 2. Personal emissions trading as a tool to achieve deep emission cuts

Personal emissions trading has been proposed as one possible tool for achieving deep emissions cuts, together with other instruments targeted at sectors outside the reach of individual-level consumption and behavior.

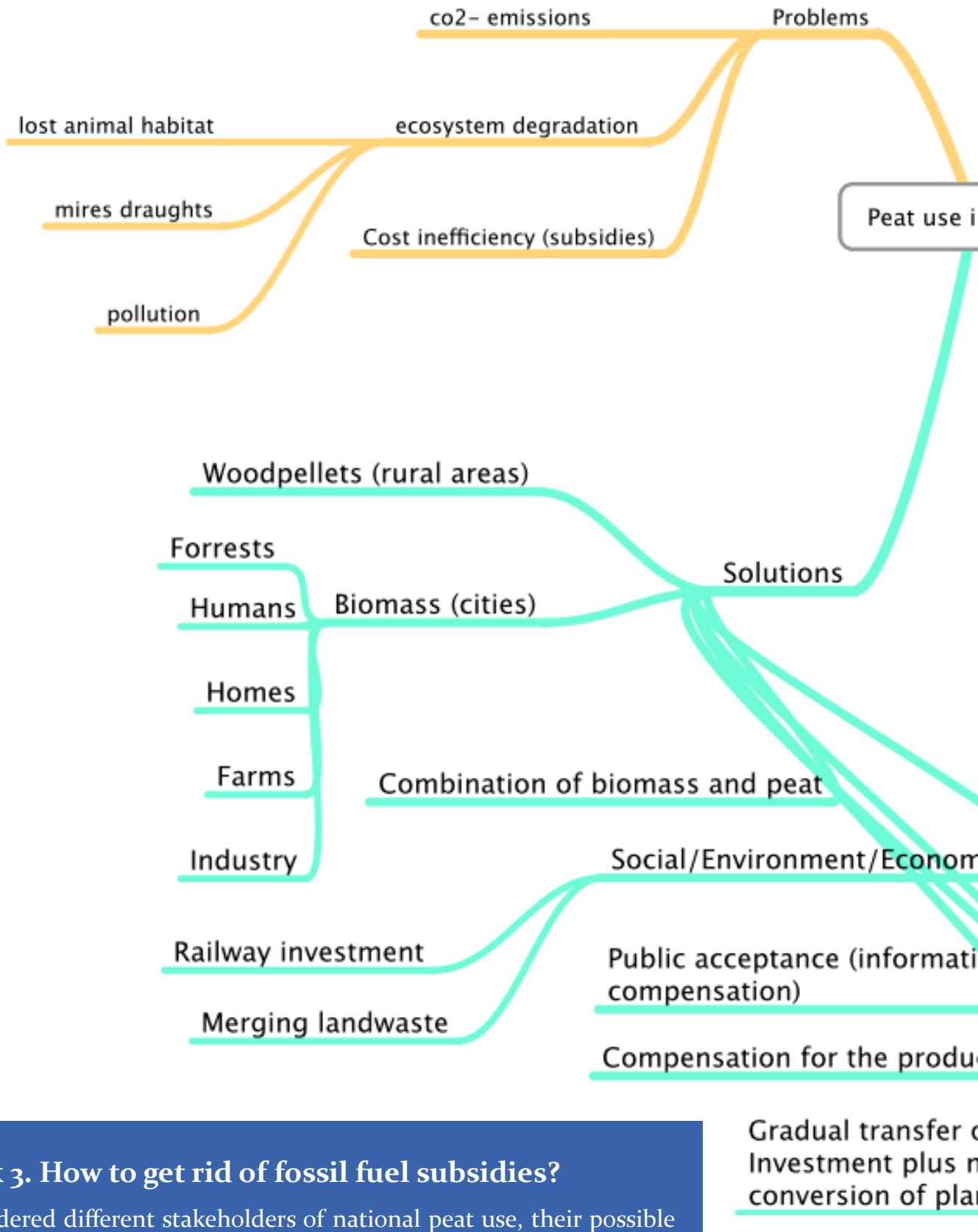
The group created a feasible and credible implementation plan of Personal Carbon Trading for **Iceland:**

### Smart card system

- Instant data collection
- Existing infrastructure
- Fewer administration and monitoring costs
- Includes all Icelandic individuals and businesses
- Provides a safety valve regarding price stability
- Permits auctioned to businesses
- Permits allocated for free to individuals
- Penalties
- Individuals and businesses would be charged some penalty for exceeding their allocation

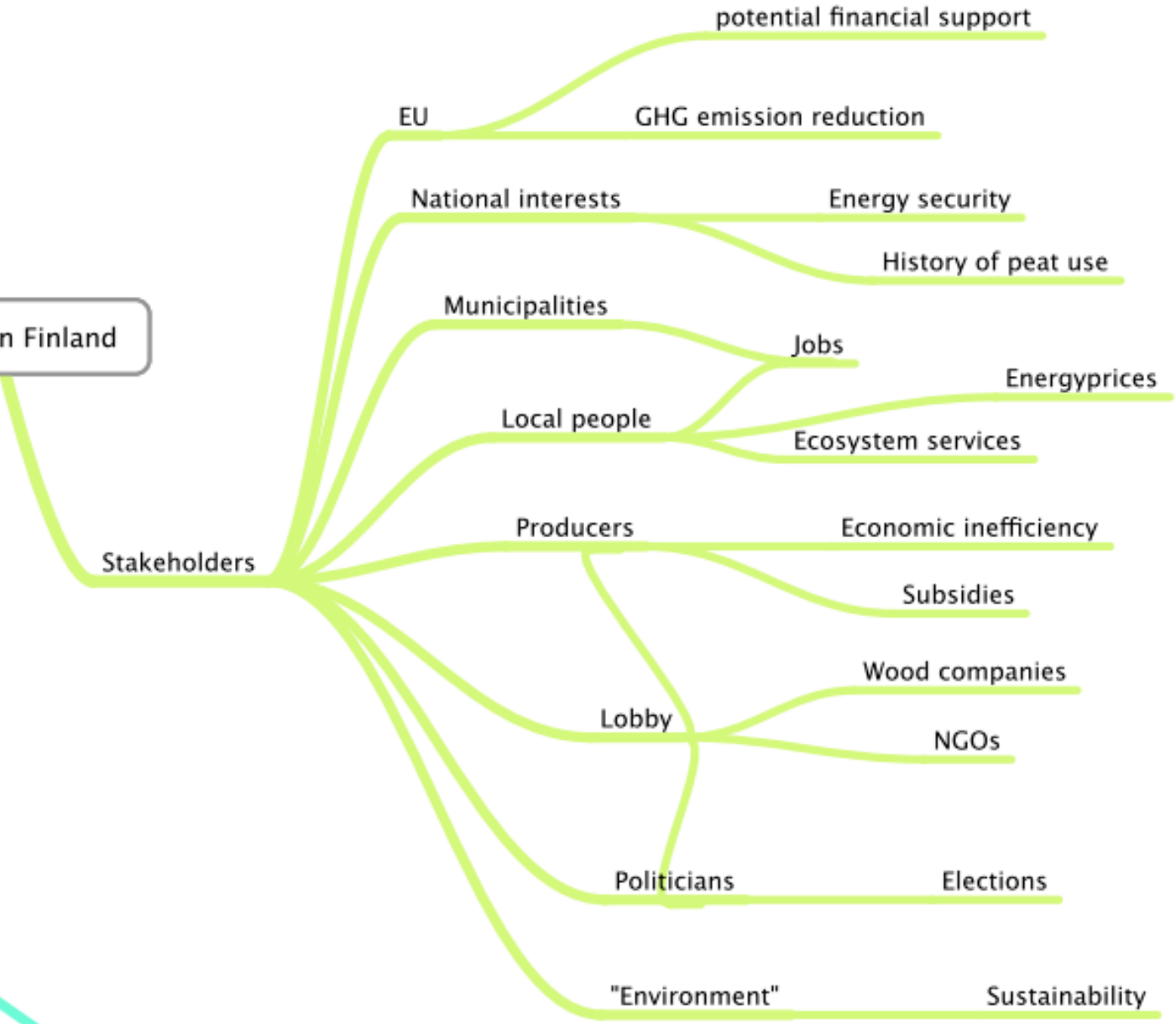


**TRACK 5; Energy Future 2050; How to get rid of Fossil fuel Subsidies?**




## Group work 3. How to get rid of fossil fuel subsidies?

Students considered different stakeholders of national peat use, their possible interests and losses are discussed and written down, and their relations were defined. A mind map was made presenting these stakeholders, their positions and relations, and possible future developments with regard to peat use in Finland and Sweden were created.

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Group members; Jiahui Lu, Kristján Hlynur Ingólfsson, Annu Jalkanen, Alessandra Pennati and Anja Gylling

**Track Chair:**
Sanna Syri, Aalto University School of Engineering, Department of Energy Technology

**Co-hosts:**
Laura Kainiemi and Tuukka Vainio, Aalto University School of Engineering, Department of Energy Technology

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| Anja Charlotte Gylling | (DK) Roskilde University |
| Kristján Hlynur Ingólfsson | (IS) University of Iceland |
| Annu Jalkanen | (FI) University of Tampere |
| Anita Aagaard Kristensen | (DK) Roskilde University |
| Teresa Lindholm | (FI/SE) Lund University |
| Jiahui Lu | (China/SE) Royal Institute of Technology |
| Syed Muhammad Raza Naqvi | (Pakistan/SE) Royal Institute of Technology |
| Alessandra Pennati | (Italy/DK) Technical University of Denmark |
| Izabella Rosengren | (SE) Lund University |
| Liene Spruzeniece | (Latvia/NO) University of Oslo |
| Johannes Quintero | (Austria/DK) Technical University of Denmark |
| Bryndís Woods | (IS/USA) University of Iceland |

*Nowadays, the continuous presence of natural disasters such as earthquakes, tsunamis and volcano eruptions around the world prove that our planet is affected. Our society has caused the problem; an uncontrolled growth of population and the excessive use of fossil fuels instead of renewable sources are at least two of the major reasons for such events. It is our responsibility to take care of the planet, whatever we do matter.*

*The Nordic countries are situated in one of the richest area in the whole world, with a population no more than 30.000.000 habitants. This area has become so far in an example of sustainable growth and technology. Of course, there is still a*

*lot to improve, and we hope that Nordic countries will be the first one with non-$CO_2$ emissions.*

*In Track 5. "Energy future 2050" I was specifically involved in personal carbon trading. The idea of this was to involve the society in such a way, that even their habits will change little by little. For that purpose, we had to choose a place where the applicability of this new process will be effective, in our case; Iceland was the perfect place since it avoids the bordering problems (Island country) and with 318.452 habitants it is easier to cover all the population.*

*After choosing the country, new bottlenecks came up. How to implement this new system? Should we give a trial period to the population in order to get used to? Would there be exceptions to certain citizens? and so on. We tried to solve all the questions but some still remained unsolved. We proposed a trial period of two years in order to let everybody know about the new system. People will receive certain amount of allocations, and this will depend of people´s conditions e.g. Does individual have children? How far that person lives from the urban areas? And so on. We decided to that people who lives in cities with less than 15.000 habitants will be allocated with extra points since they have to use more fuel to reach basic services. The age was fixed in 17 years old since is the legal age limit for driving in Iceland and if users decrease their consumption, they can sell those extra allocations to the business sector and get extra incomes.*

*Flights were not taken into account because of the conditions of the country, Iceland is an island and citizens need to flight to get out of the country. Besides this, the EU ETS is already counting the flights coming from Iceland and that will lead in a double counting. Tourists will have their impact as well in the system; since Iceland has a population of 318.452 habitants and they receive annually around 500.000 visitors. Tourist will have to buy allocation as soon as they pass immigration and this money will be used in the maintenance of the national parks and environmental resources.*

*Finally we were able to share and listen the proposals from other groups. It was astonished when group came with different strategies in order to overcome the problematic which they were dealing with. I am glad that I had the chance to be part of such as event and the connections that I created. Now I can focus my research from a different perspective, but more important is the new lifestyle that I am holding right now. As I said in the beginning, everything that we do matter and if everyone of us takes small steps, the sum of all of them will become in a huge step able to impact the rest of the world.* ■ **GERSON MARTIN**

*“The goal of our track was to talk about energy future. We were divided into three subgroups, of which I was in the one handling energy subsidies and particularly peat use in Finland. Our task was to identify issues related to peat use and governmental subsidies in general, recognize the relationships between different stakeholders and finally to come up with some solutions for the problem.*

*Peat use is being subsidized quite heavily in Finland even though peat is normally classified as a fossil fuel. Peat collection causes ecosystem degradation and its burning releases greenhouse gases. Subsidies themselves cause economic inefficiency and encourage overexploitation of resources. Thus obviously the current system is neither sustainable nor rational in any way. The first thought that comes in mind is just to eliminate the subsidies and prohibit peat use as a means of heat production. However, subsidies are a complex set of different interrelated political issues involving vast amount of different stakeholders. Unfortunately the answer can't be that simple.*

*The problem with subsidy removals is that they affect the producers and local economies. The producers gain money from subsidies and of course wouldn't want the situation to end. Big energy companies have big lobby groups that can have quite an enormous effect on politicians. The biggest peat producer company in Finland is partly state owned, which makes the interrelationships even stronger. (And subsidizing peat use even more absurd because the state is subsidizing its own actions.) Environmental groups do lot of lobbying as well, but due to the lack of resources they often have marginalized voices compared to big producer companies.*

*Local economies, especially in rural areas, can be dependent on only one plant that develops jobs for the area. These jobs provide as by-products subsistence for the other citizens of the municipality as well. Peat use has a long history in Finland, thus decreasing production would probably face great resistance among local people.*

*Subsidies mean lower energy prices. Removing subsidies would thus likely cause the prices to go up. These negative price effects would affect poor people the most, hence some sort of compensation would be needed for the poorest households. I personally found interesting the example of Romania's price reform in 2003 that I presented in my poster as well. The basic idea is simple: A citizen could choose from two different tariff options. One option was to have a lower tariff for the first 60 kWh (whatever threshold could be decided here), after which the tariff rose significantly. The second option was a constant tariff that fell between the two other*

*tariffs mentioned before. These kind of tariff policies allow lower energy prices for the households that use a smaller amount of energy (usually the poorer ones) but still provides incentives for the richer households as well to act more energy efficiently and thus also more environmentally friendly. They also don't demand any direct transfers from the government.*

*With many energy subsidies energy security is an issue as well: How to minimize the amount of imported energy? Self-sufficiency relates to many other political goals. Finland has limited option for heat production because of harsh weather conditions and long distances. On the other hand there is some political pressure to removing subsidies as well. For example the EU has placed national targets for emission reductions for every member state.*

*Now could there be any solutions for an issue this complicated? In such a limited time it was challenging to come up with any perfect answer. However, we did manage to deliberate three main points:*

*First of all public pressure is the key word. Politicians often think in shorter perspectives keeping in mind the next elections. Citizens have the power to change their leaders, thus if people want greener energy sources and decreasing subsidies that's what politicians will do. Public will is stronger than the will of producers. The producers would actually start supporting this policy as well, if that's what consumers want. So what we need is information! Spreading the word of environmental degradation, pollution and economical inefficiency helps to increase public support. How to do this is another problem. Here the civil society, NGOs and green parties have a role to play. EU-level information campaigns could also be needed. Municipalities could do some small scale efforts to produce positive examples.*

*With many energy issues the technical solutions are already there, the problem is lack of political will. In Finland the potential for waste burning hasn't yet been used in large scale. We suggest that in order to minimize the negative impacts of plant shutdowns the peat plans would be transformed into waste burning plants and the personnel retrained for new tasks. The money used for subsidies could be retargeted to help in these first stage investments. Because of large distances transporting waste around the country might cause high carbon emissions, hence we propose two options. In urban areas waste from households, companies etc. could be burned, on the country side using wood pellets, agriculture residue etc. would be more reasonable. Investing in railway transport is essential for emission cuts.*

*Our third point is that all changes must be done gradually. For example subsidies could be tied to the amount of how much peat has been replaced with waste on heat production before the subsidies would gradually be removed. Gaining acceptance for changes always takes time.*

*We do recognize that our solutions are not perfect. The task of solving questions about subsidy removals is enormous, they can't be answered in few days. I am, however, pleased with our track's work. I think we came up with some working ideas. I personally found it interesting to work with students with more technical backgrounds (I myself study international politics). They gave ideas from a technical point of view whereas I brought with me the perspective of the society. Combining all our ideas together resulted in a conversation touching every side of the issues. In my opinion this is the only way it is possible to solve any big issues facing us nowadays. Interdisciplinary cooperation is needed both in working life and in the academic world.* ■ **ANNU JALKANEN**

# Track 6: Design for Sustainability (DfS) and Dematerialization by design

# Design for Sustainability (DfS) and Dematerialization by design

Tatu Marttila and Cindy Kohtala, Department of Design,
Aalto University School of Art and Design

## Introduction

This workshop explored the possibilities to promote dematerialization by design. During the workshop track the participants gained insight into several design-for-sustainability approaches and methods, in order to exploit the strengths of the design process itself. The student participants were invited to challenge the "traditional" design approach, which often focuses only on getting a product onto the market on time, and instead looked into new ways to expand stakeholder participation, to increase the basis for decision-making into a collaboratively mediated setting of goals and aims, and to pursue the more widespread participation necessary for sustainable outcomes (Wahl and Baxter 2008). The students were then able to use these approaches to work on their predefined interest areas, to find new and meaningful ways to implement design in the pursuit of more sustainable solutions.

## Why DfS as a track focus?

It is generally accepted that design plays a key role in consumption and production and can therefore have a massive impact in resource reduction and dematerializing our society (e.g. Tukker et al. 2008). This can happen gradually by improving existing products, but greater possibilities lie in expanding stakeholder participation, affecting consumer behaviour and redesigning on a systemic level. Not everyone, however, understands the new potential roles of design and design processes, which cover much more than product creation and styling. Design can be critical and provocative and stimulate new, radical system evolution – and can even change societal and behavioural patterns of action (Tukker et al. 2008). Hence, we encouraged the students to question the existing paradigms, not only the status quo of growing material consumption but especially the difficult paradigm of sustainable design itself.

## Dematerialization through design

There are several branches of design that are appropriate in the pursuit of a more dematerialized society, including service design, product-service system design and system design, stimulating system evolution; critical design and slow design affecting the public debate; participatory design and 'open design' expanding actors' participation; and 'social design' and social innovation creating solutions from the bottom up (see e.g. Fuad-Luke 2009; Marttila 2011). Thus our starting point – the DfS process – branched into several approaches that together had the potential for dematerialization: decoupling of human needs, activities and production from resource and energy consumption. These various design approaches involve different processes especially in terms of different starting points, different stakeholders and different aims.

Prior to the workshop, through a study of the literature and research, we identified three approaches to more sustainable design:

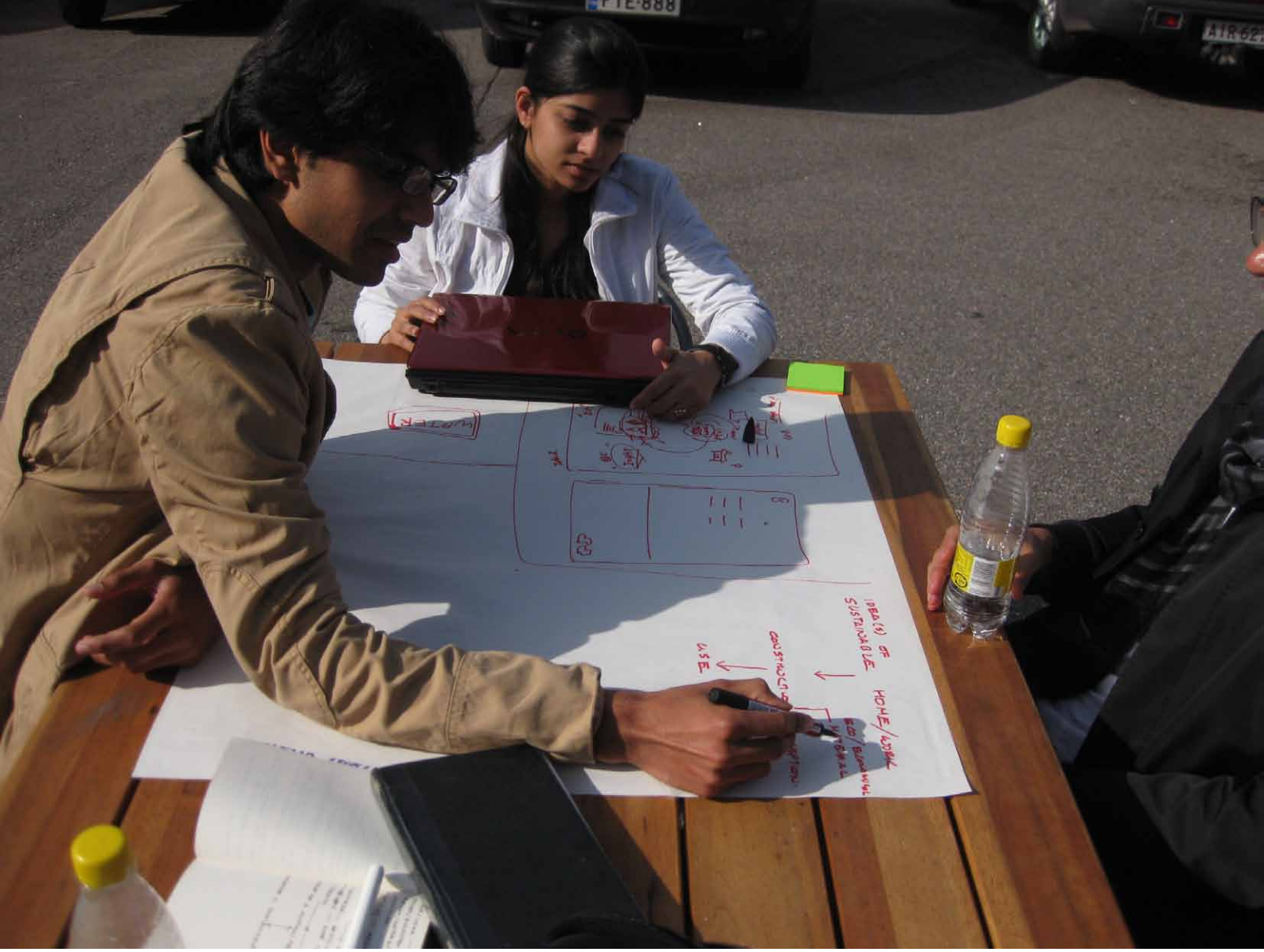
1) *Top-Down Systems Approach* (service design, PSS design, system design)
2) *Bottom-Up Systems Approach* (participatory design, open design)
3) *Communicative and Critical Approach* (critical design, slow design, design activism).

These approaches were illustrated with several examples. The students were also involved in finding and presenting design solutions showcasing these perspectives.

## Workshop organization

Developing sustainable solutions often begins by defining and agreeing upon the problem space and scope. As the aim of this workshop, however, was to better understand the potential of these new design processes in environmental problem-solving, we deliberately began from Process rather than Problem-Setting. From a design perspective, we argue that beginning from the process and then moving towards a more detailed problem setting, and continuously practicing this iterative loop, is the most fruitful method to understanding stakeholder interests and values in real-world environmental negotiations. This workshop became the perfect opportunity to test this hypothesis.

The students were grouped beforehand according to two principles. The first was their professional background, motivation letter and proposed poster topic.



This resulted in the following groups: 1) *Products*; 2) *Cities, Spaces, Urban Planning*; 3) *Soft Systems*; and 4) *Engineered/Hard Systems*. The second principle for grouping was based on four important contexts in design-for-sustainability: 1) *Society*; 2) *Home*; 3) *Energy*; and 4) *Consumer*. Furthermore the grouping evolved flexibly around the three aforementioned DfS approaches. The groups were first working in their interest group and then within a certain DfS context.

Student discussions and exercises focused on how design competence and design processes contribute to developing sustainable solutions. The workshop activities consisted of several small group tasks, after which the group reconvened to reflect collaboratively on the findings. Design is an activity of "reflection-in-action" (Schön 1983), and we proceeded iteratively and collaboratively towards our findings. Through these small research and design exercises and group activities we looked into balancing the different aspects of sustainability and creating a developed problem setting in relation to the students' own interests.

Finally, the students faced the challenge to choose an appropriate and efficient way to present our "outcomes" to the festival audience. In pursuing more

sustainable design, it is a necessity "to penetrate beyond the 'white noise' [...] of contemporary life" (Fuad-Luke 2009). In preference to case study examples or a traditional lecture-type presentation, the students performed a small, discursive play around the interplay among a producer, policymaker, designer and consumer, which emphasized the need for shared dialogue and aptly illustrated the potential of dematerialization-oriented strategies.

## Conclusions

According to our hypotheses and intentions, our workshop focused on processes rather than outcomes in order to empower development of shared visions – in this and in any future multidisciplinary problem-solving process. A key issue was the need to expand the arena for discussion and design, to involve more stakeholders in the process, from people even to the planet in the systemic sense. In the end it became apparent that many of the necessary technological solutions already exist. What is more important for sustainable design is to initiate discussions and to expand the basis for the design process, resulting in a more acceptable view on the problem-setting and its outcomes.

**Facilitators:**

Tatu Marttila and Cindy Kohtala, Department of Design,
Aalto University School of Art and Design

**Co-hosts:**

Timo Järvensivu
Paavo Järvensivu

**Participants:**

| | |
|---|---|
| Reynir Smári Atlason | (IS) University of Iceland |
| Ronen Hadar | (Israel/DK) University of Southern Denmark |
| Andreas Kamp | (DK) Copenhagen University |
| Hyunah Kim | (Korea/SE) Lund University |
| Mathieu Labour | (France/DK) Technical University of Denmark |
| Rafael Laurenti | (Brazil/SE) Royal Institute of Technology |
| Zheng Liang | (China/FI) Aalto University |
| Shraddha Mehta | (India/NO) Norwegian University of Science and Technology |

| | |
|---|---|
| *Leena Naqvi* | *(Pakistan/SE) Umeå School of Architecture (she was accepted but then was unable to come to Finland to participate)* |
| *David O'Byrne* | *(Ireland/SE) Lund University (he was accepted but then was unable to come to Finland to participate)* |
| Joong Yeol Park | (Korea/FIN) Aalto University |
| Sangram Shirke | (India/SE) Umeå School of Architecture |
| Kristen Skelton | (Canada/DK) Aalborg University |
| Maria Teder | (SE/NO) Norwegian University of Science and Technology |
| Ping Yang (China/NO) | Norwegian University of Science and Technology |

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*"I participated in workshop track 6 called "Design for sustainability and dematerialization by design" chaired by Tatu Marttila and Cindy Kohtala, both PhD candidates at the Aalto University School of Art and Design, Department of Design. The point of departure for the workshop was the notion that design plays a key role in consumption and production patterns and therefore can have a massive impact in resource reduction and dematerialization of our society.*


*The provided reference articles formed a good theoretical background and preparation by giving an introduction to some of the key concepts that were later discussed during the workshop sessions. According to Sanders and Stappers (2008) co-design refers to collective creativity (i.e. between two people or more) with designers and people not trained in design working together. The designer and/or researcher takes on the role of a facilitator (rather than an expert or translator) that is leading, guiding and providing necessary design tools. The design approach enables a wide range of disciplines to collaborate towards a common goal. Thanks to internet and other social media new generations are likely to have an easier time sharing information and distributing control and ownership over ideas (which the Nordic Climate Festival workshop in itself also proved!). Designing for a purpose rather than designing a product is crucial in the context of dematerialization and sustainable design in order to come up with solutions that are flexible enough to adapt to the individual needs of the consumers and at the same time taking the whole life cycle perspective into account. Wahl and Baxter (Wahl, Daniel Christian, and Baxter, Seaton, "The designer's new role in facilitating sustainable solu-*

*tions" in Design Issues, volume 24, number 2, p. 72-83, MIT, 2008) define sustainability as a collective, continuous design process rather than a fixed endpoint or static product. "Meta-design" refers to the way design is affecting our conscious awareness, value systems, worldviews and aspirations, and is thus the intentionality behind all materialized design. By operating on a meta-design level designers can have a great influence on the way society will function in the future; consumer patterns, lifestyle options etc. Participatory and transdisciplinary design is necessary to make appropriate decisions in a complex world as different perspectives generate different specialized knowledge about specific situations. A holistic view is essential for arriving at sustainable design proposals and processes.*

*The workshop in Helsinki started with a presentation of different options for designing for the future; is sustainability to be achieved by transmaterialization (i.e. by using new/better materials), dematerialization (i.e. by using less materials) or structural changes (of production and consumption patterns)? The role of the designer as a facilitator working with communicative design processes such as critical design (design posing critical questions about prevailing value systems and living patterns) and slow design (aiming at visualizing the steps towards a "slow" and more conscious lifestyle) was thoroughly elaborated upon within the group. Another key issue was the designing of value systems rather than products, i.e. working on the previously described meta-design level in order to create sustainable win-win solutions.*

*Three approaches for sustainable design were proposed; the top-down systemic approach (were the designer is the expert), the bottom-up systemic approach (were the user is the expert and the designer is rather the coordinator of specialists, while at the same time analyzing the design process and the results) and the communicative approach (were the designer functions almost as a philosopher or an eye-opener who is making consumption visible and asking critical questions). By applying the communicative approach, constructive provocation by design can cause a positive challenging of norms. A key notion for sustainable design is turning downcycling not only into recycling but rather into upcycling (i.e. adding more value to the material that is being used). My personal reflection on this was; could customization of products and services be regarded as upcycling if it leads to long(er)-time use of the objects that are being produced..?*

*A wide range of sustainable design tools were briefly introduced by the track leaders; source map (a tool on the internet tracking the components of a product around the globe), LCA (life cycle assessment), MET Matrix (a qualitative approach for evaluating the impact of Material Energy and Toxic emissions linked*

*to a certain product), META matrix (adds socio-cultural aspects to the previous method), PSS (Product Service System - a way of designing for a purpose rather than a product; e.g. a carpool that is selling a convenient (and at the same time sustainable) way of transportation rather than a car).*

*The second workshop day included a session on Degrowth (chaired by Paavo and Timo Järvensivu from the Helsinki School of Economics). The main topic was if design approaches can introduce alternatives to today's consumer society (where the highest priority seems to be to keep the GDP growing at any cost). Current politics focus on economical debt, but paying the social and ecological debt is as decisive for creating a truly sustainable society according to the logic of Degrowth. It can be regarded as symbolic concept, a design approach that introduces alternative measurement units such as GPI (genuine progress indicator) or happiness indexes and results in e.g. work sharing or innovations aiming at well-being rather than monetary growth. The key point is to create a world where the economy is a tool for the well-being of humans and nature rather than the other way around. Looking at the world through a more holistic lens should make it obvious that green washing (i.e. calling a product sustainable by fulfilling demands on only one of the aspects of sustainability) is a very short-sighted and simplistic solution.*

*The main workshop task was to reflect upon how designers can facilitate positive change towards true sustainability. In smaller groups (3-4 people) we elaborated on how this can be done either by influencing policies, infrastructure/energy consumption patterns, practices/services or behaviours. Subsequently the entire group discussed how all of these levels can be incorporated at the same time to create more holistic design solutions. New values like time (saved/liberated), feeling of belonging, trust and community, relation to nature, durability, freedom, self-fulfillment and meaning to life can be promoted by sustainable design (as alternatives to monetary value).*

*Personally I got familiar with many new concepts such as process-oriented development, communicative design approach, co-design, transformation design and generative design during the workshop. The "new" role of the designer as a facilitator and coordinator of participatory processes has become central to my own PhD research. Most designers are trained and good at visual thinking, conducting creative processes, finding missing information, making necessary decisions in the absence of complete information and creating design tools for non-designers (Sanders, Elizabeth B.-N., and Stappers, Pieter Jan, "Co-creation and the new landscapes of design" preprint of article submitted for consideration in CoDe-*

*sign, Taylor & Francis, http://journalsonline.tandf.co.uk, 2008). According to my own experience designers are also good at taking a holistic approach on tasks/problems and seeing "the larger picture". They can thus act as transdisciplinary integrators and facilitators in design dialogues creating "engaging local, regional and global visions of sustainability" (Wahl and Baxter, 2008). To me this is a very inspiring professional role to investigate further. I fully agree with the common conclusion of our workshop group after the days in Helsinki; sustainability is a collective process of constant learning that requires everyone to be a responsible citizen and participate in the co-designing of our common sustainable future!* ■ **MARIA TEDER**

### *Design, sustainable development and degrowth*

*In late August 2011, 90 Master's and Ph.D. students met in Espoo, Finland, to debate possibilities for developing sustainable Nordic societies in the Nordic Climate Festical @ Aalto. Arranged by Aalto University and funded mainly by the Nordic Council of Ministers, the event gathered students from all over the world representing almost all of the Nordic universities. One of the 7 workshop tracks, Design for Sustainability – Dematerialisation by Design, used design theory as a starting point for discussions on ecological limits, systems design, degrowth, energy and material consumption, equality and other values and much more. The following is a learning diary that attempts to express the content of those discussions and the thoughts they have spurred in the weeks following the visit to Finland. The learning diary primarily deals with degrowth as the main approach to reduce environmental impacts and natural resource depletion.*

#### Present challenges

*Our current lifestyle is not respecting the carrying capacity of the planet. Our wealth is based on the depletion of non-renewable resources (fossil fuels and minerals, e.g. phosphorus) and on a use of slowly renewable resources (e.g. clean atmosphere and water reserves, diversity among plants and animals, productive soil) that greatly exceeds their capacity to continually provide services we take for granted. Furthermore, we are presently witnessing how ecological crises converge with financial crises ("bubbles", increasing rates of un- and underemploy-*

*ment, inability to expand the money economy, insurmountable private and public debt) and social crises (crime; increased inequality; societal segregation based on poverty; stress, depression and other mental illnesses). It appears that decades of exhausting our natural, economic and social/human capital has left us in an unsustainable situation where we have to find ways of reducing natural, economic and social/human debt at the same time. Figures and other data to scientifically support these statements have been left out of this diary to save space. The reader is directed to [1]-[5] for a few sources among many that focus on natural resource depletion and imminent peaks in extraction.*

**Decoupling the money economy from resource use**

*There is a strong correlation between the size of the money economy and the consumption of resources [6]. Even in developed countries that are able to boast of having increased the service sector and decreased the production sector and thereby reduced the energy use or GHG emissions per GDP, the correlation remains – the actual resource use just takes place abroad (see also the text box 'Misguided sustainability indicators').*

*There are several ways of decoupling the economy from resource use (other than exporting pollution and resource use to other countries). But even if true decoupling is done, it does not automatically lead to less environmental impact or resource use. When talking about human impacts on the environment, the IPAT equation can help shed light on the relationship between consumption and impacts:*

$$I = P \times A \times T$$

*where I = environmental impact, P = population, A = affluence (consumption level or 'living standard' e.g. by GDP), and T = technology level.*

*When impact is seen as the product of population size, level of consumption (in the following represented by GDP) and the technology level, different schools of thought emerge: Those who believe population must be limited to reduce impacts, those who believe that consumption must decrease, those who believe that technology improvements will decrease the impact per consumption unit, and finally, those who advocate for a mixture of approaches. Most prominent in the present debates on sustainability are the proponents of expected improvements in efficiency through technological advances. Others argue that inevitably, the amount of people on this planet – even with improved technology and non-increased consumption levels – must stagnate or decrease. Finally, intellectuals and non-intellectuals alike are exploring the theoretical and practical implications of – in broad terms – decreasing the size of the money economy (GDP) in society*

**Misguided sustainability indicators**

The municipality of Copenhagen presented its Climate Action Plan with the ambitious goal of making Copenhagen $CO_2$ neutral in the year 2025. The present, average emissions of approximately 5 tons per person per year are to be reduced primarily by changes in energy supply, local transport and renovation of buildings.

The problem with the plan is that the emissions caused by the average Copenhagen citizen is around 20 tons where the additional 15 tons constitute the production of energy, food and goods and transport outside of Copenhagen.

In practice, the 'misunderstood' calculation procedure will result in a tendency for food, products and energy to not be produced locally, but to be produced abroad and often where environmental regulations are slack – a step backwards in terms of long-term sustainability.

"CO2 neutrality" and other popular sustainability indicators must be standardized and calculated according to consumption, not production!

*and in people's private lives. It is argued that because 'degrowth' is an approach that is neither founded in a risky "faith" in technological progress nor dependent on (strong) violation of people's natural right to have children, it is the one most effective of the mentioned approaches.*

## The problem of hoping for efficiency improvements

*Degrowth proponents possess two very strong arguments: growth is unsustainable by definition and technology-driven improvements in efficiency (leading to decreased impact per material or energy input) is accompanied by increased demand. If we play with numbers in the IPAT equation, the first will be apparent: Assuming that our impact on the environment must be halved within 25, 50 or 100 years (t) and that population remains constant (which are conservative estimates), how efficient do our technologies for e.g. providing consumer goods and end-use energy need to be to keep up with a yearly rise in 'living standard' measured by GDP of 2.5%? That is, if*

$$0.5 = 1 \times (A \times 1.025^{t}) \times (T \times (1 - r_{tech})^{t})$$

*and t = 25, then the annual efficiency increase, $r_{tech}$, must be 5% to keep up with the rise is affluence and reduce impact by 50%. If we have 50 years to halve our impact, the yearly rate of efficiency improvements must be 3.8% and if we give ourselves 100 years, the demand for improved efficiency is 3.1%. It appears that it becomes easier and easier the longer time we give ourselves. But is 3.1% every year in 100 years easier than 5% in 25 years?*

*No, it is not. Imagine a product or service that in 25 years must use only $(1-0.05)^{25}$ as much materials and energy as today. It means that it can use only around 27% of the present energy/materials use. If we demand yearly efficiency improvements of 3.1% over 100 years, the product/service can only use around 4% of the present use of energy and materials! It should be clear that with today's projections of expected population growth (around 9 billion in 2050) and the need to radically reduce our impact (by as much as 90% in e.g. GHG emissions) we are simply putting too much hope in efficiency improvements.*

*There is another very important argument against the hope of efficiency improvements. The fact is that whenever we become able to do something at a lower cost (energetic, material or labour) our demand for that product or service increases and makes up for the gain by consuming more. In effect, there is no <u>net</u> decrease of energy, material or labour inputs. This is called Jevon's paradox and is also referred to as 'rebound effect'. Take a moment to think about the last half century's impressive increases in our ability to produce food; to convert energy in fossil fuels to heat, power or motion; or to produce consumer goods like TV sets, refrigerators or cars. Now ask yourself whether these technological advances have led to less overall resource use? They have not, and we should expect the same for future advances in efficiency.*

## Degrowth: Cultural challenges to its large-scale implementation

*The main obstacles for any move to degrow the money economy is the strong cultural belief that more is better and the emphasis on material wealth measured in GDP as the indicator for personal well-being and societal progress. For decades, especially during the first half of the 20th century, the Western world experienced steady increases in living standard. This happened mainly due to the introduction of fossil fuel energy and the large-scale inclusion of women in the monetised economy's labour pool. In that period of time, increases in living standard were closely linked to people's ability to buy consumer goods and GDP was a suitable indicator for that. Growth in GDP became synonymous with a better life and the goal of mainstream economic policy. A common understanding of all else being*

**Sustainability – make it concrete!**
The Natural Step [7] proposes 4 ultimate sustainability objectives for organisations, companies and societies:
We must eliminate our contribution to systematic

1. increases in concentrations of substances from the Earth's crust,
2. increases in concentrations of substances produced by society,
3. physical degradation of nature, and
4. undermining of humanity's ability to meet its needs worldwide.

*equal, positive growth in GDP leads to increased purchasing power and thereby increased material wealth which is equal to higher living standard or well-being has become the cornerstone of political and cultural life in most of the world. Of course, all else is not equal and material wealth is not the same as life quality. More purchasing power is great, but what about more pollution, e.g. toxins and smog; more loss of animal and plant species; more use of previously untouched land; more global warming; more use of resources that can only be used once? Since more consumption (as measured by GDP) involves more of all of those, obviously more is not necessarily better. The second fallacy of the statement above is that it builds on the assumption that everything of value can be acquired if only the purchasing power is big enough, an assumption that the money economy covers all the aspects of life that it is beneficial to measure. That, as anyone who considers it for only a short moment, is of course entirely untrue.*

*More consumption and a bigger money economy have, nonetheless, become practically synonymous with something positive. Less consumption and a smaller money economy, therefore, are almost automatically perceived as something negative. This is a strong obstacle for even discussing whether degrowth can be a practical way of preparing for the looming energy shortage and environmental catastrophes ahead.*

## Positive degrowth and the introduction of meaningful indicators

*There is a need to associate degrowth of the money economy with all the positive consequences it may have instead of saying that degrowth is less of something. One way to go about this is to identify the values and principles that we want our*


*future society to be represented by and show how this system of values and principles are related to degrowth. Identified values are e.g. trust, feeling of belonging, equality, "social glue", free time, sustainable use of natural resources, clean surroundings, good physical and mental health, etc. These goals are not being reached by the present development model. But degrowth, with its emphasis on localised production of organic food and the necessary consumables is expected to relieve nature of the burdens of industrialised agriculture and increase a feeling of belonging and understanding of the importance of working together. This will help build trust and strengthen the social glue of local societies and it will reduce the impacts of transport of goods. Gains in productivity should be transformed into less demand for work and the leisure time can then be used for improving physical and mental health by sports, music, arts, family time and social activities. Furthermore, energy and material use must be constrained by strong sustainability criteria, e.g. like those of The Natural Step shown in the text box 'Sustainability – make it concrete!'.*

*When the objectives of human development have been described in terms of values and principles to follow, it is necessary to guide the transition towards*

*these goals using a new set of indicators. These indicators should reflect the identified values and replace growth in the money economy as the measure for progress. Suggested indicators are: the Gini coefficient for equality, share of organically farmed land, the share of e.g. the municipal economy that is considered 'local', $CO_2$ emissions of national consumption, average non-working time of employed population, employment rate, crime rate, life expectancy, average air quality in cities, locally produced raw resources in % of all raw resources used, etc. along the same lines.*

**Benefits of being proactive**

*Degrowth will be a reality; the projections of resource use, population increase, environmental impacts and realistic expectations for efficiency gains should be able to convince even the most sceptic. The questions are whether it will be sooner or later and how much we will be prepared for it.*

*The poorest people are likely to be the ones who will be affected the most and the younger among these are likely to show the most dissatisfaction. Recent incidents of rioting in France, Greece, the UK, and the USA are to many who follow the development in energy and food prices obvious manifestations of the limits to growth. How many and how severe will reactions be as energy and food becomes even scarcer leading to the collapse of local societies, political systems and entire economies? And how else can we imagine social unrest? Large-scale civil disobedience or deliberate sabotage to save the planet? What about geo-political tensions where climate change affected areas take deliberate action to keep over-consuming nations from getting to resources? As crises unfold and are exacerbated by counterproductive correction measures (e.g. "we must grow out of these annoying limits to growth!") decision makers are likely to lose more and more support from a still more disillusionised populace. It is possible to foresee a major loss of trust in the political system, based on the realisation that politicians did not do what they could when they had the chance.*

*One key to avoiding uncontrollable civil unrest is to be proactive. Suggestions of proactive societal design measures include but are in no way limited to: Creating the conditions for citizens and businesses that make it possible to decouple development and resource consumption. An example of this is to support a movement among industry towards more closed loop systems. This will counter the trend of designing products with planned obsolescence. Another measure could be to cap or ration key resources like clean air (get a move on, UN!), international waters, water reservoirs, oil/gas/coal extraction, or the energy use per person or*


*municipality. A global moratorium on extraction of oil from tar sands should be enforced. A progressive tax scheme for consumption/resource use could be implemented. Environmental and resource-friendly certificates and standards, e.g. on energy and material use of products should be backed officially by municipalities, countries or globally. Strict regulations could support the development of mandatory sustainability assessments for every new product. Regions or entire countries could ban or heavily tax the use of fossil fuel-driven cars or private car ownership. A ban on advertisement in public could have a large beneficial impact on consumer culture. Measures should be aimed at producers as well but mainly at consumers. Campaigns of information of a nation's consumption's impact on the environment and the depletion of resources should be supported by governments.*

*It is a popular misperception that constraining people from consumption is a violation of democratic rights and individual liberty. The suggested measures will indeed constrain the consumer compared to the present situation. It is a fallacy, however, to define individualism based on the freedom of material consumption. People do not have a right to consume. People have a right to clean, healthy surroundings where we can enjoy a stable nature indefinitely. Those who work against that – directly or indirectly – should be seen as enemies of humankind and strict rules should be enforced to keep them from doing so.* ■ **ANDREAS KAMP**

*Sources referenced in the text: [1] WWF: Living Planet Report, 2004, [2] Heinberg, R.: Peak Everything, 2007, [3] Latouche, S.: Petit traité de la décroissance sereine, [4] http://ourenergyfutures.org/, [5] Odum, H.T.: A prosperous way down, 2001. [6] Jackson, T.: Prosperity without growth, 2009, [7] Robért, K.-H.: Strategic sustainable development – selection, design and synergies of applied tools, 2002.*

# Track 7: Universities, climate change and sustainability

## Case Aalto, sustainable campus

# Universities, climate change and sustainability – Case Aalto, sustainable campus

*Meri Löyttyniemi, Aalto University, Sustainable Development*

*The best way to predict the future...is to create it.*

*Albert Einstein*

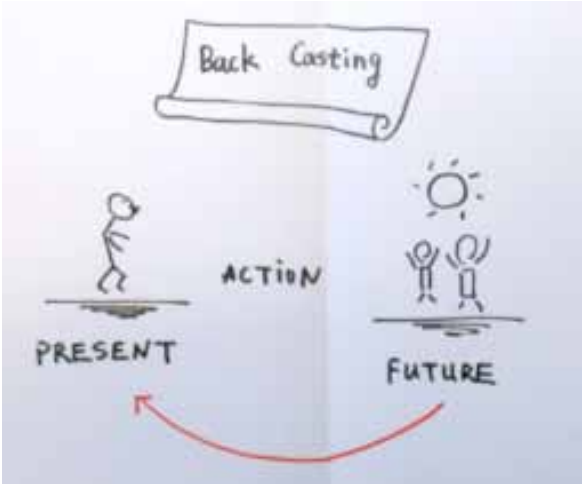
## Introduction

The students´ pre-assignment was to send a poster with an introduction of their home university and its sustainable campus activities and/or research and teaching agenda addressing climate change and sustainability. Their posters described well the huge variety of university activities around the world in a very interesting way.

The aim of sustainable campus -track was to understand universities´ role in the climate debate. The task was to create a vision of an ideal sustainable campus – the Finnish Aalto University worked as a case laboratory. In the workshop we created a vision of Aalto sustainable campus 2015 and 2050 by using the backcasting method. Backcasting is a method of envisaging a desired future and then backcasting the steps to go from that future to the present. This then leads to concrete steps, objectives and goals which can give form to abstract visions.

## Workshop organization

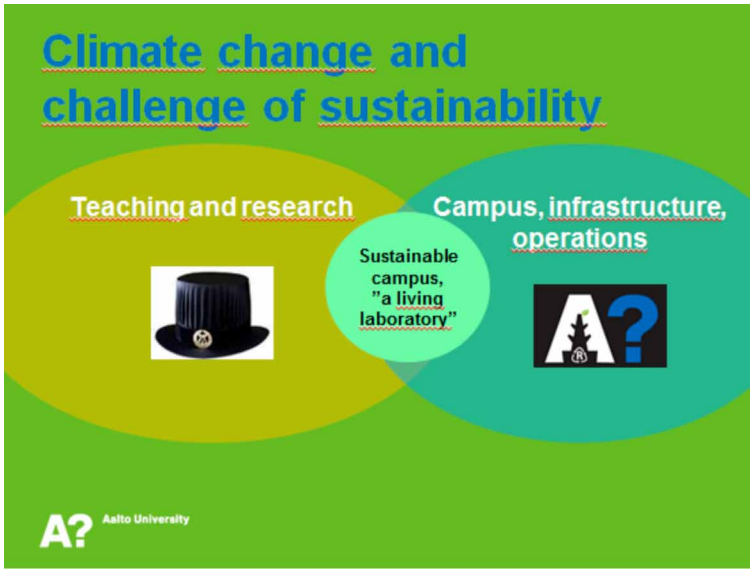
The idea of the track relied on the fact that universities have a huge impact on the society, both on local and global level. Besides focusing in research and teaching, the universities need to take responsibility for their campus operations too.




**Drawing by Yu Liu**

*Our task was to create a vision of not just how the Aalto University campus might look and operate in the future, but also the types and method of learning and research that the future university would be doing. The goal was a sustainable campus, and when looking far into the distance future, we considered that this did not mean being less unsustainable, but actually being sustainable and neutral or positive with regard to carbon emissions.*

## Workshop Outcome: Aalto Sustainable Campus by 2050 – A Vision




By 2050 sustainability isn't a topic of theories, study or research, but it is a way of being and doing that permeates all campus activities. Aalto University is not only climate neutral, but its campus is climate positive and the knowledge generated here is actively contributing to create sustainable societies.

To explore what this means in reality, the workshop used four overarching themes in order to find the steps required to achieve this vision. These themes were built environment, food, mobility and teaching and research. However, these steps require action, not just from the university, but from many other actors and stakeholders, not least the students, but the cities of Espoo and Helsinki, the property owners, the research funding bodies, industry and wider society.

### Built environment, campus infrastructure

The investment in renovated and new buildings represents a massive investment in creating this reality, whilst also preserving the heritage that gives this university its name. This adds up to 250m€ for renovation and several hundred million euro for new buildings between now and 2015. These buildings will provide the physical spaces to expand our understanding of sustainability and the different technologies, methods and innovations that we require. This represents the biggest opportunity to cement sustainability as a core value of the university.

### Food and mobility

An emphasis on local, organic, affordable and reliable broadens the choice available to students and staff. Mobility issues must be dealt with a manner, which takes into account peoples´ daily routines and behavioral patterns. Reducing the emissions associated with these two areas is indispensable, since they are second and third largest sources of emissions in Finland.

### Research and teaching

In teaching and research, by 2050, we will have overcome the barriers of narrow disciplines and funding requirements to create real education **that is sustainable rather than about sustainability.**

Drawing by Yu Liu

## Conclusions

We are already today facing devastatingly great environmental challenges. There is a huge request for implementing de-growth or similar ideas. On the other hand the basic needs of millions of people are not fulfilled. How to find the constructive methods for notable change? Universities are needed more than ever!

The challenge is that wicked problems like sustainability are often solved only by wicked and complex solutions. Nevertheless, many of the solutions are very simple and available. Carbon-free constructions, efficient use of renewable energy, ecoefficient mobility, sustainable food production and consumption, fair and eco-procurement... The list is more than familiar. Last and most important, is the sustainability and responsibility in the curricula.

Let´s remember the wise words of Rachel Carson: *The human race is challenged more than ever before to demonstrate our mastery, not over nature but of ourselves.*

Final result of the track, presented by the students in Espoo, Finland on 2nd of September 2011: ***http://prezi.com/_3proknxdqid/track-7-sustainable-campus/***

**Back row, from left:** *Thomas Skou Grindsted, Blane Grann, Ann-Kristin Hokkanen, Mert Cetinkaya, Hannah Leong, Joni Karjalainen, Nina Raundahl, Dermot Farrelly, Kati Vilonen (Aalto), Kirsi Niinimäki (Aalto), Inka Ahonen, Pekka Murto (Aalto).* **Front row, from left:** *Meri Löyttyniemi (Aalto), Yu Li, Salla Mäkelä.*

The sustainable campus –track students were asked to write an essay reflecting the learning experiences and ideas gathered during the workshop in their own area of interest under the topic "***Future's ecocampus; required actions and attitudes to reach it***". In the essays ideas created in the workshop were developed further. An excellent implementation plan for Aalto University Ecocentre was created and it will be further developed after the Nordic Climate Festival @Aalto.

**Co-hosts for track 7:**
Researchers ***Pekka Murto***, ***Kirsi Niinimäki*** and ***Kati Vilonen***,
Aalto University.

**Nordic co-hosts:**
Environmental manager ***Eddi Omrcen***, Gothenburg University, Sweden and Project manager ***Tomas Refslund Poulsen***, University of Copenhagen, Denmark.

The track operated under the friendly patronage of Aalto vice president ***Jorma Kyyrä*** and institute director and professor ***Raine Mäntysalo***, Aalto Centre for Urban and Regional Studies. Also development manager for environment and sustainability ***Satu Kankaala*** from Aalto University Properties Ltd. was actively involved.

Presentations by Nordic and Finnish co-hosts gave us inspiration during the workshop. Universities of Gothenburg and Copenhagen impressed us with their long-term commitment for sustainability, responsibility and energy issues.

**Participants:**

| | |
|---|---|
| Inka Ahonen | (FI) University of Turku |
| Mert Cetinkaya | (Turkey/SE) Lund University |
| Dermot Farrelly | (Ireland/SE) Uppsala University |
| Blane Grann | (Canada/NO) Norwegian University of Science and Technology |
| Thomas Skou Grindsted | (DK) Roskilde University |
| Ann-Kristin Hokkanen | (FI) Åbo Akademi University |
| Joni Karjalainen | (FI) University of Helsinki |
| Hannah Leong | (Singapore/DK) Technical University of Denmark |

| | |
|---|---|
| Yu Liu | (China/SE) Chalmers University of Technology |
| Salla Mäkelä | (FI) University of Turku |
| Nina Raundahl | (SE/DK) Roskilde University |

As an pre-assignment, the students read the following articles:

Schoemaker, P.J.H. (1995) "Scenario Planning: A Tool for Strategic Thinking," Sloan Management Review. Winter: 1995, pp. 25-40.

Vergragt & Quist (2011): "Backcasting for sustainability: Introduction to the special issue", Technological forecasting and social change –journal, pp. 747–755.

As further reading the following were recommended:

Leal Filho, Walter (ed.), 2010: Introducing Climate Change to University Programmes

Climate Friendly Cities – a handbook on the tasks and possibilities of European cities in relation to climate change: www.tem.fi/files/29765/Ilmastokasikirja.pdf

Article in the Nature: www.nature.com/news/2011/110504/full/473007a.html

Also recommended was to take a look on an comprehensive article describing the challenges of ecocampus issues, written by Ms. Leith Sharp, the former director of Harvard's Sustainable Campus activities: ▶ ***http://sspp.proquest.com/archives/vol5iss1/editorial.sharp.html***

*"First you might think, what do I mean with a Sustainable Campus? Sustainable campus to my mind is about sustainable development of the university. Sustainable development meaning "development that meets the needs of the present without compromising the ability of future generations to meet their own*

*needs" (World Commission on Environment and Development 1987). Like all other communities, also the university is facing the challenges of continuous growth against our planets carrying capacity.*

*We are aware of our planets scarce resources, global warming and population growth. There have been some wise men saying that our society needs sustainable development or we will find ourselves in a breaking point. The universities (like all higher education institutes) should know their responsibility and lead the way to a more sustainable society.*

*Universities have a huge role in making the difference – why is that? That is for three central reasons: Firstly, because universities provide the knowledge future policy makers, researchers, teachers and engineers will be using. Secondly, because universities have a chance to affect the business society and the industry by cooperation. And finally, because universities have an important role in showing the way of society's development.*

*Universities can tackle the challenges of sustainable development not only with teaching and research but also by its own actions. We can ask following ques-*

*tions: Where does the university get its electricity from? How does the campus consume its energy? Could the infrastructure of the campus site be more ecologically sustainable? How do the people move in and out from the university? What does the campus restaurants offer for lunch and how much of that is turned into food waste after the week? These are all things the university itself can influence with its own actions and decision making.*

*University can make ecological choices what comes for example to the infrastructure (premises), food and mobility. If we examine the campus site from the ecological sustainability point of view, we can see that there are many ways a campus can go greener. One example; in many cases the campus site could be functioning a lot more centred – that would mean that staff and the students would not have to move around so much and waste energy. Also a more centred campus would help in planning the public transport connections and improve energy effectiveness of the premises. If we would locate the student housing at the campus, it could upgrade the amount and quality of services and improve the vitality of the campus area. Maybe there could also be potential for cultivation at the campus. That's how a centred campus could offer an opportunity to produce local and organic food.*

*So it is now clear why the university should promote the green values and work for sustainable development. We have also seen that there are possibilities to make the campus more sustainable. Now we need to discuss; how do we uncover the great transitions we start to pursue, what are the actions that need to be taken to make this all happening (where does it all start), and most importantly, who are the actors behind all this reform.*

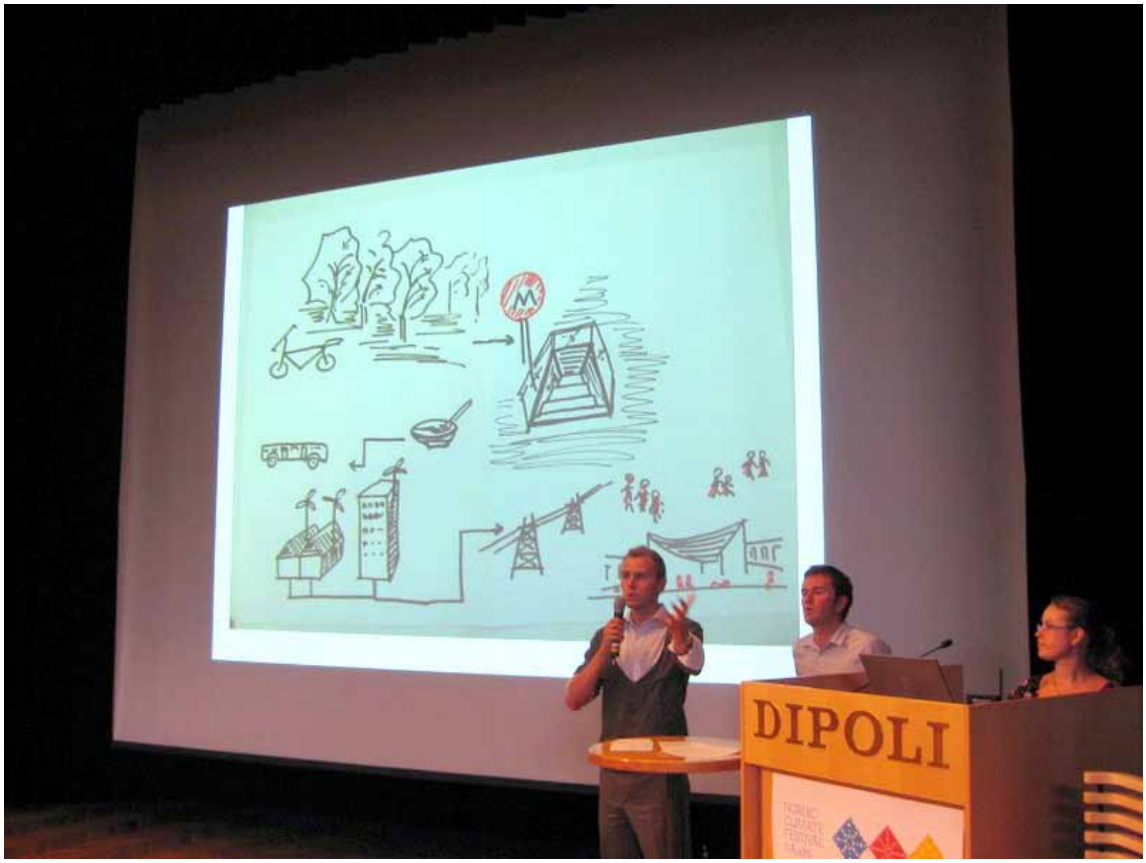
*First you start with making the vision. What should the sustainable campus be like? Future studies offer us tools to look a bit further. If you want to make a real ideal model of the future, you have to forget the limits of today's world – even just for a while. Foresight and backcasting methods are helpful in broadening your vision and the space of possibilities. In foresight you can take a look for the ideal future and then start to build you're future path step by step towards that goal. In backcasting you go to another direction, you start with the future and then backcast it to the present moment.*

*When you have a clear vision it is easier to start planning the future. To reach sustainable campus we need a change in attitude, actions and policy making. University as any community today, needs to revise the attitudes towards sustainable development and ecological planning. It is taught and researched but many times sustainable development has not yet been integrated to the university's strategy*

*and mission. Is it that we do not take that subject so seriously – while everywhere it is stated otherwise? What message does the university want to give to the people going deeper into the subject?*

*In this essay I want to bring out the possibilities of adapting the methods used in Corporate Social Responsibility into the university activities. For example stakeholder management, standards and reporting can all be adapted to sustainable development practices at the university.*

*The development towards a more sustainable university and campus has to come both ways, from top-down and bottom-up. The regulations cannot just been implemented from 'the upper stairs' but sustainable development needs the involvement of all actors of the university. That is when the stakeholder management steps in. With stakeholder management in this case I mean that the university should name its stakeholders (people and organizations affecting/ being affected by the university's operations) and consider the role of them in the university's sustainable development. Students for instance can have much potential what comes to taking part in the project. It is important to listen to all the actors and get everyone motivated towards the university's targets.*



*The university can also utilize different standards and responsibility reporting in sustainable development. With these tools the university itself is able to follow up and also inform its stakeholders about the progress in the university's sustainable development. For example the University of Gothenburg is applying ISO standards and Global Reporting Initiative (GRI) in the university's sustainable development plan (the University of Gothenburg, action plan for environment and sustainable development 2011-2015).*

*At levels of teaching and research sustainable development can be enhanced by courage, cross-disciplinary action. The challenges of sustainable development can not be solved within one discipline. There is a need for a faculty borders exceeding, global network that can view all the aspects and dimensions of sustainability. Information flow between companies, universities and other actors of the society must be enabled. This can be done with collective learning/cooperation, having visitors and going for excursions into different fields. There has to be communication between different actors of sustainable development.*

*Now we have come to the conclusion that besides it is important it is also possible for university and its campus to go green. Sustainable development can not be achieved in blink of an eye but it is about smaller things growing into something big. You have to start with baby-steps before you can run.* ■ **INKA AHONEN**

*"I was one of the lucky people who were elected to the Nordic Climate Festival, track number 7. The focus of the track was on sustainable campuses, and Aalto university was to be turned into one in our vision. In the track, we used backcasting, an interesting method where first, people imagine a desired future and then, find the ways to achieve that future rather than just try to predict what will happen based on the current situation (Vergragt, Philip J. & Quist, Jaco. 2011. Backcasting for sustainability: Introduction to the special issue. Technological Forecasting and Social Change. 78, 747-755)*

*Thus, we were to imagine what Aalto campus should be like in 2050. Our brainstorming session produced a vast number of ideas under four given categories: food, real estates, mobility and teaching and research. From these ideas each person chose the most important ones, and then the group members voted on a common future vision for the Aalto University campus.*

*Track 7 consisted of students with very different backgrounds. This was both interesting and useful in planning a desired future for Aalto University campus. It*

*soon became clear that the participants of the track knew a great deal about issues related to climate change, but at the same time we had different focuses. The participants tried to think outside the box and therefore, we did not hesitate to describe even our wildest ideas. After the initial brainstorming, the group started to be very realistic and to choose the feasible and most effective goals that would be the skeleton of the 2050 vision.*

*Track number 7 of the Nordic Climate Festival was a good demonstration of how many ideas can be generated and merged into a comprehensive plan if people from different backgrounds and different fields of expertise come together with open minds. Yet, the most difficult issue is not to make a feasible vision on how to reach a more sustainable campus. The most difficult part is what happens after; how to make people simultaneously inspired about the vision, how to make them implement the plan.*

*The importance of communicating the right types of messages was stressed in discussions during the track: It is central to remember that many sustainable development solutions can create savings even though a part of them might require initial investments. I learned in my track that constructing low-energy buildings does not actually have to be at least much more expensive than constructing ordinary ones which consume much energy. Moreover, after the initial investment the savings will be significant. This information would normally interest the financiers, hence they should hear this. Moreover, when speaking with the financiers, the decision makers and the general public, it is crucial to translate the sustainability issues, such as the reduction of carbon emissions, into a language that people can understand. One could say, for instance, that saving x amount of money thanks to switching off all unused lights and devices allows the University to employ one teacher that could not have been employed otherwise.*

*In brief, the Nordic Climate Festival track 7 on sustainable campuses showed that it is worthwhile to bring experts of different fields together. Co-operation is the key in a wider perspective as well: It is not just the sustainable development section of the university that should act because alone it can prepare good plans but achieve very few goals. On the contrary, the management, the personnel, town administration, and each and everyone of the students should take responsibility over implementing sustainable development plans. That is the only way in which a vision like that for 2050 can come true.*

*What I consider to be the most useful for me from the track, was that I was able to hear what other universities have done and how they have done it. Those experiences could certainly be used at our home universities as well – if not other-*

*wise, then at least for showing that other universities are taking action and that our home universities should do the same. The final result of the festival was that all of us were reminded to spread the word – and more importantly – to spread the actions on sustainable development, and that is the task that no one can afford to forget.* ■ **SALLA MÄKELÄ**

## 10 Major Components to Create Aalto Eco Centre – An Interdisciplinary Innovation Platform for Sustainability

This paper examines an idea, where an Aalto Eco Centre would be created in Aalto University to become the heart of eco-innovations. An Eco Centre would aim to create sustainability solutions within the university, integrating the core competencies of basic research to the solutions of applied research. Eco Centre could engage students, teachers and professors in a joint effort, where the core focus is in creating sustainable innovations, not simply innovations, where eco-friendliness is introduced as an additional component.

A green economy can only be achieved with practical solutions of everyday life, and with both social and technological design. New sustainable innovations can improve lifestyles, societies globally, and provide opportunities for commercialization. But they need to be created somewhere. This paper describes ten general-level aspects of such a model, and argues why Aalto University would prove to be a perfect platform for eco-innovation.

### 1. Eco Centre as the core concept

Aalto Eco Centre is a concept to create an interdisciplinary platform within the university, where students, teachers, professors and staff can engage in the creation process of sustainability solutions. Already, Aalto University boasts capacities in arts and design, business and technology. Their valuable knowledge and skills could be complemented with research knowledge from other fields and universities such as environmental sciences, psychology, cultural studies or mathematics. Aalto Eco Centre could create solutions of sustainability, which would result in non-profit and for-profit outcomes, depending on the project de-

sign. As universities are the societal flagships of the creation of new information, they need to endorse this century's global challenges.

## 2. Motivating factors: New elements

A factory for the creation of sustainability would address various sustainability points-of-view in different organizational designs. For business students in the School of Economics, Eco Centre could concretize the notion of corporate responsibility , where the university as an organization would provide an organizational platform for the creation of green business ideas and sustainable management of day-to-day business operations. For the School of Engineering, "a living lab" could provide an excellent incentive, integrating the sustainability into new innovations. Arts and design, in their part, can provide the user-integrated surface, as for example in Odense, Denmark, where in city planning, designers take part in the planning processes from the beginning to the end, in order to be able to combines into the original project philosophy to a user-friendly end product.

Citizens, including in the university, need institutional support to be able to reinforce the bottom-up creation of sustainable societies. Individuals, organizations and the society learn by doing, which is why Aalto University would be the perfect platform for experimenting and innovating determinedly. Although the Brundtland Report internationally recognized the notion of sustainable development already in 1987, the spill over of shaping ideas to concrete actions and sustainable practices is still a challenge for the larger society.

In Finland, the Ministry of Education developed an evaluation model to evaluate the societal and economic engagement in universities in 2007 . There, among the indicators are values of sustainable development for the ministry and the university to consider, how the university is achieving goals of sustainability in its outreach.

## 3. Benchmarking from the best

"University as a living lab" is merely a way of explaining the role of university for the benefit of the larger society, willing to engage in experiments beyond business-as-usual. Already, various universities have given substance to the notion with several concrete initiatives.

In Harvard, a Green Loan Fund has been established for student projects, which provenly improve energy-efficiency, resulting in $4.8 million annual sav-

ings . Similarly, in the University of Copenhagen, return on sustainability investments has been proven sound, resulting in organizational cost-savings and a reduced carbon footprint . Also in Brown University , many student groups' initiatives have resulted in energy and environmental progress both on and off campus. Jeffrey Sachs, the Head of Earth Institute in Columbia University (and Special Advisor to United Nations Secretary-General, Ban Ki-Moon), has been eager to create global partnerships network for universities that promote sustainability .

## 4. Advantages: What's in it for the top-management?

Achieving results and measuring impact is important for the top-management of any organization, as in business-decisions, budgeting and strategy, value for money is wanted. An Eco Centre could introduce two types of advantages: direct (internal) and indirect (external) advantages.

Learning already from the Green Campus activities in Copenhagen, direct internal outcomes would be improved energy-efficiency and organizational cost-savings, to leave money to be allocated to other strategic aspects of the university. Secondly, the possible commercialization of innovations could also benefit the university, improving its capacity as a centre for excellence.

With public interest steered towards achieving carbon-neutrality and sustainability in all sectors of the society, any university leading the race can prove attractive for prospective students and researchers, spurring the intellectual achievement in the organisation. Increased attractiveness can result in improved brand value, more motivated students, and higher interaction with the larger society through strategic partnerships.

All this creates a university, which achieves its vision of building capacities and knowledge, leverages talent, and impacts the society in the shape of both scientific results and practical solutions, creating knowledge economies with a global mindset of sustainability.

## 5. Strategic higher education goals and Eco Centre

With the Bologna Process as the main guideline steering the European higher education policy, Eco Centre could give additional meaning to the principles of fostering innovation and aiming for student-centred learning . If students were able to personally engage in a process, where research theories are combined

into practical applications, this would enhance the university environment as a centre stimulating students, merging theory, practice and innovation by student-centred learning.

Similar methods, bridging the gap between theory and practice, already exist in various domains. For example in Harvard, in the Department of Public Health and Management, the department has strong ties with policymakers and practitioners to provide students of Public Health and Management additional experience "to apply classroom learning to real world" . It is simply about bridging the gap to providing teachers and students with the right kind of incentives to achieve high-quality results.

## 6. Understanding the organizational realities

Vergragt and Quist (2011) have portrayed the idea of backcasting , where a vision needs to be supported with concrete short-, medium- and long-term steps to become a wanted scenario. Also a new project, establishing Eco-Factory, should start with the organization (Aalto University) first evaluating its current organization capacities, strengths and limitations.

Firstly, there is a long-standing culture of active student life, and even third-sector participation in Finnish universities. Traditionally, the Student Union and various student organizations have provided both Finnish and international students with platforms for social activity and interaction. But students are also interested in sustainability, like in the School of Economics, where a Sustainable Business Club (SBC) was established in 2006. In Finnish universities, student unions might have developmental or environmental committees, which meet regularly.

However, many student-based approaches, no matter how ambitious, lack continuity and adequate resources for scaling up. And this is not the case only for student organizations, but for many non-governmental organizations. It is also worth noticing that the rest of the student clubs or organizations, despite boasting with several activities and managing to attract a crowd of students, are other than sustainability-focused by nature.

In Finland, the newly created Aalto University provides a window of opportunity for experimentation whereas in traditionally, for large organizations, the pace of change is slow and difficult to achieve. However, already within a short period of time, Aalto University has had creative initiatives, both bottom-up and top-down, in the shape of Aalto Entrepreneurship Society , and Aalto's three fac-

tories: Design Factory , Media Factory  and Service Factory .

Commitment, institutional support including funding and visibility are key components to ensure that any initiative could succeed. In the case of Eco Centre, students could easily be rewarded for their sustainability engagement with ECTS credits, similarly as they are when they attend student conferences, take learning cycles, or contribute to the work of student organizations or the Student Union. Furthermore, Eco Centre could achieve interesting dimensions, and be an attractive target for both third-sector partners and corporate funding, as they both are increasingly interested in sustainable innovations.

## 7. Recognizing strategic partnerships to complement competencies

Multi-stakeholder partnerships beyond public-private partnerships (PPPs) can foster innovation by bringing in views, which supplement the organization's competencies. An Eco Centre, could greatly benefit from the knowledge and recognition of challenges of private, public, third sector and other partners.

Business sector and industries aims determinedly to cut down emissions. In Espoo, the industry already has close links with the four Schools from the former University of Technology. Business and technological sectors could mutually benefit from engaging and learning with the university in the questions of carbon-neutrality and sustainability. But, businesses are steered to make profit, which should be appreciated when defining their role.

The third sector and/or think tanks could provide interesting ideas and be interested in collaboration to scale, mainly in the environmental challenges. Often, various non-governmental organizations have years of expertise in their specific domain (cycling, energy issues, social design etc.), and could prove valuable resources, especially when narrowing down the research question. However, they are often politically- or education-oriented and might lack human resources to have in-depth knowledge. They, in their part, might greatly benefit from new innovations, and prove enthusiastic promoters of new social ideas.

For the wider implementation of eco-innovations, the public sector should be considered an important player. While gaining from these sustainable solutions, the public sector could provide funding in the shape of its different programmes or schemes in municipal, regional, national or even European-level (EU).

Other valuable stakeholders could include research networks, unions or even ordinary citizens, practically any actors in the larger society, which could be

identified to have something to contribute to the project or research design.

As the private sector is interested in profit-making, the public sector is under continuous scrutiny, and the third-sector must rely on voluntary working force, there are few actors in the Finnish society, which independently could create an innovation centre credible enough to tackle the interdisciplinary challenges in finding solutions for sustainability, which overlap different people working in different sectors.

The key is to identify win-win situations, where two (or more) partners can together combine their strengths and mutually benefit from one another's capacities. In contrast, a simple reason, why partnerships might fail, is the incapability of the different partners to understand their partners' capacities or limitations. This should be acknowledged, when Eco Centre would engage in partnerships with private, public and/or third-sector actors and various sectors.

## 8. Theories and practice

Bridging the gap between academic theory and practise is a challenge, regardless of whether working in arts, management or social sciences. In teaching, academia already is increasingly better tackling the challenges of sustainability in providing curriculums about sustainability in various domains, or providing interdisciplinary learning modules such as in the Helsinki University Centre for Environment . However, outside teaching and learning experiences, and their practical dimensions such as learning cycles, project works of group works, platforms for collaborative, high-level sustainability work, which achieves larger societal impact are limited. Consequentially, progress in achieving maximal sustainability in the daily lives of all citizens is slow.

Scientifically, in the very nature of the creation of Aalto University is the idea of applicability of theoretical research. However, without high-quality basic research, it should be assumed that it is difficult to achieve high-quality applications, as several critics already have pointed out in the case of Aalto University. Therefore, only with the right mix of basic and applied research, and a needed understanding of the surrounding society, could Eco Centre become a trustworthy response to better defining a university's role in the process of creating green innovation systems .

## 9. Organizational design and practical operations

Eco Centre could have various shapes of activities with different project or research teams focusing on different questions or sustainability challenges. The competencies needed to answer the questions could vary from establishing sector-oriented to interdisciplinary groups, specifically or loosely defined. Different questions need different types of people with different competencies. Participating people in the project teams could be students, teachers and professors working together with their strategic partners. The active or less-active commitment of the strategic partners in the process should be flexible, the partners making themselves available according to needs defined by the project team.

The focus in having an individual student, teacher or professor believing in a concept, is to build meaning around it. Connecting the university organization directly can strengthen the identity of the actor as a part of a team, and a community. Simultaneously, board-level and top-management commitment is crucial to embed the sustainability into different streams and workflows in the university.  Only this allows the continuity and visibility of the project, and the sustainability genuinely becoming a part of the identity of the university as a two-way process.

For the management or the sustainability efforts, it can be considered that any viable initiative needs continuity both in funding and staffing. In Copenhagen, achieving a Green Campus has involved establishing a three-person team, which works for the achievement of sustainability results . They have also involved students in their work. It should be assumed that in addition to current resources in Aalto University, the university should allocate necessary funding to establish a Project Team for the management of Eco Centre with full-time employees. The operations of Eco Centre should then be linked to the work of the Environmental Manager of the organization.

Only with adequate support and interest, could the concept of Eco Centre become a true success story. The vision about sustainability must be internalized, which means having staff, resources and organizational capacities to engage and mobilize researchers and students to and having top-management level commitment. This should also mean giving the people in the Eco Centre independence and ownership about their project. Allowing autonomy would not mean that Eco Centre should not define itself goals, set standards, identify baselines and create future targets for its different projects.

## 10. Aim of achieved results

In the area of sustainability, Aalto University, as currently does any organization willing to become truly sustainable, needs new, innovative approaches. A combined top-down and bottom-up approach might provide the right mix, to scale up a new concept and achieve top results.

Expected outcomes should include new eco-innovations; intensive project and research experiences; organizational learning; better flow of sustainability work; holistic project designs as a result of interdisciplinary work; innovative learning experiences; demonstrating the value of higher education already during studies with higher student motivation, better study experience and better results; increased societal and economic engagement of universities. Should the model of the Harvard Loan Fund (See: Chapter 3) be integrated to the work of Aalto Eco Centre, organizational cost-savings should be expected in near future.

Whenever creating something completely new, the future always beholds unknown as illustratively portrayed by the exclamation and question marks in the visual identity of Aalto University. But needless to say, in the case of success, why would not the concept also be something remarkable for Aalto University.

## Summary: What's in it for the individuals?

Throughout university studies, many students long for platforms, where they could engage in real-life experimentation of their skills and capacities. In universities, many of them are eager to prove their talent, develop their skills, get feedback, and learn by doing. Later on, the requirements of working life may sometimes hinder participation in such projects with timely pressure due to organizational demands. This should be considered a challenge for most organizations.

But, what if the organizational demands match exactly with the aspirations of prominent academic people? What if there would be a platform, which would satisfy the needs students, teachers and professors alike? What if the organization itself could become more creative, productive and sustainable in the process? And what if the skills learned could be carried onwards to all those organizations post-BA- or MA-studies?

From the individual's point of view, each organisation is either a gatekeeper

or a facilitator. Proven by research, climate awareness in societies is high , even though political commitments and practical solutions lag behind. To bridge the gap, individuals need platforms, where they can engage in sustainability efforts. Only this can result in larger engagement of society with sustainability, outside the traditional environmental community, NGOs or environmental teams, by different people with distinct skill sets. ■ **JONI KARJALAINEN**

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# Epilogue

Change towards sustainable lifestyles is inevitable, as Virpi Mikkonen from Tekes, the Finnish Funding Agency for Technology and Innovation put it in her commentary notes following our student presentations. This, as we saw in the groups' presentations, should not be seen as a threat but as an opportunity. However, although many new business concepts have already arisen on the field of sustainable solutions, we come to the question of obvious bottlenecks still present - why green technology still doesn't sell and what actually keeps sustainable innovations from spreading?

The workshop gave some interesting insights into this, as well as proposed some solutions. For one, although many sustainable solutions already exist, creating public and business demand for them continues to be a challenge. Track 6 on dematerialization by design discussed important things such as the need of changing the market demands – as stated by Mikkonen, the Nordic tradition in good design should involve elements of sustainable design, too. As one way of reaching more sustainable design outcomes, the theme of participatory approach to design process was discussed in track 6 as one solution to challenge the market-oriented design approach.

Presentations of track 3 were seen especially valuable in their user-centric thinking. As Mikkonen pointed out, one key challenge is to come up with integrated, ready-to-use solution packages that easily integrate with existing infrastructure and are thus easy to take in use. These were clearly present in the innovative ideas of group 2 calling after novel thinking of electric cars, not only as means of transportation but as a personal living room and a movable power source (and all the while in masses a virtual powerplant), providing a 'good fun experience' for the user. There might have been more to the Lada-metaphor presented by the group than they even thought; novel innovations need to be simple to take into use and cheap to maintain, indeed fixable 'with the tools needed for a 1980's Lada'. This mindset was also present in the work of group 7, that called after the importance of making sustainable options available in our daily routines, in ways supporting our individual behavior patterns. As stated already in our opening seminar, consumer behavior can either take us a long way towards sustainable societies or nullify all technological breakthroughs made so far.

In some cases people might even simply be unaware of the many possibilities green technology offers these days. For their part, Tekes tries to target key players on public and private sectors to think more careful on their investments for


example in connection to public procurements and to guide them towards sustainable solutions. Disseminating success stories is one important approach in spreading knowledge. 'Gamifying' difficult issues such as different strategies on climate change mitigation and adaptation, as done in track 1, might be another great way of spreading knowledge.

Mikkonen reminded us however that in any case we must remember that economy plays a major role in guiding consumer behavior, so business and marketing sectors have to be included in multi-disciplinary decision making. She also pointed out that some industries are more free to operate on green solutions than others, such as the automobile industry, as well pointed out by the lively presentation of group 2. As an opposite example, construction business seems to be somewhat locked into traditional patterns of operating. However, a lot of potential for supporting sustainable lifestyles lies in integrating e-cars and other sustainable technologies into existing infrastructure. This is especially important in the energy sector, for example in ways of integrating renewable energy solutions with the built environment – a thing that calls for co-operation between the energy producers and urban planners.

As the presentation from group 7 reminded us, many different competencies are needed in solving the sustainability challenge. As the different workshop groups concluded in our final seminar on Friday the 2nd of September, collaboration, forward-thinking attitudes and innovative mindsets are key elements in transformation towards sustainable lifestyles, and these were surely present in the upbeat and innovative presentations of the workshop groups themselves.

The presentations certainly brought back some of the optimism that one at times loses when dealing with challenges as overwhelming as climate change. I'm sure that in some way all of the workshop participants were transformed into "Ambassadors of sustainable innovations", following the indirect aim of group 2 of raising a group of "Ambassadors of E-mobility". I'm also sure that the new friendships and networks formed help in carrying this optimism further.

In four days and during two seminars and a full-day Climate Fair open for the public Nordic Climate Festival @Aalto reached some hundreds of people, both attending the events and watching webcasts from the seminars. Hopefully many of these people's mindsets were affected, too, and that the innovative and optimistic spirit of the event and the grass-root Nordic co-operation it ignited carries on to the next events organized by the Nordic council of ministers and others – and, most importantly, into our every-day lives.

The organizers warmly wish to thank Nordic Council of Ministers, Secretariat for Nordic Cooperation, Ministry of Education and Culture and Ministry of the Environment for their support for the event and Cities of Helsinki and Espoo, Helsinki Regional Transport and Nordic Investment Bank for their co-operation with Aalto University in organizing the event.

*There is no way of organizing a conference or a workshop with zero environmental impact, but in organizing Nordic Climate Festival @Aalto we did our best to push the environmental burden into minimum. For this, the following means were pursued:*

- *All emissions from travel, including both flights and domestic travel, were offset by the Iceland Carbon Fund by planting trees on a volcanic plain in Iceland.*

- *Helsinki Region Transport (HSL) provided 100 free 4-day regional bus tickets for the workshop participants and track leaders. This covered all transport during the conference.*


*• A Green Map for Helsinki region was created to enable the participants to find on their free time climate-friendly services and sites of interest related to the themes of the workshop. The map is open to the public and can be found at* ***http://greenmap.fi.***

*• We served vegetarian meals all through the seminar, with local ingredients where possible. This issue was also taken into consideration by our partners, cities of Helsinki and Espoo, during the opening reception by the City of Helsinki and the farewell dinner offered by City of Espoo in Dipoli. During the workshop we served as refreshments domestic apples, organic juices and sodas made with wind power.*

*• During our one free night with barbeque and refreshments, veggie sticks and locally made lamb and moose sausages by Chef Wotkins were served, the latter being calculated virtually greenhouse gas neutral on the part of the moose meat (30%). Refreshments were manufactured by Laitila using wind power.*

*• All banners and flags made for the festival were later recycled into shopping bags by GlobeHope. While at it, we decided to recycle flags from previous year's*

*AESOP conference, too. A total of 100 bags were made and awarded to workshop hosts as thanks for their huge effort. We count on them being heavily used instead of plastic or paper bags!*

*• As a way of thanking the speakers, most of whom participated for no cost, we handed out cook books with recipes for seasonal food (Kausiruokaa; Teos). A total of 44 books were handed out. For younger participants such as our fabulous team of video reporters from Helsinki Upper Secondary School of Art, we handed gift cards to a local vegetarian burger joint, Vegemesta. We hope that this took the spirit of the festival further both in work- and private lives of our many speakers and orientated them towards the theme of this year's Nordic Climate Day, celebrated on 11.11. with the theme 'Climate friendly food'.* ■

*“This year, the city of Helsinki and the renowned Aalto University held the Climate Festival. Students from the Nordic countries were asked to apply, providing details on interest and to create a specific research poster targeting one special assigned workshop track. The following is my 5 days journey into the realm of sustainability within the Nordic countries at Aalto University.*

**29. August, 04:30.** *Woke up. Breakfast, showered and brushed teeth. Left to the airport. Flight left at 07:55. Plenty of time. Three hours and 20 minutes later, we, the Icelandic representatives of both PhD and master students, land safely in Helsinki, the capital of Finland. Arriving a day ahead the beginning of the climate festival, were received with open arms, as we now had time for some sightseeing, eating-out and getting to know one another better.*

**30. August, 08:25.** *Slow morning. Complementary breakfast. Collective departure to the opening ceremony at 12:00. Short walk. Coffee, tea and finger-food. Ministers, professors and coordinators held speeches, welcoming all of us, and stressing the importance of a Nordic collaborative region. All seven workshop tracks were introduced. People came not only from the Nordic countries, as there were participants from Italy, Greece and Sir Lanka present (too name a few). Participants also came from a wide diversity of study fields, such as environmental management, engineering, economics and/or electric technologies. The short informal group meetings were broken up, as the schedule had a river cruise on its agenda. Here we got to get to know one another even more, while touring the harbor of Helsinki in a cloudy, part time sunny weather, followed by information in regards to sustainable projects that where on-going in the vicinity of the seashore. After the river cruise, we were guided to another venue, where a representative from the Mayor of Helsinki’s office welcomed us. Wine, beer and finger-food. Speech. At 20:00 we all at to leave the venue, and some of us chose to continue the core message of a workshop, mainly getting to know one another better at a local bar.*

**31. August.** *The first day of “work”. Collective departure to Aalto University at 08:00 by tram and bus. Led to the main auditorium, where we were again welcomed by Aalto University and the coordinators. Speakers then followed, addressing the main interest points, problems and possible solutions to our Nordic region. Mainly stressing the importance of a collaborative, accessible and incorporating Nordic area. More speakers. Panel discussion, where the Nordic view on climate, sustainability, environment, future, issues and possible solutions were*

*addressed. Lunch at "the design factory". We were then divided into our respective track groups, and the workshop could really get started. Track 2 had hired a professional facilitator, to truly get our creative sides rolling, our minds ready and open to think "outside the box". After establishing where we all came from, both country and discipline, we had to create our own view of ourselves in Lego. Which both sparked our creative side, while at the same time helped us get over the fear of being different, in skill, previous knowledge and/or profession. Brainstorming our issue (the future of electrical cars in Scandinavia). We were told to re-think the whole aspect of the electrical car. By not looking it as just a car, but a battery on wheels, allowed for more creative ideas related to the possible future needs of us as a human race. After having brain storming in smaller groups within the track, we came to around 20 ideas we wanted to follow up on. Narrowing it down was then imminent. After a heated, interesting discussion, we managed to narrow it down to four pillar questions we wanted to address, concentrated around the users, sustainability, LCA and how one could use the EV (electric vehicle) as a power source. With this in mind, we finished the day off around 16:00. Complementary BBQ and beer was on the agenda, where we loosened up some after a stressful, yet exiting day of brainstorming, merging with other tracks, meeting both old and new friends. After the BBQ some of us chose to go to a nearby pub, within the vicinity of the train station of Helsinki, to continue discussing both our own professional environmental interests and to further our new-made friendships. Hit the bed at 01:20.*

**01. September, 07:20.** *Again, complementary breakfast at the hostel. However not a collective departure, as some track groups where meeting at different times and places. 09:00 at Dipoli, classroom 26 we continued our session from the previous day with new thoughts and a fresh mind. We started brainstorming again, divided into smaller groups, played interactive games to stimulate our creativity and created new ways to ask our previous questions, as so we could look at them with different eyes, and come up with new interesting ideas. By bending the question, shifting our worlds and adding new, often even not related to our definite goal, we where able to narrow our concluding ideas even further.*

*After establishing our main focus areas, and the clock hitting 16:00, our workshop leaders left it to us to create a presentation. Missing dinner and having an Aalto party in the vicinity of our working station surely slowed us down a bit, as we only finished it all around 21:20. However stressful, we had a good time, as we conducted a play to formulate/present our concepts and the future of EV's to the other groups the following day.*

**02. September. 07:10.** *Presentation day. As the other previous mornings, complementary breakfast from the organizers. All of us Icelanders had to pack-up before leaving to Aalto University, as our plane left straight after lunch. We did however enjoy the full day, with fabulous presentations and awards. Track 2 apparently came in second best, decided from votes, so we did great! Left for the airport in a taxi straight after lunch.*

*Having fully settled in with uni work back in Iceland, I have had the chance to reflect some on my experiences and outcomes, and I must truly thank the organizer for such a fabulous inspiring event. Getting to know other students from various fields, but with a shared interest in sustainability will prove to become invaluable. Being engaged in multidisciplinary thinking and problem solving, newfound friendships, great experiences and personal broadening, has truly been reflected in the work I have been apart of, and for that, I would like to sincerely give my thanks!* ■ **KARL MARTIN KJÆRHEIM**


CLIMATE FAIR
Parliament Panel –
Young members of the new parliament
Johanna Karimäki (The Greens of Finland/Vihreät)
Silvia Modig (The Left Alliance/Vasemmistoliitto)
Chair: Rap Artist Paleface
PROGRAMME OF THE DAY
12:00 – 12:10 Welcome Words, Ville Andersson, Mini
12:10 – 12:30 Company Break I
12:30 – 12:45 Carbon Neutral Municipalities, HINKU
12:45- 13:10 Organization Break
13:10 – 13:40 Quiz for High Schools / Lukiolaisten T
13:40 – 14:00 Idea Break I
14:00 – 14:10 Dodo ry – Megapolis 2011
14:10 – 14:40 Idea Break II
14:40 – 15:00 Ballet Performance by Finnish Natio
15:00 – 15:30 Parliament Panel
15:30 – 16:00 Paleface


Kysymys 1. Mitkä ovat kolme haitallisinta ihmisen toiminnasta syntyvää kasvihuonekaasua?
Fråga 1. Vilka är de tre skadligaste växthusgaserna som uppkommer av mänsklig verksamhet?


Finnish National Ballet
Finnish National Ballet
Deloitte
Deloitte

# Finnish SD-forum with a nordic twist

Beside the workshop, Climate Fair and open seminars, Nordic Climate Festival also acted as a platform for several meetings. Finnish Universities' Sustainable development -forum for higher education and environmental network of university facilities management had their bi-annual meeting in Otaniemi 1.9.2011.

## Finnish SD-forum with a nordic twist

This national forum gathers colleagues from Finnish universities and schools of higher education. It provides an excellent platform for learning and sharing experiences. The need and question for more active and even formal Nordic sustainability co-operation was raised during the meeting. Interesting presentations fueled lively discussions. Also the focal role of national ministries was noted and urge to act on a more profound level.

**Participants of Finnish SD-forum for universities and our Nordic guests visited the Nordic Climate Fair at Aalto Otaniemi campus, Finland on 1st of September 2011.**

## Nordic Climate Festival @Aalto – results will be sent to Rio+20

The United Nations Conference on Sustainable Development (UNCSD) will take place in Brazil on June 2012 to mark the 20th anniversary of the 1992 United Nations Conference on Environment and Development (UNCED), in Rio de Janeiro, and the 10th anniversary of the 2002 World Summit on Sustainable Development (WSSD) in Johannesburg. It is envisaged as a conference at the highest possible level. The conference will result in a focused political document. As a parallel event, "World Symposium on Sustainable Development at Universities" (WSSDU-2012) will be organized. The results of Nordic Climate Festival will be sent to Rio to concretize the work Aalto University and the state of Finland is doing. It gives also an overview of the Nordic approach to climate change. ■

Rio+20:
*http://www.uncsd2012.org/*


WSSDU-2012:
*http://www.uncsd2012.org/rio20/index.php?page=view&type=13&nr=289&menu=27*

New (and tried)
Nordic ideas on...

*The following section features a collection of poster presentations about novel sustainable Nordic innovations made by the participants of Shortcuts to Sustainable Nordic Communities –workshop while applying for Nordic Climate Festival @Aalto. The posters were on public display during the Climate Fair on 1.9. 2011 at Design Factory in Otaniemi.*

…Everyday Sustainability…

# $CO_2$ Pyramid

*Philip Giødesen Lund (s062292@student.dtu.dk) and Lars Krogsgaard Madsen (s072345@student.dtu.dk), Technical University of Denmark (DTU), in cooperation with professor Michael Søgaard Jørgensen (msj@man.dtu.dk).*

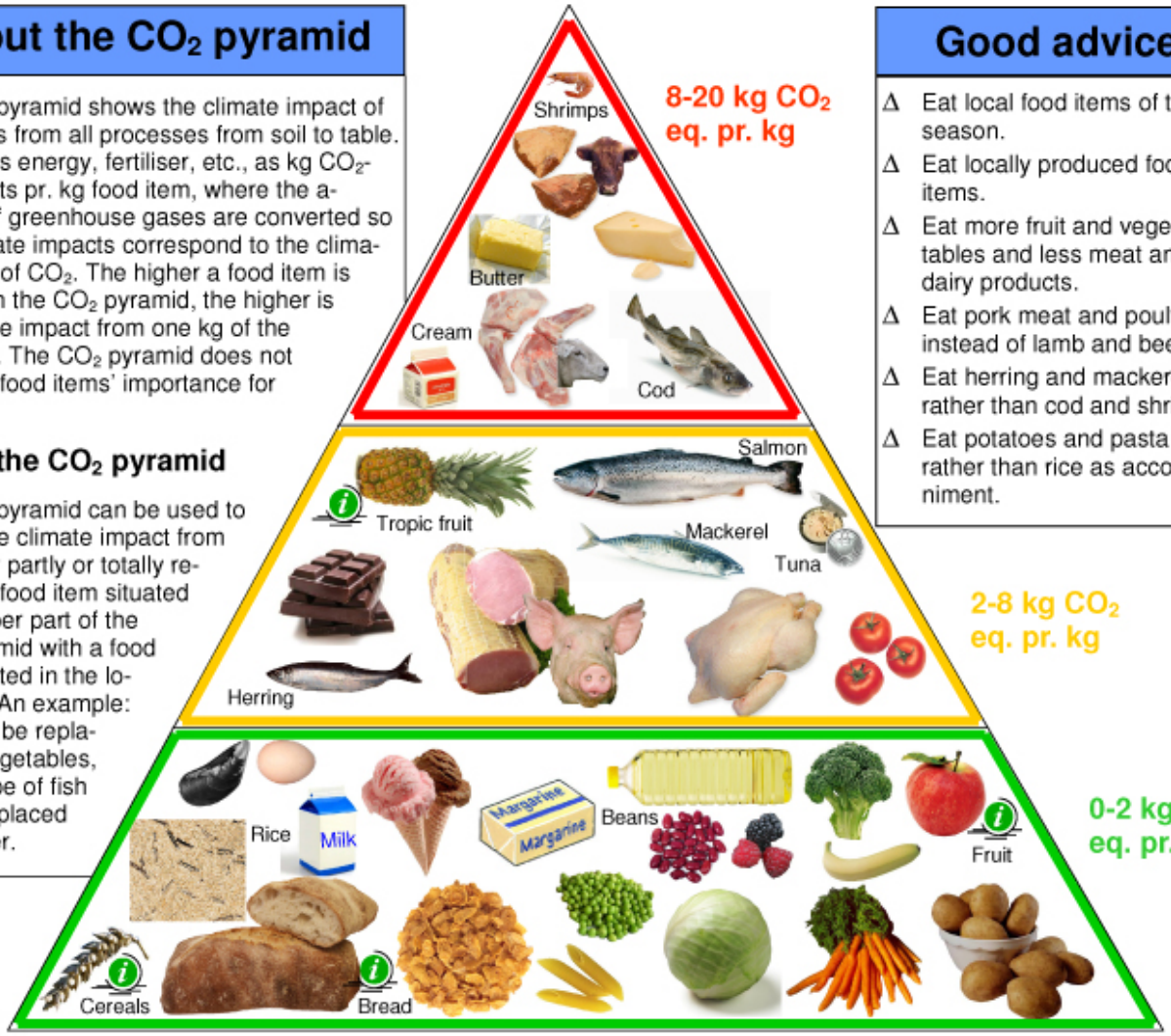
*References: Lund, P. G., Madsen, L. K., 2008, Måltiders klimapåvirkning, DTU. Based on Carlsson-Kanyama (1998, 2003, 2007) and Rose (2007).*

## About the $CO_2$ pyramid

The $CO_2$ pyramid shows the climate impact of food items from all processes from soil to table. Included is energy, fertiliser, etc., as kg $CO_2$-equivalents pr. kg food item, where the amounts of greenhouse gases are converted so their climate impacts correspond to the climate impact of $CO_2$. The higher a food item is situated in the $CO_2$ pyramid, the higher is the climate impact from one kg of the food item. The $CO_2$ pyramid does not show the food items' importance for health.

### Use of the $CO_2$ pyramid

The $CO_2$ pyramid can be used to reduce the climate impact from a meal by partly or totally replacing a food item situated in the upper part of the $CO_2$ pyramid with a food item situated in the lower part. An example: meat can be replaced by vegetables, or one type of fish can be replaced by another.




## Good advice

- Δ Eat local food items of the season.
- Δ Eat locally produced food items.
- Δ Eat more fruit and vegetables and less meat and dairy products.
- Δ Eat pork meat and poultry instead of lamb and beef.
- Δ Eat herring and mackerel rather than cod and shrimps.
- Δ Eat potatoes and pasta rather than rice as accompaniment.

## Fruits and vegetables of the season in Denmark

| Jan. - Mar. | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|
| Carrots<br>Cabbage<br>Potatoes<br>Onion<br>Leek<br>Apples | Carrots<br>Cabbage<br>Potatoes<br>Onion<br>Leek<br>Salad<br>Spinach<br>Apples | Asparagus<br>Parsley<br>Salad<br>Spinach | Asparagus<br>Cauliflower<br>Broccoli<br>Carrots<br>Strawberries<br>Onion<br>Parsley<br>Salad<br>Spinach<br>Peas | Cauliflower<br>Broccoli<br>Berries<br>Carrots<br>Strawberries<br>Potatoes<br>Onion<br>Parsley<br>Salad<br>Spinach<br>Peas | Cauliflower<br>Broccoli<br>Berries<br>Beans<br>Carrots<br>Cabbage<br>Potatoes<br>Onion<br>Corn<br>Parsley<br>Leek<br>Pears<br>Salad<br>Spinach<br>Apples<br>Peas | Cauliflower<br>Broccoli<br>Beans<br>Carrots<br>Cabbage<br>Potatoes<br>Onion<br>Corn<br>Parsley<br>Leek<br>Pears<br>Salad<br>Spinach<br>Apples | Cauliflower<br>Broccoli<br>Carrots<br>Cabbage<br>Potatoes<br>Onion<br>Corn<br>Parsley<br>Leek<br>Pears<br>Salad<br>Spinach<br>Apples | Cauliflower<br>Carrots<br>Cabbage<br>Potatoes<br>Onion<br>Leek<br>Pears<br>Salad<br>Apples | Cauliflower<br>Carrots<br>Cabbage<br>Potatoes<br>Onion<br>Leek<br>Pears<br>Apples |

DTU Technical University of Denmark

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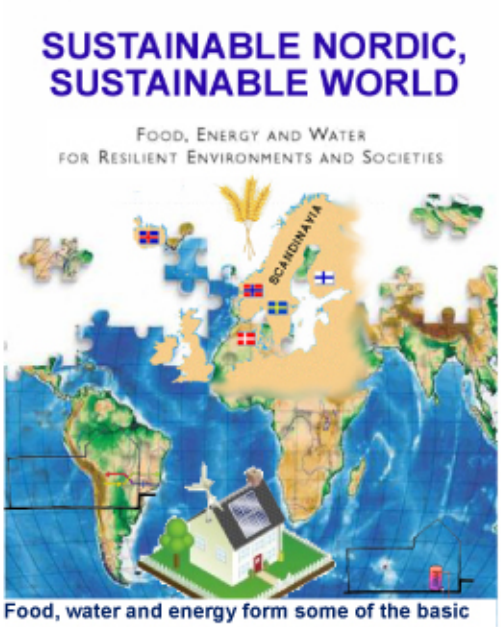
NORDIC CLIMATE FESTIVAL @Aalto

NORDEN 2011

# Climate change and Resource use

*Arjun Basnet*
*Norwegian Institute of Science and Technology (NTNU)*
*Norway*




**Food, water and energy form some of the basic elements of sustainability considerations.**

Mitigation and adaptation are tools towards climate change resilience. Urban areas are centres of economic activity, where high concentration of energy use takes place, and therefore a mitigation response is needed to reduce energy flows. On the other hand, adapting ourselves to climate change is equally important if we are to ensure resilience to environments and societies [1]. Thus changing our way of using resources, specially reducing energy use is necessary. Policy makers and scientists have framed mitigation and adaptation as complementary but disconnected approaches where synergies and trade-offs are of marginal relevance for climate strategies. Mitigative strategies have resulted in various measures, methods and approaches to reduce the emission of GHGs and thus to mitigate global warming in the long run. The impacts of adaptive measures are most noticeable locally and are generally not designed to contribute to the reduction on GHG in the long run. In general, adaptive measures are short-term investments with short-term solutions to the impact of climate change and natural variability, whilst mitigation strategies are short-term investments for long-term climate results [2].

The Nordic is vulnerable to the consequences of climate change, in particular, to sea level rise as most cities and settlements in this region are near the coast. We need to change our way of eating, using energy and water with an aim to reduce GHGs for resilient environments and societies, for a sustainable Nordic and a sustainable world.

## Use of resources in the Nordic Countries:

| Current Situation | Suggestions |
|---|---|
| Excessive use of packed/canned food | Using food without having to be packed/canned. ie, use of locally available food items. |
| Houses with conventional insulation, lack of air tightness which account for more use of energy for heating | Zero energy/zero emission houses, passive houses |
| Conventional grid energy use which are produced from non-renewable sources such as coal, gas and oil | On site production and use of energy from renewable source such as solar, wind and geothermal energy. |
| Imports of everyday use items, construction materials from far away countries which will need a lot of energy for transport. | Minimize imports from far away countries specially form those countries using coal as the chief source of energy. |
| Use of lights consuming more power. Eg: incandescent lamp | Minimize incandescent lamp use, replace with LED. Eg: LED street lighting in Ann Arbor, MI; energy reduction is 80%. LED traffic lights in Chicago has achieved 85% of energy use [3]. |
| More use of cars from home to work place | Mixed use settlements where work place is at walking distance from residences. Restricting car access to the city in the morning and evening peak periods. |
| High water consumption | Sustainable use of water and other resources. |
| Organic wastes mixed with other wastes are sent to incineration | Composting of organic wastes at household level. |

The above suggestions are few of many examples which can be considered as adaptive behavior creating synergies to mitigation whose aim is to reduce GHGs that are mostly associated with the use of resources such as energy. So, with efficient use of resources, the energy consumption is minimized thereby reducing the load of GHGs in the atmosphere thus helping mitigate climate change.

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3. Zimmerman, R. & Faris, C., 2011 Climate change mitigation and adaptation in North American cities. *Current Opinion in Environmental Sustainability,* 3(3), pp. 181-187
4. Picture collage: pictures used from http://www.google.com/

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NORDIC CLIMATE FESTIVAL @Aalto

NORDEN 2011

# Design and Organic PLA in the North

## Introduction

Product designers play a key role in material selection for products. Scarcity in fossil oil based plastics is inevitable but there are solutions. This poster will discuss the posibility for organic PLA plastic production within the Nordic Countries and if designers should focus on these materials.

## What is PLA?

Polylactic Acid, also known as PLA is a thermoplastic that resembles to PET[1] (Polyethylene terephthalate). The material is derived from re-newable sources and can be decomposted safely under correct conditions. The material is not fossil fuel based and is produced from feedstock such as cornstarch or sugarcanes. It is transparent in nature and can be formed like most plastics with blow molding, injection molding, sheet extrusion, or thermoforming[6]. PLA loses its compostability if mixed with petroleum based plastics but gets heat resistant. Recycling is done through heat and pressure process which produces high grade PLA that loses hardly any of the material properties and can be regarded as virgin material, it is therefore ideal to use in Cradle-to-Cradle products[2].

Can Nokia ever be expected to fokus on bio-plastics?[7]

## Change

A system is usually not in place to recycle PLA. A change within societies is needed in order for PLA to be used as a common plastic. Today this material can not be recycled with other plastics. City Planners need therefore to account for PLA within Societies.

*Reynir Smári Atlason*
*University of Iceland*
*Iceland*

## Organic farming and energy

With the increasing scarcity of fossil fuels, agriculture needs to find alternative solutions to continue its production. Many claim that humans have already reached ”peak oil”[4] and alternatives need to be found to our current production model. Research has shown that organic agriculture is much less energy intensive than conventional agriculture[5] since it does not rely on herbicides, pesticides or fertilizers. The future in plastic production could therefore be in materials such as PLA, grown organically by Nordic farmers.

## Where the influence is

By experimenting with different materials, such as bio-plastics, designers are more likely to come across solutions that are viable, economically as well as environmentally. Getting companies to open their minds to bio-plastics might not be the easiest task but will in the end be extremely beneficial to the environment. A question arises however, if farmers should grown plastics or food. But does that question really needs to be answered? Can both be done?

Will organic PLA be the future plastic?[3]

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Recycling tree

# "Recycling tree"

## A product for the sustainable life

*Joong yeol Park*
*Aalto University school of art and design*
*Creative sustainable design*
*Finalnd*

We produce tones of waste in our lifetime.
Nature and human -beings suffer from this waste.
The Recycling Tree helps change non-recycling and wastefull behavior.
Saving the Earth starts at home through small changes in everylife life.

## Sustainable points

Using the existing bins

Paper material used (bio-degradable)

Easy to Recycle itself

Package from the rest of pieces

Change non-recycling behavior into

**recycling behavior**

This product was developed from the project
"How to change the world 2011 "
in Aalto university

Un-Folding the tree

only one bin

Many bins

### Instruction

Recycling tree is a designed divider for recycling.
The Shape is a tree to remind people saving nature through your recycling behavior.
Material is paper, because it also can be one of recyclable waste in the future.
Simply un-fold the Recycling Tree and place it in your existing bin personal area,
or connect 3bins together with a rubber band in a public place.
Then attach stickers to indicate the type of waste you want to sort.
If you want to sort more types of waste, plastic bags can be hung from the branches of the tree.

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...Sustainable Energy
Production...

# Biogas-based Fuel Cell system will promote the sustainability of Sweden

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*Royal Institute of Technology*
*Sweden*
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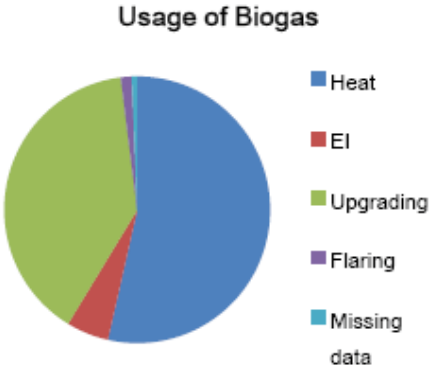
Fuel cell is a kind of energy system that can convert the chemical energy of fuel to electric energy with high efficiency and low emissions, and usually the fuel is hydrogen. To qualify for a position in a future sustainable energy system the fuel cell system must be operated on renewable, and preferably, locally produced fuels. Biogas is a renewable fuel that is produced through digestion of sludge in waste water plants, rests from the food industry or households sewage. Important fuel components are methane and carbon dioxide.

## The production and usage of biogas in Sweden




**Biogas is produced when organic material is broken down by microorganisms without access to oxygen, also called anaerobic digestion. Biogas is composed mainly of carbon dioxide and methane, small amounts of sulfide and water vapor.**
**In 2009, a total of 230 biogas-producing sites identified. These produced a total of 1363 GWh of energy. The 230 biogas-producing plants were distributed in 136 sewage treatment plants, 57 landfills, 21 co-digestion plants, four industries and 12 farm sites. The number of upgrading plants amounted to 38 pieces and at seven locations injection of upgraded biogas in the natural gas network.**
**the proportion of the biogas was used to the heat was 667 GWh (49%), which also includes heat loss, 488 GWh (36%) were upgraded, 64 GWh (5%) of electricity was generated and 135 GWh (10%) compartments was removed**

## The demonstration project-----GlashusEtt(English Glass-house-One)

**The modern urban district, Hammarby Sjostad has ambitious environmental goals, the achievement of those goals requires cooperation and modification by many aspects. Hence, Stockholm Vateen AB, Fortum AB and The Real Estate and Traffic Committee established the GlashusEtt project. GlashusEtt (see Figure 5, is an information center built to inspire residents on how to achieve a more sustainable lifestyle. With the financial support from the Local Investment Programme (LIP) council in Stockholm and the Swedish Energy Agency, ABB andFortum complemented the exiting energy system in GlashusEtt with an alternative energy system.**
**This alternative energy system is a 4kW PEFC fueled by the hydrogen and upgraded biogas, and the hydrogen is produced by a photovoltaic array. The upgraded biogas is from the Henriksdal waste water-treatment plant, and the methane concentration in the gas is 97%. This fuel cell is supplied by H-power and accumulated a total of 1800 hours. The electrical efficiency was 13% and a thermal efficiency of 56% (LHV).**
**Later the PEFC is replaced a 5kW combined heat and power (CHP) SOFC, supplied by Acumentrics, one of the SECA (Solid State Energy Conversion Alliance) partner and was also operated on upgraded gas. The total operating time is 3310 hours and the average electrical efficiency is 30%, and the thermal output is 1.6kW.**

Reference: [1] Produktion och användning av biogas år 2009
[2] Description and modeling of the solar–hydrogen–biogas-fuel cell system in GlashusEtt. L. Hedström , C. Wallmark P. Alvfors , M. Rissanen , B. Stridh , J. Ekmanc. Journal of Power Sources 131 (2004) 340–350.

VERKÍS Consulting Engineers
www.verkis.is

# Algae based biofuels

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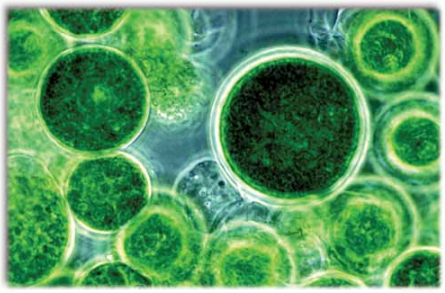
*Iceland*



Microalgae (www.celsias.com)

**They are one of earth´s oldest life forms, they are the key factor in both oceanic and freshwater ecosystems and they supply us who live on land with up to half of our oxygen demand. These ancient single cellular life forms called microalgae are and have historically been one of the main building blocks for life on earth, but now their part could become even greater as they may hold the key for our future energy needs.**

## What makes algae such an intriguing option for biofuels?

Algaebloom in Baltic Sea (www.NASA.gov)

Despite all of mankind´s technological breakthroughs and discoveries in the past, present and future then one stone cold fact must be faced and that is that the lifeblood of the global economy, fossil fuels, are a finite resource. Mankind may maybe not run out of the fossil fuels tomorrow or in the next years but it will surely happen and the date for that draws ever more near with global increases in demand. The fact that fossil fuels are finite along the hypothesis of global warming gaining increased ground has led to a global quest for fossil fuel´s environmental friendly and sustainable replacement. Although electricity made from renewable resources is likely to play a significant role in replacing petroleum fuels in the transportation sector then it´s likely that it will mostly be limited to smaller vehicles for now. Another energy source that has a similar energy density as petroleum fuels will for some period of time still be needed for heavy or long ranging machinery like trucks, ships and airplanes. Thus biofuels, whatever generation they may be, will still be needed for the near future if we are to keep the global economy and standards of living going as they can sufficiently be used by before mentioned machinery.

One of those biofuels is biodiesel that is generally made by the growing of a certain plant that has rich oil content that is then separated from the rest of the plants mass and further produced into diesel oil that can be used on conventional motors. Most of the biodiesel on the market today comes from land based plants grown especially for energy purposes like soybean, rapeseed and oil palms. Although the overall image of biodiesel is generally a positive one then growing and production of the before mentioned fuel feedstocks is often environmentally unfriendly and unsustainable. This stems from the fact of the cultivation often being energy- (heavy machinery being used), chemically- (significant amounts of chemical fertilizers and pesticides being used) and land intensive (replacing existent agriculture or encouraging slash and burn practices of forests), thus looking at the bigger picture doing more environmental damage than good along with causing negative externalities. These flaws of the currently dominant biofuel feedstocks make microalgae an intriguing option for the following reasons. [1]

In comparison to other biofuel feedstocks then microalgae are generally easy when it comes to cultivation as they are highly adaptive creatures that can grow under conditions on marginal areas deemed unsuitable for other cultivation without needing much attention, with basic inputs for the cultivation being water, sunlight and simple nutrients. Microalgae can for example be cultivated in brackish sewage and wastewater that is generally poisonous to aquatic ecosystems. Such as wastewater from intense agriculture and factory farming that is highly contaminated with $NH_4$, $NO_3$ and $PO_4$, but such runoff is causing an increasing global trend of deadly eutrophication in watercourses on both land and sea (see photo of Baltic Sea). Such wastewater can easily be used for microalgae cultivation where the alga removes most of the nutrients causing the eutrophication, hence combining wastewater treatment and energy production. The cultivation of microalgae is also not as land intensive as the cultivation of other biofuel feedstocks as they have much higher oil yield per unit of land. This is mainly because of their high oil content (see comparison in table) and high growth rates as a complete growth cycle is over in a few days. As the Nordic countries all have abundance of coastlines and high rates of sunlight during the summer time then microalgae could be a feasible option to look into in regards of areal energy production. However this option is still deemed non-competitive to in regards of costs but that is likely to change with increased innovation increasing the feasibility. [1]

**Comparison of biodiesel feedstocks.** [1]

| Plant source | Seed oil content (%) | Oil yield (L/ha year) | Land use ($m^2$/kg biodiesel year) |
|---|---|---|---|
| Corn/Maize | 44 | 172 | 66 |
| Soybean | 18 | 636 | 18 |
| Jatropha | 28 | 741 | 15 |
| Canola/rapeseed | 41 | 974 | 12 |
| Sunflower | 40 | 1.070 | 11 |
| Palm oil | 36 | 5.366 | 2 |
| Microalgae (low) | 30 | 58.700 | 0,2 |
| Microalgae (medium) | 50 | 97.800 | 0,1 |
| Microalgae (high) | 70 | 136.900 | 0,1 |

[1] Mata, Teresa M., Martins, António, A. Martins & Caeato, Nidia S. (2009). Microalgae for biodiesel production and other applications: A review. *Renewable and sustainable Energy reviews, 14*(1), pages 217-232.

# Forests in Climate Change Mitigation and Adaptation

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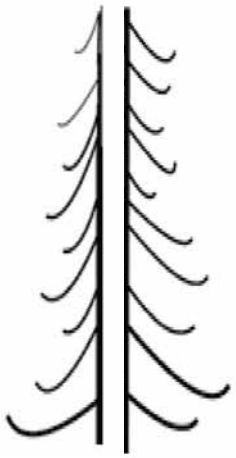

## Forests and climate change

- Forests currently contribute about 1/6 of global carbon emissions when cleared, overused or degraded.
- Forests (growing and dead biomass & soil) work as a carbon sink and storage. Maintaining or increasing the forest area has an immediate effect on the carbon stock and thus works as a short term mitigation option.
- Forests provide a source of renewable energy and renewable materials when managed sustainably.
- Forests have to adapt to climate change. Adaptation strategies needed also for Nordic forests.
- Forests offer local ecosystem services. For example, they reduce the ecosystem vulnerability, and in dry regions may reduce the risk of floods and drought.

## How should we use the forests?

- As carbon storages (Risks: forest fires, diseases)
- As a source of bioenergy (Risks: loosing the carbon storage, time scale of biomass re-growth and re-absorption of CO2)
- As a source of renewable raw materials, e.g. in construction (The carbon storage can be maintained)
- For recreational purposes
- For nature conservation purposes

## Many factors affect the decision making related to the forestry

- Functioning of the market (wood and paper industry)
- Energy politics: energy security, energy independence, ambitious political targets to produce renewable energy
- Economic reasons, actions of the forest owners
- Politics related to the climate change mitigation and adaptation
- Politics related to other environmental issues, e.g. biodiversity

## Forestry competes on the land available with other sectors

- Infrastructure and urbanism
- Production of food, feed and biomaterials
- Production of other biomass for renewable energy, e.g. raw materials for transportation biofuels

**→ Conflicts in decision making probable → A need for balancing between different targets so that synergies can be found!**

## Forests - a possibility for urban climate change adaptation?

- Forests/trees offer a cooling and shading effect in urban areas and moderate the need for air conditioning.
- Forests/trees reduce stormwater runoff, erosion and surface water pollution. They provide protection from the impacts of intensified storms.
- Forests minimize smog formation.
- Also the forests in cities have to adapt to climate change (conditions in cities are already challenging for trees).

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# May the Forest Be with You!

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*Finland*

## District Heating Using Biomass

Around 85% of Finland is covered by forests. With a process known as District Heating it is possible to heat both space and water in more densely populated areas burning biomass energy to produce electricity while acquiring heat as a by-product. This technology could also be scaled down to use in more rural areas on a smaller scale to meet demand for heat and power. There is a variety of different boiler sizes and price ranges to make this type of technology affordable to everyone.

District heating is a system where boilers are used to combust a fuel and the by-product of combustion is heat. The heat is then used to heat air or liquid which can then be pumped through underground pipes to residential or commercial buildings which need heating. This is normally carried out in plants called CHP (Combined Heat and Power) plants. More information on district heating in Finland can be found from http://www2.energia.fi/energiauutiset/chp.html [1]

## District Heat in Finland

An example of small scale heat and power productions is the ecovillage in Kempele, Finland. *"Good news! From Finland"* describes the project as "Electrical and heat energy for the ecovillage are produced entirely in its own CHP (combined heat and power) plant from wood chips and using wind power. The aim of the pilot project is to create energy self-sufficiency based on renewable energy sources, a communal spirit and to save energy." [2]

Winter 2009 and 2010 were colder than normal for longer periods of time, this increased the amount of electricity used and the demand for district heating during these colder periods. Summer's have been warmer and increased the desire for district cooling. [Adapted from 3]

- Retro fitting for homes and small scale is possible for this type of technology.
- Many types of boilers available in many different sizes
- Cash savings = pay back over time
- Green technology all biomass fuel

***Image: Ecovillage* Kempele, Finland [2]**

In Finland, district heating already accounts for 49% of the market shares in energy during 2010 according to *Energiateollisuus [3].*

***Image: City District Heating & Cooling [4]***

## Advantages

- Renewable Energy
- Useable technology
- Useful by-products e.g. heat
- District Cooling in summer
- Savings on heating costs

## Disadvantages

- Fossil fuels can be used in combined stations
- Expensive to build
- Lower energy yield without fossil fuels
- Biomass plants are larger
- Co firing with peat best

## Challenges

In Finland, the use of coal in district heating decreased, unfortunately the use of natural gas and peat increased. It would have been more environmentally friendly if renewable energy had increased instead of non-renewables. Only 18% renewable energy was used by energia.fi in 2010. [Adapted from 3]

## Conclusion

There has recently been an advancement in popularity of a system that reduces $CO_2$ emissions from coal burning power stations. *YLE* recently report on a technology which reduces $CO_2$ emissions and forms by-products less harmful than the original air emissions [5]

Maybe the Finnish governemnt could pass an Act where power stations use all bioenergy resources or have to have this $CO_2$ reduction technology installed or something similar in order to reduce emissions.

***Image: Jyväskylä*, Keljo biomass plant Finland [6]**

Ecovillages such as Kempele, should be the future of Finnish buildings to bring renewable energy to the centre of building design. [2]

Completely renewable energy fuelled systems for district heating are still on a country scale a long way off but steps toward it are being made. Increased Pay-in tariffs and subsides from the government could help this process to progress.

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[7] Katie Warren, Background Image, "Forest", Ahvenisjärvi, Hervanta, Tampere, Finland, taken 15th May 2010

# Urban Wind Energy

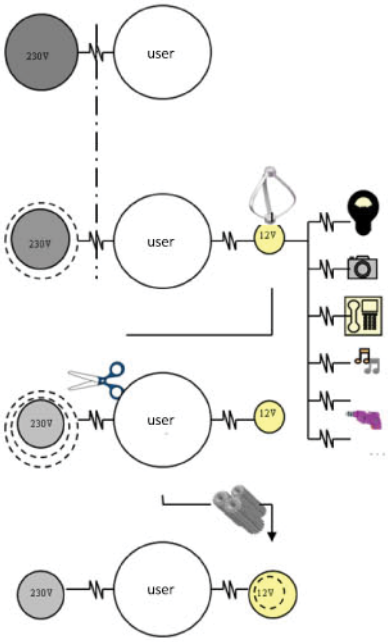
*Christina Beller*
*Risø DTU*
*Denmark*

In the recent years, wind turbine models, available before and also especially designed for the use in the urban environment, were installed in the inhabited environment in various ways- in symbiosis with a new constructed building structure, attached to existing buildings, and free-standing close to buildings. So far, implementations of small-scale wind turbines in cities took place at several sites around the world, including for example Japan, Bahrain, America, UK, Holland, Portugal and DK. Among these test cases, a few intensive field trials were conducted (1,2), where the results were rather disappointing with regard to the energy output, but on the other hand delivered more experience, knowledge and with that a working surface.

The expectations to the energy outcome are dependent on the local wind climate, the rotor positioning within this wind climate and the wind turbine design's capability to operate at this chosen position.

## Examples in Copenhagen


Nowadays, the energy production is mostly decoupled from the user. New research showed that visualization of energy consumption can affect the user to reduce his/her consumption through awareness. This theory is referring to the so called eco-visualization (3). Another phenomenon can be triggered by the so called eco-feedback (4). A wide spread application of the eco-feedback can be found in cars, where the momentary fuel consumption rate is displayed to the driver. In this way the driver is informed about the consumption of the car in combination with the way of driving and can directly influence it by a more economical and ecological driving style. The same effects can be evoked by energy systems connected immediate to the user.




The efficiency of small-scale wind turbines in urban wind climates cannot be compared to the energy output per rotor area of large-scale offshore wind turbines. But, in the efficiency determination of urban wind energy applications has to be included the reduced energy transmission losses, the reduced energy consumption due to increased energy usage awareness and the perspective of increasing energy prices, controlled by the industry, which is owning offshore windparks, whereas small locally installed wind energy conversion systems are affordable for private persons, small companies and the like.

(1) http://www.warwickwindtrials.org.uk/resources/Helen+Brown+-+Encraft+-+Results+of+the+Warwick+Wind+Trial.pdf
(2) http://www.energysavingtrust.org.uk/Global-Data/Publications/Location-location-location-The-Energy-Saving-Trust-s-field-trial-report-on-domestic-wind-turbines
(3) http://www.indiana.edu/~sustain/docs/sinterns_08/pierce_report.pdf
(4) http://www.thescavenger.net/environment/eco-feedback-can-change-our-consuming-ways.html

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# Solar Walls For Heating of Buildings

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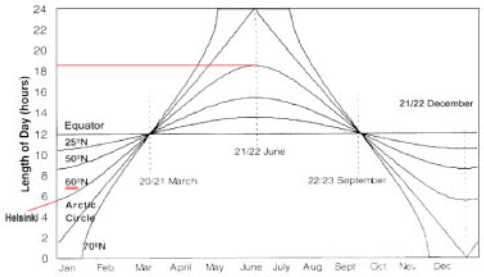
*Denmark*

With the ever growing concern of climate change, we should start to make that positive change from within our own homes. Solar energy is an inexhaustible pollution free energy source that is harnessable throughout the world. The concept of solar walls can be integrated into existing or new buildings, providing a ”free” and pollution free heat source.

## Potentials for solar energy in Scandinavia




- Number of day light hours during the year for Helsinki is winter = 6hr, summer =18.5hr
- The intensity of the solar radiation in Scandinavia ≈ 1000 kWh/m$^2$

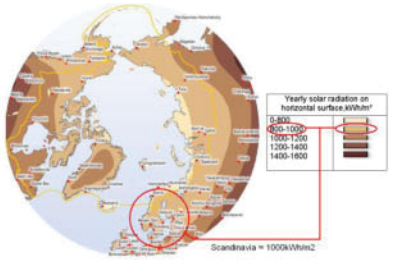
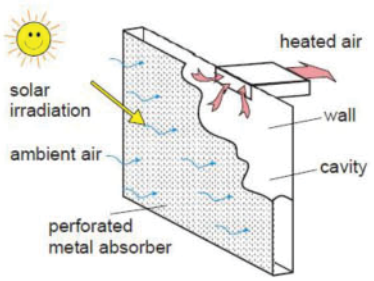



Figure 1 Length of hours per day per latitudes

Figure 2 Intensity of solar radiation

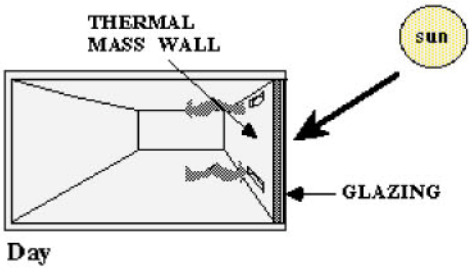
## Variations of solar wall glazed or unglazed




- Aesthetically pleasing on exterior of buildings
- Can be applied to both existing and new buildings
- Large energy saving potentials

Figure 3 Example of an unglazed thermal solar wall

Figure 4 Example of a solar wall Shandong University, China




- Can potentially use existing wall as the collector
- Daytime heating by air convection
- Wall acts as thermal storage, radiating heat during the night

Figure 5 Glazed solar thermal wall

Figure 6 My own home made glazed solar wall

An institution that currently has a worldwide market in this design (Figure 4) is SolarWall by Conserval Engineering inc. Contact info@solarwall.eu

Reference: Figure 1, Figure 2: Simon Furbo, Solar Heating Systems course, 2011, DTU.
Figure 3: Mark Lawson, R. H. (2010). *WP 1.6 and 1.7 Field trials on a Transpired Solar Collector renovation system* . Berkshire: SCI Steel knowledge.
Figure 4: SolarWall. (2011). *SolarWall Photo Gallery*. Retrieved 08 17, 2011, from SolarWall: http://solarwall.com/en/products/solarwall-gallery.php
Figure 5: Sustainable Sources. (2011). *Passive Solar Design*. Retrieved 08 17, 2011, from Sustainable Sources: http://passivesolar.sustainablesources.com

# Solar heating systems with PCM storage for low energy buildings

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*Technical University of Denmark*
*Denmark*

The goal of Danish laboratory experiments made in 2009 (Professor Simon Furbo, sf@byg.dtu.dk, Department of Civil Engineering, DTU, Lyngby, DK) is to achieve 100% solar fraction in low energy houses. Phase change materials (PCM) have been investigated to increase the heat storage energy density by exploitation of the heat of fusion energy.

## What is a PCM?

- Ex: Salt hydrate sodium acetate trihydrate, $NaCH_3COO\text{-}3H_2O$;
- The considered PCM can be fully melted at a temperature higher than 58°C;
- After melting it can be cooled down to ambient temperature;
- The latent heat is preserved until a demand occurs;
- Solidification can be activated to release the storage energy;
- Solidification may start immediately by dropping a salt crystal into the supercooled PCM.

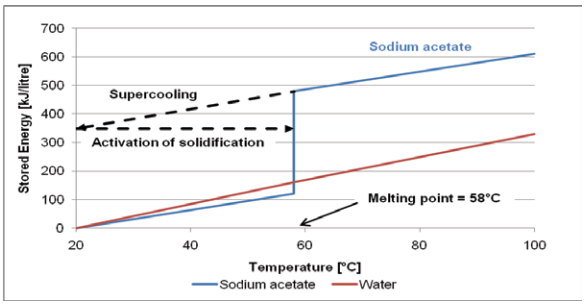
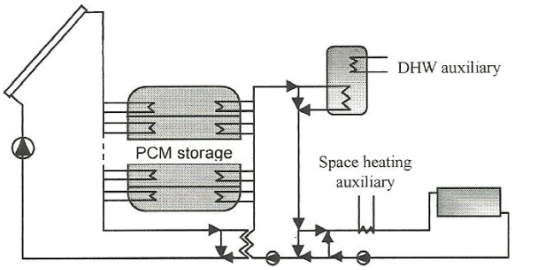



**Fig. 1: Energy density of sodium acetate in the super cooling process compared to water.**

## How does the system work?




System Parameters: 36 $m^2$ solar collector area, 6 $m^3$ PCM storage volume, 180 litres DHW tank

**Fig. 2: System design**

- Energy from the solar collector can either be used for direct charging of the PCM storage or transferred to the demand loop (DHW) through the heat exchanger;
- The PCM storage is made up of a number of subsections that can be individually charged or discharged to activate the solidification in different moments.

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# Micro hydro power plants

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*University of Iceland*

*Iceland*

## Introduction

Micro hydro power plants were the norm in Iceland. In 1950 there were about 530 private power stations in operation around the country but after that they reduced in numbers when the farms were connected to the national power grid that was being built. In 2003 the Icelandic government issued a manual to landowners about micro hydro power plants and since then they have grown in numbers.

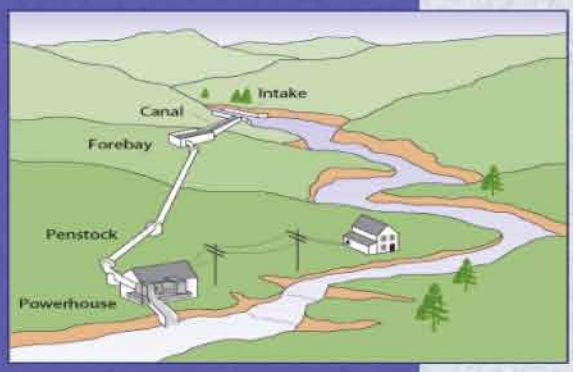


Figure 1. Example of a micro hydro power plant (photo: engineering.com)

Figure 2. A micro hydro in the West fjords (photo: Evan Bloom)

Figure 3. Power plant from scrap metal (photo: Evan Bloom)

## Governmental policies for micro hydro

Micro hydro power plants can be a substantial contribution to electricity production. In 2003 the Icelandic government issued a manual for landowners about building micro hydro power plants, preparation and regulation. Since then, 25 – 30 micro hydro plants have been build and 19 of which are connected to the national grid, supplying electricity to customers.

In other countries, higher price is paid for electricity from micro hydro plants because they are considered environmentally friendly and strengthen rural areas.

In Iceland, the government has helped through information and better legislation. Also, cheap loans are available for landowners who want to utilize flowing water on their land. Conference, called “The Energy Farmer”, is also held on regular basis, informing people who are interested in energy issues about various environmentally energy solutions. Big part of that conference is about micro hydro power plants and ways to build one on your land.

An example of a cheap micro hydro power plant can be found at the farm Hóll in the West Fjords, where the farmer has built his own power plant from scrap over the course of few years. He now is self sufficient with electricity and plans to increase power production as he acquires more parts that other people has thrown away. Either he will connect to the national grid or use the excess power to produce for example his own fertilizer.

The small stream in figure two is the stream that is running through the power plant but a bigger stream is running close by, with good potential.

## Conclusion

Micro hydro power plants can be a good addition to power production but needs governmental initiative and clear regulation in order to attract landowners interest. Direct subsidies are not necessary but landowners have to be informed on how to get started on their own micro hydro power plant. Governments therefore have to take the initiative to make it appealing to landowners to build a micro hydro power plant.

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# Go green with blue energy

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*Sweden*

Of all electricity produced today, only a negligible amount comes from wave energy. Still, the International Energy Agency estimates a energy production potential of 10,000-15,000 TWh/year, which is around half of the annual global electricity consumption.

## How it works

There is tremendous energy in the ocean waves. The power produced by a wave is related to its height and speed - strong wind equals great potential. Wave energy is then captured directly from surface waves or from pressure fluctuations below the surface. When it comes to harnessing the energy, there is a wide range of techniques, all adapted to the unique environment (see below).

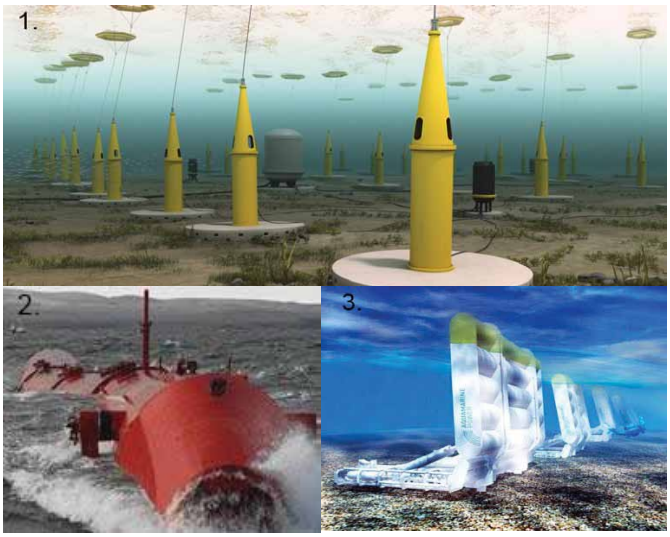


**Figure 1,2,3: 1) Buoys, 2) The Pelarmis, 3) The WaveRoller/Oyster.**

## Advantages and disadvantages

Wave Energy, like all other forms of Energy, suffers from both advantages and disadvantages:

- Wave energy technology is currently in infant phase of its growth and it is therefore difficult to fully understand the ecological impact. While wave energy is almost completely non-polluting, accidents like oil spill and unforeseen conditions may cause environmental concerns. Generators may have negative impacts on the marine environment, both through noise pollution and through changes at the ocean floor.
- Harnessing wave energy is expensive. Using offshore wind power as a reference, the estimated production cost of wave power will have to be reduced by 2/3, ie from 0,5 SEK/kWh to 0,15 SEK/kWh.
- Waves can go from 1-15 meters in a matter of hours. Consequently, any wave energy device must be made incredibly durable in order to survive harsh ocean conditions. Hence, such projects could be expensive to develop.
- Wave energy requires a consistent supply of waves to fuel the electrical needs, making it location dependent.
- Wave plants could cause displacement of commercial and recreational fishermen from productive fishing grounds.

However, wave energy comes with a lot of advantages as well:

- Waves contain a vast amount of energy. Considering that over 70% of our planet is covered by water makes the capacity for waves as a renewable energy source enormous. Even small wave energy devices are capable of producing a great deal of energy.
- Wave energy is a renewable and “clean” source of energy. There are no carbon dioxide emissions and it reduces our dependence on fossil fuels.
- Wave energy devices are usually low profile and do not provide much of a visual distraction if placed off-shore.
- Many scientists believe that wave power plants, in the long run, could have a positive impact on the nature and serve as artificial coral reefs.

## Nordic relevance

The energy potential for Nordic countries varies considerably. Generally, the best wave power locations are the western coastal areas in temperate zones, such as Norway, the UK and Ireland's west coast. Here, a strong westerly wind creates good conditions for wave energy. The theoretical wave resource potential for Denmark is estimated to 30 Twh/year, whereas Norway, with its long and exposed coast, has an estimated potential of 600 Twh/year. Due to the lack of strong wind zones, the Swedish potential is estimated to 12 Twh/year. The practical wave potential is around 5-10% of the wave resources.


**Figure 4: Wave resource distribution.**

## Cost

The total cost for a wave energy power plant- from idea to full-scale prototype of 10 MW- is estimated to 300 million SEK. However, many techniques are scalable and can be expanded in stages. Repayment of the facility can thus be initiated long before the wave power plant is completed. The most cost effective wave energy generation plants are operating around 0,5 SEK/kWh, as opposed to coal fired power stations at 0,2 SEK/kWh. But once more Wave Energy Power Plants are up and running, energy costs will decrease and be able to compete with non-renewable energy prices.

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# Tidal Energy

*Bryndís Arndal Woods*
*University of Iceland*
*Iceland*

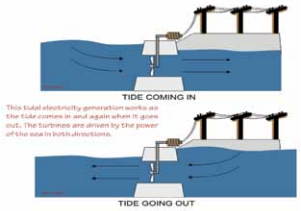
## *Introduction:*

Tidal power is widely recognized as possessing high potential for future electricity generation, particularly since tides are more predictable than many other sources of renewable energy, including wind and solar power. Although tidal energy does not currently enjoy wide-spread use, research and development efforts have picked up speed in recent years. Tidal energy has often been swept aside as a result of relatively high capital investment costs and limited availability of appropriate tidal sites. However, recent technological developments and improvements have indicated that the total availability of tidal power may be higher than previously assumed and that costs may be reduced to competitive levels.

## *Tidal Power Technologies:*

**Tidal Barrages** work much like a dam in that they use the potential energy from the difference in height from low to high tides. The world's first large-scale tidal power plant, the Rance Tidal Power Station in France, became operational in 1966 and is a barrage system. Unfortunately, tidal barrages have many drawbacks; they entail high capital costs to build necessary infrastructure (although they are cheap to operate), there are very few suitable sites on which to build them, and they cause environmental damages to the local ecosystem and wildlife.

How a Tidal Barrage Works:

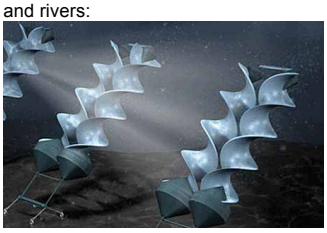



Tidal barrage on the Rance River, France:

**Tidal Stream Generators (TSG's)** use kinetic energy from tidal currents to power turbines, like underwater windmills. The world's first commercial-scale and grid-connected tidal stream generator, SeaGen, in Ireland, was installed in 2008. These systems are cheaper to build and have fewer negative impacts on the local environment than barrage systems. Their design variations allow TSG's to be placed in a wider range of areas than barrage systems; basically anywhere there is a concentration of high-velocity waterflows, such as entrances to bays and rivers or between land masses where currents are strong.

Example of a three blade, horizontal-axis TSG installed in Kvalsund in Finnmark, Norway:

This TSG, produced by Flumill, a Norweigan company, is designed for use in streams and rivers:



***A Brief History:*** The use of tidal mills, wheels, and barrages can be dated back into Antiquity; there are written reports concerning water energy from both Ancient Rome and Ancient Chinese civilizations. The earliest excavated mill dates from AD 787 in Northern Ireland. Water energy was most often used to operate mills or irrigate land although throughout history it has been used for a variety of other purposes such as sawing lumber, operating ironworks, manufacturing paper and cotton, and grinding seeds, pepper and gunpowder.

***Tidal Power Today:*** There are currently only three operating barrage systems in the world: on the Rance River in France, in the Bay of Fundy, Nova Scotia and the Barents Sea at Kislaya Guba in Russia. Alternatively, there is only one operational commercial-scale TSG in the world today, SeaGen, which was installed in Strangford Lough in Northern Ireland in 2008. However, research and development concerning tidal turbine technologies is extensive and appears to be picking up speed as there are numerous projects underway or projected across the world; particularly in Britain, Scotland, and Ireland. In Scandinavia alone, there are 13 tidal technology companies innovating new and more efficient tidal technologies.

***Advantages and Challenges of Tidal Energy:*** The largest environmental advantage of tidal energy is that it is carbon neutral. Tidal energy is also more predictable than many other renewable energy sources and arguably less 'unsightly' than above-ground wind farms. Additionally, although tidal energy entails high start-up costs, operating costs are low which means that the payback period will be shorter than with other capital-intensive clean technologies. Finally, although the cost of tidal energy is not yet competitive with conventional fossil fuel power, continued research and development efforts have the potential to lower costs to competitive levels. However, there are numerous challenges associated with tidal energy as well, such as a limited number of suitable sites on which to harness tidal energy. Additionally, since very few tidal systems have been installed on a fully commercial basis, it is difficult to accurately estimate costs and savings due to limited experience and higher perceptions of risk. Finally, although tidal energy is more predictable than many other renewable sources, it is still variable in nature, which has implications for large scale grid integration.

***Relevancy in the Nordic Context:*** If the Nordic countries are to achieve the challenging goals they have set for themselves regarding climate change and renewable energies, tidal energy is a worthwhile endeavor. Whereas Norway and Iceland already generate 100% of their electricity from renewable sources, the rest of the Scandinavian countries do not. Norway has demonstrated leadership with regards to tidal energy research and development, similarly, Sweden's policies regarding the promotion of renewable energies have similarly set a good example to follow. As there are already more than a dozen companies in Scandinavia that see the opportunities of tidal energy and are developing promising new technologies, the Nordic countries should take advantage of the momentum that is being gained and work together to ensure that all of Scandinavia works towards a 100% renewable electricity profile.

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# Iceland: exporting geothermal

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Iceland is a good example of how low-carbon economy can be effectively implemented thanks to the employment of renewable energies. As of 2009, Iceland energy comes mostly from geothermal energy and hydropower, and since 1999 renewable energy has provided over 70% of the nation's primary energy and 99.9% of Iceland's electricity [1]. Iceland's carbon emissions per capita are 62% lower than those of the United States [2] even if the use of primary energy per capita is higher [3]. Iceland is aiming at carbon neutrality and expects to use only renewable energy by 2050.
A key role in Icelandic energy is represented by geothermal power, of which 57.4% is used for space heating, 15.9% for electricity and the remaining amount in many different areas [3]. Geothermal energy meets 86% of the space heating requirements of Iceland. The electricity production capacity from geothermal fields was 1.3 TWh per year in 2000; an assessment of the total potential for electricity production from the high-temperature geothermal fields in the country gives a value of about 1500 TWh or 15 TWh per year over a 100 year period [4].

**The Nesjavellir geothermal power plant (120 MW), Iceland**

## Icelandic know-how exported around the world

Iceland is exporting its geothermal technology and know-how around the world. For example, Geysir Green Energy geothermal energy company has worked successfully at developing geothermal heating utility projects in China and is undertaking geothermal power projects in Germany and the Philippines. The first geothermal power plant fully engineered and constructed by an Icelandic company outside of Iceland was done by Enex in El Salvador, with capacity 9.3 MW [5]. Iceland's state-owned and largest energy company, Landsvirkjun, is considering laying the world's longest underwater electric cable in order to sell the country's vast geothermal and volcanic energy to Europe, for example to the UK, Norway, Holland, and Germany [3]. Iceland and the Commonwealth of Dominica have signed a Memorandum of Understanding on geothermal energy cooperation. Dominica depends heavily on imported fossil fuel for electricity generation, although the island has access to abundant geothermal resources. In the year 2007 electricity production was 86 GWh and therefore it is estimated that a 15 MW geothermal power plant could cover the electricity consumption of the island. By inter-connecting the islands with submarine cables, Dominica could export geothermal energy to its neighbors Guadeloupe and Martinique, thus reducing even further greenhouse gas emissions. Icelandic experience could possibly make this feasible [6].

The most promising application, however, is in China. District heating would make possible to reduce the consumption of the greatest country which relies on fossil fuels as a source of energy. The Shaanxi Green Energy (SGE), a joint venture between Enex and Sinopec Star, operates a geothermal district heating system providing heating for 1.2 million square meters in Xianyang city (100 MWth) since 2006. SGE is developing a second district heating project in Xiong County. The new system will provide heating up to 3 millions square meters by 2012. Xiong County, with a population of 354,000, has low-temperature geothermal fields with water temperature ranging from 55-86°C at a well depth of 500-1,500 meters. The new geothermal system will help improve the county's air quality since heating would otherwise come from coal fired heat centrals. By reducing the county's dependence on coal heating and reducing carbon dioxide emissions the operation can generate CER (Carbon Credits) that strengthens the economical viability of the project. The use of geothermal energy instead of coal for heating in Xianyang is reducing carbon dioxide emissions by more than 48,000 tons annually. [5]

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# Potential $CO_2$ Capture with Black Liquor Gasification at the Pulp Mills In Sweden

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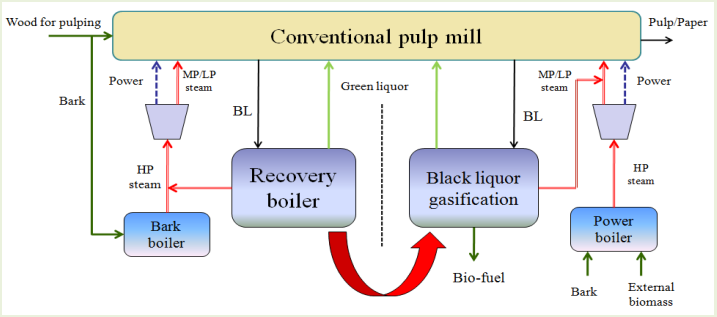
*Stockholm, Sweden*

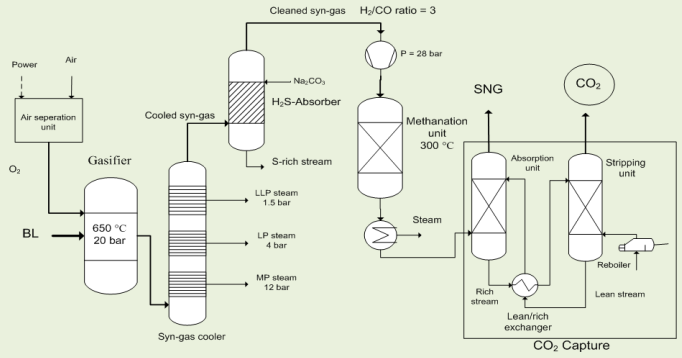
## Introduction

- Pulp and paper industry consumes a large proportion of biomass worldwide that include bark, wood residues, and **black liquor** (BL).
- Black liquor gasification (BLG) based bio-refineries to co-produce **electricity**, **chemicals** or **bio-fuels** with pulp and paper products.
- Transport bio-fuels such as **DME (dimethyl ether), synthetic natural gas, methanol, hydrogen or synthetic diesel** from BLG can potentially replace significant amount of **conventional fossil fuels**.




## $CO_2$ capture integrated with BLG

- Possible to **integrate CCS technology** with black liquor gasification for climate change mitigation.
- The fossil $CO_2$ emissions in **Swedish pulp and paper mills** are not significant but the biomass based $CO_2$ emissions are large.
- Total black liquor capacity in Sweden was about **10%** of the world in 2008 and simple estimations shows possible reductions in $CO_2$ about **100 million tonnes per year** with CCS integration with BLG systems in pulp and paper mills.
- Although in principle bio-based $CO_2$ is neutral, possibility to capture bio-based $CO_2$ exists which was identical for the fossil fuel based plants e.g. **Synthetic natural gas** production with $CO_2$ capture (see Figure).




## Potential Motor Fuel Replacement

- From SNG production using black liquor available in various regions e.g. Sweden, Europe, and World, substantial amount of motor fuel can be replaced (see Table).

Potential annual motor fuel replacement from SNG produced based on black liquor availability in 2008 (Naqvi et al., 2011)

| | Sweden | Europe | World |
|---|---|---|---|
| Black liquor, TWh | 47 | 184 | 733 |
| SNG production, TWh | 31.3 | 122.5 | 488.7 |
| Gasoline use[a], TWh | 43.6 | 1667 | 10019 |
| Diesel use[b], TWh | 34.1 | 2243 | 7614 |
| Gasoline replacement, % | 72 | 7.4 | 4.9 |
| Motor fuel replacement, % | 40.2 | 3.1 | 2.7 |

[a] Based on the Food and Agriculture (FAO) database (FAO, 2008)
[b] Data from Earth Trends: Environmental information (Earth trends, 2008)

Naqvi, M., Yan, J., Dahlquist, E., 2011. Integrated synthetic natural gas production from oxygen blown dry black liquor gasification process with direct causticization. ICAE 2011, Perugia, Italy

## Important Aspects related to CCS

- The scientific research and development (R&D) work needed to solve issues and to fill research knowledge gaps i.e.
  1. Technical aspects of $CO_2$ capture and storage
  2. Geographical relationship between sources and storage opportunities of $CO_2$
  3. Cost of CCS systems
  4. Barriers to investment in carbon capture
  5. Legal and regulatory issues

## Conclusions

- $CO_2$ capture and storage could play an important role as an emerging technology in climate mitigation reducing greenhouse gas emissions.
- The consensus among researchers, industries and governments would help CCS commercialization in near future.
- With BLG systems, a significant $CO_2$ abatement is possible especially in Nordic countries such as Sweden due to large pulp and paper industry.
- A substantial motor fuel replacement in transport sector to replace large amount of fossil based fuels.

# $CO_2$ absorption and desorption with "Switchable Solvents"

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*Åbo Akademi University*
*Finland*

*Amine-based technologies are widely applied in industry for $CO_2$ removal. However, due to the intensive research in the area of $CO_2$ utilization, quite many new solvents have been discovered that possess a high potential for $CO_2$ capture. Among the most promising absorbents are ionic liquids (ILs). Conventional (Ils) show, however, some disadvantages and several of them were proven to be toxic. Due to this fact, a new more environmentally friendly class of solvents called "switchable ionic liquids" (SILs) has been developed.*

## Introduction

Switchable solvents are able to carry out more than one step in the industrial processes before they need to be replaced (Fig 1). For this reason, conventional solvents as media for reaction or separations are disadvantageous compared with the switchable ionic liquids (Fig 2). Using these new classes of switchable ionic liquids means decreasing production costs and less environmental waste for the entire process.

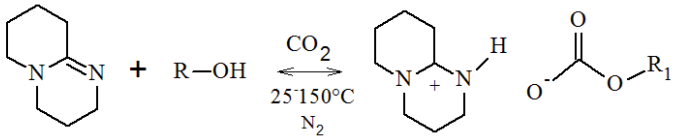


Fig 2. Reversible binding of $CO_2$ with an amidine (DBU) and an alcohol [2]

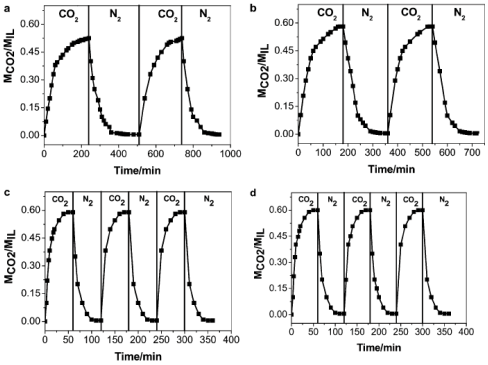


Fig 1. Cycles of $CO_2$ absorption by [Choline][Pro] and [Choline][Pro] / PEG200 mixtures. [1]
(a) *W*[Choline][Pro]/*W*PEG200 = 1:0, 323.15 K;
(b) *W*[Choline][Pro]/*W*PEG200 = 2 : 1, 308.15 K;
(c) *W*[Choline][Pro]/*W*PEG200 = 1 : 1, 308.15 K;
(d) *W*[Choline][Pro]/*W*PEG200 = 1 : 3, 308.15 K. [1]

**Advantage**

- Ideal selectivity for $CO_2/N_2$ and $CO_2/CH_4$
- Negligible vapor pressure
- Wide liquid range
- High stability
- Low corrosion rate

**Disadvantage**

- High viscosity
- High cost
- Poor $CO_2/H_2S$ selectivity

The durability of SILs have been tested in several articles. DBU/1-hexanol $CO_2$BOL was exposed to five capture and release cycles of $CO_2$ using an automated gas burette system to verify the robustness and reproducibility of the $CO_2$BOL system. The DBU/1-hexanol was loaded in a flask and $CO_2$ was sparged through the liquid for 5 minutes, making the [BaseH+][$ROCO_2$-] salt. After $CO_2$ uptake had ceased, the flask was connected to the burette system and then decarboxylated by dipping the flask into a pre-heated oil bath at 90 °C. (Fig 3).After $CO_2$ evolution had ceased, the flask was cooled to 25 °C and the flask was disconnected from the burette and then promptly carboxylated again by sparging CO2 through the liquid for 5 minutes. This process was performed a total of 5 times, with no observable loss of $CO_2$ binding capacity. Formal measurements are underway to determine the lifetime of $CO_2$BOLs on mock flue gas streams.

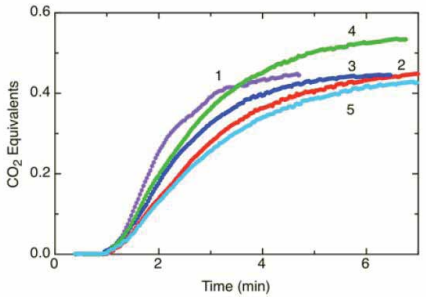


Fig 3. Lifetime/repeated CO2 release from DBU and 1-Hexanol at 90 °C. Heating begins at 1 minute. [2]

## Conclusion

*Switchable ionic liquids seem to be so far competitive solvents for $CO_2$ capture. They can easily release $CO_2$ under high temperature and via bubbling of an inert gas.* The reuse of the absorbent can decrease the solvent costs and benefits the economy of the process. High cost and the lack of information are the major drawback of these components.

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# Carbon capture and storage via fermentative succinic acid production

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## Introduction

Within the current society the demand on large quantities of chemicals is steadily increasing. Chemicals are used within all spectrums of our lives, e.g. medicine, design and manufacturing of pharmaceuticals, food industry, agricultural industry and many more. Currently chemicals are almost exclusive produced from petrochemical feedstock. Producing functional equivalent chemicals from renewable sources could have a positive effect in regards to emission of greenhouse gases. Furthermore the fermentative production of succinic acid consumes $CO_2$. The green house gas savings per ton of producing succinic acid via fermentation would be up to 70%.

## Succinic acid and its use

Succinic acid is a saturated dicarboxylic acid; other important acids from this family are e.g. adipic acid, maleic acid and oxalic acid

The table below shows possible application of succinic acid; whereas figure 1 shows possible derivates from succinic acid

| Industry | Application |
|---|---|
| Food | Flavouring agent, softening agent, preservative, … |
| Pharmaceuticals | Anti-carcinogen agent, starting material, antidode, … |
| Agriculture | Enhance germination, growth and yield, preservative, … |

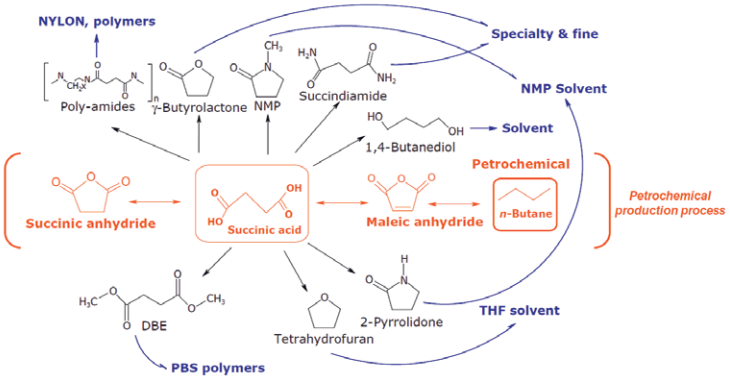


**Figure 1:** The diverse chemical synthesis opportunities offered by using succinic acid as a building block chemical

## Fermentative succinic acid production

The fermentation process producing succinic acid is run under anaerobic operating conditions at pH values where rater succinate salt is produced than the free acid. The theoretical stoichiometry of the process is as follows:

$$\text{glucose} + 2\ \text{HCO}_3^- + 2\ \text{H}_2 \rightarrow 2\ \text{succinate}^{2-} + 2\ \text{H}_2\text{O} + 2\ \text{H}^+$$

Figure 2 shows a possible process schema for succinic acid production. Within the process *Anaerobiospirillum succiniciproducens* is used to produce succinate at a concentration of 42 g/L and productivity of 14.8 g/L h. The fermentation broth will be further concentrated via the separation step of a monopolar electrodialysis stack to 83 g/L.

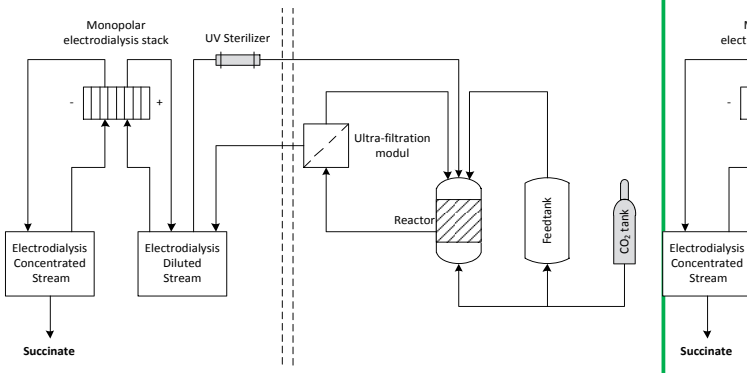


**Figure 1:** Schematic process flow of producing “green” succinic acid of an integrated membrane-bioreactor-electrodialysis system

## Conclusion

Industrial biotechnology chemicals as succinic acid are not yet viable to their petrochemical equivalents. Nevertheless utilizing cheap industrial waste products, e.g. glycerol, whey or lignocellulosic material, and the ability of utilizing $CO_2$ within the process makes them more economical feasible. Approximately 6 k-ton of $CO_2$ can be captured by producing the current world demand of 16 k-ton succinic acid via fermentation.

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# Solid Oxide Fuel Cells:
## Super-Efficient Heating and Power

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*Technical University of Denmark & Topsoe Fuel Cell A/S*
*Denmark*

Solid Oxide Fuel Cells (SOFC's), produced by Topsoe Fuel Cell[1] of Denmark, are electro-chemical units that generate power from fuel and air without the need for combustion. As a by-product, they release heat during operation. Able to run on various fuels such as natural gas and biogas, SOFC's are acknowledged as a clean and sustainable energy technology by policy-makers and research institutions[2] due to their highly efficient operation and drastically reduced greenhouse gas emissions.

SOFC's in Scandinavia are on their way from demonstration phases to mass-market on various market segments. The 1 kW PowerCore™ is dedicated to cover households' need for heat and power in a decentralized and energy-efficient manner.

The fuel cell producer is not the only stakeholder. Further involved in the business are:

- *System integrators and installers*
- *Grid and utility companies*
- *Public-private Danish Strategic Partnership for Hydrogen and Fuel Cells*
- *Danish demonstration project consortium*


**Integrated PowerCore™: SOFC's stacked to give 1 kW[1]**


**SOFC Market segments: Transportation, Households and Large power**

Operative and investment support from the public is critical for the market penetration of SOFC's[3].

Policy actors therefore evaluate leverages for SOFC's among other technology options in terms of their adaptive and mitigative implications.

## Adaptive and Mitigative Implications

| Trade-offs | | Synergies | |
|---|---|---|---|
| **Mitigative** | **Adaptive** | **Mitigative** | **Adaptive** |
| Short-term SOFC-vision mainly based on a fossil fuel: natural gas | Enhanced long-term energy security due to the fuel flexibility of SOFC's | Reduced $CO_2$ and virtually no $NO_x$ and $SO_x$ emissions in SOFC operation | Decentralized power: reliable against extreme events such as storm surges or high load |
| SOFC stakeholders compete against other renewables for incentives in the short-term | Complementary use of SOFC's with renewables envisioned for the long-term | Increased wind power planned for the future: emission-free energy | SOFC's insure the grid against intermittent and fluctuating wind power |
| Large-scale grid-connected SOFC use acts as a clean Virtual Power Plant | Warmer winters due to global warming: small-scale value of mCHP units decreased | Need for more land allocation for mitigative purposes e.g. afforestation | Efficient land-use: demand-site deployment of SOFC's instead of central power plant |

[1] Topsoe Fuel Cell A/S Denmark Official Webpage, available at: http://www.topsoefuelcell.com/
[2] Risø DTU Fuel Cells, available at: http://www.risoe.dtu.dk/Research/sustainable_energy/fuel_cells.aspx
[3] Danish Partnership for Hydrogen and Fuel Cells, Sep. 2010, National SOFC Strategy 2010-2020, pp.1-37

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# End of Life Options for Wind Rotor Blades

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AALBORG UNIVERSITY

Considerable environmental implications expected with the growing wind industry in terms of both number & size of turbines and rotor blades. Currently 90% of a wind turbine is recyclable; the non-recyclable 10% primarily represents the rotor blade. Since the wind industry is relatively young, only a limited amount of practical experience on the removal & treatment of rotor blades exists. Currently **few established, commercial-sized methods** - non-economical separation & recycling of composites (labour intensive); low salvage value for FRP recyclate compared to other materials (e.g. steel); small input volumes; etc. The majority of worn out blades or production failures are therefore incinerated or sent for landfill.

It's estimated that for each 1 kW of installed power, 10 kg of rotor blade material are needed. For a 7.5 MW turbine, that translates into 75 tonnes of blade material. Furthermore, it's predicted that by 2034, around 225 000 tonnes of rotor blade material will be disposable per year worldwide.[1]

## Existing Options[2]

**Landfill:** cheapest option but becoming more expensive. Most countries looking to reduce landfill mass. Landfill is also likely to be more tightly regulated in future. Recent disposal bans for some material types (e.g. GRP, CF).

**Incineration:** currently the most common option. 60% of blade scrap remains as ash, requiring further post-treatment options. Also emissions of hazardous flue gas. However, thermal & material recyclate (ash). Must consider countries outside of Europe who don't use incineration.

**Mechanical recycling & reuse:** FRP **material recyclate** (10-40%) used in a variety of applications. Examples include filler for new products such as cement.

**Chemical recycling & reuse:** thermal & material recovery via **pyrolysis & gasification** or **solvolysis**. Recyclates are primarily used as thermo-resistant insulation materials or fillers, gas or oil.

**Reuse:** either via **refurbished turbines** (sent to developing countries) or **architectonic reuse** (using discarded wind turbines in full form as structural support units (e.g. columns & beams)).

The following options don't eliminate the fact that at one point into the future, blades will require decommissioning & treatment. However, they are still important considerations to be explored: i) **new materials** (thermoplastics, natural fibres, etc.) which are more recyclable & easier to dispose of; ii) design for **longer lifetime** (20-40 years); iii) **improve field repair systems** & **increase maintenance activities**.

## Future Considerations

Renewable or "green" technologies such as wind energy imply the demand for practical, ecological solutions. Nordic wind manufacturers have an influential & **proactive producer role** to play for other manufacturers & similar industries around the world. Points for consideration include:

- Combination of technical & regulatory changes/innovations pertaining to material choice & waste handling needed;
- Proactive rather than reactive activities before market demands & legislation arise;
- In-depth analysis of the various recovery processes & technologies currently available;
- Experimentation with various other rotor blade materials (e.g. thermoplastics) that may be more easily disposed of & reused/recycled;
- Improved collaboration with all relevant & related industries (competitors, suppliers, waste handlers, similar industries (e.g. helicopter rotors / propellers; airline, boat & auto industries));
- Launch of an EU-wide legislation for the end-of-life treatment of rotor blades or wind turbines, similar to those in the auto & electronics industry.

## References

[1] Albers, H. (2009) Recycling of Wind Turbine Rotor Blades – Fact or Fiction? DEWI Magazine No. 34, February 2009
[2] Larsen, K. (2009) Recycling Wind. Reinforced Plastics Volume 53, Issue 1, January/February 2009, pp. 20-25

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# Solar powered residential hydrogen fueling station

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EU's Energy Performance of Buildings Directive requires that all new buildings must be nearly zero energy buildings by 2020. This goal will be met by implementing technologies for on-site renewable energy generation. The seasonal and diurnal variation in photovoltaic power production can be evened out by using hydrogen as energy storage.

## High pressure electrolysis cuts costs

Once produced by electrolysis, hydrogen has to be compressed to high pressures. Using a high pressure electrolyzer lowers the cost, footprint and energy required for hydrogen compression since a separate electric compressor is not needed. Pressures of up to 800 bar have been reached using electrochemical compression. [2]

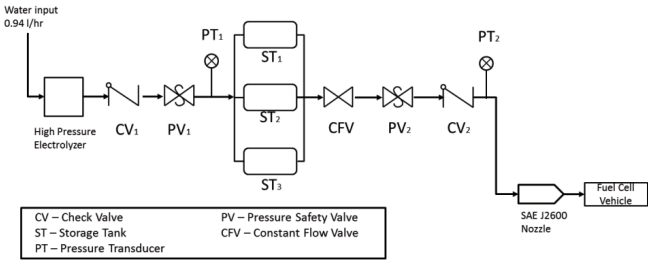


**Figure 1: Major components of a residential hydrogen filling station. Redrawn from [1]**

A conceptual design of a solar powered hydrogen filling station for a single family home has been developed in Missouri University of Science and Technology, Department of Mechanical & Aerospace Engineering. Figure 1 illustrates this system intended to be located in Wallingford, Connecticut USA. The concept conforms to Wallingford's zoning regulations and safety codes for the hydrogen fueling system. [1]

## The fuel cell electric vehicle supplements the grid

A fuel cell converts hydrogen and oxygen into water, and in the process it produces electricity. Fuel cell vehicles are, in effect, electric vehicles since the electricity generated by the fuel cell is used to drive the electric motor. The fuel cell electric vehicle can act as a backup generator for homes and supplement the grid during peak hours, and charge in off-peak hours at lower cost.

Compared to the traditional electric car the Fuel Cell Electric Vehicle (FCEV) has a longer range and faster refueling. These properties make it suitable for Nordic countries, where distances between settlements are large. In figure 2 safety issues raised by high pressures and the flammability of hydrogen have been settled by roof ventilation and open structure of the garage.

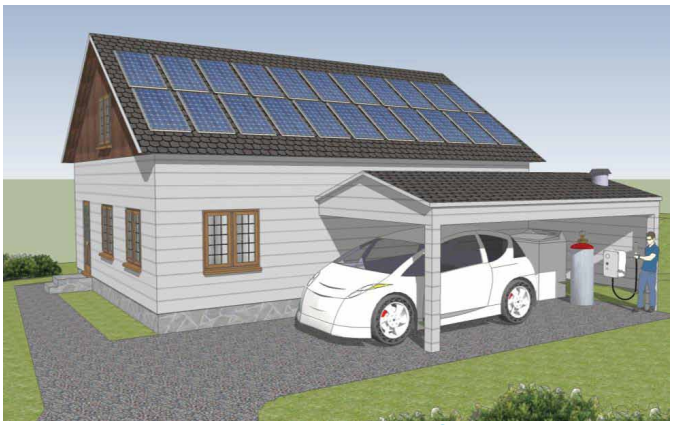

**Figure 2: A nearly 0-energy home. The Fuel Cell Vehicle running on solar hydrogen produces zero emissions**

References:
[1] Aanchal Shah*, Vijay Mohan, John W. Sheffield, Kevin B. Martin. Solar powered residential hydrogen fueling station. Missouri University of Science and Technology, Department of Mechanical & Aerospace Engineering. International Journal of Hydrogen Energy, In Press, Corrected Proof.
[2] HyET Achieves 800 Bar Electrochemical Compression, Fuel Cell Today News, http://www.fuelcelltoday.com/online/news/articles/2011-08/HyET-Achieves-800-Bar-Electroche (Last accessed 25.08.11).

# Solar Walls For Heating of Buildings

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With the ever growing concern of climate change, we should start to make that positive change from within our own homes. Solar energy is an inexhaustible pollution free energy source that is harnessable throughout the world. The concept of solar walls can be integrated into existing or new buildings, providing a ”free” and pollution free heat source.

## Potentials for solar energy in Scandinavia

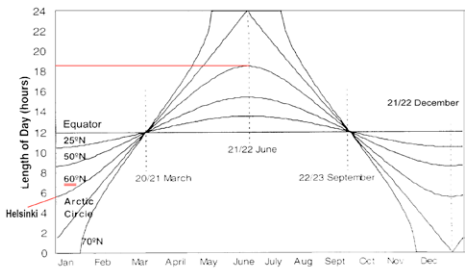


Figure 1 Length of hours per day per latitudes

- Number of day light hours during the year for Helsinki is winter = 6hr, summer =18.5hr
- The intensity of the solar radiation in Scandinavia ≈ 1000 kWh/m$^2$

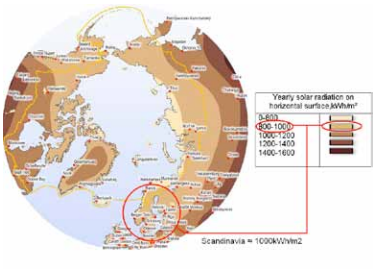


Figure 2 Intensity of solar radiation

## Variations of solar wall glazed or unglazed

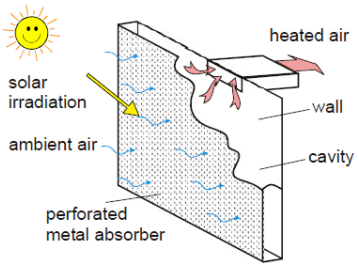


Figure 3 Example of an unglazed thermal solar wall

- Aesthetically pleasing on exterior of buildings
- Can be applied to both existing and new buildings
- Large energy saving potentials

Figure 4 Example of a solar wall Shandong University, China

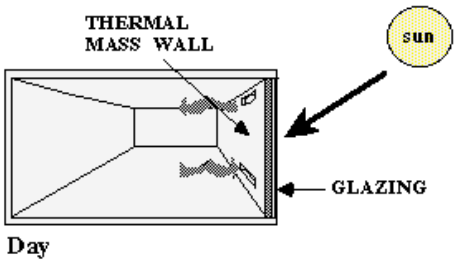


Figure 5 Glazed solar thermal wall

- Can potentially use existing wall as the collector
- Daytime heating by air convection
- Wall acts as thermal storage, radiating heat during the night

Figure 6 My own home made glazed solar wall

An institution that currently has a worldwide market in this design (Figure 4) is SolarWall by Conserval Engineering inc. Contact info@solarwall.eu

Reference: Figure 1, Figure 2: Simon Furbo, Solar Heating Systems course, 2011, DTU.
Figure 3: Mark Lawson, R. H. (2010). *WP 1.6 and 1.7 Field trials on a Transpired Solar Collector renovation system* . Berkshire: SCI Steel knowledge.
Figure 4: SolarWall. (2011). *SolarWall Photo Gallery*. Retrieved 08 17, 2011, from SolarWall: http://solarwall.com/en/products/solarwall-gallery.php
Figure 5: Sustainable Sources. (2011). *Passive Solar Design*. Retrieved 08 17, 2011, from Sustainable Sources: http://passivesolar.sustainablesources.com

...Sustainable Mobility...

# Solution by Design

## Electrical cars in Scandinavia

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Electrical cars have been around for quite some time, and up until recently they have been fairly impractical as they are slow and short ranged. However, due to our recent modern technological improvements and innovations within the field of electrical car capacity and longevity, we have been able to switch this negative trend somewhat around. Still, the environmental advantages and the lower operational costs, provided by electrical cars over standard vehicles with oil combustion engines, are overshadowed by three major concerns; the range of the car, its price and the availability of charging stations [1]. These are all factors, which by implementing a better sound design strategy we are fully capable of solving, today. The range of the electrical cars and the availability of charging station will be further addressed here, price is left out, as it is more of an economical issue than a design related problem.

## Reach and charging stations

Companies such as for example Renault-Nissan launched their electric car called Leaf in 2010, which has a range of 160 km, and Tesla Motors is scheduled to launch their Model S, which is supposed to be able to reach up to 480 km [1]. Weather, speed and the use of electrical accessories such as air conditioning can however all significantly decrease the reach. The fear of being "stranded" therefore arises [3]. However, reach by itself does in theory not matter if one are given the option to charge at strategically positioned stations when leaving your electrical car, or while actually driving, as explained by HaloIPT where one can charge while either driving on specific roads or by stopping at a red light in an intersection [2].


**Image 1: The haloIPT wireless charging system. 1 – Power supply. 2 – Electrical wires. 3 – Transmitter pad. 4 – Wireless electricity transfer. 5 – Receiver pad. 6 – Data receiver. 7 – Battery [7].**

**Image 2: The Renault-Nissan Leaf [8].**

## The future within Iceland

Electrical cars could have an immense renaissance in Iceland, and give it just the push it needs to gain further economical viability in the automotive industry worldwide. This is manly due to the fact that Iceland consists of a concentrated population of 319.000 people [4], where 75% lives within 37 miles of Reykjavik [5] and that the road ring (Þjóðvegur 1), connecting Iceland's rural areas with the capital is 840 miles long, making it possible to only set up 15 fast-charging stations along the road [5]. Further, Iceland's primary energy consists of 80% renewable energy (geothermal/hydro), making it a prime location, environmentally, in terms of type, price and amount of energy needed [6].

## How "green" are electrical cars?

There is no surprise that the initial thought everyone would have in their mind is that electrical cars are way more sustainable than its rival, the gas-powered car, as the electrical cars themselves give off no emissions. Still, an MIT study found that electrical cars charged with either nuclear or renewable energy sources sure were cleaner than their rivals, but when the initial energy charge came from coal plants, the environmental impact actually became worse than the gas-powered cars [3]. This truly proves that, even if the car itself is considered green, the materials used, production phase, and in this case, type of energy, can all have severe impacts on the environmental performance of electrical cars. By conducing a full life cycle assessment (LCA) any electrical car company would be able to pinpoint any environmental weaknesses, and utilize this as an opportunity to improve. To advance even further one could easily dive into the field of biomimicry (technology replicating nature) or even cradle-to-cradle thought to solve future design problems.

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# Electric cars ”to go”

## Combining the benefits of electric cars and trains for a flexible, long-range and emission-free way of transportation

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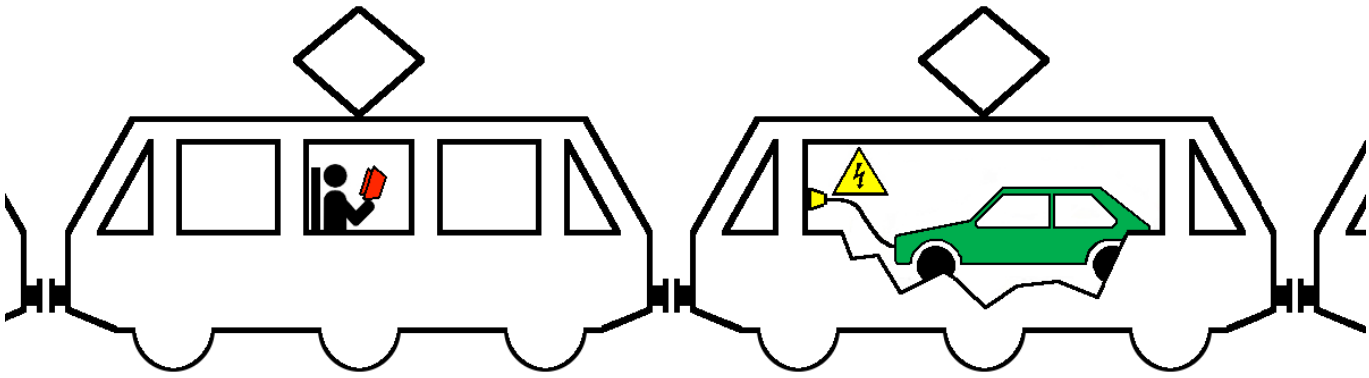
*Finland*

**W**ith an innovative concept of transporting electric cars inside trains the Swiss car manufacturer Rinspeed shows how to overcome the limited operating range of today's electric cars. During the train ride the cars are parked in customized wagons and recharged for the continuation of the journey, while the driver can spend his time on the train working or resting.

## Advantages of the new mobility concept

The central component in Rinspeed's mobility concept is a small electric car with a driving range of about 100 km, enough for most of the trips taking place in urban areas. Its small size comes in handy for city traffic and commuting, and it also allows for easy storage inside a customized train wagon, should the journey exceed the 100 km distance. Some features the wagons have to provide include big doors and loading ramps, fastening appliances for the cars, and electric connections to enable a recharging of the car batteries. But as the train itself already runs on electricity an installation of such connections seems quite possible. The whole journey is carried out using solely electric energy, making the concept carbon neutral - provided the electricity is generated from renewable energy sources. For the driver there are also advantages to this new transportation concept: Instead of driving he or she can use the time on the train for working, eating or relaxing, be it in the car or in the train seats.



**Future transportation or far-fetched idea? The car is charged on the train, the passenger making use of the travelling time.**

## The challenge of implementation

In order to put this idea into practice the corresponding infrastructure has to be developed. First of all new train wagons and matching cars have to be designed and built (currently in progress). A method of swiftly loading the cars to the trains has to be devised, which might require a restructuring of railway stations. Once the concept proves mass compatible, the numbers of trains and train wagons has to be increased and a suitable booking system has to be provided. A very crucial point is of course the sufficient supply of electrical energy, without which nothing moves.

So far this concept has not been put into use, but it is under constant progress. The prototypes might be found in Switzerland in the near future. With equipment appropriate for cold weather conditions this way of transportation is an interesting option also in the Nordic context, as it makes it possible to overcome the usually rather long distances between main cities with a present state electric car.

*Inventor of the mobility concept: Rinspeed AG, CH-8126 Zumikon, Switzerland; www.rinspeed.com*

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# Electric cars of tomorrow

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## Introduction

Electrification of the road vehicle fleet is considered the most promising solution in the transport sector to answer the pressing challenges and concerns over human-induced climate change and oil-dependency. Furthermore, electric vehicles (EVs) result no local air emissions or noise pollution, thus enabling better air quality and comfortable environments especially in the urban context. Even though mass market introduction of electric cars has been delayed time after time, current policy trends, most recently declared in the 2011 White Paper [1] and the European strategy on clean and energy efficient vehicles [2], seem to finally accelerate the development and mobilization of the electric vehicle industry.

## Electrification of the vehicle fleet

The types of electric cars most likely to enter the market in the short-term perspective are plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs), both of which are best suited for short trips in urban environments. In medium- to long-term perspective also the fuel cell electric vehicles (FCEVs) are anticipated to be available, serving the need for bigger cars for longer distances. Combined to simultaneous progress and innovations regarding e.g. intelligent energy grids and intelligent transport systems (ITS), a new window of opportunities to integrate cars in the surrounding physical and virtual infrastructures is opening. Elements in this include solutions dealing with charging infrastructure, energy management, use of biofuels, infotainment, automation, transport pricing, transport safety, use of ICT, etc.

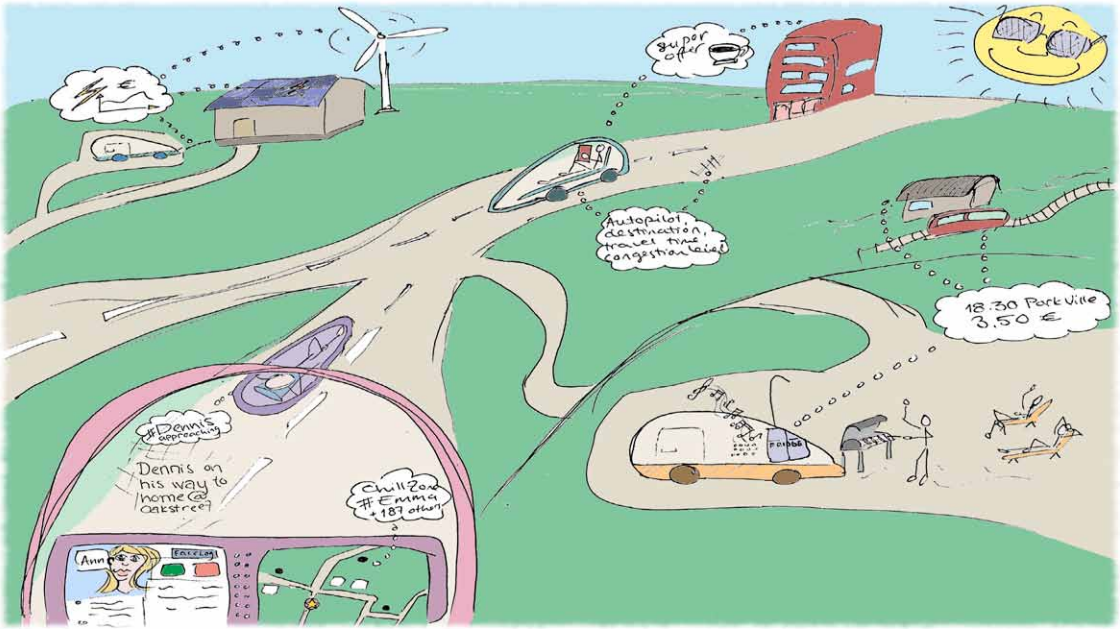


**Figure 1. An image of a future with automated electric cars with a multitude of add-on services and applications.**

## Opportunities for the next decades

Imagine life in 2025 and a future with automated electric cars. You have your own personal EV with fully transparent car body and the opportunity to spend the time while travelling in your cars as you wish (Figure 1). You could just relax and enjoy the view, an experience complemented by the computer system providing information on the display panel but also on the all-embracing interactive windshield surface. You could receive offers from the café nearby, spot out a friend approaching in another vehicle or check out your virtual mailbox. The intelligent solutions for charging your vehicle would take care of all the practicalities, and the autopilot can figure out the travel time and best route to your destination whenever you want to go somewhere. The availability of electricity in the vehicle allows integration of equipment and appliances of your choice to the vehicle, whether it was a barbecue grill or a personal movie theatre. You might actually have forgotten that the primary use for the vehicle was to move from point A to point B since it now very much acts as your mobile (and stationary) personal computer, wallet, phone, entertainment centre, a place to study and work and even as a replacement to summer cottage, hotel night or visit to the movies. Although, if you want to, you can simply use your EV for going to the supermarket. Or maybe you want to send it there on its own to pick up the groceries for you.

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[1] European Commission. 2011. WHITE PAPER, Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system. COM (2011) 144 final. Brussels, Belgium.
[2] European Commission. 2010. Communication from the Commission to the European Parliament, the council and the European Economic and Social Committee: A European strategy on clean and energy efficient vehicles. COM (2010) 186 final. Brussels, Belgium.

# A Novel Battery Technology for Electric Cars of the Future

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**Electric Vehicles for the Future**

Electric automobiles are propelled by motors using electrical energy that is usually stored in batteries. With the global warming being a pressing issue in the current world more and more efforts are being made to find an ideal kind of electric vehicle for the future. Electric cars produce no greenhouse gases since they run on batteries which are charged at home or special charging stations. However widespread future use of electric vehicles depend vastly on advances in battery technology as existing battery technologies are limited by low efficiency and higher weight and cost.

## Semi Solid Flow Battery (SSFC)

A team of scientists at Massachusetts Institute of Technology, USA has developed a battery which combines high energy of rechargeable batteries with flexibility of fuel cells and flow batteries[1]. Unlike previous batteries here charging and discharging functions take place separately. The positive and negative electrodes are composed of particles suspended in liquid electrolyte and the two suspensions are percolated through a network of channels in an ion exchange and electron extraction stack[1,2]. Used semi-solid active material having a high energy density is $LiCoO_2$ with Ketjen Black dispersed in Alkyl Carbonate electrolyte as the conductive phase that flows through the system[1].

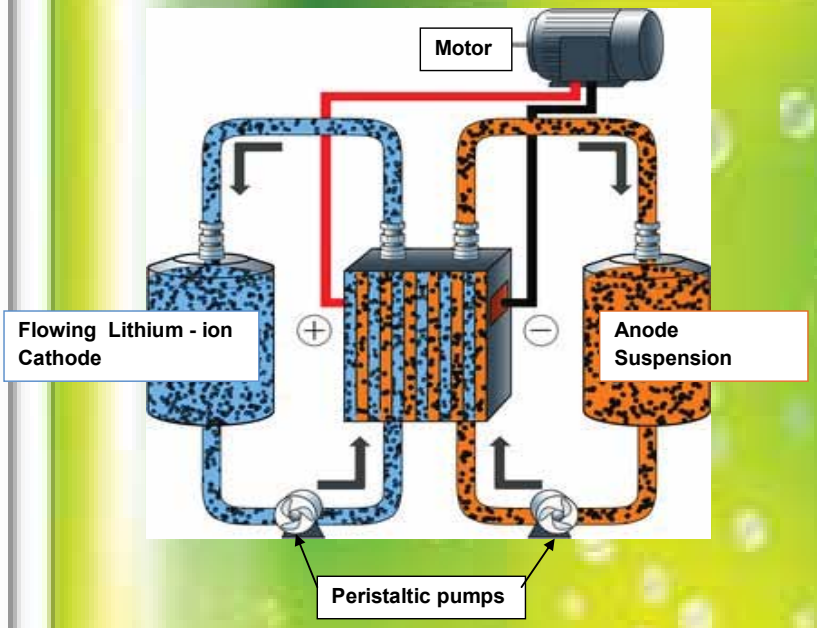


**Figure 01. Schematic diagram of SSFC[1]**

**Figure 02. Semi-Solid Suspension containing $LiCoO_2$ [1]**

**Advantages**

- Energy density is more than 10 times that of conventional flow batteries.
- Low cost, lightweight and simplicity lead to construction of large scale systems compared to existing Lithium –ion batteries, making it ideal for use on electric vehicles.

**Disadvantages**

- Not suitable for smaller equipment having a short time – high voltage requirement.

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2. http://web.mit.edu/newsoffice/2011/flow-batteries-0606.html.

# Hybrid FCEVs vs. BEVs comparison

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*Iceland*

## Introduction

With the growing concern about environmental issues, there is a need for “green” vehicles. Today’s options vary between gasoline-electric hybrid vehicles as well as different fully electric vehicles (BEVs, PHEVs and FCVs). All types have their advantages and disadvantages. The focus of this paper is on hybrid fuel cell electric vehicles (hybrid FCEVs), which have a balanced combination of battery and fuel cell.

## Solution

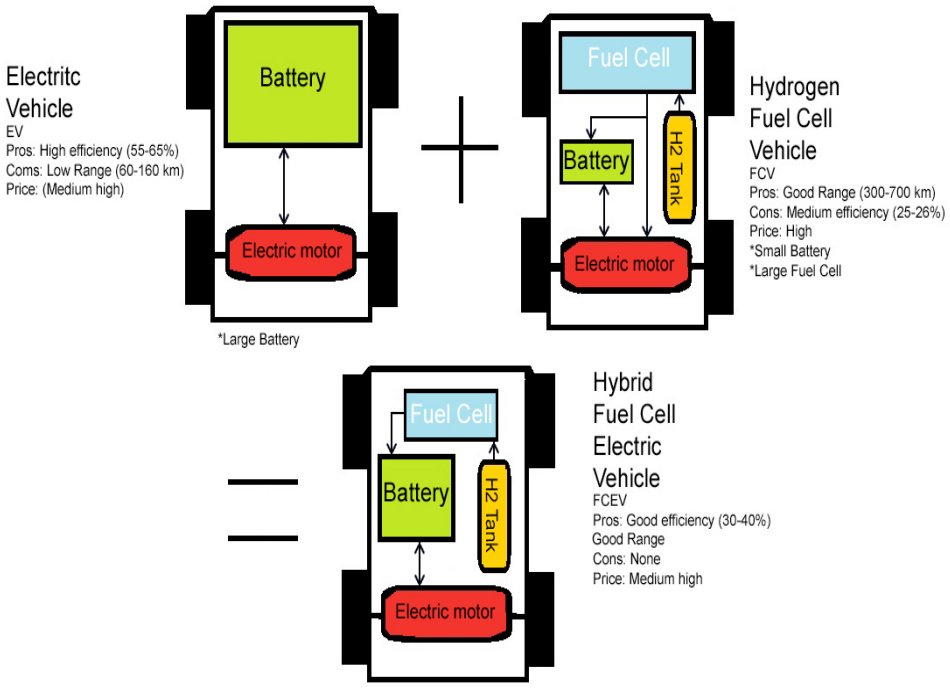


**Figure 1. Comparison of FCVs vs. BEVs (Icelandic Hydrogen)**

The picture on the left demonstrates the difference between “pure hydrogen vehicles” and “pure battery vehicles” in terms of range, efficiency and price, as well as presents the optimal mergence between these two technologies. Today there are only two primary options to power all-electric vehicles: batteries or fuel cells. Both generate electricity to drive electric motors, eliminating the pollution and inefficiencies of the internal combustion engine. Batteries obtain their energy through charging from electrical grid, while fuel cells derive their energy from hydrogen stored on board the vehicle. Both hydrogen and electricity are zero-carbon fuels and can be produced from low or zero-carbon sources, like renewable or nuclear energy.

As both BEVs and FCEVs can eliminate virtually all controllable urban air pollution, it is important to look into various “secondary” features of the EVs, in order to decide whether one type should be preferred over another.
Hybrid FCEVs are implemented in Iceland by several companies, for example Icelandic New Energy and Icelandic Hydrogen. Hybrid FCEVs should be considered primary as vehicles allowing significant range extension, while having a competitive price.

## Advantages and challenges

Hybrid FCEVs, BEVs and PHEVs have been compared in terms of vehicle cost, total life cycle cost (LCC) or total cost of ownership (TCO), fuel infrastructure cost, greenhouse gas (GHG) emissions, local air emissions, oil consumption and commercial readiness, and hybrid FCEVs showed superiority in most criteria compared to other EVs. Recent studies found that hybrid FCEVs, in particular:

- are best option for longer trips and medium-size to large cars, with average range of 500-600 km and acceleration and speed range similar to the ICEs
- refueling time takes only a few minutes, comparing to 6-8 hours needed to fully recharge the battery
- refueling infrastructure is affordable and in line with other EV options

Besides, it has been stated that hybrid FCEVs have such advantages as lower weight, taking up less space on the vehicle and requiring less well-to-wheels natural gas or biomass energy. Moreover, FCEVs have lower vehicle purchasing price if they are mass-produced, and lower operational costs during their life-cycle. BEVs in turn have lower fuel cost per kilometer and initially greater access to fueling capability. Efficiency problem, which exists in pure FCEVs can be overcome by finding the compromise between the size of the battery and the fuel cell.

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# V2G – Vehicle To Grid

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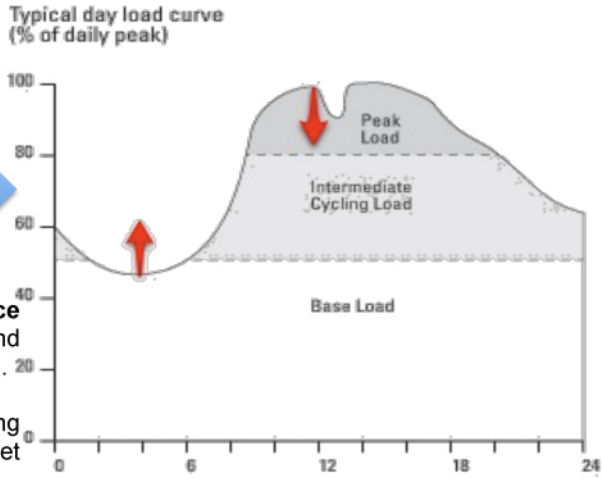
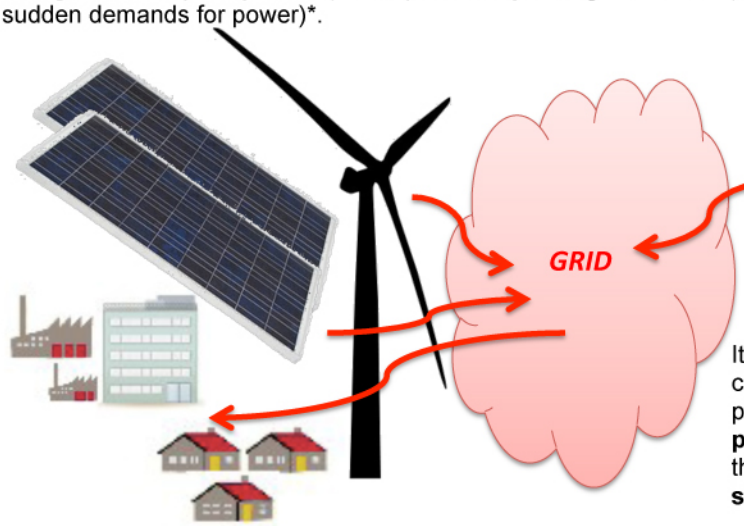
**Centre for Electric Technology**
Department of Electrical Engineering



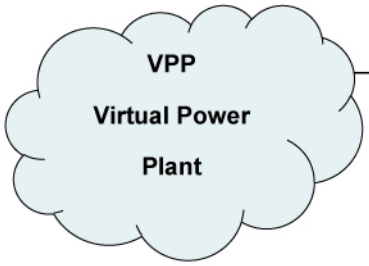

The concept allows **electric vehicles** to provide power to help **balance loads** by "**valley filling**" (charging at night when demand is low) and "**peak shaving**" (sending power back to the grid when demand is high).

It can enable utilities new ways to provide **regulation services** (keeping voltage and frequency stable) and provide **spinning reserves** (meet sudden demands for power)*.





It has been proposed that such use of electric vehicles could **buffer renewable power sources** such as wind power, for example, by **storing excess energy produced** during windy periods and providing it back to the grid during high load periods, thus **effectively stabilizing the intermittency** of wind power*.





The electric vehicle equipped by a V2G module can receive **negative charging schedules**, which are the way to indicate the intention of making V2G.

| | |
|---|---|
| 18:00 | -500W |
| 19:00 | 0W |
| 20:00 | 2000W |
| 21:30 | 0W |
| 22:00 | 2000W |
| 03:00 | 0W |

V2G Commands can be sent by a **Virtual Power Plant**, which works as an **aggregator** of several Electric Vehicles.

In order to facilitate the communication between the VPP and the **charging spot**, the **standard IEC 61850** has been extended, utilized and implemented as a server in .NET.

*http://en.wikipedia.org/wiki/Vehicle-to-grid

# Beneficial Features & Services of EVs

*Asimenia Korompili*
*Technical University of Denmark*
*Denmark*

Engineers vision 1.3 million EVs in the Nordic countries by 2020 [1]. Although additional load, EVs could provide several services to grid, profitable for EVs' owners, when specific functional features occuring. Affecting key factors are determined and should be further investigated in future studies.

## Features creating functional framework for providing services to grid

- Vehicle-to-Grid (V2G) operation:
  EV charges/discharges into grid
  → increase grid reliability/reserve
  decrease costs/emissions [2] [3]

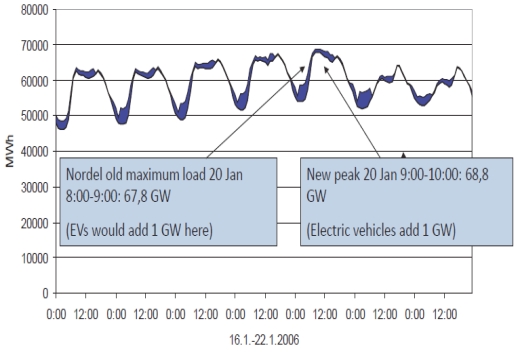
- Uncoordinated charging:
  EVs charge at full power
  when plugged-in
  until fully charged or disconnected
  (initial case before penetration
  of smart technologies
  and advanced metering infrastructure
  for electricity price availability
  →extra power losses
  voltage deviations) [2][3]

- Quick charging: EV draws higher load
  to charge faster [3]

- Importance of fleet
  manager/aggregator:
  +accumulated power of vehicles
  +smoother availability profile [2]

- Coordinated charging [3]:
  info/incentives coerce
  charging at specific times
  - Stagger charging:
    charging throttled based on
    predefined power levels
    communicated through grid
    via smart technologies
  - Household load control:
    houses shed non-essential load
    to charge EVs fully or quickly

  →Less power loss/voltage drop
  postpone grid reinforcement




**Example of coordinated (smart) charging in Nordic power system: The peak load moves to next hour (compared to case of no EVs). Load follows same pattern during time period making better use of Nordic power production capacity [1]**

## Services provided to grid

- Voltage regulation:
  voltage controller
  embedded in EV charger
  (charging stops
  when low grid voltage) [2]

- Frequency regulation:
  when freq<50Hz
  EVs discharge (regulation up via V2G)
  when freq>50Hz
  EVs charge (regulation down)
  (reaction time: few sec) [2]

- Load leveling/peak power supply:
  EVs charge in off-peak hours
  and discharge in peak hours
  → shifting demand
  → min power losses
  increase grid efficiency
  Smart technology/ real - time pricing/
  coordinated charging essential [2]

- Renewable energy balancing:
  EVs charge with excess energy
  when high RES energy
  instead of power plants output decrease
  Stored energy can be used
  for driving needs or provide power
  at later time
  V2G makes RES energy dispatchable
  competitive with fossil fuel prices
  →lower energy costs/energy losses [2][3]

- Regulation vs. peak shaving:
  V2G used for regulation on daily basis
  → significant financial return for individuals
  V2G used for peak reduction
  when high electricity demand and
  poor ambient air quality (few days)
  → great environmental benefits but
  little financial incentive for individuals
  Profits in dual-use program higher than
  single-use program [4]

## References

[1] Nordic Energy Perspectives, 2010, *Towards a sustainable Nordic Energy System*
[2] Clement-Nyns, K. et al., 2009, *The impact of vehicle-to-grid on the distribution grid,* Electric Power Systems Research vol.81 pp.185-192
[3] Green II, C., R. et al., 2010, *The impact of plug-in hybrid electric vehicles on distribution networks: A review and outlook,* Renewable and Sustainable Energy Reviews vol. 15 pp. 544-553
[4] White, D., C. et al., 2010, *Using vehicle-to-grid technology for frequency regulation and peak-load reduction,* Journal of Power Sources vol. 196 pp. 3972-3980
[5] Andersson S.-L. et al., 2010, *Plug-in hybrid electric vehicles as regulating power providers: Case studies of Sweden and Germany,* Energy Policy vol. 38 pp. 2751-2762

## Key-factors affecting benefits from provided services

- Driving patterns:
  -clustered together EVs → concentrated additional load [3]
  -night-time (house) vs. daytime (workplace) connection [5]
  -stochastic driving models [3]
- Multiple charging scenarios combination
  considering age of EVs fleet [3]

- EVs penetration considering individual profits:
  elec. prices follow load → great load leveling → lower elec. prices when EVs owners sell energy to grid and higher prices when buy energy from grid → reduce revenues
  Regulation capacity beyond required level → regulation prices decrease or V2G participants out of market [4]

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## Beyond Sustainable Transport: Electric Car Features and Services

# WIRELESS ENERGY-SUPPLYING PUBLIC TRANSPORT

## Introduction

The idea of wireless charging vehicles has been already circulating for the past few years and has even been implemented from some companies. Furthermore, the charging procedure can work also backwards. In this way the energy surplus of the vehicle's battery supply a house, an office and even the grid while the vehicle is parked. In this case we can talk about a fleet of cars that will be providing energy back to the grid. This idea can actually go even further when you the public transport is also taken into consideration.

## Wireless Power

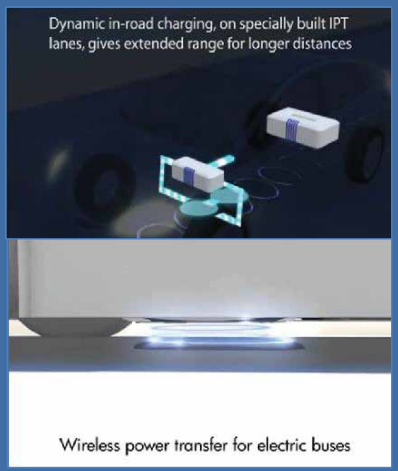
Gavin Harvey created the idea to simplify logistics of electrically wireless public transport infrastructure simply by charging the bus stops. Harvey integrates technology from WiCity in China into his model to create a bus station that charges a bus each time they stop and pass by. The excess energy will be fed back into the grid.

(*Eco Buses Wirelessly Charge In The Future - http://www.wirelesspowerplanet.com*)

http://www.wampfler.com


The OLEV system uses a patented and proprietary method of SMFIR™ (Shaped Magnetic Field in Resonance) to safely and efficiently transfer electric power from road-embedded charging strips, or an "electric road", to a relatively small on-board battery and vehicle powertrain. The OLEV system is initially targeted at operators of fixed route transportation systems such as airport buses, bus rapid transit (BRT) and catenary-free electric trolleys and trams to reduce their use of fossil fuels and energy costs by as much as 80%, and to replace their inefficient vehicle fleets—busses and other mass transit vehicles—with efficient lower cost electric vehicles enabled with on-road wireless charging capability. (*Olev Technologies: Delivering Advanced Wireless Charging Solutions for Public Transit - http://www.olevtech.com*)

- By implementing the wireless pad receivers to the existing priority bus lanes we have a electric motorway ready to charge the vehicle on the fly. This provides the energy required for the vehicle to complete its route.
- On the other hand, when the bus or the buses are back at the depot station they can unload all the energy surplus back to the grid creating wireless power plant!
- Although a bus requires larger amounts of energy to operate and thus will be equipped with higher capacity batteries. The wireless lane can fully support these needs while the batteries provide even more power than those in a usual electric car.




*http://www.haloipt.com*

*Konstantinos Vavatsoulas*
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# Electric cars service network – Better Place

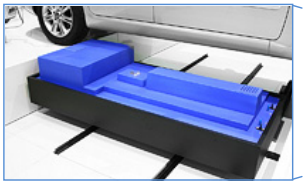
*Ronen Hadar*
*The University of Southern Denmark*
*Denmark*


## The problem

Electric Vehicles (EV) has been long identified as having immense potential. Presently, short battery life, lack of infrastructure and services, poor vehicle performance, and a need in recycling technologies progress, hinder the development and implantation of EVs as a viable and feasible mean of transportation.

## The solution

Better Place's main idea is that car owners do not own their EVs battery but rather lease them in addition to selling the elctricity used to charge them.



1. Leasing replaceable lithium-ion batteries for EVs.

2. A worldwide network of baterry switching station


3. Grid connected charging stations widely available

4. EV related services (software, network, etc.)

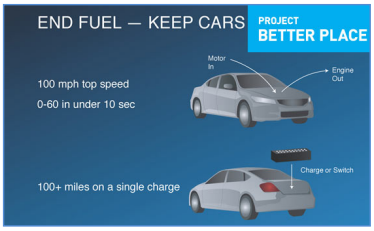


## Current state

- Alliance with Renault-Nissan for developing EV batteries and cars
- Alliance with Dong Energy for establishing a charging station grid and changing stations across Denmark
- Aarhus, Middlefart, and Fredericia municipalities and their energy providers entered joint ventures while Aarhus is already laying foundations for recharging depots in the city
- A pilot at a taxi station in Tokyo, Japan, for the evaluation and optimization of their technology
- Collaboration with 92 corporate fleet owners and a major gas-station operator in Israel
- First Renault Z.E launched in Israel
- Cooperation with the government of Canada, Australia, USA, China, Denmark, Israel, and the EU

## The challenges

1. Danger of replacement by car manufacturers or energy providers
2. Enormous investments in order to replace exciting infrastructure
3. Requires direct government support
4. Other technologies for EVs are being developed simultaneously and may prove to be cheaper and better
5. Battery technology is still lacking to reach customer satisfaction




Better Place chose Denmark as a starting point already in 2007 due to the Danish government's commitment to green and renewable energy. Additionally, Denmark's efforts in wind and solar energy allows collaboration regarding charging of batteries.


References: http://www.betterplace.com; http://www.bizjournals.com/sanfrancisco/blog/2009/08/ford_5_better_place_challenges.html;

# Solar powered residential hydrogen fueling station

*Antti Teräsvirta*
*Aalto University*
*Finland*

EU's Energy Performance of Buildings Directive requires that all new buildings must be nearly zero energy buildings by 2020. This goal will be met by implementing technologies for on-site renewable energy generation. The seasonal and diurnal variation in photovoltaic power production can be evened out by using hydrogen as energy storage.

## High pressure electrolysis cuts costs

Once produced by electrolysis, hydrogen has to be compressed to high pressures. Using a high pressure electrolyzer lowers the cost, footprint and energy required for hydrogen compression since a separate electric compressor is not needed. Pressures of up to 800 bar have been reached using electrochemical compression. [2]

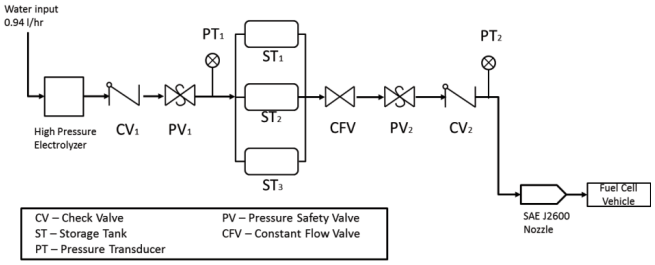



**Figure 1: Major components of a residential hydrogen filling station. Redrawn from [1]**

A conceptual design of a solar powered hydrogen filling station for a single family home has been developed in Missouri University of Science and Technology, Department of Mechanical & Aerospace Engineering. Figure 1 illustrates this system intended to be located in Wallingford, Connecticut USA. The concept conforms to Wallingford's zoning regulations and safety codes for the hydrogen fueling system. [1]

## The fuel cell electric vehicle supplements the grid

A fuel cell converts hydrogen and oxygen into water, and in the process it produces electricity. Fuel cell vehicles are, in effect, electric vehicles since the electricity generated by the fuel cell is used to drive the electric motor. The fuel cell electric vehicle can act as a backup generator for homes and supplement the grid during peak hours, and charge in off-peak hours at lower cost.

Compared to the traditional electric car the Fuel Cell Electric Vehicle (FCEV) has a longer range and faster refueling. These properties make it suitable for Nordic countries, where distances between settlements are large. In figure 2 safety issues raised by high pressures and the flammability of hydrogen have been settled by roof ventilation and open structure of the garage.

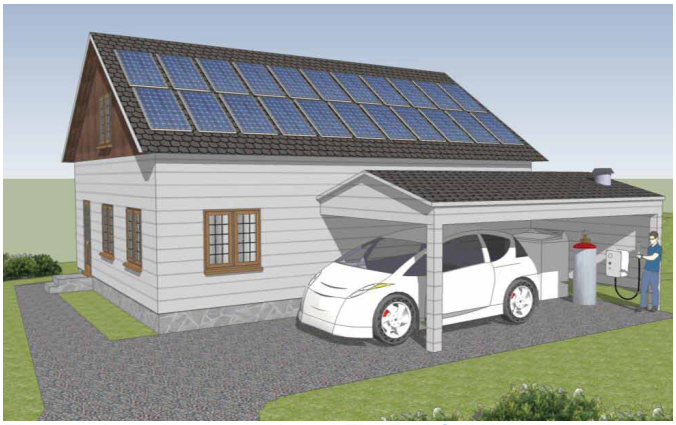


**Figure 2: A nearly 0-energy home. The Fuel Cell Vehicle running on solar hydrogen produces zero emissions**

References:
[1] Aanchal Shah*, Vijay Mohan, John W. Sheffield, Kevin B. Martin. Solar powered residential hydrogen fueling station. Missouri University of Science and Technology, Department of Mechanical & Aerospace Engineering. International Journal of Hydrogen Energy, In Press, Corrected Proof.
[2] HyET Achieves 800 Bar Electrochemical Compression, Fuel Cell Today News, http://www.fuelcelltoday.com/online/news/articles/2011-08/HyET-Achieves-800-Bar-Electroche (Last accessed 25.08.11).

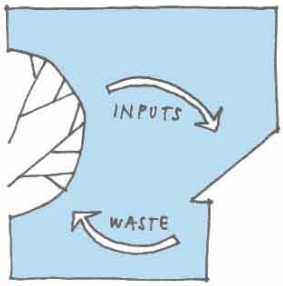
...Sustainable Urban Environments...

# Building, Dwelling, Gardening

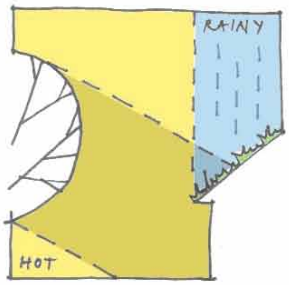
*Alise Plavina*
*Norwegian University of Science and Technology (NTNU)*
*Norway*

Gardening can be used for maintaining natural cycles, improving the micro-climate in buildings and strengthening communities. Following the premise that “to think environmentally is to find the reasons to garden” [1], the contribution of vegetation to more sustainable built environment has been explored.

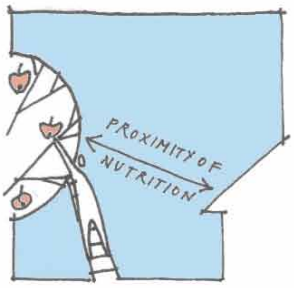
## Four reasons to garden




1 Maintaing natural cycles




2 Natural climate control




3 Providing nutrition


4 Community building

Maintaing natural cycles

*Possibilities*: management of the natural cycles to incorporate the inputs necessary and wastes generated by a building; relatively high impact possibility for the reversible cycles of water, carbon-oxygen and nitrogen [2]; carbon/oxygen – household $CO_2$ emissions compensated by carbon sequestration in plant biomass; nitrogen – household waste and plant nutrient cycle
*Limitations*: limited green urban areas, existing infrastructures, seasonality of carbon/oxygen cycle for deciduous plants

Natural climate control

*Possibilities:* plants can have impact on most of the environmental conditions that impact the thermal comfort of the human body and building micro-climate; by shading and transpiration plants significantly reduce air and ground temperatures during summer and the cooling effect of the wind in cold climates; use of building-integrated vegetation on roofs and facades
*Limitations:* limited efficiency, seasonality, densely built urban environments

Providing nutrition

*Possibilities*: reducing energy use for food transport; intertwining food, waste and energy (from biomass) cycles [3]; reconsidering urban elements such as vacant lands, roadsides and rooftops as appropriate for gardening
*Limitations:* seasonality, lack of time and knowledge of gardeners-to-be, competing leisure activities, limited incentive

Community building

*Possibilities*: strengthening community bonds through urban land resources and shared gardening practices; providing employment for disadvantaged groups through urban farming and street or courtyard upgrading projects; creating a wider range of habitats for urban wildlife
*Limitations:* limited land use and ownership, slow change in the perception and use of urban areas

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1. Pollan, M. Beyond Wilderness and Lawn // Saunders, W.S. (ed) Nature, Landscape and Building for Sustainability. Minneapolis, Minn.: University of Minnesota Press, 2008.
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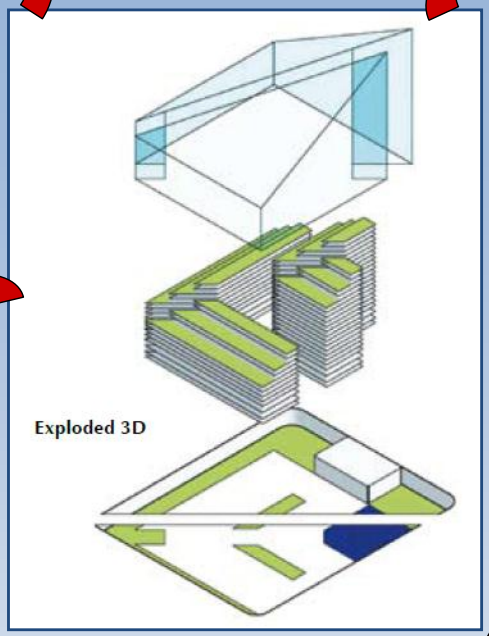
# “Microclimatic envelopes covering building areas in Nordic countries”

*The concept behind this innovation is to create a microclimate within a transparent envelope supported by steel structures. This will create a warmer environment in the heating season while maintaining similar temperatures in the non-heating season compared to those present outside the envelope.*

## Applicability

- Groups of dwellings including open spaces between them
- Alternative solution for retrofitting and renovation




## Microclimate

- The temperatures inside the envelope are relatively higher in winter, considerably higher in spring and autumn and cooler in summer due to shading
- Less hours with temperatures below zero degrees Celsius
- Less temperature fluctuations

## Protection

- The envelope increases the durability of the buildings by protecting them from the external weather agents; rain, snow and wind.

## Building materials

- Less insulation required
- Water tight constructions can be neglected
- Double glazed windows might be sufficient

## Energy Consumption

- Warmer temperatures inside the envelope lead to a lower heating demand for the buildings during the heating season
- Annual usage of natural ventilation is increased
- PV cells can be used both as a means to generate electricity and as a shading mechanism, especially if well distributed.
- Shading provides more favorable temperatures in summer

## Existing cases

- Germany: Academy Mont-Cenis by Jourda & Perraudin and architects Hegger
- China: Parkview Green by Integrated design Associates and Arup

*Authors:*
*Amy Faramroze Baria*
*Maxim Koltomov Sierra*
*Technical University of Denmark*
*Denmark*

*References for pictures: Building Journal – Parkview green Microclimatic envelope www.building.com.hk/downpdf.asp?id=138*

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# Model-Based Predictive Control of Buildings

*Kevin Michael Smith*
*DTU*
*Denmark*

As we move toward zero-energy buildings, passive solar design may cause over-heating. We can prevent this in non-residential buildings by allowing a building to pre-cool overnight. However, this is not wise if the next day will be cold. As a solution, we can use weather forecasts and a dynamic building model to predict its thermal response. This can tell us when to pre-cool and the best way to do it. This is just one example of model predictive control (MPC) in buildings.

## Statistical weather prediction and thermal models

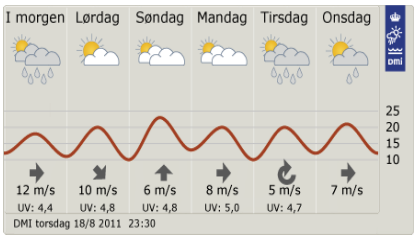


Figure 1 Basic long-term weather forecast

Statistical methods for better weather prediction – available globally

Statistical methods to fit thermal building models with real data

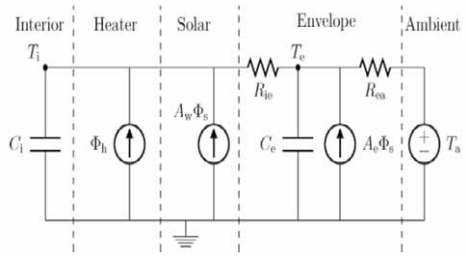


Fig. 2 Example RC-network thermal building model

## Model-based predictive control

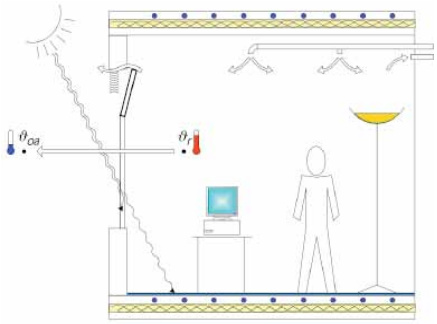

Figure 3 Potential automated subsystems

May include other subsystems in the model for integrated control

Formulate a control optimization with comfort criteria and energy use

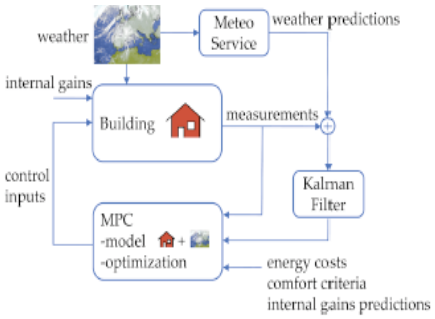


Figure 4 Example of an MPC formulation

## Implementation and results

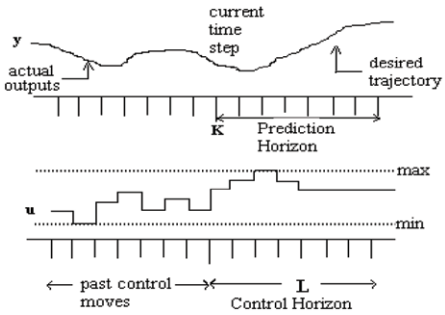


Fig. 5 Energy use (top) and temperature (bottom)

Calculate optimal control strategy for energy savings

Identify potential and implement in reality

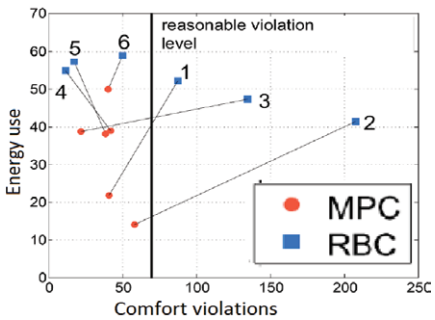


Fig. 6 MPC versus the next best control technique

References
Figure 1: DMI Weather <http://www.dmi.dk/dmi/index/danmark/landsudsigten.htm>
Figure 2: P. Bacher and H. Madsen. "Identifying suitable models for the heat dynamics of buildings." Energy and Buildings. 2011.
Figure 3, 4, 6: D. Gyalistras et al. "Final Report: Use of Weather and Occupancy Forecasts for Optimal Building Climate Control (OptiControl)." ETH Zurich. 2010. <http://www.opticontrol.ethz.ch/Lit/Gyal_10_Rep-OptiCtrlFinalRep.pdf.php>
Figure 5: S. J. Qin and T. A. Badgwell. "A survey of industrial model predictive control technology." Control Engineering Practice. 2003.

# TRANSITIONAL USE

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*Norway*

In the rapidly changing, fragmented and multicultural Western societies of today, public spaces are essential both for bringing different groups of people together and for giving them a sense of attachment to their close environments. According to the theories of environmental psychology personal connection to a place creates a sense of belonging, which in turn gives significance and meaning to life. However, formal planning practices tend to be bureaucratic and inflexible and very few people are currently influencing the way most cities are developing. New planning practices are needed in order to achieve truly sustainable public spaces; spaces that are inclusive and responsive to the needs and desires of the inhabitants.

In my understanding sustainable design is based on creating a sense of true meaning for the users. I believe that meaningful public spaces can increase social inclusion in society and make people less dependent on (individually owned) material objects to give value to their lives. Due to economic crises and the intrinsic inertia of the building industry many cities are provided with gaps in the built structure. If hosting temporary functions and activities while awaiting more permanent development these spaces can offer a possibility to explore new urban development strategies that could increase both public action and exchange between different groups of people.

## Creating meaningful places for many by hands-on brain storming


***Transitional use* on Berlin's Schloßplatz 2004-2005; trying possible future functions for Palast der Republik (the former DDR government building).**

*Transitional use* can briefly be described as temporarily allowing potentially innovative land use on disused urban sites and thereby creating a series of different land uses between two formally planned zonings. During the formal planning process effects and consequences of different development options are evaluated theoretically by a few politicians, planners and commercial stakeholders before producing a legally binding document (eg. a local plan in Sweden). *Transitional use* instead allows many different individuals to take direct physical action during a certain period of time. By literally trying out different possibilities for the future – is the site best used as a playground, a park, an art gallery or maybe as a gym for the elderly..? - the actual effects of different activities can be evaluated according to the desired output (eg. activity during different times of the day or presence of certain target groups).

During the period of *transitional use* more citizens have the chance of presenting and realizing their ideas about what the city and its' public spaces should be. The process creates both a functional and mental transition between more stable phases in the urban development. If inclusive in its character, *transitional use* could be conceptualized as a collective and hands-on brain storming about the future of a public site. In Berlin, as well as in some other European cities, this has been used during the last decade as a way of dealing with the complexity and uncertainty of temporarily unused land. The process is believed to create urban spaces that are more diverse and adapted to the varying requests of the inhabitants. With expanded stakeholder/public participation these ***urban laboratories*** have the potential of changing societal and behavioural patterns of action by collectively shaping the common grounds of the city.

# Trade-offs in Urban Planning & Design: “Re-wilding” Our Cities for Long-term Sustainability

*Chad Stephen Boda*
*Lund University Center for Sustainability Studies*
*Sweden*

“As we build, so shall we live.”- Richard Register, Eco-cities

“Re-wilding” is bringing nature back into the city and turning un-adaptable concrete jungles into functional, living habitat for humans and nature! A “re-wilded” city is a Sustainable City in balance with nature! Where cutting edge science meets ecological common sense!

Nordic cities over-all can expect more rainfall and warmer temperatures as a result of Climate Change. To help prevent and adapt to the most severe affects of climate change, “re-wilding” our cities can be an important, realistic solution. “Re-wilding”, as both an adaptation and mitigation strategy, would promote biodiversity, reduce atmospheric green house gases, buffer extreme weather, support food security, and foster resilience in a changing world.

**However, “re-wilding” involves considerable trade-offs!**

Climate Change will put unprecedented pressure on our natural and built environments. Natural habitat will be reduced, impermeable urban environments may exacerbate flooding, and extreme weather may make life unpredictable and more difficult.

**“Re-wilding” must include collaboration between Innovative City Planners, Local to National Government, and concerned citizens of all walks of life!**

## Synergies and Conflicts include:

**TEMPORAL SYNERGY!** Starting now will help mitigate the worst affects of climate change and provide mechanisms for adapting to inevitable change

**POWER AND DECISION MAKING!** Centralized decision making is essential to ensure national adaptation and mitigation strategies but decentralized decision making can better provide for the diversity and bio-regional focus necessary for successful re-wilding

**GEOGRAPHIC INTERDEPENDENCE!** Working within bio-regions and between local and regional governments can help reduce conflicts between different areas within a country and help the country as a whole adopt mitigation and adaptation strategies that promotes regional diversity and interdependence

**COLLABORATION VERSUS COMPETITION!** Re-wilding is an excellent idea for sustainability, but it involves giving up what could be very lucrative and expensive land for what ultimately will be a communal good. Trading economic productivity for natural productivity might not bring in the most money; business interests could reject such a proposal, thwarting mitigation and making adaptation more difficult and more expensive

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**REFERENCES** Graphic designed by Linnea Berg. Chalmers University, Gothenburg, Sweden
Register, Richard. “Eco-cities: Rebuilding Cities in Balance with Nature”. New Society Publishers; Revised edition. April 1, 2006

# On the loss of green spaces

## - dense cities or green areas, do we have to choose?

*Linda Strandenhed*
*Swedish University of Agricultural Sciences*
*Sweden*

Today, for the first time in the history of mankind, more humans live in cities than in rural areas. The number of people who live in cities or mega-cities is rapidly increasing, a rate of urbanisation that have far-reaching consequences in the present and for a future facing global climate change. As the price of land is skyrocketing, the temptation to build on every available square of land is hard to resist. In many cities around the world, green spaces are a scarce resource and the access to them very much a class issue. A growing body of research is showing the importance of green spaces, both for environmental sustainability and the health and well-being of humans. Green spaces in cities increase biodiversity, prevent erosion, help with rainwater runoff, absorb pollutants and noise, improve air quality and cool down the area. They can also provide recreational, educational and aestetically pleasing elements in the city.

But there are also environmental and social arguments for favoring dense cities. Well-built, dense cities can help mitigate climate change. Dense cities can reduce energy use, encourage alternative forms of transport, prevent cities from growing on arable land, create living, social environments that open up meeting spaces and work against segregation and gentrification. But sustainably dense cities need to include lots of green spaces. Too often, these spaces are lost when cities are growing.

## Case Study: Seminarieparken

Seminarieparken is situated in Uppsala, Sweden's fourth largest city. The park and the building was constructed in 1917 as a school for teachers, a function that it retained until 2010. The political struggle over how to use the area has been in full swing since 2006. The first proposal was to fill the whole park with a mix of rented and owned apartments, similar to newly constructed areas nearby (Left Image). Proponents of this idea cites more life and energy to the area, the dire need of further housing in Uppsala and the threat of the city growing over arable land in the outskirts of Uppsala. Opponents want to keep the park. They are concerned with the implications of turning the in practice public park into (expensive) private spaces, of the loss of a green area in a part of town where parks are scarce, of loosing the historical importance of the place (the orchard and the layout of the park, for example) and in general of loosing the numerous benefits that green areas bring. Right now, there are attempts to reconcile both sides. The suggestion is to build some houses along the outskirts of the park, towards the big roads, but preserve some parts of the park untouched. A great variety of innovative ideas for how to develop the area and keep the park has been proposed by citizens. As the matter stands, the park is still threatened.

## Solutions

**Preserving green areas:**
Keep the parks!
Build housing on other areas.
One of the proposals in Uppsala is to lower the norm of the ratio of parking places to apartments. That will encourage people to choose other modes of transport, preserve the parks and still allow more houses to be built.
Parking houses and improved use of space along roads save space for mixed-use neighborhoods in a welcoming city.

**Microparks:**
Creatively utilizing small spaces in densely built environments.
Compliment to existing large parks. (**Not** replacements!)
Corners of buildings, on walls, on rooftops, between streets, in roundabouts and so on can be turned into green spaces.
Added green areas can work as green corridors for wildlife and help provide various ecosystem services.
Can raise awareness of environmental issues.
Open up meeting spaces for people.
Serve both aesthetic and practical purposes.
Several microparks around the same theme can serve as tourist attractions and encourage walking or biking tours.

**Image: Hardy mosses and plants in a No Park zone in New York. The micropark allow emergency parking and help deal with water runoff.**

References: Uppsala Kommun: *Detaljplan Seminarieparken*, Uppsala Nya Tidning www.unt.se, *Seeing like a State – How certain schemes to improve the human condition have failed*, 1999, James C Scott, NoPARK Project: www.environmentalhealthclinic.net/projects/nopark/
Pictures: http://all-free-download.com/

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# Renovating to Low Energy Houses

*Marie Louise Olin*
*Roskilde University*
*Denmark*

It is only 1% of the entire building stock that is new houses in Denmark. So even if new houses were built after the most energy efficient standards, it would not cause a significant reduction in the carbon emission. The existing building stock is consuming 40 % of the total energy in Denmark, and it is in this field that it is possible to make a huge difference. So what to do about the houses that are already build?

## Social Houses

**Bunk houses from 1970 in Albertslund, Sealand.**

There are more than ½ million social houses in Denmark. The social houses are for renting. Most of the social houses were built in the 1960-70 – before the oil crisis. They were mass produced, and that gives an advanced when they have to be renovated. It is possible to mass produce solutions for huge building blocks and keeping the costs low.
The average time a resident is living in the same house/flat is 8-10 years. That means that the profitability of a renovation has to be in 4-5 years before a renovation is voted for at a tenants' meeting.

## The Residents' Homes

Each Housing Department is responsible for ensuring that the homes are in good condition, and is highly responsible for the refurbishing, which has to be approved by the residents. One has to take into consideration the people who are living in the houses and involve them so they can be a part of the finale solution. It is also important to consider their social, economic and cultural background. Residents' democracy is a very important part of social housing because the residents have a legal right to influence their own homes, and every decision that has influence on the rent must come to a vote.

## Barriers & Incentives

Below is listed some of the barriers and incentives that usually occurs when a building has to be energy refurbished.

- Technical difficult
- Financing
- On your own if it is a private home
- What kind of technical solution to choose?
- I would rather have a new kitchen!
- New technology can be difficult to understand

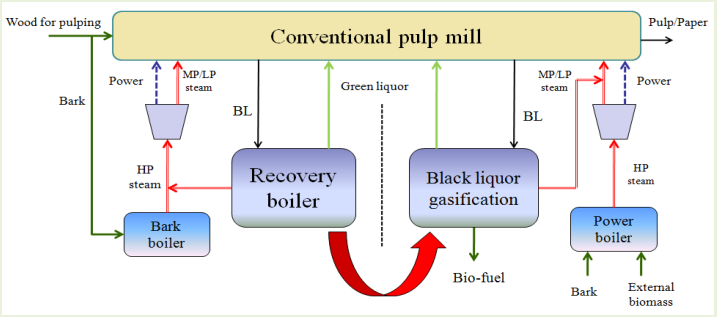
- Savings on the heating bill
- Good for the environment
- Added value to the home
- Legislation
- Subsidies
- Guarantee loans
- If private ownership: Easier to sell the house

# Potential $CO_2$ Capture with Black Liquor Gasification at the Pulp Mills In Sweden

*Muhammmad Naqvi*
*The Royal Institute of Technology, KTH*
*Stockholm, Sweden*

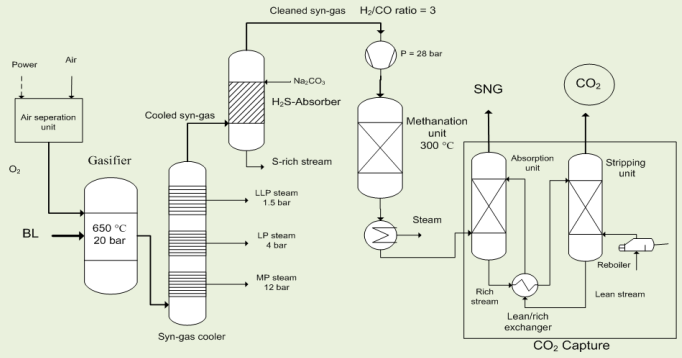
## Introduction

- Pulp and paper industry consumes a large proportion of biomass worldwide that include bark, wood residues, and **black liquor** (BL).
- Black liquor gasification (BLG) based bio-refineries to co-produce **electricity**, **chemicals** or **bio-fuels** with pulp and paper products.
- Transport bio-fuels such as **DME (dimethyl ether), synthetic natural gas, methanol, hydrogen or synthetic diesel** from BLG can potentially replace significant amount of **conventional fossil fuels**.




## $CO_2$ capture integrated with BLG

- Possible to **integrate CCS technology** with black liquor gasification for climate change mitigation.
- The fossil $CO_2$ emissions in **Swedish pulp and paper mills** are not significant but the biomass based $CO_2$ emissions are large.
- Total black liquor capacity in Sweden was about **10%** of the world in 2008 and simple estimations shows possible reductions in $CO_2$ about **100 million tonnes per year** with CCS integration with BLG systems in pulp and paper mills.
- Although in principle bio-based $CO_2$ is neutral, possibility to capture bio-based $CO_2$ exists which was identical for the fossil fuel based plants e.g. **Synthetic natural gas** production with $CO_2$ capture (see Figure).




## Potential Motor Fuel Replacement

- From SNG production using black liquor available in various regions e.g. Sweden, Europe, and World, substantial amount of motor fuel can be replaced (see Table).

Potential annual motor fuel replacement from SNG produced based on black liquor availability in 2008 (Naqvi et al., 2011)

| | Sweden | Europe | World |
|---|---|---|---|
| Black liquor, TWh | 47 | 184 | 733 |
| SNG production, TWh | 31.3 | 122.5 | 488.7 |
| Gasoline use[a], TWh | 43.6 | 1667 | 10019 |
| Diesel use[b], TWh | 34.1 | 2243 | 7614 |
| Gasoline replacement, % | 72 | 7.4 | 4.9 |
| Motor fuel replacement, % | 40.2 | 3.1 | 2.7 |

[a] Based on the Food and Agriculture (FAO) database (FAO, 2008)
[b] Data from Earth Trends: Environmental information (Earth trends, 2008)

Naqvi, M., Yan, J., Dahlquist, E., 2011. Integrated synthetic natural gas production from oxygen blown dry black liquor gasification process with direct causticization. ICAE 2011, Perugia, Italy

## Important Aspects related to CCS

- The scientific research and development (R&D) work needed to solve issues and to fill research knowledge gaps i.e.
  1. Technical aspects of $CO_2$ capture and storage
  2. Geographical relationship between sources and storage opportunities of $CO_2$
  3. Cost of CCS systems
  4. Barriers to investment in carbon capture
  5. Legal and regulatory issues

## Conclusions

- $CO_2$ capture and storage could play an important role as an emerging technology in climate mitigation reducing greenhouse gas emissions.
- The consensus among researchers, industries and governments would help CCS commercialization in near future.
- With BLG systems, a significant $CO_2$ abatement is possible especially in Nordic countries such as Sweden due to large pulp and paper industry.
- A substantial motor fuel replacement in transport sector to replace large amount of fossil based fuels.

# Stavneblokka +

*Michael Gruner*
*Norwegian University of Science and Technology*
*Norway*

The Stavneblokka was initially conceived by Berge, Nordby et al. as a robust wall construction system for self-building using reclaimed wood as source material. The development presented here focuses on its functioning as independent structural system which is one of the key issues of the block.

Stavneblokka 2010

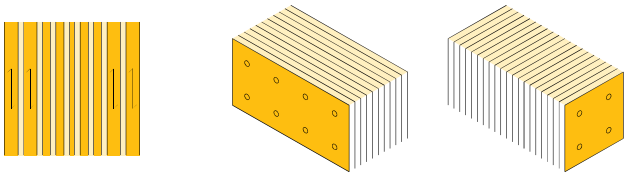
## Intentions

- Use of reused scrap and low quality waste wood as source material
- Waste and carbon storage (´the more wood, the better´)
- Low-technology manufacturing process with low production-related energy demand
- Small scale, generic module allowing flexibility and self-building
- Utilisation of the sound hygrothermal and structural properties of wood
- Possibility of disassembly (no metal or chemical adhesives used as connectors or joints)
- Energy recovery by burning in wooden stoves [1, 2, 3]

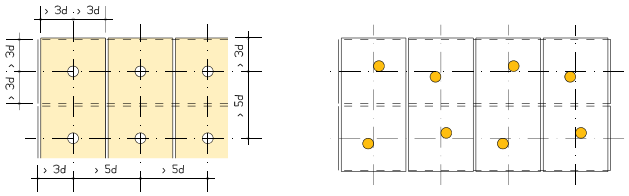
## Development

In a first step the issues of the block have been assessed and solutions for single issues have been developed and alternative possibilities proposed.

They address the evaluation of the unpredictable properties of the source material by visual grading, optimisation of the module and shape to cope with the individuality of the blocks and system inherent tolerances. Also the arrangement and proper location of the lamellae within the block, the positioning of the dowels to prevent splitting of boards and finding suitable solutions for the joints were investigated.



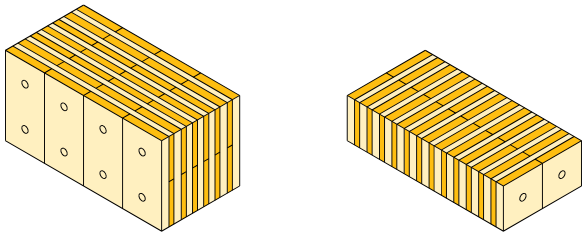
Lamellae arrangement and orientation




Dowel spacing and distribution pattern

## Proposals

The single solutions for individual aspects have been bundled in two preliminary alternatives for modules. One proposal focuses on maximum use of wood and load-bearing strength. The second one is lighter and suitable as one-hand block.



Alternative proposals 1 (left) and 2 (right)

References

(1) Berge, Bjørn. (2006) “Klimablokken – Et byggesystem av massivtre”. Gaia Lista
(2) Nordby, Anne Sigrid et al. (2009) “Developing the Stavne timber block”
(3) Wigum, K. S. et al. (2010) “Utvikling av Stavneblokka – fra ide til virkelighet!” Sluttrapport

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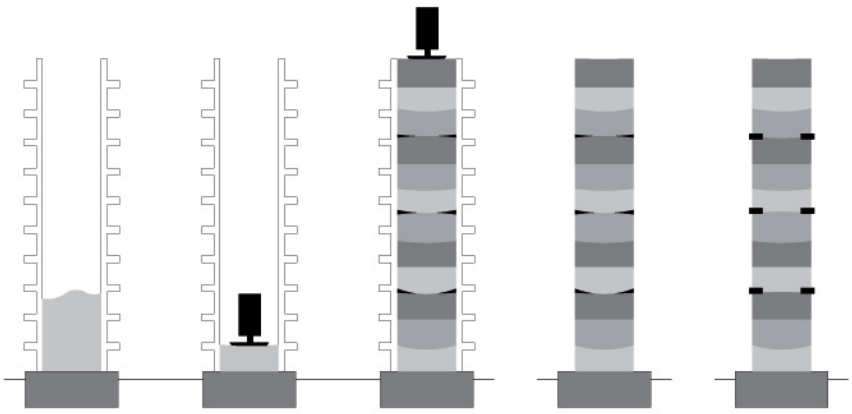
# Building with Earth

*Maiju Suomi*
*Aalto University*
*Finland*

As we look for new ways to build our surroundings sustainably - both ecologically and economically - it is often wise to look into the past. The vernacular traditions around the world offer a variety of natural and inexpensive building solutions that can be applied and further developed in the modern world. Perhaps the oldest building material in the world is earth - clay, gravel, sand, silt, loam and mud. Still today approximately between a third and a half of the world's population lives in houses built of earth. The variety in available soil types has resulted in an abundance of different earth building techniques on our planet. Among these are rammed earth, mud bick, compressed earth block and molded earth.

## Rammed Earth

This age-old technology has its roots in the Late Neolithic period China. Today it can offer us both technically and aesthetically an interesting option e.g. to the energy intensive concrete. The ecological advantages of rammed earth are in its complete recycleability, in its low embodied energy and the potential of the heavy earthen walls to provide thermal mass for passive solar heating. The raw material earth is extremely low-cost and can often be excavated right from the building site.



Arch. Roger Boltshauser, Martin Rauch:
House Rauch
Schlins, Austria, 2005 - 2008

Succesive layers of moist earth are filled into the reinforced plywood mould and compacted - in the end creating a rock-hard structure

ideal mixture of earth:
15-18% clay
23%coarse aggregate
30% sand
32% silt
mortar layers, stone slabs, metal or fired strips of ceramics can be applied as erosion brakes

## Resources

Earth Architecture
Rael, Ronald
New York: Princeton Architectural Press 2009

www.eartharchitecture.org
A broad source on what's currently happening in the world of earth architecture

http://www.lehmtonerde.at/en/
Martin Rauch's website offers a good source of information on earthen building materials

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# Weaving into the city structure

*Sangram Shirke*
*Umeå School of Architecture*
*Sweden*

Green corridors connecting city blocks

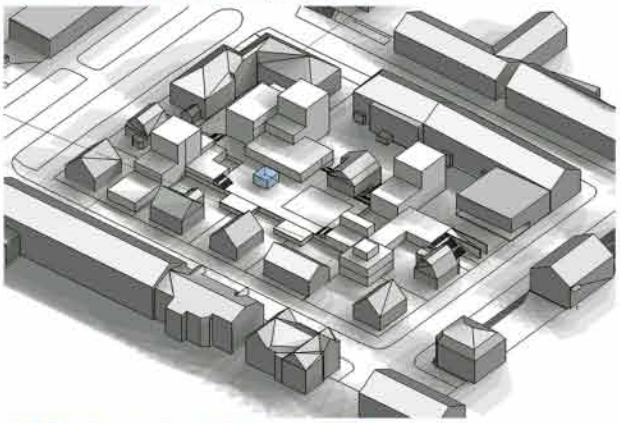
Many of the smaller Nordic cities the of the size of Umeå or Vaasa are growing cities with a typical grid-iron layout and low density. The expansion of such cities is resulting in the decentralization of the cities and a fast spreading urban sprawl.
**Environmental** + **Economic impact**: Ecological imbalances and a tremendous rise in the infrastructure cost and material-
**Social impact**: The city center loosing it's significance and social character.

Currently the open spaces between the living units in the city block are used for parking/services. The proposal is to densify the existing city blocks by weaving in the new built areas without disturbing the character of the city.

*Existing:*
Total built-up area- 6078 sq m

*Proposed:*
Built-up area- (6078 sq m) + 3200 sq m

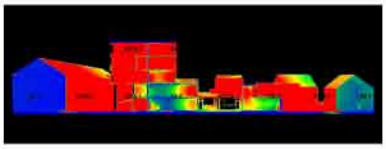
Increase in built area: 52%



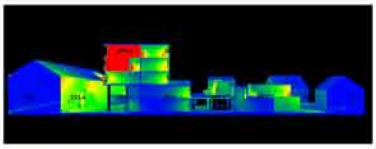
3-D Shadow analysis of the proposal


Proposed densification plan

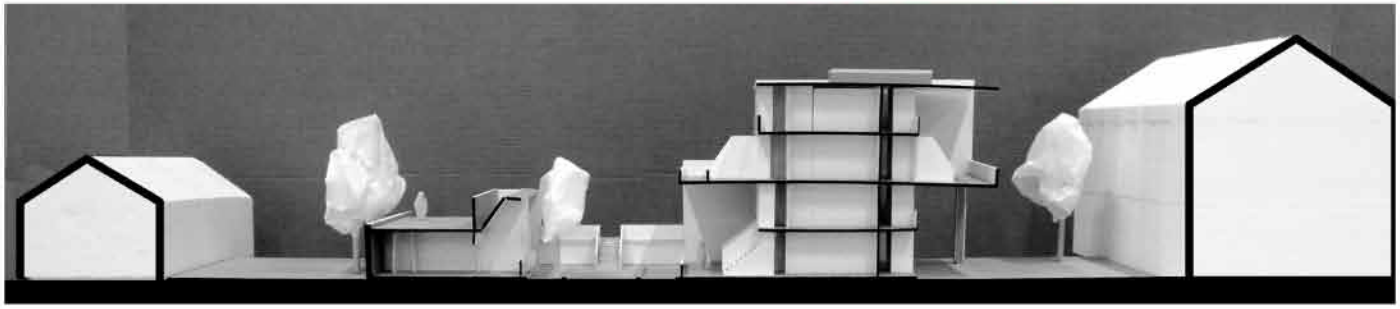
**Daylight analysis for the densified proposal at different months of the year**



*March*



*November*



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# User interaction with Environmentally Adapted Zero Emission Buildings

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*NTNU Trondheim*
*Norway*

The intimate relationship between body, mind and space are challenged by technological advancements in the building industry towards reduced energy consumption. Automatic control of ventilation systems, solar shading and reduced window openings as well as super insulated climatic envelopes with minimal infiltration can create environments that give a sensation of distance and lack of control. Contemporary building installations are most often tuned to comfort criteria based on expected user satisfaction, often controlled directly with a sensor that registers a variable, for example $CO^2$ concentration in the air. When the registered concentration meets a target value, e.g. the air flow through the ventilation system, the system is activated and the flow is increased. This registration and adjustment of conditions based on one sensor in the individual space has a very low resolution and give a global response to changed conditions, with limited ability for variations of local conditions. The lack of interface and user focused data creates a slow feed back loop between user and environment. By increasing the resolution and by setting up visual and interactive interfaces the user is empowered and will thereby have a greater sense of control and ability to adapt the immediate surroundings to the individual wishes and needs. The space becomes informed and the response time of the interaction between the user and the environment can be optimized and $CO^2$ emissions can be reduced with increased sensation of comfort and control.

## App based visualization of Building Performance for quick feed back loop between user and building


***Sketch for a Building Performance app where the user of the building can find information on $CO^2$ emission, indoor climate, energy consumption, cost etc. with an interface that can control appliances and installations remotely.***

The Building Performance app gathers information from the sensors and measuring devices installed. By connecting the sensors wirelessly and feed the data live over the internet to the phone, the app can track air temperature, humidity, light conditions, $CO^2$ concentration etc. The findings are illustrated by chronotopic diagrams visualising fluctuation in energy consumption, $CO^2$ emission etc. over time. With augmented reality technology the information can also be visualized directly on a picture of the space. For example can information on electricity consumption be overlaid the live streaming picture from the camera. By changing layers real time information on energy consumption, in door climate conditions, cost etc. can be visualized to make the user become informed and improve the users ability to interact with the building to optimize performance and negotiate environmental conditions. By installing wireless sensors with a microprocessor the technical installations can be controlled wirelessly by the user and the immediate environment can be adjusted remotely.

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# Back to the Future

*Hildur Gunnlaugsdóttir*
*University of Iceland*
*Iceland*

We should not only to look toward innovation and new technology but also remember to look back. We in Iceland could learn a great deal from the way we used to build houses. Before there was easy access to heating, electricity and building materials Icelandic people had to use nature to their advantage.

## Large and small scale benifits of green roofs

Well into the last century a large part of the Icelandic nation lived in homes with green roofs and insulation. It kept them warm in the cold winters.[1]

Small scale mitigation:
Houses with green roofs need less insulation and therefore need less heating and cooling.[2]

Large scale mitigation:
Less heating and cooling also mean that less energy is needed. Green roofs also sink carbon.[3]

Green roofs can also slow flooding and can in that way help a city adapt.[2]

Church[4]

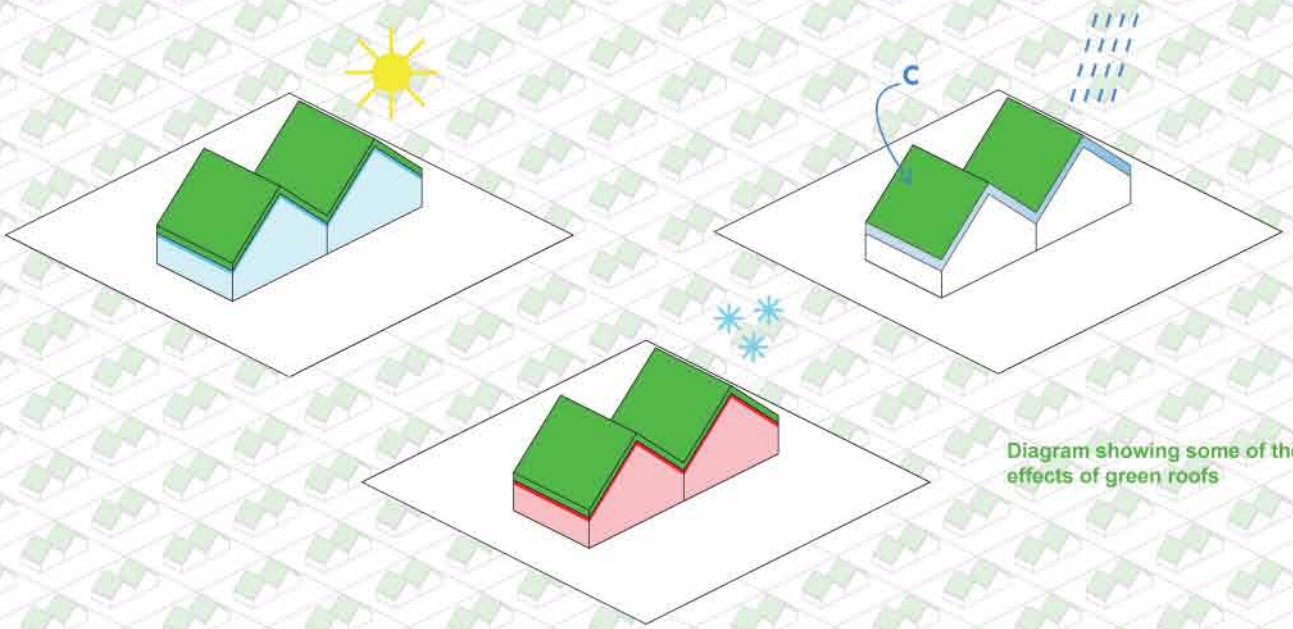


Diagram showing some of the effects of green roofs

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# Self-supply of an isolated village with a wind / pumped storage system

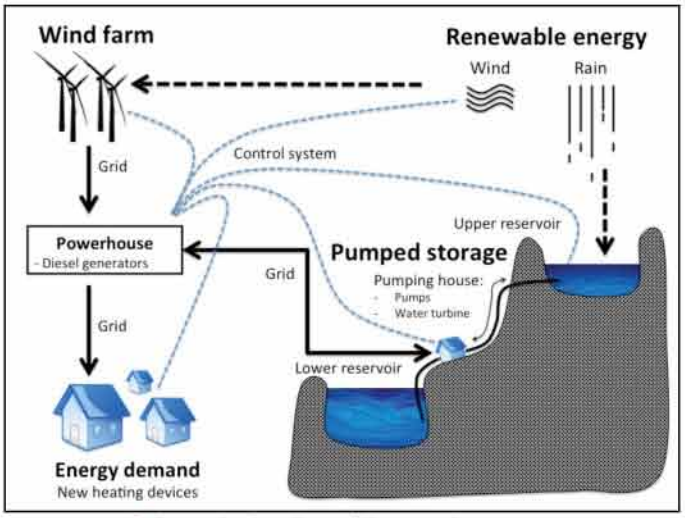
## Master thesis, Master sustainable energy

*Mathieu Labour*
*Technical University of Denmark, DTU, Lyngby, Denmark*
*France.*

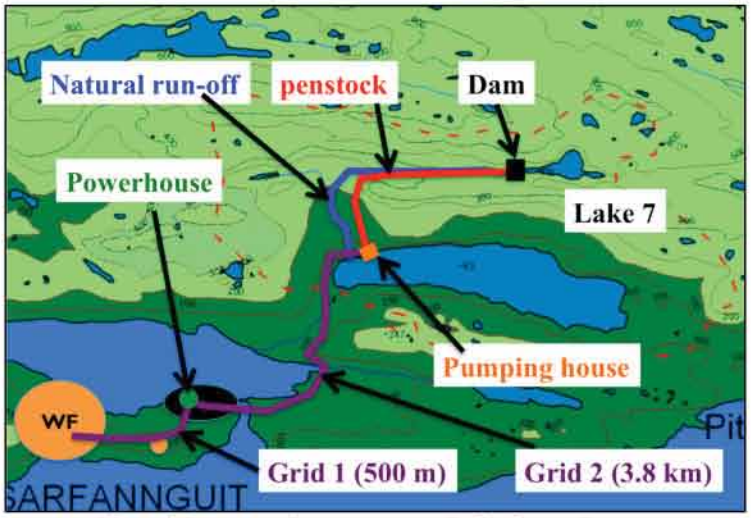
Sustainability by design can be presented from the energy supply point of view. This poster summarizes a master thesis from this perspective. The project was a prefeasibility study of a wind / pumped storage system in an isolated, small village: Sarfannguit, in Greenland. The aim of the project was to assess the possibility to provide energy to the system with 100 % renewable energy. The poster focus on the choices made, as sustainability by design is a question of choices, points of interest and priority.

## Renewable energy supply

The basic concept of a wind / pumped storage system is to use wind energy as the main source of energy. The pumped storage component of the system is used to match production and demand at any time. When the wind speed is high, the extra wind energy produced is used to pump water up from a lower to an upper reservoir. Electrical energy is transformed into potential energy. When the wind speed is low, the stored energy is released and generate again with a water turbine. On the left is presented the supply system's components. On the right is a map of the components located on a map of the area. The system is technically feasible. In addition the system is proven to be socially and environmentally feasible. Only the economy is a limit of the implementation of the project.




Schematic drawing of the supply system




Map of the system's components in Sarfannguit area

## Sustainability by design

Here are presented the important questions tackled by the project designer from a sustainability perspective:

- At which conditions is it fair to use a natural lake as reservoir?
  → Protected areas, discussion with locals, prevent salt/fresh water mixing.
- What is the role of the energy system? What is the impact on the design?
  → Avoiding usage of fossil fuel, security of supply, village development
  → The fish factory industry, the only industry in the village, must be included in the design
- Is their impact on the environment? Can the designer limit them?
  → Wind farm: noise, shadow flickering, birds. Good distance from the people.
  → Penstock (pipes): visual impact. Hidden from the village.
- Economic and social consequences on the people?
  → The new system provide the same energy service at today's prices.

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# ...Universities and Sustainability...

# Towards a more sustainable organization - Copenhagen University

*Nina Raundahl*
*Roskilde University*
*Denmark*

Copenhagen University has around 40.000 students and staff members that on a daily basis uses the approx. 1.000.000 $m^2$ of the university. Copenhagen University has acknowledged that it has a "green responsibility" and in 2008 the management adopted targets for Green Campus, which is the University´s effort to create a more sustainable organization. The primary targets are to reduce $CO_2$ emissions and energy consumption by 20 % in 2013 compared to the year 2006, measured in man years for staff and students. The targets are based on analysis of Copenhagen University´s first Green Account. The Green Campus office develops and coordinates green initiatives in order to reach the targets in 2013. The office is part of the central administration and works together with the 8 faculties of the university.
Copenhagen University focuses both on the operation of their buildings and the energy behaviour of the staff and students, as well as having specific sustainability demands for new buildings.

## Key priorities for Copenhagen University

In order to reduce the energy consumption and the $CO_2$ emissions from the university´s activities there will, by 2013, be invested around 100 million DKK in technical solutions and energy management. Much of the 20% reduction should come from more energy efficient operations of the buildings and the technology in them. There is focus on ventilation, lighting and heating but also on the technical devices in the laboratories.

To secure energy efficiency and sustainable buildings, Copenhagen University tries to integrate sustainability from the beginning of the process of creating a new building. This is done by listing demands on e.g. energy efficiency in the public procurement. The image shows the winning proposal for the faculty of health´s new building.

One of the difficulties with new buildings, especially laboratories, is that the users demand for new and more technology can increase the use of energy even though the building is energy efficient in itself.

**Panum: from the wining proposal by C.F. Møller**


Beside the focus on the energy efficiency of the operations and new buildings, the university has created Green Action that addresses the staff and students behaviour. Most of the focus has so far been on the staff since they have the greatest impact on the energy consumption. One initiative is the Green Ambassadors, which are staff members that have volunteered to spread information locally about energy efficient behaviour and tries to influence their co-workers behaviour.

One challenge, in a big organization as Copenhagen University, is to create a feeling of that you make a difference if you switch of your computer, lamp or printer.

**See more at: http://groengerning.ku.dk/english/**

For more information about Green Campus go to: http://climate.ku.dk/green_campus/

# One year experience of Master Program - Design for sustainable development at Chalmers University of Technology

*Yu Liu*
*Chalmers University of Technology*
*Sweden*

The Department of Architecture at Chalmers University of Technology is being developed with the vision of supporting architecture and sustainable development with a high degree of artistic and scientific quality and technical refinement.

As a student who is taking this MPDSD program in CTH, I would like to share my experience chronologically during the last year, it includes 2 courses, 2 studios and 3 activities which are related to sustainability.

course activity studio

## Sustainable Development and the Design Professions

Literature Studies | Assignment | Seminar | Study Visit | Lecture | Film Festival | Presentations

How do we learn

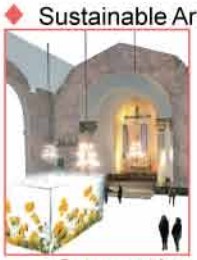

Lecture


Study trip

Literature

Film festival

## Sustainable Architectural Conservation


Conservation


Studio


Local material


Passive house VS church


Presentation

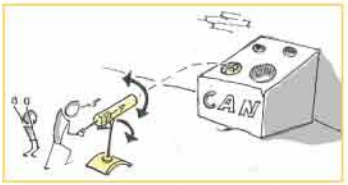
## Design System


Workshop


Critics

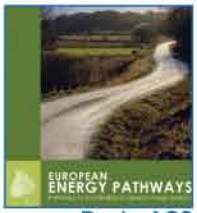

System


Sustainable future



Innovation design

- Sustainability and Change - AGS Meeting 2011 (CTH,Sweden)
- Best Green Days - Best Gothenburg
- 2011 International Student Conference on Environment and Sustainability (Shanghai,China)



Book - AGS


BEST GREEN DAYS: Study visit - Kuggen


Shanghai - Poster exhibition

## Sustainable Building


Material exhibition


Rubber house


workshop


Passive house on the roof

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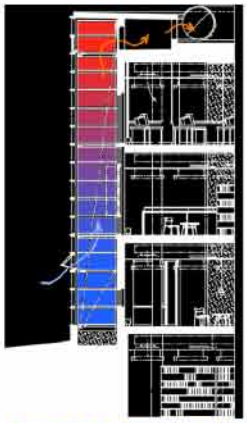
# Creating a Green Learning Environment: Viikki Campus and Infocentre Korona

*Joni Karjalainen, joni.karjalainen@helsinki.fi, +358 40 702 9691*
*University of Helsinki*
*Finland*

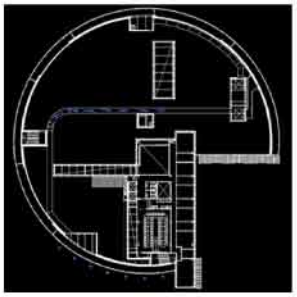
Setting an example helps others act. The main building of Viikki Campus, Infocentre Korona, is an example of climate-friendly experimenting and thinking. A result of an invited competition, it was completed in 1999, leading the new wave of construction to build Viikki Science Park. Today, highlighting the Viikki green philosophy, environmental thinking is valued also outside the university. Nearby the campus is Eko-Viikki, an experimental eco-district, which in 2007 received both Sustainable City Award in the North Sea and Baltic Region in Malmö and Ecobuilding Performance Grand Prix in Paris.
Also called a Green Campus, Viikki profiles University of Helsinki as a promoter of ecological sustainability. Viikki Campus provides environmental research in sustainable use of natural resources, climate change, forests and biodiversity. Viikki aims to become one of the world's leading bioscience campuses in future. It hosts Faculties of Agriculture and Forestry, Biosciences, Pharmacy, Veterinary Medicine, various research centres, and also Gardenia Tropical Garden.

## Viikki Campus

By its initiatives, the multidisciplinary Viikki campus provides examples of eco-construction and thinking, advancing the sustainable use of natural resources and preservation of biodiversity.



Located 8 km from Helsinki city centre is **Viikki Campus, the second largest of the four university campuses. Its main building, circular-shaped Infocentre Korona, received the Finnish State Prize in Architecture: it has a glazed envelope and a curved facade as eco-technical solutions: reducing heat losses during winter, and need for cooling in the summer. In Viikki, the green philosohpy is supported by a matching organization. Recently in 2010, WWF Green Office was piloted in the campus. Also, near the campus is Eko-Viikki residential area, the first eco-district in Finland.**



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# Cemus - Student Driven Education in Uppsala

*Dermot Farrelly*
*Uppsala University*
*Sweden*

**CEMUS**
**Centrum för miljö- och utvecklingsstudier**

Cemus provides student-driven educational opportunities in the sustainability area. Cemus is a part of an organisation called CSDUppsala and is a joint initiative between Uppsala University and the Swedish University of Agricultural Sciences (SLU). Employing a unique approach, Cemus attempts to enable students to investigate their own understanding of sustainable development, in tandem with raising their critical thinking and reflective skills. The centre grew out of the frustrations of two students at the university in the early 1990's. They lamented the lack of interdisciplinary courses connected to environmental issues. Emboldened by supportive staff, they developed a course plan and got support from the university to give it themselves. The course "Humanity and Nature" involved weekly guest lecturers, and was a great success, leading to the establishment of a centre dedicated to this type of education. That centre, Cemus, operates in much the same fashion today.





## How does it operate?

Cemus relies on student course coordinators (amanuenser) to design, run and administer their courses. They are supported in this by a dedicated working group, consisting of researchers, teacher and practitioners. They provide a rigorous eye over the course plans, structure and examinations, so that the course goals for the students are achievable. In addition to this, there is Cemus itself, with a director of studies, a program director and an educational coordinator, all willing to assist and support the course coordinators in creating an interesting, innovative and robust educational experience for the students. A key feature of Cemus is its guest lecturers, drawn from across the academic and practical worlds, who can bring to the courses knowledge from their disciplines and experiences. This enables the students to get an interdisciplinary, birds-eye view of cross cutting, horizontal issues such as Climate Change. Each year approximately 25 course coordinators form, plan and implement course (currently there are 17 different courses offered), and in doing so gain vital project planning, creative, presentation, pedagogic and administrative skills, whilst the constant influx of new coordinators gives the centre vitality, creativity and new methods, perspectives and ideas about learning and didactics.

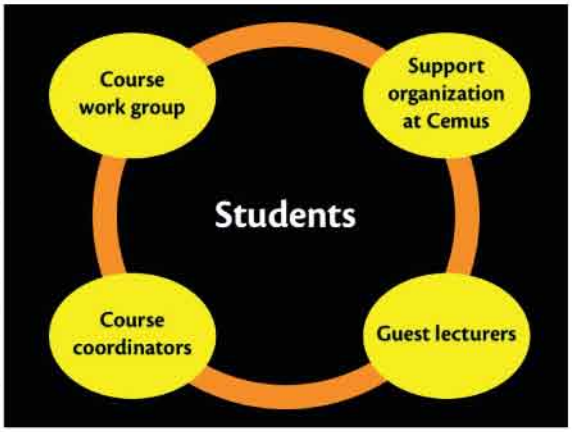


Fig 1. The Cemus Model explaining the different parts of the organisation that cooperate to provide each individual course

## Effect

Cemus courses have expanded throughout the years, as the demand and need for new activities has arisen. At this time, over 3000 students have undertaken courses at Cemus, gaining a wide-ranging perspective and knowledge on environmental questions and issues. At the same time, Cemus has expanded the role of the university, bringing knowledge sharing into the student population instead of the traditional lecturer-student relationship, and through its Cemus Forum connecting the university to society through collaboration with other actors, such as Folkuniversitet, as well as providing a forum and meeting place for all involved in environmental issues. Cemus has also hosted several conferences, often in collaboration with others.

The author was a course coordinator of two courses at Cemus during his studies; Actors & Strategies - Towards Global Sustainabilities and Climate Change Leadership - Power, Politices and Culture. This poster draws on information contained in the Cemus publication "Transcending Boundaries", which is available free from utbildning@csduppsala.uu.se.

# Sustainable Development
## in the University of Turku

*Inka Ahonen*
*University of Turku*
*Finland*

Turun yliopisto
University of Turku

KEKÅ
Kestävä kehitys Turun korkeakouluissa
Högskolorna i Åbo främjar en hållbar utveckling

In the University of Turku it is made clear that challenges of sustainable development are not solved within one discipline. Sustainable development know-how, research and teaching are provided by different faculties.

Teaching of sustainable development is provided as Sustainable Development Studies kept together by different faculties of the University of Turku and as Responsible Business education scheme kept by Turku School of Economics. Besides you can study Environmental Science and Development Studies.

The network of researchers, teachers and students between different disciplines aims to tackle the challenges of sustainable development in all of its dimensions.

KeKÅ Group wants with its own activities to promote sustainable activities in the Turku area of higher education. The aim is that universities would share best practices and explore different ways on sustainable development.

The vision of KeKÅ is that the education, monitoring and practices of sustainable development would be consistent in the area of Turku. In the institutions of higher education students and the staff should be able to act sustainably.

KeKÅ Group consists of staff from all the higher education institutions in Turku except from the Humak and Diaconia University of Applied Sciences (Diak).


In 2010 KeKÅ Group launched its goal to make all the higher education institutes of Turku a Fair Trade Campus. The title of Fairtrade can be applied by universities and colleges that fill the criteria set for the honorary title; For example all cafeterias and restaurants at the campus site must be able to offer Fair Trade coffee and tea. Finland's first Fair Trade University is the University of Tampere.

The higher education institutes of Turku now pursue the title of Finland's first Fairtrade campus area. The University of Turku, Åbo Akademi, Turku University of Applied Sciences, Diak, Humak and Yrkeshögskolan Novia are all together in the project. The aim is that the higher education institutes will have the honorary title of Fairtrade in 2011.

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# Sustainability in Singapore: Nanyang Technological University

*Hannah Leong*
*Technical University of Denmark*
*Denmark*

**Sustainable Earth** is one of the **Five Peaks of Excellence** at NTU

NTU is the **anchor tenant** at the new **Cleantech Park**

## Research Centres

Earth Observatory of Singapore
Singapore Centre on Environmental Life Sciences Engineering
Nanyang Environment & Water Research Institute
Energy Research Institute @ NTU

## Earthlink (Student environmental club)

**Activities**


External outreach event in the city

Fieldtrip to the mudflats


Magazine feature

International Coastal Cleanup

Environmental Awareness Week

**Campaigns**


Bring Your Own Bag

Guided nature walks on campus


Double sided printing

Recycling

Trekking in the Borneo rainforest

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# CIRS at The University of British Columbia

*Blane Grann*
*MSc Candidate, Industrial Ecology*
*Norwegian University of Science and Technology*

**The Centre for Interactive Research on Sustainability.** ***Source – UBC Sustainability Initiative***

## Introduction

While already a leader in campus sustainability, the University of British Columbia (UBC) in Vancouver, Canada is looking to push further ahead with the soon to be completed Centre for Interactive Research for Sustainability (CIRS). This new home for the UBC Sustainability Initiative, a strategic management approach integrating teaching, research and campus operations around sustainability issues, represents a unique contribution towards advancing sustainability. CIRS aims to accelerate sustainability in the region and the world by focusing on three integrated areas: Building Performance, Community Engagement and Partnerships.

## Sustainable Buildings

With construction almost complete, the CIRS building is self promoted to be one of the greenest buildings on earth, suggesting that they will easily achieve the highest rating, Platinum, by the LEED (Leadership in energy and environmental design) Green Building Rating System™ (USGBC, n.d.). They also aim to be one of the first Canadian buildings certified under the rigorous Living Building Challenge which puts an emphasis on moving beyond reducing negative environmental impacts to contributing in positive ways to the surroundings (ILFI, n.d.). While projected to have a similar *lifecycle* cost as a similar 'conventional' building they also hope to achieve their performance objectives with minimal additional capital costs from traditional construction. Beyond the high performance/low impact technologies employed in the building, the building inhabitants are encouraged to contribute to improving the building performance through the Inhabitant Sustainability Charter and by providing them with greater local control over their work environment.

## Community Engagement

Finding new ways to engage people and organizations in the transition to sustainable futures is a priority for CIRS. This involves opening their doors to those on and off campus interested in exploring what sustainability means using interactive modeling and simulation tools that incorporate user feedback. As a starting point this research seeks to understand the discrepancy between stated preferences and individual actions and how advanced modeling and visualization tools, responsive to user feedback, influence behaviour and collective policies.

The interactive models are used to help demonstrate some of the potential tradeoffs and synergies connected to critical sustainability decisions facing communities today, enabling different user groups to explore scenarios related to sustainable futures. The visualization component demonstrates how urban landscapes (e.g. transportation, green space, buildings, etc.) may evolve given different policy decisions. These interactive tools will be put to use in the BC Hydro Theatre, in the CIRS building, where participants can help construct and explore sustainability scenarios feeding in information through handheld wireless devices. The decisions of participants will then influence the urban landscapes that are visualized before them.

## Partnerships

Developing new forms of partnership between researchers, businesses, governments and non-governmental players in order to analyze, pursue and implement common sustainability goals is the final area of focus for CIRS. A key to this approach is co-locating actors from these different sectors within the CIRS building in order to accelerate the commercialization of new technologies and the implementation of new policies.

## Summary

Universities not only have a responsibility for educating the next generation of leaders about the challenges we collectively face, but also for testing out and demonstrating new solutions to our problems. UBC's approach is to forge new partnerships between researchers, businesses, NGO's and governments with a stake in the sustainability debate and to use advanced simulation and visualization techniques that help demonstrate the complicated tradeoffs and synergies that lay before us.

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3) US Green Building Council (n.d.). What LEED is. Retrieved from http://www.usgbc.org/DisplayPage.aspx?CMSPageID=51

# Lund University and Sustainability

*Mert Cetinkaya*
*Lund Universtiy*
*Sweden*

Lund University, the second oldest university in Sweden, has an important role to play in society as a driver of sustainable development. Through education, research and cooperation with the community, it will provide reliable knowledge today and in the future. In Lund University's Sustainable Development Policy Statement for 2010 – 2011, they describe the university's Sustainable Development vision statement as "Lund University shall conduct its operations in a way that promotes sustainable development so as to ensure that present and future generations are able to enjoy a healthy and good environment, economic and social welfare and justice. The operations shall contribute to the achievement of the UN Millennium Goals and other national and international commitments." Having this vision as a foundation, sustainability in Lund University is flourishing through three different main components which fundamentally constitute the university as a significant institution in transition to sustainability. These components are the University with its infrastructure, Academy (Research) and Students.

## University

The principle of 'practicing what we preach' will characterize day-to-day activities at the University. This is an issue of credibility, and it requires active participation on the part of University employees and students alike. Therefore, in Lund University's Environmental Action Plan, they decentralize the management of the plan to the departments and rely on active collaboration and interaction of various departments in order to implement this plan. Environmental Action Plan suggests some important goals as energy efficiency, travel-free meetings, better inter-department communication for efficient action and green campus agenda. Moreover, through the same plan, they are addressing to change unsustainable daily routines by better waste management, comprehensive recycling policy, efficient use of economic resources and ways for monitoring the progress to meet the Environmental Action Plan.

**Lund University Library**

## Academy and Research

Lund University also directs their research agenda in line with their sustainability vision. Lund University's research and innovation for sustainable development are based on the University's scientific diversity, a strong innovation environment and cross-disciplinary collaboration for sustainable development within and outside the University. Lund University conducts research on sustainability through different institutes and centers, also teaches sustainability in various taught programs.

- **Lund University Centre for Sustainability Studies (LUCSUS):** LUCSUS is a platform for education, research and cooperation inside and outside academia on questions related to sustainable development. The focus on research and education in Sustainability Science spans global, regional and local issues, events and relationships. The focal points are the two major interfaces between Natural and Social sciences and between scientific knowledge and society's use of this knowledge to promote sustainable development.
- **International Institute for Industrial Environmental Economics (IIIEE):** Research at the IIIEE focuses on policy, strategies, and management for advancing sustainable solutions by governments, businesses and other relevant societal stakeholders. Specific focus is on understanding the power of business and social innovation in addressing the sustainability challenges.
- **Lund University International Master's Programme in Environmental Studies and Sustainability Science (LUMES):** LUMES is a 2-year international M.Sc. programme focusing on the important sustainability challenges facing humankind. LUMES is designed to build on the previous knowledge, skills and experiences students possess with the intention of producing graduates with capacities as creators of change from local to global levels.

## Students

- **Hållbart Universitet:** "Lund Students for Sustainability"'s aim is to strengthen and coordinate student engagement in environmental and sustainability issues at Lund University. Through hard work of many engaged students is Hållbart Universitet contributing to developing the environmental work at the university. As a social movement organization they also feel the responsibility to stimulate debate and reflection on sustainable development and make a difference on this planet.
- **Disciplines Without Borders (DWB):** A student run organisation that aims to broaden student networks, as they see interdisciplinary interactions are key elements for achieving sustainability. DWB is working to provide a space that fosters open interaction and communication, which allows one to expose, share and challenge ones perspectives by empathising with diverse views.

# A second hand ‘starter pack’ for university students

*Ms. Shraddha Mehta*
*Msc. Industrial Ecology, Norwegian university of science and technology.*
*Trondheim, Norway*

This poster describes a design of such a service that will enable students to buy second hand ‘starter pack’ i.e. the basic requirements of students who move to a new place. This activity to some extent is carried out amongst the students, in spite of this there is some amount of materials and goods that are directly disposed off or damaged.

## Students go ‘vintage modern’ shopping…

This is most commonly seen in many student towns where many international students tend to leave behind a number of utility items which are in good condition as the baggage limit during their return exceeds. Some students sell their stuff, give it away or just discard it. All these things if systematically procured by an agency and stored till the next batch of students come in, the new students can buy a ‘starter pack’ from these agencies for a much cheaper price than the store price. The starter pack would include stationeries, basic kitchen wear, cleaning equipments etc. This practice is carried out by some students but not all. The storage of these items can pose a problem. Companies like IKEA can start a service where in they accept used IKEA items and sell it to students for a cheaper price. This service can also be utilized by families and other households. Ikea is now selling second hand furniture online and a Norwegian company Fretex has established many second hand stores in the country. Source- http://inhabitat.com/ikea-now-selling-second-hand-furniture-online/ and http://www.fretex.no
The aim here is to design such a service including the collection, transportation, storage and resale of these utility goods.

C&U **(cheap and used)**


Photograph source: - http://www.trading4u.co.uk/store/product_details.php?category_id=231&item_id=1490

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# Energy innovation and integrative learning at universities

*Thomas Skou Grindsted*
*Roskilde University*
*Denmark*

Studies have shown that there is a relationship between innovation and green campus strategies. This suggests that organizational innovation is closely connected to technological innovation and learning. Energy innovation systems and the formation of learning labs is an integrative process that bridges the gap between research, education and campus operation. Organizational innovation in this sense, tries to analyze the university as a factory of knowledge in which the university integrates green campus operations into research and educational programs. In such a way it is not only a source of inspiration for researches and students to think in terms of green innovation, but also that the university becomes a test center, project demonstration center and a window frame for the broader society.

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## Universities as a test center, project demonstration center and window frame for clean tech innovations

- Install new technologies at the campus invented by a research team or regional clean tech companies.
- It could be technology demonstration such as solar air conditioning, energy storing, electric vehicles, smart grid, optical fibers for indoor lightning, energy efficient technologies etc.
- Project demonstration should be integrated in education, as a project for calculation, economics, behavioral studies, technical solutions etc.
- Project demonstration should develop students' environmental awareness and invite to innovative problem solution, and development of green campus. Systematic innovative thinking should be integrated into planning and operational processes.
- The test center should be a window frame for regional enterprises. Green campus operations create regional development as it enables clean tech companies to refer to products in use at the university.

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# HOW EDUCATION FOR SUSTAINABLE DEVELOPMENT IS CONSIDERED IN QUALITY ASSURANCE SYSTEMS AT NORDIC UNIVERSITIES

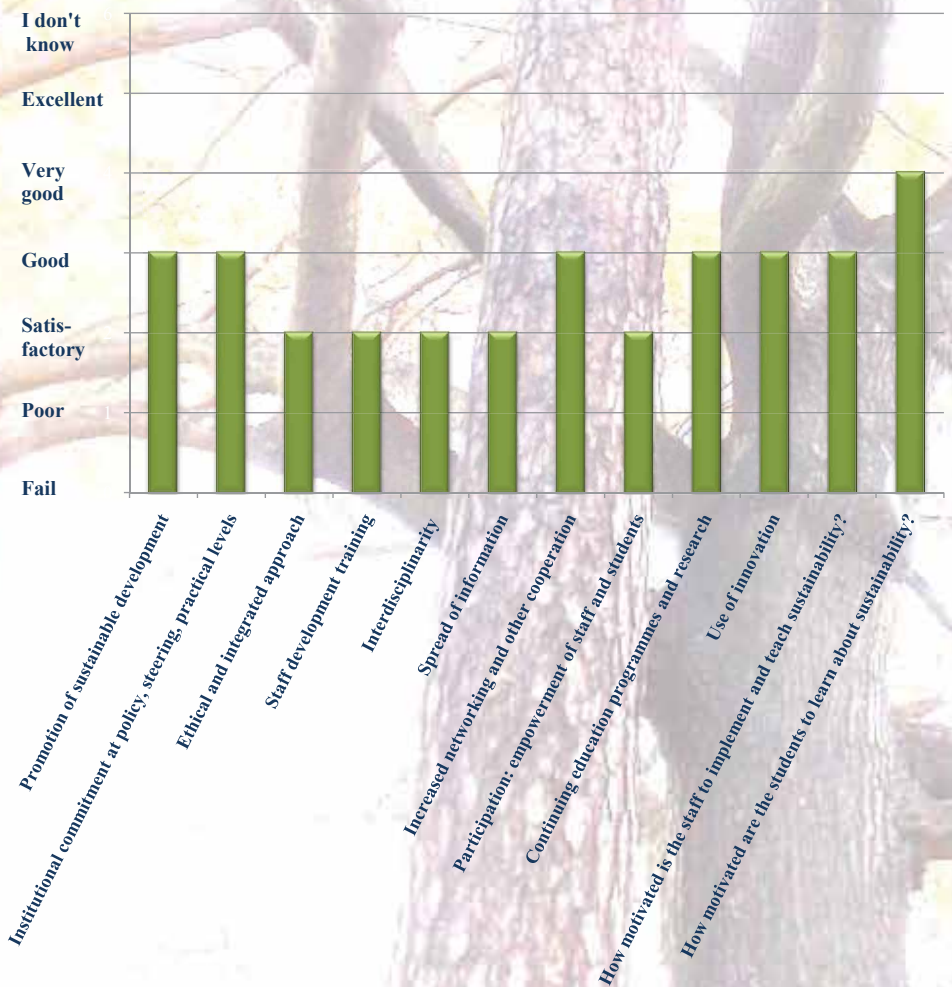
## Introduction

The following information are some results from a survey made about education for sustainable development at Nordic universities. The survey is for the project "Education for Sustainable Development in Academia in the Nordic countries", which has a two year financing from the Nordic Council of Ministers. The project's objective is to develop guidance for how knowledge for sustainable development can be included in curricula and as result identify and publish examples of relevant sustainability issues in different degree programs in Institutions of higher education in the Nordic countries. The results will be published.

The purpose of this survey was to investigate how education for sustainable development is considered at present time in Nordic universities, especially with the quality assurance work, and to make suggestions for improvement of the topic.

27 universities in Finland, Sweden, Norway and Denmark answered the survey.

## How well are the sustainability goals reached at your university?




27 universities answered this question and the diagram shows the median. In cases where the median was between two grades, the grade closer to the mode was chosen

## Examples of how ESD is taken into account in strategies of Nordic universities:

- Core value
- All operations must take SD into account
- A target and method of work
- Obligatory course/courses

## Connections between ESD and the quality assurance work:

- 17 out of 27 universities have a clear connection between ESD and quality assurance, it is handled through quality assurance systems like EMS and ISO.
- 10 out of 27 reported that there is no connection or that it is very weak.

## Examples of how ESD is taken into account in curriculums of Nordic universities:

- Obligatory course/courses
- SD integrated where it is relevant
- Quite many courses handle SD but are not marked as sustainability courses
- All masters programs must have the idea of SD integrated somehow
- Eco-labeling of courses, but course and program leaders decide if they integrate SD or not

## Examples of resources needed in order to improve the education for sustainable development at Nordic universities:

- Management, commitment, cooperation and time (time resources for e.g. education about ESD for teachers)
- ESD-coordinator
- Knowledgement (e.g. how ESD can be implemented)
- Better communication strategy
- Extra and continued funding
- National syllabus
- Stricter directives and laws

*Ann-Kristin Hokkanen, Master's degree student at the department of biosciences at Åbo Akademi University, Turku, Finland*
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norden Nordic Council of Ministers
NOVIA UNIVERSITY OF APPLIED SCIENCES
Åbo Akademi University

...Sustainable Policies
and Practicies...

# Transfer conflicts into synergies in climate change policy-making by holistic, integrated and multi-disciplinary approach

*YING YIN, ROYAL INSTITUTE OF TECHNOLOGY, SWEDEN*

## Problem：Conflicts between climate adaption and climate mitigation

Conflicts often emerge between climate adaption policies and climate mitigation policies. (Examples in Table 1) One reason is because the different objectives for each, another is that the police-makers and police-making process of them are separated. The differences between the two kinds of policies indeed exist, but if policy-makers use a holistic, integrated and multi-disciplinary approach to analyze this two perspectives in advance together, the conflicts could be transferred into synergies. This poster tries to introduce this methodology to solve the conflicts, which is innovated by SIDA[1].

**Table 1 Examples of Conflicts between climate adaption and climate mitigation**

| Climate adaption | | Climate mitigation |
|---|---|---|
| Create more green open space and low dense urban structure to reduce the heat island effect but lead to more energy use | VS | Create denser urban structure to reduce car and building energy use |
| Use individual air-conditions to provide comfortable inside environment but consume more energy use as a short-term approach | | Encourage district heating and cold to save energy consumption as a long-term strategy |

## Method：Holistic, integrated and multi-disciplinary approach

In the holistic, integrated and multi-disciplinary approach, a number of issues and relationships of relevance to climate change are considered together, then the potential conflicts could be avoided, and the potential synergies between different subsystems could be utilized. This approach includes two parts as below：

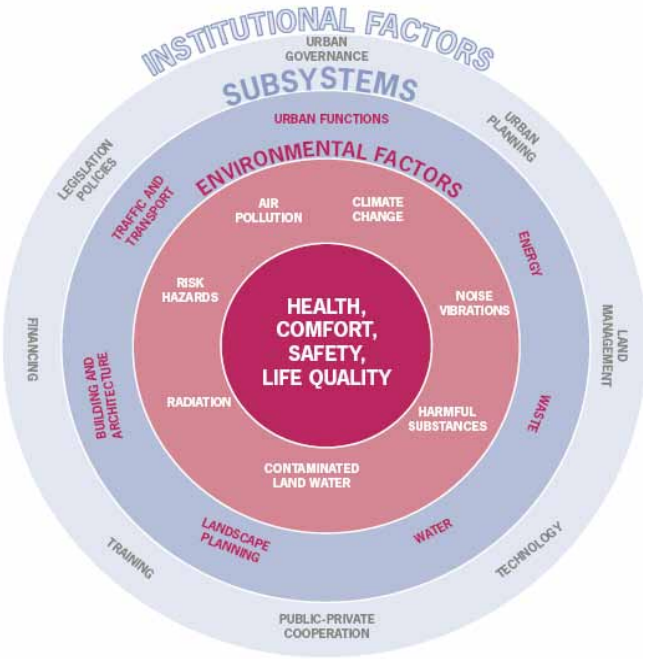
### Part 1: A cyclical, iterative working procedure

Step 1 Define and organize the sustainability review
Step 2 Make a diagnosis of the current situation
**Step 3 Specify key issues and objectives**
**Step 4 Develop alternative proposals**
**Step 5 Analyze anticipated, possible impacts**
Step 6 Choose a strategy for implementation and follow-up

### Part 2: specific subsystems and their potential synergies (P. 1)

**Example: 'Low-density urban structure to reduce the heat island effect' VS 'Denser urban structure to reduce car and building energy use'**

The way to solve the conflicts between the two policies is multiple and embodies the synergies, e.g. Layout of buildings and surrounding landscape design with regard to microclimates, public transport with renewable energy using to reduce the fossil fuel use……




**Picture1. Conceptual model for a systematic and integrated approach to the urban environment**
(The Sustainable City Approach - Manual for Support to Environmentally Sustainable Urban Development in Developing Countries, Sida, www.sida.se/publications)

[1] SIDA is a SWEDISH INTERNATIONAL DEVELOPMENT COOPERATION AGENCY, SE-105 25 Stockholm, www.sida/urban.se, urban@sida.se

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*Teresa Lindholm*
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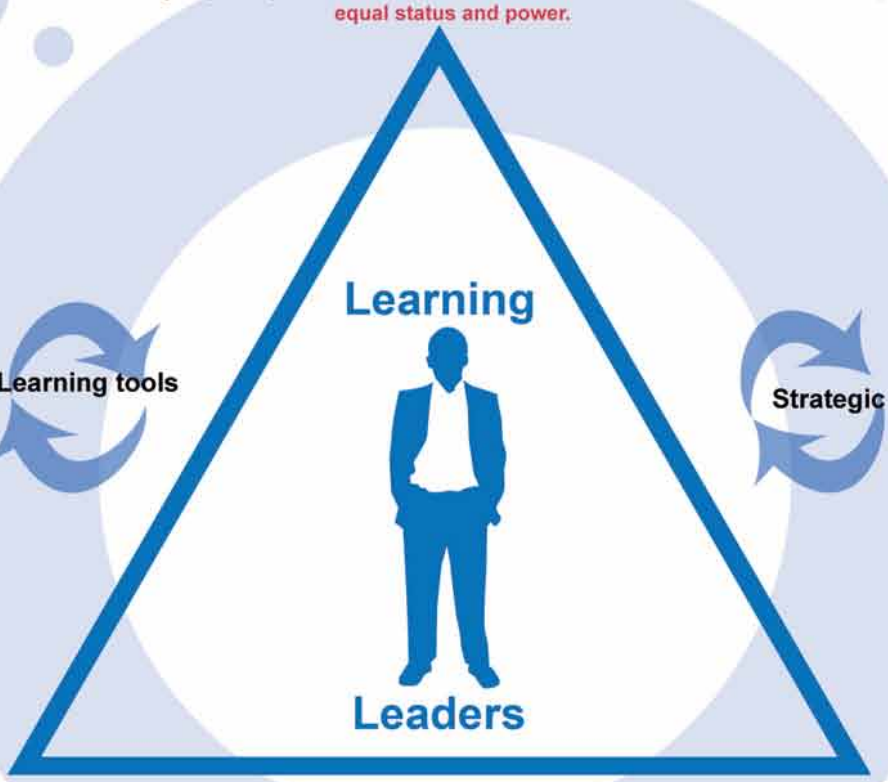
# Catalytic Capacity Building

Capacity building is used for strenghtening skills and competencies, which improve the capabilities of organizations to perform specific activities. This includes enhancing the organization's ability to educate stakeholders about the implications of the project, and to allow for better public participation in the decision making progress. By informing and involving those affected by the activity the project has a better chance of gaining public acceptance, which successively increases the chance of successful project completion. Catalytic capacity building aims to create a continuous learning environment which enhances the spread of ideas. It serves as a tool to help bridge organizational gaps and a catalyst to share good practices, creating a foundation for a more sustainable society.

## Peer Networks

**Utilizing the power of social networks for spreading good practices, through: Organization-to-organization coaching, learning clusters or leadership circles, site visits and learning exchange as well as learning networks or communities. Clear individual learning goals and self-assessments ensure progress. Peer networks can consist of a large variety of participants, however, the common denominator should be equal status and power.**




**Best practices and Learning tools**

**Strategic markets and Partners**

## Accessible Experts

**Building expertice and technical skills of local consultants is a good investment as utilizing local talent helps overcome geographical and cultural obstacles. High-quality consultant services can provide insight to a project without the distraction of staff duties. Consultants have a catalytic impact as they spread new ideas via learned lessons from previous projects.**

**Communications and Technology**

## Coaches and Mentors

**Mentoring programs, or learning networks, create confidential two-way relationships between the mentor and protégé. By enabling a sharing of mistakes and fears the learning experience can be enhanced. Support and rewards from the top of the organization are vital for success of the program, and can be augmented by designing the programs to link to organizational missions and goals. Mentoring should consist of a balance of feedback and advice to build problem-solving skills and specific competencies.**

**Bringing it to scale,** catalytic capacity building is designed as a tool to initiate a chain reaction. The strategies reinforce eachother creating a synergistic effect. Through collaboration, utilizing local partners and developing shared goals with clear deliverables organizations can unlock latent potential and move towards lasting change.

**Audrey Newman, 2001: Built to Change: Catalytic Capacity-Building in Nonprofit Organizations.**
A Sabbatical report submitted to The David and Lucile Packard Foundation and The Nature Conservancy.

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# System Intelligence for Eco-Friendly Life

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## Seamless Integration of E-cars with Sustainable Healthy Life

Almost everything is in the linked network (Barabási, 2002), from cell to global ecosystem, from economic world to health care, and from cultural identity to technological innovations. All human life is embedded and located in what is going on systemically, locally and globally; all human life takes place in the systemic process contexts of "something-larger than-self" (Hämäläinen, Saarinen, 2010). For making the right decisions in every day life, we need the guidance from system planning and systematic wisdom; this is not only good for the natural and living environment, but helpful to improve the physical and psychological healthy living conditions of every person. Therefore, we advance the system planning for the eco-friendly everyday life, and the seamless integration of E-cars with sustainable happy life will be one of the avenues.

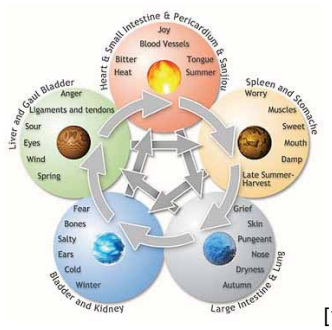
## System Structures determine System Behaviours

Picture from http://www.fotolia.com

Often the system behaviour is due to the nature of system structure, as systems mould people, influence their actions, ways of interaction, ways of talking and ways of thinking, and thus create an impact that eventually is going to have a systemic, far-reaching impact (Hämäläinen, Saarinen, 2010). I suppose that the promising way to suggest people choosing the eco-friendly living styles would be supplying them the bigger pictures clearly showing their positions in the developing trends of global ecosystem, the endeavors of protecting it and their gains from it, e.g. the physical and/or psychological health.

Urban planners as the mediators (Forester, 2011) of different interest group could help both the users and the stakeholders to have a better understanding to each other and to the bigger systematic picture. Ancient Chinese Culture is engaged in achieving the harmonious relationships between human beings and the living environments, and might supply useful theoretical guidance.

## The System Intelligence for Achieving Eco-Friendly Life




[1]

| Wood | Fire | Earth | Metal | Water |
|---|---|---|---|---|
| Sunrise, spring, upward, liver and gallbladder anger, impatience, activity, positive | Midday, summer, outward heart intestine hysteria, expressive, outgoing, social. Bitter | Afternoon, late summer pancreas and stomach, quality of life, homely practicality, stability, Sweet | Evening, autumn, lungs and colon, depression, contentment, inner strength. Pungent | Night, winter, flowing in any direction, kidney and bladder, fear, objective, artistic, original, flexibility. Salty |

No matter how complicate is the economic system, social society and global ecosystem, the relationships between human beings and living environments are constant. According to traditional Chinese culture and philosophy, Five Element theory as an ancient physics, could be used to explain everything and every relationships, no matter how complex or simple, and therefore would be an useful tool to achieve understanding of the bigger picture.

**Reference**

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Hämäläinen, Saarinen, 2010. Essays on Systems Intelligence. Systems Analysis Laboratory, Aalto University, School of Science and Technology, This publication is freely downloadable at http://www.systemsintelligence.tkk.fi
Forester J., Susskind L., Umemoto K., et al. Planning Theory & Practice. 2011.
Five element picture from http://kaleidoscope.cultural-china.com/en/118Kaleidoscope360.html, and http://www.earthwaykinesiology.com/

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# Decision Making for Optimal Low-Emissions Cost-Effective Dwellings: Finnish Study

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## Introduction

The current Finnish building regulations stipulate good measures for energy saving. However, the regulations do not guarantee low-emission solutions for buildings. The regulations will soon be focusing on the primary energy use. This could lead to expensive concepts, producing more challenges in decision making. The current study introduces a set of optimal solutions for the legislator and decision makers.

## Method

The current study addresses a single family house in the cold climate of Finland. The finical viability of 13,456 integrated building solutions is calculated using the payback method (Fig. 1). The time value of money is considered assuming realistic values of interest, inflation, and energy price escalation rates. The 13,456 candidate solutions represent different combinations between eight design variables (Table 1): level of building tightness, insulation thickness of the external wall, floor and roof, type of window glazing, window shading, heat recovery and heating systems. The environmental impact of those combinations is calculated assessing the CO2-eq emissions related to the heating energy consumption and the $CO_2$-eq emissions related to the embodied energies of insulation volume and window type. Four heating energy sources (direct electrical heating, oil fire boiler, district heating, and ground source heat pump) are investigated using measured greenhouse-gas emission factors. The factors were evaluated by a recent study for Helsinki area.

Table 1: Design variable

| Variables | Reference design | Lower bound | Upper bound |
|---|---|---|---|
| Insulation thickness of external wall (m) | 0.124* | 0.024 | 0.424 |
| Insulation thickness of roof (m) | 0.21* | 0.11 | 0.51 |
| Insulation thickness of floor (m) | 0.14* | 0.04 | 0.44 |
| Windows type | 1 | 1 | 5 |
| Heat recovery | 1 | 1 | 3 |
| Shading type | 1 | 1 | 2 |
| Building tightness type | 1 | 1 | 5 |
| Heating/cooling System type | 1 | 1 | 4 |

## Results

The environmental impact and the finical viability are evaluated comparing to a reference design. The reference design meets the Finnish building codes (2003-2007) and uses a direct electrical heating system. Pareto front concept is applied achieving a set of optimal solutions compromise the two objectives: minimum payback time and maximum $CO_2$-emission reduction. The results show that, assuming 30 year lifespan, the optimal solutions of the ground source heat pump (GSHP) can reduce the $CO_2$-eq emissions by 1300 $kgCO_2/m^2$ with 17 year payback time or by 1180 $kgCO_2/m^2$ with 12.5 year payback time. Less reduction can be achieved by the district heating optimal solutions (i.e., 1150 $kgCO_2/m^2$ with 12 year payback time or 1050 $kgCO_2/m^2$ with 9.5 year payback time). The oil fire boiler can cut 850 $kgCO_2$/m2 with 8.5 year payback time. If the reference-design heating system (direct electrical heating) is not replaced at most 650 $kgCO_2/m^2$ can be diminished by additional insulation and/or higher efficient heat recovery types. This has a payback time of 5.5 years. The previous evaluations are calculated, assuming 4% real interest rate and 2%, 3.5%, and 3% energy price escalation rates for electrical, light fuel, district heating, respectively. Other case study assumed different rates (1% real interest rate and 4%, 7%, and 6% energy price escalation rates) inline with the economical situation in Finland (2000-2009). This leaded to shorter payback times.

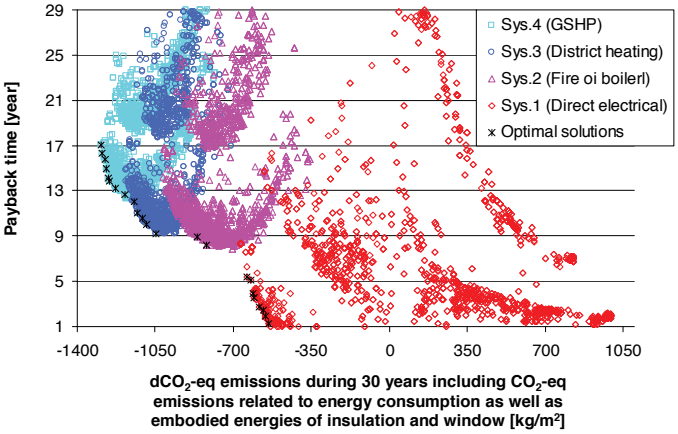


Fig 1: Payback time of different energy saving measures

## Conclusions

In order to achieve cost-effective houses with low environmental impact, it is important to consider the type of heating energy source as a a design variable in the first stages of design.

# Evaluating sustainability of complex systems during the early phases of design

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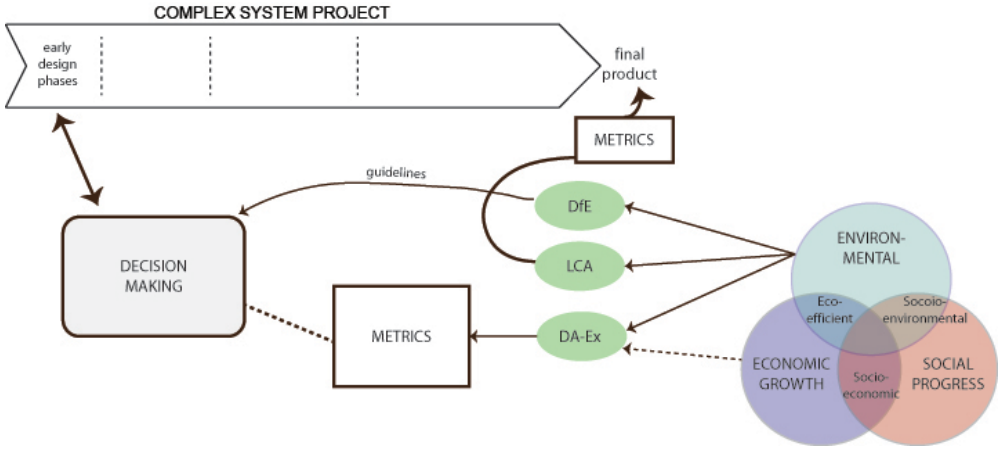
The decisions made during the very early stages of a complex system project, such as the design and construction of a zero emission house, are the most important ones but their full impact of the final sustainability of the system is often only understood at the very end and any changes to be made require more resources, from a monetary, time, etc. perspective.

## Dimensional analysis and exergy (DA-Ex) as metrics




**Position of the proposed DA-Ex tool in comparison with other widely used tools (LCA, for example) and guidelines (Design for Environment, for example).**

The DA-Ex approach is aimed at the very early stages of design where currently the main tools are guidelines and previous experience. Dimensional analysis is a powerful tool that allows easy calculations through orders of magnitude and model scaling, exergy provides a common metric for all material and energy resources.

Previously study cases for the approach include an environmentally conscious hybrid passenger ferry which provided the perfect study ground for alternative energy sources and energy conservation in a harsh environment (see references below). A low or zero emission dwelling in the Nordic climate provides a similar testing subject but with an even wider array of energy sources, potential architectures and materials to use.

Related references:
Medyna, G., Coatanea, E., & Millet, D., 2011, Environmental and economic evaluation of solar thermal panels using exergy and dimensional analysis. *18th CIRP International Conference on Life Cycle Engineering, Braunschweig, 2011*.
Medyna, G., Coatanea, E., & Millet, D., 2011, Evaluation Of Parts Of A Boat Cabin Based On Exergy - Focusing On Environmental And Economic Assessments. *ASME 2011 International Mechanical Engineering Congress & Exposition, Denver, CO, USA, 2011.*

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# Insurance and sustainable transportation

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## Introduction

Transportation links positively and negatively to the economic, social and environmental dimensions of sustainability. It contributes positively to trade, economic wealth, quality of life and accessibility, while air pollution, diminishing of resources, noise, accidents and health issues are signs of negative impacts (1). Transportation emissions differ by countries, ranging from 15-40% of the total CO2 emissions (2). To realize sustainable transportation various players have to be mobilized. The insurance sector is one of the sectors able to influence positive development. It is one of the biggest industries in the world (3), interacting with most parts of the economy (4). Insurers have vested interest in mitigating emissions causing climate change. They are exposed to population increase and consentration of wealth, driving disaster losses (5). Climate change offers new opportunities to insurers as they can develop insurance product related to renewable energy technology. In addition, insurers are in position to raise public awareness, focus on loss prevention and extort behavioral changes through pricing policies.

## Methodology

The methodology used was a literature search for the terms sustainable transportation and insurance combined with results from interviews with executives and specialists from the Nordic insurance sector dealing with environmental and issues.

## Results

The Centre for Sustainable Transportation offers a definition of a sustainable transportation system (6). The system has three elements; meeting access needs, affordability and limiting waste and emissions, see figure 1. Ideas on how the insurance sector can influence positive development of sustainable transportation are graphically presented together with the definition.

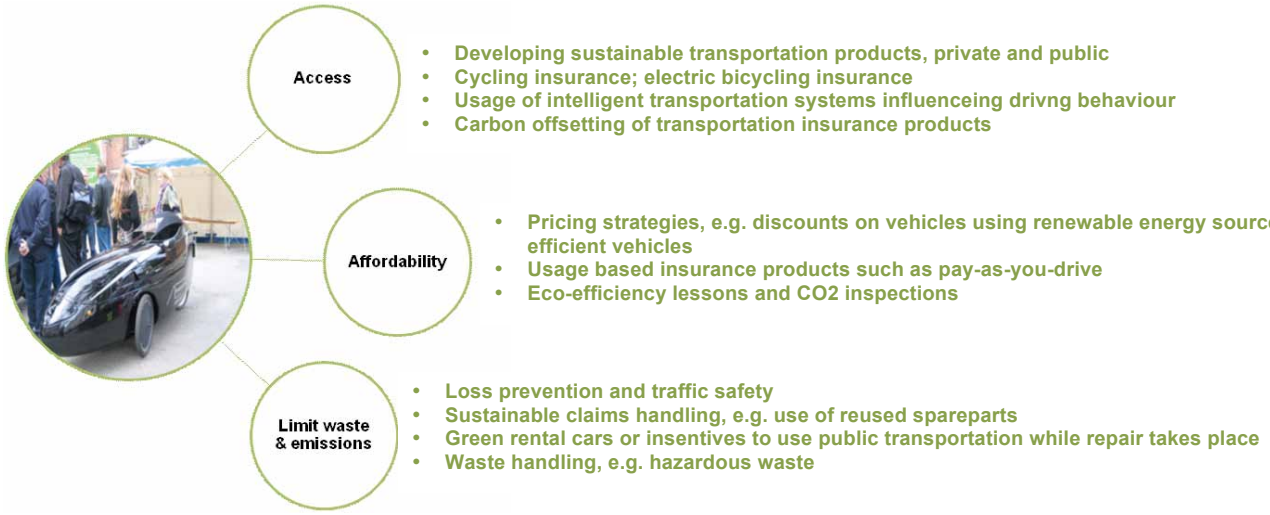


Figure 1. Sustainable transportation adapted from the Centre for Sustainable transportation (6)

## Conclusion

The insurance sector is one of the critical players in development of sustainable transportation. When adding the insurance role and emphasis to the definition of sustainable transportation system (figure 1) it comes evident that the emphasis on the human dimension and actions should be strengthen, because the social sustainability according to the definition emphasis affordability not actions. Technological solutions are not sufficient, behavioral changes are needed as well. Insurers are in position of raising awareness about green transportation solutions and stimulating actions by educating clients and use financial incentives. Sustainable transportation is economically advantageous as it means less fuel consumption, less maintenance both for vehicles and infrastructure.

## Resources

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# Peat Subsidies in Finland

*Jiahui Lu*
*Royal Institute of Technology-KTH*
*China*

With the more and more complxt situation of clean energy supply and market, a crucial problem has become a fender to the development of nordic countries as well as the whole world, a stable clean energy supply. According to OECD and IEA, fossile fuel subsides is a mian issue in terms of climate change.
This poster aims to address the definition of energy subsidy and the environmental impacts of fossil fuel subsidies. Since peat is typical case in terms of fossil fuel sunsidies, a case in Finland and Sweden tackling with peat use is studied and several corresopnding and feasible advices are proposed.

## WHAT is Energy Subsidy?

Any measure that keeps prices for consumers below market levels, or for producers above market levels or that reduces costs for consmers and producers.(OECD)

Any government action that concerns primarily the energy sector that lowers the cost of energy production, raises the price received by energy producers or lowers the price paid by energy consumers(IEA)

## WHAT Fossil Fuel Subsidies Lead?

1. More GHG emission: the phase-out will cut 10% emission by 2050
2. Inefficient use of energy
3. More air pollutants emission: SO2,NOx and particulate matter

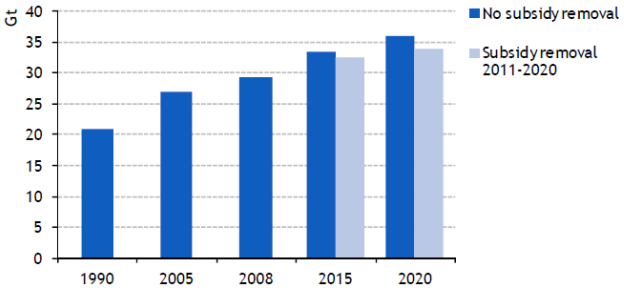


Fig 1. Impact of Fossil-fuel Consumption Subsidy Phase-out on Global Energy-related $CO_2$ Emissions

## Peat Use Case Study in Sweden and Finland

Peat plays a critical role in the both Swedish and Finnish energy supply. Through several years' working, Sweden has almost gotten rid of peat use in the electricity generation sector. Finland might benefit from Sweden's experience.

### Sweden's Case

#### Policy

Peat situation much changed dut to the introduction of electricity certificate in 2004 and the European Unions Emissions Trading Scheme(EU ETS). The substitute of peat is set to be biofuels. Policy instruments reduced the competitiveness of peat to biofuel, especially in CHP. Since 2004, the use of peat has decreased rapidly

#### Investment

Investment support in Sweden since 1991 has targeted biomass-based CHP and initially amounted to 444 €/kW (4000 SEK/kW) of installed electric capacity. This level was lowered in 1997 to 333 €/kW (3000 SEK/kW), or a maximum of 25% of the investment cost.

### Lesson Learnt from Sweden for Finland

Considering with the large reservior of peat in Finland and also its large share of electricity generation, phasing out its subsidies is not so easy.

1. reduce the direct subsidies on peat gradually
2. growing public concern
3. incrase the investment to the biomass use, heat & power
4. more support in biomass utilization policily
5. couple the reform with measures to stimulate economic development, and therefore create new job opportunities in areas where industrial activities are to be scaled down or close

According to IEA, an analytical framework to phase out fossil fuel subsidies should follow:

1. the impacts of existing subsidies on efficiency and equity issues;
2. the cost effectiveness of the subsidy tools compared with alternative sectoral instruments;
3. the opportunity cost of the subsidy on fossil fuel, i.e. whether the same amount of money can be reallocated to other more socially or environmental desirable activities

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Sources: 1. Analysis of the scope of energy subsidies and suggestion for the G-20 Initiative; 2. The scope of fossil fuel sunsidies in 2009 and a roadmap for phasing out fossil fuel subsidies; 3. K.Ericsson, Bioenergy Policy and Market Development in Finland and Sweden; 4. Energy policy of European country-Finland 2007; 5. Improving environment through reducing subsidies

# Exergy-based carbon units allocation for CHP with district heating systems

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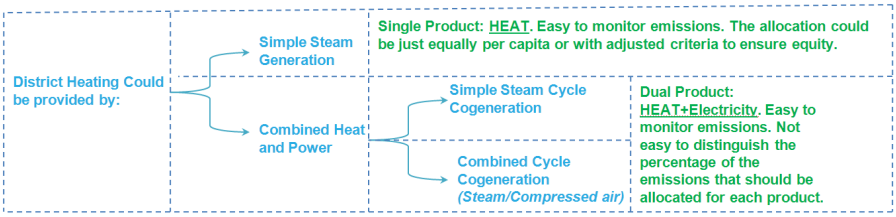
*Technical University of Denmark*
*Denmark*

Introduction

The issue was mentioned as a suggestion for further research by Fawcett (2010). Complications arise when the PCT payment structure run on district heating systems. Fawcett proposed the development of a methodology for allocating carbon emissions to heat and electricity consumption in such systems. The approach presented here suggests a methodology based on simple thermodynamics that could provide a way out of this issue without compromising equity.

## The problem at hand…

Figure 1 illustrates the configuration which is met in district heating networks. When the product is just heat, the allocation is easy and straight-forward. However this is not the case in combined heat and power plants. In such systems, water is heated until it becomes superheated steam and then it is guided to turbines which convert the thermal energy in mechanical work. The work produced on the turbines is transferred through a shaft to the electricity generators where it is further converted to electricity. But not all of the thermal energy is converted to mechanical work.

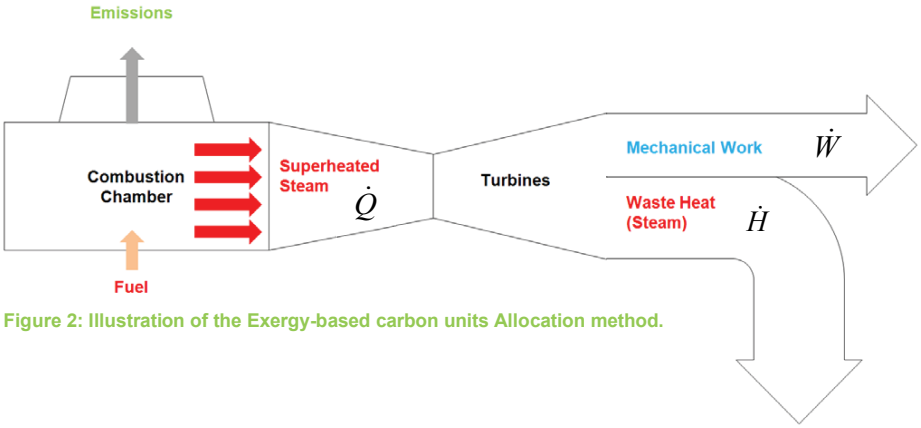



Only a percentage of it does. It is defined by the thermodynamic efficiency of the turbines. **However, the end-user purchases electricity. Which means that he/she purchases mechanical work sent to the electricity generator shaft.**

**Figure 1: The governing configuration of district heating systems.**

## What can exergy[1] do for us…

The percentage of the steam which extracts the system unused is not of interest or responsibility to the consumer. Hence why should he/she be allocated carbon units that stand for lost energy? **Only the emissions which represent the exergetic content of the input steam should be allocated to the electricity consumers.** The rest of the emissions should remain in the hold of the Power Producer. **In the case of a DISTRICT HEATING network, these emissions will be allocated to the consumers that are connected in the network**. Otherwise the Power Producer will have incentive to further utilize or sell elsewhere the lost heat.




$$n_{th} = \frac{\dot{W}}{\dot{Q}}$$

**Figure 2: Illustration of the Exergy-based carbon units Allocation method.**

[1] *Exergy: The amount of work(=entropy-free energy) a system can perform when it is brought into thermodynamic equilibrium with its environment (Jorgensen, 2001).*

**References**

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2) Jorgensen S.E., 2001,'Thermodynamics and ecological modelling', CRC Press, 2001.

# Climate change actions – Case Copenhagen

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Initiatives to mitigate global climate change and to adapt to the consequenses hereof are taken on all levels of society; from international to local. Often the initatives will involve trade-offs, the initatives inbetween or from a greater system perspective.

In 2009 the Copenhagen municipality put forward a plan to become $CO_2$ neutral by the year 2025, cutting away the estimated 2.5 mio tons $CO_2$ emitted each baseline year[1]. Some of the plan's focus areas and the appertaining initiatives are presented below.

Limit car use
- Congestion charges
- Environmental zone
- Parking restrictions

More effective car use
- Infrastructure for electric and hydrogen cars
- Car sharing, eco driving


Provide alternatives to car use
- More bikes
- More public transport
- $CO_2$ reductions from public busses

Electricity and heat production
- Increase use of biomass
- Renewable energy (geothermal, wind turbines)
- Increase energy efficiency (from waste incineration and centralized heating)


Urban design
- Energy savings in buildings (low energy housing, local electricity production)
- Planning for lower transport needs

Raised sea and groundwater level
- Ensure coast line against floods and increased sea level


More rainwater and higher temperatures
- Local drainage of rainwater
- Greening the city
- Adapt buildings

## Perspectives on Copenhagen's climate action initiatives

- Low energy housing often uses materials whose production is more energy intensive[2] (temporal and geographical trade-off)
- Could biomass be used more effectively outside the defined Copenhagen system? (geographical trade-off)
- Not necessarily possible to translate these climate initiatives directly to all societies. Smaller urban societies in the Nordic region may have to make their climate initiatives compatible with e.g. economic development, cultural offers or general wellbeing of the citizens. An example of this is Sønderborg[3] whose climate action plan is more oriented on business cooperation.
- 2,500,000 tons $CO_2$ for the approx. 650,000 Copenhageners (4 tons per person) but numbers are excluding $CO_2$ from private consumption (food and material goods produced, travels). Total emission per Dane approx. 12 tons $CO_2$ (or a carbon footprint of 19 tons if imported goods are accounted for[4]), i.e. still a long way to go for "real" carbon neutrality in Copenhagen!

References: 1: Københavns Klimaplan, Københavns Kommunes Center for Miljø, 2009, København; 2: Anvendelse af LCA-data for danske byggevarer, Statens Byggeforskningsinstitut, Hørsholm; 3: Vejen mod nullet, Project Zero, 2009, Sønderborg; 4: Forbrugernes klimapåvirkning, CONCITO, 2010

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# Sustainability driven systems-oriented design

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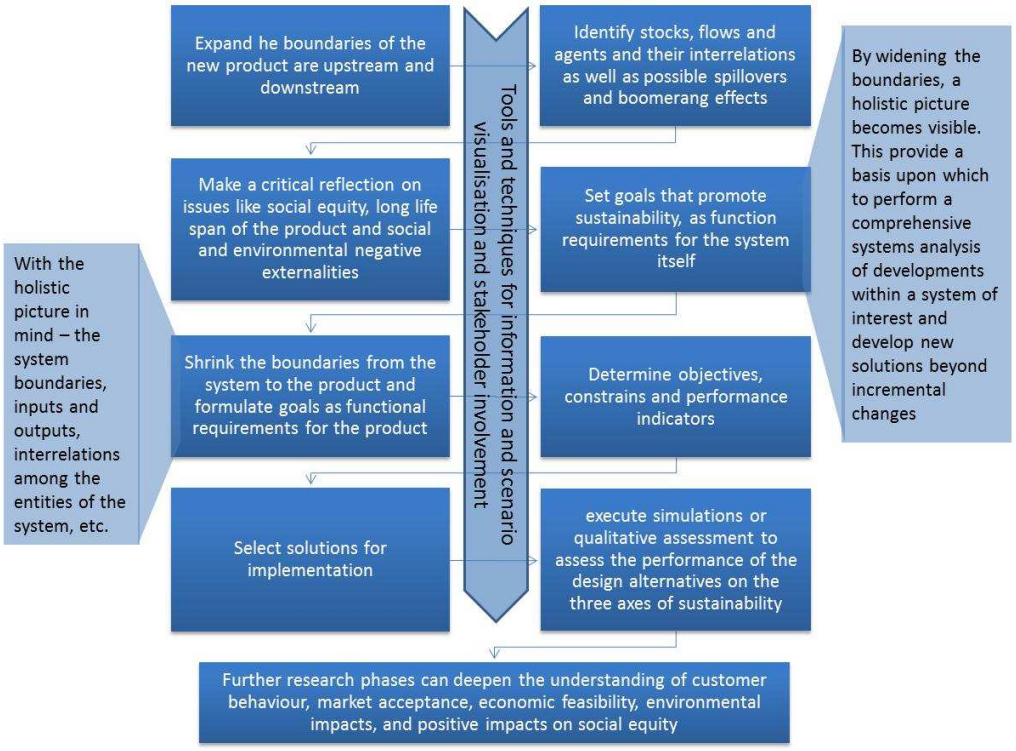
*Sweden*

Systems-oriented design is a methodology, currently being researched and developed by Professor Birger Sevaldson from the Oslo School of Architecture and Design (http://www.systemsorienteddesign.net/). It draws on existing concepts of systems approaches especially Soft Systems Methodologies and Critical Systems Thinking and contributes by developing design proprietary methods, techniques and skills. Sustainability driven systems-oriented design is project in cooperation with the Oslo School of Architecture and Design and the Division of Industrial Ecology, KTH (contact information rafa@kth.se). It serves for the purpose of addressing great complexity and large amounts of information to produce new innovative interventions that the currently sustainability challenges urge. The mechanism behind the concept is to broaden the boundaries from the product to the system, focusing on relations rather than on devising the system as such. A system-level perspective helps one to get a better insight into spillovers of the complex problem, such as, the negative externalities and rebound effects of production and consumption systems.




**Framework of sustainability driven systems oriented design**

A starting point could be the reframing of the problem the project sets out to solve. The boundaries of the new product are expanded upstream and downstream. Being more inclusive as possible, stock, flows and agents and their interrelations should be identified as well as possible spillovers and boomerang effects. A critical reflection on issues like social equity (*e.g.*, share of operating revenues to be redistributed to local communities), long life span of the product (planned obsolescence and perceived obsolescence), final disposal (tack-back strategies, producer responsibility, etc.), etc. shall be made. Great amount of information needed to be collected, analysed and presented. Thus, tools for information visualisation should be used.

By widening the boundaries, a holistic picture becomes visible. This provides a basis upon which to perform a comprehensive systems analysis of developments within a system of interest and develop new solutions beyond incremental changes. Goals that promote sustainability should be set. These goals are function requirements for the system itself. With the holistic picture in mind – the system boundaries, inputs and outputs, interrelations among the entities of the system, etc. – the boundaries are shrunk and goals as functional requirements for the product are formulated. In addition to the goals, objectives and constrains should be determined and performance indicators identified, whereby one can assess whether and to what amount the objectives and constraints are met. Techniques such as stakeholder involvement and participatory design and scenario visualisation can be applied.

The new solutions generated are then selected for implementation. If performance indicators were well defined (i.e. they are measurable and unambiguous), it is possible to develop and execute simulations that can assess the performance of the design alternatives on the three axes of sustainability. An alternative to simulations is to perform qualitative assessments. The goals and objectives are assessed against performance indicators. It is important to note that the performance indicators as well as the assessment processes should be developed together with stakeholders. Further research phases can deepen the understanding of customer behaviour, market acceptance, economic feasibility, environmental impacts, and positive impacts on social equity. Finally, the new solution is implemented and adequate follow-up is set.

*SEVALDSON, B., HENSEL, M. U. & FROSTELL, B. 2010. Systems oriented design and sustainability. Sustainability in Design - Now! Challenges and Opportunities for Design Research, Education and Practice in the XXI Century. Bangalore, India.*

# Sustainable Design Communication: Engaging in Sustainable Lifestyle through Product Design

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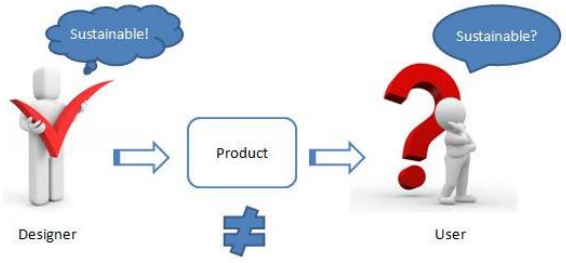
## Introduction

Sustainable Design Communication mentioned in this presentation is a process to convey the sustainable concept between designers and customers through the carrier of products. Actually,this process including two aspects: encoding and decoding[1]. Most importantly, the effect of the communication will affect the users' decisions and actions. Efficiently communication can reduce the cognitive gap between designers and users(figure 1), meanwhile it will help customers to get known well about the sustainable products and persuade users willingly to take the responsibility for the sustainability.

The main aim of this presentation is to provide designers an understanding of sustainable design communication and design strategies through analysis of the users' behavior and psychological perspective. For this purpose, a sustainable design communication model (figure 2) has been established to demostrate the relationship of designers, products,users and other factors.

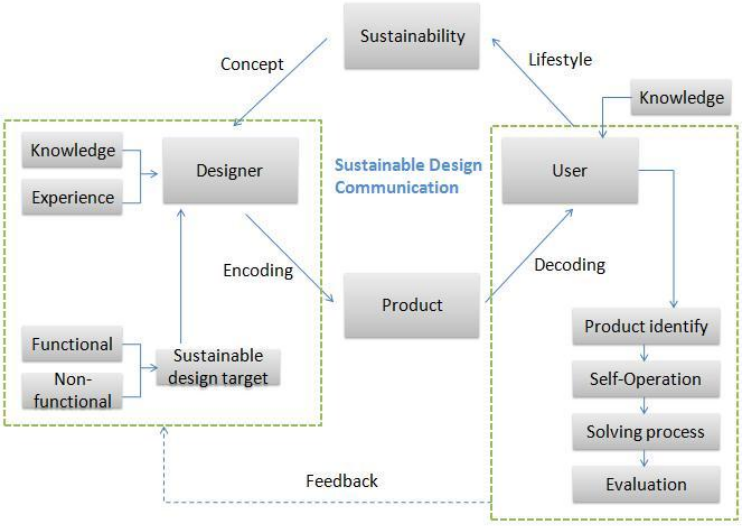
This presentaion is built on product sematics[2] and Cognitive Psychology. This presentation serves as a framework of the writer's ongoing paper "Sustainable Design Communication: Engaging in Sustainable Lifestyle through Product Design" which will be presented in international conference EcoDesign 2011 in November 2011.




**(Figure1. Cognitive Gap Between Designer and User)**

## Sustainable Desgin Encoding and Decoding

Over 80% of environmental impacts are determined during the product design phase[3],thus in the sustainable design encoding process,designers can contribute more to sustainability. Basically, it relates to the professional knowledge and experience of designers themselves.As the sustainable design decoding process is connect with several aspects(such as functional needs of users,thinking habits,characteristic of human behaviors,process of cognition , and so on),it can be used to surpport designers as a feedback.Since the increasing of recognition that "designers are in the behaviour business" (Fabricant 2009)[4], It is prossible for designers to integrate the design strategies with the pshycological theories to change the users attitude and behavior and persuade users choosing sustainble lifestyle.




**(Figure2. Sustainable Design Communication Model)**

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[2]. Krippendorff,K.,1990 Product Semantics: A Triangulation and Four Design Theories. In Product Semantic '89. Seppo Väkevä (Ed.). Finland: University of Industrial Arts.

[3]. Environmental Change Institute (2005)40% house Report,Oxford University,Oxford.

[4]. Fabricant,R.,2009, Behaving badly in Vancouver.Design Mind, [online] Available at: <http://designmind.frogdesign.com/blog/behaving-badly-invancouver.html>.

# Rethinking Design Competitions to Promote Sustainable Urban Development

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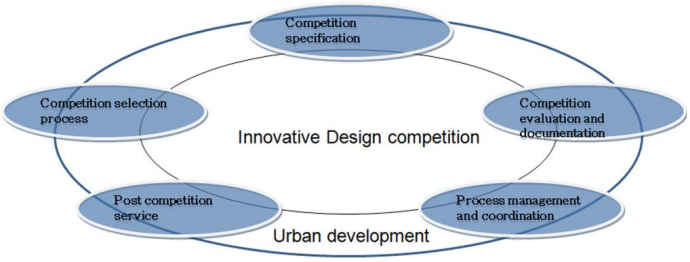
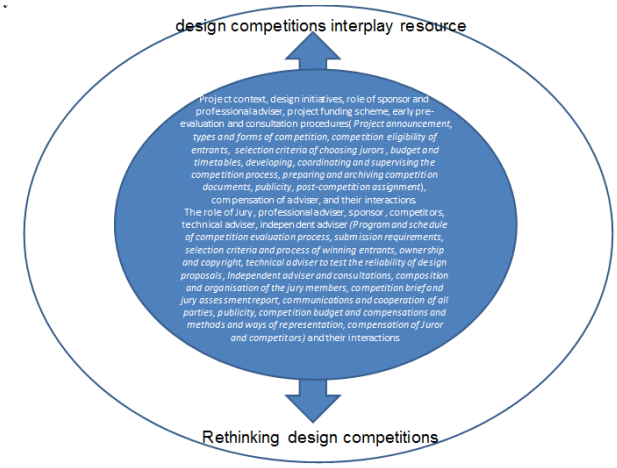
By means of systematically examining interactions of different roles, networks and their relations with design qualities, this research will creatively elevate, elaborate, scrutinize and map innovative design solutions and therefore constitute the interplay resource of design competitions to reconstruct better design competition format in a sustainable way, when confronted with the change of our 21st century built environment. The case study of contemporary large-scale architectural design competitions between Finland and China were chosen because of the relatively high availability of information and corporate networks.

## A Comparative Analysis between Finland and China

The history of design competition in Finland has over 130 year's history. Nearly 2000 design competitions have been held in Finland up to now. Around a third of them are open competitions. Needless to say, design competitions also play an extremely significant role in China. This study will benefit Chinese urban development and supply a field for practice and improvement for international intellectual exchanges. Most importantly, the synthesis of the project will also work towards potential procedural innovations of design competitions and chance of collaboration.




We will systematically elucidate the 'black box' of design competitions and therefore improve their transparency, integrity, efficiency and sustainability, which is integral for the improvement of the quality of our built environment. The results will be used among all parties involved in design competitions for their decision-making process and judgements on large-scale architectural design competitions. Also, this knowledge can be transferred to other countries. Furthermore, it will facilitate the communication among stake holders involved in competitions, avoid potential failures, reduce the costs associated with unnecessary rework and promote sustainable urban development in longer term.

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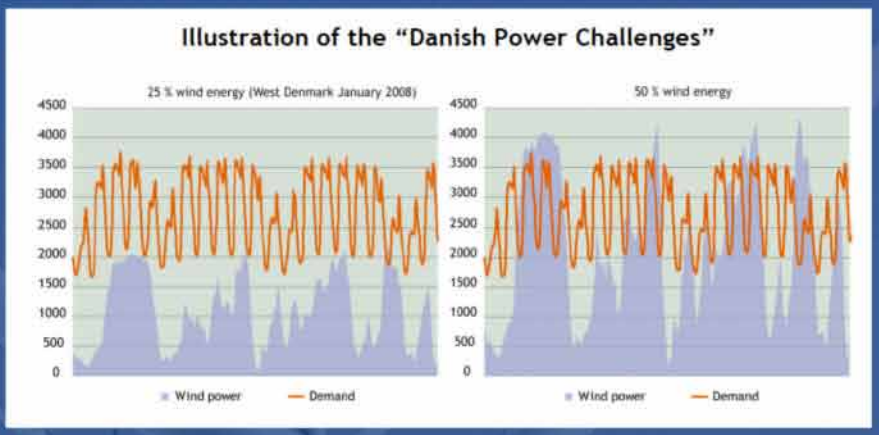
# INTEGRATION OF 50 % MORE WIND POWER CAPACITY IN THE DANISH ENERGY SYSTEM BY 2025

## INTRO

Today the installed wind power capacity in Denmark has increased to 3,180 MW and wind power generation corresponds to approximately 20 % of the total Danish electricity consumption in 2008. In the Governments "Energy Strategy 2025" a new target of 30 % renewable energy in 2025 is set out, implying a doubling of wind power capacity. Although the future energy system must be effective and flexible in order to use renewable energy where the value is highest, the political conditions themselves are to some extend blocking for such development. Fluctuating energy imposes challenges to the flexibility of the energy system and new solutions must be found to meet these variations from wind power as well as hydro and solar power.




*(Ecogrid.dk, 2007)*

## ISSUES

- Surplus Wind power must be used
- Missing incentives to use energy when prices are low because tariffs and fees are too high (because the tariffs and fees are primarily executed as fiscal revenue why they are not optimal in a environmental context (polluter pays principle)
- Production coverage when wind power is not available
- Communication steering

## SOLUTION

- More flexible production and consumption is needed
- Change of tariffs and fees
- Upgrading of Nordic transmission grid and cooperation
- Energy storage
- Interaction with heating sector

## WHY IS IT RELEVANT?

- The long-term goal is to mitigate climate change via $CO_2$-emission reductions in a renewable energy system, and an interactive cooperating Nordic energy system is central, both regarding production & consumption of renewable energy.

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# Energy tariffs in Romania – Mitigating negative impacts of price reform

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The government of Romania started to reform Romania's energy sector in 2003. The goal was to lift energy prices to market level. In order to mitigate the negative effects of this the government introduced new energy tariffs that I find useful to consider in the Nordic context as well.

## Two tariff options

The problem with rising energy prices is that it affects poor the most. The government of Romania attacked this problem with a quite simple but working solution. Actually Romania had five different kinds of electricity tariff options which the citizens could choose from. However, I find two of them the most interesting. The basic idea was simple: A citizen had a choice. If his energy consumption level was low, he could choose a tariff that was lower for a certain amount of consumption (for the first 60kWh/month) but rose significantly after that. Another option was to choose a constant tariff that fell in between the two-tier tariff mentioned before.

| | |
|---|---|
| Two different tariffs to choose from: | **A two-tier tariff** with a threshold and commodity charges:<br>( In Romania: 1,339 ROL*/kWh below the threshold<br>5,759 ROL/kWh above the threshold)<br><br>**A constant tariff:**<br>(In Romania: Capacity charge of 1,044 ROL/day<br>Commodity charge of 2,106 ROL/kWh) |

*Romanian leu
This table has been modified from the original one in Velody 2003, 48.

## Relevance for Nordic policies and sustainable development

Romania's example can give some starting points for policies regarding energy subsidy removals in Nordic countries. If subsidies would be removed it would cause an increase in energy prices. The policy introduced still means government interference to energy prices but in limited scale. This policy supports social equity in case of subsidy removals without the need for any direct transfers from the government and thus also takes into account the social aspects of sustainable development. The tariff system includes incentives for richer households as well because by acting more energy efficient/investing in energy efficient equipment they can start paying a lower tariff. Energy efficiency reduces pollution and contributes to the wellbeing of the environment. This kind of policy also still allows energy companies to do their business without too strong a control, thus economic growth is still possible.
Also the administrative costs would be quite low compared to energy subsidies. Real-time energy consumption meters are already being installed at least in Finland, therefore the monitoring could be organized quite smoothly. Electricity companies already have different kind of tariffs options e.g. for different times of the day, It would be easier to gain public acceptance for subsidy removals if one could have influence on their own payments. There's still, however, left open the question of how to guide production to use more environmentally friendly energy sources. Different taxation levels could be useful here.

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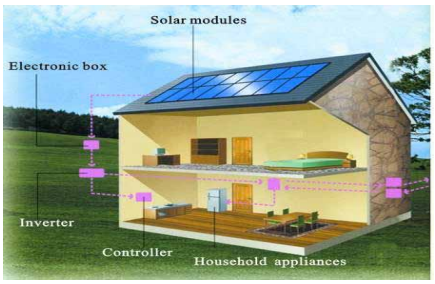
Velody, Mark (2003): Regional Review of Social Safety Net Approaches in Support of Energy-Sector Reform. Appendix 6: Energy Reform and Social Protection in Romania. http://www.reneuer.com/upload/RENEUER-CIHouse-053.pdf (referred to 12.8.2011)
*Mulas-Granados, Carlos & Segura-Ubiergo, Alex (2006):* Subsidy Reform in EU's New Member States. IMF working paper. http://www.ucm.es/info/ecap2/mulas_carlos/documentos_trabajo_recientes/Subsidy%20Reform.pdf (referred to 12.8.2001)

# Sweden and Solar Energy

*Seyed Amir Aleali*
*Karlstad University*
*Sweden*



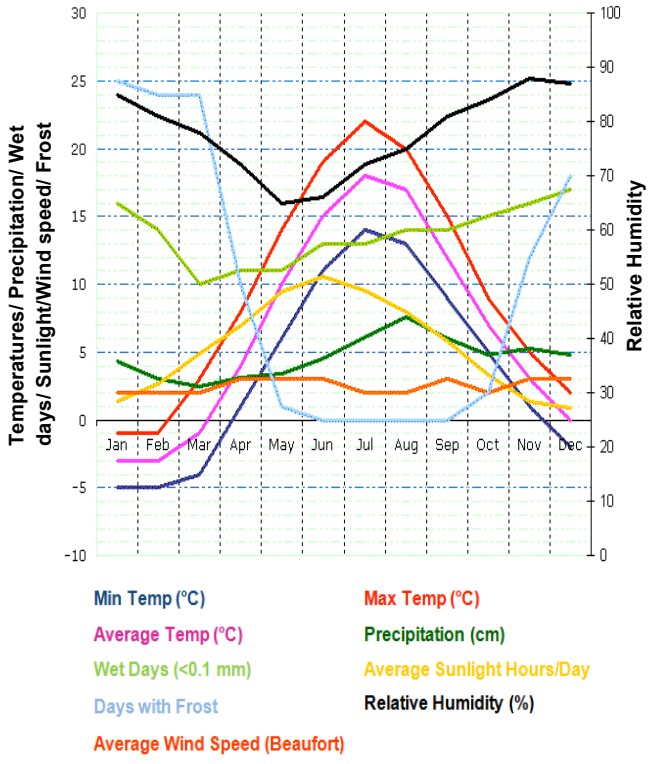

Individuals have a vital role in helping to achieve a low and even zero-carbon society. Therefore, there is a need for governments to educate as well as encourage its citizens to use renewable energy by setting the right policies; but, the Swedish government does not seem to pay enough attention to this issue. For instance, if a household has installed solar panels and it produces more energy that it needs, s/he is not allowed to sell this extra energy to others.

## A comparison between Germany and Sweden use of solar energy

| **Sweden** | |
|---|---|
| Renewable energy production change (%) (1990 compare to 2009) | +40 |
| Average sunshine hours/day | 5.4 |
| Total annual sunshine hours | 1,973 |

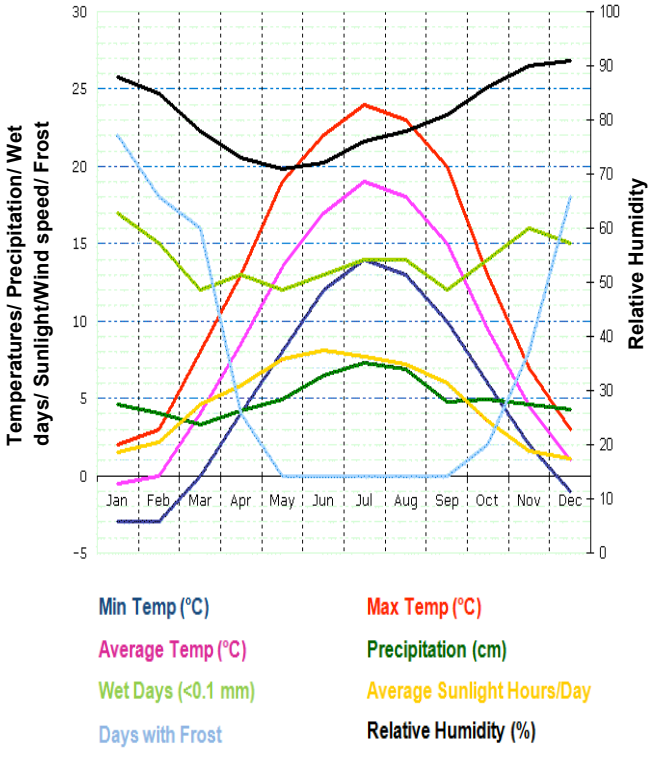
| **Germany** | |
|---|---|
| Renewable energy production change (%) (1990 compare to 2009) | +500 |
| Average sunshine hours/day | 4.8 |
| Total annual sunshine hours | 1,738 |

**Stockholm, Sweden Climate Graph (Altitude: 44 m)**




Min Temp (°C) — Max Temp (°C)
Average Temp (°C) — Precipitation (cm)
Wet Days (<0.1 mm) — Average Sunlight Hours/Day
Days with Frost — Relative Humidity (%)
Average Wind Speed (Beaufort)

**Berlin, Germany Climate Graph (Altitude: 50 m)**




Min Temp (°C) — Max Temp (°C)
Average Temp (°C) — Precipitation (cm)
Wet Days (<0.1 mm) — Average Sunlight Hours/Day
Days with Frost — Relative Humidity (%)

So, what can/should be done? Government needs to change its policies to encourage households to utilize solar energy by providing incentives such as the followings:

- Allow households to sell the extra energy produced by their solar panels.
- Reduce the energy bills of the households utilizing the solar energy on the times when there is not enough sun, such as during winter.

1) http://www.climatetemp.info/sweden/ 2) http://www.climatetemp.info/germany/
3) http://www.inverter-china.com/blog/articles/solar-energy/ 4) http://egenel.etc.se/
5) http://ec.europa.eu/energy/publications/statistics/doc/2011-2009-country-factsheets.pdf

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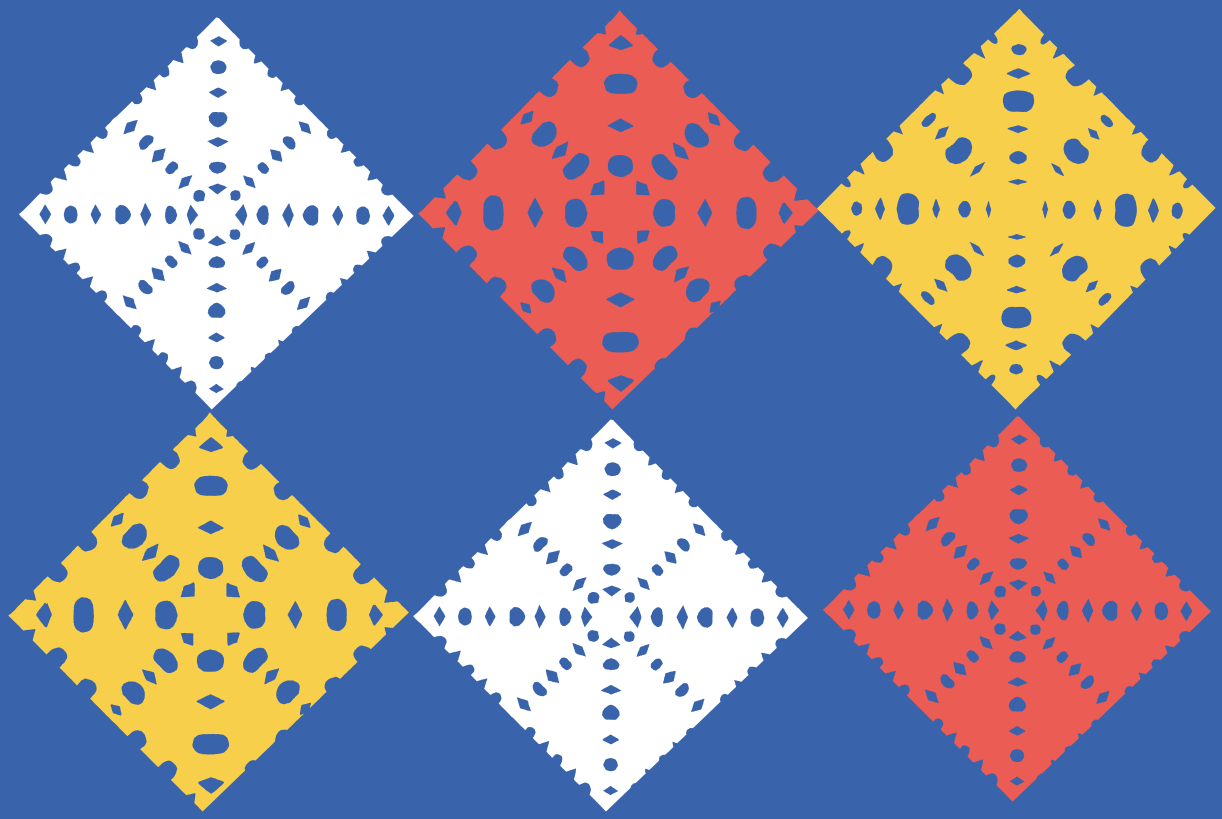

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