



hytte

| Team Norge

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ZEB  NTNU

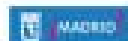
 SINTEF



sd europe
SOLAR DECATHLON



CON LA COLABORACIÓN DE:
WITH THE SUPPORT OF:



Progress summary

The ZEB research centre on ZERO EMISSION BUILDINGS not only confirmed its technical support to the project but also the economical one with the intention of transforming the +hytte into a **Living Lab for active research** once back from Madrid. The ZEB research centre approved also the construction of a **second prototype for comparative analyses**. This will be built next April and then attached to the one participating to the Solar Decathlon next september. A test version of the +hytte will be built in April 2012 in correspondence with the TECHNOPORT 2012 conference "Transition towards a green economy" in Trondheim (<http://www.technoport.no> under development). The test version of the +hytte will be facilitating a broad user participation process, with exhibitions and demonstrations in and around the building, to ensure feedback from laypeople and industry, which will inform the final development process of the +hytte.

The nature of the co-operation with the industry partners of the Research Centre for Zero Emission Buildings (ZEB; www.zeb.no) was recently negotiated, including contact with the most likely contractor, and the arrangement of a visit to their prefabrication facilities with students and teachers after Easter. **SKANSKA** confirmed its technical support as building contractor of the project and will provide in the next months helpful contacts for different material providers and consultants.

There are positive discussions with Trondheim municipality on the location of the +hytte at Brøset, after the SDE competition has ended. Brøset will be the location of a low-carbon neighbourhood, as part of the Norwegian Cities of the Future programme, with construction aimed to start in 2015 (<http://www.regjeringen.no/en/sub/framtiden-sbyer/fordside.html?id=551422>). The +hytte could, in the meantime, function as a Living Lab to test user-friendly, high-quality and low-emission solutions for future living. This issue, however, needs to be discussed thoroughly with the site owners in order to develop clear boundary conditions.

Calendar of the activities when +hytte was and will be presented:

2011-11-15 _ Boston (USA). Architecture in the Fourth dimension, International conference.

2011-10-18 _ Helsinki (Finland). SB11, World sustainable buildings conference.

2011-09-28 _ Oslo (Norway), Arkitekturforskning 2011.

2011-09-21 _ Trondheim (Norway). SFFE, Senter for fornybar energi NTNU-SINTEF-IFE-UiO.

2011-09-19 _ Trondheim (Norway). JRC SJTU Joint research center.

2011-08-29 _ Helsinki (Finland), Nordic climate festival.

2011-06-28 _ Trondheim (Norway). European Energy Network.

2011-05-02 _ Bari (Italy). Rete Vitruvio, first International conference.

2011-02-01 _ Oslo (Norway), NAL, congress, +hytte. NTNU proposal for Solar Decathlon Europe 2012.

TEAM MEMBERS

Assoc. Prof. Annemie Wyckmans is an architectural engineer and Associate Professor at NTNU, Faculty of Architecture and Fine Art. She holds a PhD in Building Technology, and a post-doctoral degree in creating learning environments for sustainable architecture. Wyckmans is engaged in a variety of interdisciplinary research projects related to the low-impact built environment, on a Norwegian and European level. Among them is the Brøset research project in close co-operation with Trondheim Urban Planning Office. Wyckmans is the initiator and leader of an international, interdisciplinary MSc in Sustainable Architecture, and also leads an interdisciplinary course "Experts in Team" and the monthly series of breakfast seminars (KLIMAX).

Assoc. Prof. Matthias Haase is associate professor at NTNU at the Department of Architectural Design, History and Technology. He is also part-time research scientist at SINTEF Building and Infrastructure, where he works on developing energy efficient building design solutions. He received his PhD from the Department of Architecture of Hong Kong University in the field of advanced facade technology for warm climates. As solar engineer from his background with seven years industry experience in BIPV facade design, Haase is very much interested in a climate responsive approach to building design that takes climate change challenges into account.

PROJECT ARCHITECT_Adjunct Prof. Per Kr. Monsen has been a co-owner at GASA Architects AS since the beginning in 1980. As co-owner at GASA, he has headed work on development plans, housing projects, education facilities and environmental projects. He is constantly involved with the firm's work on architecture competitions. As head of several of the firm's environmental projects, he has built up special competence with regards to environmental issues in planning and architecture. He is employed as Professor II at NTNU in Trondheim.

Cecilia Haskins is a post-doctoral researcher at the Norwegian University of Science and Technology (NTNU). Her research interests focus on the applications of engineering to technology solutions in support of sustainable development. She also teaches courses in research methods, globalization, CSR and sustainable development, systems engineering and project management.

Adjunct Prof. Inger Andresen has more than 15 years of experience in research and development within building technology and utilization of renewable energy. Her main scientific interest is in the area of energy conservation and the use of solar energy. She was educated at the University of Colorado (M.Sc) and the NTNU (PhD). Since 1991 she has been a researcher at SINTEF Architecture and Building Technology, Trondheim, and from 2008 a professor in energy and environment at NTNU. She has been active in several international research projects both within the IEA's Solar Heating and Cooling Programme and within the EU.

Assoc. Prof. Steffen Wellinger is Associate professor at NTNU since 2004 and has been recently awarded by SINTEF for his outstanding teaching. Wellinger is Master of Architecture from the University of Stuttgart and has been in the last years involved in the design of many complex programs public buildings. His main research interests concern design methods, teaching and sustainability.

Assoc. Prof. Rolf André Bohne is Associate Professor at NTNU at the Faculty of Engineering Science and Technology. He is currently the leader of the research group on "building and material technology". He holds a master of Science in Microbiology from the University of Bergen (Norway) and a PhD in Industrial Ecology from the Norwegian University of Science and Technology (NTNU). Bohne is engaged in a variety of interdisciplinary research projects related to the low-impact built environment, on a Norwegian and European level. He is responsible for the teaching of the introductory course in "Building Materials" and "Refurbishment, Renovation and Management".

Postdoctoral Research Fellow Anne Sigrid Nordby is an Architect and works as a Postdoc Research Fellow at the department of Product Design, Industrial Ecology Programme at NTNU. She worked for approximately 10 years in various Architects offices before starting her PhD with the title "Salvageability of building materials. Reasons, criteria and consequences regarding architectural design that facilitate reuse and recycling". Her current research includes developing a reusable building system based on reclaimed wood called Klimablokka.

Postdoctoral Research Fellow Aoife Houlihan Wiberg is a Post Doctoral Research Fellow at ZEB at the NTNU. She is a Chartered member of RIBA since 2001 and has worked in practice in The Bahamas, Malaysia, UK and Ireland. Her PhD research at The University of Cambridge researched the effectiveness of selected certification schemes in reducing global CO2 emissions in the hotel sector and proposed a simple, accurate method of CO2 emissions calculation for operational energy. Her current research is developing this method further.

Postdoctoral Research Fellow Luca Finocchiaro is a building engineer today Postdoc Research Fellow at the department of Architectural design, history and technology of NTNU. Luca got Master in Urban Building from the

Glasgow School of Art and practiced architecture in Italy and Spain. His current research focuses on architectural design of low-energy office buildings. His scientific interest are bioclimatics, aesthetics and morphology of sustainable architecture.

Postdoctoral Research Fellow Erica Lofstrom is a postdoc/researcher at the department of Interdisciplinary Studies of Culture, NTNU, working with future carbon-neutral settlements in connection to the planned area of Brøset. She holds a PhD in Energy Systems from Sweden and has previously worked as an energy expert for the Royal Swedish Academy of Engineering Sciences (IVA) and for the Swedish Government Office. Her main research area includes eco- and energy visualization technology.

Scientific Assistant Anne Solbraa is Research Assistant at the Norwegian University of Science and Technology (NTNU), Department of Architectural Design, History and Technology. Her main occupations are coordination of the MSc in Sustainable Architecture and dissemination of research to students and professionals in the city through organizing breakfast seminar series on sustainability in architecture and planning.

Student Assistant Linda Emdal is a undergraduate student of Architecture at the department of Architectural design, history and technology of NTNU. Linda also have courses from the building engineering program at NTNU where her interest for construction, materials and energy gave a broader interest for the topics on sustainable architecture.

PhD Research Fellow Julien S. Bourrelle is Research Fellow at ZEB centre and PhD Candidate at the Norwegian University of Science and Technology (NTNU). His current research focuses on energy calculation methodologies for Zero Emission Buildings and the study of associated flows and boundaries. He has been a regular participant to the International Energy Agency (IEA) Task 40 Towards Net Zero Energy Solar Buildings since 2009.

PhD Research Fellow Nicola Lolli is currently employed as PHD candidate at the Norwegian University of Science and Technology (NTNU) within the department of Architectural Design, History and Technology since 2009. His research work is carried on within the Zero Emission Buildings Research Centre. His research topic focuses on energy retrofitting of existing residential stock in Norway.

Assist. Prof. Pasi Aalto is an architect working with digital modeling and fabrication using parametric generative algorithms and CNC technology. His masters thesis explored the possibilities of a prefabricated building system for disaster response and aid organizations, as well as housing strategies after disruptive events. His areas of interest include digital analysis, Building Information Modeling and programming based generation of geometry

Helene Slagstad _ waste&water consultant

David Klar: "After graduating with a Bachelors of Environmental Studies from York University in Toronto, Canada, my desire to learn the tenets of Industrial Ecology led me to NTNU in Trondheim, Norway. In the last semester of a 2 year MSc in Industrial Ecology, I am currently in the process of writing my thesis under the supervision of Cecilia Haskins. My mixed-methods investigation focuses on the barriers to the widespread adoption of sustainable housing; with specific attention given to design for disassembly and non-conventional ownership models."

Bendik Manum, born 1962, has a master degree in civil engineering from the Norwegian University of Science and Technology (NTNU) and a master degree and a PhD from the Oslo School of Architecture and Design (AHO). He is now teaching at the Faculty of Architecture and Fine Art, NTNU.

ZEB team members: workpackages leaders

Prof. Anne Grete Hestnes (Research centre Director) is an architect with degrees from M.I.T. and UC Berkeley. She has been full professor at the Norwegian University of Science and Technology since 1985. Her main scientific interest is in the areas of energy conservation and the use of solar energy in buildings, and in 2005 she was awarded an honorary doctorate by Chalmers University for her work within the field of sustainable development. She is now Director of the National Centre for Environment-friendly Energy Research – Zero Emission Buildings.

Prof. Arild Gustavsen (WP1 leader). Arild Gustavsen is professor in Building Physics at Department of Architectural Design, History and Technology at the Norwegian University of Science and Technology (NTNU). His research interests are heat, air and moisture transfer in building envelope systems, and energy use in buildings. He is currently involved in the research projects "Robust Envelope Construction Details for Buildings of the 21st Century" (ROBUST) and The Research Centre on Zero Emission Buildings - ZEB, where he is investigating the usability of advanced materials technologies in energy efficient buildings. In addition he is researching the potentials for highly insulating window frames with The Windows and Daylighting Group at Lawrence Berkeley National Laboratory

Senior researcher Berit Time (WP2 leader) is a civil engineer and has a doctoral degree in building physics

from NTNU. She is the manager of the building physics research group at SINTEF Building and Infrastructure. Her main scientific interest is in the areas of climate adaption of buildings, moisture, heat and air transport in building envelopes. She is in charge of the research project Climate Adapted Buildings (CAB) and she is a part of the management team of the ZEB. Time is and has been a member of national and international committees.

Prof. PhD Vojislav Novakovic (WP3 leader)

Assoc. Prof. Thomas Berker (WP4 leader) is an associate professor at the Centre for Technology and Society at NTNU, Norway. His present research activities comprise the whole range of political, societal and cultural aspects connected to socio-technological innovation. He is particularly interested in the diffusion and implementation of new products and services and how these innovations become embedded in everyday life.

Senior Researcher PhD Tor Helge Dokka (WP5 leader)

Student members

MSc in sustainable architecture candidates

Alise Plavina (MSc) Riga Technical University, Latvia.
 Arjun Basnet (BA) Tribhuvan University, Nepal.
 Chenchen Guo (BEng) VIA Univerisity, Denmark.
 Elisabetta Caharija (BA), University of Trieste, Italy.
 Isabelle Davoult (BEng energy) Mines de Douai, France.
 Ivan Kalc (MA) University of Novi Sad, Serbia.
 Kristof Lijnen (Beng) University of Xios, Belgium.
 Lin Du (BEng) Shanxi Agricultural University, China.
 Michael Gruner (BArts), Univeristy of applied sciences of Dessau, Germany.
 Milla Shrestha (BA), Purbanchal University, Nepal.
 Nigar Zeynalova (BA) architecture and arts, State academy of Arts, Azerbaijan.
 Noora Alinaghizadeh (BA), Shariaty university, Tehran, Iran.
 Vegard Heide (MSc), Norwegian University of Life Sciences, Ås, Norway.

MASTER OF ARCHITECTURE STUDENTS, Climate and Built form design course, AUTUMN 2010:

Bjarte Lykke (BA) NTNU, Norway.
 Elisabeth Lilleby (BA) NTNU, Norway.
 Maria Coral Albelda-Estellés Ness (MA), Universidad Politécnica de Valencia, Spain.
 Nico Dürr (MArts) Hochschule Luzern, Switzerland
 Ole Kristian Kråkmo (BA) NTNU, Norway.
 Pablo Alarcó González BA, Polytechnic University of Madrid, Spain.
 Thea Hegstad Foss (BA) NTNU, Norway.

EXPERTS IN TEAM SPRING 2011:

Eirik Oksavik Lockertsen (Facilitator and Student Assistant)

Roger Moen (Facilitator and Student Assistant)

Flexibility:

Kine Marie Carlsen (MSc student in Facility Management)

Camilla Lauridsen (Msc student in Neuro Science)

Silje Skinnes Lunde (MSc student in Architecture)

Martin Røskaft (MSc student in Economics)

Jørgen Larsen Sugar (Stud Med)

Mari Trae (MSc student in Architecture)

Eco-visualiaation:

Marius Coucheron (Stud Med)

Ingvill Marie Moen (Msc student in Chemistry)

Audun Nordtveit (MSc student in Industrial Economy)

Eirik Wilberg Rebnord (Stud Med)

Karin Sjöstrand (MSc student in Industrial Ecology)

PROJECT DESCRIPTION. +hytte, NTNU's contribution to the Solar Decathlon Europe 2012:

The Norwegian University of Science and Technology (NTNU) is taking part in the international competition Solar Decathlon Europe 2012 where it competes with 19 other universities in order to build the best solar powered house in the summer of 2012 in Madrid. NTNU's project proposal that gave access to the competition was developed with great enthusiasm and close cooperation between students of the 2-year master's programme "Master of Science in Sustainable Architecture" within the Faculty of Architecture and Fine Art, NTNU. These students have relevant background in architecture and engineering.

NTNU's contribution to Solar Decathlon Europe 2012 is "+hytte", a small technologically advanced cabin offering a modern concept of living. It can be placed in rough Norwegian nature as well as in the urban jungle. The features of the +hytte is a positive energy account, flexibility in the use of space, low greenhouse gas emissions and the ability to be moved without leaving traces. The +hytte can also be attached to already existing buildings. As such it may compensate for the lack of energy efficiency of these adjacent buildings, e.g. the detached wooden houses which represent the most energy demanding architectural typology in Norway.

The +hytte is meant to be connected to the existing infrastructure, but may if desired be independent of the grid and infrastructure, thanks to a clever use of natural resources. Once back from Madrid, the +hytte will become a Living Lab for action research on technology and lifestyles in co-operation with private industries and public institutions.

NTNU, the Research Centre on Zero Emission Buildings & Brøset

The development of +hytte is integrated into the 2-year Master's degree in Sustainable Architecture at the Faculty of Architecture and Fine Art (AB), NTNU; in cooperation with the Faculty of Engineering and Technology (IVT) and the Department of Interdisciplinary Cultural Studies (KULT). This constellation is based on many decades of cooperation between these departments at NTNU.

Research and innovation is a driving force to develop a robust Norwegian society that manages natural resources in a sustainable manner and is resilient to climate change. Energy efficiency and renewable energy represent two of the seven national priorities put forward by the Norwegian Research Council which established

eight national centres for Environment-friendly Energy Research (FME/CEER). NTNU hosts The Research Centre on Zero Emission Buildings (ZEB), one of the FME centres. The centre builds on 30 years of interdisciplinary collaboration among architects, engineers and social scientists, researchers, industry, users and public administration. Participation in Solar Decathlon Europe was included as an important innovation project for ZEB when founded in 2009.

In addition, the development of Brøset as a zero emission urban area in Trondheim is highly relevant. This pilot project, operated by the City of Trondheim in the national program "Cities of the Future", includes extensive co-operation between the municipality and researchers from NTNU and SINTEF (The Foundation for Scientific and Technical Research at the Norwegian Institute of Technology). Many of these researchers also participate in the development of the +hytte, in order to use it as a Living Lab in Trondheim after the competition in Madrid is over.

Challenges in the development of the +hytte will be discussed at the monthly breakfast seminars at Dokkhuset in Trondheim. These seminars are organized by the Master programme in Sustainable Architecture in collaboration with Partners for Innovation and Technology (NTNU, NTE, Sparebank Midt-Norge). They highlight how the construction industry can contribute to a low carbon society.

Participation in Solar Decathlon Europe 2012 represents a unique opportunity to create a common platform to strengthen interdisciplinary research and innovation within the NTNU, in cooperation with Norwegian industry and public administration.