SEB'12

International Conference on Sustainability in Energy and Buildings 2012

Contents

Welcome Message 1
Organisation 3
International Programme Committee 5

Keynote Speaker and Lectures 7
Sustainability Challenges for the Building Sector 7
Professor Göran Finnveden 7
Buildings – both part of the problem and the solution! 8
Professor Per Heiselberg 8
Meeting the challenges of climatic change - the hard way or the clever way 9
Professor Guðni A. Jóhannesson 9
The Questions That Keep Me Up At Night 11
Professor Lynne A. Slivovsky 11

Conference Schedule 12

Schedule and Papers 15
Monday 3rd of September 2012 15
Panel: Sustainability: Current and Future with focus on Energy, Buildings and ICT 15
Tuesday 4th of September 2012 16
Session 1 17
Session 2 30
Wednesday 5th of September 2012 43
Session 3 43
Session 4 53
Session 5 59
REQUEST Workshop 68

Organising Institution 72

Other information 73

Schedule - Short version 76
Monday 3rd of September 2012 76
Tuesday 4th of September 2012 76
Wednesday 5th of September 2012 78

Preface and Welcome Message

The International Conference on Sustainability in Energy and Buildings is a respected conference focussing on a broad range of topics relating to sustainability in buildings but also encompassing energy sustainability more widely. Following the success of earlier events in the series, the 2012 conference includes the themes Sustainability, Energy, and Buildings and Information and Communication Technology, ICT.

We are very pleased to warmly welcome all delegates, keynote speakers and panellists to the Fourth International Conference on Sustainability in Energy and Buildings 2012, SEB'12. The SEB'12 conference takes place in Stockholm, Sweden, and is organised by KTH Royal Institute of Technology, Stockholm, Sweden and KES International.

KTH Royal Institute of Technology is ranked as the premier technical university in Sweden, and as one of the leading seats of learning in Europe. KTH is a research university, housing world-class research within a number of areas and has a long academic tradition of offering high-quality education and research, dating back to 1827. It has a strong tradition of engineering excellence and technical innovation and is ranked as the premier technical university in Sweden, and as one of the leading seats of learning in Europe.

KES International is a knowledge transfer organisation providing high-quality conference events and publishing opportunities for researchers. The KES association is a community consisting of several thousand research scientists and engineers who participate in KES activities. KES International is a member of the *World Renewable Energy Congress/Network.*

For more than a decade, KES has been a leader in the area of Knowledge Based and Intelligent information and Engineering Systems. In 2009, KES started to contribute in the area of Sustainability and Renewable Energy with the First Sustainability in Energy and Buildings conference, SEB'09, specifically on renewable energy and its application to domestic and other buildings. Following SEB'09 conference, both SEB'10, Brighton and Hove, United Kingdom, and SEB'11, Marseille, France, have continued to attract high level researchers from countries around the world including Australia, USA, and a number of countries in Asia and Europe. ERA2010, The Australian Research Council Excellence for Research in Australia survey in 2010 rated SEB as a Grade 'A' (top grade) conference.

SEB'12 has invited participation and paper submissions across a broad range of renewable energy and sustainability-related topics relevant to the main theme of Sustainability in Energy and Buildings. Applicable areas include technology for renewable energy and sustainability in the built environment, optimisation and modeling techniques, information and communication technology usage, behaviour and practice, including applications.

In addition to the presentations, SEB'12 includes expert keynote speeches, invited sessions and workshop. SEB'12 is an exciting chance to present, interact, and learn about the latest research in this important area.

This, the fourth conference in the SEB series, attracted a large number of submissions, which were subjected to a two-stage review process. With the objective of producing a high quality conference, papers have been selected for presentation at the conference and publication in

the proceedings. The papers for presentation are grouped into themes. The papers will be included in the proceedings, to be published after the conference by Springer Verlag in the KES Springer Smart Innovations, Systems and Technologies book series.

Thanks are due to the very many people who have given their time and goodwill freely to make the SEB'12 a success. We would like to thank the Vice-President, Göran Finnveden for accepting the invitation to open the conference. We would also like to thank the members of the International Programme Committee who were essential in providing their reviews of the conference papers, ensuring appropriate quality. Moreover, we would like to thank invited session chairs for their hard work and providing reviewers of the conference papers and upholding appropriate quality. We thank the high profile keynote speakers and panellists for agreeing to come and provide very interesting theme and talks, as well as, inform delegates and provoke discussions. Important contributors to SEB'12 are the authors, presenters and delegates without whom the conference could not have taken place, so we offer them our thanks for choosing SEB'12 conference. The KES International and KES Secretariat staff worked very hard to bring the conference to a high level of organisation, and we appreciate their tremendous help and we are thankful to them. Finally, we thank the people of KTH Royal Institute of Technology and City Hall, City of Stockholm Sweden for hosting the reception for the SEB'12 conference and the staff of the Quality Hotel Nacka for accommodating the conference 3 – 5 of September 2012 International Conference on Sustainability in Energy and Buildings.

We hope that delegates will find SEB'12 an interesting, informative and enjoyable experience. We are pleased to welcome you to the KES community and hope to see you at future KES events.

Assoc Professor Anne Håkansson and Professor Mattias Höjer
SEB'12 General Chairs
KTH Royal Institute of Technology,
Sweden

Professor Robert J Howlett
Executive chair
KES International & Bournemouth University,
United Kingdom

Organisation

Honorary Chairs

Göran Finnveden
Strategic Environmental Analysis
KTH Royal Institute of Technology, Sweden

Björn Birgisson
Division of Highway Engineering
KTH Royal Institute of Technology, Sweden

and

Professor Lakhmi C. Jain
University of South Australia, Australia

General Chairs

Assoc Prof. Anne Håkansson
Communication Systems
KTH Royal Institute of Technology, Sweden

and

Professor Mattias Höjer
Centre for Sustainable Communications
KTH Royal Institute of Technology, Sweden

Executive Chair

Professor Robert J. Howlett
Executive Chair, KES International &
Bournemouth University, United Kingdom

Program Chairs

Ronald Hartung
Computer Sciences and Mathematics
Franklin University, Columbus, Ohio, USA

and

Mark Smith
Communication Systems
KTH Royal Institute of Technology, Stockholm, Sweden

Publicity and Support Chairs

Bernhard Huber
Centre for Sustainable Communications (CESC)
KTH Royal Institute of Technology, Stockholm, Sweden
and

Dan Wu
Communication Systems
KTH Royal Institute of Technology, Stockholm, Sweden

Nils Brown
Centre for Sustainable Communications (CESC)
KTH Royal Institute of Technology, Stockholm, Sweden

and

Esmiralda Moradian
Communication Systems
KTH Royal Institute of Technology, Stockholm, Sweden

Faye Alexander
Conference Operations, KES International, UK

Shaun Lee
Information Systems Support, KES International, UK

and

Russ Hepworth
Business Development Manager, KES International, UK

International Programme Committee

Name	Affiliation
Meniai Abdeslam-Hasse	Université Mentouri de Constantine, Algeria
Nora Cherifa Abid	Aix-Marseille University, France
Vivek Agarwal	Indian Institute of Technology Bombay, India
Abdel Aitouche	Lagis Hei, France
Nader Anani	Manchester Metropolitan University, UK
Naamane Aziz	Marseilles Aix Marseille Universite (AMU), France
Messaouda Azzouzi	Ziane Achour University of Djelfa, Algeria
Brahim Benhamou	Cadi Ayyad University of Marrakech, Morroco
Frede Blaabjerg	Aalborg University Inst. Of Energy Technology, Denmark
Saadi Bougoul	Université de Batna, Algerie
Mohamed Chadli	University of Picardie Jules Verne, France
Christopher Chao	Hong Kong University of Science and Technology, China
Zhen Chen	Heriot-Watt University, Scotland
Derek Clements-Croome	Reading University, UK
Gouri Datta	Deshbandhu College, Kalkaji, University of Delhi, India and Stromstad Academy, Stromstad.
Mohamed Djemai	Université de Valenciennes et du Hainaut Cambrésis, France
Philip Eames	Loughborough University, UK
Mahieddine Emziane	Masdar Institute of Science and Technology, Abu Dhabi
Luis Fajardo-Ruano	UUMSNH, MORELIA, MEXICO
Antonio Gagliano	University of Catania, Italy
Oleg Golubchikov	University of Birmingham, UK
Ahmed Hajjaji	University of Picardie Jules Verne, France
Abdelaziz Hamzaoui	University of Reims Champagne Ardenne, France
Sture Holmberg	Royal Institute of Technology (KTH) Stockholm, Sweden
Robert J Howlett	Bournemouth University, UK
Bin-Juine Huang	National Taiwan University, Taipei, Taiwan
Kenneth Ip	University of Brighton, UK
Hong Jin	Harbin Institute of Technology, China
Roger Kemp	Lancaster University, UK
Sumathy Krishnan	North Dakota State University, USA
Angui Li	Xi'an University of Architecture & Technology, China
Soren Linderoth	Technical University of Denmark

John Littlewood	Cardiff Metropolitan University, UK
Nacer Kouider M'Sirdi	Laboratoire des Sciences del'Information et des Systèmes, France
Noureddine Manamani	University of Reims, France
Ahmed Mezrhab	University Mohammed 1, Oujda Morocco
Behdad Moghtaderi	University of Newcastle, Australia
Roger Morgan	Liverpool John Moores University, UK
Mostafa Mrabti	Universite Sidi Mohamed Ben Abdellah, Fes, Morocco
Rui Neves-Silva	Universidade Nova de Lisboa FCT/UNL, Portugal
Emeka Efe Osaji	University of Wolverhampton, UK
Frederici Pittaluga	University of Genova, Italy
Giuliano C Premier	University of Glamorgan, UK
Abdelhamid Rabhi	MIS Amiens, France
Ahmed Rachid	University of Picardie Jules Verne, France
Enzo Siviero	University IUAV of Venice, Italy
Shyam Lal Soni	Malaviya National Institute of Technology, Jaipur, India
Catalina Spataru	UCL Energy Institute, Uk
Alessandro Stocco	University of Nova Gorica and partner Progeest S.r.l. of Padua, Italy
Lounes Tadrist	Polytech.univ-mrs, France
Dario Trabucco	IUAV University of Venice, Italy
Mummadi Veerachary	Indian Institute of Technology, Delhi, India
Wim Zeiler	TU Eindhoven, Faculty of the Built Environment, Netherlands
Mohcine Zouak	USMBA FST, Morocco
Rainer Zah	Life Cycle Assessment & Modelling Group, Empa, Switzerland

Keynote Speaker and Lectures

We are very pleased to have acquired the services of an excellent selection of keynote speakers for SEB'12. These speakers will give SEB'12 delegates a view about technological and scientific activities, relating to sustainability in energy and buildings, taking place in various areas of the world.

Professor Göran Finnveden
KTH Royal Institute of Technology, Sweden

Sustainability Challenges for the Building Sector

Abstract:

The building and real estate management sector is responsible for a significant part of the environmental impacts of our society. The sector's contribution to the threat of climate change for production of heat and electricity for the buildings are of special importance. It is important to consider the full life-cycle of buildings and also consider production and transportation of building materials, construction and waste management. In Sweden, emissions of gases contributing to climate change from heating of buildings have decreased during the last decades as results of strong policy instruments. One the other hand emissions from other parts of the life-cycle of buildings have increased, illustrating the need to have a wide systems perspective in order to avoid sub-optimizations. It is also important to consider other environmental threats such as the use of hazardous chemicals, air quality, generation of waste and impacts on ecosystems from production of building materials as well as on building sites.

The building sector has a large potential to reduce its environmental footprint. Many of the most cost-efficient possibilities for mitigation of climate change are related to the building sector. Governmental policies are important for changes to be made. Voluntary instruments such as building rating tools may have an additional role. The ICT-sector may have one of its largest potentials in contributing to a more sustainable society in the building sector. Because of the long life-time of buildings, we are now constructing the future environmental impacts. When looking for cost-efficient solutions, we must therefore also consider the future cost-efficiency. In the presentation also social aspects of sustainability will be discussed including possibilities for the building sector to contribute to a better health and reduced health inequalities.

Biography:

Göran Finnveden is Professor in Environmental Strategic Analysis and Vice-President for sustainable development at KTH Royal Institute of Technology, Stockholm, Sweden. He is a M.Sc. in Chemical Engineering 1989, PhD in Natural Resources Management, Associate Professor in Industrial Ecology 2003 and full Professor 2007. His research has focused on environmental systems analysis tools such as Life Cycle Assessment, Strategic Environmental Assessment and Input-Output Analysis. It has included both methodological development and case studies. Application areas include buildings, energy systems, information and communication technologies, infrastructure and waste management. He

has also worked with environmental policy in areas such as environmental policy integration, integrated product policy and waste policy. He is a currently a member of the Scientific Advisory Council to the Swedish Minister of the Environment, an expert in the governmental commission on waste management and a member of the board of directors of the Swedish Waste Nuclear Fund. According to Scopus he has published more than 60 scientific papers and is cited nearly 2000 times.

Professor Per Heiselberg
Aalborg University, Denmark

Buildings – both part of the problem and the solution!

Abstract:

Energy use for room heating, cooling and ventilation accounts for more than one-third of the total, primary energy demand in the industrialized countries, and is in this way a major polluter of the environment. At the same time the building sector is identified as providing the largest potential for CO2 reduction in the future and many countries across the world have set very ambitious targets for energy efficiency improvements in new and existing buildings. For example at European level the short term goal has recently been expressed in the recast of the EU Building Performance Directive as "near zero energy buildings" by 2020.

To successfully achieve such a target it is necessary to identify and develop innovative integrated building and energy technologies, which facilitates considerable energy savings and the implementation and integration of renewable energy devices within the built environment. The rapid development in materials science, information and sensor technology offers at the same time considerable opportunities for development of new intelligent building components and systems with multiple functions.

Such a development will impose major challenges on the building industry as building design will completely change from design of individual components and systems to integrated design of systems and concepts involving design teams of both architects, engineers and other experts. Future system and concepts solutions will require that building components must be able fulfill multiple performance criteria and often contradictory requirements from aesthetics, durability, energy use, health and comfort. A key example of this is building facades that instead of the existing static performance characteristics must develop into dynamic solutions with the ability to dynamically adjust physical properties and energetic performance in response to fluctuations in the outdoor environment and changing needs of the occupants in order to fulfill the future targets for energy use and comfort. Buildings will also be both consumers and producers of energy, which creates a number of new challenges for building design like identification of the optimum balance between energy savings and renewable energy production. The interaction between the energy "prosuming" building and the energy supply grid will also be an important issue to solve.

The lecture will address and illustrate these future challenges for the building sector and give directions for solutions.

Biography:

Per Heiselberg is Professor at the Department of Civil Engineering at Aalborg University, Denmark. He holds a M.Sc. and a Ph.D. in Indoor Environmental Engineering. His research and teaching subjects are within architectural engineering and are focused on the following topics:

• Energy-efficient building design (Net zero energy buildings, design of low energy buildings - integration of architectural and technical issues, modelling of double skin facades, night cooling of buildings and utilization of thermal mass, multifunctional facades, daylight in buildings, passive energy technologies for buildings, modeling of building energy use and indoor environment)

• Ventilation and air flow in buildings (Modelling and measurements of air and contaminants flows (both gas- and particles) in buildings, ventilation effectiveness, efficient ventilation of large enclosures, numerical simulation (computational fluid dynamics) of air and contaminant flows as well as modeling of natural and hybrid ventilation)

He has published about 300 articles and papers on these subjects.

Currently, Per Heiselberg is leading the national strategic research centre on Net Zero Energy Buildings in Denmark (www.zeb.aau.dk). The centre has a multidisciplinary research approach and a close cooperation with leading Danish companies. He has been involved in many EU and IEA research projects in the past 20 years. He was the operating agent of IEA-ECBCS Annex 35 (1997-2002) and IEA-ECBCS Annex 44 (2005-2009), (www.ecbcs.org). Presently he is involved in ECBCS Annexes 52, 53 and 59.

Professor Guðni A. Jóhannesson
Icelandic National Energy Authority, Iceland

Meeting the challenges of climatic change - the hard way or the clever way

Abstract:

We may not agree on how the possible CO2 driven scenarios of climate change in the future may look like but we all can agree that the anthropogenic increase in CO2 levels in the world atmosphere exposes humanity to higher risks of changes in the environment than we want to face in our, our children's or their children's lifetime.

It is evident that we are now facing a global challenge that we are more often dealing with by local solutions. Our guiding rule is that by saving energy we are also mitigating greenhouse gas emission. Also if we are using renewable energy and substituting fossil fuels we are also moving in the right direction. There are however important system aspects that we should be considering.

The first one if we are using the right quality of energy for the right purpose. A common example is when high quality energy such as electricity or gas is used directly to provide domestic hot water or heat houses instead of using heat pumps or cogeneration processes to get the highest possible ratio between the used energy and the primary energy input.

The second one is if we are obstructing necessary structural changes that could lead to a more effective energy system globally. We have big reserves of cost effective renewable energy sources, hydropower and geothermal energy around the world that are far from the markets and would therefore need relocation structural changes in our industrial production system to be utilized.

The third aspect is if we are using our investments in energy conversion and energy savings in the best way to meet our climatic goals or if we are directed by other hidden agendas to such a degree that a large part of our economical input is wasted.

It is evident that the national and local strategies for energy savings are closely linked to other strategic areas such as industrial development, household economy, mobility. Also a necessary precondition for investment is that the nations maintain their economic strength and their ability to develop their renewable resources and to invest in new more efficient processes.

The key to success in mitigating the climatic change is therefor to create a holistic strategy that beside the development of technical solutions for energy efficiency and utilization of renewable energy also considers the local and global system aspects. With present technologies for energy efficient solutions, proper energy quality management r and with utilization of cost effective renewable energy sources we have all possibilities to reduce energy related the global CO2 emissions to acceptable levels.

Biography:

Professor Guðni A. Jóhannesson is born in Reykjavik 1951. He finished his MSc in Engineering physics in 1976, his PhD thesis on thermal models for buildings in 1981 and was appointed as an associate professor at Lund University in 1982. He was awarded the title of doctor honoris causae from the University of Debrecen in 2008 and the Swedish Concrete Award in 2011. From 1975 he worked as a research assistant at Lund University, from 1982 as a consultant in research and building physics in Reykjavik and from 1990 as a professor in Building Technology at KTH in Stockholm and from 2008 an affiliated professor at KTH. His research has mainly concerned the thermodynamical studies of buildings, innovative building systems and energy conservation in the built environment. Since the beginning of 2008 he is the Director General of the Icelandic National Energy Authority which is responsible for public administration of energy research, energy utilization and regulation. He was a member of the The Hydropower Sustainability Assessment Forum processing the Hydropower Sustainability Assessment Protocol adopted by IHA in November 2010 and presently the chair of IPGT the International Partnership for Geothermal Technologies.

Professor Lynne A. Slivovsky
California Polytechnic State University, USA

The Questions That Keep Me Up At Night

Abstract:

This keynote will provide an opportunity for reflection on the work we do. We're here talking about energy and sustainability but we're also talking about a different way of living. We, as a technical field, a society, a world, are on a path of profound technological development. What does it mean to educate someone to contribute to this world? To have a technical education? What does it mean to live in this world? And is it possible that we as designers, innovators, engineers, and scientists can consider these questions in our day-to-day work?

Biography:

Lynne A. Slivovsky (Ph.D., Purdue University, 2001) is Associate Professor of Electrical and Computer Engineering at California Polytechnic State University, San Luis Obispo, California, USA. In 2003 she received the Frontiers In Education New Faculty Fellow Award. Her work in service-learning led to her selection in 2007 as a California Campus Compact-Carnegie Foundation for the Advancement of Teaching Faculty Fellow for Service-Learning for Political Engagement. In 2010 she received the Cal Poly President's Community Service Award for Significant Faculty Contribution. She currently oversees two multidisciplinary service-learning programs: the Access by Design Project that has capstone students designing recreational devices for people with disabilities and the Organic Twittering Project that merges social media with sustainability. Her work examines design learning in the context of engagement and the interdependence between technology and society.

Conference Schedule

Monday 3rd of September 2012

	Day 1
13.00 - 13.30	Early Registration
13.30 - 14.00	
14.00 - 14.30	Plenary Keynote Talk
14.30 -15.00	
15.00 - 15.30	Coffee
15.30 - 16.00	Industrial Round Table Discussion
16.00 -16.30	
16.30 -17.00	
17.00 -17.30	
17.30 - 18.00	
18.00 - 18.30	18.30 - Bus to City Hall
Evening	Welcome Reception City Hall Stockholm 19.00 - 22.00 21.30, Bus to Quality Hotel Nacka

* The Welcome Reception is hosted by City Hall, City of Stockholm, Sweden.

** Buses to and from City Hall departure and arrive at Quality Hotel Nacka*

Tuesday 4th of September 2012

	Day 2
8.00 - 8.30	**Registration**
8.30 - 9.00	
9.00 - 9.30	**Conference Opening & Welcome Ceremony**
9.30 - 10.00	**Plenary Keynote Talk**
10.00 - 10.30	
10.30 - 11.00	**Coffee and Poster Presentations**
11.00 - 11.30	**Oral Paper Presentations**
11.30 - 12.00	5 Parallel sessions, 20 min presentations
12.00 - 12.30	
12.40 - 13.00	**Lunch**
13.00 - 13.30	
13.30 - 14.00	**Plenary Keynote Talk**
14.00 - 14.30	
14.30 -15.00	**Coffee** **Poster Presentations**
15.00 - 15.30	
15.30 - 16.00	**Oral Paper Presentations**
16.00 -16.30	5 Parallel sessions, 20 min presentations
16.30 -17.00	
17.00 -17.30	
17.30 - 18.00	**17.30 - Bus to Vasa Museum ***
18.00 - 18.30	
Evening	**Guided tour and Gala Dinner** **Vasa Museum** **17.30 - 22.00** **21.30, Bus to Quality Hotel Nacka**

** Buses to and from Vasa Museum departure and arrive at Quality Hotel Nacka*

Wednesday 5th of September 2012

		Day 3
8.00 - 8.30		**Registration**
8.30 - 9.00		
9.00 - 9.30		**Plenary Keynote Talk**
9.30 - 10.00		
10.00 - 10.30		**Coffee** **Poster Presentations**
10.30 - 11.00		**Oral Paper Presentations** 5 Parallel sessions, 20 min presentations REQUEST Workshop
11.00 - 11.30		
11.30 - 12.00		
12.00 - 12.30		
12.40 - 13.00		**Lunch**
13.00 - 13.30		
13.30 - 14.00		**Oral Paper Presentations** 5 Parallel sessions, 20 min presentations REQUEST Workshop
14.00 - 14.30		
14.30 -15.00		**Coffee** **Poster Presentations**
15.00 - 15.30		**Oral Paper Presentations** 5 Parallel sessions, 20 min presentations REQUEST Workshop
15.30 - 16.00		
16.00 -16.30		
16.30 -17.00		
17.00 -17.30		**Closing Ceremony**
17.30 - 18.00		
18.00 - 18.30		

**In case of questions or problems please approach the organisation at the venue.*

Schedule and Papers

Monday 3rd of September 2012

14.00-15.00
Keynote speaker
Professor Göran Finnveden, KTH Royal Institute of Technology, Sweden

Room: Atlas Diesel Floor 1, Quality Hotel Nacka
Chair: Prof Mattias Höjer

15.00-15.30
Coffee break

15.30-17.30 (approx time for finishing)

Panel: Sustainability: Current and Future with focus on Energy, Buildings and ICT

Room: Atlas Diesel Floor 1, Quality Hotel Nacka
Chair: Prof Mattias Höjer

Panel:
Sofia Ahlroth, Working Party on Integrating Environmental and Economic Policies (WPIEEP), Swedish EPA
Magnus Enell, Senior Advisor Sustainability at Vattenfall AB, Sweden
Göran Finnveden, Professor, KTH Royal Institute of Technology, Sweden
Danielle Freilich, Environmental expert at The Swedish Construction Federation (BI), Sweden
Catherine.Karagianni, Manager for Environmental and Sustainable Development at Teliasonera, Sweden
Örjan Lönngren, Climate and energy expert, Environment and Health Department, City of Stockholm, Sweden
Per Sahlin, Simulation entrepreneur, Owner of EQUA Simulation AB, Sweden
Mark Smith, Professor, KTH Royal Institute of Technology, Sweden
Örjan Svane, Professor, KTH Royal Institute of Technology, Sweden
Olle Zetterberg, CEO, Stockholm Business Region, Stockholm, Sweden

18.30
Bus to City Hall, Stockholm

19.00 – 22.00
Welcome Reception, City Hall, Stockholm

Welcome Reception is hosted by City Hall, City of Stockholm, Sweden.

Tuesday 4th of September 2012

09.00-09.30
Conference Opening and Welcome Ceremony
Organisation SEB12

09.30-10.30
Keynote speaker
Professor Guðni A. Jóhannesson, Icelandic National Energy Authority, Iceland
Room: Atlas Diesel, Floor 1
Chair: Assoc Prof Anne Håkansson

10.30-11.00
Posters
Room: Atlas Diesel, Floor 1
Chair: PhD Esmiralda Moradian and PhD Student Dan Wu

A stochastic model for collective resident activity patterns and energy use: preliminaries

Joakim Munkhammar, and Joakim Widén
Uppsala University, Sweden

This paper describes the framework for a stochastic model of collective resident activity patterns and consequent energy use. The model is calibrated with a large set of time-use data and produces a probability density distribution of activities with consequent energy use. The complete evaluation of this concept along with the potential prospect of including the complex components involved in interacting individuals is left for future studies.

Design and Validation of Solar Calorimeter

Michael Blanding, Kyle Hoppe, Rajesh Reddy, Uday Kumar, and Hamid Kayal
KTH Royal Institute of Technology, Stockholm, Sweden,
CSEM-UAE Innovation Center LLC, Ras al Kamiah, UAE

One of the more efficient and cost effective passive methods for reducing the cooling (heating) load of a building is with the use of solar insulating materials. CSEM-UAE has performed a theoretical study of different cost-effective and thermally efficient solutions regarding the solar insulating materials for buildings. The preliminary laboratory scale calorimetric study on solar insulating materials showed that energy savings of 20-30% can be obtained with different solar insulating and reflective materials. To perform a real outdoor test of the savings obtained with solar insulating materials, a solar calorimetric test facility has been designed. The present design is aimed at determining the energy savings of different measures with similar indoor conditions, with and without solar insulating materials for the same ambient conditions. The design and simulation results of the test facility with various solar insulating materials are presented in this paper.

On The Application Of Simulation Tools In Building Design With Emphasis On Sustainability

Navid Gohardani, and Folke Björk
Royal Institute of Technology (KTH), Sweden

A planned building design is assessed based on a simulation approach where in particular the peak load heating and peak load cooling analysis is carried out on the building. In particular within the scope of this research, sustainability has been assessed based on modified geometries and different geographical locations of a generic building structure. The employed methodology in this study establishes a foundation for comparison between the original building design and a modified one, with particular emphasis on sustainability and the overall building performance.

11.00-12.40

Session 1

General track

Track 1

Room: Atlas Diesel, 1st floor
Chair: Prof Mattias Höjer

Role of Lochiel Park Green Village

Mr Stephen Berry
University of South Australia, Australia

Energy use in housing has a significant negative impact on the environment. The South Australian Government responded to concern for anthropogenic greenhouse gas emissions by creating a model green village of near zero carbon homes in a near zero carbon impact estate. The creation of the Lochiel Park Green Village challenged actors from industry and government to set objectives, performance targets and regulatory guidelines outside existing institutional and professional norms. Evidence collected through a series of interviews has found that industry has responded to their involvement in the development by shifting away from some dominant technologies, practices and beliefs, and embracing new tools, construction practices and technologies, and policy makers have used the experience to consider new standards of building performance. Using a multi-level socio-technical framework this paper demonstrates how structural change at the regime level has come from the experience of actors at the niche level. The creation of the Lochiel Park Green Village has allowed many organisations to gain a more detailed and practical understanding of sustainable housing, and has given organisations the confidence to change industry practices, government policies, and regulatory standards.

Evaluation and Validation of an Electrical Model of Photovoltaic Module based on Manufacturer Measurement

PhD Giuseppe Tina, and PhD Cristina Ventura
Dipartimento di Ingegneria Elettrica, Elettronica e Informat, Italy

The analysis of the performance of a photovoltaic (PV) array needs basically the reporting the real working conditions to a reference con- dition of irradiance and temperature. Normally it is used the Standard Test Conditions (STC). Then the corrected I-V curves can be compared and an analysis of the performances can be carried out. In this context this paper proposes an analytical model to evaluate the energy performance of a PV module. The proposed model is based on some data provided by the manu- facturer of the module in STC conditions. The photovoltaic module used as test-bed in the experiments gives the possibility to have the six terminals of the three strings forming the module, that normally are connected in series. This is very useful in the case of shading or disuniform radiation. The model is validated with numerical examples, and tested using both measured and estimated data relative to each single string and their connection in series and parallel. Results show how the parameters extraction depends on the measured value of the maximum power points, if measures are not accurate the analytic model here implemented can not converge to a feasible solution.

Evolution of environmental sustainability for timber and steel construction

Dr.-Ing., Ass. Prof. Dimitrios Kaziolas, Dr. -Ing., Professor Charalambos Baniotopoulos, Professor Dimitrios Emmanouloudis, Dr. -Ing., Professor Georgios Stavroulakis,and Dr. -Ing. Iordanis Zygomalas
Technological Educational Institute of Kavala, Greece

The movement for sustainable development aims at the optimization of the whole of human activity in terms of environmental, economic and social impact. The aim of the present paper is the examination of the content and evolution of environmental sustainability in order to identify the key implications and requirements regarding timber and steel structures, two fields with significant potential in terms of sustainability. The conclusions drawn include the identification of issues such as raw materials, the construction stage of a project and waste management and their potential influence on the environmental sustainability of timber and steel construction.

Using the energy signature method to es-timate the effective U-value of buildings

PhD Student Gustav Nordström, Associate Professor Helena Johnsson, and PhD Sofia Lidelöw
Luleå University of Technology, Sweden

The oil crisis of the 1970s and the growing concern about global warming have created an urge to increase the energy efficiency of residential buildings. Space heating and domestic hot water production account for approximately 20% of Sweden's total energy use. This study examines the energy performance of existing building stock by estimating effective U-values for six single-family houses built between 1962 and 2006. A static energy signature model for estimating effective U-values was tested, in which the energy signature was based on measurements of the total power used for heating and the indoor and outdoor temperatures for each studied house during three winter months in northern Sweden. Theoretical U-values for hypothetical houses built to the specifications of the Swedish building codes in force between

1960 and 2011 were calculated and compared to the U-values calculated for the studied real-world houses. The results show that the increasingly strict U-value requirements of more recent building codes have resulted in lower U-values for newer buildings, and that static energy signature models can be used to estimate the effective U-value of buildings provided that the differences between the indoor and outdoor temperatures are sufficiently large.

Energy consumption patterns in fixtures, systems and appliances of Australian residential buildings: geographical and socio-economical disaggregation

Prof. Patrick Zou, and Dr. Rebecca Yang
Discipline of Building and Construction Management, Faculty

Abstract to announced

Track 2

Room: Propellern, 2nd floor
Chair: PhD Student Nils Brown

Two Case Studies in Energy Efficient Renovation of Multi-family Housing; Explaining Robustness as a Characteristic to Assess Long-term Sustainability

Mr. Vahid Sabouri, and Dr. Paula Femenias

This study addresses two energy efficiency approaches to renovation of multi-family housing in Sweden aiming at a better understanding of *robustness* as a building characteristic especially in terms of energy performance of buildings and indoor environmental quality. The study includes a theoretical part where the concept of robustness has been investigated in technical and socio-technical systems and analogously in architectural design. It also includes two case studies as the empirical material of the research. Solar houses in Gårdsten and passive houses in Brogården have been chosen as two different approaches to renovation of multi-family housing with energy efficiency objectives. Finally, the two cases have been analyzed using an analytical framework which has been developed based on the findings of this research study to assess the robustness of applied energy efficiency measures.
The performance of some systems in operational situation is not the same as their expected performance during the design phase. This could be caused by poor assumptions during modeling or disregarding users' behavior. In case of energy efficient buildings such misestimation can result in vulnerable measures which would affect energy objectives of the design. Thus, to achieve sustainable architecture especially in a long-term perspective, applying more robust measures (measures which are not sensitive to probable future changes) would reduce vulnerability of design to unforeseen situations and enhance durability and reliability of building. So a building could be assessed for robustness of design from different aspects such as robustness of structure and building elements, robustness of users' comfort and satisfaction and robustness of feasible operation and maintenance each of which could enhance robustness of the whole building as a unified system. Concerning energy performance of a building, robustness could be enhanced applying user-oriented and climate-oriented design approaches which increase the adaptability of design to unforeseen future situations.

In the empirical studies the focus has been mainly on the technical aspects. However, in the case analysis, the user-building interface has been also highlighted as an important factor affecting robustness of technical systems. In Gårdsten, the renovation proposal is mostly based on solar gain through solutions such as glazed balconies and solar panels while in Brogården the approach is based on the concept of passive housing and the result is highly insulated, air tight buildings.
In the analysis, it has been tried to assess long-term sustainability of the cases through a qualitative method. The two cases have been analyzed using an analytical framework which has been developed based on the findings of this study to assess the robustness of applied EE measures. *Adaptability*, *Redundancy*, *preference for passive techniques*, *users control over IAQ*, *transparency of systems to users* and *maintenance facility* have been considered as the main criteria for robustness analysis and the performance of cases has been studied in relation to seven major factors likely to face uncertainties including *household appliances*, *occupant behavior*, *maintenance support*, *energy sources*, *technical systems*, *envelope quality* and *climatic conditions (HOMETEC factors of change)*.

Exploring the Courtyard Microclimate through an Example of Anatolian Seljuk Architecture: the Thirteenth-Century Sahabiye Madrassa in Kayseri

ASSIST.PROF.DR. HAKAN HISARLIGIL
Meliksah University, Turkey

The aim of the study was to investigate the microscale climatic conditions of courtyard buildings constructed by the Seljuk Turks throughout Anatolia in the thirteenth century. The particular focus was on how semi-open spaces, such as iwan and arcades surrounding the courtyard, are used to control daily and seasonal variation in the harsh semi-arid climate. Sahabiye Madrassa, in Kayseri, was used as a case study. Using ENVI-met 3.1, numerical simulations were run on a three-dimensional microclimate model to observe (a) the variations in microclimatic parameters, such as air temperature, incoming short-wave radiation, outgoing long-wave radiation, wind speed, and mean radiant temperature, and (b) how these variations affect comfort indices, such as the Predicted Mean Vote (PMV) and Predicted Percentage Dissatisfied (PPD). It was found that the madrassa responds dynamically to variation in external parameters and provides its users with increased levels of comfort, which belies its static and massive appearance.

Analysis of structural changes of the load profiles of the German residential sector due to decentralized electricity generation and e-mobility

M.Sc. Rainer Elsland, Dipl.-Ing. Tobias Bo§mann, Dr. Massimo Genoese, Dipl.-Wirt.-Ing. Till Gnann, Dipl.-Ing. Rupert Hartel, and Prof. Dr. Martin Wietschel
Fraunhofer ISI

In this paper, a bottom-up energy demand model is applied to a scenario-based analysis of the load profiles of the German residential sector until the year 2040. This analysis takes into account the increasing diffusion of e-mobility and decentralized electricity generation and addresses questions such as: How much demand has to be met by the electricity supply system and what kind of structural changes in the load profile are to be expected. In order to assess the maximum contribution of decentralized electricity generation, a weekday in summer was chosen for the analysis. Assessing the future residential electricity demand on an hourly basis clearly depicts an increased volatility due to the shift in demand from night-time to daytime hours which is mainly caused by the greater number of ICT appliances.

Furthermore, electric vehicles lead to a significant increase in the evening demand peaks. At the same time, electricity generation from photovoltaic sources can entirely compensate this additional demand by e-mobility, if decentralized electricity generation can be matched with the electricity demand via demand-side-management (DSM) or storage devices.

The impact of hedonism on domestic hot water energy demand for showering - the case of the Schanzenfest, Hamburg

Mr Stephen Lorimer, Miss Marianne Jang, and Miss Korinna Thielen
University College London

The causes of variation in energy demand for hot water in showering or bathing within the same dwelling is often difficult to understand. This study followed the activities of a study group living as a large household and working on projects in architecture studios. Consumption diaries for lifestyle choices and showering times was triangulated with electric meter data to examine energy use behaviours and explore changes in hot water demand. This occurred over a two week period that included a street festival, the *Schanzenfest,* on the weekend. The study found that total energy demand amongst the same group could double depending on the amount of hedonism, or the seeking of fun and self-gratification, on display the previous evening. Therefore, this paper proposes that the increase of opportunities to have fun and the lack of structure on the weekend significantly increase domestic energy demand compared to a more structured weekday and should be the subject of further research.

The Process of Delivery – A Case Study Evaluation of Residential Handover Procedures in Sustainable Housing

Mr David Bailey, Professor Mark Gillott, Dr Robin Wilson
Nottingham University, UK

At present research groups are developing a growing body of evidence quantitatively demonstrating through post occupancy evaluation, a significant gap between the actual physical performance characteristics and the design predictions of sustainable dwellings. In examining this documented performance variability this paper argues that a substantial proportion of this gap may be the result of mismanagement and misuse of sustainable systems by the occupants who have received little to no training in the specialised equipment and design techniques regularly employed in modern sustainable housing. Specifically this paper looks into the training and guidance given to new house owners during the critical handover phase. The research adopts a direct observational methodology in conjunction with a suitable housing case study and the associated handover process. By recording and analysing the handover procedures of a representative housing developer the study hopes to gain valuable insight into the current technological training and guidance provided to new tenants of modern ecologically certified housing. The study finds occupants are not receiving adequate training and guidance with regard to the sustainable measures employed in their housing. In addition the survey suggests that residents struggle to absorb the information provided in the current format. Ultimately the study proposes a complete reform of the handover process, based on existing commercial precedence and focusing on both the accessibility and content of the handover procedure.

Invited sessions

Track 3

Room: Blåslampan, 2nd floor
Sustainable and healthy buildings
Chair: Prof Jeong Tai Kim

Mobile Motion Sensor-based Human Activity Recognition and Energy Expenditure Estimation in Building Environments

Professor Tae-Seong Kim, Mr. Jin-Ho Cho, and Professor Jeong Tai Kim
Kyung Hee University

This paper presents a work on human activity recognition (HAR) using motion sensors embedded in a smart phone in building environments. Our HAR system recognizes general human activities including walking, going-upstairs, going-downstairs, running, and motionless, using statistical and orientation features from signals of motion sensors and a hierarchical Support Vector Machine classifier. Upon activity recognition, our system also generates energy expenditures of the recognized physical activities: energy expenditures are computed based on Metabolic Equivalents (METS) values, step count, distance, speed, and duration of activities. By testing our system in building environments, we have obtained an average recognition rate of 98.26% with physically consumed energy information. With the presented system, different building designs and environments can be evaluated in terms of energy consumptions of residents for their physical activities.

Cost and CO2 Analysis of Composite Precast Concrete Columns

Graduate Student Keun Ho Kim, Professor Jeong Tai Kim, Professor Sunkuk Kim, Graduate Student Chaeyeon Lim, and Graduate Student Youngju Na
Department of Architectural Engineering, Kyung Hee Univ.

Green Frame is developed not only to reduce costs and construction duration and improve safety and constructability, but also to enhance environmental-friendliness resulting from reduction of CO_2 emission. Green Frame is a column-beam system composed of the Green Column and Green Beam, which are the composite precast concrete members. There are 5 types of Green Columns with different cost required and CO_2 emission. The importance of cost and CO_2 emission varies depending on the characteristics of a given project. Thus, this research is intended to perform cost and CO_2 analysis in order to help engineers select the most appropriate Green Column type. As a result, it is drawn out that a specific type is not superior in all aspects. If a wide range of performances including productivity, constructability, construction safety and construction period are analyzed in the future, it will be likely to suggest a meaningful guideline to engineers in selecting a suitable Green Column for Green Frame.

A Field Survey of Thermal Comfort in Office Building with a unitary heat-pump and energy recovery ventilator

Prof. Geun Young Yun Yun, Mr. Seon Ho Jo, and Prof. Jeong Tai Kim
Kyung Hee University

Air-conditioning plays an important role in creating comfortable indoor environment. This paper reports the field monitoring campaign and questionnaire survey of office building with a unitary heat-pump and energy recovery ventilator in Suwon, Korea, from 16 April to 20 April 2012. This study investigated the patterns of indoor thermal conditions, their relationship with the controls of the unitary heat-pump, and actual thermal satisfaction of building occupants. Although the setting temperature of each interior unit differed significantly from each other, the indoor temperature remained relatively constant and showed a pattern that the perimeter zone was 1 °C lower than the interior zone on average. It is found that there was a big discrepancy between the actual thermal satisfaction of the occupants and predicted thermal satisfaction by PMV. The theoretical predictions by PMV indicated that only 42% of the occupants would feel thermally comfortable, although the proportion of the thermally comfortable occupants was observed 95%.

An analysis of Standby Power Consumption of Single households in Korea

Student Ji Sun Lee, Student Ji Yea Jung, Professor Jeong Tai kim, Professor Hyunsoo Lee, and Ph.D. Sung Jun Park
Yonsei University

This purpose of this study is to investigate the standby power consumption behaviors of live-alones. The research was performed by a survey that included general demographic characteristics like age, gender, and type of housing, and electrical energy consumption factors to analyze the standby power consumption of single-person households. Analyses were performed to find power consumption characteristics by households including the ratio of standby power consumption to total electrical energy consumption and respective waiting time and standby power consumption for each electrical appliance. In addition, the actual practice of plugging/unplugging, which in one of the consuming behaviors that directly affects standby power consumption, was investigated. Finally, the correlation of the amount of standby power and 9 consumption factors including: time spent at home, number of appliances, plugging ration of electrical appliances, and 5 other factors categorized by the use of appliances. Here is the summary of the analysis results. Firstly, average standby power consumption of single-member households accounted for 6.48% of overall monthly electricity consumption. Secondly, the significant factors affecting standby power of single-person households proved to be 'number of appliances', 'size of the house', and 'plugging ratio'. Lastly, we divided respondents of questionnaire into two groups; one was those who consumed standby power more than average and the other was those consuming standby power less than average. Three variables, TV, water purifier, rice cooker impact on standby power consumption in the first group and two variables, computer, electric frying pan influence on standby power consumption in the second group. In terms of correlation test, the set top box turned out to be one of the most important variables determining standby consumption in the first group. In the second group, computer and monitor were the most important variables determining standby consumption. This study is believed to have verified that standby power saving contributes significantly to total electrical energy savings of households.

A Classification of Real Sky Conditions for Yongin, Korea

Ph.D. Candidate Hyo Joo Kong, and Professor Jeong Tai Kim
Dept. of Architectural Engineering, Kyung Hee University

Information on sky condition classification is important to the energy-efficient and sustainable building designs for predicting the energy consumption and daylight performance. Sky conditions are commonly classified into overcast, partly cloudy, and clear sky. IESNA's Sky Ratio (SR), Perez's Clearness Index (CI), Li's Clearness Index (Kt) are representative sky conditions classification. However, reliable and accurate daylight climatic data are lacking in Korea. Thus, this paper presents a classification of real sky condition for Yongin, Korea from data recorded during a period of one year at the KHU station. For the research, illuminance and irradiance data were obtained from 1st February 2011 to 31st January 2012. Hourly frequency of sky conditions occurrence and hourly global horizontal illuminance were analysed according to sky conditions. It was found that sky conditions in Yongin, Korea are classified, respectively, as clear and overcast skies 34% and 17% of the time in Yongin, Korea. These findings indicate that sky condition classification and illuminance information gathered at KHU could be applied for various daylight design applications and energy-efficient building design in Yongin, Korea.

Track 4

Room: Kåbergs, ground floor
Improving Office Building Energy Performance
Chair: Dr Emeka Osaji

A sustainable energy saving method for hotels by green hotel deals

Dr Hamid Abdi, Dr Doug Creighton, and Prof Saeid Nahavandi
CISR

The hospitality industry is the largest business worldwide with an increasing market. The energy used in this industry produces a considerable amount of greenhouse gas emissions. Further improvements are required to address climate change requirements despite various existing technologies for saving energy and water in hotels. Providing more energy saving options can encourage hoteliers to perform further suitability measures. There is a special requirement of methods for energy saving that suits for small and medium size hotels. This paper introduces a sustainable energy saving method for hotels that uses active engagement of the guests in energy saving process. The proposed method provides the guests a direct benefit from the saved energy. The paper presents a novel concept of green hotel deals is provide an initial design for the system. The sustainability analysis of the proposed method shows that the method is able to benefit guests, hoteliers, governments and importantly the environment.

The Role of Building Energy and Environmental Assessment in Facilitating Office Building Energy-Efficiency

Mr Emeka Osaji, Dr Ezekiel Chinyio, and Dr Subashini Suresh
University of Wolverhampton

Ten years ago, the primary author developed the Building Energy-Efficient Hive (BEEHive) concept in order to demonstrate in theory that environmental design – which is aimed at addressing environmental parameters – can support the design and operation of energy-efficient office buildings. This was a result of his analysis of the spheroid form's efficiency in nature, and his development of a spheroid-like energy-efficient office built form. The BEEHive incorporates environmental design principles such as: site considerations; built form; ventilation strategy; daylighting strategy; and services strategy. Furthermore, several notable environmental design advocates and practitioners have made significant contributions in order to improve building performance. However, in practice environmental design has had limited success in the attainment of balance and optimisation in all aspects of energy use; hence there is typically a gap between predicted and actual office building energy use. The primary author's previous study established the impacts of contributory factors in the gap between predicted and actual office building energy use. It has contributed to this current study, which is also a part of the primary author's doctor of philosophy (Ph.D) research, and it has established the role of a key contributory factor, that is, the role of building energy and environmental assessment in facilitating office building energy-efficiency. It involved a combination of literature reviews, multiple case study research and comparative studies in order to build theory. It also established the methods and tool to be used in the primary author's Ph.D research for multiple case studies and simulation studies of office building energy-efficiency. Analysis of the literature revealed that the role of building energy and environmental assessment involves assessment of the impacts of environmental design principles, and the impacts of factors that contribute to office building energy use gap decreases, for example: solar gain minimisation orientations; energy-efficient strategies for built forms, ventilation, lighting and services; and decreases in hours of operation and occupancy. Its role also involves assessment of the impacts of factors that contribute to office building energy use gap increases, for example: weather variation and microclimates; and increases in hours of operation and occupancy. There are three key types of building energy and environmental assessment, and these are: building energy use audit method; building energy simulation analysis method and tools; and building energy and environmental assessment rating method and tools. Their respective roles include: tracking building energy use over time; predicting future building energy use within multiple environmental design scenarios and parameters; and assessing, rating, and certifying building energy and environmental efficiency. However, limitations of building energy and environmental assessment, and impacts of factors that contribute to office building energy use gap increases need to be addressed in order to achieve: optimum building energy use assessments and predictions; optimum environmental design principles; and building energy use gap decreases for improved energy performance. This study has contributed to ideas for the development of a Building Management System (BMS-Optimum) for Bridging the Gap, which is comprised of optimum conditions and considerations such as: optimum environmental design principles; optimum weather and microclimate considerations; accessibility to reliable office building energy use data; optimum building energy and environmental assessment; optimum hours of operation; and optimum level and nature of occupancy. Future work will include further development of BMS-Optimum, using methods such as: multiple case study research supported by building energy use audits, observations, questionnaire surveys, interviews, benchmarking and comparative studies; building energy simulations within multiple

scenarios, parameters and variables, and supported by benchmarking and comparative studies; and peer reviews and focus group sessions. These will also help establish and validate a Framework for Improved Environmental Design and Energy Performance (FEDEP).

Human in the loop for improved personalized comfort: a necessity for a SMART building grid

Prof.ir. Wim Zeiler, Ir. Gert Boxem, and Ing. Derek Vissers
TU Eindhoven

The reasons for the inferior performance of many of the current buildings and their related energy systems are diverse and for a major part caused by insufficient attention to the influence of occupant behaviour. In Smart buildings it is necessary to implement new opportunities to integrate human behaviour in the Heating Ventilation and Air-Conditiong process control loop. To realize this strategy we developed an advanced control setup, based on the combination of ubiquitous low cost wireless sensors. The article describes the proof of the principle to take the perceived thermal comfort as leading principles in the comfort/energy process control. The experiments described illustrate the feasibility of the approach. Due to the large individual differences between building occupants it is more desirable that the building system can adapt to the individual needs and behaviour of the end-user, realizing highest comfort level and highest energy savings. Therefore the user has to be the leading factor in the control of comfort systems. Integration of the distributed information about the user behaviour in the control of building systems results in (a) more inclusion of building occupants in the control loops (human focussed principle), (b) achieving demand-responsive energy management in buildings (energy-saving), and (c) combining all building systems into one efficient system. Low cost wireless sensors and low cost infra red sensors networks of a smart building provide real-time comfort-energy management on workplace and even personal level. Indicators for thermal comfort on personal level could be the skin- and/or clothing temperatures of the building occupant. This information provided by the distributed sensors can be used to derive real-time set points for task-ambient conditioning (TAC) systems to the minimal required room conditions. Further research is needed on the robustness of the measurable indicators representing the individual comfort feeling of the building occupant.

Reducing Ventilation Energy Demand by Using Air-to-Earth Heat Exchangers - Part 1 - Parametric Study

Dr Hans Havtun, and Ms Caroline Törnqvist
KTH Royal Institute of Technology

Air-to-Earth heat exchangers (earth tubes) utilize the fact that the temperature in the ground is relatively constant during the year. By letting the air travel through an air-to-earth heat exchanger before reaching the house's ventilation air intake the air gets preconditioned by acquiring heat from the soil in the winter, and by rejecting heat to the soil in the summer. There are few studies showing how large the energy saving would be by using earth tubes. The existing studies and models are adapted to a warm climate like India and Southern Europe. Few studies are made for a Nordic climate.
To be able to use earth tubes efficiently, different parameters need to be optimized. The parameters that have the largest effect are length, depth, and diameter of the earth tube , as well as the air velocity inside the tube. To analyze this influence, a numerical model has been created in the simulation program Comsol Multiphysics 4.0a. Weather data for Stockholm, Sweden was used for all simulations. The soil type was chosen to be clay and the material of

the duct was polyethylene. The parameters were varied one at a time and compared to a base case consisting of a 10 m long duct placed at a depth of 2 m and with a diameter of 20 cm. The air velocity in the duct for the base case is 2 m/s and the corresponding volumetric flow rate is 60 l/s. Results show that longer heat exchangers with a smaller diameter, lower air velocity and buried at a deeper depth gives a larger energy saving. The increase in efficiency that comes from a deeper placed earth tube levels out at depth over 3.5 m. The decrease in efficiency that comes from an increase of the diameter of the duct levels out at diameters of 60 cm. The total energy saving for one year increased by 70 % for a 20 m long earth tube compared to a 10 m long earth tube. The energy saving for the base case is 525 kWh/year for the heating season and 300 kWh/year for the cooling season. This corresponds to an energy saving of 5 % for heating and 50 % for cooling compared to a case where no earth tube is used.

Reducing Ventilation Energy Demand by Using Air-to-Earth Heat Exchangers - Part 2 - System Design Considerations

Dr Hans Havtun, and Ms Caroline Törnqvist
KTH Royal Institute of Technology

Air-to-Earth heat exchangers (earth tubes) utilize the fact that the temperature in the ground is relatively constant during the year. By letting the air travel through an air-to-earth heat exchanger before reaching the house's ventilation air intake the air gets preconditioned by acquiring heat from the soil in the winter, and by rejecting heat to the soil in the summer. There are few studies showing how large the energy saving would be by using earth tubes. The existing studies and models are adapted to a warm climate like India and Southern Europe. Few studies are made for a Nordic climate.

To be able to use earth tubes efficiently, different parameters need to be optimized. A numerical model has been developed using Comsol Multiphysics 4.0.a in order to study earth tubes with multiple ducts. Both the spacing between ducts as well as the number of ducts is simulated. Finally, results have been extrapolated to mimic an installation in a building with a large ventilation demand. Weather data for Stockholm, Sweden was used for all simulations. The soil type was chosen to be clay and the material of the duct was polyethylene.

For the cases where the duct spacing was investigated, results showed that the outlet temperature of the earth ducts changed only marginally for the three cases simulated. The energy saving per duct showed a slight increase as the spacing was increased. For the cases with different number of ducts, the energy saving increases with increasing number of ducts. However, the increase in energy saving is less than the increase in heat transfer area. The case study considering a building with a large ventilation energy demand, several configurations of earth tube installations have been investigated. Results showed that the best configuration is a case with a small velocity, small duct diameters, long ducts installed at as deep in the earth as possible. However, Once the depth goes below 3.5 m, the increase in energy saving is marginal. For the building having a ventilation air flow demand of 1000 liters/s, a configuration of 33 parallel ducts with a duct diameter of 20 cm and a spacing of 1 meter gave the greatest energy saving. For this configuration, a total energy saving of 34.2 % is possible.

Track 5
Room: Ångturbinen, 2nd floor
Sustainable and healthy buildings
Chair: Prof. Geun Young Yun

Influence of application of sorptive building materials on decrease in indoor toluene concentration

Professor Seo Janghoo, and Professor Kim Jeong Tai
Department of Architectural Engineering, Chosun University
Graduate school Park Sunghyun

In order to improve indoor air quality, the interest in and the use of sorptive building materials that decrease the concentration of an indoor air pollutant have increased. The use of sorptive building materials is one way to decrease the concentration of an indoor pollutant that can adversely affect human health. In this study, we evaluated the effects of sorptive building materials applied to a wall on the decrease in the concentration of toluene emitted from the flooring. We also examined how the air exchange rate of the room, the loading factor of the sorptive materials, and the mass transfer coefficient influenced the sorptive performance; these effects were well reproduced experimentally with computational fluid dynamics (CFD) simulations. The results show that sorptive building materials have a fairly strong effect on the decrease in toluene concentrations in rooms and that this effect can be expected in real-world scenarios.

Perceived Experiences on Comfort and Health in Two Apartment Complexes with Different Service Life

Dr Mi Jeong Kim, Dr Myung Eun Cho, and Professor Jeong Tai Kim
Housing and Interior Design, Kyung Hee University

Residents' responses and illnesses related to the new houses become currently a popular subject of 'sick building syndrome' research. Compared to the research dealing with varied symptoms experienced by residents in new built houses, there has been little attention to residents' health life for a rather long period in old houses with different service life. Thus, we investigate residents' perceived comfort and health in two apartments with different service life and see if there is any difference among them depending on the service life. Contrary to our expectation, the results show that the physical properties of the apartments do not much influence residents' perceived comfort further the energy efficiency does not affect their perceived comfort either. In terms of health, residents' perceived symptoms in the 33 years old apartment are a bit more severe compared to those in the 11 years old apartment.

Impact of different placements of shading device on building thermal performance

Professor Gon KIM, and Ph.D.Student Hongsoo LIM
Kangwon National University

In America, the method of receiving the certification for environmental architecture through renovation is activated but in South Korea, it is difficult to find except for the minor renovations occurred to change the previous construction material built in early 2000. It is more efficient to raise the value of an old building by putting over a double skin façade on the outside to make the building more energy efficient than to build a new building. Thus, in this study the energy efficiency of the shading device, the most frequently used composition in

designing the double skin façade, is evaluated. Also, the energy efficiency of the typical horizontal blind and the shading device with V-shape slat were compared and used to evaluate the cooling and heating load according to the position changes

Daylighting and Thermal Performance of Venetian Blinds in an Apartment Living Room

Ms Ju Young shin, Ms Yoon Jeong Kim, and Prof. Jeong Tai Kim
Kyung Hee University

This paper investigated the daylighting and thermal performance of manually operated venetian blinds in an apartment living room. For the purpose the Mock-up model room with 7m length, 5.2m width and 2.4m ceiling height was used. Thirty-two subjects were asked to control the blinds angle and height to eliminate glare and maintain visual comfort from 9 a.m to 5p.m. The monitored window luminance and indoor horizontal illuminance were used to evaluate daylighting performance. Also indoor solar radiation was predicted with Ecotect software to analyze thermal performance. The results showed that adjusting venetian blind in winter times reduced the daylighting and thermal performance about 30% compared to without venetian blind conditions. However using venetian blind could increase the daylighting and thermal performance up to 40% at 15 and 16 hours.

Environmentally-Friendly Apartment Buildings using a Sustainable Hybrid Precast Composite System

Graduate student Ji-Hun Kim, Professor Won-Kee Hong, Professor Jeong Tai Kim, Graduate student Hyo-Jin Ko, and Ph.D Seon-Chee Park
Department of Architectural Engineering, Kyunghee Univ.

Recently, as part of an effort to comply with the low-carbon green growth policy adopted in Korea, the building of new long-life apartment buildings has been encouraged to replace existing apartment buildings with bearing walls. The regulations imposed regarding floor area ratios, height, and available sunlight can all be alleviated when apartment buildings are built using the Rahmen structural frame instead of conventional bearing walls, which are difficult to remodel. However, a Rahmen structural frame with reinforced concrete increases the floor height due to the increased beam depth, resulting in economic issues. This paper introduces a hybrid precast composite structural system. Apartment buildings optimized using the hybrid precast composite Rahmen structural system was compared with concrete Rahmen structural frames. The results show that the lower material quantity used in the hybrid precast composite structural system reduces carbon emissions and as well as energy inputs related to construction. It is expected that the hybrid precast composite Rahmen structural system will play a significant role in building sustainable and healthy long-life apartment buildings.

13.30-14.30
Keynote speaker
Professor Per Heiselberg, Aalborg University, Denmark
Room: Atlas Diesel, Floor 1
Chair: Prof Ronald L Hartung

14.30-15.00
Posters
Room: Atlas Diesel, Floor 1
Chair: PhD Esmiralda Moradian and PhD Student Dan Wu

A stochastic model for collective resident activity patterns and energy use: preliminaries
Joakim Munkhammar, and Joakim Widén
Uppsala University, Sweden

Design and Validation of Solar Calorimeter
Michael Blanding, Kyle Hoppe, Rajesh Reddy, Uday Kumar, and Hamid Kayal
KTH Royal Institute of Technology, Stockholm, Sweden,
CSEM-UAE Innovation Center LLC, Ras al Kamiah, UAE

On The Application Of Simulation Tools In Building Design With Emphasis On Sustainability
Navid Gohardani, and Folke Björk
Royal Institute of Technology (KTH), Sweden

15.00-17.00

Session 2

General track

Track 1
Room: Atlas Diesel, 1st floor
Chair: Prof Ronald L Hartung

SUSTAINABLE RENOVATION AND OPERATION OF FAMILY HOUSES FOR IMPROVED CLIMATE EFFICIENCY
Mr. Ricardo Ramirez Villegas, and Professor Björn Frostell
Division of Industrial Ecology, The Royal Institute of Techn

In the developed world the existing stock of houses will provide shelter to the majority of population in the upcoming years. Houses are physical objects that consume material and energy and need to be maintained, repaired and restructured from time to time. In order to

fulfill the requirements of the Kyoto Protocol and be comfortable for their inhabitants, the existing stock needs to be renovated. Strong disagreements between different parts of the scientific community and overlapping and contradictory concepts make the definition of sustainable renovation confusing. In this study, therefore, an approach of renovation and operation for higher energy efficiency and lower climate impact has been the main focus. Based on a systems analysis approach, the aim of this work is to evaluate cost and benefits of possible actions and choosing the most energy and cost effective approach of a series of alternatives. With the result of this analysis, a sustainable renovation and operation staircase is proposed. The work found that it is possible to develop a staircase manual for sustainable renovation and operation of family houses that follows a logical step-by-step approach and could result in considerable life cycle reductions in both costs and climate impact. The work also suggests that it is possible for academic experts to develop material in a simpler form and language to reach the public in a more understandable form.

Solar Collector Based on Heat Pipes for Buildings FaÁade

Dr. Sergii Khairnasov, Mr. Rostyslav Musiy, Mr. Andrii Rassamakin, and Mr. Boris Rassamakin
National Technical University of Ukraine KPI

A variety of liquid thermal solar collectors designs used for water heating have been developed by the previous researchers. But the majority of them do not meet the requirements on small weight, easy assembling and installing, versatility, scalability, and adaptability of the design, which are particularly important when they are façade integrated. In order to avoid the above mentioned drawbacks of the liquid thermal collectors the article authors propose to apply to them extruded aluminum alloy made heat pipes of originally designed cross-sectional profile with wide fins and longitudinal grooves. Such solar collectors could be a good solution for building façade and roof integration, because they are assembled of several standard and independent, hermetically sealed and light-weight modules, easy mounted and “dry” connected to the main pipeline. At that, their thermal performances are not worse than of the other known ones made of heavier and more expensive copper with higher thermal conductance, or having entire rigid designs. Some variants of the developed solar collectors shaping of the assembled modules for building façade or roof integration are proposed. Variously coloured coatings to the absorbers are developed and made of carbon–siliceous nano-composites by means of sol-gel method. Their optical performances were compared with “anodized black”. It is stated that coloured coatings have a good prospects in thermal SC adaptation to building facades decoration, but the works on study and upgrade of their performances should be continued.

ICT applications to lower energy usage in the already built environment

PhD Student Anna Kramers
KTH, Centre for Sustainable Communications

ICT could play a role as a key enabler for decreasing energy usage in buildings. This study identifies, list and describe ICT applications that can reduce energy use in buildings without the need for refurbishment or extensive change. For each area of application, there is a study from the actor perspective to understand who can make use of the different ICT applications to influence energy usage.

Using dynamic programming optimization to maintain comfort in building during summer periods

Mr Bérenger FAVRE, and Dr Bruno PEUPORTIER
Centre Energétique et Procédés, Mines-ParisTech

Being increasingly insulated, new buildings are more and more sensitive to variations of solar and internal gains. Controlling solar protections and ventilation is therefore becoming essential. In this publication, we study the possibility to maintain comfort in the building by controlling either mechanical ventilation for night cooling or solar protections or both of them during hot periods. The proposed energy management is a predictive set of optimal commands issued from a dynamic programming optimization knowing in advance the weather, occupation and internal gains for the next 24 hours. This method is tested on a bioclimatic house situated in Chambery, France with an annual heating demand of 26 kWh/m².

Assisting inhabitants of residential homes with management of their energy consumption

Dr Masood Masoodian, Prof Elisabeth Andre, Mr Michael Kugler, Mr Florian Reinhart, Mr Bill Rogers, and Mr Kevin Schlieper
University of Waikato

Although there are already a range of energy monitoring and automation systems available in the market that target residential homes, mostly with the aim of reducing their total energy consumption, very few of these systems are directly concerned with how those energy savings are actually made. As such, these systems do not provide tools that would allow users to make intelligent decisions about their energy usage strategies, and encourage them to change their energy use behaviour. In this paper we describe a system designed to facilitate planning and control of energy usage activities in residential homes. We also report on a user study of this system which demonstrates its potential for making energy savings possible.

Track 2

Room: Ångturbinen, 2nd floor
Chair: Prof Örjan Svane

ICT and smarter infrastructure for energy efficiency in Hammarby Sjöstad, Stockholm

Professor Örjan Svane
KTH Royal Institute of Technology, Sweden

Internationally, Stockholm's brownfield development Hammarby Sjöstad is often seen as "one of the world's highest profile examples of Sustainable City Development" (Economist, 2011). To what extent do the district's real estate owners and managers, residents etc. rely on smart infrastructure, to control energy use and its impacts? Does ICT integrate energy system components through automation, does it interact with its users, informing or persuading? This paper reports from an ongoing study, in which smart infrastructure is defined as infrastructure that makes it easy for users and managers of the Sjöstad buildings to keep energy use and its

impacts low, without compromising utility or comfort. Data is collected from documents and interviews, which also served to identify the real estate units that have smart infrastructure. Previous evaluation indicates that the average energy performance of Hammarby Sjöstad's buildings is no better than in similar buildings of the same period, but with a factor three dispersion. In all, about 5 per cent of the total number of flats in eight real estate units were found to have smart infrastructure, mainly to automatically integrate one or more novel components such as photovoltaics into the energy systems. In a few cases, buildings were provided with ICT that actively interacts with the system operators or the residents. Already from the first phase of development in 2000, the district was provided with a comprehensive fibre network, so the potential for smartness is there, but only in part utilised in the buildings. Thus there is a great untapped potential for "Renewing a New City" in terms of energy efficiency, if the local demand shapers – residents' housing cooperatives and other real estate owners – are able to interest ICT providers to team up and form a suitable business model.

Raising High Energy Performance Glass Block from Waste Glasses with Cavity and Interlayer

Ms. Floriberta Binarti, Mr. Agustinus Istiadji, Dr. Priyo Iswanto, and Prof. Prasasto Satwiko
Architecture Department, University of Atma Jaya Yogyakarta

The main glazing energy performance measure in warm humid climates is light-to-solar-gain ratio (LSG), which denotes the ratio of the visible light transmittance (VT) and its solar heat gain coefficient (SHGC). In laminated glazing the LSG depends on the design of the cavity and (inter)layers. This study explored the contribution of cavity and interlayer in raising high energy performance glass block from laminated waste glasses. Analytical method and computational simulations using comparative method and heat balance model were employed to obtain glass block model with the most optimum combination of the VT, the SHGC and its thermal transmittance (U). The effect of cavity on increasing the VT was showed by simulation and laboratory test results. Based on SHGC laboratory tests, the presence of interlayer declined 69-89% of the simulated SHGC. Laminated glass block with certain number of closed cavity and interlayer can raise 4.35 of the LSG.

A new model for appropriate selection of window

Ass Prof. Dr Abdolsalam Ebrahimpour, and Dr Yousef Karimi Vahed
Tabriz Branch, Islamic Azad University, Tabriz, Iran

Appropriate selection of window is important task to reduce the building energy consumption. Calculating of window energy transfer is difficult and must be calculate with the computer simulation softwares. Therefore, simple software is necessary to estimate the window energy transfer and to compare the different window types without complex computer simulation. In this study, a new software (named as Panjare) has been prepared to calculate hourly window energy transfer and to select appropriate window in the building. Using this software, the window can be designed based on the minimum building energy consumption.

Invited sessions

Track 3

Room: Kåbergs, ground floor
Improving Office Building Energy Performance and Multi- Energy Sources
Chair: Dr Emeka Osaji
Chair: Prof Aziz Naamane

The Green Room: A Giant Leap in Development of Energy-efficient Cooling Solutions for Datacenters

Dr Hans Havtun, Mr Charles El Azzi, and Mr Roozbeh Izadi
KTH Royal Institute of Technology

Nowadays, promoting energy-efficient solutions will have a strong return on investment not only economically but also socially and environmentally. As an added value to economic savings, the carbon footprint of the companies will be reduced and contribute to slowing down the environmental degradation and global warming. The IT-sector is no exception in this aspect. Swedish-Finnish Company *TeliaSonera* has taken a giant leap in the development of energy reduction by introducing the *Green Room Concept* which combines not only an energy-efficient cooling production but also an efficient way of distributing the cooling air flow inside the room. Both of these technologies will reduce the energy needed for cooling the equipment on their own, but combining them ensures a very energy-efficient datacenter. Although geothermal cooling or free-cooling would be the preferred choice for cooling production, it is dependent on the geographical location and climate conditions of the site, and investment potential of the company and hence not a possible solution in all cases. For these cases, the Green Room can be installed with a conventional chiller-based cooling production and still reduce the energy consumption.

The main feature of the Green Room concept is that the air coolers are installed along the length of the room parallel to the cabinet rows which will minimize the air flow complications in the cold aisle. This delivers cold air to the cabinet in a straight flow path to the racks and hence avoids the conventional raised floor to deliver cold air. One of the downsides of raised floor air-distribution is that it usually suffers from maldistribution of cooling air meaning that some racks suffer from inadequate cooling. The improved air flow distribution of the Green Room concept consequently leads to a more efficient cooling system. By carefully ensuring that no cold air bypasses the racks, any unwanted mixture of hot and cold air is also eliminated. In conventional datacenters, this problem usually occurs because proper hot/cold aisle separation is often neglected during construction. Furthermore, while many conventional datacenters face numerous problems as a result of messy cablings both inside and outside of the cabinets, the Green Room concept has managed to resolve these issues thanks to an effective cable management.

The research method in this project was to conduct a series of experimental tests to collect as much necessary data as possible. During tests, temperatures inside the cold and hot aile were monitored and recorded. Special emphasis was put on measuring the temperature distribution in the cold aisle as the temperatures reflect the air distribution. Afterwards, the parameters used to evaluate the efficiency of the system were calculated and in some parts, simulated. Finally, the results were compared with other equivalent data and measurement from other datacenters and conclusions were made based on them. In addition to quantitative results based on a variety of calculations, the qualitative characteristics of this approach are also included to provide the readers with a better outlook on the system while being compared to

other solutions currently available for datacenters. To assess the energy efficiency of a datacenter, critical measures such as Power Usage Effectiveness (PUE), defined as the total site power consumption divided by the power consumption of the IT-services, as well as the Coefficient of Performance (COP), defined as the power consumtion of the IT-services divded by the power consumtion needed to operate the cooling system. Results show that the PUE with room operational temperature of 22.5 °C can be as low as 1.05 for for a Green Room with geothermal cooling production, 1.11 for free-cooling, and 1.50 for chiller-based cooling production using old chillers and 1.32 for chiller-based cooling production using modern and more advanced chillers as compared to a PUE of 2.0 for a typical raised floor datacenter.

The Impacts of Contributory Factors in the Gap between Predicted and Actual Office Building Energy Use

Mr Emeka Osaji, Dr Ezekiel Chinyio, and Dr Subashini Suresh
University of Wolverhampton

Ten years ago, the primary author developed the Building Energy-Efficient Hive (BEEHive) concept in order to demonstrate in theory that environmental design – which is aimed at addressing environmental parameters – can support the design and operation of energy-efficient office buildings. This was a result of his analysis of the spheroid form's efficiency in nature, and his development of a spheroid-like energy-efficient office built form that encloses and shades the most volume of office space with the least surface area possible. The BEEHive concept also incorporates several other aspects of the environmental design philosophy, including: site considerations (location and weather, microclimate, site layout and orientation); built form (shape, thermal response, insulation and windows/glazing); ventilation strategy; daylighting strategy; and services strategy (plants and controls, fuels and metering). Furthermore, several notable environmental design advocates and practitioners have made significant contributions in order to improve building performance. However, in practice environmental design has had limited success in the attainment of balance and optimisation in all aspects of energy use; hence there is typically a gap between predicted and actual office building energy use. This study has established the impacts of contributory factors in the gap between predicted and actual office building energy use, and it is a part of the primary author's doctor of philosophy (Ph.D) research. It involved a combination of literature reviews, multiple case study research and comparative studies in order to build theory, and it established the reasons for the gap, as well as the best ways to bridge it for improved office building environmental design and energy performance. Analysis of the literature revealed two types of gaps, and these are a gap increase and a gap decrease, which are among the impacts attributable to contributory factors in the gap between predicted and actual office building energy use such as: the nature of environmental design measures implemented; weather variation and microclimates; unavailability of reliable building energy use data; limitations of building energy simulation software; level of hours of operation; and level and nature of occupancy. Amongst these, the key contributors to gap increases are increases in hours of operation and occupancy, and weather variation and microclimates. Their respective major impacts are discrepancy between predicted and actual hours of operation and increased energy use, increased heat output and uncertainties, and variable heating and cooling requirements. The key contributors to gap decreases are environmental design measures such as the use of: natural ventilation strategies; daylighting strategies; solar photovoltaic systems; and spheroid-like built forms. Their respective major impacts are: the production of more energy than an office building uses; and energy uses that are below, for instance, Energy Consumption Guide 19 typical and good practice energy use for office type 4, and relevant

ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers) standards. This study has contributed to ideas for the development of a Building Management System for Bridging the Gap, otherwise known as 'BMS-Optimum', which is comprised of optimum conditions and considerations such as: optimum environmental design principles; optimum weather and microclimate considerations; accessibility to reliable office building energy use data; optimum building energy and environmental assessment; optimum hours of operation; and optimum level and nature of occupancy. Future work will include further development of BMS-Optimum, using methods such as: multiple case study research supported by building energy use audits, observations, questionnaire surveys, interviews, benchmarking and comparative studies; building energy simulations within multiple scenarios, parameters and variables, and supported by benchmarking and comparative studies; and peer reviews and focus group sessions. These will also help establish and validate a Framework for Improved Environmental Design and Energy Performance (FEDEP).

Multi- Energy Sources
Chair: Prof Aziz Naamane

IMPROVING MULTIPLE POWER SOURCES MANAGEMENT USING STATE FLOW APPROACH

Professor Naamane aziz
LSIS

The optimum design of a multiple power source supply system becomes complicated through uncertain renewable energy supplies and load demand. The optimum configuration and optimum control strategy of systems supplied by multiple power sources need to dispatch the power by matching the supply and demand in accordance with the power management tasks. Accurate load matching is especially critical for renewable energy sources such as photovoltaic panel and wind aero turbines, because it impacts on the available power utility. This paper advocates the use of the state flow approach as an alternative mean to manage the multi power source distribution for multiple supply systems by a load matching switch.

Technical-economic analysis of solar water heating systems at Batna in Algeria

Doctor Mounir AKSAS, and Master student Rima ZOUAGRI, and Naamane Aziz
Laboratoire de Physique, EnergŽtique AppliquŽe (LPEA)

The solar water heater (SWH) is one of the most important applications of solar energy because it affects several major hot water consumer sectors, such as houses, hotels, hospitals, barracks, etc.., where it can satisfy up to 70% of the needs and contributes to reducing greenhouse gas (GHG) emissions and saving energy. To do this, Algeria has established a major program for the development of SWH for the different sectors. The aim of this work is to study the technical-economic feasibility of SWH integration in Hospital Centers (HC) in the province of Batna, and the possibility of reducing GHG emissions. SWH installations analysis was done by RETScreen software, a mathematical model for clean energy projects analysis. The analysis showed the possibility of significant energy savings with SWH installation in the HC (Total annual provided energy (MWh) = 1427,1) and a considerable

reduction in GHG (Total annual net reduction of GHG = 905,84 tCO_2, which corresponds to 2106,1 barrels of not consumed crude oil). However, the main barriers to the development of such projects are the low cost of fuel in Algeria and, conversely, the exorbitant cost of SWH installations. This highlights the need for government subvention for this type of project.

Design and Control of a Diode Clamped Multilevel Wind Energy System Using a Stand-Alone AC-DC-AC Converter

Professor Yasser Dessouky, and Lecturer Mona Moussa
Arab Academy for Science and Technology and Maritime Transpo

The major application of the stand-alone power system is in remote areas where utility lines are uneconomical to install due to terrain, the right-of way difficulties or the environmental concerns. Villages that are not yet connected to utility lines are the largest potential market of the hybrid stand-alone systems using diesel generator with wind or PV for meeting their energy needs. The stand-alone hybrid system is technically more challenging and expensive to design than the grid-connected system that simply augments the existing utility system.
Multilevel inverter technology has emerged recently as a very important alternative in the area of high-power medium-voltage energy control. This paper presents the topology of the diode-clamped inverter, and also presents the relevant control and modulation method developed for this converter, which is: multilevel selective harmonic elimination, where additional notches are introduced in the multi-level output voltage. These notches eliminate harmonics at the low order/frequency and hence the filter size is reduced without increasing the switching losses and cost of the system. The proposed modulation method is verified through simulation using a five-level Diode-clamped inverter prototype. The system consists of a 690V wind-driven permanent magnet synchronous generator whose output is stepped down via a multiphase transformer, designed to eliminate lower order harmonics of the generator current. The transformer secondary voltages are rectified through an uncontrolled AC/DC converters to provide different input DC voltage levels of the diode clamp quazi phase multilevel inverter where the pulse widths are adjusted to eliminate low order harmonics of the output voltage whose magnitude is kept constant with different loading condition by controlling the inverter switching and maintaining low total harmonic distortion THD.

Track 4

Room: Propellern, 2nd floor
Assessment and Monitoring The Environmental Performance of Buildings
Chair: Dr John Littlewood

Exploring indoor climate and comfort effects in refurbished multi-family dwellings with improved energy performance

PhD student Linn Liu, and PHD student Josefin Thoresson
Linkoping University

The building stock in Sweden includes many older residential dwellings often with inadequate building envelopes and poor insulation resulting in high energy use and uncomfortable indoor climate. Improving energy performance in multi-family dwellings by refurbishment processes is the key factor to success in order to meet national and European energy goals to reduce energy use in the building sector by 50 % through 2050. How is indoor environment affected when dwellings are refurbished to become low-energy dwellings? This paper aims to explore parameters for indoor climate and comfort in refurbished dwellings transformed into low-energy dwellings from an inter-disciplinary perspective, taking into account both quantitative and qualitative aspects of indoor climate using technical measurements, a questionnaire survey, and qualitative interviews. Based on a combination of methods, the results show that the indoor climate has largely been improved and user satisfaction was high in the refurbished dwellings. Results also showed that however indoor temperatures were too high during summer, resulting in dissatisfaction from residents. Overheating can be prevented by providing information to the residents about the functionality of the heating system and by adding shade in front of the windows.

Occupancy-driven supervisory control strategies to minimise energy consumption of airport terminal building

Research Student Mr Abdulhameed Mambo, Dr Mahroo Efthekhari, and Dr Thomas Steffen
Loughborough University, United Kingdom

The most cost-effective way to improve the energy efficiency of a building is often achieved through efficient control strategy. Such strategies may include shutting down plant or setting back/up setpoints of indoor environment systems as the case may be during the period that the building is not occupied and providing optimal setpoints for comfort during occupancy. In most cases, airport terminal indoor environment systems run on designed conditions and do not have fine control based on detailed passenger flow information. While opportunities for complete shut-down of HVAC and lighting systems are limited in busy airport terminals due to round-the-clock operations, this paper uses a professional building software to examined the potentials of applying appropriate setpoints during occupancy conditions and setback operation during inoccupancy conditions as an energy saving strategy for the indoor spaces of airport terminal. Based on some acquired site information, existing HVAC and lighting control system, a thermal model of a real UK airport terminal building was constructed. This base model was upgraded to a more energy efficient model based on real-time passenger flow. Results showing improved energy and CO_2 savings are presented.

An investigation into the practical application of residential energy certificates

Mr Alan Abela (Nottingham Trent University), Prof Steve Goodhew, Prof Mike Hoxley, Mr Paddy McGrath

The Energy Performance of Buildings Directive (EPBD) 2002/91/EC introduced various obligatory requirements intended to achieve the reduction of use of energy resources in buildings and consequentially the reduction of the impact of energy use in buildings. Article 7 of the directive formally specified the current European requirement for the energy certification of buildings. In order to implement this requirement, a general framework for establishing a methodology of calculation of the total energy performance of buildings became necessary. The Maltese methodology for the issuance of energy performance certificates for residential property was developed and introduced by the Ministry of Resources and Rural Affairs in 2010. This methodology differs from that of most other European countries since the energy used for cooling in summer is taken into consideration when carrying out the calculation. Most states only consider the energy for heating in winter for residential energy certificates. A study of the results produced by the Maltese certification process is being used to identify whether the methodology implemented is an accurate tool for environmental monitoring of energy use in Maltese residential property. The analysis is utilised to establish a benchmark for energy use in different residential property typologies. This analysis is developed further to highlight the strengths and weaknesses of the certification procedure as a design tool, and to understand whether the procedure can be effectively applied in the cost optimisation of residential construction or refurbishment projects.

Post-occupancy Evaluation of a Mixed-use Academic Office Building

Dr Katharine Wall, and Dr Andy Shea
BRE Centre for Innovative Construction Materials (CICM)

The paper presents the results from a Building User Study (BUS) survey undertaken as part of the Technology Strategy Board's (TSB) Building Performance Evaluation project. The results are from a mixed-used academic building on the University of Bath campus and are presented in relation to the design strategies used within the two distinct parts of the building, the new build and the refurbished, joined by an atrium. The summary indices from the BUS survey for both parts of the building are presented along with the results from twelve overall variables. The variables are then discussed in terms of the use and operation of the building in six sections: air quality; lighting characteristics; sources of noise; satisfaction with temperature; comfort, productivity and perceived health; and design and image to visitors. The paper concludes by highlighting potential changes to the redevelopment of buildings of this type in the future, many of which are more widely applicable.

The human as key element in the assessment and monitoring of the environmental performance of buildings

Prof.ir. Wim Zeiler, Ir. Gert Boxem, and Ing. Rik Maaijen
TU Eindhoven

To further reduce the environmental load future buildings must be much more sustainable than the existing buildings. Currently most decisions about the building sustainability are made by applying sustainability assessment tools such as BREEAM and LEED. However these tools are not really suited for monitoring the environmental performance of buildings

during its whole life cycle. New methods and approaches are necessary to asses and monitor the environmental performance of buildings. Optimizing comfort for occupants and its related energy use is becoming more important for facility managers. Presently however HVAC installations often do not operate effectively and efficiently in practice, because the behaviour of occupants is not included. This result in comfort complains as well as unnecessary high energy consumption. As the end-user influence becomes even more important for the resulting energy consumption of sustainable buildings, the focus should be how to integrate the occupants in the building's performance control loop. This leads to new approaches which enable the inclusion of occupant's behaviour in the process control of the building's performance to help facilities managers operate and maintain their sustainable buildings more efficiently. In an experiment in a real in-use office building a wireless sensor network was applied to describe user behaviour. The results showed that it is possible to capture individual user behaviour and to use this to further optimize comfort in relation to energy consumption. Based on our experiments we could determine the influence of occupants' behaviour on energy use and determine possible energy reduction by implementing the human-in-the-loop process control strategy.
The actual measured energy demands for heating and cooling are higher than designed, while in the new approach the heating and cooling demand is lower. Based on the first data it can be concluded that energy savings can be gained, especially for the cooling demand of around 15% compared to original design and more than 25% compared to the actual measured situation.

Track 5
Room: Blåslampan, 2nd floor
Methodology for Renewable Energy Assessment and Energy Planning in Buildings and Policy Implications
Chair: Dr Rainer Zah
Chair: Dr Eva Maleviti

LCA in the Netherlands: a case study

Prof.ir. Wim Zeiler, Ir. Wim Maassen, and Ing Ruben Pelzer
TU Eindhoven

The Municipality of Venlo is building new municipal offices based on the guiding principles of C2C. A case study is presented on the townhall Venlo preformed in the LCA tool GreenCalc+ V2 (GC+) in a comparison with two GC+ studies on the offices of TNT and townhall Utrechtse Heuvelrug. In concluding, the MIG (Environmental Index Building) score of townhall Venlo, TNT Green Office and townhall Utrechtse Heuvelrug were calculated which showed that making a good comparison is very difficult. This indicates that is important to know how to deal with specific characteristic aspects when calculating the environmental assessment score. During the research it was found that limitations of the GC+ catalogue, numerous installation elements could not to be addressed during the material inventory of City hall Venlo. Also, the materials of the energy generation facilities in both studies from literature were not addressed, due to these limitations. In general, references used in score computations should be constant values or average values found by statistical

analysis or, if statistical analysis is not possible, should be estimated by the best possible method. However, when mathematical models are used to generate a reference based on imported data of a building, deviations in the characteristics (variables such as GFA, Ecost, FTE) of a building can occur, since the equations in reference model can change proportions of these characteristics.

Comparative life-cycle assessment of residential heating systems, focused on solid oxide fuel cells

Mrs Alba Canovas, Rainer Zah and Santiago Gassó
Universitat Politicnica de Catalunya

This study aims to analyze a Solid Oxide Fuel Cell (SOFC) for residential heating applications by applying Life Cycle Assessment (LCA). To do so, three perspectives have been chosen: the *producer*, the *user* as an individual and the *user* intended as the heating demand of a building, applied by default in Switzerland. This SOFC is compared to other systems which fulfill the same function and are already inventoried in international databases (Ecoinvent). That are: a Stirling engine, three types of heat pump, a polyelectrolyte membrane fuel cell (PEMFC) and a gas boiler. The results of these analyses in *SimaPro* software have shown that from the perspective of the producer, impacts reduction should come from reducing the metallic parts included in the inverter unit and parts made of copper, there is a 7.5% reduction potential if recyclable parts are properly managed. From the user perspective, the choice among different heating systems depends strongly on the electricity mix of the country. From the buildings perspective, the SOFC is best suited to a family house type like the SIA-380/1 (Schweizerischer Ingenieur- und Architektenverein) building Swiss standard, which consumes less energy than the current average Swiss family houses.

Energy Planning in Buildings and Policy Implications
Chair: Dr Eva Maleviti

RISK AND UNCERTAINTY IN SUSTAINABLE BUILDING PERFORMANCE

Mr Seyed Masoud Sajjadian, Mr John Lewis, Professor Stephen Sharples
The University of Liverpool

Decision-making in the design of sustainable building envelopes will mostly consider the trade-off between initial cost and energy savings. However, this leads to an insufficiently holistic approach to the assessment of the sustainable performance of the building envelope. Moreover, the decisions that designers face are subject to uncertainties and risks with regards to design variations. This research examines a range of concepts and definitions of risk, uncertainty and sustainability in the context of climate, building construction and overheating. These concepts are then combined to objectify a range of risks and uncertainties affecting the decision. A simple computer model was used to analyze different building cladding constructions in terms of an overheating risk inside a building. The paper concludes by considering how the cladding materials may be chosen to optimize a model that will aid

decision-making in design. The research suggests that none of the cladding systems would completely eliminate the risk of overheating for a range of climate change scenarios.

Potential Savings in Buildings using Stand-alone PV Systems

Eva Maleviti1, Christos Tsitsiriggos2
1University of Central Greece, Levadia, 32100, Greece,
2 Visiontask Consultancy, Athens, 15562 Greece

This research analyses the electricity consumption and CO2 emissions of 3 hotels in Greece using energy auditing. Following this analysis, the energy generation, at the same month, from a stand alone PV system will be presented for each case, showing its contribution in electricity consumption and its possible share on the total electricity consumption. The PV systems are installed from the same company, and they have different power capacity of 75, 100 and 200kW. This research aims at showing potential energy and emissions savings from the selected cases, showing the necessity to promote the application of renewable energy sources and in particular PV stand alone systems in Greek hotels considering the current socio-economic situation of the country.

Analysis of a Potential Energy-saving Scenario in the Shanghai Domestic Sector

Ph.D Wei Bai, Professor Weiding Long, and Ph.D student Ying Yin
Royal Institute of Technology

Abstract to be announced

Wednesday 5th of September 2012

09.00-10.00
Keynote speaker
Professor Lynne A. Slivovsky California Polytechnic State University, USA
Room: Atlas Diesel Floor 1 (250 people)
Chair: Mark Smith

10.30-12.40

Session 3

General track

Track 1
Room: Atlas Diesel, 1st floor
Chair: Prof Mattias Höjer

Improved Real Time Amorphous PV Model for Fault Diagnostic Usage
Mr Davarifar Davarifar, Dr Jerome Bosche, Pr Ahmed EL Hajjaji, Dr Xavier Pierre, and Dr Abdelhamid Rabhi
Laboratory of Modeling, Information and Systems (M.I.S)

Amorphous PV panel is modeled in this paper to improve electrical characteristic and curve fitting in real time data processing such as fault diagnostic and Maximum Power Point Tracking (MPPT). The proposed model uses the basic circuit model of PV solar cell by manipulating component parameters, and also changing online shunt resistance by considering solar irradiation and temperature variation effects. Irradiation and temperature data of the PV panel are captured by National Instrument data acquisition system (NI DAQ USB-6212) and applied to the simulation in Matlab software to calculate the I-V curve of PV panel in real time. Then simulation outputs are compared with measured voltage and current for fault diagnostic deliberation. This model is done for triple layers Amorphous PV panel (Unit-solar ES-62T), which is installed in MIS laboratory energy renewable platform

An investigation of energy efficient and sustainable heating systems for buildings: Combining photovoltaics with heat pump
Mrs Arefeh Hesaraki, and Prof. Sture Holmberg
School of Civil and Architectural Engineering, KTH

Renewable energy sources contribute considerable amounts of energy when natural phenomena are converted into useful forms of energy. Solar energy, i.e. renewable energy, is converted to electricity by photovoltaic systems (PV). This study was aimed at investigating the possibility of combining PV with Heat Pump (HP) (PV-HP system). HP uses direct electricity to produce heat. In order to increase the sustainability and efficiency of the system, the required electricity for the HP was supposed to be produced by solar energy via PV. For this purpose a newly-built semi-detached building equipped with exhaust air heat pump and low temperature-heating system was chosen in Stockholm, Sweden. The heat pump provides

heat for Domestic Hot Water (DHW) consumption and space heating. Since selling the overproduction of PV to the grid is not yet an option in Sweden, the PV should be designed to avoid overproduction. During the summer, the HP uses electricity only to supply DHW. Hence, the PV should be designed to balance the production and consumption during the summer months. In this study two simulation programs were used: IDA Indoor Climate and Energy (ICE) as a building energy simulation tool to calculate the energy consumption of the building, and the simulation program WINSUN to estimate the output of the PV. Simulation showed that a 7.3 m^2 PV area with 15 % efficiency produces nearly the whole electricity demand of the HP for DHW during summer time. As a result, the contribution of free solar energy in producing heat through 7.3 m^2 fixed PV with 23º tilt is 17 % of the annual heat pump consumption. This energy supports 51 % of the total DHW demand.

A System for Energy Saving in Commercial and Organizational Buildings

Dr Hamid Abdi, Dr Michael Fielding, Dr James Mullins, and Prof Saeid Nahavandi
CISR

Energy consumption in commercial and organizational buildings with shared electricity produces a considerable amount of greenhouse gas emissions worldwide. Sustainable reduction of greenhouse gas emissions in these building remains to be a challenge and further research is required to address this problem due to the complexity of human behavior. The present paper introduces distributed meters for these buildings in order to achieve a sustainable energy saving. The method provides a direct control to a humans' behavior that is essential for effectiveness of the energy saving. It is shown that by using distributed meters, the system can actively engage humans in the energy saving process. The hardware and software required to implement this concept are explored and the sustainability of the proposed method is discussed.

Assessment of Solar Radiation Potential for Different Cities in Iran Using a Temperature-Based Method

Farivar Fazelpour1, Majid Vafaeipour1,, Omid Rahbari1, Mohammad H. Valizadeh2*
Shiraz University of Technology, Shiraz, Iran

The amount of solar irradiation in any region, is the most important required parameter for sizing and installing solar systems. Unavailability of this data has led to presenting different models for estimating its value. Using temperature based models is one of the most considered methods due to its simplicity and validity. Introducing various temperature based methods, Hargreaves and Samani's model has picked out to evaluate solar radiation potential in 4 different cities with various climate conditions and latitudes in Iran. Solar Radiation has been estimated in each city and the results are discussed. This investigation shows high solar radiation potential of Iran specially in Shiraz city.

Track 2
Room: Dynamiten, ground floor
Chair: PhD Student Nils Brown

A Decision Support Framework for Evaluation of Environmentally and Economically Optimal Retrofit of Non-domestic Buildings

Mr Taofeeq Ibn-Mohammed, Dr Adolf Acquaye, Dr Rick Greenough, Dr Leticia Ozawa-Meida, and Dr Simon Taylor
Institute of Energy and Sustainable Development

Currently, the building sector has an oversized carbon footprint as it represent the single largest contributor to global greenhouse gas emissions (GHG), with approximately one third of global energy end use taking place within buildings. The challenge to successfully reduce the energy consumption in the building sector is to find effective strategies for retrofitting existing buildings. Significant emissions reductions are possible from applying low carbon retrofit intervention options to existing buildings. The choice of low carbon retrofit intervention options involves evaluation of applicability, energy end uses, environmental impact and cost of application versus energy savings. To develop energy efficiency strategies for building stock, there is the need for optimised methodologies and decision aid tools to evaluate whole-life economic and net environmental gain of the options. This paper describes the development of an integrated framework for a Decision Support System (DSS) based on the optimal ranking and sequencing of retrofit options for emissions reduction in non-domestic buildings. The DSS framework integrates economic (cost) and net environmental (embodied and operational emissions) cost or benefit parameters and an optimization scheme to produce an output based on ranking principles such as marginal abatement cost curve (MACC). The methodology developed can be used to identify and communicate trade-offs between various refurbishment options to aid decisions that are informed both by environmental and financial considerations.

Modeling, From the Energy Viewpoint, a Free-Form, High Energy Performance, Transparent Envelope

PhD Student Luis Alonso, Professor Fernando Alonso, Professor Bedoya Bedoya, and Titular professor Benito Lauret
Department of Construction and Technology in Architecture

This article examines a new lightweight, slim, high energy efficient, light-transmitting, self-supporting envelope system, providing for seamless, free-form designs for use in architectural projects. The system exploits vacuum insulation panel technology. The research was based on envelope components already existing on the market and patents and prototypes built by independent laboratories, especially components implemented with silica gel insulation, as this is the most effective transparent thermal insulation there is today. The tests run on these materials revealed that there is not one that has all the features required of the new envelope model, although some do have properties that could be exploited to generate this envelope, namely, the vacuum chamber of vacuum insulation panels, the use of monolithic aerogel as insulation in some prototypes, and reinforced polyester barriers. These three design components have been combined and tested to design a new, variable geometry, energy-saving envelope system that also solves many of the problems that other studies ascribe to the use of vacuum insulation panels.

Effect of spectral characteristics of the solar radiation and the building facade on solar heat gain and daylighting

Ph.D., Assist. Prof. MASAYUKI ICHINOSE
Tokyo Metropolitan University

Abstract to be announced

A Mathematical Model to Pre-Evaluate Thermal Efficiencies in Elongated Building Designs

Doctor Alberto Jose Fz.de Trocóniz y Revuelta, Student Alberto Xabier Fz.de Trocóniz y Rueda, and Doctor Miguel Ángel Gálvez Huerta
Departamento de Física e Instalaciones de la Escuela Técnica Superior de Arquitectura de la Universidad Politécnica de Madrid

1. A Simple Model

This paper exposes the basic structure and results of a mathematical model that treats in a simple way the preliminary evaluation of the energy demand for certain building typologies: those annular Courtyard types, and also long Blocks. It derives from the fact that some thermal characteristics depend of a certain parameter of the three-dimensional shape, which in turn, for those typologies, is identical to that parameter considered for the mean cross section of the building. The corresponding dimensional reduction from 3D to 2D, implies that many problems of preliminary thermal analysis and design can be easily modelled for a variety of fields: urban planning, building projects, and in general morphology.

2. Basis: "A Thermal Identity in 3D & 2D"

This model constitutes a useful application of the theoretical concepts exposed by us in a previous paper (at this same forum: "A Simple way to Assess and Compare the Thermal Efficacy in Elongated Building Designs"[4]). All derives from an unveiled a Geometrical Law (mathematically formalised in an Identity Theorem), that establishes that for certain typologies of elongated buildings (Annular types of building, and also long Blocks and Towers), the Form Factor of their three-dimensional shape "Surface Envelope to Volume Ratio" (FF_3= S/V) is identical to the Form Factor of the mean cross section "Perimeter to Section Area Ratio" (FF_2= p/a), and so: $FF_3 = FF_2$. This pure geometrical law is also shown to be valid when applied to the thermal body, as it happens that the same identity is maintained with the weighted (by thermal transmitance coefficients) factors, i.e. (FF^*_3 = S*/V) = (FF^*_2= p*/a). Thus to achieve a greater energy efficiency (by thermal transfer), there is no need (at the first design stages) for considering the whole exterior envelope; it is enough to ensure a "good" cross section (in the tower would be the floor plan), trying to achieve the most adequate, compact and large 2D figure, and the most insulated perimeter for it; the rest of the volume can be overlooked.

3. Practical Application: a "2D Morpho-Thermal Model"

Now, in an operative development of those concepts, we expose here one of its more practical & useful applications; it is the formalisation of a simple mathematical model that takes full advantage of the potentialities of the dimensional reduction applied to the elongated buildings in plan (long blocks & annular courtyards).
The inputs for the model are 2D geometrical and physical parameters such as width, height,

thermal transmittances, etc. The outputs are 2D (& 3D) thermal efficiencies expressed as the unitary and specific flow of transmission heat through the envelope, and also some comparison percentages between different possibilities. Based on the cuantitative and graphical results of the model, we can conclude a number of interesting facts for the variation of the THERMAL EFFICIENCY or "TERMITUDE" of the building according to changes in its morphology. Further refinements of the model are of course possible, and also following those guidelines, similar types of modelling tools can be devised and extended (for example to towers). All this is relevant for building and urban planning: mainly applied to improve in a "preliminary way" the quality of thermal transmission by just optimizing the heights & widths of cross sections (given one fixed insulation level). That can be done at multiple stages: town planning, by-laws ordinances, architectural projects, etc. Using these procedures, design tasks not restricted by volume, can focus only on the section of the elongated buildings, thus their plan layouts can be freely adapted to what is more appropriate in relation to other important aspects: street guidelines, sunlight & wind orientation, lighting, etc.

Invited sessions

Track 3

Room: Blåslampan, 2nd floor
Technologies and Applications of Solar Energy
Chair: Prof Mahieddine Emziane

Analyzing the Optical Performance of Intelligent Thin Films Applied to Architectural Glazing and Solar Collectors

Prof. Saad Mekhilef, Mr. Kamalisarvestani Masoud, and Dr. Rahman Saidur
Dept. of Electrical Engineering, University of Malaya

Windows provide us with natural light and fine-looking connections to the outdoors. However, a huge amount of energy is lost through these building envelopes. Similarly, the glazing is used in many other systems such as solar collector covers and photovoltaic cells. This study reviews the most common and contemporary coatings of the glass surface with thin films. It is analyzed how the smart windows operate and help us in enhancing energy efficiency, getting the most out of indoor comfort and improving the performance of solar collectors and PV cells. These intelligent coatings feature different and selective optical properties in different environmental conditions. The analysis emphasizes on the radiation equations and discusses the different scenarios based on these equations.

A SUNSPOT MODEL FOR ENERGY EFFICIENCY IN BUILDINGS

Miss Yosr BOUKHRIS, Ms Leila GHARBI, Ms Nadia GHRAB
National School for Engineers of Tunis

Studying the distribution of beam solar radiation in buildings is becoming more important with the emphasis on curtailing energy consumption. This paper presents a model developed in order to evaluate sunspot position and area through a window on each wall of a parallelepiped room. The results of this developed model have been compared with numerical

published data. An application of the model to study the sunspot progression on walls of a Tunisian building is also presented.

Towards 24/7 Solar Energy Utilization: The Masdar Institute Campus as a case study

Mona Aal Ali, and Prof. Mahieddine Emziane, Masdar Institute of Science and Technology

In addition to the cost, storage of energy from solar generators remains a critical problem that is preventing the solar industry from reaching its full potential. Storage technologies are expensive and may not be suitable for large scale installations. Recent research suggests that electric vehicles (EVs) can be used for matching power demand with generation from distributed PV installations. This approach, called Vehicle-to-Grid (V2G), has never been demonstrated on a residential district to make it independent of the grid. In this study, we adopt the V2G concept and apply it to the Masdar Institute (MI) campus. Our aim is to investigate the feasibility of powering MI campus 24/7 from its own rooftop solar installations by using its EVs infrastructure for storage. The results showed that the generation and EV infrastructure already in place can power MI campus for 1 to 7 hrs of storage time, respectively. We have also conducted a feasibility and cost analysis to achieve 24/7 solar energy utilization by using different types of EVs.

Effect of selective emitter temperature on the performance of thermophotovoltaic devices

Dr Emziane Mahieddine, and Mr Hsieh Yao-Tsung
Masdar Institute of Science and Technology

We investigated the performance of thermophotovoltaic (TPV) systems that are composed of different cells and selective emitters. We selected three cells which are the Si conventional PV cell and the low bandgap Ge and InGaAs TPV cells. The three cells operating with Yb based selective emitters were simulated. The effects of the emission spectra on the the performance of these cells are presented and discussed, especially with regard to the emitter temperature. By comparing the overall cell performances, the best combinations of cells and selective emitters were determined.

New tandem device designs for various PV applications

Dr Mahieddine Emziane
Masdar Institute of Science and Technology

We report on new tandem device designs based on IV or III-V semiconductors for the top cell, and group IV materials for the bottom cell. In addition to the extended spectral coverage leading to more photons being converted, three and four-terminal device configurations were considered in order to avoid the current matching and the associated tunnel junctions between the two sub-cells. A comprehensive modeling analysis is presented where device structures were designed and optimized, and the behavior of the sub-cells studied. Optimal cell characteristics were obtained with the quantum efficiency. The applications of these devices were assessed and the output parameters were predicted as a function of the device simulated operating conditions.

Track 4

Room: Propellern, 2nd floor
Assessment and Monitoring The Environmental Performance of Buildings
Chair: Dr John Littlewood

The Effects of Weather Conditions on Domestic Ground-Source Heat Pump Performance in the UK

Dr Anne Stafford
Leeds Metropolitan University

Unpredictable and variable weather is often cited as one of the factors which may contribute to the underperformance of heat pumps in the UK, compared with other European countries. In this study, 10 similar ground-source heat pump systems, installed in existing social housing in North Yorkshire, were monitored intensively over a period of almost two years. A weather station, closely co-located with six of the ten dwellings, was also established giving data on local external temperatures and other parameters. Differences in the performance characteristics of the heat pump systems over 2010 and 2011 are assessed with particular reference to differences in local weather conditions.

Asset and Operational Energy Performance Rating of a Modern Apartment in Malta

Ass Lecturer EUR ING Charles Yousif, Ms Raquel Mucienetes Diez, and Dr. Francisco Javier Rey Martinez

The European Directive on Energy Performance of Buildings 2010/31/EU has continued to improve on the original directive that introduced the energy performance certificate of buildings and required the establishment of minimum energy efficiency standards for new buildings in all Member States. Most of the exigencies of this Directive have been transposed into National Legislation in Malta. Also, several instruments have been instated to support it, such as the development of specific software for issuing the Energy Performance Rating of Residential Dwellings (EPRDM) and the training of assessors to carry out the required evaluation. On an international level, several other software have been developed such as DesignBuilder – EnergyPlus software that is being used in many countries including UK, India, Australia, U.S.A. and others.
This paper aims to evaluate the asset and operational energy performance rating of a typical modern apartment in Malta, by comparing modelling results of DesignBuilder-EnergyPlus and the Energy Performance Rating of Dwellings Malta (EPRDM) software, to actual energy consumption in the apartment. In order to carry out this exercise, an EnergyPlus Weather (EPW) data file for Malta has been created, tested and validated, based on hourly weather data for the year 2010.
Results showed that EPRDM results compared favourably with the DesignBuilder results, although, the latter one showed higher energy consumption for cooling. This is attributed to the fact that EnergyPlus considers the hottest week in the sizing of cooling systems and the simulation is carried out dynamically for every hour of the day. Actual energy consumption for heating and cooling is generally lower than modelled results, which augurs well for the overall energy consumption in Maltese buildings. The thermal mass of Maltese buildings plays an important role in reducing peak loads.

With regards to the asset and operational energy performance rating, the simplicity of the Maltese EPRDM software may be taken as an advantage, as there is less possibility of making errors in inputting data. On the other hand, it is not flexible and the results provide yearly outputs, which are sufficient for the production of the energy performance certificate, but may not provide adequate information for the analysis and improvement of energy performance in buildings. On the other hand, DesignBuilder provides a more powerful tool to analyse any type of building, but it is important to ensure that the input parameters are correctly set by the assessor. Some countries have already adopted DesignBuilder in their scheme of approved software for the production of energy certificates, such as the UK and Portugal. This should also be considered in Malta.
On the other hand, the behaviour of the residents in the dwelling has affected the total energy consumption in the majority of cases. The quantity of times of opening windows and doors, use of artificial lighting, air-conditioning, water heating and other equipment such as fans, are all human actions that are hard to predict, as they depend on the particular lifestyle. Nevertheless, the overall simulations showed that this can be quantified to an agreeable level of accuracy.

Low carbon housing: understanding occupant guidance and training

Ms Isabel Carmona-Andreu, Mrs Mary Hancock, Professor Fionn Stevenson
CA Sustainable Architecture

Recent research into occupant behaviour in low carbon housing indicates that for the same type of house, energy and water use can vary by up to fourteen times between different households. This paper assesses the information and training the occupants received in two contrasting building performance evaluation case studies of exemplary low carbon housing. Key findings showed a lack of a coordinated set of guidance for occupants and poor understanding on the trainers' part on specifics of the centralised heating and mechanical ventilation systems. As a consequence occupants were unable to operate or maintain these systems with confidence. Recommendations are made to develop guidance and "hands on" training that keeps usability in mind and empowers occupants to contribute to reductions in carbon emissions.

Embodied energy as an indicator for environmental impacts - a case study for fire sprinkler systems

Mr Tom Penny, Mr Simon Aum™nier, Mr Michael Collins, Ms Kay Ramchurn, and Mr Terry Thiele
Environmental Resources Management

This paper appraises the utility of embodied energy as an indicator of environmental impact through the use of life cycle assessment (LCA). This utility is considered in terms of its use for the preferential selection of materials and for hotspot analysis for the purposes of identifying reduction opportunities. An appraisal of the peer-reviewed LCA of BlazeMaster® CPVC fire sprinkler system and subsequent LCA work commissioned by the Lubrizol Corporation is conducted to investigate the utility of embodied energy as an environmental indicator. Embodied energy is assessed using the Cumulative Energy Demand (CED) method and environmental impacts are ppraised using the ReCiPe method. Embodied energy is found to reflect the impact results in terms of preference for CPVC when compared to steel sprinkler systems. However, the inability of CED to identify hotspots consistently, or to provide a reliable measure of relative performance for individual environmental impacts, indicates limited utility.

Understanding the gap between 'as designed' and 'as built' performance of a new low carbon housing development in UK

Professor Rajat Gupta, and Ms Dimitra Dantsiou
Low Carbon Building Group, Oxford Brookes University

This paper investigates forensically the discrepancy between 'as designed' and 'as built' performance of exemplar low carbon housing in UK, since this performance gap has the potential to undermine zero carbon housing policy. Driven by the UK Government Technology Strategy Board's *Building Performance* Evaluation (BPE) competition, a BPE study is undertaken by the authors during post construction and initial occupancy stage of a Code level 5 housing scheme (Swindon, UK) focusing on two house typologies. The performance of the building envelope and service systems are evaluated through a detailed review of design and construction specifications and processes, fabric performance evaluation, observation of handover processes and mapping of occupant satisfaction. This reveals unintended fabric losses, installation and commission issues associated with low carbon technologies, lack of co-ordination and proper sequencing of the building works, and complexity of control interfaces. Lessons from different elements of the BPE study are pointed out and recommendations are drawn for councils, developers, house builders, designers and equipment suppliers to reduce the gap between 'as designed' and 'as built' performance of future low carbon housing developments.

Track 5

Room: Ångturbinen, 2nd floor
Smart Buildings, Smart Grids
Chair: Dr Catalina Spataru

Smart Consumers, Smart Controls, Smart Grid

Catalina Spataru, Mark Barrett
Energy Institute, University College of London, London

The grid has three components: demand, transmission/distribution and generation, with the latter being mainly dispatchable, conventional power generation. A future grid based on renewable energy sources will impose serious challenges due to the variable nature of resources (wind, solar). In the transition from the current grid based on fossil and nuclear energy to a more sustainable one, based on renewable energy sources and components such as storage and with possible active participation by consumers, controls will play an important role, providing essential infrastructure for end users and system managers to monitor and control their energy usage. The uncertainty in the supply due to the integration of wind and solar energy will require intelligent control and with possible ways for shifting demand. The paper will discuss challenges, issues and advantages of demand reduction and demand shifting within a future smart grid with some illustrative examples.

A qualitative comparison of unobtrusive domestic occupancy measurement technologies

Mr Eldar Nagijew, Mr Mark Gillott, Mr Robin Wilson
University of Nottingham

Domestic occupancy measurement could save significant amounts of energy, either instantly via a home automation system or retrospectively via post-occupancy evaluation and feedback. However, not many localisation technologies are applicable to a domestic environment. In this paper three unobtrusive occupancy measuring technologies, i.e. Passive Infra-Red (PIR), Carbon Dioxide (CO_2) and Device-free Localisation (DfL), are compared. Their operation is explained and possible advantages and disadvantages are outlined. A qualitative experimental study then analyses the abilities of each system to detect overall occupancy, detect room level occupancy, count the number of occupants and localise them. It has been found that CO_2 and PIR sensors are very limited. The impacts of other factors, such as windows or occupants' metabolic rates, were significant on the reliability of the measured data. Device-free localisation on the other hand has great potential, but requires further research.

Review of methods to map people's daily activity ñ application for smart homes

Miss Stephanie Gauthier, and Dr David Shipworth
UCL Energy Institute

People's daily activity in their home has widespread implications, including health and energy consumption, yet in most environmental studies people's activity is only estimated by using screening or structured observation. This paper reviews the current protocols and standards, and then identifies a mixed-method approach to measure people's activity levels in free-living environments. One of the key issues is to gather accurate measurements while using 'discreet' observatory methods to have minimum impact on their behaviour. With the recent emergence and advancement of more accurate and affordable sensing technologies, this problem might be overcome. Drawn from physiological research, heart-rate monitoring, accelerometry, and automated visual diary, were used in a field study, which monitored a small sample of UK households during the winter of 2012. Within a smart home, these methods could potentially be used to forecast energy demand for heating and to manage power distribution peaks.

Optimizing building energy systems and controls for energy and environment policy

Dr Mark Barrett, and Dr. Catalina Spataru
UCL Energy Institute

This is an informal introduction to some aspects of energy system optimisation to provide sustainable services to people in dwellings. This paper advances data, methods and results of optimising building energy systems and controls for energy and environment policy using quantitative techniques. Optimisation can aid the design of systems to meet policy objectives efficiently and at low cost. Three op- timisation methods were applied: genetic algorithm (GA), particle swarm optimi- sation (PSO) and steepest decent (SD). It was concluded that the higher the energy price, the greater the efficiency of the dwelling envelope and heating system to achieve least cost. Ultimately, optimisation should be done across all systems and stock, and simultaneously for configuration, size and controls.

Towards a Self-managing Tool for Optimizing Energy Usage in Buildings

Dr Naveed Arshad, Mr Fahad Javed, and Mr Muhammad Liaqat
Department of Computer Science

Smart grid is the next generation of electricity generation, transmission and distribution technology. A major component of smart grid is an overlay communication network for two-way communication between the power providers and the customers. With this feature smart grid provides exciting new ways of energy management and conservation. One of ways to conserve energy using a smart grid is to control and optimize energy usage in buildings. Buildings consume more than one third of the energy produced in the world. Therefore, conserving energy in buildings is cited as the "most important fuel"" in energy generation. To this end, we have developed a self-managing approach to optimize energy usage in buildings. We have evaluated our approach using a software tool called Power Conservation Analysis Tool (PCAT). Our initial results using PCAT show upto 38\% savings in the energy bills of customers that could directly translates into reduction in energy production costs for power producers.

13.30-14.30

Session 4

General track

Track 1

Room: Atlas Diesel, 1st floor
Chair: Prof Ronald Hartung

Effect of Reaction Conditions on the Catalytic Performance of Ruthenium Supported Alumina Catalyst for Fischer-Tropsch Synthesis

Mr. Piyapong Hunpinyo
King Mongkut's University of Technology North Bangkok

A Ru/ɤ-Al_2O_3 catalyst was prepared using by sol-gel technique in order to study its conversion and selectivity in the Fischer-Tropsch Synthesis (FTS). The effects of reaction conditions on the performance of a catalyst were carried out in a fixed bed reactor. The variation of the steady-state experiments were investigated under reaction temperature of 160-220˚C, inlet H_2/CO molar feed ratio of 1/1-3/1, which both atmospheric pressure and gas space hour velocity of 1061 hr^{-1} were restricted. The influence of changing factors on CO conversion and on the selectivity of the formation of different hydrocarbon products in the reaction conditions was performed and compared to assess optimum operating conditions. In terms of FTS results, the increase of reaction temperatures led to increase of CO conversion and light hydrocarbon, while higher H_2/CO ratio has strongly influenced to increase the selectivity to higher molecular weight hydrocarbons and chain growth probability (α). Moreover, our catalyst was also markedly found to maintain selectivity to diesel faction for a wide range of H_2/CO molar feed ratios from BTL application.

Integration of wind power and hydrogen hybrid electric vehicles into electric grids

Prof. Dr. Lars Gusig, Dr Stephen Carr, Prof.Dr. Alan Guwy, Prof.Dr. Giuliano Premier, Dr Kary Thanapalan, and Dr Fan Zhang
University of Applied Sciences and Arts Hannover

The effort to increase the amount of renewable energy utilized in energy systems is important to a variety of sectors; especially in the area of i) transportation and mobility, ii) in housing and building, and iii) process and production industries. As all three are connected by electrical power grids and apart from optimizing each subsystem, an alternative approach is to look at interaction between different elements of the whole. A rapid increase in wind power and the change from fossil fueled internal combustion engine vehicles to electrical vehicles is expected. Integrating wind energy and electrical car fleets with the electrical grids can result in large and erratic fluctuations from these additional power sources and loads.
To identify the potential use of hydrogen storage in hydrogen-hybrid-electric vehicles, a grid-to-vehicle model (G2V) has been developed. A network with wind farms, consumer load, and hydrogen vehicle demand supplied by electrolysis is studied in three configurations. The target is to maximize hydrogen supply to vehicles, and to facilitate more renewable energy onto the grid. Two different power management scenarios have been investigated. In a passive demand scenario the hydrogen demand acts as a dispatchable load on the network. This load does not have to be met if network constraints do not allow it. In this case extra wind power is allowed onto the network passively. In an active hydrogen demand scenario the use of objective functions maximizes the amount of wind energy accepted onto the network by taking energy in the form of hydrogen into storage.
Daily analysis for an existing network shows that under passive demand conditions extra wind is allowed onto the network, but some wind must be curtailed, while not all the hydrogen demand can be satisfied. With active demand, all of the wind is utilized and all hydrogen demand can be met. In addition a significant amount of hydrogen remains in store at the end of a day for further utilization.

Track 2
Room: Propellern, 2nd floor
Chair: Prof Mark Smith

Energetic and Exergetic Performance Evaluation of an AC and a Solar Powered DC Compressor

Dr. Orhan Ekren, and Dr. Serdar Celik
Ege University

This study represents experimental performance analyses of an alternative current (AC) and a direct current (DC) refrigeration compressors implemented in a 79 liter refrigerator. Experiments were carried out at continuously running (ON) and periodically running (ON/OFF) operation modes. Data was analyzed and a comparison in terms of cooling capacity, power input, coefficient of performance (COP), Carnot COP, and exergy efficiency was conducted. The comparison showed that DC compressors can be much more efficient than AC compressors in refrigeration units.

Effectiveness of sustainable assessment methods in achieving high indoor air quality in the UK

Miss Grainne McGill, Dr Lukumon Oyedele, and Dr Menghao Qin
Queen's University Belfast

The use of sustainable assessment methods in the UK is on the rise, emulating the future regulatory trajectory towards *zero carbon* by 2016. The indisputable influence of sustainable rating tools on UK building regulations conveys the importance of evaluating their effectiveness in achieving *true* sustainable design, without adversely effecting human health and wellbeing. This paper reviews the potential trade-offs between human and ecological health in sustainable building design, particularly between building energy conservation and indoor air quality. The barriers to effective adoption of indoor air quality strategies in sustainable assessment tools are investigated, including recommendations, suggestions and future research needs. The consideration of occupants' health and wellbeing should be paramount in any sustainability assessment method, particularly indoor air quality, thus should not be overshadowed or obscured by the drive towards energy efficiency. A balance is essential.

A comprehensive monitoring system to assess the performance of a prototype house

Dr. Oliver Kinnane, Prof. Mark Dyer, and Mr. Tom Grey
TrinityHaus, Trinity College Dublin

This paper presents a monitoring system and methodology designed for the evaluation of a prototype house, and proposed as an exemplar for comprehensive domestic monitoring. This system will enable assessment of a wide range of parameters for proof of concept and technology of the prototype. Consumption, occupancy patterns, indoor air quality, thermal conditions and building efficiency are monitored so as to gain a real-time understanding of building performance and occupant interaction with the house. The broad range of parameters will allow quantification of the correlation between for example; occupancy and consumption patterns, or air quality and ventilation system operation. Results of this monitoring study will inform future design iterations of this housing product.

Invited sessions

Track 3

Room: Blåslampan, 2nd floor
Technologies and Applications of Solar Energy
Chair: Prof Mahieddine Emziane

GIS-based decision support for solar photovoltaic planning in urban environment

Prof. Antonio Gagliano, dott. Alfonso Capizzi, dott. Aldo Galesi, prof. Francesco Nocera, and prof. Francesco Patania
D.I.I.M. - university of Catania

In 2007, the European Council decided a fixing goal of 20% contribution of the renewable energy sources (RES) to the total European electric energy production in 2020. Micro-generation systems integrated in urban environment are an interesting opportunity, in terms of research and development of RES. The development of a solar energy planning system to predict the potential of solar energy photovoltaic, solar water heating and passive solar gain is necessary for the optimization of energy efficiency strategies and integration of renewable energy systems in urban areas. The work discussed here relates to solar photovoltaic (PV), technology which has matured to become a technically viable large-scale source of renewable energy sources. This paper illustrates the capabilities of Geographic Information Systems (GIS) to determine the available rooftop area for PV deployment for an urban area and how the methodology may enable planners to consider the urban-scale application of solar energy with greatly increased confidence.

Infrared thermography study of the temperature effect on the performance of photovoltaic cells

M. Fares ZAOUI, Dr. Abdennacer ABOUBOU, Dr. Mohamed BECHERIF, Dr. Mahieddine EMZIANE, and M. Soufiane MEBAREK ASSEM
MSE Laboratory, Biskra University

Silicon solar cells are widely used in the Photovoltaic (PV) industry. The silicon PV electrical performance is described by its current–voltage (I–V) characteristic, which is a function of the device used and material properties. The PV cell efficiency is strongly temperature dependent. This work studies the electric performance of a polycrystalline Si solar panel under different atmospheric conditions by using thermographic images. The PV performance study is carried out as function of the junction temperature and solar insolation. An infrared analysis as close to the junction temperature has allowed measurements of the cells surface temperature in order to increase the measurement accuracy and to make a reliable assessment of the PV module performance.

Integrating Solar Heating and PV Cooling into the Building Envelope

Mr. Sleiman Farah, Dr. Martin Belusko, and Prof. Wasim Saman
Barbara Hardy Institute - School of AME – UniSA

Photovoltaic/thermal (PVT) systems generate electrical and thermal energy. In summer, the usage of the collected heat is limited to domestic hot water heating. By contrast in winter,

more useful heat collection is favorable, however, the PVT collectors require less cooling; therefore, the improved electrical output is limited. In this paper a new one-dimensional steady-state building integrated solar collector model is presented and examined, incorporating PVT and thermal (PVTT) collectors connected in series. In summer, the PVT collector is air-cooled, and the collected heat is discarded to the surroundings while the thermal collector heats the water for domestic use. In winter, both the PVT and thermal collectors are water-cooled generating domestic hot water. The efficiencies of the new collector are compared to that of a PVT collector, with both collectors having the same total area and characteristics. Both collectors are able to meet the summer thermal load and to provide useful thermal energy in winter. The PVTT collector reduces the collector thermal stresses and provides slight additional electrical power output.

Track 4

Room: Dynamiten, ground floor
Chair: Prof Robert Howlett

A Comparative Analysis of Embodied and Operational CO2 Emissions from the External Wall of a Reconstructed Bosphorus Mansion in Istanbul

PhD Candidate Fatih Yazicioglu, and Assoc. Prof. Hulya Kus
Istanbul Technical University

In 2012 a Bosporus Mansion, which was demolished because of a fire in 1995, is reconstructed. Although it's facades were constructed the same as the original building, it's structural system component was made of reinforced concrete. But today doing so is forbiden by the new legislations in Istanbul, Turkey. It's structural system components must also be constructed with the original kind of materials and techniques. In the paper; firstly the embodied CO2 emissions of the reconstructed external wall and an eventual reconstruction of it according to the new legislation are calculated; secondly the U-Values of both alternatives are calculated; and thirdly operational CO2 emissions are calculated. And lastly embodied and operational CO2 emissions are compared and contrasted.

Sustainable integration of Renewable Energy Systems in a Mediterranean island: a case study

Prof Eleonora Riva_Sanseverino, Prof Domenico Costantino, Prof Mariano Giuseppe Ippolito, PhD Raffaella Riva_Sanseverino, and Eng Valentina Vaccaro
DIEETCAM University di Palermo

Starting from a previous technical and economical feasibility study, this paper analyzes the integration of Renewable Energy Sources into an existing territory with specified features of the natural landscape and of the built environment. The work puts into evidence that territories development must use suitable tools and rules based on integrated knowledge, since technical feasibility studies do not assess the sustainability of the proposed infrastructures within the built environment and landscape. The studied system is in the island of Pantelleria situated between Sicily and northern Africa.

Track 5
Room: Ångturbinen, 2nd floor
Smart Buildings, Smart Grids
Chair: Dr Catalina Spataru

A library of energy efficiency functions for home appliances

Dr Hamid Abdi, Dr Michael Fielding, Dr James Mullins, and Prof Saeid Nahavandi
CISR

Emerging home automation technologies have the potential to help householders save energy, reduce their energy expenses and contribute to the climate change by decreasing the net emitted greenhouse gas by reduced energy consumption. The present paper introduces a distributed energy saving method that is developed for a home automation system. The proposed method consists of two levels functional elements; a central controller and distributed smart power points. The smart power points consist of a proposed a library of energy saving functions that are specifically developed for different home appliances or devices. Establishing a library of high performing, energy saving functions can speed up development of a buildings control system and maximum the potential reduction in energy consumption.

Smart Energy Façade for Building Comfort to optimize interaction with the Smart Grid

Prof.ir. Wim Zeiler, Ir. Gert Boxem, Ir. Joep van der Velden, and Dr.ir. Rinus van Houten
TU Eindhoven

An Intelligent Electrical Energy supply Grid is being developed to cope with fluctuations in energy generation from the different energy sources. To better match energy demand and energy need to achieve improved overall efficiency, the process control of the energy flows in the buildings in relation to the outside envi- ronment and the user behavior also needs to become smart, intelligent and capable of adaptation to changing conditions. Especially is it of great importance to take in account the goal of the energy use: human comfort. There is need for dynamic in- dividual local comfort control instead of only process control at room level. Espe- cially with these new possibilities the interaction becomes essential between the energy flows around the façade and comfort of the occupants. The façade is a pas- sive and active energy source on the one hand and a critical factor in relation to the perceived individual comfort. To optimize will be one of the essential chal- lenges for the near future in the built environment.

Building for Future Climate Resilience

Dr Lucelia Rodrigues, and Professor Mark Gillott
University of Nottingham

A great deal of literature has been published in recent years around the need to mitigate climate change and the building industry is already working to make buildings more energy efficient. However, some changes to our climate cannot be avoided so we will need to change the way we design, construct, refurbish and use buildings to adapt to the likely increases in temperature. A great proportion of British housing is now being built using Modern Methods of Construction (MMC) systems, and this number is expected to rise significantly over the

next decade. All systems are potentially able to deliver good buildings, so how to choose? Sustainability should be the order, but it is only achievable if future climate resilience is considered. Otherwise, the use of MMC to build dwellings that use less energy for heating today could result in a future undesirable scenario when energy for cooling is also needed. In this work, the occurrence of overheating today and in the future in a highly insulated 100m^2 space built using eight different walls constructions has been investigated in a parametric study. The building was dynamically simulated with few parameters to allow easy comparison of the performance of each constructive system. It was found that there is a high risk of overheating in houses and this risk will not be mitigated by one solution alone. Although this not a comprehensive study by any means, it is the start of a discussion to instigate further research that could inform design decisions that address future climate resilience.

15.00-17.00

Session 5

General track

Track 1

Room: Atlas Diesel, 1st floor
Chair: Prof Ronald Hartung

Analysis of thermal comfort and space heating strategy - case study of an Irish public building

Dr. Oliver Kinnane
TrinityHaus, Trinity College Dublin

Targets have been set to reduce the energy consumption in public buildings in Ireland by 33% by 2020. Space heating accounts for a significant portion of the energy load of public buildings. Diverse space heating strategies are often required to meet the requirements of spaces of various usage within public buildings, including within multi-purpose or event spaces. To analyse the thermal comfort of occupants and efficiency of the space heating strategy a post-occupancy evaluation was carried out on an event space at Dublin City Council local authority offices. The evaluation, based on the results of monitoring (temperature, energy), modeling and the assessment of comfort as perceived by occupants, has shown that thermal comfort is not adequately achieved. This is the case even though significant energy is being expended to achieve comfort levels via a current inefficient space heating strategy.

PROTECTION OF RING DISTRIBUTION NETWORKS WITH DISTRIBUTED GENERATION BASED ON PETRI NETS

Dr. Haidar Samet, and Mr. Mohsen Khorasany
Shiraz University

Nowadays limitation of energy sources has increased the demands for using Distributed Generation (DG) in electricity generation. Entrance of DG to network is accompanied by some problems in network protection. DGs connection to network makes some problems in coordination between protection relays. Wrong operation of relays interns irreparable shocks

to network. So for increasing the protection of DG in distribution network we should solve protection problems. In this article at first the problems that caused by entrance of DGs in protection system, are presented. After that an error detection system in function of relays based on Petri net is introduced. In the past, Petri net was used for radial system protection in presence of DG. The main goal of this article is explanation of Petri net structure corresponding to ring distribution network and use of backup relay for insurance of DG separation from network.

Real-Time Optimization of Shared Resource Renewable Energy Networks

Dr. Stephen Treado, and Mr. Kevin Carbonnier

Shared resource renewable energy networks allow for the burden of high capital cost to be managed by sharing the cost and benefits of renewable energy use. In order to maximize the benefit gained from shared renewable energy, we propose a methodology to optimize the use of renewables via scheduling of energy use. By offering reduced energy rates, residents will be encouraged to run heavy energy consumers such as clothes dryers at times which improve the load generation and energy demand matching as deemed by a designed and optimized decision engine.

Track 2

Room: Dynamiten, ground floor
Chair: Prof Mark Smith

Evaluation of the LCA Approaches for the Assessment of Embodied Energy of Building Products

Assist. Prof. Dr. Aysen Ciravoglu
Yildiz Technical University, Turkey

In this study among current approaches that involve usage of LCA that are employed in different countries and established by different institutions, Athena, BEAM, BEES, BREEAM, DGNB, EcoHomes, GaBi, Green Star and LEED are studied. Findings related to General Information, Usage Features, LCA Processes, Environmental Impact Assessment Criteria, Features of Assessment and Energy in Environmental Impact Assessment Criteria of Evaluated Tools are given and tools are compared related to these subjects. Comparison and evaluation of embodied energy criteria in selected tools that evaluate environmental impacts that have occurred throughout the lifespan of building products present the importance of product decision processes in building design. Appropriate product decision requires an adequate level of product information and this necessitates an information database. Besides, development of weightings, grading, and/or calculation methods that are appropriate to countries and regions where the evaluation tool is used is important in terms of effectiveness and productivity of the evaluation.

Exergetic life cycle assessment: An improved option to analyze resource use efficiency in the construction industry

Mr. Mohammad Hoque, Dr. Xavier Gabarrell Durany, Dr. Cristina Sendra Sala, and Dr. Gara Villalba Méndez
Departament of Chemical Engineering, ICTA, XRB

This article presents an effort to pinpoint how efficiently resources are used in the construction sector applying exergetic life cycle assessment methodology in a cradle-to-grave life cycle approach. Polypropylene (PP) and polyvinyl chloride (PVC), two widely used thermoplastics in construction applications, are chosen as case study materials in this analysis involving raw material extraction, resin manufacturing, and post-consumer waste management life cycle stages. Overall life cycle exergy efficiency of PP and PVC is

quantified 27.1% and 9.3%, respectively, characterized by a low efficiency of manufacturing and recycling processes for both materials. Improving the efficiency of manufacturing and recycling processes will thus reduce exergy losses from the system. From resource conservation point of view, mechanical recycling can be the viable option for end-of-life plastic waste management, since it loops materials back directly into new life cycle, and thus reduces primary resource inputs in the production chain and associated environmental impacts.

Methodology for the preparation of the standard model for schools investigator for the sustainability of energy systems and building services

Dr Hisham Elshimy
Pharos University

Sustainable architecture is a major goal for all the bodies and institutions interested in architecture in various directions (planning - design - construction); especially with the lack of environmental resources required to ensure building of environmentally compatible with the built environment and the natural environment
Diverse concepts of sustainability and green architecture in the property sector:
Sustainable design, Green Architecture, Sustainable Construction and Green Building are all new methods of design and construction, evoking environmental and economic challenges. This has cast a shadow over the various sectors in this era. The premises are new, design, implementation and operation of sophisticated methods and techniques contributing to reducing environmental impact, and at the same time minimizing costs, specifically operating and maintenance costs (Running Costs), as these premises contribute to a safe and comfortable physical environment. Thus, motivating the adoption of the concept of Sustainability in the property sector is not different from the motivation that led to the emergence and adoption of the concepts of Sustainable Development, Dimensions of Environmental, and Economic and Social entity.

Invited sessions

Track 3

Room: Ångturbinen, 2nd floor
From industrial pollutions to clean energy
Chair: Prof Abdeslam-Hassen Meniai

Experimental study of the energetically valorised dairy wastes

PhD Derbal Kerroum, Pr Meniai Abdeslem Hassen, Master Boumaza Amina, Master Guessoum Hala, and Pr. Bencheikhlehocine Mossaab
1Laboratoire de l'Ingénierie des Procédés de l'Environnement

Anaerobic digestion has proven to be an adequate technique for the treatment of the solid wastes rich in biodegradable organic matter which, under the action of micro-organisms, is transformed into methane rich biogas (50-75%) which can be used as an energy source for heating or to produce electricity.

The present study reports the obtained results concerning the determination of the biodegradability of dairy wastes issued from a local dairy unit, under mesophilic conditions. The experiments were carried out in identical batch reactors of 570 ml in volume, kept at 35°C in a thermostatic device, for an incubation period of 80 days. A priori a characterisation of the dairy waste and the sludge was carried out. The results showed that the waste was very rich in biodegradable volatile matter (86.52 % TVS), stimulating this anaerobic digestion based type of treatment and valorisation. The results did also show that the net biogas volume under mesophilic conditions increased with the increase of the dairy waste load to the reactor, and the methane percentage in the biogas varied from 42 to 53.31% for the different considered cases.

Determination of the biodegradability of dairy wastes under thermophilic conditions

PhD Derbal Kerroum, Pr Meniai Abdeslem Hassen, Master Boumaza Amina, Master Guessoum Hala, and Pr. Bencheikhlehocine Mossaab
Laboratoire de l'Ingénierie des Procédés de l'Environnement

Nowadays the anaerobic digestion despite the fact of being used in solid waste treatment, it is also greatly contributing to the development of renewable energies. Therefore this technique is also known as bio- methanization and has two major advantages: environmentally and energetically. The present work concerns the study of the biodegradability of dairy wastes issued from a local dairy unit, under thermophilic conditions (T =55°C). The anaerobic process consisted of an incubation of dairy wastes in ten identical reactors of volume equal to 570 ml, using inoculums (sludge) for 80 days, a period during which the biogas volume was monitored. The characterization of the dairy waste showed that it was very rich in volatile organic matter (86.52 % TVS). The volume of the produced biogas increased with the increase of the dairy waste load with a methane percentage varying from 40 to 60%, a better performance than the previously tested process under mesophilic conditions.

Comparison between the effect of acid and basic chemicals activation of cedar cone on the sorption of Rhodmaine B from aqueous solution

Miss meriem zamouche, Mme Sihem ARRIS, Mr Mosaib BENCHEIKH LEHOCINE, and Mr Abdslem Hacen MENIAI
Laboratory of the engineering and the processes of environment

Abstract to be announced

Track 4

Room: Propellern, 2nd floor
Assessment and Monitoring The Environmental Performance of Buildings
Chair: Dr John Littlewood

Preliminary evaluation of design and construction details to maximize health and well-being in a new built public school in Wroclaw

Ph.D. Architect Magdalena Baborska-Narozny, and Ph.D. Architect Anna Bac
Faculty of Architecture, Wroclaw University of Technology

The paper presents preliminary evaluation of a design approach and solutions applied in the first sustainable school complex in Wroclaw, Poland. The scope of this paper is focused on health and wellbeing of the occupants. The building completed in the year 2009 is planned for an in-depth POE to start this year – the first such broad evaluation project to be carried out in Poland. Measurements taken already and the feedback from the occupants received so far indicate whether certain design intentions have been met. Selected usability problems that have already occurred are discussed as well as the way the occupants cope with them. Selected details that proved to be successful are also presented. An overview of the process of the building delivery, handover and maintenance is also presented as in the authors opinion it has a major impact on the building's overall performance. The paper concludes that most usability problems are lessons to be learned indicating improvements that can be made in a building's life early stages.

Comparison of design intentions and construction solutions delivered to enhance environmental performance and minimize carbon emissions of a new public school in Wroclaw

Ph.D. Architect Magdalena Baborska-Narozny, and Ph.D. Architect Anna Bac
Faculty of Architecture, Wroclaw University of Technology

The paper presents an analysis of the first public school complex in Wroclaw, Poland to use renewable energy sources with an introductory summary of low emissions constructions in Poland. Described is the process of the building's delivery and a preliminary evaluation of selected design solutions. The building, completed in the year 2009, is planned for an in-depth POE to start this year – the first such broad evaluation project to be carried out in Poland. An in depth knowledge of the design and construction process, measurements taken already, feedback from the occupants, and tracks of all faults reported so far, allow a preliminary evaluation of the building's environmental performance. A comparison of total energy consumption and CO_2 emissions between the analyzed building and two other selected schools from Wroclaw is included. It is based on energy bills for all fuel sources used. It indicates energy efficiency of the building and relatively high CO_2 emissions due to its sole dependence on electricity.

An exploration of design alternatives using dynamic thermal modelling software of an exemplar, affordable, low carbon residential development constructed by a registered social landlord in a rural area of Wales

Mr Simon Hatherley, Mr Wesley Cole, Mr John Counsell, Professor Andrew Geens, Dr John Littlewood, and Mr Nigel Sinnett
Cardiff Metropolitan University

Pembrokeshire Housing Association (PHA) a registered social landlord, based in Haverfordwest, Wales, UK, have developed six low carbon houses to meet Code for Sustainable Homes (CfSH) level four, as part of an exemplar scheme for the Welsh Government's CfSH pilot project. A tried and tested methodology was adopted in developing the PHA's pilot project houses that meant alternative low and zero carbon design methods were not fully explored. This paper employs comparative analysis to evaluate the final PHA scheme against other design op- tions in order to assess alternative low energy approaches that might have been considered during the design of the project. Dynamic thermal modelling is used to assess and compare the design options in which the following are considered: building form; use of the thermal mass within the building fabric; design of the ex- ternal envelope; and passive solar design strategies. The discussion considers the implications of the results with regard to approaches to low carbon design, as part of a doctoral research project, by the lead author on to develop innovative, afford- able, low carbon housing in rural areas of Wales, UK.

Basic Energy and Global Warming Potential Calculations at an Early Stage in the Development of Residential Properties

Mr. Nils Brown
Royal Institute of Technology - KTH

In this paper three different structural alternatives (wooden frame, solid wood and concrete) for multifamily buildings are compared in terms of global warming potential (GWP) due to material production and bought energy-in-use from a life-cycle perspective using the ENSLIC tool. The work has been performed in the pre-programming phase of a real construction project, aiming at achieving passive house standard and certification with the Swedish environmental rating tool Miljöbyggnad (MB).
The results suggest that the wooden structural alternatives are better in terms of GWP (1.8 to 1.9 kg CO_2-e/m^2, year) compared to the concrete alternative (4.9 kg CO_2-e/m^2, year). Having said that, there is considerable uncertainty in key input parameters in the calculation. Firstly, construction contractors in question could not supply standardized data for GWP and lifetime for their structural elements, and a combination of generic data and assumptions were used. Secondly, GWP for different energy sources was not available in such a way that it could be analyzed for reliability.

Passive cooling strategies for multi-storey residential buildings in Tehran, Iran and Swansea, UK

Mrs Masoudeh Nooraei, Mr Nick Evans, and Dr John Littlewood
The EBERE Group, Cardiff Metropolitan University

Like the UK, the residential sector in Iran has a significant share of the national energy consumption. Therefore, efforts are needed to reduce energy use and greenhouse gas (GHG) emissions from dwellings. This paper discusses two case studies for residential apartment buildings and explores the cooling strategies which could be adopted to reduce energy usage

and the associated GHG emissions. For case study one (in Tehran) results from dynamic thermal modelling and simulation tests are presented that assess the effectiveness of a number of design cooling strategies. These include appropriate orientation, solar shading and thermal mass with night time ventilation. These strategies are seen as effective methods to control heat gain and to dissipate excess heat from the residential apartment building during the summer. For case study two (in Swansea) pilot results from spot tests undertaken during interviews with apartment occupants are presented. These spot results illustrate that dynamic thermal modelling should have been undertaken by the design team to inform the design decisions for this building, which was completed and occupied in November 2011, since internal conditions exceed recommended comfort conditions for level four (of the code for sustainable homes) dwellings. Furthermore, measures such as solar shading may need to be retrofitted and combined with a change to the ventilation strategy to reduce overheating during the year. The basis for the paper is to compare the results of two residential apartment buildings that both experience similar problems of overheating, even though they are located in two different countries and adopt different methodologies for recording the data. Lessons adopted as part of case study one to reduce overheating are being considered as potential solutions for case study two.

An (un)attainable map of sustainable urban regeneration

Mrs. Linda Toledo, and Dr. John Littlewood
Cardiff Metropolitan University

Reuben et al. (2010) suggests that 'before we can effectively change a system, we must first improve our understanding of the system'. In this spirit, the paper attempts to evaluate the knowledge obtained from interviews with key stakeholders engaged on an urban regeneration project in Swansea, UK known as 'Urban Village'. Urban regeneration is an activity that is largely characterised by complexity, uncertainty and ambiguity. The tacit knowledge acquired from the interviews with the stakeholders of the Urban Village project have been mapped out with IDEFØ language in order to record data and processes that have characterised the project. The intermediate goal of this effort is to recover the connections missed by a first fragmentary subdivision of the collected interviews. In order to achieve this goal, we have re-mapped out the previously collected responses, by so creating a decision-making process tool aimed to orient professionals. In the process we have managed to create a device for the guidance and assessment of the decision making process in urban regeneration. The ultimate goal will be hence reflected in the provision of a tool that provides more scope for auditing the decision process in urban regeneration rather that leaving it up to expert individuals.
This paper fits into the sub-theme 'validation of design and environmental assessment tools and modelling with performance in use - through physical and/or social assessment', at SEB'12 conference.

Track 5
Room: Blåslampan, 2nd floor
Sustainable Energy Systems and Building Services
Chair: Prof Ivo Martinac

The application of LCCA toward industrialized building retrofitting-case studies of Swedish residential building stock

PhD Student Qian Wang, Prof Ivo Martinac
KTH Royal Institute of Technology, Brinellvägen 23, Stockholm, Sweden

This study analyzed how industrialized building retrofitting measures contribute better decision supports for building retrofitting strategy to the energy saving po- tential from a Swedish building typology approach. Contributions to cost- effectiveness retrofitting from one distinguishing but major type of Swedish build- ing stock in Stockholm, Sweden, one of which case was studied from a life cycle perspective as demonstrations for the introduced renovation alternatives. A basic life cycle costing tool coupled with building energy demand calculation was ap- plied. The study focus on the relative costing impact mainly from retrofitting ma- terials and building energy consumptions, as well as corresponding importance of the cost contribution from four life cycle stages .
The tool analyzes the retrofitting material costs and embodied energy consump- tion after undergoing proposed retrofitting work packages as regards as the rele- vant payback time simulation. For the case type of building stock, a retrofitting measure compounds in terms of various energy saving and architectural service refurbishments were introduced, the most costly measures could be the most cost- effectiveness alternatives in different life cycle stages based on the typology of the target building.

A Proposal of Urban District Carbon Budgets for Sustainable Urban Development Projects

Mr. Aumnad Phdungsilp, and Prof. Ivo Martinac
Royal Institute of Technology

Energy security and carbon emissions are key issues for policy-makers and research communities worldwide. Climate change mitigation poses many challenges for all levels of society. Energy-related carbon emissions in urban areas have received a great deal of attention. This paper builds on the principle that urban areas are major sources of emissions and play an important role in the carbon cycle. Urban development can serve as a cornerstone for achieving transition towards a sustainable city. This paper proposes and describes a framework for carbon budgets with a focus on urban district level. The urban district carbon budget is a mechanism for embedding long-term total emission restrictions into the urban economy. This paper proposes a proposal of urban district carbon budgets in an effort to provide the figure for emission allowances that can be emitted in a given amount of time. The paper presents a design framework of urban district carbon budgets and discusses the scope and scale of carbon budget allocation approaches. It also examines the emission reduction potential and co-benefits of the proposal.

A Study of the Design Criteria Affecting Energy Demand in New Building Clusters Using Fuzzy AHP

Mr HAI LU, Prof. Ivo Martinac, and Prof. Aumnad Phdungsilp
KTH-Royal Institute of Technology

The level of concern regarding the total energy consumption in new building clusters/urban districts (BCDs) has increased recently. Rising living standards have led to a significant increase in building energy consumption over the past few decades. Therefore, along with sustainability requirements, it is essential to establish an effective and precise energy demand model for new building clusters/districts. In principle, energy demand in building clusters is hard to plan and pre-calculate because a number of design criteria influence energy performance. Establishing such a model would require a decision-making base, and the present study proposes two methods for achieving this objective. The study uses general survey aims to collect and identify the design criteria that affect the energy demand model and to evaluate the priorities of each criterion using the fuzzy analytical hierarchy process (AHP) method. Four main criteria – location, building design, government and cluster design – are established, along with a total of 13 secondary criteria. The results show that the use of the AHP method can accurately guide the energy demand model and automatically rank significant criteria. The method can provide the weighting value for each criterion as well as the relative ranking for the energy demand building model. According to the sustainability concept, one crucial benefit is an improvement in the energy performance of building clusters/urban districts and a reduction in energy consumption. Another advantage of this methodology is that it can provide accurate energy input for future energy supply system optimisation.

Design Optimization of the Cooling Coil for HVAC Energy Saving and Comfort Enhancement

Mr vahid vakiloroaya, and Mr Jafar Madadnia
University of Technology, Sydney, Australia

In designing an energy-efficient HVAC system, several factors being to play an important role. Among several others, the performance of cooling coil which is embodied through its configuration, directly influence the performance of HVAC systems and should be considered to be crucial. This paper investigates and recommends design improvements of cooling coil geometry contributes for a central cooling system by using a simulation-optimisation approach. An actual central cooling plant of a commercial building in the hot and dry climate condition is used for experimentation and data collection. An algorithm was created in a transient system simulation program to predict the best design. Available experimental results were compared to predicted results to validate the model. Then different models of several new designs for cooling coil were constructed to evaluate the potential of design improvements. Afterwards, the computer model was used to predict how changes in cooling coil geometry would affect the building environment conditions and the energy consumption of the HVAC components.

REQUEST Workshop

10.00-10.30
Registration and Coffee

10.30 - 17.00
Workshop
Room: Kåbergs, ground floor
Chair: Van Holm Marlies
REQUEST coordinator (Energy Savings Trust – UK)

10.30-10.45
Welcoming words by the REQUEST coordinator **(Energy Saving Trust – UK)**

Block 1 – REQUEST aims and key outcomes within the broader policy perspective on energy performance of buildings

10.45-12.40
Presentations of external initiatives by external speakers and introduction to the key outcomes of REQUEST:

ProjectZero, a ZEROcarbon Sonderborg before the end of 2029
Peter Rathje (ProjectZero)
Engaging builders in the UK low carbon agenda
Hayley Fry (Federation of Master Builders)
REQUEST survey and database of existing best practices at EU level and worldwide
Italian National Agency For New Technologies, Energy And Sustainable Economic Development (ENEA)
REQUEST tools and techniques to increase EPC recommendations uptake
Portugese Energy Agency (ADENE)
REQUEST quality standard for energy renovation of dwellings
German Energy Agency (dena)

12.40-13.30
Lunch break

Block 2 - Tools and Techniques to increase the uptake of EPC recommendations

13.30-14.30
Presentations of external initiatives by external speakers and introduction to the REQUEST pilot projects with main focus on improving EPCs:

The ICMQ Label Sistema Edificio in Italy
Alberto Lodi (ICMQ)

Tailor made energy advice providing recommendations and cost benefit analyses for energy renovation measures
Flemish Institute for Technological Research (VITO)

Development and testing of a building typology as a basis for high quality EPC refurbishment recommendations, with special focus on Viennese residential buildings
Austrian Energy Agency (AEA)

Increasing the uptake of energy consultations in Slovakia by means of the Energy "Minder", an advisory training web tool for quality assured renovation processes to be used in SIEA's regional consultation centers
Slovak Innovation and Energy Agency (SIEA)

14.30-15.00
Coffee break

Block 3 - Providing quality standards and guidance for low carbon renovation

15.00-16.45
Presentations of external initiatives by external speakers and introduction to the REQUEST pilot projects focussing on quality standards and renovation activities:

IEE SQUARE - A Quality Assurance System for Improvement of Indoor Environment and Energy Use when Retrofitting Residential Housing
Kristina Mjörnell (SP)

Support and monitoring towards a quality integrated renovation approach for social housing in Italy
Marco Corradi (CECODHAS, ACER)

Energy renovation of large scale apartment buildings in the wider Athens area with involvement of unemployed inhabitants of the building blocks, recruited and trained as installers and maintainers for their building
Centre for Renewable Energy Sources and Saving (CRES)

Increasing awareness with home owners, raising energy efficiency and quality standards for the energy renovation of large scale residential buildings in Bulgaria
Energy Efficiency Agency (EEA)

Setting up collaborative initiatives to engage tenants and property owners in the energy retrofit of large scale residential buildings with communal ownership in Warsaw
Polish National Energy Conservation Agency (KAPE)

Impact of knowledge centre activities on the uptake of energy efficient renovation - illustrated by ProjectZero uptake in the municipality of Sonderborg
Danish Building Research Institute, part of Aalborg University (AAU/SBi)
Development and testing of room by room energy efficient retrofit guidance and training material for tradesmen and homeowners in the UK
Energy Saving Trust (EST)

16.45
Closing

Organising Institution

ROYAL INSTITUTE
OF TECHNOLOGY

KTH Royal Institute of technology

KTH Royal Institute of technology in Stockholm is the largest, oldest and most international technical university in Sweden. No less than one-third of Sweden's technical research and engineering education capacity at university level is provided by KTH. Education and research spans from natural sciences to all the branches of engineering and includes architecture, industrial management and urban planning. The educational programmes lead to Bachelor, Master or PhD degrees in engineering, science, or architecture. There are a total of just over 17,000 full-year equivalent undergraduate students, more than 1,600 active postgraduate students and almost 4,300 employees at KTH.

The international dimension is evident. KTH cooperates with top technical universities worldwide in terms of research projects, student exchanges, etc. The student population includes 3500 international students and more than 100 different nationalities! KTH has a tradition of offering an extensive introduction programme for international students; including, for example, information meetings, social activities, introduction to Stockholm, and Swedish language courses. And, most importantly, a number of independent surveys show that a degree from KTH is a great starting point for a successful career.

Other information

REQUEST WORKSHOP

1 European REQUEST closing event on September 5, 2012 in Stockholm

Work package leader: VITO, Belgium

The European closing event marking the end of the REQUEST program on **Renovation through quality supply chains and energy performance certification standards (2010-2012)** will be held on September 5, 2012 in the Swedish capital Stockholm. This closing event forms a part of the Fourth International Conference on Sustainability in Energy and Buildings SEB'12 taking place from 3 September – 5 September 2012 at the KTH Royal Institute of Technology in partnership with KES International. In addition to presentations by academic researchers on the basis of abstract submission, SEB'12 will include expert keynote talks, and a series of invited sessions and workshops, amongst which the REQUEST closing event. More information can be found on the SEB'12 website.

The REQUEST program, supported by Intelligent Energy Europe, focuses around increasing the uptake of low carbon renovation measures in residential properties across Europe, by encouraging **action on Energy Performance Certificate (EPC) recommendations** and by providing a **quality standard for low carbon renovation**. Key outcomes of REQUEST:

• **Existing best practices** that encourage the uptake of EPC recommendations and improve quality standards were identified and summarised in an inventory of tools, techniques and schemes – for more information and to access the inventory click here;
• Based on the inventory, we have developed the **Efficiency Assistant**, giving an overview of **tools and strategies** that can be used to stimulate and encourage action on EPC recommendations – for more information on the efficiency assistant click here;
• A new replicable **mechanism for quality assurance** in the delivery of low carbon renovation is set in place. This will identify applicable standards for a quality assured renovation process; definition of quality standards for the renovation process and information about how to access and work with key actors – more information will be available shortly;
• **Piloting** of the tools, techniques and quality assurance schemes started in 2011 and will continue throughout 2012. The various pilot projects rely on the engagement of key actors in the partner countries, both on the supply and the demand side. For more information on the pilot projects click here.

The one-day REQUEST closing event is aimed at an audience of policy makers and energy agencies at city, regional or EU member states level, as well as academic researchers, energy advisors, trades federations, housing and home owners associations.

2 General information on REQUEST

Project duration: April 2010 - November 2012

Project website: www.building-request.eu

Partners involved
EST - Energy Saving Trust (UK) – Programme coordinator
AEA - Austrian Energy Agency (AT)
VITO - Flemish Institute for Technological Research (BE)

EEA - Energy Efficiency Agency (BG)
AAU/SBi - Danish Building Research Institute, part of Aalborg University (DK)
DENA - German Energy Agency (DE)
CRES - Centre for Renewable Energy Sources and Saving (EL)
ENEA - Italian National Agency For New Technologies, Energy And Sustainable Economic Development (IT)
KAPE - Polish National Energy Conservation Agency (PL)
ADENE - Portugese Energy Agency (PT)
SIEA - Slovak Innovation and Energy Agency (SL)

Offer to the SEB'12 Delegates / Authors and Co-authors

Emerald Group Publishing and the Smart and Sustainable Built Environment (SASBE) journal are pleased to support the 2012 International Conference on Sustainability in Energy and Buildings.

Emerald offers an exclusive 30 day complimentary access for the SEB'12 delegates, authors and co-authors to the content of five journals: Smart and Sustainable Built Environment; Construction Innovation; Engineering, Construction and Architectural Management; Structural Survey; and the International Journal of Energy Sector Management.

To access the papers, please go to: http://www.emeraldinsight.com and enter the following login id:

Username: SEB2012
Password: Emerald

The access is valid from 03 September to 03 October 2012.

Emerald would like to take this opportunity to inform you that Prof. Jay Yang, Editor-in-Chief of SASBE, is inviting SEB'12 delegates, authors and co-authors to submit their work relevant to SASBE, as well as, recruiting new reviewers. For author guidelines, please check the journal web site at http://www.emeraldinsight.com/sasbe.htm. If you are interested in reviewing for SASBE, please contact Prof Yang at j.yang@qut.edu.au with your CV and areas of expertise.

Schedule - Short version

Monday 3rd of September 2012

14.00-15.00
Keynote speaker
Professor Göran Finnveden, KTH Royal Institute of Technology, Sweden
Room: Atlas Diesel Floor 1, Quality Hotel Nacka
Chair: Prof Mattias Höjer

15.00-15.30
Coffee break

15.30-17.30
Panel: Sustainability: Current and Future with focus on Energy, Buildings and ICT
Room: Atlas Diesel Floor 1, Quality Hotel Nacka
Chair: Prof Mattias Höjer

18.30
Bus to City Hall, Stockholm

19.00 – 22.00
Welcome Reception, City Hall, Stockholm

Welcome Reception is hosted by City Hall, City of Stockholm, Sweden.

Tuesday 4th of September 2012

09.30-10.30
Keynote speaker
Professor Guðni A. Jóhannesson, Icelandic National Energy Authority, Iceland
Room: Atlas Diesel, Floor 1
Chair: Assoc Prof Anne Håkansson

10.30-11.00
Posters
Room: Atlas Diesel, Floor 1
Chair: PhD Esmiralda Moradian and PhD Student Dan Wu

11.00-12.40
Session 1

Track 1
Room: Atlas Diesel, 1st floor
General track
Chair: Prof Mattias Höjer

Track 2
Room: Propellern, 2nd floor
General track
Chair: PhD Student Nils Brown

Track 3
Room: Blåslampan, 2nd floor
Sustainable and healthy buildings
Chair: Prof Jeong Tai Kim

Track 4
Room: Kåbergs, ground floor
Improving Office Building Energy Performance
Chair: Dr Emeka Osaji

Track 5
Room: Ångturbinen, 2nd floor
Sustainable and healthy buildings
Chair: Prof. Geun Young Yun

13.30-14.30
Keynote speaker
Professor Per Heiselberg, Aalborg University, Denmark
Room: Atlas Diesel, Floor 1
Chair: Prof Ronald L Hartung

14.30-15.00
Posters
Room: Atlas Diesel, Floor 1
Chair: PhD Esmiralda Moradian and PhD Student Dan Wu

15.00-17.00
Session 2

Track 1
Room: Atlas Diesel, 1st floor
General track
Chair: Prof Ronald L Hartung

Track 2
Room: Ångturbinen, 2nd floor
General track
Chair: Prof Örjan Svane

Track 3
Room: Kåbergs, ground floor
Improving Office Building Energy Performance
Chair: Dr Emeka Osaji

Multi- Energy Sources
Chair: Prof Aziz Naamane

Track 4
Room: Propellern, 2nd floor
Assessment and Monitoring The Environmental Performance of Buildings
Chair: Dr John Littlewood

Track 5
Room: Blåslampan, 2nd floor
Methodology for Renewable Energy Assessment
Chair: Dr Rainer Zah

Energy Planning in Buildings and Policy Implications
Chair: Dr Eva Maleviti

Wednesday 5th of September 2012

09.00-10.00
Keynote speaker
Professor Lynne A. Slivovsky California Polytechnic State University, USA
Room: Atlas Diesel Floor 1 (250 people)
Chair: Prof Mark Smith

10.30-12.40
Session 3

Track 1
Room: Atlas Diesel, 1st floor
General track
Chair: Prof Mattias Höjer

Track 2
Room: Dynamiten, ground floor
General track
Chair: PhD Student Nils Brown

Track 3
Room: Blåslampan, 2nd floor
Technologies and Applications of Solar Energy
Chair: Prof Mahieddine Emziane

Track 4
Room: Propellern, 2nd floor
Assessment and Monitoring The Environmental Performance of Buildings
Chair: Dr John Littlewood

Track 5
Room: Ångturbinen, 2nd floor
Smart Buildings, Smart Grids
Chair: Dr Catalina Spataru

13.30-14.30
Session 4

Track 1
Room: Atlas Diesel, 1st floor
General track
Chair: Prof Ronald Hartung

Track 2
Room: Propellern, 2nd floor
General track
Chair: Prof Mark Smith

Track 3
Room: Blåslampan, 2nd floor
Technologies and Applications of Solar Energy
Chair: Prof Mahieddine Emziane

Track 4
Room: Dynamiten, ground floor
Special session
Chair: Prof Robert Howlett

Track 5
Room: Ångturbinen, 2nd floor
Smart Buildings, Smart Grids
Chair: Dr Catalina Spataru

15.00-17.00
Session 5

Track 1
Room: Atlas Diesel, 1st floor
General Track
Chair: Prof Ronald Hartung

Track 2
Room: Dynamiten, ground floor
General Track
Chair: Prof Mark Smith

Track 3
Room: Ångturbinen, 2nd floor
From industrial pollutions to clean energy
Chair: Prof Abdeslam-Hassen Meniai

Track 4
Room: Propellern, 2nd floor
Assessment and Monitoring The Environmental Performance of Buildings
Chair: Dr John Littlewood

Track 5
Room: Blåslampan, 2nd floor
Sustainable Energy Systems and Building Services
Chair: Prof Ivo Martinac

It is our ambition that all delegates have a pleasant stay and joyful conference.

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