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Chair's Welcome Message

We are very pleased to extend to all delegates and speakers a warm welcome to the Second International Conference on Sustainability in Energy and Buildings, SEB'10, held in the City of Brighton and Hove in the United Kingdom, organised by KES International.

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.

For over a decade KES has been a leader in the area of Knowledge Based and Intelligent information and Engineering Systems. In 2009 KES started to make a contribution 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.

This, the second conference in the SEB series, attracted about 100 submissions which were subjected to a two-stage review process. With the objective of producing a high quality conference, fewer than 30 of these were selected for presentation at the conference and publication in the proceedings. The papers for presentation were grouped into five themes: Building Sustainability, Sustainable Power Generation, Sustainable Energy Policy and Strategy, Energy Monitoring and Management and Solar Energy Technology. The papers will be included in the proceedings, to be published after the conference by Springer-Verlag in the new 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'10 a success. We would like to thank the Deputy Mayor of Brighton and Hove, Councillor Garry Peltzer Dunn for opening the conference. We would like to thank the members of the International Programme Committee who were essential in providing their reviews of the conference papers, ensuring appropriate quality. We thank the high-profile keynote speakers for providing interesting talks to inform delegates and provoke discussion. Important contributors to SEB'10 were made by the authors, presenters and delegates without whom the conference could not have taken place, so we offer them our thanks. The KES Secretariat staff worked hard to bring the conference to a high level of organisation, and we thank them. Finally we thank the staff of the Holiday Inn, and the people of Brighton and Hove for welcoming the conference.

We hope that delegates will find SEB'10 an interesting, informative and enjoyable experience. We are pleased to welcome you to the KES community and hope to see you at a future KES event.

Professor Bob Howlett

SEB'10 General Chair
KES International Executive Chair

Organisation

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

Chair (Knowledge Based and Intelligent Systems)
Professor Lakhmi C. Jain
University of South Australia

Chair (Renewable Energy)
Professor Ali Sayigh
Chairman of World Renewable Energy Congress
Director General of WREN

Chair (Electricity Generation and Distribution)
Professor Roger Morgan
Liverpool John Moores University, United Kingdom

Chair (Intelligent Buildings)
Professor In-Young Ko
Korea Advanced Institute of Science and Technology
South Korea

Chair (Built Environment)
Professor Andrew Miller
Centre for Sustainability in the Built Environment
University of Brighton, United Kingdom

Chair (China Liaison)
Professor Hong Jin
Director of Green Building Research Institute
Director of Architectural Technology Department
Harbin Institute of Technology, China

Local Arrangements Chair
Mr Shaun Lee
Centre for Smart Systems
University of Brighton, United Kingdom

KES International

The organisation and operation of SEB'10 is the responsibility of the KES International organisation

Executive Chair: Prof Robert J. Howlett, KES International & Bournemouth University
Founder: Professor Lakhmi Jain, University of South Australia
Operations Manager: Mr Peter Cushion
On-site Registration Assistant: Ms Anna Howlett

International Programme Committee

Name	Affiliation
Prof. Vivek Agarwal	Indian Institute of Technology Bombay, India
Prof. Abdel Aitouche	Haute Etudes Ingenieurs Grande Ecole, Lille, France
Prof. Naamane Aziz	Laboratoire des Sciences de l*Information et des Systems, Marseilles, France
Prof. Frede Blaabjerg	Aalborg University Inst. Of Energy Technology, Denmark
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Prof. in-Young Ko	Korea Advanced Institute of Science and Technology, Korea
Dr Sumathy Krishnan	North Dakota State University, USA
Prof. Søren Linderoth	Technical University of Denmark
Prof. Andrew Miller	University of Brighton, UK
Prof. Roger Morgan	Liverpool John Moores University, UK
Prof. Saffa Riffat	University of Nottingham, UK
Dr Cesar Sanin	University of Newcastle, Australia
Prof. Ali Sayigh	World Renewable Energy Congress / Network
Dr Marina Sokolova	University of Castilla-La Mancha Albacete, Spain
Prof. Ed Szczerbicki	University of Newcastle, Australia
Prof. Alan Turner	University of Sussex, UK
Dr Humberto Varum	University of Aveiro, Portugal
Prof. Mummadi Veerachary	Indian Institute of Technology, Delhi, India
Dr Simon Walters	University of Brighton, UK

Keynote Lectures

Professor Andrew Miller
Centre for Sustainability of the Built Environment
University of Brighton, UK

Building Energy Efficiency: - towards energy sustainability

Abstract: Throughout the developed world the energy required for constructing, operating and maintaining our buildings represents a major proportion of the prime energy consumed and of greenhouse gases emitted to the atmosphere. Reduction in demand is therefore key to ensuring sustainability of energy supply, making existing buildings more efficient and constructing new buildings with optimum energy demands. It is also necessary to take a whole life cycle approach to the evaluation of energy consumption considering the embodied energy of the building materials and the demolition and recycling of the materials at the end of the useful life of the building.
This paper will take a whole life cycle approach to the analysis of energy efficiency in buildings. It will consider the principles of design for energy efficient buildings and focus on the issues associated with improving efficiency in existing buildings and their adaptability for utilizing renewable energy.

Biography: Prof Andrew Miller is a member of the School of Environment and Technology at the University of Brighton and the Head of the Centre for Sustainability in the Built Environment.

Professor Roger Morgan
School of Engineering
Liverpool John Moores University, UK

Displacement of conventional domestic energy demands by 'green' electricity

Abstract: With an increasing proportion of electricity coming from renewable and from other low-carbon-dioxide sources, probably including nuclear in the future, it becomes attractive to look for a displacement of existing energy-consuming activities, both in the home and for activities associated with the home, away from fossil fuel burning appliances and towards electricity. However, this can be justified only if the increased electrical load is genuinely met from low-CO_2 sources. In practice, this probably means using as large a proportion as possible of the 'new' loads at night, using base-load generation. This would make the best possible use of generation capacity, especially if the proportion of nuclear and renewable generation is increased. It would also improve the utilisation of the transmission and distribution infrastructure, which, like the generation capacity, is not fully utilised at night.

A good example is private electric vehicles, which displace the use of petrol and diesel, which are still mostly fossil-fuel based despite the availability of bio-diesel and other bio-fuels. Private cars and bikes are typically kept at home in the evening, and need to be charged at home overnight. This has implications for the suburban electricity distribution network. Currently, most residential areas in the UK are cabled on the assumption of a 2kW (or even a 1kW) average demand. Any major increase in residential load, even at night, might involve reinforcement of the suburban distribution network, including both the substations and the underground cables.

Another good example is domestic space and water heating, which in much of the UK is dominated by natural gas. Replacing some or most of this demand by electricity would displace natural gas, which is not only fossil fuel based but also increasingly an import. This may mean a new lease of life for electric thermal storage heating. With the widespread use of hydronic (wet) heating systems in this country, any new thermal storage proposals need to be compatible with conventional pipes and radiators. This can be achieved not only with water storage, but also with a number of other thermal storage substances. But again, any increase in domestic load, even at night, might necessitate reinforcement of the suburban distribution network.

Are we prepared for the cost and disruption this would cause? Or can we use demand-side management to regulate the demand of new loads so as to make more effective use of the existing capacity?

This paper will use experimental evidence based on case studies, together with estimates based on existing information, to calculate the magnitude of extra electricity demand which might result from changing to electricity and away from the

direct use of fossil fuel for domestic demands. An attempt will be made to include reductions in demand resulting from improved efficiencies and conservation measures. The resulting figures will be used to estimate how much demand could be met without increasing generation capacity or reinforcing the transmission and distribution infrastructure, and what level of reinforcement might be needed if the whole of the demand is to be met by electricity.

Biography: Roger Morgan is an Emeritus Professor at Liverpool John Moores University, an honorary post which he has held since retiring from the Professorship of Electrical and Electronic Engineering in 2008. He has also held academic posts at the University of Brighton and the University of Ulster. His first job was with the Central Electricity Generating Board, where he was a research officer in nuclear power generation. After graduating from Cambridge University in 1964, his research career began with a PhD in materials science, but since the early 1970s has concentrated on energy efficiency and the effective use of natural energy sources. He is the author or co-author of over 150 papers and reports, and eight books. Since retiring, he has become a student again; he is enrolled in the External Degree through the medium of Welsh at Aberystwyth University. His other leisure interests include sea-going sailing, climbing mountains, and playing the mandolin in a folk-dancing band.

Conference Schedule

	Wednesday 5 May 2010
8.00 - 8.30	
8.30 - 9.15	
9.00 - 9.30	
9.30 - 10.00	
10.00 - 10.30	
10.30 - 11.00	
11.00 - 11.30	
11.30 - 12.00	
12.00 - 12.30	
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14.00 - 14.30	
14.30 -15.00	
15.00 - 15.30	
15.30 - 16.00	
16.00 - 16.30	
16.30 - 17.00	
	7.30 pm **Welcome Drinks Reception** **Holiday Inn Hotel** **(All Delegates Welcome)**

	Thursday 6 May 2010
8.00 - 8.30	**Registration**
8.30 - 9.15	
9.00 - 9.30	**Conference Opening & Welcome** Deputy Mayor of Brighton & Hove, Councillor Garry Peltzer Dunn
9.30 - 10.00	**Plenary Keynote Talk** **(9.30 - 10.30)** ***Prof Andrew Miller*** *Building Energy Efficiency - Towards Energy Sustainability*
10.00 - 10.30	
10.30 - 11.00	**Coffee**
11.00 - 11.30	**Oral Paper Presentation Session** **(11.00 - 13.00)** ***Session A : Building Sustainability***
11.30 - 12.00	
12.00 - 12.30	
12.30 - 13.00	
13.00 - 13.30	**Lunch**
13.30 - 14.00	
14.00 - 14.30	**Oral Paper Presentation Session** **(14.00 - 15.00)**
14.30 -15.00	***Session B: Sustainable Power Generation - 1***
15.00 - 15.30	**Coffee**
15.30 - 16.00	**Oral Paper Presentation Session** **(15.30 - 16.30)**
16.00 - 16.30	***Session C: Sustainable Power Generation - 2***
16.30 - 17.00	
	7.30 pm Conference Dinner **Al Freso Restaurant, Brighton Sea Front** **(Tickets Required)**

	Friday 7 May 2009
8.00 - 8.30	
8.30 - 9.15 9.00 - 9.30	**Registration**
9.30 - 10.00 10.00 - 10.30	**Plenary Keynote Talk** **(9.30 - 10.00)** ***Prof Roger Morgan*** *Displacement of conventional domestic energy demands by 'green' electricity*
10.30 - 11.00	**Coffee**
11.00 - 11.30 11.30 - 12.00 12.00 - 12.30 12.30 - 13.00	**Oral Paper Presentation Session** **(11.00 - 13.00)** ***Session D: Sustainable Energy Policy and Strategy***
13.00 - 13.30 13.30 - 14.00	**Lunch**
14.00 - 14.30 14.30 -15.00	**Oral Paper Presentation Session** **(14.00 - 15.00)** ***Session E: Energy Monitoring and Management***
15.00 - 15.30	**Coffee**
15.30 - 16.00 16.00 - 16.30	**Oral Paper Presentation Session** **(15.30 - 16.30)** ***Session F: Solar Energy Technology***
16.30 - 17.00	**Closing Ceremony**

SUSTAINABILITY IN ENERGY AND BUILDINGS 2010
Conference Timetable

Paper Presentations

Session A: Building Sustainability
Thursday 6 May: 11.00-13.00

Achieving Energy Efficiency in Office Building
Dr. Rusdy Hartungi, Dr. Liben Jiang

Energy Analysis of Ventilated Roof
Professor Francesco Patani, Dr Alfio Ferlito, Professor Antonio Gagliano, Dr Aldo Galesi, Dr Francesco Nocera

An Analytic Hierarchy Process Model for Assessing Occupants' Adaptations to Thermal Comfort in Offices
Mr Jing Liu, Dr Rachel McCloy, Dr Runming Yao

Advantages of Using Raw Materials in Ancient and Recent Buildings
Eng. António Murta, Eng. Jorge Pinto, Eng. Humberto Varum

Energy Saving Technologies for Conventional Dwellings: A 'Whole House' Concept
Mr Pat Addy, Mr Pat Addy

Modifying Courtyard Wall Geometries to Maximise Daylight Performance of Courtyard
Dr. Ahmad Freewan

Session B: Sustainable Power Generation - 1
Thursday 6 May: 14.00-15.00

IFOC: A CONTROL STRATEGY FOR ELECTRIC WIND POWER CONVERSION
Professor Aziz Naamane, Professor Nacer Msirdi

Model Predictive Control of a Wind Energy Storage System for Frequency Regulation
Mr Muhammad Khalid, Prof. Andrey Savkin

Development of a Simulation Tool to Predict Urban Wind Potential
Ms Christina Beller

Session C: Sustainable Power Generation - 2
Thursday 6 May: 15.30-16.30

Direction Dependent Power Curves for Wind Power Prediction: A Case Study
Mr Muhammad Khalid, Prof. Andrey Savkin

Tools and Techniques for Intelligent Characterization of Fuels
Dr Simon Walters, Dr Cyril Crua

Use of super-capacitor to enhance charging performance of stand-alone solar PV system
Professor B J Huang, MS student P Y Ho, PhD student P C Hsu

Comparitive Study of Biogas Slurry with Farmyard Manure as Fertilizer on Maize Crop
Mr. Mehmood Riaz, Mr. Muhammad Azeem Khan, Dr. Faizan-ul-Haq Khan, Dr. Abdul Nasir

Session D: Sustainable Energy Policy and Strategy
Friday 7 May: 11.00-13.00

Renewable Energies in the EU Energy Policy. Model of Territorial Distribution of the Efforts in Order to Fulfil the Strategic Goal for 2020.
Ph.D. Alfredo Tolón-Becerra, Ph.D. Fernando Bienvenido-Bárcena, Ph.D. student Xavier Lastra-Bravo

Future-proofed Design for Sustainable Urban Communities
Miss Maria-Christina Georgiadou, Dr Theophilus Hacking

Enabling Low Carbon Living in New Housing Developments: A Triple Bottom Line Analysis
Ms Steffie Broer, Dr Helena Titheridge

Aspects of Life Cycle Investing for Sustainable Refurbishments in Australia
Associate Professor Eckhart Hertzsch, Senior Lecturer Chris Heywood, Associate,

Advent of Climate Change and the Resultant Energy Related Obsolescence in the Built Environment
Dr. Talib Butt, Ms Justine Cooper, Prof. Bob Giddings, Prof. Keith Jones, Mr. Bonny Umeadi (PhD)

How Hotelier's Attitudes Shape the Energy Profile of their Facilities; Exploring the Energy Consumption in Hotels using Energy Scenarios.
Miss Eva Maleviti

Session E: Energy Monitoring and Management
Friday 7 May 14.00-15.00

The EcoSense Project: An Intelligent Energy Management System with a Wireless Sensor and Actor Network
Dr. Teresa Olivares, PhD student Tomas Clemente, PhDstudent Pedro Diaz, PhD Student Raul Galindo

The Use of Intelligent Systems for Monitoring Energy Use and Occupancy in Existing Homes
Dr Catalina Spataru, Dr Mark Gillott

Assessing the Energy Performance of Office Buildings
Mrs Christina Konstantinidou, Lecturer Argiro DIMOUDI, Assoc. Professor Panos Kosmopoulos

Session F: Solar Energy Technology
Friday 7 May 15.30-16.30

Optimisation of Integrated Low-Carbon Energy Strategies: A Case Study for 'Zero Carbon' Social Housing in the UK
Dr Li Mei, Dr Paul Rowley

Characterisation of a Line-Axis Solar Thermal Collector for Building Façade Integration
Mr Miguel Ramirez Stefanou, Dr Trevor Hyde, Dr Tapas Mallick, Dr Jayanta Mondol, Dr Mervyn Smyth, Dr Aggelos Zacharopoulos

Transformerless 3-phase PV Inverter Simulation for Efficient Building Installations
MSc Prodromos Fetfatzis, Professor Konstadinos Alafodimos, Mr Miltiadis Kallousis, MSc Kofinas Kofinas

Architectural Daylighting Analysis of Photovoltaic Panels of BIPV with Zero Energy Emission Approach
Dr. Shahram Nassehzadeh Tabriz, Arch. Ahadollah A'zami

Paper Titles and Abstracts

Session A: Building Sustainability

Achieving Energy Efficiency in Office Building

Rusdy Hartungi, Liben Jiang

School of Built and Natural Environment
University of Central Lancashire (UCLan)
Preston PR1 2HE, Tel.: +44-(0)1772 893210; Fax: +44-(0)1772 892916
Correspondence Email: RHartungi@uclan.ac.uk

This paper is to present a case of a newly built office building in the UK and to show how the energy efficiency technology in building might contribute to the energy conservation and therefore in full compliance with Part L building regulation. A large array of solutions are used which include the use of ventilation system with good high heat recovery system, limiting the heat loss and gain through the fabric by enhancing levels of insulation of building fabric to achieve lower u-values, limiting the heat loss and gain through the fabric of the building by improving air tightness to minimise any uncontrolled air leakage, provision of space heating and hot water systems which are energy efficient, improve daylight levels and reduce artificial lighting energy, provision of lighting control systems with appropriate lamps so that energy can be used efficiently improve control and monitoring of mechanical heating and ventilation systems. The office building in case study has shown the compliance with the building regulation and thus conserves the energy. Energy conservation and the compliance with building regulation are achieved through early incorporation into the building design.

Energy Analysis of Ventilated Roof

F. Patania[1], A. Gagliano[1], F. Nocera[1], A. Ferlito[1], A. Galesi[1]

[1] *Department of Industrial and Mechanics Engineering, Faculty of Engineering, University of Catania, Viale A. Doria n.6 95125 - Catania, Italy*

The thermal performance of the building envelope is an important requirement for guaranteeing both a comfortable indoor climate and building's energy efficiency.
Ventilated facades and ventilated roofs could be considered as a passive cooling system that contribute to realize low energy building.

The energy advantages provided by the ventilation of structures, during the summer, is the reduction of the cooling load due to the combined effect of the shading of the external wall and the heat removed by the air flow rate in the ventilated duct.
The objective of this study is to evaluate, the effects of the pitch angle, the intensity of solar radiation, size and shape of the cavity, on the thermal behaviour of ventilated roof. The results show the amount of the Energy Saving obtainable by the ventilation of the roof.

An Analytic Hierarchy Process Model for Assessing Occupants' Adaptations to Thermal Comfort in Offices

Jing Liu[1,*], Runming Yao[1], Rachel McCloy[2]

School of Construction Management and Engineering, the University of Reading, UK
School of Psychology and Clinical Language Sciences, the University of Reading, UK
[*]J.liu@reading.ac.uk

The adaptations people utilize in response to ambient physical environmental variations are critical factors for the thermal comfort of occupants in real environments. From the adaptive point of view, thermal comfort is not solely dependent on physical thermal stimuli, but involves complex interactions between the occupants' adaptations to the physical environmental stimuli and socio-economic-cultural issues. Under certain circumstances, the adaptation of occupants to their environment may be affected by physiological, behavioural and psychological factors. The interaction of the three adaptations further affects the extent of the thermal comfort the occupants finally feel. This paper introduces a method for the evaluation of the weight of contributions of three categories of adaptations to attain thermal comfort in office environments using the Analytic Hierarchy Process (AHP). The AHP is an ideal tool for decision-making where multiple factors are involved. Through solving a pairwise comparison matrix, the weight of each adaptation category can be produced. This paper aims to develop an empirical occupants' adaptation-based thermal comfort model for office environments. The feasibility and validity of such the model has been verified by a pilot study.

Advantages of Using Raw Materials in Ancient and Recent Buildings

A. Murta[1], H. Varum[2], J. Pinto[3]

[1]*University of Trás-os-Montes e Alto Douro, Vila Real, Portugal*
[2]*University of Aveiro, Aveiro, Portugal*
[3]*University of Trás-os-Montes e Alto Douro, Vila Real, Portugal*

Many of the existing buildings constructed mostly with natural raw materials, in European sites, are frequently lacking proper maintenance and, there- fore, a high degree of degradation is verified in these buildings compromising their integrity and reducing their lifetime probability. Often in the rehabilitation or reconstruction of old buildings the solution adopted is the partial or integral demolition and substitution of several building components. The aims of this study are to describe the most common constructive solutions in Portuguese buildings constructed with raw natural materials, to specify the principal problems that affect each building component, and to present possible solutions to correct each defect. This study is focused on the principal elements that compose the building structures in Portugal, including load-bearing walls, wooden floor and roof structures. The architecture solution, the structure solution, the building material's identification/characterization, the sequence of structural failures and the main pathologies identification/characterization related to an early XX century Portuguese watermill were described and detailed. It may be considered as a real scale experimental model which may contribute to the rehabilitation and conservation fields of traditional Portuguese buildings. The structural failure sequence was analyzed, the corrective solutions presented and studied privileges the adoption of materials and techniques similar and most compatible with the original ones. It's also presented the structural solution savings of energy consumption and CO2 emission. The results of this study were found to be easily extrapolated to the repairing of the Portuguese traditional buildings which are in general environmental friendly.

Energy Saving Technologies for Conventional Dwellings: A 'Whole House' Concept

Pat Addy and Dave Webb

Leeds Metropolitan University, Leeds, U.K.

A significant effect that the majority of the population of the U.K. can have on energy saving is based within their own dwelling place. The aim of this paper is to examine the hypothesis that substantial energy savings can be made in a conventionally built house by using appropriate energy production and by the application of relevant and

practical electronic monitoring and control systems. Energy saving in the home is often looked at in isolation and focussed on a small area within the house. However, there is a need to look at home energy usage as a whole. This paper examines some of the existing and developing energy saving technologies and analyses the true potential and viability of each of the systems that are available and could be developed. The energy saving that can be achieved by using various 'alternative' or 'appropriate' technologies is analysed and studies of the application of electronic and electromechanical control to the systems are made and discussed. The concept of a 'whole house' is rarely applied to individual dwellings because each is generally regarded as a loosely connected collection of stand- alone systems that are provided by different manufacturers with hardly any account being given to interconnectability within the overall concept of a house as a single entity. Most houses have very basic systems for the control of major energy sources including heating and lighting. Electronic control systems requiring only basic skills to install and service can give occupants an ongoing overview of their energy use and facilitate minor changes in habit / lifestyle to allow further savings. The effects and lifetime of these control systems will be improved if they include the ability to be reprogrammed to take into account future improvement projects such as upgrades in insulation or the fitting of double glazing or a change in energy supply. Lifestyle and occupation patterns will have a major effect on energy saving within domestic premises. Any proposed system must be adaptable to suit different living patterns. Interfaces between various components therefore need to be as simple as possible to allow 'mixing' of different technologies and possible future developments. The technologies applicable to saving energy in domestic premises are identified as falling into the following categories:

- Practical, cost effective and usable – such as solar panels, rainwater harvesting and biomass
- Practical but not cost effective with existing levels of development – such as photovoltaic panels and heat pumps
- Practical and cost effective but with no directly measurable ongoing energy saving – such as lighting systems
- Practical systems that require further development for future domestic applications – such as local hydrogen production and solar powered or flue heat extraction Stirling engines.

It is concluded that a whole house control system that is practical, cost effective, future proof and easy to use is viable but that it could not utilise a single processor design. Instead, a hierarchical system is proposed that presents the possibility of a simple, future proof whole house control system that will accept inputs that are not specified at the time of installation.

Modifying Courtyard Wall Geometries to Maximise Daylight Performance of Courtyard

Ahmed A. Freewan, PhD

Assistant Professor, Jordan University of Science and Technology, 22110 Irbid, Jordan

Courtyard in a building regulates its daylight, air movement and thermal interaction with outdoor environment. The daylight performance of a courtyard depends principally on how the daylight received and delivered into interior spaces. The current research investigates how courtyards vertical surface geometries could improve the daylight in adjacent spaces of the courtyard. The research used Radiance to investigate the impact that vertical walls, inward sloped walls, outward sloped, staggered walls and double layer walls could have on both daylight quantity and quality. Courtyards with Inward sloped, inward staggered and double layer walls were found to improve the daylight quality and control the excessive light level, while outward sloped and outward staggered walls increase daylight level.

Session B: Sustainable Power Generation - 1

IFOC: A CONTROL STRATEGY FOR ELECTRIC WIND POWER CONVERSION

Aziz NAAMANE and Nacer K. M'SIRDI

LSIS, CNRS UMR 6168, Domaine Universitaire de Saint Jerome, Av. Escadrille Normandie-Niemen. 13397, Marseille Cedex 20, France

Different electric wind power conversion systems structures can be used based on the structures of converters used. The main objective in all topologies is always the same: the wind energy at varying wind velocities has to be converted to electric power with the highest performances. In this paper a wind energy conversion schemes is presented based on the Indirect Flux Oriented Control (IFOC).

Model Predictive Control of a Wind Energy Storage System for Frequency Regulation

Muhammad Khalid[1] and Andrey V. Savkin[2]

[1]*School of Electrical Engineering and Telecommunications, The University of New South Wales, UNSW, Sydney, NSW 2052, Australia, e-mail: m.khalid@student.unsw.edu.au*
[2]*School of Electrical Engineering and Telecommunications, The University of New South Wales, UNSW, Sydney, NSW 2052, Australia, e-mail: a.savkin@unsw.edu.au*

This paper presents a method to regulate the power frequency at a nominal value using a battery energy storage system (BESS). A control system model is proposed to simulate the BESS for frequency control application. A controller based on model predictive control (MPC) is designed for the optimal operation of the BESS for primary frequency regulation. A frequency prediction model based on Grey theory is also designed to optimize the performance of our controller. The method is tested using real measurements from a real power grid in the presence of multiple and realistic physical system constraints. The effectiveness of the proposed frequency regulation scheme is demonstrated with a simulation example.

Development of a Simulation Tool to Predict Urban Wind Potential

Christina Beller

Risø DTU National Laboratory for Sustainable Energy
Wind Energy Division, P.O. Box 49, 4000 Roskilde, Denmark
Tel: +45 4677 5434, e-mail: cbel@risoe.dtu.dk

Since energy production is no longer limited to decentralized systems, but brought into the urban environment, where a huge amount of energy consumption takes place, new technologies are emerging and already known technologies are used in another context. One of these technologies is wind energy. Even though the wind energy is significantly lower in urban districts wind turbines are currently erected and new design of wind turbines could possibly be designed rather cost effective. Several trials in different countries were conducted, where small-scale wind turbines were attached to building walls or mounted on rooftops. The used wind turbine configurations were various, including lift-driven horizontal axis wind turbines, drag-driven vertical axis wind turbines, but also completely new concepts. One essential part for a promising integration of wind energy in an urban context is a well designed wind turbine; well designed for the wind condition it is going to be exposed to. In this work a simulation tool is introduced to determine the wind energy potential in urban districts. The idea is to be able to rebuild typical building configurations within a computational fluid dynamic (CFD) simulation environment.

Session C: Sustainable Power Generation - 2

Direction Dependent Power Curves for Wind Power Prediction: A Case Study

Muhammad Khalid and Andrey V. Savkin

This paper describes the significance of empirical direction dependent power curves for wind power prediction at a wind farm site. The results, based on empirical studies, demonstrate that use of directional power curves for wind farm power prediction can lead to an accuracy improvement in the final power prediction of the wind farm. In general, the influence of wind direction on power output is less significant as compared with wind speed due to the fact that turbines are directed to face the wind during its operation. However, maximum wind power potential could not be achieved due to the specific site conditions and important factors like wake effects, environmental effects, hysteresis, and curtailments in the wind farms. Therefore, it is important to model the local conditions of the wind farm; directional power curves are one of the techniques to maximize the expected power production. This case study is based on real-world measurements from a selected wind farm site in Australia.

Tools and Techniques for Intelligent Characterization of Fuels

Dr Simon Walters[1], Dr Cyril Crua[2]

[1]*Smart Systems Research Group, University of Brighton, Moulsecoomb, Brighton*
s.d.walters@brighton.ac.uk
[2]*Centre for Automotive Engineering, University of Brighton, Moulsecoomb, Brighton*

The on-going adoption of biofuels is presenting problems for automotive diesel engine systems, due to the differing mixture preparation and combustion properties of the widely varying fuel blends in the vehicle tank. Diesel engine management has improved enormously, yet it still relies largely on look-up tables and 'reactive' exhaust treatment technologies. 'Intelligent Fuel Characterization' facilitates a 'proactive' engine management role by gathering, processing and making available information about the precise fuel blend which is about to be combusted in the engine. The engine management system can then use this information to optimise engine system operating points for the exact blend of fuel. This paper introduces the concept of Intelligent Fuel Characterization and presents ideas for its implementation, including promising sensor and data analysis technologies.

Use of super-capacitor to enhance charging performance of stand-alone solar PV system

B. J. Huang, P. C. Hsu, and P.Y Ho

New Energy Center, Department of Mechanical Engineering
National Taiwan University, Taipei, Taiwan
bjhuang@seed.net.tw

The battery charging performance in a stand-alone solar PV system affects the PV system efficiency and the load operating time. The New Energy Center of National Taiwan University has been devoted to the development of a PWM charging technique to continue charging the lead-acid battery after the overcharge point to increase the battery storage capacity by more than 10%. The present study intends to use the super-capacitor to further increase the charge capacity before the overcharge point of the battery. The super-capacitor is connected in parallel to the lead-acid battery. This will reduce the overall charging impedance during the charge and increase the charging current, especially in sunny weather. A system dynamics model of the lead-acid battery and super-capacitor was derived and the control system simulation was carried out to predict the charging performance for various weathers. It shows that the overall battery impedance decreases and charging power increases with increasing solar radiation. An outdoor comparative test for two identical PV systems with and without super-capacitor was carried out. The use of super-capacitor is shown to be able to increase the lead-acid charging capacity by more than 25% at sunny weather and 10% in cloudy weather.

Comparitive Study of Biogas Slurry with Farmyard Manure as Fertilizer on Maize Crop

F.H. Khan, A. Nasir, M. Riaz and M.A. Khan

Department of Structures and Environmental Engineering, University of Agriculture, Faisalabad. 38040. Pakistan

A field experiment was conducted at JK farms Jhumra Road Faisalabad, to evaluate the potential of Bio-slurry as a fertilizer in contrast with farmyard manure and also with recommended chemical fertilizer to improve the yield, growth and nutritive value of maize crop. Six different treatments were applied to check the efficiency under field conditions. Two Different levels of Biogas Slurry were used to evaluate its efficiency in relation with its quantity. Biogas slurry was taken from biogas plant of JK farms from a floating drum of 35 m^3. The experiment was conducted by using complete block

design with six treatments and three replications. The crop was harvested manually at its physiological maturity at the ground level using a sickle and tied into separate bundles. Data regarding plant height, fresh biomass, cob yield, grain yield and 1000-grain weight were recorded. Plants samples were analyzed for NPK concentrations in straw and grain. The results showed that plots, where Recommended Chemical fertilizer was applied, showed maximum yield. It increases plant height, cob yield, grain yield, and 1000-grain weight, compared with control. Concentration of Nitrogen, Phosphorous and Potassium and their uptake were also increased over control. Other plots where Biogas Slurry was applied @ 20t/ha showed next better results as compared with rest of treatments. It increased the plant height, cob yield, grain yield, 1000-grain weight and NPK level significantly as compared with control and plants treated with farmyard manure.

Session D: Sustainable Energy Policy and Strategy

Renewable Energies in the EU Energy Policy. Model of Territorial Distribution of the Efforts in Order to Fulfil the Strategic Goal for 2020

A. Tolón-Becerra[1], X. Lastra-Bravo[1], F. Bienvenido-Bárcena[2]

[1]University of Almeria. Area of Engineering Projects. atolon@ual.es.
[2]University of Almeria. Department of Computer Science.

First, we analyzed available data on renewable energy consumption and the share in the European Union, taking 2005 data, total and per capita general energy consumption and per capita income during 2000-2006 as references. Afterwards, a nonlinear methodology for territorial distribution of the EU-27 goal for reaching a 20% share of renewable energy in the gross final consumption of energy is proposed. This methodology is applied to the year 2020 on the NUTS0 territorial level, that is, to members of the European Union, according to the EUROSTAT Nomenclature of Territorial Units for Statistics (NUTS). Weighting is done based on the share of energy from non-renewable sources in gross final consumption of energy, energy from non-renewable sources per capita, energy from non-renewable sources per GDP and GDP per capita. Finally, a multicriteria formula was applied, weighting the variables used in this study.

Future-proofed Design for Sustainable Urban Communities

Maria-Christina Georgiadou[1], Dr. Theophilus Hacking[2]

[1]PhD Candidate, mcg36@cam.ac.uk; [2]Senior Research Associate, th252@cam.ac.uk
Centre for Sustainable Development, Department of Engineering, University of Cambridge, CB2 1PZ, United Kingdom

This research investigates 'best practice' design and decision-making processes for achieving sustainable buildings and communities over the long-term. Amongst the core objectives of strategic urban planning for sustainable communities is to accommodate future changes, however this is not explicitly integrated into the planning and design processes. A framework of future-proofed building design is proposed, which aims to bridge the gap between the traditional short-term outlook and the need for resilient and flexible buildings over the long-term. An overview of design principles for sustainable urban communities and buildings within them is followed by an examination of decision-support techniques and tools. Insights regarding how new developments should address these objectives are captured. The

research represents a shift away from the short-term mindset that still dominates design and construction practices, and provides a critical review of assessment methods for improving and incentivising sustainable urban design over the long-term.

Enabling Low Carbon Living in New Housing Developments: A Triple Bottom Line Analysis

Steffie Broer & Dr Helena Titheridge

UCL Civil, Environmental and Geomatic Engineering
Chadwick Building, University College London
Gower Street, London WC1E 6BT
Tel. 020 7679 7224

Current approaches to the design and planning of new housing developments in the UK do not sufficiently contribute to the necessary carbon emission reductions that will be required to meet UK Government targets and to avoid dangerous climate change. A tool (the Climate Challenge Tool) has been developed, which allows house builders to calculate whole life carbon equivalent emissions and costs of various carbon and energy reduction options for new developments. These cover technical and soft measures; energy used within the home, energy embodied in the building materials and emissions from transport, food and waste treatment. The tool has been used to assess the potential of various carbon reduction options for a proposed new housing development in Cambridgeshire. It was found that carbon reductions can be achieved at much lower costs through an approach which enables sustainable lifestyles rather than one which purely focuses on reducing heat lost through the fabric of the building and improving the heating and lighting systems. Furthermore a triple-bottom line analysis shows additional social and economic benefits from many of the measures.

Aspects of Life Cycle Investing for Sustainable Refurbishments in Australia

Eckhart Hertzsch,[1] Chris Heywood,[1] Mirek Piechowski[2] and Adrian Rowe[2]

[1] Faculty of Architecture, Building and Planning, University of Melbourne,
eckharth@unimelb.edu.au & c.heywood@unimelb.edu.au
[2] Meinhardt Building Science, Meinhardt Australia Pty Ltd.

Refurbishing existing buildings to reduce greenhouse gas (GHG) emissions is important in meeting Australian government aspirational targets of a minimum of 25% by 2020. Previous studies of such refurbishments tend to provide only general upgrade, cost

and investment advice because they apply generic building attributes and location criteria. They also ignore life cycle aspects such as component assets being replaced at the end of their service life and sustainability investments are over-and-above these 'normal' investments. This research investigates an appropriate methodology for more realistic evaluations of refurbishments and life cycle investment to upgrade buildings to 5 to 6-stars on the NABERS Australian energy rating system. The methodology is presented and discussed as a suite of inputs, simulation tools, and outputs. Preliminary results from ongoing work illustrate the outputs and their interrelatedness.

This work focuses on façade improvements because they can have a major influence on the energy consumption and upgrades based on HVACs alone are often insufficient in achieving the required energy savings.

'Sets of improvements' are introduced as a means of controlling the variables by way of façade improvements and related changes to mechanical and electrical systems required because of the interconnectedness of building envelopes and these services.

Advent of Climate Change and the Resultant Energy Related Obsolescence in the Built Environment

T. E. Butt(PhD)[1], Prof. B. Giddings[2], B. B. N. Umeadi (PhD)[3]; J. Cooper[1]; and Prof. K. G. Jones[1]

[1] Department of Property Housing & Urban Regeneration, School of Architecture & Construction, University of Greenwich, Avery Hill Campus, Bexley Road, Eltham, London. PostCode: SE9 2PQ. England, UK
Tel: +44(0)7817 139170 Email: t_e_butt@hotmail.com
[2] School of Built Environment, Northumbria University, Ellison Building Newcastle upon Tyne, PostCode: NE1 8ST. England,UK
[3] NanoMind ICD, 160 – 166 Kensington High Street, London. PostCode: W8 7RG. England,UK

By 2050s the UK is expected to experience: increases in average summer mean temperatures (predicted to rise by up to 3.5oC) and frequency of heat-waves / very hot days; and increases in winter precipitation (of up to 20%) and possibly more frequent severe storms. Also, in 2050s approximately 70% of UK buildings will have been built before 2010, which due to aforesaid climate change factors are bound to suffer various degrees of obsolescence in different ways including energy related obsolescence. Thus, if the built environment is to be rendered sustainable against climate change, and the investment in these buildings (which was approximately £129 billion in 2007 in the UK alone) is to be protected. Actions need to be taken now to assess the vulnerability and resilience of the existing UK built environment, and plan

adaptation / mitigation interventions, that allow to continue to support the quality of life and well-being of UK citizens. The situation with other countries around the globe is not to be far different than this, although there may be some variation in nature and quantity of not only climate change impacts but also the way these impacts shall manifest (along with their subsequent 'knock- on' affects) and be dealt with in view of resources and governance of a given country. Failure to act now will mean that the costs of tackling climate change in future will be much higher, jeopardising not only environmental but also economic sustainability. In view of these concerns, although this paper shall briefly describe different kinds of obsolescence in general, but the main focus of discussion shall be those obsolescence types that are associated with energy and yet induced due to various climate change related factors. The climate change factors that shall be specifically covered in relation to their influence on energy aspects of the built environment, include: global warming, flooding (pluvial, fluvial, tidal and coastal), air pollution / air quality, GHG emissions, environmental law, and other relevant EU Directives, UK regulatory frameworks and Acts such as building regulations, energy related legislation and regulations. Based on these factors, energy related obsolescence types shall be categorised into direct and indirect obsolescence groups. Moreover, though the article shall encapsulate both 'ends of the pipe' of energy, i.e. generation as well as consumption, the later shall be more specifically addressed in terms of ever accelerating demand of efficient energy consumption in buildings to cut down carbon emissions. Thus, the paper shall outline a fundamental and holistic framework for identification and categorisation of energy related obsolescences in the built environment from a number of perspectives and yet in association with the main theme i.e. climate change. This framework shall attract interests for further investigation from both researchers in academe and practitioners in industry and commerce, in terms of which types / categories of energy related obsolescences need to be addressed in what specific ways to enhance and secure sustainability of our built environment in coming crucial decades of climate change.

How Hotelier's Attitudes Shape the Energy Profile of their Facilities; Exploring the Energy Consumption in Hotels using Energy Scenarios.

Eva Maleviti[1], Walter Wehrmeyer[1], Yacob Mulugetta[1]

[1]*Centre for Environmental Strategy, University of Surrey, Guildford, Surrey*
e.maleviti@surrey.ac.uk

This paper describes the Greek hoteliers' attitudes about energy policy implementation and the energy operations in their facilities. The aim of this paper is to demonstrate the interaction between the users' behaviour and the way energy is consumed in Greek hotels in a long-term period. This paper is part of a wider research

project that explores the energy consumption in several Greek hotels and the effects of several parameters in their total energy use. This paper explains one of these parameters, which is the owners' attitudes, describing how energy is consumed in their facilities. Through interviews with open-ended questions, their responses reveal their opinions and the level of information they have on the existing legislation-Greek and European- on energy use in buildings. Further than that, a short analysis of the energy use of hotels is displayed, explaining the effect of the existing energy policy and its effectiveness in hotels. The methodology used for the energy analysis, is scenario development and it is given through the use of the software Long Range Energy Alternative Planning (LEAP). The scenarios are developed considering the existing Greek legislation, which includes the new introduced law for energy use in buildings, and the Greek National Action Plan. Furthermore, the European Legislation is considered, focusing mainly in the Directive for Energy Performance in Buildings. The results of this analysis show how energy consumption in hotels changes under the policy implementation if the hotel owners approve it. Three energy scenarios are developed, exploring three different possible storylines for hotels' energy profile. Each one of them exhibits different findings proposing significant but easy to apply alterations to hotels.

Session E: Energy Monitoring and Management

The EcoSense Project: An Intelligent Energy Management System with a Wireless Sensor and Actor Network

Pedro Díaz[1], Teresa Olivares[1], Raúl Galindo[1], Antonio Ortiz[1], Fernando Royo[1] and Tomás Clemente[2]

[1] Albacete Research Institute of Informatics,
Campus Universitario, 02071 Albacete
[2] Professors Centre, Avenida España, 13, 02004, Albacete
(pedrodiaz, teresa, raul, amanuel, froyo)@dsi.uclm.es, tomas.clemente@edu.jccm.es

Wireless sensor networks provide a new way of working for applications such as indoor monitoring, security or robotics. The Ecosense project aims to monitor all devices consuming energy in an intelligent building. We are developing this project in steps. Firstly, we have deployed a network equipped only with sensors (for temperature, humidity, luminosity, and electrical consumption, as well as presence detectors). Secondly, we will add an upper layer of manager agents (actors) to communicate and negotiate services. Afterwards, we will obtain conclusions about the sensed data and we will then extend a full wireless sensor network to cover the whole building. The network prototype will also be used to test power-and-time efficient protocols developed by us.

The Use of Intelligent Systems for Monitoring Energy Use and Occupancy in Existing Homes

Catalina Spataru, Mark Gillott

Department of the Built Environment, University of Nottingham, Nottingham, UK

In the UK the existing domestic building stock accounts for 27 % of the total carbon dioxide emissions. The UK Government has set ambitious targets for reducing UK carbon dioxide emissions by 80% by 2050. These targets will require significant changes to the existing buildings. To understand and quantify the benefits of refurbishment solutions, it is vital to monitor exemplar buildings and to bring them to an energy efficiency standard with lower associated carbon emissions, by finding the most efficient way to refurbish them. A 1930's replica three bed semi-detached house analyzed in this study is located in the University of Nottingham campus and is fully monitored, including monitoring of the occupants patterns, environmental monitoring, electricity use and energy associated with space and hot water heating.

This paper analyses techniques used for tracking computing technologies in everyday domestic settings. A Real Time Occupancy Monitoring System using ultra wideband (UW) radio frequency (RF) is used in this study to track person's location within the research house. The results presented in this paper show that energy consumption profiles are related to the occupants and their profiles. The data also depends on the outside weather conditions and occupants' behaviour. The study shows that it is not enough just to improve building performance in order to improve energy efficiency; it is also important to understand and influence occupant behaviour, due to the fact that in domestic buildings the occupants exert complete control of the appliances, lights, heating, and ventilation. The results of this study suggest that general behavioural trends and patterns can be extracted from long-term collected data. This systematic study could benefit the existing housing stock in the UK by applying the same methods used in the research house.

Assessing the Energy Performance of Office Buildings

Konstantinidou Chr., Dimoudi A., Kosmopoulos P.

Department of Environmental Engineering,
Democritus University of Thrace,
Vass. Sofias 12, 67 100 Xanthi, Greece
Email: adimoudi@env.duth.gr

The production and use of energy are the cause for the 94% of CO_2 emissions, with an important share, at least 45%, corresponding at the building sector. Buildings are accounting for the 40% of energy consumption in Europe, while the increase of demand of electric energy is forecasted to reach up to 42% at 2020. Greek buildings absorb roughly the 1/3 of consumed energy and emit the 45% of CO_2. Particularly, the tertiary sector represents roughly the 25% of total number of Greek buildings. The category of offices/commercial buildings constitutes the higher percentage between the main categories of tertiary sector and it represents the 2.74% of total building reserve, that corresponds at a total energy consumption equal to 339 kWh/m^2.
In this paper, the energy behaviour of public buildings is studied. The energy situation of public office buildings in the prefecture of Florina, in North Greece is investigated. The paper demonstrates the energy assessment of office buildings and it formulates proposals for the improvement of their energy efficiency. The evaluation of the existing energy situation and the proposed energy interventions was performed with the EPA-NR software,
The parameters that were taken into account were the constructional data of the buildings, the data on the operation of the buildings, energy consumption and the exterior climatic local conditions.

Session F: Solar Energy Technology

Optimisation of Integrated Low-Carbon Energy Strategies: A Case Study for 'Zero Carbon' Social Housing in the UK

Li Mei and P. N. Rowley

CREST, Department of Electronic and Electrical Engineering,
Loughborough University, Loughborough
Leicestershire, LE11 3TU

This paper details the modelling and prediction of the solar energy supply available for hot water and space heating in a domestic house designed to 'zero carbon' standards in the UK Midlands. The design strategy for the dwelling includes a highly insulated timber frame fabric with a south-facing full-height sunspace and 'low-U' glazing to optimise natural lighting and solar energy gain over the year. A solar thermal system installation is intended to further reduce fossil energy consumption. In conjunction with post-occupancy evaluation, a computational whole-building model with sub-systems has been configured to represent and evaluate in detail the integrated system energy performance including domestic hot water and space heating requirements.

Characterisation of a Line-Axis Solar Thermal Collector for Building Façade Integration

M Ramirez-Stefanou[1], T Mallick[2], M Smyth[1], JD Mondol[1], A Zacharopoulos[1] & TJ Hyde[1]

[1]Centre for Sustainable Technologies, School of the Built Environment,
University of Ulster, Newtownabbey BT37 0QB, N. Ireland.
Tel: ++44(0)2890366122, Fax: ++44(0)2890368239, e-mail: m.ramirez@ulster.ac.uk
[2]Mechanical Engineering, Heriot Watt University, Edinburgh, UK, EH14 4AS.
Tel: ++ 44(0)1314514379, e-mail: t.mallick@hw.ac.uk

The integration of concentrating solar thermal collectors into the structural envelope of buildings can significantly increase the cost effectiveness of solar thermal utilisation in the UK. The key, however, to their wide scale application is performance. Typically, most solar thermal collectors are mounted on inclined roof structures, thus presenting an optimal surface area for solar gain. Vertical building facades offer an alternative mounting surface and whilst they may have an overall lower level of incident solar radiation, the collector receives a more uniform annual distribution of solar radiation, reducing potential summer over heating problems. Furthermore, facade integration is

beneficial to the building performance as the collector unit results in a higher U-value realising higher building heat retention.
In concentrating solar thermal collector systems, the absorbing surface area is reduced relative to that of the aperture, leading to a reduction in the overall heat loss from the system, hence improving thermal efficiency. To maximise collection in a vertically mounted concentrating solar thermal collector however, the concentrator profile should be optimised to benefit solar collection relative to the mounting inclination.
This paper presents the optical and experimental investigation of a low concentration line axis solar thermal collector employing symmetric and asymmetric CPC geometries. The potential for collected solar radiation when façade integrated has been investigated with the use of three-dimensional ray trace. Several prototype units were fabricated and experimentally evaluated. A series of fluid flow configurations (serpentine and parallel) using different flow velocities have been investigated and a range of slope angles (β) considered.
Results from this study have shown that this type of concentrating solar thermal collector has particular application for domestic hot water production and that the design can effectively operate in the vertical orientation and is suitable for building façade integration in Northern European locations.

Transformerless 3-phase PV Inverter Simulation for Efficient Building Installations

P. Fetfatzis[1], P. Kofinas[1], M. Kallousis[1], K. Alafodimos[1]

[1]Industrial Installation Lab., Automation Department, Technological Educational Institute of Piraeus p_fetfatzis@yahoo.gr

In a world that energy demand is growing and the risks of climate change have to be encountered, we should consider using ways of environmentally friendly energy production. Energy generated from replenished natural resources can be used and in combination with state of the art technology in order to cover the energy demands of domestic consumers. During the last years photovoltaic cogeneration and microcogeneration systems have been developed. Grid connected PV systems can be hosted at nearly every building covering to minimum their power consumption. Therefore we are capable to built efficient home and efficient company, which not only save energy, but also produce, reducing the emissions of greenhouse gases as much as possible, contributing greatly to the environmental protection.
A transformerless 3-phase grid connected pv inverter is being presented in this paper. The simulation model of the inverter is developed in Matlab Simulink. The total PV generator efficiency depends on the inverters output performance. Transformerless topologies can improve the efficiency of the system. There are however issues such as

the leakage current phenomenon that have to be dealt with. This is due to the lack of the galvanic isolation that the transformer provides. Solutions for the certain problem are being discussed. Furthermore active filtering techniques can improve the generated power quality. The concept involves using active filters to reduce the harmonic distortion of the current that is injected to the grid.
We analyze the parts of the model that are: the pv model we use, the MPPT algorithm by the means of a DC/DC converter, the inverters control circuit, the LC filter, and the connection to AC grid. A steady state analysis is given for the control circuit. We analyze the passive filter performance that is used in the model. We also discuss the use of a Kalman filter and other active filtering techniques that are used in order to reduce the total harmonic distortion. The connection to the Electrical distribution grid is performed and the analysis is focused on the leakage current, the earth's parasitic capacitance and the total harmonic distortion. The analysis and the results we extract, arise from a whole system simulation, taking into account all the parameters from all the subsystems.

Architectural Daylighting Analysis of Photovoltaic Panels of BIPV with Zero Energy Emission Approach

Shahram Nassehzadeh Tabriz[1], Ahadollah A'zami[2]

[1]Department of Architecture, Islamic Azad University-Miyaneh Branch, Miyaneh, Iran, archtab@gmail.com
[2]Department of Architecture, Islamic Azad University-Hadishahr Branch, Hadishahr, Iran azami@iauj.ac.ir

Direct or diffuse sunlight shining on the solar cells induces the photovoltaic (PV) effect, generating unregulated DC electric power. Building-integrated photovoltaic (BIPV) is a relatively recent new application of PV energy technologies involves combining solar photovoltaic electricity technologies with those of building construction. This subject is of great interest to those in the fields of energy conservation and building design. These are some of the basic terms used in describing PV technologies, BIPV products, and their uses: conversion efficiency, curtain wall, PV array, PV laminate and solar access.
Building BIPV systems are considered to be multifunctional building materials, and they are therefore usually designed to serve more than one function. For example, a BIPV skylight is an integral component of the building envelope, a solar energy system that generates electricity for the building, and daylighting element. BIPV can affect every aspect of the design process such as: layout and orientation, energy strategies, appearance and architectural expression. Most of BIPV systems can be grouped into two main categories: facade systems and roofing systems. Facade systems include

curtain wall products, spandrel panels, and glazing. Roofing systems include tiles, shingles, standing seam products, and skylights.

The design of transparent building components and windows is, on the one hand, defined by the primary function of light penetration and visual transparency. On the other hand, these elements fulfill an important control function with regard to strongly fluctuating radiation intensities and are also relevant for aspects of lighting and heating/cooling. Translucent PV modules used as roofing materials serve as water and sun protection as well as transmitting daylight. In glass covered areas, such as sunrooms and atriums, sun protection in the roof is necessary in order to avoid overheating in summer. The space between the cells transmits enough diffuse daylight to achieve a pleasant lighting level in the area. As an exterior insulation BIPV roof system, PV laminates are attached to polystyrene insulation, and it provides thermal insulation rated R-10 or R-15.

A successful BIPV solution requires integration between building design and PV system design. The integration of PV systems in architecture can be divided into five approaches. It can be: Applied seamlessly; Added to the design; Added to the architectural image; Used to determine the architectural image; Used to explore new architectural concepts. But the fundamental first step in any BIPV application is to maximize energy efficiency within the building's energy demand or load. The efficiency of each BIPV product is specified by the manufacturer. Efficiencies range from as low as 5%-10% (in direct sunlight) to as high as 15%-16% (in the diffuse light of cloudy days). Windows, skylights, and facade shelves can be designed to increase daylighting opportunities in interior spaces. PV awnings can be designed to reduce unwanted glare and heat gain. This integrated approach, which brings together energy conservation, energy efficiency, building envelope design, and PV technology and placement, maximizes energy savings and makes the most of opportunities to use BIPV systems. Architecturally, the size of the BIPV system is physically limited to the dimensions of the building's available surface area. For example, systems made ofamorphous silicon require a larger surface area but cost less than equivalent systems composed of single crystal solar cells.

Meanwhile PV in building renovation is not the prior measure to reduce the high energy demand of the existing building stock. But, as part of a well balanced renovation concept (thermal insulation, improved windows, improved ventilation system and solar collectors) it marks a further step towards sustainable housing. At a large scale, towns and cities present an ideal opportunity for the exploitation of PVs. The spacing between buildings is an important factor in determining façade PV opportunities. The suitability of BIPV is dependent upon a variety of factors. For example, flat roofs are the most appropriate sites in city centres, combining flexibility with unobtrusiveness. The next generation of thin film PVs looks like offering opportunities to integrate PVs into buildings without compromising their historic integrity, also BIPV does more than offer perspectives for the next century.

The objective of this paper is to enhance the architectural quality, the technical quality and the daylighting issues of PV systems in the built environment and to assess and remove non-technical barriers to their introduction as an energy-significant option. BIPV research and development should therefore focus on achieving these cost reductions, by optimizing integration concepts, by developing new building products and by the development of standardized products.