Solar Energy and Building Physics Laboratory (LESO-PB)
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EPFL Solar Energy and Building Physics Laboratory (LESO-PB)

ACTIVITY REPORT 2011

The Solar Energy and Building Physics Laboratory (LESO-PB) works at the forefront of research and technological development in renewable energy, building science and urban physics. It is part of the Civil Engineering Institute (IIC) of the School of Architecture, Civil and Environmental Engineering (ENAC) of the Swiss Federal Institute of Technology (EPFL) in Lausanne, Switzerland. Placed under the responsibility of Prof. Dr Jean-Louis Scartezzini and four group leaders, the laboratory counts about 40 scientists, engineers and technicians. This report presents the teaching, research and dissemination activities for 2011.

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RESEARCH

INTRODUCTION

The research activities of the Solar Energy and Building Physics Laboratory focus on the development and implementation of energy efficient and renewable energy technologies in the built environment:

- Intensive use and perception of daylight
- Sustainable urban development
- Bio-mimetic building control
- Renewables integration in the built environment
- Nanotechnology for solar energy conversion
- Computer modelling of complex systems

Highlights 2011

- The inauguration of the Nanotechnology for Solar Energy conversion Lab and exciting new developments in the fields of solar absorber coatings and microstructured glass for daylighting under the direction of Dr Andreas Schüler
- A research study by Münch M. et al on the effects of prior light exposure on early evening performance, subjective sleepiness, and hormonal secretion published in "Behavioral Neuroscience"
- Several years of research published in two books authored by LESO-PB researchers:
  - "Computer modelling for sustainable urban design" edited by Darren Robinson with contributions by Jérôme Kaempf and other authors shows the state of the art in modelling of urban spaces.
  - "Architectural integration and design of solar thermal systems" by MC. Munari-Probst and C. Roecker shows new attractive and efficient ways of architecturally integrating solar thermal technology.
- The first version of Geronimo, software wizard for the visualization of the impact of complex fenestration systems, put at the disposal of architects and lighting designers.

Further research activities are presented in the following pages.

2011 AWARDS AND HONOURS

<table>
<thead>
<tr>
<th>Name</th>
<th>Award, distinction</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>MER Dr D. Robinson</td>
<td>Full Professor, University of Nottingham (UK)</td>
<td>2011</td>
</tr>
<tr>
<td>F. Haldi, MER Dr D. Robinson</td>
<td>Best Paper Award – Journal of Building Performance Simulation</td>
<td>2011</td>
</tr>
</tbody>
</table>
DAYLIGHTING AND PERCEPTION

Group leader: Prof. Jean-Louis Scartezzini
Research associate: Dr Mirjam Münch
Postdoctoral researcher: Dr Jérôme Kämpf
PhD students: Apiparn Borisuit, Chantal Basurto
Guest PhD student: Lenka Maierova, Czech University Prague

The daylighting and perception research group works on advanced systems for optimal use of daylight in buildings with the aim to improve user comfort and health and reduce energy consumption.

The group has set up a sophisticated daylighting laboratory with, among other, a scanning sky simulator and an automated heliodon, which allow reproducing with very high precision all daylight conditions that exist around the world. Several anidolic (non-imaging) daylight systems have been developed and tested by the group. Furthermore, a bidirectional reflection and transmission goniophotometer based on digital imaging allows assessing the characteristics of complex fenestration systems.

Research on the impact of natural and artificial light on circadian rhythms in humans (chronobiology) is combined with technological advances in a multidisciplinary approach.

Glare sources are indicated with different colors and quantified by using ‘Evalglare’ (Wienold & Christoffersen, 2006).

Published work relates to

- Circadian rhythms and impact of light in humans, visual comfort
- Daylighting computer design and analysis tools
- Integrated day- and electric lighting systems
- Bidirectional reflection and transmission goniophotometer
- Anidolic daylighting systems
- Scanning sky simulator and automated heliodon
- Experimental and ergonomical daylighting test modules

2011 Activities

Two new laboratory studies on day- and artificial lighting started and one major project with different office light conditions was completed last year. An intense laboratory study with extreme chronotypes was initiated to shed light on inter-individual lighting preferences in offices during work hours. Another project with patients suffering from ophthalmological diseases started in collaboration with MER Dr. A. Kawasaki of Hôpital Ophtalmique Jules Gonin, Lausanne. The impact of different wavelengths of light stimuli on EEG brains activity were tested on 16 healthy subjects in order to assess acute and short time changes of neuronal activity in response to different light stimuli.
Current Projects

**Comparison of non-visual light-dependent functions in healthy subjects & patients with retinal ganglion cell loss**  
**Funding:** Swiss National Science Foundation (SNSF) (project in collaboration with Hôpital Ophtalmique Jules-Gonin, Lausanne, PD MER Dr. med. Aki Kawasaki)  
**Duration:** 2011-2013  
This project aims to characterize alertness, cognitive performance and hormonal secretion in response to light exposure in patients with neuroretinal disease as well as healthy controls, and to correlate such changes to the pupil light reflex.

**Circadian Light for Humans with Dementia**  
**Funding:** Sonnweid Foundation (Switzerland), Age-Foundation (Switzerland)  
**Duration:** 2011-2012  
The study aims to demonstrate that the increase of circadian amplitude induced by efficient light with the right spectral composition serves not only psychological factors such as mood and well-being, but also influences important regulatory health functions in demented patients.

**INTER — Individual Lighting Preferences of Office Occupants**  
**Funding:** Scientific Exchange Prog. Switzerland-EU New Member States (Sciex-MMS), Velux Foundation (CH)  
**Duration:** 2011-2012  
This project aims to analyse subjective and objective visual and thermal comfort variables in young volunteers with known differences of their diurnal preference under varying (day-) lighting conditions.

**Daylighting Design and Visualisation Tools**  
**Funding:** Swiss Federal Office of Energy (SFOE)  
**Duration:** 2009-2012  
The project is aiming to set up a daylighting design tool for the visualisation of the light redirecting properties of complex fenestration systems, which will be complemented by an advanced ray-tracing computer simulation algorithm.

**Integrated Multifunctional Glazing for Dynamical Daylighting**  
**Funding:** Swiss Federal Office of Energy (SFOE)  
**Duration:** 2009-2012  
The project is aiming to set the bases for an integrated multi-functional glazing for dynamic daylighting using novel microstructures which will redirect sunlight into office rooms.

**Postdoctoral Fellowship in Daylighting & Perception**  
**Funding:** VELUX Foundation (Switzerland)  
**Duration:** 2008-2012  
This project is aiming to strengthen the education and research activities in the fields of building science and chronobiology. It is expected moreover to initiate innovating activities in relation to psycho-physiological aspects of daylight with an emphasis on human response factors, such as the perception of three-dimensional spaces and luminous environment.

**PhD theses published in this domain at LESO-PB**

**Awards in this domain**
- Marilyne Andersen, EPFL PhD Thesis #2941 (2004), Chorafas Award 2005
SUSTAINABLE URBAN DEVELOPMENT

Group leader: MER Dr Darren Robinson (until 9.2011) / Dr Jérôme Kaempf (from 10.2011)
Postdoctoral researcher: Dr Wanjing Li
PhD students: Diane Perez, Urs Wilke, Olivier Pol
Visiting researchers: Maria Papadopoulou, Dapeng Li

The principal mission of this group is, through the simulation of physical processes, to better understand how to optimise the sustainability of urban systems, predominantly from environmental but also from social and economic perspectives.

Specific research interests include:

- Simulation and evaluation of resource fluxes (energy and matter) in urban systems
- Demand and supply side control of urban energy flows
- Urban microclimatology
- External environmental comfort and social wellbeing
- Stochastic modelling of human behaviour

Optimisation of the cooling energy demand of the district of Alt-Wiedikon/Zurich.

Published work relates to

- Modelling and optimisation of urban energy fluxes
- Occupant behaviour and comfort
- Sustainable urban design
- Thermodynamics in the city
- Radiosity algorithms and internal illumination prediction

2011 Activities

Our book “Computer modelling for sustainable urban design” was published in March 2011. It harmonises our work in urban modelling over the past decade and has become a reference in the domain of urban simulation.

From the first encouraging applications of our urban energy modelling tool CitySim at a neighbourhood scale, we proceeded to a larger scale. The city centre of Neuchâtel was simulated to evaluate cooling needs and the possible installation of a free cooling facility with lake water. In several districts of Zurich city a field survey was carried out to improve the predictions previously obtained with our modelling tool. A new project was submitted to the CCEM board to establish a link between atmospheric models and CitySim. This project will start in 2012.
Current Projects

QUAD - Sustainable Districts
Funding: Research Center for Energy and Municipalities (CREM)
Duration: 2011-2011
Development of a prototype decision aid tool for architects, construction companies and city councils. This tool will allow urban design competition participants to define building specifications incorporating energy efficiency criteria.

IEA ECBCS Annex 51 – Energy Efficient Communities: Case Studies and Strategic Guidance for Urban decision Makers
Funding: Swiss Federal Office of Energy (SFOE)
Duration: 2009-2012
Participation in IEA ECBCS Annex 51 “Energy Efficient Communities: Case Studies and Strategic Guidance for Urban Decision makers”. Contributions of case study material to the relevant sub-tasks. Preparation of a chapter on Urban Modelling for a book to be published by the members of this Annex.

Investigation of Strategies Leading to a 2kW City Using Bottom-Up Models of Urban Energy Flows
Funding: Swiss National Science Foundation (SNSF)
Duration: 2009-2012
Development of a detailed spatially explicit model of the dynamic flows of energy and matter within a city due to transportation, the operation of buildings and the activities accommodated by them, involving the further development and integration of CitySim -- for explicit simulation of building-related energy flows in urban settlements -- and MATSIM -- for transport micro-simulation. Application to the city of Zürich to produce new guidance for its development up until 2050, with a view to achieving a 2000W/capita city.

Innovative Planning and Management Instruments of Urban Energy Systems
Funding: EPFL Energy Center
Duration: 2009-2012
In this project we will work closely with municipalities, the EPFL Energy Centre as well as the Industrial Energy Systems Laboratory at EPFL to develop a new urban energy planning tool for use by municipalities. The purpose of this tool will be to support municipalities’ urban energy planning and investment decisions.

HOLISTIC - Holistic Optimisation Leading to Integration of Sustainable Technologies in Communities
Funding: European Union (EU) 6th Framework Program
Duration: 2007-2012
The HOLISTIC project aims to stimulate a paradigm shift in the use of energy within communities to more sustainable patterns. It will demonstrate how this transformation can be initiated in three typical communities, in Dundalk (IRE) Mödling (AU) and Neuchâtel (CH), by acting on every aspect of community life. The role of the LESO-PB within this 32MEuro European RTD project is to develop new software for optimising the energy performance of urban districts.

PhD theses published at LESO-PB in this domain
- Towards a unified model of occupants’ behaviour and comfort for building energy simulation F. Haldi, EPFL PhD Thesis #4587, 2010

Awards in this domain
- Darren Robinson: Visiting Professorship, Technical Research Centre of Finland.
BIO-MIMETIC BUILDING CONTROL

Group leader: Dr Nicolas Morel  
PhD students: David Daum, Nikos Zarkadis

Bio-mimetic control of building services (heating, cooling, ventilation, blinds, electric lighting) can simultaneously optimize energy use and indoor comfort (thermal, visual, air quality) through the use of advanced computer methodologies such as artificial neural networks, genetic algorithms, fuzzy logic, or advanced optimization algorithms. Our laboratory investigates control algorithms allowing at the same time:

- an optimal response to changing conditions (weather, building occupancy, lighting levels, thermal characteristics)
- a progressive adaptation to (possibly changing) building characteristics and to user preferences.

Research projects normally include two steps:

- development of innovative control algorithms and evaluation with computer simulation tools
- testing under real situations and evaluation of energy and comfort performances as well as acceptance by users.

Most bio-mimetic controllers are evaluated in the LESO building, which represents a powerful tool for our group.

Published work relates to

- Self-adaptive integrated building control systems
- Blind and electric lighting control algorithms
- Advanced control of electrochromic glazing
- Genetic algorithms for adaptation to user preferences
- Fuzzy logic for implementing building physics expert knowledge into the control algorithms
- Artificial neural networks for adaptive models and various control systems (for instance thermal model of the building or weather evolution).

Activities 2011

The LESO-PB contributed to the CCEM project on renovation of historical buildings (SuRHiB) with a study on the optimal use of heating, cooling and ventilation services in such buildings.

Furthermore, a smart algorithm for the project on predictive control of electrochromic glazings (ECControl) was elaborated, and the experimental setup for the validation of this algorithm was started.

A new research project was successfully submitted to the Hasler Fundation for financial support. The project Green-Mod will start in January 2012. It aims at the elaboration of an information system able to optimize energy consumption in buildings while preserving human comfort. The main innovation of the project is the use of state-based stochastic modelling applied to temporal signals acquired from heterogeneous sources such as distributed sensors and user wishes and preferences.
Current Projects in Biomimetic Building Control

Advanced Control of Electrochromic Glazing

Funding: Swiss Federal Office of Energy (SFOE)
Duration: 2009-2012

Electrochromic (EC) glazings might be used as an alternative to conventional mobile solar shadings or solar protection glazings, which are not well suited to most weather conditions and as a rule not efficient enough against overheating. EC glazings have until now essentially been actuated manually by the users. Some elementary control schemes have also been proposed, but the time characteristics of these glazings have not been considered. Therefore, a predictive algorithm, like those used for controlling building services, taking into account the thermal inertia, may bring some advantages with regard to user comfort (both thermal and visual). The project includes the development of an adequate control strategy, and the experimentation of this strategy in an office room of the LESO building, with real persons.

CCEM-SuRHiB: Sustainable Renovation of Historical Buildings

Funding: Swiss Competence Center for Energy and Mobility (CCEM)
Duration: 2009-2012

Historical buildings, if normally heated, cause relatively high energy consumption. As their façades need to be conserved, the thermal insulation of such buildings is difficult and risky. The moisture balance of walls has to be carefully considered besides the energy balance. Internal insulation that could effectively reduce thermal losses would hinder the drying process of walls. A careful risk assessment and robust guidelines have to be developed. A highly insulating light weight plaster finish based on aerogel particles, which insulates like polystyrene – inside or outside - but is open for moisture diffusion, is developed and tested in this project. Furthermore, appropriate heating systems and optimal solar integration are studied by LESO-PB.

PhD theses published in this domain at LESO-PB

- On the adaptation of building controls to the envelope and the occupants, David Daum, EPFL PhD Thesis #4935 (2010)
- Bayesian optimisation of visual comfort, David Lindelöf, EPFL PhD Thesis #3918 (2007)

Awards in this domain

- Antoine Guillemin, EPFL PhD Thesis #2778 (2003), Chorafas Award 2004
BUILDING INTEGRATION OF RENEWABLE ENERGIES

Group leader: Ing. EPFL Christian Roecker
Postdoctoral researcher: Dr Maria Cristina Munari Probst
PhD student: Raquel Peres Gagliano
Research assistants: Marja Edelmann, Gregor Stoll

Many building surfaces are ideally suited for the use of solar energy, but high costs, technical and aesthetic considerations have long kept building owners and architects from using even a small part of this potential. This is why the research group "Renewables Integration into the Built Environment" addresses the issue of optimal architectural integration of photovoltaic and thermal solar systems.

Major progress has been made in photovoltaics integration in the framework of several international projects over the last years. Currently, the group focuses on the integration of solar thermal technology and is co-leading the new IEA Task 41 “Solar Energy and Architecture”.

Façade integrated evacuated solar collectors (Sunny Woods, arch. Beat Kämpfen)

Published work relates to

- Façade integration of solar thermal systems
- Criteria for successful architectural integration of active solar systems (PV & ST)
- Façade and roof integration systems for photovoltaics (pilot installations /development of new systems)
- Ergonomic interface for simulation software and “wizard” expert system
- Criteria and recommendations for solar installations authorisation

2011 Activities

One main activity of the group was the lead of Subtask A “Criteria for Architectural Integration” in the IEA SHCP Task “Solar Energy and Architecture” (Task 41).

Specific teaching on architectural integration of active solar systems continued through a dedicated ENAC Teaching Unit (UEE 04, “Intégration architecturale de l’Energie Solaire”) and participation in Architects courses.

Work on a new architect specific interface for LESOSAI (building physics and solar thermal simulation software) was pursued, implementing a “wizard” concept for data entry.


Architectural integration research work continued in collaboration with several Swiss institutions (SUPSI, HSLU, Swissolar).

A project for the implementation of coloured glasses for solar collectors is on the way, in collaboration with an industrial partner.
Current Projects

ECLEER – Architectural Solar Design for Collective Residential Buildings
Funding: Electricité de France (EDF)
Duration: 2009-2012
The goal of this project is to study the possibilities and propose solutions to use solar thermal energy in the field of collective residential buildings. One important option is to take the opportunity offered by retrofit work on existing buildings to combine it with the installation of a proposed innovative product.

Solar Energy and Architecture - IEA SHC Task 41
Funding: Swiss Federal Office of Energy (SFOE)
Duration: 2009-2012
The main goal of the Task is to help achieving high quality architecture for buildings integrating solar energy systems, mainly by improving architects' qualifications and enhancing solar thermal manufacturers' awareness of building integration issues.

Unique and Innovative Solution for Building Integration of Thin Film Silicon PV modules
ARCHINSOLAR
Funding: Competence Center Energy and Mobility CCEM-CH
Duration: 2009-2012
The Archinsolar project aims at the development of a new generation of photovoltaic elements based on thin film silicon technology (single amorphous and tandem amorphous/microcrystalline cells). Specific issues to ensure a good “integrability” of the developed products are central focus for the group.

LESO QSV method
Funding: Swiss Federal Office of Energy (SFOE)
Duration 2011-2012
The goal of the project is to propose a method to help improving the architectural quality of the active solar installation projects. The method offers a way to assess the quality of a proposed integration, and helps define required quality levels function of site sensitivity and system visibility.

Book published in this domain at LESO-PB

Due to their fascinating optical and electronic properties, nanometric scaled structures play an important role in solar energy conversion. The research group "Nanotechnology for Solar Energy Conversions", develops and characterizes novel nanostructured materials for solar energy applications. The nanocomposite coatings consist typically of dielectrics, semiconductors or metal nanocrystals embedded in a dielectric matrix. Applications include antireflection coatings on solar collector glazing, colored coatings with high solar transmittance for novel glazing of solar thermal façades, photoluminescent quantum dot solar concentrators for photovoltaic energy conversion and optical selective absorber coatings for thermal solar collectors and thermoelectric power generation.

The research group carries out fundamental research on novel nanocomposite materials and thin film materials and promotes the introduction of novel solar technologies through upscaling of the corresponding innovative manufacturing processes.

Published work relates to

- Colored glazed solar collectors, active solar thermal façades
- Quantum dot solar concentrators
- Highly durable selective solar absorber coatings
- Novel thermochromic solar absorber coatings for overheating protection

Activities 2011

Major highlights from our activities include:

- Construction of technical infrastructure, installation of equipment and inauguration of a new Laboratory for Nanotechnology for Solar Energy Conversion
- Large scale prototype production of novel solar glazing
- Scientific findings which might give raise to several patents in the fields of
  - highly durable selective solar absorber coatings
  - colored solar glazing for photovoltaic modules / solar thermal collectors
  - novel microstructured glazing for daylighting
Current Projects

Technology Transfer of Coloured Solar Thermal Collectors

**Funding:** SwissINSO Trade & Invest Ltd  
**Duration:** 2009-2012

At LESO, novel nanocomposite coatings on architectural glazing for solar active thermal façades have been developed. The electronic and optical properties of the novel nanocomposite materials are thoroughly characterized. LESO-PB provides the transfer of the developed technology from science to market - including the upscaling of the processes to industrial production. The novel glazing will allow a perfect architectural integration of solar thermal collectors into the building envelope, thereby creating new possibilities for water and space heating as well as for solar cooling.

Integrated Multifunctional Glazing for Dynamical Daylighting

**Funding:** Swiss Federal Office of Energy (SFOE)  
**Duration:** 2009-2012

The project is aiming to set the bases for an integrated multi-functional glazing for dynamic daylighting using novel microstructures which will redirect sunlight into office rooms.

Unique and Innovative Solution for Building Integration of Thin Film Silicon PV modules

ARCHINSOLAR

**Funding:** SwissElectric Research, Swiss Federal Office of Energy (SFOE), Competence Center Energy and Mobility CCEM-CH, Services Industriels de Genève  
**Duration:** 2009-2012

The Archinsolar project aims at the development of a new generation of photovoltaic elements based on thin film silicon technology (single amorphous and tandem amorph/microcrystalline cells). These new elements will be ultra-reliable. They will make possible very low manufacturing costs and unique architectural integration, and be respectful of the environment, landscape, buildings and traditions.

Advanced Switchable Selective Absorber Coating for Overheating Protection of Solar Thermal Collectors

**Funding:** Swiss Federal Office of Energy (SFOE)  
**Duration:** 2009-2011

Overheating and the resulting stagnation of solar thermal collectors is a common problem even in central European latitudes. A promising way to protect solar thermal systems without any mechanical device (e.g. for shading or for pressure release) is to provide them with a coating which exhibits a change in optical properties at a critical temperature $T_c$. This project aims at the development of such coatings with thermochromic, “intelligent” properties.
COMPUTER MODELLING OF COMPLEX SYSTEMS

Group leaders: Dr Darren Robinson (until 9.2011) / Dr Jérôme Kaempf (from 10.2011)
PhD student: Urs Wilke

By itself, building physics is concerned with rather elementary physics laws. But the construction, operation, and demolition of a building are connected with many different aspects, and their interactions makes the complete system complex. The complexity is even increased when dealing with a whole district or a city instead of only one building.

This research domain includes two different aspects:

- modelling of building behaviour where non-deterministic aspects must be considered, such as user behaviour (occupancy, individual preferences relative to comfort, etc) or the stochastic nature of weather conditions;
- modelling of large groups of elementary buildings, where the complexity arises from the numerous interactions between the individual objects (buildings).

This domain is closely linked with the domain Sustainable Urban Development: notably, both domains cover the study of similar objects (urban districts or a whole city), and they are concerned with the modelling of similar phenomena (ecosystemic modelling, interaction with the environment).

Published work relates to

- Urban sustainable planning tools with 3D models (Suntool)

Activities 2011

In 2011 a weak link was established between the SNSF project partner’s multi-agent modelling tool MATSim and our urban energy flow modelling tool CitySim. The first case study was carried out on a small neighbourhood of Zurich city. Its scope is due to be extended in 2012.
Current Projects

**An Investigation of Strategies leading to a 2000W City using Bottom-up Models of Urban Energy Flows**

**Funding:** Swiss National Science Foundation (SNSF)

**Duration:** 2009-2012

In this project we will develop a detailed spatially explicit model of the dynamic flows of energy and matter within a city due to transportation, the operation of buildings and the activities accommodated by them. This will involve the further development and integration of CitySim -- the most fully developed model available for explicit simulation of building-related energy flows in urban settlements -- and MATSIM -- a detailed transport micro-simulation model. The resulting platform should allow the simulation of all key physical urban resource flows. Once integrated, calibrated and validated, it will be applied to the city of Zürich to produce new guidance for its development up until 2050, with a view to achieving a 2000W/capita city.
# EDUCATION AND TEACHING

## COURSES AND STUDENT NUMBERS 2011/2012

### Bachelor/Master Programmes

<table>
<thead>
<tr>
<th>Course title</th>
<th>Lecturer</th>
<th>Students</th>
<th>Students numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Physics I</td>
<td>Prof. J.-L. Scartezzini</td>
<td>AR BA SEM1</td>
<td>361</td>
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<tr>
<td>Building Physics II</td>
<td>Dr A. Schuler</td>
<td>AR BA SEM2</td>
<td>310</td>
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<td>Building Physics III</td>
<td>Dr J. Kaempf</td>
<td>AR BA SEM3</td>
<td>134</td>
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<td>Building Physics IV</td>
<td>Prof. J.-L. Scartezzini</td>
<td>AR BA SEM4</td>
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<td>Building Physics V</td>
<td>Prof. J.-L. Scartezzini</td>
<td>AR BA SEM5</td>
<td>168</td>
</tr>
<tr>
<td>Building Physics VI</td>
<td>Prof. J.-L. Scartezzini, MSc J.-C. Hadorn</td>
<td>AR BA SEM6</td>
<td>139</td>
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<tr>
<td>Indoor Environment Quality</td>
<td>Prof. C.-A. Roulet, Dr M.C. Munari Probst, MSc C. Roecker</td>
<td>AR MA SEM1</td>
<td>98</td>
</tr>
<tr>
<td>Energy within Buildings</td>
<td>Dr N. Morel, MER Dr E. Gnansounou</td>
<td>GC MA SEM1+3</td>
<td>75</td>
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<tr>
<td>Sustainable Urban Development, Infrastructures</td>
<td>Prof. J.-L. Scartezzini, MER Dr D. Robinson</td>
<td>AR/GC/SIE BA SEM6 (ENAC Learning Units)</td>
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<tr>
<td>Building Integration of Renewable Energy</td>
<td>MSc C. Roecker, Dr M.C. Munari Probst</td>
<td>AR/GC BA SEM6 (ENAC Learning Units)</td>
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<td>Energy in the City</td>
<td>MER Dr D. Robinson, MER Dr E. Gnansounou</td>
<td>AR/GC/SIE BA SEM4 (ENAC Weeks)</td>
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<tr>
<td>Monitoring within ENAC</td>
<td>Dr N. Morel</td>
<td>AR/GC/SIE BA SEM4 (ENAC Weeks)</td>
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<td>Minor in Energy</td>
<td>Dr. N. Morel</td>
<td>AR/GC/SIE MA SEM1+3</td>
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<tr>
<td>Light and the Built Environment: Impact on Circadian Rhythms in Human</td>
<td>Dr M. Münch</td>
<td>EPFL PhD Students (Doctoral program Neuroscience)</td>
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## PhD Theses 2011

<table>
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<th>Title</th>
<th>Name</th>
<th>Advisers</th>
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<th># EPFL-Thesis</th>
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<tbody>
<tr>
<td>Urban districts' energy performance</td>
<td>O. Pol</td>
<td>MER Dr D. Robinson</td>
<td>2014</td>
<td>N/A</td>
</tr>
<tr>
<td>Multifunctional microstructured glazing for seasonal thermal control and daylighting</td>
<td>A. Kostro</td>
<td>Prof. J.-L. Scartezzini Dr A. Schueler</td>
<td>2014</td>
<td>N/A</td>
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<td>Automatic control of electrochromic Windows</td>
<td>N. Zarkadis</td>
<td>Prof. J.-L. Scartezzini Dr N. Morel</td>
<td>2014</td>
<td>N/A</td>
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<tr>
<td>Optimization of daylight in educational buildings in prevailing clear sky conditions and its consequent influence on energy efficiency</td>
<td>C. Basurto Davilla</td>
<td>Prof. J.-L. Scartezzini Dr J. Kaempf</td>
<td>2014</td>
<td>N/A</td>
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<td>Nano-structured Multilayer Coatings on Architectural Glazing for active Solar Energy Facades</td>
<td>S. Mertin</td>
<td>Prof. J.-L. Scartezzini Dr A. Schueler</td>
<td>2013</td>
<td>N/A</td>
</tr>
<tr>
<td>Building integrated Solar Energy Solutions for the Residential and Tertiary Sector</td>
<td>R. Peres Gagliano</td>
<td>Prof. J.-L. Scartezzini Dr M.C. Munari Probst</td>
<td>2013</td>
<td>N/A</td>
</tr>
<tr>
<td>Thermochromic VO2 Films for “Smart” Solar Energy Applications</td>
<td>A. Paone</td>
<td>Prof. J.-L. Scartezzini Dr A. Schueler</td>
<td>2013</td>
<td>N/A</td>
</tr>
<tr>
<td>A Bottom-up Model of City Metabolism</td>
<td>U. Wilke</td>
<td>MER Dr D. Robinson Dr F. Haldi</td>
<td>2013</td>
<td>N/A</td>
</tr>
<tr>
<td>The impact of Light on Comfort including Non-Image-Forming Effects</td>
<td>A. Borisuit</td>
<td>Prof. J.-L. Scartezzini Dr M. Münch</td>
<td>2013</td>
<td>N/A</td>
</tr>
<tr>
<td>Urban resource Flow Modelling: from the Neighbourhood to the City</td>
<td>D. Perez</td>
<td>MER Dr D. Robinson Dr J. Kaempf</td>
<td>2013</td>
<td>N/A</td>
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<tr>
<td>Heat and Corrosion resistant Nano-composite selective Solar Absorber Coatings by Sol-Gel Processing</td>
<td>M. Joly</td>
<td>Prof. J.-L. Scartezzini Dr A. Schueler</td>
<td>2012</td>
<td>N/A</td>
</tr>
<tr>
<td>On the Adaptation of Building Controls to the Envelope and the Occupants</td>
<td>D. Daum</td>
<td>Prof. J.-L. Scartezzini Dr N. Morel</td>
<td>2010-2011</td>
<td>4935</td>
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</table>

## PhD External Committees

<table>
<thead>
<tr>
<th>Involvement</th>
<th>Name</th>
<th>University</th>
<th>Adviser</th>
<th>Year</th>
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</thead>
<tbody>
<tr>
<td>PhD Candidacy exam</td>
<td>C.P. Agullo</td>
<td>EPFL CCLAB</td>
<td>Dr A. Schueler</td>
<td>2011</td>
</tr>
<tr>
<td>Co-supervisor PhD thesis</td>
<td>L. Maierova</td>
<td>Czech Univ. Prague</td>
<td>Dr M. Münch</td>
<td>2011-2013</td>
</tr>
<tr>
<td>Co-supervisor PhD thesis</td>
<td>G. Caruso</td>
<td>University of Pisa</td>
<td>Dr J. Kaempf</td>
<td>2011-2012</td>
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</table>

## Outside Teaching

<table>
<thead>
<tr>
<th>Title</th>
<th>Institution</th>
<th>Year</th>
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<tbody>
<tr>
<td>Light and Rhythms, Lecture within optional Bachelor course &quot;Sleep and circadian rhythms&quot; led by MER Dr P. Franken – Dr M. Münch</td>
<td>Lausanne University</td>
<td>2011</td>
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Master Theses

<table>
<thead>
<tr>
<th>Title</th>
<th>Student/Institution</th>
<th>Year</th>
<th>Programme</th>
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</thead>
<tbody>
<tr>
<td>Architecture de montagne et écologie: un bâtiment public à Verbier (VS)</td>
<td>L. Berset (EPFL) S. Martin (EPFL)</td>
<td>2011-2012</td>
<td>MSc Architecture</td>
</tr>
<tr>
<td>Un bâtiment de logements comme réponse économique et sociale, à Mégève (F)</td>
<td>M. Chardon (EPFL)</td>
<td>2011-2012</td>
<td>MSc Architecture</td>
</tr>
<tr>
<td>Restructuration d’un site industriel</td>
<td>G. Cochand (EPFL) P. Gautschi (EPFL)</td>
<td>2011-2012</td>
<td>MSc Architecture</td>
</tr>
<tr>
<td>Centre sportif sur le site de la Tronchennaz à Villeneuve</td>
<td>M. Ruck (EPFL)</td>
<td>2011-2012</td>
<td>MSc Architecture</td>
</tr>
<tr>
<td>Masterplan EPFL Research Center in Ras al Khainah (UAE)</td>
<td>S. Coccol (Politecnico di Torino)</td>
<td>2011-2012</td>
<td>M Architecture</td>
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</table>

STUDENTS FROM FOREIGN UNIVERSITIES, INTERNS AND GRANT HOLDERS

<table>
<thead>
<tr>
<th>LESO-PB Research Group</th>
<th>Student/Institution</th>
<th>Year</th>
<th>Programme</th>
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</thead>
<tbody>
<tr>
<td>Study of Passive Solar Energy in Social Housing in Bogota, Colombia</td>
<td>A. Cifuentes</td>
<td>2011-2012</td>
<td>Confederation grant holder</td>
</tr>
<tr>
<td>Nanostructured Materials for Renewable Energies</td>
<td>N. Jolissaint</td>
<td>2011-2012</td>
<td>Intern BNF</td>
</tr>
<tr>
<td>Variation Calculus Method for the Optimization of Building Form</td>
<td>G. Caruso, University of Pisa</td>
<td>2011-2012</td>
<td>PhD Student</td>
</tr>
<tr>
<td>Influence of Daylight on the Indoor Environment Quality</td>
<td>L. Maierova, Czech Univ. Prague</td>
<td>2011</td>
<td>PhD Student Sciex-NMS</td>
</tr>
<tr>
<td>Sustainable Urban Development and Modelling</td>
<td>S. Pili, University of Cagliari</td>
<td>2011</td>
<td>PhD Student</td>
</tr>
<tr>
<td>Computer Simulations of Advanced Daylighting Systems</td>
<td>A. Jahveri, IIT Mumbay</td>
<td>2011</td>
<td>Post-grad Intern</td>
</tr>
<tr>
<td>Sustainable Urban Development and Modelling</td>
<td>S. Metha, IIT Madras - Chennai</td>
<td>2011</td>
<td>Post-grad Intern</td>
</tr>
<tr>
<td>Nanostructured Materials for Renewable Energies</td>
<td>M. Geiger</td>
<td>2011</td>
<td>Post-grad Intern</td>
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<tr>
<td>Sustainable Urban Development and Modelling</td>
<td>N. Gharbi, Ecole centrale de Lyon</td>
<td>2011</td>
<td>Masters Intern</td>
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<tr>
<td>IT Support</td>
<td>P. Roulin, ETML</td>
<td>2011</td>
<td>Trainee</td>
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<tr>
<td>IT Support</td>
<td>R. Mas, ETML</td>
<td>2011</td>
<td>Trainee</td>
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<tr>
<td>Modelling and Optimisation of Energy Flows</td>
<td>D. Li, China</td>
<td>2010-2011</td>
<td>PhD Grant holder</td>
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<tr>
<td>Sustainable Urban Development and Modelling</td>
<td>M. Papadopoulou</td>
<td>2010-2011</td>
<td>Confederation grant holder</td>
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<tr>
<td>IT Support</td>
<td>J. Ceppi</td>
<td>2010-2011</td>
<td>Civil Service</td>
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<tr>
<td>Building Integration of Renewable Energies</td>
<td>G. Stoll</td>
<td>2010-2011</td>
<td>Civil Service</td>
</tr>
</tbody>
</table>
PUBLICATIONS 2011

Details see http://infoscience.epfl.ch.

REFEREED SCIENTIFIC JOURNALS


D. Daum, F. Haldi and N. Morel. A personalized measure of thermal comfort for building controls, in *Building and Environment*, vol. 46, num. 1, p. 3-11, 2011


CONFERENCE PROCEEDINGS


Conference proceedings [cont’d]


O. Pol, D. Robinson, Impact of urban morphology on building energy needs: A review on knowledge gained from modeling and monitoring activities, in Proc. of CISBAT 2011, Lausanne, September 14-16, 2011


EXTENDED CONFERENCE ABSTRACTS


Conference abstracts [cont’d]


BOOKS, PHD THESES


OTHER PUBLICATIONS, REVIEWS, EXPERTISE REPORTS


M. Münch, Chronobiologie: Rhythmen des Lebens (German), in Psychiatrie & Neurologie, vol 2, p.16-18, 2011
INVITED PRESENTATIONS


Scartezzini J.-L., State of the Union in Daylighting at EPFL. Keynote Speaker, 4th VELUX Daylight Symposium, EPFL Campus, Lausanne (Switzerland), May 2011


Scartezzini J.-L., CleanTech Worldwide Categories: The Switzerland Assets, Invited Lecture, CleanTech Investment Seminar, Beaulieu Conference Center, Lausanne (Switzerland), December 7th-8th 2011

Kämpf J., Solar Energy from Nano to Urban Scale: Actual Projects and Perspectives in the Sustainable Urban Development Group, Invited Lecture, Joint EPFL-SJTU Workshop on Sustainable Urban Regeneration, Jiaotong University, Shanghai, 7-11 November 2011

Schüler A., Nanocomposite thin films for solar energy applications, Invited Lecture, Centre de Recherche Européenne CREE de St-Gobain, Cavaillon, France, January 26th, 2011


Schüler A., Nanocomposite coatings for solar energy conversion: Large opportunities for small structures, Invited Lecture, Eidgenössische Technische Hochschule Zürich ETHZ, May 19th, 2011


Munari Probst M.C., Solar Thermal Technologies and Buildings, Invited Lecture, Melbourne Forum: Solar Architecture Melbourne, Australia, 29 September 2011

Munari Probst M.C., Integration des systèmes solaires: limites et possibilités, Invited Lecture, Commune de Pully, 25 May 2011

Munari Probst M.C., Architectural Integration of Solar Thermal, Invited Lecture, Solar Energy and Architecture: Knowledge and Inspiration Seminar, Oslo, Norway, 1 April 2011

Munari Probst M.C., Invited Lecture, Solar energy and Urban Planning Workshop, Copenhagen February 2011

Münch M., Daylight: Visual comfort and non-visual functions, Keynote Speaker, 4th VELUX Daylight Symposium, EPFL, Lausanne (Switzerland), May 2011

Li W., CitySim: Comprehensive Micro-simulation of Energy Flows for Sustainable Urban Planning and Retrofitting, Invited Lecture, Joint EPFL-SJTU Workshop on Sustainable Urban Regeneration, Jiaotong University, Shanghai, 7-11 November 2011

Perez D., Modélisation des flux énergétiques durables, Invited Speaker, Ecoparc Neuchâtel, March 24, 2011
### MEDIA

Borisuit A.,

Münch M.,
Natural light is best for the brain, *World Radio Switzerland*, June 7, 2011

Münch M., Scartezzini J.-L.,

Münch M.,
Fit durch Licht; *Focus*, January 2011 Lectures

Münch M.,
Licht sorgt für Gesundheit (German), *Tagesanzeiger*, October 2011

### LESO LUNCHTIME LECTURES

<table>
<thead>
<tr>
<th>Title</th>
<th>Lecturer</th>
<th>Date</th>
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<tbody>
<tr>
<td>L’Adaptation au lieu de l’architecture vernaculaire dans les régions de montagne avec les nouvelles techniques constructives, combinaison parfaite prouvée pour construire ou rénover des bâtiments performants</td>
<td>Josep Bunyesc, architecte indépendant / Technical University of Catalogna (E)</td>
<td>02.12.2011</td>
</tr>
<tr>
<td>Ouvertures et impasses d’une politique énergétique de ville</td>
<td>Jean-Yves Pidoux, conseiller municipal, directeur</td>
<td>11.11.2011</td>
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<tr>
<td>A GIS based Spatial Decision Support System for integrating buildings energy efficiency in urban policies</td>
<td>Stefano Pili, University of Cagliari (I)</td>
<td>15.07.2011</td>
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<tr>
<td>Dynamic thermal behaviour and energy optimization of building envelope, in regions with high levels of solar radiation</td>
<td>Gianpiero Caruso, University of Pisa (I)</td>
<td>17.06.2011</td>
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<tr>
<td>Daylight and Windows - Is it possible to address a more ‘holistic’ approach to daylight requirements?</td>
<td>Jens Christoffersen, Velux (DK)</td>
<td>06.05.2011</td>
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<tr>
<td>Sustainable urban growth: New floating dwellings on the lagoon of Venice</td>
<td>Andrea Ferialdi, Studio Ferialdi - Zannovello, Venice (I)</td>
<td>15.04.2011</td>
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# REPRESENTATION

## EPFL INTERNAL

<table>
<thead>
<tr>
<th>Name</th>
<th>Board, committee etc.</th>
<th>Start</th>
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</thead>
<tbody>
<tr>
<td>Prof. J.-L. Scartezzini</td>
<td>Member of ENAC Academic Promotion Committee</td>
<td>2009</td>
<td>-</td>
</tr>
<tr>
<td>Prof. J.-L. Scartezzini</td>
<td>Chairman of CISBAT 2011 Editorial Committee</td>
<td>2011</td>
<td>2012</td>
</tr>
<tr>
<td>Prof. J.-L. Scartezzini</td>
<td>Member of Working Group on Excellence in Doctoral Education</td>
<td>2008</td>
<td>-</td>
</tr>
<tr>
<td>Prof. J.-L. Scartezzini</td>
<td>EPFL Doctoral Programme in Energy (EDEY), Member of Doctoral Committee</td>
<td>2010</td>
<td>-</td>
</tr>
<tr>
<td>Dr. N. Morel</td>
<td>Member of CISBAT 2011 Scientific Committee</td>
<td>2009</td>
<td>2011</td>
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<tr>
<td>MER Dr D. Robinson</td>
<td>Member of CISBAT 2011 Scientific Committee</td>
<td>2009</td>
<td>2011</td>
</tr>
<tr>
<td>Dr. M.C. Munari P.</td>
<td>Expert examiner at EPFL Design Studio of Prof. S. Benish</td>
<td>2011</td>
<td>2011</td>
</tr>
<tr>
<td>Dr. A. Schueler</td>
<td>Member of CISBAT 2011 Scientific Committee</td>
<td>2009</td>
<td>2011</td>
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<tr>
<td>Dr. A. Schueler</td>
<td>Coordinator for Security COSEC for LESO-PB</td>
<td>2011</td>
<td>-</td>
</tr>
<tr>
<td>Dr. A. Schueler</td>
<td>Coordination of technical services EPFL, validation of security for new Nanosolar Laboratory</td>
<td>2011</td>
<td>2011</td>
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<tr>
<td>MSc C. Roecker</td>
<td>Member of CISBAT 2011 Scientific Committee</td>
<td>2009</td>
<td>2011</td>
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<tr>
<td>MSc C. Roecker</td>
<td>Member of ESOPP Scientific and Piloting Committees</td>
<td>2010</td>
<td>-</td>
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<tr>
<td>MSc M. Joly</td>
<td>Coordinator Bike to Work contest</td>
<td>2010</td>
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## EPFL EXTERNAL

<table>
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<tr>
<th>Name</th>
<th>Organisation, Function</th>
<th>Start</th>
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<tbody>
<tr>
<td>Prof. J.-L. Scartezzini</td>
<td>Novatlantis Platform, ETH-Board Evaluation (Bern), Member of Experts Panel</td>
<td>2010</td>
<td>2011</td>
</tr>
<tr>
<td>Prof. J.-L. Scartezzini</td>
<td>European Centre and Laboratories for Energy Efficiency Research (ECLER), Member of Advisory Board</td>
<td>2009</td>
<td>-</td>
</tr>
<tr>
<td>Prof. J.-L. Scartezzini</td>
<td>International Journal of Photoenergy, Member of Editorial Advisory Board</td>
<td>2010</td>
<td>-</td>
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<tr>
<td>Prof. J.-L. Scartezzini</td>
<td>The Open Construction &amp; Building Technology Journal, Member of Editorial Advisory Board</td>
<td>2009</td>
<td>-</td>
</tr>
<tr>
<td>Prof. J.-L. Scartezzini</td>
<td>Solar Energy International Journal, Associate Editor</td>
<td>2000</td>
<td>-</td>
</tr>
<tr>
<td>Prof. J.-L. Scartezzini</td>
<td>Qatar National Research Fund (QNRF), National Priorities Research Program (NRRP), Peer Reviewer</td>
<td>2007</td>
<td>-</td>
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<tr>
<td>Prof. J.-L. Scartezzini</td>
<td>SIA Regards 2011 – National award for sustainable and promising achievements, Swiss Society for Engineers and Architects (SIA), Zurich, Member of Jury Panel</td>
<td>2010</td>
<td>2011</td>
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<tr>
<td>Prof. J.-L. Scartezzini</td>
<td>Swiss Competence Centre for Energy and Mobility (CCEM-CH), Research Committee Chair</td>
<td>2005</td>
<td>-</td>
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<tr>
<td>Prof. J.-L. Scartezzini</td>
<td>International Council for Research and Innovation in Building and Construction, EPFL Representative</td>
<td>2004</td>
<td>-</td>
</tr>
<tr>
<td>Prof. J.-L. Scartezzini</td>
<td>European Renewable Energy Research Centres Agency (EUREC), College of Members, EPFL Representative</td>
<td>2004</td>
<td>-</td>
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### EPFL external representation [cont’d]

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<thead>
<tr>
<th>Name</th>
<th>Position/Programme/Association</th>
<th>Years</th>
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<tr>
<td>Prof. J.-L. Scartezzini</td>
<td>Ministry of Région Wallone, Energy Division, ENERBAT 2011 Programme, Expert Reviewer</td>
<td>2011</td>
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<tr>
<td>MER Dr. D. Robinson</td>
<td>Journal of Building Performance Simulation, Editorial Board Member</td>
<td>2009</td>
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<tr>
<td>MER Dr. D. Robinson</td>
<td>National Science Foundation of Portugal, Programme Architecture and Urban Studies, Member of Evaluation Committee</td>
<td>2009</td>
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<tr>
<td>MER Dr. D. Robinson</td>
<td>Research Program &quot;UrbanNet&quot;, Swedish Research Council, Member of Evaluation Committee</td>
<td>2010</td>
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<tr>
<td>MER Dr. D. Robinson</td>
<td>On-line journal “Sustainability”, Editorial Board Member</td>
<td>2009</td>
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<tr>
<td>MER Dr. D. Robinson</td>
<td>EcoParc (Neuchâtel), Board Member</td>
<td>2009</td>
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<tr>
<td>MER Dr. D. Robinson</td>
<td>French National Research Agency (ANR), Programme “Villes Durables”, Member of Evaluation Committee</td>
<td>2008</td>
</tr>
<tr>
<td>MER Dr. D. Robinson</td>
<td>Swiss Chapter of Int. Building Performance Simulation Association (IBPSA-CH), Founding Board Member</td>
<td>2006</td>
</tr>
<tr>
<td>Dr M.C. Munari Probst</td>
<td>IEA Task 41 Solar Energy and Architecture, Subtask A co-leader</td>
<td>2009</td>
</tr>
<tr>
<td>Dr M.C. Munari Probst</td>
<td>Swissolar Association (Bern), Member of Architecture Group</td>
<td>2010</td>
</tr>
<tr>
<td>Dr M.C. Munari Probst</td>
<td>Conference PLEA 2011, Louvain La Neuve, Belgium, Session Chair</td>
<td>2011</td>
</tr>
<tr>
<td>MSc C. Roecker</td>
<td>IEA Task 41 Solar Energy and Architecture, Subtask A co-leader</td>
<td>2009</td>
</tr>
<tr>
<td>MSc C. Roecker</td>
<td>French National Research Agency (ANR), Member of Evaluation Committee</td>
<td>2011</td>
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</tbody>
</table>
Solar Energy and Building Physics Laboratory (LESO-PB)
Swiss Federal Institute of Technology Lausanne (EPFL)
School of Architecture, Civil and Environmental Engineering (ENAC)
Civil Engineering Institute (IIC)

EPFL – ENAC – LESO-PB
Bâtiment LE
Station 18
CH-1015 Lausanne
Switzerland

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Fax: +41 21 693 2722
Email: leso-pb@epfl.ch

http://leso.epfl.ch