Activity Report 2013

Innovations for Renewable Energy Use in the Built Environment
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 and project leaders, the laboratory counts about 40 scientists, engineers and technicians. This report presents the teaching, research and technology transfer for 2013.

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RESEARCH HIGHLIGHTS

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. Due to the staff development in 2013-14, the following new research axes have been defined:

- Complex urban systems
- Smart buildings / Smart cities
- Nanotechnology for solar energy conversion
- Integrated day and electric lighting
- Architectural integration of renewable energy

This report describes the activities of the lab as structured until 2013.

Highlights 2013

- **CISBAT 2013 International Conference "CleanTech for Smart Cities and Buildings - From Nano to Urban Scale"** - Designed as a platform for interdisciplinary dialog and presentations of innovative research and development in the field of sustainability in the built environment, the conference covered a wide range of subjects from solar nanotechnologies to the simulation of buildings and urban areas. LESO-PB hosted the conference for the 12th time in academic partnership with Cambridge University, MIT and the Swiss Chapter of IBPSA, and backed by a strong international scientific committee. The conference registered a record number of participants and submissions and received excellent feedback.

- **Four patents pre-submitted in 2012 were filed in 2013** by the group "Nanotechnology for Solar Energy Conversion" in the framework of collaboration with different industrial partners (SwissINSO SA, BASF Switzerland AG, Solar Control SA, Zettl GmbH).

- **Release of CitySim**, a decision support software tool for urban energy planners and stakeholders to minimize the net use of non-renewable energy sources as well as the associated emissions of greenhouse gases. The software comprises CitySim Designer, a Graphical User Interface (GUI) set-up to facilitate the 3D geometrical and thermo-physical description of buildings as well as the visualization of simulation results. It also includes CitySim Solver, an Integrated Solver (IS) for simulating the energy demand and supply of buildings for space conditioning. Great interest has been shown for this tool both by the academic world and by city planners.

Further research activities are presented in the following pages.

2013 AWARDS AND HONOURS

<table>
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<tr>
<th>Name</th>
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<th>Year</th>
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| Dr M. Joly, Dr A. Schuler and al. | Solar Energy Journal  
Best Paper Award 2012-2013 | 2013  |
| Dr M. Münch              | Election at the Scientific Board Member in the Society for Light Treatment and Biological Rhythms | 2013  |
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, Czeck 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.

- 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

2013 Activities

A project with patients suffering from ophthalmological diseases was completed in 2013 in collaboration with Privat Docent MER Dr. A. Kawasaki of Hôpital Ophtalmique Jules Gonin, Lausanne. A study on regulatory health functions of light in demented patients was also completed in 2013. A PhD thesis was successfully presented on the Impact of Light including Non-Image Forming Effects on Visual Comfort (Dr A. Borisuit) after completion of studies carried out on human subjects in the photobiological test rooms of the LESO Solar Experimental Building as well as in the Photobiological Laboratory (PHOBIO). Last year has also seen the conclusion of the main phase of the Post-Doctoral Fellowship in Daylighting and Perception supported by the VELUX Foundation at EPFL (2009-2013) and the promotion of Post-Doctoral Fellow Dr Mirjam Münch to Lecturer and Senior Researcher at University Hospital La Charité in Berlin (Germany). Further analyses of a large amount of data regarding the Non-Image Forming Effects of Light, collected during experimental campaigns, will be carried out in 2014 in the course of Post-Doctoral studies of the newly promoted PhDs.
Current Projects

IEA-SHC Task 50 Advanced lighting solutions for retrofitting buildings
**Funding:** Swiss Federal Office of Energy (SFOE)
**Duration:** 2013-2015
Lighting accounts for approx. 19% of the global electricity demand. Energy efficient lighting techniques including daylighting, electric lighting and control can contribute to significant reduction of the electricity consumption. IEA SHC Task 50 will be focused on non-residential buildings dealing with advanced lighting solutions for building retrofits.

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:** 2012-2013
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.

Integrated Multifunctional Glazing for Dynamical Daylighting
**Funding:** Swiss Federal Office of Energy (SFOE)
**Duration:** 2009-2013
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:** 2013-2014
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
- The impact of light including non-image forming effects on visual comfort, EPFL PhD thesis #6007, 2013
- Energetic, visual and non-visual aspects of office lighting, Friedrich Linhart, EPFL PhD Thesis #4587, 2010
- Bayesian optimisation of visual comfort, David Lindelof, EPFL PhD Thesis #3918, 2007

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

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

2013 Activities

A CCEM project “Integration of Decentralized Energy Adaptive Systems for cities” was initiated in 2013 to study the adequacy between the renewable energy production and storage through the possibility of groups of buildings to function as islanded from the resource networks (electricity, gas and heat). This project is a new collaboration between EPFL, ETHZ and EMPA in the field of “Urban Physics”.

The last year saw also the completion of the MEU project “Innovative Planning and Management Instruments of Urban Energy Systems” initiated by the EPFL Energy Centre and supported by Swiss municipalities.
Current Projects

QUAD - Sustainable Districts
Funding: Research Center for Energy and Municipalities (CREM)
Duration: 2011-2013
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.

Innovative Planning and Management Instruments of Urban Energy Systems
Funding: EPFL Energy Center
Duration: 2009-2013
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.

IDEAS4cities – Integration of Decentralized Energy Adaptive Systems for cities
Funding: Competence Center Energy and Mobility (CCEM)
Duration: 2013-2016
This project is centred at introducing the concepts of the urban energy hub, a facility that manages the energy flows within a city quarter or community, and the urban microgrid, a small-scale urban energy system integrating electrical and thermal local generation, loads and storage having the possibility to locally interact with these devices to achieve optimal control functionalities. The integration of energy hubs and microgrids in urban energy systems would lead to a new system configuration where the pros and cons of the different energy carriers are better utilized as compared with today’s urban energy system.

UMEM - Sustainable cities and urban energy systems of the future: Urban Multiscale Energy Modelling
Funding: Competence Center Energy and Mobility (CCEM)
Duration: 2012-2015
In this project the focus is on finding sustainable solutions for achieving energy targets on city quarter level, rather than at building scale. The urban energy retrofit scenarios profit from the enlarged economical potential of energy efficiency, energy production and energy storage by a cluster of buildings which are interconnected in a city neighbourhood and profiting from the urban energy infrastructure. The new urban energy retrofit scenarios’ have to take into account the impact of the urban heat island effect and the changing urban microclimate (e.g. heat waves) due to climatic change. The new concepts have to guarantee sustainable living conditions, comfort and health for their inhabitants in the urban and building environment. The developed urban energy simulation framework will help collectivities, urban planners and stakeholders to evaluate the environmental impact of cities in a changing climate and to provide a basis for testing new urban energy retrofit scenarios.

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
BIO-MIMETIC BUILDING CONTROL

Group leader: Dr Nicolas Morel
PhD student: 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).

2013 Activities

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.

The group’s work focused on the project Green-Mod supported by the Hasler Foundation; 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

**Green-Mod: Toward Reliable Stochastic Data-Driven Models Applied to the Energy Savings in Buildings**

*Funding:* Hasler Foundation  
*Duration:* 2012-2014  

The Green-Mod project aims to produce a Building Information Management System (BIMS) able to minimize the energy demand in buildings while preserving human comfort. The main innovation of this BIMS for HVAC, sunshadings and electric lighting will be the use of state-based stochastic modelling applied to temporal signals acquired from heterogeneous sources.

**CCEM-SuRHiB: Sustainable Renovation of Historical Buildings**

*Funding:* Swiss Competence Center for Energy and Mobility (CCEM)  
*Duration:* 2009-2013  

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


Awards in this domain

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

Group leader: MSc. EPFL Christian Roecker
Postdoctoral researcher: Dr Maria Cristina Munari Probst
Research assistants: Georges Meylan

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 51 “Solar Energy in Urban Planning”.

Published work relates to

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

2013 Activities

One main activity of the group was the lead of working group in "Processes, methods and tools" in the IEA SHCP Task 51 “Solar Energy in Urban Planning”.

Specific teaching on architectural integration of active+e solar systems continued through a dedicated ENAC Learning Unit (UEE 04, “Intégration architecturale de l’Energie Solaire”) and participation in theoretical courses. Participation for architectural integration specifications in the project Archinsolar, contribution to tile design. Architectural integration research work continued in collaboration with several Swiss institutions (SUPSI, HSLU, Swissolar). Further development and preparation of an application documents for the practical implementation of the "LESO-QSV" method.
Current Projects

**IEA SHC Task 51 Solar Energy in Urban Planning**
*Funding:* Swiss Federal Office of Energy (SFOE)
*Duration:* 2013 - 2017
The main goal of Task 51 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.

**ARCHINSOLAR - Unique and Innovative Solution for Building Integration of Thin Film Silicon PV modules**
*Funding:* Competence Center Energy and Mobility (CCEM-CH)
*Duration:* 2009-2013
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:* 2011-2013
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.

Documents published in this domain


Christian Roecker, Maria Cristina Munari Probst, responsables du site web pour les Task 41 et Task 51
Web-site: Innovative solar products for architectural integration
NANOTECHNOLOGY FOR SOLAR ENERGY CONVERSION

Group leader: Dr Andreas Schüler
Postdoctoral researcher: Dr Martin Joly; Research Engineers: Olivia Bouvard, Matthieu Perrenoud
PhD students: Antonio Paone, André Kostro; Internship student: Mario Geiger

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

2013 Activities

Highlights from LESO-PB activities in Nanotechnology include:
- Novel colored glazing for roof-integrated photovoltaic modules (project ARCHINSOLAR)
- Novel project on microstructured glazing for daylighting under investigation (SFOE)
- Studies on energy-efficiency of public transportation in collaboration with University of Basel, Lucerne University of Applied Sciences and major Swiss transportation companies
- Collaboration with industry in the field of receiver tubes for parabolic trough collectors

Promotion of patent applications 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

**MICRO3D – Innovative fenestration system combining seasonal thermal dynamics, daylighting, glare protection and transparency – Manufacturing of embedded 3D microstructures**  
*Funding:* Swiss Federal Office of Energy (SFOE)  
*Duration: 2013-2015*

The innovative glazing system proposed in this project will combine several functions. Solar gains will be used during wintertime to reduce the heating demand; sunrays will be blocked during summertime to mitigate the cooling load and avoid glare. A judicious use of daylighting will reduce furthermore the electricity demand for lighting and improve the wellbeing of occupants.

**Technology Transfer of Coloured Solar Thermal Collectors**  
*Funding:* SwissINSO Trade & Invest Ltd  
*Duration: 2009-2013*

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: 2009-2013*

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 (SER), Swiss Federal Office of Energy (SFOE), Competence Center Energy and Mobility (CCEM-CH), Services Industriels de Genève (SIG)  
*Duration: 2009-2013*

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.

**Thermochromic coatings for overheating protection of solar thermal collectors: temperature matching and triggering**  
*Funding:* Swiss Federal Office of Energy (SFOE)  
*Duration: 2012-2013*

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.

**Energy efficiency of public transportation**  
*Funding:* SwissElectric Research (SER), Swiss Federal Office of Energy (SFOE), Federal Office of Transport (FOT)  
*Duration: 2012-2015*

Recent studies have shown that the energy used for heating and cooling of trains and trolleybuses can be in the same order of magnitude than the energy used for traction. The project aims at understanding the reasons for these tremendous energy losses, and at making suggestions for improvement. Several trains are equipped with data acquisition systems for a detailed monitoring of the various consumers on board, as well as with sensors for characterizing the outdoor and indoor climatic conditions. Thermal models of the trains and trolleybuses allow quantifying the potential impact of measures for improving their energy efficiency. Within this project, we focus on improvement of the envelope of the trains and trolleybuses.
COMPUTER MODELLING OF COMPLEX SYSTEMS

Group leader: Dr Jérôme Kaempf
PhD student: Urs Wilke

By itself, building and urban 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)

2013 Activities

The activities in this domain were formally completed at the end of the SNSF project “An investigation of strategies leading to a 2000 Watts society using bottom-up models of urban energy flows”. It came to a fruitful conclusion with the successful presentation of Dr Urs Wilke’s PhD thesis dedicated to a Probabilistic Bottom-up Modelling of Occupancy and Activities in Residential Buildings.
Latest 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.

PhD thesis published in this domain at LESO-PB
## EDUCATION AND TEACHING

### COURSES AND STUDENT NUMBERS 2012/2013

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<thead>
<tr>
<th>Bachelor/Master Programmes</th>
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<td>Bachelor / Master Programmes</td>
<td>Building Physics I</td>
<td>Prof. J.-L. Scartezzini</td>
<td>AR BA SEM1</td>
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<td>Building Physics II</td>
<td>Dr. A. Schueler</td>
<td>AR BA SEM2</td>
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<td>AR BA SEM4</td>
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<td>AR BA SEM5</td>
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<td>Building Physics VI</td>
<td>Prof. J.-L. Scartezzini, MSc J.-C. Hadorn</td>
<td>AR BA SEM6</td>
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<tr>
<td></td>
<td>Indoor Environment Quality</td>
<td>Prof. M. Andersen, P. Zurbrügg, Dr. B. Karamata, Dr. M.C. Munari Probst</td>
<td>AR MA SEM1</td>
<td>14</td>
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<td></td>
<td>Energy within Buildings</td>
<td>Dr. N. Morel, Prof. tit. E. Gnansounou</td>
<td>GC MA SEM 1+3</td>
<td>57</td>
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<td></td>
<td>Sustainable Urban Development, Infrastructures</td>
<td>Prof. J.-L. Scartezzini, Dr. J. Kaempf, S. Coccolo</td>
<td>AR/GC/SIE BA SEM6 (ENAC Learning Units)</td>
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<td>Building Integration of Renewable Energy</td>
<td>MSc. Meylan Georges, Dr. M.C. Munari Probst, MSc. C. Roecker</td>
<td>AR/GC BA SEM6 (ENAC Learning Units)</td>
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<td>Monitoring within ENAC</td>
<td>Dr. M. Bensimon, MSc O. Burdet, MSc. M. Deront, M. Kradolfer, Dr. N. Morel</td>
<td>AR/GC/SIE BA SEM4 (ENAC Weeks)</td>
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## PhD Theses 2013

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<th>Name</th>
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<td>Bioclimatic Design of Sustainable Campuses using Advanced Optimisation Methods</td>
<td>S. Coccolo</td>
<td>Prof. J.-L. Scartezzini Dr J. Kämpf</td>
<td>2016</td>
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<td>Urban Multiscale Energy Modelling</td>
<td>G. Upadhyay</td>
<td>Prof. J.-L. Scartezzini Dr J. Kämpf</td>
<td>2016</td>
<td>N/A</td>
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<td>Solar Architecture Facades</td>
<td>R. Xu</td>
<td>Prof. J.-L. Scartezzini Prof. S. Wittkopf (NUS/HSLU Luzern)</td>
<td>2016</td>
<td>N/A</td>
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<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>
</tr>
<tr>
<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>2014</td>
<td>N/A</td>
</tr>
<tr>
<td>Urban resource Flow Modelling: from the Neighbourhood to the City</td>
<td>D. Perez</td>
<td>Prof. J.-L. Scartezzini Dr J. Kaempf</td>
<td>2014</td>
<td>N/A</td>
</tr>
<tr>
<td>The impact of Light Including Non-Image Forming Effects on Visual Comfort</td>
<td>A. Borisuit</td>
<td>Prof. J.-L. Scartezzini Dr M. Münch</td>
<td>2013</td>
<td>6007</td>
</tr>
<tr>
<td>Switchable Selective Absorber Coatings for Overheating Protection of Solar Collectors</td>
<td>A. Paone</td>
<td>Prof. J.-L. Scartezzini Dr A. Schueler</td>
<td>2013</td>
<td>5878</td>
</tr>
<tr>
<td>Probabilistic Bottom-up Modelling of Occupancy and Activities to Predict Electricity Demand in Residential Buildings</td>
<td>U. Wilke</td>
<td>Prof. J.-L. Scartezzini Dr F. Haldi</td>
<td>2013</td>
<td>5673</td>
</tr>
</tbody>
</table>

## PhD External Committees

<table>
<thead>
<tr>
<th>Involvement</th>
<th>Name</th>
<th>University</th>
<th>Adviser</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-supervisor PhD thesis</td>
<td>L. Maierova</td>
<td>Czech Univ. Prague</td>
<td>Dr M. Münch</td>
<td>2012-2014</td>
</tr>
<tr>
<td>Co-supervisor PhD thesis</td>
<td>J. Bunyesc</td>
<td>Universitat Politécnica de Catalunya Barcelona</td>
<td>Dr J. Kaempf</td>
<td>2009-2013</td>
</tr>
</tbody>
</table>

## Outside Teaching

<table>
<thead>
<tr>
<th>Title</th>
<th>Institution</th>
<th>Year</th>
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</thead>
<tbody>
<tr>
<td>Integrated approach to energy systems, Doctoral course, Dr J. Kämpf (32 students)</td>
<td>EuroTech PhD Summer School</td>
<td>2013</td>
</tr>
<tr>
<td>Integrated approach to energy systems, Doctoral course, Dr M.C. Munari Probst (32 students)</td>
<td>EuroTech PhD Summer School</td>
<td>2013</td>
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</tbody>
</table>
### Master Theses 2013

<table>
<thead>
<tr>
<th>Title</th>
<th>Student/Institution</th>
<th>Year</th>
<th>Programme</th>
</tr>
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<tbody>
<tr>
<td>Un écoquartier pour le plus grand nombre</td>
<td>Y. Mezzour (EPFL) J.D. Vesco (EPFL)</td>
<td>2012-2013</td>
<td>MSc Architecture</td>
</tr>
<tr>
<td>Masterplan EPFL Research Center in Ras al Khainah (UAE)</td>
<td>S. Coccolo (Politecnico di Torino)</td>
<td>2012-2013</td>
<td>MSc Architecture</td>
</tr>
</tbody>
</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>
</tr>
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<tbody>
<tr>
<td>Use of city energy simulator (CitySim) in the urban form optimisation</td>
<td>Th. Vermeulen, Univ. Compiègne (UTC), France</td>
<td>2013</td>
<td>PhD Student</td>
</tr>
<tr>
<td>Sustainable Urban Development and Modelling</td>
<td>S. Coccolo, Politecnico di Torino, Italy</td>
<td>2012-2013</td>
<td>Master Student</td>
</tr>
<tr>
<td>Sustainable Urban Development and Modelling</td>
<td>E. Walter</td>
<td>2013</td>
<td>Semester Student</td>
</tr>
<tr>
<td>IT Support</td>
<td>R. Jufer (ETML)</td>
<td>2013-2014</td>
<td>Trainee</td>
</tr>
<tr>
<td>IT Support</td>
<td>M. Delafontaine (ETML)</td>
<td>2012-2013</td>
<td>Trainee</td>
</tr>
<tr>
<td>Nanotechnology support</td>
<td>M. Perrenoud</td>
<td>2013</td>
<td>Civil Service</td>
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<tr>
<td>IT Support</td>
<td>F. Aeby</td>
<td>2013</td>
<td>Civil Service</td>
</tr>
</tbody>
</table>
PUBLICATIONS 2013

REFEREED SCIENTIFIC JOURNALS


A. Kawasaki, S. Collomb, L. Leon, L. M. Münch, Pupil responses derived from outer and inner retinal photoreception are normal in patients with hereditary optic neuropathy, in Experimental Eye Research, vol.120, p.161-166, 2013

S. Mertin, Stefan; Hody-Le Caër, Virginie; Joly, Martin; Mack, Iris; Oelhafen, Peter; Scartezzini, Jean-Louis; Schueler, Andreas. Reactively sputtered coatings on architectural glazing for coloured active solar thermal façades, in Energy and Buildings, [E-publication ahead of print in Jan. 2013].


A. Putilov, M. Münch, C. Cajochen, Principal component structuring of the Non-REM sleep EEG spectrum in older adults yields age - related changes in the sleep and wake drives, in Current Aging Science. 6(3), pp 280-293, 2013.


CONFERENCE PROCEEDINGS


Conference Proceedings [cont’d]


A. Cuéllar Cifuentes, V., J.H. Kämpf. Urban Energy Simulation of a Social Housing Neighbourhood in Bogota, Colombia. CISBAT 2013, Lausanne, Switzerland, September 4-6, 2013.


G. Reber, P. Oelhafen, L. Burnier and A. Schueler. Angular Dependent Solar Gain for Multiple Glazing from Optical and Thermal Data. CISBAT 2013, Lausanne, Switzerland, September 4-6, 2013.


N. Zarkadis and N. Morel. Advanced Control of Electrochromic Windows. CISBAT 2013, Lausanne, Switzerland, September 4-6, 2013.
EXTENDED CONFERENCE ABSTRACTS


OTHER PUBLICATIONS, REVIEWS, PATENTS, REPORTS


BOOKS, PHD THESES


INVITED PRESENTATIONS

Coccolo S., Il progetto bioclimatico urbano e la realtà montana. Spunti e riflessioni, Invited Lecture, Politecnico di Torino, 12th March 2013 (Italy)


Scartezzini J.-L., Opening address, CISBAT 2013 International Conference “Cleantech for Smart Cities and Buildings – From Nano to Urban Scale, EPFL, 4-6 September 2013, Lausanne (Switzerland)


Scartezzini J.-L., Daylight and Humans, Invited Lecture, Collegium Helveticum, November 18th 2013, Zürich, Switzerland

MEDIA

Scartezzini J.-L., Interview for SIA Prize Umsicht / Regard / Sguardo 2013, Schwarz pictures, April 21, 2013

LESO LUNCHTIME LECTURES

<table>
<thead>
<tr>
<th>Title</th>
<th>Lecturer</th>
<th>Date</th>
</tr>
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<tbody>
<tr>
<td>Singapore: The conflict between modern technology and sustainability</td>
<td>Ran Xu (EPFL and Lucerne University of Applied Sciences and Arts)</td>
<td>15.03.2013</td>
</tr>
<tr>
<td>Diametric strategies for ultra-efficient photovoltaics</td>
<td>Prof. Jeffrey Gordon (Ben Gurion University of the Negev, Israël)</td>
<td>23.07.2013</td>
</tr>
<tr>
<td>LEDsafari – A low-cost-easy-to-make electric lamp for developing countries</td>
<td>Govinda Upadhyay (EPFL)</td>
<td>08.11.2013</td>
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<tr>
<td>The evolution and complexities of urban structures</td>
<td>Nahid Mohajeri (EPFL)</td>
<td>06.12.2013</td>
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</table>
### EPFL INTERNAL

<table>
<thead>
<tr>
<th>Name</th>
<th>Board, committee etc.</th>
<th>Start</th>
<th>End</th>
</tr>
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<tbody>
<tr>
<td>Prof. J.-L. Scartezzini</td>
<td>Member of EPFL Excellence Fellowship Committee</td>
<td>2012</td>
<td>-</td>
</tr>
<tr>
<td>Prof. J.-L. Scartezzini</td>
<td>Member of SAR Academic Committee</td>
<td>2012</td>
<td>-</td>
</tr>
<tr>
<td>Prof. J.-L. Scartezzini</td>
<td>CISBAT 2013 Scientific Committee</td>
<td>2013</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>Prof. J.-L. Scartezzini</td>
<td>Member of Working Group on Excellence in Doctoral Education</td>
<td>2008</td>
<td>2013</td>
</tr>
<tr>
<td>Dr. J. Kämpf</td>
<td>CISBAT 2013 Scientific Committees</td>
<td>2013</td>
<td>-</td>
</tr>
<tr>
<td>Dr. N. Morel</td>
<td>CISBAT 2013 Scientific Committees</td>
<td>2013</td>
<td>-</td>
</tr>
<tr>
<td>Dr. M.C. Munari Pros</td>
<td>Member of CISBAT 2013 Scientific Committees</td>
<td>2013</td>
<td>-</td>
</tr>
<tr>
<td>Dr. A. Schueler</td>
<td>Member of SAR Teaching Committee</td>
<td>2011</td>
<td>-</td>
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<tr>
<td>Dr. A. Schueler</td>
<td>CISBAT 2013 Scientific Committee</td>
<td>2013</td>
<td>-</td>
</tr>
<tr>
<td>MSc C. Roecker</td>
<td>Member of ESOPP Scientific and Piloting Committees</td>
<td>2010</td>
<td>-</td>
</tr>
<tr>
<td>MSc C. Roecker</td>
<td>Member of programming group Swiss PV days</td>
<td>2013</td>
<td>2014</td>
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<tr>
<td>MSc C. Roecker</td>
<td>Member of CISBAT 2013 Scientific Committees</td>
<td>2013</td>
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### EPFL EXTERNAL

<table>
<thead>
<tr>
<th>Name</th>
<th>Organisation, Function</th>
<th>Start</th>
<th>End</th>
</tr>
</thead>
<tbody>
<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>IPCC Working Group III – Mitigation, Scoping Meeting for Renewable Energy, Expert Reviewer</td>
<td>2008</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>
</tr>
<tr>
<td>Prof. J.-L. Scartezzini</td>
<td>SIA Regards 2013 – National award for sustainable and promising achievements, Swiss Society for Engineers and Architects (SIA), Zurich, Member of Jury Panel</td>
<td>2013</td>
<td>2014</td>
</tr>
<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>2014</td>
</tr>
<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>
</tr>
<tr>
<td>Prof. J.-L. Scartezzini</td>
<td>Canadian Foundation for Innovation (CFI), Expert Reviewer</td>
<td>2010</td>
<td>-</td>
</tr>
<tr>
<td>Prof. J.-L. Scartezzini</td>
<td>Canadian Natural Science and Engineering Research Council (NSREC), Expert Reviewer</td>
<td>2012</td>
<td>-</td>
</tr>
<tr>
<td>Prof. J.-L. Scartezzini</td>
<td>Italian National Agency for the Evaluation of Universities and Research Institutes (ANVUR), Expert Reviewer</td>
<td>2012</td>
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**EPFL external representation (cont’d)**

<table>
<thead>
<tr>
<th>Name</th>
<th>Role and Responsibilities</th>
<th>Year 1</th>
<th>Year 2</th>
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<tbody>
<tr>
<td>Prof. J.-L. Scartezzini</td>
<td>CLIMA 2013 International Conference (Prague), Member of Scientific Committee and Session Chairman</td>
<td>2012</td>
<td>2013</td>
</tr>
<tr>
<td>Dr M.C. Munari Probst</td>
<td>IEA Task 51 Solar Energy and Urbanism, Subtask leader</td>
<td>2013</td>
<td>2017</td>
</tr>
<tr>
<td>Dr M.C. Munari Probst</td>
<td>Swissolar Association (Bern), Member of Architecture Group</td>
<td>2010</td>
<td>-</td>
</tr>
<tr>
<td>Dr M. Münch</td>
<td>Society for Light Treatment and Biological Rhythms Scientific Board</td>
<td>2013</td>
<td>-</td>
</tr>
<tr>
<td>MSc C. Roecker</td>
<td>IEA Task 51 Solar Energy and Urbanism, Subtask B leader group</td>
<td>2013</td>
<td>2017</td>
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<tr>
<td>MSc C. Roecker</td>
<td>Swiss PV days programming group</td>
<td>2013</td>
<td>-</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

Phone: +41 21 693 4545
Fax: +41 21 693 2722
Email: leso-pb@epfl.ch

http://leso.epfl.ch