3D Simulation tool to evaluate the urban energy efficiency performance
Summary

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2. CitySim 3D Simulation Tool
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1. Introduction

EDUCATION

Prof. PhD Jérôme Kaempf

3 Masters
- Physics (University of Lausanne)
- Computer Science (University of Lausanne)
- Pedagogics (HEPL)

PhD on the modelling and optimisation of urban energy fluxes (EPFL)

ACTIVITIES
- Professor of Building Energy Efficiency (University of Applied Sciences of Western Switzerland, Fribourg)
- Host Professor at EPFL
- Founder and managing partner of Consulting in energy and urban physics (CitySim)

EDUCATION

Arch. Susan Knodel

Bachelor in Architecture and Urban Planning (Brazil)

2 Specialisations – Urban Environmental Management (Brazil / France)
- Geomatics (University of Geneva)

1 Master - Environnemental Sciences (University of Geneva)

ACTIVITIES
- Architecture and Urban Planning Projects (Brazil)
- Consultant for J.I.C.A (Japan International Cooperation Agency), Japan
- Urban Planning Department in Carouge City (Geneva)
- Consultant for Consulting in energy and urban physics (CitySim)
1. Introduction

- Building sector consumes nearly 40% of total final energy consumption in the EU. (Eurostat’s data)

- Energy performance tools and policies have primarily addressed the performance of single buildings and implementation of smart energy systems.

- The building energy performance and renewable energy strategies depend on the urban morphology configuration.

- There is a need to expand the energy performance assessment from the building scale to urban scale.
1. Introduction

- How can we identify the inefficient buildings?
- How to increase their efficiency?
- How to analyse the impact of retrofitting measures?
- How to simulate different scenarios?
- How to evaluate the energy performance of a city or neighbourhood?
- How to measure the impact of UHI effect on energy consumption of buildings?

*3D simulation is an important tool for city decision-makers to foresee the urban development, including the impact of climate change.*
1. Introduction

Spin-off company of the Solar Energy and Building Physics Laboratory at EPFL (École Polytechnique Fédérale de Lausanne)

Architects

Masterplan 3D Geometry

DXF

CitySim

Energy Demand & Production + Urban Comfort

Urban Planner

Cadaster 2D/3D Geometry

CityGML

Partnership with the Swiss Competence Center in Energy Research (FEEB&D) Future Energy Efficient Buildings and Districts
2. CitySim 3D simulation tool

- Establish an Energy ADE Database (3D City DB with energy-related attributes)
- Energy Demand (Heating & Cooling)
- Solar Potential Analysis
- Evaluate the energy performance of retrofitting Buildings / Neighbourhoods
- Radiant Urban Comfort (Urban Heat Island Effect)

Considering:
- Passive solar gains (Glazing)
- Fixed and Moveable Solar shading (blinds)
- Internal heat gains due to occupants' activities

Source: CCEM Retrofit Project
3. Previous and current projects

**Urban Multiscale Energy Modelling (UMEM)**
- Develop an integrated multiscale modelling approach interfacing 3 domains: urban microclimate, building energy systems and human flows.
- Evaluate different urban energy retrofit scenarios.

**Integration of Decentralized Energy Adaptive Systems for cities (IDEAS4cities)**
- Introduce the concept of the urban energy hub
  - Simulate the energy demand, generation, storage and management of the buildings in the city.

**OSCARS (on-going)**
- Compare building retrofit strategy considering connections of district heating, integrating renewable energy and economic analysis.

**Competence Center for Energy and Mobility (Switzerland)**
3. Previous and current projects

Research EPFL (July 2016)

Jonction, Geneva

Source: STG

Evaluate the energy performance of retrofitting scenarios or new buildings implementation.


3. Previous and current projects

PhD research EPFL "Bioclimatic Design of Sustainable Campuses using advanced optimisation methods", Silvia Coccolo (2017)

Comfort map

What is the cooling effect of greening, and how does it impact both the energy demand of buildings and the outdoor thermal comfort?

Energy simulations were performed in order to provide recommendations for the architectural design and the development of a Minergie Standard for topical climate.

Annual Solar irradiance in the Swiss International School Campus in Dubai.
3. Previous and current projects

Evapotranspiration model to evaluate the cooling potential in urban areas.

Multi-scale modelling to evaluate building energy consumption at the neighbourhood scale. (Dasaraden Mauree et al., 2017)

There is a significant decrease in the surface temperature using vegetation (annual decreasing of 2.4° C in 2030 scenario)

The importance of vegetation for reducing energy costs of building heating and cooling demands has been increasingly recognized as a cost effective reason for improving urban greenery.
The energy performance simulation model “CitySim” provides a decision support tool for urban energy planners, collectivities and stakeholders.
Thanks for your attention!

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