ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

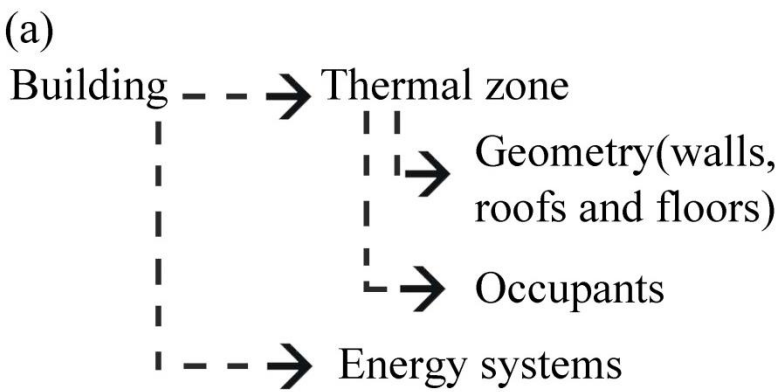
LABORATOIRE D'ENERGIE SOLAIRE
PHYSIQUE DU BÂTIMENT

CityGML Energy ADE and CitySim

Nice, 12th May 2015

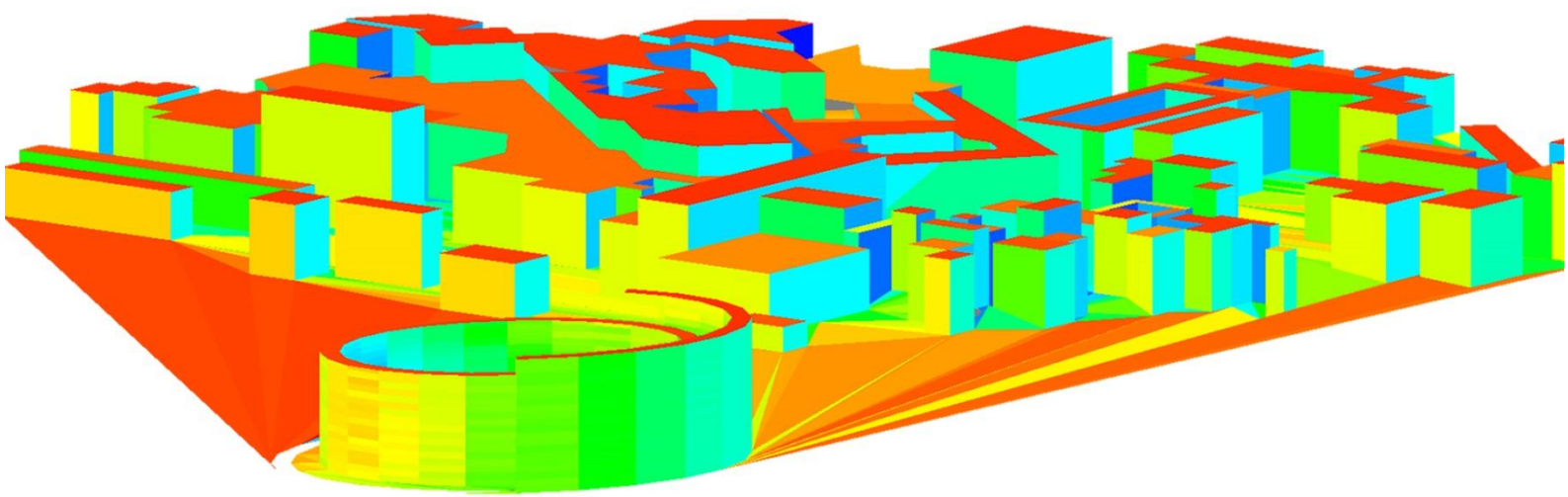
CITYSIM SOFTWARE

Urban energy modelling, able to quantify heating and cooling demand from a single building to the urban scale, with simplified input physical and geometrical data.



CitySim xml format

Module	Description
Building geometry	Volume, inhabitable surface and geometrical description of the envelope
Building envelope	Physical characteristics of windows (U-value, g-value and ratio) and opaque surfaces (short wave reflectance and U-value)
Building thermal zone	Set up temperature for heating/ cooling systems, infiltration rate, number of occupants, and their profile during the day
Building energy systems	Heating, cooling and photovoltaic systems



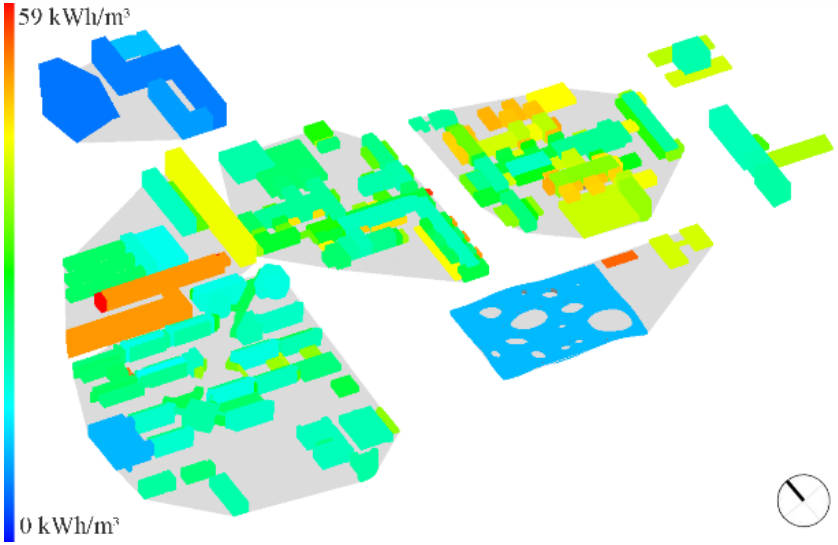
CITYSIM SOFTWARE

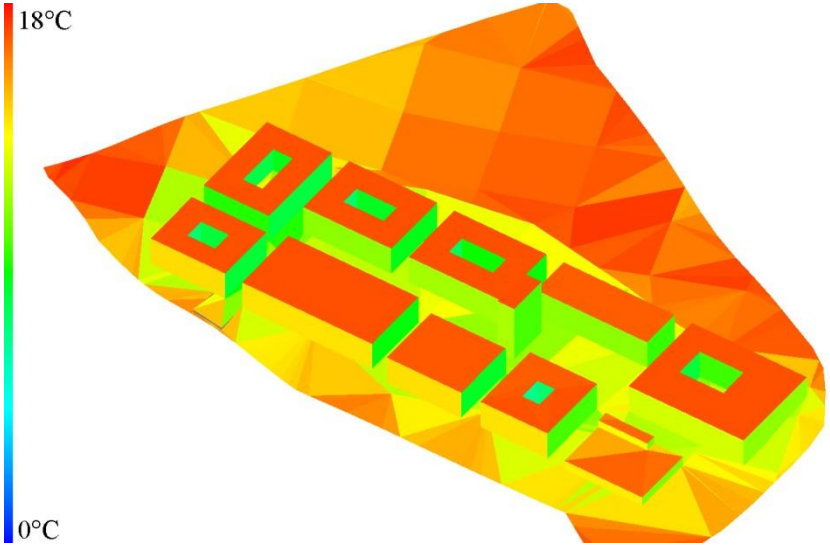
LOD 1

- Climate and topography (Meteonorm)
- Solar irradiation (shortwave and longwave) received by buildings
- Mutual impact (shadowing) between buildings

LOD 3

- Energy demand for heating and cooling of buildings
- Energy supply (HP, Cogeneration..)
- Electricity production by photovoltaics panels
- Surface's temperature (indoor and outdoor)





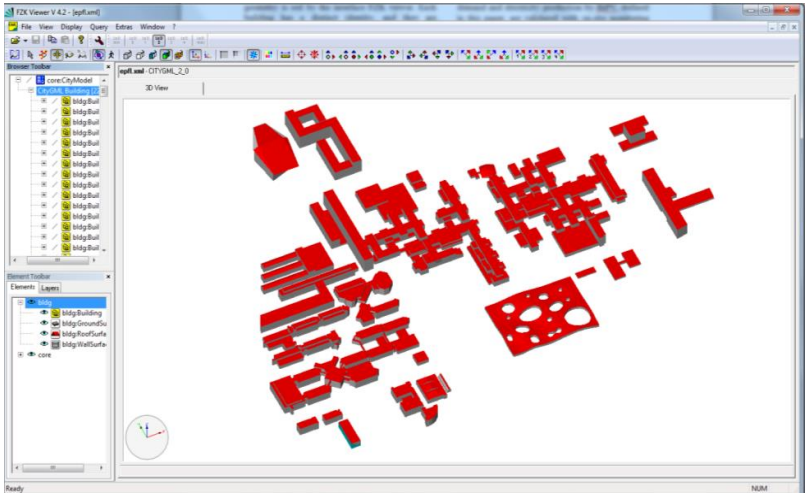
CITYGML with Energy ADE

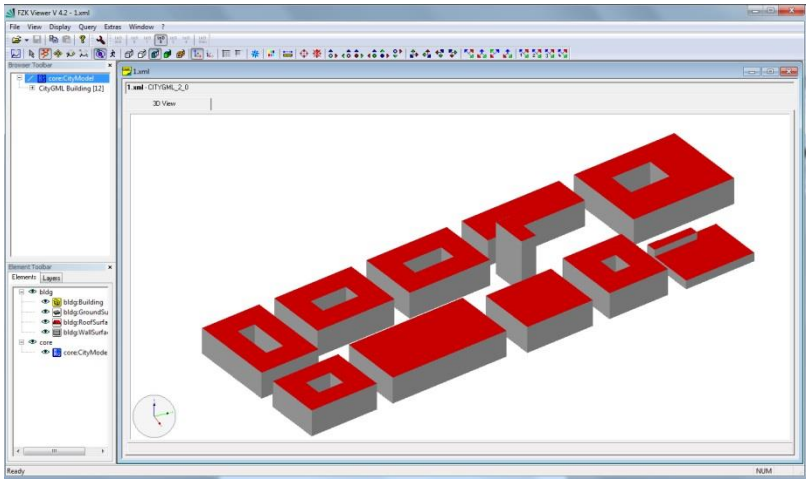
Building, Zones and Boundaries: buildings geometry, thermal zones, opening and schedules

Construction and Layer: physical characteristics of the envelope, such as material, and their physical and optical properties (emittance, absorptance, transmittance, and reflectance).

Occupancy Module: usage of the building, the presence of occupants, and the consequently usage of facilities and appliances.

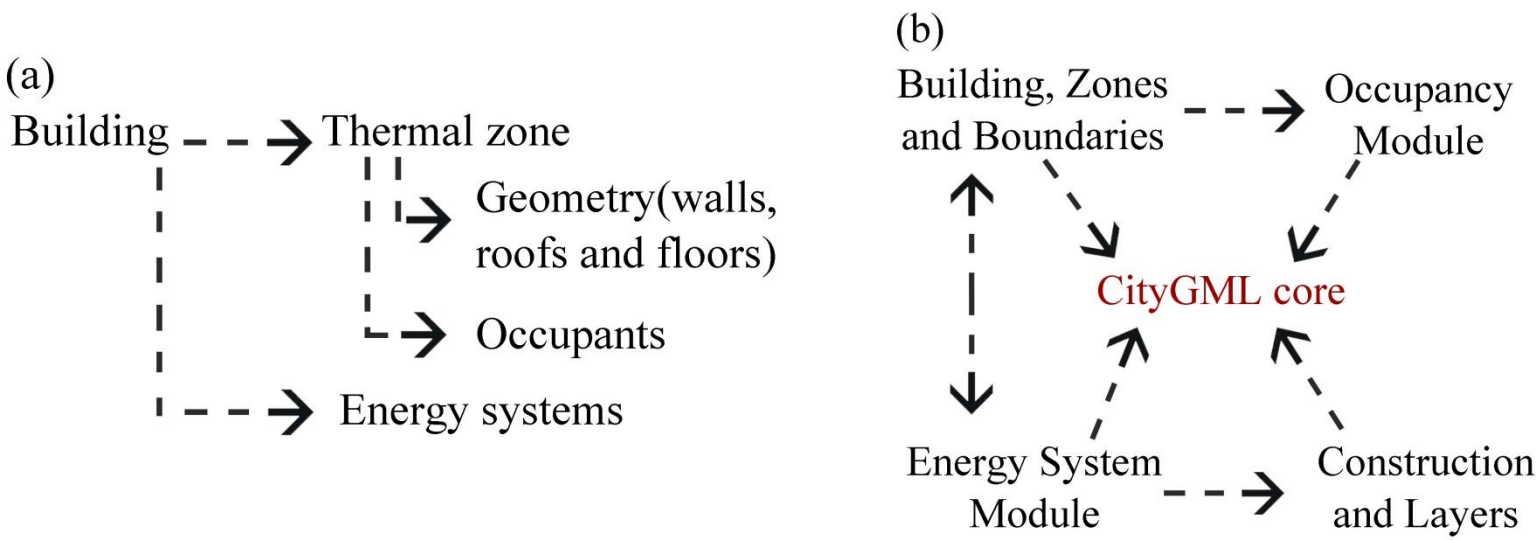
Energy System Module: energy demand, supplied by different energy systems (conversion, distribution and storage)





CITYSIM AND CITYGML

CitySim	CityGML
Building geometry	Building, Zones and Boundaries
Building envelope	Construction and Layers
Building thermal zone	Occupancy Module
Building energy systems	Energy System Module



CITYSIM AND CITYGML

CitySim_XML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CityGML_XML


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 xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:gml="http://www.opengis.net/gml"
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                                                3832.30 2486.53 2.13
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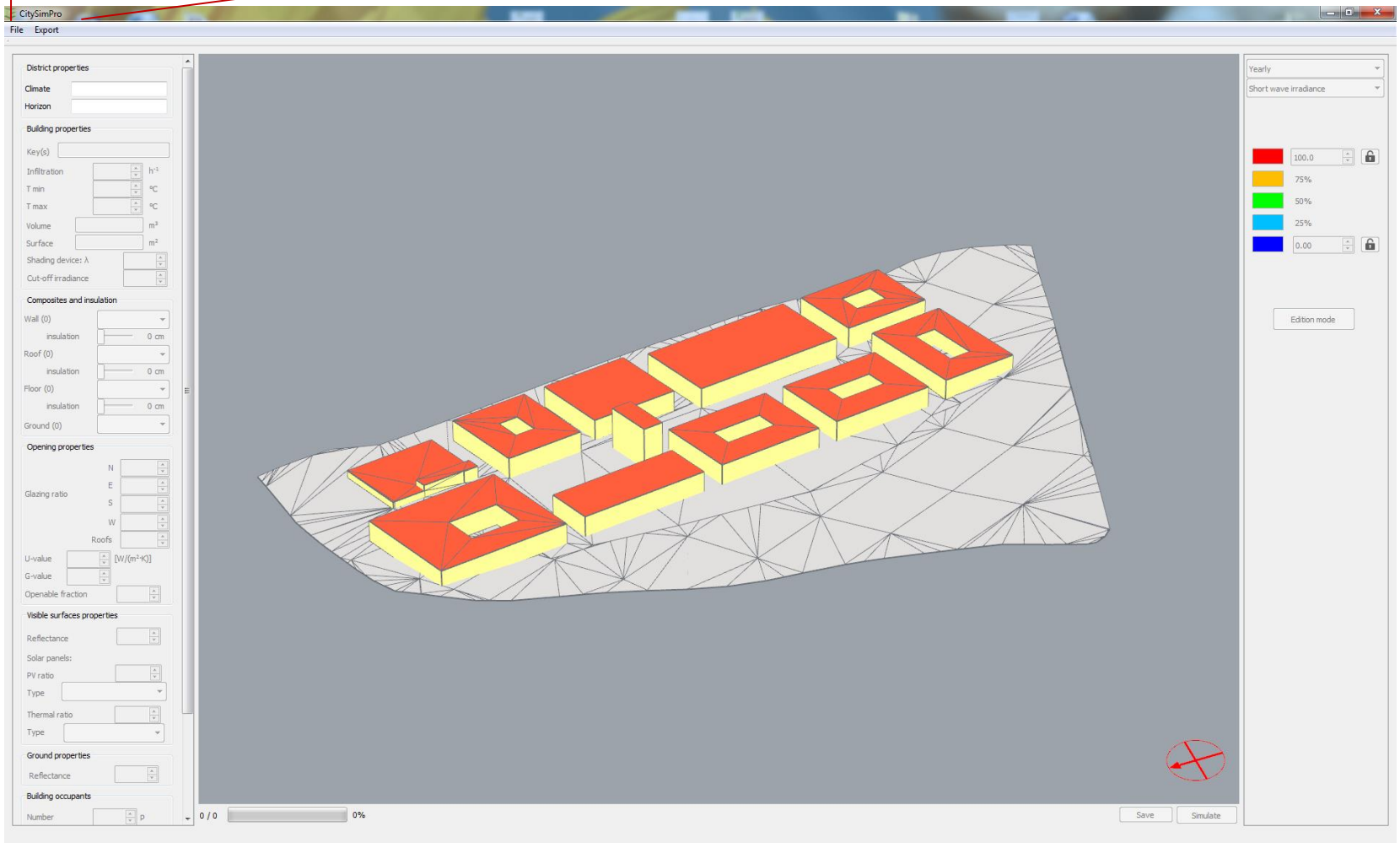
```

CITYSIM AND CITYGML

CitySim PRO

Import CitySim xml

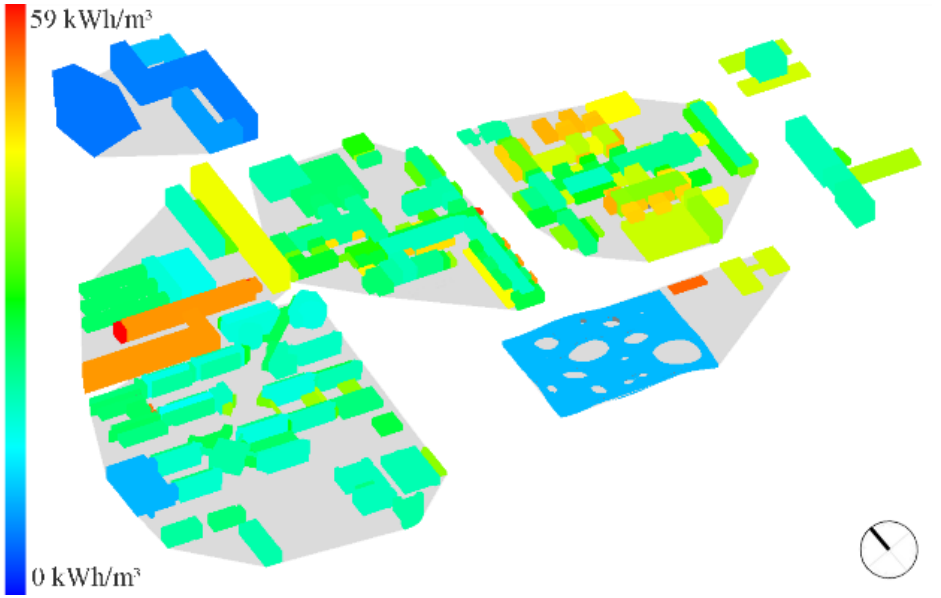
Export CityGML



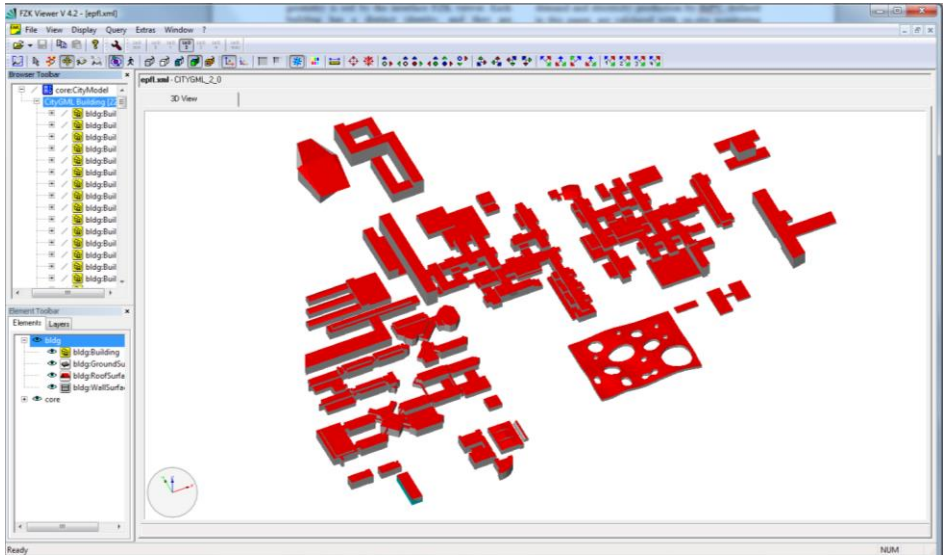
CITYSIM AND CITYGML

The EPFL Campus, Lausanne (Switzerland)

Dynamic heating and cooling demand of the site
(correlation with monitoring R^2=0.89)



BiPV production (correlation with monitoring R^2=0.93)

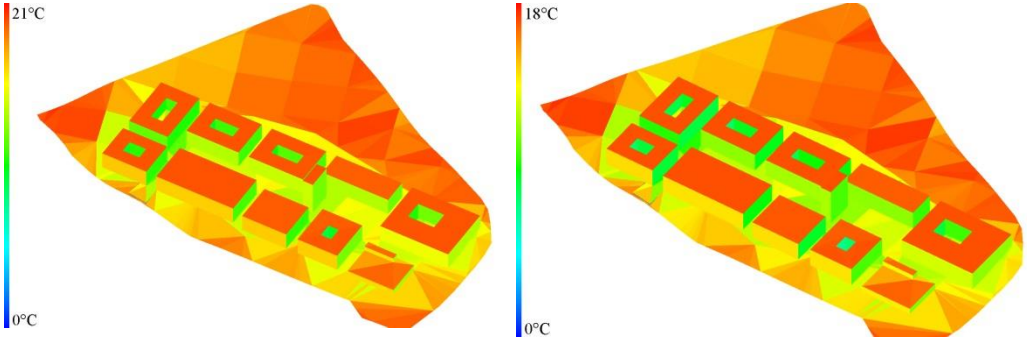


S.Coccolo, J. Kaempf. *Urban energy simulation based on a new data model paradigm: the CityGML Application Domain Extension Energy. A case study in the EPFL campus of Lausanne*. Building Simulation Conference (2015)

CITYSIM AND CITYGML

The EPFL Campus, Freiburg (Switzerland)

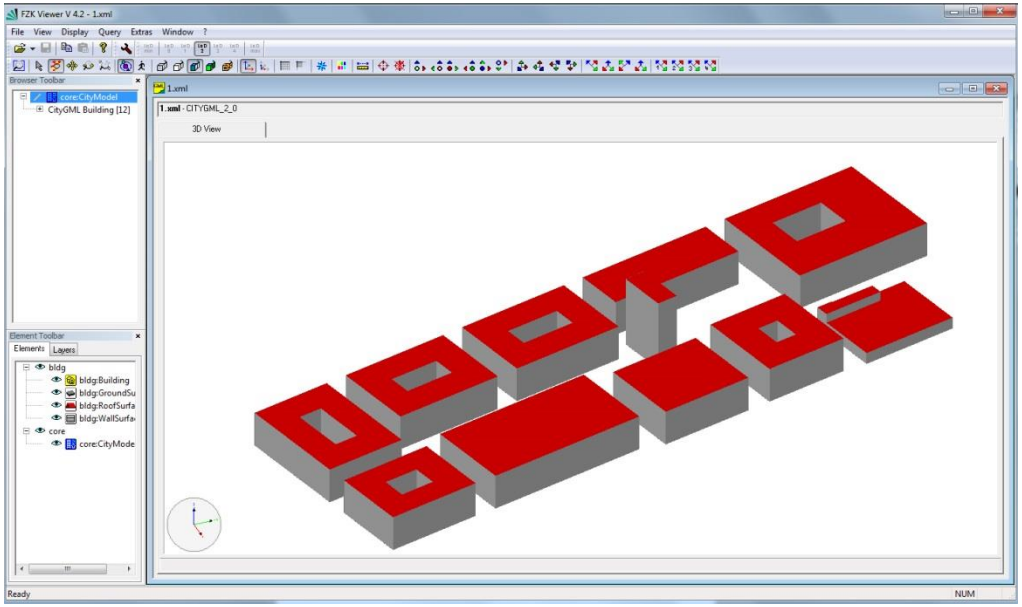
Minergie-P building



Future climatic scenarios (IPCC 2100 A1, A2 and A1B):

Heating demand decrease by 6% (scenario B1) to 17% (scenario A2)

Cooling demand would increase by 35% (scenario B1) to 140% (scenario A2)



S.Coccolo, J. Kaempf. *Urban energy simulation of the EPFL Campus in Fribourg using a new paradigm: the CITYGML application domain extension energy*. CISBAT (2015)

FUTURE WORK

CitySim	CityGML
Building geometry	Building, Zones and Boundaries
Building envelope	Construction and Layers
Building thermal zone	Occupancy Module
Building energy systems	Energy System Module

Export geometry in CityGML format

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Export geometry in CityGML format

Export all modules

FUTURE WORK

CitySim	CityGML
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Export all modules

Import CityGML in CitySim

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