

Urban Energy Demand and Supply Simulation Based on 3D City Models

Prof. Dr. Volker Coors

UDMS and GeoSmartCity Workshop, Ghent, 24.4.2015



2015: 150Years Education in Geodesy at HFT Stuttgart



HFT Stuttgart

Facts and Figures

- 3.900 students
- More than 125 professors
- More than 400 lecturers from industry and economy

- 14 Bachelor programmes
- 14 Master programmes, also part-time

- My research group on Geoinformatics
 - 10 Researcher
 - Focus on 3D Spatial Data Infrastructures and
 - Geovisualisation



Future Cities



Quelle: ZEIT 02/2014

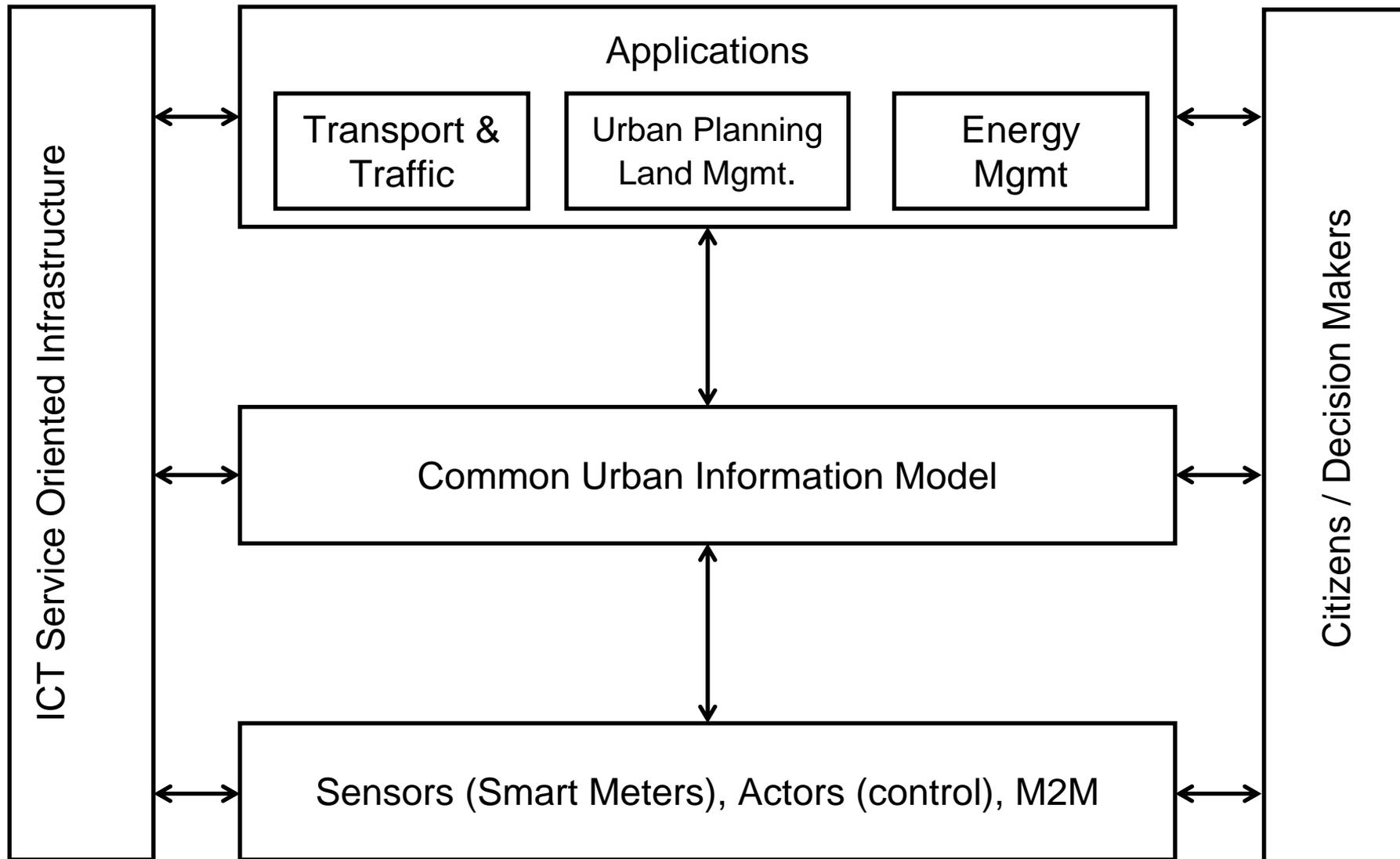


Paris 2050
© Vincent Callebaut

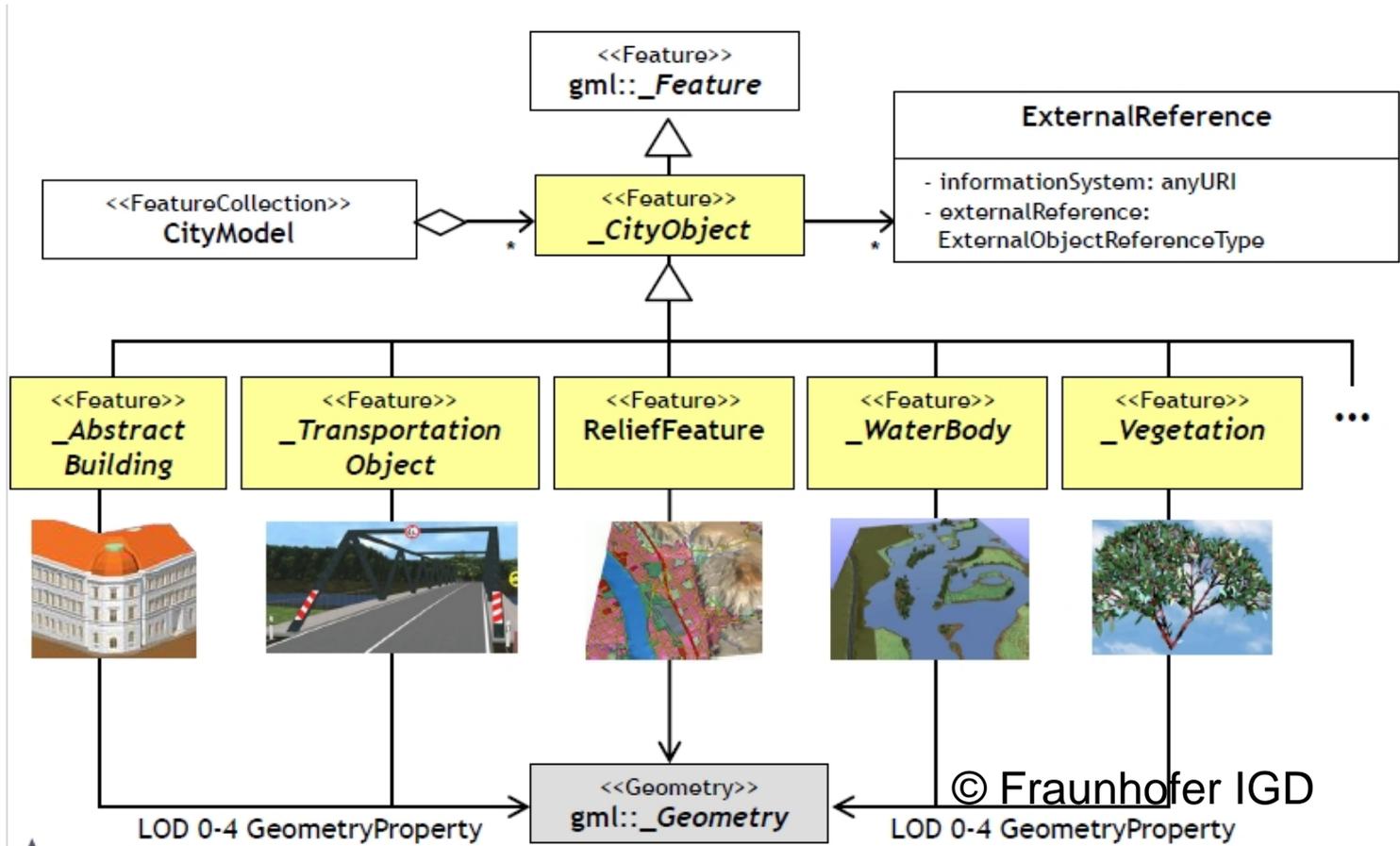
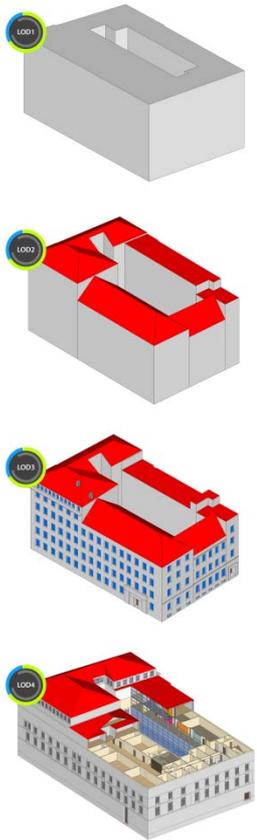
More and more complex and heterogenous Geodata are needed for Land and Urban Management to face challenges such as demography and urban growth, climate change, energy efficiency, ...



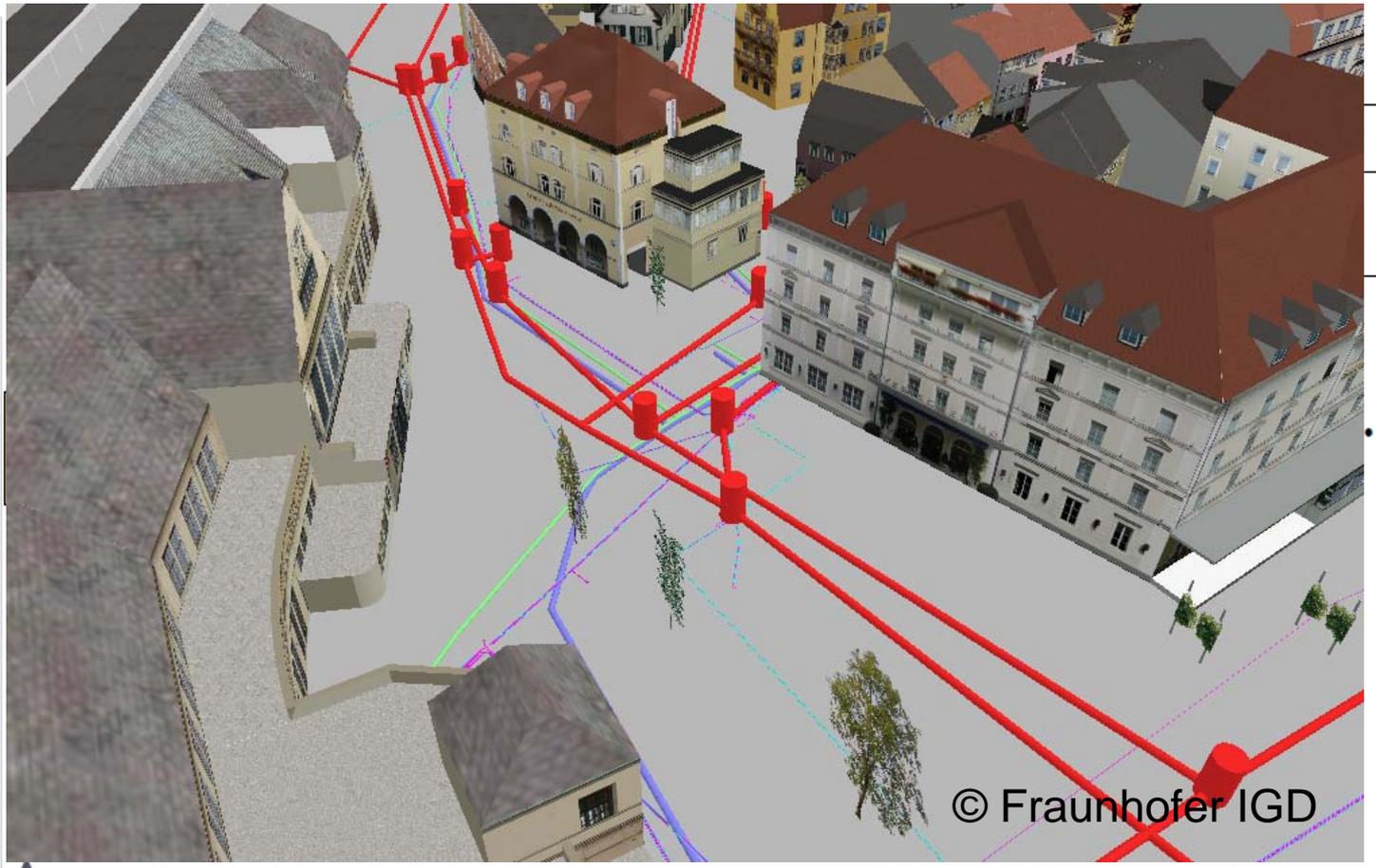
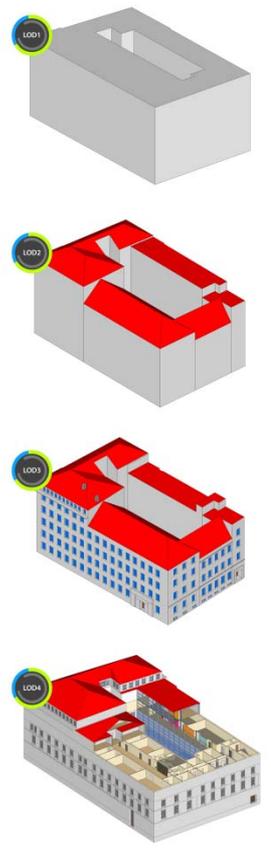
Our Contribution



CityGML

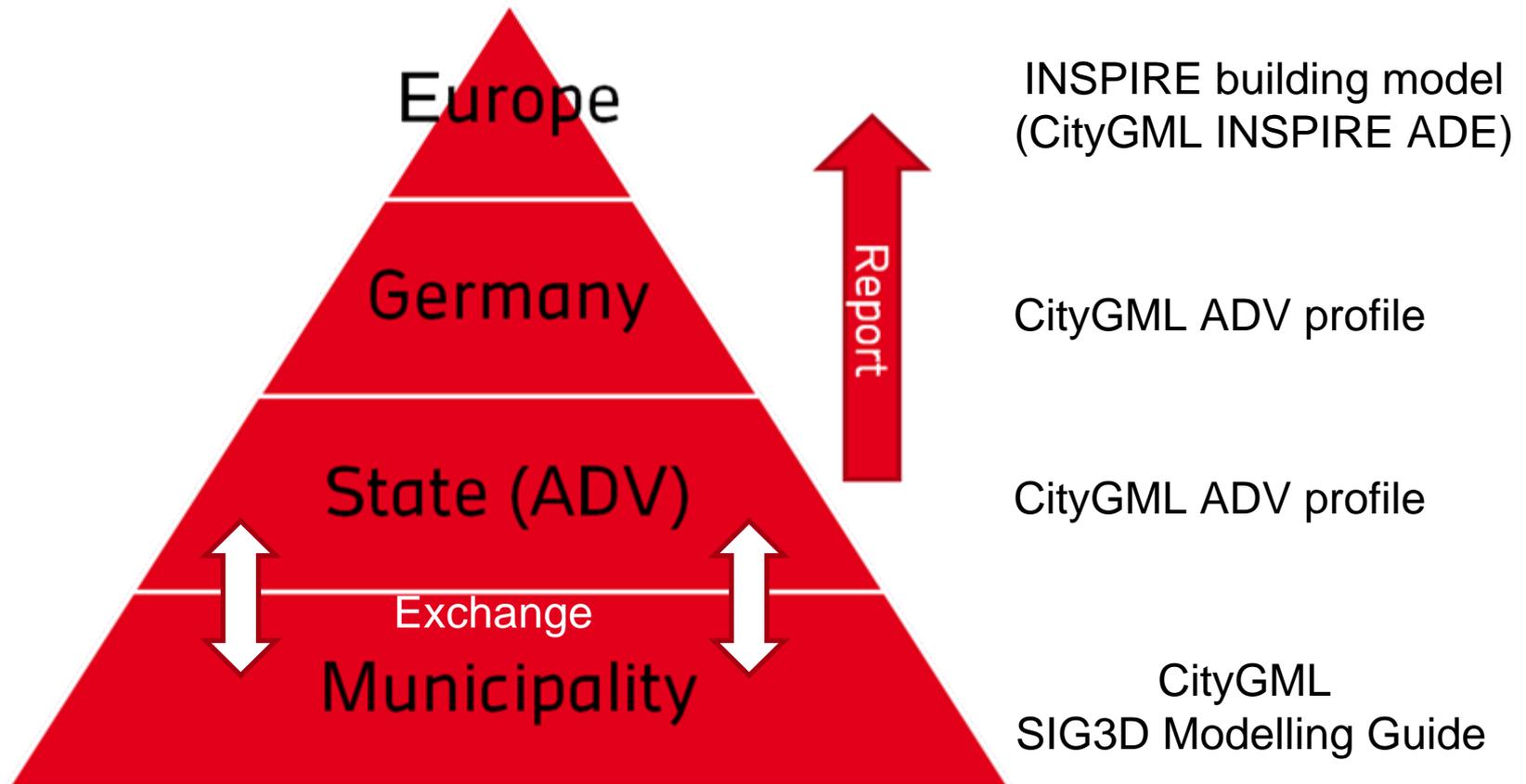


CityGML



© Fraunhofer IGD

3D City Models



EnViSaGe

EnViSaGe - Kommunale netzgebundene Energieversorgung - Vision 2020 am Beispiel der Gemeinde Wüstenrot

Gefördert durch:

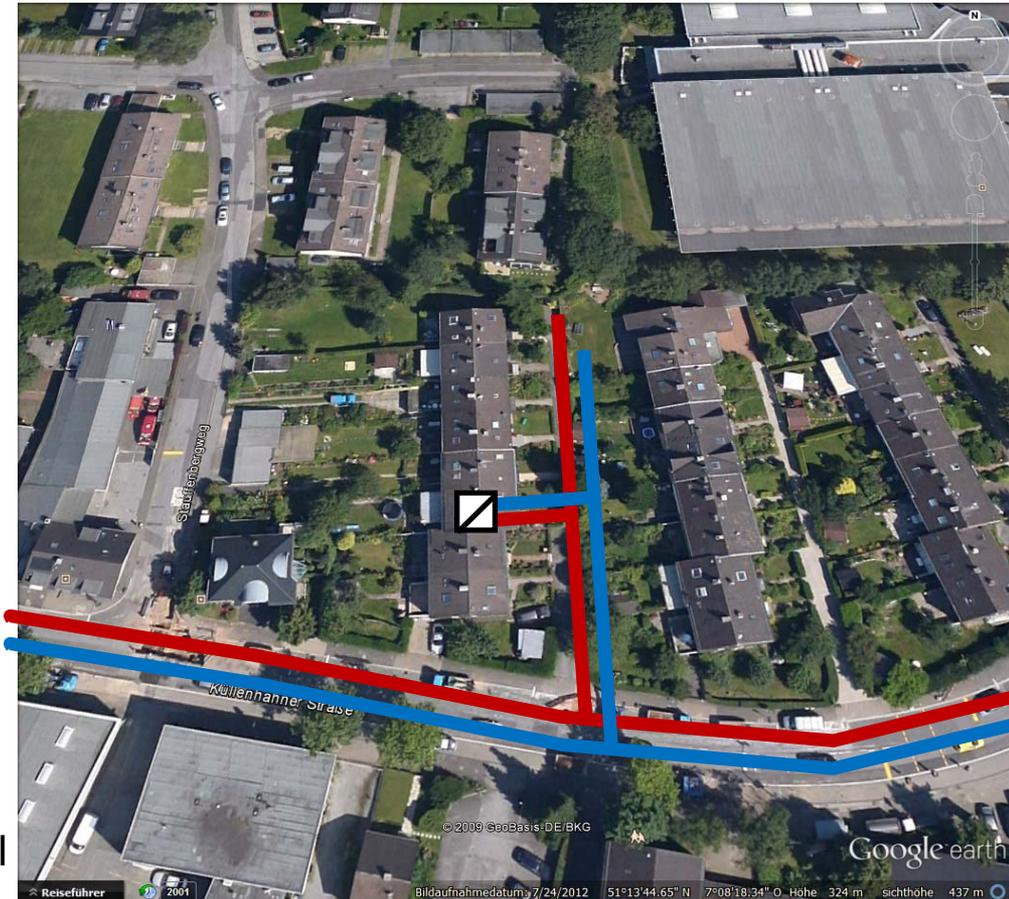
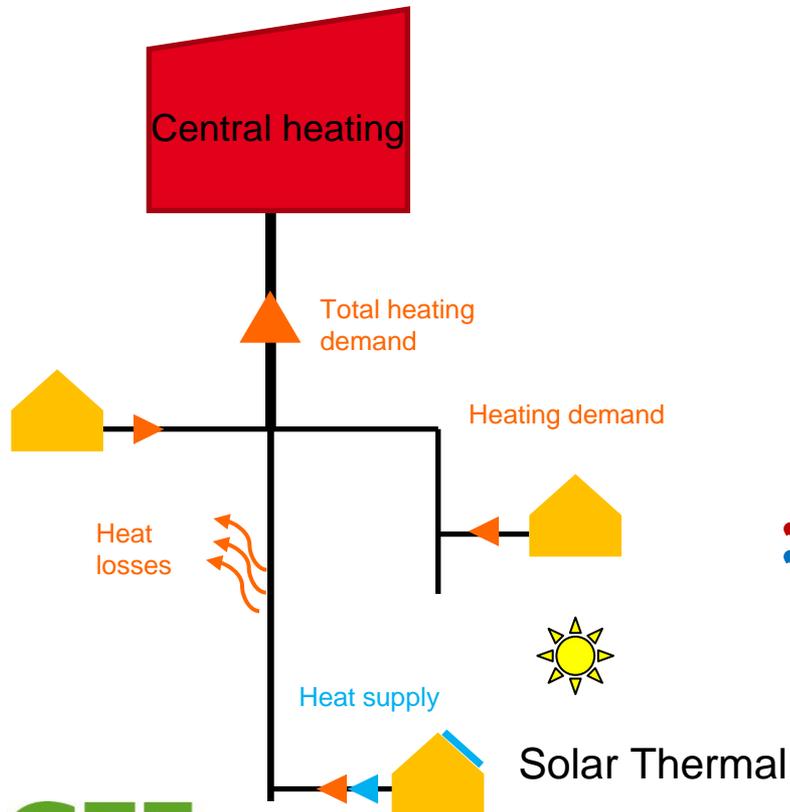


aufgrund eines Beschlusses
des Deutschen Bundestages

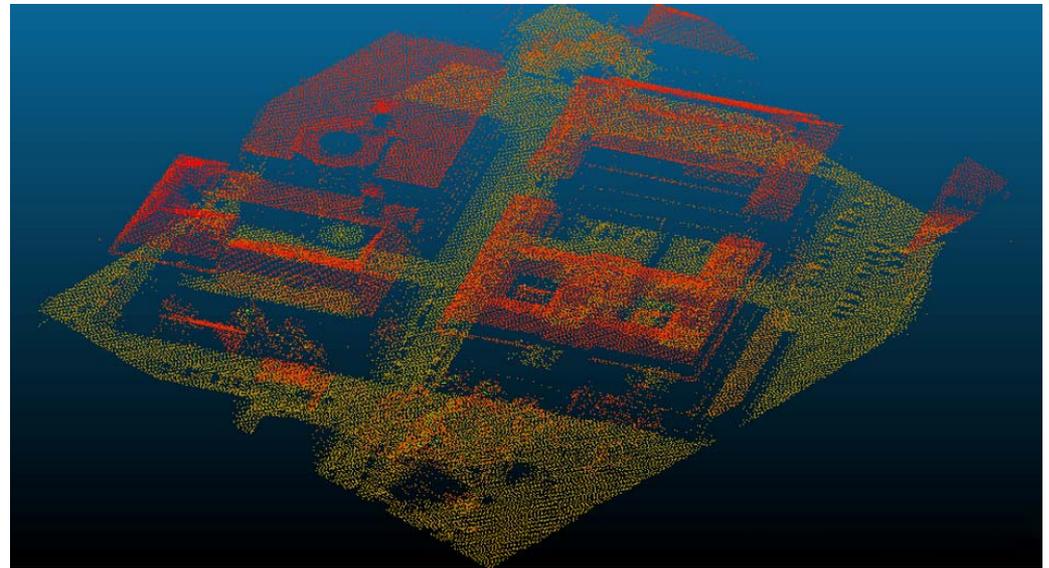
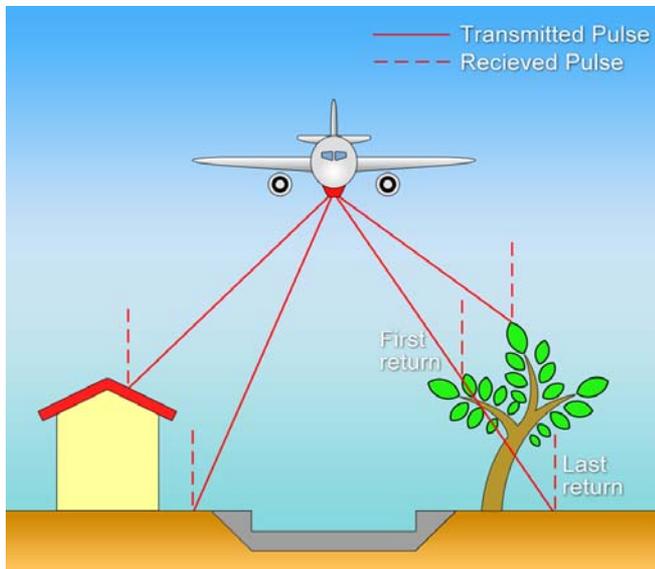
- Wüstenrot aims to become Plus-Energy Community in 2020
- Renewables: PV, Solarthermal, geothermal, biomass
- District Heating Network



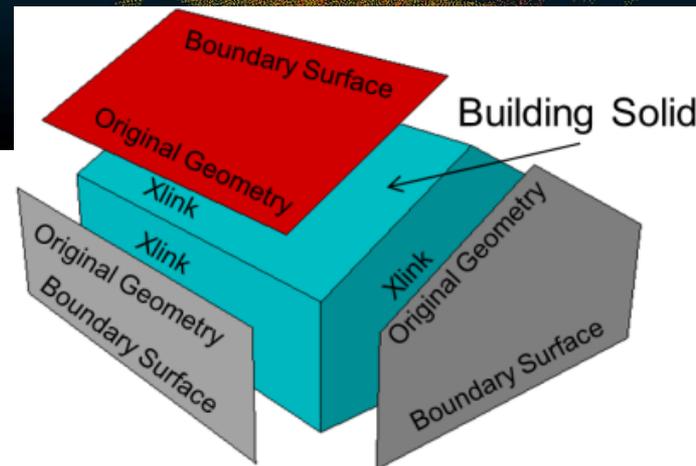
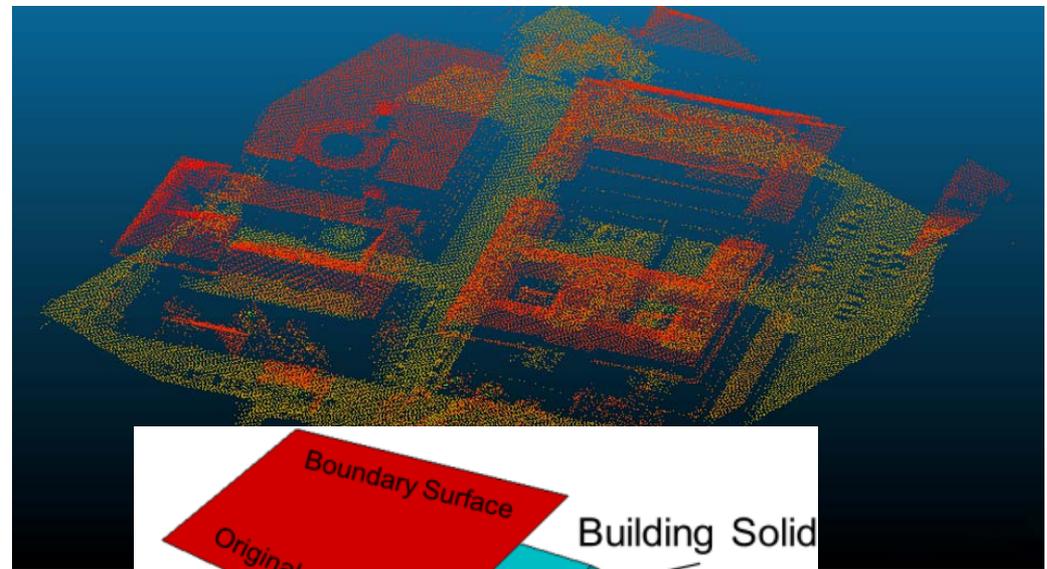
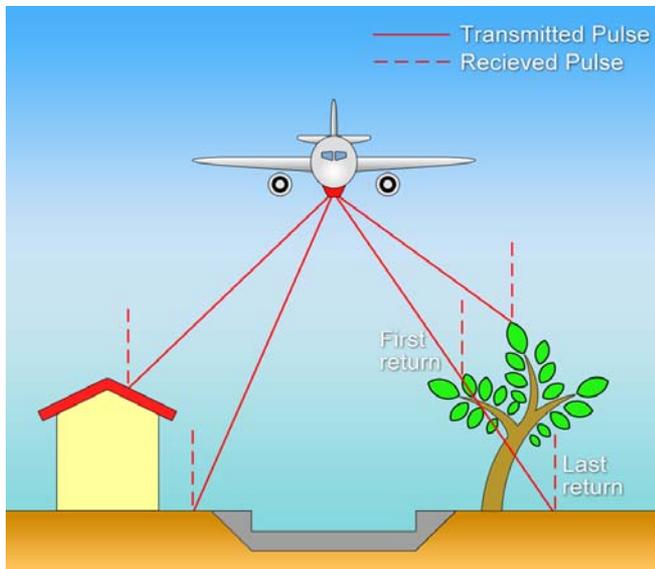
District Heating Network



3D Building Model



3D Building Model



Vegetation



Geobasisdaten © Landesamt für Geoinformation und Landentwicklung Baden-Württemberg, www.lgl-bw.de

Vegetation

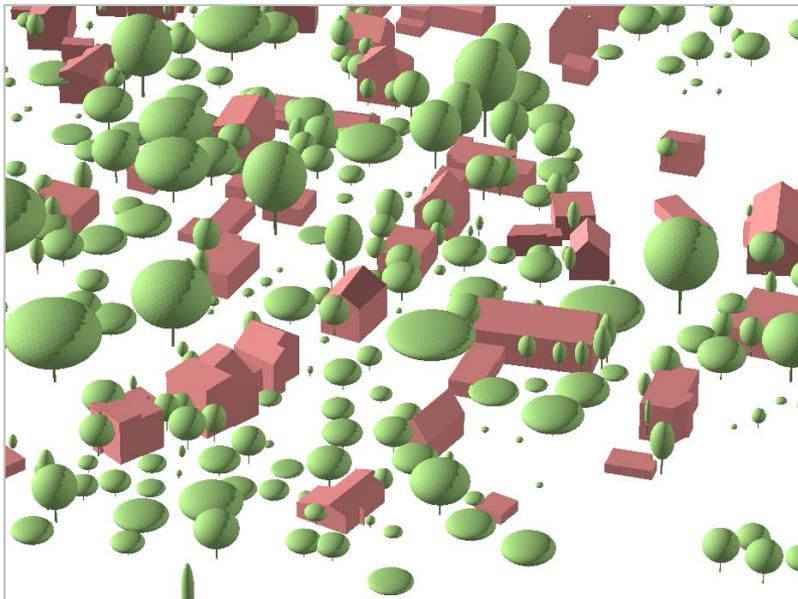


Geobasisdaten © Landesamt für Geoinformation und Landentwicklung Baden-Württemberg, www.lgl-bw.de

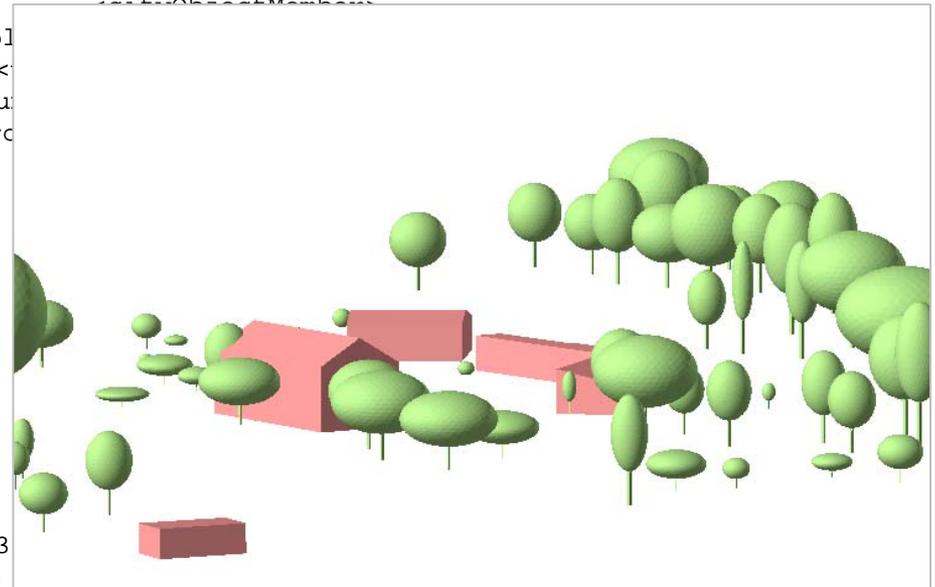
Verschattungsobjekte

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Verschattungsobjekte

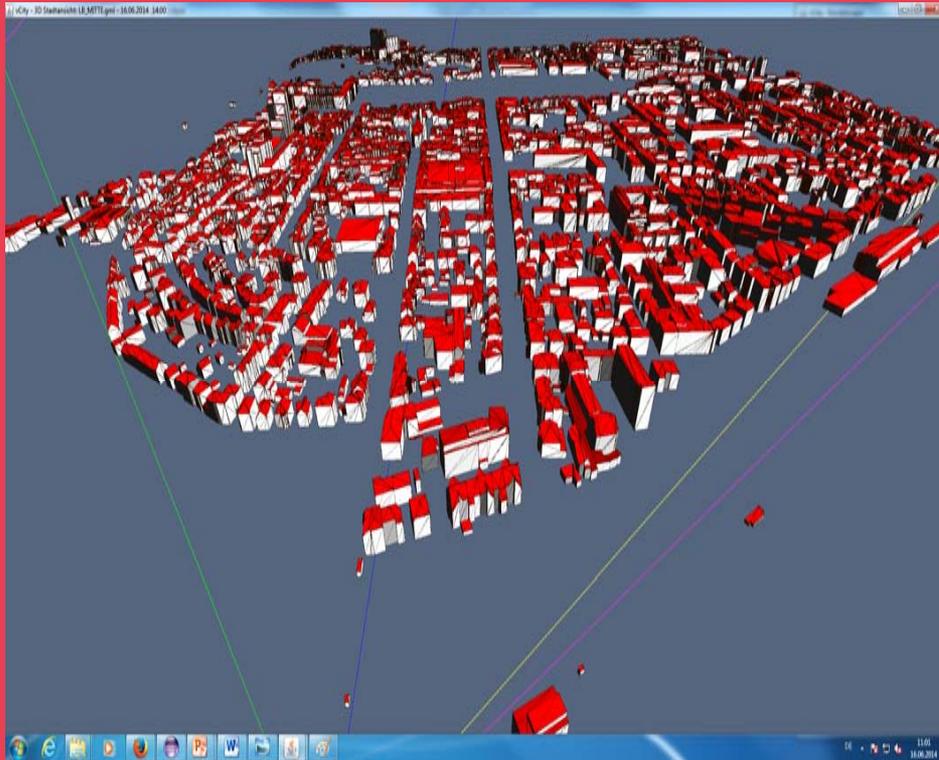


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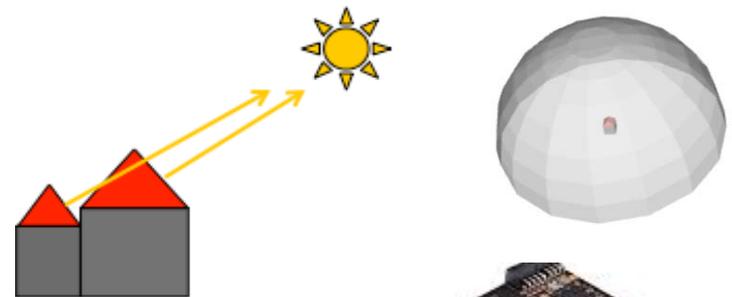
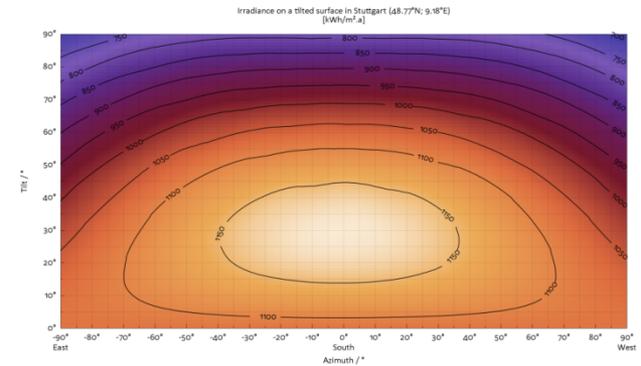
PV / Solarthermal: Irradiance + Shadow



Shadow per Surface for an entire year

LoD2-Modell Ludwigsburg, 2200 Buildings
Resolution 5 m², ~ 850 000 Triangles
10 Minutes computation time

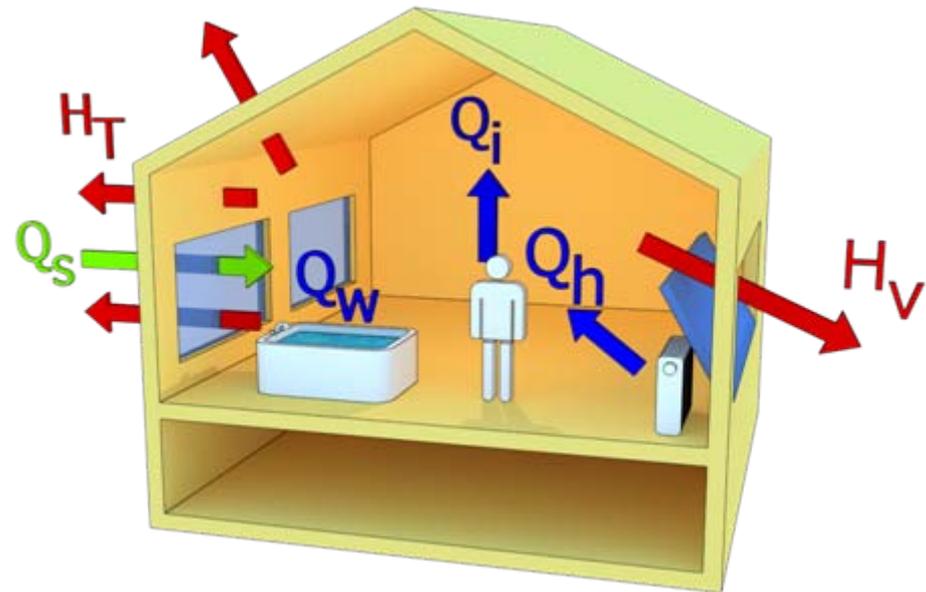
Resolution 0.75 m², ~ 5 300 000 Triangles
40 Minutes computation time



GPU NVIDIA, 3072 CUDA
Kernel 4 GB RAM

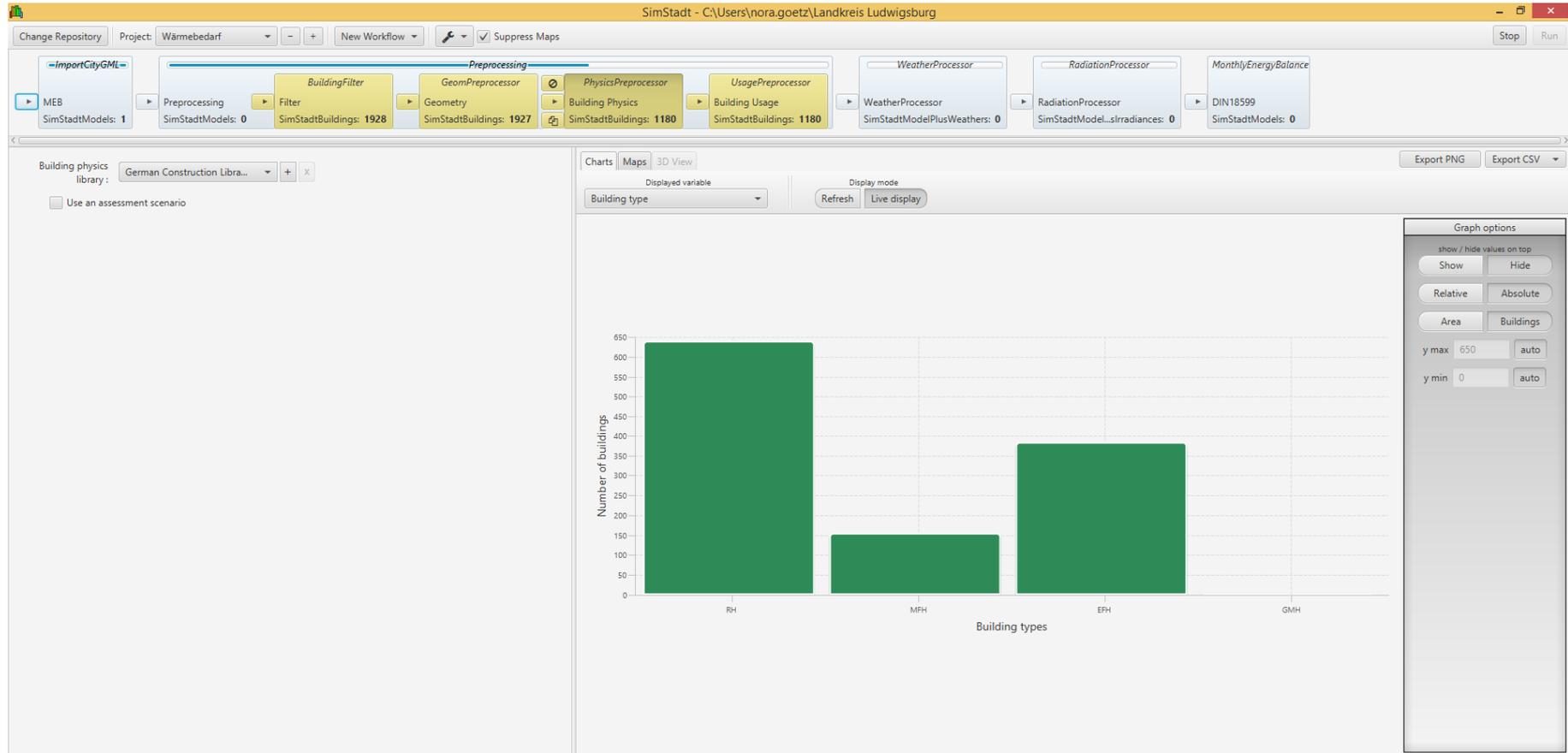
Heating demand

- Q_h heating demand
- Q_w hot water heating demand
- Q_s solar gains
- Q_i internal gains
- H_T transmission heat loss
- H_V ventilation losses



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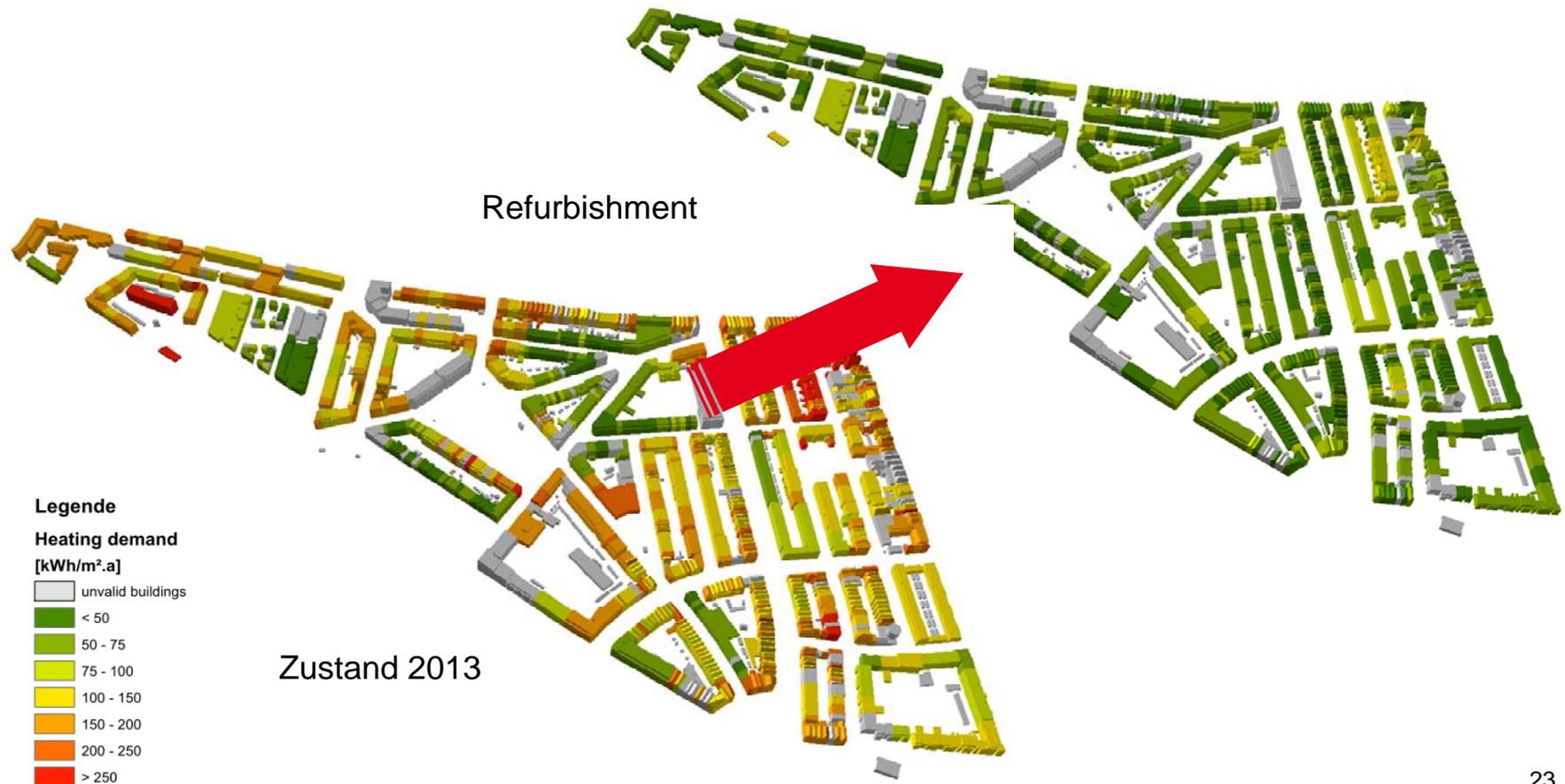
SimStadt: Heat Demand



A short description of workflow step and its parameters and results.

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Scenario: Refurbishment



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SimStadt: Heat Demand



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SimStadt: Heat Demand



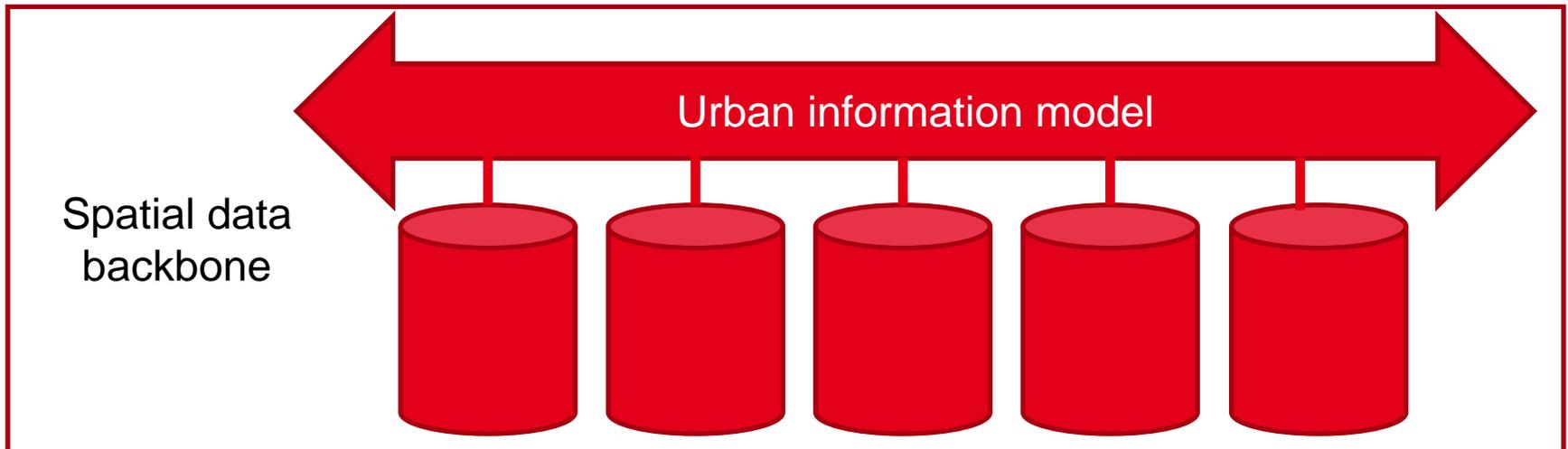
Y kx d d } d w l r q

S x e d f # \$ d u w l f l s d w l r q # W r x f k O d e



Future Work

Simulation as a Service



Simulation as a Service

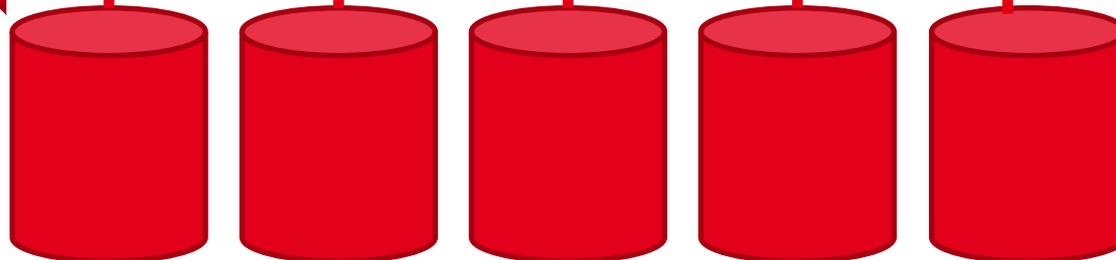
Dynamic
Heat demand
(hourly)
(IQ VHO)

Solar Thermal / PV
(hourly)
(INSEL)

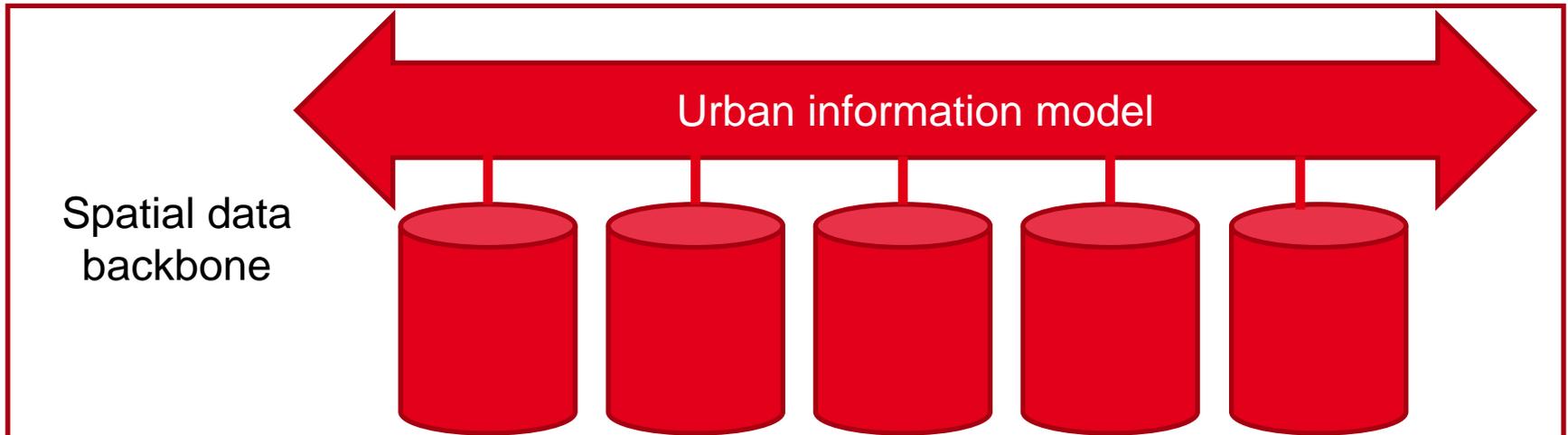
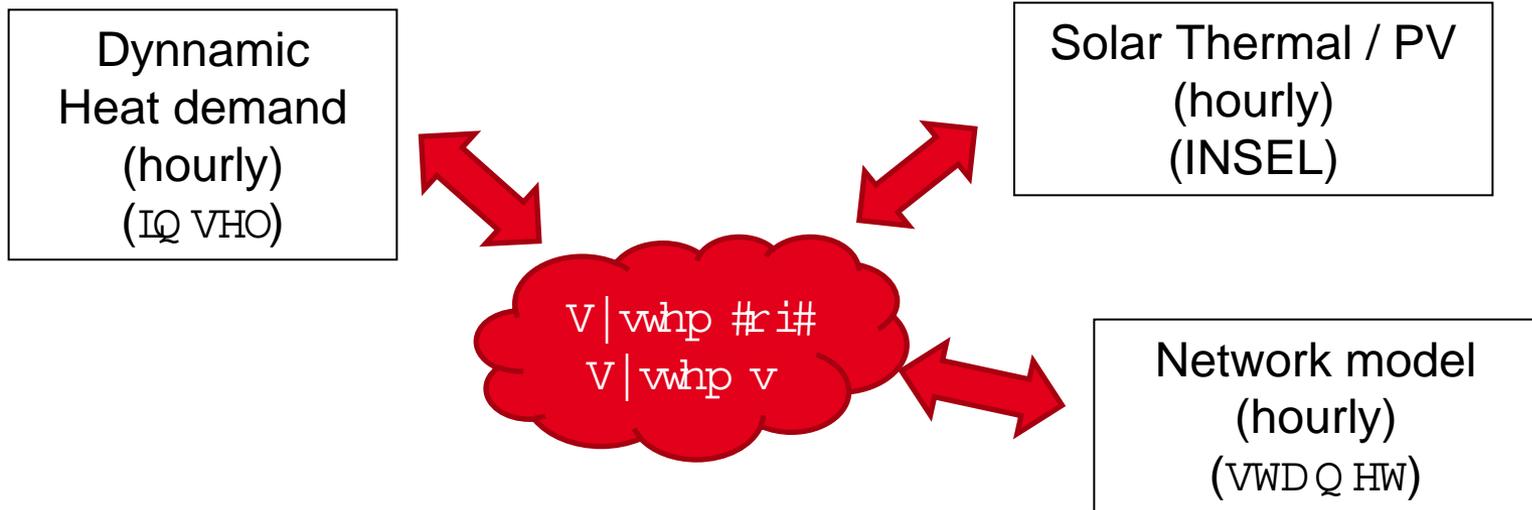
Network model
(hourly)
(VWD Q HW)

Urban information model

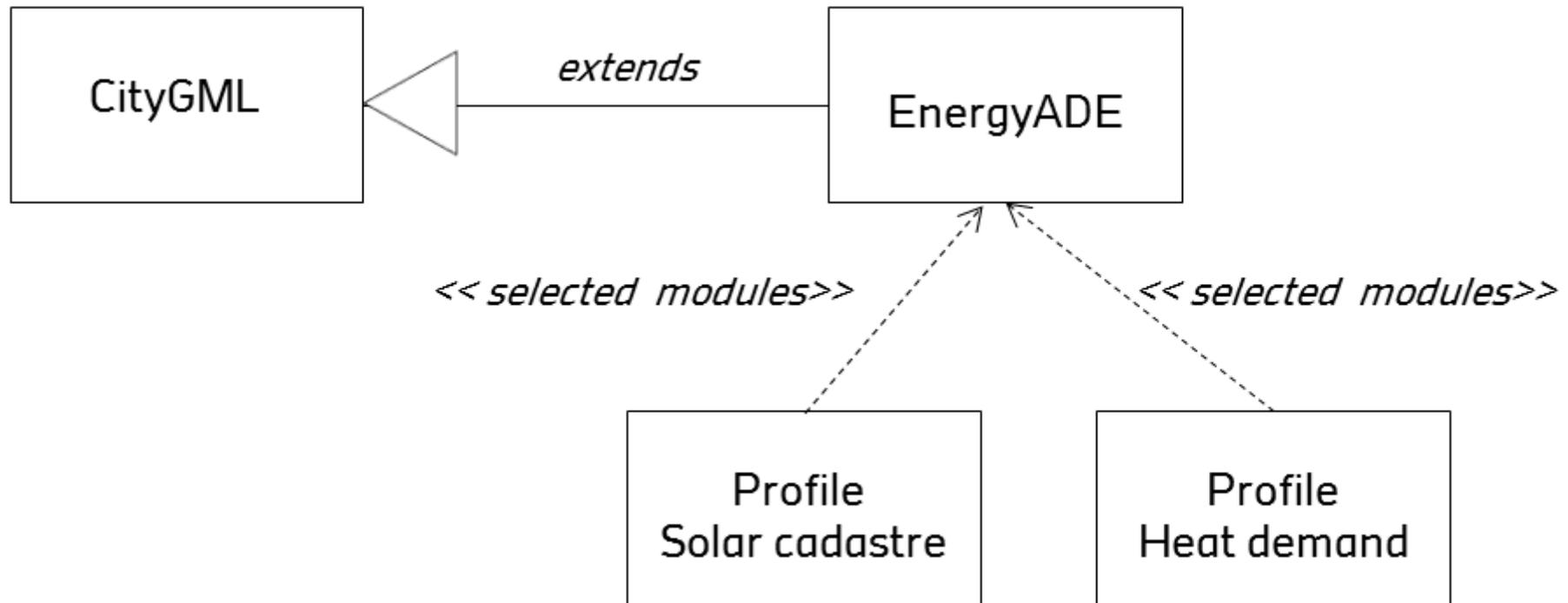
Spatial data
backbone



Simulation as a Service



CityGML ADE Energy



Marie Curie Initial Training Network

Funding: €3.7M EU FP7-PEOPLE-2013-ITN

Duration: 48 months

Grant Agreement: No. 606851

Coordinator: HFT Stuttgart

GOAL: interdisciplinary PhD Program training young scientists in urban decision-making and operational optimisation software tools to minimise non-renewable energy use in cities



Co-funded by the Intelligent Energy Europe
Programme of the European Union



Fellows: 11 Early Stage Researchers representing 6 European countries, Russia, India and China

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Future Work

Full Partners

SIEMENS



The University of
Nottingham



INTEGRATED
ENVIRONMENTAL
SOLUTIONS



ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE



WIEN ENERGIE

HFT Stuttgart
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AIT
AUSTRIAN INSTITUTE
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TOMORROW TODAY



POLITECNICO
DI TORINO

D vvr fldwhg # \$ duwghuv



TECHNISCHE
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StadT Wien



REPUBLIQUE
ET CANTON
DE GENEVE

ROSE THEOBALD LAM

Frqwdfw

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