
URBAN LEARNING Final event
17 October 2017, Vienna, Austria

The Building stock model (BSM)

Conceiving, planning, implementing and monitoring energy
and climate policy goals

A tool to assist authorities, urban energy planners and utilities

Dr. Martin Jakob, TEP Energy

Challenge: Ambitious goals, how to achieve?

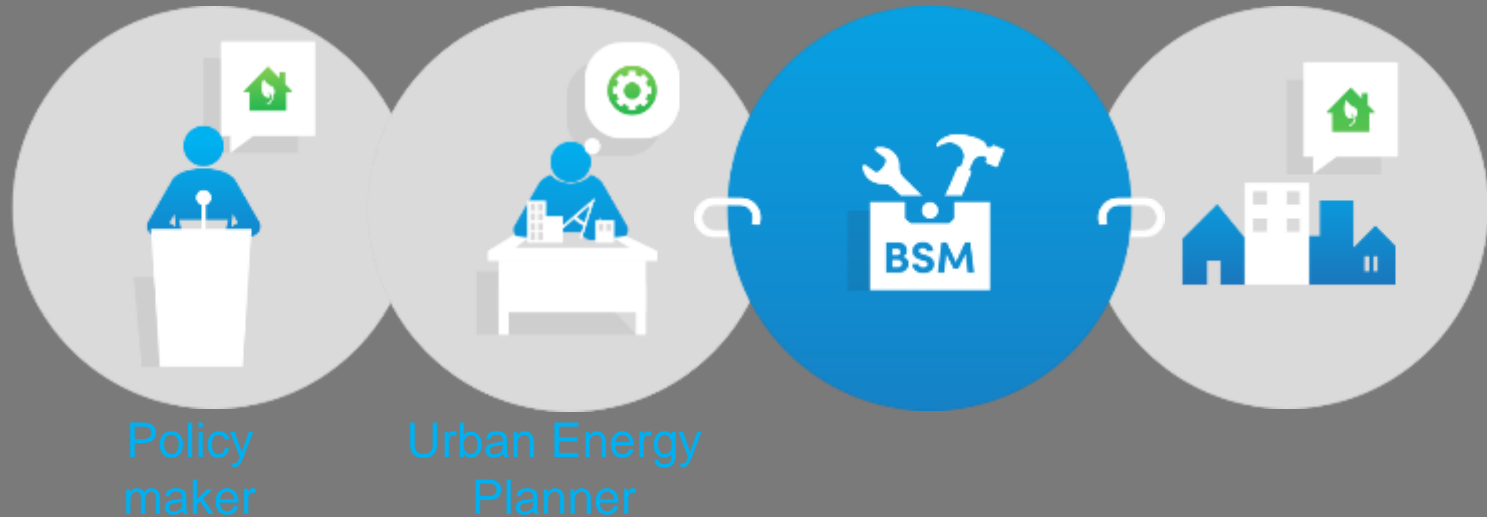
Countries, regions, cities, and communities...

... lack a tool that allows linking goals to implementation



Solution: Building stock modelling

The building stock model (BSM) allows describing the status quo, modelling development pathways and monitoring their progress on them.



BSM does this by

- building an inventory and
- modelling scenarios





2017

Building stock:

Energy Demand
CO₂-Emissions
Renewable Energy Supply



2050

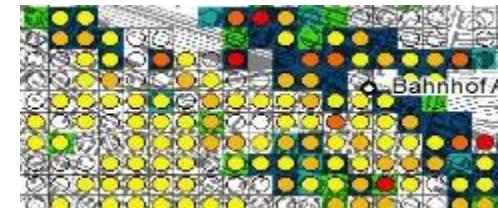
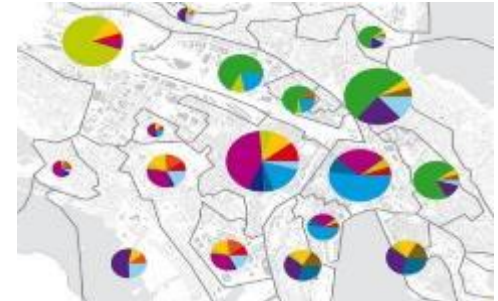
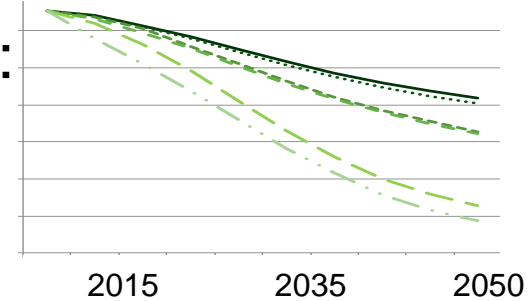
Building stock:

Energy Demand ▼
CO₂-Emissions ▼
Renewable Energy Supply ▲

Approach

In 3 distinct steps

1. Step: Goal setting and strategic approach:
Measures and their impact at city scale
2. Step: Integral assessment of demand, efficiency and renewable by zone/district
3. Step: Data for Energy planning at high spatial resolution (hectare, block, area or building scale)



Building stock model: Requirements

of the city of Zurich and others

To provide quantitative, evidence and data based fundamentals :

1. **Bottom-up** and building element and technology based
2. **GIS-bound:** Spatial differentiation of building characteristics, infrastructure and local RES potentials: multi-layered assessments
3. **Result indicators:** energy, emission, LCA, material use, economics
 - a. Current building stock inventory, energy consumption structure (sectors, use categories, cohorts etc.)
 - b. Scenario calculation to evaluate feasibility of long term carbon mitigation and primary energy consumption reduction goals



BSM: Typical representation of results

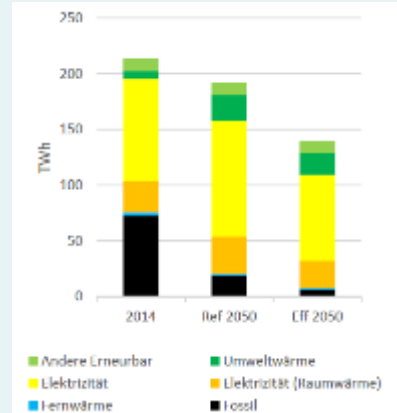
- Population, employee, floor area
- Useful, final, primary, embodied energy
- Direct and embodied GHG emissions

- Building type, use type, service
- Policy scenario, time
- Zone, street, coordinate

Tables

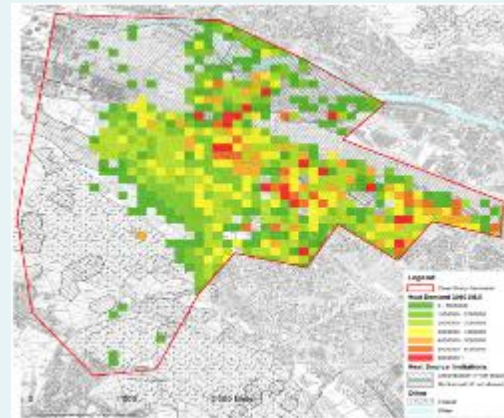
	2010	2050	
	Referenz-szenario	Referenz-szenario	Effizienz-szenario
Fläche [km²]	7871787	8568000 ^a	
UHL _{tot} [Mt CO ₂ -eq]	3.0	4.9	5.1
THGE _{tot} [Mt CO ₂ -eq]	18.8	6.2	3.4
UHL _{geb} [Mt CO ₂ -eq]	21.0	11.1	6.6
THGE pro-Kopf [t CO ₂ -eq/a]	2.8	1.2	0.8
PE _{geb, netz} [TWh]	12	19	20
PE _{tot, netz} [TWh]	134	28	14
PE _{tot, netz} [TWh]	146	45	34
PE _{geb, netz} pro-Kopf [WEP]	2100	537	408
HL _{geb, tot} [TWh]	15	24	26
PE _{geb, tot} [TWh]	156	88	60
HL _{tot} [TWh]	171	110	66
PE _{tot} pro-Kopf [WEP]	2484	1317	1046

Figures



Maps

By Hectare



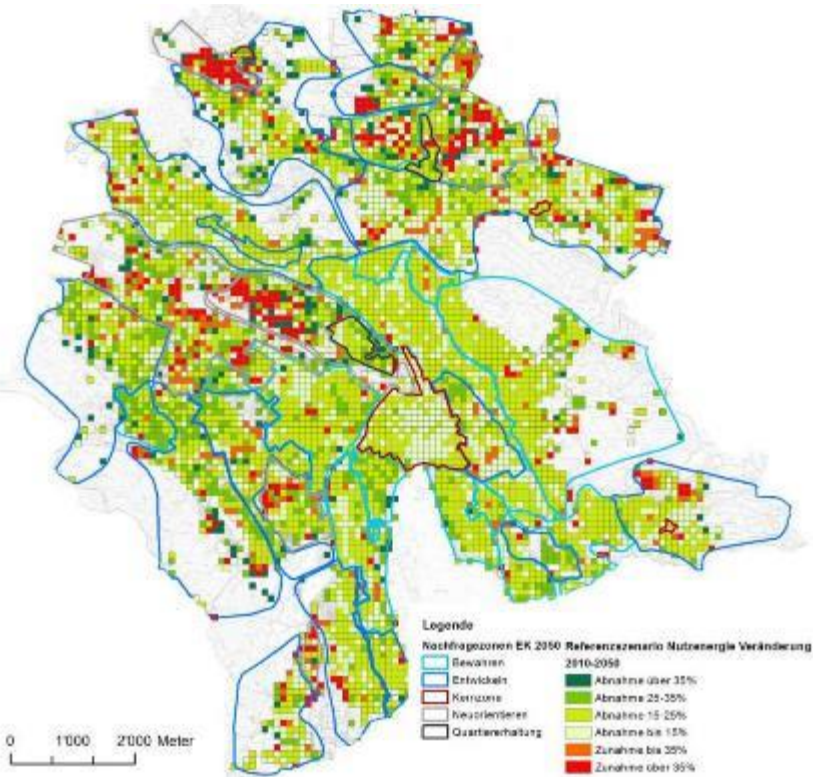
By building



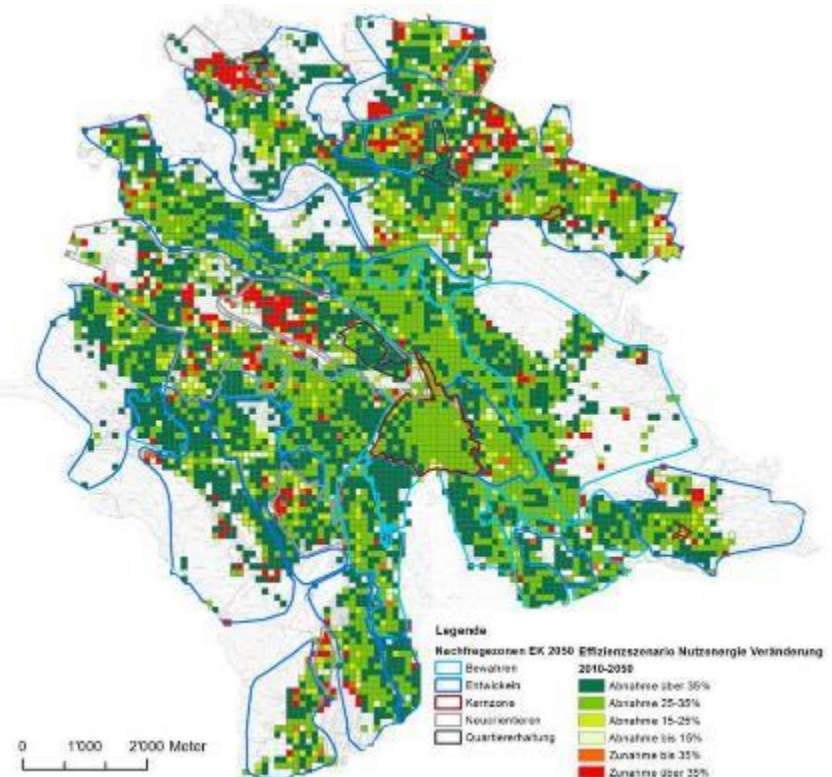
Change of energy demand for heating 2010-2050

Case study city of Zurich

2010-2050: Reference scenario

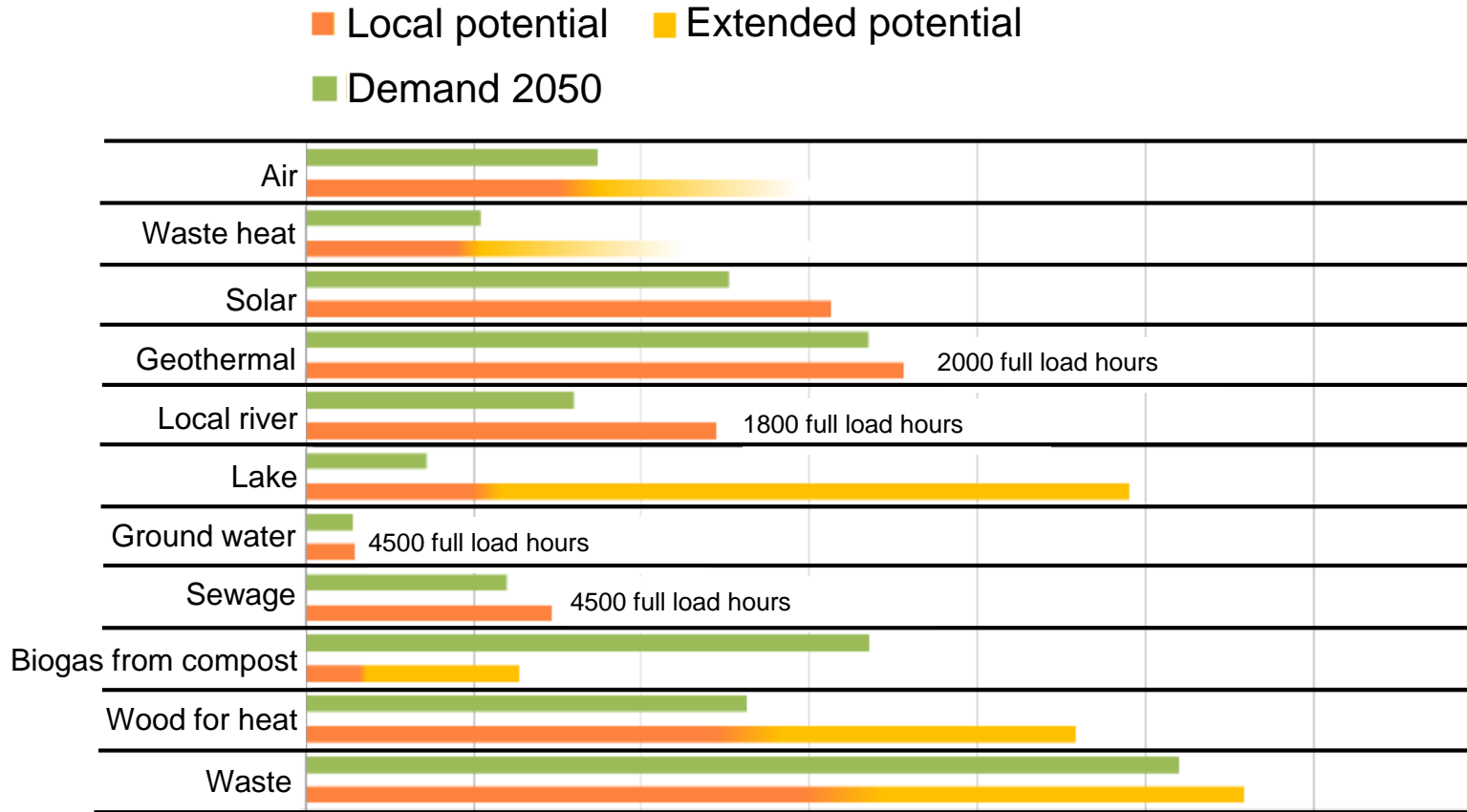


2010-2050: Efficiency scenario



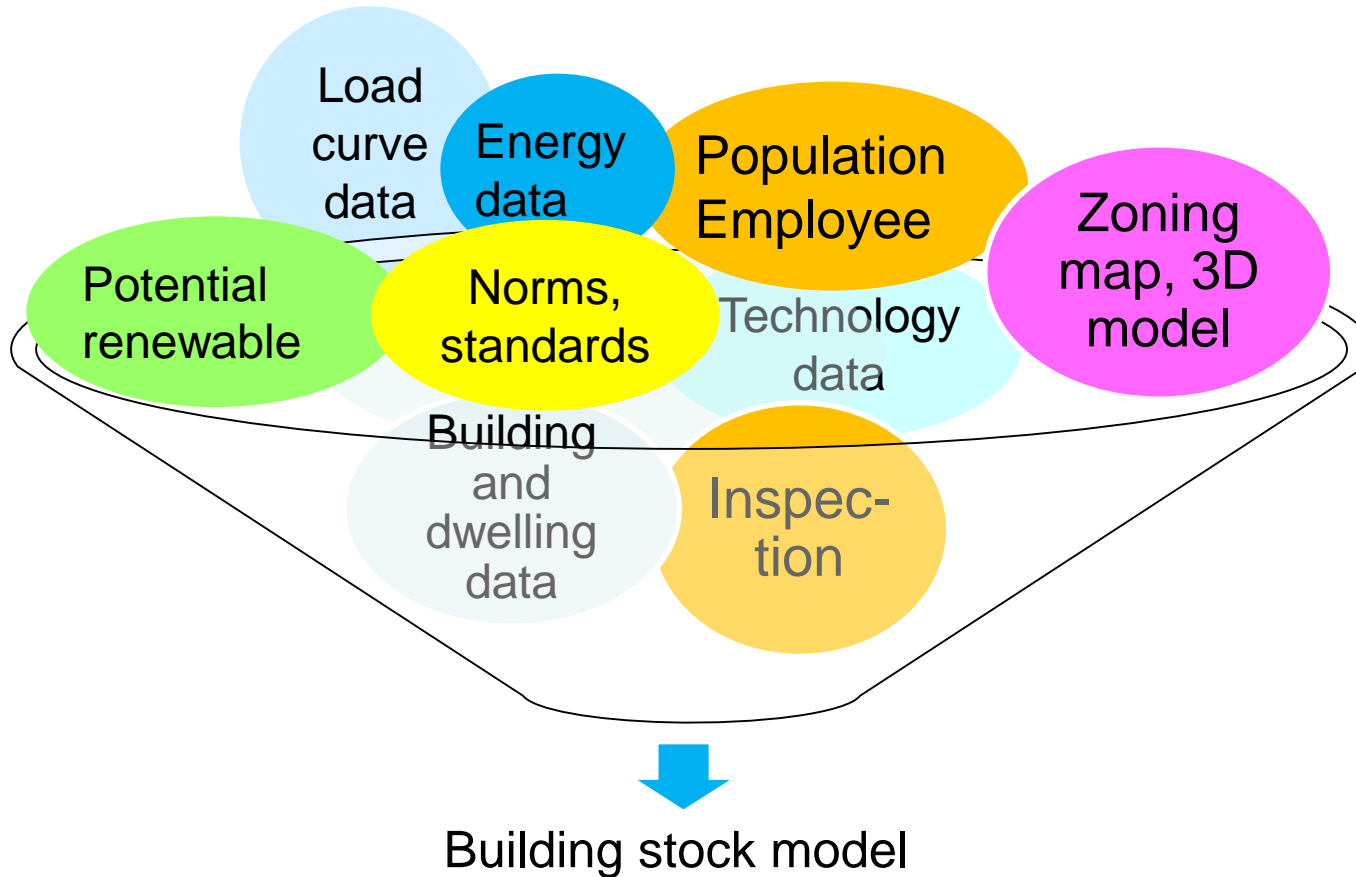
Match future demand and potentials

Case study city of Zurich



Building stock model

Data base



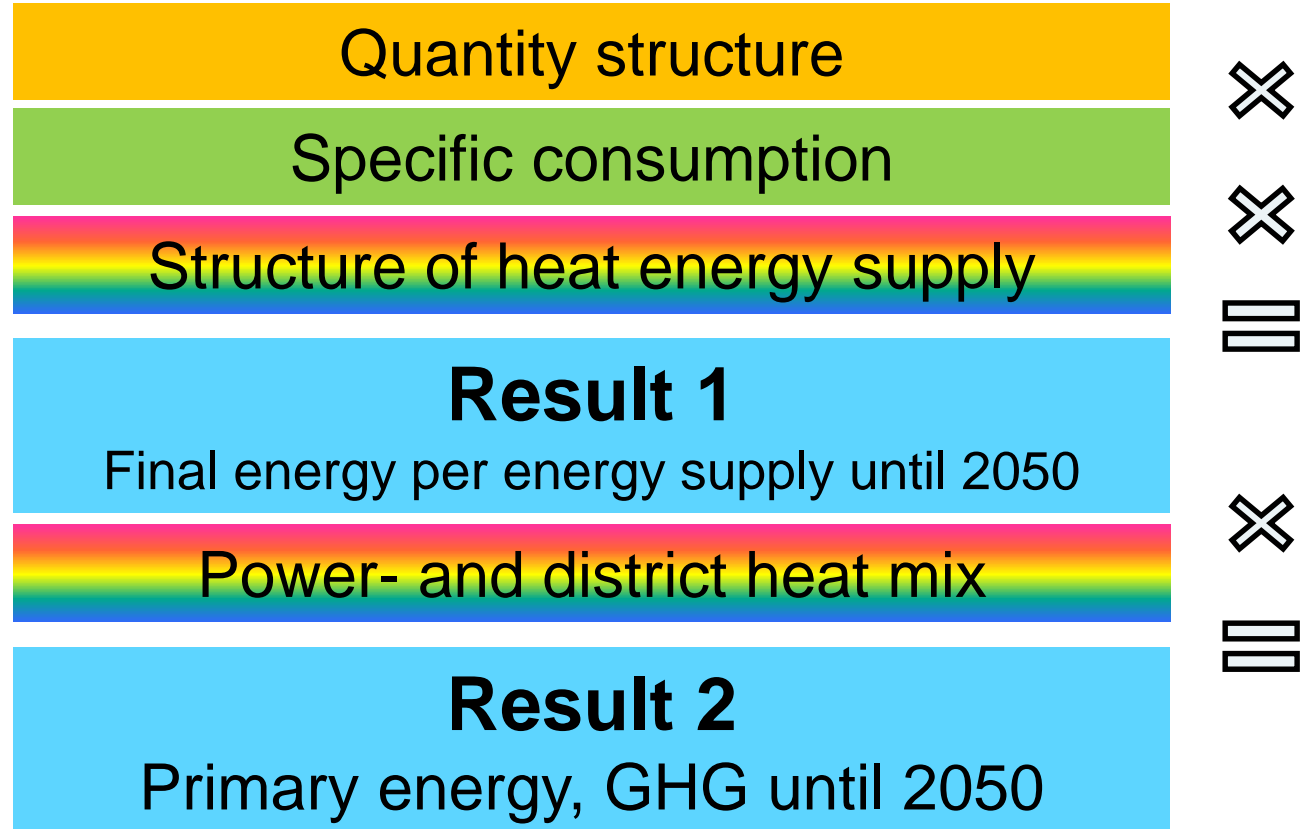
Building Stock Model

Data base and its resolution

	Type of building, sector	City-, neighbour hoods	Hectares, streets, blocks	Buildings / parcels
Building-specific data: Building registers <ul style="list-style-type: none"> - Building spaces, occupied (industry), inhabitant - Type of building, building period, building use 	(X)			X X
Facility-specific data: Utilities, construction permits, authorities <ul style="list-style-type: none"> - Connected buildings, energy carriers, PV-plant - Consumption, installed power 			(X)	X (X)
Building- and zone regulation: Department of urban development <ul style="list-style-type: none"> - Urban development zones - Available construction sites, 3D-Modell 		X		X
Potential of energy: Energy planning department <ul style="list-style-type: none"> - Lost heat-, Solar panels - Renewable potentials, limiting factors 	X (X)	X	(X) (X)	(X) (X)
Empirical studies, standards, norms	X	(X)		
Evaluation of results: as required	X	X	X	X

Structure of the building stock model

(Highly simplified representation)



Foundation of the building stock model

The BSM and related services:

1. Modular approach
2. Methodology and data: International foundation
3. Broad experience in various use cases:

Acknowledgment



Stadt Zürich

SUSTAINABLE CITY
OPEN TO THE WORLD



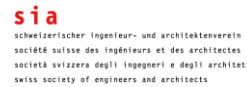
City of
Gothenburg



ewz

energie360°

BASEL
LANDSCHAFT



The BSM is available

Building Stock Model: modular structure

Functionalities and spatial resolution

	Spatial resolution		
	City area, partly areas	Hectare	Building or/and sites
Strategic energy planning	X	(X)	
Urban planning, site development		X	X
Operative energy planning		X	(X)
Grid planning		X	(X)
Conception, Planning: Energy Service Provider (ESP)		X	X
Management of buildings-portfolio			X

Availability of the building stock model

3 options



About us

- **Dr. Martin Jakob and Dr. Giacomo Catenazzi**

Co-founder, executive partner and senior modeler at TEP Energy GmbH

- Energy and building stock models from the neighborhood to the European scale
- Conduct empirical studies, and evaluate techno-economic and market potentials
- Conceives and runs promotion programs.

- **Prof. Dr. Holger Wallbaum and Claudio Nägeli**

Chair of sustainable building , Civil and Environmental Engineering, Chalmers

- Sustainable building on concepts, tools and strategies
- To enhance the sustainability performance
- Of construction materials, building products, buildings, as well as entire cities.

- **Long-term collaboration in building stock modelling**

Acknowledgment to Climate-KIC,
the EU's main climate innovation initiative,
who is co-funding the project CREAM2



Climate-KIC is supported by the EIT,
a body of the European Union

The Climate Challenge

- Urgent need for both mitigation & adaptation
- Combined action of business, academia, citizens & government
- Huge global risk, but great opportunity for creation of a green economy
- Climate-KIC in key position



Impact for:

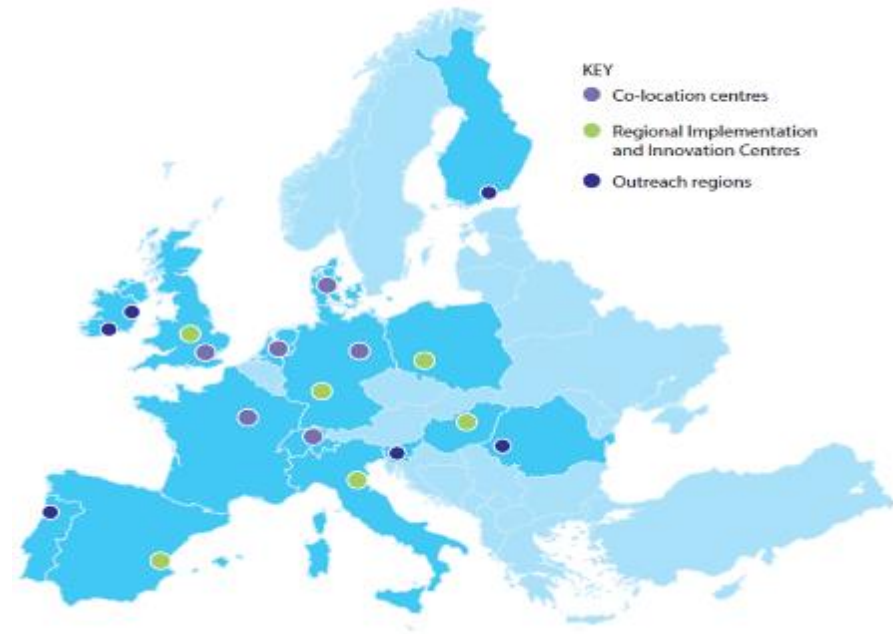
CLIMATE

ECONOMY

SOCIETY

Climate-KIC started in 2010...

- Climate-KIC is the EU's largest public private partnership addressing climate change
- **Mission:** we bring together, inspire and empower a dynamic community to build a zero carbon economy
- **Vision:** to enable Europe to lead the global transformation towards sustainability



Thank you!

Questions?

- Answers now
- Or at
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References

- Jakob M., Ott W. et al (2014). Integrated strategies and policy instruments for retrofitting buildings to reduce primary energy use and GHG emissions (INSPIRE), Swiss contribution to the ERA-NET «Eracobuild», 20. März 2014
- Jakob M., Ott W. et al (2014). Integrated strategies and policy instruments for retrofitting buildings to reduce primary energy use and GHG emissions (INSPIRE), Final report, 19 January 2015
- Jakob M. et al (2013). A comprehensive instrument to assess the cost-effectiveness of strategies to increase energy efficiency and mitigate greenhouse gas emissions in buildings, 6. September 2013
- Nägeli C., Jakob M. Sunarjo B. Catenazzi G. (2015). A building specific, economic building stock model to evaluate energy efficiency and renewable energy. Conference CISBAT, 10-11 September, Lausanne.