Smart City concepts: chances and risks of energy efficient urban development

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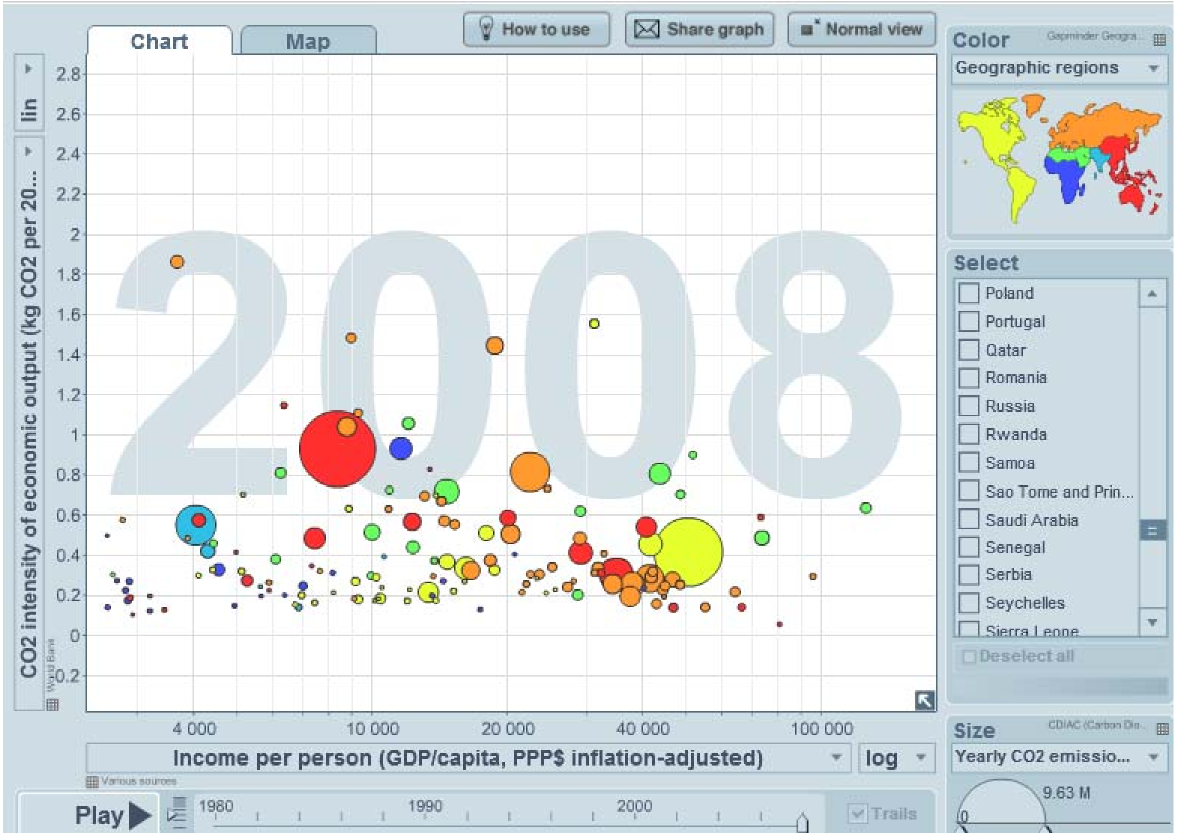
Objectives & structure

- Trends and Challenges
  - Economic wealth - urbanisation – emissions
  - Global challenge – urban task
- Understanding: an integrative perspective
  - From technical dominance – to place based evidence
  - European Smart City: PLEEC Energy Efficiency
    - From evidence to road map and recommendations
    - From innovation potentials to a place based road map
  - Planning model: from evidence to action and monitoring
- Conclusions
  - Risks & perspectives

economic wealth & emissions

On national level different conditions / situations

- No clear relation between CO2-intensity of economic performance and economic wealth
  - European countries are different: East – West
  - Oil producing countries are not sensitive against emissions
  - population size matters



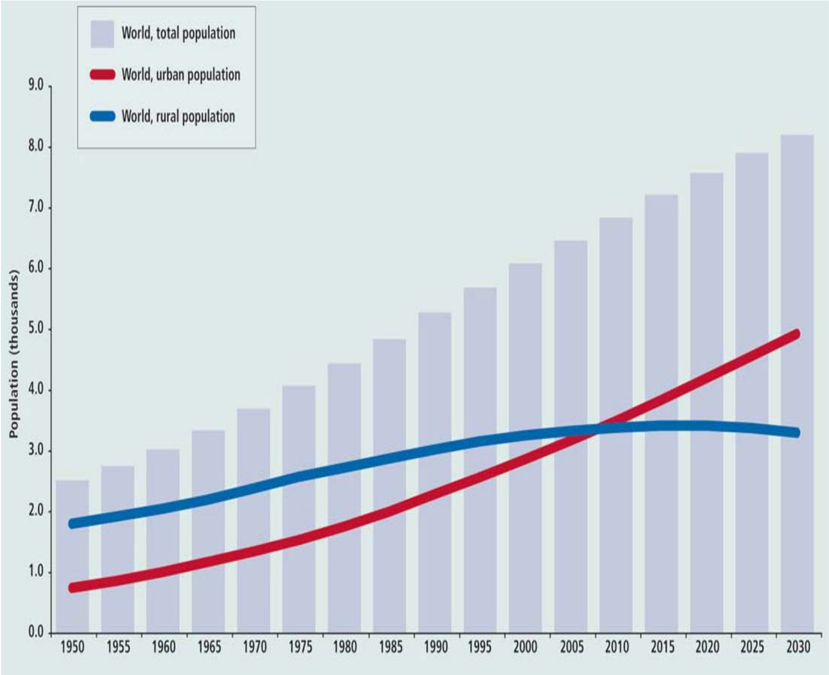
Source: http://www.gapminder.org/world/

Basic challenges
→ common policies on national level across continents
→ No decoupling but a combination of economic performance with reduction of emissions

Urbanisation

❑ Unbroken trend …

- Population in 2007 around 50% in urban areas; in 2030 around 60 %
- Change in urban systems: rapid growing cities and metropolises
- Increasing metropolitan regions: Suburbanisation and satellite cities
- Change of land use and settlement patterns
- More than 400 cities > 1 million inhab.



Challenges

→ Demographic growth: more efficient use of infrastructure

→ Urban sprawl: higher densities and improved mobility conditions

→ Economic performance and living conditions: transformation of energy production combined with reduction

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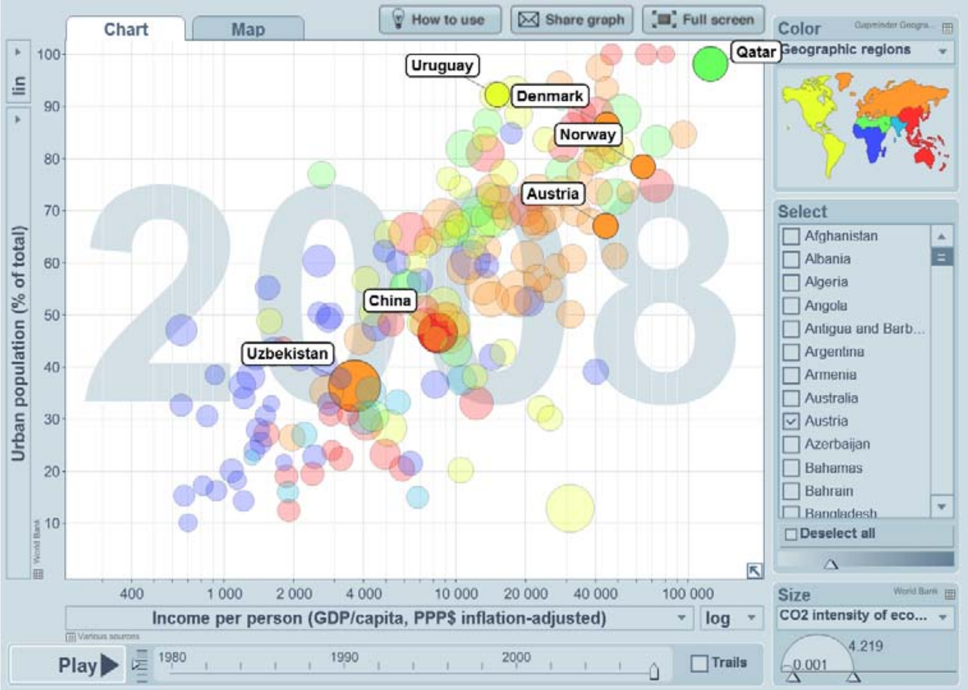
Urbanisation - Economic Wealth – CO_2 intensity p. GDP

Unbroken macro trend …
… an urban / metropolitan task

- Economic wealth and urbanisation go hand in hand
- CO2-intensity not necessarily linked to this trend
- Metropolises with > 1 mill inhabitants
  - produce 80 % of global CO2-emissions
- About 50 % of population in urban areas – energy consumption and economic performance around 75 %

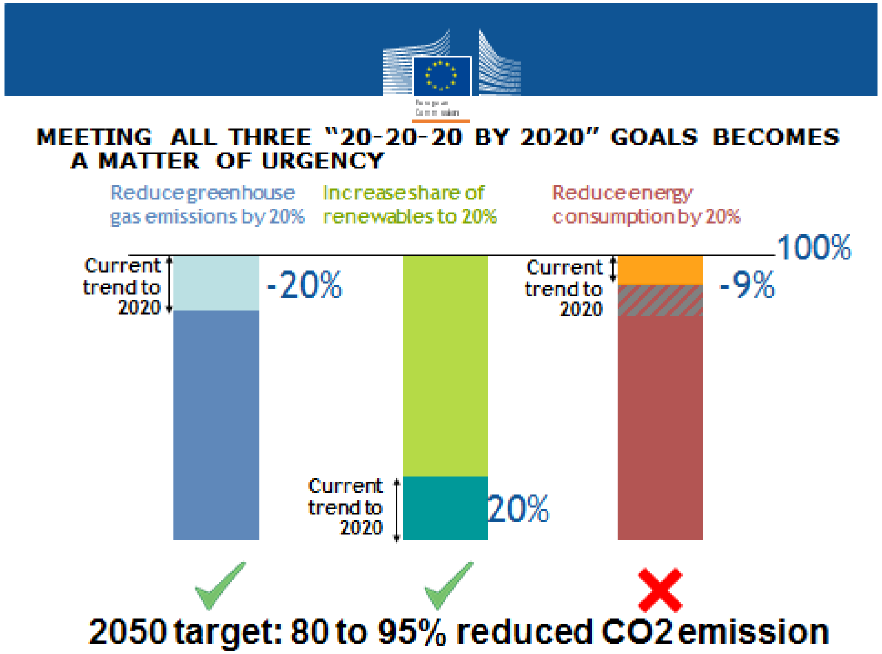


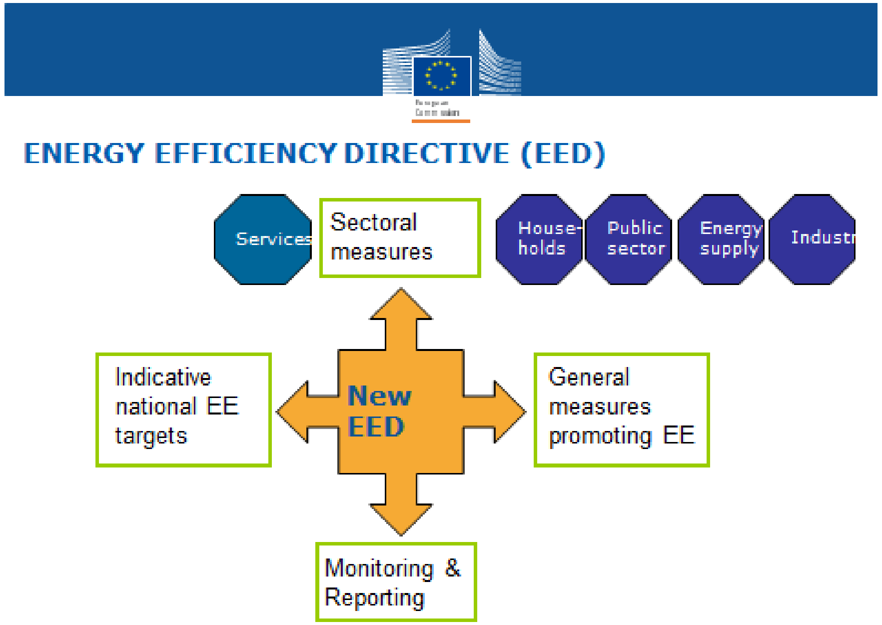
Source: http://www.gapminder.org/world/

Main challenges

→ Increasing demand and consumption of energy in large urban areas
→ Increase of energy efficiency / reduction of emissions in specific key fields of urban development

EU - Energy objectives: policy relevance





Presentation of *Sven Dammann*
DG ENER-C2, Stoke-on-Trent, 5th of November, 2013

Upscaling: from buildings to districts to cities

- Political focus on energy efficiency and emission
  - Programs and funding: predominantly aiming at technology
  - City as technical object or enabler of sustainable development ?

What is a ‚Smart City'?
origins and basic idea

- … originated from the 'information city'
  - … using new ICTs innovatively ….. for example implementing a network of sensors in the city
  - … believe in a wired, ICT-driven form of development
  - … stresses the integrated database for city governance

http://www.youtube.com/watch?v=NENo4sjZB9Y

- *„… when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through a participated governance."*
  - » *Caragliu, DelBoand, Nijkamp (2009)*
  - Emphasizing important components of investments
  - considering sustainable economic growth and quality of life
  - Inclusive understanding through participative approach

Understanding - comprehensive & integrative

- ….defines ‘Smart City’ initiatives as multi-stakeholder municipally based partnerships aimed at addressing problems of common interest with the aid of ICTs, which underpin ‘Smart’ classification.
- ‘Smart City’ initiatives address problems of common interest with the aid of ICTs. To be classified as a Smart City …a city … addresses one or more of the following characteristics: Smart Governance, Smart People, Smart Living, Smart Mobility, Smart Economy and Smart Environment.

DG Internal Policies (2014) Mapping Smart Cities in the EU.
http://www.europarl.europa.eu/RegData/etudes/etudes/join/2014/507480/IPOL-ITRE_ET(2014)507480_EN.pdf

→ **Increasing common or diverse understanding ?**

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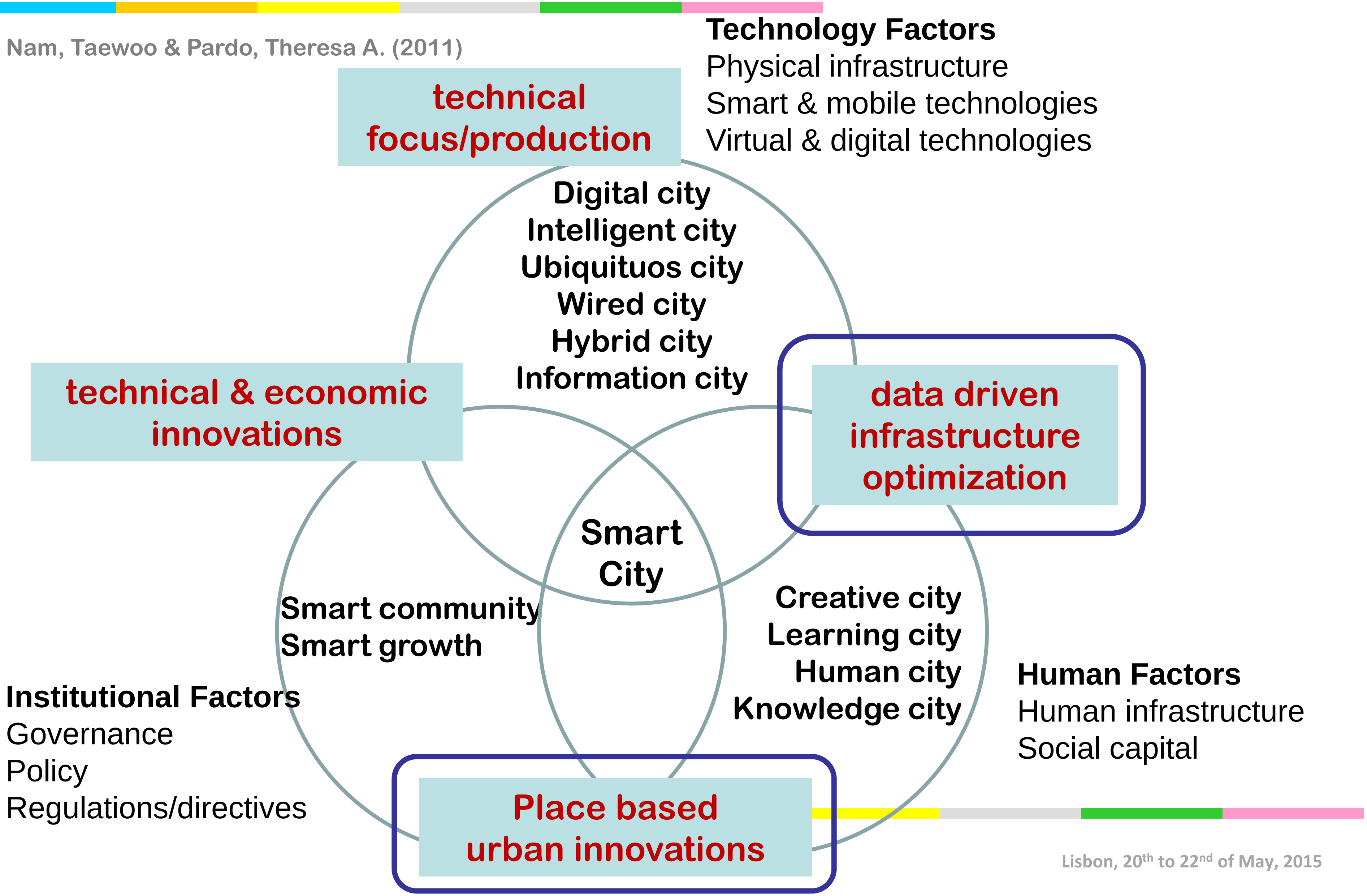
What is a Smart City? Different Understandings

Nam, Taewoo & Pardo, Theresa A. (2011)



SC: Technical understanding

„Smart Cities combine diverse technologies to reduce their environmental impact and offer citizens better lives.

This is not, however, simply a technical challenge....”

European Smart City stakeholder platform’
http://www.eu-smartcities.eu/faqs# Smart_Cities; 25.2.2013

- **an ICT-centered smart city: highly instrumented**
  - **to optimize decision making in the short and long term**
  - **better to manage and to control city systems by collating ever-detailed information about real time functioning**
  - **to mitigate and remedy current urban problems and make urban transport more sustainable**

- **enabeling urban growth with ‚better life‘**

→ **For whom? In which dimensions?**

→ **Which impacts ?**

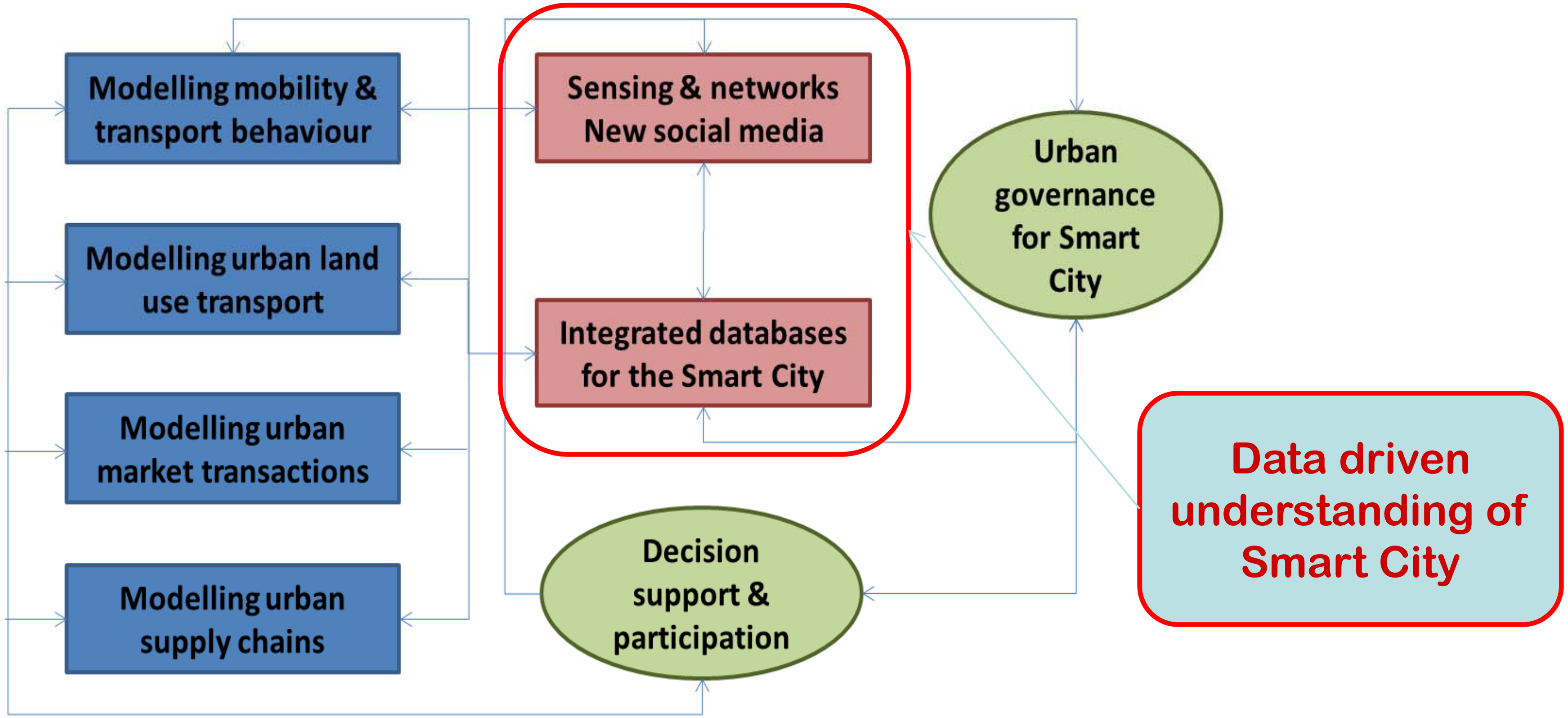
Main risks of technical understanding

Rebound effect

- denominates the impact of energy cost reductions through technical innovations on the increase of energy consumption and of emissions. These impacts result in additional consumption
  - of the same (i.e., more energy through price effect) or
  - of other goods (through relative income effect)
    - (Herring and Roy, 2007)
- Rebound effects through reduction of energy consumption
  - for instance, lightning or individual motorized transport

→ Technical innovations usually are not sufficient for the reduction of energy consumption and emissions but need complementary changes in behavior and structural conditions

SC: analytical / data driven understanding



Batty et al., (2012) Smart Cities for the Future, p. 508

Regarding energy efficiency: no explicit focus on thermal housing refurbishment
- Comparatively highest potential in European Cities

SC - Barcelona:
data driven infrastructure optimization

Vision **Barcelona Smart City**

The city of people

Technology as an enabler for:

- ✓ *Urban mobility more efficient and sustainable*
- ✓ *Environmental sustainability*
- ✓ *Business-friendly and attracting capital*
- ✓ *Integration and social cohesion*
- ✓ *Communication and proximity with people*
- ✓ *Knowledge, creativity and innovation*
- ✓ *Transparency and democratic culture*
- ✓ *Universal access to culture, education and health care*

Improve citizens' welfare and quality of life

Economic progress

Barcelona (2014)
http://de.slideshare.net/fullscreen/citybrandinggr/barcelona-smartcity-strategy/21; 17.5.2014

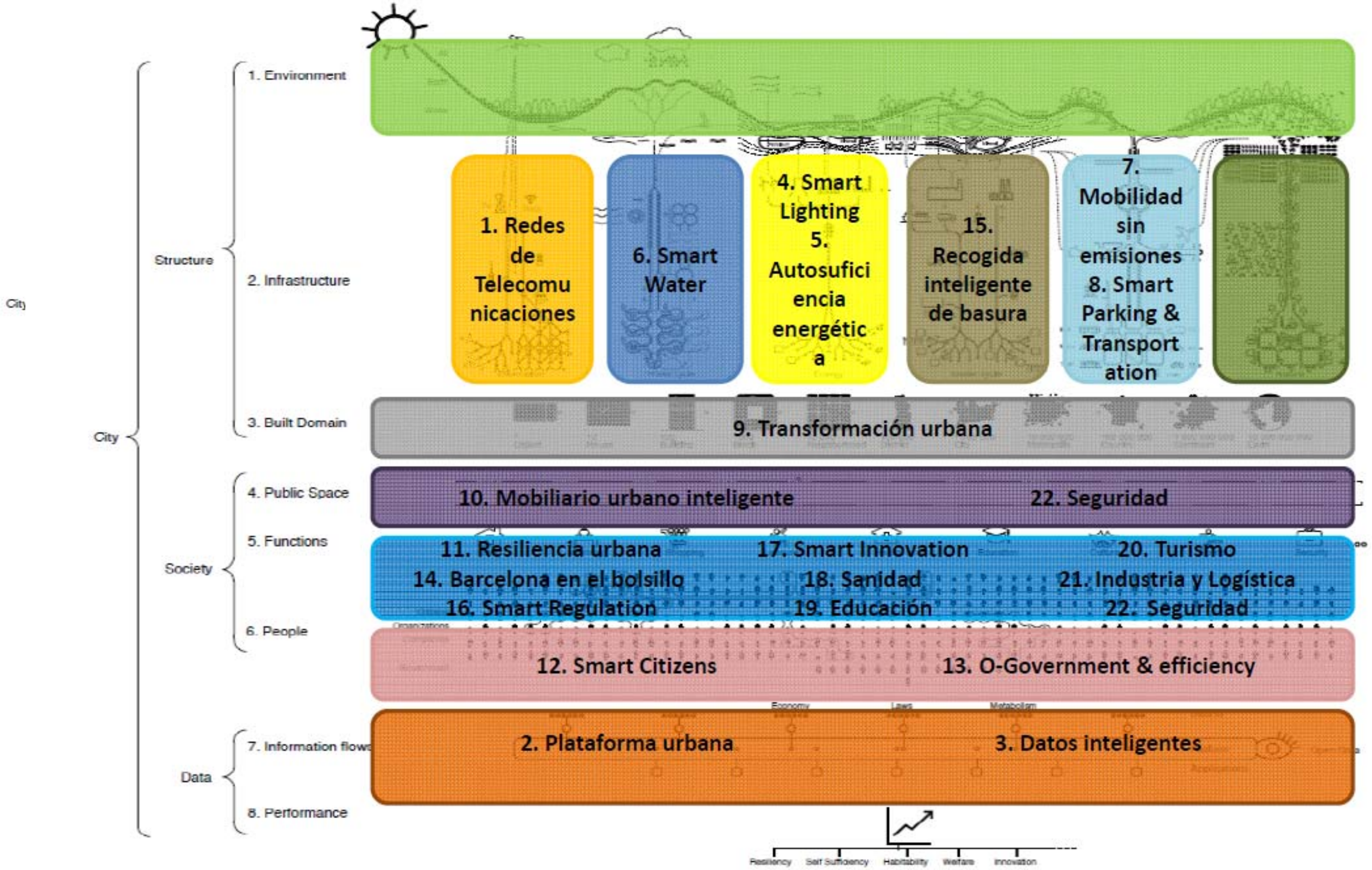
→ **Objectives for integrative and innovation based urban development with modern infrastructure**

SC - Barcelona: technology based provision of new urban services

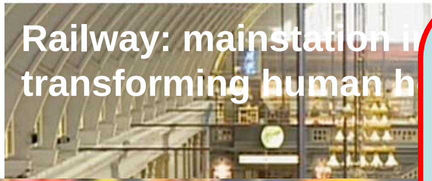
ANATOMÍA DE LA CIUDAD

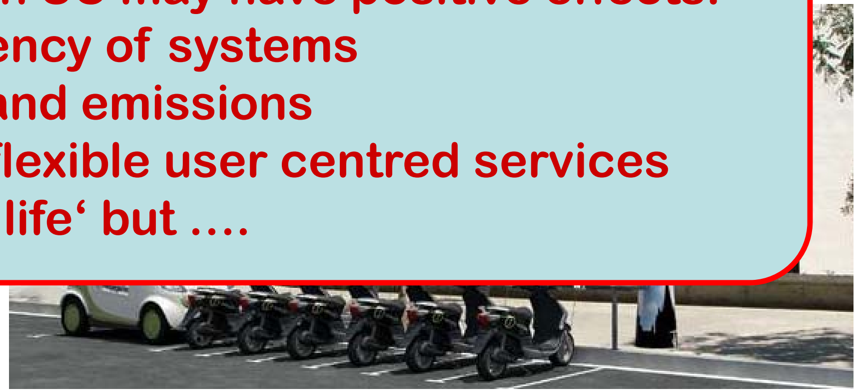
MODELO CONCEPTUAL DE BARCELONA

LOS 22 PROGRAMAS EN LOS 12 ÁMBITOS



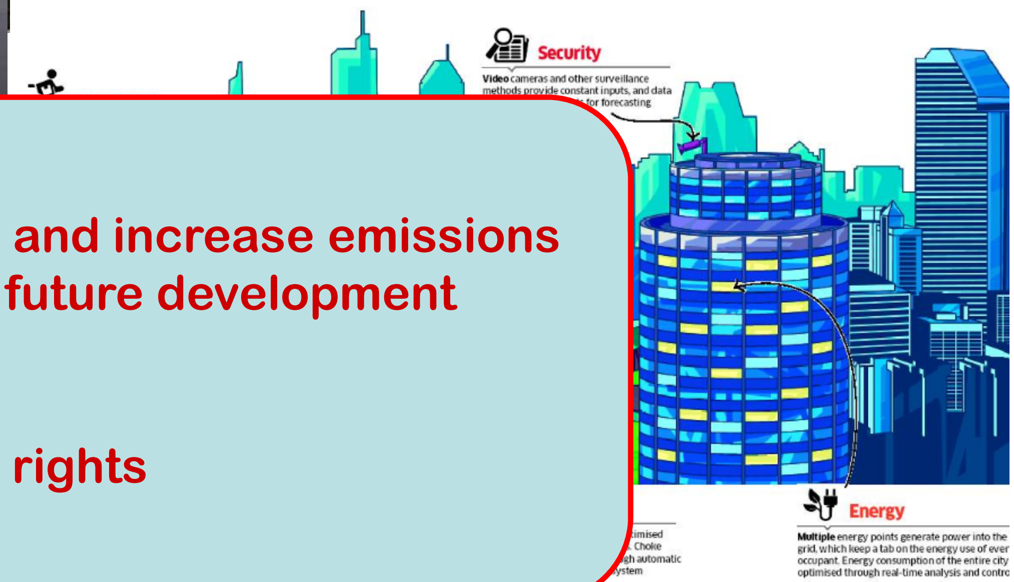
technical & data driven understanding: which effects ?





Technically driven SC may have positive effects:

- improve efficiency of systems
- reduce costs and emissions
- provide more flexible user centred services
- enable ‚better life' but ....



But may bring risks:

- provoke rebound effects and increase emissions
- cause lock-in effects for future development
- enforce social exclusion
- misuse big data sets
- endanger individual civil rights
- ...

Strategic Planning perspective: place based

Operationalisation of Smart City

- .... a city well performing in a forward-looking way in specific key fields of urban development, ...
- ....for which the path of development is decisive
  - ...efforts improving performance in distinct fields of development
- ... the challenge on city level...
  - ... to activate the potentials through integration of stakeholders, costumers and residents
  - ... to transform them into assets what makes a city smart

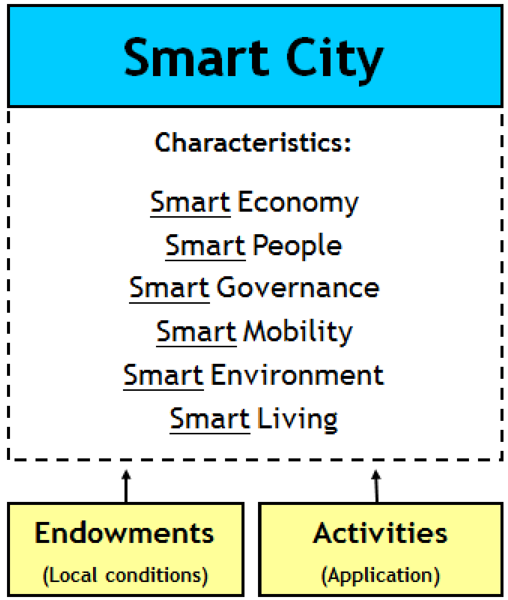
→ **Need for a definition of energy efficiency**

- In most definitions an emphasis on ‚sustainable' or ‚better life'
- Not on ‚efficiency'

European Smart Cities

Ranking and Benchmarking approach

Giffinger, et al.,2007



PLEEC – Planning for Energy Efficient Cities

EC, FP-7; DG Energy;
Lead: Eskilstuna Energy and Environment (Sweden)
Partner: TU Wien (A)

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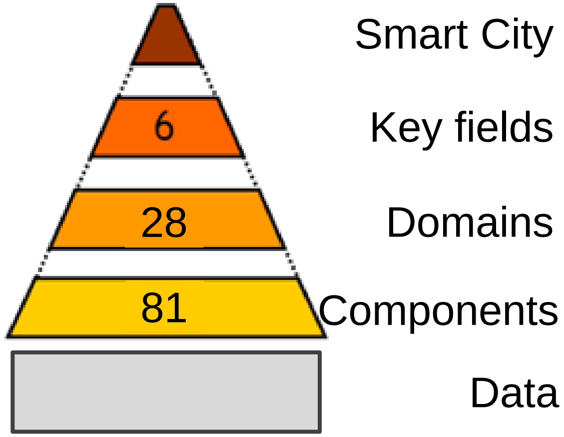
Smart City
place based learning process

SC understanding



SC learning process

Workshops

Participatory settings

Expert interviews

based on quantitative information

- Detecting urban position and profile based on key fields
- Identifying assets and deficits
- Supporting benchmarking and place based evidence

based on qualitative information

- Discussion of most relevant key fields and domains
- Identifying strengths and weaknesses based on profiles
- Defining relevant projects

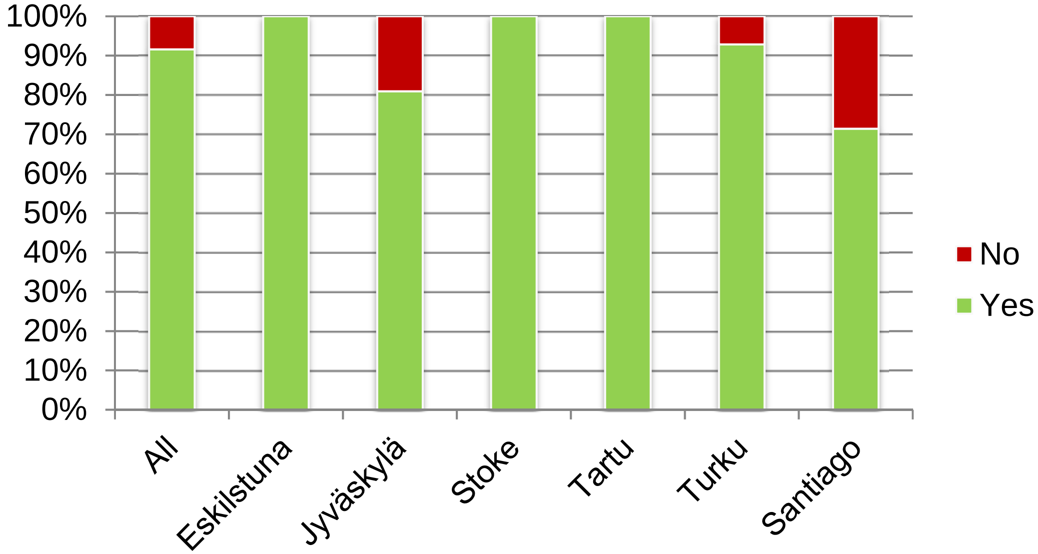
Strategic projects / Roadmap
Monitoring System

PLEEC – Planning Energy Efficient Cities; EC, FP-7; DG Energy; TU Wien; or
SMART_KOM; Krakow Technology Park; TU Wien; Interreg; or
BUF – Baltic Sea Region Urban Forum; Interreg.

Definition of energy efficiency

PLEEC – Planning Energy Efficient Cities; EC, FP-7; DG Energy; TU Wien
http://www.pleecproject.eu/

- ***"Energy efficiency means the use of less energy to provide the same services considering aspects of economic, social and ecologic sustainability and the life-cycle of materials."***
- **Broad acceptance (92% of respondents fully agree) on definition:**
- **Web based surveys**
  - **2 consecutive questionnaires**
  - **in 6 PLEEC cities**
  - **With a maximum of 101 stakeholders**



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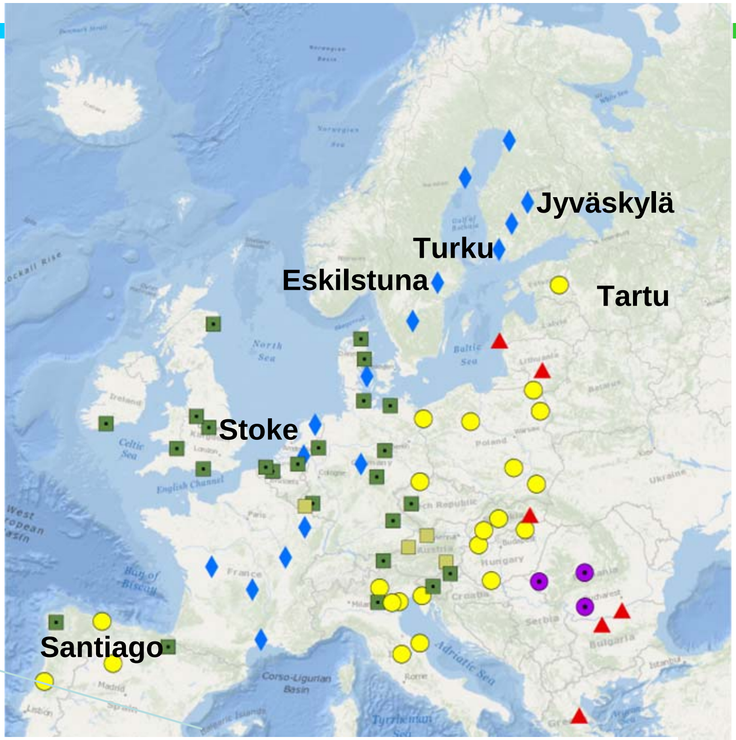
PLEEC : Planning Energy Efficient Cities
Profiles detecting innovation potentials (FP-7 project)



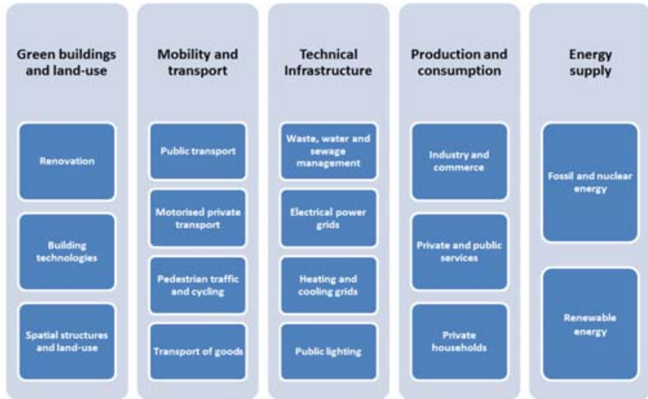
→ Innovation Potentials

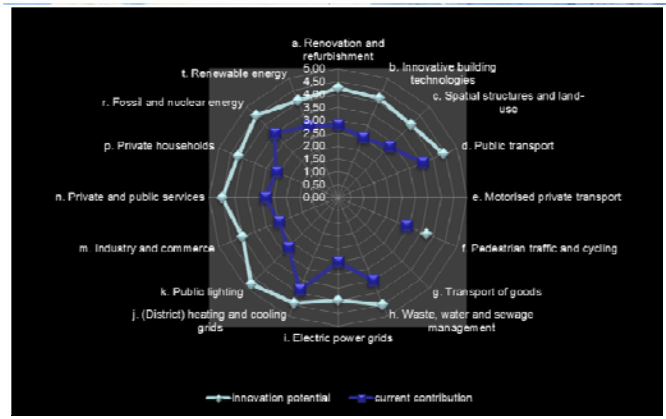
European consortium:
- scientists and 6 partner cities:
  - 2 surveys and several workshops

→ Energy relevant key fields & domains

→ relevant Innovations

- **Experts: search – assess – propose**





→ Road Map with each Cities
- Proposal of adequate innovations

→ Planning Model
- Recommendations
- Indicators for monitoring

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Classification of key fields and domains of energy efficiency

PLEEC – Planning Energy Efficient Cities; EC, FP-7; DG Energy; TU Wien

Key fields	Green buildings and land-use	Mobility and transport	Technical Infrastructure	Production and consumption	Energy supply
Domains	Renovation	Public transport	Waste, water and sewage management	Industry and commerce	Fossil and nuclear energy
	Building technologies	Motorised private transport	Electrical power grids	Private and public services	Renewable energy
	Spatial structures and land-use	Pedestrian traffic and cycling	Heating and cooling grids	Private households	
		Transport of goods	Public lighting		

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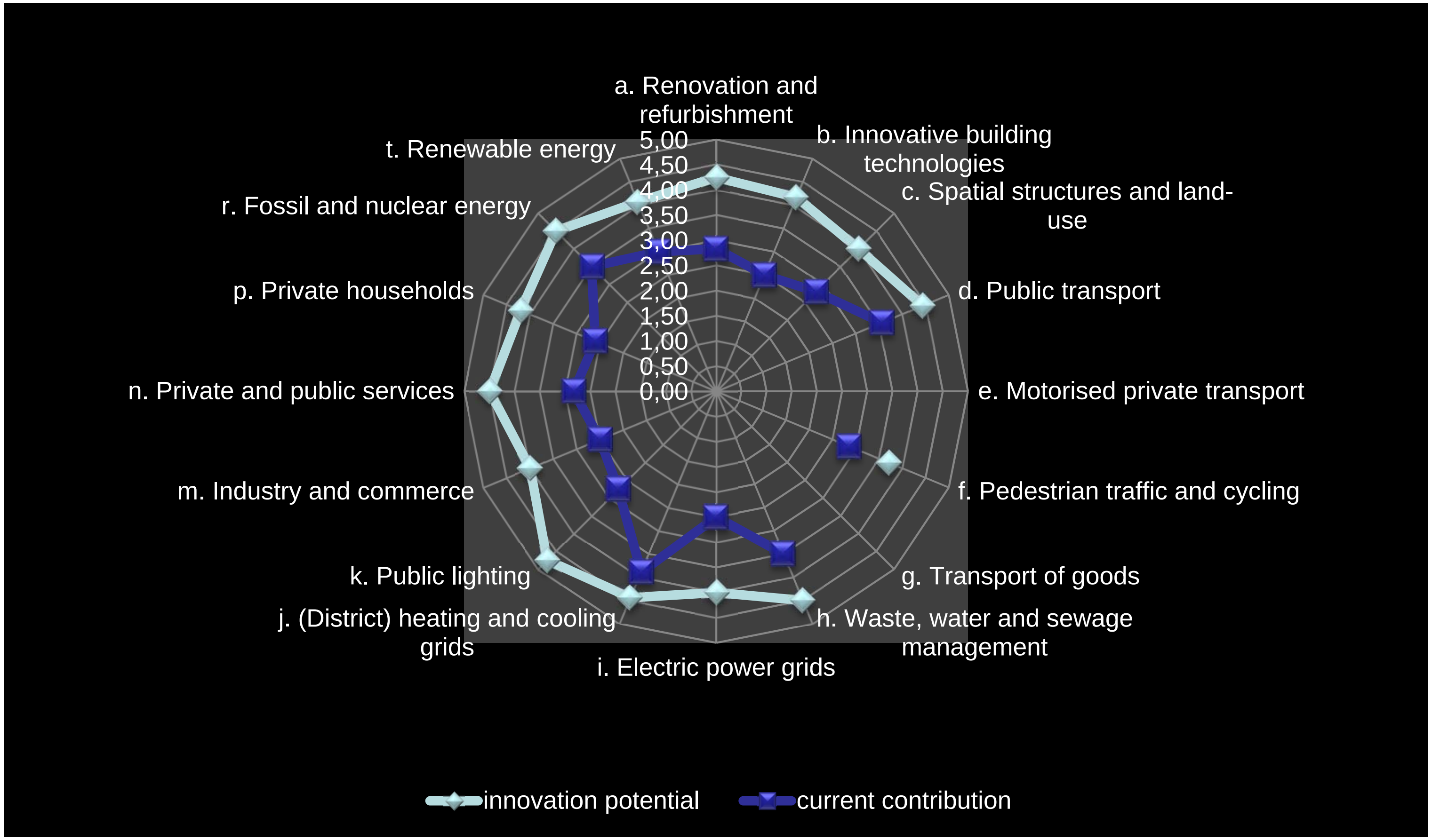
City evidence
innovation potential: profile Tartu

»How would you judge the current contribution of the domain "…" for energy efficiency in your city today?«
»How would you judge the innovation potential for energy efficiency in the domain "…" in your city in the near future?
»(1…very low, 2… low, 3… fair, 4… high, 5… very high)«



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Technical innovations: enabling impact on energy efficiency in respective domain

- ❑ **Integration of knowledge : scientists (universities), technicians (multinational enterprises)**
  - ➢ **technical innovations and their expected impact on ee**
- ❑ **Key fields defined by domains** (see above)
  - ➢ **Corresponding central indicators describing impacts**
  - ➢ **Enabling technologies: assumed impact**

PLEEC – Planning Energy Efficient Cities; EC, FP-7; DG Energy; Mälardalen University

Building Technology	**Share of private low energy buildings**	Building Energy management system (BEMS)	HIGH
		Mechanical ventilation system with a heat recovery wheel	HIGH
		LED lighting	MED
		Heatpumps for heating, cooling and hot water	LOW
		Smart Lighting Control	HIGH
	Share of public low energy buildings	Building Energy management system (BEMS)	HIGH
		Mechanical ventilation system with a heat recovery wheel	MED
		LED lighting	HIGH
		Heatpumps for heating, cooling and hot water	MED
		Building Micro CHP	MED
		Smart Lighting Control	MED

PLEEC: integrative approach

Structure & governance | Behaviour & target groups

PLEEC – Planning Energy Efficient Cities; EC, FP-7; DG Energy;

Fertner C., et al., 2015, WP 4, D4.1 | Kunnasvirta A., et al., 2015, WP 5, D5.1

- For each city
  - institutional settings for energy planning
  - Main actors, competencies
  - Management & Planning tools
  - Pilot projects/good practice/ lessons learned/links to other WPs
  - Perspectives
- 'case-driven' collection of knowledge
  - from the six cities and scientific literature on
    - Key fields and domains

- identification of potential for increase of energy efficiency; i.e. reduction of use
  - exploiting the Best Available Practices (BAP) across key fields
- examples of behav. interventions
  - Green buildings and land use:
    - Energy efficient shopping
    - building renovation
  - Mobility and Transport
    - Mobility plans for new urban areas
    - Walk & cycle to school
  - Production and Consumption
    - Energy neighbourhoods project

Road Map WITH each Partner City

Elaboration of innovation potentials

- Experts identify innovation potentials for each domain based on their city specific experiences
  - In general, INNOVATION POTENTIAL
    - for each domain the differential between status quo and optimum status is described

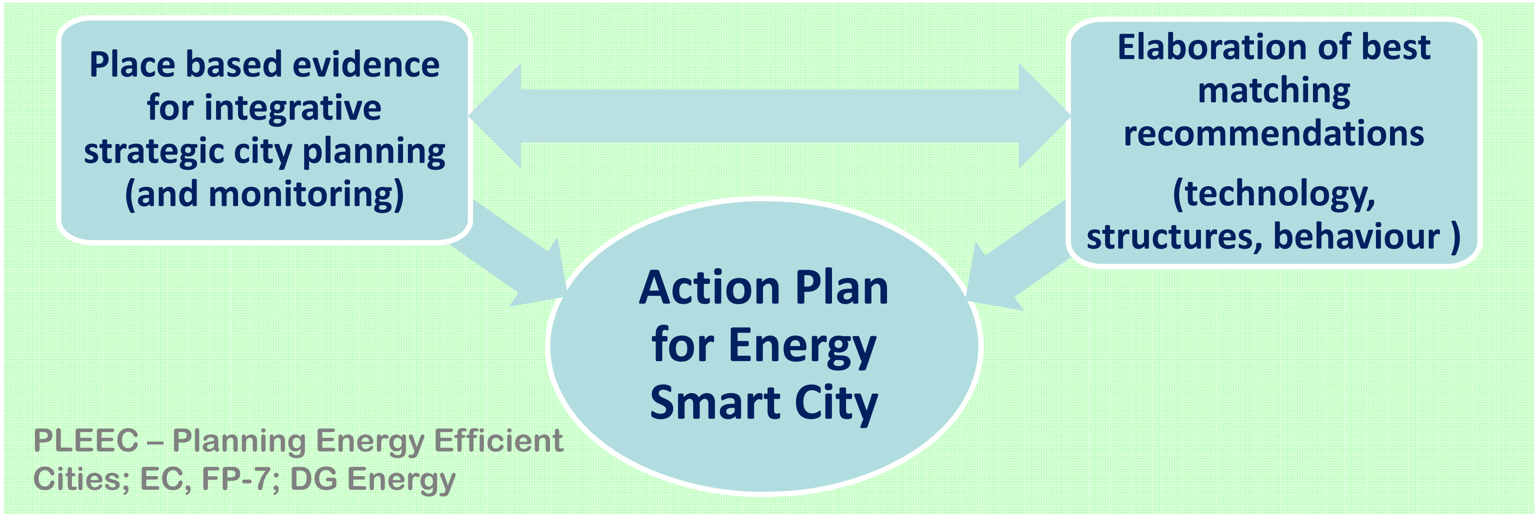
Elaboration of technical, structural and behavioural innovations

- Experts identify and assess potential impacts of
  - technical INNOVATIVE SOLUTIONS
  - BAPs regarding BEHAVIOUR
  - MANAGEMENT and PLANNING TOOLS regarding PILOT PROJECTS

Elaboration of a road map

Proposal of adequate innovations

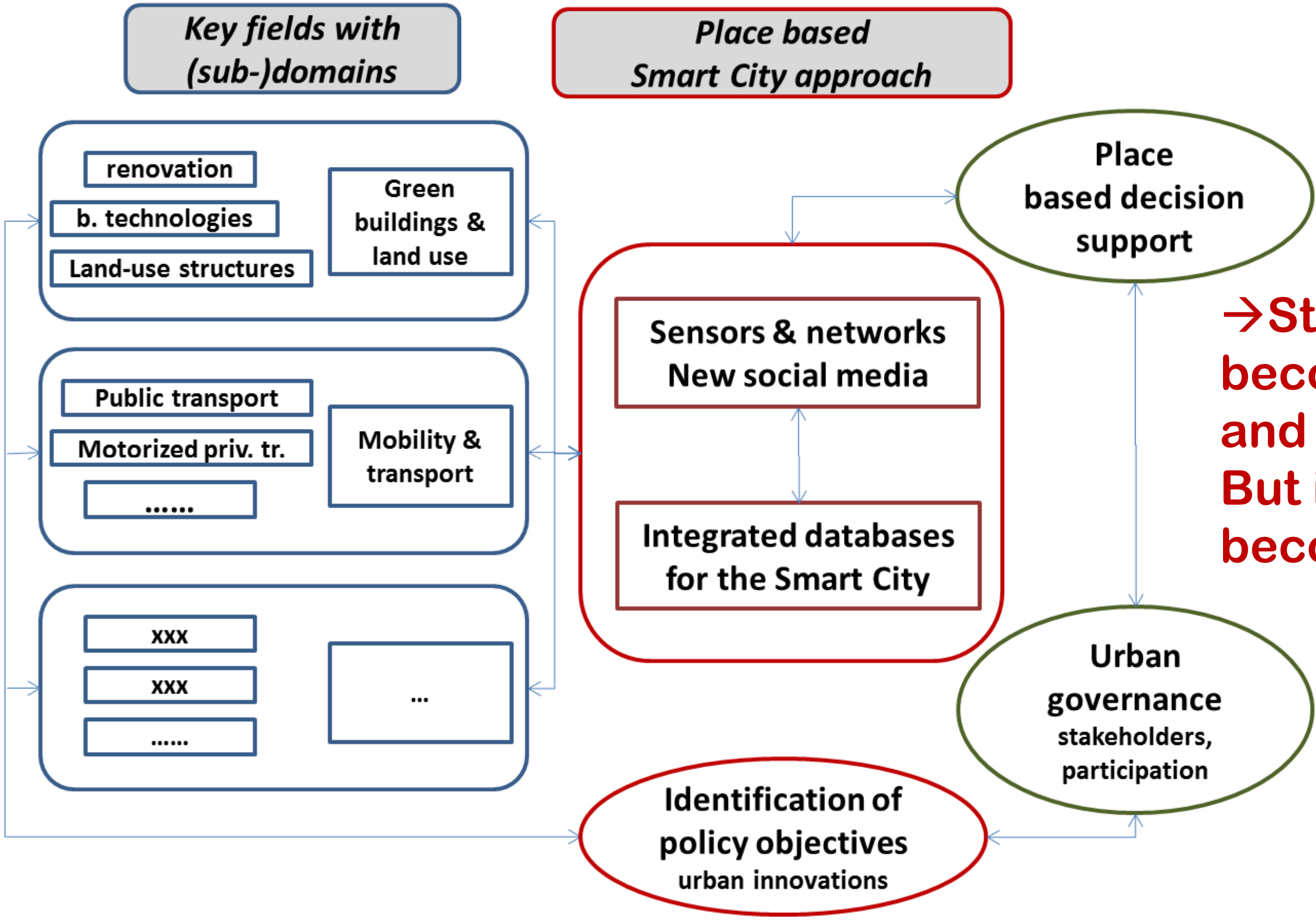
Integrative planning model:
smart urban development



Preliminary results

- Matrix on Key Fields and Domains:
  - for energy efficient discussion very helpful
- Road map and recommendations:
  - need of integrative process understanding
- Indicators for monitoring ee development:
  - very important but up-to-now deficiently developed

Conclusion 1
SC strategies on the way, but…



→Strategy finding process becomes more complex and effective.
But is it endangered to become in-transparent?

→Today concepts are effective local problem solving or dominated by technical-economic interests?

Conclusion 2
challenges of SC: place based & transparent

- **Smart City is much more than a SIM City**
  - Considering and accepting path dependence: cities are different
  - More than the adding of technical features
  - No commodification
- **Avoidance of unintended impacts**
  - No socio-spatial exclusion: i.e. costs of renewable energy
  - No new silo-thinking: Intersectoral concepts providing integrative projects are necessary
  - Minimizing rebound effects
- **Avoidance of short termed non-transparent decision processes**
  - Political will (and risk) for ambitious medium/long termed objectives
  - Transparent processes of decision finding between local needs and public interests
  - Monitoring allowing critical and fast assessments of recent trends

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Conclusion 3
strategic planning – but how?

- **Strategic planning**
  - **Integrative strategy should regard city as socio-technical system**
    - Interlink (not duality) between materiality (elements, functions and interactions) and social construction (perception, assessments, attitudes)
  - **Conflict solving between environmental, economic and social systems:**
    - Efficiency: environment, labour, capital as scarce resources
    - Justice: distribution of wealth, environmental quality
  - **Place based strategies for energy efficient development should**
    - focus on urban structures (material and environmental conditions) & urban performances & social values and attitudes
    - foster sustainable and balanced development instead of silo-solutions
    - go far beyond technical innovations avoiding rebound effects

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PLEEC – Planning Energy Efficient Cities; EC, FP-7; DG Energy; http://www.pleecproject.eu/

SMART_KOM; Krakow Technology Park; http://www.sse.krakow.pl/en/krakow-technology-park/projects.html

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Many Thanks for Your Attention

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