



Energy efficient urban development: challenges and pitfalls in planning and research

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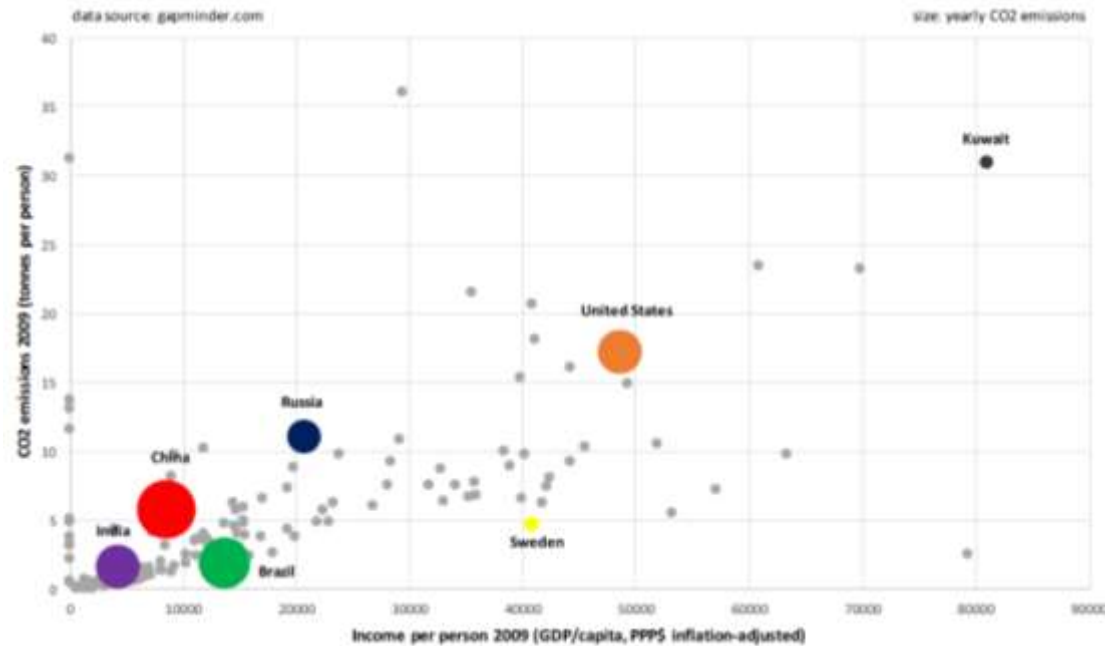
EE-FI Smart City Seminar
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Is ICT/technology enabling sustainable urban development?

- **General Trends and Challenges**
 - Urbanisation – economic wealth – emissions
 - Global challenge – urban task
- **SC - General Understanding**
 - Common focus – different perspectives
 - ICT driven understanding
 - ICT and technical innovation
 - chances and risks
 - Target driven smart initiatives
 - Local conditions and urban innovations
 - Chances and risks
- **Conclusions for Research and Planning**
 - Challenges and pitfalls

economic wealth – emissions, 2009

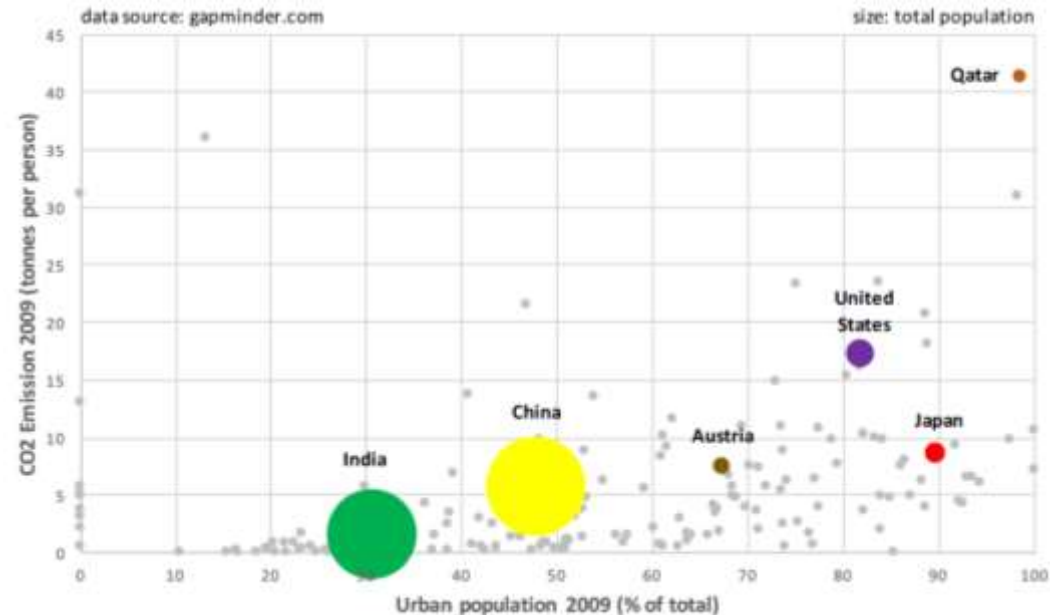
- ❑ **Not only size matters...**
 - Increase of emissions with growing economic wealth
- ❑ **But also important**
 - Replacement of most emitting industries
 - Structure of imported goods and resp. emissions (mostly not considered)
 - Techn. standards and environ. regulations



- Improve of sustainable economic development
- Combination of economic growth with more environmental-friendly economic activities
- Increase of energy efficiency / reduction of emssions in specific key fields of economic development

Urbanisation and size matter

- **economic re-structuring and urban attraction**
 - knowledge intensive activities
 - Improved living and environmental conditions
- **new life styles**
 - Increased mobility
 - Changing patterns of consumption



But rebound effects take place

- **Micro level:** more and additional consumption of products and activities
- **Meso level:** production of higher quality with same/less energy input in distinct branches (cars)
- **Macro level:** Increasing traffic (persons & goods) and consumption and wealth

Basic challenges

- How can we de-couple urbanisation and energy consumption avoiding rebound effects?
- Can technology make urbanisation more sustainable and reduce emissions?

Urbanisation - Economic Wealth – CO₂ intensity p. GDP

Unbroken macro trend ...

... an urban / metropolitan task

- ❑ Economic wealth and urbanisation go strongly hand in hand
- ❑ CO₂-intensity not necessarily linked to this trend
 - About 50 % of population in urban areas – energy consumption and economic performance around 75 %
 - 80% of total CO₂ from cities



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

Main challenges

- Slow down demand and consumption of energy/emissions along with urbanisation process
- Combination of economic wealth / urbanisation / reduction of emissions
- Increase of energy efficiency / reduction of emissions in specific key fields of urban development – through what? Technology?

Why policy and strategy? competitiveness and sustainable development

Main factors of influence

General conditions
socioeconomic,
historical, geopolitical

Agglomerativ conditions
urbanisation, localisation,
urban regional governance

Specific conditions
innov. milieu, capacity R&D,
markets, transaction costs



Living quality

- Socioeconomic & urban standards
- Environmental standards



Economic performance

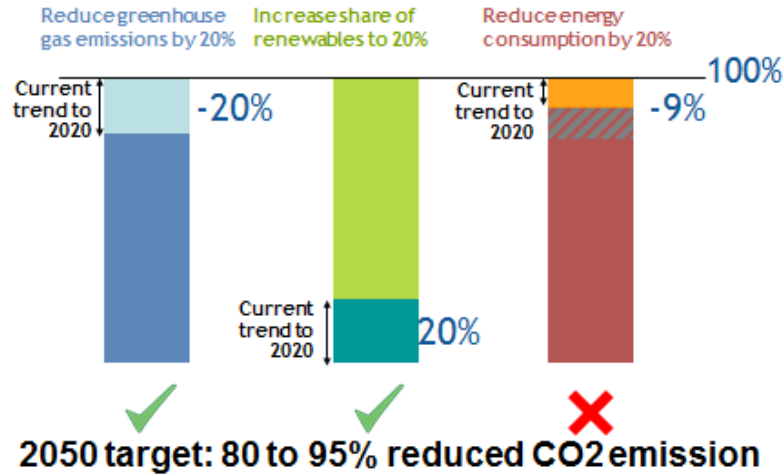
- GDP, employment rate, productivity
- Knowledge intensive activities

- Technology as forth or fifth pillar of sustainable development?
- How to consider technical innovations in the urban context?
- What is a smart City?

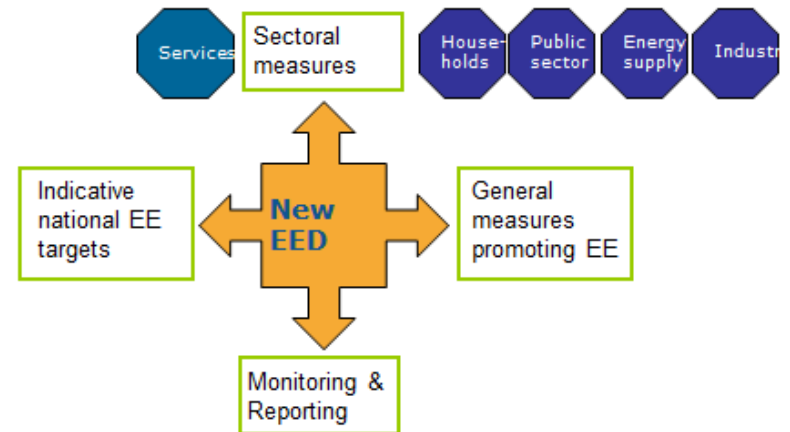
EU - Energy objectives: policy relevance



MEETING ALL THREE "20-20-20 BY 2020" GOALS BECOMES A MATTER OF URGENCY



ENERGY EFFICIENCY DIRECTIVE (EED)



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

Upscaling: from buildings to districts to cities

Political focus and funding on energy efficiency and emission

- aiming at technology: who drives the process: city or economy?
- City as object of technical devices or enabler of sustainable development?

What is a ‚Smart City‘?

origins and coherent basic idea

- ❑ ***... originated from the ‘information city’ ...using new ICTs innovatively ... 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>*
- ❑ ***A Smart City is a city well performing in these 6 characteristics, built on the ‘smart’ combination of endowments and activities of self-decisive, independent and aware citizens.***
 - » *Giffinger et al. (2007)*
- ❑ ***... 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 (2011)*
- ❑ ***‘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.

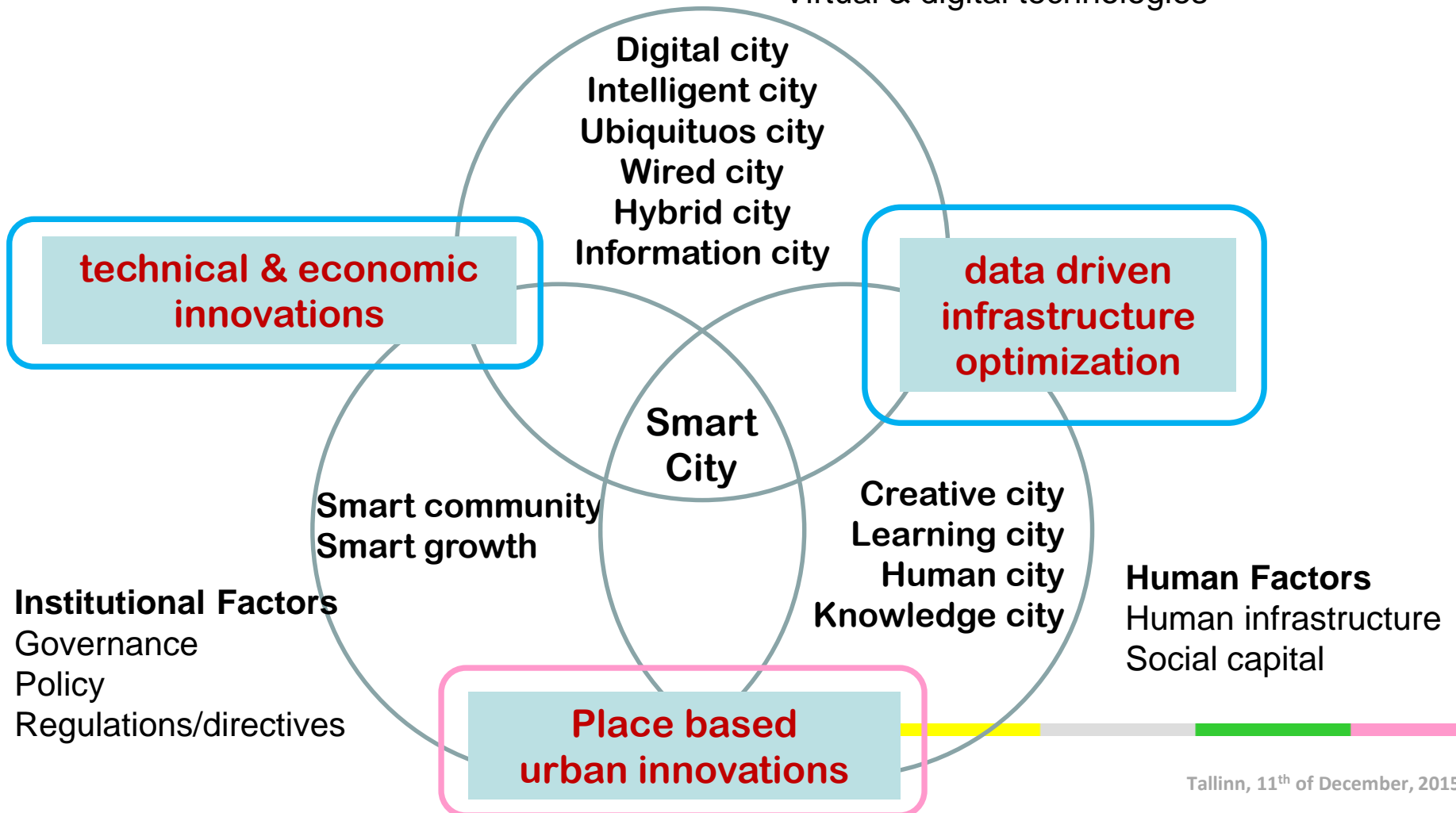
[http://www.europarl.europa.eu/RegData/etudes/etudes/join/2014/507480/IPOL-ITRE_ET\(2014\)507480_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/etudes/join/2014/507480/IPOL-ITRE_ET(2014)507480_EN.pdf)

What is a Smart City? Different Perspectives

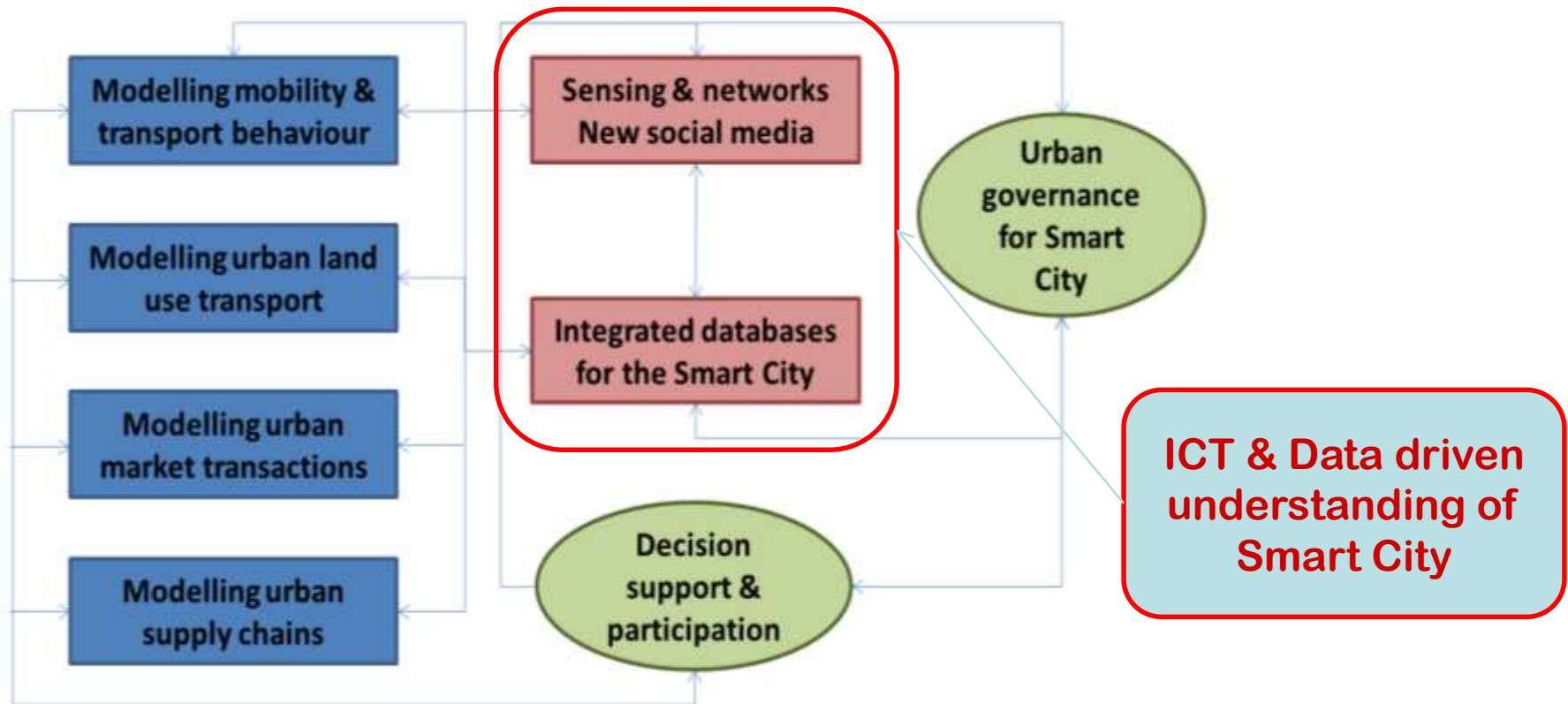
Nam, Taewoo & Pardo, Theresa A. (2011)

Technology Factors

Physical infrastructure
Smart & mobile technologies
Virtual & digital technologies



SC: technical innovation and ICT driven perspective



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

Regarding energy efficiency

- Explicit focus on transport sector as key field
- ICT as driver of efficiency in transport sector but not in a holistic view

ICT driven technical perspective

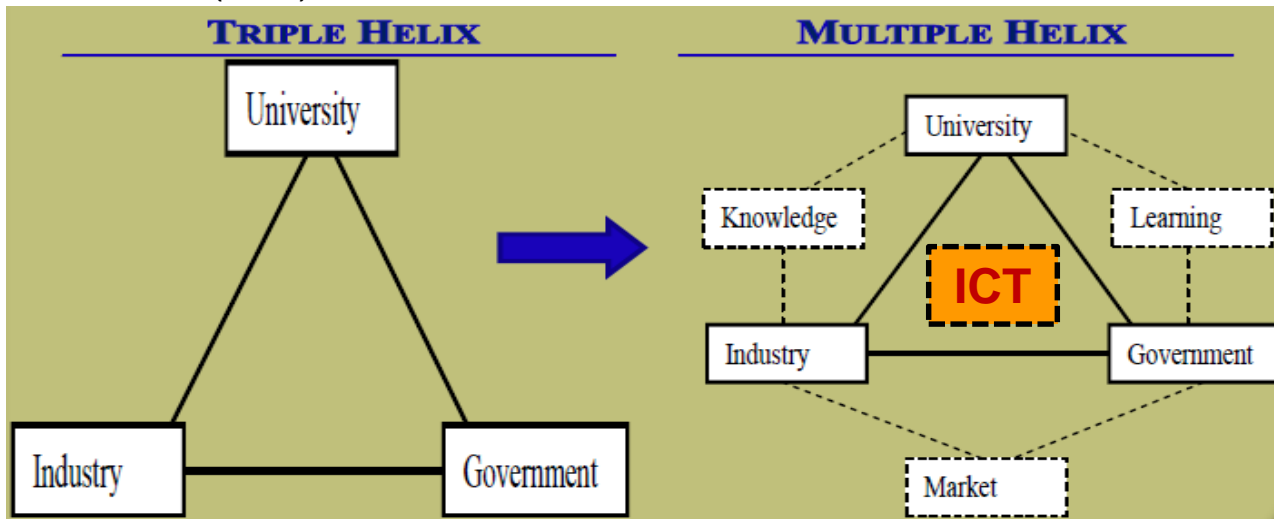
„Smart Cities combine diverse technologies to reduce their environmental impact and offer citizens better lives.

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

European Smart City stakeholder platform'

http://www.eu-smartcities.eu/faqs# Smart_Cities; 25.2.2013

Caragliu A., et al., 2011
or Deakin M. (2011)

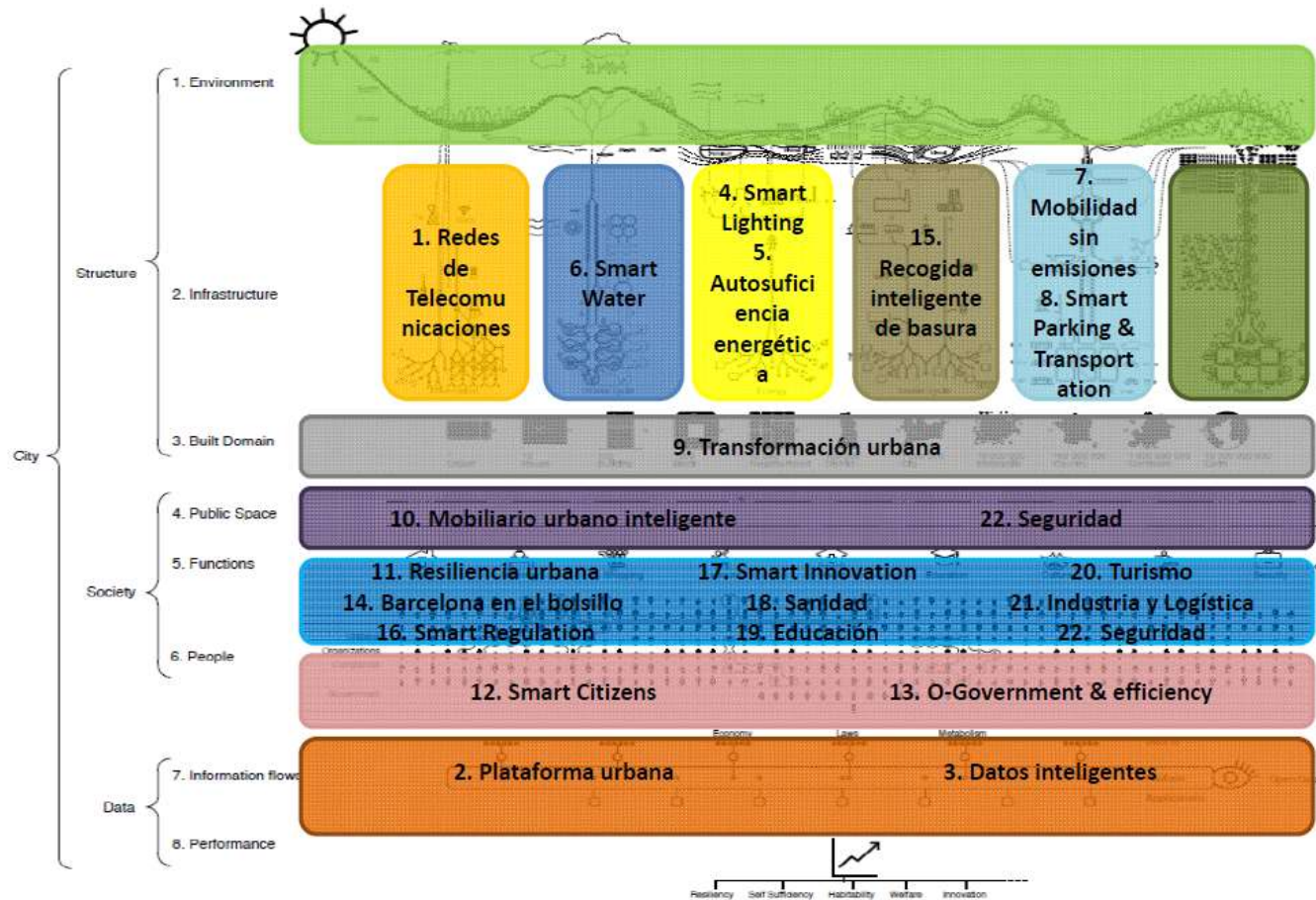


SC - Barcelona: ICT driven modernisation

ANATOMÍA DE LA CIUDAD

MODELO CONCEPTUAL DE BARCELONA

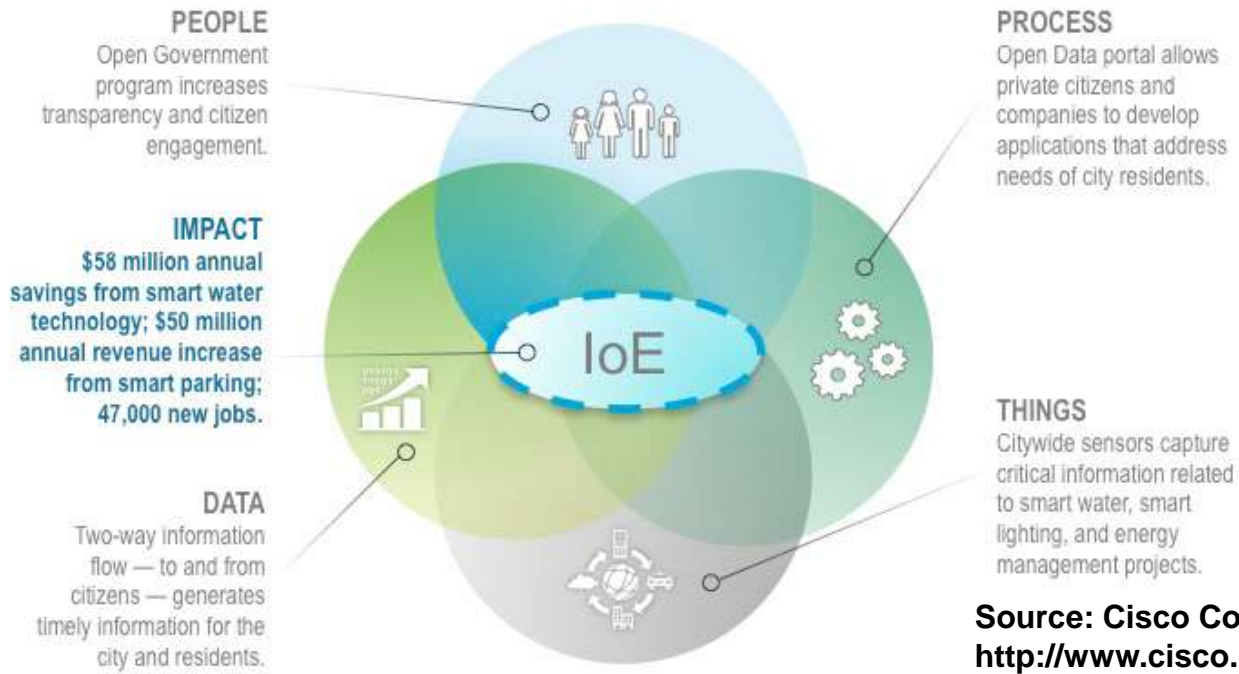
LOS 22 PROGRAMAS EN LOS 12 ÁMBITOS



- ❑ **More efficient use of resources**
- ❑ **Provision/enabling new services**
-

- ❑ **Socially inclusive?**
- ❑ **How strong are lock-in effects of big technical investments?**

Smart City Barcelona: IoE Connections and Impacts



Source: Cisco Consulting Services, 2014
http://www.cisco.com/assets/global/ZA/tomorrow-starts-here/pdf/barcelona_jurisdiction_profile_zs.pdf

Collating ever-detailed information about real time functioning

- ❑ Increase of economic performance (new activities, higher productivity) through technical innovations
- ❑ optimizing decision making within IS-systems in the short and long term
- ❑ City as producer: More efficient use of resources

Rebound effects

- ❑ Techn. innovations drive consumption and production on micro, meso and macro level
- ❑ Avoidance of reb.effects only through limitation by politics

Lock-In effects

- ❑ No chance to avoid them the bigger ICT-investments are

Enforcing socio-territorial urban problems

- ❑ Neglecting socio-environmental issues: enforce exclusion through costs, regulations, digital illiteracy
- ❑ Increasing disparities: investments in most attractive locations
- ❑ Misuse of information & civil rights

Rebound effects

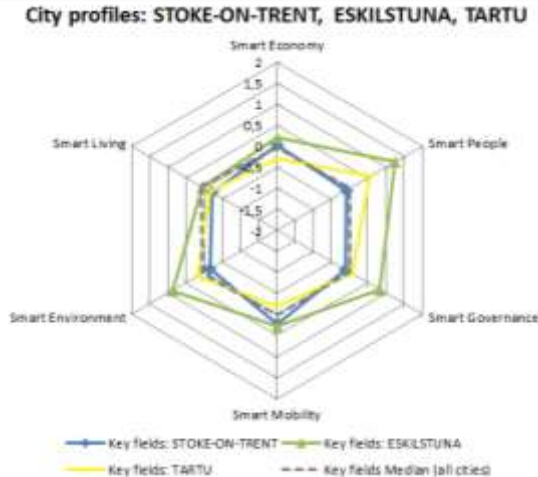
- ❑ enable ‚better life‘ but increase energy consumption and emissions: housing, consumption, mobility

Lock-In effects

- ❑ Increasing with centralized technical solution and size of investment: local ICT-cluster as POTENTIAL solution

Place based Smart City perspective from local evidence to urban initiatives

Identifying assets & deficits



SC learning process

Workshops

Participatory
settings

Surveys

Documents



based on quantitative information

- Detecting urban position and profile
- Identifying assets and deficits
- Supporting benchmarking and local evidence

based on qualitative information

- Discussion of most relevant problems
- Identifying strengths and weaknesses
- Defining relevant initiatives

**City specific Strategy or Roadmap
defining and improving
Objectives, instruments and projects**

PLEEC – Planning Energy Efficient Cities

- assessing the energy-saving solutions and potentials
- integrative planning through consideration of technology, structure and behaviour
- create Action Plans to be presented to decision-makers in the cities

□ *“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.”*

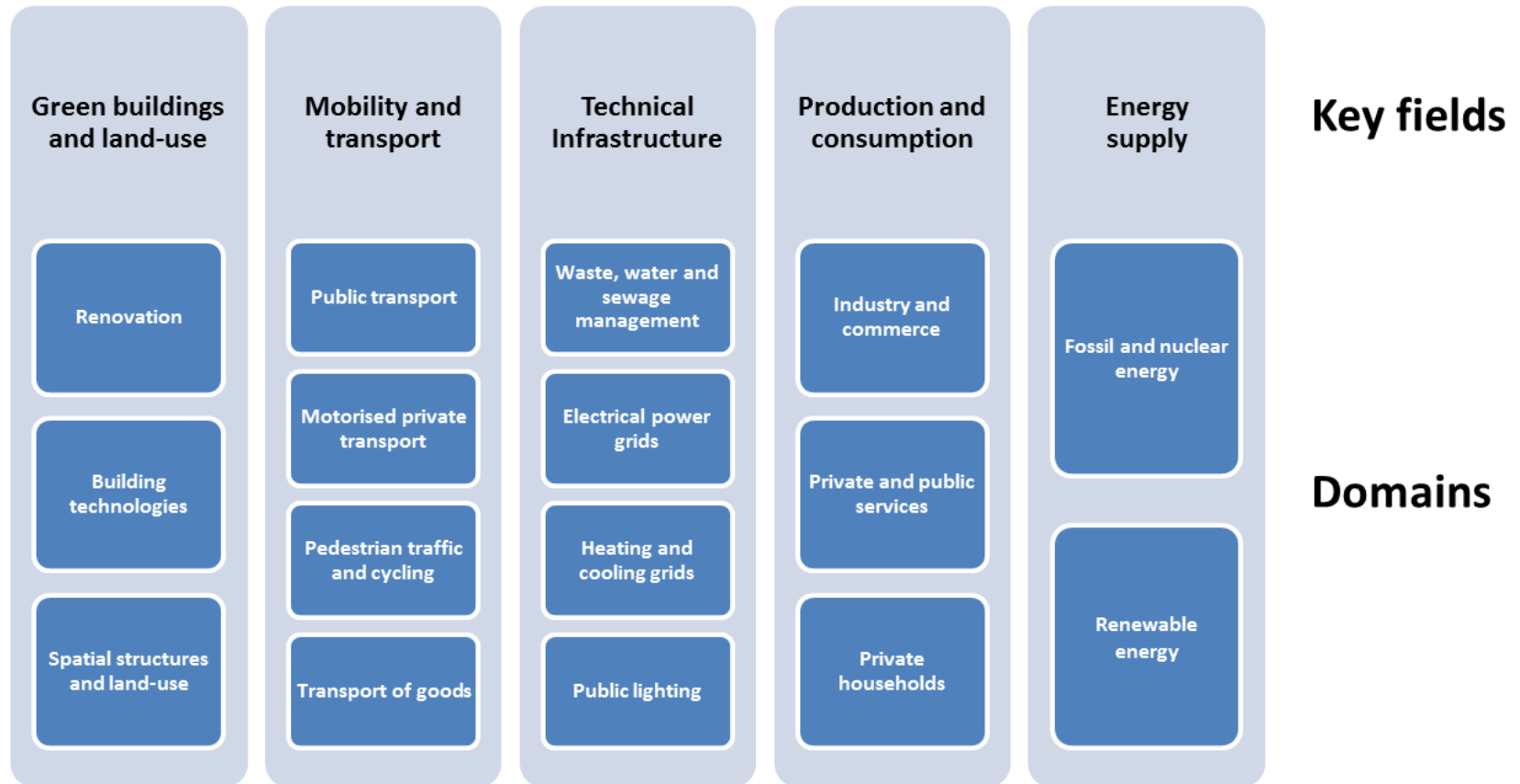
□ Web based surveys

- 2 consecutive questionnaires
- in 6 PLEEC cities
- With a maximum of 101 stakeholders

PLEEC
EC, FP-7; DG Energy; TU Wien
<http://www.pleecproject.eu/>

Classification of key fields and domains of energy efficiency

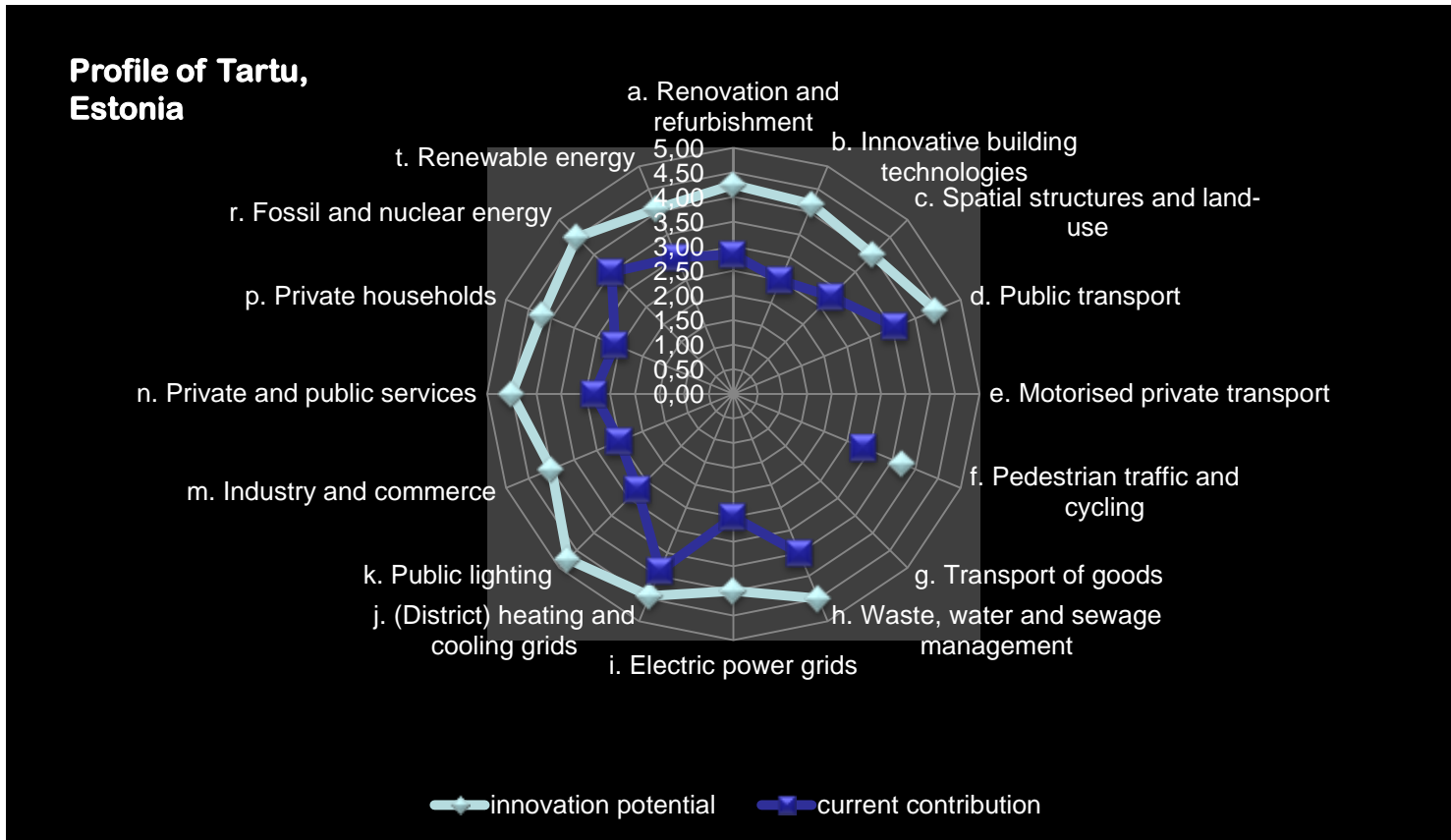
PLEEC – Planning Energy Efficient Cities;
EC, FP-7; DG Energy; TU Wien



Which domains are well or bad established in the city?
→ indicators or survey

City evidence / perception based profile of innovation potential

»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)«



- **Integration of knowledge : scientists (universities), technicians (multinational enterprises)**
 - **Technology** and their expected impact on ee
 - Enabling **technologies**: assumed impact
 - **General findings of Structure & Governance**
 - institutional settings for energy planning, management & planning tools, pilot projects/good practice
 - **Best available practices regarding Behaviour of target groups**
 - examples of behav. Interventions: Green buildings and land use, Energy efficient shopping, building renovation, mobility and Transport, Walk & cycle to school

Elaboration of **urban innovation potentials**

- Experts identify innovation potentials for each domain based on their city specific experiences
 - urban INNOVATION POTENTIAL across domains of relevant key fields

Elaboration of **technical, structural and behavioural innovations**

- Experts identify most relevant actions and assess their potential impact
 - technical INNOVATIVE SOLUTIONS
 - Structural DRIVERS and BARRIERS
 - Behavioral CHANGES (sufficiency)



Elaboration/modification of city's road map

Proposal of adequate innovations
In collaboration with **local City Energy Forum**

SC integrative perspective a framework for assessing projects

Project context



Cities Global challenges:

- Ageing population
- Pollution
- Climate change
- Traffic Congestion
- Lack of affordable housing
- Urban sprawl
- Rising cost of urban infrastructure
- Poverty
- Social Tensions

It is crucial to **manage growing cities** in ways that **support and drive economic growth** and **competitiveness** while **achieving social cohesion and environmental sustainability**



Integrative approach:

- Holistic view on urban development
- Consideration of strongly divergent local conditions in Mediterr. Region
- Assessment of projects according to a city's objectives related to energy efficiency and most important challenges

Common focus in place based SC perspective

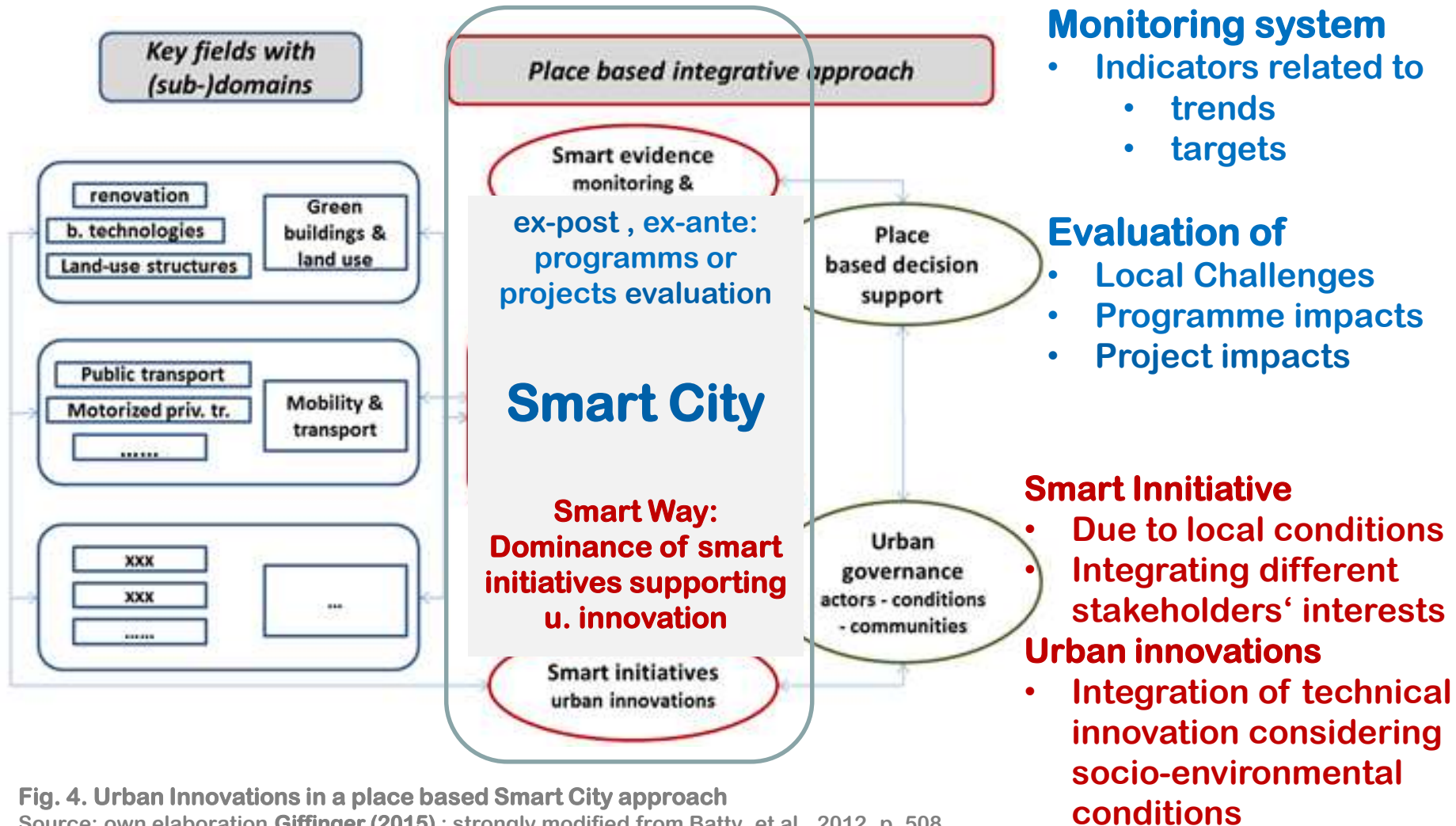


Fig. 4. Urban Innovations in a place based Smart City approach

Source: own elaboration Giffinger (2015) ; strongly modified from Batty, et al., 2012, p. 508.

Place based identification & management of urban initiatives

- ❑ Increasing effectivity through an inclusive approach considering relevant social and envir. conditions
- ❑ target orientated adaptive governance integrating bottom-up initiatives with top-down expertise

Rebound effects

- ❑ Decrease through explicit consideration of group specific attitudes: higher acceptance of environmental issues instead of economic wealth - **Lock-In effects**
- ❑ ICT-investments in collaboration with local actors: less external economic dependency

Dominance of stakeholder interests

- ❑ Interest driven problem resp. target definition by dominant stakeholders
- ❑ Lack of efficiency through long lasting learning and decision processes

Rebound effects

- ❑ replacing efficiency by sufficiency needs strong political commitment for a changed ‚better life‘
- ❑ Implementation of socio-technical innovations through SC initiative is slower than of pure technical innovations on markets

Lock-In effects

- ❑ Increasing with size and costs of technical solution

□ challenges

- **How can we adapt / synchronize speed of different systems?**
 - Need of better understanding and monitoring of respective systems in research: relevant indicators & modelling
 - Definition of urban initiatives as part of strategic planning in an inclusive bottom-up / top-down approach
 - Need of target driven adaptive governance empowering initiatives based on sufficiency instead of efficiency

- **Under which conditions is technology sustainable?**
 - (improved) Identification of innovation potentials
 - Involvement of relevant stakeholders and politicians
 - Assessing need of technical innovations in the context of specific local conditions minimizing rebound effects (micro level)
 - Considering/including social and economic conditions minimizing rebound effects (efficiency of a city's use of resources induces further energy consuming activities) and lock-in effects for cities

□ Pitfalls

- **How should a city be understood?**
 - In a path dependent way consisting of different systems: cultural, economical, social, technological
 - AND NOT as a technical product like a SIM-City
- **What endangers and jeopardizes urban sustainability most?**
 - Deficit in systemic knowledge of urban trends: insufficient understanding and inadequate monitoring
 - Unexpected strong social or environmental impacts
 - Lock-In effects through fast economy driven inadequate investments
 - Rebound effects as back fire because of insufficient integration of technical innovations into more holistic strategies aiming at the energy awareness of involved citizens, actors and stakeholders
- ...

Many Thanks for Your Attention

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