

Research needs for Smart Cities

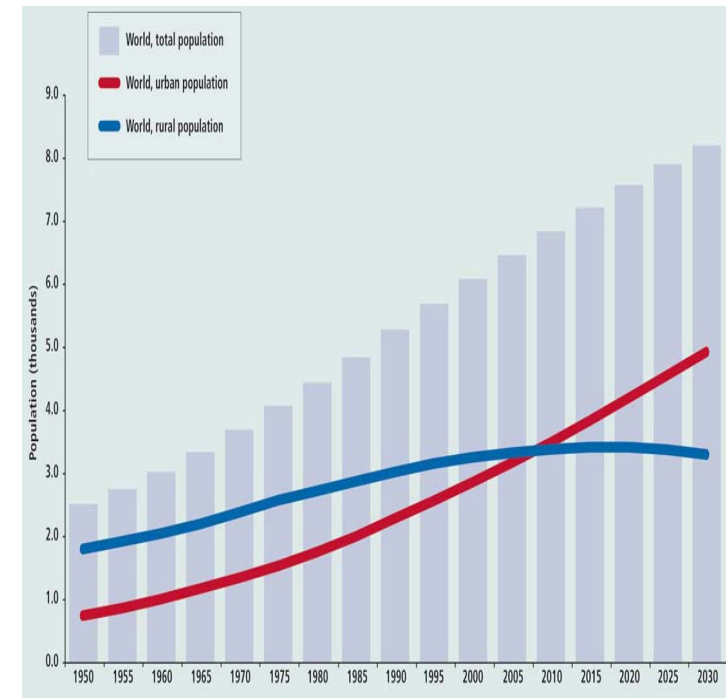
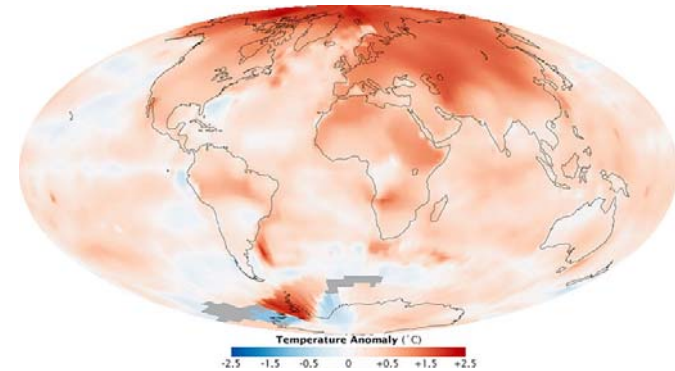
Member States Initiative Smart Cities

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Drivers and challenges

- Climate change – CO₂ Reductions
- Increasing energy demand
 - Industrialisation (China, India, etc.)
 - Increased wealth + living standards
 - Globalisation
- Dependency on fossil energy sources
- Strong coupling of CO₂ emissions to GDP
- Increase in population
- Worldwide urbanisation
- Significant impact on urban environment

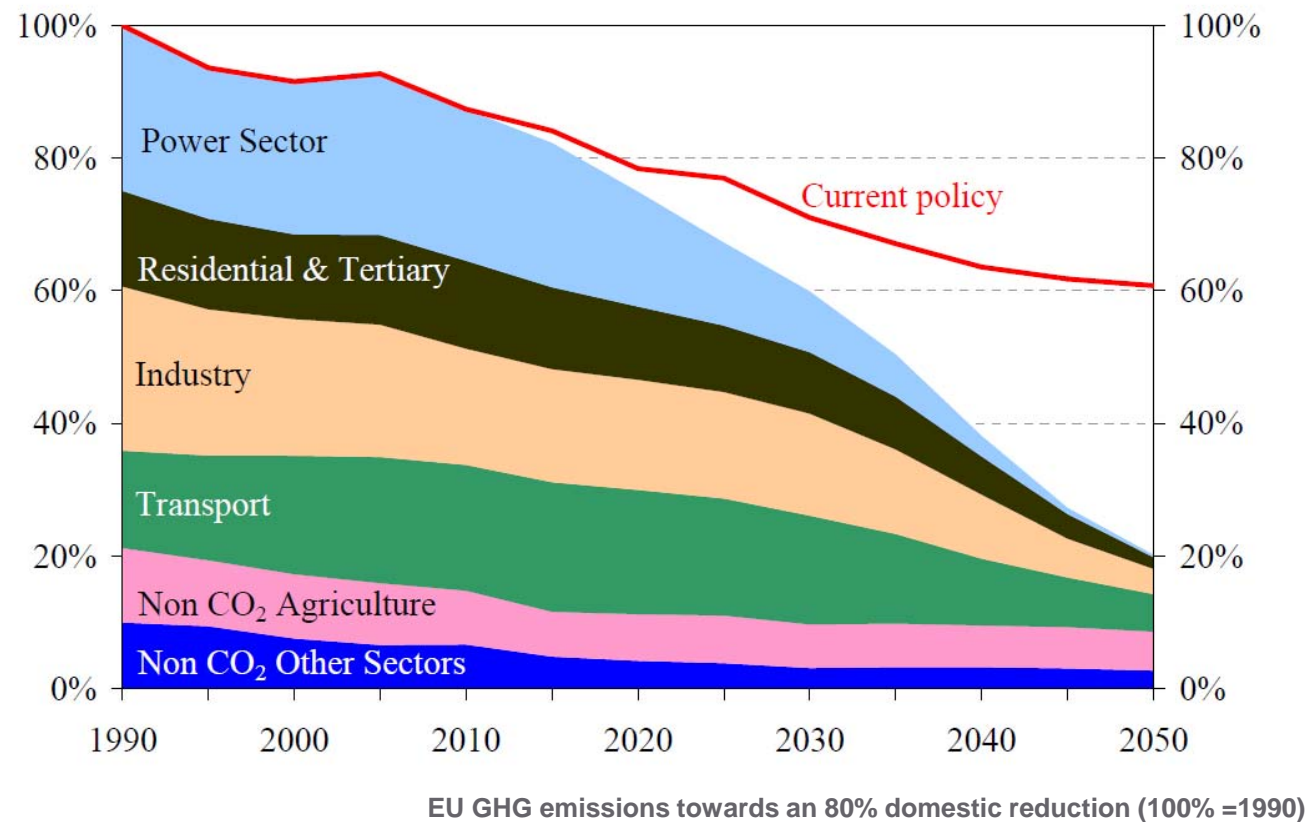


European strategies and targets

- Climate change and energy – the “20-20-20 targets”
 - Reduce GHG-emissions by 20%
 - Increase share of renewables in EU energy consumption to 20%
 - Achieve an energy-efficiency target of 20%
- Europe`s leadership in energy technology and innovation
 - Economic boost and job creation
- Strengthening the role of cities
 - High living standards for citizens
 - Sustainable environment for next generations
 - High competitiveness of the cities

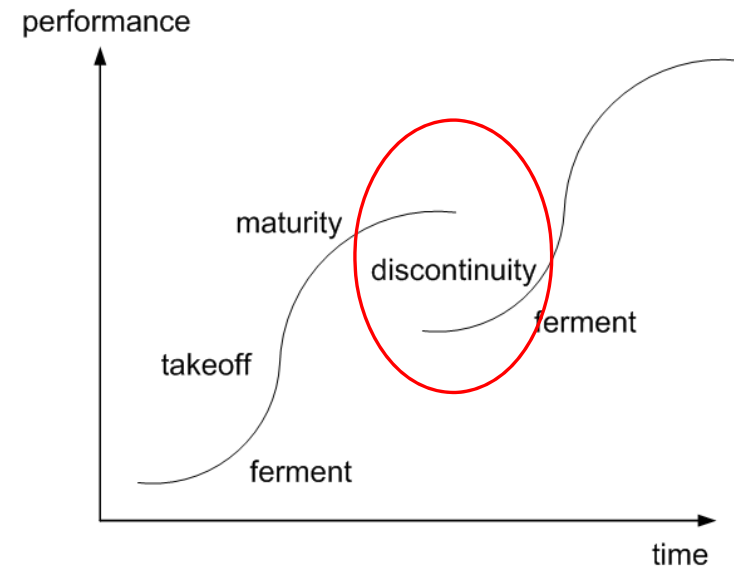
Vision 2050 - Low Carbon Economy Roadmap

European policy framework



Radical Innovation for Urban Energy Supply

- **Smart Cities** require new approaches
 - Fully integrated designed and intelligently managed energy systems
 - From single technology solutions to multi technology perspective
 - Multi-layer infrastructure framework
 - Interdisciplinary system approach
 - Broad stakeholder engagement



Smart Cities – the scope

the *Smart Cities* concept:

- considers **the city as a whole** in all its complexity (holistic approach)
- **focuses on energy** (demand, supply, distribution, storage) and resulting carbon emissions
- **considers interactions** between energy and mobility, water, waste, the quality of life of its citizens and socio-economic conditions within the city

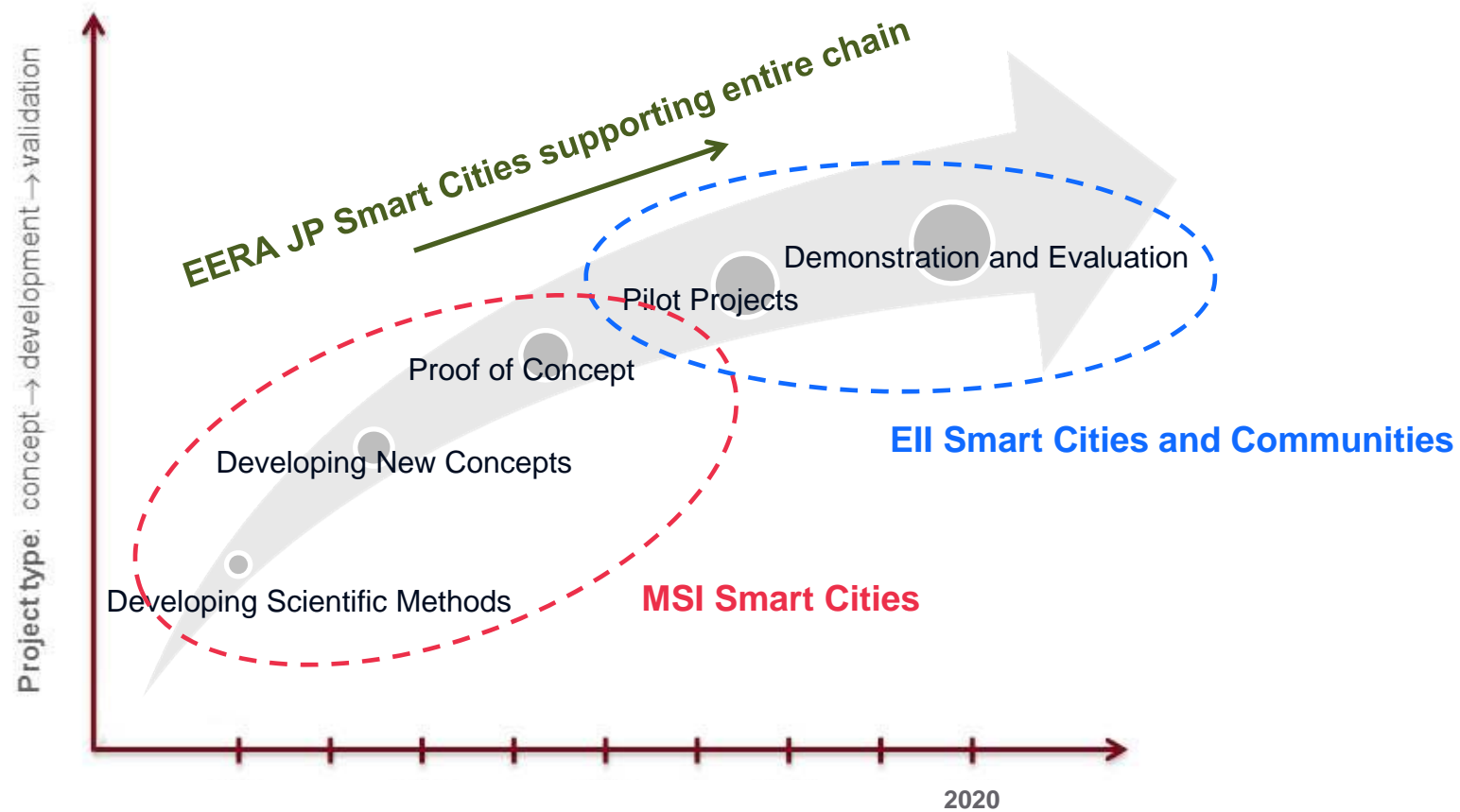


Smart Cities – the method

the *Smart Cities* concept relies on the **integration of processes, concepts and technologies**:

- processes (e.g. policy, urban planning, infrastructure planning, detailed design, financing and stakeholder processes)
- concepts (e.g. energy efficiency measures; decentralised and centralised energy production strategies for heat, cold, electricity and fuels; mobility, waste and water strategies)
- and technologies (e.g. CHPower, heat pumps, solar PV and thermal collectors, smart electrical and thermal network components).

Driving Innovation for Smart Cities



Smart Cities – Thematic areas

ICT & Energy Technologies are merging
Intelligent energy management on regional & city level

- **Integrated Urban Energy Planning**
- **Smart Urban Energy Networks**
- **Energy-efficient Interactive Buildings**
- **Urban Supply Technologies (RES)**
- **Mobility**
- **New Business Models + financial schemes**



Smart Cities research needs

General approach

- Research needs to address several levels:
 - Processes
 - Concepts
 - Tools
 - Standards and evaluation
- Method oriented research questions enabling scientific support for city transformations

Integrated Urban Energy Planning

Research needs



- New innovation and organisational processes for city transformations (multiple stakeholder participation)
- Tools for understanding energy characteristics/performance of cities
 - Decision support tools for urban energy master-planning and city roadmaps
 - Dynamical simulation tools for the design and management of city-wide integrated energy systems
 - Methods for linking urban energy, transport and spatial planning
- Innovative concepts for
 - Realizing idea of „Living-labs“
 - Ultra low-carbon urban infrastructure development
- Standards and evaluation procedures:
 - Development of Smart Cities KPIs
 - City-wide energy data monitoring approaches and systems
- Interaction between energy, mobility, sustainability aspects (waste, water, etc.) and ICT

Urban energy networks

Research needs



- Development of new tools:
 - Energy network planning and design
 - Fundamental methods for smart network operation (control structures, stability, ICT, etc.)
 - Multi-source energy management (interface for different energy sources at city level)
 - Methods for integration of decentralised RES into urban energy networks
- Concepts for smart energy management:
 - Demand-side management (load shifting) and storage capacities
 - Low-carbon DHC networks (e.g. low-temperature heat networks)
 - Electric networks with highly increased share of RES (e.g. PV)
- Standards and evaluation:
 - Data monitoring, management and analysis
- Interaction of urban networks with E-Mobility („Vehicle-to-grid“)

Energy-efficient Interactive Buildings



Research needs

- Tool development:
 - Development of building simulation tools for planning, design and operation in city context
 - Building – grid interaction („building-to-grid“)
 - Self-adapting systems for B2G (fault detection, optimization of efficiency, costs, etc.)
 - Building – user interaction
- Innovative concepts:
 - New concepts for energy-efficient retrofitting of existing building stock (historical buildings)
 - Multifunctional building concepts
 - Smart energy management of buildings and clusters
 - Advanced building automation systems
- Standards and evaluation:
 - Advanced monitoring approaches for buildings and clusters
- Interface to:
 - Compact high-density heating & cooling storages
 - Innovative building materials

Urban Energy Supply (RES)

Research needs



- Tools development:
 - New planning and design tools for large-scale integration of RES into urban environment
 - Management of energy supply systems at city level
 - Simulation tools for smart operation of RES at city level
 - Methods for large-scale industrial applications of RES
 - Integration into industrial processes
- Innovative concepts:
 - Concepts for cascade use of resources in cities
 - Development of hybrid systems based on different technologies
- Standards and procedures:
 - New testing/monitoring infrastructure and procedures
 - Adaptation of standards and design codes
- Further development of technologies towards improved performance (materials, components, systems, etc.)

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