

# Smart Cities answering global Trends

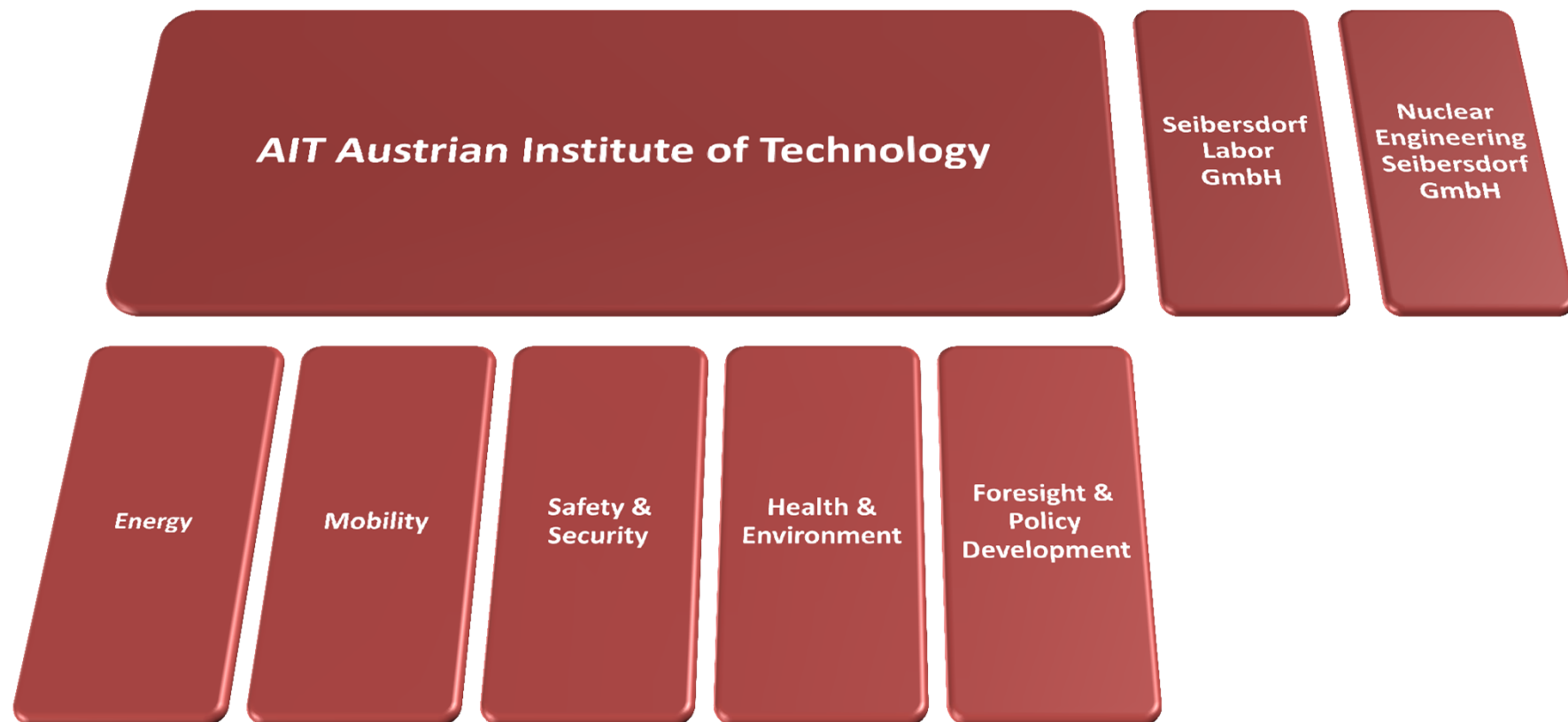
Smart Cities Member States Initiative, 2<sup>nd</sup> of December 2011

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# AIT Austrian Institute of Technology



## Structure



## Area 1: Electric Energy Infrastructure

- **Smart Grids**

- Development of network management concepts
- Interaction between system and components
- Power system components: method development for design, validation and diagnosis

- **Photovoltaics**

- Advanced experimental investigation, characterisation and modelling of thin film photovoltaic modules and new PV technologies (concentrator PV)
- Simulation of system output and life-cycle testing, integration of PV into other infrastructure (buildings, automotive, etc.)
- PV thin-film cell technology

## Area 2: Energy for the Built Environment

### **Energy in Cities**

- Development of energy planning and management concepts for urban areas
- Interaction between energy performance characteristics (urban morphology, end use mixes, building energy performance, ....) and thermal and electric grids
- Development of community energy management concepts (load management, energy storage concepts...)

### **Energy in Buildings**

- Development of new design concepts (form, envelope characteristics, thermal mass storage..)
- Integration of energy efficient and renewable energy supply systems (compression and absorption heat pumps, solar thermal systems, solar cooling,...)
- Energy management and control strategies (weather, energy prices, load management with real time simulation, ...)

### **Renewable Heating and Cooling**

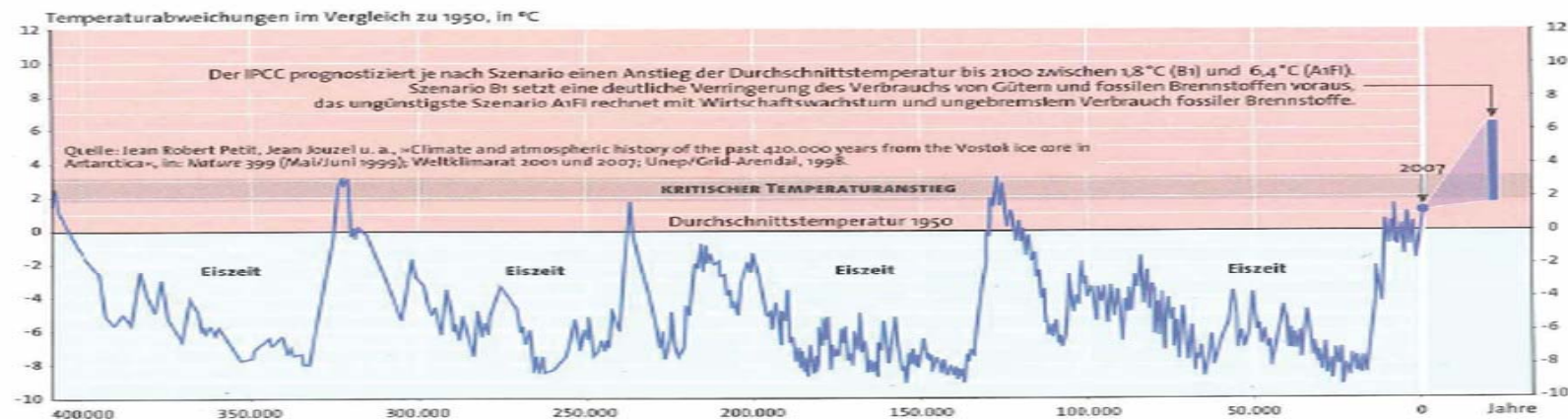
- Heat and mass transfer devices (new heat and mass exchanger concepts for absorption and compression heat pumps – microchannel flows, icing)
- Solar thermal components (collector physics for modeling and virtual prototyping, mid-temperature collectors)



**GLOBAL TRENDS**

# Global Climate Change

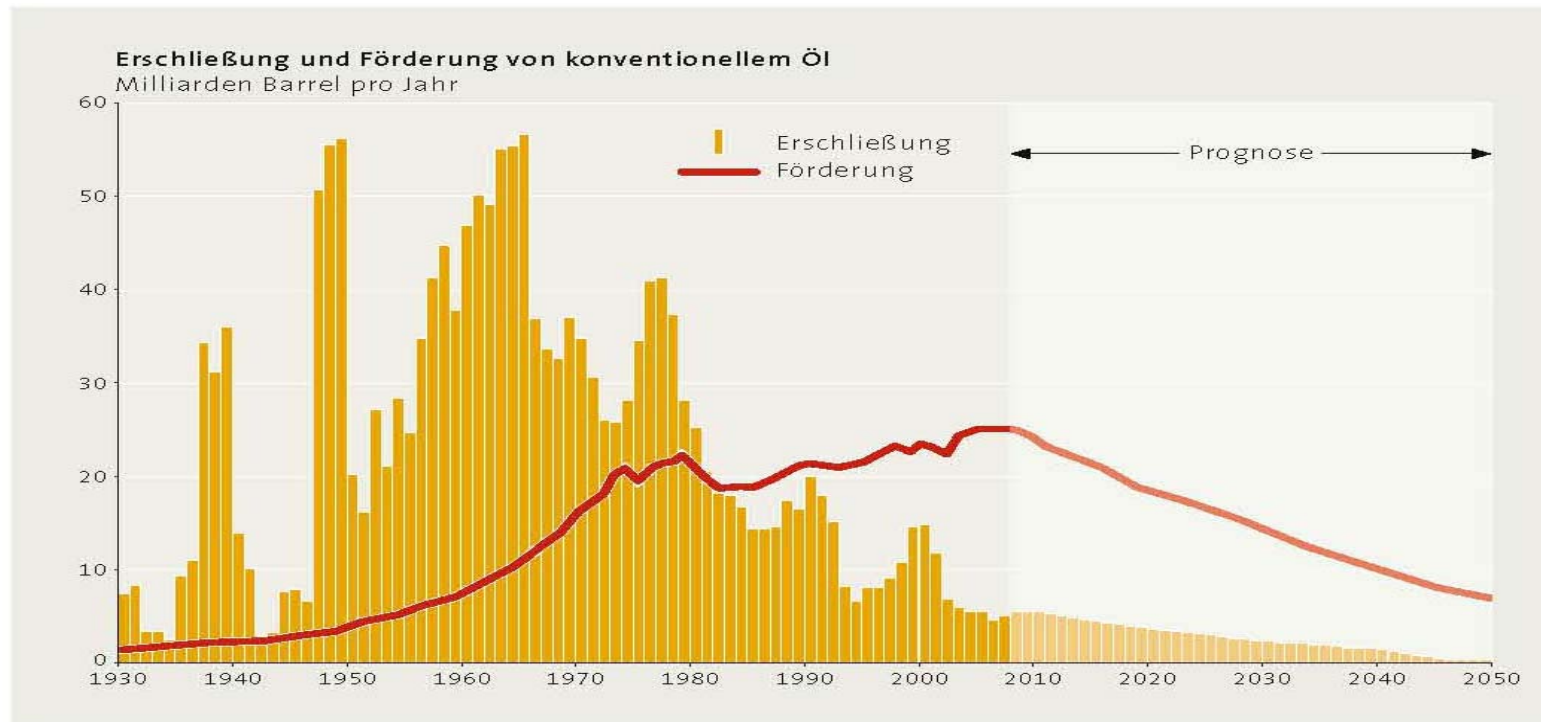
## Temperature Development



Langfristige Temperaturentwicklung  
©2008 LE MONDE diplomatique, Atlas der Globalisierung - Spezial, Berlin

Source: Le Monde Diplomatique, Atlas der Globalisierung – Spezial, P. 33

# Forecast Oilproduction



## Die herkömmlichen Ölquellen versiegen

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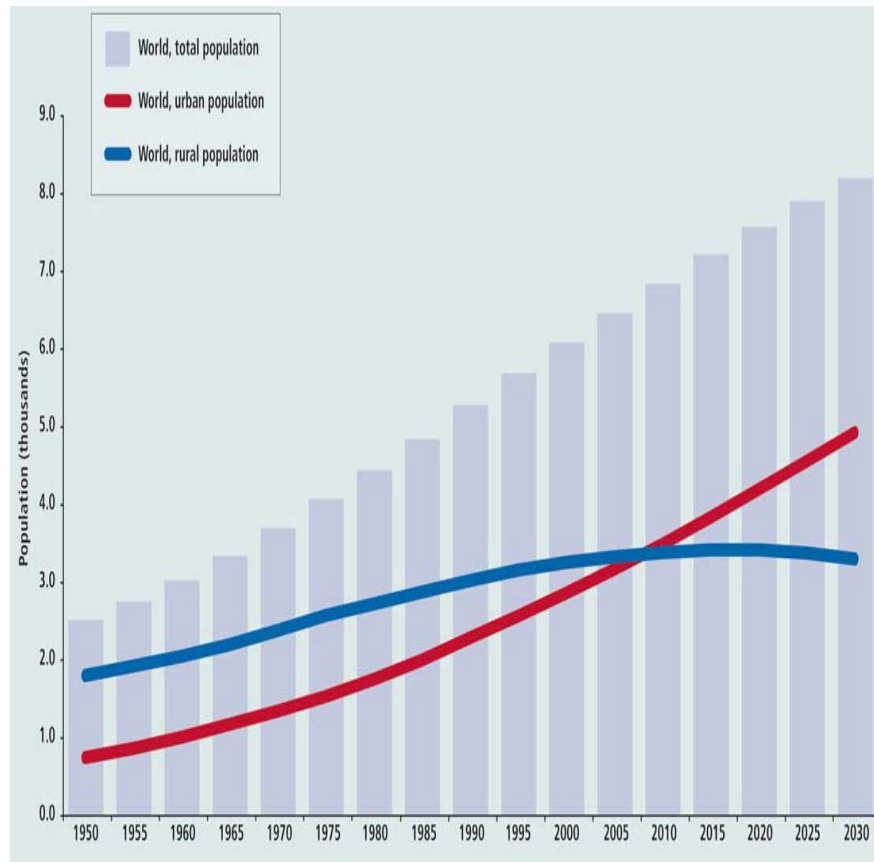
Quelle: Colin Campbell, Association pour l'étude des pics de production de pétrole et de gaz naturel, 2008.

Source: Le Monde Diplomatique, Atlas der Globalisierung, P. 80



# Urbanization

## Urban & Rural Population 1950 - 2030



- Urbanization worldwide:
  - 2005: 3,2 billion people live in cities (49 % of humankind).
  - 2010: Urban population exceeds rural population
  - 2030: 60% (4.9 billion) of the world's population is projected to be urban
  
- Urbanization in Europe:
  - Majority of population lives in and around cities

Source: 2005 Revision of the UN World Urbanization Prospects report

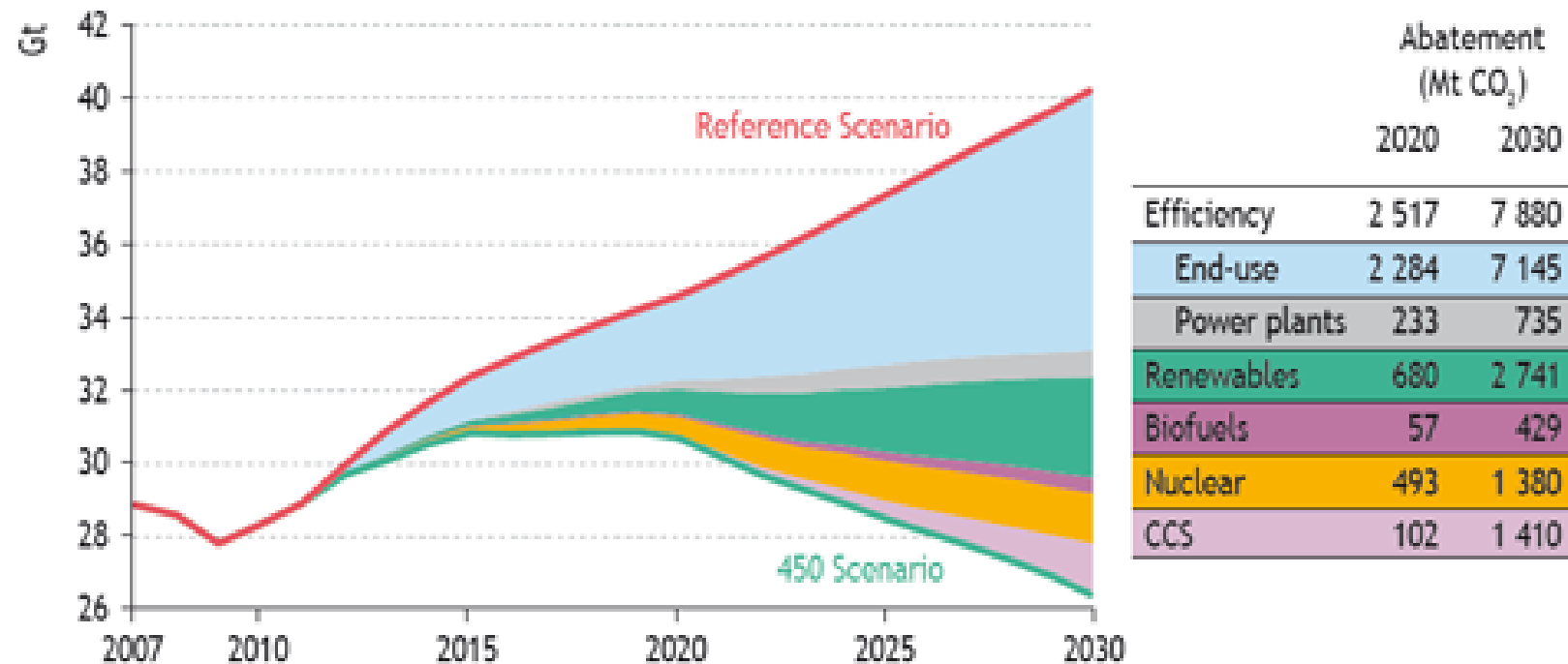




**EUROPEAN INITIATIVES**

## Global Challenge

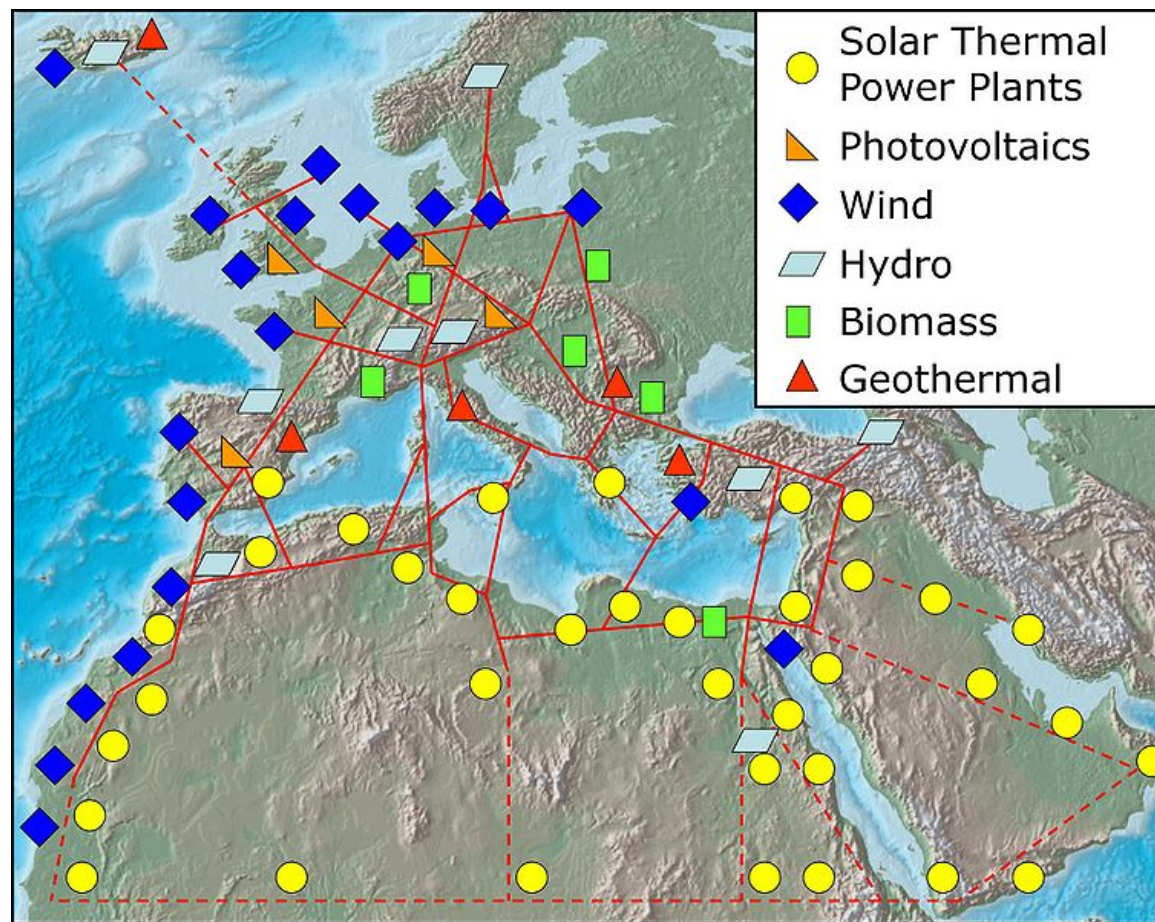
### World Energy Related CO<sub>2</sub> Emission Savings by Policy Measure in the 450 Scenario



Source: IEA World Energy Outlook 2009, P. 211

# Renewable Electricity Generation

## Future Developments in Europe



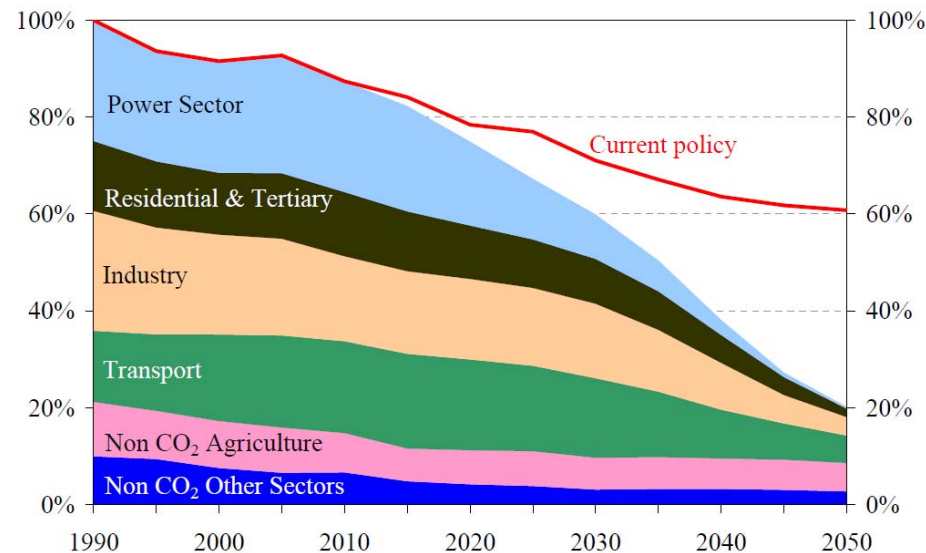
# Europe 2020 Strategy and 2050 Roadmap

## 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%

### Roadmap 2050

### -80% GHG reduction



Source: EC, Low Carbon Economy Roadmap 2050



# SET Plan

## Strategic Energy Technology Plan

- **Crucial Instrument** of the EU to face climate change
- **Transformation of Energiesystem**
  - Through Affordable, Low-Carbon Technologies
- **20-20-20 Targets**
  - Increase in Energyefficiency by min. 20%
  - Reduction of CO<sub>2</sub>- Emissions through use of new technologies by 20%
  - Increase in Percentage of Renewable Energy up to 20% of total consumption
- **Large-scale Programmes** (8 Industrial Initiatives)
  - 'Technology roadmaps' for Research and Implementation
  - Systemic Approach, organizational Innovation, sustainable Finance Management, energiepolitical basic parameters
- **EERA** (European Energy Research Alliance)



Source: EC, Low Carbon Economy Roadmap 2050



**WHY SMART CITIES?**



# Radical Innovations

Smart Cities need new Concepts

- 1 Interdivisional Planning
- 2 Cooperative Processes, Innovationprocesses  
⇒ Integration and Cooperation of all relevant Stakeholders
- 3 From a Single-Technology to Multi-Technology Approach
- 4 'Smarte' Energyinfrastructure





## Smart City ⇒ Challenge + Chance ,Radical Innovations‘

- **Multi-Disciplinary Thinking and Working** ⇒
  - Architects, Building technicians, City Planners, Transportation Planners,...
- **Multi-Sectoral** ⇒
  - Energyindustry, Buildingindustry, Mobilityindustry, ...
  - **Inter- and transdisciplinary Cooperationen**
- **Stakeholder Processes** ⇒
  - Visions; Integration of Citizen, Living Lab's
- **Method Development** ⇒
  - Collection, Displaying and Optimization of Energyrelevant Data in a Systemlevel

## Stakeholders

- Mayors, politicians
- City administration
- Utilities, energy service companies, grid operators (electric, thermal)
- Developers, architects, planners
- Construction companies
- Component manufacturers (windows, facades, HVAC components, ...)
- Renewable energy industry (PV, solar thermal, heat pumps, ...)
- ICT companies
- Financial Institutions
- R&D institutes and universities
- Inhabitants



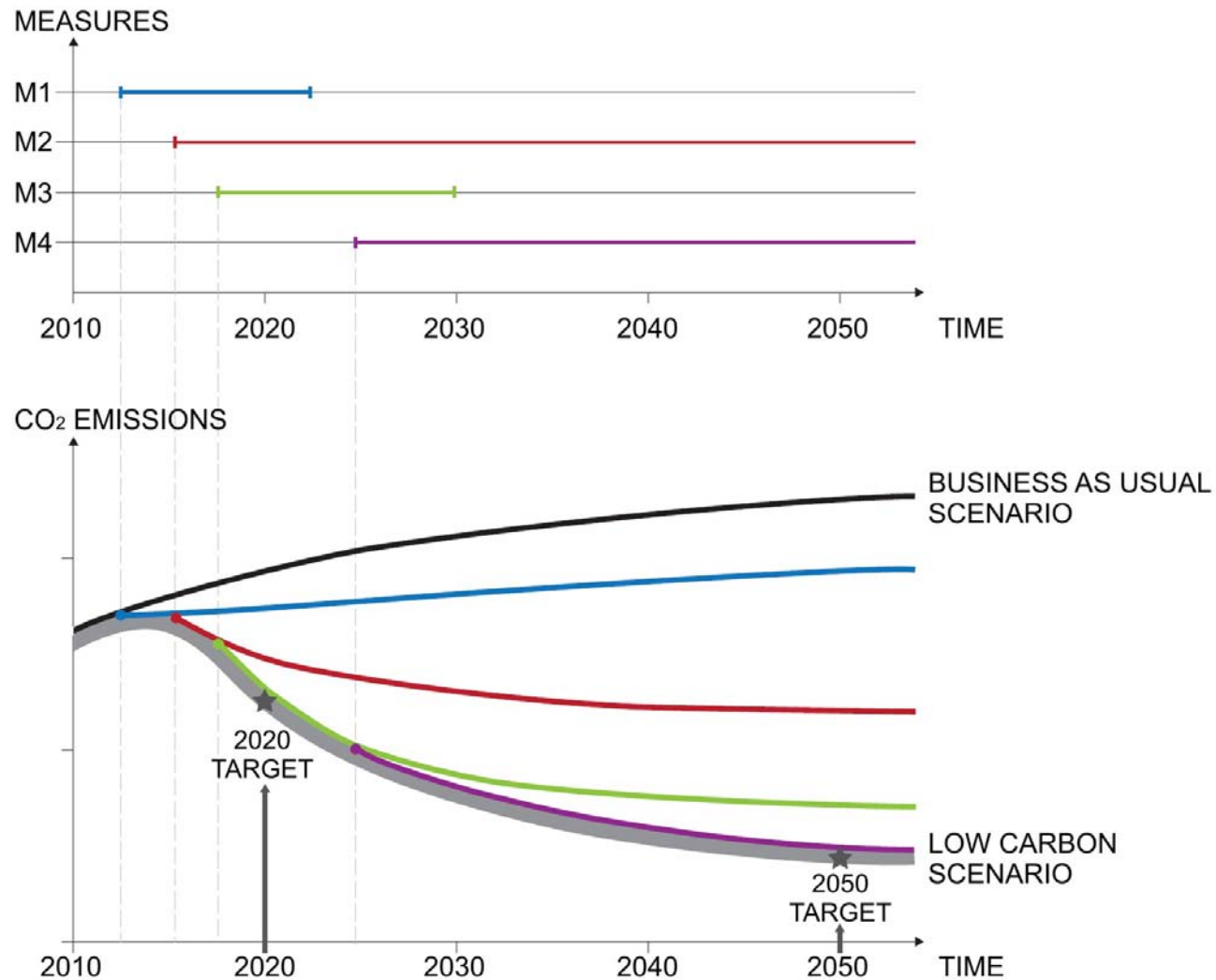
## Interdivisional Planning

### Urban Planning Levels: Target

- Integrated Planning Tasks
- Heterogen Stakeholder-Processes
- Consolidated Targets
- Standardized Time Schedules
- Intensive, Continuous Adjustment
- Optimization of overall System



## Measures towards a Smart City



## Living labs

- Real life Ecosystem
  - natural settings, cities, regions
- User-involving, open innovation approach
  - Co-Creation and exploration through participation
  - All stakeholders on equal terms, technology push & application pull
- “Laboratory” experimental approach
  - ‘bring the lab to the people’ (ulder et al., 2008)
  - Integration of new technologies
  - Implementing Innovation Cycle  
(innovation into market, assessement, lessons learned, feedback process, use the Living-Lab for project oriented education..)
- Little experience

## Smart Cities – Areas of research

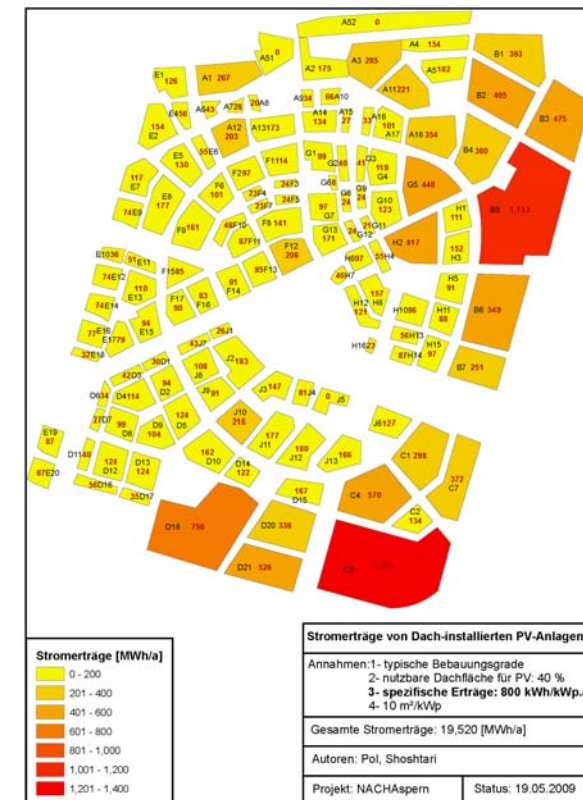
ICT & Energy Technologies are merging  
Intelligent energy management on regional & city level

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



# Urban Energy Planning

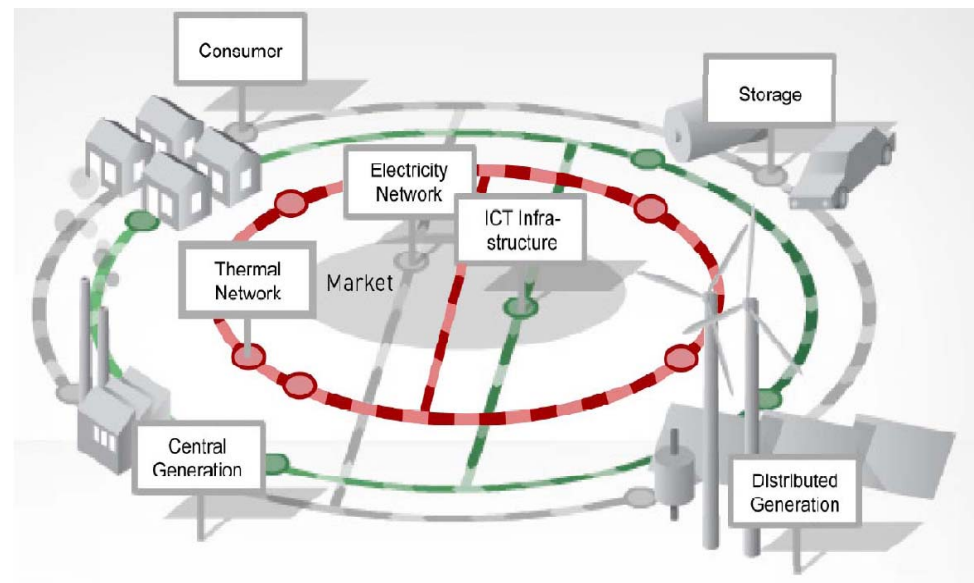
- Understand energy characteristics of cities
- Urban Morphology (density, topography, height,...)
- Spatial planning in the context of energy
- End-use mixes (industry, households, commerce,...)
- Decision support tools for urban energy master-planning
- Dynamical simulation tools for the design and management of city-wide integrated energy systems
- Extension to socio-economic aspects





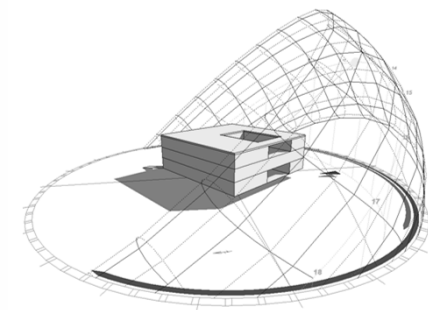
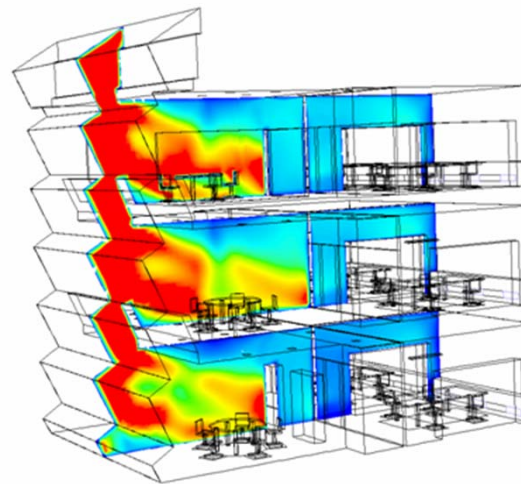
## Urban Energy Networks

- Smart electric grids (including optimised load management)
- Smart thermal grids (including low temperature heating)
- Use of potential for shift between thermal and electric load
- Planning and operation
- Demand-side management
- Integration of decentralised RES
- Thermal + electrical storage



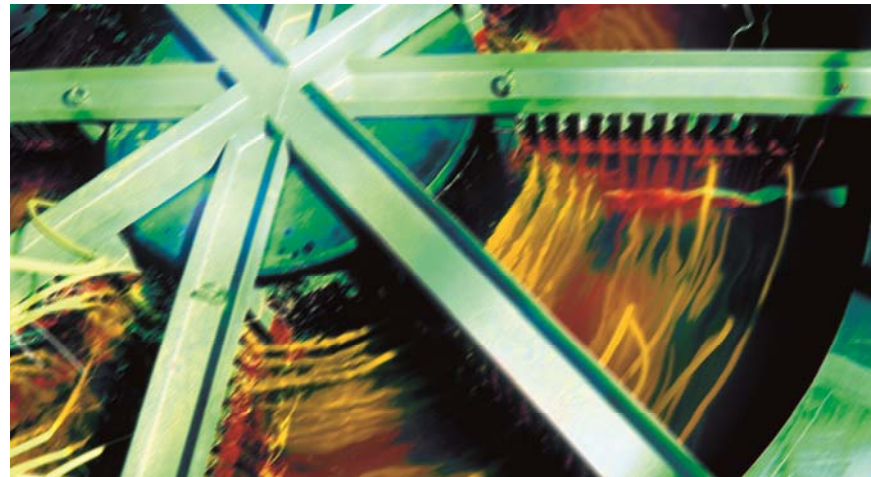
## Interactive Buildings

- Low energy building with on-site energy generation
- Active demand side node in network-management („building to grid“)
- Innovative building design concepts (architecture, shape, envelope,...)
- Building automation
- Retrofitting of existing buildings
- Building as energy storage



## Supply Technologies

- On-site renewables
- Polygeneration and use of waste heat
- Cascade use of resources
- Optimised HVAC
- Energy storage
- Tools for the integration of supply systems
- Large-scale testing & monitoring concepts



## Further Important „Smart Cities“ Topics

### Transport / Mobility

- Improve public transport system in cities
- Modal split
- Include non-motorised transport (walking, cycling)
- Passenger and freight logistics
- Share of alternative fuel vehicles
- Traffic concepts related to urban energy planning



### Socio-economic aspects

- New business models and financial schemes
- New regulations and legal frameworks
- Aiming for increase in quality of life
- Technology acceptance by user
- Organisational innovation (stakeholders, companies, institutions,...)



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your ingenious partner

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