Scientific and Practical Understandings of Smart Cities

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Introduction

- Cities: Important agents of change in the upcoming energy transition

- In Switzerland: 352 communities are labelled 'Energiestadt' (Energiestadt, 2014)

  – Promotion of energy
    efficiency in different domains

  – 'Piecemeal' solutions

Die Schweizer Energiestädte

- Concept of 'Smart City' as a promising tool to link domains for both scientists and practitioners

Smart City from Scientific Perspective

- A multitude of different understandings and definitions

- Some key characteristics: Smart Cities …
  - adapt to changing needs of users (Mars-Maestre et al., 2008)
  - use smart technologies to monitor and integrate infrastructure (e.g., ICT; Hall, 2000)
  - link domains such as smart economy, smart people, smart governance, smart mobility, smart environment, and smart living (Giffinger & Haindlmaier, 2010)
  - empower inhabitants to participate in decisions and shape smart cities (Partridge, 2004)

- The example of Switzerland:

Goal of Study and Research Questions

- Goal of the study:
  - Better understand what constitutes a smart city
  - Better understand respective differences between science and practice

- Research Questions:
  - How can the term smart city be characterised from both scientific and practical perspectives?
  - What are the similarities and differences between the two perspectives?
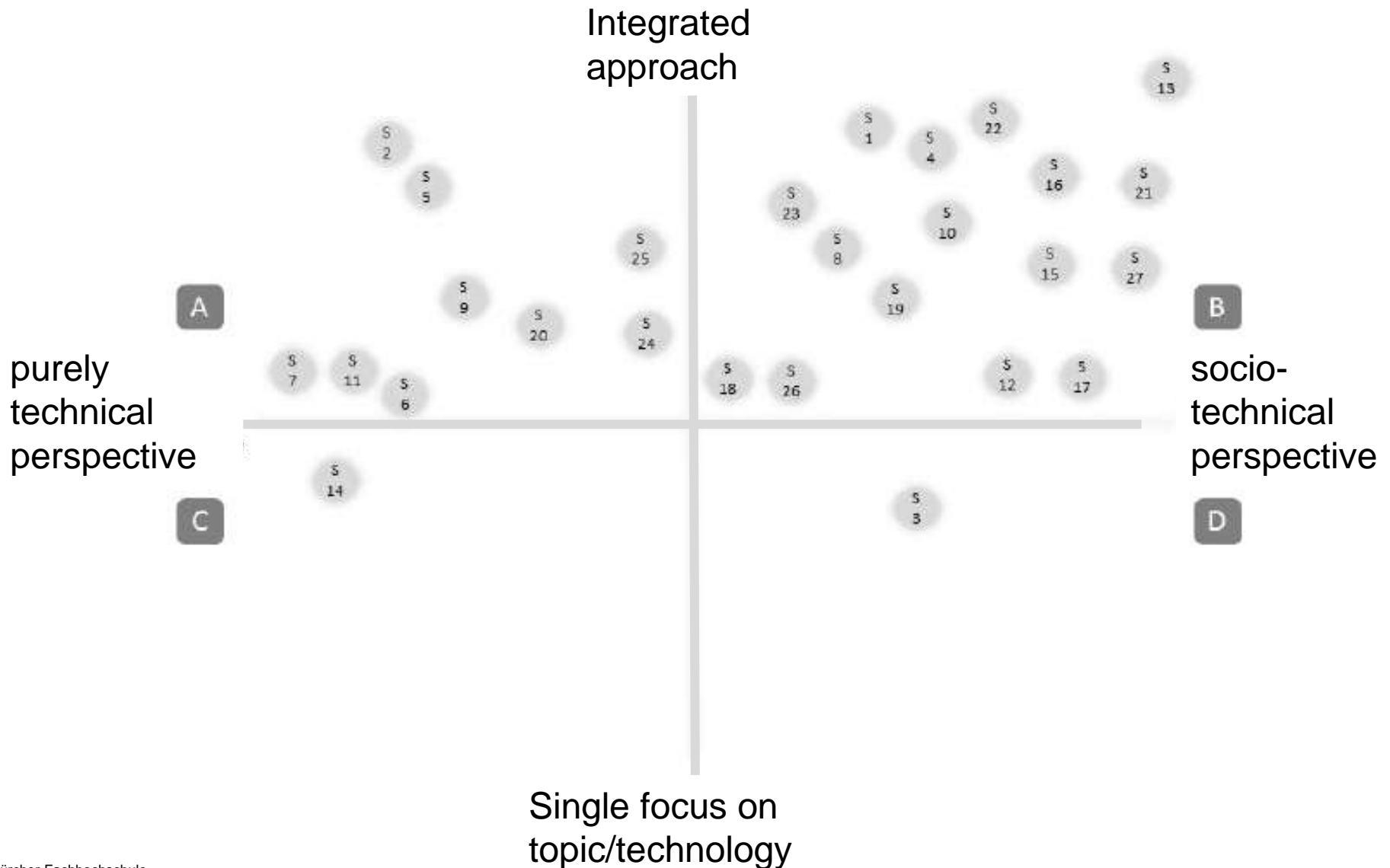
Method

- Literature review of scientific studies
  - Search in literature databases (e.g., Web of Science)
  - Key word: 'smart city', only papers providing an overview
  - $N = 27$ papers

- Literature review of practical projects
  - Search in three online project databases provided by Switzerland, Germany, and Austria
  - Only implemented projects were selected
  - $N = 50$ projects

Analytic Framework

- Two dimensional framework to place scientific papers and practical projects
- Based on smart city definitions
- Dimensions:
  - Level of integration: degree to which different technologies and domains are integrated; single focus on topic/technology vs. integrated approach
  - Socio-technical embedding: degree to which a coupled socio-technical approach is taken; purely technocal perspective vs. socio-technical perspective

# Analysed Scientific Studies Take an Integrated Approach

Some Examples

ID, quadrant	Description	Technologies	Level of integration	Socio-technical embedding
S5, A	Framework for an intelligent ecosystem city which links buildings and infrastructures through ICT	ICT	ICT is used to link and coordinate different activities and infrastructures in cities	Rather technical focus, no participatory processes described
S13, B	A smart city links different fields of action such as application domains, namely natural resources and energy, transport and mobility, buildings, living, government and economy and people. The goal is to enhance quality of life	ICT, energy grids	Highly integrative approach, links buildings, infrastructure, mobility, energy, resources, waste management, etc.	Approach includes areas such as education, culture and policies

Analysed <u>Practical Projects</u> Take a more Focused Perspective, Country-Specific Differences
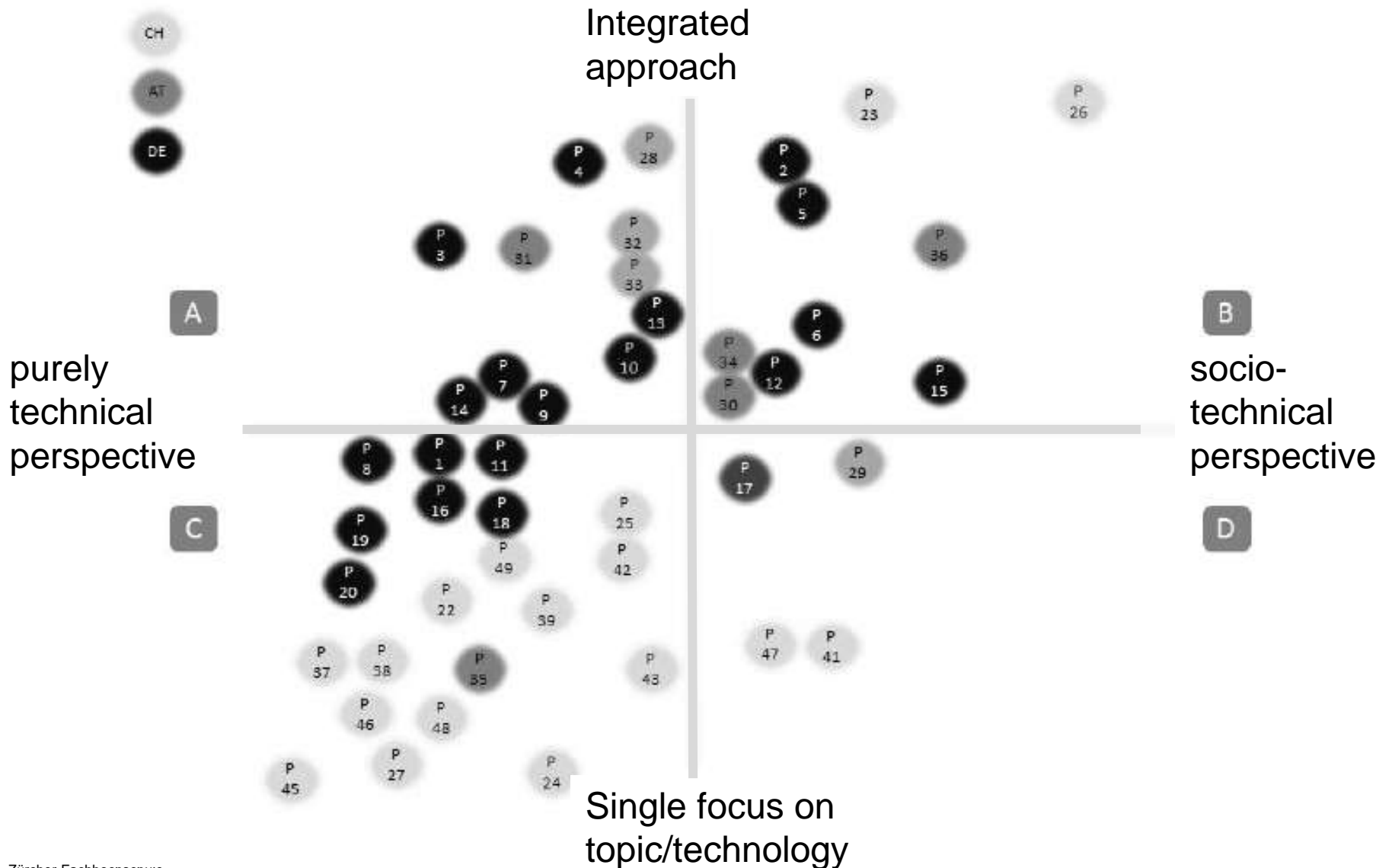
Some Examples

ID, quadrant	Name & keywords	Technologies	Level of integration	Socio-technical embedding
P41, D	**E-cars** Pilot project, test of a series of e-cars; joint learning process and evaluation including all involved stakeholders	E-cars	Focus on one technology (e-mobility)	Project takes users' perspectives into consideration
P39, C	**Smart metering** Pilot project, installation of 1000 smart meters in a Swiss community	Smart metering, smart grid	Focus on distribution of electricity (smart metering and smart grids)	Households take part in pilot study by having a smart meter, no participatory processes described
P31, A	**Smart city quarter in Austria** Refurbishment of heritage protected buildings, realisation of a smart grid, establishment of car sharing infrastructure/e-mobility, district heating system, city-wide communication and information system	District heating, ICT, smart grid, refurbishment of buildings	Highly integrated (buildings, mobility, energy supply)	Rather technical focus, no participatory processes described
P15, B	**Net zero energy quarter** Links buildings and technical appliances, potential influences on electricity grid, analysis of user behaviour and raising awareness amongst users	Insulation, heat pumps, geo-thermal, monitoring technologies, ICT	Integrates buildings and energy supply without e.g. mobility	Includes user perspectives in project

Similarities and Differences between both Perspectives

- Both understandings barely include singular projects that are participatory (Quadrant D)

- Not many analysed studies and projects take a participatory, socio-technical perspective

- While many of the analysed scientific studies take an integrated perspective, many analysed practical projects take a rather narrow, technical perspective

Potential Implications of our Study

- For practical projects
  - Need for more integration (technologies and people) -> no piecemeal solutions
  - Need for interdisciplinary teams
- For science
  - Development of ideas and methods to reach requested level of integration
  - Concrete projects inform science about feasibility as well as about potential social conflicts
- Important: We only analysed a restricted sample (both scientific studies and practical projects)

- Smart City Winterthur: Joint development of projects with partners from city administration, local energy supplier, research, business, …

- Tri-national exchange with the cities of Salzburg and Karlsruhe (D-A-CH project)

- Two projects where INE-ZHAW is involved:
  - «Analysis of electricity consumption patterns»
  - «Smart design of refurbishment process»

- Collaboration with 4 housing cooperatives that plan partial refurbishment and new houses in a quarter in Winterthur

- Design of a participatory process to involve inhabitants in the process

- <u>Goals:</u>
  - Integration of different domains (housing, energy, mobility)
  - Integration of residents' needs
  - Smart, integrated technical solutions and smart social and organisational integration to reduce energy consumption

- <u>Partners:</u> housing cooperatives, department of city development of Winterthur

Thank you for your attention!

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