



Politicised Nexus Thinking in Practice: Integrating Urban Utilities into Regional Energy Markets

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Infrastructures are key interfaces of urban resource use:

- connect production to consumption, cities to hinterland, energy to water and land use

Yet largely absent in debates on nexus thinking / urban nexus

- advances in understanding urban infrastructures as dynamic, relational and socio-technical configurations have eluded scholarship on nexus

Conversely, research on urban infrastructures highlights interactions between infrastructures and cities, between nature and the city and between production and consumption, but neglects interplay between different infrastructure systems

Objective: study attempts to connect urban wastewater to regional energy systems

- Aspirations and experiences of 8 German cities / city-regions to enrol their wastewater utilities as so-called 'flexibility option' providers in energy markets for electricity, gas and heating
- Reality check on ideals of 'urban nexus'
- Explaining nexus practices in terms of reordering political geographies of socio-technical assemblages



Potential role of wastewater utilities in Germany's energy market:

- Not just feeding home-grown electricity to the grid, but providing resource-efficient ways of dealing with intermittent flows of renewable energy (wind, solar)
- Strategic advantages as flexibility providers:
 - Principal source of energy in wastewater treatment – biomass as sewage/ sludge – not dependent on wind or sunshine; can be provided in relatively constant quantity
 - Can store energy in various ways, e.g. as gas or heat, that can supply regional gas or heating networks or be transformed (back) into electricity and fed into grid when required



Actor aspirations:

1. **Energy-optimised wastewater processor:** maximising self-sufficiency, minimising costs & selling excess energy: economic feasibility
2. **Inter-sectoral resource manager:** enrolling municipal wastewater utilities to advance urban energy transitions: model projects
3. **Hesitant observer:** waiting to see whether nexus practices could jeopardise core business: wary of interventions



1. Wastewater to power transmission grid:

- tough prequalification standards to operate in balancing energy markets >>> pooling of small generating facilities
- Municipal utilities marketing virtual power plants around wastewater plant: via energy trader or own company (Kaiserslautern)

2. Wastewater to power distribution grid:

- As yet no balancing markets in power distribution grids; ca. 700 (private) operators reluctant to accommodate new market entrants
- Wastewater utilities campaigning for legal, organisational and financial incentives to act as flexibility provider

3. Wastewater to purified sewage gas/hydrogen/synthetic gas:

- Hamburg and Cologne feed purified sewage gas into regional gas network: encountering resistance from incumbent gas network operators
- Power-to-gas (storing surplus electricity from grid): currently limited given legal uncertainties over accountability and tax liabilities

4. Wastewater to heat:

- Sewage gas used to cogenerate heat and power: surplus heat fed into local district heating network
- Dependent upon proximity of heating network, cost of new connections, cooperation of district heating operator

Materialities of integration



- Flows of energy and resources: understanding different kinds of energy produced at specific stages in wastewater treatment process and how these can help balance supply and demand in power, gas and heating networks
- Physical infrastructures: assessing potential connectivity between wastewater and energy networks, using ICT to measure, model and steer interactions

Spatialities of integration

- Cities as nexus pioneers: positioning their wastewater utilities as models for cross-sectoral practices in urban energy transitions
- Beyond urban self-sufficiency: connecting renewable energy from cities to energy networks locally (e.g. district heating), regionally (e.g. distribution grid), nationally (e.g. pooling for transmission grid) >>> problems of scalar mismatch

Politics of integration

- Involvement of municipal wastewater utilities in regional energy markets politicising grids >>> resistance of network operators as gatekeepers
- Utilities responding by enrolling support of their cities, entering alliances with other utilities, lobbying for less restrictive regulations & market incentives



1. **Deconstruct notion of urban nexus as idealised vision of optimal integration and win-win solutions of universal benefit**
 - Infrastructure integration is about much more than achieving a new techno-managerial fix
2. **Rather than denying validity of cross-sectoral collaboration for urban sustainability, need to subject experiences in integrating infrastructures to critical scrutiny**
 - Findings reveal great variety of opportunities for urban wastewater utilities to act as local energy managers, but also huge challenges involved in reconfiguring energy and wastewater infrastructures:
 - Putting nexus thinking into practice is running up against political contestation, economic uncertainty, institutional obduracy and spatial mismatch
3. **Interpret experiences in terms of materialities, spatialities and politics of integration**
 - For a better understanding of the political geographies involved in reconfiguring urban infrastructures along more cross-sectoral, nexus-oriented lines