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Where are urban energy transitions governed? Conceptualizing the complex governance arrangements for low-carbon mobility in Europe



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ABSTRACT

This article addresses the question of where urban low-carbon energy transitions are governed. A challenge is that urban governance is not simply urban, but a complex assemblage of institutions, networks and socio-technical arrangements. There are several on-going literature debates discussing the different types of processes in which cities are involved. I disaggregate these into vertical processes (multilevel governance perspectives), horizontal processes (network and policy mobility perspectives), and what I term infrastructural processes (steering by conditions in the built environment). The purpose of the article is to show how all these types of governance processes combine to drive urban low-carbon energy transitions. Using the notion of policy assemblage, I outline a framework through which the different types of governance processes can be reconciled. This is illustrated through a discussion of how the different types of processes interact in the context of urban low-carbon mobility in Europe. A discussion of the case of Stavanger, Norway, shows how different types of governance processes combine to drive and constrain low-carbon energy transitions and underlines the importance of taking seriously the constraints of the built environment.

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1. Introduction

It has become a commonplace assertion that urban governance is not simply urban. Cities are widely seen as governed through processes above and beyond the territorial boundaries of cities themselves. In recognition of this, urban scholars have become increasingly concerned with how cities are produced in and through cross-scale relationships, by flows of people, capital and ideas (Bulkeley & Betsill, 2005; Campbell, 2012; McCann, 2011). The theoretical impetus for the interest in the trans-urban processes shaping urban governance can be linked to several broader theoretical debates, for example to thinking on globalization, networked society and the reconfiguration of state authority (Brenner, 2004; Castells, 2000; Sassen, 2000; Swyngedouw, 2004), critiques of ideological shifts in urban governance (following on from Harvey, 1989), and broader debates on the spatiality of contemporary politics in human geography (Jessop, Brenner, & Jones, 2008).

Following from the recognition of the increasing role of cities, there has also been a growing acknowledgment of the emerging role of cities in responding to climate change and in driving low-carbon energy transitions (Rosenzweig, Solecki, Hammer, & Mehrotra, 2010). This is particularly the case on the policy-making side, for example as witnessed by the emergence of many city-to-city networks of urban policy makers connecting pioneering cities that attempt to develop climate change

responses (e.g. C40). Responding to climate change has also become a strategic challenge for cities in terms of positioning in relation to energy security, carbon markets and image (Bulkeley, 2013; Hodson & Marvin, 2012). And finally, international and transnational governance institutions seem to increasingly reorient solutions and initiatives towards cities and actors at the level of urban municipal governments. For example, the European Commission has mobilized several initiatives directed at climate change and low-carbon transitions in cities and in cooperation with city authorities (Pflieger, 2014). City governments and local authorities are seen as critical actors both in implementing adaptation and in governing adaptation responses in relation to other cities and governance actors (Kern & Abler, 2008).

As is the case with governance systems more widely (Rosenau, 2005), there seem to be a growing complexity and fragmentation of climate change and low-carbon transition governance. Given this growing complexity, there is a need to assess and conceptualize the whereabouts of the authority and capability for addressing the challenges of climate change and transitions. The basic question posed in this article is: *where are urban low-carbon transitions governed?*

In addressing this question, the article outlines and discusses some key approaches to analyzing the arrangements through which urban low-carbon transitions are governed. Analysts tend to emphasize either vertical processes (primarily understood through the multilevel governance perspectives), horizontal processes (network and policy mobility perspectives), or to a lesser extent, what I term infrastructural processes (emphasizing urban form and the built environment). I argue that all

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these different types of processes need to be taken into account if we are to understand what drives urban low-carbon transitions, and outline a framework through which they can be reconciled. To illustrate the argument the article examines how the different types of processes interact in the context of urban low-carbon mobility in Europe. The case discussion of Stavanger, Norway, shows how different types of governance processes combine to drive and constrain low-carbon energy transitions, and underlines the importance of taking seriously the constraints of the built environment.

2. The whereabouts of urban low-carbon governance

2.1. Vertical and horizontal perspectives

With the fragmentation and decentralization of political decision-making processes for the past decades (Rosenau, 2005), analysts are primarily looking for power and influence in networks and institutional hierarchies that span territorial borders and the immediate scope of singular governmental institutions. Within this complex assemblage of cross-cutting and overlapping governance relations, analysts tend to emphasize different types of processes.

The *vertical perspective* emphasizes governance processes that are to a significant degree structured by formal jurisdictions and a hierarchical set of governance institutions. The basic framework here is the multi-level governance perspective (Bache & Flinders, 2005). In relation to cities, the primary focus is on how cities are positioned within broader political structures and how they maneuver in relations with national states and international institutions. Bulkeley and Betsill's (2005) influential article showed the way for later work by foregrounding the way cities engage in multi-level governance relationships with the state and other actors. They illustrate how national policy and international programs condition local and urban decision-making. Even though the MLG perspective is not always explicitly referenced, many writers on urban governance now position cities in larger policy-making systems and consider the influence of "higher" policy levels (Späth & Rohrer, 2012). For example, Hodson and Marvin write that agency at the city level cannot be reduced to the actors working at this scale, "it also involves and requires understanding of, the influence of actors at national and supranational scales of action..." (Hodson & Marvin, 2010, p. 481). The perspective is particularly helpful in revealing how lack of interaction between levels creates barriers to effective governance. Research within this perspective has shown that states often do not put to use the instruments they have at hand to push for local authorities to respond to climate change (Kern & Abler, 2008). Multi-level governance perspectives often take informal and networked relations into account as well (which is what Marks and Hooghe (2005) term Type-II multi-level governance), for example by examining how they interact with formal structures. Kern and Bulkeley (2009) examined how transnational municipal networks maneuver and lobby in the context of multi-level European governance. Yet the underlying premise is that levels or scales of institutions and organizational hierarchies structure governance.

Other analysts and contributions have understood trans-urban governance processes in more *horizontal* terms. In human geography there has been an emerging interest in the "mobility" of urban policy and how policy knowledge about cities circulates in networks in which urban policy-making authorities engage. Here writers draw on the relational perspective on cities (Jacobs, 2012), in which cities are not "bound by scale", but rather "intensive nodes that gather connections from more widely distributed spaces" (Rodgers, Barnett, & Cochrane, 2014, p. 1553). This perspective pays less attention to institutional hierarchies and the "territorial orthodoxy in urban studies" (McCann & Ward, 2012, p. 42) and is instead more concerned with the informal flows of discourses, ideas and knowledge. A key reference in point is the work of Jamie Peck (Peck, 2011; Peck & Theodore, 2012), who argues that policy-making now spills across borders and "mutates" in the contexts where they are adopted. In terms of low-carbon energy transitions,

this perspective is helpful in shedding light on how ideas for green solutions emerge and travel between cities, who promotes them and who adopts them, and how do they mutate to fit the particular context of the cities that adopt them. It is evident that particular cities, like Freiburg, Utrecht or Copenhagen, have become "models" and sources of inspiration, and receive delegations of policy-makers and activists seeking to learn. McCann (2011), who studied how Vancouver functions as a site for learning about popular ideas for environmentally and socially sustainable urban development, coined the term "policy mobility" to describe these processes. Wood (2015) studied the politics of policy circulation that led to the varied adoption of Bus Rapid Transit (a model that originated in Bogotá) in South Africa. These network perspectives are certainly not ignorant of scales and hierarchical relations – McCann stresses that policy knowledge is structured by embedded institutional legacies and path dependencies – but they suggest that an increasingly important part of urban policy-making processes is shaped in these city-to-city networks and circuits of information and knowledge exchange.

What the vertical and horizontal perspectives share is that they look at governance processes (decision-making, learning, exchange of ideas) in *trans-urban* arenas. They are complementary in the sense that they highlight different types of urban governance processes, from the formal, hierarchical structures to the highly informal and flexible relations of networks. The strength of these perspectives is precisely that they unpick how power and discourses circulating in trans-urban arenas impact on urban development. However, given that the key sites of intervention that they highlight are those taking place above and between cities, I find it useful to evoke a third perspective on the whereabouts of urban governance. As a complement to transurban forms of governance here is a need to take greater account of material nature of cities, and how low-carbon transitions and climate change responses are mediated by existing infrastructures and built environment in cities. This is what I here term the *infrastructural perspective* on where and how urban-low carbon transitions are governed.

2.2. The infrastructural perspective

It is a well-documented insight that the physical shape of cities conditions the behaviour of residents as well as the options available to change that behaviour. Studies show a clear link between urban form and greenhouse gas emissions, with extensive cities and suburban areas having far greater per capita emissions than compact cities and city centers (Newman & Kenworthy, 1989; VandeWeghe & Kennedy, 2007). The clear policy recommendations from these studies are to increase urban densities, concentrate developments around city centers and public transport corridors, and restrict suburban developments. While such ideas have become relatively common-sensical within a "sustainable mobility paradigm" (Banister, 2008), they now appear to be increasingly brought into debates on finding solutions to climate change. The 2014 New Climate Economy report listed as one of its ten policy recommendations that policy makers should "[m]ake connected and compact cities the preferred form of urban development" (Global Commission on the Economy and Climate, 2014).

The emphasis on urban form suggests that urban low-carbon transitions are mediated, if not governed in the traditional sense of the term, by the infrastructure and built environment in cities. Several theoretical contributions suggest that material and technical infrastructures condition and constrain policy action. For instance, Unruh's (2000) discussion of "carbon lock-in" illustrates how particular infrastructures enable existing technological systems to benefit from economies of scale, and thereby block competing systems even if their design may be superior (for example in terms of lower carbon intensities). The socio-technical transition literature stresses how infrastructure and technological design spur relatively stable "regimes" that condition social and behaviour (Geels, 2013; Rip & Kemp, 1998). It is clear that the seemingly mundane and hidden infrastructure that surround us is never neutral – it

embodies power relations and conventions of practice (Shove et al., in press; Star, 1999).

Brought into the urban governance field, the infrastructural perspective suggests that the role of cities in low-carbon transitions is to rethink the large and small decisions through which the urban infrastructures and the built environment are created. To McFarlane and Rutherford (2008), urban infrastructure has profound political implications in the sense that they govern social practices, mind-sets and the way cities are used and experienced. This can be used with sinister effects: in the classic article “Do artefacts have politics?” Winner (1980) suggests that transport infrastructures in New York were constructed in particular ways in order to keep undesired social elements out of the wealthier areas of the city. Several authors have linked oil dependence to the “lock-in” of car-based culture through the construction of the US highway system, which devastated inner urban cores and boosted suburban sprawl (Huber, 2013; Kunstler, 1994; Urry, 2013).

But there is also an impetus to consider how urban infrastructures can be tweaked, reconfigured and adapted to low-carbon forms of living. For example, research has also shown that reducing the number of car lanes leads to decreasing traffic, rather than simply more congestion (Cairns, Atkins, & Goodwin, 2002), as people adjust to changes in the availability of infrastructure. The role of infrastructures and socio-technical regimes is a key theme in the recent edited book *Cities and low carbon transitions* (Bulkeley, Castán Broto, Hodson, & Marvin, 2013).

The infrastructural perspective proposes that urban low-carbon transitions are mediated by the urban infrastructure and the socio-technical regimes in which they are immersed, rather than by trans-urban arenas of networks and policy circulation. In turn it is the seemingly small and mundane decisions made in city governments and planning departments that essentially determine the conditions for urban low-carbon transitions. As Star (1999) emphasizes, infrastructures “fixed in modular increments, not all at once or globally”. In other words, infrastructures are key sites of intervention, more so than the networks of “mobile” policy experts or the authorities at higher levels in governance hierarchies.

In somewhat stylized fashion, we can then typify the three perspectives from the literature as:

1. the vertical perspective, which emphasizes the governance processes that flow between formal jurisdictions and a hierarchical set of governance institutions. The key reference is the multilevel governance literature, particularly of the Type I variety (see Marks & Hooghe, 2005).
2. the horizontal perspective, stressing city-to-city and inter-city circuits of policy circulation and learning. Primary literature sources are growing policy mobility literature (McCann, 2011; Peck, 2011; Wood, 2015).
3. the infrastructural perspective, which places politics in the local and seemingly minute construction of the built environment (for instance McFarlane & Rutherford, 2008; Winner, 1980).

3. Conceptualizing the whereabouts of urban low-carbon governance in Europe

In order to understand how urban low-carbon energy transitions can be stimulated, we need to understand what levers can be pushed and where those levers are. The three perspectives discussed above offer different perspectives on the whereabouts of the key sites of intervention. In a conceptual framework for understanding the whereabouts of urban low-carbon governance we need to draw on all of these to different degrees. They are not contrasting visions of the exact same thing, and should not be understood as such. Rather, they point to and emphasize different aspects of the complex assemblage of institutions, networks and socio-technical artifacts through which urban low-carbon transitions are governed.

The use of the concept of *assemblage* here is not coincidental. It has recently been put to use in urban theory to understand cities as created in a gathering processes of different cultural, political, economic and material elements (McFarlane, 2011). Assemblage thinking more broadly is an approach in social science that describes phenomena as more or less temporary constellations of different social and material forms (DeLanda, 2006). Applied to understand the production of urban low-carbon policy, the assemblage concept can provide a frame for drawing together vertical, horizontal and infrastructural processes. As Prince (2010, p. 173) puts it, an implemented policy is “an assemblage of texts, actors, agencies, institutions, and networks”, which come together in particular “policy-making locales”. In other words, the process of producing and implementing low-carbon policy in cities must be analyzed in ways that take into account how these different elements come into play.

The approach is highly useful for the purposes discussed here, because it enables us to go beyond understanding urban low-carbon policy as produced by a single type of governance process, be it vertical, horizontal or infrastructural. It opens for considering all these different processes at the same time, or at least – since empirical analysis always has to remain pragmatic in terms of the amount of data that can be included – consider elements from these different processes. In particular, it is attentive to how policy-making ideas circulating in networks and formal institutions have to be made applicable in particular contexts (such as cities), and that this involves interfusion with pre-existing infrastructure and the built environment that has accumulated historically in those contexts. Cities are in fact layered by the projects, ideas and conflicts of the past, and it is into these “messy” situations that abstract policies or policy ideas around low-carbon development arrive. The success of those policies, and in turn the success of the political project of urban low-carbon energy transitions, depends on the outcome of this meeting between the global/abstract project on one hand and the local/concrete materiality on the other. Drawing on Prince (2010), then, we can understand a policy assemblage as the co-articulation of policy instruments, policy ideas, networks, actors, and institutions that come together in particular locales.

Following on from that, I will use of notion of the policy assemblage to illustrate how vertical, horizontal and infrastructural processes combine to shape urban low-carbon governance. I will focus in particular on the urban mobility sector and the European context. Urban mobility is constituted by a particular technology (the cars, the buses, the subways), particular actors (the travel behaviour of individuals) and a site-specific infrastructure (the roads, the tunnels, the built environment, the urban form). These aspects entangle urban mobility in the global trajectories of technological development, regional cultures shaping what is “normal” transport behaviour, and local histories of city-building and land use. In order to intervene in the urban mobility sphere, for example to make urban mobility more sustainable, policy-makers have to try to affect some of these factors and they have different instruments at their disposal to do so.

For the European Union, urban mobility seems increasingly important, as it lies at the intersection of the Commission’s goals for dealing with climate change and urbanization, and for regaining economic competitiveness. Europe is rapidly urbanizing, and as a host of EU level reports and statements now advertise, two thirds of its population now live in urban areas (EU, 2011). While CO₂ emissions from most other sectors are decreasing, transport emissions are on the rise. The increasing emphasis in the EU on the importance of cities is illustrated by the fact that the Commission recently changed the name of the Directorate General (DG) for Regional Policy to DG Regional and Urban Policy. Sustainable urban mobility has been on the central agenda at least since the publication of the Green Paper “Towards a new culture for urban mobility” in 2007. In 2013 the European Commission released the *Urban mobility package*, which sought to address CO₂ emissions, air quality issues, congestion, and other issues. However, policy intervention in the urban mobility area is not straight-forward; the EU only has certain policy

mechanisms at its disposal, and these do not include explicit policy competence in urban development (EU, 2011). It has been able to intervene on the technology-side, for example by mandating fuel efficiency standards in cars. But as the urban mobility package indicates, “Commission initiatives cannot reach out to each of the thousands of town and cities across Europe” (European Commission, 2013, p. 3). Mostly the EU is left with a set of “softer” policy mechanisms, such as defining standards, guidelines, supporting networks and observatories, showcasing best practice, and commissioning studies. It initiates and funds “reflection processes” (see for example the Cities of Tomorrow initiative, EU, 2011) and a large volume of reports and white/green papers, which set the tone for debate and promote particular authoritative concepts and ideas (such as “smart city”). It initiates various partnership arrangements that connect cities around particular agendas and make available funding for demonstration projects (such as the CIVITAS initiative, with the catch phrase “Cleaner and better transport in cities”). And it organizes arenas for networking and exchange of ideas, such as the European Week of Regions and Cities (Open Days) in Brussels every autumn. In other words, the EU arguably operates on urban mobility less through vertical process, but more by stimulating horizontal processes. It has little direct power over the urban mobility sphere, but has significant resources to disseminate discourses and knowledge about cities.

National states typically have more control over the vertical governance processes. They oversee the legal framework for spatial planning, and regulate the financial conditions for urban spatial development. States also oversee energy and climate policy that influences pricing (price of gasoline for example), and they are typically charged with developing national–regional transport infrastructures that influence urban mobility in different ways. States also facilitate networks and initiate studies and other types of knowledge generation characteristic of horizontal types of governance processes. Obviously, there are wide differences between national systems and states’ capacities to mobilize horizontal governance processes. Ultimately, however, it is local authorities – the cities themselves – that have the authority over some of the most fundamental aspects of urban mobility. Cities plan land use, organize urban transport systems, and initiate public participation. Cities also decide how they are going to engage in trans-urban networks, and are the ultimate arbitrator of how ideas circulating in trans-urban networks are “brought home”, see Table 1.

point of a particular city. Stavanger proclaims itself as an “international energy centre”, and is the fastest growing city region in Norway after the capital of Oslo. Located on the south-western coast of Norway close to the offshore oil activity, Stavanger has become a hub for much of the oil industry. It has the headquarters of Statoil, the Norwegian partly state-owned oil company, as well as other oil company offices, and therefore an influx of foreign workers and managers (Hidle & Normann, 2013). Its position as an international energy center makes it a useful case through which to examine the variety of governance processes of the policy assemblage. The trans-urban governance linkages are easy to spot, and at the same time, the oil industry has left a clear imprint on the city’s built environment.

The empirical discussion draws on interviews with eleven local planners and policy-makers, participation in presentations and events in Brussels and Stavanger, an analysis of city planning documents, and secondary historical accounts.

Despite its position as a hub for the oil sector, Stavanger has in recent years had a significant policy focus on sustainable urban development. It is in the process of building a Bus Rapid Transit system, and some recent zoning decisions have been based on compact city or new urbanism principles of walkability and mixed-use development. However, a major clamp on the foot of low-carbon mobility strategies is the Forus Industrial Park right outside the city center. The industrial park, which hosts more than 40,000 employees and companies representing one fifth of Norway’s total GDP, is highly car-dependent (Blomgren, 2012). Generally, mobility in the city relies on the private car. In its own assessment, the municipality admits that it is, “... lacking a well-functioning public transport system, something that contributes to a continuously growing vehicle traffic and large CO₂-emissions” (Stavanger municipality, 2012, p. 4). Nevertheless, the city is attempting to rebrand itself as an “energy city” (rather than an oil city), and in interviews, planners and policy-makers are keen to stress the need to get beyond the oil-dominated past. In 2014, Stavanger won an EU-bid to become a smart city “lighthouse”, in a project with Manchester and Eindhoven. This project, called Triangulum, combines several mobility initiatives (electric buses, communication technologies) in specific sites (“laboratories”) in the city. To properly understand the attempt of the city to make its mobility system more sustainable, then, we need to look at how initiatives are constituted in trans-urban arenas, both vertical and horizontal processes, as well as how these initiatives interact with infra-

Table 1
The policy assemblage of urban low-carbon mobility in Europe.

Policy process	Vertical	Horizontal	Infrastructural
Types of relations in focus Role of EU	Regulations, laws, mandates, funding Standards, benchmarks (such as fuel efficiency in cars)	Ideas, discourse, knowledge generation Agenda-setting Defining concepts Commissioning studies, reports, funding research Creating arenas for exchange of ideas, best practice	Material conditions, the built environment Limited Some projects fund urban infrastructure
Role of states	Basic legal framework and guidelines for local spatial planning Energy and climate policies Funding for urban programs	Initiating reports, white papers, research	Planning and financing national transport infrastructure
Role of cities	Comply with national regulations	Participation in networks Stimulating local participation	Zoning Land use decisions Public transport infrastructure

4. The multiple pathways of low-carbon policy

In the previous section I held that with the conceptual notion of policy assemblage we can assess how policy instruments, policy ideas, networks, actors, and institutions come together in particular locales. In this final section of the article I will illustrate the varied processes through which urban low-carbon transitions in Europe are governed from the vantage

structures and the built environment. We will now consider these in turn.

4.1. Vertical governance processes

There are few formal state or EU regulations that push Stavanger to make mobility more sustainable. The regional authorities and the state

can intervene in land use planning if the municipality's plans are significantly in violation of regional or national plans. Around Stavanger a key issue of contention between governance levels has been over the preservation of farmland, which has often forced the municipality to develop in more compact ways (Næss, Strand, Næss, & Nicolaisen, 2011). National climate policy also mandates that all growth of traffic in the major cities, including Stavanger, should be covered by public transportation, cycling or walking. This is an abstract policy goal, however, and will be made legally binding only through direct state intervention in specific plans. There are also funding mechanisms between state and local authorities that depend on how well the city is shifting towards sustainable and public transport options. Nevertheless, the state is not using formal mechanisms in a particularly strong way to affect change in urban mobility. But there are softer policy mechanisms at work. The government started a program called Cities of the Future, a cooperation program between the state and the 13 largest cities in Norway, with the aim of reducing CO₂ emissions and improving urban environments. The program was a mix of vertical processes, in the sense that the national state set the framework and obligated local municipalities to follow action plans, and horizontal, in the sense that it enabled city-to-city exchange of ideas.

In the absence of strong vertical steering from the national state, the European policy arena seems equally important to the work of transitioning Stavanger in a low-carbon direction. Norway is not an official member of the European Union, but is integrated in Europe through the European Economic Agreement (EEA), which makes most EU legislation apply in Norway. In any case, since Europe is the primary market for Norway petroleum products, actions in Brussels are affecting the city significantly. Stavanger has operated its own lobbying office in Brussels for more than 25 years. The Stavanger office in Brussels is owned by municipalities in the region, as well as the University, a local energy company and other actors. Stavanger was the first Norwegian municipality to sign the Covenant of Mayors, committing the city to supersede the EU's 20/20/20 by 2020 goal, alongside almost 4000 other European cities. However, since the EU has no explicit policy competence in urban development (EU, 2011), it has few direct means to influence urban mobility in Stavanger.

In turn, neither the EU nor the national state engages strongly in hard or intervening policy actions to mandate changes in urban low carbon development. Rather, both attempt to mobilize change through what Kern and Abler (2008) term "enabling" actions, such as pilot programs and inter-city learning. In a way these are horizontal processes, put in motion by formal governance institutions. But the formal governance institutions manage to maintain a degree of authority through such programs, since they define the parameters and determine where funding flows (Haarstad, in press).

4.2. Horizontal processes

On-going urban transformation processes in Stavanger illustrate that there is high "uptake" of hot policy ideas from transurban policy circuits. In interviews with the author, local planners and policy-makers use hot concepts such as "living lab" and "smart city" to describe their initiatives. It appears that the past decade there has been a strong willingness among local authorities to achieve changes in transport systems and urban development, and a corresponding search for ideas and approaches to frame these changes. From planning documents going back to the early 2000s it is evident that planners have put to work ideas of sea front development, mixed use development, multi-modal transport planning, and intra-city light rail, which have also been popular elsewhere under the "sustainable mobility paradigm" (Banister, 2008). Urban policies appear to be a significant extent constituted in the trans-urban sphere, through the adoption of authoritative ideas and discourses around urban development.

The Triangulum project is the most prominent example of how Stavanger networks with other cities to exchange ideas and approaches.

Funded by the EU through the Smart Cities and Communities program, Stavanger cooperates with Manchester and Eindhoven to become "Lighthouse" cities, to develop and implement "smart city" solutions. In addition, Leipzig, Sabadell and Prague are part of the project as "follower cities", to learn and implement solutions from the three Lighthouse cities. The project was awarded €24 million under EU's partnership on Smart Cities and Communities. While much of the policy mobility literature portrays this process as driven by the seductive narratives of influential models, like the Singapore model (Pow, 2014) or the Vancouver model (McCann, 2011), here policy mobility appears more bottom up, as the cities are voluntarily taking part in inter-city networks. There is of course a certain seduction in large funding opportunities and in achieving national and international recognition. There are also elements of vertical steering by the EU in this program, in the sense that the EU sets the parameters, defines the concepts, etc.

But at the same time, the "smart city" label is sufficiently flexible to allow Stavanger a great deal of lee-way in how to "fill it". In interviews with the local project partners, it became clear that most of the separate initiatives of the project (electric buses, smart home technology) were conceived prior to the initiation of the Triangulum project. As such, these solutions could be framed in many different ways – green, eco-friendly, energy efficient, etc. – but framing them within "smart city", and linking up with other potentially "smart" cities, opened the door to a particular trans-urban arena for intercity exchange of ideas and knowledge. The interest of local actors in the Triangulum project is to a significant extent the relationships it enables, both internal within the city region and with the other cities in the project. Triangulum has a Twitter identity, and the prominently placed calendar on the project's website lists a range of conferences and events relevant to "smart cities". And Stavanger has, as part of the ambition "to become the leading Smart Region in the Nordic countries", established the annual Nordic Edge Expo, which aims to be "a not-to-be-missed arena for ideas exchange, inspiration, insights and action" (Nordic Edge Expo, 2015).

The smart city initiative provides an entry point for Stavanger into a trans-urban arena, where ideas and experiences around urban sustainability are exchanged. Local actors attach themselves to authoritative discourses on sustainable urban development, and use these to frame their own initiatives. It is also the most publically visible aspect of the low-carbon agenda. But it is not necessarily the most important in terms of promoting a low-carbon transition.

4.3. Infrastructural processes

Urban infrastructures pose significant constraints on the smart city project and other low-carbon mobility initiatives in Stavanger. One of the demonstration sites in Triangulum is the Forus Industrial Park, where the energy provider Lyse will develop and test video solutions, automated energy controls and smart charging of electric vehicles. However, as a demonstration project it is primarily aimed at developing a product for Lyse, rather than actually making substantive change in the urban and regional transport and mobility system. While the smart city project is clearly the most visible and prominent initiative of the city, there are arguably other governance processes that are addressing the mobility challenge more directly. As the infrastructural perspective suggests, urban form and the built environment are the key determinants of energy use and CO₂ emissions (Newman & Kenworthy, 1989; VandeWeghe & Kennedy, 2007). Smart city initiatives are mediated by the built environment of the city, such as how the Forus Industrial Park is planned and integrated with transport infrastructure.

There are on-going initiatives by Stavanger municipality and two other bordering municipalities to make an inter-municipal plan for Forus, to manage its future growth and balance it with the interests of the urban centers in the region. In interviews, planners working on Forus point back to planning decisions made in the 1970s and 1980s to explain the challenges that they are currently facing. The desire of

local politicians to make Stavanger the national “oil capital” meant that few restrictions were placed on businesses wanting to come located in the industrial park. This is created what a local official referred to as a “money machine and an abscess” (interview with the author). A transport survey revealed that 75% of trips to work at Forus are made by car, even though 80% of those who work there live within 15 km of their workplace. The industrial corporation in charge of the industrial park has hired a Danish architecture firm to come up with ideas for new urban development at Forus. They put forward a proposal termed The Forus Vision, which envisaged the industrial park as a properly urban area, with residential and commercial areas. The paradox now is that allowing Forus to urbanize through mixed-use development, allowing residential developments in the outskirts of the park, could threaten the traditional city center of Stavanger.

Initiatives to make Stavanger's transport and mobility system more sustainable are mediated by the pre-existing infrastructure and the built environment of the city. New initiatives, like smart city project, encounter layers of planning and urban development decisions of the past decades. Their success depends on how well they are integrated with the existing geography.

5. Discussion and conclusions

The question of *where urban low-carbon transitions are governed* is prompted by the now commonplace assertion that urban governance is not simply urban. Urban governance involves a complex assemblage of institutions, networks and socio-technical artifacts. In this paper I have suggested that existing literature offers (at least) three different ways of understanding the whereabouts of urban governance: the horizontal, the vertical and the infrastructural perspectives. The vertical perspective rests to a significant extent on insights from multi-level governance, and is primarily (but not solely) concerned with relationships between formal institutions at different levels, in other words how urban governance is shaped by higher-level institutions. The horizontal perspective is primarily concerned with how cities operate in networks and draw on “mobile” policy knowledge and policy ideas. I have held that both of these relatively separate theoretical debates addressing trans-urban forms of governance should to a greater degree engage with what I have termed the infrastructural perspective, namely the longer running theoretical debate on how infrastructure and the built environment of cities condition practices (McFarlane & Rutherford, 2008; Unruh, 2000; Winner, 1980), and mediate policy initiatives for urban transformations. Ultimately, all these perspectives and processes matter for urban sustainability transitions, and should be taken into account in the analyses. The notion of policy assemblage can incorporate the interaction of policy instruments at different levels, the circulation of policy ideas in networks, and the interaction with various socio-technical arrangements and infrastructures in particular locales.

The policy assemblage of urban mobility in Europe is to some extent driven by the European Union, since it is part of dealing with urbanization, climate change and other challenges. The vertical perspective addresses an important process here, regarding the standards, benchmarks and agenda-setting activities the EU is responsible for. In line with Kern and Abler (2008), I find little evidence of “hard” regulatory policies in vertical arrangements towards cities, from either the EU or the national state level. While the EU has no direct policy competence in urban development, it operates by setting in motion and funding horizontal processes, such as networks, conferences and demonstration projects. There are also a host of networks and activities mobilized by the cities themselves.

Therefore, low-carbon mobility governance in specific cities is “assembled” by a variety of trans-urban processes that are brought to bear on the built environment and existing infrastructures in those cities. My illustration of the Stavanger case illustrated how vertical, horizontal and infrastructural processes combine to drive and constrain

the governance drive for more sustainable urban mobility. Vertical governance relations exist, but the EU and the national state are primarily intervening by setting in motion and funding network-based activities such as the EU's Smart Cities and Communities program or the national Cities of the Future program. Urban-level actors are keen to adopt authoritative concepts and participate in network activities. However, as the smart city project installs e-charging and transport logistic technology in Forus Industrial Park, it meets up with layers of car-based infrastructure resulting from large and small planning decisions of the past decades.

It is at the intersection of formal policy instruments, the circuits of policy knowledge and the materiality of cities that possibilities for low-carbon transitions are created. As analysts we should strive to take a wide range of processes into account in our assessments of urban low-carbon energy transitions. There are different ways of doing this, but it is essential that analyses take into account how the built environment and the material context of cities shape conditions for governance. There is a need for new and innovative policy ideas for urban transformations, but it is the way they are adapted to and reconfiguring the pre-existing built environment that will in fundamental ways determine their success.

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