Urban Green Assemblages:
An ANT View on Sustainable City Building Projects

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In this article, I sketch an STS-theoretical approach to world-wide growing concerns with urban climate risks and sustainable urbanism more generally in terms of what I call 'urban green assemblages'. This approach draws inspiration from recent attempts to bring actor-network theory (ANT) closer to urban studies, infusing urban political economies with STS sensibility towards the contingencies of eco-socio-technical design and transformation processes. ANT, I argue, offers a new ontology for the city, allowing the study of those concrete and plural sites at which urban sustainability is known, practiced, scaled, negotiated and contested, in heterogeneous and dynamic assemblages of humans and non-humans. I explore the analytical potentials of this ANT urban ontology through a case study of how architects, engineers, and urban planners currently perform *Nordhavn*, one of Europe's large-scale sustainable city building projects, as a site of multiple matters of public-political concern with urban natures.

Keywords: Actor-network theory; Assemblage urbanism; Sustainable city-building

Introduction: Bringing ANT into Urban Ecology

Urban ecology may have once been the province of community activists occupying industrial waste-lands – but as public concerns with environmental and climatic risks have grown, ideas and practices related to the greening of cities have now entered the realm of urban truths circulating among policy-makers and planners world-wide (Jamison, 2008). On the one hand, figures pointing to cities as responsible for more than 70% of global carbon emissions are now commonplace; on the other, cities on all continents actively re-position themselves as 'living laboratories' for innovating and testing the green technologies needed to move towards a low- or zero-carbon transition (Evans & Karvonen, 2010; Bulkeley, 2012; Blok, 2012a)[1]. Everything from low-energy houses to bicycle infrastructures, from green roofs to solar heating panels, the professional worlds of architecture, engineering, and urban planning are now called upon to re-design long-standing urban metabolisms. Urban ecology, in short, is fast becoming an important domain for observing the large-scale reassembling of nature, technology and society.

In this article, I argue that Science and Technology Studies (STS) in general, and actor-network theory (ANT) in particular, help bring new insights to bear on urban ecology, conceived broadly as relational processes of city-based eco-socio-technical change. At the same time, I deploy urban ecology as an invitation to push STS and ANT thinking in new directions, related to questions of how sustainable urbanism works as a particular mode of knowledge-making and a specific format of contentious (cosmo)political experimentation?

Developing these themes entails positioning ANT at the intersection of multiple on-going conversations on the (un)sustainability of cities, sprawling the hinterlands of STS, urban studies, human geography, and political ecology. Although STS concepts clearly figure in these conversations (e.g. Hinchliffe et al., 2005; Heynen et al., 2006), there is still much work to be done, I suggest, in trying to spell out the exact implications of ANT to urban ecological politics, and, conversely, in specifying the challenge of urban ecology to ANT (and STS) theorizing. This, then, is the task I pursue in this article, in terms of developing the concept of 'urban green assemblages' as an important ANT-derived contribution to cross-cutting debates on sustainable urbanism and urban political ecology.

While thus motivated primarily by theoretical concerns, I want here to pursue this double challenge – of ANT in urban ecology – by an on-going case study, which looks at the dynamics of knowledge-making and political contestation in one of Europe's large-scale sustainable city building projects. In Copenhagen, capital of Denmark and home to 1.5 million people, ambitious plans are underway to rebuild the old industrial harbor area known as *Nordhavn* ('North harbor') into what the urban designers confidently refer to as 'the sustainable city of the future'. By 2050, this 300 hectare area by the water, to the north-east of city center, aspires to house 40.000 new inhabitants in a 'green', carbon neutral, bicycle-friendly, and renewable energy-based urban district. So far, all of this exists mostly in architectural models, engineering projections, planning documents and local politics. In empirical terms, my aim is to explore how urban natures are mobilized in-between these divergent modes of city engagement. How and by whom are knowledges on (global) ecological risks translated into situated city-making practices, and what kinds of inscription devices and coordination practices does this work entail?[2]

My exploration of these questions proceeds by way of bringing together, conceptually and empirically, two promising strands of ANT encounters with cities-in-the-making. First, I pick up the thread from how ANT has recently been brought to bear on the field of urban studies, in what has become known as 'assemblage urbanism' (Farías, 2010; McFarlane, 2011). Pushing this turn further, I develop the notion of urban green assemblages as a means of bringing ANT sensibilities to the study of how urban green knowledge is produced, translated and contested across specific urban sites, scales and relations. Second, I bring this new ontology of urban ecology together with STS studies that deploy ANT to elucidate specific building and architectural design projects as complex ecologies of professional, juridical, economic and cultural relations (Yaneva, 2009; Houdart, 2008). Using primary textual material from the *Nordhavn* case to illustrate both encounters, my discussion aims also to contribute to a nascent STS interest in practices of sustainable architecture and design (e.g. Moore & Karvonen, 2008). Via the notion of urban green assemblages, however, I want to suggest that ANT entails particular analytical (and ethical) commitments to this agenda, pushing

STS to study the implication of design in (cosmo)political controversies over multiple attachments to urban 'greening' (cf. Yaneva, 2012).

In what follows, I start by developing the conceptual contours of urban green assemblages. Informed by ANT sensibilities, assemblage urbanism, I argue, brings a new ontology of the city to urban ecology, one that emphasize the need for situated empirical inquiries into those practices of knowledge-making, scaling, and material intervention whereby urban actors reassemble city-based natures. Next, I bring this notion of urban green assemblages into dialogue with STS work on architectural practice, in order to suggest that sustainable architecture works as a specific modality of inscribing ecological concerns into urban political life.

This leads into a more empirical exploration of how architects (and engineers) inscribe urban natures into plans for the future of *Nordhavn* – and how these inscriptions are in turn contested in specific urban publics. In terms of method, my analysis relies primarily on access to primary textual architectural and engineering design consultancy material supplemented by media analysis, interviews with key actors, and participant observation at public hearings. In particular, my analysis seeks to show how architectural inscriptions of urban natures in *Nordhavn* come in multiple overlapping forms, each with different dynamics of knowledge and politics. Importantly, this suggests that, rather than facing a singular challenge of rendering places more 'environmentally sustainable'[3], architects are key actors in juxtaposing and coordinating a multiplicity of co-existing attachments to, and practices of, urban ecology (cf. Mol, 2002).

These explorations lead me to suggest, in conclusion, that ANT entails a particular notion of urban political ecology, one committed to place-based collective experimentation and learning around (global) ecological risks – and one that orients urban design towards the overarching question of cosmopolitics, the politics of the common cosmos (McFarlane, 2011; Latour, 2007). In a world of multiplying ecological risks, I suggest, this may prove an important STS contribution to debating, and rethinking, city-making as currently practiced.

Urban Green Assemblages: A New Ontology of City Metabolisms?

Compared to its substantial engagements with scientific laboratories and technological development complexes, it is fair to say that the field of STS has yet to pay extensive attention to urban sites and processes (Hommels, 2005; Coutard & Guy, 2007). This is surprising, given that – as Aibar and Bijker (1997) note in their study on the planning of Barcelona – cities may be treated as 'enormous socio-technical artifacts', heterogeneously engineered by a range of competing actors and institutions. In the case of Barcelona, Aibar and Bijker show how contrasting visions of city extension among engineers, architects, and local communities resulted from different yet overlapping socio-technical frames, encompassing such issues as hygiene, mobility, social distinction, and land ownership. In this contentious process, closure around a final urban design was achieved through situational micro-struggles and compromises over the width of streets, the depths of buildings, and public access to facilities and parks. While so far rather marginal, STS would indeed seem well placed to study such politics of urban design (Moore & Karvonen, 2008).

To understand this situation of relative non-engagement, however, we should note some intellectual particularities

of that academic domain which claims the city as its 'truth-spot' (Gieryn, 2006), that is, urban studies. As Coutard and Guy (2007) suggest, much contemporary urban studies is marked by a universalized imaginary of urban decline, splintering and discrimination – an orientation at odds with a widespread STS sensibility toward the contingency and ambivalence of *any* socio-technical transformation process. Such divergence, no doubt, may be further traced to the continuing influence within urban studies by various branches of critical theory, including post-Marxist urban political economies of the 1970s (McFarlane, 2011). However internally diverse, urban political economy approaches (e.g. Harvey, Castells, Lefebvre, Sassen) tend to understand cities primarily as local nodes in wider global processes of capital circulation and accumulation. This orientation, in turn, downplays the need for such situated and open-ended ethnographic explorations as favored by STS scholars (Farías, 2011)[4].

Recently, however, the terms of engagement between STS and urban studies appear to be changing, as various critical urbanisms are increasingly being challenged by theorists of 'assemblage urbanism' (McFarlane, 2011). Importantly, assemblage urbanism traces its genealogy in large part to actor-network theory (ANT), including the STS and Deleuzian intersections of this theory, as an attempt to 'test' the contribution of ANT for rethinking the city in urban studies (Farías, 2010). In this vein, assemblage theorists seek to delineate how ANT offers up "an alternative ontology of the city" as a de-centered object (Farías, 2010: 13). According to Farías (2010: 2), then, cities are "relentlessly being assembled at concrete sites of urban practice", as a "multiplicity of processes of becoming, affixing socio-technical networks, hybrid collectives and alternative topologies". Here, assemblage urbanism resonates strongly with Bruno Latour's own ANT take on the composition of city life through situated techniques and flows (Latour & Hermant, 2006).

Assemblage urbanism has a number of important consequences for rethinking the city – all of which, I want to suggest, will prove beneficial to our understanding of urban ecology, in terms of what I dub urban green assemblages. First, and most literally, assemblage urbanism conceives of cities as ensembles of heterogeneous actors, giving analytical priority to the active dynamics of arranging or fitting together socio-material elements. Cities may be assembled in multiple ways, depending on how heterogeneous connections are forged among objects, places, materials, machines, bodies, symbols, natures, policies and so on (Farías, 2010: 14). This is also the sense in which, like ANT in general (Murdoch, 2001), assemblage urbanism may be said to promote an inherently *ecological* view of the city, one that stresses the agency of urban materiality, natures and non-humans. In the language of Isabelle Stengers (2005), assemblage urbanism invites a view of cities as overlapping ecologies of human and non-human practices.

It is important to note, however, that most urban ecologies – as shaped by obdurate socio-material infrastructures of electricity, water, housing, transportation and waste – tend to remain unnoticed backdrops to city life (Star, 1999; Hommels, 2005). Only under specific conditions, similar to what Geoffrey Bowker (1995) calls 'infrastructural inversions', are urban socio-material relations articulated as matters of (un)sustainability concern[5]. In the *Nordhavn* case, for instance, such articulations were explicitly built into the architectural competition brief, constraining designers to frame their place-making visions in accordance with wider environmental goals of the Copenhagen

municipal government. As such, *Nordhavn* emerges as an urban green assemblage, in the sense that heterogeneous actors here come to orient themselves towards *redesigning* urban eco-socio-technical relations in 'green' directions. I explore what this means in more detail later on. So far, the main analytical point is that, while urban green assemblages may operate at different scales, from the domestic (Marres, 2008) to the global (Sassen, 2010), they will tend to bring together particular constellations of technologies, sites and actors, from engineers and architects to developers, regulators, civic associations and urban residents.

This relates also to a second analytical effect of assemblage urbanism in terms of how it deals with issues of space, place, and scale. The main point here is simple, but it carries wide-ranging consequences: rather than granting explanatory autonomy to spatial categories like *the* city, assemblage urbanism conceives the city as a plurality of *sites*, the connections among which are changing and contingent. In this sense, there simply is no city as a whole, but rather a multiplicity of sites and processes assembling the city in different, sometimes contradictory, ways (Farías, 2011: 369). Importantly, urban sites are defined not by geographical boundaries or scales, but by types and lines of activity, whereby spatialities emerge through the actor-networks that connect places (Latour, 2005; Farías, 2010: 6). An urban green assemblage like *Nordhavn*, for instance, gradually emerge as connections are forged – through such devices as the architectural competition brief – among otherwise non-related places, from the post-industrial landscape of an old harbor area in Copenhagen, via local government bureaucracies to architectural and engineering offices. At all of these sites, moreover, connections will be fanning out to other scientific, political, economic and cultural nodes, locally and trans-nationally (cf. Yaneva, 2012).

This notion of spatiality as assembled sites also entail a particular approach to scale-making, in that 'local' and 'global' are not fixed geographical coordinates, but rather denotes the variable end-products of collective scale-making practices (Latour, 2005). In terms of urban green assemblages, this is a crucial point, given that contemporary urban ecology derive much of its rationale and dynamics from urban sites being selectively brought into contact with (supposedly) 'global' environmental risks, thereby setting in motion various re-scaling trajectories (e.g. Sassen, 2010). Indeed, the entire *Nordhavn* project might reasonably be described in such terms, in that the project re-scales climate change as being in significant parts an *urban* (rather than, say, national) challenge – while, at the same time, re-scaling *Nordhavn* as an 'eco-city' of potentially *global* significance (Blok, 2012a). Still, assemblage urbanism invites us to also be more specific, in terms of analyzing how socio-geographical scales come into being, in concrete cultural, political and architectural practices, as actors stabilize their connections of proximity and distance (Slater & Ariztía, 2010). Hence, one key question for the study of urban green assemblages is how, by whom, and via what kinds of inscription devices, knowledges on 'global' ecological risks are translated and asserted within 'local' city-making practices, such as *Nordhavn*?

Third and finally, assemblage urbanism also carries far-reaching implications for how to deal with issues of urban asymmetries and power; and hence for rethinking the political dimensions of urban ecology. This is a difficult point, because ANT is often misunderstood as promoting a vision of flat ('power-free') social territories. It is certainly true that, unlike (some) critical urbanisms, assemblage urbanism refuses to

imagine overarching and all-encompassing power structures – such as 'global neoliberal capitalism' – which would over-determine city life and politics, including the politics of sustainability. However, as always in ANT, this analytical refusal is made precisely in order to study those concrete and situated practices of socio-material ordering, whereby agency capacities, resources and power end up being unequally distributed within specific urban relations (Farías, 2011: 370). Inside an urban green assemblage like *Nordhavn*, for instance, particular actors – including developers, municipal planners, and architects – clearly inhabit city-ordering centers, or 'oligopticons', that allow them to act as spokespersons of wider urban constituencies (Latour, 2005). What is made present and what is made absent at these powerful urban sites, and hence which concerns enter the city-building frames and which overflows them (Callon, 1998), are critical questions for urban assemblage studies.

Embedded in this analytical approach to the dynamic asymmetries of urban ecologies, moreover, is a particular vision of democratic city politics, helping to specify the political project wedded with the notion of urban green assemblages. By introducing technologies, natures and non-humans into urban politics, assemblage urbanism amounts to what Latour (2004) calls a 'cosmopolitics', a politics of the common cosmos. No longer a matter solely of human (e.g. class) interests, urban cosmopolitics involve conflicts over different city 'cosmograms', that is, ways of articulating the elements of the city, the world, and their mutual connections (Farías, 2011: 371). Understanding political ecology *as* cosmopolitics means becoming attuned to the way urban democratic publics (in the plural) are dynamically constituted around specific ecological situations and matters-of-concern, say, concerns with inner-city wildlife (Hinchliffe et al., 2005). Moreover, as I stress in this article, it also entails paying special attention to the ways in which architectural and other professional city-making inscriptions may both *constitute* and *constrain* such engagements. As such, I suggest, the politics of urban green assemblages arises mostly through forms of public experimentation and learning at the fringes of urban expert planning sites.

In sum, this article joins on-going work at the intersection of STS and urban studies, in order to conceptualize urban green assemblages as part of a more general rethinking of the ontology, materiality, sociality and politics of cities. Urban green assemblages are defined as ensembles of heterogeneous actors, human and non-human, which orient themselves to the gradual redesign of urban eco-socio-technical relations in 'green' (or 'sustainable') directions. Such assemblages arise from the way actors forge urban ecological connections between otherwise non-related sites and practices, including those of engineers, architects, regulators, civic associations and urban residents, enrolling technologies, inscriptions, standards and natures in the process. Urban assemblages entail issues of asymmetry and power, but they also open up new spaces of democratic experimentation around ecological matters-of-concern, in and beyond sites of expert urban planning. To further specify how this works, I turn now to consider sustainable architecture as a specific modality of engagement with urban ecologies-in-the-making.

Sustainable Architecture: Urban Ecology as Movable Projects

While there is no *inherent* connection between architecture and urban green assemblages, it remains the case that, throughout the 20th century, architects

have been frequent participants in shifting coalitions of urban environmentalist experimentation (Jamison, 2008). Conversely, lines of influence from the science of ecology run deep in the history of architectural modernism (Galison, 1990; Anker, 2010), as well as in contemporary practices of so-called 'eco-', 'sustainable' or 'green' architecture (Owen & Dowey, 2008; Moore & Karvonen, 2008). From the perspective of assemblage urbanism, the main question is how to conceptualize such architecture as a particular modality of ecological knowledge practice and a specific form of urban cosmopolitics? Answering this question is challenging, in part because 'eco-architecture' clearly does not designate a homogeneous set of practices. Rather, considered as a globalized assemblage in its own right, architectural engagements with urban ecology exhibit widespread differences in time and space (Guy & Moore, 2005). Before turning to the *Nordhavn* case, and by way of capturing the distinctiveness of the ANT approach, it is worth considering some such important axes of difference.

As a first approximation, the recent history of eco-architecture suggests that this assemblage fluctuates together with the vagaries of environmentalist thinking and practice. Hence, as STS scholar Andrew Jamison notes (2008: 290), architects were often central to the many small-scale alternative-technology movements that coalesced in the 1970s, especially in Europe, engaging in decentralized experiments with low-energy houses, urban agriculture, and wind power generation with a view to broad social critique. With growing institutionalization of environmental commitments since the 1980s, however, alignments between architecture, markets and politics also changed. 'Sustainability' has emerged as a polyvalent marker of differentiation, in market and value terms, within the field of architectural consultancy work (Owen & Dovey, 2008). The architect of sustainability, in this sense, is a fairly recent socio-professional kind, co-emerging with other material practices such as those of eco-engineers, green-tech companies, and environmental regulators (Fischer & Guy, 2009). Together, these will commonly be the most prominent knowledge-making practices involved in contemporary urban sustainability projects.

In the vein of critical urbanism, Jamison (2008: 293) reads these cultural-political transformations largely as a (deplorable) turn to market dominance in urban development, leading to the downplaying of environmental ambitions. This is where assemblage urbanism objects, however, to such structural notions of overarching power relations. In the guise of commercial consultancy practices, sustainable architecture will certainly be shaped in part by its relations to powerful economic actors, such as land developers, as is also the case in *Nordhavn*. However, this point should be extended to include *all* the conflicting stakeholders involved in any urban sustainability project, including urban authorities, expert consultants, environmentalists, neighborhood communities, building users, and so on. In this sense, any building project is a contested ecology of unequal relations (Latour & Yaneva, 2008: 88), making it hard to say *a priori* what relative strength will be exerted by 'economic' concerns. For assemblage urbanism, then, the key point is that capital is hardly the *only* force exerting itself within city-making practices (cf. Farías, 2011). Indeed, focusing too narrowly on the commercial aspects of eco-architecture risks blurring the inherent diversity and socio-technical importance of architectural design practice itself.

Instead, as Moore and Karvonen (2008) suggest, STS needs to be brought closer into contact with the socio-technical frames of

design thinking. This is also where the two ANT approaches to cities-in-the-making come together: on the one hand, assemblage urbanism; and, on the other, ethnographic studies on architectural practice as a specific semiotic-material modality of world-making (Yaneva, 2009; Houdart, 2008). So far, these two creative strands of ANT studies have had little contact. Bringing them together, as I do here, will help position architectural engagements with sustainability projects as urban 'hybrid forums' (Callon et al., 2009), entangling a range of mutually contentious knowledges, material practices, and value commitments within an urban green assemblage. What unites such otherwise divergent projects, arguably, is the fact that *some* architectural proposal will act as an obligatory point of passage, in terms of juxtaposing and giving material form to site-specific settlements amongst contentious forces. In this sense, I suggest, architects and their inscriptions act as important mediators in urban 'greening' processes, as vehicles for articulating urban localities as matters of ecological concern.

In their own work, Moore and Karvonen (2008) suggests to distinguish three 'geo-historical frames' of sustainable architecture, in terms of their relations to 'context': the context-bound, the context-free, and the context-rich. Context-bound design refers to traditions of 'vernacular' architecture, crafted from local materials with 'natural' qualities, such as straw or wood. Context-free design, by contrast, refers to a dominant form of modernist sustainable architecture, centered on the functional deployment of efficient technologies, and without any consideration of particular places or ecologies. Context-rich design, finally, connotes traditions of participatory and community-based architecture, whereby advanced technologies come to be related to their social ecologies by way of inclusive collective experimentation[6].

Cast in these terms, the *Nordhavn* case clearly exhibit strong elements of context-free design thinking: in their design specifications, architects and engineers position *Nordhavn* as an urban 'laboratory' for testing various 'cutting-edge' green technologies, implying that experiences gained from this locality will be readily transferable to other contexts (cf. Gieryn, 2006). Moreover, highly technical and quantified notions of energy-efficiency, environmental impact reductions and carbon neutrality, as tied in different ways to housing, energy, and transportation infrastructures, play prominent roles in the overall design frame. Unlike the grander epochal claims of Jamison's critical urbanism, then, Moore and Karvonen's ideal-types are helpful in drawing out some of the specific features which sets apart a design project like *Nordhavn* from other contemporaneous efforts of sustainable architecture – including other on-going projects in the city of Copenhagen – which draws more heavily on context-bound or context-rich design traditions[7]. As such, their concepts point to important axes of difference among urban green assemblages.

While thus framed through a broadly context-free design imaginary, however, practices pertaining to more context-bound and context-rich traditions are clearly also visible *within* the frame of the *Nordhavn* architectural project. As such, the various traditions seem to intermingle and co-articulate in discernible patterns, often in relation to different aspects, or different eco-socio-technical relations, enfolded within the same plans for this large-scale urban district. This is what I unfold empirically later on through the concept of the 'urban green multiple' – considered as one important form of urban green assemblages – which captures the way a multiplicity of co-existing attachments to urban natures come to be enfolded in a single sustainable

architecture project (cf. Mol, 2002). What this sense of multiplicity and juxtaposition point to, I believe, are the inherent limitations of an ideal-typical approach such as that of Moore and Karvonen (2008). Hence, while their concepts are helpful in sensitizing STS researchers to major differences in design imaginaries, they have little to say about the situational requirements and (cosmo) political controversies that shape how specific sustainable architecture projects unfold.

To fully get at this level of site-specificity, I suggest, we should follow the ANT footsteps of Latour and Yaneva (2008) in making the simple but powerful observation that buildings (and urban settings generally) are not static objects but movable projects. Resonating with assemblage urbanism language, what this suggests is that, in analyzing a specific urban sustainability project such as *Nordhavn*, we need to trace how their complex ecologies transform over time as new elements impinge upon the architectural frame, and as new controversies arise (cf. Yaneva, 2012). Zoning laws, land prices, construction materials, energy technologies, risk analyses, building standards, stylistic fashions, user habits, and so on – all of this (and more) is brought together, worked upon, modeled and modified in and beyond the architectural office. Over time, as powerful allies are mobilized around a specific design proposal, the architectural frame will start to stabilize enough for the project to gain its spatial, temporal, and eco-socio-technical dimensions. Such dimensions are never entirely freeze-framed, however; they may be re-opened for public-political scrutiny once architectural design inscriptions start circulating in media and other formats.

Importantly, in climate-sensitive urban restructuring, part of what impinges on the architectural frame are new local manifestations of global environmental risks, necessitating material accommodations. In this context, the contested relations that pertain to any building project may be said to gain yet more layers, as design expertise is further pluralized, leading to new co-articulations of architectural, engineering, and natural science tools and knowledges. In the *Nordhavn* case, architectural and engineering consultants have been working closely together for the duration of the design process, thus illustrating a tendency for architectural practice to grow more reliant on engineering expertise in the context of sustainable design (Fischer & Guy, 2009)[8]. Moreover, the exact knowledge ecologies and material natures enacted in such urban green assemblages matters greatly to architectural practice. In the *Nordhavn* project, for instance, architects had to deal in their design with projected sea-level rises, made known through expert agencies' computer modeling on the localized urban effects of climate change. During the architectural inscription period itself, these sea-level projections for Copenhagen moved upwards approximately 30 centimeters, approaching the range of a one meter rise by 2100. This change had major implications, as islet bridges and sea-side front-spaces had to be re-scaled[9].

To sum up, this section situates sustainable urban design within a changing landscape of socio-professional knowledges and tools. In doing so, I critique the tendency of Jamison (2008) and other critical urban scholars to focus narrowly on the (real) market constraints manifested in large-scale (and somewhat 'context-free') sustainable city building projects like *Nordhavn*. Instead, I suggest here to augment the ontology of assemblage urbanism by adding an ANT-inspired view on green architecture, which sees buildings and eco-districts not as static objects but as movable projects, emerging through a complex ecology of contentious knowledges, material practices, and value

commitments (Latour & Yaneva, 2008; Yaneva, 2012). In methodological terms, this requires a site-specific approach, capable of registering how urban building projects change, in part through the architectural inscription of new ecological concerns. In the remainder of this article, I explore these claims further by tracing how different urban natures, in the plural, are inscribed – and publicly contested – in the design of *Nordhavn* as a sustainable city district.

The Urban Green Multiple: *Nordhavn* as Ecological Matters-of-concern

Right from the brief of the international design competition, launched in May 2008, the future of *Nordhavn* has been couched in the rhetoric of sustainable urban development. Hosted by the powerful Copenhagen City and Port land development agency, in conjunction with municipal authorities and the Architects Association of Denmark, the competition brief frames the task as one of envisioning "a sustainable city district of the twenty-first century", capable of providing 'future-oriented solutions' to such challenges as 'climate change and resource consumption'. Of the 180 competition entries, three were singled out for special attention; and among these, the joint proposal by COBE, a Copenhagen-based architectural consultancy firm, and engineering consultancy Ramboll was subsequently appointed winner. This overall design vision (known as 'Urban Delta') has been elaborated since, through processes of policy and public consultation, into a local act for the inner-most part of *Nordhavn* ('Aarhusgadekvarteret'), taking effect in 2012 and allowing construction to commence. Meanwhile, the *Nordhavn* vision has achieved considerable attention and circulation in professional design circuits; in 2010, for instance, the project was showcased and highlighted as a 'sustainable urban lab' at the Venice Architecture Biennale.

By the time I visit the architectural office of COBE in late 2010, much of the initial work of stabilizing an overall eco-socio-technical design frame, and enrolling urban policy allies behind it, has thus already been achieved. Now, focus is more on details of the local act. In terms of urban sustainability, the overall design principles are highlighted across a range of architectural inscriptions, in textual and visual form: the future *Nordhavn*, I learn, will feature everything from ocean windmills, solar panel islands and geothermal energy to two-lane bicycle tracks, new metro extensions, green roofs, tight housing energy standards, climate adaptation flood protection, and much more. While heavily focused around climate change, the design frame also includes various other ecological aspects, from ample parks, trees and other green-spaces to concerns with urban wildlife and biodiversity. As such, the *Nordhavn* design frame makes it clear how urban sites are traversed not only by a variety of environmental and climatic risks (cf. November, 2004), but also by a dense layering of multiple urban ecological concerns, practices and attachments. Architectural inscriptions, I suggest, thereby enact *Nordhavn* as an urban green multiple.

To Copenhagen policy-makers, *Nordhavn* represents part of a wider climatic commitment, made public in 2009, to become the first carbon neutral capital in the world by 2025. Importantly, this commitment coincided in time with Copenhagen hosting the COP15 United Nations climate summit, an event attracting massive international attention, and thus branding and investment opportunities to the city and its green-tech industries. Indeed, *Nordhavn* designs enjoyed their own exhibition space during the COP15 meeting. Following assemblage urbanism

tenets, the case of *Nordhavn* thus exemplifies how architectural engagements with urban green assemblages arise in response to a variety of ecological concerns, each enjoying particular relations to the urban sites in question. Hence, the Copenhagen case clearly illustrates how anticipations of new climatic risks, in particular, are currently transforming the meaning and practice of urban sites like *Nordhavn*, which in turn acts to implicate cities in new moral geographies of global carbon emissions. There seems to be little doubt that large-scale sustainable city-building projects such as *Nordhavn* – and more generally the select ideas of urban greening that enter the realm of policy truths – stem in large part from growing scientific, political, and public concerns with the cascading urban risks of climate change[10].

In short, *Nordhavn* is presently becoming an urban green multiple through specific constellations of architectural, industry, policy and public sites, knowledges and relations, distributed throughout Copenhagen and beyond. All of this involves partial perspectives and conflicting attachments. When talking to the architects and engineers, it is clear that they view *Nordhavn* partly as a fortuitous child of its specific (trans)local political circumstances, symbolized in the inscription of carbon neutrality as an overall design vision for the district. Amidst widespread concerns with economic crises, this design enactment of strict climatic policy ambitions looks in hindsight like a narrow window of opportunity. Moreover, the political positioning of *Nordhavn* as an experimental site of urban sustainability has allowed the architects to extend their ecological commitments beyond a narrow focus on carbon. In other words, as 'climate' has been translated, extended and contested, both in the process of architectural inscription and as these inscriptions enter into urban public settings, climate has come to multiply into a variety of ecological 'matters-of-concern' (cf. Latour, 2007).

Apart from extending the project further towards material realization, however, policy and public engagement have also served to spur a variety of new design controversies, centered on attachments to urban natures. In what follows, I analyze the becoming of *Nordhavn* as an urban green multiple by unpacking some of these heterogeneous eco-socio-technical relations – first, as they come to be configured as specific design objects, and later, when they are contested as public matters of ecological concern. In methodological terms, my analysis relies primarily on privileged access to extensive textual material, produced by the architects and engineers, specifying design principles and details of spatial layout. This is supplemented, for contextual understanding, by media analysis of Danish newspaper coverage; qualitative interviews with architects, policy-makers and activists; and participatory observation at a local citizens' hearing on *Nordhavn* (held in August 2011). Rather than exhaustiveness, my three 'eco-objects' (windmills, plantings, frogs) are meant to illustrate the claim, integral to the concept of urban green assemblages, that multiple urban natures are made known and visible in sustainable architectural practice – thereby constraining *and* enabling new urban political ecologies[11].

Ocean windmills: the politics of front-yard aesthetics?

As part of the vision to turn *Nordhavn* into a carbon-neutral eco-district, the design frame imagines energy as flowing from local renewable sources, including four windmills extending into the ocean at the tip of this urban peninsula. According to engineering estimations, four efficient tower-like windmills would provide one-

third of the energy needed by inhabitants in this new urban district. To the designers, windmills clearly stand for 'environmental friendliness': they explicitly state that the windmills should "be visible to future residents", as this will contribute to "the sense of living in a sustainable urban district". However, placing four windmills on their visual maps of the future *Nordhavn* district has also ended up entangling the designers' 'global' carbon ambitions into an intensely local politics of aesthetic value. Often, complaints over unwanted side-effects of large-scale windmills are simply overheard in the name of low-carbon progress. In the case of *Nordhavn*, however, the neighbors that would be affected happen to possess quite some economic and political resources; and their protests have exerted considerable powers of re-design, providing a case in point of conflicting 'cosmograms' in urban green assemblages.

Put briefly, the dramatic cosmopolitical events of the *Nordhavn* windmills can be recounted as follows: in the course of 2010, as design visions were made public, residents in a wealthy, Northern sea-side suburb to Copenhagen started mobilizing against their actual materialization. Were the windmills to be constructed off *Nordhavn*, they argued, this would seriously impinge on their front-yard views of a picturesque ocean seascape, damaging the aesthetic and market values of their property. This claim was picked up also by influential local politicians, helping to transform the windmills from architectural design object into a hotly disputed political frontline between adjacent municipalities. From being inscribed in future-oriented visions of sustainable urban transitions, the windmills thus started showing up within neighborhood association petitions and counter-statements from environmental NGOs. As architectural inscriptions, in short, the *Nordhavn* windmills had become publicly contested matters-of-concern, re-scaled from an object of global sustainability to a divisive issue in a local political frontline.

From this state of uncertain ontological being, the windmills were to take another cosmopolitical turn (Latour, 2007), as they became judicially enrolled in the machineries of national sovereignty in early 2011. Allegedly through some dodgy political maneuvering[12], the windmills now became part of a national parliamentary law-making exercise to determine the future of the Copenhagen harbor. In a left-right political scenography, the right-of-center government eventually terminated the life of the *Nordhavn* windmills by juridical fiat, much to the dismay of Copenhagen urban planners. In consequence, the vision of a carbon-neutral eco-district has now been placed in doubt, even before any new buildings have emerged on site. When interrogated on the point during public hearings, municipal planners say they are now looking to solar panels as a substitution; as such, the politics of low-carbon energy looks set to continue by other material means, implying further work of eco-socio-technical reassembling.

Green plantings: socializing (in) urban natures?

To future inhabitants of the *Nordhavn* eco-district, the area will look, feel and smell not only blue – owing to its ocean proximity – but also green, as trees, parks, housing-façade plantings and rooftop gardens will make for ample sensuous connections to varied vegetation landscapes. In this vision of a literal urban greening, Copenhagen architects join urban designers around the world, given that the multiple values of green-space has by now entered the mobile circuits of city planning truths. According to the *Nordhavn* designers, the many green-spaces of this district will provide aesthetic and recreational benefits to their users;

foster living-spaces for diverse populations of non-human species; and help collect and channel excess water during heavy rains. Moreover, ample green-spaces are also part of fostering a certain place-identity, making the area attractive to environmentally-conscious (and, presumably, financially well-off) middle classes. In the words of the designers, it will make the city district feel "open, friendly and livable".

Echoing assemblage urbanism thinking, the design frame of architects and engineers thus stages urban greenery as one amongst a range of highly important non-human actors whose services have to be enrolled, and socialized, in order to realize the vision of a sustainable *Nordhavn*. Indeed, their designs exude high hopes on the part of urban vegetation-making. On the one hand, as noted, a dense and variegated landscape of greenery is imagined to shape the urban district as accessible, friendly, safe and livable; small parks, for instance, positioned in-between compact living- and work-places, provide breathing spaces for relaxation, contemplation and play. On the other hand, urban greenery mediates the effort to minimize risks of climate change, without the need for active participation on the part of would-be inhabitants: green façades and rooftops cool down the interior of buildings, thus lowering energy needs in a heated future. In this way, vegetation is socialized to act as a bio-technology of micro-climatic control, serving to counter-act the accumulated effects of anthropogenic climate-making.

Judging from media coverage, and unlike the ocean windmills, the projected green vegetation of *Nordhavn* enjoys wide public support, set amidst a range of civic association and community group activities to establish small-scale urban farming, tree-planting, and rooftop greening projects across Copenhagen. To the urban designers, however, the greening of *Nordhavn* also implicitly addresses a more serious concern: how to ensure those qualities of an attractive and vibrant urban public life that has so far escaped recent efforts at large-scale urban planning in Copenhagen? One answer, on the part of architects, is that building-near greenery may act to "draw life from inside houses and into the streets", serving as a "boundary zone between private and public states of dwelling". In this sense, while socializing vegetation for human ends (i.e. climate adaptation), architects are also humanizing vegetation for social ends (i.e. an attractive public atmosphere). Indeed, consistent with the idea of urban green assemblages, the two concerns merge in a singular place-based ecology of human and non-human practices.

Protected frogs: urban wild co-habitation?

The derelict post-industrial area on the outer parts of *Nordhavn*, furthest removed from the city, consists in low-vegetation grasslands that are home to migratory bird species, rare butterflies, and an estimated 600 green toads. According to the design frame, much of this urban wild landscape is destined to stay untouched – or rather, to be actively blended into the nearby emerging city, thus providing residents with a sensation of closeness to 'nature'. Here, *Nordhavn* architects and engineers imagine nature as a graded scale, running from the 'urban-like' to the 'wild', with each landscape along the way providing its own set of human and non-human affordances. Closer to the wild pole, "children may play while learning about plant and animal species", and "residents may cultivate fruit plantations"; closer to the urban pole, human-made greenery landscapes provide a 'livable atmosphere'. This is all part, in the language of designers, of strengthening the 'nature content' and 'biological variation' of the city district.

In many ways, *Nordhavn* thus emerges as a site where the value of non-human spaces,

co-habitation and flourishing – in short, of 'urban wild things' (Hinchliffe et al., 2005) – seems comparatively well entrenched in expert and citizen networks of urban planning. One important condition for such multispecies co-habitation, no doubt, are the many amateur conservationists and bird-watch enthusiasts, who frequent the site, make observations, and report data on animal sightings to relevant authorities. Such 'concerned groups' (Callon et al., 2009) help knowing and inscribing animal beings into the sites, documents and considerations of urban planning professionals. This work is enabled, moreover, by various legal instruments, which provide non-human animals a certain standing in expert decision-making processes. Mandatory environmental assessment exercises, for instance, institute a space of public accountability whereby spokespersons of animals may have a say in what constitutes a sustainable politics of co-habitation. This is true even as wildlife enthusiasts, in interview, express some concerns for the future of the district.

In *Nordhavn*, by far the best protected non-human is the green toad (*Bufo viridis*). As a species designated protection-worthy by the European Union (EU) Habitat Directive, this toad inhabits and enrolls an urban green assemblage that stretches well beyond its own place-based ecology. In its legal capacity, the green toad thus illustrates the importance attached to scale-making in assemblage urbanism; embodying powerful transnational connections, the protected green toad acquires significant moral-political standing in its local (cosmo)political setting. Even as urban developments will only gradually encroach on its present habitats, the contours of a conflict-ridden toad-centered cosmopolitics is already visible; with plans to move the Copenhagen cruise ship harbor outward, in the direction of toad territory, terminals, trucks and tourists will emerge as new menaces to this version of biodiversity. In countermeasure, a set of green engineering techniques – in the shape of new toad-friendly fences, canals, substitute habitats and road exits – are being mobilized by designers. Here, at least, sustainable architecture, and sustainable urbanism, explicitly means building for humans *and* non-humans alike.

Conclusion: A New Urban Green Cosmopolitics for STS?

While STS is yet to pay extensive attention to cities as massive socio-technical artifacts, this article suggests that things may be slowly changing as assemblage urbanism help bring actor-network theory (ANT) to bear on core issues of urban studies. Foremost amongst these issues, I argue, should be those practices of urban ecology, low-carbon transition, and sustainable architecture which are presently shaping the cultural and political agendas of cities worldwide. ANT is well placed, I suggest, to elucidate the (cosmo)politics of sustainable urban design, given its ecological commitment to a view of how situated worlds are shaped in heterogeneous knowledge practices that enroll both human and non-human actors. As cities are increasingly confronted with new environmental and climatic risks, the tools, practices, and value commitments of architects, engineers and city planners are emerging as key sites for STS to explore, engage and debate. Partaking in a large-scale reassembling of nature, technology and society, the complex ecologies of sustainable architecture are nowadays central components of global environmental futures.

In theoretical terms, my argument engages two promising strands of ANT encounter with cities-in-the-making in order to forge the concept of urban green assemblages as a key tool for interrogating

processes of urban sustainability (re) design. Drawing together discussions on assemblage urbanism (e.g. Farías, 2010) and architectural practice (e.g. Yaneva, 2009), I define urban green assemblages as ensembles of heterogeneous actors, human and non-human, that orient themselves towards the practical redesign of urban eco-socio-technical relations in the direction of (some sense of) 'sustainability'. Like other urban assemblages, urban greening practices involve changing constellations of sites, objects and actors, from architects and engineers to regulators, green-tech companies, civic associations and urban residents, coalescing at shifting levels of proximity and distance, from the 'local' (e.g. a specific eco-house) to the 'global' (e.g. climate change projections). Indeed, via the notion of the urban green multiple – conceived as one particular form of urban green assemblage – I stress the inherent multiplicity of ecological concerns, practices, and attachments that come to be juxtaposed, and publicly contested, in projects of sustainable architecture and urban design (cf. Mol, 2002; Yaneva, 2012).

Empirically, I deploy this notion of urban green assemblages in a case study of one of Europe's large-scale sustainable city building projects, situated in the post-industrial harbor district of Copenhagen, known as *Nordhavn*. In analyzing how urban natures are multiply inscribed in the architectural and engineering visions for the future of this eco-district – confidently cast as 'the sustainable city of the future' – I highlight how the design process impinges upon, and articulates, a variety of overlapping matters of ecological concern. Alongside those 'global' political visions of carbon neutrality that come to be translated into a locally sensitive politics of windmills, designers take into account a range of more 'vernacular' ecological attachments, from housing greenery to endangered toads, allotting each their niche in a conflict-ridden balancing of eco-socio-technical relations. As an urban green multiple, the design frame for *Nordhavn* embodies a gradually evolving cosmogram of more-than-human co-habitation (Latour, 2007).

On this note, however, processes and realities of urban political ecology come to the fore; and I want to end this discussion by briefly suggesting what ANT may imply in terms of rethinking such political ecology. In this respect, it seems important to consider the inherently preliminary character of my empirical case study; while the professional urban design frame for the future of *Nordhavn* is by now largely stabilized, this represents only a first approximation of those multiple processes of translation and contestation whereby this Copenhagen eco-district will gradually attain material shape. As the tale of the *Nordhavn* windmills show, otherwise stabilized design objects may suddenly be turned into publicly contested and legally erasable matters-of-concern, situated in unequal processes of contentious (cosmo)political negotiation. *Nordhavn*, in short, will continue to be a movable project rather than a static object (cf. Latour & Yaneva, 2008) – implying that it will be important for STS analysts and practitioners alike to consider what may count as 'due process' in sustainable city-making (cf. Latour, 2007). My answer, in brief, is urban collective experimentation and learning (cf. Farías, 2011; McFarlane, 2011).

As STS researcher, the inherent future-orientation of sustainable city-building projects poses important methodological and normative challenges. In methodological terms, STS engagement with sustainable urban design will have to concern itself centrally with how future visions come to have performative effects in the present. Indeed, via the techno-science of climate change risks, much contemporary concern with urban low-carbon transitions

– including, to a large extent, in *Nordhavn* – is *at root* a performative effect of specific anticipated futures. Studying how architects, engineers, and urban planners mediate such future-oriented climate inscriptions, and how they scale divergent moral-political concerns in site-specific ways, is an important analytical task for further work on urban green assemblages (cf. Yaneva, 2005; Slater & Ariztía, 2010). Temporal questions, however, should also be extended further: How, for instance, do urban planners imagine the organization of maintenance and repair around future green eco-socio-technical infrastructures? (cf. Graham & Thrift, 2007). From an ANT (and STS) perspective, there is every reason to insist on the importance of such mundane questions – and to cast them in the language of collective experimentation and learning – even as they tend to be sidelined somewhat in the hyperbolic 'futurism' of much sustainable urban design rhetoric.

On the other hand, and on a more normative note, the long-term temporality of urban sustainable design projects – together with their self-consciously open-ended character – also entails that STS researchers will by necessity have to conceptualize themselves as situated participants to such collective urban experimentation (cf. Hinchliffe et al., 2005; Evans & Karvonen, 2010). In this respect, the commitment of assemblage urbanism to democratic, public, and inclusive forms of knowledge-making, in and beyond expert sites of urban planning, provides an important set of questions that ought to inform STS engagements with sustainable urbanism (cf. Farías, 2011; McFarlane, 2011). Situated in *Nordhavn*, for instance, questions should be raised in terms of how inclusive public participation in critical design decisions could perhaps be furthered – by drawing inspiration, for instance, from 'context-rich' traditions in sustainable architecture (cf. Moore & Karvonen, 2008) – beyond the somewhat techno-centric practices of the present design frame? Likewise, to paraphrase Latour (2007), in the specific case of urban windmill cosmopolitics, how might this contestation of (un)sustainable energy cosmograms be turned from its present state of disarray into a *well-ordered cosmos* of human and non-human co-habitation? While no easy answers to this question seems forthcoming, it seems equally obvious that the actual (cosmo) political process in this case was far, indeed, from any sense of 'due process'.

Further specifying what collective experimentation and learning around urban green assemblages entail, and how STS may participate most fruitfully in it, will have to await further empirical and theoretical engagement. Meanwhile, the present article has aimed to open up a set of important conversations, in and beyond STS, on the future of urban natures. By bringing the multiple agencies of natures and ecologies to bear more forcefully on urban politics, and by providing urban studies with a different ontology of cities-in-the-making, it is my conviction that ANT and assemblage urbanism may slowly help change city life in more sustainable directions. To echo Coutard and Guy (2007), bringing ANT into urban ecology, I believe, is a way of infusing hope into both, as we undertake to redesign the climate of cities for the 21st century.

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Notes

1 One recent survey of 100 large-scale cities around the world finds a total of 626 urban climate change 'experiments', mainly in the sectors of urban infrastructure, built environment and transport, and most numerous in European, Latin American and Asian cities (Bulkeley, 2012).

2 This article is part of an on-going empirical research project, aiming to compare 'ambitious' urban sustainability and climate change projects in three larger-scale cities in three different parts of the world: Copenhagen (Denmark/Northern Europe); Kyoto (Japan/East Asia); and Surat (India/South Asia). Given this article's more theoretical ambitions, I focus here solely on the Copenhagen case, pushing the comparative dimensions ahead of me as a further challenge for STS and assemblage urbanism (see McFarlane, 2010).

3 Throughout this article, the notion of 'sustainability' refers (unless otherwise stated) only to 'environmental sustainability'. In policy rhetoric, including the rhetoric surrounding *Nordhavn*, it is common to use the term in a broader sense, to include social and economic dimensions. Given my analytical focus on urban green assemblages, however, this broader set of debates is beyond the scope of my argument.

4 The contrast drawn up here between 'critical' and 'assemblage' urbanism derives from on-going debates set on the intellectual territory of urban studies (e.g. McFarlane, 2011; Farías, 2011). While space prevents a fuller discussion, I want to acknowledge that more critical-constructive conceptual engagement with various urban theories, on the part of STS, is certainly warranted (see, e.g., Yaneva, 2012).

5 Urban sustainability is one domain where further cross-fertilization is needed between urban studies, innovation studies, ANT, and wider STS work on Large Technical Systems – particularly around the key notion of 'infrastructure' (see Monstadt, 2009; Blok, 2012b). In a different context, I am part of an international research project that explores these issues through the notion of 'environmental infrastructures'.

6 Unsurprisingly, Moore and Karvonen (2008: 42) emphasize the strong resonances between context-rich design thinking and core STS sensibilities.

7 In my wider project, I research a Kyoto-based eco-house construction project that draws heavily on (Japanese) context-bound design thinking. As for Copenhagen, the examples are numerous, and would include various urban community gardening and alternative-technology civil society projects.

8 When I asked one of the *Nordhavn* architects about the challenges posed by working so closely together with engineers, he simply laughed and said: "I think the stereotype of the pipe-smoking architect sitting lonely in his office is 50 years behind us"! The architect-engineer relations within sustainable building projects are an important topic for further STS exploration, but it is beyond the scope of this article.

9 Notions of scaling are crucial in the practice of architecture, where modeling at different scales serve as a means of gaining new knowledge of spaces. For an elegant STS elucidation, see Yaneva (2005).

10 In the survey previously mentioned (Bulkeley, 2012), conducted in 2009, the vast majority of urban climate change experiments were found to have been initiated within the last five years. This testifies to the specific and recent temporality in the link between climatic risks and urban territories.

11 A fuller account of the *Nordhavn* site would encompass several additional urban natures-in-the-making, revolving around such eco-political objects as metros, bicycles, algae, and flood-protection barriers. The analyses presented here should be seen as a first empirical approximation, pointing the way towards more exhaustive accounts of this and other urban green assemblages.

12 Basically, a case of pork barrel politics: one national member of parliament, representing the ruling liberal party, happened to also be a local representative of the anti-windmill municipality, making for strong allegations against him for practicing an untimely mixing of jurisdictional competences.

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