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

Introduction: bringing ANT into urban ecology

If urban ecology was once the province of bearded community activists occupying industrial waste-lands, the whole domain seems to have undergone something of a cultural repositioning over the past few years (Jamison 2008). As public concerns with environmental and climatic risks have grown, select ideas and practices related to the greening of cities has entered the realm of circulating urban truths, exerting their effects within world-spanning networks of policy-makers and planners. On the one hand, figures pointing to cities as responsible for 70% of world carbon emissions are now commonplace; on the other, cities around the world 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)¹. In 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 paper, I want to suggest that Science and Technology Studies (STS) in general, and actor-network theory (ANT) in particular, help bring new insights into urban ecology, conceived broadly as relational processes of eco-socio-technological change. Conversely, I deploy urban ecology as an invitation to push ANT thinking in new directions, related to questions of how sustainable urbanism work as a particular mode of knowledge-making and a specific format of contentious (cosmo-)political experimentation? Developing these themes will entail positioning ANT at the intersection of multiple on-going conversations on the sustainability of cities, sprawling the hinterlands of STS, urban studies, human geography and political ecology. While ANT concepts figure in these conversations, and while existing research is often sensitive to the multiple materialities of urban natures (e.g. Hinchliffe et al. 2005; Heynen et al. 2006), there is work to be done, I suggest, in spelling out the exact implications of ANT to urban ecological politics, and in specifying the challenge of urban ecology to ANT (and STS) theorizing.

Rather than an exercise in pure theorizing, however, I want to pursue this double challenge – of ANT in urban ecology – by way of an on-going case study, which looks at the dynamics

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 2011).

of knowledge-making and political contestation in one of Europe's larger-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 refer to confidently 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 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 the empirical parts of this paper, I ask how urban natures are mobilized, via diverse inscription devices, in-between these modes of city engagement?²

My explorations proceed by way of bringing together 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' (Fariás 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 the city together with STS studies that employ ANT to elucidate specific building and architectural design projects as complex ecologies of professional, juridical, economic and cultural relations (Yaneva 2009; Houdart 2008). Illustrating both encounters via the Nordhavn case study, and using secondary sources to trace some historical precursors to present-day concerns, my discussion aims to contribute to a nascent STS interest in practices of sustainable architecture and city-building (e.g. Moore & Karvonen 2008).

In the following, I start by developing the contours of urban green assemblages, in part by contrasting this ANT sensibility to existing schools of post-Marxist critical urbanism. 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 natures. Next, I bring the 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 urban ecological concerns, thereby making them visible and contestable to local publics. This leads into an empirical exploration of how architects and engineers inscribe urban natures into their plans for the future of Nordhavn – and how these inscriptions are in turn translated and contested in specific urban publics. Rather than one single ecology, I show, urban natures come in multiple and overlapping shades, with different dynamics of public knowledge and politics.

These explorations lead me to suggest, in conclusion, that ANT entails a particular notion of urban political ecology, one committed to collective experimentation and learning, and one that orients urban design towards the question of cosmopolitics, the politics of the cosmos (McFarlane 2011; Latour 2007). In a world of multiplying ecological risks, this will be one important contribution of ANT to transforming 'the social' as currently practiced in cities.

² This paper 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 paper's more theoretical ambitions, I will focus here solely on the Copenhagen case, pushing the comparative dimensions ahead of me, as a further challenge for assemblage urbanism (see McFarlane 2010).

Urban green assemblages: a new ontology of city metabolisms?

Compared to its substantial engagements with the places of 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 the contrasting visions of engineers, architects and local communities for the extension of the city resulted from different yet overlapping socio-technical frames, encompassing issues of hygiene, mobility, economic growth, social distinction and land ownership. In this contentious process, closure around a final urban design had to be achieved through situational micro-struggles and compromises over the width of streets, the depths of buildings, and the public access to facilities and parks. While so far marginal, STS would seem well placed to study such politics of design, whereby human visions gradually gain material form in the urban world (Moore & Karvonen 2008).

To understand this situation of relative non-engagement, we probably need to note some intellectual particularities of that academic domain which claims the city as its truth-spot, that is, urban studies (see Gieryn 2006). As Coutard and Guy (2007) has valuably suggested, 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 process of change. Such divergence, no doubt, may be further traced to the continuing influence exerted within urban studies by various branches of critical theory, including the Marxist-inspired urban political economy 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 accumulation. This orientation, in turn, downplays the need for such situated and open-ended ethnographic explorations as favored by STS scholars (Farías 2011).

Recently, however, the terms of engagement between STS and urban studies looks set to change, as the various critical urbanisms are increasingly being challenged by the growing popularity of ‘assemblage urbanism’ (McFarlane 2011). Importantly, assemblage urbanism traces its genealogy in large part to actor-network theory (ANT), including this theory’s Deleuzian intersections, as an attempt to ‘test’ the contribution of ANT for rethinking the city (Farías 2010). In this vein, assemblage theorists invests great hopes in the ability of ANT to reinvigorate the field of urban studies; in fact, the ambitious aim is to delineate how ANT offers up ‘an alternative ontology of the city’ as a de-centered object (ibid.:13). According to Farías (2010:2), cities are “relessly 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 take on the composition of city life through situated techniques and flows (Latour & Hermant 2006)³.

³ Apart from his work on *Paris: The Invisible City*, Latour’s study of *Aramis* (1996), the failed Parisian light-rail project, clearly points in the direction of an ANT engagement with technological urbanism.

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 natures, ecologies and ethologies. In the language of Isabelle Stengers (2005), assemblage urbanism invites a view of cities as overlapping ecologies of human and non-human practices.

While thus resonating with concerns of urban ecology, it is important to note that most city metabolisms – as shaped by relatively obdurate socio-material infrastructures of electricity, water, housing, transportation, waste – tend to remain unnoticed, part of the taken-for-granted backdrop of urban 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 concern⁴. This is what the notion of urban green assemblages connotes, defined as ensembles of heterogeneous actors, human and non-human, that orient themselves towards *redesigning* urban eco-socio-technical relations in directions of sustainability. Like other urban assemblages, urban green assemblages come in multiple shapes, across varied scales from the domestic to the global (Marres 2008; Sassen 2010), and involve changing constellations of technologies, standards, practices, sites and actors, from engineers and architects to investors, regulators, civic associations and urban residents. The Nordhavn project in Copenhagen, as we shall see, is one version of urban green assemblages.

This brings us to a second important 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*, as is standard in urban studies, 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 ways (Farías 2011:369). Importantly, 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 different sites (Latour 2005; Farías 2010:6). Urban green assemblages, for instance, emerge as connections are forged among otherwise non-related sites, from the post-industrial landscape of an old harbor area in Copenhagen, via local government bureaucracies to architectural and engineering offices – with connections fanning out, at all of these places, to other scientific, political, economic and cultural nodes, locally and trans-nationally.

The 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

⁴ Urban sustainability is one domain where further cross-fertilization is needed between urban studies, innovation studies, and STS work on ‘Large Technical Systems’ – particularly around the key notion of ‘infrastructure’ (see Monstadt 2009). In a different context, I am part of an international research project that tries to deal with these issues through the notion of ‘environmental infrastructures’ (Blok 2011).

variable end-products of collective scale-making practices. As Latour (2005:185) is always keen on emphasizing, with ANT, 'scale is the actor's own achievement'. In terms of cities, this implies the need to pay careful attention to the ways in which socio-geographical scales are assembled, by stabilizing connections at different levels of proximity and distance, in concrete cultural, political and architectural practices (Slater & Ariztía 2010). Such issues are particularly acute in relation to urban ecology, which derive much of its rationale and dynamics from urban sites being selectively brought into contact with 'global' environmental risks, such as from climate change, thereby setting in motion various re-scaling trajectories. Indeed, one important question about urban green assemblages concerns how, by whom, and by what kinds of inscription devices, knowledge on 'global' ecological risks is translated into situated city-making practices.

Third and finally, assemblage urbanism carries far-reaching implications for how to deal with issues of urban inequalities, asymmetries and power; and hence for rethinking urban political ecology. This is a difficult point, because ANT is often misunderstood as promoting a vision of flat social territories. Unlike critical urbanism, assemblage urbanism refuses to imagine overarching and all-encompassing power structures – such as 'global neoliberal capitalism' – which would determine all of city life and politics. 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 urban green assemblages, for instance, particular actors – including planning professionals, engineers 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 enters 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 (class) interests, urban cosmopolitics now 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 paying attention to the way urban democratic publics (in the plural) are dynamically constituted around specific ecological situations, controversies and matters-of-concern, say, concerns with inner-city wildlife (Hinchliffe et al. 2005). The politics of urban green assemblages is thus attached to new forms of public experimentation and learning, arising at the fringes of existing urban expert planning sites.

In sum, this section 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 along sustainability lines. 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 resi-

dents, enrolling technologies, inscriptions, standards and natures in the process. Urban assemblages entail clear issues of inequality and power, but they also open up new spaces of democratic experimentation around ecological matters-of-concern, in and beyond the sites of expert urban planning. To see how this may work, we 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 necessary 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, as manifested famously in the commitment of German Bauhaus designers of the 1930s to solve social and environmental problems through the rational application of technology to buildings (Galison 1990). Indeed, in times of new climatic risks and growing enthusiasm for the greening of rooftops, the remark made in 1938 by Walter Gropius, co-founder of Bauhaus, can seem more than a little prescient: “Seen from the skies, the leafy house-tops of the cities of the future will look like endless chains of hanging gardens” (quoted in Anker 2010:12). Elements of the architectural visions of the past clearly linger on in how sustainable cities are presently re-imagined.

Considered as a globalized assemblage of practices in its own right, however, sustainable architecture has a considerably more variegated temporality and spatiality than what is suggested by such smooth modernist lineages. This, indeed, is part of what the concept of urban green assemblages make clear. In temporal terms, one way of tracing the variegated histories of sustainable architecture since the 1960s is to note how, along lines already suggested, this assemblage seems to fluctuate together with the vagaries of environmentalist thinking and practice. Hence, as STS scholar Andrew Jamison (2008:290) notes, architects were often central to the many small-scale, appropriate- and alternative-technology networks and projects that coalesced, especially in Europe in the 1970s, centered on experiments with low-energy houses, urban agriculture, solar heating panels and wind power plants in various shapes and sizes. Part of broader environmental grassroots, some of these ‘technology-oriented movements’ achieved considerable innovation successes – laying the socio-technical foundations, for instance, for what was to become a world-leading Danish wind power industry (Hess 2005).

With growing institutionalization and professionalization of environmental commitments since the 1980s, several changes are discernable in the dominant modes of alignment between architecture, economics and political ecology. One such change, indeed, is the emergence of ‘sustainable architecture’ as a recognized professional practice – and as a polyvalent marker of value commitments and market differentiation within the wider field of architectural consultancy work (Owen & Dovey 2008). The architect of sustainability, in this sense, is an emerging socio-professional kind, co-articulated alongside a range of new calculative techniques, environmental regulations, engineering models, and so on, inside architecture firms (Fischer & Guy 2009). Practices of sustainable architecture thus also co-emerge with other novel professional identities, such as those of ‘city ecologists’, ‘eco-engineers’, ‘green-tech companies’ and ‘environmental regula-

tors'. Together, these will commonly be the most prominent knowledge professions and material practices involved in current 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, where environmental aspects are downplayed and commercial aspects take on primary importance. Certainly, this claim has some credibility, in and beyond the particular case – of the so-called Turning Torso in the Swedish city of Malmö – discussed by Jamison himself. In the guise of commercial consultancy practices, sustainable architecture is shaped in part by its relations to powerful economic actors, notably landowners and developers. This point, however, should really be extended to include *all* the conflicting stakeholders involved in *any* urban sustainability project: the paying clients, for sure, but also the city authorities, the government, conservationists, experts, neighborhood communities, users, and so on. In this sense, any building project is a complex and contested ecology of unequal relations (Latour & Yaneva 2008:88), making it hard to say *a priori* what relative strength will be exerted by strictly 'economic' concerns.

From the perspective of assemblage urbanism, the key point is that capital is hardly the *only* force exerting itself within city-making practices of sustainable urban design (Fariás 2011). Urban sustainability projects need to be seen as contingent arenas of contestation, or 'hybrid forums' (Callon et al. 2009), entangling a range of divergent and often mutually contentious knowledges, material practices and value commitments. Understood as part of urban green assemblages, sustainable architectural design projects will come in multiple shapes, depending on the heterogeneous and changing constellations of actors, sites, and technologies within which they emerge and articulate. What unites such projects, however, is the fact that *some* architectural office will act as an obligatory point of passage, in terms of juxtaposing and giving material form to some site-specific compromise amongst contentious forces. In this sense, architects act as important intermediaries in urban sustainability transitions (Fisher & Guy 2009), as a vehicle for articulating urban settings as partly a matter of ecological concern.

In other words, focusing too narrowly on the commercial aspects of sustainable architecture risks blurring the inherent diversity and socio-technical importance of architectural design practice itself. Hence, as Moore and Karvonen (2008) suggests, STS needs to be brought closer into contact with design thinking, in terms of highlighting the various traditions and socio-technical frames visible in worlds of architecture. This is where the two ANT approaches to cities-in-the-making can most profitably come together: on the one hand, the assemblage urbanism articulated into urban studies; 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 strands of creative STS studies has had little contact; and existing ethnographies of architectural practice does not focus specifically on issues of sustainability and ecology⁵. Part of the ambition of this paper, then, is to open up a new productive meeting-ground.

⁵ However, there are interesting overlaps to explore, particularly through the work of Sophie Houdart (2008), who shows how Japanese architects inscribe trees, forests and skies into their computer-aided design practices in the setting of the Japanese World Fair in Aichi, 2005. Like comparative dimensions more generally, pursuing these overlaps looks promising, but is beyond the scope of this paper.

Framing sustainable architecture in Copenhagen

From the perspective of ANT, the challenge is to grasp sustainable architecture as a specific modality of cosmopolitics. One promising starting point here is the work of Moore and Karvonen (2008), who 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, thereby staying within the imagined limits of local ecologies. Context-free design, by contrast, refers to a dominant form of modernist sustainable architecture, centered around the functional deployment of efficient technologies, and without any consideration of particular places or ecologies. Finally, context-rich design connotes traditions of participatory and community-based architecture, whereby advanced technologies come to be related to their social ecologies by way of inclusive collective experimentation⁶.

Moore and Karvonen’s ideal-types are helpful, I believe, in relativizing some of Jamison’s grander epochal claims. Hence, whereas the Nordhavn city-building case indeed exhibit strong elements of context-free design thinking, resonating also with some of Jamison’s claims, this should not blind us from observing that *other* contemporaneous projects of sustainable architecture – including other on-going projects in Copenhagen – draw more heavily on context-bound or context-rich traditions⁷. Moreover, I want to suggest that, while framed through a broadly context-free design imaginary, elements of practices pertaining to more context-bound and context-rich traditions are clearly discernible also *within* the frame of the Nordhavn architectural project. In other words, the various traditions seem to intermingle and co-articulate in discernable patterns, often in relation to different aspects – and, indeed, different eco-socio-technological relations – enfolded within the same plans for this large-scale urban district. This kind of practical intermingling, arguably, marks the limitation of any ideal-typical approach.

Translated in the language of assemblage urbanism, this implies that sustainable architecture may take shape within a variety of urban greening sites, each likely to exhibit important design specificities and situational requirements. To fully get at this level of site-specificity, we need careful empirical attention to specific urban sustainability projects, in terms of tracing how their complex ecologies transform over time, as new elements impinge upon the architectural frame. Zoning laws, land prices, construction materials, energy technologies, risk analyses, building standards, stylistic fashions, user habits, and so on – all of this (and much more) is brought together, worked upon, modeled and modified in the architectural office. Over time, a specific design frame starts to stabilize, enough to give the project its spatial, temporal and eco-socio-technological dimensions. Buildings, in this sense, are not static objects but movable projects (Latour & Yaneva 2008); and the same is true for an eco-district like Nordhavn.

Importantly, in the context of climate-sensitive urban restructuring, part of what impinges on the architectural frame are new local manifestations of global environmental risks, ne-

⁶ Unsurprisingly, Moore and Karvonen (2008:42) emphasize the strong resonances between context-rich design thinking and core STS sensibilities. One point of connection, they suggest, is a common commitment to abductive or phronetic styles of reasoning, prominent in pragmatist and Aristotelian traditions.

⁷ In my own research project, I study a Kyoto-based eco-house construction project, which 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.

cessitating material accommodations. To take a specific example from the Nordhavn project: as an urban district surrounded by water on three sides, the architects must 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 Nordhavn architectural inscription period, these sea-level projections moved upwards approximately 30 centimeters for Copenhagen, approaching the range of a one meter rise by 2100. This change had major implications for designers, as islet bridges and sea-side front-spaces had to be re-scaled⁸. In this sense, material natures (in the plural) are made to exert themselves within practices of sustainable architecture.

What this example also illustrates, arguably, is a growing reliance on engineering and natural-science expertise within sustainable building projects, as compared to standard architectural practice (Fischer & Guy 2009). In the Nordhavn case, engineering and architectural consultants have been working closely together, on all aspects of the urban district, for the duration of the design process⁹. In this sense, the contested ecology of a building project gains even more layers in the practice of sustainable architecture, as design expertise is further pluralized and specialized, giving rise to new challenges and opportunities (ibid.:2589f). Often, the ecological dimensions of sustainable architecture will emerge through co-articulations, combining natural science, engineering and architectural tools, knowledges and concerns. As I attempt to show in the next section, this situation likely gives rise also to multiple versions of urban greening, as assemblages co-existing and overlapping within the *same* site of sustainable design.

To sum up, this section has traced some important geo-historical frames of sustainable architecture, in terms of situating contemporary design practices within a changing landscape of socio-professional knowledges and tools. Here, I critique the tendency, visible in the critical urbanism of Jamison (2008) and others, to focus narrowly on the (very real) market constraints manifested in 'context-free' forms of large-scale sustainable city building projects such as Nordhavn. Instead, I suggest we follow the ANT view of Latour and Yaneva (2008), in seeing 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. In methodological terms, this requires a site-specific approach, capable of registering how urban building projects change, in part through the articulation of new ecological concerns. In the remainder of this paper, I aim to illustrate these claims 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

If, as Fariás (2010:2) suggests, cities are assembled at concrete sites of urban practice, through a multiplicity of processes of becoming, then what might this imply for the way we understand the becoming of Nordhavn as a concrete site of urban ecology? One answer, as the preceding discus-

⁸ Notions of scaling are crucial in the practice of architecture, where modeling at different scales serves as a means of gaining new knowledge of spaces. For an elegant STS elucidation, see Yaneva (2005).

⁹ 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"! Clearly, architect-engineer relations within sustainable building projects is a topic for further exploration, beyond the scope of this paper.

sion shows, is that Nordhavn is presently becoming as a sustainable city district through particular constellations of architectural, engineering and urban planning sites, knowledges, tools and relations, distributed throughout Copenhagen and beyond. In this section, I pursue a related but different answer, revolving around urban ecological matters-of-concern. I want to suggest that Nordhavn is presently becoming through the flowing together, in this particular site, of a multiplicity of urban green assemblages, all partly mediated via architectural and engineering inscription devices. Nordhavn, I claim, is becoming as an urban green multiple¹⁰.

One way of approaching this is to note that urban green assemblages arise in response to a variety of ecological risks and concerns, each implying particular relations to the urban territories in question, in this case Copenhagen. As Valerie November argues (2004; 2008), cities are territories traversed by various risks – pandemics, fires, road accidents, terrorist attacks, floods – and the consequences of such risks tend to be more severe in urban contexts. With global climate change, the link between ecological risks and urban territories is undergoing important transformations, as cities experience new types of risks (heat islands, severe floods), and as cities come to be inscribed in new moral geographies of global carbon emissions. New climatic risks, in this sense, may transform the meaning and practice of urban sites, raise awareness of urban ecological matters, and lead to new meetings and hybrid forums of affected city stakeholders. The fact that select ideas of urban greening has entered the realm of circulating policy truths, giving rise to sustainable building projects like Nordhavn, stems in large part from growing scientific, political and public concerns with the multiplying urban risks of climate change¹¹.

In the local setting of Copenhagen, several trajectories of urban ecology, or several urban green assemblages, thus flow together in the making of Nordhavn as an experimental site of sustainability. Foremost amongst these, no doubt, is a growing concern amongst municipal administrators with the city's carbon emissions, as witnessed by the inscription of carbon neutrality as an overall design vision for the Nordhavn district. To the urban administration, Nordhavn represents part of a wider climatic political commitment, made public in 2009, to become the first carbon neutral capital in the world by 2025. Importantly, this commitment coincides 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. Amongst the architects and engineers, the Nordhavn project is seen partly as a fortuitous child of this specific constellation of trans-local political events.

While the 'climatization' of the Copenhagen territory is thus a main factor in the Nordhavn project, this process is multiply translated, extended and contested, both in the process of architectural inscription and as these inscriptions enter into urban public settings. According to the socio-technical design frame stabilized during 2008 and 2009 in-between the city administration and the architectural and engineering consultants, addressing climate change in Nordhavn will involve everything from ocean windmills, solar panel islands and geothermal energy to two-lane bicycle tracks, new metro extensions, green roofs, tight housing energy standards, flood pro-

¹⁰ Here as elsewhere, the language of multiplicity in an ANT context is strongly indebted to Annemarie Mol and her discussion of the body multiple (2002), to which my urban green multiple connotes.

¹¹ In the survey mentioned in footnote 1 (Bulkeley 2011), conducted in 2009, the vast majority of urban climate change experiments were found to have been initiated within the last five years. This testifies clearly to the specific and recent temporality in the link between climatic risks and urban territories.

tection, and much more. Moreover, beyond a narrow climatic focus, the design frame includes numerous other ecological attachments, from ample parks, trees and other green-spaces to concerns with urban wildlife and biodiversity, turning the site into a spatially dense layering of mutually interfering urban green assemblages, risks and ecological values.

In what follows, I attempt to unpack Nordhavn as an urban green multiple, by way of tracing the trajectory of some of these heterogeneous relations, as they become embedded in specific design objects configured as public matters of ecological concern. In methodological terms, my analysis relies primarily on documentary material produced by the architects and engineers, specifying various design principles and details of spatial layout. This is supplemented by two qualitative interviews with the architects; media analyses of Danish newspaper coverage of the project; and participatory observation at a local citizens' meeting on the future of Nordhavn (held in August 2011). Rather than exhaustiveness, my three objects are meant to illustrate the core claim that multiple urban natures are made known and visible in sustainable architectural practice – opening up novel public contestations and political ecologies¹².

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. In a Danish context, windmills represent the obvious choice of renewable energy technologies. However, placing four windmills on their visual maps of the future Nordhavn district has also ended up entangling the designers' 'global' sustainability ambitions into an intensely local politics of aesthetic value. As efficient windmills have grown into tower-like technological giants, near-by residents frequently complain of unwanted ecological side-effects, of noise, killed-off birds and detrimental aesthetic impacts on the landscape. Often, such complaints are simply overheard in the name of low-carbon progress. In the case of Nordhavn, however, the affected neighbors happen to possess quite some economic and political resources; and their protests have exerted considerable powers of re-design.

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, as political frontline, within neighborhood association petitions and counter-statements from environmental NGOs. The Nordhavn windmills, in short, had become publicly contested matters-of-concern.

¹² A fuller account of the Nordhavn site would encompass several other urban natures-in-the-making, revolving around such eco-political objects as metros, bicycles, algae and flood-protection barriers.

From this intermittent state of uncertain ontological being, the windmills were to take another cosmopolitical turn (Latour 2007), as they became enrolled in the machineries of national sovereignty in early 2011. Allegedly through some dodgy political maneuvering¹³, the Nordhavn windmills now entered a judicial state of existence, part of a national parliamentary law-making exercise to determine the future of the Copenhagen harbor. In a standard 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 the Copenhagen municipal planners. In consequence, the vision of a carbon-neutral Nordhavn has now been placed in doubt, even before any new eco-buildings have emerged on site. Urban planners are looking to solar panels as a substitution; the politics of sustainable energy thus looks set to continue by other material means.

Green plantings: socializing (in) sub-urban natures?

To future inhabitants of the Nordhavn eco-district, the area will look, feel and smell not only blue – owing to its marked 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 follow the stylistic fashion of urban designers around the world, as the multiple values of green-space has gradually joined the mobile circuits of city planning truths. Urban green-spaces provide aesthetic, health and recreational benefits to their human users; they foster living-spaces for more diverse populations of non-human species; and they help collect and channel excess water during heavy rains. In the case of Nordhavn, no doubt, urban green-spaces also aim to foster a certain place-identity, making the area attractive to environmentally-conscious (and well-off) middle classes, who may want to substitute their sub-urban lawns for a wider sense of urban ‘gardening’.

In the design frame of architects and engineers, urban greenery thus belongs to the list of those highly important non-human actors whose services have to be enrolled, and socialized, in order to realize the vision of a sustainable Nordhavn. Indeed, high hopes are staged on the part of urban vegetation-making. On the one hand, 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 human awareness: 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 writ large.

Unlike the ocean windmills, the Nordhavn green vegetation will likely have more public friends than enemies: all over Copenhagen, civic associations and community groups are busy establishing small-scale urban farming, tree-planting and rooftop greening projects. To the urban designers, however, the greening of Nordhavn implicitly addresses a more serious concern: how

¹³ 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.

to ensure those qualities of an active 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, intriguingly, is that building-near greenery will act to draw life from inside houses and into the streets, serving as a boundary zone between private and public states of being. In this sense, while socializing vegetation for human ends, architects are likewise humanizing vegetation for social ends. Time will tell how this more-than-human (sub-)urban symbiosis will materialize.

Protected frogs: urban wild co-habitation?

As a largely derelict post-industrial area, those outer parts of Nordhavn that are furthest removed from the city presently consists in low-vegetation grasslands, home to several species of migratory birds, some rare butterflies, and an estimated 600 green toads. In the emerging design frame, most of this urban wild landscape is destined to stay untouched – or rather, to blend and mix gradually into the nearby city, providing residents with a sensation of closeness to ‘nature’. In this sense, the architects and engineers imagine nature as a graded scale, running from the more urban to the more wild, with each relational 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 landscapes of planted greenery takes over the scene.

In many ways, Nordhavn thus emerges as a site where the value of non-human spaces, co-habitation and flourishing – of urban wild things (Hinchliffe et al. 2005) – seems relatively well entrenched in expert networks of urban planning. One important condition for such co-habitation, no doubt, are the many amateur conservationists and bird-watch enthusiasts, who frequent the site, make observations, and often report data on animal sightings to relevant authorities. Such concerned groups, we might say, help know and inscribe animal beings into the sites, documents and considerations of urban planning professionals. This work would be difficult, however, without the simultaneous presence of 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.

In Nordhavn, 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 an urban green assemblage that stretches well beyond its own site of embodiment. While urban developments will only gradually encroach on its present wild habitats, sooner or later, the green toad will find itself the center of local cosmopolitics. The contour of human-toad competition are 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 biodiversity. Already, however, a set of green engineering techniques are ready to assist the toads, in the shape of new toad-friendly fences, canals, substitute habitats and road exists. In this case, then, sustainable architecture means building for humans *and* non-humans alike.

Conclusion: a new urban green cosmopolitics?

While STS is yet to pay extensive attention to cities as massive socio-technical artifacts, this paper suggests that things may be slowly changing, as assemblage urbanism brings actor-network theory (ANT) to bear on core issues of urban studies. Foremost amongst these issues, I suggest, should be those practices of urban ecology, sustainable design and low-carbon transitions, which are currently shaping the cultural and political agendas of cities worldwide. ANT, and STS more generally, is well placed to elucidate the 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 values commitments of architects, engineers and city planners, I suggest, are emerging as key sites for the large-scale reassembling of nature, technology and society. In many ways, the complex ecologies of sustainable architecture is nowadays a central component of global environmental futures (Sassen 2010).

In theoretical terms, the paper engages two promising strands of ANT encounter with cities-in-the-making, in order to position the concept of urban green assemblages as a key tool for interrogating processes of urban sustainability design. Drawing together discussions on assemblage urbanism (Farías 2010) and architectural practice (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 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). As such, urban green assemblages join the multitude of other economic, political and cultural processes, whereby cities are being reassembled in densely layered sites of urban practice – in ways sometimes congruent but oftentimes conflicting to urban ecological concerns.

Empirically, I deploy this notion of urban green assemblages in a case study of one of Europe's larger-scale sustainable city building projects, situated in the post-industrial harbor district of Copenhagen, known as Nordhavn. In analyzing how urban natures are 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 public ecological concern. Alongside those 'global' political visions of carbon neutrality that come to be translated into a locally sensitive politics of windmills, architects and engineers take into account a range of more 'vernacular' ecological materials, from housing greenery to endangered toads, allotting each their niche in the sensitive balancing of eco-socio-technical relations. As an urban green multiple, the design frame for Nordhavn thus suggests an intriguing 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 specifying what ANT implies in terms of rethinking political ecology as collective experimentation and learning in cities (Farías 2011; McFarlane 2011). 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 stabi-

lized, this represents only a first approximation of those multiple processes of translation, whereby architectural visions will gradually gain material form in Copenhagen. As the fable of the Nordhavn windmills show, otherwise stabilized design objects may quickly be turned into publicly contested and legally erasable matters-of-concern, situated in unequal and contentious processes of cosmopolitical negotiation. Nordhavn, in short, will continue to be a movable project, rather than a static object, for quite some time to come (Latour & Yaneva 2008).

As STS researchers, the inherent future-orientation of sustainable city-building projects poses important methodological and normative challenges. On the one hand, STS engagements with sustainable urban design will have to concern itself centrally with how future visions come to have performative effects in the present. Indeed, much contemporary concern with urban low-carbon transitions – including, to a large extent, in Nordhavn – is *at root* a performative effect of specific futures, to do with the techno-scientific anticipation of climate change risks. Studying how architects, engineers and urban planners mediate such future-oriented inscriptions, and how they scale divergent political concerns in rather site-specific ways, is an important task for further work on urban green assemblages (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 socio-technical infrastructures; activities that STS shows to be crucial to the workings of cities? (Graham & Thrift 2007).

On the other hand, the long-term temporality of urban sustainable design projects, and their self-consciously open-ended character, also entails that STS researchers will by necessity have to conceptualize themselves as situated participants to collective urban experimentation (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 normative questions that ought to inform STS engagements with sustainable urbanism. Situated in Nordhavn, for instance, questions should be raised in terms of how inclusive public participation in critical design decisions could be furthered, drawing inspiration from context-rich traditions in sustainable architecture? Likewise, to paraphrase Latour (2007), in the specific case of urban windmill cosmopolitics, we should ask how this contestation of sustainable energy futures may be turned from its present state of disarray into a *well-ordered cosmos* of human and non-human co-habitation?

Answering such questions will have to await further empirical and theoretical engagement, on the part of STS researchers, in important conversations on the future sustainability of cities. 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, assemblage urbanism is slowly changing how ‘the social’ may be practiced more sustainably in cities. To echo Coutard and Guy (2007), bringing ANT into urban ecology is thus a way of infusing hope into both, as we undertake to redesign the climate of cities for the 21st century.

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