Smart to green: smart eco-cities in the green economy

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Abstract

Drawing on examples from various cities, the chapter traces the convergence between eco-urbanism and smart urbanism in the past two decades. The chapter begins by tracing the eco-city and smart city's conceptual trajectories, before moving on to consider how these have become enmeshed into what has been called the 'smart eco-city' from the mid-2010s onwards. The chapter then moves on to consider, briefly, the broad terrain around the 'green economy'. The smart eco-city is placed within a broader concern with harnessing Big Data, the Internet of Things, digital lifestyles and infrastructures to connect the urban to green economy visions, strategies and pathways. Concluding, the discussion highlights the divergence between mainstream smart eco-urbanism and potential alternatives that emerge when considering urban social sustainability more closely.

Introduction

In the late 2010s, smart urbanism has become a key guiding concept for sustainable urban development. City and national governments refer to the smart city as a solution to a panoply of problems, including but not limited to the challenges of deindustrialisation, stimulating urban economies, technological and economic growth, and governance experiments in an increasingly urbanising society. In some national settings, such as in

rapidly developing countries, smart urbanism is branded as a solution for keeping GDP growth rates high, as seen in the following extract from a 2012 *China Daily* article: 'At a time when China is experiencing slower economic growth, building smart cities will be a huge driving force for not only the information industry but also related industries' (China Daily 2012, np). At the same time, in national contexts facing economic crisis, smart cities are presented as ways of facing up to the economic challenges of stagnation or even contraction. In a landscape of post-2008 austerity measures, for example, the smart city became seen as 'a political device that was used to frame a number of new national and local policies as "technical" solutions to low budgets and economic stagnation' (Pollio 2016, 514). Nonetheless, the common thread linking smart urban strategies and roadmaps is that of an interest in specific (albeit sometimes contrasting) visions of future urbanism. As the US National Science and Technology Council (NSTC) states:

> 'Motivated by a vision of ubiquitous, smart infrastructure, systems, and services, many cities and communities view advances in networking and information technology as a way to increase efficiency, reduce costs, and improve quality of life for their residents' (NSTC 2017: 5).

What can be seen in this statement is a clear interest in smart urbanism because of its promises in terms of efficiency, speed, analytical power and governance and market opportunities. What is often missing in both policy and scholarly accounts of the smart city, however, is a discussion of how plans for smart urbanism contribute to, and intersect with, one of the key driving forces behind national and international agendas: environmental sustainability in the context of sustainable development.

Although there is, currently, a strong and evident focus on high-tech, digital urbanism, green agendas have not disappeared from the urban scene. They been replaced by the buzz around ubiquitous computing, the Internet of Things (IoT) and digital economies. Eco-urbanism, in its multiple guises, is a continuing and enduring area of focus at a variety of scales (Caprotti 2015; Joss 2015), in large part because of the real, material and deepening challenges associated with anthropogenic climate change and its impact on current and future cities. Indeed, in the late 2010s eco-urbanism arguably has a more material effect on cities worldwide than smart urbanism. This effect can be felt through international policymaking, national policies and directives, environmental regulation,

low-carbon policies and incentives, and citizen and grassroots interest in greener urban environments. Indeed, the 2016 UN Paris Agreement on climate change identified cities as important actors in shaping sustainable futures (Roberts 2016), and the New Urban Agenda, heralded at the 2016 UN-HABITAT III conference in Quito, Ecuador, included cities as a focus for sustainable development (Caprotti et al. 2017).

A key challenge facing urban policymakers and scholars today is how to reconcile 'smart' and 'eco' urban agendas. In order to do so, it is important to recognise that these agendas have specific (if diverse) roots, and that there are areas of distinct overlap and shared intent in their logics. The chapter begins by tracing the roots of eco-urbanism and then smart urbanism, focusing on their contextualisation within a deeply modern project to *reshape* the city, and citizens, often according to market logics. The green economy is then introduced as a concept that potentially holds together both smart and eco-urbanism, through what can be called the 'smart eco-city' (Caprotti et al. 2016). The chapter then concludes by focusing on the ways in which more socially sensitive approaches to smart-eco futures could help to challenge hegemonic technocratic views of the future city.

Cutting the Gordian knot between nature and the city: tracing the genealogies of the eco-urbanism:

The genealogy of eco-urbanism can, in many ways, be directly traced to the development of environmental consciousness. The roots of eco-urbanism are, therefore, multiple. They are not reconcilable to a single point of origin, although it is sometimes tempting to read urban environmental history as issuing from one tradition, whether it be scholarly, or more socio-historically grounded in a particular place or period. Nonetheless, and briefly, contemporary trends in eco-urbanism draw strongly on the 1970s environmental movement, as well as on broader 20th century attempts to establish a science of cities and their ecology and metabolism (Melosi 1993). These attempts range from those more influenced by natural and physical sciences, such as studies of cities' urban metabolism that attempted to materially and statistically account for material, energy and other urban inflows and outflows; to studies of urban metabolism from a critical and radical standpoint that focus on how the city, as a metabolic entity, both produces and reproduces socio-environmental inequalities and injustices at a variety of scales (Swyngedouw 2009). Overall, what characterises these attempts to develop an understanding of eco-urbanism is an interest in the relationship between nature and the city.

While the latter half of the 20th century saw key interventions in the development of eco-urbanism from both a policy and scholarly standpoint, eco-urbanism is also rooted much more deeply in the broader context of modernity (Kaika 2005). This can be seen rather strikingly in the oft-used example of Ebenezer Howard's Garden City concept, an attempt to reconcile the positive aspects of countryside living with those of urban life, while reducing or eliminating the negatives associated with either (Ward 2016). Howard's concept was a response to the inequalities and socio-environmental degradation and excesses of the Industrial Revolution and its aftermath: an attempt to shape new cities in the image of a kinder, gentler and more humane urban industrial capitalism that would also be more sensitive to the natural environment of, and around, the city.

Garden Cities are an early example of the variety of ways in which the relationship between nature and the city has been tackled in modernity. Resolving and untying the Gordian knot of nature-city relations was, in many ways, a driving part of the urban project of modernity. The 'knot', in this context, is the problem of how to reconcile the growth of industrial economies, the attendant emergence and expansion of cities throughout the industrialised and industrialising world, and the effect this has had on natural ecosystems, landscapes, and the environmental landscape. Attempts to unravel the difficult link between cities and their 'negative' effects on the natural world have happened in a multiplicity of ways, often experimental, in different settings. For example, the New Towns built in the Soviet Union (Bolotova 2012), or in fascist Italy (Caprotti 2007), were in large part attempts to reshape the city and re-orient urban structure so as to fit more closely into metabolic trajectories decided by the state. This was carried out through the tools and techniques of urban planning, urban design, architecture, engineering and other areas of urban technique through which specific political-ideological views came to be expressed and materialised. The emphasis on (re)shaping the city in the image of a new, greener society can also be seen in more recent projects. This is the case, for example, with China's eco-city construction programme (de Jong et al. 2016), which numbers over 100 cities with plans for eco-city construction.

The eco-city concept is, like the broader trend of eco-urbanism within which it is situated, genealogically rooted in deeply modern developments occurring over decades. While all these strands cannot be summarised here (but see Roseland 1997), the eco-city concept has its roots in Richard Register's 1975 Urban Ecology think tank and in his *Eco-City Berkeley* (Register 1987), in which the broad outlines of an eco-city as an urban area that

was sensitive to its ecological environment was codified (Roseland 1997). The eco-city concept became further enshrined and broadened, as well as accepted by broader policy audiences, in the 1990s with the start of the EcoCity World Summits, held every two years. This partially enabled the eco-city to become a key guiding concept for sustainable urban development, lending itself especially to projects for newly-build cities in geographical contexts from China, to the Gulf, to North America. Some of the key, canonical eco-city examples completed or under construction by the end of the 2010s include the Sino-Singapore Tianjin Eco-City in China (Caprotti, Springer, and Harmer 2015; Chang, Leitner, and Sheppard 2016), Treasure Island in California (Joss 2011), Eko Atlantic in Nigeria (Watson 2014), and Masdar eco-city in Abu Dhabi (Cugurullo 2016; Chakravarty 2017). More broadly, eco-city principles influenced national sustainable urban development strategies, from China's eco-city programme mentioned above, to the UK's late 2000s eco-town projects, to France's nationwide Écoquartier strategy.

Tracing the genealogies of smart urbanism

When compared with eco-cities, it can appear at first glance as if the smart city concept is completely new and novel. Indeed, the notion of the smart city has only become popular and mainstreamed from the 2000s onwards (Hollands 2008), and the term 'smart' is now synonymous with notions of innovative, new and ground-breaking urban trajectories and projects. Smart urbanism refers to a panoply of initiatives, technologies and approaches, from national strategic policies aimed at stimulating the digital economy, to e-governance, urban environmental, security, transport and social sensor systems, driverless vehicles, the sharing and 'gig' economy, and the integration of socio-economic activities through smartphone technologies. Corporations, from IBM to the increasingly well-established technology leaders of Asia (such as Samsung, Alibaba, Tencent, Huawei and Baidu) have taken centre stage in much of this rapid development of interest in smart urbanism. Indeed, it has been argued that smart cities 'describe cities that, on the one hand, are increasingly composed of and monitored by pervasive and ubiquitous computing and, on the other, whose economy and governance is being driven by innovation, creativity and entrepreneurship, enacted by smart people' (Kitchin 2013, 1).

Notwithstanding the at times frothy focus on ever-increasing production of new technologies, products and applications, the smart city, like the eco-city, has roots that stretch back decades, or even longer – certainly far before the digital era. Indeed, the

focus on data, efficiency and processing power can be seen as stemming from the focus on increasing production and economic efficiency that is a characteristic of the industrial era. Taylorism, the production line, and the use of scientific methods to control industrial production (much of it aimed at urban markets) can in turn be seen as contributing to smart urbanism's focus on efficiency, speed, pervasiveness and control. Indeed, the transparent and highly ordered, scientifically-organised urban society described by Zamyatin in his 1924 novel *We*, in many ways prefigures the city of smart glass and Big Data of the 21st century (Zamyatin 2013). In turn, the wired technologies of electricity grids and telephone networks, as well as radio communications, heralded an increasingly networked society that was always at least partially wireless.

Another set of historical roots to the smart city can be seen around the design and importance of the smart city control rooms that are celebrated as futuristic today (such as that of the Rio Operations Centre, or the Glasgow Operations Centre). These are, in turn, similar to the factory control rooms introduced in industrial plants, or the power plant control rooms present in nuclear power stations from their inception. Just as a nuclear plant is an attempt to control and harness the atom through its control room, the smart city control room can be likened to an attempt to gain control of the often uncontrollable: social life in the city. Likewise, the architecture and design of these smart urban spaces often materialises previous imaginative visions: NASA space programme control rooms from the 1970s, for example, resemble today's smart city control rooms. (Picon 2015). At the same time, the specific screen-based, macro view of the city enabled through smart city technologies, sensors and Big Data can be seen as symbolic references to earlier visual imaginations of future society, from videogames, to science fiction. And yet, it could be argued that control rooms and videological approaches to the smart city are part and parcel of a liquid modernity (Bauman 2013), functioning as islands of illusory technological stability in the shifting seas of techno-social change. While these spaces and views of the smart city seem to function to render the dynamic smart city visible and controllable, they are also rendered almost instantly obsolete through the mere fact of their solid construction.

Overall, then, smart urbanism has become a leading, guiding concept in ways of thinking about and potentially directing urban change. In terms of the circulation of discourses around sustainable urbanism, the smart city concept has overtaken eco-urban ideas (such as the eco-city) in terms of usage and spread (de Jong et al. 2015). The emergence to

discursive and policy prominence of smart urbanism can be seen as part and parcel of the rise of the networked society (Castells 2013). With this development comes a potential risk of overlooking environmental sustainability, if only because mainstream visions and strategies for smart cities seem to exclude, or at least sideline, alternatives that may bring environmental (and social) sustainability more to the fore of planning, policymaking, and corporate smart product marketing. If smart cities are a way of exploring the 'symbiotic relationship between cities and information technology' (Townsend 2013, 4), environmental and social concerns are striking through their absence.

Nonetheless, smart urbanism is, in the late 2010s, discussed and debated widely at conferences, conventions, and practitioner fora. Smart cities garner interest at the level of the grassroots, of communities, neighbourhoods, and municipalities, as well as being expressed in national programmes aiming to promote future forms of urban development. An example of this is the 2012-13 Future Cities Demonstrator competition, run in the UK by the UK government's Technology Strategy Board. The competition awarded over £24m in funding to cities (namely Glasgow, Bristol, London and Peterborough) that developed plans for becoming smart city demonstrators, and can be seen as an example of the broad appeal of smart urban ideals in the second decade of the 21st century (Caprotti and Cowley 2019).

Smart and eco-urbanism in the green economy

The chapter's focus on smart and eco-urbanism as two dominant trends in urban development would be incomplete without considering one of the key themes in sustainable development over the last few decades: that of the *green economy*. The ideal of moving the global economy towards greener, more ecologically sensitive outcomes has become widespread. Indeed it is enshrined in the 2012 Rio+20 UN Conference on Sustainable Development as a guiding principle for contemporary sustainable development (Bernstein 2013). Prior to this, the green economy was already a concept commonly used and deployed at a variety of scales. Indeed, after the 2008 financial crisis, the green economy was the focus of 'green recovery plans' in the USA, Germany, France, South Korea, South Africa, Mexico and elsewhere. In South Korea, for example, 79% of the financial stimulus made available by the state in the aftermath of the crisis was part of a 'green stimulus' package (UNEP 2009).

There has been widespread critique of mainstream ideals around the green economy as based on slightly changed 'business as usual' scenarios (Schulz and Bailey 2014). Scholars have highlighted how dominant green economy discourses produced by national and international policy actors tend to replicate and not challenge mainly neoliberal discourses that enshrine economic growth (and its socio-environmental costs) as an unassailable given (Wanner 2015). An example of these types of discourses can be found in the United Nations Environment Programme's (UNEP) broad definition of what is understood by reorienting the economy towards 'green' futures:

> 'Greening the economy refers to the process of reconfiguring businesses and infrastructure to deliver better returns on natural, human and economic capital investments, while at the same time reducing greenhouse gas emissions, extracting and using less natural resources, creating less waste and reducing social disparities.' (UNEP 2009, 1)

What is highlighted in the above quote is a focus on the green economy as a way to both lessen the environmental impact of economic-industrial activity, and also as a way of taking ownership of future economic opportunities around green technology by focusing on the potential for economic growth in these sectors and industries (Georgeson, Caprotti, and Bailey 2014). It is not simply the financial crisis of 2008 that has become a justificatory logic for the green economy. A range of other issues, including Peak Oil, the rise of emerging markets, increasing environmental regulation, and rising rates of urbanisation, are all presented as examples of challenges and developments that can be ameliorated through the green economy.

The city, as a sub-national actor around which national economies are largely organised, has become identified as a key site for experimentation with visions for a green economy future. This is the case, for example, with Masdar, an eco-city in Abu Dhabi that was built from scratch from 2008. Its guiding aim is to reduce carbon, waste and energy use while at the same time functioning as a node within the Masdar Free Zone (MFZ). The MFZ functions as a Special Economic Zone (SEZ) aiming to attract corporations active in the renewable energy and sustainable technologies sectors. Masdar can be seen as an example of a new urban project that uses the urban sphere as a focus point for eco-urban and green economy initiatives. In the case of Masdar, the urban future is allegedly guaranteed through the (green) technologically-contingent development made possible through

transition towards green economic futures. Nonetheless, it is important to note the multiple critiques made of eco-cities such as Masdar in terms of their broader social performance (Cugurullo 2013). This is paralleled by the existence of other high-profile cases – such as Dongtan, China (Chang and Sheppard 2013) – of eco-city projects which promised green urban futures, but which did not initially succeed, for a variety of reasons.

Enter the smart eco-city

The chapter has highlighted how eco-urbanism and smart urbanism have both been rooted in deeply modern attempts to reshape the city. Smart city ideals have risen to prominence since the 2000s, and are now a dominant way of talking about urban futures. At the same time, eco-urban ideals are characterised by their permanence: this is because while smart urbanism has emerged, there has not been a concurrent decrease in interest in low-carbon or sustainable urbanism. Rather, what has occurred is an expansion of the discursive envelope around sustainable urbanism so as to now include 'smart' urban trajectories.

It is this chapter's contention that the green economy functions as a catalyst through which eco-urban and smart urban trajectories coalesce into sustainable urbanism. Indeed, various contemporary national and city-scale urban projects attempt to approach sustainable urban and economic development from a standpoint that attempts to hold together both environmental amelioration and economic growth. This is the case, for example, in Bristol, UK (Burton et al. 2018). The city was awarded the European Green Capital award in 2015, and several urban projects have attempted to experiment with low-carbon urbanism. This has included experimental initiatives, such as Bristol's 3e Houses project, that aimed to help council house tenants in a sample of 100 houses reduce energy usage through the roll-out of Toshiba smart tablets used for tracking energy usage. At the same time, Bristol has invested in large-scale smart urban projects that have focused on Big Data and creating an urban IoT network and open data. Thus, Bristol is an example of a city that focuses both on eco- and smart urban themes.

It seems clear that in a context of rising interest in smart urbanism, the eco-urban component of sustainable urban development has not ceased to exist, but rather has persisted and in some cases merged with smart city initiatives. It is here that we can note the emergence of what has been called the 'smart eco-city' (Caprotti et al. 2016) as a way of achieving environmentally amenable objectives in part through and within smart urban

agendas. Furthermore, and as seen in the Bristol example cited above, the smart eco-city can be placed within a broader context of concern with harnessing Big Data, the IoT, digital lifestyles, and various infrastructures to connect the urban sphere to green economy visions, strategies and pathways. This means, in turn, that the smart eco-city is in many ways an attempt to encapsulate eco-urban priorities and themes within a broader remit of integration of environmental aims with new (digital) forms of governance and economic organisation.

The blending of eco-urban and smart digital priorities into the smart eco-city may appear as though the latter is a confused and vague construct, difficult to grasp conceptually, and empirically slippery. This, however, does not seem to be the case with regards to several smart eco-city initiatives underway at the time of writing. Indeed, several of these initiatives are in fact highly defined through recourse to distinct physical, geographical and discursive boundedness. For example, the Euratlantique project to redevelop a 738-hectare area of central Bordeaux is clearly defined through negotiated and clearly marked boundaries: lines on a map that limit the spatial extent of Euratlantique as an experimental project. The project itself is anchored by a redeveloped station for the new Paris-Bordeaux rail line, opened in 2017, The project has environmental aims (such as around green building standards and energy use), as well as a clear focus on promoting digital enterprises and economic growth. Another example of a smart eco-city is the Sino-Singapore Tianjin Eco-City (SSTEC). It differs from many other smart eco-city cases in that its key defining identity, as seen through policy and corporate documentation, lies squarely in the 'eco' bracket. Nonetheless, the city's developments plans have grown to include and incorporate smart characteristics, such as a focus on smart grids, and the development of a smart city master plan in 2017. Economically, SSTEC attempts to attract industries and firms active in the green economy as well as the smart economy, as seen through the attraction of digital creative industries. Thus, SSTEC is an example of a smart eco-city developed with an eco-urban identity but now clearly incorporating smart elements in its development and design. At the same time, both SSTEC and Bordeaux's Ecoatlantique are examples of projects that attempt to connect to green economic agendas by developing different economic growth trajectories in the city.

Between mainstream and alternative: urban social sustainability

In summary, eco-urban and smart agendas have coalesced into urban constructs that can

be termed smart eco-cities in that they combine elements of green planning and digital innovation with a focus on greening the municipal and wider economy. And yet, criticisms of these types of approaches to sustainable urban development are widespread. Briefly, critiques point to the fact that today's smart eco-cities, and mainstream notions of the green economy, represent 'business as usual' scenarios. Thus, the economic and political bases for the generation of the urban and environmental 'problems' that the smart eco-city is meant to solve are not tackled at root. The smart eco-city, then, has been presented as a way of dealing with the symptoms of unbridled economic growth. At the same time, many smart and eco-urban projects have been critically analysed in light of their clearly commercial or profit-driven characteristics (Luque-Ayala and Marvin 2015). Scholars have highlighted how notions of a smart and eco-urban future are more often than not produced by coalitions of powerful actors (corporations, governments, consultants, and others) (McNeill 2015; Wiig 2015; Hollands 2015; Ren 2017) often with little or no reference to local or grassroots contexts. Similar critiques are made of eco-city and eco-urban projects as examples of green capitalism and a desire to find financial returns in new (eco) markets (Rapoport 2014). In urban planning terms, the disjuncture between digitally-augmented cities and physical urban space has also been highlighted (Aurigi 2013).

Critiques of 'business as usual' scenarios in the smart eco-city are largely centred on the ecologically modernising character of smart and eco-urban initiatives, which rely on logics based in the market, regulation, and technology to deliver desired outcomes. In turn, outcomes are often conceptualised as economic, technical, technological and governance-based – they are rarely defined in terms of citizens or citizenship (Joss, Cook, and Dayot 2017). An ecologically modernising smart eco-city (based on the ideals of economic growth and gradual technological improvements delivering more environmentally amenable outcomes), therefore, can be seen as playing a part in reshaping and rethinking the city for the future, but in specific ways constrained by the logics of profit, the bottom line, and the drivers behind the agency of powerful corporate and policy actors. A key critique of smart eco-cities rooted in visions of transitions towards the (ill-defined) green economy, then, is that these approaches and new projects do little to deal with the core reasons behind the development of unequally distributed socio-environmental externalities in the first place. In so doing, they risk deepening and replicating these problems, while generating new ones.

The core issue remains the rootedness of smart, eco-urban and green economy approaches in deeply modern visions of the city as a product of distinct binaries (such as that between nature and the city). The institution and reinforcement of these binaries effectively functions to fetishize specific aspects of the city, while overlooking or eliding others. Thus, eco-urbanism can be described as fetishizing the environment, while smart urbanism fetishizes technology and technique (Ellul 1973). Cities' social dimensions – arguably harder to conceptually grasp than digital infrastructure networks and flows of $CO2$ and energy – remain absent in this dualistic perspective.

What is to be done? It is clearly desirable to move beyond facile dualisms and binary oppositions in conceptualising and operationalising sustainable urban development. And yet what is striking, as noted by Hemani and Das (2016) in their discussion of urban sustainability in India, is the lack of focus on the *human* element in projects aiming to bring about smart and eco-urban futures. A focus on urban social sustainability as a reference point from which to contextualise smart urbanism and eco-urbanism may be a fruitful way of both thinking about, and shaping, cities of the future. This is because holding the *human city* at the core of, and as a starting point for, urban sustainable development may help to reframe both technology and environmental goals. This reframing has the potential of becoming progressive and inclusive when urban development is carried out with human welfare in mind. It is clear that the details of how this can work in practice needs research, theorising, and operational examples, but the current literature on urban social sustainability (Dempsey et al. 2011) provides useful entry points into attempts to turn smart eco-urbanism into a more socially sustainable vision of future urban development. While the smart eco-cities of the contemporary era are expressions of elite power and agency, one wonders what the smart eco-cities of the future could look and feel like if the starting point was planning for the most vulnerable citizens and for enabling human development.

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