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SMART-ECO CITIES IN THE UK: TRENDS AND CITY PROFILES 2016

August 2016

SMART-ECO CITIES IN THE UK: TRENDS AND CITY PROFILES 2016

Federico Caprotti

Robert Cowley

Andrew Flynn

Simon Joss

Li Yu

smartecocities

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INTRODUCTION

THE SMART-ECO PROJECT

This report forms part of a series also covering China, France, Germany, and the Netherlands, and draws on preliminary findings from a three-year (2015-2018), ESRC-funded research project titled *Smart Eco-cities for a Green economy: A Comparative Study of Europe and China*. The project is being coordinated by the University of Exeter, in collaboration with an interdisciplinary team of researchers from King's College London, the Universities of Westminster, Plymouth and Cardiff (UK); TU Delft and Utrecht University (the Netherlands); the French Centre for Scientific Research (CNRS) and the University of Toulouse (France); Freiburg University (Germany); Renmin University of China, and the University of Nottingham Ningbo China. As well as funding from the UK's ESRC, the research is supported by the national funding agencies of China, Germany, Netherlands and France.

The focus of our research is on the 'smart-eco city'. The smart-eco city concept captures the recent trend for future-oriented urban development schemes that display both 'green' and 'smart' ambitions. More precisely, the smart-eco city is defined as "an experimental city which functions as a potential niche where both environmental and economic reforms can be tested and introduced in areas which are both spatially proximate (the surrounding region) and in an international context (through networks of knowledge, technology and policy transfer and learning)". The idea of the 'experiment' in this definition consciously refers to recent work identifying a tendency for new urban technologies and ways of working to be trialled at a limited scale, often through cross-sectoral partnership approaches, and with the aim of learning lessons, where traditionally firmer policy commitments might have been expected (see eg: Bulkeley & Castán Broto 2013; Karvonen & van Heur 2014; Evans *et al.* 2016). The concept of the 'niche' is taken from the expanding field of 'socio-technical transitions' scholarship, which studies the processes through which innovations come about and are taken up in society more widely (for an introduction, see eg: Geels 2002; Kemp *et al.* 2007).

Each of the national reports in this series profiles a series of cities, selected on the basis that they have relatively substantial smart-eco ambitions and/or activities already taking place. This selection was made following a wider 'horizon scan' of smart and eco initiatives taking place in each country (see this report's Appendix for the method adopted in the UK). The intention is not to promote the profiled cities as necessarily representing the 'best practice' examples in the field, but rather to

illustrate the variety of 'actually existing' smart-eco cities in each country. The profiles provide a contextual overview of each city's aims, relevant policies, and the key actors involved, along with short descriptions of some of the main activities or projects taking place on the ground.

FOR MORE INFORMATION ON THE SMART-ECO RESEARCH PROJECT, AND TO DOWNLOAD THE OTHER REPORTS, PLEASE VISIT OUR WEBSITE: WWW.SMART-ECO-CITIES.ORG

THE UK SMART-ECO LANDSCAPE

The overall UK landscape is characterised by rapid change, with older environmental commitments (such as low-carbon action plans) at urban level becoming increasingly inflected with notions of the 'smart city'. Surveying what is 'smart' is far from straightforward, however, since the concept is mobilised differently from city to city. In some cases, it refers narrowly to data-driven governance solutions, or has limited reference to a particular sector of activity (for example, transport); in others it encompasses a wide range of environmental, social and economic ambitions, and may include particular initiatives which have little to do with the potential benefits of adopting digital technologies. Some smart activities are more clearly led by policy; others take the form of pre-existing initiatives which policy-makers have articulated into a smart 'umbrella' programme. Nevertheless, based on the definitions used by the key actors themselves, we found that just under a third of the UK's urban areas with populations of over 100,000 currently have a clear 'smart-eco' ambition and/or substantial related initiatives taking place (this rises to just under a half if Greater Manchester and Greater London are treated as single urban areas). These 34 cases do not tell the whole story, however: elsewhere too, plans are at early stages of discussion and development.

The national government has served an enabling role in this process. The Future Cities Catapult initiative, supported by Innovate UK (the national innovation agency), actively supports a wide range of related initiatives in different cities. Alongside the UK's entrenched national framework of environmental legislation, it is significant that the British Standards Institute (BSI) has recently published a 'Smart City Framework' (see BSI nd), commissioned by the national Department for Business, Innovation and Skills. At the same time, smart-eco initiatives operate at some remove from the policy mainstream. Rather than constituting traditionally 'planned' programmes of investment, they are typically driven by ad-hoc partnerships

involving city councils, universities, private sector actors and non-governmental organisations, and exemplify the broader contemporary phenomenon of 'urban experimentation' as a mode of effecting urban change, as noted above. Even where holistic strategy documents and roadmaps have been drawn up, many of the practical initiatives envisaged or showcased take the form of pilot schemes, or are focused on small urban districts. Even taken as a whole, it would be difficult to argue that these clustered activities already constitute a convincing transition to a hi-tech green economy in any of the cities investigated.

The hope that this peripheral experimentation has the potential to catalyse wider change is indicated by the significant national resources supporting it. Most notably, the Technology Strategy Board (Innovate UK's predecessor) ran a competition in 2012 offering £24m for the best proposal to develop a large-scale *Future Cities Demonstrator* project, as well as funding for 30 cities to develop feasibility studies. The winner, Glasgow, has since implemented its *Future City Glasgow* programme of activities, which includes the creation of a data-driven central Operations Centre. Elsewhere, albeit unevenly (Taylor Buck & While 2015), ideas developed in the feasibility studies have been taken forward. The Future Cities Catapult is one of nine national 'Catapult' organisations set up to "transform the UK's capability for innovation in specific areas and help drive future economic growth" (Catapult Future Cities, nd a). It focuses on "promoting healthy cities, building resilience in urban infrastructure, and designing strategies to help cities adopt and finance smarter technologies" (Catapult Future Cities, nd b). Local digital infrastructure improvements have also been supported by national government programmes such as the UK Broadband Fund. Significant funding for a variety of the projects profiled in this report, additionally, has been provided by the European Union.

The spread of the experimental smart eco-city in the UK does not only, then, reflect a desire on the part of city-level networks of actors to project an entrepreneurial, hi-tech, and low-carbon image on the world stage. It also appeals as a means of attracting external funding, and making more efficient uses of resources, at a time of ongoing cuts to local government budgets. The essentially economic focus of these ambitions would appear to be in tension with an ongoing awareness that top-down technology 'fixes' are unlikely to have convincingly transformative effects if they are not met with enthusiasm within society more generally. If corporate and institutional enthusiasm has not yet been matched by a widespread bottom-up embrace of the smart eco-city's potential, this may of course reflect the nascent status of the phenomenon – and in places such as Milton Keynes and Bristol, active attempts are clearly being made to involve longstanding networks of civil society actors in the transformation of the city. On

the other hand, our analysis of the UK's 34 most developed smart eco-cities suggests that planned and operational activities most typically focus on environmental, economic and mobilities issues: the relative lack of consideration given to social sustainability would appear to be at odds with the 'citizen-centred' rhetoric often mobilised within policy documentation.

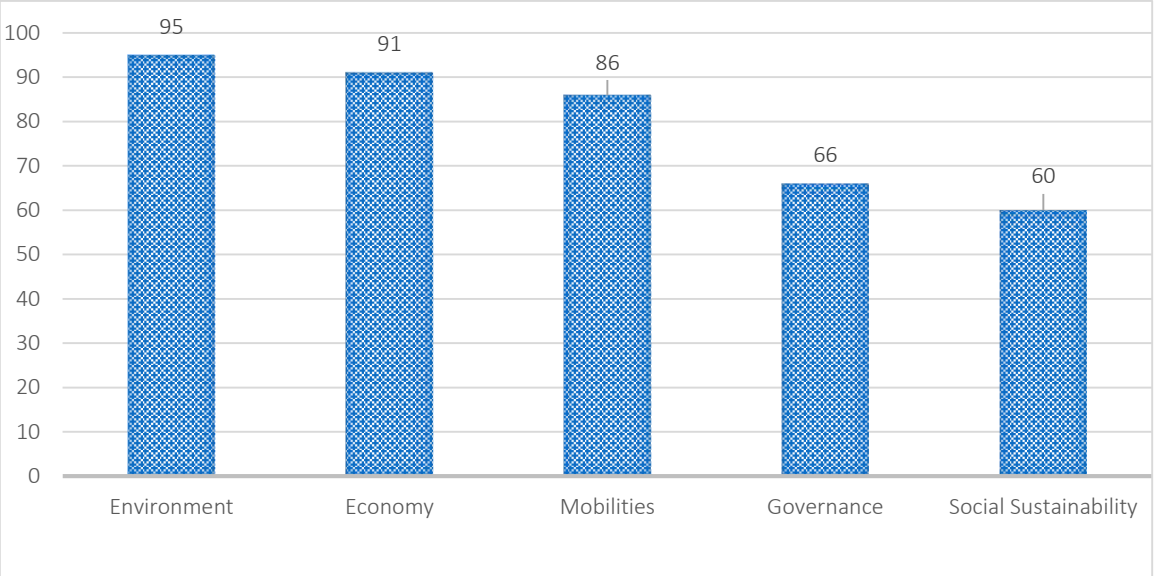

Figure 1: Categorisation of smart city activities, showing number in each, across all 34 cities examined. Categories based on recent smart city mapping exercise conducted by the European Parliament's economic and scientific policy department (European Parliament, 2014).

Overall tendencies aside, the ten cities profiled in this report illustrate the variegated nature of the UK smart-eco landscape. This variety relates not only to thematic emphases within, and the breadth of, each city's programmatic scope and the technologies adopted, but also to the degree of embedment within local policy-making, the arrangements of the networks of actors involved, local enabling contexts, and the discursive framings through which relevant activities are presented. The experimental tendencies of the smart eco-city, in other words, are oriented not only at situated socio-technical outcomes, but also at a broader set of questions related to pragmatic twenty-first century governance arrangements.

REFERENCES (INTRODUCTION)

BSI (nd) *PAS 181:2014 Smart city framework – Guide to establishing strategies for smart cities and communities: Executive summary.* British Standards Institute. Online: http://shop.bsigroup.com/upload/Smart_cities/BSI-PAS-181-executive-summary-UK-EN.pdf (accessed 7 June 2016).

Bulkeley, H. & Castán Broto, V. (2013) Government by experiment? Global cities and the governing of climate change. *Transactions of the Institute of British Geographers*, 38(3): 361–375.

Catapult Future Cities (nd a) *The Catapult Network*. Online: http://futurecities.catapult.org.uk/about/the-catapult-network (accessed 7 June 2016).

Catapult Future Cities (nd b) *Who we are*. Online: http://futurecities.catapult.org.uk/about/ (accessed 7 June 2016).

European Parliament (2014) *Mapping Smart Cities in the EU*. IP/A/ITRE/ST/2013B02. Brussels, European Parliament. Online: http://www.smartcities.at/assets/Publikationen/Weitere-Publikationen-zum-Thema/mappingsmartcities.pdf (accessed 6 June 2016).

Evans, J. & Karvonen, A. (2014) Give Me a Laboratory and I Will Lower Your Carbon Footprint!' — Urban Laboratories and the Governance of Low-Carbon Futures. *International Journal of Urban and Regional Research*, 38(2): 413–430.

Evans, J., Karvonen, A. & Raven, R. (eds.) (2016) *The Experimental City*. London: Routledge.

Geels, F.W. (2002) Technological transitions as evolutionary reconfiguration processes: a multi-level perspective. *Research Policy*, 31(8): 1257–1274.

Kemp, R., Loorbach, D. & Rotmans, J. (2007) Transition management as a model for managing processes of co-evolution towards sustainable development. *International Journal of Sustainable Development & World Ecology*, 14(1): 78–91.

Taylor Buck, N. & While, A. (2015) Competitive urbanism and the limits to smart city innovation: The UK Future Cities initiative. *Urban Studies*, online advance version. DOI: 42098015597162.

BIRMINGHAM

Author: Federico Caprotti

As a city, Birmingham has a series of smart city and low-carbon projects underway, although its overall approach is perhaps less visionary and has less strategic direction than that of, say, Bristol, Peterborough or Glasgow. Birmingham has developed a Smart City Roadmap and a Smart City Vision, both of which are being pursued by the city's Smart City Commission. The city now features several active projects, including fast broadband network development, open data capability (see the Birmingham Data Factory project outlined below), and business digital capacity improvements and training (eg through the new Greater Birmingham Digital Academy, also outlined below). In 2016, the city was named as a 'contender' for eventually becoming one of the UK's top smart cities in a smart cities survey carried out by Chinese technology firm Huawei. In the survey, Birmingham was ranked third in the country (behind London and Bristol, but ahead of Glasgow and Manchester) (Huawei 2016).

Birmingham's smart city strategies are, in city council documents at least, linked to its carbon action plan. One of the interesting points about this is that Birmingham is an industrialised (and in some areas, a de-industrialised) city. We might hypothesise a tendency for cities with an industrial history, like Birmingham (and, for example, Glasgow), to make more explicit links between the smart and the low-carbon as a result of the need to repurpose buildings and former industrial areas, redevelop brownfield sites, decommission and reclaim former industrial areas, and the like.

Interestingly, the City Council has, itself, highlighted the barriers it sees in rolling out a smart city / digital city strategy in Birmingham. This was done in a study by the Atos consultancy, commissioned by the Council. The identified barriers include: a.) a lack of statutory authority to enforce specific technology requirements; b.) the absence of universal standards to enable, for example, open infrastructures; c.) complex, disparate networks owned and operated by multiple vendors; d.) fragmented and incomplete GIS information about city utilities; e.) the slow pace and bureaucratic nature of civic planning processes; f.) a rising demand for high-speed connectivity via multiple devices; and g.) the need for more bandwidth and power for data-intensive services (Atos 2015).

Figure 2: the Selfridges Building, Birmingham

Source: The Birmingham Toolkit: http://birminghamtoolkit.com

EXAMPLES OF PROJECTS

EASTERN CORRIDOR SMART DEMONSTRATOR

The Eastern Corridor Smart Demonstrator is a pilot project to trial and test smart technologies and services in multiple neighbourhood areas. Although the project has identified these geographical areas (they are mapped out on the project website), there is as yet little detail on the specific projects that will be part of this overall demonstrator. This is because the project is relatively recent: it started in July 2015 (Digital Birmingham, 2015). The demonstrator will include 6-8 sub-projects, which are currently being defined in consultation with the Future Cities Catapult.

> URL: HTTP://DIGITALBIRMINGHAM.CO.UK/PROJECT/EAST-BIRMINGHAM-SMART-CITY-DEMONTRATOR/

BIRMINGHAM DATA FACTORY

The Birmingham Data Factory is an open data portal for the city. It is organised by Digital Birmingham, which is run by Birmingham City Council. While the Data Factory is basically an open data repository, with the capability for coders to use code from the site, and for a range of users to download data made available by organisations which are members of the Greater Birmingham Local Enterprise Partnership, the broader aim is that the Data Factory will have economic benefits as well as providing data that is openly accessible to citizens. As the Birmingham Data Factory website states: "Open Data is as much part of the economic agenda as it is of being transparent about an organisations business" (Birmingham Data Factory, 2016).

The data portal has been fully developed and datasets are available for download, although little evidence was found, at the time of writing, of geo-mapping or data geo-visualisation capabilities: datasets can be downloaded as .xls or .csv files.

URL: HTTPS://DATA.BIRMINGHAM.GOV.UK

GREATER BIRMINGHAM DIGITAL ACADEMY

The Greater Birmingham Digital Academy (GBDA) is an institution focused on Small and Medium Enterprises (SMEs). The Academy aims to provide support and skills training and improvement for businesses which use digital technologies in a range of areas. Training is in the areas of digital marketing, cloud technology, Big Data, market impact, and digital business (Digital Birmingham 2016). The GBDA is focused on improving and heightening local SMEs' potential in terms of their integration into the digital economy. Its focus seems to be on 'bringing up to speed' rather than fostering and enabling innovation per se.

The GBDA's first activities (training sessions) took place in 2015. It now runs a range of training sessions, a summer schools, and has a speaker series (GBDA 2016). It organised a digital summit for more than 300 local SMEs in February 2015: the Birmingham Digital Summit was held at Birmingham's International Conference Centre (ICC), and included the involvement of global technology corporations such as Google, LinkedIn and Microsoft. The GBDA is funded by the UK's Department for Business, Innovation and Skills (DBIS) and by the EU

URL: HTTP://GBDA.ORG.UK/

REFERENCES (BIRMINGHAM)

Atos (2015) *Developing a MyCity vision for a digital Birmingham*. Online: https://atos.net/content/dam/global/case-study/atos-birmingham-case-study.pdf (accessed 10 May 2016).

Birmingham Data Factory (2016) *About us*. Online: https://data.birmingham.gov.uk/about (accessed 5 June 2016).

Digital Birmingham (2016) *The Greater Birmingham Digital Academy*. Online: http://digitalbirmingham.co.uk/project/the-greater-birmingham-digital-academy/ (accessed 10 May 2016).

Digital Birmingham (2015) *Eastern Corridor Smart City Demonstrator*. Online: http://digitalbirmingham.co.uk/project/east-birmingham-smart-city-demontrator/ (accessed 10 May 2016).

GBDA (2016) *Greater Birmingham Digital Academy*. Online: http://www.gbda.org.uk (accessed 10 May 2016).

Huawei (2016) *London and Bristol crowned UK's leading smart cities*. Press release, 17 May 2016. Online: http://www.huawei.com/en/news/2016/5/UKs-leading-smart-cities (accessed 5 June 2016).

BRISTOL

Author: Federico Caprotti

Bristol has clearly stated ambitions to be a leading city in terms of environmental sustainability. City authorities also aim to shape Bristol into a leading smart city. These ambitions do not simply exist in policy documents and reports: the city won the European Green Capital award in 2015. Bristol also participates in the international Covenant of Mayors initiative, and has committed to a target of 40% carbon reduction by 2020. Bristol has been increasingly marketed as a 'green' alternative to the UK's other important cities, such as London or Manchester. Bristol City Council describes the city as an exciting and ongoing experiment, and as a 'living lab' (Hudson 2013) where new technologies, policies and ways of organizing urban life can be tested and trialled. Stephen Hilton, Director of Sustainable and Innovative Urban Futures at Bristol City Council, describes its smart city strategies as aimed at positioning "Bristol as a city laboratory for change – where the people are not treated as guinea pigs" (Hilton, in Cosgrave *et al.* 2014).

Bristol's smart and 'eco' city ambitions are being promoted particularly strongly by a range of city authorities and other organisations, such as Bristol University. Various initiatives led by these institutions aim to place Bristol on the map as a city that is both smart and connected to the global digital economy, and as an urban centre that is green. In a 2013 presentation by the city council (Hudson 2013), for example, Bristol was described as a 'green digital city', which highlights attempts by local authorities to speak to, and appropriate, both 'green/eco' and 'smart' monikers. Examples of activities in this context (some of which are explored in following sections) are the city's Digital Charter (which includes 'green ICT' and 'smart city' categories), the Bristol is Open initiative, attempts to roll out a digital urban operating system, and the setting up of a range of smart city experiments (many of them with a clear 'eco' component, such as around smart energy). Bristol already spends around £35m annually (this figure is for 2011-14) on IT: at nearly 10% of total council expenditure annually, this is higher than the UK city council average of 6% total spend on IT (Cosgrave *et al.* 2014). From new digital networks, to data visualisation and media infrastructure, to economic and smart city policies and strategies for the future, there are a wide range of projects and visions in place already in Bristol.

These smart and green ambitions are heavily promoted, but there are obstacles and challenges that Bristol faces at the current time. The city is dogged by the question (which applies to all UK cities) of how these strategies and projects will help

to reduce existing wealth and health inequalities, such as fuel poverty (or, in the worst case, how they may end up deepening these divides) (Hudson 2013). Some commentators have also asked whether the smart city projects being rolled out in Bristol are sufficiently ambitious and systemic, and whether Bristol can adequately compete with urban centres such as London, which are close by and attract talent away from the regions (*The Economist* 2016), although others note that the city is expected to increase its population by over 20% by the end of the 2020s (Hudson 2013). Bristol's smart city ambitions risk being side-lined if the city becomes a 'London lite': a city that is not only expensive but unaffordable, where transport and mobility is slow and costly, and where the poor and low-paid are increasingly side-lined and excluded from the glittering visions of Bristol as a 'smart' capital for the South-West

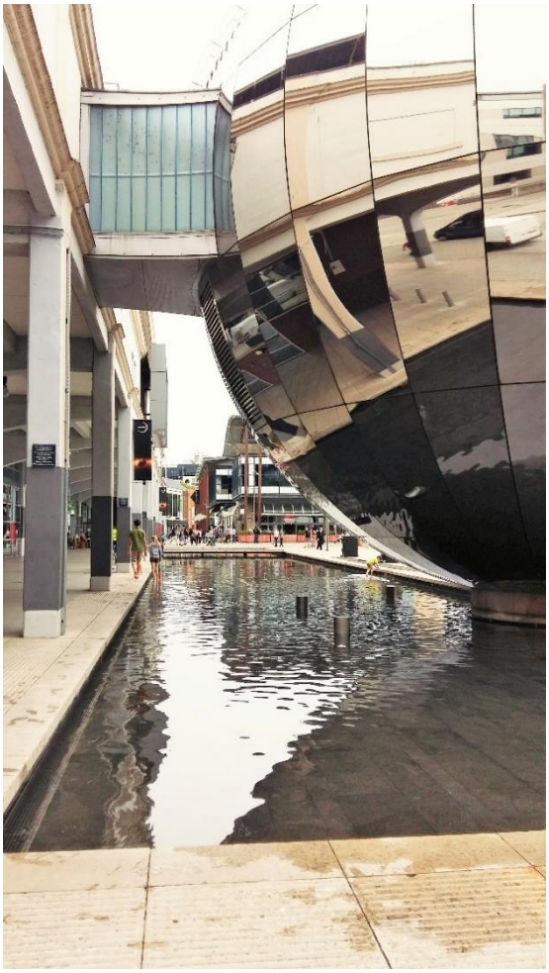

Figure 3: At-Bristol Planetarium
Photograph: Fakhriazam Afsahi

Figure 4: Energy Tree, Millennium Square, Bristol
Photograph: Fakhriazam Afsahi

EXAMPLES OF PROJECTS

There are several 'smart' and 'eco' projects currently underway, or that have been completed, in Bristol. This section outlines six key projects: the original Future Cities demonstrator initiative, a smart metering initiative, the Data Dome building, and the more systemic, digital infrastructure-focused Bristol is Open and Bristol GigaBit projects, as well as the Knowle West Media Centre (KWMC). Several other projects are not covered in this report, but form interesting examples of Bristol's 'smart' and 'eco' ambition in their own right. These include: the Smart Spaces initiative to reduce energy demand and use ICT in public buildings; the STEEP Smart Energy Master Plan; the So La Bristol smart grid project; the Media Sandbox, a Pervasive Media Studio; ICT 4 EVEU (ICT for Electric Vehicles – Enhancing the User Experience); and two smart transport-focused projects: the Traffic Control Centre, and a Freight Consolidation Centre.

CONNECT BRISTOL (FUTURE CITIES DEMONSTRATOR)

Connect Bristol is the city's Future Cities Demonstrator project, funded via a £3m grant from the UK government's Technology Strategy Board (TSB). Bristol competed with other UK cities to win this funding in 2013. The key focus of the project was on integrating multiple digital systems in new ways. The initiatives tested included on-demand mobility, more personalised health and social care systems, city governance, and future workplaces. The project tested system integration by using an integration platform.

The Connect Bristol project was an ambitious long-term initiative with a 5-10 years plan (known as a 'Business Development Plan') aimed at integrating different systems (and different specific experimentation projects such as Bristol is Open – see the project outline below). Connect Bristol also aimed to produce a city Open Data platform and a City Dashboard. The project was deemed complete at the end of 2015, although the strategic vision developed as part of the project has been incorporated and modified into Bristol's digital city strategies and other projects.

Connect Bristol was led by Bristol City Council. However, it involved other governmental and corporate actors. The project was enabled by a bid to the Future Cities competition, made possible by a proposal jointly developed by Bristol City Council, Arup, IBM, the University of Bristol, Knowle West Media Centre, Hewlett Packard, Toshiba, and Advancing Sustainability LLP. These public and private organizations and corporations carried out a 12-week feasibility study which was developed into the Future Cities proposal (Bristol City Council 2012a, 2012b). Funding actors included the UK Technology Strategy

Board (for the initial concept funding of £50,000 in 2012), and the Future Cities Catapult (which ran the demonstrator competition in 2012-13).

> URL: HTTP://WWW.CONNECTINGBRISTOL.ORG

GIGABIT BRISTOL

GigaBit Bristol was the overarching project umbrella name for a range of projects aiming to transition Bristol towards digital infrastructures and smart city technologies. It includes other projects such as Bristol is Open (see below). The project aims to provide a significant upgrade for the city's digital infrastructure, with the main aim being economic (enabling businesses to benefit from fast digital networks). It contained a clear infrastructural element (more details below), and was completed by late 2015.

Historically, GigaBit Bristol is based on Bristol City Council's purchase, at the start of the 2000s, of fibre cable networks and associated ducting, and progressively turning this network into an active digital network in Bristol. However, the project website contains mentions of an ambition to extend the project to an 'Open Programmable City Region'. Capital spending started in 2014 and was completed by the end of 2015 (Hilton 2014). By late 2015, most work had been completed: In infrastructural terms, there is currently a network of 76km of fibre cables in Bristol, most of which are in active use and make up the 'B-Net' network, which is operated by Bristol City Council.

The main organisations responsible for developing and delivering the GigaBit Bristol project were Bristol City Council, the UK government (which funded the project), and CityFibre (from 2016), a corporation that will expand the existing network. GigaBit Bristol was funded with £11m (Bristol City Council, 2015b) from the UK's Urban Broadband Fund. Bristol was one of 10 cities to gain funding in this way. The GigaBit Bristol activities that were funded in this way included (Hilton 2015):

- £570k for a demonstrator suite in the Engine Shed & survey of BNet, BCC's own fibre network
- £4.3m for R&D testbed, RF Sensor Mesh, and street furniture upgrades £1.62m for general purpose ducting in BTQEZ, to be offered as a concession
- Wireless concession covering 80% of Bristol, including the 54 business growth areas
- £4.8m for SME connection vouchers as the Bristol component of a national scheme.

> URL: HTTP://WWW.CITYFIBRE.COM/GIGABIT-BRISTOL/

BRISTOL IS OPEN

Bristol is Open is an ambitious project to provide an "open and programmable experimental platform in the centre of Bristol" (Simeonidou 2015: 3). It will be based on computing, optical and wireless systems, and the Internet of Things. The platform will be available for experimentation, as well as for use by city authorities to provide services. Bristol is Open is the first joint venture between Bristol City Council and the University of Bristol (Simeonidou 2015).

Bristol is Open is aimed at shifting Bristol City Council and the wider Bristol urban area into achieving much more emphasis on, and use of, digital platforms. In this sense, the project is highly transitional and could be seen to correspond to what Barns (2016) has called "entrepreneurial governance by code". The project's use of a data platform which can be tested and experimented with also points to the conceptualisation of the project itself, of urban data streams, and of central Bristol, as experimental zones. Nonetheless, the project's approach – of conceptualising the city as an entity that can be influenced and perhaps controlled through digital technologies – could be seen as an example of what MIT scholar Antoine Picon has called a 'neo-cybernetic illusion' (Picon 2015): viewing digital infrastructures as more important for achieving change, than they perhaps really are.

The project's aims are wide-ranging, including the ambition to enable smart metering, driverless cars, streaming feeds from ambulances to hospitals, various sensor systems, and connections between the city centre network and the Bristol city-region. Bristol is Open is currently focused on central Bristol, although project documentation refers to the city-region scale (Simeonidou 2015). The project's next phases see the expansion of the network to Bath and other nearby areas.

The project is currently in the development phase, and key elements of physical, wired infrastructure are being installed, including the laying of cables in rivers, and the modification of existing lampposts. Phase I of the project (to end 2015) includes the laying of a fibre network in the city centre, the installation of 54 fibred lamppost clusters, and rolling out the test City Operating System. Phase II (to end 2017) includes expansion of the project to Bath, the Filton Enterprise Area, and other universities, and thus it will have a bigger spatial footprint, as well as extending across municipal authority boundaries.

The two main organisations driving the project are its joint venture partners, Bristol City Council and Bristol University. Bristol is Open also has partners including the At-Bristol 3D visualisation organization, Watershed (a pervasive media outfit), and the Engine Shed (a city and region-focused business incubator).

The investment amount for the project is difficult to calculate because the different

sub-projects all have individual budgets. However, the overall project was awarded £5.3m from the UK Government's Super Connected SCC programme (Bristol City Council 2015a). Based on experience with Bristol is Open, Bristol (in a consortium with Santander and Florence) also submitted a bid to the EU REPLICATE programme in 2015, and was awarded (with the other two cities) €25m for developing smart city solutions to common urban problems (Bristol is Open 2015b). The REPLICATE project was launched in February 2016, and will see a variety of energy, mobility and ICT initiatives being trialled in Bristol's Ashley, Easton and Lawrence Hill neighbourhoods (Connecting Bristol nd).

> URL:
> HTTP://WWW.BRISTOLISOPEN.COM

3-E HOUSES

3-E Houses is a project that aimed to deploy smart meters in social housing, with the aim of having impact on energy and carbon use, as well as on bills associated with energy consumption. The project ran from April 2012 to May 2013 in Bristol, and in 2010-2013 overall. It was part of an international experiment with smart metering in social housing: the initial pilot phase took place in Spain and Germany, while the 'replication' phase (Hudson 2013) was focused on the UK and Bulgaria. In Bristol, the project was based on tablet-based engagement with residents of two experimental areas, one of which is characterised by council houses, the other composed of apartments in council-owned tower blocks.

The project aimed to achieve a reduction in energy and carbon use, thus lowering of carbon emissions as part of wider urban carbon reduction targets. This involved trying to stimulate change in how residents of social housing engage with energy provision: the smart meter is the main interface through which this was meant to happen.

In Bristol the project was based in two pilot areas comprising a combined total of around 100 houses. The first area is Knowle West, in South Bristol, in which 43 houses took part in the project. The population of this area is over 120,000, and the social houses are mostly of 1930s vintage. The houses are mostly terraced council houses. Knowle West is designated as a European Living Lab area. The second area is Dove Street in central Bristol, and is composed of 1960s tower block social housing. Each tower block contains over 100 apartments. 57 apartments were included in the project. The project found significant difficulties in engaging with citizens, and in recruiting participants: Hudson (2013) notes that even giving away free Toshiba tablets did not seem to have much impact in galvanising interest in participation. Hudson (2013) also noted how the impacts of the project could only be maintained

through regular re-engagement with participants "to maintain impact and reinforce positive behaviours".

There were several city-level, national and international organisations involved in the project. The project involved the city council (and at the European level, the city councils of the other towns involved in the study). It also involved (in the UK) the Knowle West Media Centre, Toshiba and IP Performance, and in the EU, Indra, Ennovatis, and Gas Natural Fenosa (3-E Houses 2013).

> URL:
> HTTP://KWMC.ORG.UK/PROJECTS/3EHOUSES/

BRISTOL DATA DOME

The Bristol Data Dome is an upgrade/retrofit of the At-Bristol planetarium in the city centre, which is connected to a supercomputer at the University of Bristol and is used as a 4D space to display various types of data to citizens. It was unveiled in November 2015. It has also generated interest from corporations, such as Rolls Royce, due to the ability to visualise engineering products in 3D.

As the Bristol is Open website states: "Bristol's Data Dome – building real-time city data visualisation from Bristol Is Open's emerging city-wide digital network – is launched at the festival, with a variety of content being shown from earth sciences, to open-data, to sociological mapping about cities now. Rolls-Royce has been quick to spot the potential of the Data Dome. They are using it to help their engineers visualise engines, and the data coming from them, in new and exciting ways. They will show some of their early progress. Rolls-Royce have kindly sponsored the buffet and networking session […].

The Data Dome is part of Bristol Is Open [author's note: see project description above], a collaboration between the technology, media & telecommunications industry, universities, local communities, and local and national government. Bristol Is Open is a joint venture between Bristol City Council and the University of Bristol. It is a digital urban R&D test bed to develop smart city projects, including the Data Dome, as part of the world's first open programmable city region." (Bristol is Open 2015a).

> URL:
> HTTP://FUTURECITIES.CATAPULT.ORG.UK/PROJECT/BRISTOL-DATA-DOME/

KNOWLE WEST MEDIA CENTRE (KWMC)

KWMC is a community centre that is heavily focused on digital technologies, digital arts, design, gaming, training, and other activities and technologies, and runs a range of projects, courses and activities including, recently, sensor-driven citizen technology activities. A 2014 report by Arup described the KWMC in these terms:

"'Bristol's Knowle West Media Centre is a community group that uses technology to empower citizens across all aspects of their lives. For example, the web-based platform 'University of Local Knowledge' harnesses local knowledge and disseminates it amongst the community. Here, citizens can add to the wealth of information already available on the site by uploading and sharing videos of their own knowledge and putting together their own playlist-like courses. They also run training sessions for the elderly, teaching them how to access basic online services like online shopping, booking holidays or using applications such as Skype. These Community-run sessions enable vulnerable people to access basic services and feel more connected to their families and local community" (Cosgrave *et al*. 2014: 19).

KWMC was founded in 1996 and is currently operational, although it received significant input from the Future Cities demonstrator bid, as well as follow-on activities such as Bristol is Open.

The building in which it is housed incorporates a range of 'green' technologies including straw cladding and solar power. The building was new-build in 2008 (KWMC moved, in that year, from the old concrete former surgery it had occupied since 1996). The centre aims to make digital technologies and especially the creative use of digital technologies accessible to a wide range of citizen users, as seen by its wide range of activities spanning training, education, and the like.

URL: HTTP://KWMC.ORG.UK

REFERENCES (BRISTOL)

3-e Houses (2013) *Best Practice Guide*. Online: http://lowcarbonuk.com/downloads/3eHousesBooklet.pdf (accessed 5 June 2016).

Barns, S. (2016) *Mine your data: open data, digital strategies and entrepreneurial governance by code. Urban Geography*, advance online version. DOI:10.1080/02723638.2016.1139876

Bristol City Council (2015a) *Bristol is Open – the open programmable city*. Report, 3 February 2015. Online: https://www2.bristol.gov.uk/committee/2015/ua/ua000/02037.pdf (accessed 5 June 2016).

Bristol City Council (2015b) *BNet Commercialization – Duct Concession*. Report, 6 October 2015. Online: https://www2.bristol.gov.uk/committee/2015/ua/ua000/1006_6.pdf (accessed 12 May 2016).

Bristol City Council (2012a) *Connect Bristol Feasibility Study*. Bristol, Bristol City Council. Online: https://connect.innovateuk.org/documents/3130726/6091879/Feasibility+Study++Bristol+City+Council.pdf/4269233f-cd8b-47da-9f0b-58a27294a684 (accessed 12 May 2016).

Bristol City Council (2012b) *Bristol wins Future City award*. Press release, 25 July 2012. Online: http://news.bristol.gov.uk/bristol-wins-future-city-award (accessed 10 May 2016).

Bristol is Open (2015a) *Bristol is Open launches the Data Dome*. Online: http://www.bristolisopen.com/bristol-is-open-launches-the-data-dome/ (accessed 10 May 2016).

Bristol is Open (2015b) *Bristol bids to become the UK's IoT capital as it wins prestigious EU award. Bristol is Open website*. Online: http://www.bristolisopen.com/bristol-bids-to-become-the-uks-iot-capital-as-it-wins-prestigious-eu-award/ (accessed 10 May 2016).

Connecting Bristol (nd) *REPLICATE Project*. Online: http://www.connectingbristol.org/replicate-project/ (accessed 28 June 2016).

Cosgrave, E., Doody, L. and Walt, N. (2014) *Delivering the Smart City: Governing Cities in the Digital Age*. London, Arup.

The Economist (2016) London-upon-Avon. *The Economist*, 19 March. Online: http://www.economist.com/news/britain/21695067-south-western-powerhouse-needs-better-government-if-it-prosper-london-upon-avon (accessed 12 May 2016).

Hilton, S. (2014) *Report to the Sustainable Development & Transport Scrutiny Commission, 19 March 2014*. Online: https://www2.bristol.gov.uk/committee/2014/sc/sc024/0319_16.pdf (accessed 5 June 2016).

Hudson, L. (2013) *Smart City Bristol*. Presentation. Online: http://ec.europa.eu/information society/activities/sustainablegrowth/docs/smart-cities/bristol.pdf (accessed 12 May 2016).

Picon, A. (2015) Smart Cities: *A Spatialised Intelligence*. Chichester, Wiley.

Simeonidou, D. (2015) *Future Cities: Bristol is Open*. Presentation, Faculty of Engineering Research Showcase, University of Bristol, 24 June 2015. Online: http://www.bristol.ac.uk/media-library/sites/engineering/ilo/documents/future-cities.pdf (accessed 10 May 2016).

GLASGOW

Author: Andrew Flynn

The literature on Glasgow provides a fascinating insight into a city that is trying to reinvent itself through competition and awards. These include:

- Glasgow European Capital of Culture 1990
- Glasgow City of Science (a partnership between the Council, universities, technology companies to promote science and technology)
- Glasgow City of Music (in 1998, it was named a UNESCO City of Music, and is now one of nine Music Cities in the UNESCO Creative Cities Network)
- Future City Glasgow (awarded by the Technology Strategy Board – now Innovate UK – in 2013).

The documentation related to these awards paints a picture of a city with long-standing social problems (eg high rates of poverty and social exclusion), whose economy has been radically restructured, and which is seeking to promote ideas on regeneration. In this way, the city is pursuing an economic development strategy via competitive branding in which Glasgow becomes synonymous as the 'City of …'.

The high level commitments to transforming the city through competition awards have important implications for how 'smart' and 'eco' are conceptualised and delivered. First, the city is well geared up to writing award winning bids. This is reflected in the text on governance which points to an inclusive highly networked city with a commitment to partnership working. For example, it is noted that there is "[s]trong partnership infrastructure" (Glasgow City Council 2012: 2), relating to a variety of networks including Glasgow Conference and Marketing Bureau, Glasgow Community Safety Partnership and Glasgow Sustainable Tourism Group. Similarly, a key strength is its "Strong public and private sector leadership with a shared ambition and vision for Glasgow" (Glasgow City Council 2012, Appendix A: 1). As a model of change, it positions itself as a city where responsibility for innovation is shared amongst key actors. The documentation also makes much of the award criteria in making a case for support (eg Glasgow City Council 2012).

Second, it is able to flag up its commitment to a comprehensive vision – for example, with reference to the *Fifty Year Vision for the Future* (Glasgow City Council 2011) – in which improving the quality of the physical environment and the quality of citizens lives are central. Such visions may be important factors in winning awards as they demonstrate how funding will contribute to long-term goals. A vision can also be significant for governance since it suggests that innovation can be steered

or made purposeful; and for the City Council this will primarily be to improve the delivery of services. Third, as part of the Glasgow vision, which is wide-ranging, it means that when applying for awards it is possible to bring together disparate ideas, initiatives and activities to present them as being integrated and able to deliver more than the sum of their parts (eg Future City Glasgow draws together a mobile phone app to contact the City, asset management and street lighting). Fourth, and as a consequence, ideas of transformation, of what is to be transformed, and by who, can appear vague. For example, the new intelligent street lights scheme (see description below) is innovative in that its "sensors … will gather information such as footfall and traffic flow. This information will be sent back to the city data hub where it will be freely available to view" (Invest Glasgow 2015). And yet the direct benefits of making these data public are not made clear. More generally within the documents, there is an assumption that providing data/evidence will lead to action (change that may be transformative) but the type of action is rarely specified. Finally, the Glasgow approach to a 'smart' city could be summarised as opportunistic (as opposed to strategy led), based around funding opportunities and drawing on the input of creative organizations/individuals that results in ad hoc projects.

The £24m awarded to Glasgow in 2012 by the national Technology Strategy Board (TSB) for its winning competition entry to develop a Future City 'large-scale demonstrator project' marks it out as having the potential for smart city characteristics – or at least as having actively embraced the language of a smart city in its ambitions. The feasibility study is underpinned by a benign view of technology that is enabling for all: "Enabling data will in turn enable technology, enable research and development, enable investment, enable businesses and enable people" (Glasgow City Council 2012: 17). As a technology driven initiative, the resulting Future City Glasgow programme of activities is well aligned with a smart city approach. However, the link between this technology and eco-improvements is only sometimes made explicit – for example, in the programme to manage street lighting more efficiently.

In the bidding for the TSB funding, Future City Glasgow was known as the Glasgow City Management System, focused on system integration by "delivering an additional layer of technology that will accelerate the integration of city systems in innovative ways and complete the transformation into a truly Future City" (Glasgow City Council 2012: 3). Quite what a "truly Future City" might be for Glasgow was not clearly specified, but it appears to be one in which multiple agencies can deliver improved and responsive services (Glasgow City Council 2012: 3). The Glasgow City Management System was to include:

- City Observatory
- MyGlasgow phone app
- City Dashboards
- Intelligent Operations Platform
- Data Repository

What is noticeable about these envisaged projects is that (i) they are largely independent activities and (ii) in terms of council services those most directly affected are health, energy, transport and public safety.

Approximately half of the TSB award (Davies 2014) has been spent on an Operations Centre (see below) and the other half on a number of smaller activities which have expanded the core activities envisaged in the feasibility study (also outlined below). It is difficult, however, to judge the current status of many of these projects, beyond their original implementation. Part of the difficulty is that the webpages for Future City Glasgow have not been updated since 2014. Potential confusion is also raised because the information available on the Future City Glasgow and Open Glasgow websites (the latter itself a TSB project deliverable) largely duplicate one another. This is not to say that Glasgow has failed to fulfil its promises in terms of concrete deliverables: it has clearly done so, and would be able to build on these if further funding becomes available. Rather, at this stage at least, the claims made about the potential for improvements in quality of life and citizen participation may appear rather overblown:

"We have been exploring how we can use technology to make our streets safer, making it easier for people get active and improve their health and understanding how we can better use, save and generate energy.

Glasgow has unlocked hundreds of data sources and opened up access to allow smart people to do smart things. We have been involving and empowering communities, bringing people together to explore their vision for our city and inspiring future generations to make a difference" (Future City Glasgow nd).

In reflection of the way that smart city strategies, visions, and funding applications are often assembled in UK cities, it should be noted that some of the specific projects were happening already (eg street lighting) and have simply been brought into the smart city agenda; others appear, to some extent, to be a re-badging or reorganisation of tasks (eg the operations centre that includes traffic management and CCTV monitoring). Others still are private sector projects (eg Scottish and Southern Electric's renewable energy exhibition (see Glasgow City Council 2012: 22)) which are oriented towards low-key awareness raising, rather than encouraging new forms of collaborative governance within the city between public and private sectors. Indeed, beyond the ongoing functioning of the Operations Centre, the lack of recent project activity may suggest that the ability of Future City Glasgow to engage with

stakeholders to engender a broader process of change has been rather limited.

The Feasibility Study summary built on an article published in The Urban Technologist (an online publication focusing on smart city innovations), which proposed an answer to the question "What makes a city a Smart City as opposed to a city where some smart things happen?" (Robinson 2012). The criteria, we are told, are that "smart cities are led from the top by a strong and visionary champion, smart cities have a stakeholder forum of committed city stakeholders and smart cities invest in technology infrastructure" (Glasgow City Council 2012: 5). However, while the Feasibility Study did make great mention of key public sector actors (eg the universities and private companies such as SSE), the Future City Glasgow web pages provide no information about how it is governed or what networks exist. There are optimistic phrases about improvements in collaborative governance arising from data availability (see above) but ideas on how public, private and voluntary sectors might work together in a different way is not clear. In its outward communication, then, the council appears to have prioritised positioning itself as the 'strong and visionary champion' of the Future City Glasgow initiative, rather than as merely one actor among many in a governance network.

Some foundations for further development of Glasgow's smart activities have been laid in the form of the Open Glasgow website, and two strategic documents: the Open City Manifesto (Future City Glasgow 2013a) and City Technology Platform (Future City Glasgow 2013b). While, as noted above, the Open Glasgow website currently replicates much of the information provided on Future City Glasgow's web pages, it appears primarily to serve as a platform for accessing the city's open data, and potentially – it might be presumed – provides an umbrella platform for Glasgow's future smart activities which are not directly related to the Future City initiative. The Open City Manifesto (Future City Glasgow 2013a), meanwhile, lays out principles for managing data. These are largely drawn from the G8's (2013) Open Data Charter and include making data available, and engaging with the community. Throughout the text there is a sense of the economic potential of data because it can foster innovation (Future City Glasgow 2013a: 2), and the possibility of nurturing more collaborative forms of governance in which public and private sectors, citizens and academia come together to aid the delivery of policy (Future City Glasgow 2013a: 3). Bringing together communities of interest, it is asserted in the City Technology Platform document, "will deliver better outcomes through open data, innovation and engagement in the city" (Future Glasgow 2013b). Thus, data made available via the Technology Platform will, it is hoped, be of widespread benefit: businesses can more easily develop

"innovative 'future cities' products" (Future City Glasgow 2013b); the City Council will be able to use its assets, such as street lighting, more efficiently; and the community will benefit from more effective service delivery (Future City Glasgow 2013b). These texts, then, are optimistic in their assumptions on the power of data to provide opportunities for business, and to improve governance because of better collaboration. Nevertheless, entrepreneurs and other users of data are largely silent in these core strategic documents.

Figure 5: A View of Glasgow from Queens Park
Photograph by John Lindie via Wikimedia Commons
https://commons.wikimedia.org/wiki/File%3AView_of_Glasgow_from_Queens_Park.jpg

EXAMPLES OF PROJECTS

Three of the initiatives forming part of the Future City Glasgow programme are briefly described below: the Glasgow Operations Centre; Intelligent Street Lighting; and a series of Community Mapping events. The first represents the most substantial tangible legacy of the programme; the other two exemplify the varied smaller-scale or short-lived activities surrounding it. This wide range of additional activities implemented included:

- My Glasgow (an app allowing citizens to report problems)
- Linked Mapping (an online map including listings of various amenities and services)
- Renewables Mapping (a map of renewable energy opportunities within the city)
- Dashboards (allowing users to choose which city datasets will be visualised)
- Active Travel (a demonstrator smart phone app designed for pedestrians and cyclists)
- Hacking the Future (a series of four public 'hackathons' themed around public safety, energy, health, and transport)
- Energy Efficiency Demonstrator (creating a detailed data-based portrait of energy consumption across the city, to investigate the potential to reduce carbon emissions, lower fuel bills, and address fuel poverty)
- Social Transport (smart phone software allowing the city's social transport fleet to provide an improved, more flexible service)
- Engaging the City (a touring exhibition stands to raise awareness of the Future City initiative)
- Future Makers (a series of events teaching children to code)
- Citizen Engagement (a research study investigating citizens' views, with a focus on waste and road repairs)

GLASGOW OPERATIONS CENTRE

The Operations Centre was at the heart of the Future City programme funded by TSB. It first opened in time to "to keep the city moving and as safe as possible" during the Commonwealth Games in 2014 and is located in Glasgow's East End (*STV News* 2014). According to Community Safety Glasgow (nd), a partnership between the City Council and the Scottish Police Authority, its main objectives are to:

- enhance management of events and incidents
- reduce and prevent crime and antisocial behaviour
- improve incident response times
- embed more intelligent working practices with all key partners.

As well as supporting police and emergency services, it also supported the Clean Glasgow initiative, which was set up to address local environmental issues across the city (Community Safety Glasgow nd).

Inside the Centre, more than 1,000 screens are monitored 24 hours a day (*STV News* 2014). Data are drawn from an upgraded city-centre CCTV system across the city centre, which is able to detect unusual behaviour, a recently upgraded traffic monitoring systems, and police intelligence. As well as enabling the emergency services to respond more rapidly to incidents, the system makes use of facial recognition software. This aspect of the surveillance system attracted some negative coverage in the local media, along with suspicion of the Israeli company NICE which provided it (*heraldscotland* 2014; Aitchinson 2015). In future, it is planned that the "impact and value" of the Operations Centre will be assessed by mapping the intelligence gathered against a range of specific indicators (Future City Glasgow nd b), though no information appears to be currently available about what these indicators will measure.

> URL:
> HTTP://FUTURECITY.GLASGOW.GOV.UK/OPS-DATA/

INTELLIGENT STREET LIGHTING

This 'demonstrator' project trialled new street lighting technologies which promised to "improve lighting quality, quality of life, public safety, energy and maintenance efficiency" (Future City Glasgow nd c).

The trial took place in three city centre locations: a section of the walkway by the River Clyde, Gordon Street (a partly pedestrianised street), and Merchant City (a retail and leisure district). The new functionalities being tested included: sensors providing real-time data on sound levels, air quality, and pedestrian footfall; and 'Dynamic' lights able to detect motion and raise lighting levels accordingly (Future City Glasgow nd c). The data are fed automatically into the city's open data hub, launched in February 2015 (Invest Glasgow 2015; Thinking Cities 2015).

It is unclear whether the project has been more widely rolled out following this trial.

> URL:
> HTTP://FUTURECITY.GLASGOW.GOV.UK/INTELLIGENT-STREET-LIGHTING/

COMMUNITY MAPPING

This initiative consisted of a series of participatory activities to map citizens' local knowledge, held between May and September 2014. In the words of its organisers, it "complements the Future City Data Team's stakeholder strategy to encourage organisations, businesses and public services to open data. Future Maps has invited people across Glasgow to share a wealth of knowledge about the city.

Community insights offer a new point of view on the city, creating the future from the ground up." (Future City Glasgow 2014: 2). The project was a collaboration between Pidgin Perfect (a participatory urban environment design agency), Open Glasgow, Change Agents (a consultancy and training company) and the Greater Easterhouse Alcohol Awareness Project (GEAAP).

Both traditional and digital mapping techniques were employed, along with a range of open-source tools. Six types of themed activities took place: Citizen Mapping sessions in four locations; #SocEntMap Glasgow (mapping Social Enterprises, and ethical/sustainable businesses); Young City Mapping (with schools and youth groups); Mapping Parties (larger scale public events to map a particular theme); Dear Green Network (mapping the city's green spaces); and Heritage Mapping (an app encouraging people to walk around and learn about the community of Dennistoun) (Future City Glasgow 2014: 2).

The organisers claim that "[i]ncreasing people's confidence with digital resources proved to be empowering for many participants and groups" (Future City Glasgow 2014: 2). In total, the project involved 32 organisations, charities, social enterprises, schools and community groups, and 338 'citizen mappers' from across the city, over half of whom were aged 25 or under (Future City Glasgow 2014: 2). The maps and data produced were made public afterwards.

> URL:
> HTTP://FUTURECITY.GLASGOW.GOV.UK/PDFS/FUTURE%20MAPS%20FINAL%20REPORT.PDF

REFERENCES (GLASGOW)

Aitchinson, J. (2015) Should we be worried about Glasgow's new hi-tech surveillance system? *STV News*, 23 February. Online: http://glasgow.stv.tv/articles/310713-glasgows-new-surveillance-installed-by-israeli-firm-nice-systems/ (accessed 28 June 2016).

Community Safety Glasgow (nd) *Glasgow Operations Centre*. Online: http://www.communitysafetyglasgow.org/what-we-do/improving-community-safety/glasgow-operations-centre/ (accessed 28 June 2016).

Davies, S. (2014) Glasgow aims to be the first 'smart city': Experimental programmes include using big data forecast crime. *Financial Times*, 3 June. Online: http://www.ft.com/cms/s/0/d119ac06-e57e-11e3-a7f5-00144feabdc0.html#axzz49YVLCVov (accessed 28 June 2016).

Future City Glasgow (2013a) *Open Manifesto (Future City Principles)*. Online: http://open.glasgow.gov.uk/content/uploads/2013/11/FC_OPEN-Manifesto.pdf (accessed 15 May 2016).

Future City Glasgow (2013b) *City Technology Platform*. Online: http://open.glasgow.gov.uk/content/uploads/2013/12/Technical-Architecture-Context.pdf (accessed 15 May 2016).

Future City Glasgow (2014) *Future Maps: Sourcing City Data from Citizens*. Online: http://futurecity.glasgow.gov.uk/pdfs/FUTURE%20MAPS%20FINAL%20REPORT.pdf (accessed 28 June 2016).

Future City Glasgow (nd) *People Make Glasgow*. Online: http://futurecity.glasgow.gov.uk/ (accessed 28 June 2016)

Future City Glasgow (nd b) *Glasgow Operations Centre: Building a world class smart city in Glasgow*. Online: http://futurecity.glasgow.gov.uk/ops-data/ (accessed 28 June 2016)

Future City Glasgow (nd c) *Intelligent Street Lighting: Smart Lighting for a Smart City*. Online: http://futurecity.glasgow.gov.uk/intelligent-street-lighting/ (accessed 28 June 2016).

Glasgow City Council (2011) *A fifty-year vision for the future – Future Glasgow 2011 – 2061: Full consultation report*. Online: https://www.glasgowconsult.co.uk/UploadedFiles/GCC2061A4%20Full%20Version%20Online.pdf (accessed 14 July 2016).

Glasgow City Council (2012) *Glasgow City Management System*. Report prepared for Technology Strategy Board. Online: https://connect.innovateuk.org/documents/3130726/3794125/Feasibility+Study+-+Glasgow+City+Council.pdf (accessed 1 June 2016).

G8 (2013) *G8 Open Data Charter and Technical Annex*. Online: https://www.gov.uk/government/publications/open-data-charter/g8-open-data-charter-and-technical-annex (accessed 28 June 2016).

heraldscotland (2014) City's Israeli security deal. 17 August. Online: http://www.heraldscotland.com/business/opinion/13175288.City_s_Israeli_security_deal/ (accessed 28 June 2016).

Invest Glasgow (2015) *Glasgow Launches World Leading City Data Hub*. Online: http://investglasgow.com/uncategorized/glasgow-launches-world-leading-city-data-hub/ (accessed 14 July 2016).

Robinson, R. (2010) The new architecture of Smart Cities. *The Urban Technologist*, September 2012. Online: https://theurbantechnologist.com/2012/09/26/the-new-architecture-of-smart-cities/ (accessed 28 June 2016).

STV News (2014) CCTV control centre opened in Glasgow ahead of Commonwealth Games. 12 February. Online: http://stv.tv/news/west-central/263874-new-cctv-centre-opened-in-glasgow-ahead-of-commonwealth-games/ (accessed 28 June 2016).

Thinking Cities (2015) *Glasgow launches world leading city data hub*. Online: http://thinkingcities.com/glasgow-launches-world-leading-city-data-hub/ (accessed 15 July 2016).

LONDON

Author: Simon Joss

'Harnessing digital innovation to make London the best city in the world'
The Future of Smart (Greater London Authority, 2016)

London's foray into smart city innovation is closely linked with the opportunities and challenges facing the UK's capital as a global city: the smart city discourse deployed forms an integral part of the overarching narrative of London striving for continuous growth and consolidating its position as a leading international city (Mayor of London 2013; see also NESTA 2015). This trajectory, however, is seen as facing various emergent 'urban challenges' – relating to infrastructure, services and governance – for which consequently diverse 'smart' solutions need to be found. The latter are predicated on exploiting the benefits of open data and digital technology to address governance complexity and enhance socio-economic and environmental innovation.

Figure 6: City Hall, London
Photograph: Fakhriazam Afsahi

The Greater London Authority (GLA), and particularly the office of Mayor of London, has been the main orchestrating force behind the Smart London programme to date (Smart London, undated). The metropolitan authority is in charge of both strategic development – principally through the Smart London Board – and the implementation of various practical initiatives. In doing so, the GLA has actively sought to co-opt experts and community stakeholders to provide know-how and facilitate social engagement. As the authority highlights in its data strategy plan (Greater London Authority 2016), City Hall neither has all the solutions nor the capacity to implement its smart city programme singlehandedly. As a consequence, there is strong emphasis – a key feature of London's take on the smart city – on collaborative, co-creative governance involving the business and technology sectors as well as community groups and 'Londoners' more widely. The commitment to networking is reflected in two recently established Smart London Innovation Networks (Smarter London, undated) – one seeking to link up four large regeneration projects, the other to promote cross-scalar integration of infrastructure and utilities – and the Borough Data Partnership aimed at improving coordination between the 32 London boroughs, the City of London and the GLA. (A few individual boroughs, such as Greenwich and Camden, have launched their own district-level smart city initiatives; these are not included in the present analysis, which focuses on the overall metropolitan area under the auspices of the GLA.)

The Smart London programme consists of three key strategic documents, accompanied by a burgeoning number of project-based initiatives (see Table 1, below). The programme was launched in 2013, following the GLA's participation in the national Future Cities Demonstrator competition in 2012 in which London was one of the runners-up behind the winning city of Glasgow (Scotland). The *Smart London Plan* (Mayor of London 2013) and the related progress report, *The Future of Smart* (Mayor of London 2016), form the overarching smart city strategy together with the *Data for London: A City Strategy for London* (Greater London Authority 2016). The Smart London Board, established in 2013, advises the Mayor of London on the implementation of the smart city strategy. The various practical initiatives can be grouped into four overlapping categories:

a) spatially anchored projects relating to district regeneration efforts, notably the London Olympic Park (dubbed 'London's smart sustainable district');
b) infrastructure networks pursuing cross-scalar integration, including the Smart London Districts Network (especially Croydon, Elephant & Castle, Imperial West, and the London Olympic Park) and the Smart London Infrastructure Network;

c) entrepreneurial governance initiatives centred upon identifying smart technology solutions for various urban challenges (eg Civic Crowdfunding);
d) open government initiatives aimed at increasing public engagement in urban policy- and decision-making (eg Talk London).

The latter two categories (c + d) are not tied to any particular geographical locations, but seek to enrol entrepreneurs (researchers, technology start-ups, small- and medium-sized businesses, large firms) and 'Londoners' (members of the public, community groups) from across the entire metropolitan area in various virtual assemblages.

Table 1: The Smart London programme

Strategy	Key Actors	Year (launch)
Smart London Plan	Mayor of London / Smart London Board	2013
The Future of Smart	Mayor of London / Smart London Board	2016
Data for London: A City Strategy for London	Mayor of London / London Assembly	2016
Projects	**Key Actors**	**Year (launch)**
London Datastore	Mayor of London / London Assembly	2010
Smart London Innovation Networks	Mayor / BRE / Institute for Sustainability	2014
London Olympic Park	London Development Legacy Corporation	2014
Talk London	Mayor of London / London Assembly	2015
Civic Crowdfunding	Mayor of London / Spacehive	2015
Infrastructure Mapping Application	Mayor of London	2015
Speed Volunteering	Mayor of London	2016
Tech Londoners: People Solving City Challenges	Mayor of London / London Assembly	2016

There is a close thematic link between smart digital innovation and the promotion of a green economy running through the Smart London programme. Environmental governance is, however, not seen as problematic in itself; rather, it is posited as a precondition for enabling the city's projected growth trajectory. The *Smart London Plan* (Mayor of London 2013), for example, emphasises the need for innovating in smart grids to manage increased supply and demand relating to

water, energy, transport and waste. In similar vein, the *Data for London* strategy (Greater London Authority 2016) espouses 'city data' as a new type of urban infrastructure to ameliorate existing infrastructure, such as transport and energy, based on more open and integrated decision-making. Apart from providing environmental benefits and upgrading urban infrastructure, a flourishing 'city data market' is posited in socio-economic terms as key to driving innovation in research, technology and business, as well as improving social service delivery (eg health care).

This high-level strategic framing of Smart London in terms of achieving green growth through digital technological innovation and governance is, then, also reflected in the various pilot initiatives and programmes put in place to implement the strategy. For example, the Talk London initiative recently featured a discussion forum on London's housing crisis and related policies aimed at increasing the number of houses built; another discussion strand engages with strategies and initiatives for local regeneration. The latter has also been a focus of the Civic Crowdfunding pilot programme, which emphasises support for unique, bottom-up place making initiatives, such as regenerating parkland, and turning brownfield land into organic urban farms.

Figure 7: Queen Elizabeth Olympic Park
Photograph by Fakhriazam Afsahi

EXAMPLES OF PROJECTS

A selection of initiatives which serve to implement the Smart London Plan are described below. Other initiatives listed in Table 1 can be viewed on the official website (Mayor of London/London Assembly nd a).

LONDON DATA STORE

The London Data Store (Greater London Authority nd) goes back to 2010 – that is, three years prior to the formal launch of the Smart London Plan – when it was first trialled as a pilot project to open up city data. As such, it was part of the 'open government' (or e-government) movement, which has subsequently been absorbed into the smart city rhetoric. By 2016, the online data store has grown to become one of the core pillars of the Smart London programme, providing open access to over 650 governmental (as well as some non-governmental) data sets. These are organised in distinct categories including arts, education, environment, planning and transport, among others. The facility also includes an integrated dashboard which allows online visitors to view data graphics and statistics concerning a range of indicators, such as rates of recycling, recorded crime and sports participation rates, and corresponding changes across time.

Reflecting the open, cross-institutional nature of the data sets, over a dozen organisations participate in the London Data Store, which is coordinated jointly by the London Assembly and the Mayor of London. Among the partners involved are the Open Data Institute, the World Council on City Data and the UK Future Cities Catapult.

The commitment to open data governance has recently been further underlined with the publication of *Data for London: A Strategy for London* (Greater London Authority 2016). The vision here is for London to have the most dynamic and productive 'city data market' in the world. City data, as a new form of urban infrastructure, is to be deployed to save money through improved governance efficiencies, incubate innovation and, thus, drive economic growth. Under the headline 'a broader culture is now needed', the document invokes citizens centrally as producers and consumers of data: "Citizens are an integral part of the City Data Market, responsible for a significant volume of London's city data. In the main, this data mostly comes from everyday interactions with services, social media, mobile devices, vehicles, and smart cards (ibid: 27)".

> URL:
> HTTP://DATA.LONDON.GOV.UK/

SMART LONDON INNOVATION NETWORKS

As set out in the Smart London Plan, two innovation networks have been put in place aimed at consolidating urban regeneration and facilitating knowledge exchange and collaboration among technology specialists, developers and utility companies. The first, the Smart London Districts Network, was established in 2014 and seeks to foster technological partnerships with four (already existing) major district-level regeneration projects: Croydon, Elephant & Castle, Imperial West, and the London Olympic Park. The site of the 2012 London Olympics and its surrounding area in East London had originally been proposed as the core element of London's participation in 2012 in the national Future Cities Demonstrator competition hosted by the Technology Strategy Board, the UK's national innovation agency (since renamed as Innovate UK). Subsequently, with the launch of the city's own Smart London Plan in 2013, the geographical focus was extended across the metropolitan area, to include the other regeneration hubs in Central, South and West London. All four are dubbed in the Smart London Plan as 'aspirational districts', meaning that they are identified as areas of urban growth opportunities in need of 'smart-sustainable' goals to be achieved through regeneration. In 2015, the London-based Institute for Sustainability (2015) was commissioned to run a competition for technology innovators to pitch ideas and potential solutions to the developers involved in the four regeneration projects. Awards went to a range of digital and physical innovation proposals, though it is not yet clear from the official website which of these are to be implemented on the ground.

The second network, the Smart London Infrastructure Network, was launched in 2015. Its focus is on cross-scalar infrastructure innovation, bringing together various utility companies (water, transport, energy, telecommunications, waste management) and digital technology innovators. Again, using several competition schemes, small businesses and entrepreneurs have been encouraged to pitch their proposals for digital applications to help map London's underground infrastructure network. The winners have subsequently been invited to present their potential solutions to utility companies, such as Thames Water and National Grid.

> URL:
> HTTP://SMARTERLONDON.CO.UK/NEWS/

TECH LONDONERS

Launched in early 2016, under the slogan 'people solving city challenges', this new initiative aims to bring 'Londoners' – understood here as registered community

groups and charities – and technology entrepreneurs together to co-create digital solutions to contemporary urban issues. The initiative is based on an online platform which invites visitors to register so that, depending on interests, they can be matched with other online participants. To facilitate the process, the programme prioritises certain themes; the first of these, under the rubric of well-being, is about finding digital solutions – products and services – to help people living with chronic conditions (such as diabetes, obesity, heart conditions).

The GLA initiative has been outsourced to Citymart (nd), an international urban consultancy. Current community group participants include Open Age, a charity working with older Londoners, and the Health and Wellbeing Institute at London South Bank University; among the technology entrepreneurs are St Health, a consortium of start-up companies specialising in health care, and SweatCoin, a smart phone/tablet application provider.

> URL: HTTP://WWW.CITYMART.COM/TECH-LONDONERS#TECH-LONDONERS/LANDING

SPEED VOLUNTEERING

Another initiative launched in early 2016, Speed Volunteering (Mayor of London/Team London nd b) centres upon a smart phone/tablet application which matches volunteers with people seeking help with various social activities (eg visiting elderly people, dog-walking) and environmental activities (eg tree planting) within local neighbourhoods. The application is geared towards one-off, short-input voluntary help – hence, 'speed volunteering'.

> URL: HTTPS://SPEEDVOLUNTEER.LONDON.GOV.UK/

TALK LONDON

This online platform (Greater London Authority nd) was launched in 2015 to widen public participation in political deliberation concerning 'big issues' affecting London. As such, the initiative is part of an effort to further open up City Hall policy- and decision-making to the general public. The platform runs a series of online surveys, blogs and discussion boards. Some of the surveys carried out are specific to the platform: for example, the GLA's London 2015 survey engaged over 4,000 participants over a period of one-month. Other surveys amplify reviews carried out elsewhere, such as a consultation on hire

vehicle policy run by Transport for London. Issues covered include crime and safety, health and wellbeing, transport, and the environment. In 2016, air pollution has been a key discussion topic, prompted by newly elected Mayor Sadiq Khan calling for urgent action to tackle this growing problem. Another recent discussion item has been the impact of Brexit (the UK referendum to leave the European Union) on the future of London.

> URL:
> HTTP://TALKLONDON.LONDON.GOV.UK/

REFERENCES (LONDON)

Citymart (nd) *Tech Londoners. People Solving City Challenges*. Online: http://www.citymart.com/tech—londoners#tech—londoners/landing (accessed 15 April 2016).

Greater London Authority (nd) *Data for London: A City Strategy for London*. Online: http://data.london.gov.uk/dataset/data-for-london-a-city-data-strategy (accessed 15 April 2016).

Greater London Authority (nd) *London Data Store*. Online: http://data.london.gov.uk/ (accessed 15 April 2016).

Greater London Authority (nd) *Talk London*. Online: http://talklondon.london.gov.uk/ (accessed 15 April 2016).

Institute for Sustainability (2015) *Competition winners pitched tech innovations to some of London's biggest redevelopment projects*. Online: http://www.instituteforsustainability.co.uk/news/17—Sep—2015.html (accessed 15 April 2016).

Mayor of London (2013) *Smart London Plan*. Online: http://www.london.gov.uk/sites/default/files/smart_london_plan.pdf (accessed 15 April 2016).

Mayor of London (2016) *The Future of Smart. Update Report on the Smart London Plan*. Online: https://www.london.gov.uk/sites/default/files/gla_smartlondon_report_web_4.pdf (accessed 15 April 2016).

Mayor of London/London Assembly (nd a) *Smart London*. Online: https://www.london.gov.uk/what-we-do/business-and-economy/science-and-technology/smart-london (accessed 15 April 2016).

Mayor of London/London Assembly (nd b) *Crowdfunding Pilot Programme*. Online: https://www.london.gov.uk/what—we—do/regeneration/funding—opportunities/crowdfunding—pilot—programme (accessed 15 April 2016).

Mayor of London/Team London (nd) *Speed Volunteering*. Online: https://speedvolunteer.london.gov.uk/ (accessed 15 April 2016).

NESTA (2015) *CITIE. City Initiatives for Technology, Innovation and Entrepreneurship*. Report no 20. London: NESTA. Online: http://citie.org/assets/uploads/2015/04/CITIE_Report_2015.pdf (accessed 15 April 2016).

Smarter London (nd) *Smart London Innovation Networks*. Online: http://smarterlondon.co.uk/news/ (accessed 15 April 2016).

MANCHESTER

Author: Robert Cowley

Manchester projects confidence both of its position as the UK's 'second city', and of its prominence among the city regions making up the 'Northern Powerhouse' envisioned by the UK national government. Its longer history of digital innovation, and established networks of relevant cross-sectoral actors, have put it in a strong position to fund and implement a wide range of smart and low-carbon initiatives on the ground.

The City of Manchester recently published a *Smarter City Programme* (Manchester City Council 2016a) which consolidates a variety of 'smart' activities taking place in the region. This programme consciously draws on the submission made to the national government's 2012 'Future Cities Demonstrator' competition (Manchester City Council 2013: 1), which focused on the potential for Manchester's Oxford Road 'Corridor' to be developed around "five interlocking themes, namely enhanced low carbon mobility, clean energy generation and distribution, more efficient buildings, integrated logistics and resource management as well as community and citizen engagement" (TSB 2013: 44). One of the strategic aims of the Corridor Manchester partnership, meanwhile, is to develop smart city infrastructure and services, with the following objectives (Corridor Manchester 2015: 27):

1. to reduce the carbon footprint of Corridor Manchester through the more sustainable management of energy and waste
2. to be leading-edge creators using information technologies and social media to engage actively with the work of institutions and companies, public services, and the daytime and evening economy for visitors and residents
3. to integrate green and smart ideas into new development and investment proposals.

The 2km Corridor runs south from Manchester's Central Business District, taking in the city's two universities, the Central Manchester University Hospitals NHS Foundation Trust, Manchester Science Partnerships (MSP), various cultural institutions including the Royal Northern College of Music and Whitworth Art Gallery, and various hi-tech and engineering companies of different sizes. Corridor Manchester, established as an incorporated body in July 2007 (CAICT 2014: 131), hopes the district will continue to attract 'knowledge workers' to become "one of the top five innovation districts in Europe, coupled with the economic momentum of the city's economy and

devolution" (Corridor Manchester 2015: 4), achieving "local and global recognition as a place that is original, creative and smart, where knowledge is put to work" (Corridor Manchester 2015: 4).

While two significant projects are taking place on Corridor Manchester ('Triangulum' and 'CityVerve'), the council's *Smarter City* programme showcases a wider range of initiatives around the city, addressing various social and environmental issues. These include an intelligent street lighting initiative, a network of stakeholders interested in developing hydrogen fuel cells, the 'Ebb & Flow Energy Systems' project to support electric vehicles at Manchester Science Park, and the 'MiGuide' digital street wayfinding service currently operational in the city centre. Its embrace of 'New Technologies' (Manchester City Council, 2016a), exemplified by "sensors, LED lighting, smart ticketing, or low carbon technology such as electric vehicles or solar panels" (Manchester City Council 2016a), is complemented by the principle of 'New Ways of Working' (integrating systems, exploiting big data to manage the city in real time, and providing better information for residents, workers and policy-makers).

Figure 8: one of the MiGuide digital information points in Manchester City Centre
Photograph: Fakhriazam Afsahi

Manchester has a longer history of digital initiatives associated with its Digital Development Agency (MDDA), established in 2003 and disbanded in 2015, and previous digital strategies published in 2008 and 2012. Older initiatives associated with MDDA include the establishment of the European Network of 'Living Labs', whose achievements in Manchester included the development of an interactive local news and information web portal in East Manchester in 2002; and the Manchester Digital Laboratory (MadLab), a grassroots organisation promoting digital skills and experimentation (MadLab nd). The city's open data platform DataGM has been operational since 2011. Meanwhile, its climate change action plan (*Manchester – A Certain Future*), first launched in 2009, aims for a 41% reduction in CO_2 emissions by 2020 (based on 2005) and to develop "a 'low-carbon culture' in the city, prepare for and adapt to a rapidly changing climate and help to facilitate a quick transition to a low-carbon economy" (Manchester City Council 2015: 144).

A longstanding and dense network of actors from different sectors are active in shaping Manchester's activities. Manchester City Council is active in, or lends its support to much of this activity, with most other boroughs in the Greater Manchester area apparently playing a more passive role, for example by contributing open data sets. Following the demise of the MDDA, the current *Smarter City* programme might be interpreted as an attempt to reclaim ownership over, and broaden, the smart agenda, which would otherwise be centred on the Manchester Corridor. Alongside the various high-profile public and private sector actors, NGO Future Everything, established as long ago as 1995, plays a leading role in several ongoing initiatives. It "champions the role of grassroots innovation in the digital creative economy" (FutureEverything nd), and holds regular events including an annual festival of digital culture.

National funding has played an important role in Manchester's smart-eco activities. For example, the case studies showcased within the *Smarter City Programme* include: a city-wide urban sensing network, for which the council is currently working with the national Future Cities Catapult programme to secure funding (Manchester City Council 2016b); the Central Library Digital Demonstrator (a drop-in centre providing access to and education about different digital technologies), enabled by the national Urban Broadband Fund (Manchester City Council 2016c); and the previously mentioned Ebb & Flow Energy Systems project, funded by Innovate UK and the national Engineering and Physical Sciences Research Council (Manchester City Council 2016c). However, rather more obvious networked links are apparent with international actors – most obviously in the Triangulum collaboration with other European cities, but also through Manchester's strong links with the Chinese

City of Wuhan, with which it is currently collaborating in the development of smart city solutions, and its leading role in the UK-China Smartcities Initiative, a recently launched programme to "produce a blueprint for smart green city governance that will lead the way in developing more smart green cities in China, while also fostering UK-China cooperation and opening up business opportunities for UK SMEs" (UK-China Smartcities nd a).

Figure 9: Oxford Road, Manchester
Image provided by Corridor Manchester Ltd

EXAMPLES OF PROJECTS

So as to capture some of the variety of smart-eco activity taking place in Manchester, three rather different initiatives are described below: Triangulum, an EU-funded district-wide retrofitting scheme; CityVerve, describing itself as Manchester's 'Internet of Things Demonstrator' and funded by national government; and Smarter Citizen Manchester, an attempt to crowdsource sensor technologies.

TRIANGULUM

The Triangulum project, formally launched in 2015, aims to transform urban areas into 'smart quarters' in three European cities: Manchester (UK), Eindhoven (Holland) and Stavanger (Norway). Following assessment, the concept will be transferred to three 'follower cities': Leipzig (Germany), Prague (Czech Republic), and Sabadell (Spain). Manchester has recently invited the Chinese city of Tianjin to be an 'observer' of the project (UK-China Smartcities nd b). Triangulum is funded by the European Commission, which hopes to "demonstrate cutting-edge smart city technologies and roll them out across the world" (University Living Lab nd). It explicitly aims to "demonstrate 'smart green growth' – reducing carbon emissions while boosting the economy" (University Living Lab nd).

In Manchester specifically, the project team aims to integrate mobility, energy and ICT systems around three existing infrastructural assets belonging to the Corridor partners: the Civic Quarter Heat Network, University of Manchester Electricity Grid, and the Manchester Metropolitan University Electricity Grid (Triangulum nd). A range of integrated digital energy management technologies will be introduced to demonstrate the potential for supplying, storing and using energy more effectively in an urban district. Triangulum will build on data visualisation techniques developed as part of the EU-funded DIMMER project (a pilot scheme running simultaneously in Oldham and Turin), which was intended to be used as a modelling tool for energy planning scenarios and to optimise energy production and consumption, through the use of real-time data. According to Manchester City Council (2016c), DIMMER will be piloted in several more GM areas.

The Manchester demonstration will be innovative partly because of the heritage status of many of the buildings involved – "a sector that until now has proved a major challenge in terms of carbon reduction" (Triangulum nd). The project additionally aims to explore the potential benefits of the city's programme of removing cars from Oxford Road, in terms of improving freight logistics, and providing infrastructure for electric cars.

Triangulum's Manchester activities are being led by the City Council, in partnership with University of Manchester, Manchester Metropolitan University, Siemens, and digital technology company Clicks and Links. The University of Manchester is leading the monitoring element of the project as a whole, in order to help Fraunhofer IAO (a German institute for Industrial Engineering) to transfer the concept to the three 'follower cities' (Siemens 2015).

The total funding for Triangulum from the European Commission is €25m (c.£20m), of which the Manchester project will receive £4.5m over 5 years. The participating cities were chosen from all those responding the European Commission's 'Smart Cities and

Communities' Horizon 2020 funding call (Roue 2015).

> URL: HTTP://UNIVERSITYLIVINGLAB.ORG/NEWS/HORIZON-2020-TRIANGULUM-DEMONSTRATE-DISSEMINATE-REPLICATE-SMART-GREEN-GROWTH

CITYVERVE

CityVerve was launched in 2016 after beating 21 other entries in a 2015 national competition held by the national Department for Culture, Media and Sport. Its £10m of funding forms part of a £40m government investment in Internet of Things technology, announced in March 2015.

It aims to "demonstrate applications of Internet of Things technologies and services in four key areas: healthcare; transport; energy and environment; and culture and community. It will demonstrate a smart city at scale, aiming to provide a replicable model for other cities in the UK and beyond" (UK Government 2015). Specific planned applications will be demonstrated in the Manchester Corridor, and include: 'talkative bus stops' (with digital signage and sensors, and allowing passengers to 'check in' to receive information and provide bus operators with information about numbers waiting); smart street lighting; a crowdsourced and crowd-maintained bike sharing scheme; air quality sensors in street furniture; a 'Community Wellness' network of sensors in parks along the main school and commuter routes to encourage exercise; and a 'biometric sensor network' to help manage chronic respiratory conditions (UK Government 2015).

CityVerve is a partnership between the City Council, the University of Manchester, Manchester Metropolitan University, Central Manchester University Hospitals NHS, Transport for Greater Manchester, Manchester Science Partnerships (a science park operator), Ordnance Survey, along with a variety of private companies including both large technology and telecoms companies (Cisco UK, BT, and Siemens) and various SMEs, including FutureEverything (MSP 2015), which is involved in a number of other 'smart' initiatives in Manchester including the Smart Citizen Manchester project outlined below.

> URL: HTTPS://WWW.GOV.UK/GOVERNMENT/NEWS/MANCHESTER-WINS-10M-PRIZE-TO-BECOME-WORLD-LEADER-IN-SMART-CITY-TECHNOLOGY

SMART CITIZEN MANCHESTER

The Smart Citizen Manchester project aims to follow the examples of Barcelona and Amsterdam by creating a community of citizens who are "active in capturing, sharing, making sense of data on their local city, through the development of low-cost sensors" (FutureEverything 2014). It aims "to serve as a node for building productive open indicators and distributed tools, and thereafter the collective construction of the city for its own inhabitants" (FutureEverything 2014).

The initiative is being jointly led by Intel and FutureEverything, an independent organization established in 1995. The low-cost sensoring equipment runs on open-source software and can be powered by a solar panel. It measures CO and NO_2 levels, temperature, humidity, sound levels and light intensity, and streams data by wifi for collation (Smart Citizen nd). Through a web interface, participants can see data from all the installed sensors in their own city and elsewhere in the world. It envisages sensors being installed within a three-mile radius of the city centre. The sensoring equipment was developed by Fab Lab Barcelona (a small digital innovation and production centre at the educational Institute for Advanced Architecture of Catalonia).

An initial public training event was held in May 2014, at which a limited number of sensors were provided for free, and the organisers say that further training and publicity events are planned (though no dates appear to have been published for these). As of April 2016, the Smart Citizen international website suggests that 28 sensors have been installed in the Greater Manchester area (of a total of 560 in Europe and 828 worldwide). Since the organisers have not publicised the uptake of the sensors or the growth of the 'community' in Manchester, it might be presumed that – to date – broader interest in participation has been limited.

URL:
HTTP://FUTUREEVERYTHING.ORG/NEWS/SMART-CITIZEN-MANCHESTER/

REFERENCES (MANCHESTER)

CAICT [China Academy of Information and Communications Technology & EU-China Policy Dialogues Support Facility II (PDSF)] (2014) *Comparative Study of Smart Cities in Europe and China 2014*. Current Chinese Economic Report Series. Berlin: Springer.

Corridor Manchester (2015) *Corridor Manchester – A Decade of Opportunity: Strategic Vision to 2025*. Online: http://www.corridormanchester.com (accessed 12 March 2016).

FutureEverything (2014) *FutureEverything is bringing Smart Citizen to the UK with Intel*. Online: http://futureeverything.org/news/futureeverything-bringing-smart-citizen-uk-intel (accessed 12 March 2016)

GMDSP (2013) *Welcome to the Greater Manchester Data Synchronisation Programme*. Online: http://gmdsp.org.uk/2013/10/welcome-greater-manchester-data-synchronisation-programme/ (accessed 7 April 2016).

Manchester City Council (2013) *Smart Cities*. Report for Resolution. Presented to Economy Scrutiny Committee, Item 6, 11 December. Online: www.manchester.gov.uk/download/meetings/id/16126/6_smart_cities (accessed 12 March 2016).

Manchester City Council (2015) *Manchester's State of the City Report*. Online: http://www.manchester.gov.uk/download/downloads/id/23570/84325_state_of_the_city_2015_complete.pdf (accessed 25 March 2016).

Manchester City Council (2016a) *Manchester Smarter City Programme*. Online: http://www.manchester.gov.uk/info/500315/smarter_city/7013/manchester_smarter_city_programme (accessed 25 March 2016).

Manchester City Council (2016b) *Sensing Manchester*. Online: http://www.manchester.gov.uk/site/custom_scripts/smarter_city/case_studies.php?id=138650 (accessed 10 April 2016).

Manchester City Council (2016c) *Central Library Digital Demonstrator*. Online: http://www.manchester.gov.uk/site/custom_scripts/smarter_city/case_studies.php?id=138635 (accessed 10 April 2016).

MSP (2015) *Manchester announced as UK's Internet of Things (IoT) City Demonstrator and awarded £10m investment*. Online: http://www.mspl.co.uk/manchester-announced-as-uks-internet-of-things-iot-city-demonstrator-and-awarded-10m-investment/ (accessed 10 April 2016).

Roue, L. (2015) Siemens announced as technology partner for landmark project. *Manchester Evening News*, 12 Feb. Online: http://www.manchestereveningnews.co.uk/business/siemens-announced-technology-partner-landmark-8621188 (accessed 10 April 2016).

Siemens (2015) *Siemens supports Manchester's smart city vision: Energy firm selected as technology partner for Triangulum project*. Press release. Online: https://www.siemens.co.uk/en/news_press/index/news_archive/2015/siemens-supports-manchesters-smart-city-vision.htm (accessed 12 March 2016).

Smart Citizen (nd) *About*. Online: https://smartcitizen.me/about#hardware (accessed 10 April 2016).

Triangulum (nd) *City of Manchester, United Kingdom*. Online: http://triangulum-project.eu/index.php/lighthouse-cities/city-of-manchester-united-kingdom (accessed 13 March 2016).

TSB (2013) *Future Cities Demonstrator Competition – Feasibility Studies: Interim Report*. Technology Strategy Board / Future Cities Catapult. Online: https://connect.innovateuk.org/documents/3130726/6091879/Future+Cities+Feasibility+Studies++Interim+Report.pdf/4ab345d6-105c-4a88-867f-12e7b976780b (accessed 13 March 2016).

UK-China Smartcities (nd a) *Overview*. Online: http://uk-chinasmartcities.com (accessed 7 June 2016).

UK-China Smartcities (nd b) *Tianjin joins Manchester in EU flagship Lighthouse project Triangulum*. Online: http://uk-chinasmartcities.com/?p=247 (accessed 7 June 2016).

UK Government (2015) *Manchester wins £10m prize to become world leader in 'smart city' technology*. Press Release, 3 Dec. Online: https://www.gov.uk/government/news/manchester-wins-10m-prize-to-become-world-leader-in-smart-city-technology (accessed 13 March 2016).

University Living Lab (nd) *Triangulum: creating smarter cities*. University Living Lab, University of Manchester. Online: http://static.universitylivinglab.org/sites/default/files/Triangulum_0.pdf (accessed 14 March 2016).

MILTON KEYNES

Author: Li Yu

Milton Keynes (MK) is perhaps the best known example of the UK's post-WWII 'New Towns' built in an attempt to disperse the London population. It was established in the late 1960s, incorporating and expanding a series of small towns and villages 45 miles to the north west of the capital. Its local authority area now has a population of approximately 250,000, with further growth planned in the coming years. Its 'eco' characteristics can be traced back to the early period of New Town development, and particularly its master plan adopted in 1972. In many ways, this early planning was well aligned with current ideals of sustainable development: there was a strong emphasis on liveability, with provision for abundant open and green spaces, and the 1970s saw a series of innovative experiments in the field of low and efficient energy design, such as focusing the sun's rays to heat water and building interiors. Additional innovations have included its system for managing surface water run-off to avoid flooding, and the so-called "Redway System", a dedicated road network for pedestrian and cyclists (Milton Keynes Development Corporation 1992). Leading by planning policies and design guidelines, Milton Keynes has:

- formed its spatial structure in grid squares, in line with its design principle of easy movement between homes, jobs and facilities;
- offered a mix of size, density, tenure and prices to meet different needs and income groups when planning and developing its housing blocks;
- attempted to mitigate potential damage to the natural environment, particularly through the natural drainage system at its earlier planning and development stage.

In the 21st Century, Milton Keynes has confronted the challenges of supporting sustainable urban and economic growth without exceeding the capacity of the infrastructure, and met key carbon reduction targets.

Recent strategies, experimental projects and other activities indicate that the 'smart' in MK has become closely intertwined with the 'eco', particularly around the low carbon agenda, with a clear focus on maintaining the city's strong economic and population growth. In 2012, it submitted its *Future Ready MK* feasibility study to the Future Cities Demonstrator competition organised by the Technology Strategy Board (the national innovation agency at the time). This study positioned MK as having clear smart-eco ambitions: it stated the aim to become the UK's "leading digital city" (Milton Keynes Council 2012: 10), with an "unambiguous objective, backed with integrated city planning, to reduce its

carbon footprint with an energy-efficient high-tech knowledge" (Milton Keynes Council 2012: 3). Although the proposal did not win funding, the city has since launched a Future City programme, with key partners including the Open University as project leader, and the University of Bedfordshire; businesses (eg BT, Dell, E.ON, HR Wallingford and Anglian Water); and local communities (Milton Keynes Council nd). The council promotes the programme as "implementing city-scale operational capabilities along with a 'test-bed' environment for new technologies and business models. It is at the leading edge of the Government's economic strategy and its aim of releasing the economic potential of big data, one of the 'eight great technologies' identified by The Rt Hon David Willetts MP as priority enablers to promote future growth" (Milton Keynes Council nd: 4).

The Future City programme is centred on the MK:Smart project (described below), but it also includes the Low Carbon Urban Transit Zone driverless cars research initiative, an anaerobic digestion plant, a combined heat and power plant, and the FALCON smart grid (all of which are also described below); and a series of other initiatives including:

- Plugged in Places (providing electric charging infrastructure for transport)
- a Residual Waste Treatment Facility (opened in 2015 and providing energy for 12,000 homes)
- digital connectivity schemes (including a free to use wireless broadband in the city centre)
- a satellite data demonstrator programme (for use by local authority service providers and businesses).

Two further initiatives are also described below as examples of the broader range of smart-eco activities taking place in the city: a trial smart parking scheme, and the planned Tattenhoe neighbourhood.

Figure 10 Central Milton Keynes
Source: Green Digital Charter
http://www.greendigitalcharter.eu/wp-content/uploads/2012/10/Milton-Keynes.jpg

EXAMPLES OF PROJECTS

MK:SMART

The MK:Smart project (with a budget of £16m, including a grant of £8m from the Higher Education Funding Council for England) is being led by the Open University. At its heart is the MK Data Hub, designed to integrate data on energy and water consumption, transport, weather and pollution, alongside existing socio-economic datasets, and crowdsourced information from social media and specialised apps (MK:Smart nd a). Over 70 sensors across the city currently feed into the Data Hub, collecting information on topics as diverse as soil moisture, water levels, car park occupancy, recycling bin use, and weather conditions (Cooter 2016). These integrated datasets will be analysed for the purposes of developing innovative solutions to demand issues in transport, energy and water management (ibid).

Alongside these technical ambitions, it has several other aims. First, to encourage local businesses to make use of the solutions thus developed (MK:Smart nd a),

with the datasets being made available to third-party app developers and SMEs (Cooter 2016). Second, to "empower students and practitioners with the skills and competences needed to participate in the creation of a smart city" (MK:Smart nd a) by providing training to local schoolchildren, higher education students, and the business community. And third, to establish a "Citizen Lab" to engage local residents in "innovation-centric decision-making processes" (ibid). The citizen engagement programme aims to "hear and act on what MK citizens think would make our city more sustainable" (MK:Smart nd b). This is being achieved by analysing face-to-face conversations alongside comments and feedback received via the specially designed 'Quick Chat' app; and through the online 'ideation platform' Our MK (ibid), which publishes selected proposals and ideas received from the public, and allows them to be voted on and discussed. Our MK claims thereby to demonstrate the potential for digital tools to "empower citizens to take the lead in conceiving of and running bottom-up initiatives, with implications for Smart City projects across the UK and internationally" (ibid).

In 2015, the MK:Smart project won the Best of Show Prize at the VMWorld Europe User Awards, and was a finalist in the awards at the Smart Cities World Expo in Barcelona (the overall 'Smart City of the Year 2015' prize went to Peterborough). After winning the VMWorld prize, Geoff Snelson, the Director of Strategy at Milton Keynes Council commented that "*Overall the MK:Smart initiative is forecast to make savings of 20 per cent in water use and almost three per cent in energy use, with 50 per cent less traffic congestion and reduced fuel use and vehicle emissions. Smart parking will contribute significantly to that latter area*". The ongoing backing given by the UK government to smart city initiatives was reflected the comment made by Corin Wilson, Head of Smart Cities at UKTI (the national trade and investment body) that "*This valuable recognition of our cities and the collaboration between local government, education and business really demonstrates that the UK is a leader in this domain*" (UK Government 2015).

> URL: HTTP://WWW.MKSMART.ORG/

LOW CARBON URBAN TRANSPORT ZONE

The Low Carbon Urban Transport Zone (LUTZ) is a research and development programme in which three driverless 'pod' cars are being trialled in pedestrian areas of the city centre. It is intended that the trial will lead to the introduction of a larger fleet of pods (40) in Milton Keynes and Coventry, along with other driverless road vehicles Catapult Transport Systems (nd).

LUTZ is being developed by the Intelligent Mobility Working Group (IMWG) of the UK Automotive Council. It is supported by two national government departments (Business, Industry & Skills, and Transport), as well as the Transport Systems Catapult (one of seven centres established by Innovate UK, the current national innovation agency, to support growth in targeted areas of hi-tech industry). The council describes the overall objectives of the project as follows (Milton Keynes Council nd: 2):

- to "explore the potential for Intelligent Mobility to deliver early benefits within 5 years and substantial benefits to the UK transport system by 2030"
- to "demonstrate the ability of the UK to perform at the leading edge of transport innovation"
- to "do something demonstrably 'smarter' – than anything seen elsewhere in the world, including autonomous and on-demand services – and explore the extent to which they might offer solutions for the challenges of urban mobility in the 21st century".

URL: HTTPS://TS.CATAPULT.ORG.UK/CURRENT-PROJECTS/SELF-DRIVING-PODS/LUTZ-PATHFINDER-AUTOMATED-PODS-PROJECT-FAQ/

ANAEROBIC DIGESTION PLANT

A new anaerobic digestion plant is being built to generate renewable energy from local municipal waste. The facility will be able to process more than 25,000 tonnes of food and garden waste, which is the total annual volume in Milton Keynes at the moment, with capacity to cope with further increases in next 5 -7 years (Milton Keynes Council 2010: 21). It is due to be fully operational in September 2016 (Milton Keynes Council 2015a).

This project has been supported a grant of £1.5 million from the Low Carbon Infrastructure Fund, set up by the government's Home & Communities Agency (HCA), towards the addition of a 'gas scrubber' to the plant. This will increase the amount of renewable gas available to residents by allowing biogas from the plant to be injected directly into the local network, and has never previously been implemented in the UK (Milton Keynes Council 2010: 21).

URL: HTTP://WWW.ZEROCARBONHUB.ORG/SITES/DEFAULT/FILES/RESOURCES/REPORTS/MILTON_KEYNES_A_SUSTAINABLE_FUTURE-A_LOW_CARBON_PROSPECTUS.PDF

COMBINED HEAT AND POWER PLANT

Milton Keynes has developed a 6 megawatt Combined Heat and Power plant (CHP). CHP systems can reduce total fuel usage and protect the environment by reducing carbon dioxide emissions. The CHP is connected to the mains power grid for back-up electricity, with excess electricity sold back to energy companies. This system was designed to generate and supply electricity and heat to certain commercial and housing areas in the West End and central business district of Central Milton Keynes (Milton Keynes Council 2010: 21), and now provides energy to three large mixed-use developments (HCA nd).

> URL: HTTP://UDC.HOMESANDCOMMUNITIES.CO.UK/MILTON-KEYNES-CHP

FALCON SMART GRID

The FALCON smart grid trial project was supported by a £13m grant from the government's gas and electricity regulator OFGEM, and delivered by Western Power Distribution, an electricity provider, in partnership with Cranfield University and the Open University. It was launched in 2011, and completed in 2015.

The project aimed to test ways of optimising the power network, with a particular focus on the risks of blackouts due to increased future demand, and the problems of variability in the output from new low carbon energy generation technologies, and the implications of new technologies such as electric vehicles and heat pumps for the energy grid (Milton Keynes Council nd: 2-3).

> URL: HTTPS://WWW.WESTERNPOWERINNOVATION.CO.UK/PROJECTS/FALCON.ASPX

SMART PARKING

This pilot initiative, taking place in 2015 and designed by technology company Deteq in collaboration with BT, involved the installation of 300 sensors to manage the use of short-term parking spaces at Milton Keynes railway station. It allowed information to be provided information on roadside displays and smartphone apps to guide vehicles towards available parking spaces. As well as optimising the use of existing parking infrastructure, 'smart parking' systems of this type potentially reduce fuel consumption and emissions from vehicles driving around in search of spaces.

The sensors, powered by lithium-ion batteries with a lifespan of over four years, monitor vehicle movements. After detecting an arrival or departure, the sensors send information wirelessly to

lamppost mounted solar-powered repeaters. These aggregate the data and transmit it over the internet to the MK Data Hub, where it is processed, with the resulting analysis made available on the Milton Keynes Council public information dashboard. The information is also available on smartphones, with parking bay status displayed as red (occupied) or green (free) via an overlay to Google maps.

Later in 2015, the council announced that a further 200 sensors were to be introduced in the city's Grafton Gate/Avebury Boulevard car park, for a six-month trial period, with the hope of eventually covering all 20,000 parking spaces in central Milton Keynes (Milton Keynes Council 2015b).

> URL: HTTP://WWW.GLOBALSERVICES.BT.COM/STATIC/ASSETS/PDF/CASE_STUDIES/EN_NEW/MILTON_KEYNES_CASE_STUDY.PDF

TATTENHOE PARK

This planned new neighbourhood will provide approximately 1,300 new homes, with shops and community facilities, allotment gardens and public open space. A new primary school has already been completed.

The aim is to deliver an environmentally friendly and attractive neighbourhood development, which is well connected with surrounding neighbourhoods and the wider city. Much of the open space in the area has already been landscaped; and the primary infrastructure (roads and services) has been constructed. To manage surface water run-off, a Sustainable Urban Drainage System (SUDS) consisting of a series of waterways and ponds is adopted. Smart metering technology will be provided in the area together with other planned smart grid applications in order to test ways of lowering carbon emissions.

> URL: HTTP://WWW.TATTENHOEPARKHOMES.CO.UK/

REFERENCES (MILTON KEYNES)

BT (2014) *Smart Parking in Milton Keynes: Innovative parking space pilot project*. Online: http://www.globalservices.bt.com/static/assets/pdf/case_studies/EN_NEW/milton_keynes_case_study.pdf (accessed 6 April 2016).

Catapult Transport Systems (nd) *LUTZ Pathfinder automated pods project – FAQ*. Online: https://ts.catapult.org.uk/current-projects/self-driving-pods/lutz-pathfinder-automated-pods-project-faq/ (accessed 4 July 2016).

Cooter, M. (2016) Taking a closer look at the Milton Keynes smart city project. *Computer Weekly*, 11 January. Online: http://www.computerweekly.com/news/4500270203/Taking-a-closer-look-at-the-Milton-Keynes-smart-city-project (accessed 7 April 2016).

HCA (nd) *Milton Keynes CHP: Combined Heat and Power (CHP) system. Impact.* Homes & Communities Agency. Online: http://udc.homesandcommunities.co.uk/milton-keynes-chp (accessed 7 July 2016).

Milton Keynes Development Corporation (1992) *The Milton Keynes Planning Manual*. Milton Keynes: Chesterton Consulting.

Milton Keynes Council (2010) *Milton Keynes: A Sustainable Future. A Low Carbon Prospectus*. Online: http://www.zerocarbonhub.org/sites/default/files/resources/reports/MiltonKeynesASustainableFuture-ALowCarbonProspectus.pdf (accessed 5 July 2016).

Milton Keynes Council (2015a) *Milton Keynes Waste Recovery Park is really starting to take shape*. Press Release, 2 January. Online: https://www.milton-keynes.gov.uk/pressreleases/2015/jan/milton-keynes-waste-recovery-park-is-really-starting-to-take-shape (accessed 7 July 2016).

Milton Keynes Council (2015b) *Be part of our parking trial: 6-month pilot scheme to test parking sensors in CMK. Online*: https://www.milton-keynes.gov.uk/assets/attach/25519/Parking%20Sensor%20Pilot.pdf (accessed 7 July 2016)

Milton Keynes Council (nd) *Milton Keynes Future City Programme*. Online: http://milton-keynes.cmis.uk.com/milton-keynes/Document.ashx?czJKcaeAi5tUFL1DTL2UE4zNRBcoShgo=URPrSMWuvbnM%2BQDM4jYE0g1P6HNk%2FqvzqIRl%2Fmiw0Jkr5lXH3ZvTZw%3D%3D&rUzwRPf%2BZ3zd4E7Ikn8Lyw%3D%3D=pwRE6AGJFLDNlh225F5QMaQWCtPHwdhUfCZ%2FLUQzgA2uL5jNRG4jdQ%3D%3D&mCTIbCubSFfXsDGW9IXnlg%3D%3D=hFflUdN3100%3D&kCx1AnS9%2FpWZQ40DXFvdEw%3D%3D=hFflUdN3100%3D&uJovDxwdjMPoYv%2BAJvYtyA%3D%3D=ctNJFf55vVA%3D&FgPlIEJYlotS%2BYGoBi5olA%3D%3D=NHdURQburHA%3D&d9Qjj0ag1Pd993jsyOJqFvmyB7X0CSQK=ctNJFf55vVA%3D&WGewmoAfeNR9xqBux0r1Q8Za60lavYmz=ctNJFf55vVA%3D&WGewmoAfeNQ16B2MHuCpMRKZMwaG1PaO=ctNJFf55vVA%3D (accessed 7 April 2016).

MK:Smart (nd a) *About*. Online: http://www.mksmart.org/about/ (accessed 4 July 2016).

MK:Smart (nd b) *Citizens*. Online: http://www.mksmart.org/citizens/ (accessed 4 July 2016).

NHBC (2010) *Milton Keynes: A Sustainable Future. A Low Carbon Prospectus*. Online: http://www.zerocarbonhub.org/sites/default/files/resources/reports/Milton_Keynes_A_Sustainable_Future-A_Low_Carbon_Prospectus.pdf (accessed 7 April 2016).

UK Government (2015) *UK's Smart Cities recognised as World Class*. Online: https://www.gov.uk/government/news/uks-smart-cities-recognised-as-world-class (accessed 11 April 2016).

NEWCASTLE

Author: Robert Cowley

Newcastle's 'eco' and 'smart' ambitions are interwoven very consciously in the service of economic development. These ambitions are being realised within a very visible and clearly defined area of the city centre, Science Central, which is actively promoted as a flagship / laboratory for North East region as a whole.

The city of Newcastle has a population of just under 300,000, and sits within the Tyneside urban conurbation of almost 900,000. Since the 1970s, it has suffered from the decline of heavy industry, but has made efforts to promote itself as a centre for hi-tech and low-carbon industries. Policies and promotional materials relating both to the Science Central project and the broader economic strategies for the city region mobilise a narrative of continuity with, but transformation of, the city's industrial heritage. The symbolic charge of Science Central being developed on the site of a brewery and a nineteenth-century coal mine is exploited in the documentation.

Figure 11: The River Tyne in Newcastle City Centre
Photograph: JimmyGuano via Wikimedia Commons
https://commons.wikimedia.org/wiki/File:Newcastle-upon-Tyne-bridges-and-skyline_cropped.jpg

Newcastle and Gateshead jointly published an economic and spatial strategy in 2010, announcing the ambition to become a 'low-carbon city' region, conceived of both in terms of ongoing reduction of carbon emissions and playing "a leading role in developing low-carbon technologies for the world" (1NG 2010: 10). Newcastle agreed a *City Deal* in 2012, as part of the national Government's broader

devolution strategy, which accorded it the policy status of 'low carbon pioneering city', including a carbon reduction target of 34% by 2020 (UK Government 2012: 16). The *City Deal* also created an 'Accelerated Development Zone' focused on four sites in the city centres of Newcastle and Gateshead, in which business-rate income has been ring-fenced to encourage redevelopment. Among these, the Science Central development in Newcastle is a 9.7-hectare flagship project dedicated to the development of digital and low carbon technologies, with a strong urban sustainability innovations framing.

SCIENCE CENTRAL

Science Central describes itself as a 'test bed' for new digital technologies with environmental applications, which aims to be a "global centre for urban innovation" (Science Central 2016). As well as being a centre for research and development, it also promotes itself as a 'living laboratory' in which smart technology can be trialled and brought to market. The initiatives already based there include the 'Cloud Innovation Centre', and a National Institute for Smart Data Innovation. Its 18 plots will house commercial and technology lab space and some residential units. Notable buildings will include 'The Key' (an eco-friendly 'bubble building'), a Conference and Learning Centre, and an Urban Sciences Building housing a grid-connected energy storage test bed, a 'Decision Theatre' which will "facilitate public and stakeholder engagement around urban sustainability" (Science Central 2015:7), and an 'Urban Observatory' collating data from around the city to inform planning decisions and emergency services. Prior to the development, the university had dug a 1,800 bore hole on the site with the potential to provide the site and surrounding area with geothermal energy. The Core building was opened in November 2014 and, as of March 2016, is reported as almost fully occupied, with some research labs operating on site in The Key, and construction of the Urban Sciences Building underway. The whole development is due to be complete by 2018.

The main actors involved are Newcastle University and Newcastle City Council, building on an existing long-term 'Science City' partnership established to "maximise the North East's scientific potential, raising awareness of the region's scientific expertise across the world" (NSC Partnership nd). The development is also backed by Dynamo (an industry-led initiative to promote the regional tech sector). Organisations partnering on infrastructural research projects include Northumbrian Water, Northern Powergrid, and the Tyne and Wear Urban Traffic Management Control Centre, while private sector technology partners include Siemens, Philips, Microsoft and Zero Carbon Futures.

As well as being backed by national Government through the 2012 Newcastle City Deal, it received further funding for

infrastructural projects from the Chancellor in 2015, and has a total budget of £250m. Flagship building The Core was partly funded by the European Union Regional Development Fund (2007-13). Its partners include international tech companies, and it clearly has its eyes on international export markets.

> URL:
> HTTP://WWW.NEWCASTLESCIENCECENTRAL.COM/

NEWCASTLE (REFERENCES)

Dynamo (undated) *Our Vision*. Online: http://www.dynamonortheast.co.uk/ (accessed 10 March 2016).

NSC Partnership (undated). *NSC Partnership*. Online: http://www.newcastlesciencecentral.com/about/nsc-partnership/ (accessed 10 March 2016).

Science Central (2016) *About Science Central*. Online: http://www.ncl.ac.uk/sciencecentral/about/ (accessed 8 April 2016).

Science Central (2015) *Science. Central to Your Future*. Marketing Brochure. Online: http://www.newcastlesciencecentral.com/wp-content/uploads/2016/03/Science-Central-brochure-updated-oct-15-FINAL-small.pdf (accessed 8 April 2016).

UK Government (2012) Unlocking growth in cities: city deals – wave 1. Online: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/221009/Guide-to-City-Deals-wave-1.pdf (accessed 10 March 2016).

1NG (2010) *1Plan: An Economic and Spatial Strategy for Newcastle Gateshead*. Online: http://www.newcastle.gov.uk/sites/default/files/wwwfileroot/planning-and-buildings/planning/01.121plananeconomicandspatialplanfornewcastlegatesheadjune2011.pdf (accessed 8 April 2016).

NOTTINGHAM

Author: Li Yu

While little remains of the textile industry which gave Nottingham its rapid growth in the nineteenth century, it is currently one of the largest cities in the UK's Midlands: its broader metropolitan region has a population of c.1.5 million (the city itself has c.310,000 residents, or c.730,000 including its suburbs), and features among the top ten UK metropolitan economies by size. It is a member of the 'Core Cities' group, made up of the "councils of England's eight largest city economies outside London along with Glasgow and Cardiff", and which aims to "promote the role of our cities in driving economic growth and the case for city devolution" (Core Cities nd). Nevertheless, it has not featured prominently on the international landscape of 'smart' urban innovation. This may well change in future: it was recently named one of the UK's 'top ten' smart cities in a recent report commissioned by Huawei (Woods *et al.* 2016). Though not positioned among the 'leaders' in this report, Nottingham was bracketed with Sheffield as a 'contender' city, which has developed a smart vision and has begun to implement some significant specific activities.

Figure 12: Trent Bridge, Nottingham
(photograph by Insignia3 via Wikimedia Commons)
https://commons.wikimedia.org/wiki/File%3ARiverTrentNottingham.jpg

Nottingham has a series of well established 'eco' credentials, including its recognition by the Department of Energy and Climate Change as a 'Low Carbon Pioneer City' (Nottingham City Council 2013). It claims to be the "most energy self-sufficient large city in the UK" (Nottingham City Council 2012: 1; Local Government Association 2012) and "one of the least car-dependent cities in the UK" (Nottingham City Council 2013b: 8). Additionally, 1 in 10 of Nottingham's homes (12,000 in total) were recently retrofitted to reduce energy consumption, including the installation of solar PV systems at 3,500 properties (NTU nd).

Key environment-related policy documents have included its *Energy Strategy 2010-2020* (Nottingham City Council 2010; and see description below), which was followed by the *Nottingham Community Climate Change Strategy* (2012), promising residents a "secure career at the forefront of the low carbon technology, within a thriving green economy" (Nottingham City Council 2013: 9). Two specific projects outlined below are the significantly expanded NET tram network, and its Enviroenergy district heating company, launched in 1995. In 2015, the council also launched Robin Hood Energy, a not-for-profit low-cost energy company. The Nottingham Energy Partnership, a carbon reduction charity originally set up by the council in 1997, won the Queens Award for Sustainable Development in 2014. The Chair of the NEP Board, Councillor Dave Liversidge, commented that "Winning the Queen's Award is a marvellous recognition of NEP's dedication to reducing fuel poverty and cutting carbon emissions. With a number of changes to government energy policy, it has been a trying time for us; this will certainly give us a boost to strive and build on our track record" (Nottingham Energy Partner nd).

Figure 13: Tram in Nottingham City Centre
Photograph: Elliott Brown, via Wikicommons media
https://commons.wikimedia.org/wiki/File%3ANottingham_Express_Transit_-_Market_Street%2C_Nottingham_-_tram_212_-_William_Booth_(15705981068).jpg

The momentum achieved through these environmental initiatives and awards appears to have allowed the city to move more recently towards a smart city agenda, particularly through its current involvement in the EU-funding REMOURBAN project (see outline below). The emphasis on energy and transport infrastructure in this project reflects the content of Nottingham's earlier bid for funding in the national *Future Cities Demonstrator* competition (Nottingham City Council 2012b), which also contained proposals for a 'Smart City Information Model' to help deliver the projects and monitor performance. The citywide energy map which it has developed is described as intending to meet the vision of "A smart city where energy flows are planned, mapped and monitored", with the aim of reducing the city's carbon emissions by 26% between 2005 and 2020, and meeting 20% of energy demand locally from low and zero carbon sources by 2020 (Nottingham Energy Partnership 2012).

In the meantime, it is making efforts to build up its hi-tech industries. The Nottingham Growth Plan, launched in 2012, identifies "natural strengths in three high-value growth sectors: digital content, lifesciences and clean technology" (Nottingham City Council 2013b: 18), and it was recognised by the UK Government in 2005 as one of the UK's six 'Science Cities' (Nottingham Science City nd) in reflection of the scientific strengths of its two universities, industrial base, and long history of scientific discoveries. The council hosts and shares open datasets through its Nottingham Insight internet portal.

EXAMPLES OF PROJECTS

REMOURBAN

In 2015, Nottingham was awarded £5m to be one of demonstrator cities in the five-year REMOURBAN ('REgeneration MOdel for accelerating the smart URBAN transformation') programme, supported by EU Horizon 2020. REMOURBAN aims to "design and deploy a model of urban regeneration in towns and cities that exploits the convergence between energy, mobility and ICT to improve quality of life, ensure social acceptance and environmental sustainability, accelerate the deployment of innovative solutions and the adoption of new business models for city renovation" (REMOURBAN nd a). The other cities involved are Valladolid (Spain) and Eskisehir (Turkey), with Seraing (Belgium) and Miskolc (Hungary) also taking part as 'follower cities'.

The five demonstrator cities each mobilise a different approach to integrating sustainability into their urban regeneration schemes. They are expected to share their local expertise and complementary actions, and to develop a model of smart urban transformation. In Nottingham, as elsewhere, the programme is being operated through a partnership among various stakeholders, including national and local government, local communities, businesses and universities. In the first phase, between 2016 and 2017, it has a budget of over £3m.

In Nottingham's case, 'smart' technologies offer possible tools to address a range of difficult issues related to sustainable urban development. Specific interventions include:

- the creation of a low-energy district in the Sneinton neighbourhood, by retrofitting selected older properties to high standards of energy efficiency (TNU nd), extending the district heating network (REMOURBAN nd b; also see below), and installing photovoltaic panels (REMOURBAN nd c);
- an 'intelligent control system' in Sneinton which, among other things, will monitor energy consumption in homes for billing purposes, provide feedback on this to users, and provide alerts and alarms for vulnerable residents (REMOURBAN nd d)
- further development of the city's green transport infrastructure, including the introduction of two electric vehicles for tourists, small electric vehicles for last-mile delivery to homes and businesses, and an hourly car hire scheme (REMOURBAN nd e)
- a programme of community engagement (REMOURBAN nd e)
- a City Information Platform including a simulation model drawing on various types of data, including energy consumption and transport use (REMOURBAN nd d).

URL:
HTTP://WWW.REMOURBAN.EU/

DISTRICT HEATING AND POWER SYSTEMS

Nottingham boasts the largest district heating network in the UK. Its Eastcroft Energy from Waste (EfW) plant waste plant has been generating energy since 1972. The EfW plant is now the property of Nottingham City Council but is operated by private contractor WRG. The steam is sold to Enviroenergy Limited, an energy services company established in 1995 and wholly owned by Nottingham City Council. Enviroenergy runs the CHP and district heating infrastructure and manages distribution, metering and billing. The existing network of 68km piping has already supplied over 145GWh of heat locally, 127GWh of which comes from renewables and waste. The heat and power station already provides 4% of the entire city's power consumption and 3.5% of the entire city's heat consumption. It now supplies as many as 4,700 homes and 100 businesses across the city (Enviroenergy nd).

Nottingham has decided to expand the district heating network to connect multiple heat providers, so as to form a linked secure network supplying heat across the city (Nottingham Energy Partnership 2012). The project will enable Nottingham to create a resilient supply network as a response to climate change and build the resilience of the city to external price pressures. The project intends to create the foundations for increased infrastructure integration and the delivery of smart grid concepts across the city. The aims of the project include:

- tackling fuel poverty;
- reducing carbon emissions; and
- energy security in terms of price and supply to prepare for the decline of oil availability.

The work is focused on the Southern Gateway, the Boots Enterprise Zone and the Creative Quarter, parts of which have been covered by existing district heating network (Nottingham City Council 2012b). The project aims to extend the network further to allow new business growth to be supported with low heating costs provided by a low carbon network. As well as reducing fuel poverty and energy bills, the project aims to bolster the city's image as a centre of green industry, and thereby attract new investments. In 2012, it was estimated that 27,000 tons of CO2 emissions were offset annually by the existing network (LGA 2012).

URL:
HTTP://WWW.LOCAL.GOV.UK/CLIMATE-CHANGE//JOURNAL_CONTENT/56/10180/3511234/ARTICLE

NOTTINGHAM EXPRESS TRANSIT (NET)

Nottingham Express Transit (NET) is a 32 kilometre (20 mile) tramway. In March 2000, the joint promoters, Nottingham City Council and Nottinghamshire County Council, awarded a 30-year Private Finance Initiative concession to the Arrow Light Rail Ltd consortium, with responsibility for the design, funding, building, operation and maintenance of the line. The consortium was made up of Adtranz (later subsumed into Bombardier Transportation) responsible for trams; Carillion responsible for the infrastructure; along with Transdev and Nottingham City Transport. The system opened to the public on March 9th 2004. Its second phase with £570 million investment to more than double its size, opened on August 25th 2015. It is expected that the newly expanded system will be used by 23 million passengers a year (*ITV News* 2015).

NET has proved to be very successful: in the first phase, public transport use in the Nottingham urban area increased 8% in the first five years to 2008, together with a less than 1% growth in road traffic, compared with the national average of 4% (*railway-technology.com* nd). The City Council is investigating the potential for the Nottingham Express Transit to become a customer of Enviroenergy (see above) and benefit from a future "Nottingham Energy Tariff" (Nottingham City Council 2012b). An integrated smart ticketing system, usable on all trams and buses, is due to be operational in the near future (*Nottingham Post* 2015; UK Government 2016).

> URL: HTTP://WWW.THETRAM.NET/

ASPLEY COMMUNITY MICRO POWER PLANT

Nottingham City Council and E.ON worked in partnership to identify 600 council houses in the Aspley district which would be suitable to have solar panels fitted by E.ON. The Council rented the roof space to E.ON, who then funded and installed up to 10 panels on each participating house in 2011. E.ON processes the electricity generated, and sells any surplus electricity generated back to the National Grid. This is the single largest domestic photovoltaic (PV) scheme delivered in the UK. It is hoped that this scheme and similar future planned investments offer the potential of a small community based 'micro power plant' forming part of the incremental development of a clean energy network (Nottingham City Council 2012b)

Aspley is a relatively deprived part of the city. As part of the project, E.ON provided green skills training and work experience opportunities for unemployed local residents (E.ON nd). If the views of one local resident quoted by E.ON are representative of wider local opinion, the reduction in

energy bills will also be warmly welcomed: “We were hoping to save money on our electricity bills. I think this month our bill has been cut by half because we’ve had some great weather – I hope it continues! It sounds too good to be true but I’d encourage other families in the area to snap up the chance to have solar panels fitted if their house is suitable” (E.ON nd).

URL: HTTPS://WWW.EONENERGY.COM/FOR-YOUR-BUSINESS/LARGE-ENERGY-USERS/MANAGE-ENERGY/ON-SITE-GENERATION/ON-SITE-GENERATION-CASE-STUDIES/NOTTINGHAM-CITY-COUNCIL

REFERENCES (NOTTINGHAM)

Core Cities (nd) *A unique and influential voice for cities*. Online: www.corecities.com (accessed 4 July 2016).

E.ON (nd) *Nottingham City Council*. Online: https://www.eonenergy.com/for-your-business/large-energy-users/manage-energy/on-site-generation/on-site-generation-case-studies/nottingham-city-council (accessed 2 April 2016).

ITV News (2015) Nottingham's New £570 million tram network: everything you need to know. Online: http://www.itv.com/news/central/2015-08-25/nottinghams-new-570-million-tram-network-everything-you-need-to-know/ (accessed on April 3rd 2016).

LGA (2012) *Nottingham's warmth from waste system*. Online: http://www.local.gov.uk/climate-change/-/journal_content/56/10180/3511234/ARTICLE (accessed 3 April 2016).

Nottingham City Council (2012a) *Connected, Creative, Competitive Nottingham. The Nottingham City Deal*. Online: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/221016/Nottingham-City-Deal-final.pdf (accessed 3 July 2016).

Nottingham City Council (2012b) *Nottingham Future Cities: Feasibility Study 2012*. Online: https://connect.innovateuk.org/documents/3130726/3794125/Feasibility+Study++Nottingham+City+Council.pdf/838f9293-4ac8-4d32-9852-fbc66a7db259 (accessed 4 July 2016).

Nottingham City Council (2013*) Nottingham City land and planning policies: Development Plan Document*. Climate Change Background Paper. Online: file:///C:/Users/Rob/Downloads/Climate%20Change%20Background%20Paper.pdf (accessed 3 July 2016).

Nottingham City Council (2013b) *The Nottingham Growth Plan*. Online: http://www.mynottingham.gov.uk/static/nottinghamgrowthplan/files/Nottingham%20Growth%20Plan%20Web.pdf (accessed 4 July 2016).

Nottingham Energy Partnership (2012) *Local Economic impact study for the Nottingham Energy Strategy*. Online: http://www.nottenergy.com/images/uploads/pdfs/EmploymentandskillsimpactofdeliveringNottingham_v7.pdf (accessed 27 March 2016).

Nottingham Post (2015) Nottingham to get 'Oyster card-style' ticket system - for all buses and trams. Online: http://www.nottinghampost.com/smart-way-travel/story-28074230-detail/story.html (accessed 7 July 2016).

Nottingham Science City (nd) *Proud to be a Science City*. Online: http://www.science-city.co.uk/about-us/proud-to-be-a-science-city.aspx (accessed 4 July 2016).

NTU (nd) *REMOURBAN City Demonstrator Project*. Online: http://www4.ntu.ac.uk/apps/research/groups/6/home.aspx/project/165424/overview/remourban_city_demonstrator_project (accessed 7 July 2016).

REMOURBAN (nd a) *Project*. Online: http://nottingham.remourban.eu/The-Project/Project.kl (accessed 4 July 2016).

REMOURBAN (nd b) *Sneinton district of Nottingham, England, showing the way for a sustainable energy future in Europe*. Online: http://www.remourban.eu/News--Events/News/Sneinton-District-Of-Nottingham-England-Showing-The-Way-For-A-Sustainable-Energy-Future-In-Europe.kl (accessed 27 March 2016).

REMOURBAN (nd c) *Low Energy districts actions*. Online: http://www.remourban.eu/Cities/Lighthouse-Cities/Nottingham/Interventions/ENERGY.kl (accessed 7 July 2016).

REMOURBAN (nd d) *Integrated infrastructure actions*. Online: http://www.remourban.eu/Cities/Lighthouse-Cities/Nottingham/Interventions/Integrated-Infrastructures-Actions.kl (accessed 7 July 2016).

REMOURBAN (nd e) *Sustainable mobility actions*. Online: http://www.remourban.eu/Cities/Lighthouse-Cities/Nottingham/Interventions/MOBILITY.kl (accessed 7 July 2016).

REMOURBAN (nd f) *Society - Non technical actions*. Online: http://www.remourban.eu/Cities/Lighthouse-Cities/Nottingham/Interventions/Society.kl (accessed 7 July 2016).

UK Government (2016) *Roll-out of smart ticketing will improve bus, rail and tram journeys for millions*. Online: https://www.gov.uk/government/news/roll-out-of-smart-ticketing-will-improve-bus-rail-and-tram-journeys-for-millions (accessed 7 July 2016).

railway-technology.com (undated) Nottingham Express Transit, United Kingdom. Online: http://www.railway-technology.com/projects/nottingham/ (accessed 25 July 2016).

Woods, E., Alexander, D., Rodriguez Labastida, R. & Watson, R. (2016) *UK Smart Cities Index: Assessment of Strategy and Execution for 10 Cities*. White Paper. Navigant Research. Online: https://www.navigantresearch.com/research/uk-smart-cities-index (accessed 3 July 2016).

PETERBOROUGH

Author: Federico Caprotti

Peterborough has a well-developed and focused smart city strategy encompassing a range of projects, from urban fibre to wearable health technologies, from networked weather stations to more traditional business innovation and incubator facilities. Peterborough may not feature in the mental maps of many professionals and scholars working on smart cities, but evidence from the policy and urban planning practice world suggests that it should. In the Future Cities Demonstrator competition run by the UK government in 2012-13, Peterborough came second and was awarded £3 million to develop the Peterborough DNA project (see details below). Peterborough was also awarded the Smart City of the Year 2015 award at the World Smart City Congress held in Barcelona in late 2015, coming top of a list of 265 cities (Opportunity Peterborough 2015). In the competition, Peterborough was ranked higher than global contenders such as Dubai, and higher than other UK entries. On the UK smart cities map, Peterborough is widely ranked higher than Cambridge, its more academic rival and neighbour.

Figure 14: Cathedral Square, Peterborough
Photograph: Fakhriazam Afsahi

Peterborough's focus on 'smart' and 'eco' projects is mainly concentrated on the former at the urban (city and neighbourhood) scale, although due to the political geography of the UK, Peterborough is clearly linked to, and affected by, Cambridgeshire County Council. There is significant evidence in policy and other documents of discourses aiming to place Peterborough in a global smart cities league by dint of its larger projects (eg the Gigabit City project), which Peterborough claims will enable it to compete with Seoul, Tokyo, and other world cities in the digital economy – a claim that perhaps does not stand up to scrutiny when considering the skills shortage that the UK suffers in these areas. Peterborough's smart city projects also consistently refer to the British Standards Institute (BSI) framework for smart cities, and specify how the city fits into this. This helps place Peterborough on the 'map' of globally recognisable evaluation and performance frameworks for smart cities. Nonetheless, apart from the UK's skills shortage, Peterborough's smart city ambitions are potentially at risk from its subordinate position within Cambridgeshire: in 2015-16 there were discussions about cuts in funding from the county council, and fears about how this would affect Peterborough City Council and its ability to implement its digital city strategy.

EXAMPLES OF PROJECTS

Peterborough has several projects that can be described as smart city initiatives. There is less evidence of a consistent focus on the 'eco' or 'green' dimension, or on the notion of Peterborough as an environmentally sustainable city, apart from services provided by the council to enable environmental impact reduction for city businesses (see below).

PETERBOROUGH DNA

Peterborough DNA started in 2012: its origins are in the £3m grant given to the city as part of the UK Technology Strategy Board Future Cities Demonstrator competition which ran in 2012-13. In that competition, Peterborough was ranked second in the whole of the UK. Peterborough DNA is an umbrella project containing activities in the areas of *smart business*, *innovation*, *living data* and *future skills* (Opportunity Peterborough 2016).

In the *smart business* strand, Peterborough has instituted a Smart Business Network including corporates such as Skanska, Viridor and Amey. On the eco side, the city has also founded a scheme which provides advice to businesses in how to reduce their environmental impact.

In the *living data* strand, Peterborough has inaugurated a Living Data Portal with access to council open data integrated into Google Earth. The city has also started a

series of urban hackathons. Finally, it has installed weather stations at 25 schools, although there is little explanation of how this fits into a smart city strategy apart from providing environmental monitoring capability.

In the *future skills* DNA strand, Peterborough is now actively running a graduate scheme and a Masters bursary scheme, both of which fund programmes involving local businesses and both of which are innovation-focused. A Skills and Innovation Centre has also been founded, integrated within the Peterborough United football stadium. The Skills and Innovation Centre also features an Innovation Lab with 3D printers, manufacturing facilities for innovative products, and workshop and discussion space. The Centre is part innovation space, part business incubator, and was one of the key Peterborough DNA deliverables.

Although Peterborough DNA started as a demonstrator, it is now the overall umbrella organization attempting to bring together and deploy a range of other smart city projects in the city. The project is, at the time of writing, operational: several activities have already been organised and have taken place as a result. Examples of these are the Innovation Challenge Fund and the Test Bed Fund, two funds made available through the Peterborough DNA programme for the funding of small-scale and innovative smart city projects.

As part of Peterborough DNA, the city has also developed an online platform called Brainwave, where citizens and users of the city's services can post urban challenges in a range of areas, and then discuss and agree on solutions (Brainwave 2016). Although the platform basically seems to function as a sustainable city / smart city discussion forum, it is active and includes input from citizens, businesses and council authorities on a range of topics from infrastructure, to green building materials, to schools, to how to enable more solar PV deployment in the city.

> URL:
> HTTP://WWW.PETERBOROUGHDNA.COM/

DIGITAL CITY PETERBOROUGH

Digital City Peterborough is an umbrella project encompassing a range of activities aimed at improving the city's digital connectivity. Key activities within Digital City Peterborough include Peterborough CORE, a city-wide fibre-optic network currently near completion and being built by CityFibre (Peterborough CORE 2016). The project makes explicit references to its aim to link to the British Standards smart city framework.

Peterborough CORE saw construction start in 2014, and the fibre network is now extensive. Within 12 weeks of Peterborough registering as a Gigabit City in 2014, over 450 businesses in the city registered for access to the gigabit network – this represents 10% of businesses in the city (Digital City Peterborough 2016).

URL:
HTTP://WWW.DCPETERBOROUGH.CO.UK/

ALCOVE PETERBOROUGH

The project is a partnership between the city council and Alcove, a tech start-up firm. In September 2015 the city council and Alcove agreed to launch a project, initially involving 100 end-users who would be trialling smart health technologies in an Internet of Things 'connected care framework'. This involves smart sensors, connected wearable health devices (currently Samsung smart watches with communication capabilities), tablets, and RFID monitors for tracking care visits and updates to users' homes. The sensors will alert the user, as well as the health services, to changes in health status as they happen, as well as enable instant response and communication from health and other professionals through the wearable technology. A partnership agreement was signed in September 2015, but the testing on 100 users started in August 2015. Alcove had a previous test run with residents at the East Thames Group housing association (TechCityinsider 2016).

The broader aims of the Alcove project are to provide responsive care and preventive care for older and disabled people, and to enable real-time, in-home monitoring. The (currently unstated) other aim is presumably a change in the current urban healthcare model, which is based on patients attending surgeries, hospitals etc. to be evaluated before treatment. Under the Alcove model, health professionals evaluate in real time but remotely, and dispatch nurses or other professionals to administer care when required.

At the moment the project is a small-scale experiment in the city, but it falls within the landscape of similar projects being trialled in other cities, such as Singapore.

URL:
HTTP://WWW.YOURALCOVE.COM/ALCOVE-PARTNER-WITH-PIONEERING-PETERBOROUGH/

REFERENCES (PETERBOROUGH)

Brainwave (2016) *Latest from Brainwave*. Online: http://www.brainwaveinnovations.co.uk (accessed 15 June 2016).

Digital City Peterborough (2016) *Digital City Peterborough*. Online: http://www.dcpeterborough.co.uk (accessed 1 June 2016).

Godfrey, R. (nd) *Digital City Peterborough*. Presentation. Online: https://connect.innovateuk.org/c/document_library/get_file?groupId=32827478&folderId=32863738&title=DIGITAL+CITY+PETERBOROUGH (accessed 1 June 2016).

Opportunity Peterborough (2015) *Peterborough awarded smart city of the year 2015*. Press release, 20 November. Online: http://www.opportunitypeterborough.co.uk/peterborough-awarded-smart-city-of-the-year-2015/ (accessed 1 June 2016).

Opportunity Peterborough (2016) *Peterborough DNA: Future Cities Programme*. Online: http://www.opportunitypeterborough.co.uk/projects/test-3/ (accessed 1 June 2016).

Peterborough City Council (2014) *Peterborough: delivering a truly smart city*. Report. Online: http://www.brainwaveinnovations.co.uk/upload/cmspage/peterborough-dna/10-09-1411-58-35peterboroughdnaonline.pdf (accessed 1 June 2016).

Peterborough CORE (2016) *Peterborough CORE*. Online: http://www.peterboroughcore.com (accessed 1 June 2016).

TechCityinsider (2016) Alcove offers mature style and care. Article, 29 January. Online: http://www.techcityinsider.net/alcove-offers-mature-style-and-care/ (accessed 1 June 2016).

SHEFFIELD

Author: Robert Cowley

The 'smart' agenda has very recently gained traction in Sheffield, and the "first iteration" of a 'Smart City Strategy' (Dymond 2015: 2) has been published. The policy context for this strategy is given extended attention in what follows, since it illustrates the often ambiguous role of policy-making in this field. As appears to be the case in many other cities, the council is not so much leading the process as working in partnership with others to consolidate a mixture of disparate existing activities into a coherent vision which chimes with the city's broader ambitions. The nascent strategy is of additional interest since its conception of the 'smart' extends far beyond the digital, into a wide variety of social and environmental initiatives.

The broader context is one of Sheffield's ongoing attempts to define and reassert its economic identity following the decline of its iron, steel and coalmining in the 1970s and 1980s. Since the 1990s, Sheffield has seen significant economic recovery, along with a variety of high-profile regeneration programmes, and the expansion of its 'Supertram' network, the first section of which opened in 1994. The city has a stable population of approximately 500,000, but the broader Sheffield City Region (as defined in October 2015 national Government devolution plans, and including eight neighbouring local authorities) is home to more than 1.8 million people (Sheffield City Region nd). A range of powers and responsibilities are being devolved to the Sheffield City Region Combined Authority (HM Treasury & Sheffield City Region 2015), established in 2014 to formalise existing cooperation between the nine local authorities. This brings together two statutory bodies - the Integrated Transport Authority and Economic Prosperity Board, in partnership with the private sector-led Local Enterprise Partnership. As part of the 'Northern Powerhouse' envisaged by the Government, the Sheffield City Region is expected to benefit from proposed improvements to its rail and road connectivity.

The Sheffield City Region agreement, building on the 2012 Sheffield *City Deal* (Sheffield City Region 2012) aims to enhance its reputation as a "world class centre for advanced manufacturing and engineering", with an emphasis on science and innovation (HM Treasury & Sheffield City Region 2015: 5). Although this agreement does not emphasise Sheffield's credentials as a centre for digital and 'eco' technologies, sustainability was one of the five key principles laid down in the city's strategic plan for 2010-2020 (Sheffield First Partnership 2010), envisioning the future Sheffield as "a low-carbon city, using

energy wisely and utilising new technology. It is also a low waste city, with a focus on reducing and renewing and recycling. Sheffield has a balanced, diverse and sustainable economy and is constantly utilising new environmentally friendly forms of industry and transport" (21). Alongside the ambition of communicating Sheffield's "distinctive and authentic character" to the world, the plan conceives of economic success at a city-regional level, and envisions a "city where everyone plays their part to ensure that…Sheffield plays a role on the international stage in protecting our environment" (Sheffield First Partnership 2010:10).

In the more recent *Sheffield 2035* report (SEB 2013), similar environmental ambitions are augmented by the desire to become a "smart and connected" city through digital technology and an improved digital infrastructure. This report followed Sheffield's feasibility study to create a large-scale 'Future Cities Demonstrator' initiative, submitted as part of a national competition in 2012 organised by the UK's Technology Strategy Board (TSB), which proposed to use smart meters and community Wi-Fi to expand its district heating system, which was already the largest in the country (TSB 2013: 58). The *Sheffield 2035* report explores the concept of 'Smart Municipalism', understood as in terms of networked governance in a time of cutbacks. The attempt to promote this concept as differentiated from both 'market thinking' and 'localism' demonstrates an active desire to rethink the role of the local authority in shaping a 'smarter' city.

Meanwhile, in the council's annual *State of Sheffield* report, the word 'smart' did not appear until 2015. In 2016, however, it has become a significant strategic framing concept for the region's planned economic future, with a commitment to "invest in…infrastructure, with improved transport links, high quality digital connectivity, and greater use of 'Smart' technology. Smart cities, where technology is used to improve the quality of life for local people and businesses, will be a critical area of development over the next five years" (Sheffield First Partnership 2016: 110-111). Economic growth is foreseen in terms of the digital and creative industries as well as in advanced manufacturing. The 'Growth and Income' section of the report is prefaced by a local business leader's predictions that:

"Digital and advanced manufacturing can, and will, co-exist and support each other….To 'tech' start-ups thinking of China for manufacturing we can say 'look North, not East'…There is a glimpse of the type of Sheffield we could be looking at in the future and as these companies grow, they will offer jobs across the salary spectrum with links to technology, digital, manufacturing and exports" (ibid: 44).

In parallel, the council has recently published *Sheffield's Green Commitment* (Sheffield Green Commission 2016), in which the word 'smart' appears repeatedly

alongside 'sustainable' and 'green'. Alongside goals related to biodiversity, green space and more environmentally friendly energy use, the commitment relates to digitally enabled improvements to transport systems, and the aim of making Sheffield a 'learning city'. It claims that Sheffield is "continuously learning from and collaborating with other major UK and European cities, to organise collective action across Europe that has positive local and global impacts, eg tackling climate change and CO2 reduction" (ibid: 22), and positions Sheffield as the "anchor city on the Sheffield City Region…poised to play a pivotal role in the 'Northern Powerhouse'" (ibid: 23).

In short, the idea of the 'smart' has appeared across a variety of policy documents in the last few years, aligned with broader environmental and regional economic ambitions. The *Smart City Strategy* serves to link the policy aspiration with existing and planned activities on the ground, and is described in further detail below. The *Sheffield Smart Lab Urban Innovation* initiative is also profiled as an example of a parallel activity, led by private sector actors, but supported by the council, within this broader process of consolidation.

This is a good case of a smart agenda being linked retrospectively to an existing set of ambitions and activities linked more or less loosely to various dimensions of sustainability. The 'smart' concept appears to be gaining traction because it brings together a variety of broad agendas so as to allow a rhetorically coherent set of city-regional aspirations for the future to be articulated. Sheffield's concept of the 'smart' is experimental in its open-endedness; and the city appears to be open-minded at this early stage about which of these will most successfully support Sheffield as a regional entity, and promote it on the international stage.

EXAMPLES OF PROJECTS

SMART CITY STRATEGY FOR SHEFFIELD

This "first iteration" of a Smart City strategy, published in February 2015, was commissioned by the Sheffield First Partnership, which is led by the Sheffield Executive Board (SEB), whose members are leading figures in the public, private, voluntary, community and faith sectors in the city. The report was developed by a private-sector consultant, following consultation with the public, private and voluntary sectors, and local educational institutions, and with reference to Smart City 'best practices' in other European cities. It outlines a series of principles to inform the development of future Smart City initiatives in the city, and charts relevant existing activities across seven 'domains' (people, resources, mobility, buildings, living, economy, and

governance). These domains map onto the EU's Smart Cities categories "so there is a link back to aid in funding applications" (Dymond 2015: 24), and are divided into further subdomains, as shown in Table 2.

Table 2: the 'Domains' and 'Subdomains' of the Sheffield Smart City Strategy framework

Smart People	Smart Resources	Smart Mobility	Smart Buildings	Smart Living	Smart Economy	Smart Governance
Welfare and social inclusion	Renewable energy	Public transport	Facilities management	Healthcare & wellbeing	Innovation & Entrepre-neurship	eGovernment
Digital inclusion	Smart grids	Private transport	Building services (Mechanical & Electric)	Entertainment & Sport	Digital skills	eDemocracy
Education	Waste management	City logistics	Housing quality	Culture	eBusiness	Procurement
Human capital management	Water management	Road network	Assisted living	Retail		Transparency
	Food & agriculture	Public lighting	Cultural heritage management	Hospitality & Tourism		Communications
				Pollution control		
				Public spaces management		
				Security (blue light)		

(Source: adapted from Dymond, 2015)

46 existing initiatives in the city are thus defined as smart. Many clearly relate to different aspects of digital technology (for example, the city's smart meter deployment programme, the South Yorkshire Intelligent Transport System, Bus Apps, 'hackathon' events, the city's Open Data facility, and an online map of local

sustainable food production and retail). Others describe more traditional sustainability concerns, including the Sheffield Renewables scheme, a biomass plant, the Living Streets road maintenance scheme, improvements to cycling infrastructure, and 'Love Square' – a "new type of 'smart urban nature park that brings wildflowers and wildlife into the very heart of the city" (Love Square nd). Additionally, various opportunities and specific new proposals are highlighted.

> URL: HTTPS://WWW.SHEFFIELDFIRST.COM/DMS/SF/MANAGEMENT/CORPORATE-COMMUNICATIONS/DOCUMENTS/SFP/SEB-PAPERS/JANUARY-2015/ITEM-4A---THE-SMARTSHEFFIELD-PROCESS/ITEM%204A%20-%20THE%20SMARTSHEFFIELD%20PROCESS.PDF

SHEFFIELD SMART LAB

This programme is designed to "help startups and SMEs develop and pilot their product in a live city environment" (Sheffield Smart Lab nd a). It consciously positions itself as contributing to the long-term industrial transformation of Sheffield, by "helping promote Sheffield as a city of innovation" (Sheffield Smart Lab nd a). The programme works through 'open innovation competitions', the winners of which are offered an 'incubation and mentoring' programme from the city's two universities, and the chance to pilot and demonstrate their projects.

The two areas of challenge in the first competition, held in 2015, related to:

- 'Energising Sheffield City Centre', inviting proposals on how to exploit existing footfall data from the city centre, make better use of empty commercial premises, and other spaces during 'quiet' times of the day, and encourage wider use of sustainable transport;
- 'Supporting people to live independently', which was "looking for solutions to transform the connectivity of housebound people and help coordinate their care" (Sheffield Smart Lab nd b).

In both cases, the competition organisers did not define these 'smart' challenges explicitly in terms of digital technology, though clearly left the door open for it; the winning projects announced in December 2015 were based on digital technology. In the Energising Sheffield City Centre category, the winners were 'Better Cities Digital High Street Collaboration Scheme', a 'Gather Analyse Play Strengthen (GAPS) Dashboard' to unlock potential of 'gaps' in the city, the 'Overhear' event mapping app, and 'Situate', a self-guided city tour app. Winners in the 'supporting people to live independently' category were: 'Alcove Pioneering Independent

Living' (using Internet of Things technology), 'Give&TakeCare' (a system independent of the state and private interests allowing people to earn CareCredits which can be used to pay for elderly care later on), 'Goodgym Sheffield' (encouraging volunteers to combine exercise with helping the elderly, rather than go to the gym) 'Mindmate' (an app providing brain games and physical exercise for older people), and 'NANA: Novel Assessment of Nutrition and Ageing' (an "interface…designed to be empowering for older adults by giving them some control over the data capture and also the decisions about how the data should be shared and with whom" (Sheffield Smart Lab nd c)). Competition winners will be invited to demonstrate their projects in public during summer 2016.

The 'incubation and acceleration' programme for winning projects will be run by the city's two universities, and mentoring will be provided by experienced business growth consultants. The initiative as a whole has been driven by Amey (a UK-based public and regulated services provider, which manages the Streets Ahead Highways Maintenance and Management service in Sheffield), and its parent company Ferrovial Services, (an international infrastructural management and investment company), in collaboration with Sheffield City Council. Ferrovial describes itself as having "a strong know-how in collaborative urban innovation programmes, channelled through its global Centre of Excellence for Cities. In 2014, the Centre of Excellence for Cities successfully deployed the Madrid Smart Lab which supported 9 international start-ups" (Sheffield Smart Lab nd d).

URL:
HTTP://WWW.SHEFFIELDSMARTLAB.CO.UK/

Figure 15: Tram & High Street, Sheffield

Photograph: Mick Knapton at the English language Wikipedia

https://commons.wikimedia.org/wiki/File:High_Street,_Sheffield.jpg

REFERENCES (SHEFFIELD)

Dymond, C. (2015) *Smart Sheffield*. Version 1.0. Online: https://www.sheffieldfirst.com/dms/sf/management/corporate-communications/documents/SFP/SEB-Papers/February-2015/Item-4---Sheffield-Smart-City-Framework/Item%204%20-%20Sheffield%20Smart%20City%20Framework.pdf [accessed 27 March 2016).

HM Treasury & Sheffield City Region (2015) *Sheffield City Region Devolution Agreement*. Online: http://sheffieldcityregion.org.uk/wp-content/uploads/2016/01/SCR-Devolution-Agreement-2015.pdf (accessed 9 April 2016).

Love Square (nd) *What is Love Square?* Online: http://lovesquare.group.shef.ac.uk/ (accessed 9 April 2016).

SEB (2013) *Sheffield 2035 - A Cat Among the Pigeons*. Sheffield: Sheffield First Partnership / Sheffield Executive Board. Online: https://www.sheffieldfirst.com/dms/sf/management/corporate-communications/documents/SFP/Key-Documents/Sheffield-2035/Sheffield%202035.pdf (accessed 9 April 2016).

Sheffield City Region (2012) *MADE in Sheffield – a deal for growth*. Online: http://sheffieldcityregion.org.uk/wp-content/uploads/2012/07/Sheffield-City-Deal-Final.pdf (accessed 9 April 2016).

Sheffield City Region (nd) *About the Area*. Online: http://sheffieldcityregion.org.uk/about/overview/ (accessed 9 April 2016).

Sheffield First Partnership (2010) *Sheffield 2020: The Sheffield City Strategy 2010-2020*. Sheffield: Sheffield First Partnership. Online: https://www.sheffieldfirst.com/key-documents/city-strategy.html (accessed 27 March 2016).

Sheffield First Partnership (2016) *State of Sheffield 2016*. Online: https://www.sheffieldfirst.com/dms/sf/management/corporate-communications/documents/SFP/Key-Documents/State-of-Sheffield-2016/State%20of%20Sheffield%202016.pdf (accessed 1 April 2016).

Sheffield Green Commission (2016) *Sheffield's Green Commitment*. Online: https://sheffield.citizenspace.com/place-business-strategy/sheffield-green-commission/supporting_documents/Sheffield%20Green%20Commitment%20Report_FINAL.pdf (accessed 9 April 2016).

Sheffield Smart Lab (nd a) *Sheffield Smart Lab*. Online: http://www.sheffieldsmartlab.co.uk/#home1 (accessed 9 April 2016).

Sheffield Smart Lab (nd b) *Supporting people to live independently*. Online: http://www.sheffieldsmartlab.co.uk/supporting-people-to-live-independently/ (accessed 27 March 2016).

Sheffield Smart Lab (nd c) *Energising Sheffield City Centre: Winners*. Online: http://www.sheffieldsmartlab.co.uk/winners-energising-city-centre/ (accessed 27 March 2016b).

Sheffield Smart Lab (nd d) *The Programme*. Online: http://www.sheffieldsmartlab.co.uk/theprogramme/ (accessed 27 March 2016).

TSB (2013) *Future Cities Demonstrator Competition: Feasibility Studies Interim Summary Report*. Technology Strategy Board / Future Cities Catapult. Online: https://connect.innovateuk.org/documents/3130726/6091879/Future+Cities+Feasibility+Studies++Interim+Report.pdf/4ab345d6-105c-4a88-867f-12e7b976780b (accessed 13 March 2016).

APPENDIX: METHOD FOR SELECTING UK CASE STUDIES

A four-stage process was used to select the ten cities profiled in this report. A summary of the cities considered and selected appears in Table 3, following the detailed description of the method below.

STAGE ONE

- a preliminary list was compiled of UK cities identified as 'smart' in prominent national policy and corporate initiatives and reports
- all other cities (and boroughs of London and Greater Manchester) with a population over 100,000 were added to the list
- this yielded a total of 110 cases

STAGE TWO

- based on internet searches for smart activity related to each city, and on local council websites, a first 'sift' was conducted to identify which of the 110 had stated ambitions to be 'smart' and/or are currently implementing a smart initiative
- 'smart' (rather than 'eco') was used as the entry point, on the assumption that all cities would at least have environmental policies in compliance with national legislation.
- cases were excluded from the list if they had no obvious smart ambition/initiative at the municipal scale at least
- cases where a smart ambition was clearly in evidence, and those requiring further research, were kept in the list
- the vast majority also had 'eco' ambitions of some type. Those few cases where this was not obviously the case (suggesting that there was little appetite among key actors to go beyond compliance with minimal standards and regulations) were excluded at this stage

STAGE THREE

- a more detailed second sift was then conducted, examining more closely the smart city documentation available online for each remaining case
- those which, on closer inspection, did not have a substantial smart ambition were excluded (for example, if the 'smart' initiative turned out to be a short-lived research project only; or where there was no evidence of any planning or activity beyond bids for funding; or if the smart descriptor was only used to describe a particular piece of technology such as smart meters)
- following this sift, 34 cases remained in the long list

- through qualitative documentary analysis, the practical content of each city's plans and activities was then coded onto a spreadsheet
- the code frame was structured around the broad categories used in a recent smart city mapping exercise conducted by the European Parliament's economic and scientific policy department (European Parliament, 2014). Within these broad categories, an attempt was made to apply Yin's *et al*. (2015) more detailed framework of specific smart activities. However, the latter proved unsuitable, and a more grounded approach was taken instead, with codes created and combined as required during the process of analysis
- a summary report containing some key findings from this analysis was circulated at a Smart Cities & Communities: Shaping the Future event in Manchester on 15 March 2016, attended by Federico Caprotti and Rob Cowley. A pdf version of this report can be downloaded from the project website: http://www.smart-eco-cities.org/wp-content/uploads/2016/03/Kings-College-London-UK-Smart-Cities-Survey-2016-summary.pdf).
- NB: an attempt was also made to categorise each case in terms of its level of emergence, using a modified version of the European Parliament's (2014) classification of smart city 'maturity'. However, this classification proved unsuitable. Most problematically, it assumes a linear process whereby all smart activities follow on from a preliminary planning process; in fact, it was very often the case that individual smart activities preceded the creation of an official vision/plan/roadmap. Additionally, the scale was insufficiently sensitive, given that most smart city initiatives in the UK are at a similar, early stage of emergence.

STAGE FOUR

- the suitability of each of the 34 cases for inclusion in the current report was then considered
- 10 were finally selected on the basis that (a) they had relatively well articulated plans or substantial activities, and (b) collectively, they would give a good overview of the variety of smart-eco city policies and practices in the UK at present
- It is not intended, then, that the cases selected necessarily represent the UK's 'top ten' smart-eco cities. In the absence of a clear and widely accepted definition of either the 'smart' or the 'eco' with regards to urban initiatives, a ranking exercise would be to some extent arbitrary – and the ten cases themselves have been presented in alphabetical order in the report. All ten cases are characterised, nevertheless, by the relative prominence of 'smart' discourse and practice; this is interpreted variously depending on context, and interwoven in different ways with their 'eco' ambitions.

Table 3: List of Cities Considered and Selected

Cities and towns with population over 100k (Total = 110)	Significant 'smart' & 'eco' ambitions ('long list'): (Total = 34)	Selected for write-up ('short list') (Total = 10)
Aberdeen	✓	
Basildon		
Belfast	✓	
Birmingham	✓	✓
Blackburn		
Blackpool		
Bournemouth	✓	
Bradford		
Brighton and Hove	✓	
Bristol	✓	✓
Cambridge	✓	
Cardiff	✓	
Chelmsford		
Cheltenham		
Colchester		
Coventry	✓	
Crawley		
Derby	✓	
Dudley		
Dundee		
Edinburgh	✓	
Exeter		
Gateshead		
Glasgow	✓	✓
Gloucester		
Greenwich		
High Wycombe		
Huddersfield		
Ipswich		
Kingston upon Hull		

Cities and towns with population over 100k (Total = 110)	Significant 'smart' & 'eco' ambitions ('long list'): (Total = 34)	Selected for write-up ('short list') (Total = 10)
Leeds	✓	
Leicester	✓	
Liverpool	✓	
London - GLA	✓	✓
London boroughs:		
• Barking and Dagenham		
• Barnet		
• Bexley		
• Brent		
• Bromley		
• Camden		
• Croydon		
• Ealing		
• Enfield		
• Greenwich	✓	
• Hackney		
• Hammersmith and Fulham		
• Haringey		
• Harrow		
• Havering		
• Hillingdon		
• Hounslow		
• Islington		
• Kensington and Chelsea		
• Kingston upon Thames		
• Lambeth		
• Lewisham		
• Merton		
• Newham		
• Redbridge		

Cities and towns with population over 100k (Total = 110)	Significant 'smart' & 'eco' ambitions ('long list'): (Total = 34)	Selected for write-up ('short list') (Total = 10)
• Richmond upon Thames		
• Southwark		
• Sutton		
• Tower Hamlets		
• Waltham Forest		
• Wandsworth		
• Westminster		
Luton		
Maidstone		
Greater Manchester boroughs:		
• Bolton		
• Bury		
• Manchester	✓	✓
• Oldham		
• Rochdale		
• Salford		
• Stockport		
• Tameside		
• Trafford		
• Wigan		
Middlesbrough		
Milton Keynes	✓	✓
Newcastle upon Tyne	✓	✓
Newport	✓	
Northampton	✓	
Norwich		
Nottingham	✓	✓
Oxford		
Peterborough	✓	✓
Plymouth		

Cities and towns with population over 100k (Total = 110)	Significant 'smart' & 'eco' ambitions ('long list'): (Total = 34)	Selected for write-up ('short list') (Total = 10)
Poole		
Portsmouth	✓	
Preston		
Reading		
Rotherham		
Sheffield	✓	✓
Shrewsbury		
Slough		
Southampton	✓	
Southend-on-Sea	✓	
St Helens		
Stoke-on-Trent	✓	
Sunderland	✓	
Swansea	✓	
Swindon	✓	
Telford		
Walsall	✓	
Warrington		
West Bromwich		
Wolverhampton	✓	
York		

Our project partners:

Our funders: