Solutions for Cities:

An analysis of the feasibility studies from the Future Cities Demonstrator Programme

Technology Strategy Board
Driving Innovation

ARUP

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This report has been prepared by Arup for the Technology Strategy Board. While this report draws heavily on Arup's experience, the opinions expressed in it are those of the Technology Strategy Board.

01 | Foreword

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Helping UK firms to meet the needs of the world's cities

Just over a year ago the Technology Strategy Board launched the Future Cities Demonstrator competition. We challenged UK cities to show how they would integrate their city systems to create better places to live and work. Cities have different challenges, opportunities and ambitions, and so we asked each of them to develop their proposal around their unique situation. In doing so we have built up a detailed picture of some of the future visions of UK cities, the challenges they face, and the opportunities they have to deliver an improved quality of life for their citizens.

The studies undertaken cover a very wide range of challenges and propose solutions, so we engaged engineering and planning consultants Arup to synthesise the market intelligence that we gathered through the competition, to make it more accessible to a wider audience, and to continue to expand the discussion that has started. Using their experience of working on city projects around the world, Arup has drawn out the common trends and themes that unite these unique city visions of a smarter, more sustainable future. By identifying these common themes, we can identify areas for future collaborations between cities and industry, new challenges for the research base, and new business opportunities for innovative companies.

We have been encouraged by the support, enthusiasm and momentum that the demonstrator programme has generated. UK cities, industry and academia have all committed themselves to the challenge. Having spoken to people throughout the competition process, we know that it has increased collaboration and conversation around the future needs of cities. Cities are using the outputs of the demonstrator feasibility studies to guide, develop and implement their own plans.

The aim of the Technology Strategy Board's Future Cities Programme is to support UK firms to develop products and services to meet the needs of the world's cities. The demonstrator projects will show what can be achieved by innovative use of the tools and techniques we have available to us today. The Future Cities Catapult will bring cities, industry and academia together in a unique partnership to develop new solutions to the major challenges facing cities in the future. An ongoing programme of investment in innovation projects addressing the needs of cities will build on the UK's existing strengths. Together they will accelerate the development of the capabilities of UK business to make the most of this exciting global opportunity.

02 | Executive summary

Context

Half the world's population are already living in urban areas, and making cities work better is a critical challenge for this century. Cities want to provide their citizens with a thriving economy and a great quality of life, and to do this with a reduced environmental impact. Making this possible is a big opportunity for UK business.

In response to the challenges faced by cities internationally, and the opportunity presented to UK business, the Technology Strategy Board organised a competition which saw 30 UK cities granted £50,000 each to develop an innovative scheme to dramatically improve their performance. Cities prepared feasibility studies for their schemes, and submitted these alongside their applications for funding.

Following the competition, £24m was awarded to Glasgow for a Future Cities Demonstrator, to show at scale the benefits of integrating services on a level not seen before. Following an additional period of consideration, it was also announced in April 2013 that Peterborough, London and Bristol will also receive grants of £3m each to bring forward elements of their proposals.

This report provides an analysis of the feasibility studies submitted by these cities, exploring the common city visions behind their smart programmes, the themes of the projects and the expected benefits. The report also explores the requirements for successful delivery of Future Cities Demonstrator projects, based on international comparators, and the role of the Future Cities Catapult in the next steps in the UK future cities story.

Challenges

The feasibility studies presented in this report show an exciting level of ambition for the development of future cities in the UK, with a broad focus on the facilitating nature of open data and its role in improving access to information, service delivery and economic development in a city.

The short time frame allowed for the development of the feasibility studies showed that those cities that had already been considering the 'smart agenda' were at a considerable advantage in the development of their proposals. The challenges identified by cities are typified by the need to become more sustainable, while improving quality of life for residents, with growing and ageing populations, in a context of public sector budget cuts and a struggling UK economy.

Findings

The majority of cities developed similar solutions, generally focused on utilising open data platforms to improve access to information, and facilitating delivery of new, better or more efficient services, whilst responding to decreasing public sector budgets.

Cities that have established programmes in this area were able to produce more complete proposals. Proposals were particularly strong where there was strong existing leadership and representation of the programme, such as in Glasgow and Bristol.

Engagement emerged as a key influence on the strength of the proposals: all the shortlisted cities with strong proposals involved extensive engagement with a range of partners, including industry, academia and citizen groups.

The feasibility study process catalysed development in the smart and future cities space in the participating cities – allowing time to consider applying smart and future city solutions, and providing a platform for future development. The UK was previously a laggard in this area, but this work, alongside work undertaken by the Department for Business, Innovation and Skills, is allowing the UK to catch up with the market leaders.

Next steps

Cities have converged around similar solutions through commonalities in challenges, and by responding to exemplar cities around the world. Case studies of international best practice could be made available, and knowledge-sharing between more and less advanced cities could be facilitated through relationship-building at officer and director level. The Future Cities Demonstrator projects have a key role to play in this process, communicating successes and lessons learned to other cities throughout the development process.

The convergence of solutions should also be leveraged in the development of the future cities market in the UK, indicating particular areas where cities are able to collaborate to share learning, and where there are opportunities to begin standardising solutions.

Cities need to become intelligent future cities clients, to ensure that the most appropriate solutions are delivered in each individual case. There is an opportunity to build upon learning from other cities, and in particular from the large projects brought forward through the Demonstrator. Businesses need to become intelligent future cities marketers to develop solutions that meet the needs of individual cities and their challenges, to overcome an existing translational barrier that is slowing mass take-up of available solutions.

Further development within public organisations should be undertaken, to ensure that local government has mechanisms for testing innovations and mainstreaming successful programmes. Organisationally this can be addressed by establishing a function whose role it is to act entrepreneurially; taking risks and testing new ideas.

The development of this space in the UK is contingent on collaboration between the key stakeholders. The more successful proposals demonstrated this collaboration, drawing upon existing relationships with industry, academia and citizens in the development of projects.

The feasibility study process catalysed development in the future cities space in participating cities, providing time and space to engage with a wide group of local stakeholders to consider the application of smart solutions against specific city challenges, providing a platform from which cities could develop and take forward their plans. The Future Cities Demonstrator competition process alongside work undertaken by the Department for Business, Innovation and Skills, is helping shape the UK future cities market that is catching up with other global leaders.

SMEs were an important part of many of the demonstrator proposals. New procurement models may be needed in the public sector to allow small, innovative companies to participate, to take advantage of the innovation that they bring to the market.

Whilst there is now momentum in this area, there is a need to identify sustainable business cases for the public sector. This is a particular challenge, as it is often difficult to quantify the benefits of novel solutions, highlighting again the need for organisational structures capable of dealing with innovation.

The Future Cities Catapult should help with these next steps, building on the momentum gained through the feasibility process to facilitate the sharing of best practice from the demonstrator cities among the wider community, and providing a platform for collaboration between industry and academia, to ensure that the UK becomes a market leader in the future cities space.

Cities want to provide their citizens with a **thriving economy** and a **great quality of life**, and to do this with a **reduced environmental impact**. Making this possible is a big opportunity for UK business.

03 | Introduction

We need innovation in **integrated** and city-wide solutions.

With over half the world's population already living in urban areas, making cities work better is a critical challenge for this century. Cities want to provide their citizens with a thriving economy and a great quality of life, and to do this with a reduced environmental impact. Making this possible is a big opportunity for UK business.

Cities are vital to the future global economy. In 2008, for the first time in human history, more people lived in urban areas than outside of them. By 2050 more than 70% of the global population will live in cities. In the UK cities are equally important, with one third of the country's total population living in the ten largest urban areas.

Cities are more economically productive and have a lower carbon footprint per capita than rural areas. However, cities are also struggling with climate change, changes in population and demographics, congestion, healthcare and pressure on key resources. To succeed in the future, city governments have to deliver a sustainable local economy, and a good quality of life with a reduced environmental footprint. We need to create city systems that maximise the benefits of city life, whilst managing the downsides.

High-quality city infrastructure is essential to meeting this future need, but it is becoming increasingly clear that we cannot progress fast enough by optimising the city's individual components and systems. We need innovation in integrated and city-wide solutions.

Over time there will be a large market for integrated approaches to delivering efficient, attractive and resilient cities. The Technology Strategy Board estimates that integrated city solutions could represent a £200bn global market by 2030. The UK is well positioned to exploit this growing market. We have world-leading companies in project management, engineering, architecture, energy and transport systems, communications and the digital economy, finance, legal services and insurance. The UK has a world-class science and research base that supports the development of innovative solutions, and provides a talent pool for UK and global firms. Our ability to bring together the cluster of companies needed to design, finance, risk manage and execute large infrastructure projects makes the UK a major global centre for such projects.

City-wide integration is a complex challenge with many risks. Wide take-up of new solutions will require extensive evidence of performance in use. A large-scale Future Cities Demonstrator programme, covering a substantial population and a significant urban area, will support UK-based businesses in developing new approaches and solutions that can be exported around the globe, and help UK cities to plan and build for the challenges of the future, improving their international competitiveness. The purpose of the Future Cities Demonstrator programme will be for a group of cities to work with suppliers to test the additional value that can be created, by integrating city systems to a level not previously achieved in the UK. This will allow cities to explore new approaches to delivering a strong local economy and excellent quality of life for their citizens, whilst reducing their environmental footprint and increasing their resilience to environmental change. The Future Cities Demonstrator programme is about what can be done today, by innovative use of what is available 'off the shelf'.

At the same time, the Technology Strategy Board is setting up a Future Cities Catapult Centre, which will be a world-leading research laboratory to develop new technologies and new solutions for the future, which UK companies can sell to the world's cities. Sir David King has been appointed as the Chair of the Catapult, with Peter Madden as its CEO, to lead innovation for integrated cities.

The Technology Strategy Board organised a competition in 2012 which saw 30 UK cities granted £50,000 each to develop an innovative proposal to dramatically improve their performance. Cities prepared feasibility studies for their schemes, and submitted these alongside applications for funding.

In **2008**, for the first time in **human history**, more people lived in urban areas than outside of them.

Following the competition, £24m was awarded to Glasgow for a Future Cities Demonstrator Project[1], to demonstrate at scale the benefits of integrating city systems. Due to the excellent quality of the runner-up proposals, in April 2013 it was announced that Peterborough, London and Bristol would also receive grants of £3m each to bring forward elements of their original proposals.

This report presents an analysis of the feasibility studies submitted by these cities, exploring the common visions of their smart programmes, the themes of the projects, expected benefits, and some potential next steps in the UK future cities story. It also provides a brief background to the Future Cities Demonstrator, and an overview of the competition process and participants. The full versions of the feasibility studies can be found on the Technology Strategy Board's _connect website, under the Future Cities Special Interest Group[2].

The Technology Strategy Board Future Cities Demonstrator programme and Future Cities Catapult are part of a wider UK programme in this area, led at a central Government level by the Department for Business, Innovation and Skills (BIS), and at a regional level through bodies such as the London Smart Cities Advisory Board's and the Scottish Enterprise Smart Cities Programme.

[1] https://www.innovateuk.org/web/corporate1/news-display-page/-/asset_publisher/GS3PqMs1A7uj/content/glasgow-selected-to-be-city-of-the-future
[2] https://connect.innovateuk.org/web/future-cities-special-interest-group/feasibility-studies

The Technology Strategy Board organised a competition in 2012 which saw **30 UK cities** granted **£50,000 each** to develop an innovative proposal to **dramatically improve their performance.**

04 | Future Cities Demonstrator: the city context

A review of the **29 feasibility assessments** has been undertaken to **identify key themes** in the challenges faced by the cities, and their visions for future development.

The Future Cities Demonstrator competition was held as a two-stage process. In the first stage, cities were invited to bid for funding to carry out a feasibility study and develop their Demonstrator project proposal. Over 50 cities submitted proposals for feasibility studies, and whilst initially only 20 were expected to be funded, the quality of the submissions was so impressive that 30 cities were awarded grants of £50,000.

In the second stage, cities completed their feasibility study reports, and also submitted proposals for the large-scale Demonstrator project, for which up to £24m was available. Out of the 30 cities that were awarded grants, 29 completed their feasibility study reports and 26 submitted proposals for the large-scale Demonstrator.

The feasibility studies were publicly funded at 100% of eligible costs, and cities were required to produce a publicly available report on the results of their studies. The feasibility reports have been published on the Technology Strategy Board's _connect website under the Future Cities Special Interest Group[1], and widely disseminated amongst the local authority, business and academic communities.

The 29 councils councils from across the UK illustrated on the following page submitted feasibility studies in support of their demonstration projects:

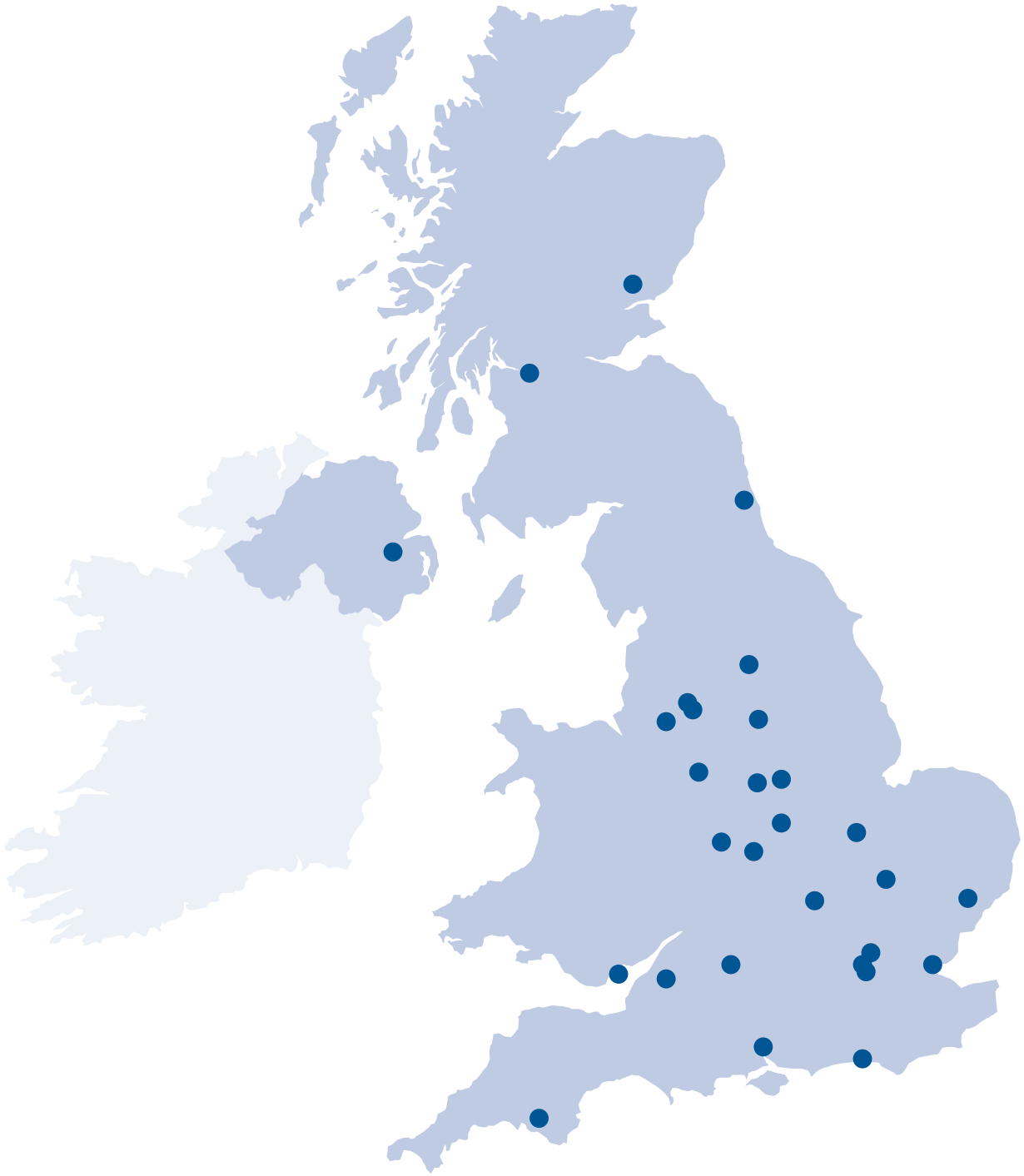
City challenges and visions

A review of the 29 feasibility assessments has been undertaken to identify key themes in the challenges faced by the cities, and their visions for future development, to identify common areas for collaboration between the cities.

The challenges and visions reported by the cities are well defined, calling on existing strategies for city development. Peterborough's Sustainable Community Strategy, for example, sets out the city's goals to create opportunities and tackle inequality, create strong and supportive communities, become the UK's environmental capital and deliver substantial and truly sustainable growth. These visions have been utilised directly in the development of the future cities feasibility studies, ensuring that outcomes align with wider city development objectives.

The following sections set out in more detail the challenges identified by cities, and the corresponding visions for future development.

[1] https://connect.innovateuk.org/web/future-cities-special-interest-group/feasibility-studies



Belfast City Council*
Birmingham City Council
Brighton and Hove City Council
Bristol City Council
Cambridge City Council
Cardiff City Council
Coventry City Council
Derby City Council*
Dundee City Council
Glasgow City Council
Greater London Authority
Enfield Borough Council
Ipswich Borough Council
Leeds and Bradford City Councils
Leicester City Council
London Borough of Camden*
Manchester City Council
Milton Keynes Council
Newcastle City Council
Nottingham City Council
Peterborough City Council
Plymouth City Council
Salford City Council
Sheffield City Council
Southampton City Council
Southend-on-Sea Borough Council
Stoke-on-Trent City Council
Swindon Borough Council
Warrington Borough Council

*Did not submit a proposal for the large-scale demonstrator.

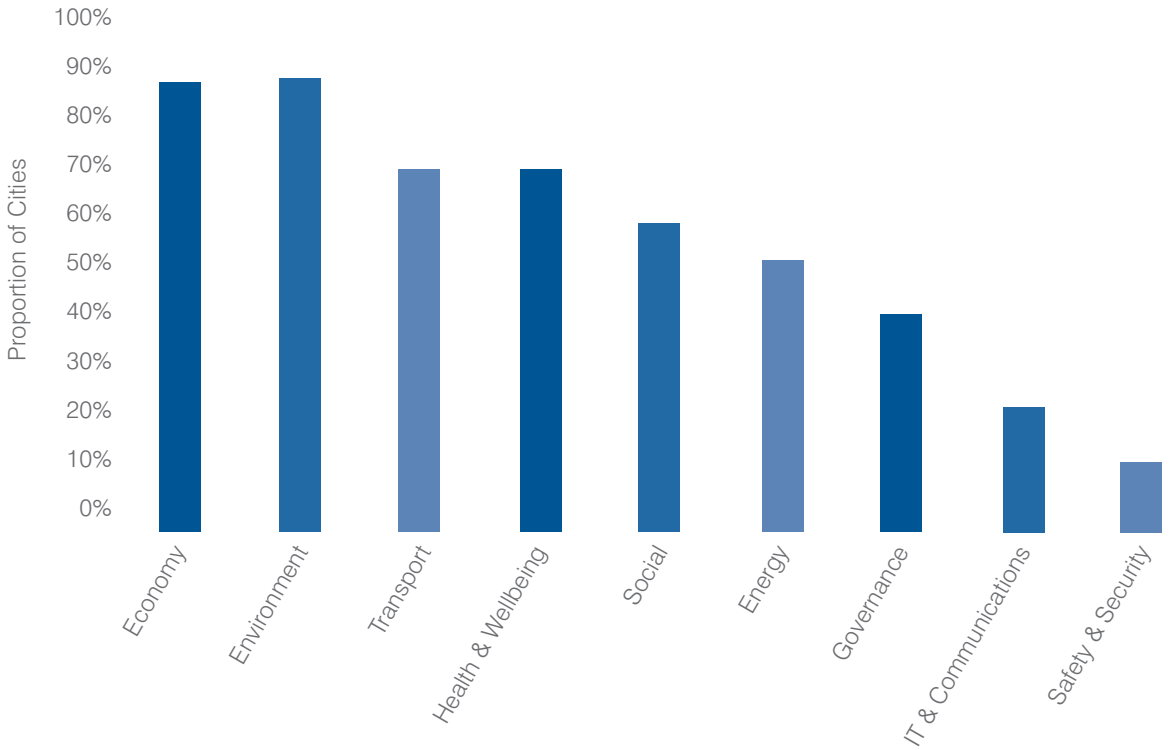
Challenges

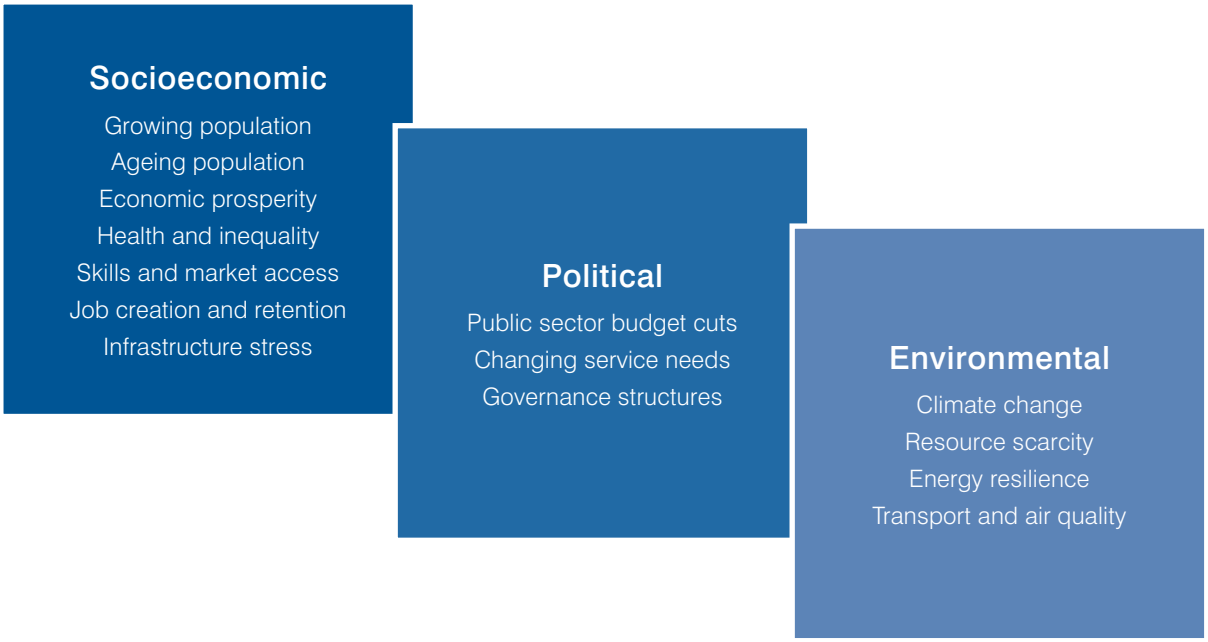
The challenges highlighted by the cities in the feasibility reports cut across the range of services delivered by Councils, other public bodies and the private sector. 90% of cities identified the economy and the environment as key challenges, followed by transport, health and wellbeing, and social issues.

Following an assessment of the 29 feasibility studies, the challenges identified by the participating cities have been categorised. It is worth noting that the challenges identified by cities in the reports are inherently subjective, and this is reflected in the analysis. The themes identified are presented in the table below, with examples of each from the feasibility studies.

Category	Example
Economy and enterprise	**Leicester:** In 2010, the employment rate was 61% of the working age population, significantly lower than the national average of 70.5%.
Environment	**Ipswich:** Established a target to reduce its CO_2 emissions by 60% by 2025.
Transport	**Stoke-on-Trent:** Congestion significantly affects public transport reliability and journey speed.
Health and wellbeing	**Bristol:** Changing and growing health needs of citizens.
Social	**Glasgow:** Last year 40% of citizens reported an incident of antisocial behaviour.
Energy	**Southend-on-Sea:** Rising energy costs leading to an increase in fuel poverty.
Safety and security	**Leeds-Bradford:** Key infrastructure and housing vulnerable to flooding.

Challenges identified by cities





The challenges identified cut across socio-economic, political and environmental issues. The majority of the challenges identified are socio-economic, with marginally less focus on environmental and political challenges. Environmental challenges are often mentioned alongside the challenges of growing an economy, particularly in the context of sustainable development.

The diagram above groups specific challenges identified by the cities according to these overriding themes.

Future challenges identified by cities focus on increasing urban populations, and the knock-on impacts of this. Such challenges include an increase in infrastructure stress, changing public service needs, and the need for additional employment opportunities. Bristol in particular is expecting a 31% rise in population by 2028:

> *'As a rapidly growing City, population growth and diversification is probably the greatest challenge we are facing. Bristol is expecting a 31% rise in population by 2028; we need to plan in partnership to meet the needs of those people.' Bristol*

In contrast, Manchester is already feeling the effects of these changes, having increased in population by nearly 20% in the past decade. Manchester cites an increased demand for services and resources, rising traffic congestion and the corresponding increase in the challenge of reducing local air pollution, as impacts of this change.

Milton Keynes is anticipating an increase in the age of its population, and highlights the need for a focus on the prevention and management of age-related illness in response:

> *'The over-65 population is expected to increase by 120% over the next two decades. To maintain the quality of life in the borough, MK will focus on the prevention and management of long-term medical conditions, and approaches to independent and assisted living.' Milton Keynes*

In contrast, Birmingham has one of the youngest populations in Europe, and is expected to get younger as it grows:

> *'Birmingham is a diverse and constantly changing city, home to just over one million residents, and estimated to grow by almost 0.2 million by 2028. Almost half of the population are aged under 35, which makes it one of the youngest cities in Europe, and by 2035 it is expected to get younger, with above-national-average growth in the number of people from all age groups below 65.' Birmingham*

In response to this change, Birmingham is looking to create the conditions for employment growth, to be delivered in the face of the global economic crisis.

Economic development is at the heart of many of the cities' visions. Set in the context of the global economic downturn, subsequent reductions in public sector budgets, and increasing economic competitiveness between cities in the UK and globally, economic development is seen as a key solution to many of the challenges facing cities today. These challenges range from reducing local inequalities as in Glasgow, promoting prosperity and becoming a market leader as in Bristol, or finding a means of retaining talented citizens as in Cardiff.

The cities' visions, in response to their individual challenges, are well-defined, with a focus on improving local quality of life, improvements in economic opportunity, community engagement and integration, and a reduction in environmental footprint.

City visions

The cities' visions, in response to their individual challenges, are well-defined, and have often been established as part of an existing strategy or programme, including corporate strategies such as the Belfast City Council Masterplan 2005-2015, the Greater Birmingham and Solihull Local Enterprise Partnership Strategy for Growth, the Coventry City Council Plan (2011-2014), and 'Future Glasgow 2011-2061: A Fifty Year Vision for the Future'.

The overwhelming focus of the visions is on improving local quality of life. Following on from this, and linked to it, are improvements in economic opportunity, community engagement and integration, and a reduction in environmental footprint (sustainability).

The tag cloud on the page opposite shows the key themes represented in the cities' visions. It places a strong emphasis on citizens, communities and quality of life, whilst demonstrating a focus on economic and social issues, all within an overarching vision of a sustainable future.

The vision presented by Ipswich succinctly covers the key themes observed across many cities:

> *'Our vision is to improve the quality of life for all who live in, work in, study in and visit Ipswich, by delivering growth to create opportunities while ensuring that development takes place in a sustainable way.' Ipswich*

The following sections explore in more detail the key themes represented in the cities' challenges and visions:

- Quality of life
- Economic development
- Community engagement and integration
- Sustainability.

City visions: quality of life

The aspects of quality of life presented by the cities as part of their vision statements are typified by:

- Reducing social inequality by promoting independence and healthy lives
- Ensuring that citizens feel safe and secure
- Ensuring that residents have the opportunities to meet their potential. This includes supporting and celebrating young and older people.

The cities' visions recognise the breadth of factors that contribute to a good quality of life. The impacts of social inequality in Glasgow are demonstrated by the significant current disparity in life expectancy across the city, and in comparison with other UK cities:

> *'Glasgow continues to have the lowest life expectancy in the UK. Female life expectancy at birth (78 years, 2008-2010) is greater than male life expectancy (71.6 years, 2008- 2010) but both were much lower than the UK national average for females (82.3 years) and males (78.2 years) in 2010... There is also a striking contrast between the rich and the poor areas across Glasgow. A report by the World Health Organisation (WHO) found that men in one of the poorest parts of the city had a life expectancy of just 54 years, and that this was 28 years shorter than that of a man in a richer area only 15 minutes' drive away.' Glasgow*

In contrast, Bristol, as one of the healthiest of the eight Core Cities, still faces issues associated with social inequality:

> *'Bristol is a prosperous City, with most people enjoying a healthy lifestyle. However, this overall picture hides levels of inequality and areas where people experience lower levels of income, health and education, and higher levels of crime.' Bristol*

The safety and security of citizens has been identified by cities as essential for a good quality of life. Bristol aims to build strong and safe communities, while Peterborough will create a healthy, safe and exciting city. Derby is building a city with 'being safe and feeling safe' as a key priority.

The ability for citizens to meet their potential is undoubtedly a contributor to local quality of life, and it is identified by Manchester as an element of its vision for the Future City:

> *'Manchester's vision as a world class city is one... where all our residents can meet their full potential, are valued and secure.' Manchester*

Set in a context of reducing public budgets, and the changing role of the local authority in areas such as health care, a key element of the visions is to improve the efficiency of public service delivery, allowing a Council to do more with less, as demonstrated by Plymouth:

> *'Reducing budgets/increasing demand for services [represent a challenge leading to] the need to look at alternative and more integrated service delivery models, especially in relation to health and adult care services; for example, it is expected that those aged over 65 with a limiting long-term illness will increase from 20,132 in 2010 to 28,960 in 2030, and there is a need to reduce costs in Adult Social Care, particularly in relation to expensive care packages in Learning Disability.' Plymouth*

City visions: economic development

Economic development is seen as a challenge across the majority of the cities, and it is prioritised in city visions in all cases. As explored above, the motivations for encouraging economic development are varied, from addressing existing social challenges such as inequality to increasing prosperity and retaining talented citizens. Across the board, sustainability and economic development are presented as complementary goals.

The aspects of economic development and quality of life presented by the cities as part of their vision statements are characterised by:

- Sustainable economic development and prosperity
- The creation of relevant, highly skilled jobs and diversification of economic growth
- Fostering of enterprise and innovation, attracting and retaining talent and businesses.

Bristol's vision prioritises sustainable economic growth, with an aspiration to become a world leader in green and smart technologies, while Milton Keynes's focus is concentrated on promoting innovation, to become the UK's digital capital. In contrast, Cambridge is looking to improve integration in its existing economy to improve efficiency and increase output. On a similar note, within its wider vision to become the most sustainable city in the UK, Leicester is looking to become a cosmopolitan centre for small businesses:

> *'We want to ensure that prosperity is sustainable and Bristol becomes a world leader in green and smart technology, helping to meet Bristol's citywide target to reduce CO_2 emissions by 40% by 2020.' Bristol*

> *'We will establish an open innovation environment of flourishing creativity, becoming the UK's leading digital city.' Milton Keynes*

> *'Make the economy more integrated, more efficient, and able to make an even stronger contribution to the UK economy.' Cambridge*

> *'The City's ambition is that by 2020 Leicester will be a confident city with a national reputation as a cosmopolitan, creative and academically rich place in which small businesses thrive and there is strong growth in jobs and skills.' Leicester*

City visions: engagement and community integration

Many cities, such as Leeds and Bradford, highlight the fact that strong, engaged and active communities are less reliant on public services and more able to make good choices based on the available information:

> *'Our approach is to deliver healthcare and adult social care services in an innovative way that also drives overall health and well-being…[allowing people to be] more informed, so as to make better/different decisions and so lessen the burden on healthcare providers and themselves, reducing the dependency between citizens and the state.' Leeds and Bradford*

The key elements of cities' visions relating to engagement and community integration are:

- Enabling and empowering citizens and communities to make informed decisions
- Increasing early intervention
- Building stronger and safer communities
- Developing healthy communities which have addressed the root causes of social and economic exclusion.

In particular, Warrington is looking to enable citizens to produce and apply solutions independent of the Council, improving Council efficiency:

> *'Enable citizens to search for, develop and apply solutions collectively, to adapt to future challenges, whether foreseen or not' Warrington*

More effective engagement can help with the delivery of services to disadvantaged citizens and improve early intervention – improving both the standard of care and reducing the overall cost of services to the Council. Nottingham's pioneering Early Intervention programme, presented as part of the city's vision, is a prime example of this.

City visions: sustainability

Many cities' visions focus particularly on environmental sustainability, referring to adopted emissions reduction targets for the local area. Brighton and Hove has adopted the principles of 'One Planet Living' as the central pillar of its future city vision:

> *'To become a One Planet Smart City that is open, vibrant, creative, sustainable and fair, becoming a model location for new thinking and solutions to city systems design and operation.' Brighton and Hove*

Similarly, Milton Keynes Council has a Low Carbon Living Strategy and Action Plan for the period 2010 to 2020, which shows how the Milton Keynes community can reduce greenhouse gas emissions locally to tackle climate change:

> *'[The strategies] show how the Milton Keynes community can reduce greenhouse gas emissions locally and thereby help tackle global climate change by:*
>
> - *Integrating sustainability and carbon reduction into the planning and delivery of the Council's aims*
> - *Reducing the authority's carbon footprint*
> - *Demonstrating community leadership in tackling climate change and sustainability issues, including reducing the overall carbon footprint of the borough.'*
>
> *Milton Keynes*

Environmental sustainability is often set alongside economic growth and development, particularly where cities have an ambition to develop a new green economy. Southampton's Low Carbon City strategy is a good example of this:

> *'The Low Carbon City strategy sets out the Council's ambition for Southampton to become the country's leading low carbon city. The vision for 2020 is for Southampton to thrive in a new low carbon economy, becoming a focal point for green business as the city moves to low carbon energy, low carbon transport and a low carbon built environment.' Southampton*

Alongside the general theme of developing sustainable cities, increasing the supply of renewable and low carbon energy, improving resilience to climate change and promoting sustainable development, particular examples which stand out are Camden's ambition to become self-sufficient in the management of waste, and Stoke-on-Trent's ambition to become energy-self-sufficient.

Existing resources and opportunities

This section of the review summarises the resources and opportunities, identified by cities in their feasibility reports, which will contribute to their development of future cities solutions.

Cities have identified a range of existing resources and opportunities to develop their future cities visions, including:

- Governance and senior leadership
- Existing partnerships
- New development
- Existing infrastructure and industry
- Forward funding.

The impact of a senior champion within the city is clear from the strength of the studies from cities who have already undertaken some development of a future cities programme. Indeed, within the context of the Technology Strategy Board's Future Cities Demonstrator competition, senior-level support within the Council was required to demonstrate deliverability.

The Smart City Bristol initiative has been running since 2011, and the city has invested in a £9m fibre optic network (BNet), a Digital Enterprise Zone set to offer gigabyte connectivity:

> *'The City's digital infrastructure is well-established. BNet is a £9m, City Council-owned and managed, city-wide fibre network, and the recently funded £20m Gigabyte (GB) Bristol is a Digital Enterprise Zone (DEZ) that will ensure that gigabyte connectivity is readily available to SMEs, and that ultra-fast broadband will be available to all consumers.' Bristol*

The Birmingham Digital Strategy is another good example of strong existing governance in the smart arena:

> *'Digital Strategy encompasses a world-leading digital connectivity programme, covering both super-fast fibre optic broadband across all the key areas of the city for business growth, innovation and learning, and a high-speed, city-wide, next-generation wireless network by 2015.' Birmingham*

Digital Birmingham is focused on ensuring that all citizens have access to the internet and enjoy the benefits of digital technologies.

Other cities are building on existing industry and infrastructure, such as the MedTech campus in Southend-on-Sea and BioCity in Nottingham – both development campuses for medical technologies and pharmaceuticals which could be used to catalyse smart development.

Strong relationships with local universities and stakeholders will be utilised in Manchester and Cambridge, including Cambridge University's Centre for Smart Infrastructure and Construction.

Existing development plans with committed funding can also represent a catalyst for a city-wide smart solution, by allowing the integration of smart solutions in the new development at an early stage, such as for the Glasgow 2014 Commonwealth Games:

> *'Glasgow 2014 Commonwealth Games – twenty major infrastructure projects dramatically altering the physical landscape of the city (including sustainable design of athlete's village with district heating network, world-class portfolio of Games venues, Games Route transport network and waste management), representing over £500 million in associated venues and new-build infrastructure.' Glasgow*

London in particular is planning a novel approach to exploiting existing infrastructure through a clever integration of transport and energy services. London is planning to extract waste heat from existing infrastructure, such as the London Underground system, electrical substations and data centres, to supply citizens and businesses with heat via district heating networks:

> *'Linked London will extract low-grade waste heat from the London Underground, electricity substations and data centres, and transmit it through nearby district heating networks to supply schools, hospitals, leisure centres and large retail outlets.' London*

Cities have **identified** a range of existing resources and **opportunities** to **develop** their future cities visions.

05 | Future Cities Demonstrator: projects

Project proposals

The Technology Strategy Board's brief for the feasibility assessments asked cities to propose projects that integrate city systems at a large scale, to tackle specific challenges in the city.

The competition invited proposals which:

- Showed the integration of multiple systems in novel ways
- Tackled specific challenges in the host city
- Had a potentially significant effect on the economy, quality of life and environmental impact of the city
- Combined recent or current investment in city infrastructure with the Demonstrator funding to create a more effective test environment
- Provided a platform that allows innovative companies, particularly SMEs, to test their ideas
- Offered the potential for innovations in how services are delivered
- Had the potential for further development and use beyond the initial two years of funding
- Delivered projects which would not otherwise come forward, and
- Were led by the city government or equivalent body.

The following two sections of the report explore common themes in the projects proposed by the cities, and in the integration across city sectors.

Common project themes

The solutions proposed in the future cities project follow general themes covering the range of services delivered within a city, including transport, social services, and access to information. The solutions are based on a range of differing infrastructures and platforms which utilise data from a range of sources.

In order to understand the themes arising from the solutions, they have been grouped according to:

- Organisation
- Infrastructure
- Platform
- Application.

The organisation is the source of the data, for example the local bus service operator providing the GPS location of the local buses, or crowd-sourced data from citizens on the use of the local leisure centre.

The infrastructure is any infrastructure required to enable the smart solution, such as environmental sensors, a Wi-Fi network or a central database.

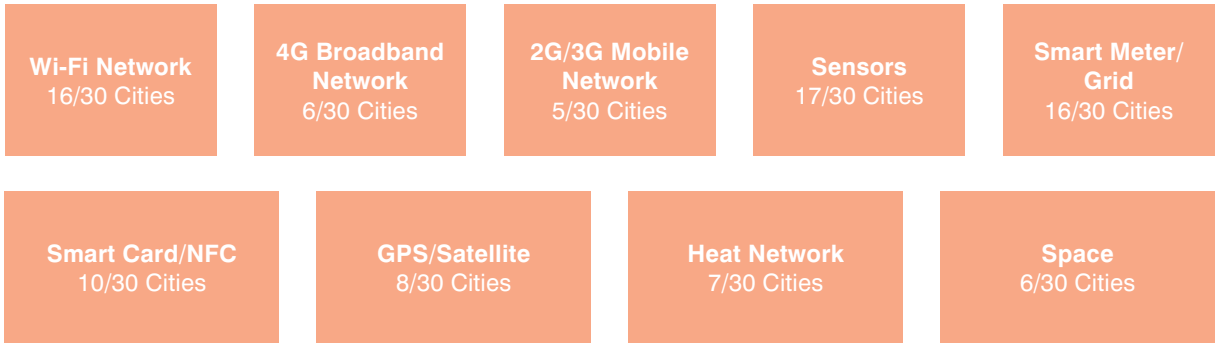
The platform is where the data is processed and made available, for example though an online portal.

The processed data can then be used in its final application, where it can deliver its planned outcome, for example a transport app displaying live bus locations and arrival times on a smart phone to aid mobility, increase public transport usage and reduce congestion.

The following diagram illustrates this division of the integrated solutions, with further examples given in each layer. This methodology has been used to characterise the solutions proposed by the cities, and group them around common infrastructures, platforms and solutions. Cities have not been grouped by organisation, as there is not much variation in these across the solutions.

Systems Application Layer

Platform Layer



Infrastructure Layer

Organisation Layer

Infrastructure themes

Infrastructure categories identified across the feasibility studies include:

- Wi-Fi
- 4G broadband
- Sensors
- Smart meters/grid
- Smart cards
- Heat networks
- GPS
- 2G/3G mobile networks, and
- Physical space.

The majority of cities are proposing to improve the capability of the local internet, and utilise sensors as the integrated infrastructure underpinning solution in meeting the challenges identified previously in the future cities proposals.

Bristol's Community Communications Canopy would provide a network of communication infrastructure extending the existing access to broadband, and introducing a network to transmit information collected by sensors. The network will be based on radio frequency (RF)-enabled photocells retrofitted to the existing street lighting system:

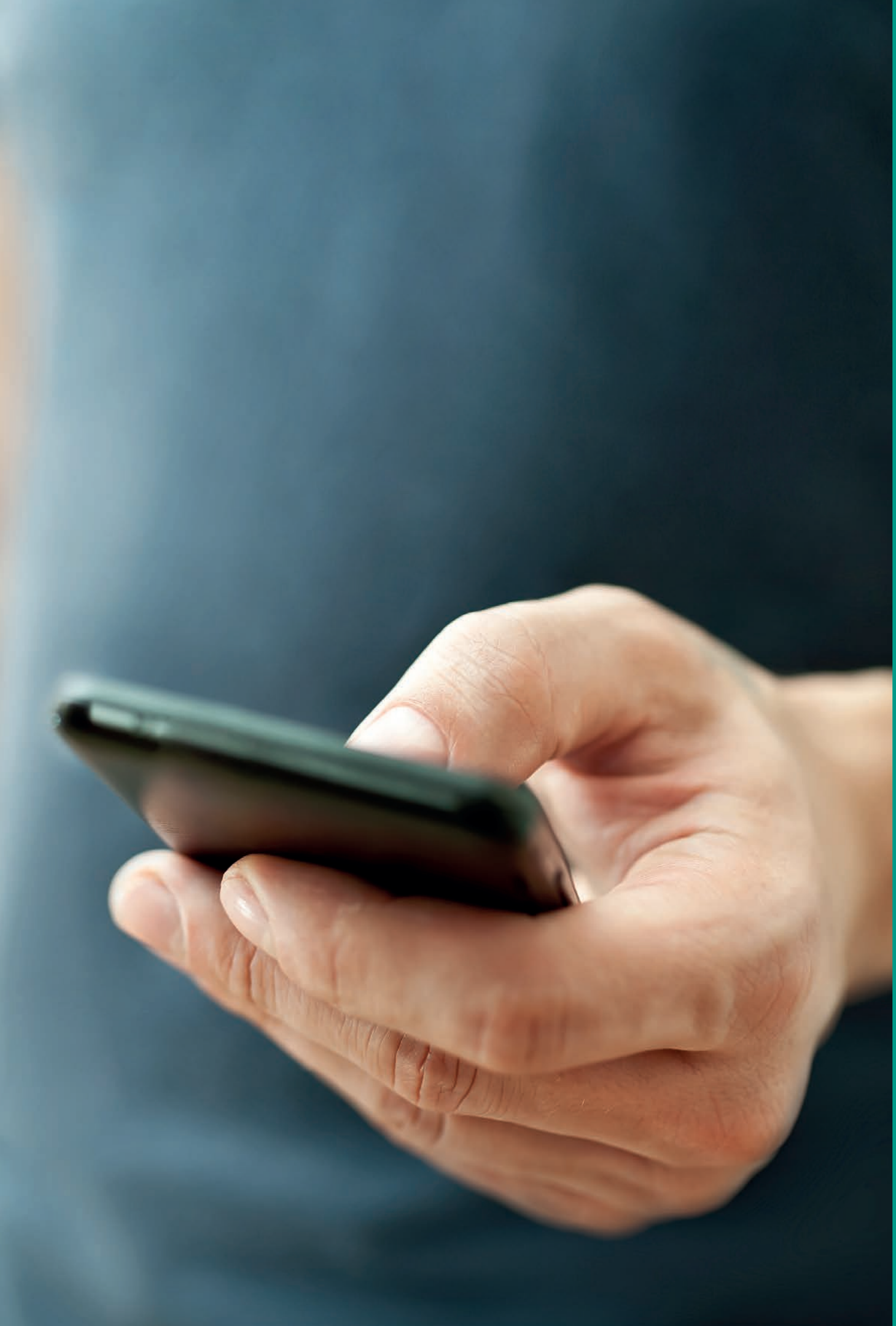
> *'Community Communications Canopy: this will be established by retrofitting existing photocells in Bristol's streetlights with RF (Radio Frequency)-enabled photocells, compatible with open standards existing power sources (NEMA). The RF transceivers within them will not only be able to operate as sensors for environmental information but will also create a mesh connected network which will then be integrated into the City's existing fibre network. The network will also be open to SMEs, academia, and the wider community to develop services based on sensor information and other devices that will exploit this network via the B-COP.' Bristol*

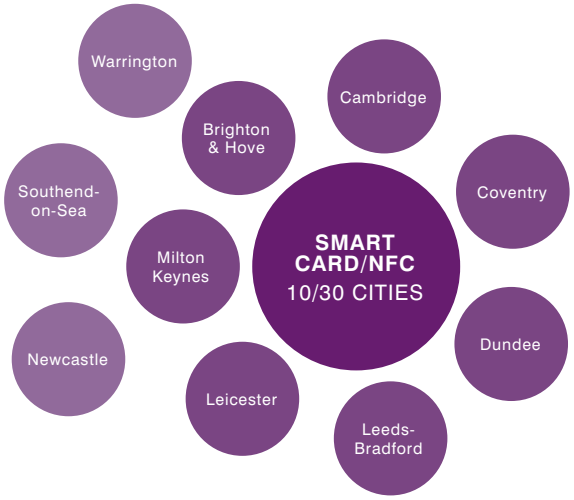
Sheffield proposed to install a new Wi-Fi network alongside a new district heating network, facilitating the integration of real-time smart energy metering alongside the social and economic benefits of widespread internet access:

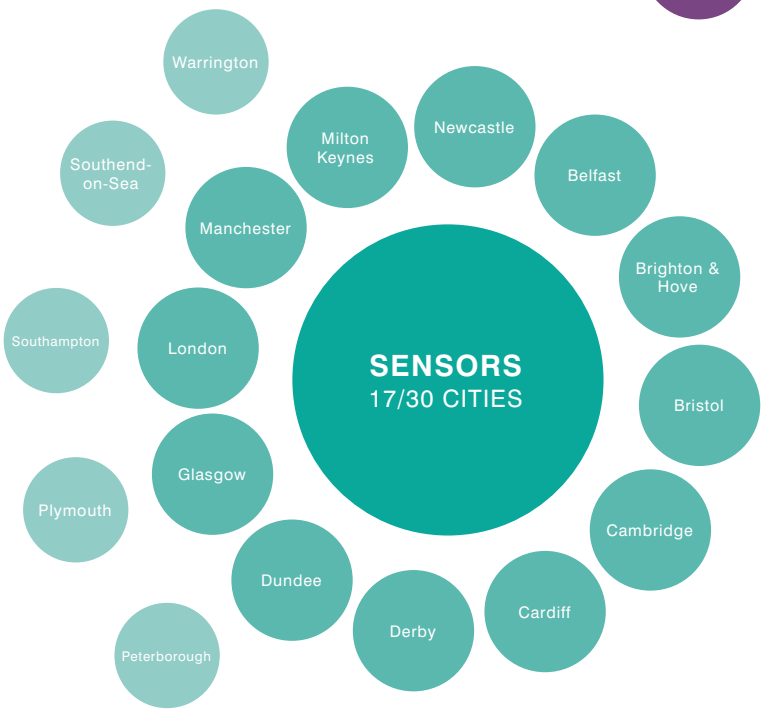
> *'The proposal for the Future Cities Demonstrator Project is to install community-scale Wi-Fi in the areas where smart meters are being installed, connect over 2,000 more homes to the large city centre heating network, and connect a new, nearly zero-carbon heating source.' Sheffield*

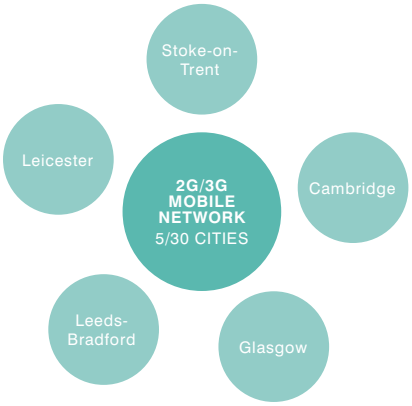
The prevalence of Wi-Fi across the cities indicates the facilitating nature of this technology as a means of responding to the challenges that have been identified, and capitalising on new social and economic opportunities. A potential means of delivering smart solutions, despite current economic constraints, is to identify areas where Wi-Fi deployment will lead to sufficient improvement in the cost of delivering public services to pay back the initial investment. The presence of Wi-Fi can then facilitate pockets of integration across a city, and once a critical mass of integration has been achieved, an integrated data platform could be launched to unlock the full potential of local smart solutions.

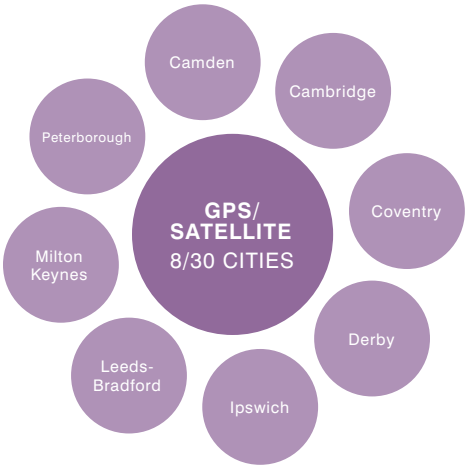
Cities are grouped around these infrastructure types in the spider diagram on pages 24 and 25.





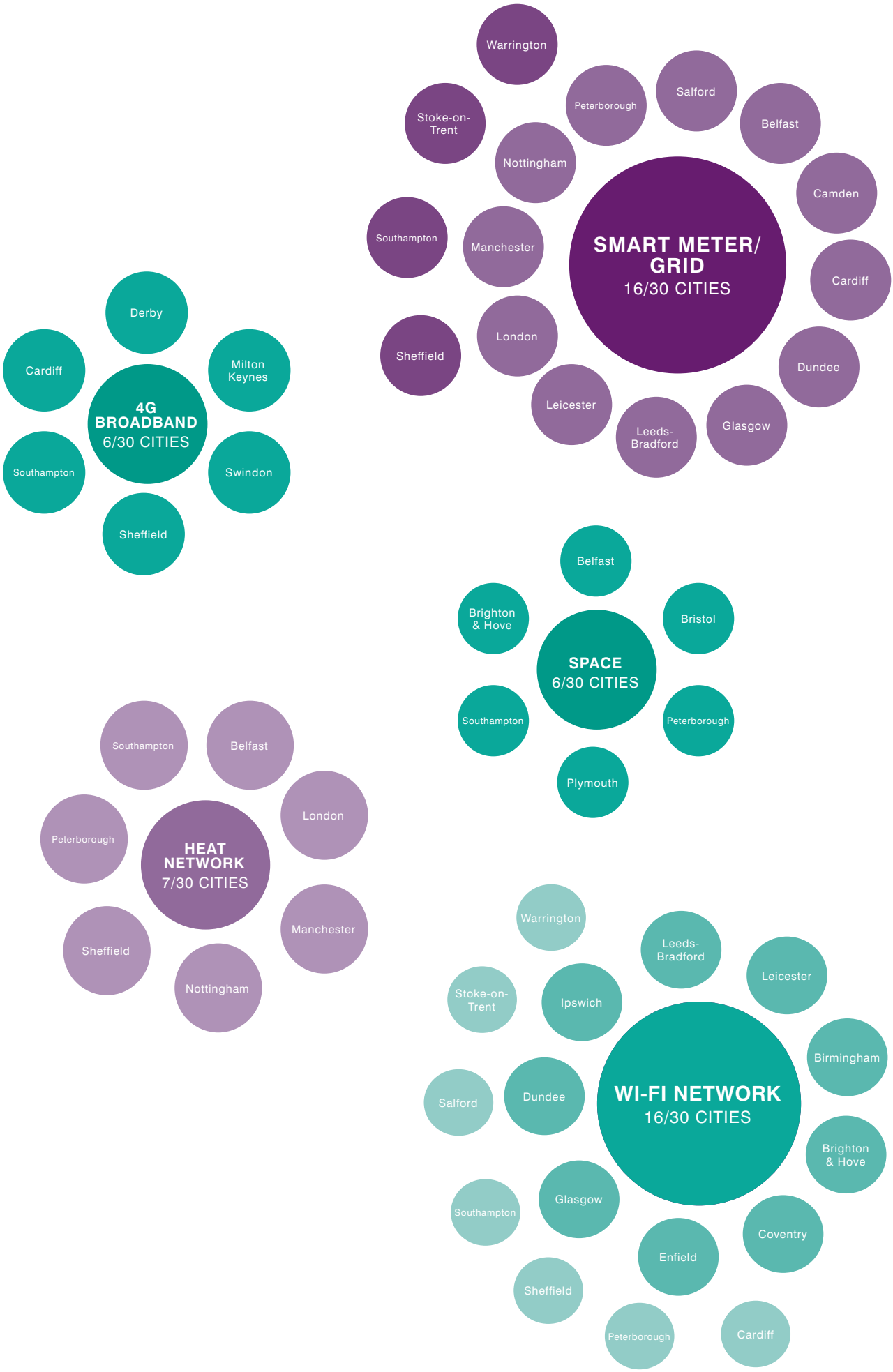






INFRASTRUCTURE

Wi-Fi Network
4G Broadband Network
2G/3G Mobile Network
Sensors
Smart Meter/Grid
Smart Card/NFC
GPS/Satellite
Heat Network
Space


SMART METER/ GRID
16/30 CITIES
Warrington
Peterborough
Salford
Belfast
Stoke-on-Trent
Nottingham
Camden
Southampton
Manchester
Cardiff
Sheffield
London
Dundee
Leicester
Leeds-Bradford
Glasgow
4G BROADBAND
6/30 CITIES
Derby
Cardiff
Milton Keynes
Southampton
Swindon
Sheffield
SPACE
6/30 CITIES
Belfast
Brighton & Hove
Bristol
Southampton
Peterborough
Plymouth
HEAT NETWORK
7/30 CITIES
Southampton
Belfast
London
Peterborough
Manchester
Sheffield
Nottingham
WI-FI NETWORK
16/30 CITIES
Warrington
Leeds-Bradford
Leicester
Stoke-on-Trent
Ipswich
Birmingham
Salford
Dundee
Brighton & Hove
Glasgow
Southampton
Coventry
Enfield
Sheffield
Peterborough
Cardiff

Platform themes

Each future cities proposal employs a platform to make information available to citizens, organisations or city Councils themselves. Making data available across system silos, for intelligent analysis and integration, is seen as a key enabler in meeting the cross-cutting challenges identified by the cities. Indeed, it is not the platform itself that makes the city smart, but how the data realised through the platform is applied for the benefit of citizens and the city.

The platforms identified across the feasibility studies are set out in the table below, with associated definitions. Examples of each platform type are given in the following sections.

Platform Type	Definition
Web-based/Virtual Service Platform	A platform which allows citizens, local businesses and third parties to access information or services provided by local authorities, such as job matching, long distance learning, healthcare support, city dashboard information or real-time transport information.
Open Data Platform	A platform which makes data freely available to everyone to access, use and republish without copyright or patent restrictions. Open data platforms may also release APIs (Application Programme Interfaces) to allow individuals and organisations to develop software applications to share content and/or data. Open data platforms can be used as a tool to improve government transparency, encourage innovation, connect citizens, local authorities and businesses, and promote changes in behaviour.
Data Platform	A platform which contains a range of data and which can only be accessed by certain groups of people, eg local authorities or public bodies. A data platform is usually used as a tool to turn raw data into useful information to inform decision-making or policy development.
In-Home Device/ Interface	A hardware device/interface with a control panel and display which is installed in the home, and which can monitor home energy consumption, and provide real-time service information and access to public services. Most in-home devices/interfaces have wireless communication embedded (eg Wi-Fi or 4G broadband) which allows the device to communicate to other devices or systems, transfer data to a data hub and receive information from local authorities or service providers.

Virtual service platforms

Web-based and virtual service platforms are popular among the cities as a simple way of making information and data available publicly. Virtual service platforms, in the form of an online dashboard, are occasionally accompanied by physical infrastructure such as electronic signs which display information in the city environment, such as Peterborough's 21st Century Noticeboard:

> *'The Living Data strand will incorporate development of a '21st Century Noticeboard', to transform organisation-to-citizen engagement, providing information about neighbourhood and city issues and activities in a widely accessible format.' Peterborough*

Leeds and Bradford plan on utilising a virtual service platform to optimise health and care service delivery systems:

> *'Optimising home health and care service delivery systems, linked with a technology platform to plan, monitor and co-ordinate home care provision. It also provides opportunities to manage community-based transport that provides a foundation for home care and mobility of those in care.' Leeds and Bradford*

Data platforms

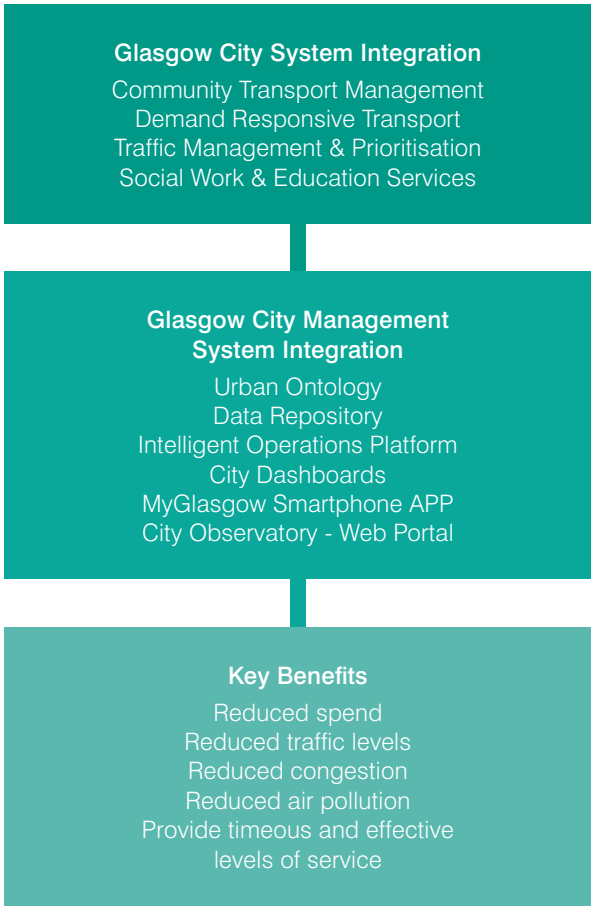
Data platforms have either been proposed as open, with appropriate information available to citizens and businesses, or closed, with data available only to the city government and other public bodies. Often, a city management system is proposed, to ensure that the information is integrated across services to maximise the benefits of the projects.

The application of an open data platform, very often in conjunction with a web-based platform, is seen across the majority of applications. Some examples are:

- Manchester-I City Observatory
- Glasgow City Management System
- London Digital Design Authority
- Bristol City Living Lab and Operating Platform
- Birmingham Citi-Sense Platform.

Many cities proposed utilising real-time traffic information, made available on the data platform and part of a city management system, to provide information to citizens on the best routes to take for a given journey, or waiting times for public transport. These improvements in traffic management could then meet the challenges of improving local air quality by reducing standing queues, improving journey times and quality of life through increased mobility, and reducing local CO_2 emissions.

Glasgow in particular was able to demonstrate how this integration could be achieved via its City Management System, as shown in the following figure, taken from Glasgow's report.



The benefits of an open platform in facilitating projects and gaining quick wins are highlighted by Glasgow and Bristol, particularly in taking advantage of open innovation and improving efficiency:

> *'The improved awareness and use of existing data will also identify real opportunities to link current data collections, extend current data collections and expose duplication within current datasets, which could lead to significant improvements in the efficiency of data-gathering in the future – realising the potential of "big data".' Glasgow*

Demonstrating the benefits, and particularly quick wins, associated with open data has the potential to encourage more people and organisations to give access to data, and overcome any initial inertia.

In contrast to the open platforms above, Cardiff and Stoke-on-Trent are proposing data platforms for use by the local authority to inform strategic decision-making and understanding of the cities' systems:

> *'The [City Information Management Model] CIM2 platform will have an understanding of inter-systems variable interdependencies, it will use indicators to understand real-time city system dynamics and impacts, and it will aid in risk assessment and informed decision-making.' Cardiff*

> *'We intend to create an Urban Optimisation Centre [where] analysis can take place that will inform our own strategic decision-making and policy development, eg it will allow us to build on our observation of the relationship between travel flows and weather events, to explain it, and to predict future patterns – in some cases this will then also influence investment and infrastructure decisions.' Stoke-on-Trent*

In-home interface

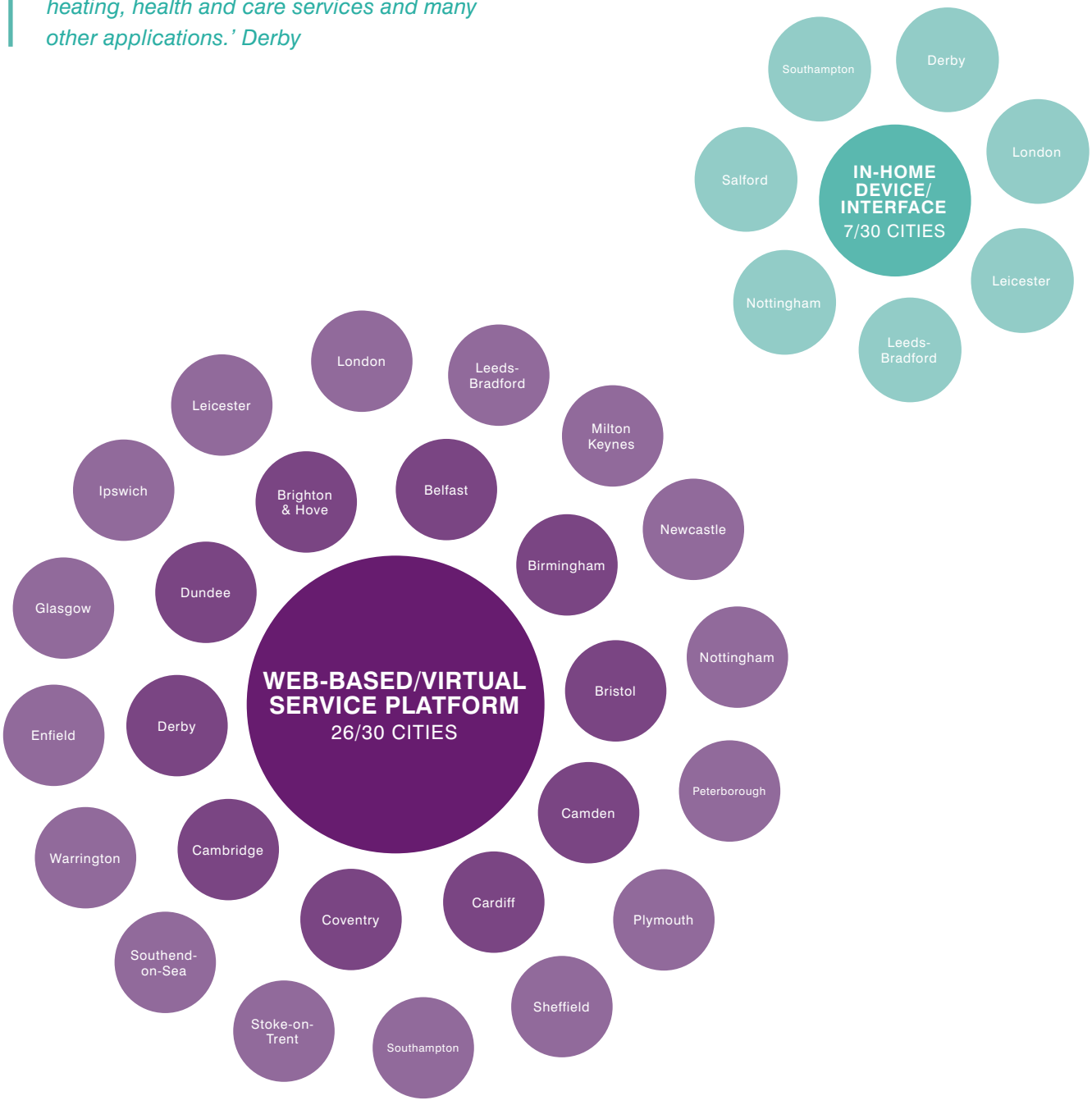
The application of an in-home interface or device is less prevalent, but it is often proposed as an integration of a home energy management system interface and a more versatile interface, providing information on transport and weather, and access to public services.

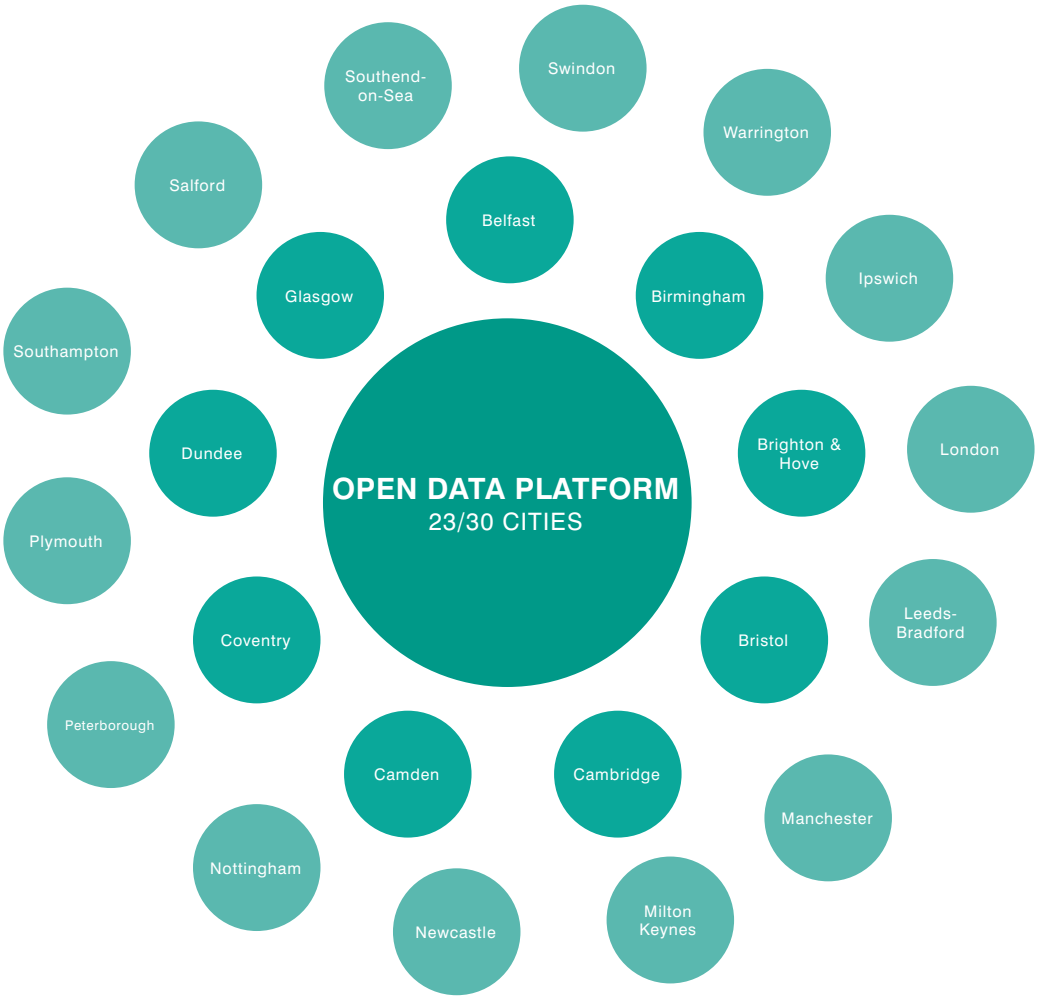
Derby is proposing the installation of Digital Consumer Units in homes in order to open access to service delivery to new suppliers, and give access to new services for consumers:

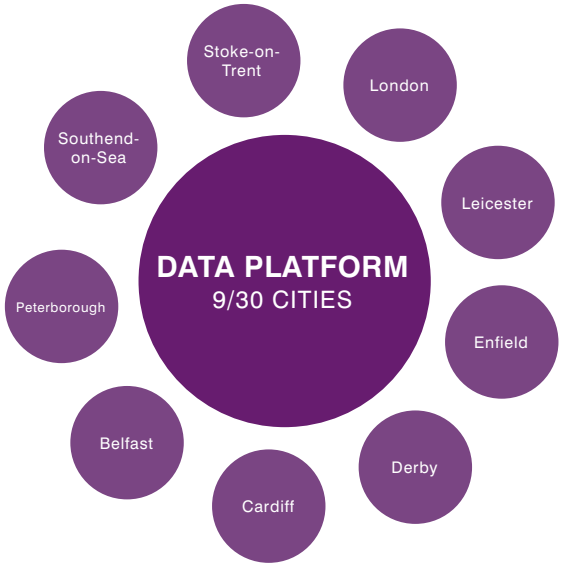
> *'The Digital Consumer Unit… enables services to be provided by any supplier to any person. The Open DCU is expected to enable the marketplace for low-cost sensors and actuators and thus for smart services such as energy-saving systems, intelligent heating, health and care services and many other applications.' Derby*

Similarly, Salford is proposing a Home Information Panel which would provide dashboards and infographics on relative behaviour patterns to encourage a move towards 'smart' behaviours:

> *'The Home City Information Panel… will provide dashboards and infographics specific to the resident(s), showing them comparative information on their habits compared with the City average, to motivate changes in behaviour.' Salford*







PLATFORM

Web-based/Virtual
Service Platform
Open Data Platform
Data Platform
In-Home Device/Interface

System themes

Mapping of the solutions has been done around the system of application, in order to draw out themes across the proposals. The sectors of application identified are:

- Energy
- Water
- Transport
- Health & Social Care
- Safety & Security
- Community
- Local Economy
- Buildings
- Education
- Environment
- Waste
- Housing

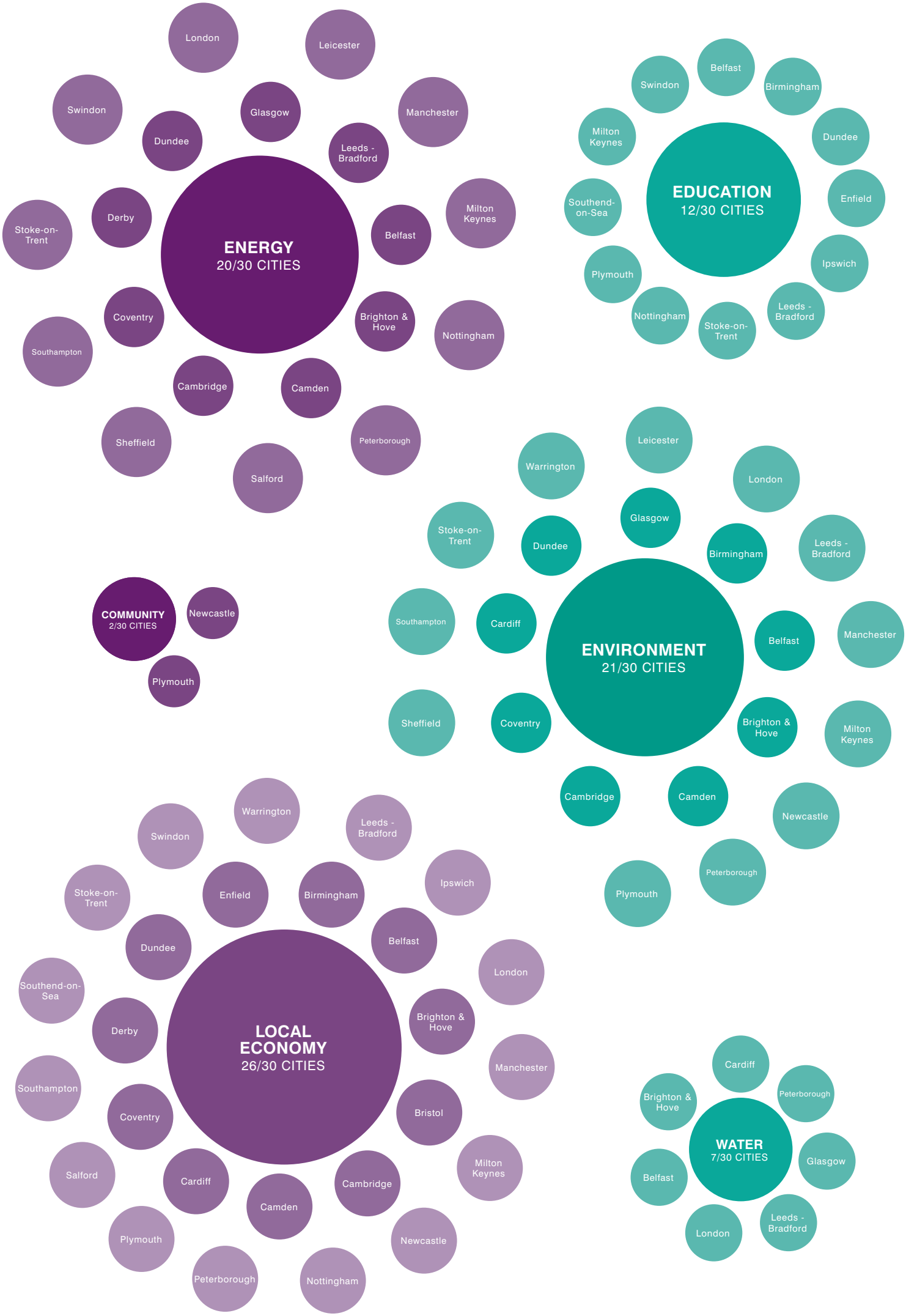
There are significant clusters of cities around the Transport, Local Economy, Environment and Health and Social Care application sectors.

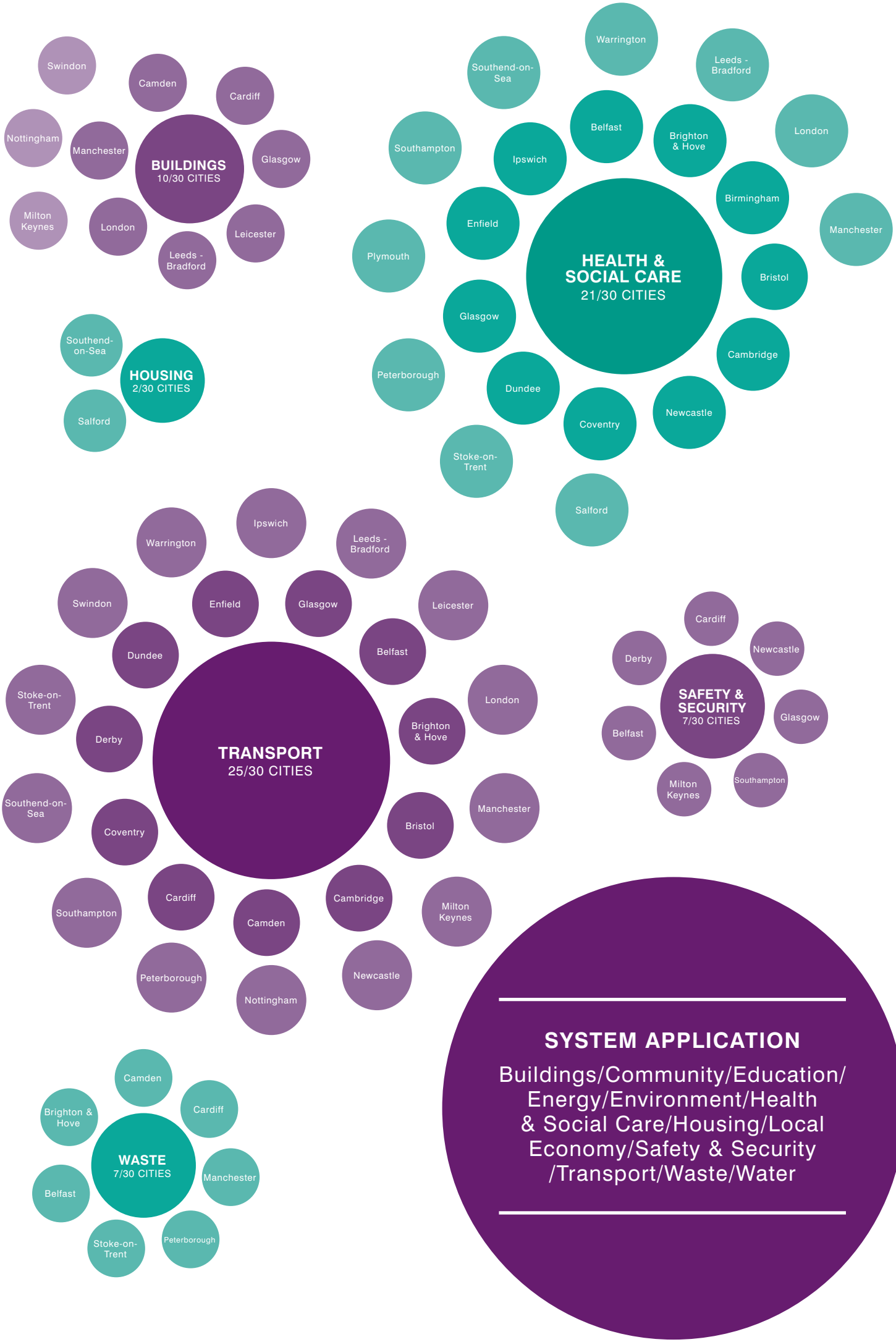
Manchester's logistics projects are particularly interesting and innovative – citing the fact that 15 to 20% of traffic in a city carries freight, with a disproportionate impact on congestion, pollution, noise and fatal accidents involving cyclists, they have proposed the development of a business case for a smart freight distribution system. The system would be incorporated into a 'super trench,' encompassing other smart infrastructure such as DC cabling, and would test technology for small package distribution via a rail trolley system.

> *'A network of freight consolidation centres to improve deliveries and reduce congestion/ pollution; a "super-trench" combining heat-network piping, DC cabling and evaluating an innovative new "last-mile" freight and waste system.' Manchester*

Many cities proposed real-time transport solutions. Newcastle is planning to build on its existing Tyne and Wear Urban Traffic Management System (UTMC), opening-up existing data to leverage additional value from the system:

> *'The [UTMC] system provides a comprehensive source of data which can be leveraged and disseminated more widely, increasing the value derived from the system… Enhancing [the system] by increasing the emphasis on an open-data approach will clearly be valuable in a number of ways, particularly in using this data hub to bring together data and potential interventions across a range of policy areas outside of the world of transport.' Newcastle*


ENERGY
20/30 CITIES
London
Leicester
Swindon
Glasgow
Manchester
Dundee
Leeds - Bradford
Derby
Milton Keynes
Stoke-on-Trent
Belfast
Coventry
Brighton & Hove
Nottingham
Southampton
Cambridge
Camden
Sheffield
Peterborough
Salford
EDUCATION
12/30 CITIES
Belfast
Swindon
Birmingham
Milton Keynes
Dundee
Southend-on-Sea
Enfield
Plymouth
Ipswich
Nottingham
Stoke-on-Trent
Leeds - Bradford
COMMUNITY
2/30 CITIES
Newcastle
Plymouth
ENVIRONMENT
21/30 CITIES
Warrington
Leicester
London
Glasgow
Stoke-on-Trent
Dundee
Birmingham
Leeds - Bradford
Southampton
Cardiff
Belfast
Manchester
Sheffield
Coventry
Brighton & Hove
Milton Keynes
Cambridge
Camden
Newcastle
Peterborough
Plymouth
LOCAL ECONOMY
26/30 CITIES
Warrington
Swindon
Leeds - Bradford
Stoke-on-Trent
Enfield
Birmingham
Ipswich
Dundee
Belfast
London
Southend-on-Sea
Brighton & Hove
Derby
Manchester
Southampton
Bristol
Coventry
Salford
Cardiff
Cambridge
Milton Keynes
Camden
Plymouth
Newcastle
Peterborough
Nottingham
WATER
7/30 CITIES
Cardiff
Peterborough
Brighton & Hove
Glasgow
Belfast
London
Leeds - Bradford


BUILDINGS
10/30 CITIES
Swindon
Camden
Cardiff
Nottingham
Manchester
Glasgow
Milton Keynes
London
Leicester
Leeds - Bradford
HEALTH & SOCIAL CARE
21/30 CITIES
Warrington
Southend-on-Sea
Leeds - Bradford
Belfast
Brighton & Hove
London
Southampton
Ipswich
Birmingham
Enfield
Manchester
Plymouth
Bristol
Glasgow
Cambridge
Peterborough
Dundee
Newcastle
Coventry
Stoke-on-Trent
Salford
HOUSING
2/30 CITIES
Southend-on-Sea
Salford
TRANSPORT
25/30 CITIES
Ipswich
Warrington
Leeds - Bradford
Swindon
Enfield
Glasgow
Leicester
Dundee
Belfast
Stoke-on-Trent
London
Derby
Brighton & Hove
Southend-on-Sea
Manchester
Coventry
Bristol
Cardiff
Cambridge
Southampton
Milton Keynes
Camden
Peterborough
Newcastle
Nottingham
SAFETY & SECURITY
7/30 CITIES
Cardiff
Derby
Newcastle
Glasgow
Belfast
Milton Keynes
Southampton
WASTE
7/30 CITIES
Camden
Brighton & Hove
Cardiff
Manchester
Belfast
Stoke-on-Trent
Peterborough
SYSTEM APPLICATION
Buildings/Community/Education/
Energy/Environment/Health
& Social Care/Housing/Local
Economy/Safety & Security
/Transport/Waste/Water

Common integration themes

Integration of city systems, in terms of organisation, infrastructure, platforms and applications, is a key part of future cities proposals that aim to tackle challenges in a way that can't be done by optimising systems individually.

In order to identify common themes in system integration across the proposals, the projects proposed by the cities have been mapped according to the city systems they coordinate.

In this context, a project has been deemed to offer city service integration where it coordinates the existing functions, services or data of two or more urban systems in order to develop and support new services, or to achieve an improvement in the quality or efficiency of the delivery of existing services, in order to benefit targeted end users in relation to identified challenges.

Bringing raw data or information from two or more independent urban systems together as open data or on a data platform is not recognised as system integration in this context, unless a specific integrating application is proposed, i.e. that data is used to reveal new insights or opportunities to address a particular challenge.

Where solutions have been proposed that apply ICT to improve efficiency or transform existing service delivery within a single urban system (eg in relation to ticketing integration, e-learning or tele-health), these have not been recognised as system integration in this context.

Integration as defined above is often achieved through changes to the cities' infrastructure, enabling interoperability between service systems through a common data platform, or occasionally through more conventional means of integration such as improved communication between delivery bodies.

The projects have been categorised according to the following city sectors:

- **Buildings:** The building sector contains local authority-owned, public, private and commercial buildings.
- **Housing:** Local Councils work with local communities and developers to provide affordable accommodation for citizens, improve the quality of housing, help more people to buy a home, and provide housing support for vulnerable people.
- **Community:** A local community or neighbourhood that shares common values and resources, has common requirements, or faces common risks.
- **Health and Social Care:** Health care is delivered by local GPs, hospitals and other care providers. Social care includes services provided by local authorities to improve the quality of life and wellbeing of an individual, group or community.
- **Education:** Any form of education services provided by local authorities and academia to support citizens to learn, gain knowledge, improve skills, and adapt to changes.
- **Safety and Security:** Represents services and city systems operated by local authorities to prevent and respond to a range of risks including crime, accidents, emergencies and disasters.
- **Energy:** Systems which generate heat and electricity to enable cities to operate infrastructure and urban systems, and to enable citizens to use energy to satisfy their everyday needs.
- **Waste:** Comprises the urban system which manages waste, including municipal waste, waste water etc, produced within cities.
- **Environment:** The biophysical environment such as the terrestrial and marine environment, and environmental conditions, such as air quality, temperature, amount of carbon dioxide, pollution and climate change etc.
- **Water:** Surface water, ground water, drinking water and other types of water resource supply and distribution.
- **Local Economy:** Includes local employees, enterprises, and local authorities (eg innovation support for SMEs and skills training for employees).
- **Transport:** Includes three elements: (1) transport infrastructure, such as railways, roads and charge points, (2) vehicles, such as bicycles, trains, buses, electric vehicles and private cars, and (3) transport services provided both by public and private operators in urban areas.

The figure on the next page demonstrates the outcome of the mapping, allowing key themes across projects to emerge.

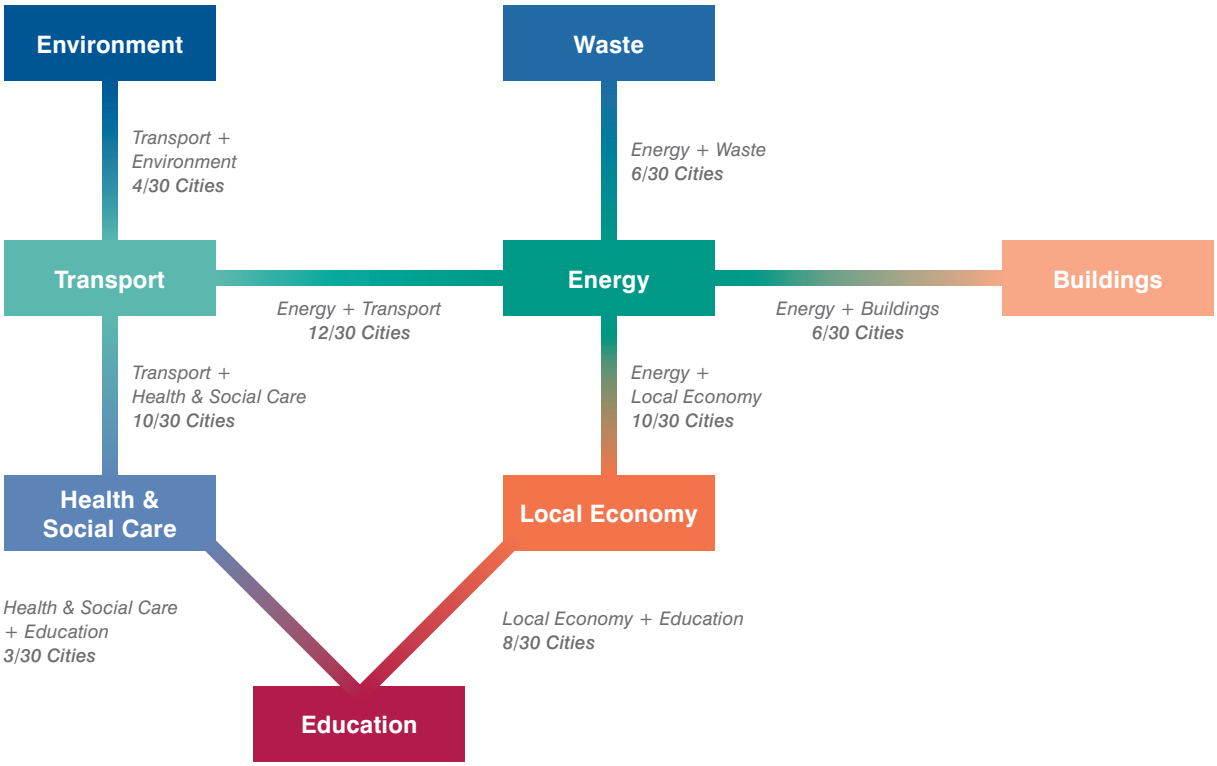
The level of integration presented in the proposed projects varied significantly – from a substantial level in projects such as Camden's anaerobic digestion and transport scheme (on page 37) to less ambitious projects which presented an open data platform, but which did not set out in detail what the purpose and priorities of the platform were, and what it would deliver for citizens and the city. In many cases intra-sector integration was also proposed, for example in the transport sector, integrating service information to deliver multi-modal public transport solutions.

The integration plot also demonstrates a division in the sectors proposed for integration. The top half of the diagram generally represents infrastructure-based sectors (aside from Safety and Security) and the bottom half generally social service-based sectors. These groups are linked by transport and energy in the centre of the diagram.

The six most common city sector integrations identified are:

1. **Transport + Energy**
2. **Energy + Economy**
3. **Transport + Health & Social Care**
4. **Economy + Education**
5. **Energy + Waste**
6. **Energy + Buildings.**

Examples of how cities are proposing to achieve these sectoral integrations are presented on the following pages.



Energy + Transport

Belfast
Brighton & Hove
Camden
Coventry
Derby
London
Nottingham
Peterborough
Southampton
Stoke-on-Trent
Swindon

Energy + Local Economy

Belfast
Cambridge
Camden
Milton Keynes
Nottingham
Peterborough
Plymouth
Salford
Southampton
Swindon

Transport + Health & Social Care

Bristol
Birmingham
Cambridge
Coventry
Dundee
Glasgow
Ipswich
Leeds-Bradford
London
Milton Keynes

Local Economy + Education

Enfield
Ipswich
Leeds-Bradford
Milton Keynes
Nottingham
Peterborough
Plymouth
Swindon

Energy + Waste

Belfast
Camden
Manchester
Milton Keynes
Peterborough
Stoke-on-Trent

Buildings

Glasgow
Leeds-Bradford
Leicester
London
Milton Keynes
Nottingham

Transport and energy

The integration of transport and energy is treated in different ways across the cities, generally as a means of reducing local greenhouse gas emissions and improving environmental sustainability. Nottingham's approach is to allow the Nottingham Express Transit trams to supply electricity recovered through regenerative braking into the power network:

> *'Linking the Nottingham (NET) Tram 3 line network's thirteen sub-stations in to our power network; the trams have the potential to input electricity into the grid via their regenerative braking systems.' Nottingham*

Taking a different approach, London is proposing a 'last-mile' freight system which utilises electric vans to take advantage of alternative energy sources and storage.

Energy and economy

The energy and local economy systems have been integrated in order to mitigate fuel poverty, promote energy sustainability and create employment through investment in local infrastructure. Belfast is looking to establish agriculture and biomass production in the Glencairn area, which will integrate power generation and food production:

> *'Agriculture and biomass production is a 10 year programme which invests in and integrates power generation and food production systems to help the Glencairn area to become a resilient and self-sustaining part of the city.' Belfast*

Milton Keynes is planning to implement an integrated low carbon heat and power strategy, establishing an Energy Supply Company to invest in new infrastructure and establish a long-term customer base:

> *'To implement an integrated low carbon heat and power strategy, Future City MK is working with partners to establish an Energy Supply Company (ESCo) that will be able to attract the investment to finance new infrastructure and develop a long-term customer base. Working with developers to ensure new connections, the ESCo would focus in the first instance on low carbon heat and power networks.' Milton Keynes*

Transport and health & social care

Transport and health & social care integrations have been proposed to tackle social inequality, improve resource efficiency and improve transport flow.

The feasibility studies often highlight the prevalence of NHS traffic in cities, and look to reduce the impact of NHS transport and logistics on city travel. London relates that the NHS has been reported to account for 5% of total traffic in England, and is looking to engage with hospitals to consolidate and increase the flexibility of their freight demand.

Bristol and Birmingham both propose initiatives integrating health and transport. This is driven by the closure of local daycentres, requiring people to travel longer distances to receive care. In Birmingham in particular, NHS-related business makes up 30% of all traffic on the roads. Mapping of transport and health information is made possible through the People Travelling in Birmingham project:

> *'To date, innovation has been affected by limited availability of transport data and particularly the lack of opportunity to map it onto other areas such as health. For example, NHS-related business (hospital and patient transport and supply of goods and services) accounts for 30% of all the traffic on the roads at any one time, and presents a plethora of logistical and resource issues. Citi-Sense provides the marketplace to bring together the data producers and consumers to deliver new applications and citizen-facing services.' Birmingham*

Economy and education

Proposals to integrate economy and education systems are focused on reducing the unemployment rate, promoting sustainable economic growth and improving social equality by linking business needs and education systems.

Enfield is proposing a Living Gateway to centralise information on an individual's skills, offering a comparison with employment and training opportunities:

> *'The Living Gateway provides a consolidated view of the individual's skills, education and experience for comparison with a consolidated view of local training opportunities and skills, education and experience prerequisites. When linked with other agency systems, the Living Gateway can display local education and skills development courses that the individual could use in order to become suitable for the desired employment.' Enfield*

On a similar note, Peterborough is planning to establish a Knowledge Transfer Partnership with Cranfield University:

> *'Develop a Knowledge Transfer Partnership with Cranfield University which will match research and development opportunities with local business needs, through a link between this strand and the Innovation Pool portal.' Peterborough*

Energy and waste

The key theme running through the cities' proposals for the integration of energy and waste is utilising municipal waste to generate energy for local consumption, promoting local sustainability.

Manchester is proposing the introduction of an anaerobic digestion facility which would be integrated into an already-funded CHP scheme, utilising waste from catering outlets, faculties and residential properties to produce biogas for the production of heat and electricity.

Camden proposed the implementation of a borough-wide organic waste collection, anaerobic digestion and energy provision solution:

> *'The project would work with existing bodies to develop a decentralised waste-to-energy network where all sectors as well as individuals can engage through an inclusive, collaborative approach to evolving local energy management, infrastructure development and urban future-proofing strategies.' Camden*

Energy and buildings

The energy and buildings systems have been integrated to reduce local carbon emissions, energy consumption and costs by optimising resource efficiency and monitoring the real-time performance of the built environment.

Proposals are generally for energy and buildings systems to be integrated through a smart user interface and Building Management System (BMS) in existing buildings, such as Salford's Home City Information Panel. Salford's proposal integrates an element of competition, by informing the resident of how they perform relative to the city average:

> *'The Home City Information Panel will be based on a 10-inch tablet form factor with a wall mounting case. Integrated Wi-Fi will enable communication with the home network and external communications. The Information Panel will provide dashboards and infographics specific to the resident(s), showing them comparative information on their habits compared with the City average, to motivate changes in behaviour.' Salford*

Glasgow's proposal includes commercial buildings, and integrates the proposed BMS system with an Intelligent Operations Platform. The platform would be capable of providing building managers with real-time performance information, and recommendations for efficiency improvements:

> *'Building Management Systems (BMSs) that interact with an Intelligent Operations Platform and allow real-time information and recommendations to be provided to building managers. For example: recommendations with respect to the operation of the building, energy conservation measures, deep retrofit options for the building or information with respect to the building's actual performance against optimal performance.' Salford*

Organisations

Responsibility for the development of the Future Cities Programme within cities is either taken on internally by Councils, or by an arm's length organisation. This section sets out some of the themes evident in the organisational structures across the feasibility studies, as well as the role of external partnerships and citizen engagement in the development and implementation of the programme.

Internal council delivery

Bristol and Birmingham, among others, are driving the development of their smart agendas internally. Birmingham calls on the award-winning Digital Birmingham, which forms part of a strategic group in the city, incorporating more than 40 public and private organisations. The advantage of this approach is the day-to-day organisational integration of the future cities agenda with the operation of the city.

The departmental lead in Councils is often taken by the strategic and economic development directorate, or in some cases an environmental team.

Following on from the feasibility process and building on the city's past work, Manchester has created a new post in the Leader's Office, with responsibility for the future cities programme.

Similarly to Manchester, recognising the constraints imposed by the remits of the various local authority departments and committees, Nottingham has proposed establishing a cross-departmental group chaired by the Deputy Leader of the City Council. The group will have responsibility for the co-ordination and delivery of the future cities programme. Following on from this, Nottingham has proposed a transition to a newly-established Special Purpose Vehicle (SPV) to deliver its smart city vision:

> *'To ensure early delivery and accountability, it is envisaged that there will be a transition to an evolved SPV arrangement with business partners, academia and energy providers, to ensure the future sustainability of the Smart Energy City initiative.' Nottingham*

London has established an expert steering group called the Smart London Advisory Board, who would guide the direction of the development of the programme in the capital:

> *'The Mayor of London is establishing a Smart London Advisory Board that brings together thought-leaders and decision-makers from the city's innovative SMEs and world-leading infrastructure, digital and service sectors. This group will oversee Linked London and will harness London's expertise in governance, business, operating model redesign, and social and financing innovation, to ensure that the Demonstrator translates value into sustainable, scalable economic models.' London*

Common to nearly all the proposals, regardless of which department is leading, is a recognition that integration, and the realisation of new opportunities to tackle key city challenges, will not happen without cross-departmental co-ordination and engagement with wider industry, academia and citizen stakeholders. There is also a recognition that Councils need to develop as intelligent purchasers of future cities solutions, as highlighted by Swindon's ambition to develop 'local intelligent client capacity.'

Common to nearly all the proposals is a recognition that **integration**, and the **realisation of new opportunities** to tackle key city challenges, will not happen without cross-departmental co-ordination and **engagement with wider industry**, academia and citizen stakeholders.

External delivery

Other cities are developing their programmes through an Arm's Length Management Organisation (ALMO), such as Opportunity Peterborough. Many local authorities have already developed ALMOs and Local Economic Partnerships (LEPs) to encourage local economic growth, and private sector engagement forms a central element of their remit. Given the requirement for engagement to develop their future cities proposals, capturing these existing relationships and skills will be extremely valuable. In addition to their existing relationships, ALMOs can be more flexible than those embedded in Council organisations, and may avoid any negative connotations associated with Councils.

Partnerships

Whether led internally or externally, successful future cities projects will integrate systems and services across cities, to realise benefits for citizens. Recognising this challenge, many of the studies proposed new partnerships, and the utilisation of existing partnerships.

Manchester in particular proposed to build on its existing partnerships, including the Manchester Corridor partnership:

> *'Established in 2007, the Corridor Manchester Board brings together Manchester City Council, Manchester Metropolitan University, the University of Manchester and Central Manchester NHS Foundation Trust, along with leading local businesses - Manchester Science Park, Bruntwood and Arup, and the Cornerhouse Arts Trust.' Manchester*

The strength of this partnership was evident in the proposal. A core steering group, chaired by the leader of the Council, was established for the development of the future cities proposal, including representatives of organisations responsible for the delivery of key systems such as transport, energy, water and waste, as well as the Council's existing local academic partners (Manchester Metropolitan University, the University of Manchester) and Manchester New Economy.

The depth and breadth of the partnerships utilised in the development of Manchester's proposal reflects its ambition for the city, which covers mobility, energy, buildings logistics and liveability.

Citizen engagement

Direct engagement with citizens in the development of the feasibility assessments was rare. It is acknowledged that the challenging timescales for the Future Cities Demonstrator competition made wide stakeholder engagement difficult. It can be observed that those cities with strong stakeholder engagement mechanisms in place generally produced the strongest proposals.

Bristol engaged citizens through focus groups and the Knowle West Media Centre in the development of its proposals, and proposed to continue this engagement through the development of its projects:

> *'We will focus engagement in the platform by involving local stakeholders (including SMEs, start-ups, academia, and citizens) through the Living Lab to address the key urban challenges of reducing congestion, improving health and social care provision, reconstructing the future workplace and increasing government accountability through transparency.' Bristol*

06 | Expected benefits and impacts

The expected benefits of the solutions presented in the Future Cities Demonstrator feasibility studies are largely focused on citizens (improving quality of life), and developing local economies through support for enterprises.

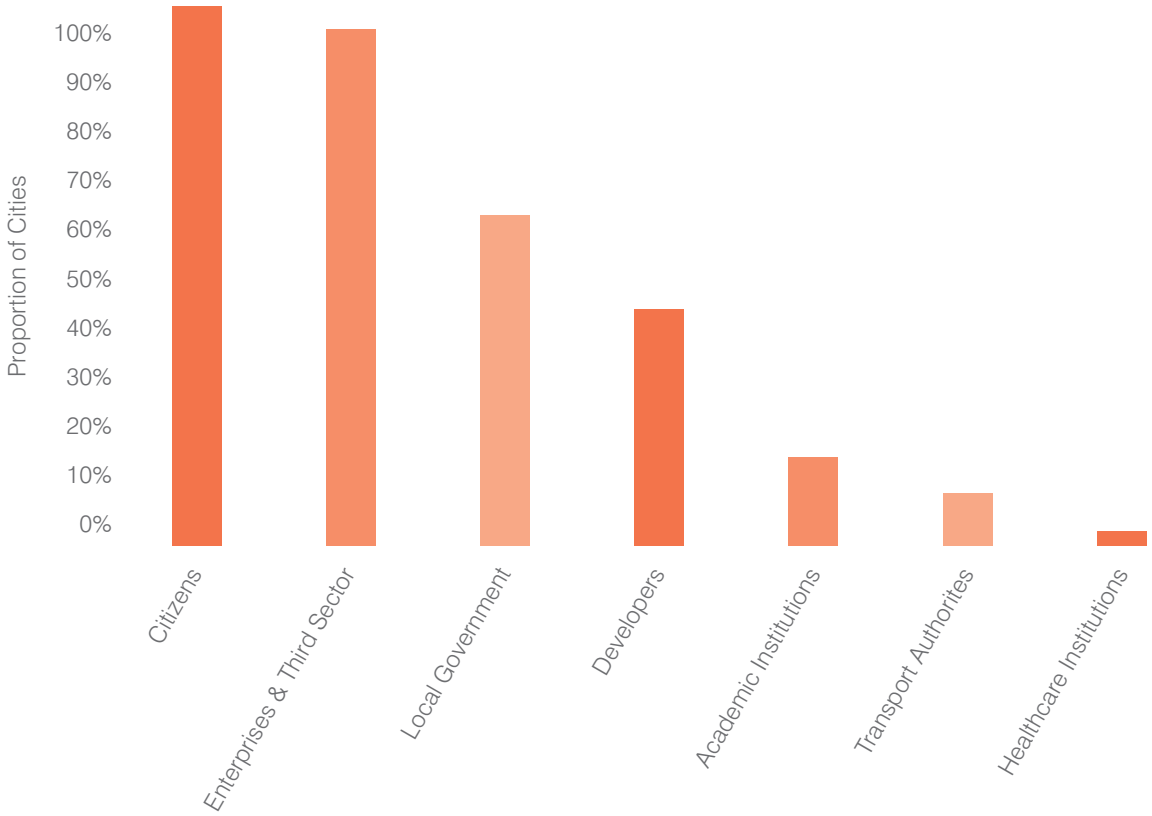
Project benefits

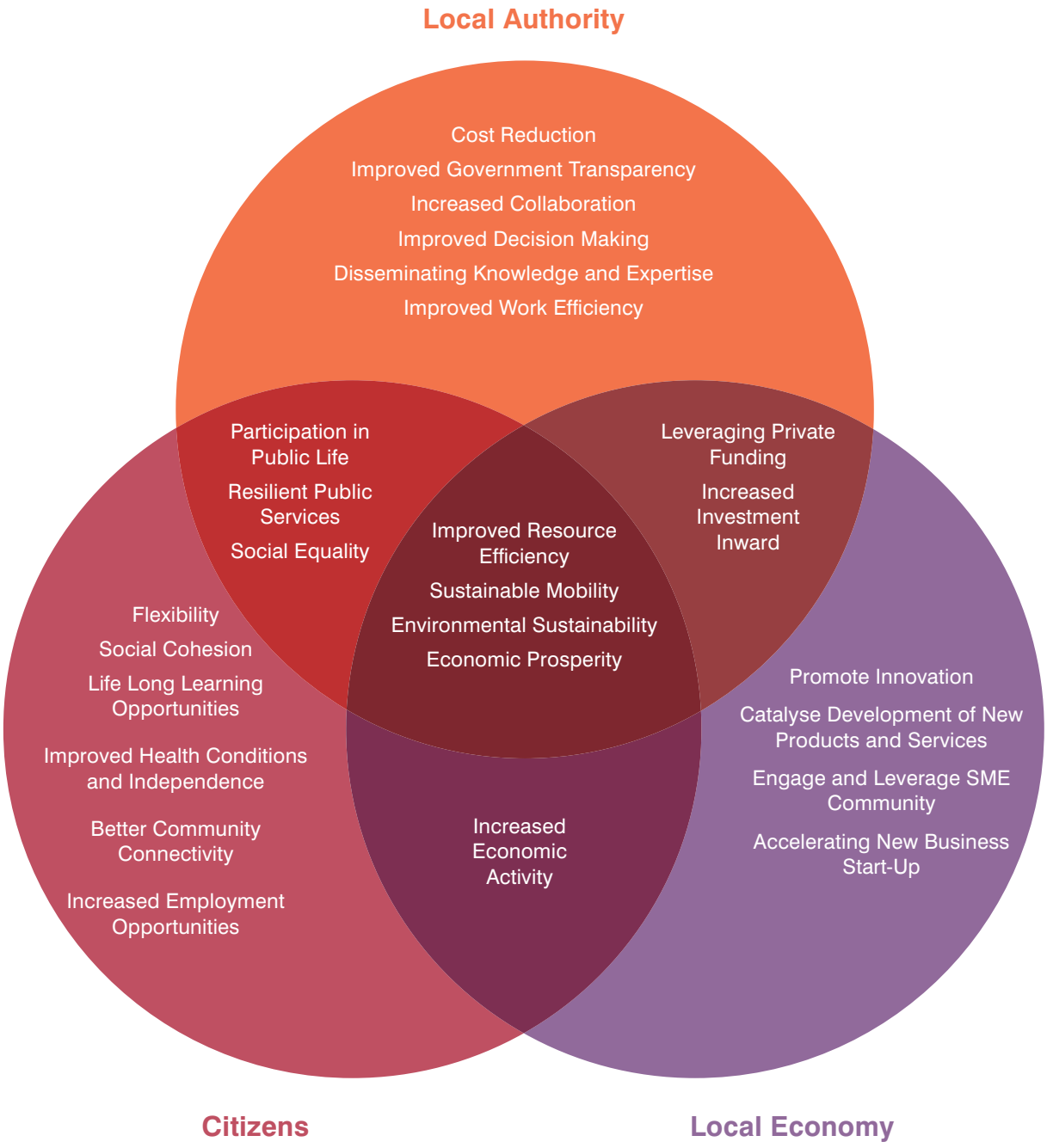
The expected benefits of the solutions presented in the Future Cities Demonstrator feasibility studies reflect the challenges and visions of the cities involved. They are largely focused on citizens (improving quality of life), and developing local economies through support for enterprises. Local authorities are also looking to improve their transparency and decision-making, whilst improving the efficiency of service delivery. Improvements in environmental sustainability were also highlighted, though these were generally secondary to the benefits mentioned above.

The figure on the following page shows the clustering of benefits around the citizen, the local economy and the local authority. The following sections set out project examples relating to each of these stakeholders.

The graph below shows the end users targeted by each city, demonstrating the focus on citizens, the local economy and local authorities.

Targeted end users




Local Authority
Cost Reduction
Improved Government Transparency
Increased Collaboration
Improved Decision Making
Disseminating Knowledge and Expertise
Improved Work Efficiency
Participation in Public Life
Resilient Public Services
Social Equality
Leveraging Private Funding
Increased Investment Inward
Improved Resource Efficiency
Sustainable Mobility
Environmental Sustainability
Economic Prosperity
Flexibility
Social Cohesion
Life Long Learning Opportunities
Improved Health Conditions and Independence
Better Community Connectivity
Increased Employment Opportunities
Increased Economic Activity
Promote Innovation
Catalyse Development of New Products and Services
Engage and Leverage SME Community
Accelerating New Business Start-Up
Citizens
Local Economy

Expected benefits: citizens

The expected benefits to citizens were often set out as broad improvements in quality of life, across the range of public sector services. Benefits include difficult-to-define factors such as improved community connectivity and self-reliance, and more discrete factors such as home energy efficiency. London and Camden's proposals are illustrative of this:

> *'Linked London will enable [citizens] to live easier, less expensive, more efficient and more connected lives. Specific socio-economic benefits will include more efficient homes, greater community connectivity and access to new employment opportunities, energy, health, and other community services through channels which better match their modern lifestyles.' London*

> *'Communication and co-operative actions within communities will increase social wellbeing, self-reliance and resilience to outside pressures and changes.' Camden*

Expected benefits: local economy

Economic benefits from future cities projects are generally linked to improvements in local prosperity and quality of life. Generally, these benefits are characterised by the development of new products and services, and catalysing local start-ups.

Southampton is anticipating the development of new products and services catalysed by access to the city's open data platforms:

> *'Cities can make data created through optimisation projects, or other data, available as raw material to businesses of all sizes, to allow them to create innovative products and services for citizens, thus enabling economic growth. Open data is a key trend for cities and government, making static and real-time data available to the public.' Southampton*

Similarly, Warrington and Belfast are looking to facilitate new business start-ups as a result of skills developed through the deployment of their future cities proposals:

> *'With the new skills base in the community, more micro-businesses will be established, such as in application development, a microbus to offer a low-cost travel alternative, and affordable organic food delivery.' Warrington*

> *'The feasibility studies described present the opportunity for new business development and job creation not only in the development and operation of the newest technology but in the skilled and semi-skilled construction sector: jobs which Belfast so badly needs.' Belfast*

The potential multiplier effect of local improvements on inward investment was also highlighted by Leeds and Bradford:

> *'[The Future cities Demonstrator will] incentivise inward investment through improved quality of place – as a result of beneficial impacts that enable significant improvements in the day-to-day operation of businesses and in the lives of residents.' Leeds and Bradford*

Expected benefits: local authority

The expected benefits to local authorities are focused around improved decision-making, collaboration and transparency, along with more efficient delivery of services and reduced costs.

Cambridge is hoping to reduce costs by developing business models to decrease the public sector subsidy to the local bus service:

> *'Future Cambridge Transport is currently exploring user needs and new business models to reduce the bus subsidy for local authorities. They will provide a use case for the various other systems, with the objective of improving passenger experience in the city, to increase patronage and so reduce the amount of subsidy.' Cambridge*

Glasgow is looking to improve decision-making at the local authority level through improved access to more valuable data, with benefits flowing to other city stakeholders:

> *'Enable and empower agencies across the city to make informed decisions about the planning, resource resilience and system mutuality of Peterborough – realising environmental, societal and financial advantages.' Peterborough*

Ipswich is looking to improve public sector collaboration between the County, District and Borough Councils and other public organisations:

> *'Improved collaboration and working within the major public sector constituencies, namely Ipswich Borough Council, Suffolk County Council, District Councils, the NHS, the Police etc.' Ipswich*

Many cities have managed to **define their visions of success**, quantifying measurable outputs of the projects.

Measuring benefits

The tight time frame of the feasibility assessments and the predominance of qualitative strategic visions mean that it is often difficult to quantify the benefits of the proposals. However, many cities have managed to define their visions of success, quantifying measurable outputs of the projects. The table below gives examples where cities were able to quantify the potential benefits of their programmes.

Birmingham	Estimates that Citi-Sense will add more than £300m pa additional GVA to the city by 2020, representing a 719% return on investment to the Technology Strategy Board and Birmingham. In the first two years Birmingham will build a new data-driven business sector, anticipated to be worth £126m pa by 2020, and by joining up fragmented services, will achieve a £50m boost to the economy through reduced lifetime costs to the public sector.
Cardiff	Anticipates a £500m increase in revenue over five years, and the development of new products and services worth £1.5bn over 10 years. Cardiff estimates that it will create 5,000 new jobs over five years and 15,000 over 10 years.
London	Linked London will invest £24m from the Technology Strategy Board, combined with c. £340m of additional funding, to deliver at least £42m of benefits by the end of 2017. 5.3m hours of paid employment will be facilitated through the use of the Micro-work platform.
Manchester	Predicts that every £1 of Technology Strategy Board funding will be supported by over £100 of investment from Manchester.
Nottingham	Anticipates that the programme will help meet city targets to reduce carbon emissions by 26% and meet 20% of energy requirements from renewable and low carbon sources by 2020. It will also create 300 jobs.
Sheffield	Estimates that new digital infrastructure has the potential to generate output gains of around 1.5% over a three-year period. This would equate to an output gain of approximately £144m.
Southend-on-Sea	Anticipates the creation of 4,000 jobs by the end of the Demonstrator project and 16,000 by 2021. The net contribution to turnover will be £400m by the end of the Demonstrator project and £1.6bn by 2021, with a total net contribution to GVA of £218m by the end of the Demonstrator project and £874m by 2021.
Stoke-on-Trent	Sees potential for 4,500 new jobs in the business and service sectors as a result of the Demonstrator, with local sources meeting 33% of city energy demand for heat or gas, and a smaller proportion for power.

Such positive economic indicators bode well for the Future Cities Demonstrator programme, though as the background to the figures was not generally shared as part of the feasibility studies, it is difficult to assess their veracity. The timescales involved in the production of the feasibility studies would have restricted the amount of detailed assessment that could be undertaken on the overall economic impact of the cities' proposals, and it is expected that more work will be required to have sufficient confidence in them.

One of the key capabilities of the Future Cities Catapult will be to develop the evidence base for such projects, developing a greater understanding of the expected impacts according to economic, social and environmental indicators. Understanding how to assess the expected financial impacts will be a critical element in developing the business case and financial models to open up the future cities market opportunity.

While there are many barriers that have a constraining effect on the **development of smart solutions**, the funding cuts brought about as a response to the current economic climate appear to be **stimulating innovative** future cities solutions.

Risks and barriers

The key risks and barriers highlighted by the cities in the feasibility reports can be characterised in terms of first order (external) and second order (internal) barriers.

Barriers highlighted by the cities that are external to their own organisations include:

- Lack of funding (including public budget cuts)
- Lack of the necessary skill set amongst citizens
- Problems with data security, data sharing and ethics
- Problems with data consistency, format, storage, analysis and accessibility
- Lack of stakeholder engagement to share data
- The need for behaviour change among citizens and businesses
- The need to secure buy-in from citizens
- The complexity of delivering the solutions, and
- The need to develop a long-term sustainable financial model.

Internal barriers identified by cities include:

- The need for leadership
- Organisational silos
- The need to agree a common vision of a Future City
- The need for coordination of stakeholders and partners
- The need for behaviour change within Councils, and
- Lack of the necessary skill sets within Councils.

Whilst the majority of these barriers have a constraining effect on the development of smart solutions, the funding cuts brought about as a response to the current economic climate appear to be stimulating innovative future cities solutions. The ability to deliver services more efficiently has the potential to maintain and potentially improve existing service levels in the context of decreasing public budgets.

Attracting private sector investment in solutions will require the development of robust business cases and financial models for solutions, with clearly defined allocation of risks and responsibilities where solutions are delivered as a public-private partnership.

Many cities highlighted the risks associated with opposition from citizens and organisations, in opening up data to facilitate smart solutions. Plymouth proposed a process founded on engagement, incorporating anonymisation tools, and a tiered approach to data availability:

> *'To mitigate [the risk of organisations not sharing data], the following are suggested:*
>
> *1. The protocols to enable data sharing can be drafted and agreed between the organisations*
>
> *2. The evaluation and procurement of suitable anonymisation tools can be started.*
>
> *3. Following the work of cleansing the data, a sizing calculation can take place to inform the design and procurement of the data warehouse.*
>
> *4. Work can begin on developing the consent model and the security profiles and authentication requirements.*
>
> *5. Other data sources can be evaluated as to their suitability to add to the overall richness of the data model that is being created.*
>
> *Once the catalogue of data items is established and agreed, then the correct governance arrangements can be finalised and data sets can be evaluated for the following categories:*
>
> *1. Inter-organisational sharing only, according to agreed role profiles.*
>
> *2. Authorised/authenticated SME data access.*
>
> *3. Published data.*
>
> *4. Individual citizen-specific data access.*
>
> *5. Internal analytical access only.'*
>
> *Plymouth*

Bristol proposed to have an ethics committee to ensure that citizens' interests remained a key focus in the way that information is used and shared, thus building trust that the sensitivities and ethics of data privacy would be respected.

Many cities also highlighted the lack of the necessary skill sets within Councils as a barrier to the procurement of smart infrastructure and solutions. Councils will be required to become sophisticated customers with the right skills to express clearly their aims and objectives, whilst industry will be required to become sophisticated marketers to cities, overcoming an existing translational barrier to developing effective solutions. This need for skills is further highlighted by the potential mismatch of benefits to Councils and delivery contractors. Incentive mechanisms that were considered will contribute to aligning the behaviour of contractors with the project ambitions of the Councils.

Concerns about organisational risks associated with siloing were also prevalent among the proposals. This is particularly pertinent for Leeds and Bradford, who highlighted the risk of major disagreement between the two cities involved in the programme. In order to keep channels of communication open, they proposed regular partnership meetings, and one-to-one meetings with key stakeholders. The incorporation of inter-city organisations in the partnership is also proposed, to ensure that a neutral view is represented.

It should be noted that the work of the British Standards Institute in their development of a Smart Cities inter-operability standard PAS 181, and the work of the Open Data Institute, will contribute to overcoming some of these barriers. The Technology Strategy Board and the Future Cities Catapult will be working closely with both of these organisations to ensure an aligned, integrated approach.

07 | Findings

City challenges and solutions

The 29 cities which submitted feasibility studies are all different, but presented similar socioeconomic, political and environmental challenges to be addressed in the realisation of their visions. These are typified by the need to become more sustainable, while improving quality of life for residents, with growing and ageing populations, in a context of public sector budget cuts and a struggling UK economy.

In response to these challenges, the cities have identified smart urban solutions which will allow more efficient and responsive services, to be delivered with fewer resources, enabling citizens to develop solutions independent of the local government, and businesses to develop and thrive in an open information marketplace.

Lessons learnt from the feasibility study process

Cities that have established programmes in this space were able to produce more complete proposals. Proposals were particularly strong where there was strong existing leadership and representation in the Council, such as in Glasgow and Bristol.

Engagement emerged as a key influence on the strength of the proposals: all the shortlisted cities with strong proposals had extensive engagement with a range of partners including industry, academia and citizen groups.

The majority of cities developed similar solutions, generally focused on utilising data platforms to provide better access to information, improving service delivery, and facilitating economic development to meet future and existing challenges. This convergence of solutions is likely to be due to a combination of four key factors:

1. Commonalities in city challenges and visions
2. Utilising exemplar cities as role models for development in a new and uncertain area
3. Working with similar organisations in the development of proposals, and
4. Needing to conform to the expectations of the Technology Strategy Board in order to win funding.

The majority of development in the UK smart and future cities area has focused on vertical integration in energy, waste, water and transport. The Future Cities Demonstrator Programme has enabled cities to begin thinking about horizontal integration across and between these systems, to begin unlocking and exploiting the opportunities for new and more efficient services.

Next steps

Cities have converged around similar solutions through commonalities in challenges, and by responding to exemplar cites around the world. These commonalities in approach should be leveraged in the development of the future cities market in the UK. Case studies of international best practice could be made available, and knowledge-sharing between more and less advanced cities could be facilitated through relationship-building at officer and director level. The Demonstrator projects have a key role to play in this process, communicating successes and lessons learned to other cities throughout the development process.

The convergence of solutions should also be leveraged in the development of the future cities market in the UK: indicating particular areas where cities are able to collaborate to share learning, and where there may be opportunities to standardise solutions.

Solutions could be standardised on a modular basis such that packages could be built up to reflect the individual challenges of a particular city. Care should be taken that the standardisation process does not prohibit innovation in this space, and should be developed through public-private collaboration as best practice solutions emerge in the UK. The British Standards Institution, commissioned by BIS, is looking to develop recommendations for technological standards for industry in this area.

Cities need to become intelligent future cities clients, to ensure that the most appropriate solutions are delivered in each individual case. There is an opportunity to build upon learning from other cities, and in particular from the large projects brought forward though the Demonstrator. In contrast, businesses need to become intelligent future cities marketers to develop solutions that meet the needs of individual cities and their challenges, to overcome an existing translational barrier that is slowing mass take-up of available solutions.

Further development within public organisations should be undertaken, to ensure that local government has mechanisms for testing innovations and mainstreaming successful programmes. Organisationally this can be addressed by establishing a function whose role it is to act entrepreneurially, taking risks and testing new ideas. Most local authorities do not currently have the organisational structures to allow them to do this in this space, and existing structures can block cross-departmental strategic actions. In response, some authorities have established roles in departments which already sit across multiple Council departments, such as the mayor or leader's office.

The Future Cities Catapult could **help with these next steps**, by building on the momentum gained through the **feasibility process** to facilitate the sharing of best practice.

The development of this space in the UK is contingent on collaboration between the key stakeholders: namely citizens, local government, academia and the private sector. The more successful proposals demonstrated this collaboration: building on existing relationships with industry, academia and citizens. Cities need to be capable of dealing with smart solution vendors, and conversely vendors need to understand the governance and procurement processes required by their public sector colleagues. Mutually beneficial collaboration should be the focus here, for example through private product developers engaging with public data store owners regarding new data sources to be opened up to the marketplace.

The feasibility study process catalysed development in the smart and future cities space in the participating cities, allowing cities the time to consider applying smart and Future City solutions, and providing a platform for future development. The UK was previously a laggard in this space, but this work, alongside work undertaken by the Department for Business, Innovation and Skills, is helping the UK to catch up with the market leaders, and anecdotal evidence suggests that industry is reprioritising the UK as a key future cities market.

SMEs were an important part of many of the Demonstrator proposals. New procurement models may be needed in the public sector to allow small, innovative companies to participate, to take advantage of the innovation that they bring to the market.

Whilst there is now momentum in this area, there is a need to identify sustainable business cases for the public sector. This is a particular challenge, as it is often difficult to quantify the benefits of novel solutions, highlighting again the need for organisational structures capable of dealing with innovation. Business cases could be developed on the basis of on-going savings to the city government, or new revenue streams realised from the future cities solutions.

The Future Cities Catapult could help with these next steps, by building on the momentum gained through the feasibility process to facilitate the sharing of best practice from the Demonstrator cities among the wider community, and provide a platform for the industry and academic collaboration that is required to ensure that the UK becomes a market leader in this space.

To capture the momentum gathered through the Future Cities Demonstrator project, and help the continued development of the **integrated city systems agenda**, the Future Cities Catapult is currently being established as a world-leading technology and innovation centre in London.

The Future Cities Catapult

The capability and ambition demonstrated by cities through the development of their feasibility studies represents an excellent foundation for progress in the future cities arena in the UK. The aim of the Future Cities Demonstrator feasibility study process was two-fold. Firstly, to create momentum and pull through some of the UK cities, by providing the resource and incentive to assess the potential of future cities in relation to their specific city challenges, and secondly, to send a signal to the markets that the UK and its cities were serious about the future cities agenda.

The Technology Strategy Board is building upon the involvement of all the local authorities who have given so much time and shown so much enthusiasm throughout this process, and aims to continue working together to develop the ideas and themes addressed in the feasibility studies.

Anecdotally, the process of undertaking the feasibility studies has been extremely beneficial within Councils: raising the profile of the smart agenda within local authorities, and building relationships within Councils and with external stakeholders that will be crucial to the successful delivery of the programmes. Building on the outcomes of the feasibility study process, several Councils have either accessed EU funding or are using the outputs of this process to support funding applications. Key industry players have recently reassessed their commitment to the UK market and are placing it among their priority markets. Whilst this cannot be directly attributed to the Future Cities Demonstrator process, it is clear from discussions with cities, industry and academia that the process has galvanised stakeholders, and injected significant momentum that provides new opportunities for UK businesses and cities in this emerging global market.

To capture the momentum gathered through the Future Cities Demonstrator project, and help the continued development of the integrated city systems agenda, the Future Cities Catapult is currently being established as a world-leading technology and innovation centre in London. The Future Cities Catapult will be chaired by Sir David King, with Peter Madden as its CEO.

The Future Cities Catapult will join business, city governments and academia in a unique collaboration to enable business to develop products and services for the cities of the future. It will test innovative business solutions through the Demonstrator projects in Glasgow, London, Peterborough and Bristol, help to put the citizens at the heart of the city by integrating city systems, and take on challenges such as increasing city density without increasing congestion, and moving to a low-carbon economy.

08 | Appendix A - study assessment data

Horizons sustainable economy framework

The Technology Strategy Board and Aviva, in collaboration with Forum for the Future, have developed a tool called Horizons that defines what a sustainable economy looks like, and in so doing breaks downs the environmental limits for a healthy planet, the social and political factors necessary for a healthy society, and the essential needs of humans. It is a robust and comprehensive framework that captures all the critical issues involved in a sustainable economy, as shown in the diagram on the next page.

To strengthen the Demonstrator projects, it is proposed to use Horizons as a tool to think systematically about the environmental limits that they face, and the social and political factors that need to be considered in projects, and as a reminder of the essential needs for their citizens.

Most cities have cited education, energy and health as their key needs. They have identified some limiting environmental factors (notably climate change, waste and renewable resources), but integrating these with social factors is more challenging, given the wide range of stakeholders involved, and their less tangible nature. The feasibility studies have picked up on the importance of accountable governance, mobility, information, interdependence, equity, resilience, skills and evidence. Increasing capacity for action and understanding these and other areas is vital to fully mapping the challenges for the cities, and designing systems that can deal with them over the long term.

Horizons can be the starting point for building a picture of a sustainable economy at a city level by capturing the issues common to all cities, signposting those which are more of a priority to some, and crucially defining what safe and sustainable thresholds are at a city level. What are safe levels of waste, water and biodiversity for Peterborough? What does fair and equitable access to energy entail for Glasgow? What does adequate nutrition mean for Bristol? What should be the boundaries at a city level? It will be very powerful to define and quantify, where possible, the key elements of a sustainable city, where the cities are now, and what the 'safe' levels are. The thresholds are likely to vary from place to place depending on their resources, population and constraints. These then need to be placed within the broader context of the cumulative thresholds of the cities – what do they look like? And how can they cooperate and work together to achieve mutual goals?

Essentially, Horizons is a bottom-up approach to mapping the critical issues facing the city, and a way of enriching thinking, for example by exploring in detail the interrelationship between the behaviours and structures that influence our use of resources. The Future Cities Catapult is using Horizons already to help think about sustainability risks and opportunities.

One or two cities are likely to work with the Technology Strategy Board and Forum for the Future in close collaboration, to design a process using Horizons that will help them to deliver their visions, engage with stakeholders and act as a barometer for a sustainable city. The outputs will be shared more broadly with all the Demonstrator cities, who are encouraged to use the online tool in the meantime: **https://horizons.innovateuk.org/**

Environmental Boundaries

Social/Political Factors

Essential Needs

Infrastructure

City	Wi-Fi Network	Sensors	Smart Meter /Grid	Smart Card /NFC	Heat Network	4G Broadband	2G/3G Mobile Network	GPS/Satellite	Space
Bristol		●							●
Swindon						●			
Milton Keynes		●		●		●		●	
Warrington	●	●	●	●					
Southend-on-Sea		●		●					
Cardiff	●	●	●			●			
Peterborough	●	●	●		●			●	●
Derby		●				●		●	
Camden			●					●	
Sheffield	●		●		●	●			
Manchester		●	●		●				
Birmingham	●								
Coventry	●			●				●	
Glasgow	●	●	●				●		
Leeds and Bradford	●		●	●			●	●	
Stoke-on-Trent	●		●				●		
Ipswich	●							●	
London		●	●		●				
Enfield	●								
Leicester	●		●	●			●		
Nottingham			●		●				
Southampton	●	●	●		●	●			●
Plymouth		●							●
Newcastle		●		●					
Salford	●		●						
Brighton & Hove	●	●		●					●
Belfast		●	●		●				●
Cambridge		●		●			●	●	
Dundee	●	●	●	●					
Total	16	17	16	10	7	6	5	8	6

Platforms

City	Web-based /Virtual Service Platform	Open Data Platform	In-Home Device / Interface	Data Platform
Bristol	●	●		
Swindon		●		
Milton Keynes	●	●		
Warrington	●	●		
Southend-on-Sea	●	●		●
Cardiff	●			●
Peterborough	●	●		●
Derby	●		●	●
Camden	●	●		
Sheffield	●			
Manchester		●		
Birmingham	●	●		
Coventry	●	●		
Glasgow	●	●		
Leeds and Bradford	●	●	●	
Stoke-on-Trent	●			●
Ipswich	●	●		
London	●	●	●	●
Enfield	●			●
Leicester	●		●	●
Nottingham	●	●	●	
Southampton	●	●	●	
Plymouth	●	●		
Newcastle	●	●		
Salford		●	●	
Brighton & Hove	●	●		
Belfast	●	●		●
Cambridge	●	●		
Dundee	●	●		
Total	**26**	**23**	**7**	**9**

System of application

City	Energy	Water	Transport	Community	Health & Social Care	Safety & Security	Local Economy	Buildings	Education	Environment	Housing	Waste
Bristol			●		●		●					
Swindon	●		●				●	●	●			
Milton Keynes	●		●			●	●	●	●	●		
Warrington			●		●		●			●		
Southend-on-Sea			●		●		●		●		●	
Cardiff		●	●			●	●	●		●		●
Peterborough	●	●	●		●		●			●		●
Derby	●		●			●	●					
Camden	●		●				●	●		●		●
Sheffield	●									●		
Manchester	●		●		●		●	●		●		●
Birmingham					●		●		●	●		
Coventry	●		●		●		●			●		
Glasgow	●	●	●		●	●		●		●		
Leeds and Bradford	●	●	●		●		●	●	●	●		
Stoke-on-Trent	●		●		●		●		●	●		●
Ipswich			●		●		●		●			
London	●	●	●		●		●	●		●		
Enfield			●		●		●		●			
Leicester	●		●					●		●		
Nottingham	●		●				●	●	●			
Southampton	●		●		●	●	●			●		
Plymouth				●	●		●		●	●		
Newcastle			●	●	●	●	●			●		
Salford	●				●		●				●	
Brighton & Hove	●	●	●		●		●			●		●
Belfast	●	●	●		●	●	●		●	●		●
Cambridge	●		●		●		●			●		
Dundee	●		●		●		●		●	●		
Total	20	7	25	2	21	7	26	10	12	21	2	7

Integration themes

City	Transport + Energy	Energy + Economy	Transport + Health & Social Care	Economy + Education	Energy + Waste	Energy + Buildings
Bristol			●			
Swindon	●	●		●		
Milton Keynes		●	●	●	●	●
Warrington						
Southend-on-Sea						
Cardiff						
Peterborough	●	●		●	●	
Derby	●					
Camden	●	●			●	
Sheffield						
Manchester					●	
Birmingham			●			
Coventry	●		●			
Glasgow			●			●
Leeds and Bradford			●	●		●
Stoke-on-Trent	●				●	
Ipswich			●	●		
London	●		●			●
Enfield				●		
Leicester						●
Nottingham	●	●		●		●
Southampton	●	●				
Plymouth		●		●		
Newcastle						
Salford		●				
Brighton & Hove	●					
Belfast	●	●			●	
Cambridge		●	●			
Dundee			●			
Total	**11**	**10**	**10**	**8**	**6**	**6**

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