

Smart & Sustainable Cities

Richard Bellingham & Nicholas Purshouse, University of Strathclyde

Summary

The University of Strathclyde is creating a new Institute for Future Cities that aims to improve the quality of human life across the world through innovative research that enables cities to be understood in new ways, and innovative approaches to be developed for the way we live, work, learn and invest in cities. The new Institute will create a focus and strategy to coordinate academic research on urban themes, and partnerships with cities, businesses, research institutions and governments across the world.

This paper outlines the wider context and issues for urban policy and research, and describes some of the key objectives and activities of the Institute for Future Cities - including the €3.7 million EU FP7 STEP UP project on sustainable city planning and implementation, a new ESRC research programme on crime prediction, and the City Observatory within the £24 million TSB Future City Demonstrator in Glasgow.

Background

Over half the world's population now lives in cities – this simple fact, whilst it emphasises the global importance of urban society and its impacts, conceals a much more complex picture of change across the world. Some projections estimate that global urban population will increase from around 3.6 billion in 2011 to reach about 5 billion by 2030 and 6.2 billion by 2050ⁱ, with significant consequences for economies, environment, resource utilisation and governance – as well as significant opportunities for integration and transformation of urban systems. Current and projected growth in city populations will occur mainly in the developing world – with many developed world cities having broadly flat or shrinking populations. Cities are also the drivers of many economies across the world. Urban areas currently account for 70% of global GDP (World Bank, 2010)ⁱⁱ, and according to MGI (2011)ⁱⁱⁱ 600 metropolises will contribute more than 60% of world GDP growth in 2025. In Korea, Hungary, and Belgium the capital city accounts for around half of total GDP^{iv}.

Urbanisation has often been considered a process that needed to be curbed and controlled, however policy makers are increasingly recognising urbanisation as a powerful force in support of economic growth and poverty reduction (World Bank, 2010). China plans to move hundreds of millions of people into cities over the next 20 years in an effort to lift a larger proportion of its population out of poverty.

As well as growth of cities there are powerful processes driving other types of significant on-going change in cities. The role and relevance of different drivers varies according to the individual context of each city.

Some examples are given below:

- demographic change (eg increasing populations, aging populations, changing social structures)
- need to improve public services and reduce costs
- tackling social problems – crime, health, education
- economic growth or recession - opportunity and changing economic structures
- consumerism and the desire for improved quality of life
- policies to reduce environmental impacts (including carbon emissions)
- natural or man-made crises
- climate change
- political and cultural change
- opportunities for change created by new technologies and adoption of those technologies.

Cities in the developed world often have rigorous long-term planning systems and policies – but as the impacts of these drivers are not always fully understood, major strategic decisions are taken in the face of

unpredictable change, and therefore can result in the delivery of infrastructure and systems that are misaligned with the needs of cities and citizens as the ground continually changes beneath the feet of planners. The ability of cities to reduce risk and be successful in a range of possible futures is a critical issue for city planners and citizens.

Very different models of city governance are in place across the world – with some cities having strong powers, strong governance, and effective local systems; some cities with weaker powers (as more power is held by central government), and some largely chaotic cities struggle to create and implement effective policies and strategies at a city level (and are therefore particularly vulnerable to the above drivers for change).

Consumption of global resources is fundamentally linked to GDP and the total size of human population across the world. Cities interact with global consumption in several ways:

- due to system efficiencies cities enable larger populations to be supported;
- by increasing wealth and education they promote both consumption and production;
- by allowing people to become better educated and wealthier cities encourage lower birth rates.

Cities therefore have a significant role to play in meeting global policy objectives (and can be used to bypass national policy frameworks). The role of cities is increasingly recognised – for example, the European Commission created the Covenant of Mayors which promotes action at city level through political commitment to a process of reducing carbon emissions by at least 20% by 2020. Over 4000 cities across Europe have signed the Covenant but relatively few have produced credible strategies to deliver low carbon futures for their cities – and equally few have taken steps towards implementing those strategies in a co-ordinated fashion - though there are isolated examples of good projects in many cities. Increasingly influential networks of cities are being formed to exchange knowledge, improve skills, promote strategic thinking, develop multi-city strategies, and attract investment - such as C40, Eurocities, and the Scottish Cities Alliance.

Across the world we see growing interest from cities, governments, businesses and universities in the creation of smart sustainable cities – in the US cities like Chicago and New York show real political commitment, and in China some major cities are now signing the equivalent of the EU covenant of mayors.

Glasgow City and Strathclyde University together are becoming a growing focus of attention. In 2010 Glasgow published the Sustainable Glasgow strategy – this strategy aims to help Glasgow become one of Europe's most sustainable cities. For Glasgow this means achieving a mix of objectives – reducing carbon – but also achieving urban regeneration; delivering jobs and training; helping change the city's image; regenerating communities, and tackling fuel poverty. A set of major feasibility studies helped Glasgow understand its carbon emissions, and identify the technically and financially viable opportunities that could feasibly reduce the city's carbon emissions by 30% within 10 years. Since 2010 we have started to see some of the report's major recommendations being implemented – with the designation of district heating zones in City Plan 3; creation of a waste to energy plant at Polmadie capable of handling all the city's municipal waste; and proposals to improve the efficiency of street lighting. Next year Glasgow will host a low carbon Commonwealth Games – watched by over 1 billion people worldwide – which includes the development of district heating for hundreds of homes and other facilities in the Commonwealth Games zone.

Strathclyde University built on its work creating the Sustainable Glasgow strategy to win €3.7 million in EU funding for the STEP UP programme, and to support Glasgow's winning bid for the TSB's £24 million Future Cities Demonstrator (see below) - a win that is drawing attention from around the world. Strathclyde is also currently creating the £89 million Technology and Innovation Centre that is forming joint academic/commercial research partnerships on agreed themes – including low carbon energy and future cities.

Given the global context, strong interest from commercial partners, local opportunity and resource, and the relevant strengths that Strathclyde has across multiple disciplines, the University decided to create a new Institute for Future Cities.

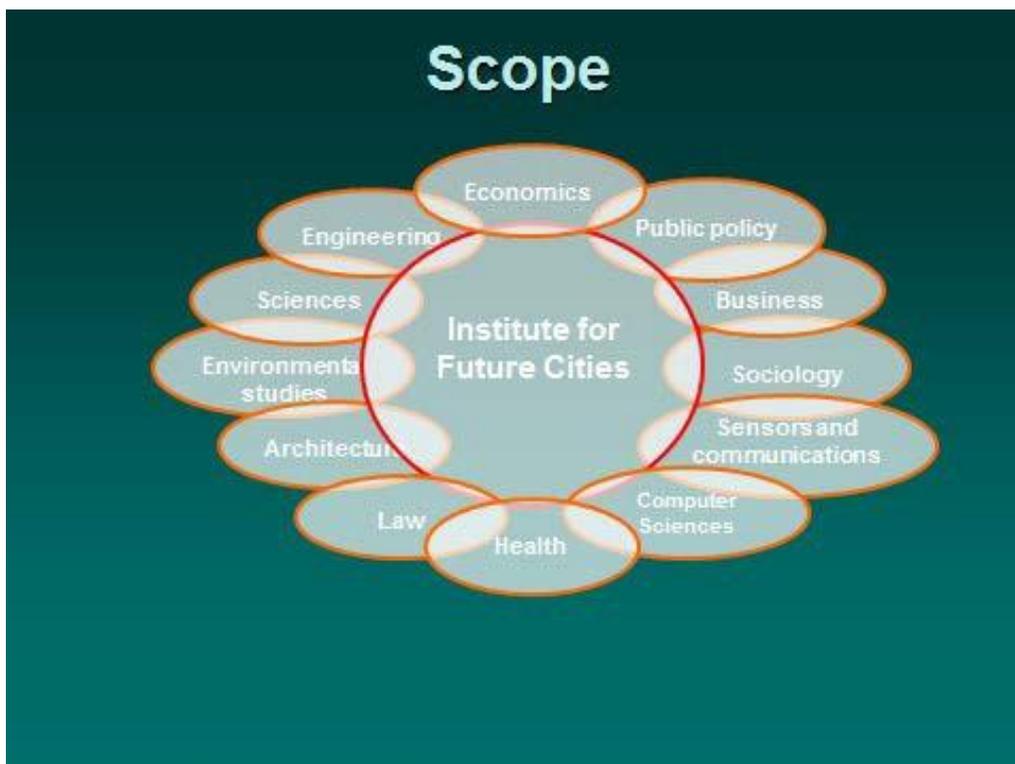
The Institute for Future Cities

The University of Strathclyde is creating a new Institute for Future Cities to improve the quality of human life across the world through innovative research that enables cities to be understood in new ways, and innovative approaches to be developed for the way we live, work, learn and invest in cities. The new Institute will create a focus and strategy to coordinate academic research on urban themes, and partnerships with cities, business and government across the world.

The Institute will tackle the large, complex and difficult issues and opportunities for cities across the world. The Institute will work in partnership – integrating and catalysing expertise and research from multiple disciplines within Strathclyde University and other research institutes and working with Glasgow and other cities across the world; commercial organisations and local and national government organisations.

Multiple disciplines need to work together to develop effective solutions, and to capitalise on the very significant opportunities offered by cities to deliver economic growth, reduce environmental impacts, and tackle major social issues (eg in crime, health, and education).

The University of Strathclyde and its partners have strengths in a range of relevant disciplines – such as sensors, communications, energy, engineering, computing, mathematics, sociology, health, public policy, architecture, design, law, business, and economics. Through a coordinated approach these strengths can work together to optimise research opportunities and outcomes, and deliver significant tangible impacts in the urban context.



Significantly increased public and commercial funding for research in the UK, Europe and across the world is creating opportunities to address key urban issues using the tools and the scale necessary to create innovative and relevant solutions that work in both current and future cities.

The Institute aims to create a world-leading centre for research and teaching on smart sustainable cities that integrates and catalyses expertise and research across sectors and multiple disciplines, to address challenges, seize opportunities, and inform decisions. The Institute's research programmes and teaching aim to deliver tangible impacts on real cities - enabling policy makers to create strategies that have greater prospect of success, reduced risk, and greater positive impacts; citizens to influence and make better use

of services, make informed decisions, live richer and more fulfilled lives; and businesses to identify new opportunities and create new business models. The Institute will work in partnership across the world - with cities, research institutions and commercial organisations to conduct research, share data, develop techniques, maximise impact, share experience and improve understanding in cities. Already the Institute is finding significant interest from major commercial organisations in joint research programmes. The Institute will also make a major contribution to the University's internationalisation agenda through creating links with cities and research institutions globally. These partnerships will develop and be enlarged throughout the life of the Institute.

The Institute will build on a series of existing projects and opportunities including:

- the €3.7 million EU FP7 STEP UP programme on planning and implementation of sustainable cities
- a new Masters degree on planning and implementation of sustainable cities
- a new ESRC research programme on crime prediction and crime reduction measures
- the City Observatory within the TSB Future City Demonstrator

Further details of these programmes are given below.

The Institute will also develop major new research programmes in areas such as:

- Risk, resilience and agile urban systems
- Health improvement in urban populations
- Citizen engagement in urban design and system management
- Key success factors in economic and social transformation of cities
- Effective governance and business models in urban environments
- Use of big data to model and simulate urban systems

STEP UP

The Smart Cities and Communities EU FP7 initiative, launched in June 2011, supports like-minded cities to work together to achieve their energy and climate goals – with a focus on assisting achievement of the EU's 2020 CO2 reduction and renewable energy targets. Through creation of enhanced Sustainable Energy Action Plans (SEAPs) cities describe their low carbon strategies – with specific activities, measures and time frames. The initiative encourages cities to create demonstration projects and accelerate the deployment of best practice solutions for actions such as low carbon energy production (waste to energy, renewable energy, district heating and energy recovery); retrofitting building energy efficiency measures; low carbon transport and mobility; and energy demand management.

STEP UP (Strategies Towards Energy Performance and Urban Planning) is a €3.7 million EU FP7 Smart Cities and Communities initiative running Autumn 2012 to Spring 2015. The project, coordinated by the University of Strathclyde, consists of four partner cities: Glasgow (UK), Ghent (Belgium), Riga (Latvia), and Gothenburg (Sweden), their associated local authorities, as well as academic institutes and industry partners in each city. For Glasgow, the local partnership consists of Glasgow City Council, University of Strathclyde, and Scottish Power.

STEP UP is creating a coherent and easy-to-use model for energy planning. This model will be adopted in multiple cities to deliver faster and greater impacts for Europe's 2020 energy targets – and wider policy objectives such as improving security of energy supplies, achieving urban regeneration, economic growth, and tackling fuel poverty – making these cities better places to live, work, learn, and do business.

The cities in the STEP UP partnership were deliberately selected so that they have similarities that enhance their ability to work with each other. The cities have all signed the European Covenant of Mayors and are therefore committed to significantly reducing their carbon emissions by 2020. The cities all have populations in the range 0.5 to 1 million, and are all historic port cities in Northern Europe- which leads to a number of common topologies, socio-economic factors, opportunities and issues.



STEP UP is a partnership of twelve organisations from city government, academia, and business. The combination of a local authority, commercial and research partner from each city, together with links into local partnerships and local stakeholder groups, ensures that STEP UP will be able to facilitate the delivery of real projects in participating cities by using a multi-disciplinary, multi-sector and integrative approach. The range of expertise and experience of the partners involved will ensure the provision of holistic solutions that deliver real economic, environmental and technological advances in each city with regards to sustainable city planning. The active involvement of city councils will ensure that the plans meet the needs of citizens, businesses and existing infrastructure. The involvement of the commercial sector (including energy companies and banks) ensures proposals are economically feasible.

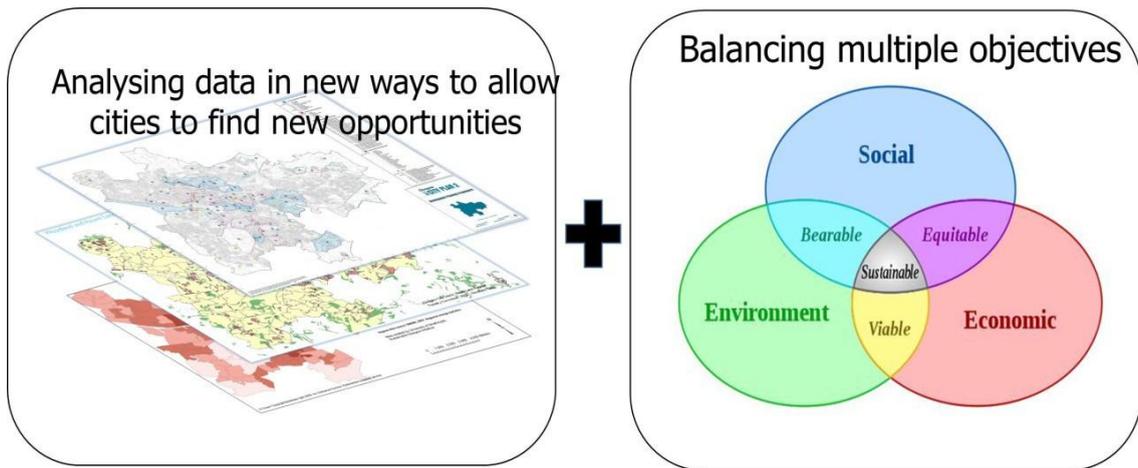
Supported at the highest political level in all four cities, city leaders are playing an active role in the project throughout its life, ensuring it delivers on its objectives, and has clear and significant impact in the partner cities and beyond.

An Integrated Approach

The project is taking an integrated approach to energy planning, integrated project design and implementation by addressing three vital themes of energy and technology, economics, and organisation and stakeholders together:

The challenges associated with becoming more sustainable will be addressed by the project through:

- Creating an energy planning approach for developing and enhancing strategic energy action plans
- Demonstrating this approach works to deliver faster and greater positive environmental and economic impacts
- Disseminating and replicating this approach through a learning network to other ambitious cities across Europe (and beyond)
- Showcasing best practice innovative cross-sector low carbon solutions and projects
- Developing a “framework” for integrated project development and bringing several high level innovation pilot projects to the edge of application.
- Addressing economics, financing and stakeholder engagement to facilitate rapid deployment and replication.



STEP UP will identify and promote existing best practice on integrated cross sector energy solutions, such as industrial waste heat integrated into district heating networks or electric vehicles linked to smart electricity grids. STEP UP partner cities will draw inspiration from the winning elements of these lighthouse projects and develop common innovative projects which contribute to tackling their joint climate and energy challenges and opportunities. These innovative projects aim to show that integrated planning achieves better energy outcomes and economics as compared to the traditional approach which segments projects and sectors.

The programme will engage other cities in a Learning Network where skills and expertise on energy planning and best practice on integrated cross sector energy solutions are shared and supported. A small number of cities will become companion cities to the STEP UP partners and receive close guidance, coaching and training. Nuremberg is Glasgow's companion city – and an additional companion city is expected to be identified in the next few weeks.

The approach for enhancing Sustainable Energy Action Plans will be documented, replicated in companion cities and disseminated via the STEP UP web portal. Lighthouse demonstration projects will also be promoted via the web portal. Study tours of the STEP UP partners' cities will be run for city planning professionals and commercial enterprises interested in energy planning and the Step Up approach to integrated cross sector project development. Training and learning initiatives will extend the impact of STEP UP beyond the life of the project and across a much wider range of cities. This includes the creation of a new Masters degree in sustainable city planning and implementation that will be taught jointly by the University of Strathclyde with partner Universities across the world.

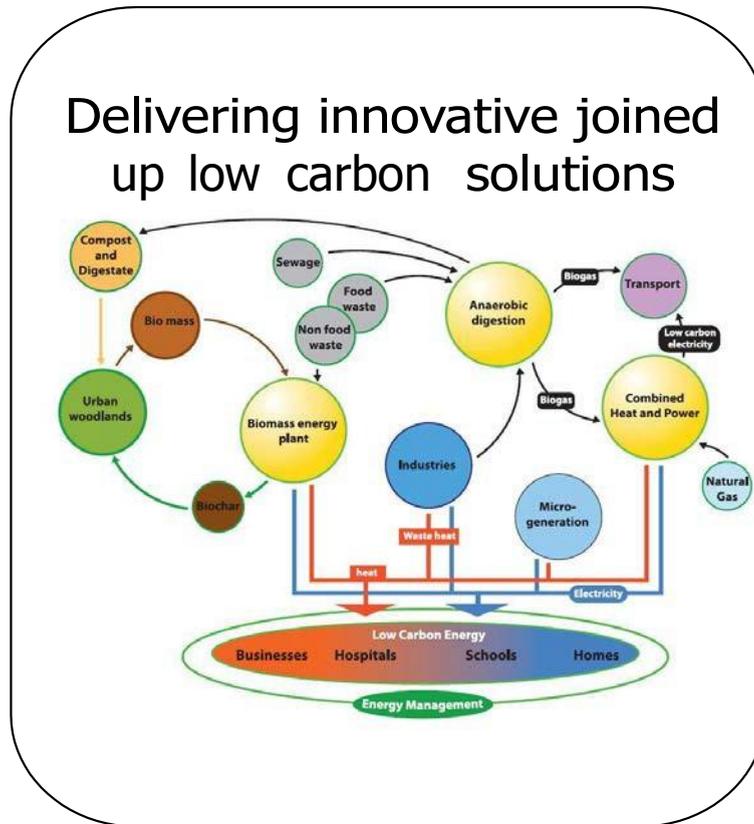
First Steps

Since starting in November 2012, the project has formed a committed consortium of partners successfully working together across Europe. Each city has now completed detailed stakeholder mapping and engagement plans; is conducting a gap and issue analysis of current energy plans; as well as the mapping of energy flows throughout the city. Large sets of data for energy consumption and efficiency are compiled for each city and Geographical Information Systems (GIS) are used to model and visualise opportunities and to demonstrate scenarios for of future energy flows.

Cities are also in the process of identifying best practice ("lighthouse") integrative projects from their region which will be promoted and used to identify common issues and opportunities that all partner cities can learn from. In order to encourage fast replication of successful models and practices, a learning network of cities across Europe is being created that will test how STEP UP approaches work in different situations, and improve expertise in the network by sharing knowledge.

To ensure availability of tools, expertise, and lessons learnt, the project has launched a website (www.stepupsmartcities.eu) and later this year will be holding workshops to pass knowledge to the

learning network of cities. To assist cities to work more closely together to develop enhanced smart and sustainable city energy plans an open conference involving all projects partners, and the wider learning network will be held in June 2013.



For more details please refer to the website at: www.stepupsmartcities.eu or e-mail info@stepupsmartcities.eu

Future Cities Demonstrator

Last year, the Technology Strategy Board (TSB) launched a Future Cities Demonstrator competition; with the winner receiving £24million to showcase large-scale solutions that demonstrate unique and functional methods of integrating city systems in an environmentally-sound, economical way to improve the overall quality of life for citizens.

From an initial list of 30 cities, Glasgow was shortlisted along with London, Bristol and Peterborough, winning the competition earlier this year with a strong, local authority led project proposal in partnership with business and academic communities. Glasgow is building on major projects such as the Commonwealth games to demonstrate quickly the impact of innovative city solutions to the world.

The Future City Demonstrator supports the TSB's objective of accelerating economic growth by stimulating and supporting business-led innovation with aim of positioning UK companies – supported by a world-class academic and research base – to export innovative approaches to delivering efficient, attractive and resilient cities across the world. The TSB assess this sector as being worth £200 billion per annum globally. Their aim is for the demonstrator to act as a showcase for the impact of innovative urban technologies on real cities - helping UK companies accelerate development of viable solutions and technologies for the wider benefit of the UK economy (Technology and Strategy Board, 2013).

Future City Demonstrator – key themes

Led by Glasgow City Council in partnership with key public, private and academic organisations, including the University of Strathclyde, implementation of the Demonstrator project will be completed by mid-2014 and will demonstrate how providing new integrated services across health, transport, energy and public safety can improve the local economy and increase the quality of life of Glasgow's citizens (Glasgow City Council, 2013).

The project will contribute to addressing some of the city's pressing energy, transport and health needs and will also show how innovative use of technology can improve the Council's service provision, while additional potential benefits include improved crime prevention, a reduction in anti-social behaviour and improvements in travel infrastructure. (Technology & Strategy Board, 2013).

The demonstrator will develop programmes to promote healthy living; deliver advanced street lighting to address community safety and perception of crime; and enhance building energy efficiency to provide affordable warmth. The University of Strathclyde's Technology and Innovation Centre will host major elements of the City Observatory. This will allow academic and business and industry researchers to analyse hundreds of data sets about Glasgow - its health, economy, transport, energy use – enabling the city to be understood in new ways, new solutions to be developed and tested, and the city to be used as a "living lab". A city dashboard and a management system will be created that allows policy makers to see the city as an integrated whole, and new interfaces created to improve service delivery to citizens. Opening up access to data should also create new business opportunities through creation of new services and business models.

The project proposals for the demonstrator are currently being developed – example projects include:

- Journey planning - providing citizens with a real time view of traffic levels, and checking that buses and trains are on time.
- Monitoring of energy levels across the city - including new Combined Heat and Power (CHP) systems, that could allow the city to store energy when demand is low and then use it during times when it is higher. This has the potential to cut fuel bills and help the city tackle fuel poverty.
- Monitoring footfall and retail demand to analyse economic performance within Glasgow and assist tailoring of public policy at a local level.
- Via smartphone apps citizens will be able to report issues like pot holes or missing bin collections and monitor problem resolution.
- Improved identification and management of traffic incidents and emergencies by better integration of CCTV and traffic management.
- Improved crime prevention and detection of crime as well as, helping to reduce anti-social behaviour incidents through the improved use of camera technology and integration of data.
- Potential to give residents real-time information on waiting lists in hospitals around the city.
- Use of sensors to assist older and disabled people to live independently.

The city's political leaders have made clear that they see the demonstrator as a huge boost to Glasgow's ambitions to build a better future for the city and its people. They aim to use technology intelligently to integrate management of different city systems to make Glasgow a better place to live, work and do business - helping it to attract new businesses and residents. More widely, the results from Glasgow's demonstrator are expected to assist UK businesses to test and develop innovative integrated urban solutions and technologies that can be sold around the world.

Predictive Crime

In June the Institute for Future Cities will start a new £300,000 ESRC research project that will analyse multiple live and historic datasets to understand the pattern of crime in the city in new ways, to influence policy and test new approaches to managing street environments to reduce crime.

Street crime and fear of street crime have significant adverse impacts on individual lives, the use and regeneration of urban areas, the ability to attract businesses and investment, the price of property, and the ability of citizens to live full and creative lives. Previous studies have examined the relationships between a range of social, economic and situational factors and levels and predictability of crime using a range of techniques. However the impact of altering these factors (where they can be influenced), and how such measures might be combined with other potential crime reduction measures is not necessarily fully understood. This research projects aims to achieve new insights into the pattern of crime in cities using big data analytics to analyse the relationships between multiple datasets and levels of crime and to derive innovative optimised strategies that result in lower levels of street crime, as well as balancing other objectives – such as lower service costs (e.g. from improved design of street lighting, and policing patterns), lower carbon emissions, and improved public confidence and acceptance. Subject to agreement from key stakeholders the project may test some of these strategies through using the city as a living lab.

This project aims to help to achieve several different goals at the same time:

- Reduce actual levels of street crime and the perceived risk of crime;
- Improve the confidence of people and increase positive uses of public street space;
- Attract investment and businesses;
- Redesign services (such as lighting) to reduce costs and carbon emissions.

The project will review and analyse the significant ethical issues raised by conducting this type of research. It will create an external reference group to consider the ethical issues of the proposed research which will include academics, city government, local community representatives, the police and other key stakeholders – and may include experts from outside the city. This reference group will assist in reviewing protocols for ethical use of big data analytics in urban environments.

ⁱ UN Urbanisation Prospects -2011 Revision.

ⁱⁱ World Bank, 2010, Systems of Cities: Harnessing Urbanisation for Growth and Poverty Alleviation – The World Bank Urban and Local Government Strategy, The World Bank, Washington D.C.

ⁱⁱⁱ MGI, 2011, Urban World: Mapping the Economic Power of Cities, McKinsey Global Institute, Washington D.C.

^{iv} “Smart Opportunities in Smart Cities” Frost and Sullivan