GREATER MANCHESTER INDEPENDENT PROSPERITY REVIEW

A MISSION-ORIENTED APPROACH TO CLEAN GROWTH

A technical report for the research on
Innovation & Global Competitiveness

March 2019

Authors: Professor Mariana Mazzucato, Director, UCL Institute for Innovation and Public Purpose (IIPP); Martha McPherson, Head of Green Economy and Sustainable Growth, IIPP; Dan Hill, Visiting Professor at IIPP, member of the Commission for Mission Oriented Innovation and Industrial Strategy (MOIIS), hosted at IIPP, and Director of Strategic Design at Vinnova.

With support from: Professor Rainer Kattel, Deputy Director, IIPP; Dr George Dibb, Head of Industrial Strategy and Policy Engagement, IIPP; Francesca Froy, Research Fellow at IIPP and PhD candidate at the Bartlett School of Architecture.

The Institute for Innovation and Public Purpose (IIPP) is a department within University College London (UCL) and part of The Bartlett faculty, known internationally for its radical thinking about space, design and sustainability. IIPP's mission is to change how public value is imagined, practiced and evaluated to tackle societal challenges and achieve economic growth that is more innovation-led, sustainable and inclusive. Their research and teaching programmes aim to shape a dynamic and bold public sector driven by public purpose. Markets can be shaped by purposeful policy making and by new collaborations between the state, business and civil society. Markets can be designed to deliver public value.

The views expressed in this report are those of the authors and, as usual, errors and omissions in this report remain the responsibility of the authors alone.

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The Greater Manchester Independent Prosperity Review was commissioned to provide a detailed and rigorous assessment of the current state, and future potential, of Greater Manchester's economy. Ten years on from the path-breaking Manchester Independent Economic Review, it provides a fresh understanding of what needs to be done to improve productivity and drive prosperity across the city region.

Independent of local and national government, the Prosperity Review was carried out under the leadership of a Panel of six experts:

Professor Diane Coyle
Bennett Professor of Public Policy, University of Cambridge, and
Chair of the Greater Manchester Independent Prosperity Review

Stephanie Flanders
Head of Bloomberg Economics

Professor Ed Glaeser
Fred and Eleanor Glimp Professor of Economics, Harvard University

Professor Mariana Mazzucato
Professor in the Economics of Innovation & Public Value and Director of UCL Institute for Innovation and Public Purpose

Professor Henry Overman
Professor of Economic Geography, London School of Economics, and
Director of the What Works Centre for Local Economic Growth

Darra Singh
Government and Public Sector Lead at Ernst and Young (EY)

The Panel commissioned studies in four areas, providing a thorough and cutting edge analysis of key economic issues affecting the city region:

- Analysis of productivity, taking a deep-dive into labour productivity performance across Greater Manchester (GM), including a granular analysis of the 'long tail' of low-productivity firms and low pay;
- Analysis of education and skills transitions, reviewing the role of the entire education and skills system and how individuals pass through key transitions;
- Exploration of the city region's innovation ecosystems, national and international supply chains and trade linkages; and sources of global competitiveness, building on the 2016 Science and Innovation Audit; and
- Work to review the infrastructure needs of Greater Manchester for raising productivity, including the potential for new approaches to unlock additional investment.

A call for evidence and international comparative analysis, developed in collaboration with the Organisation for European Cooperation and Development (OECD) and European Commission, also supported this work.

All of the Greater Manchester Independent Prosperity Review outputs are available to download at **www.gmprosperityreview.co.uk**.

This technical report is one of a suite of Greater Manchester Independent Prosperity Review Background Reports.

Contents

1. Introduction to mission-oriented innovation

Industrial strategy is key to the ability of economies to grow through innovation and investment-led growth. It can be framed at the level of a city, city region, region, or nation. Historically industrial policies have had two dimensions – horizontal measures aimed at improving skills, education and infrastructure; and vertical measures, targeting sectors. Our mission-oriented approach to industrial policy transforms the vertical focus from sectors to societal problems. This reduces the probability of capture of government policies by particular actors, and focusses on all actors coming together to solve problems with high relevance to society.

Mission-oriented innovation policy defines an ambitious goal, and then uses this to create a long-term policy landscape, setting out tasks that mobilize various actors for bottom-up experimentation across different sectors. Mission-oriented thinking requires an understanding of the difference between broad societal challenges, and the concrete problems that different sectors can address to tackle them. Sectors define the boundaries within which firms operate, such as transport, health or energy, whilst it is symbiotic, mutualistic partnerships between public and private sector organisations that make up the actors in mission-oriented approaches. Challenges are distinct from missions: a challenge is a broadly defined area which a state, region, city region or organisation may identify as a priority, and may include areas like inequality, climate change, or the challenges of an ageing population. Missions, on the other hand, are more granular and involve framing and tackling specific problems, such as reducing carbon emissions by a given percentage over a specific time period. They require different sectors to come together in new ways: climate change cannot be fought by the energy sector alone, but will also require changes in transport, nutrition, buildings, and land use, as well as many other areas.

An example of a successful mission is that of the Apollo moon program in 1969. The mission was framed and set at the beginning of the decade in 1962, with US President John F. Kennedy's famous 'we choose to go to the moon' speech at Rice Stadium in Texas. The Apollo program required innovation across many different sectors, including aerospace, and low-tech sectors, such as textiles and nutrition. The mission itself was top-down in vision, but set a timeline and a goal for bottom-up experimentation and innovation from a multitude of cross-sector actors and different types of partnerships to solve the 'homework problems' of getting a human onto the moon. Working in cross-sector collaboration to solve these problems not only led to a successful mission outcome, but created hundreds of other innovations and directions for innovation along the way. These dynamic spillovers, and cross-party projects, galvanised ensuing growth beyond the mission itself.

Societal challenges are complex. More complex than going to the moon, which was mainly a technical feat. To solve them requires attention to the ways in which socio-economic issues interact with politics and technology, to the need for smart regulation, and to the critical feedback processes that take place across the entire innovation chain. It also requires stronger civic engagement. Many highly tangible and successful mission-oriented, cross-sector projects have been seen historically in green innovation. The German Energiewende (Energy Transition) policy has required all sectors in Germany to transform themselves, such as the steel sector lowering energy consumption through repurpose, reuse and recycling strategies[1]. The USA's SunShot Initiative in photovoltaic solar cells has mobilized 347 organizations through grants in nine subprogrammes, covering actors from manufacturing firms to municipalities seeking innovative solutions to permitting, zoning and financing[2].

[1] UNEP, (2018) "The Emissions Gap Report 2018", available at http://wedocs.unep.org/bitstream/handle/20.500.11822/26895/EGR2018_FullReport_EN.pdf

[2] DOE (2018) Solar Project Download. Available at: https://www.energy.gov/eere/solar/downloads/solar-projects-download

This Technical Paper, written by researchers at the University College London Institute for Innovation and Public Purpose (IIPP), with support from the Commission for Mission Oriented Innovation and Industrial Strategy (MOIIS), which they host, contains an introduction to IIPP's mission-oriented approach to innovation and policy, key criteria for selecting and framing successful missions, and a case study applying this approach to Greater Manchester's clean growth challenge: to become a carbon neutral city region by 2038.

The Institute for Innovation and Public Purpose's work on mission-oriented innovation has been adopted by institutions worldwide. The MOIIS Commission has been advising the UK Government on shaping its industrial strategy through a series of Grand Challenges and missions. In 2018, the European Commissioner for Research and Innovation, Carlos Moedas, asked IIPP Director Professor Mazzucato to draft strategic recommendations on mission-oriented research and innovation in the EU, to guide the future European Union Framework Programme for Research and Innovation. The report released was Mission-Oriented Research and Innovation in the European Union, and we refer to several examples from the report within this paper. The United Nations Environment Programme took innovation as a key focus for its 2018 Emissions Report. Professor Mazzucato and Dr Gregor Semieniuk acted as lead authors on the chapter 'Bridging the gap: The role of innovation policy and market creation', which discussed the role of mission-oriented innovation alongside risk-taking, patient strategic finance, directed innovation portfolios, organisational aims and mandates, and competition on an international stage.[3] The UN's Sustainable Development Solutions Network opened their 2018 report with IIPP's work on mission-led research and innovation in support of the Sustainable Development Goals.[4] IIPP was also integral in developing plans for a Scottish National Investment Bank, to be launched by 2020, which takes as one of its core missions 'transitioning to a low carbon economy, including decarbonisation of the transport network.'[5] In 2019, IIPP will begin a project supporting the Mexican Energy Ministry, and Mexican National Council on Science and Technology, to assess current innovation landscapes, systems, and institutional capacities, and to co-create mission-oriented projects and policies to secure the low carbon transition.

[3] UNEP, (2018) "The Emissions Gap Report 2018", available at http://wedocs.unep.org/bitstream/handle/20.500.11822/26895/EGR2018_FullReport_EN.pdf

[4] United Nations Sustainable Development Solutions Network, (2018) "SDSN Networks in Action 2018", available at http://unsdsn.org/wp-content/uploads/2018/09/SDSN-network_2018-layout-web-1p.pdf

[5] Chief Economist Directorate, (2018) "Scottish National Investment Bank: implementation plan"

2. How to select a mission

There are five key criteria which have been identified to create successful missions, and to develop from challenges into missions[6]. These criteria were outlined in full in the European Commission report *Mission-Oriented Research and Innovation in the European Union* and are applicable to all missions:

1. Bold, inspirational with wide societal relevance

Missions should engage the public. They should make clear that through ambitious, bold action, solutions will be developed that will have an impact on people's daily lives. To do this, missions must outline exciting opportunities for bold innovation — while being connected to debates in society about what the key challenges are, like sustainability, inequality, health, climate change, and increasing the quality of the welfare state. Missions developed for Greater Manchester should touch the lives of, or inspire, a significant part of the population. However, it is important to note that relevance does not necessarily equate with popularity.

2. A clear direction: targeted, measurable and time-bound

Missions need to be very clearly framed. While enabling long-term investments, they need a specific target that can either be formulated in binary ways (as clearly as whether man has reached the moon and returned back safely) or quantified (as clearly as whether a certain percentage reduction in carbon emissions against a baseline has been reached across manufacturing). In addition, they will need a clear timeframe within which actions should take place. This needs to be long enough to allow the process to grow, for actors to build relationships and interact, while at the same time being time-limited. Without specific targets and timing, it will not be possible to determine success (or failure), or measure progress towards success.

3. Ambitious but realistic research & innovation actions

Mission objectives should be set in an ambitious manner (taking risks), centred on research and innovation activities across the entire innovation chain, including the feedback effects between basic and applied research. Ambitious objectives will ensure that researchers and innovators are challenged to deliver what would otherwise not be attempted ("additionality" in research). Yet, the objective should be framed to be on the one hand high-risk but also realistically feasible, at least in theory, within the given time period. Setting the technical objectives unrealistically high will result in a lack of buy-in, while setting the objective too low will not incentivise extra efforts – or provide inspiration. Furthermore, the required technological development should attract research and innovation activities that otherwise would likely not be undertaken by private actors, providing the justification and legitimacy for public intervention. This does not have to be done within a narrow market failure framework, but a more active market 'co-creation' framework.

4. Cross-disciplinary, cross-sectoral and cross-actor innovation

Missions should be framed in such a way as to spark activity across, and among, multiple scientific disciplines (including social sciences and humanities), across different industrial sectors (e.g. transport, nutrition, health, services), and different types of actors (public, private, third sector, civil society organisations). Missions need to be chosen to address clear challenges that stimulate the private sector to invest where it would not have otherwise

[6] Mazzucato, M., (2018). Missions: Mission-Oriented Research & Innovation in the European Union. European Commission. Available online at https://ec.europa.eu/info/sites/info/files/mazzucato_report_2018.pdf

invested ("additionality" in business). By taking a problem-focussed lens and not a sectoral lens, problems related to sustainability will not just involve, for example, renewable energy, but could also involve transport, strategic design, and new digital solutions, amongst others. Similarly, problems related to health will not only involve innovation in pharmaceuticals but also in such areas as nutrition, artificial intelligence, mobility and new forms of digitally enhanced public service provision. Missions connect all relevant actors through new forms of partnerships for co-design and co-creation by focussing on targets that require multiple sectors and actors to solve. Thus, mission-oriented innovation has the possibility of leading to system-wide transformation.

5. Multiple, bottom-up solutions

Missions should not be achievable by a single development path, or by a single technology. They must be open to being addressed by different types of solutions. A mission-based approach is clear on the expected outcome. However, the trajectory to reach the outcome must be based on a bottom-up approach of multiple solutions — of which some will fail or have to be adjusted along the way. Creating the policy and innovation environment within which experimentation, and even failure, can occur, is a key part of mission-oriented approaches; success can only be achieved by a portfolio of research and innovation projects and supportive measures, such as policy interventions and involvement of end-users[7]. Missions should be broad enough to engage the public and attract cross-sectoral investment; and remain focussed enough to involve industry and achieve measurable success.

Funding and investment, ideally from multiple sources with a variety of engaged shareholders, is also needed to build and sustain missions. In fact, by actively creating new areas of growth, mission-oriented innovation is also able to 'crowd in' business investment by increasing business expectations about where future growth opportunities might lie[8]. A mission-oriented approach to innovation should create a higher economic multiplier than funding for a single technology or sector as it leverages in private sector R&D and investment spending across multiple sectors in to new, high growth areas of the economy. The systemic effect also creates a stronger link between manufacturing and services[9].

The below mission roadmap, also developed for the European Commission report on *Mission-Oriented Research and Innovation in the European Union*, demonstrates IIPP's approach to concretising and visualising missions, and developing implementable cross-sectoral 'mission projects'. This roadmap was not designed to decide what future European research and innovation missions should be, but rather to offer guidance in their selection and implementation. It is useful, nonetheless, to provide an example of how to define missions, and is not, and nor is it intended to be, scientifically, technically, or otherwise complete.[10]

[7] Kattel, R, Mazzucato, M, (2018) "Mission-oriented innovation policy and dynamic capabilities in the public sector. UCL Institute for Innovation and Public Purpose", Working Paper Series (IIPP WP 2018-5). http://www.ucl.ac.uk/bartlett/public-purpose/wp2018-05

[8] ibid

[9] Deleidi, M, De Lipsis, V., Mazzucato, M., Ryan-Collins, J. & Agnolucci, P., (2018). 'The macroeconomic impact of different types of fiscal policy'. UCL Institute for Innovation and Public Purpose policy report for Innovate UK (forthcoming).

[10] Mazzucato, M., (2018). Missions: Mission-Oriented Research & Innovation in the European Union. European Commission. Available online at https://ec.europa.eu/info/sites/info/files/mazzucato_report_2018.pdf

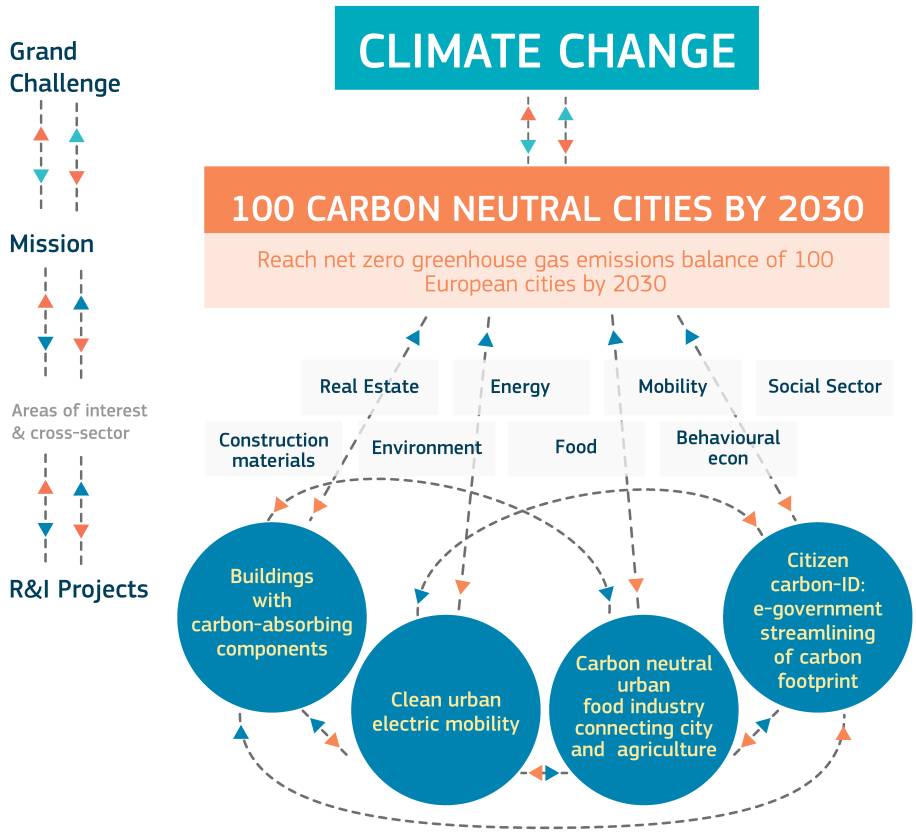

Fig 1. Mission Roadmap for 100 Carbon Neutral Cities By 2030, designed for the European Commission report *Mission-Oriented Research and Innovation in the European Union*

3. A clean growth mission for Greater Manchester

The importance of mission-setting for Greater Manchester Combined Authority

Greater Manchester faces a number of challenges to which a mission-oriented approach could be, and in some cases is already being applied. The Greater Manchester Strategy "Our People, Our Place" explains the ambitions for the future of our city region and the 2.8 million people who live in the towns, cities, communities and neighbourhoods that make up Greater Manchester. It was written by all 10 councils, the Mayor, the NHS, transport, the police and the fire service, with help from businesses, voluntary, community and social enterprise organisations, and members of the public and covers health, wellbeing, work and jobs, housing, green city region, transport, skills, early years, training and economic growth. This includes several key challenges the city region faces in these areas, to which the approach could be applied.

Greater Manchester's environment and ambitions for clean growth is one such area. The city region faces key challenges in this area – how to reduce carbon emissions, how to improve air quality, how to enhance the natural environment and how to increase the efficiency with which resources are used. These are ones where applying the criteria of the mission-oriented approach are crucial – particularly the need for research and innovation, cross-disciplinary, cross-sectoral and cross-actor innovation and multiple, bottom-up solutions.

Mission-Oriented Approach to Industrial Strategy: The work of the Commission for Mission Oriented Innovation and Industrial Strategy (MOIIS)

Missions have an important role in national and local industrial strategy. A mission-based approach can help to ensure that industrial policy does not end up as merely a static list of sectors to support. The Institute for Innovation and Public Purpose is proud to host the Mission Oriented Innovation and Industrial Strategy (MOIIS) Commission. The Commission is co-chaired by Professor Mariana Mazzucato and Lord David Willetts, and was launched in 2017 by Greg Clark MP, Secretary of State for Business, Energy and Industrial Strategy. Having already supported the UK Government at the developmental stage of its mission-led industrial strategy in 2017, the MOIIS Commission is now working with cross-sector experts and government representatives to dig deeper into mission project development and implementation.

Currently, this means focusing on the four Grand Challenges devised for the UK's industrial strategy: Ageing Society, Clean Growth, Artificial Intelligence and Data, and Future of Mobility. It is helpful to think of societal grand challenges as complex design problems that require radical innovations and multiple areas of the economy to alter their trajectory[11]. MOIIS Commissioners, and Grand Challenge sub-groups, are exploring specific mission projects, investigating how dynamic metrics can be used to evaluate them, and aiming to understand how these missions can best deliver public value goals. Within MOIIS, a sub-group tackling clean growth offers a rich cross-sectoral focus on climate, sustainability and inclusive economic development.

[11] Kattel, R, Mazzucato, M, Ryan-Collins, J, Sharpe, S, "The economics of change: Policy and appraisal for missions, market shaping and public purpose" (2018), IIPP Working Paper 2018-06, Institute for Innovation and Public Purpose, UCL. Available online at https://www.ucl.ac.uk/bartlett/public-purpose/sites/public-purpose/files/iipp-wp-2018-06_1.pdf

Greater Manchester carbon neutral context

Industrial strategy and the carbon neutrality aim

Greater Manchester is one of three 'trailblazer' areas where the government is supporting the co-designing and development of the first Local Industrial Strategies, which will be created in early 2019. The overarching vision of the Greater Manchester Strategy (autumn 2017) is ''to make Greater Manchester one of the best places in the world to grow up, get on and get old'[12]: this cross-sectoral vision should be at the forefront when considering the role of Greater Manchester's public and private, multi-sector communities to support innovation and industrial strategy. Mission development, aiming for cross-sectoral gains and spill-overs, will also consider the role of relatedness, and of city regional resilience in industries and skills.

In March 2018, the Mayor of Greater Manchester Andy Burnham hosted the city region's first ever Green Summit, which gathered opinions from residents and businesses on the city region's environmental priorities, and engaged 4000 people in the biggest ever environmental conference in Greater Manchester. 42 listening events alongside expert workshops and recommendations fed into the summit. Over 200 organisations, businesses and individuals, subsequently pledged to act on becoming a greener and carbon neutral city region. The output was the Greater Manchester Springboard to a Green City Region report, which shares 17 actions for year 1, many of which have fed into our mission projects below.

The Springboard also sets a consultation on the vision for a carbon neutral Greater Manchester by 2038 - 12 years earlier than the previous goal of 2050. This will be based on two pioneering pieces of research. The first was a report from the Tyndall Centre for Climate Change at the University of Manchester, *Quantifying the implications of the Paris Agreement for Manchester*, which made the recommendation that Greater Manchester 'initiate an immediate, rapid and deep reduction in its annual carbon dioxide emissions of, at the very least 10% p.a, towards carbon neutrality by 2038'[13], with the acknowledgement that this is a challenging and ambitious target, which aims higher than current national policy. The Tyndall report uses science-based targets and top-down approaches to advise on the agenda needed for GM to have a ''fair' contribution to a globally stable climate', and whilst it does not approach the 1.5°C target efforts considered in the Paris Agreement, the report's recommendations are challenging and ambitious for the city region. The second was the use of the SCATTER (Setting City Area Targets and Trajectories for Emission Reduction) model to understand potential emission reduction pathways. The model is based on the Department for Energy and Climate Change 2050 calculator, which is the first ever UK city wide greenhouse gas model emissions tool, and which was piloted in GM before being rolled out to other UK cities. Of the four scenarios highlighted in the SCATTER modelling, only the most ambitious came close to the Tyndall report target. Aiming for this shift by 2038 places Greater Manchester amongst 'the leading 'green cities' of the world'[14].

A second Green Summit, on 25 March 2019, will see the launch of a 5 Year Environment Plan for GM which will include the results of further modelling from SCATTER, which will be coupled with those from a different but comparative model – the Energy System Catapult's Energy System Modelling Environment (ESME) tool.

There are many reasons to aim for a carbon neutral GM, from ameliorating the local environment to mitigating global climate change. There are also recognised wider benefits,

[12] https://www.greatermanchester-ca.gov.uk/ourpeopleourplace
[13] Kuriakose, J, Anderson, K, Broderick, J, McLachlan, C, (2018) "Quantifying the implications of the Paris Agreement for Greater Manchester"
[14] ibid

particularly from improving local air quality, the subject of GM's Low Emissions Strategy and Air Quality Strategy and Action Plan. Emissions and air quality are associated with low productivity and decreased economic activity. The concurrent challenge of a growing population and of jobs growth across the conurbation, but especially in Greater Manchester's regional centre,[15] could lead to residents and visitors being more highly exposed to poor air quality[16]. DEFRA's 2007 National Air Quality Strategy states that low air costs society between £8.5 billion and £20.2 billion a year[17].

Greater Manchester sectoral advantages and high and low carbon sectors

There are multiple sectors where Greater Manchester has a regional history and competitive advantage which can offer strong support to the carbon neutral mission innovation roadmap. Accompanying Technical Reports provide an overview of GM's local innovation systems - including universities, science parks and sector hubs such as MediaCityUK - which offer potential for experimentation and test-bedding. The recent Greater Manchester and Cheshire East Science and Innovation Audit (SIA) concluded, however, that almost half of firms are not yet 'innovation-active' and that productivity is comparatively low. However, GM also has a strength as one of the most economically diverse city regions in the UK, and this business diversity means high resilience and insulation from economic shocks[18].

The SIA identified core strengths of health innovation and advanced materials, as well as growth opportunities in digital, energy and industrial biotechnology. The Low Carbon and Environmental Goods and Services (LCEGS) sector is growing in significance, with 6.3% year on year growth[19]. Within the UK, Greater Manchester's LCEGs sector is ranked third in the UK in terms of turnover sales, and the sales value vs GDP ratio is significantly above average compared to similar global cities[20]. Wind, PV, Water, Waste, Building Technologies, Carbon Finance & Alternative Fuels/Vehicles are high-potential growth areas[21], and employment development potential is large in this growing area, which is a positive indicator for the low-carbon industries which will develop from our suggested mission projects. Some of GM's most substantial carbon emissions challenges also are linked to high-polluting and difficult-to-abate sectors. Road transport is one such area, accounting for 65% of nitrogen oxide, 79% of particulate emissions and 31% of carbon dioxide emissions[22].

Papers and research

Using The Data City's new Innovation Explorer[23], it is possible to explore academic papers written within specific areas to understand key city regional and intellectual focal points. Cities are designated global rankings by innovation area, based on the quantity of papers published addressing these topics. Comparative cities include global capitals and regional hubs, from London to Lille, and Los Angeles to Lanzhou. Looking at its strengths across the board, Manchester comes out strongly in specific areas related to manufacturing, including design methods (3), aluminium alloy (4), clothing (4) and textile (6), friction welding (5), and in energy and electrical engineering branches such as cathodic protection (6) and induction

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15 The regional centre is an area encompassing Manchester City Centre, inner Salford and Trafford Wharfside. The regional centre is now the location of one in five jobs in the city region and it accounted for a third of all jobs growth in Greater Manchester between 2010 and 2015)
16 TfGM, GMCA, "Greater Manchester Low-Emission Strategy" (2016)
17 ibid
18 "Greater Manchester Evidence Review: Greater Manchester: Independent Prosperity Review Background Report" (2018)
19 Nicholson, S, "Greater Manchester's LCEGS Sector", Business Growth Hub
20 ibid
21 ibid
22 TfGM, GMCA, "Greater Manchester Low-Emission Strategy" (2016)
23 https://www.thedatacity.com/

generation (6). This will help direct our considerations of the 'willing' actors to work on cross-sectoral mission projects. In carbon-linked areas, Manchester has a high ranking in key broad-brush themes, with a ranking of 27 for sustainability papers and 27 for environmental resource management papers. Similarly, there is strong output in healthcare (ranked 11), manufacturing (ranked 26), and industrial production (ranked 21). At a more specific and technical level, Manchester has fewer outputs. For transportation planning, a key focus particularly in the city region, Manchester has a ranking of 78, whilst in natural resources, it is at 98. Educational research, something which could support information dissemination and engagement around the carbon neutral target, comes in with a ranking of 101.

Other data and evidence provided by GMCA which have contributed to this case study's understanding of the city regional context approaching the aim of carbon neutrality by 2038 include:

- Greater Manchester's Springboard to a Green City Region;
- Climate Change and Low Emission Strategies – Whole Place Implementation Plan for GM (2016-2020);
- Greater Manchester Spatial Framework;
- Greater Manchester Infrastructure Framework;
- Greater Manchester Transport Strategy 2040 Draft Delivery Plan (2020-2025);
- Greater Manchester Spatial Energy Plan: Evidence Base Study;
- Greater Manchester Natural Capital Investment Plan: Final Report;
- Greater Manchester Air Quality Action Plan 2016-2021
- Low Carbon and Environmental Goods and Services Report.

We cannot include all the implications of these plans and strategies in our proposed mission and mission projects, but we aim to demonstrate that opportunities for these strategies and delivery plans to be brought together, to be mutually reinforcing, and to be delivered in a synergistic manner, are realisable through a mission-oriented approach.

A clean growth mission for Greater Manchester

Missions have an important role to play in addressing the Grand Challenges identified in the Industrial Strategy White Paper, including the Clean Growth Challenge and GMCA were keen to work with IIPP given their expertise in mission-oriented approaches. Developing long-term, high-level missions, which enable a stable long-term policy landscape is an approach particularly suited to cross-sectoral targets such as carbon neutrality, which inherently require long-term thinking and innovation led by multiple actors. When approaching the aim of carbon neutrality in Greater Manchester from a mission-oriented perspective, we used the following methodology:

1. Converting the current aim – 'carbon neutral by 2038', driven ultimately by the challenge of climate change – into a mission, by exploring how this can be best framed and worded to reach an outcome that is testable, applicable across multiple sectors, and inspiring across Greater Manchester;

2. Understanding the context and results of recent evidence and research undertaken by GMCA, and taking into account Greater Manchester's city regional innovation backdrop, resources, capabilities and designs;

3. Plotting our research, underpinned by IIPP's recent experiences in working with the UK Department for Business, Energy and Industrial Strategy, as well as the European Commission, on missions, and analysis into IIPP's 'mission roadmap' format, to tease out key sectors which are best-placed for cross-sector interaction, and begin to understand areas of cross-sectoral interest and mutual complementarities;

4. Populating on our mission roadmap the key hypothetical mission projects that can grow, through bottom-up experimentation, from the solid public policy support given in a large geographical city region to a 20-year, cross-sector and cross-disciplinary mission-oriented approach.

Converting and framing the mission

The challenge that sits behind Greater Manchester's carbon neutrality aim is climate change, and its implications on citizens and lifestyles. The challenge of 'climate change' will thus sit at the top of our emerging mission roadmap. What is needed next is a mission which translates the climate change challenge to meet the five key mission criteria outlined above. The mission we have developed is:

Carbon neutral living within the Greater Manchester economy by 2038

This mission meets our five criteria: it is bold, and directly recognisable as having societal relevance to everyone who lives in Greater Manchester; it is measurable and time bound; it is ambitious but realistic, and will encourage innovation along the research and development value chain; it is by nature cross-disciplinary, as it is concerned with daily activities rather than sectors; and it is open to being addressed by multiple, bottom-up experimental solutions – not least those coming from citizens and communities of citizens, as it they are the people doing the 'living' that is at the heart of this mission.

It is important that this mission is approached from through the lens of 'living' and of the day-to-day life of everyone in the city region. The move to carbon neutrality is a cross-demographic, cross-sectoral, inclusive shift, and this mission framing encourages policy makers to think about every activity throughout the day, undertaken by every demographic group, in terms of age, socio-economic background, postcode, occupation, and family status. There is an easy test and measurability mechanism for this mission, so, like the moonshot, it is clear when it has been achieved: it should be possible to take a schedule of the daily activities and interactions of any one – or indeed the average - resident of Greater Manchester in 2038, and track the emissions produced.

This is a mission for the Greater Manchester city region, and should not be taken to include either residents' consumption of imported goods and services to the city region, or transit, particularly aviation, beyond the city region. Given the ambitious timescale to achieve carbon neutrality by 2038, it is unlikely that other regions will be able to deliver the same level of carbon neutral goods and services as Greater Manchester.

The mission is sensitive to the scope of carbon neutrality for Greater Manchester set out in a report from the Tyndall Centre report, which cites UNEP's 2014 Emissions Gap Report, where carbon neutrality means that 'global anthropogenic carbon dioxide emissions from energy, industry, and land use / land cover change are quantitatively balanced to be 'net zero' by carbon dioxide removals'[24], although this chapter will not drill down to the level of considering carbon removal innovation specifically.

[24] TfGM, GMCA, "Greater Manchester Low-Emission Strategy" (2016)

Creating a mission roadmap

The mission roadmap framework is how we develop our thinking on the mission, reflecting especially on how we envision sectors interacting, and government levers being used to foster bottom-up experimentation. Example projects will be used in this case study to flesh out our thinking, but it should be clear that these are only examples at this stage; the goal is to demonstrate how it is possible to be bold *and* pragmatic, via new kinds of cross-cutting collaborations. The mission's focus on outcomes and how they affect citizens' everyday lives leads to a holistic approach, centred on tangible arenas like 'home', 'work', 'school', and 'leisure', as opposed to traditional sector-based approaches. This approach requires an active engagement with the reality of peoples' lives. It is the user-centred approach that has transformed much public and private sector practice over the last decade, yet fused to a strategic agenda that balances user needs with wider systemic outcomes; in this case, carbon neutrality.

A successful mission roadmap identifies the range of sectors that have to be engaged to address the challenge, as well as suggesting the range of approaches. The aim is not to 'pick winners' but instead to 'pick the willing'. As such, among this list of sectors there will be organisations and businesses that are eager to engage in this ambitious challenge.

The projects listed on the mission roadmap are not exhaustive, and have not been evaluated. In reality, projects should emerge from initial engagements with a range of stakeholders, from citizens to policymakers and all points in-between, as part of a participative co-design process. This will require dedicated time and planning, which was beyond the scope of this initial consultation. However, we have made suggestions of projects, as well as areas within the mission remit where policy interventions could be made. At the implementation phase, these projects would require analysis to be completed concerning appropriate policy levers, whether business or consumer incentives, procurement directions, new public services, or innovation-linked taxes, grants or prizes.

A mission roadmap for Greater Manchester: Carbon neutral city region by 2038

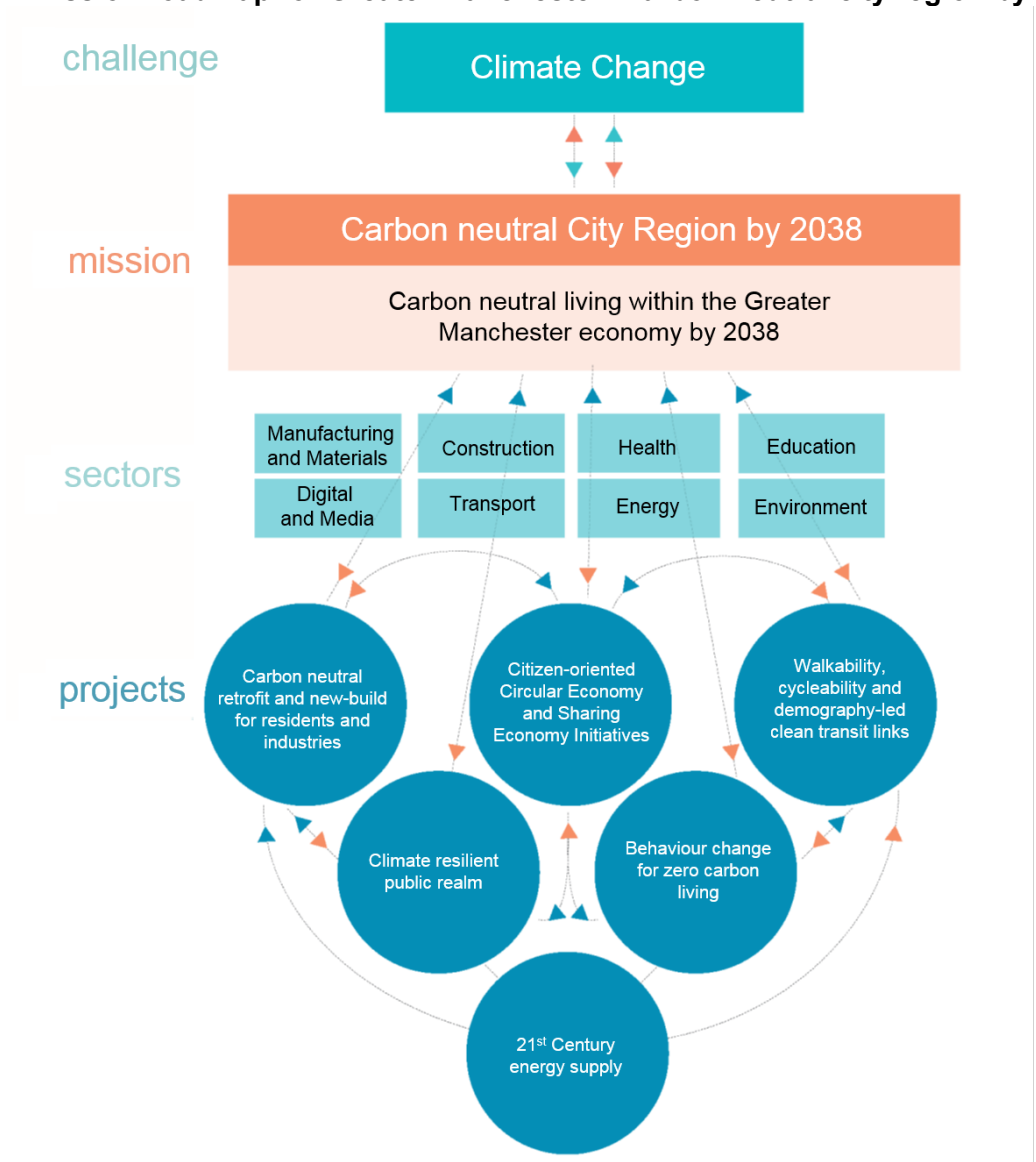

Fig 2. Mission Roadmap for Carbon Neutral City Region by 2038, designed for Greater Manchester Combined Authority

Mission projects

These mission projects are hypothetical and have been developed based on recent sectoral and cross-sectoral studies undertaken by GMCA, and specialised to the Greater Manchester city region. Whilst the projects are implementable, more work is needed to flesh out the development direction and details. As noted previously, in reality projects would ideally emerge from participative co-design processes, reinforcing 'bottom-up' engagement as a core principle of mission-oriented innovation. This not only produces more creative approaches, emerging from true user-need and a detailed understanding of context, but also ensures that projects are delivered more easily and effectively, as citizens have been on-board from day one. However, even a truly participative process is best kickstarted with a set of tangible suggestions, so the following suggested projects are a useful starting point.

Project 1: Carbon neutral retrofit and new-build for residents and industries

A mission-oriented project on deep residential and industrial retrofit is an approach which aligns the energy sector with construction, employment, training, buildings, materials,

technologies, and natural capital, and would be highly impactful on emissions from the domestic market, where space heating and hot water account for 77% of energy demand[25].

'Retrofit' here refers to building efficiency methods such as insulation, double-glazed windows, shared energy use, and, in industrial buildings, innovation on items including more efficient chimney stacks and 'smart buildings'- advanced technologies enabling shared resources, machine learning-led optimisation and new digital services for tenants. The market for deeper, more disruptive retrofit has yet to come to maturity and will require innovative finance mechanisms to do so. Disruptive retrofit will include more advanced insulation for floors and walls. Super-local battery storage aligned to local renewable energy generation further widens the approach. Strict, early-impact, city region-wide buildings standards could support this work, if aligned to feedback loops from ongoing monitoring (from real-time data and trained operatives.) This is a short term, high impact step towards 2038 carbon neutrality, with high lock-in effect, which could simultaneously tackle city regional energy poverty through targeted retrofits on the poorest first. Greater Manchester competencies in technical ceramics and technical textiles could see these areas grow and lead the development of innovative insulation materials. Similarly, machine learning provides a way of handling complexity in energy sharing at local and city regional scale, and is another opportunity for local expertise. The need to deploy sensors to generate real-time data on use provides a meaningful focal point for GM's smart city initiatives. The Spatial Framework mentions 'district heating, individual electric heat pumps, bio-fuels and solar technologies for both hot water and electricity' as having the 'highest technical potential'[26] for large-scale roll-out.

Whilst retrofit projects are already squarely in view, alongside heat and cooling demand reduction plans, horizontal impact will be realised when retrofitting plans are supported by large-scale training programmes, equally embedded in the construction, utility and energy systems industries, with low-carbon retrofit materials procured in line with integration innovation in the LCEGS and Natural Capital sectors. Crucially, this must include ongoing engagement with building retrofits, rather than the 'fire and forget' approach typical in the built environment sector. Ongoing maintenance and calibration is key to the success of any such initiatives. This too takes trained staff, as well as large scale sensor deployment. Retrofits, energy efficiency methods and smart energy systems in the domestic sector alone has the 'potential to create 55,000 jobs'[27]: this mission project is the way to create long-term, sustainable, green economy jobs in installation, research and development, and electricity, where trained employees will be fungible to support future carbon neutrality activities. The project could begin with high profile local government procurement for public buildings across the ten local authorities, with associated local training and local LCEGs and Natural Capital links. SCATTER's highest quartile threshold for change includes insulating 0.7 million houses, and decreasing thermal leakiness by 75%[28]: there is a lot of potential identified here.

Similar targets must be set around new build, obviating the need for future retrofit in the many new buildings likely to emerge in Greater Manchester before 2038. This could include a focus on both smart buildings and traditional materials, such as timber — an intrinsically carbon-positive building material if aligned to tree planting, (which, in turn, can mitigate flooding—an example of cross-system outcomes possible in the mission-oriented approach, outlined in project 2, below) A focus on design ensures buildings are ready for adaptation and intensified use, and maintained and monitored accordingly. Each new building should also generate open data on its use, shared with GMCA, in order to map the progress

[25] Energy Technologies Institute, Energy Systems Catapult, (2016) "Greater Manchester Spatial Energy Plan"
[26] ibid
[27] GMCA, Low Carbon Hub, "Greater Manchester's Springboard to a Green City Region"
[28] Anthesis, Tyndall Centre, GMCA, BEIS, Core Cities UK, "SCATTER" (2018)

towards 2038, as well as enable ongoing calibration and iterative design. The need for meaningful city architect positions and teams should be reconsidered, in order to build capability in this area; to enable coherent framework setting and 'smart client' positioning at least, if not building directly via the public sector.

International examples:

The Dutch Energiesprong model involves building or retrofitting homes using prefabricated external insulation, as well as PV and battery storage additions. The modular approach means that installation can be done more quickly than usual, and manufacturing benefits from scale economies. Targets include the requirement that all energy use, including plug-load is net-zero carbon[29]. Energiesprong has been developed in the UK using combined funding from multiple grants, with houses in Nottingham.

Project 2: Climate resilient public realm

Flood management, water quality and the physical and/or mental health benefits provided by the natural environment, both in rural and city areas, are vital components when thinking about the stewarding of natural capital, a high value part of the GM economy[30]. Climate change is expected to mean GM will increasingly experience warm dry summers, with implications for water supply and soil shrinkage, and wetter winters with increased flood risks[31]. Floodwater catchment services through Sustainable Drainage Systems (SuDS) in city regions can be simply developed by increasing the planting of trees in city areas, which typically have run-off issues due to high levels of concreting.

Concreting can lead to sewer flooding during storms and high rain, with implications for mass transit, health and wellbeing, and even energy and infrastructure systems more widely – not least that existing sewer systems will begin to leak and wear out more quickly, meaning more maintenance costs, and a shorter overall lifespan.

To create local, residential and city-sewer decentralised SuDS through tree-planting would require the integration of digital and social tools and engagement. Work from the strong local digital sector, including expertise in relevant 'Internet of Things' developments, could electronically link data from drains, soils, air, and biodiverse environments generally. This would also address air pollution, through providing local carbon sinks, and dry city heat as trees decrease street temperatures. These pleasant environments also encourage walkability and other forms of active transport, which make for healthier citizens, reducing local health and social care costs accordingly. These sensors also enable tracking towards 2038. Encouraging citizen involvement in green infrastructure is relatively straightforward, and is highly motivating, as indicated by Amsterdam's 'Rainproof' projects, in which citizens are incentivised to replant hard surfaces, reversing 20th century trends towards concreting[32]. This in turn links to citizen literacy and behaviour change projects (see project 6 below), as well as actively changing the hard fabric of our cities. Finally, incentivising new forms of timber building (cross-laminated timber, glu-lam and equivalent) should necessitate mass replanting schemes.

[29]Energiesprong, https://www.cibsejournal.com/case-studies/a-forward-leap-how-dutch-housing-process-energiesprong-guarantees-performance/
[30] "Greater Manchester Evidence Review: Greater Manchester: Independent Prosperity Review Background Report" (2018)
[31] TfGM, GMCA, "Greater Manchester Low-Emission Strategy" (2016)
[32] Amsterdam Rainproof, https://amsterdamsmartcity.com/projects/amsterdam-rainproof

International Examples:

The 'Mini Holland' project in Enfield, Kingston and Waltham Forest is part of the Mayor of London's Healthy Streets agenda to help Londoners use cars less and walk, cycle and use public transport more, at the same time as enjoying more green space, trees and plants, specifically addressing the demands of growth in outer London. More than 90 schemes have been proposed by the three Mini-Holland boroughs, including a range of innovative improvements for cyclists: Cycle Enfield, with Quietway routes linking key destinations using quiet back streets; Go Kingston with cycle routes developed around Kingston station, and Enjoy Waltham Forest with cycle hubs throughout the borough[33].

Project 3: Citizen-oriented Circular Economy and Sharing Economy Initiatives

A mission project around waste exchange, including energy, food, landfill and industrial materials, including industrial heat, could be implemented across the city region's homes and businesses. This is particularly useful in supporting the development of a targets framework for commercial and industrial (C&I) waste – whilst domestic waste has set targets, C&I waste is not currently subject to targets. The Green City Region Springboard report includes a focus on Sustainable Consumption and Production and consultation on a Resource Strategy[34], both of which relate to circular economy; rapid, mass uptake of circular ecosystems could be achieved through bilateral or multilateral industry linkages, or industrial symbiosis, where the processes of one business or industry act as another's inputs, and there are innovation (and employment) opportunities extended for bottom-up experimentation to create such links between industries[35].

Waste should be seen as a resource, particularly at a time of material resource pressure[36], and food waste, chemical waste exchange, industrial heat and even sewage and composting could all come under this mission project. Initial selections could be made in areas where Greater Manchester is globally competitive and productive, and where there is inter-sectoral skills relatedness - the textiles, paper manufacturing, food, and chemicals industries for example. GM's comparative advantage in waste management underpins this mission project, as does work in more specific areas like biomass.

Funds could be developed within the frameworks of universities or research catapults to support such innovation, and a data-driven platform created to enable specific manufacturing links to be made. For example, there is an opportunity to do this within graphene, capitalising on the investment in facilities that has been made, and developing partnerships between government, Greater Manchester Combined Authority, universities and the private sector to commercialise this breakthrough material. There is strong potential in waste-to-energy innovation, particularly in wood waste and in the biofuels sector: science-based targets indicate that 17% of Greater Manchester energy demand could be met by bioenergy in 2050[37].

There are clear spillover effects on, and links to, the greening of transit, as a circular economy can be linked with inter-sectoral supply co-ordination, so that freight transport between waste-partner businesses can be consolidated. Trucks can be taken off the streets, reducing emissions and air pollution. Incentives to transport waste could mean quicker waste removal, ameliorating smells and other issues surrounding waste, and freeing up storage

[33] TfL, https://tfl.gov.uk/travel-information/improvements-and-projects/cycle-mini-hollands
[34] GMCA, Low Carbon Hub, "Greater Manchester's Springboard to a Green City Region"
[35] Perez, C, Mazzucato, M, "Innovation as Growth Policy: the challenge for Europe", (2014) Working Paper Series SWPS 2014-13, University of Sussex
[36] DEFRA, "Government Review of Waste Policy in England" (2011)
[37] GMCA, Low Carbon Hub, "Greater Manchester's Springboard to a Green City Region" (2018)

space which could be converted into stockrooms. A more holistic understanding, transparency, and data-driven service embedded in a circular economy framework will lead to greater awareness of city region-wide industrial inputs and outputs, creating a feedback loop to researchers and innovation systems which will lead to greater levels of efficiency and sustainability. Innovation platforms can be developed to understand industrial symbiosis opportunities and product-lifecycle approaches, as well as to develop new materials and textiles that are both technically advanced and also recyclable with highly fungible waste outputs.

Logistics for waste systems should also be targeted, and the use of machine learning-based systems, predicated on predictive analytics via real-time data emerging from various forms of sensor, can enable far more effective waste collection. Moving towards autonomous vehicles for various types of waste collection could, where appropriate, also ensure that waste movements are not during busy, populated daylight hours.

Importantly, the relationship between citizens and waste should be a primary focus, noting that consumption is both the starting point and end point of these processes and systems, and equally that citizens can change behaviour and culture relatively quickly, given imaginative engagement, as seen in the recent turnaround in terms of single-use plastics, such as bags and straws. This indicates that this end of the system is in fact easier to change, easier to engage with, and faster to move. A deeper understanding of peoples' lives, via in-depth ethnography, design research and participative co-design processes, would quickly uncover opportunities for behaviour change around waste. The Participatory City Foundation in London, and their Everyone Everyday projects, indicate an exemplary approach to co-production models for sustainable communities[38]. Pursuing similar co-production models in Greater Manchester would unlock waste behaviours at this end of the system, symbiotically counterpointing the heavier industrial approaches described above. With both 'ends' of the system in play, the city region can move towards neutrality more effectively.

International examples:

Innovation is rapid at start-up level in the waste, recycling and circular economies. Many food waste apps, including Too Good To Go[39], and Olio[40], are leading the way. Air Ink from Graviky Labs, an MIT spin-out based in India[41], captures carbon emissions and converts them into printer ink, whilst InfraSalience[42], based in London, repurposes waste streams from energy into green chemical outputs. Qarnot[43] redistributes industrial and office computing waste heat to power residential heating systems.

ECO3, located in the city of Nokia in Finland, is a 150 hectare industrial scale bio-economy and circular economy business park with 28 participating organisations and a Public-Private-People-Partnership platform[44], which pioneers bio-, circular and water- economies, and acts as a demonstration and piloting environment for experimentation in these fields. It is part of Kolmenkulma Eco-Industrial Park, situated within the Finnish growth corridor, and its work is developed in co-operation with the City of Nokia, and alongside national universities and company partners. Projects include biogas production, linked to agriculture, and ash

[38] Participatory City, http://www.participatorycity.org/
[39] Too Good to Go, https://toogoodtogo.co.uk/en-gb
[40] Olio, https://olioex.com/
[41] Graviky, http://www.graviky.com/
[42] InfraSalience, http://www.infrasalience.com/
[43] Quarnot, https://www.qarnot.com/
[44] Sitra, https://www.sitra.fi/en/articles/eco3/

granulation which brings together thermal heat treatment with road and construction materials.

Project 4: 21st Century energy supply

As well as developments on the demand side outlined above, addressing energy efficiency and energy (and financial) savings for end-users, a fully cross-sectoral approach entails developing green companies, technologies and markets on the supply side[45]. There are multiple energy generation and infrastructure innovations available, from incremental to radical (more efficient coal fired power plants vs. smart grids); and these should be social and organisational as well as technological[46].

Bottom-up experimentation is already widespread in Greater Manchester's energy, construction and transport sectors, which are well-linked. The results must be investigated and grouped to build a true 21st century energy supply system. Greater Manchester plans to become an Energy Transition City Region, and there are already many current as well as future test-bed projects, including the Northern Gateway heat decarbonisation project for high-rise neighbourhoods, using gas combined heat and power alongside storage units for high-rise neighbourhoods, with PV on medium and low rise; the Homes as Energy Systems demonstration will also test the energy network's flexibility and management at a domestic level for 700 houses across the city region[47]. Machine learning-based systems can enable more effective load distribution and peak-shaving, both at the super-local (street) level as well as the district, urban and city regional scales. These innovation investments and test-bedding projects in specific Manchester locales should have their profiles raised at citizen level, via the mission project on carbon literacy (see project 6 below).

Decisions now need to be made around picking the correct industries and projects to work on. A mission-led approach advises picking the willing, not the winners: working with the industries and sectors that are rapidly developing, and are aligned with carbon emissions goals. Decarbonisation of heating from gas is one of the least easy-to-abate sources of carbon emissions. Identified district heat network plans, and the OPEN project[48], should be drawn into the linked industries mission project outlined above in terms of industrial waste heat in urban areas.

The next step for Manchester is to create social and organisational readiness for full systems change, and the shift to a 21st century energy supply system, both for domestic and for C&I users. Considering the energy system as a 'constantly evolving supply chain' is key, within which customer information and customer choice makes for citizens who are 'much more likely to engage with the changes required to meet carbon reduction budgets'[49]. This requires a mixture of physical, digital and social infrastructure, with a clear focus on end-user needs and motivations, yet balanced with systemic outcomes that go beyond simplistic user-need. Where new generation projects are cross-city regional, it should be possible for end-users to trial and experience the benefits of each. Community-level ownership of generation, storage, and peer-to-peer energy sharing – even at building or street level – from PV installations, will not only decarbonise energy and align with technology-specific goals (notably, the aim for 12% of energy demand to be met by solar in 2050[50]), but also

[45] Mazzucato, M, "The Green Entrepreneurial State", (2015) Working Paper Series SWPS 2015-28, University of Sussex
[46] Watson, J, Mazzucato, M, Semieniuk, G, "What will it take to get us to a green revolution?" (2015), University of Sussex
[47] Energy Systems Catapult, "Whole System Smart Energy Plan for Greater Manchester", (2018)
[48] ibid
[49] ibid
[50] GMCA, Low Carbon Hub, "Greater Manchester's Springboard to a Green City Region"

encourage local cohesion, and a high level of knowledge from end-users about their energy consumption. (Equally, super-local generation can be via heat pumps, biowaste, potentially even wind turbines, and others i.e. not simply PV.) On a wider scale local energy hubs, launched throughout the city region, could provide a one-stop shop for domestic and C&I consumers on pan-energy-innovation issues, including smart metering, incentives for PV or heat pump installation, opportunities for flexibility/capacity payments at C&I level and electric vehicle charging, as well as embedding the planned Local Energy Markets[51].

Project 5: Walkability, cycle-ability and demography-led clean transit links

Improving health and wellbeing, accessibility and safety, transforming the quality of the public realm and its related activities, re-greening streets, and reducing congestion and pollution are key linked outcomes for 21st century mobility systems, and can clearly benefit the citizens of Greater Manchester. Existing and forthcoming transport strategies highlight increased local investment in infrastructure over the last decade, and strong desire for the city region to bring together transport modes into an integrated system. Cycling and walking in Greater Manchester has increased over the past decade, and should be further encouraged. 19% of trips into Greater Manchester town centres during the day in 2015 were made on foot, and there is strong appetite for cycling, with more cycle lanes being provided to overcome the top barrier cited to cycling – volume of road traffic[52]. Clean electric transit links for core public transport systems, including ultra-low emission trams, trains and buses, should be deployed based on both demographic trends and high-frequency routes between destinations. The gaps in between these 'peak load' systems should be filled by various forms of shared public infrastructure, such as bike-sharing, e-bike sharing, autonomous shuttles, electric scooters, logistics robots, and cargo bikes. These should be supported by highly walkable and cycle-able environments for personal transport, and by more ambitious planning to reduce the need for unnecessary mobility demand as practically as possible.

The goal should be to better link the various nodes in patterns of everyday life via clean and active transit based on genuine user needs and desires, and ambitious levels of user experience, understood and articulated across all demographics. Understanding traveller needs through participative design processes ensures that demographically-appropriate health and wellbeing goals can be met, and services designed to be run cost-effectively at high quality. The demographic shift in many areas of Greater Manchester towards an older population will require a focus on age-appropriate transit. Building short optional walkable and cycle-able sections into routes which suit this demographic, whilst ensuring 'peak load' routes are also fully accessible, is one example of cross-sectoral thinking; developing routes which encourage the communal living of multiple demographics, such as younger families and older people, can have positive spillover effects on issues such as loneliness, social cohesion, and community building. There are opportunities to develop incentive-based infrastructure pricing, to encourage staggered peak time journeys, and to use machine learning-based predictive analytics to calibrate service provision more effectively. Autonomous shuttles, as forms of public transport, could unlock entirely new kinds of journey, cost effectively, for a wide range of demographics. Creating more sophisticated fare zoning methodologies for various transport modes is the first step to support this, which could also support low-income demographics.

Clean transit routes and infrastructure tracking should grow alongside innovation around a data framework which sits within the Digital City Region plan. Work to assess and develop useful datasets to support customer choices around modes and connections, could lead to new tools, improving quality and choice in transport offers, and taking high quality transport

[51] Energy Systems Catapult, "Whole System Smart Energy Plan for Greater Manchester", (2018)
[52] "Greater Manchester Evidence Review: Greater Manchester: Independent Prosperity Review Background Paper" (2018)

choices as a direction for innovation. Importantly, this means that transit supply can be calibrated to match demand in real-time. Sharing data on usage with active public agencies can mitigate against underperformance or wasteful over-supply accordingly, as we move towards real-time systems. Crucially, an increased emphasis on high quality and integrated user experience — in terms of physical, digital and social touchpoints — is the most important refocusing required, as this is increasingly the fundamental differentiator in terms of user acceptance, and take-up of new and existing systems.

International examples:

The CityMapper app, active in many global cities and regions, including Greater Manchester, shows users the quickest, or most effective, way to travel between destinations, including private and public transport. The app is already integrated with local sharing economy providers, including floating and fixed bicycle sharing schemes. This means that it is easy to plot a journey which would, for example, indicate that the quickest way to reach a destination is to take a train for the first leg (eg. to the edge of a town or city area), and then pick up a closely situated floating sharing bicycle for the final leg into the built-up area. Any such start-up-based approach, however, should ensure that open data sharing is built into agreements, such that the city can benefit from strategic data generated by such apps, particularly given that apps rely on city-generated transit data in the first place.

The Oslo and Trondheim bike-sharing systems run by Urban Infrastructure Partner (UIP) for the respective municipalities indicate how to do need-based high quality user experience with flexibility for citizens, highly efficient service provision for the operator, and civic outcomes at the city level, balancing individual outcomes with urban outcomes and reinforcing public good. UIP's Urban Sharing system's hybrid "smart lock, dumb dock" mode allows for the use of "virtual" docking stations which can be created using geofencing technology, as well as formalised physical docking stations at logical points within the city. The feature is a result of carefully understanding the balancing act between individual flexibility and urban outcomes; or, in this case between the often wasteful 'floating bike' systems and the rather rigid traditional city bikes model. All data is shared with the municipality as well as published openly. Oslo Bysykkel's early morning maintenance crew is made up of local recently-released prisoners, who have been trained to fix bikes. This solves a problem for Urban Sharing - it needs a maintenance crew - whilst also creating a wider public good, enabling a better reintegration of former prisoners into society. Urban Sharing's approach indicates a private company working for public outcomes, as part of a public transport system. The way that Oslo Bysykkel[53] is designed and operated provides flexibility for the individual, efficiency for the operator, and social, civic and environmental outcomes for the city. It demonstrates the balancing act possible when combining both user-centred and strategic design.

Project 6: Behaviour change for carbon neutral living

Dissemination and engagement will be a significant part of a successful carbon neutrality mission, particularly one which aims for a citizen-led approach. Messaging around carbon neutrality should not be top-down; rather, citizens should be activated from the mission's beginning to develop bottom-up strategies to make the 'carbon neutral living' element of the mission a lived reality for them. Greater Manchester's digital economy is the largest outside London, generating £4.1bn per annum in GVA and employing 82,000 people[54]. Harnessing the creativity of the digital sector alongside education and training, as well as energy, manufacturing and transport can mean each mission project is embedded in a city region-wide carbon literacy engagement scheme, which interacts with all citizens, across the ten

[53] Oslo Bysykkel, https://oslobysykkel.no/en
[54] https://www.greatermanchester-ca.gov.uk/info/20153/digital_city_region

local authorities, at multiple touchpoints. There is a clear role for the education system, from pre-schools to universities and further education colleges, to play in delivering a 'carbon curriculum'-style programme to young people and children. Carbon literacy to embed behaviour change will reinforce all six mission projects, as well as supporting the development and dissemination of specific campaigns outlined in the Springboard report, such as the #Plastic Free Greater Manchester campaign and other environmental campaigns[55]. Such campaigns should also be firmly grounded with visibility and interactions at work, transport and wider lifestyle arenas. The Air Quality Action Plan aims for low-emission behaviours to be embedded into the culture of Greater Manchester's organisations and lifestyles by 2025[56].

There are already plans for Greater Manchester leaders to receive Carbon Literacy training, and employers, including BBC North, Manchester City Council and housing providers, will be encouraged to sign up as Carbon Literate organisations[57]. This is an ideal opportunity to engage the Greater Manchester population in the workplace, with high-profile employers and respected leaders embedding carbon literacy into their training programmes, HR processes and external advertising campaigns. Cross-sector competitiveness in delivering carbon literacy content could also be encouraged, and all other mission projects and forthcoming strategies should have this approach embedded. There could also be competitive tenders and prizes around the campaigns and touchpoints themselves, to engage advertising, digital and media organisations from the beginning. In the long run, there could be scope for a multi-industry Carbon Literacy Trade Association, where employees can share practitioner advice on carbon neutrality in their roles and organisations.

International Examples:

The Carbon Literacy Project originates in Manchester, and offers a day's worth of Carbon Literacy learning to everyone who works, lives or studies in the city and wider area, aiming to have a cascade effect from individual learners to a far wider audience within workplaces, schools, faith communities and more. Their largest collaborative project to date is the CL4RPs programme - Carbon Literacy for Registered Providers, which works with 20 of the largest Housing Associations across Greater Manchester, who are actively rolling out Carbon Literacy across their entire workforce and are set to disseminate to tenants, residents, suppliers, stakeholders, community groups, supply chains and other connected audiences[58].

Conclusion

This case study and accompanying mission roadmap aims to demonstrate how a mission-oriented, cross-sectoral approach can support Greater Manchester Combined Authority in addressing its challenge to become a carbon neutral city region by 2038. For more information and further development of this approach, please contact the UCL Institute for Innovation and Public Purpose.

[55] GMCA, Low Carbon Hub, "Greater Manchester's Springboard to a Green City Region"
[56] TfGM, "Greater Manchester Air Quality Action Plan: 2016 – 2021" (2016)
[57] GMCA, Low Carbon Hub, "Greater Manchester's Springboard to a Green City Region"
[58] The Carbon Literacy Project; http://www.carbonliteracy.com/cl4rps/