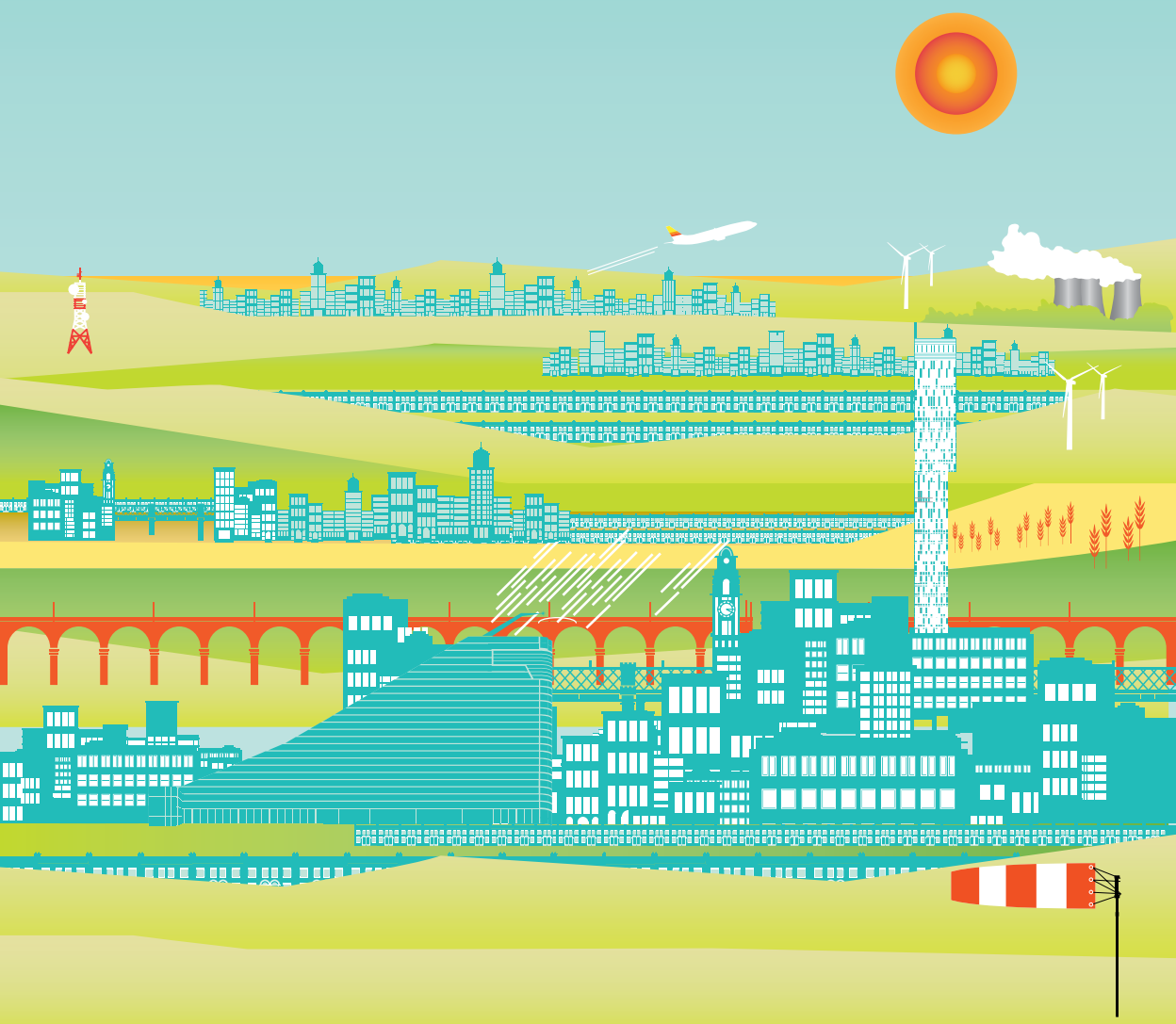


FOUR DEGREES OF PREPARATION

Greater Manchester plans for climate adaptation



Greater Manchester's adaptation imperative

What was once the worst case scenario on future climate – a 4°C increase in global temperature by the close of the 21st Century – is now looking increasingly possible as global carbon emissions continue to accelerate and as emissions reduction targets are missed.

The gases that cause climate change linger in the atmosphere for decades and so there is an in-built inertia in our climate system. This means that our actions to reduce carbon emissions today will not have an effect for decades. Additionally, the climate change predicted for the middle of the 21st Century will occur come what may. Cities and nations across the world should prepare for these mid-century changes as a matter of urgency.

So what might Greater Manchester in the 2050s look like? The annual mean temperature could have increased by up to 3.6°C, our winters could be up to 36% wetter and our summers 36% drier. There will also be greater seasonal variations in the weather, and more extreme events such as storms or flooding. Extreme summer temperatures will become more frequent and heat waves will result in more heat stress.

The shift is happening now. The weather and climate of Greater Manchester is already changing, broadly in line with the direction of future climate projections. The impacts will be felt throughout society, from business to social services, healthcare to the individual householder. It is crucial that adaptation strategies and actions are developed in response. Just as the climate will change over the coming decades, so will society. We cannot predict how Greater Manchester's businesses and communities will evolve but change can be expected and this will influence how the city is impacted by a changing climate and also how it is able to respond.

The EcoCities project

EcoCities is a joint initiative between the University of Manchester's School of Environment and Development and property company Bruntwood. The project looks at the impacts of climate change and at how we can adapt our cities to the challenges and opportunities that a changing climate presents. It is hoped that the research outputs will also have wider relevance for other urban areas engaged in responding to the challenges and potential opportunities linked to climate change. This brochure presents the headline messages from EcoCities. It also acts as a signpost to the principal outputs of the project.

EcoCities is an interdisciplinary research project that draws principally on the expertise of the University of Manchester's Manchester Architecture Research Centre (MARC) and Centre for Urban and Regional Ecology (CURE). Central to all the work of EcoCities is the concept of building adaptive capacity. This concerns helping cities to develop the skills, knowledge and expertise necessary to adapt to the impacts of climate change.



Headline messages: time for action, time to adapt

EcoCities has identified three priority areas for immediate action across Greater Manchester.

EcoCities provides support to stakeholders and decision makers, via research outputs at the individual building, local community or strategic city region level, to enable them to kick-start action across the three headline themes below. EcoCities' outputs provide relevant intelligence and insight, and build capacity to take action and adapt to change through the development of adaptation plans, strategies and actions.

Safeguarding our future prosperity

Building resilience to the changing climate into Greater Manchester will safeguard prosperity and growth. It will help to reduce perceived risks associated with living and investing in Greater Manchester. Flooding can cost millions and extreme heat hits productivity. Businesses that are not prepared will be more exposed to risk. If we adapt now we will reduce that risk and have a competitive edge over other city regions, and if we develop and exploit innovative solutions to climate change, we will take a strong position in a fast-growing global market and stimulate job creation. A few pioneer cities — such as Chicago — have already launched 'green deal' jobs programmes around adaptation. There will also be a few areas of our economy, such as tourism, where shifts in climate could be turned to our advantage.

Protecting the most vulnerable in society

Good, robust adaptation in urban areas has a key focus on people and communities. Wider research on climate change impacts has shown that some groups are more vulnerable than others; for example the elderly are at far greater risk of ill health or death due to increased levels of heat. The EcoCities project has found that two of the most significant impacts of climate change for Greater Manchester, increased flood risk and greater temperature extremes, will be felt to a higher degree by the most vulnerable in society, with poorer and more diverse communities showing higher exposure to flood risk. The adaptation challenge for Greater Manchester is to plan for 4°C in a way that powerfully protects the most vulnerable. This could be achieved by concentrated action including improvements in the physical environment (resilient and adapted housing; greener urban environments), appropriate provision of emergency services and addressing the underlying causes of vulnerability, such as poor health and material deprivation.

Building the resilience of our essential infrastructure

A city's infrastructure is critical to its future prosperity and quality of life. Adaptation of Greater Manchester's infrastructure should be a priority. In the face of climate change essential infrastructure should not be seen as purely pipes and wires, but also includes key public services and green infrastructure. As the risk of flooding, heat waves and drought increases, key elements of Greater Manchester's essential infrastructure could be at risk of malfunction or damage. Services will be impacted. Business will be inconvenienced. EcoCities looked at the risk of flooding to infrastructure. The next step is to analyse impacts on infrastructure in the conurbation and to begin to prioritise and plan for change so that Greater Manchester's businesses, services and people are resilient and ready for a changing climate. Infrastructure can also support the development of adaptation responses. For example, green infrastructure can help to cool the city and social infrastructure, such as schools, can act as shelters in the event of flooding.



Research themes

EcoCities has been organised into five research themes:

Weather and climate trends and projections

Impacts of weather and climate

Vulnerability to climate change

Adaptation responses

Scenarios and futures perspectives

Key issues relating to each of these themes are introduced below, including details of relevant EcoCities reports research.

Weather and climate trends and projections

Developing a better understanding of recent and possible future changes in the climate is an important element of creating adaptation responses, which should ideally be targeted at locally relevant climate impacts and risks. Information on these issues developed within EcoCities is of value to a wide range of different stakeholder groups wishing to learn more about weather and climate in Greater Manchester and the North West region, and preparing for the future changes.

EcoCities research shows that there have been small observable changes in climate trends across the conurbation over recent decades¹. These changes are broadly in line with the direction of projections for Greater Manchester's climate during the 21st Century. In terms of the future climate, EcoCities reports generated data for a range of different climate variables, time periods, emissions scenarios and probability levels for the North West region² and Greater Manchester³, where three distinct climate zones have been identified.

The projections point towards wetter winters, drier summers and a warming across all the seasons. There is some uncertainty over the extent of future climate change. We cannot predict whether emissions will continue to rise or how the biosphere will react to the rapidly changing climate, for example. Nevertheless, there is broad agreement that the climate is set to shift significantly, and that adaptation responses are needed.

Impacts of weather and climate

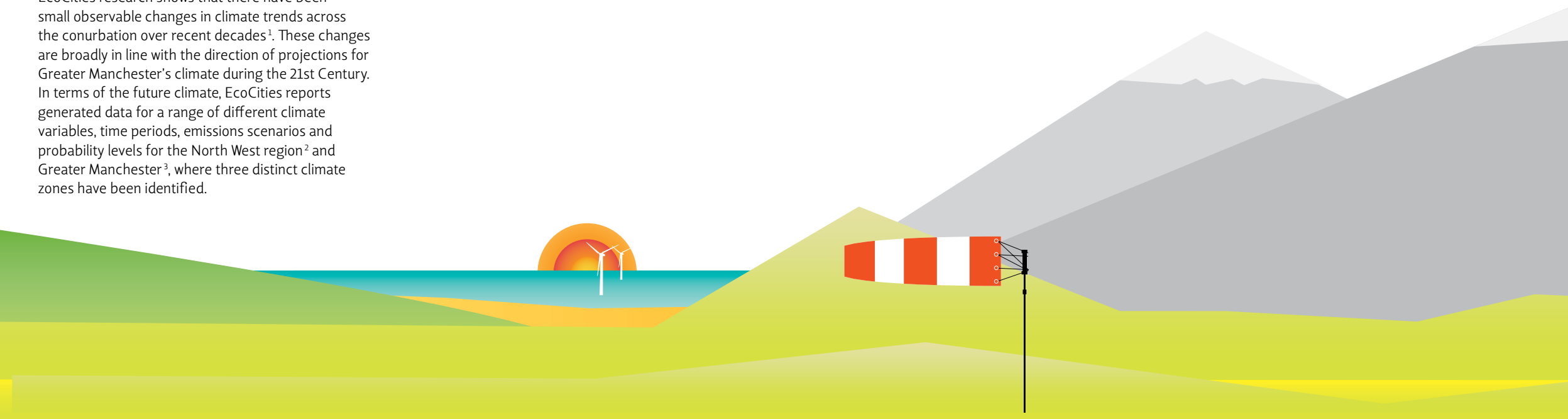
Understanding recent trends and patterns of climate events and their recorded impacts, and projecting forward considering future climate change, strengthens the basis to develop adaptation responses.

The impacts of climate change extend across different sectors and issues, from hard infrastructure to health and wellbeing. This poses risks and, in some cases, possible opportunities.

Local authorities have a wide ranging remit and are threatened by a number of climate change risks. A collaborative project between Manchester City Council, the University of Manchester and Red Rose Forest assessed how the City Council may be affected by current and potential future weather and climate. This identified risks across a number of key service areas, including leisure, housing and adult social care⁴.

This project drew on work undertaken to identify patterns in reported weather and climate events across Greater Manchester, stretching back to the 1940s. This identified floods as the most common type of event, with storms (including high winds) and cold weather also being frequent⁵. These events appear to impact particularly strongly on critical infrastructure and health and wellbeing.

In future decades some of these events, such as cold weather, are projected to become less frequent. Others, including heat waves and water shortage, are projected to occur more regularly. We have drawn on existing research to identify some of the key climate change risks facing Greater Manchester in the future⁶.



Vulnerability to climate change

Within EcoCities, we have looked at the vulnerability of infrastructure and urban communities to climate change impacts. Vulnerability is taken as the susceptibility to harm from weather and climate events. In other words, if an event does occur, how much damage might it do? Research such as this can help adaptation strategies to target the most vulnerable.

The vulnerability of communities to surface water flooding, an event that is likely to increase in the future with more intense rainfall, has been investigated^{7,15}. Groups particularly susceptible to harm include urban communities that tend to be highly diverse or affected by material deprivation. These communities also live in areas with a lower proportion of green space that may increase surface water runoff, raising the risk of flooding.

Another EcoCities report explores the risk of flooding to infrastructure in Greater Manchester⁸. Mapping of different infrastructure types against areas at risk of flooding from rivers and surface water highlights that critical infrastructure (e.g. electricity substations or water treatment plants) may be most susceptible to flooding. However, social and emergency infrastructure (e.g. hospitals, fire stations, GP surgeries etc) are less susceptible and may provide important lifelines for communities during flooding.

When extreme weather and climate events do occur in Greater Manchester, it is clear that not all infrastructure and communities will be equally affected. Data and maps on the vulnerability of communities and infrastructure to weather and climate impacts can be viewed on the Spatial Portal which is housed on the www.adaptingmanchester.co.uk website. These findings can help to guide and prioritise adaptation responses developed to address these risks.

Adaptation responses

A key goal of EcoCities has been to produce outputs that build adaptive capacity and support the development of adaptation responses to extremes in current and future weather and climate in Greater Manchester. Adapting the conurbation to the changing climate can bring multiple benefits, including enhancing economic competitiveness, increasing the resilience of infrastructure, and fostering more sustainable communities. Challenges and opportunities for progressing adaptation in Greater Manchester, as perceived by local stakeholders, are highlighted⁹.

Research in this theme explores policy frameworks¹⁰ and stakeholder networks underpinning the development and delivery of adaptation responses in Greater Manchester^{11,12}. In one report we focus on measures to strengthen the role of spatial planning as an adaptation response¹³.

Two 'risk-response' case studies look at the threat of flooding to the built environment (one of the main current climate risks)¹⁴ and heat stress to people and communities (a key future risk)¹⁵. The studies show that patterns of vulnerability, risk and exposure vary considerably across the conurbation, and provide a more detailed analysis of risks and adaptation measures at a neighbourhood scale. Research into the role of urban greening as an adaptation response for urban centres, and its perceptions by major stakeholders in the Oxford Road Corridor area of Manchester, is also reported¹⁶.

At a smaller scale, the adaptation of office buildings to weather and climate is explored. This includes a literature review of available physical and behavioural adaptation options¹⁷; an investigation into how the projected changes in climate and energy prices may affect expenditure on heating and cooling, and what adaptation measures are the most cost-effective¹⁸; and the analysis of the current use, and the perceptions affecting the potential future use, of physical and behavioural climate change adaptation measures in office buildings¹⁹.



Scenarios and futures

We need to recognise that just as the climate looks set to change significantly over the coming decades, so will urban areas. Changes to population characteristics, land use patterns and dominant economic sectors will influence how weather and climate events impact on the Greater Manchester conurbation. The development and implementation of adaptation responses will also be affected.

As part of the EcoCities project we have identified, with the help of stakeholders from Greater Manchester and beyond, some of the key drivers of change with the potential to affect the growth and development of the city over the coming decades²⁰. These include technological change, values and consumption patterns and the state of the economy. The drivers form the basis of two future scenarios for Greater Manchester, 'Upward Spiral' and 'Long Descent'²¹.

Scenarios provide a route into exploring how the conurbation may evolve. Taking a futures perspective raises critical questions around how Greater Manchester's capacity to adapt to the changing climate may shift over the coming decades. A land use modelling exercise, informed by the scenarios developed within EcoCities, maps different possible land use patterns for Greater Manchester to 2050. Their implications for adapting to climate change are considered²².

We must also be aware of the complexity of climate change impacts and adaptation responses. The case of flooding of buildings is looked at in detail in order to demonstrate this complexity²³.

This research is intended to help decision makers and interested stakeholders broaden the consideration of adaptation responses in Greater Manchester, and in other urban areas developing responses to the changing climate.

The EcoCities Spatial Portal

Central to all the work of EcoCities is the concept of building adaptive capacity. This involves helping cities to develop the skills, knowledge and expertise necessary to adapt to the impacts of climate change. The Spatial Portal can be used to support Greater Manchester in the process of planning for a changing climate.

The geographies of urban areas vary greatly, for example, in their local climate, land cover, population characteristics, and distribution of critical, social, and transport infrastructure. Such varying characteristics influence how areas will be affected by climate change, and shape the complexity of the spatial distribution of risks and vulnerability. The Spatial Portal is an interactive online mapping platform that displays spatial data and provides information to improve understanding of these issues in Greater Manchester, to facilitate climate change adaptation planning and decision-making, and aid spatially targeted climate adaptation responses.

The spatial data and information included in the Portal helps to build the evidence base available to decision makers and other stakeholders when developing climate change adaptation plans and strategies. The Spatial Portal enables all stakeholders, including community members, to visualise vulnerability, exposure and climate hazards within a particular location, thus raising awareness, aiding decision-making and facilitating community and stakeholder participation in formulating appropriate adaptation responses.

You can access the Spatial Portal through the Adapting Manchester website www.adaptingmanchester.co.uk.



Ready for change: working towards a collaborative adaptation approach for Greater Manchester

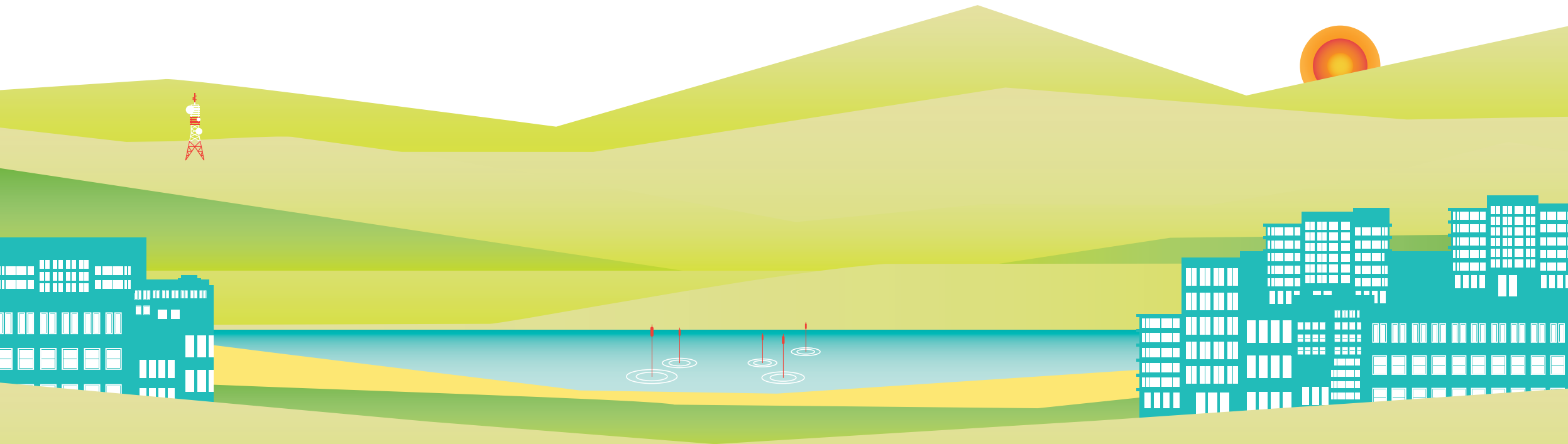
Adaptation to climate change is a 'live' policy debate in Greater Manchester and within other cities across the globe. Ongoing activities in urban areas include the preparation of adaptation strategies and, in some cases, the implementation of adaptation actions such as urban greening.

Research outputs on climate change impacts and adaptation responses can support decision makers in the public and private sector who are actively planning for urban growth and development. The merits of this science-policy linkage have emerged through recent collaboration between EcoCities researchers and decision makers developing the Manchester City Council and Greater Manchester climate change strategies. Decisions on the long term trajectory of the city can now be taken with a more comprehensive understanding of climate change. Looking more broadly, such insights can also be valuable for individuals and organisations wishing to learn more about and act upon the adaptation imperative.

A key area of opportunity for the adaptation agenda lies in developing closer networks between individuals and organisations responsible for supporting and developing adaptation strategies and guiding the implementation of adaptation actions 'on the ground.' Collaborative partnerships are needed to 'co-evolve' themes and projects, where possible targeting areas and issues of greatest local relevance. Policy makers, industry, civic groups and academics should ideally be engaged more closely in the assessment, design and implementation of adaptation responses. Options include developing a formal joint knowledge exchange unit. An example of this approach is the Institute for Sustainable Urban Development in Malmö, which links Malmö University and the City of Malmö with the aim of progressing sustainable urban development. This model moves universities beyond the preparation of capacity enhancing research outputs, into the process of supporting the development and application of adaptation strategies and actions in practice.

Aside from greater engagement with policy making audiences, it is crucial that research also connects with businesses, utilities companies and emergency service providers for example. Industry has a real imperative to adapt to a changing climate for reasons including maintaining competitiveness and protecting assets. There is also a strong civic dimension to adaptation, which is often missed. Climate change poses huge challenges to quality of life in urban areas, and it is vital that communities are made aware of these issues and engaged at the point of developing adaptation response.

Harking back to previous times, when city-states were the dominant global forces of commerce and innovation, Greater Manchester could be increasingly asked to co-operate with and compete against other major urban centres. As climate change looks set to be a key driving force for the future, a collaborative approach to developing responses to meet associated challenges and potential opportunities would seem to be an essential element of a competitive 21st Century city.



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We are keen to strengthen our links with related research initiatives and with public and private sector organisations in Greater Manchester and beyond. We would like to hear about work that you are undertaking in relation to climate change adaptation.

EcoCities is a joint initiative between the University of Manchester's School of Environment and Development and property company Bruntwood.

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www.adaptingmanchester.co.uk

