BRISTOL ONE CITY

One City Climate Strategy

A strategy for a carbon neutral, climate resilient Bristol by 2030

Foreword

From the One City Environmental Sustainability Board

We are facing a climate emergency. As a city we need to act now to reduce direct and indirect carbon emissions to net zero. We need to prepare and adapt to deal with the projected impacts of climate change.

In the One City Plan, Bristol committed to becoming **carbon neutral and climate resilient by 2030.**

To achieve this, over the next decade, we need to radically rethink how we live, work and invest in the city.

We also need action regionally, nationally and internationally.

This provides an opportunity to take a collaborative, inclusive and citywide approach to make this a fair transition.

As Bristol's Environmental Sustainability Board, we are proud to lead this transition for the city. Representing a range of organisations, we have come together to set out our shared vision in this strategy.

Given Bristol's strong history in delivering climate action, we are excited to work hand in hand across the city to continue to lead the way. We will move faster than the national average, learning with other cities on our journey.

This strategy sets the vision for where we need to be in 2030 based on sound science. We would like to thank our colleagues on Bristol's Advisory Committee on Climate Change for their review and challenge of the evidence for Bristol.

We recognise that achieving our vision will not be easy. There are entrenched market and wider forces that will support existing fossil-fuel dependent, consumption-based systems. We will need to show strong leadership to create opportunities for all to participate in the benefits of change with its costs shared fairly.

We have an exciting opportunity to address the challenge of climate change whilst also delivering new homes, reducing inequalities, creating a city with more green spaces, places for our children to play, cleaner air, jobs and opportunities for all.

Cities are complex places. We know that no single organisation, nor even the organisations that make up the Environmental Sustainability Board can deliver the scale and pace of change we need alone.

This strategy is a call to action.
We call on you, as people who live, work, visit and invest in Bristol, to join with us on this exciting decade of transformation.

We will engage widely to understand how we can work together to achieve the ambitions set out in this strategy. However, this does not mean that any organisation or individual should wait for a plan to be shared. This strategy gives the city a focus and direction and provides the framework within which we can each take responsibility and work together to transform the city.

Bristol's One City Environmental Sustainability Board, February 2020
https://www.bristolonecity.com/environment/the-environment-board/

Foreword

From the One City Environmental Sustainability Board

This strategy is:

- A strategy to set a shared vision for Bristol in 2030.
- Co-ordinated by Bristol's One City Environmental Sustainability Board, on behalf of the City Office and the One City Boards.
- A strategy for the city that will need the collaboration of multiple partners across the city to reach our city goals.
- Built on the currently available evidence base. There are gaps in understanding and more work will need to be undertaken over time.
- Integrated. It covers both direct and indirect carbon emissions as well as climate resilience.

This strategy is not:

- A delivery plan which details the exact route for the city to 2030. Detailed delivery plans will be developed and consulted on.
- Owned by any one organisation, such Bristol City Council. We will need people from across the city to meet its goals.
- Perfect. We are facing a climate emergency and we have developed this strategy at a pace commensurate with the challenge.
- Static. As the world around us evolves in terms of knowledge, legislation and policy, technology and the market, we will adapt to take advantage of these opportunities.

Environmental Sustainability Board

Executive summary

Bristol's climate vision

"In 2030, Bristol is **carbon neutral** and **climate resilient**. We have collectively achieved a fair and inclusive transition; capturing the opportunities of new jobs and investment, improved health, wellbeing and education, and a better environment for local people. We have helped lead the way to a safer global climate."

Introduction and approach

Bristol's Environmental Sustainability Board has come together to develop a One City Climate Strategy.

We are building on Bristol's challenges and opportunities, including the inequalities in the city, but also the existing climate action and the networks and knowledge in the city. However, in this strategy we are describing a step change.

We need urgent and transformative action in response to this complex, critical global challenge.

Bristol's strategy is built on a strong evidence base; setting a clear pathway to carbon neutrality for our direct emissions within Bristol. Our evidence helps us to start the journey for reducing our wider emissions and enhancing our resilience to future climate change. The challenge is huge, and we recognise that this is just the start. As our knowledge base grows, and as the world around us changes, we will adapt and evolve to deliver the best outcomes for the city.

Taking action on climate change presents a great opportunity for Bristol; supporting our One City Plan ambition to become **a fair, healthy and sustainable city. A city of hope and aspiration, where everyone can share in its success.**

Bristol's climate strategy

The action that is needed to achieve our ambition is complex and multi-faceted.

The strategy details ten key areas where climate action is needed to achieve the vision for Bristol in 2030. Across each of these, we need action at every level. These are:

1. Transport: switching to significantly more walking, cycling and zero carbon public transport modes; converting the remaining vehicles to zero carbon fuels; transforming freight, aviation and shipping

2. Buildings: retrofitting and building them to become carbon neutral and resilient to a changing climate, calling on central government to develop a supportive planning framework to deliver this

3. Heat decarbonisation: implementing a carbon neutral energy method for heating and hot water. This is one of the areas that will be supported by City Leap Energy Partnership, a radical new approach to delivering energy infrastructure in Bristol

4. Electricity: make our electricity use as smart and flexible as possible (to support electricity decarbonisation nationally), maximise local renewable energy generation and increase system resilience

5. Consumption and waste: responsible buying of goods and services, alongside zero carbon from waste management

6. Business and the economy: Bristol businesses move to be carbon neutral and climate resilient, capturing job opportunities for all through the transition

7. Public, voluntary, community and social enterprise services: carbon neutral public and VCSE services and supply chains that are also prepared for future climate conditions and hazards

Executive summary

8. Natural environment: restoring, protecting and enhancing these spaces and wildlife within them as the climate continues to change

9. Food: a resilient supply chain, with food and drink produced locally, sustainably and moving to a more plant-based diet

10. Infrastructure interdependencies: collaboration in running vital services to the city such as water, transport, waste, ICT and energy to improve their climate resilience and embed carbon neutrality across different systems.

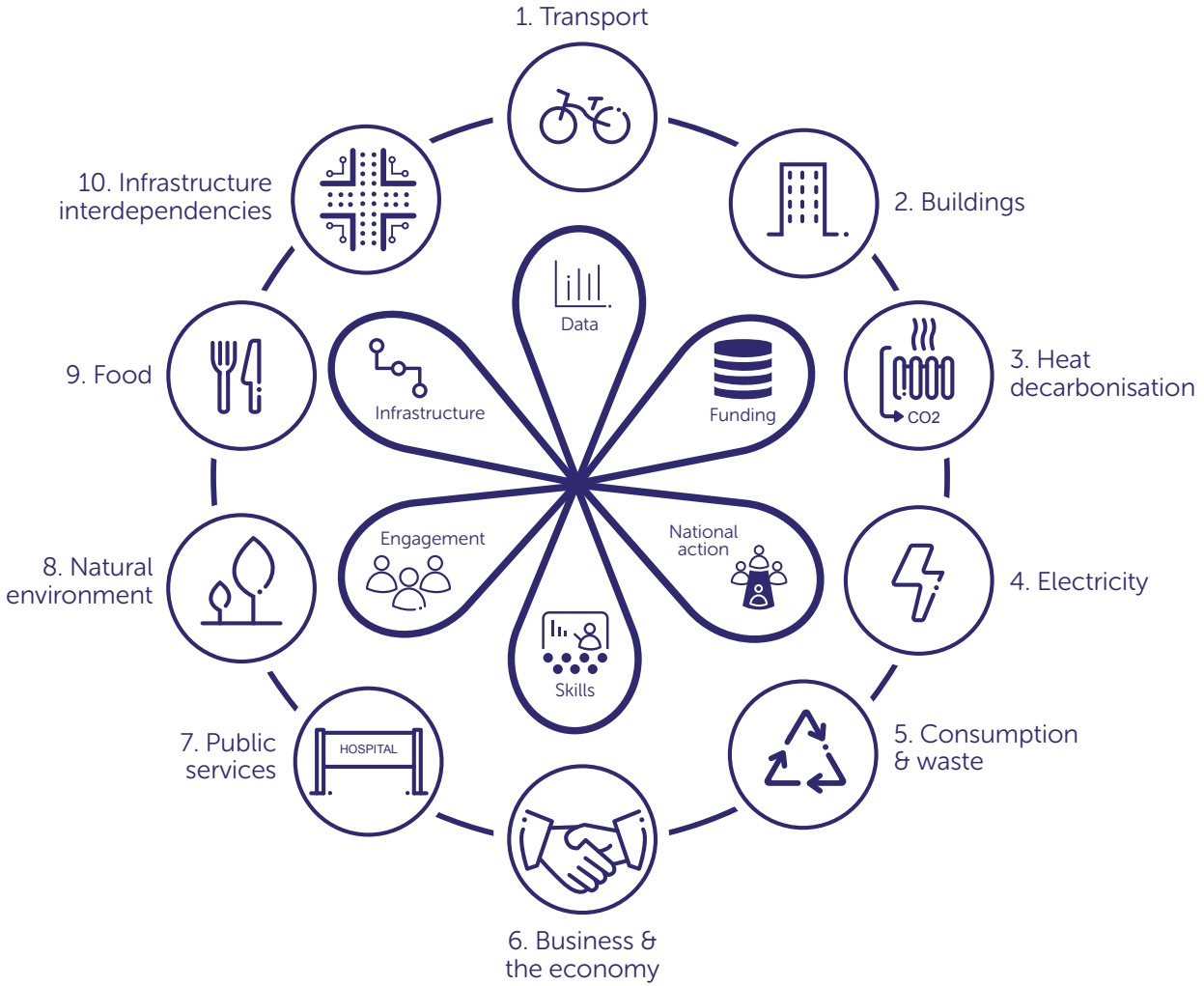
Across all these key areas there will need to be the skills, funding, national action and local leadership, data, infrastructure and engagement to enable the action to happen. Radical system changes will be required across all of these areas, at every level.

Delivery, monitoring and review

This strategy is for all of us to deliver, and nobody need wait for permission to take action.

However, in recognition that we need co-ordinated action in some areas to deliver the scale of change required, the City Office and the Environmental Sustainability Board will take the lead in co-ordinating the development of delivery plans and a clear framework for monitoring and review.

Work has already started, so we will hit the ground running. We will engage widely, and work with a wide range of organisations, community groups and individuals to transform Bristol.



Contents

1. **Vision and principles:** The vision and principles that inform and guide our strategy.
2. **Introduction and approach:** Setting out our approach and evidence base.
3. **Challenges and opportunities for Bristol:** Setting out the context that this strategy will be delivered in; our city of passion and paradoxes.
4. **Our climate strategy:** An overview of the strategy's structure.
   4a. Enabling conditions for change: The radical system changes that we need to deliver our strategy.
   4b. Delivery themes: The key areas where climate action is required in the city.
5. **Monitoring and review:** Our approach to monitoring and review of the strategy.
6. **Delivery:** Our initial approach to planning and implementation for this decade of transformation.

1. Vision and principles

Bristol's climate vision

In 2030, Bristol is **carbon neutral** and **climate resilient**. We have collectively achieved a fair and inclusive transition; capturing the opportunities of new jobs and investment, improved health, wellbeing and education, and a better environment for local people. We have helped lead the way to a safer global climate.

This vision is supported by a number of key principles:

Achieving a just transition is central to our strategy and critical to it achieving successful outcomes. This means maintaining a democratic mandate, ensuring there are opportunities for all to participate in the benefits of change with its costs shared fairly.

We are all partners with rights and responsibilities to deliver this strategy for Bristol, working inclusively and collaboratively within the city, as well as across boundaries. Good communication will be central to effective collaboration.

Bristol will be a global leader for rapid and radical city action to address the climate emergency, taking the initiative to create conditions for success and supporting others on their journey. We will embrace the opportunities that come with being a first-mover in the UK and influence the national and international agenda.

This strategy will evolve as we deliver it, learning as we go and sharing that learning within the city, building adaptive capacity, innovating and learning with other cities and regions and adapting as conditions change.

Our strategy will build on robust evidence from leading science and by harnessing collective intelligence within the city to understand how systems are performing. We recognise the global goal for the world to limit warming to 1.5°C, and acknowledge our responsibility to act.

2. Introduction and approach

Global warming and climate change present us with an urgent challenge we need to address. To solve this challenge there is the opportunity to take a collaborative city-wide approach to make transformational change.

As the Environmental Sustainability Board we have developed this strategy with partners, based on robust evidence.

We are facing a climate and ecological emergency

Human activities are estimated to have caused 1°C of global warming above pre-industrial levels. We are already seeing devastating impacts of 1°C warming; this is expected to get worse. The science on the climate emergency is clear; we need urgent action to reduce our carbon emissions to limit global temperature rise to below 1.5°C, and so prevent disastrous impacts. We also need to prepare for a changing climate.

Global warming has already impacted natural and human systems through increased flooding, devastating wildfires, storms, loss of biodiversity and extreme drought.

Climate related risks to the environment, health, livelihoods, food security, raw materials, water supply and economic growth will rise, even if we manage to limit change to 1.5°C and will be felt differently in different regions. Populations most at risk are marginalised, disadvantaged and vulnerable. In Bristol, some of our most deprived wards will be the most vulnerable to the impacts of climate change, including areas like Lawrence Hill, where flood risk is also higher.

We urgently need to transform

We are facing twin emergencies: a climate emergency and an ecological emergency.

In addition to the climate emergency, we are also experiencing unprecedented global change due to land and sea use change, direct exploitation of species, pollution and invasive alien species. Human actions threaten more species with global extinction than ever before with the sixth mass extinction already underway.

This strategy provides a way forward for Bristol to respond to the climate emergency. We explore opportunities to maximise benefits to the ecological emergency, but a full response will be developed separately.

This is a climate strategy for Bristol to respond to both:

- **Mitigation:** the causes of climate change e.g. reducing greenhouse gas emissions and improving carbon sinks; and
- **Adaptation:** addressing the potential impacts of climate change e.g. actions to adapt to floods, storms or heatwaves and ongoing stresses such as sea level rise and increasing urban heat.

It is essential that we address both climate mitigation and adaptation together as an integrated response as no single option is sufficient by itself. Integrated consideration of adaptation and mitigation will allow us to identify interdependencies, be more efficient and minimise risk.

The world is rapidly changing and there is uncertainty over what the future will look like. Climate change is likely to impact the city directly though local extreme weather events and through changes further afield which may impact the city indirectly by impacting the economy and the supply of goods and services, such as food or public services.

We need to plan for, adapt and build our resilience for projected future risk in a way that provides wider co-benefits so that, no matter what the future looks like, our city will be better for our citizens. This plan is for 2030 when we aim to have the plans and mitigation in place or in progress to make us resilient for events that will occur in 2030 and well beyond.

2. Introduction and approach

Taking this integrated approach will enable our climate action to support Bristol's wider goal, set out in the One City Plan, of becoming **a fair, healthy and sustainable city. A city of hope and aspiration, where everyone can share in its success.**

An integrated approach to delivering our One City Climate Strategy will enable us to achieve so much more for Bristol than simply achieving carbon neutrality and climate resilience.

Working together as a city, we can achieve a future that delivers improvements in public health, reduced costs for public services, improved air quality, reduced congestion, reduced inequalities and reduced poverty, increases in job and economic opportunities across society, greater community engagement, improved biodiversity alongside wider environmental benefits such as soil and water quality, and more.

This will require us, as the Environmental Sustainability Board, to work closely with the Housing Board, the Health and Wellbeing Board, the Learning and Skills Board, the Economy Board and the Transport Board, as well as with a wide range of others across the city. We are committed to doing this, as we recognise the opportunity that tackling the climate emergency brings to tackle many more challenges in the city. It will also require others to step up and take action across the city.

2. Introduction and approach

Developing this strategy

Bristol's One City Approach brings together a wide range of public, private, and third sector partners within Bristol.

As part of this approach, six boards have been set up to provide leadership on key themes. As the Environmental Sustainability Board, we have led the development of this strategy, engaging with all of the other five boards, recognising the cross-cutting nature of the challenge we face.

All of the underpinning evidence to inform this strategy has been developed with advice and challenge from the Bristol Advisory Committee on Climate Change. This evidence is explained in more detail in the remainder of this section.

We recognise that evidence is not fixed. As this evidence base evolves and we gain new learning, we will use this knowledge to overcome challenges and respond to new opportunities that arise as we implement this strategy together.

We will continue to have an open dialogue and engage with individuals, households, organisations and businesses over the coming decade.

This strategy sets the direction of travel for Bristol as a city. A number of detailed delivery plans will be developed and work has already started on these.

As we explore in section 3, we are not starting from scratch, there is wealth of activity in the city that is already underway to support the journey towards our vision. Businesses, organisations, communities and individuals will need to work hand in hand to deliver a step change in terms of scale and pace of action.

We have engaged with over 300 people in the development of this strategy.

2. Introduction and approach

Engagement

Initial engagement has already commenced. This is a One City Climate Strategy; its development has been steered by the Environmental Sustainability Board, with input from each of the other five One City Boards, supported by the Bristol Advisory Committee on Climate Change.

The strategy has also been influenced by engagement with businesses, organisations, charities and people from across the city.

This has comprised both 1-1 dialogue, and two major workshops for approximately 300 people.

The strategy will be delivered by organisations, communities and individuals working together. The engagement and collaboration is just the start of what is needed. We will continue to have an open dialogue and engage with individuals, households, organisations and businesses over the coming decade.

The evidence base

To develop the One City Climate Strategy, we commissioned evidence-based reports on reducing greenhouse gas emissions and on improving our resilience to the impacts of a changing climate.

The five studies that inform this strategy are:

1. **A scope 1 and 2 baseline and gap analysis.** This sets out the baseline, historic trends, as well as the trajectory from actions that are already planned or in place and the trajectory to meet the UK national net zero target by 2050.
2. **Total business emissions study.** This was an assessment of scope 1, 2 and 3 emissions associated with business activities in Bristol. It is based on the UK total scaled down according to Gross Value Added of industry sectors in Bristol.
3. **Household consumption emissions study.** This was a study, based on expenditure, of direct (in city) and indirect (out of city) emissions associated with the production of goods and services consumed within households in Bristol.
4. **Net zero by 2030 scope 1 and 2 study.** This study provides a detailed look at emissions from Bristol's use of energy, transport and waste management in the city and actions needed to get to net zero by 2030.
5. **Preliminary climate resilience study.** This comprised a high-level analysis of the city's hazard exposure along with addressing vulnerability of the city's key physical, social and economic assets to physical climate risk.

The climate mitigation evidence base is made up of four reports. Studies 1-3 work to establish a baseline of current emissions in Bristol. This includes the direct emissions from energy, transport and waste in the city (scope 1 and 2) and consumption-based emissions from the supply of goods and services from the wider world, such as food, clothing, electronics and surface and air travel (scope 3).

Building on the baseline in study 1, study 4 analyses the scale and nature of changes needed in the city to reach net zero scope 1 and 2 emissions by 2030. It details the conditions required to secure those changes, and outlines the actions likely to be required to create these conditions.

Studies 3 and 4 highlight the scale of the challenge for Bristol to achieve carbon neutrality. We will need economies all over the world to decarbonise at the same speed as we reduce our own direct emissions in Bristol. This will be challenging, but we can use our buying power to effect change, and demonstrate what is possible by reducing our own emissions.

2. Introduction and approach

This evidence is described in more detail in the sections that follow.

The findings of this evidence base have fed into this One City Climate Strategy. The evidence base has been reviewed by the independent Bristol Advisory Committee on Climate Change (BACCC), who note:

"The BACCC welcomes the development of a One City Climate Strategy, which sets out an ambitious plan to try to achieve the goal of Bristol being carbon neutral and climate resilient by 2030.

The Committee understands that decarbonisation and adapting to climate change will not be easy, and welcomes this important first step. In line with the requirements of a climate emergency, these reports have been developed rapidly and with limited resources, with the intention of catalysing urgent action. As such it provides a good evidence base from which to get started, whilst recognising that in some areas more evidence is needed, and this should be brought in to decision-making as it becomes available. The focus should now shift to developing the urgent next steps that are needed in areas like transport and heating.

The BACCC looks forward to continuing to work with local government and city partners and to advise on the development of the evidence base and delivery plans in order to help the city achieve its climate change ambitions."

2. Introduction and approach

Greenhouse gas emissions baseline

The evidence base provided in studies 1-3 provide a baseline assessment of greenhouse gas emissions for Bristol. Each of the three studies overlaps with one another to provide a picture of Bristol's emissions in full. A high-level summary of the results from each study is given below.

1. A scope 1 and 2 baseline and gap analysis and 4. Net zero by 2030 scope 1 and 2 study

According to this study, direct energy use, transport and waste management emissions in the city totalled ~1,600ktCO_2e in 2017. This baseline does not include the value chain emissions of these activities and does not cover land use, agriculture, and forestry, which are defined as scope 1 emissions sources Greenhouse Gas Protocol for Cities.

The study identifies that the evaluated direct emissions have decreased by 36% since 2005. However, to reach the city's target of a carbon neutral 2030, the rate of reduction will need to be 1.6 times that of the previously observed rate.

2. Total business emissions study

In a study of business related emissions in Bristol, scope 1, 2 and 3 emissions in 2016 totalled ~5,000ktCO_2e. The study identified that approximately half of all Bristol business related emissions originate in supply chain activities. As such, in order to reach the carbon neutral 2030 target, we would need economies all over the world to decarbonise at the same speed as we reduce our own direct emissions in Bristol. This will be challenging, but significant attention must be paid to reducing the value chain emissions of economic activity in the city.

Production (predominantly generation of energy), manufacturing, distribution and the provision of public services account for 82% of Bristol's business and economy footprint. Service based sectors such as finance, real estate and consultancy account for much smaller proportions of the city's business emissions.

Public services account for 14% of emissions, providing a great opportunity for public sector leadership.

3. Household consumption emissions study

This study established that in 2016, the household consumption of goods and services by citizens of Bristol resulted in approximately 4,000ktCO_2e of greenhouse gas emissions. This study takes into account the supply chain emissions of all goods and services consumed as well as any direct emissions associated with their consumption. The methodology followed is aligned with the assessment of business emissions.

Of this footprint, energy consumption, personal vehicle use, and the production of food and drink account for the highest proportion of emissions at 27%, 20% and 14% respectively.

2. Introduction and approach

5. Preliminary climate resilience assessment

In the preliminary climate resilience assessment, an evidence base was gathered on physical climate risk, based on an initial understanding of:

- Climate hazard exposure, and how this is projected to change in the coming decades on the basis of the best climate science;
- The sensitivity of the physical, social, environmental and economic systems in Bristol to these hazards; and
- Adaptive capacity, which is the ability of systems, organisations or people to adjust to events, respond to consequences or take advantage of opportunities.

Climate change is a complex challenge. We recognise the interconnected and global nature of the world, which exposes Bristol to potentially catastrophic climate risks arising well beyond the city's boundary. This evidence base was mainly focused on the projected local impacts within our city boundaries.

Climate hazards

The future climate is not certain, and we should be planning for a range of different emissions scenarios. Whilst this is a strategy setting a pathway to 2030, we recognise the need to look further into the future to consider the potential climate hazards we face if we don't take action now. Looking out to 2080, when today's school children will be reaching retirement, we can set ourselves on course for a more resilient future. Most infrastructure lasts for decades, if not hundreds of years, so investment decisions made in 2030, will still be being felt in 2080.

Under a high emissions scenario, by 2080, Bristol could expect to see:

Sea level on Bristol's coastline is projected to increase by up to

+72cm

Winter precipitation rate is projected to increase by up to

48%

Summer maximum temperature is projected to increase by over

+9°C

By 2080, summer precipitation rate in Bristol is projected to decrease by up to

68%

There is projected to be a reduction in likelihood of other hazards, such as extreme cold. However, we need to make sure we are still prepared for them.

Physical, social and economic impacts of extreme weather

The climate hazards identified here could have very serious impacts for the people of Bristol.

Of each of the climate hazards, we understand the spatial distribution of flooding best, and therefore the potential physical impacts are clearer.

We know that there are risks to homes, businesses, schools, community assets, and critical infrastructure (including, for example Temple Meads station), causing impacts to livelihoods, disruptions to our daily lives and a risk to life. These impacts will get progressively worse to 2080.

Whilst we know less about the spatial distribution of extreme heat and drought, we know that the physical impacts can be serious.

The potential impacts to our people and public services are wide ranging. We can learn and adapt from events such as the 2003 heatwave in Europe, where hundreds died.

Our food system is at risk of shortages of supply and increased costs, particularly given the global nature of the supply chain.

Our wider economic supply chain is also at risk, with clothes and electronic equipment, being the other areas particularly at risk.

This evidence base is part of the foundations of this climate strategy.

3. Challenges and opportunities for Bristol

Introduction

Bristol is a city of paradoxes. It is a city leading in many areas of climate action, but not everyone is yet engaged. Bristol was the first UK city to develop a climate strategy in 2004, and since then the city has been a leader in the UK and Europe delivering on progressively more ambitious targets. As the first European Green Capital in 2015 and the UK's first council to declare a climate emergency in 2018, Bristol is a leading voice in the response to climate change.

People of Bristol are increasingly concerned about climate change (88% reported being concerned or very concerned in 2019, a continuing upward trend).

Our city

Bristol is a place where an increasing number of people want to live, work and study. Bristol's population is increasing at a higher rate than other similar UK cities with its wealth of culture, creativity and easy access to other places appealing to many.

Bristol is a truly global city; home to a mix of cultures and ideas, with at least 91 different languages spoken.

Bristol is the only one of ten major cities outside London to be a net contributor to the UK treasury. However, Bristol remains a city of contrasts; some of the most affluent areas border some of the most deprived. Economic success has also created problems such as transport congestion, environmental pollution and increasing house prices. Contrasts are seen in levels of fuel poverty, with an estimated 20,709 fuel poor households in Bristol, 10.8% of all households.

Housing affordability and provision remains a challenge for Bristol. This has been seen through rising homelessness and a lack of public resources to address deprivation. Alongside the delivery of new homes for Bristol is a need for these homes to be part of thriving and safe communities.

Transport remains an area of concern, with 77% of people in Bristol concerned about congestion and air quality. However, 57,000 people walk or cycle to work, and the number of people cycling to work in Bristol increased by 64% between 2011 (15,800) and 2018 (25,900).

In 2018, the Low Carbon Environmental Goods and Services sector supported about 14,000 employee jobs in Bristol and about 37,000 in the West of England.

We are seeing increases in action at a personal level as a result of concern about climate change. People are reducing waste (69%), reducing energy use (57%) and flying less (25%).

Bristol's leading ambition

In order for the world to achieve our climate targets there is need for frontrunners in climate action. Bristol is excited to be pioneering the response to this challenge.

The UK has set in law the need to transition to carbon neutrality by 2050. In order to achieve this, parts of the country will need to lead the way, enabling time for other places to learn and evolve. Bristol is well-placed to lead.

3. Challenges and opportunities for Bristol

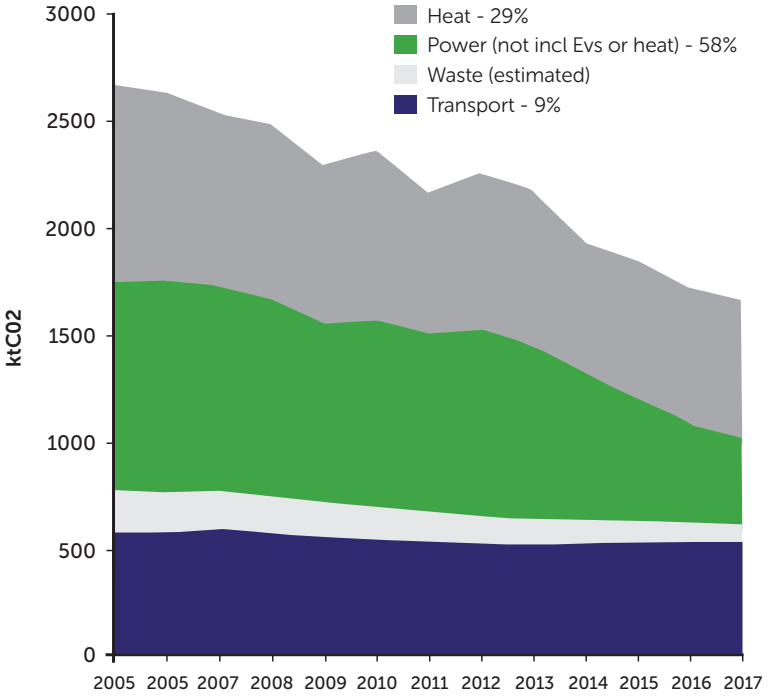
Bristol City Council (BCC), supported by political leadership from all parties, was the first UK local authority to declare a climate emergency for the city on 13th November 2018. A number of institutions in the city have followed, including (but not limited to) the University of Bristol, the Diocese of Bristol, North Bristol NHS Trust and University Hospitals Bristol NHS Foundation, We the Curious, the University of the West of England, the Watershed, Bristol Old Vic and Colston Hall.

The 2020 One City Plan sets out an ambitious goal of making Bristol carbon neutral and climate resilient by 2030. This is set in the wider context of our wider objectives, leading us to an ambition for a fair and inclusive transition that does not marginalise disadvantaged communities or leave people behind.

Bristol recognises, and is proud to play our role in minimising the impact of climate change on the most marginalised and vulnerable communities in Bristol and globally. We will do this through emissions reductions, minimising the impacts of climate change and supporting and providing security to those most affected.

Building on our success

We've already started on a journey to reduce emissions; since 2005, carbon emissions from energy, waste and transport in the city have decreased by 36%.



Bristol's direct emissions between 2005 and 2017

3. Challenges and opportunities for Bristol

History of climate action in Bristol

Bristol is an exciting and creative city with a range of organisations and individuals working towards improving our resilience and supporting carbon reduction.

It is therefore impossible to summarise the breadth and depth of this activity succinctly. We have undoubtedly left exciting and important organisations and initiatives out of this summary.

It will be important that we capitalise on this commitment and diversity, and continue to enable activity to flourish.

Knowledge and capacity

Bristol has one of the largest environmental networks of its kind - Bristol Green Capital Partnership - capturing over 900 organisations from across sectors. The Bristol Natural History Consortium (BNHC) reflects the fact that the BBC's natural history unit is in Bristol. Indeed, we have a long history of organisations based in the city with clear remits to improve our environment, such as Sustrans, the Soil Association, the Environment Agency headquarters and the Centre for Sustainable Energy.

We have a thriving Low Carbon Environmental Goods and Services sector, and a wider business sector engaged in tackling climate change.

We have two leading universities, leading in many areas of research and education to support climate action.

Past action and future commitments

A wide range of renewable energy projects have been delivered since 2005. For example, Bristol City Council has installed over 8MW solar and 8MW wind and Bristol Energy Co-operative has installed over 9MW solar. Heat networks have been installed in Bristol City Centre.

Since declaring climate emergencies through 2018/2019, we've seen organisations building on the range of actions they already had underway. One of the most visible has been We The Curious science museum's commitment to no longer having an outdoor ice rink over the winter season.

We've seen miles of cycle infrastructure built and improved, we've seen bus patronage go up significantly. From a low base in 2011, Bristol is now in the top ten cities for bus use in the UK.

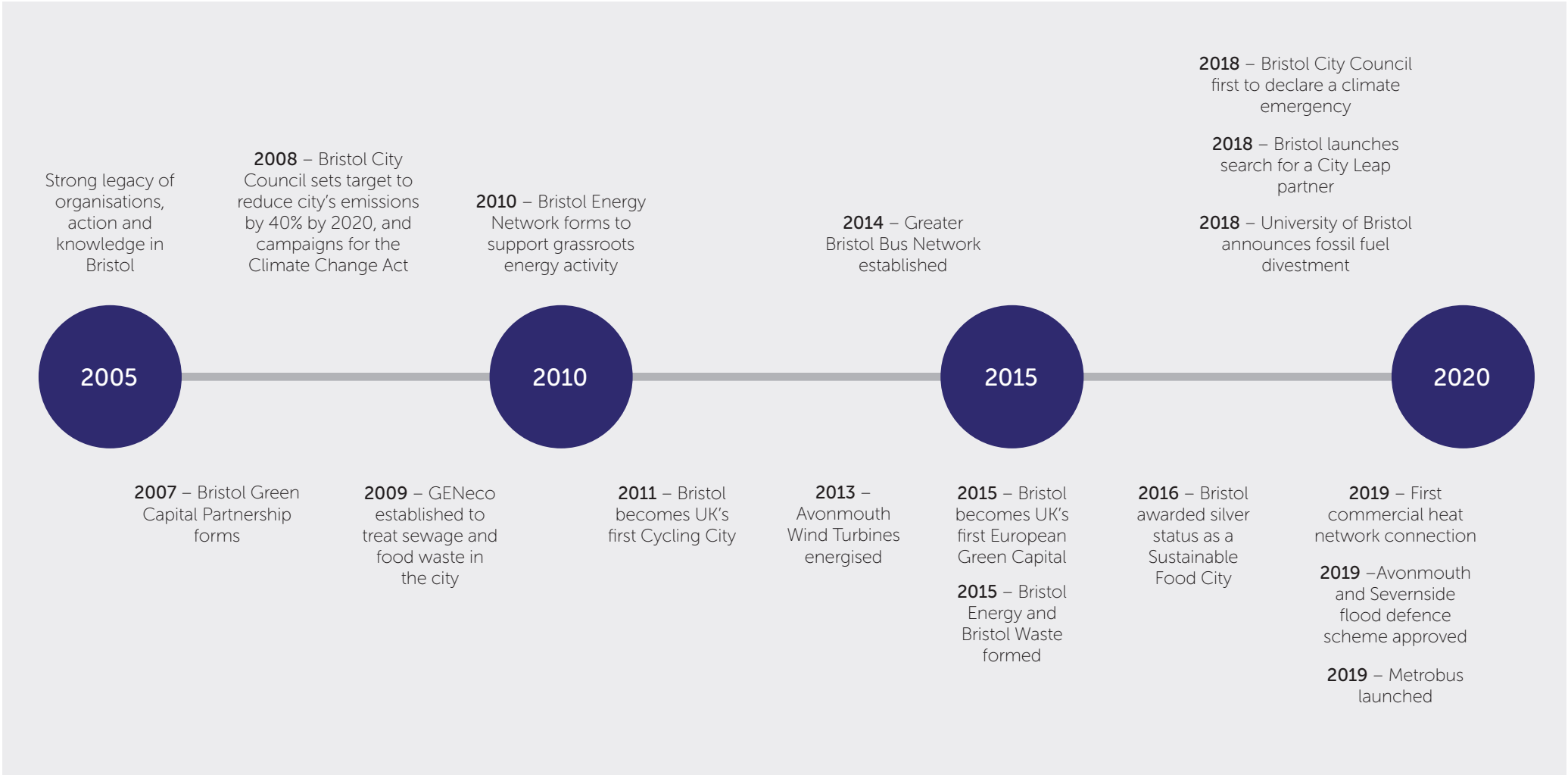
Sustainable Urban Drainage Systems (SuDS) schemes have been delivered to reduce local flood risk, such as in Embleton Road in Southmead. Similarly, Bristol City Council's gully maintenance programme has delivered significant benefits.

A range of collaborative research and development projects have been delivered, such as REPLICATE, SoLa Bristol, and 3EHouses, providing an understanding of the potential for new approaches to be adopted.

A range of community engagement projects have been delivered, from Green and Black Ambassadors, Healthy Planet Bristol, Community Places of Safety and many more.

One of the most significant future committed actions is the development of Bristol City Leap Energy Partnership. Bristol City Council is seeking one or more Joint Venture partners for a radical new approach to delivering energy infrastructure in the city. We expect this to deliver significant investment for Bristol over the coming decade.

3. Challenges and opportunities for Bristol



4. Our climate strategy

Introducing the strategy

Our climate strategy has been developed with our vision and principles informing and guiding all of our activity.

We have set out ten delivery themes for Bristol to deliver our vision (shown around the outside of the graphic).

These represent our collective commitment to capture the opportunity and respond to the challenge of reaching our ambition to be carbon neutral and climate resilient by 2030.

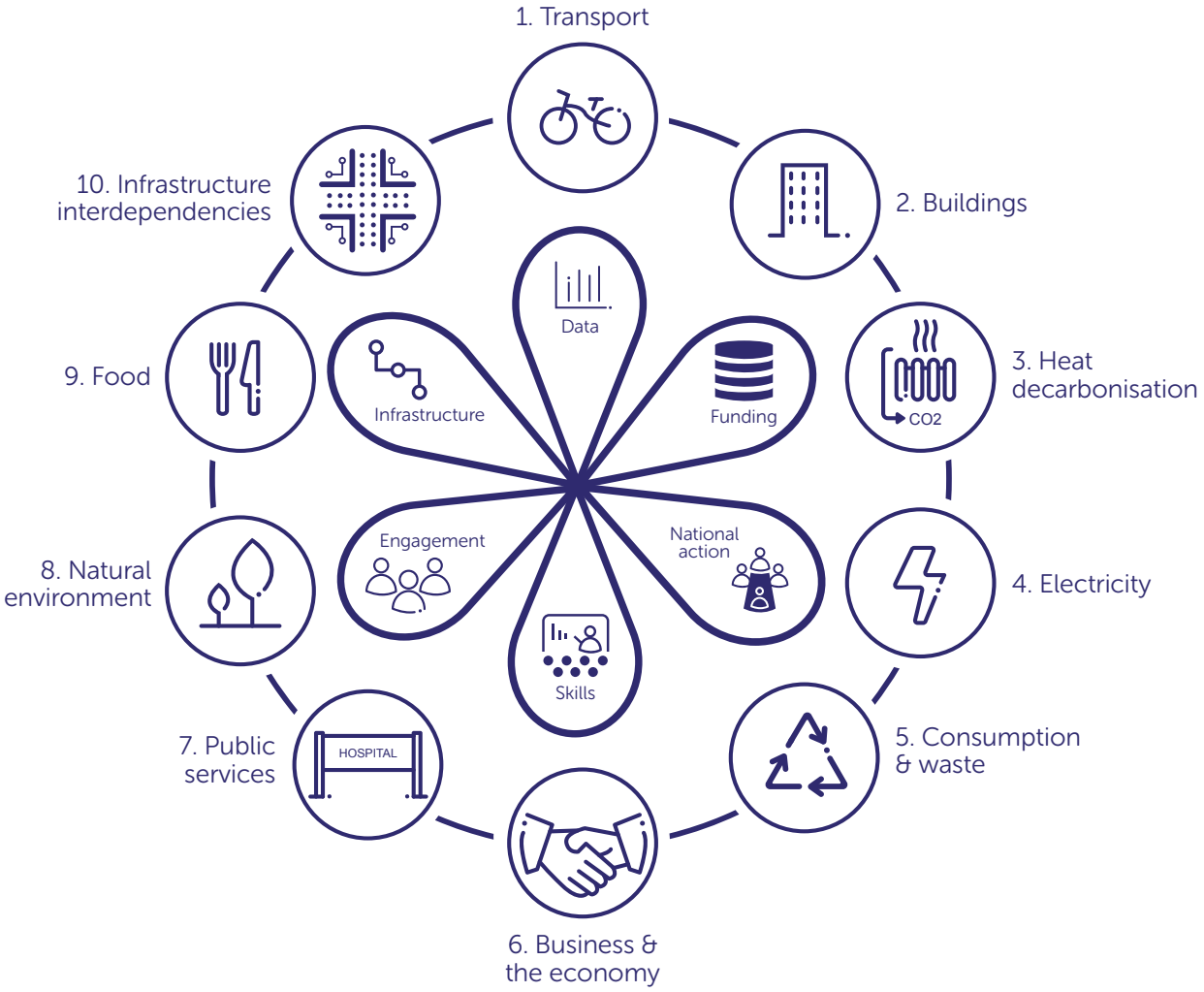
The strategy sets out our goals for 2030 in each of these themes. These are supported by 2030 objectives.

The scale of change required to achieve our vision is not to be underestimated. Some fundamental system changes will be required, within Bristol and beyond, in order to enable delivery of our plan. We've described these as "enabling conditions for change"; cross-cutting changes that will be required (shown on the inside of the graphic).

Moving to action

Time is short, our 2030 deadline means that we need careful planning to get us much right the first time as possible. This strategy is designed to enable us to do that. Having a shared vision for the city, means that we can all be working towards the same goals. As the Environmental Sustainability Board, we can work to reinforce mechanisms to enable change, and unblock some of the major barriers to change.

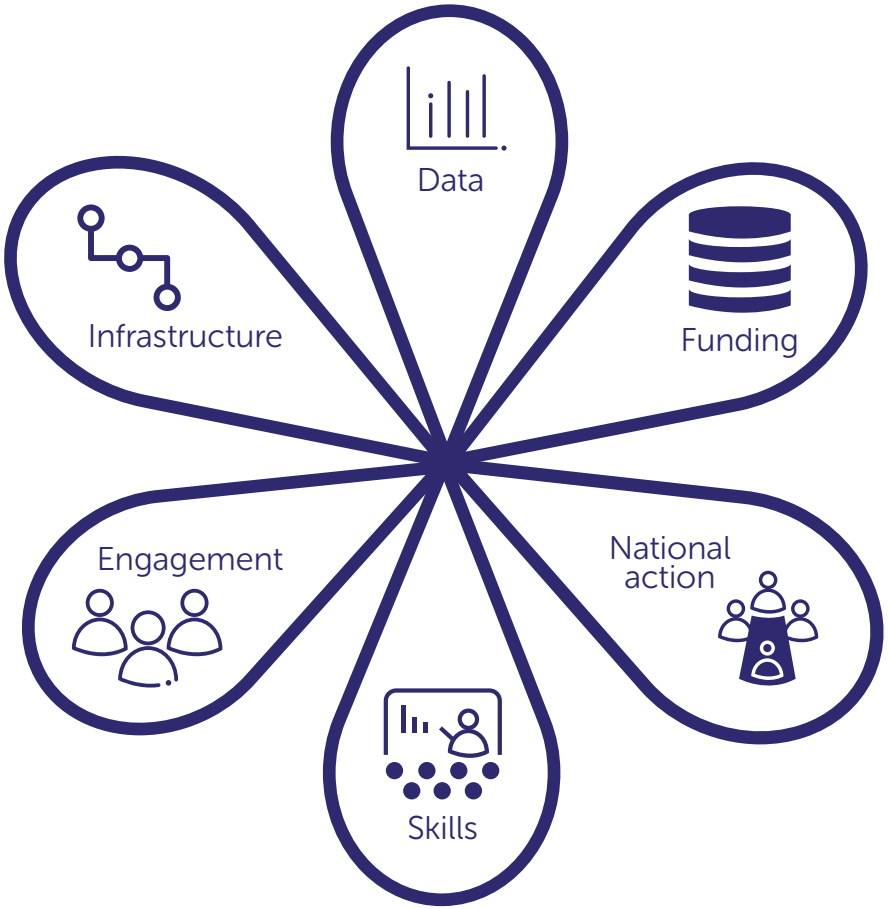
However, the pace and scale of change required also means that we need action by others to continue and scale up. We pledge not get in the way of that.



4a. Enabling conditions for change

The pace and scale of change for us to deliver our vision by 2030 requires fundamental and radical changes to the way that we currently work as a city.

We know that there are some cross-cutting changes that will be required for us to deliver across each of the ten delivery themes. Six enabling conditions for change have been identified that will support us to achieve our delivery themes.



Enabling conditions for change
Engagement, culture and inclusion

Why

The people of Bristol are concerned about climate change, in fact the majority are very concerned. This is why this strategy has been developed.

Many people are already taking action as individuals and communities, and they support changes to the city which would help them to reduce carbon emissions, such as better public transport. However, this strategy demonstrates the scale, pace and breadth of change needed.

To enable this change, we need all our citizens and communities to create, shape and be part of the city transformation. Citizens should be connected, feel empowered and able to influence the future of the city, so that all individuals have the tools, capacity and the opportunity to thrive.

To deliver a fair transition, we need to make sure that unintended negative consequences are quickly identified and minimised or avoided entirely so that change is accessible and possible for all.

What

We will all (people who live, work and play in the city) be involved in city planning, decision making and delivery of climate action. We know that different people and community groups have different needs which need to be heard and addressed.

We will engage to develop a shared understanding and language on what climate change means for the city and a shared commitment to the climate action that we need to take.

We need an improved citywide understanding of carbon emission reduction targets and the potential hazards that can impact citizens at a personal, neighbourhood and community level to support everyone to be an active part of this transition. Community climate action is a key part of this transformation and all citizens have the opportunity to make this happen.

Next steps

- In order to support and enable further citizen action, development of a communication and engagement plan with buy-in from all delivery partners, to include effective participation mechanisms.
- The development of delivery plans to ensure that the perspectives of a range of equalities groups are incorporated (in line with protected characteristics described in the Equalities Act). We will also develop approaches to engage with harder to reach communities, this could be through culture, music, dance and sport.
- City engagement on how climate change is affecting Bristol now and what a future emission scenarios would actually look like. Using this to explore steps to take to reduce carbon emissions and adapt to climate change to build community resilience.
- Working with all partners who have declared, or want to declare, a climate emergency or made public climate change commitments to support them to develop delivery plans.

Enabling conditions for change
Funding and finance

Why

To achieve the transformational change set out in this strategy, we will need long-term financial resources. We need to build carbon neutral energy, transport and waste systems and to make the city resilient to the impacts of climate change. It has been estimated that carbon neutral heating systems for the city will require £3 billion over the decade and substantial investment will be needed in sustainable transport. Some of this investment is already being made but we need to increase the scale and pace, and redirect existing finance to carbon neutral and climate resilient projects.

We need to use our purchasing power and investment activity as a city, recognising that over 50% of our emissions come through supply chains outside the city. We have the ability to support other places in undergoing a similar transformation to that planned in Bristol.

What

We need investment to deliver action. It is crucial that we think about more innovative and collaborative ways to finance climate action. This will be made possible through:

- Government, at all levels, redirecting and increasing long-term investment to support initiatives such as sustainable transport. Ensuring that decision-making processes and the length of budgetary cycles support investment needed;
- Private sector, investment funding, new business models and public private partnerships, including the City Leap Energy Partnership;
- Embedding carbon neutral and resilient infrastructure planning in investment, operational and regulatory cycles and decision-making. This will include working with regulators to change regulatory frameworks;
- New financing approaches such as Green Bonds, crowdsourcing and more;
- Growing the ability to raise local investment through charging levies, business rates etc;
- Addressing high risk shortfalls in capital and revenue budgets which could undermine our resilience, and;
- Incentivising action through procurement and supply chains.

Local government needs support to plan for the long-term, with certain long-term finance, rather than the yearly bidding cycles to central government.

The decisions individuals make will also have an impact on investment. Citizens' personal expenditure, and the choices they make about what they buy and invest in can help to drive change.

Investment assessment mechanisms need to have a firm policy basis to support new approaches. This will need to include new accounting approaches to clearly value wider benefits, such as carbon reduction and climate resilience, rather than just taking a traditional cost-benefit approach.

Expenditure in carbon reduction can often deliver direct savings. We need to take advantage of identifying and re-investing money saved.

We also need to be financially resilient, this includes being able to provide suitable investment to be able to bounce back after major events, and provide emergency services with the resources to support this.

Next steps

- In establishing City Leap Energy Partnership, Bristol City Council will form an ambitious joint venture partnership to bring investment to help transform the city's energy system.
- Quantification of the cost and benefits of preparing for climate hazards and the carbon neutral economy in Bristol to support the economic viability and stimulate investment for climate adaptation and climate mitigation interventions.
- Consideration of opportunities for an investment or trading platform to lever investment into climate action for community groups.

Enabling conditions for change
National and regional action and city leadership

Why

To have rapid and radical transformational action we will need to reshape governance systems and distribute powers appropriately. Current UK legislation and policy will not enable Bristol to become a carbon neutral and climate resilient city. We need to work with the UK government to help them create the right laws and policies and to devolve powers and freedoms to the regional and city level.

We will need to build on existing effective local, regional and national laws, regulations, policies and plans. We will also need to engage stakeholders and connect decision-makers with citizens, business owners and third sector representatives to make change happen.

What

We need long-term commitment from local, national and regional government to support, fund and accelerate the delivery of our goals. The city will also need further devolved powers to implement new polices and plans. To support this local government will need longer-term central funding to allow the city to invest and plan for the long-term, looking to 2030 and beyond. We will continue to work with other major cities and other partners to make the case for change.

We need to have supportive urban planning frameworks, to encourage and prioritise development that meets our climate goals and embed climate mitigation and adaptation as a central part of design.

To achieve a just transition and make change affordable for all we will need systemic market changes. This will require the city to lobby central government to address market failures, barriers to change and initiate a market shift in favour of climate mitigation and adaptation interventions.

Regulators and regulatory frameworks will need to support positive change and restrict further action that works against the climate vision through updated guidance and requirements from the bodies they regulate.

We will continue our collaborative approach to city leadership, using our convening power as the One City Environmental Sustainability Board to encourage other stakeholders to join with us on this journey.

Next steps

- Joint articulation with central Government on the role they have to play in enabling conditions for change, taking advantage of established city networks.
- Working to influence the national planning system to reflect the scale of change required.
- Working with other cities ahead of the UN climate talks in Glasgow November 2020 around planning, regulation, legislation and devolved power to support climate action.
- Playing a part in reviewing regulation, to ensure that regulation can be designed to use as a tool to enable an intelligent response to the climate emergency.
- Engagement with the national climate citizens assembly.

Enabling conditions for change
Skills and capacity

Why

Bristol is a Learning City, and climate challenge creates both a need and opportunity for learning, in work or in life more generally. We want everyone to be able to be part of delivering the vision and ensure that we make a fair transition away from fossil fuels.

We have estimated that replacing fossil fuels directly consumed in the city alone will require 7,500-10,000 full time workers for 10 years. This creates a great opportunity to increase employment and replace jobs that are no longer needed.

Alongside specific skills we need to support everyone to be able to make choices which reduce carbon emissions or increase climate resilience. We also need to transform the way in which all of our decisions are made, empowering everyone with the skills, knowledge and capacity.

In particular, we recognise that the skills and capacity in the construction industry to deliver the scale and pace change needs a dramatic overhaul. We need to make sure we have the skills and capacity within the city to implement and maintain these solutions. This will support the uptake of these solutions, and also support our local economy and businesses.

We recognise that many of the skills and knowledge lie within communities seldom heard within the environmental sector and we will need to share knowledge across the city. For example, some ethnic minority communities have a number of environmentally sensitive practices, which those communities do not badge as "green", but which could be more widely shared as part of existing knowledge, language and other skills transfer.

What

We need the right skills and resources through strong networks of training and skills sharing. We will also need to enable effective ways of connecting our newly skilled workforce with those with a demand for skills.

We need to make sure we take advantage of new innovation and skills and share these with wider networks, both within the city and beyond, to enable transfer of our learning.

In particular, we will need to work with the Learning and Skills Board to convene the Further Education providers in the city, who are likely to deliver much of the training required in the construction sector.

Next steps

- Development of a skills and training delivery plan for the climate strategy.
- Adult learning and updated national curriculum to improve education on climate change, hazards and carbon emissions.
- Integration of training and requirements for carbon neutral and climate resilient related knowledge and skills into Further Education, apprenticeships and job roles across all ten delivery themes.
- Identification, incentivisation and delivery of skills development training programmes to achieve our delivery theme goals.
- Engagement with citizens so that everyone has the skills and capacity to know what to do in extreme weather events. This may include a wider understanding of flood risk, knowing the nearest community place of safety or preparing a family emergency plan.
- Review of the success of the carbon literacy training programme being trialled for officers within Bristol City Council and consider wider roll-out in other organisations.

Enabling conditions for change
Data and knowledge

Why

We need more information and evidence to develop our city delivery plans to ensure that we invest in the most effective actions to achieve carbon neutrality and climate resilience. Ensuring that we build on and develop current knowledge will support the city's integrated long-term planning.

Without good data we cannot be sure we are focusing on the key issues and it is difficult to measure our progress. Therefore we need to establish baselines and set targets to allow monitoring and evaluation to take place.

We need to have a shared understanding of the challenge we are facing, and data is not always available across partners and citizens.

In order to achieve our objectives, we also need to encourage climate action elsewhere in the world; sharing and learning from other cities is therefore vital.

What

Robust, shared and organised data which can be used across the city's organisations to enable a shared understanding and a shared evidence base.

We also want to be able to share this knowledge and data, where appropriate, with other cities to share our understanding and learning from both successes and opportunities for improvement. We will look to work with partners both in the city and beyond to use the best global expertise to help meet our goals.

Given the urgency of the challenge, we need to work with our current data and evidence, but then adapt our approach as we learn more.

For some delivery themes we have good data and knowledge about the challenge and the actions which are needed (for example how we heat our homes and the low carbon options available).

For others, for example on climate impacts and resilience, we need to develop our understanding so that we can plan actions more effectively, build the business case for investment and monitor our progress.

Next steps

We need to make sure we have the right data and information to support the decisions that will support action:

- Development of further knowledge on how extreme heat, drought, storm and rainfall changes could impact the city and city assets in the future and a management plan to deal with this risk. We also need to know more about the impacts of cumulative or sequential events where we may have limited periods of time between events to recover and adapt.
- Citywide climate scenarios that are used by all in future planning, which use the most up to date climate projections to support this.
- Creation of an accessible Climate Atlas tool which allows users to investigate vulnerability to climate risks using a combination of climate hazard information, maps of city assets and socio-economic data.
- An impact assessment on the supply chains of businesses in Bristol to develop further understanding of consumption-based emissions and climate change hazards.
- Creation of a One City Climate Data Store on an open data website and encourage partners to share data.
- Identification of the appropriate tools to capture, monitor and report the impacts of climate change.
- Supporting smarter energy use across Bristol based on better access to, and analysis of, real-time data on energy demand and generation and the status of different energy assets in the city and more widely.
- Further work to inform the evidence base concerning scope 3 emissions.

Enabling conditions for change
Infrastructure

Why

To enable the delivery of this strategy, we need to deliver significant new infrastructure across the city and beyond. We also need to manage and maintain our existing infrastructure, using best practice asset management to support our transformational change.

Whilst we need to continue to undertake key maintenance, such as BCC's gully cleaning programme to support flood protection, we still need to do more. The way we live and use resources will need to change and our weather is projected to significantly change. Our infrastructure will need to enable and facilitate changes to all of the delivery themes identified whilst remaining resilient to changes in our climate and more extreme weather events.

What

Infrastructure can be described as the basic systems and services needed for society to operate. As an enabling theme, we are considering a similar definition to that taken by the national infrastructure commission (covering energy, transport, water, waste, flood risk management, and communications infrastructure).

We will need new specific infrastructure, in terms of heat, electricity and transport, to meet our goals. For example, as we move towards electrified heat and transport systems, we will need significant upgrades to our electricity distribution systems. We will need to engage with Western Power Distribution and with Ofgem to enable this to happen.

We will need significant new walking, cycling and public transport infrastructure, as well as charging infrastructure for electric vehicles, or other zero carbon fuels.

We will need to build new infrastructure to protect the city from flooding. This will include grey infrastructure, such as flood walls, but we also need to take opportunities where natural solutions could be implemented to support flood protection while providing urban cooling, environmental and health and wellbeing benefits.

We will need to protect and use our ICT and communications infrastructure to enable the use of smart technologies and to share data across the city.

We will also need to maintain and update the infrastructure which is supported, designed and invested in, and focus on ways to provide multiple wider benefits.

Next steps

- Engagement with Western Power Distribution and Ofgem ahead of the next price control period to develop a clear plan for investing in upgrades required to the electricity distribution grid.
- Implementation of the Avonmouth and Severnside flood defence project.
- Development and implementation of a city centre flood mitigation strategy.
- Development of a citywide plan for electric vehicle charging and hydrogen refuelling infrastructure and engage with the market.

4b. Delivery themes

The pages that follow set out our ten delivery themes; the key areas where climate action is required in the city.

Under each delivery theme, we have set out:

- **The challenge:** We highlight the scale of the challenge, relating this back to our evidence base;
- **Our strategy:** An introduction to our proposals as they have emerged from our evidence base;
- **A goal or goals for Bristol in 2030,** which sets out what Bristol could look like in 2030 with transformational climate action implemented;
- **Objectives for 2030,** which describe key outputs that will be needed to achieve these goals.

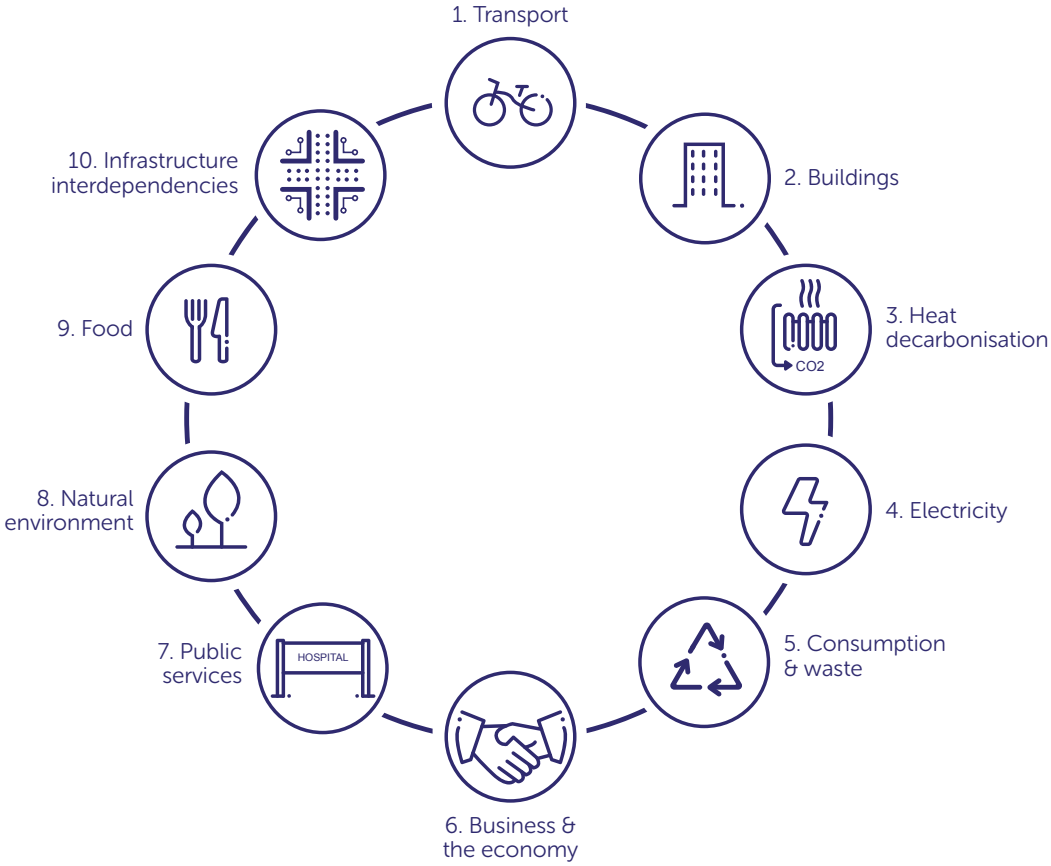
These goals and objectives set out the fundamental changes we want to achieve as a city. They form the backbone of our strategy.

Building on the enabling conditions for change, **the our journey to 2030** section sets out what our journey to make this happen might look like. This is based on the evidence we have in 2020, and we recognise that this will need to be flexible and will evolve as our evidence base improves.

We recognise that this journey will not be easy. We have therefore highlighted the **key challenges** that we will need to overcome in order to deliver a fair transition in line with our principles.

We also know that if we get this journey right, there are significant **opportunities** to achieve multiple benefits for our citizens and our city.

This evidence and framing will be critical as we move towards developing delivery plans.



Delivery theme 1
Transport

The challenge

The transport challenge refers to all movements of goods and people within Bristol. By its nature, transport is a cross-boundary issue and as such a solution for Bristol will affect, and be affected by, actors, organisations and infrastructure outside Bristol's administrative boundary. Transport accounts for 34% of the average Bristol resident's carbon footprint. Driving is the largest single element - approximately 17% from the use of diesel or petrol cars and 2% from the making of the car. Other transport services, such as buses and trains accounts for 7% and aviation accounts for about 7% of the average resident's footprint. Freight and business travel is also a substantial part of the city's footprint, constituting 17% of the economy's footprint, both within the city and beyond. So how we organise transport within the city, where we source goods from, and how we work with others to organise transport to and from the city are all critical in reducing our carbon emissions.

We also know that our transport system is vulnerable to future climate change; with some major nodes, such as Temple Meads, at risk from future flood events, and the potential impacts of high temperatures, through melting tarmac, or contorted railway tracks. We know the devasting impact loss of access to transport can have on our lives and livelihoods.

Our strategy

We know that we will significantly enhance benefits for the city through a blend of measures to achieve and deliver the carbon neutral strategy for Bristol, minimising cost, and maximising positive outcomes, including health, well-being and social usefulness for people and for businesses. Ensuring our transport system is climate resilient will enable our citizens to have usable and efficient access across the city, and outside with city, no matter what the city's future climate looks like.

Personal travel and freight must be tackled at a local, regional, national and international level, working with regional and national government as well as the private sector. For travel within the city our analysis shows we need to firstly reduce the amount of vehicles on the roads, with more people using buses, walking and cycling instead of private cars. This would positively impact peoples' health due to reduced air pollution and an increase in exercise, as well as improved transport systems benefiting lower income households. We also need to phase out petrol and diesel powered vehicles, converting to electric for most vehicles and biogas or hydrogen for some larger vehicles like buses or lorries. Without the change in travel patterns, a sudden swap to these clean vehicles would require a significant amount of charging infrastructure and would also omit the possible health, congestion and social benefits.

Delivery theme 1
Transport

2030 goal: Bristol will have a sustainable carbon neutral transport system with modal shift to significantly more citizens walking, cycling and using low carbon public transport

2030 goal: Everyone will have access to a transport system that is resilient to a changing climate

2030 Objective (i)
Significant reduction in car mileage achieved through mode shift towards public transport, walking and cycling; commercial vehicle mileage reduced through freight consolidation; aiming for a total 40% reduction in vehicle miles.

2030 Objective (ii)
All of Bristol's cars primarily consist of ultra-low emission vehicles (ULEVs) and 90% of other vehicles to be ULEV.

2030 Objective (iii)
Reduce total carbon emissions from international and domestic air travel associated with residents and businesses.

2030 Objective (iv)
Significant improvements made to accessibility and service of sustainable travel infrastructure to ensure it can support carbon neutral, climate resilient transport systems.

2030 Objective (v)
Existing transport infrastructure enhanced to withstand future climate projections with the effect that the transport network continues to function well during severe climate events.

Delivery theme 1
Transport

Our journey to 2030

We know that we need to make fundamental changes to reach our 2030 goals. Based on the evidence that we have in 2020, we anticipate this will include actions such as:

Engagement, culture and inclusion

People are key to changing our transport system. Therefore we will need to undertake extensive engagement with the public and businesses to achieve our goals across the city. This could involve programmes such as extensive electric vehicle car club/share schemes and personalised travel planning programmes.

Funding and finance

We know we will need to update how transport is financed through actions such as subsidised public transport, road user charging and business rate incentives for sustainable transport use and low aviation mileage.

National and regional action and city leadership

We know the we will need support from local and national government to achieve these objectives. These actions may include:

- The creation of a regional collaborative transport strategy organisation (akin to Transport for London, with buy-in from major public transport providers) with the powers and funding to enable rapid modal shift; and
- Information campaigns, policies and incentives to reduce air mileage of residents and businesses in the city.

Skills and capacity

We know we need to have the skills and capacity in the city to maintain and operate our updated infrastructure.

Data and knowledge

We know that we need further knowledge of how our transport infrastructure is projected to be impacted by future climate hazards. This will enable us to focus action, such as schemes to mitigate risk and enhance resilience for areas most at risk of climate and weather events. We will also aim to harness innovation from the private sector, such as mobility as a service (MAAS) business models to encourage modal shift away from car ownership.

Infrastructure

We will need to implement some new infrastructure to make this transformational change happen. This will need to be through actions like:

- Enhancing walking and cycling experience and infrastructure through reallocation of road space away from the motor vehicle;
- Using transport corridors to enhance blue and green infrastructure;
- Improving public transport services through major expansion of infrastructure and services to create an integrated, segregated, high quality, rapid and reliable service and ultra low emissions vehicles ;
- Delivering a comprehensive freight consolidation scheme, including effective first and last mile solutions, that drastically reduce delivery trips;
- Installing and smart management of electrical vehicle charging and hydrogen infrastructure across the city; and
- Reduction in parking capacity for non ultra low emission vehicles, increased car parking charges and workplace car parking levy.

Delivery theme 1
Transport

Key challenges to delivery:

- Identifying, securing and justifying funding
- Time needed for regulatory and planning processes and for construction of new infrastructure
- The higher capital cost of ultra low emission vehicles, both for private owners and commercial operators
- The input needed from national and international bodies and businesses to change the market, incentives for businesses and individuals, and policy and regulation.

Opportunities:

- Improved public transport, public realm and air quality. It has been identified that this will particularly benefit lower income households and young people.
- Release of land for other uses – e.g. housing, green space, and use of transport corridors to support green infrastructure
- Mode shift to more space efficient options will allow the city to grow effectively while easing the traffic congestion that currently costs the city's businesses
- Improved health outcomes, through both active travel and air quality improvements
- Removing unnecessary journeys by car should free up road space and save time for people whose mobility needs are more acute, such as disabled drivers.

Delivery theme 2
Buildings

The challenge

Bristol's existing buildings, both commercial and residential, will need to be transformed if the city is to achieve its target to achieve carbon neutrality by 2030 and make them resilient to the potential impacts of a changing climate. In addition, the city's need for new housing and other buildings will need to be met only from developments which are carbon neutral and climate resilient, aligning with the city's approach to decarbonising heat and transport.

In recent decades, the widespread installation of relatively straightforward and low cost energy saving measures such as cavity wall insulation and loft insulation in the city have contributed to a reduction in carbon emissions from heating buildings of 29% since 2005.

However, the next phase of energy performance improvement in buildings will involve more complex, more expensive measures which require better skills and knowledge to design and install, and some financial incentives to reduce and/or spread the cost of improvements, particularly for lower income households and small businesses. Specific approaches to tackle the generally lower energy performance of the private rented sector, for both domestic and commercial buildings, will be needed.

We know that with the projected climate changes, we need our buildings to be designed to prevent overheating. We also know that there are a number of potential new development areas in the city in areas of flood risk.

Our strategy

A focus on retrofitting will ensure our current buildings will have better energy performance, cutting heating demand and therefore carbon, and will support the target to eliminate fuel poverty and end the risk of anyone having to live in a cold home. This will also incorporate the appropriate solutions for carbon neutral heating (see delivery theme 3: Heat Decarbonisation).

A tailored approach will ensure that solutions reflect a building's use, design, heritage and construction materials, as well as reducing climate risks such as summer overheating, flooding and drought. This retrofit programme will support local jobs and businesses, with an extensive programme to upgrade skills and knowledge in the building trades so they can design, specify and deliver complex insulation programmes to a high quality using appropriate materials and techniques. We will also work with central government to call for the transformation of the planning system to deliver carbon neutral and climate resilient new buildings.

Delivery theme 2
Buildings

2030 goal: All buildings in the city will be carbon neutral and use resources efficiently, ensuring everyone can enjoy affordable warmth in winter and avoid overheating in summer

2030 goal: All buildings in the city will be resilient to a changing climate

2030 Objective (i)

New buildings are carbon neutral and climate resilient (aligning heat provision to the city's heat decarbonisation programme).

2030 Objective (ii)

The energy performance of existing buildings in the city is improved to minimise heat demand, whilst preventing overheating, through tailored retrofit solutions.

2030 Objective (iii)

All key stakeholders (with a focus on building owners and operators) work together to prepare and adapt our current building stock for future climate hazards.

Delivery theme 2
Buildings

Our journey to 2030

We know that we need to make fundamental changes to reach our 2030 goals. Based on the evidence that we have in 2020, we anticipate this will include actions such as:

Engagement, culture and inclusion

Households and businesses across the city will need to understand what a well-retrofitted 'futureproofed' building is like and how it should be managed – through demonstrators, education and advice initiatives. We will need to provide clear pathways to securing that outcome for their building, with the right advice, support and appropriate funding support to encourage prompt action. There will need to be a particular focus on those experiencing fuel poverty, with tailored support services and funding for home upgrades.

Funding and finance

Finance will be required to support and spread cost of deep retrofit, including grant support for low income households and small businesses.

National and regional action and city leadership

Transforming Bristol's buildings for a carbon neutral and climate resilient future will require:

- New powers and regulations to drive high energy efficiency and climate resilience standards for existing building retrofit and tighten up the enforcement and pace of improvement in the domestic and non-domestic private rented sectors;
- Effective powers to set and enforce requirements for new build developments to achieve meaningful carbon neutral and climate resilience standards; and
- Leadership from public sector building owners and social landlords to demonstrate opportunities, stimulate supply chains and drive technology cost reductions through effective procurement.

Skills and capacity

Such a transformation of buildings will need a skills upgrade and training for city's building contractors and technical advice for building owners on carbon neutral retrofit and climate resilience.

Data and knowledge

Guidance, advice, and support will be required for building owners (including householders) and building managers on creating and living in low carbon, climate adapted buildings.

Infrastructure

To achieve this built infrastructure upgrade by 2030 will require a programme of works across the city, linked to the heat decarbonisation and wider adaptation programmes, to provide energy retrofit solutions for every building and to orchestrate the relevant skilled contractors, funding solutions and advisory support.

Delivery theme 2
Buildings

Key challenges:

- Shifting focus of current refurbishment work and complex supply chains towards achieving carbon neutral outcomes
- Lack of skills associated with low carbon retrofit and whole building solution design (particularly for housing)
- Financing the additional upfront cost of achieving high standards of energy performance (vs standard retrofit)
- National government policy not favourable to stronger carbon neutral and climate resilient standards being set for new developments by individual local planning authorities
- Ensuring that jobs and skills opportunities from transition to zero carbon construction include those most in need to training and employment

Opportunities:

- Green jobs from major retrofit programme suiting range of qualifications
- Relatively strong local 'green building skills', building services expertise and public energy advice services
- Addressing fuel poverty goals in tandem with carbon neutral goals
- Delivering health benefits through providing better indoor environments
- Leadership from public sector to demonstrate potential with exemplar retrofits and new build projects on own buildings (including housing) and to drive skills and quality improvements.

Delivery theme 3
Heat decarbonisation

The challenge

Heating buildings and hot water in Bristol currently accounts for nearly 40% of the city's scopes 1 and 2 carbon emissions. This makes it the largest source of direct emissions. At least 85% of this heat is supplied by gas with about 10% from electricity (including storage heating). As a result of the widespread adoption of simple insulation measures (such as cavity wall and loft insulation) and other efficiency gains over the last 15 years (the future roll-out of these being covered under delivery theme 2: Buildings), the city's carbon emissions from heat have reduced by 29% since 2005.

Now we need to go much further, both by driving much deeper improvements in insulation and building energy performance (see Buildings theme) and by switching away completely from gas boilers to replace them with efficient electric heating supplied by carbon neutral electricity (see Electricity theme) and district heating (where heat is generated centrally and piped to buildings, a common approach in European cities such as Copenhagen).

Until recently, gas was the lowest carbon source of heating when compared with oil, electricity or even, according to some analysis, wood. This is no longer the case. As a result of the achievements in decarbonising electricity nationally means that electricity is a lower carbon source of heating than gas, particularly when the electricity is used in high efficiency heating like heat pumps.

Our strategy

To achieve carbon neutral emissions by 2030 will require the phase out of gas – a massive undertaking, though potentially one with significant job opportunities. Our analysis shows that to become carbon neutral we need to replace the estimated 160,000 gas boilers across the city with electric heat pumps supplied by renewable electricity or carbon neutral district heating (where heat is generated centrally from a large heat pump and piped to buildings). This will be far more efficient and have a much lower operating cost than using direct electric heating which would result in a much larger increase in electricity demand.

Some organisations are exploring the potential to replace fossil gas with hydrogen for heating. However, analysis undertaken for this strategy, confirmed by a recent publication from the UK's gas networks, suggests that this potential is not expected to be realised at scale, if at all, until well after 2030. This is even assuming that the other challenging technological breakthroughs it requires to be carbon neutral, safe and cost-effective are made promptly over the next decade. Our analysis confirms that there are limited opportunities to increase the supply of green 'biogas' within the city. These conclusions have driven our approach for Bristol.

Delivery theme 3
Heat decarbonisation

2030 goal: Bristol will have to implement carbon neutral forms of energy for heating and hot water for all by 2030

2030 Objective (i)

Individual electric heat pumps installed in ~95,000 buildings which have been well-insulated to support the phase out of gas heating in Bristol.

2030 Objective (ii)

65,000 buildings connected to heat networks to support the phase out of gas heating in Bristol.

Delivery theme 3
Heat decarbonisation

Our journey to 2030

We know that we need to make fundamental changes to reach our 2030 goals. Based on the evidence that we have in 2020, we anticipate this will include actions such as:

Engagement, culture and inclusion

After 50 years of gas central heating being seen as the desirable 'cleaner' choice, there will need to be a sustained engagement programme with households, landlords and businesses to promote 'the end of gas' and the genuinely clean, carbon neutral alternatives to achieve heat decarbonisation (potentially led by public sector and major building owners, including social landlords). Some major heat users in the city will have the capacity to determine the most appropriate approach.

Funding and finance

The cost differential between gas boilers and both heat pumps and heat networks will require funding and incentivisation to drive investment from building owners into carbon neutral heat solutions. National fuel cost subsidies for vulnerable households will also need to be redesigned to provide price protection.

The City Leap Energy Partnership is expected to provide access to new private sector funding to support the capital costs of new infrastructure.

National and regional action and city leadership

Regulations and powers will be needed to phase out gas boilers, necessitate heat network connections, protect consumers and drive retrofit with a focus on a just transition. This will include a planning system that is supportive of this transition to heat decarbonisation and requires the alignment of each new development with the city's heat decarbonisation plans.

There is potential for public sector (e.g. by social landlords and large public building owners) to drive both cost-reductions, technology performance improvement and skills development.

Skills and capacity

There will need to be training for new technology implementation (including skills upgrades for the city's heating engineers and building contractors)

Data and knowledge

Improved understanding of the performance and optimum operating regimes for heat pumps and heat networks would assist the development of staged programme of works to deliver the heat decarbonisation, likely to kick off with some carbon neutral heating pilot zones.

Infrastructure

The electricity network will need to be upgraded and operated more smartly to serve higher demand (see 'Electricity').

There will need to be early examination (with Ofgem and others) of the value of continuing to invest in upgrading the city's gas network, given the 2030 carbon neutral ambition.

Delivery theme 3
Heat decarbonisation

Key challenges:

- Cost and 'effort' differential between replacement gas boiler and carbon neutral alternatives and the current low cost of gas as a heating fuel
- Lack of powers or regulations to require action (to underpin business case for heat networks)
- Lack of skills and decent supply chains for heat pumps and heat networks
- Dominant and unchallenged cultural belief that 'natural' gas heating is the modern, efficient and 'clean' choice
- Promotion of hydrogen as an alternative carbon neutral solution
- Whilst long-term investment will lead to lower bills, there is an interim need to ensure investment costs do not adversely impact those who find it hardest to pay
- Achieving carbon emission reductions and addressing fuel poverty together with common solutions.

Opportunities:

- Reducing fuel poverty (with careful targeting to achieve affordable warmth), and improving health and economic outcomes for people
- Future-proofing now to enable a speedy transition
- New low carbon construction jobs
- Lowest lifetime cost route to carbon neutral heat by 2030
- Attract heat pump and heat network businesses to establish in exemplar city
- Avoided costs of upgrades to the gas network in the city.

Delivery theme 4
Electricity

The challenge

Achieving carbon neutrality by 2030 in Bristol will depend heavily on the electricity it consumes being decarbonised – so that virtually no carbon dioxide is emitted for every unit of electricity used in the city. This in turn depends on the decarbonisation of the national electricity system by 2030, often referred to as 'grid decarbonisation'. While this is not currently on track for 2030, it is now occurring very quickly, particularly as a result of the rapid deployment of renewable energy (such as off-shore wind and solar PV). Moreover, there are expectations and official scenarios that this will proceed apace in the 2020s and be achieved at some point in the early 2030s, having achieved very low levels of carbon intensity by 2030.

With the electrification of heat and vehicles required across the city to achieve carbon neutrality by 2030, Bristol's electricity demand is likely to increase by 50% by 2030 from current levels. These new sources of demand out-run the continuing efficiency gains in other power uses which will more than compensate for the anticipated population growth. They will also change the scale and pattern of demand peaks on the electricity network, requiring much smarter demand management across the city and a significant upgrade of the electricity distribution network to make it 'net zero ready'. This must be achieved whilst working to ensure that the electricity system is resilient to the impacts of climate change.

Our strategy

Bristol will need to play its role locally in enabling this national grid decarbonisation. The evidence demonstrates that the city can not generate within its boundaries enough zero carbon electricity to meet its own electricity demand. So it will rely on new renewable generation being installed elsewhere. But it can generate more 'in area' by realising significantly more of the potential for rooftop solar PV on residential and non-residential buildings across the city (estimated at 500MW at viable rates of return – only 28MW of which has been realised to date). Additionally, if local households, businesses and organisations contract for genuine 100% renewable electricity tariffs they will help to create strong market demand and price support for subsidy-free renewable generation across Great Britain, hastening its deployment.

But most importantly, Bristol can help accelerate and reduce the cost of national grid decarbonisation by participating at scale in smart energy solutions to create more flexible demand, to shift and reduce peaks and to store excess production. By becoming a smart and flexible demand, the city will be able to better match the output of renewable generation on the system, reduce system costs and enable higher levels of renewable generation to be accommodated.

Delivery theme 4
Electricity

2030 goal: All electricity supplied to and generated in Bristol will be carbon neutral (taking into account the anticipated 50% increase in demand by 2030)

2030 goal: We will have an electricity system that is resilient to a changing climate

2030 Objective (i)

Decarbonisation of the national grid will be supported by the extensive adoption of smart electricity solutions in Bristol.

2030 Objective (ii)

Renewable generation within the city will be maximised, including approx. 350MW solar.

2030 Objective (iii)

The local electricity network is reinforced, managed more smartly and made more resilient to accommodate increased demand.

Delivery theme 4
Electricity

Our journey to 2030

We know that we need to make fundamental changes to reach our 2030 goals. Based on the evidence that we have in 2020, we anticipate this will include actions such as:

Engagement, culture and inclusion

Bristol's businesses, public sector and households will need to be engaged with emerging demand flexibility and demand reduction services (including battery storage). This should include innovative approaches to engaging more vulnerable households to ensure that everyone in Bristol has the opportunity to participate in the benefits of a smarter energy system. The opportunities to install solar PV and sign up for genuine renewable electricity tariffs will also need active promotion.

Funding and finance

Investment in establishing innovation and engagement with smart energy solutions will be required, potentially by bidding to national funding pots and establishing a local cluster.

A citywide approach to financing new solar PV rooftop installations (such as envisaged with City Leap Energy Partnership) could significantly accelerate take up.

The business case for upgrading the electricity network will need to be developed with Western Power Distribution (see Infrastructure)

National and regional action and city leadership

To achieve grid decarbonisation nationally will require the government and the energy regulator Ofgem to continue to drive the rapid deployment of renewables, to strengthen policies to stimulate and reward smarter energy solutions and to set and strengthen high energy performance standards for energy using equipment and buildings.

Planning policies nationally, regionally and locally will need to be supportive of renewable energy generation. Public bodies in the city can use their procurement powers to drive high standards and lower costs in electricity-using equipment, flexibility services, storage and PV, opening up the resulting gains to the wider population.

Skills and capacity

For smart energy, to stimulate the required innovation, skills and partnerships at the required pace and to capture the economic benefits of smart energy for the city, an initiative such as a smart energy cluster will be needed. There will also need to be a rejuvenation of the solar PV installation sector to take advantage of the emerging viability of subsidy-free installations at scale.

Data and knowledge

Stimulating participation in smart energy opportunities across the city would benefit significantly from access to smart energy meter data and other energy system data to improve understanding of the patterns of demand, opportunities for flexibility and reduction and the potential value of action.

Infrastructure

We will need to work with Western Power Distribution (WPD) during 2020-21 to establish the engineering and business case for accelerated upgrade of the city's network to cope with the anticipated new scale and patterns of demand. We will also need to engage with regulator Ofgem to help WPD secure approval to proceed within the next price control (RIIO-ED2).

Delivery theme 4
Electricity

Key challenges:

- Developing a detailed picture of network upgrade needs to 2030 and making a legitimate case with WPD to Ofgem for accelerated investment in Bristol
- Re-booting public and business assumptions about viability of roof-top PV after the ending of Feed in Tariff subsidies
- Sufficient power systems engineers and joint fitters for network upgrade
- Complexities of markets for smart energy and flexibility services (creating significant barrier to entry).

Opportunities:

- First mover advantages of building a 'net zero ready network'
- 'Innovation test bed' for city-wide smart energy approaches (including how to enable participation by vulnerable households)
- Employment from accelerated network upgrade, PV installations and smart energy services implementation
- Smart energy business sector growth from cluster approach
- Community energy investment and local energy trading (potentially for benefit of more vulnerable households) from PV installations.

Delivery theme 5
Consumption and waste

The challenge

Cities drive the wider global economy and our consumption has an impact well beyond Bristol's boundaries; we can and need to reduce the amount we consume as a city. Just under 50% of the carbon footprint of Bristol's households comes from indirect, or scope 3, sources with approximately 50% of these emanating from outside the UK.

The management of Bristol's waste currently causes c. 5% of Bristol's scope 1 and 2 emissions, largely as a result of the incineration of residual waste and particularly the fossil-fuel derived plastics it contains.

We know that extreme weather events caused by climate hazards in other parts of the world, put some of the goods and services that we currently rely on at risk. In addition to food (see delivery theme 9), the Committee on Climate Change has highlighted that clothes and electronic equipment are especially at risk from their climate risk in international supply chains.

Our strategy

For us, responsible consumption is that as citizens and businesses/ organisations, we value and reduce our impact on the world's natural resources, focusing on fair and sustainable consumption and production. Reducing greenhouse gas emissions caused by the production of the goods and services which Bristol's residents and businesses consume and by the management of the waste we produce requires a comprehensive approach. We need to adapt and reduce our current consumption patterns, particularly our consumption of carbon-intensive products and activities and to re-use and repair items we already have rather than replace them. This change in approach to consumption will also reduce our exposure to climate risks in supply chains.

Achieving near carbon neutral emissions from waste management requires not only waste reduction and improved recycling but also the removal of these plastics from the residual waste stream or the cessation of incineration altogether.

As a city that leads on responsible consumption we can take the opportunities to develop new business models which focus on sustainable consumption, reducing waste and developing a circular economy. This will support a longer-term goal in the One City Plan for us to become a zero waste city.

Delivery theme 5
Consumption and waste

2030 goal: Bristol will generate no carbon emissions from waste management

2030 goal: Bristol will be recognised as a city of responsible consumption, buying goods and services that are carbon neutral, and reducing our exposure to climate hazards in the supply chain

2030 Objective (i)
Bristol's retail economy has transitioned to high quality, durable products that can be easily repaired.

2030 Objective (ii)
Everyone follows principles of responsible consumption, using and buying less and buying carbon neutral goods and services.

2030 Objective (iii)
Significant levels of waste reduction (particularly for food, textiles, and plastic).

2030 Objective (iv)
At least 65% of all 'waste' is repaired, recycled or re-used.

Delivery theme 5
Consumption and waste

Our journey to 2030

We know that we need to make fundamental changes to reach our 2030 goals. Based on the evidence that we have in 2020, we anticipate this will include actions such as:

Engagement, culture and inclusion

A wide-ranging engagement campaign will be needed to achieve our objectives, including:

- A comprehensive and sustained communications and engagement campaign across the public and businesses, targeting areas with higher levels of consumption, low recycling performance and reductions in food waste and plastic use;
- Developing a citywide shared understanding and commitment to responsible consumption (including lower carbon food and reduced flying), which acknowledges the generally lower impact of lower income households; and
- Creating advertising standards and restrictions to support responsible consumption.

Funding and finance

Financial incentives, such as the implementation of Pay As You Throw (PAYT) schemes, or other financial mechanisms to reduce waste and encourage recycling will be needed. There will also be a need for regional investment to improve plastics recovery from residual waste.

National and regional action and city leadership

We know that a range of policy and leadership actions will be required, including:

- Design and implementation of a tax and dividend scheme, which taxes high carbon products and services and provides the tax back as a dividend to be spent on 'green' or 'eco' products and services
- Public sector leadership to support re-use activities and use of procurement to build markets for re-use and recycled goods.
- Greater local powers to oversee commercial waste collection to reduce complexity, inefficiencies and enforcement challenges
- Legal requirements on businesses to sort waste for recycling, collect food waste separately and effective enforcement.

Skills and capacity

We will need to share skills and knowledge across businesses, individuals and community groups within Bristol, as well as sharing with networks outside the city. This will support us in becoming leaders in responsible consumption.

Data and knowledge

To develop an effective One City approach to reducing waste and improving recycling will require much better data about the commercial (i.e. non-residential) waste being produced across the city. We will also need a much better understanding of how to communicate messages and design initiatives around reducing consumption to different types of household so as to enthuse rather than alienate.

Infrastructure

Develop waste storage, transfer treatment and recyclate processing facilities that create value from waste and resources that can be directly re-invested back into the city.

Delivery theme 5
Consumption and waste

Key challenges:

- Limited influence of local authority over commercial waste management.
- Lack of powers for the local authority to introduce 'pay as you throw' and waste restrictions
- Status of EU circular economy package post Brexit
- Cultural expectations of consumption are deeply embedded, and are part of much wider national and global systems
- Existing inequalities in household carbon footprints mean messaging and support for change needs to be targeted
- Nearly 50% of our household consumption emissions originate from outside the UK, meaning that the control that we have locally may be limited.

Opportunities:

- Further cost savings for the public purse from improved more efficient recycling and waste reduction
- Cost savings for individuals through reducing overall consumption levels
- Bristol to enhance reputation as city with strong environmental credentials and approach to responsible consumption
- Opportunities for improvements to health and wellbeing, with greater societal value placed on experience over consumption
- Wider benefits of sustainable consumption to resource depletion and resource use.

Delivery theme 6
Business and economy

The challenge

Businesses in Bristol contribute £1.7bn to the UK's economy. There are approximately 18,300 businesses operating in Bristol, the large majority being independent micro and small businesses. Bristol's economy is predominantly service-based spanning professional services, food and hospitality, retail, education, healthcare. Over 20,000 people are also employed in manufacturing, construction, energy supply, water and waste management jobs. Extreme weather events can have significant consequences on the local and regional economy through direct and indirect losses, and future climate changes are likely to make extreme events more likely. International events can impact the local economy and business through international supply chains and many companies do not review and monitor the resilience of their supply chains.

Businesses and organisations in Bristol have an approximate total (scopes 1, 2 and 3) greenhouse gas footprint of 5,000ktCO2e, a significant contribution to the overall footprint of the city. Approximately 50% of this is from their indirect (scope 3) emissions, which are not well understood, and where levers for change are more distributed.

Our strategy

The carbon neutral goal and adoption of a circular economy seeks to decouple economic or business growth from resource consumption by creating value from resources in new ways. This can directly address issues around resource scarcity, productivity and carbon, while indirectly addressing issues around innovation, inclusivity and inequality. For example, it is projected that investing 0.4% (£58m) of Bristol's annual GVA to exploit energy efficiency and low carbon opportunities will result in 0.7%GVA (£102m) annual savings in the city's energy bill, 2,000 jobs in the low carbon goods and services sector and wider social and economic benefits such as a decrease in fuel poverty and improved resource efficiency.

Delivery theme 6

Business and economy

2030 goal: Bristol's businesses will be carbon neutral and climate resilient

2030 goal: Bristol will have a strong carbon neutral, and climate resilient economy, maximising on the opportunity from the transition

2030 Objective (i)
All businesses and organisations in Bristol are carbon neutral (direct and supply chain emissions) and will annually record and measure scope 1, 2 and 3 GHG emissions in accordance with the Greenhouse Gas Protocol.

2030 Objective (ii)
All businesses (especially those with high GHG footprints) are supported in the transition to carbon neutrality to ensure that Bristol's economy is diverse. This will include training, engagement, management and operation support.

2030 Objective (iii)
Businesses improve resilience to climate hazards through collaborative organisational strategy, planning and operation. Provision of services to the most vulnerable in society is prioritised.

2030 Objective (iv)
Bristol builds on its leadership position, attracting businesses at the forefront of the green revolution and developing an eco-innovation cluster, and providing access to these jobs to a diverse group of citizens.

Delivery theme 6
Business and economy

Our journey to 2030

We know that we need to make fundamental changes to reach our 2030 goals. Based on the evidence that we have in 2020, we anticipate this will include actions such as:

Engagement, culture and inclusion

We know that engagement will be required to change business models and the way in which businesses operate. This could include business-led employee programmes, promoting behaviour change and raising climate and ecological emergency awareness, or evidence-based education for senior management regarding circular economy principles and business models/planning. Our engagement, culture and inclusion programme will also need to address the diversity of the environmental sector; as new jobs are created in the carbon neutral and adaptation economies, it will be critical that they are open to all.

Funding and finance

We know that financial and tax incentives for carbon neutrality would be a strong option to offer additional help to businesses who are transitioning and adapting. Another area to explore is implementing further incentives that focus on attracting 'eco' businesses to the area, helping to drive collaborative innovation.

National and regional action and city leadership

There may be some areas where new policy and legislation is required to incentivise or mandate change for some businesses.

Skills and capacity

We recognise that the city would need to gather people and businesses alike with the relevant skills and capacity to take these steps forward, sharing their experience and knowledge for the benefit of the whole city.

Data and knowledge

Bristol is missing data to quantify the economic impacts of climate hazards. We believe it would be beneficial to evaluate the significance these hazards have on our economy. This could include the direct impacts, impacts on revenues and sales, impact on productivity, and impacts on resources, production and supply chain.

We also know that businesses and economic sectors will need to undertake analysis in order to align their future plan with Bristol's vision. This would include circularity assessments to identify and implement opportunities for circular business model development as well as supply chain analysis to establish resilience, vulnerabilities and carbon neutral intervention opportunities.

Infrastructure

We know that the city and its businesses would benefit from infrastructure that provides a strong foundation for a growing green economy.

Delivery theme 6
Business and economy

Key challenges:

- Reducing supply chain emissions and risk can be dependent on adoption of best practice of organisations outside of the city where supply chains are inflexible
- Establishing an engagement approach appropriate for the vast portfolio of Bristol businesses
- The current environmental sector is not very diverse, with limited representation of ethnic minorities in particular.

Opportunities:

- Development of specialised skills related to green economy businesses and organisations
- The opportunity to establish an economy where financial gain is not coupled with environmental and ecological degradation
- Much of the job growth from delivering the strategy and subsequent delivery plans will be in related sectors where ethnic minority workforce representation is higher; this provides an opportunity to diversify the environmental workforce
- There are opportunities for businesses to consider climate action in tandem with wider environmental and societal benefits.

Delivery theme 7
Public, voluntary, community and social enterprise services

The challenge

Public services include services such as government, education, healthcare and hospitals, social care and community facilities, public green space, emergency services and law enforcement. In some cases it also includes private companies who provide essential public services such as water or energy networks. The Voluntary, Community and Social Enterprise (VCSE) sector also provide important services which complement public services.

These services are fundamental to the lives of everyone who lives and works in Bristol. Climate change is projected to put additional strain on our public services as a result of the increased frequency and intensity of extreme weather events, this may have devasting effects on some of the most vulnerable in society .

Furthermore, the provision of public services in Bristol results in 747ktCO_2e of annual GHG emissions, which is the equivalent of driving from Land's End to John O'Groats 4,500times. This represents 14% of the overall emissions associated with Bristol's economic activity. 608ktCO_2e (or 81%) of Bristol's public services emissions are attributed to the supply chain.

The public sector will have an important role to play in delivering against each of the of the other delivery themes. This covered elsewhere.

Our strategy

Public services plan for emergencies through the Local Resilience Forum, which for Bristol works across the West of England and Somerset. They are joined in this by private companies which carry out essential public services, like water and energy distribution companies. They assess risks and work together to ensure that they have the collective capability to respond to incidents. As climate change increases the severity and frequency of severe weather events these services will need to reassess risks and increase their capability to respond. Examples include more intense and longer heat waves resulting in more people needing health care services or flooding requiring more rescue services. This is likely to require additional capacity, resources and funding.

As well as responding to severe weather, public services organisations need to maintain delivery of essential services during incidents. Maintaining this continuity of service during longer, more frequent and more intense weather events will require a strengthening of these services. Many of these services have seen significant funding reductions in the past decade and will need additional funding to provide this resilience.

Public services have also been leading action to decarbonise their activities. For example, the City Council has reduced its direct emissions by 80% since 2005 and is now working to reduce its indirect emissions. All of the key public services in the city will need to develop plans to decarbonise their operations and supply chains, helping to lead the wider changes in the city.

Delivery theme 7
Public, voluntary, community and social enterprise services

2030 goal: Our city will lead the way with carbon neutral public, voluntary, community and social enterprise services and supply chains

2030 goal: Public, voluntary, community and social enterprise services in Bristol will be prepared for future climate conditions and hazards

2030 Objective (i)

All public and VCSE service organisations in Bristol are carbon neutral (direct and supply chain emissions) and will annually record and measure scope 1, 2 and 3 GHG emissions in accordance with the Greenhouse Gas Protocol.

2030 Objective (ii)

All public and VCSE service organisations (especially those with high GHG footprints) are supported in the transition to carbon neutrality to ensure that access to services are protected for Bristol's citizens. This will include training, engagement, management and operation support.

2030 Objective (iii)

Public and VCSE service organisations improve resilience to climate hazards through collaborative organisational strategy, planning and operation. Provision of services to the most vulnerable in society is prioritised.

2030 Objective (iv)

Bristol's public and VCSE sector will build upon its leadership position, sharing lessons from its earlier transition with other organisations in the city.

Delivery theme 7

Public, voluntary, community and social enterprise services

Our journey to 2030

We know that we need to make fundamental changes to reach our 2030 goals. Based on the evidence that we have in 2020, we anticipate this will include actions such as:

Engagement, culture and inclusion

Improving education around climate change, and engaging with the public to induce wider community resilience will be key. We know that we will need to engage to explore options for community resilience, including providing information on the available public and VCSE services and respective response actions during extreme weather events. We recognise that on a day to day basis, our public and VCSE services are most used by some of the most vulnerable in the city. This means that it will be beneficial to focus on the effects of extreme weather events on health and wellbeing.

We are also aware that specific engagement and training in public service workplaces is required. This would relate to changes in service delivery and the expectations during a climate emergency.

Funding and finance

Our local public and VCSE services have stretched budgets, and competing priorities. There is a clear need for reprioritisation of budgets at a national level, as well opportunities for new and innovative financial mechanisms.

Financial resilience will be critical for our public services, as they are often funders of last resort in the case of an emergency – the ability to quickly mobilise and raise funds to support livelihoods will be critical.

National and regional action and city leadership

We know that the public sector can play an exciting leadership role for the rest of the city. We therefore recognise the need to work closely with the national and regional governments to support all public services and successfully achieve the objectives stated.

Skills and capacity

We will need to have the skills and capacity within the city and its public and VCSE services to accomplish these objectives, this include actions such as climate emergency training programmes for public services and their supply chains, covering both mitigation and adaptation.

Data and knowledge

We will aim to gather data to inform action plans and improve our understanding of the current levels of operational, organisational and financial resilience of public and VCSE services. We know that this will be achieved through work such as a Bristol public services climate vulnerability study, implementable business continuity plans and analysis of supply chains.

Infrastructure

Public services need to plan effectively in order to be resilient both now and in the long-term. We therefore recognise the importance of building infrastructure that can withstand all future climate scenarios whilst ensuring connectivity and equal access across the city.

Delivery theme 7
Public, voluntary, community and social enterprise services

Key challenges:

- The transition to carbon neutrality and the wider resilience of public services given their reliance on public funding
- Potential inflexibility of supply chain options for some public services.

Opportunities:

- Collaboration for health-led and climate resilient infrastructure to relieve the strain on healthcare and emergency services
- Leadership from the public sector could support action in other sectors, in particular through their significant buying and convening power
- Opportunities to improve shared knowledge and implementation across public services organisations, increasing capacity and saving money.

Delivery theme 8
Natural environment

The challenge

The natural environment refers to all naturally occurring living and non-living things such as living species, climate, weather and natural resources. This includes green infrastructure, a network of natural and semi-natural features, green spaces, rivers and lakes within and between urban areas. This encompasses all urban and rural green spaces in Bristol including parks, open spaces, playing fields, woodlands, allotments, trees, soils. It also includes rivers, streams, canals and other water bodies, sometimes referred to as blue infrastructure.

Developing, protecting and enhancing green infrastructure and the natural environment can help protect urban environments against the impacts of climate change by, among other things, improving surface drainage and helping to reduce the urban heat island effect. Green infrastructure can also be designed to optimise the carbon carrying capacity of the natural environment, helping to reduce the city's emissions.

Climate change can promote stress, and the spread of pests, diseases and non-native invasive species.

Our strategy

Delivering blue and green infrastructure provides co-benefits for the health and wellbeing of Bristol's citizens by reducing the direct human harm caused by flooding and extreme heat (the two major climate change induced physical risks facing the city in the upcoming years). There is also the added benefit of directly and positively impacting both mental and physical health through providing access to recreation and relaxation opportunities. Research shows that moving to greener areas can significantly improve mental health, as well as evidence to suggest that the likelihood of obesity can be reduced by 40% with increased green infrastructure.

Action in this area is also needed to limit the damage that will be caused to wildlife by the impacts of climate change, whilst also supporting opportunities for recovery and protection of species.

A response to the ecological emergency is being developed separately to this strategy. Our approach looks to achieve as many co-benefits as possible to respond to wider city challenges. However, this separate response will set out a wider range of interventions required.

Delivery theme 8
Natural environment

2030 goal: The natural environment in Bristol will be restored, protected and enhanced to deliver climate change benefits

2030 goal: As the climate changes, we will adapt to limit damage to wildlife, whilst supporting opportunities for recovery and protection of species

2030 Objective (i)

All new developments use appropriate blue and green infrastructure to protect from future climate events whilst also providing ecological net gain and enhancing the sequestration potential of all developments.

2030 Objective (ii)

The city's natural environment (including canopy cover and biodiversity) has been restored, preserved and enhanced to maximise carbon sequestration in carbon sinks, climate resilience and health and wellbeing.

2030 Objective (iii)

Everyone lives and works within a 10 minute walk of a quality green space with sufficient tree canopy cover to provide refuge for citizens during climate change induced extreme heat conditions.

2030 Objective (iv)

Bristol businesses and organisations are wildlife friendly by providing habitats, birdboxes or sponsoring the development of green infrastructure in an effort to recover wildlife lost as a direct result of climate change or urbanisation.

Delivery theme 8
Natural environment

Our journey to 2030

We know that we need to make fundamental changes to reach our 2030 goals. Based on the evidence that we have in 2020, we anticipate this will include actions such as:

Engagement, culture and inclusion

If designed right, we know that green infrastructure can have a large and positive impact on communities. We will therefore aim to use these green spaces as vehicles for community education and engagement. An example of this would be through the NHS encouraging active participation in green infrastructure and the natural environment, which in turn would benefit the health and wellbeing of Bristol's citizens. We know that engagement schemes will inform citizens on the role climate change has on the natural environment, for example on our wildlife and the spread of new species and diseases.

Funding and finance

We know we will need new funding mechanisms that fully value the natural environment, recognising the benefits that ecosystem services have on the population's wellbeing. This could involve working with organisations such as BCC and the NHS to develop models around the payment for ecosystem services.

National and regional action and city leadership

We know we will need to build on current work, working alongside city leadership to create a robust blue and green infrastructure strategy for Bristol. We will also need planning policy that supports the delivery of green infrastructure, and we may also need wider environmental regulation.

Skills and capacity

We recognise that we will need the skills and capacity to successfully implement a blue and green infrastructure strategy. This will involve a plan and programme of works that supports a nature and land-based response to the physical impacts of climate change in Bristol. As a result, we will aim to maximise the wider benefits of creating a natural urban environment.

Data and knowledge

In order to develop blue and green infrastructure planning, we know that further analysis of data will be required. An example of this could be detailed heat mapping of Bristol to understand hot spots in accordance with climate change projections.

Infrastructure

Developing new and enhancing current blue and green infrastructure in the city will play a large role in improving future resilience. Such initiatives could include:

- Integrating green infrastructure solutions into a city centre flood management strategy
- Developing wildlife and nature corridors (green and blue) to create a network through Bristol that connects to surrounding areas.

Delivery theme 8
Natural environment

Key challenges:

- Integrating blue and green infrastructure into existing crowded transport and infrastructure networks in Bristol
- Ensuring functionality of blue and green infrastructure is sufficient to support commuting/ transport needs of citizens
- Overcoming silo budgeting – creating an integrated approach to invest in public green space.

Opportunities:

- Health and wellbeing-led infrastructure approach
- True and sustainable restoration and enhancement of wildlife population and habitats in Bristol to tackle the ecological emergency
- Using other capital infrastructure to deliver green infrastructure through co-design (e.g. district heating)
- Redressing the balance of access to nature and green space, which is lower in some deprived communities who cannot always travel to access it.

Delivery theme 9
Food

The challenge

The majority of food consumed in Bristol is produced outside the city (and country) boundary and transported into the city for use in schools, hospitals, care homes, charities and businesses and for sale in supermarkets, restaurants and other consumer outlets. The total emissions associated with the production of all food and drink consumed by households in Bristol annually accounts for approximately 14% of the total (570ktCO_2e). Only 12% of these emissions occur directly within the Bristol city boundary (this covers the manufacturing of food and drink products within the city boundary and transportation of all food/drink products around the city), while the remaining 88% are attributed to our food and beverage supply chains. Meat and dairy are amongst the highest carbon food groups.

Given the complexity of our food supply chains, we are at risk of food shortages or food price rises as a result of extreme weather events elsewhere in the world. Some of the world's core crops are mainly produced in relatively concentrated geographic areas, reinforcing the vulnerability. An example of this impact in practice is the Russian heatwave in 2010 which was linked to the doubling of global wheat prices. When food prices rise, it is the poorest in society who are hit hardest.

Our strategy

Developing a resilient and low carbon food supply chain will contribute to the reduction of Bristol's carbon footprint whilst also improving security to the supply chain and boosting the local food economy. Positive change around Bristol's food culture also provides an opportunity to engage with children and adults about health, wellbeing and nutrition as well as different cultures and diets. This is especially important in a time when tens of thousands of children in Bristol are either overweight or obese.

Delivery theme 9
Food

2030 goal: Bristol will have a resilient food supply chain that supports the city region's local food economy

2030 goal: People in Bristol will consume carbon neutral food and drink

2030 Objective (i)
Sustainable and low carbon food options will be available to everyone, respectful of all dietary and cultural requirements, in all future climates.

2030 Objective (ii)
Bristol city region specific carbon neutral, climate resilient food supply and distribution solutions will be implemented.

2030 Objective (iii)
Urban food production potential is maximised for sustainable and resilient food production and is used as a mechanism for active community participation and education in food sustainability.

2030 Objective (iv)
Our citizens will have a more plant-based diet, minimise food waste and support an increase in the market for sustainable and carbon neutral food.

Delivery theme 9
Food

Our journey to 2030

We know that we need to make fundamental changes to reach our 2030 goals. Based on the evidence that we have in 2020, we anticipate this will include actions such as:

Engagement, culture and inclusion

Engaging people of all ages is essential to deliver the change required. Food can have a powerful social and cultural role, and this can be harnessed to support wider community benefits. Engagement would include providing essential information such as the origins of food, practical skills and principles of sustainable consumption for people of all ages and backgrounds.

Funding and finance

We know that we will need to provide financial support to promote sustainable food systems. This could be through national subsidies, changes in policy, including new financial incentives for consumers and businesses.

National and regional action and city leadership

The national, regional and local government has the power to make a large impact on the city's food economy. We know that this could be achieved through actions such as:

- Formal adoption of policy that designs out food waste in both commercial and residential settings
- Local reward scheme recognising low carbon businesses and farmers that operate with sustainable and resilient supply chains.
- Local government incentives, adaptation funding and guidance to support food businesses transition to carbon neutral and resilient supply chains.

Skills and capacity

We know that we will need to share skills with those that supply and distribute food within the city. Through this kind of collaboration we will have the opportunity to understand their carbon emissions and get further guidance on how they resolve matters such as improving their resilience.

Data and knowledge

We realise the importance of harnessing data to fully understand the impact of climate change in this area. An example of this would be through analysing current supply chains in order to highlight key areas for optimisation.

Infrastructure

The implementation of roof and vertical urban farming solutions is an area that we know will require a lot of focus and support. This infrastructure could include making use of redundant assets such as city carparks, which would be in alignment with a transport mode shift. We know it would also be advantageous to develop mutually beneficial systems, an example of this would be agrovoltaics (agriculture and solar PV).

Delivery theme 9
Food

Key challenges:

- Implementing a sustainable and resilient supply chain that extends across all aspects of the city's food network
- Adjusting the long-engrained preferences of citizens for convenience
- Some ethical and sustainable food items can be more expensive, which can disproportionately affect those on low incomes
- Many global companies marketing and producing a cheap and convenient high carbon food, which may be vulnerable to the impacts of climate change

Opportunities:

- Setting a national example by positively influencing the health and wellbeing of Bristol's citizens whilst establishing a sustainable, resilient and low carbon supply chain for the city
- Avoiding food waste, healthy eating and food growing can all save money and improve health for people on low incomes
- Harnessing the social and cultural power of food to promote wider societal benefits
- As well as reducing risks from global climate hazards, more local food supply chains provide the opportunity to create jobs
- Sustainable food production methods could promote wider environmental benefits, such as improved soil quality and water quality

Delivery theme 10
Infrastructure interdependencies

The challenge

This encompasses all grey infrastructure, blue and green infrastructure (covering vital services such as water, transport, waste, ICT and energy), and the social infrastructure (such as hospitals, schools, social care services, community services and emergency services) present within the city, or providing services to people in the city.

Infrastructure assets work together to provide essential services to people. For example, to receive clean drinking water, we are not only reliant on the infrastructure that treats and moves the water, but also on the transport infrastructure that enables staff to access water treatment sites, the ICT infrastructure that supports the control systems, and the electricity infrastructure that delivers power to treat and pump water.

As the city is made up of complex interdependent systems, climate risks can have direct or indirect relationships between wider city assets and cause cascading shocks and stresses. Therefore, failure of an asset can cause impacts far beyond the directly impacted area, and the failure of assets geographically remote from Bristol can have knock on consequences for the city. For example, water availability outside the city boundaries could be affected by a climate event which would in turn impact availability of water in the city.

As we develop and adapt our infrastructure to deliver a low carbon future, new interdependencies will emerge. For example, as we electrify heat and transport, additional electricity distribution infrastructure will need to be built in the city. Collaboration across infrastructure systems will be needed to plan this effectively. It will also lead to potential new vulnerabilities within city systems.

Our strategy

Adopting a joined up approach can enable more efficient resource use and share the costs and risks. Collaborating across systems will enable us to reduce system vulnerabilities in a way that is focused on protecting provision of services to the most vulnerable in the city first.

Collaborative infrastructure management for the transition to carbon neutrality will also work to minimise the disruption experienced by citizens, businesses, organisations and the city as a whole during this period of rapid and drastic change. In order to reach the goals set for 2030, it is crucial that carbon neutral designs are explored and implemented, finding the optimum solutions to ensure Bristol is resilient to climatic changes whilst working towards carbon neutrality.

Delivery theme 10
Infrastructure interdependencies

2030 goal: Infrastructure investors, owners, operators and regulators will collaborate to improve the resilience of the services provided by our infrastructure systems to future climate change and extreme weather events

2030 goal: Infrastructure investors, owners, operators and regulators will collaborate to develop and maintain infrastructure supports a carbon neutral Bristol across systems

2030 Objective (i)

Our infrastructure is projected to deliver the needs of everyone in the city in even an extreme future climate scenario. Provision of vital services, such as water and sewerage is maintained in all but the most extreme circumstances.

2030 Objective (ii)

The extent and criticality of Bristol's infrastructure interdependencies is understood by all necessary stakeholders and used to optimise performance now and in the future.

2030 Objective (iii)

We understand the risk extreme weather events pose across our infrastructure systems and collaborate to improve resilience.

2030 Objective (iv)

Infrastructure stakeholders work together to develop cross-sector, whole system carbon neutral solutions.

Delivery theme 10
Infrastructure interdependencies

Our journey to 2030

We know that we need to make fundamental changes to reach our 2030 goals. Based on the evidence that we have in 2020, we anticipate this will include actions such as:

Engagement, culture and inclusion

We acknowledge the need to undertake some form of joint community and user engagement to understand areas such as accessibility issues and potential improvements to services. This will provide assurance that infrastructure is usable and fit for purpose for citizens and organisations, as well as highlighting how to optimise infrastructure to benefit the city.

Funding and finance

Ensuring maintenance of existing infrastructure and delivery of new infrastructure across the city is critical. Sharing costs and risks implies new delivery and financing mechanisms, aligning the timescales and requirements across partners to deliver benefits that will extend beyond an individual infrastructure provider.

Financial resilience will be critical for our infrastructure services, as they are often providing critical services that need to be maintained in the case of an emergency – the ability to quickly mobilise and raise funds to support livelihoods will be critical.

National and regional action and city leadership

We know that we will need support from local and national government to achieve these objectives. These actions may include:

- Undertaking design and planning at a community level
- Using leadership within local government to encourage cross-sector design and collaboration with projects such as green infrastructure and district heat networks.

Skills and capacity

We know we will need the skills as well as training for infrastructure operation and maintenance staff to align with the identification of interdependencies between systems.

Data and knowledge

Collecting data and sharing knowledge would allow for a greater understanding of infrastructure interdependencies and informed planning. This could include:

- An infrastructure resilience plan and programme of works aligning with interdependency mapping; and
- Collaborative adaptation planning through a knowledge sharing group between major infrastructure groups e.g. Network Rail, Highways England, ICT providers, Bristol Water, Wessex Water, Western Power Distribution, National Grid, BCC, major building owners, large institutions like the NHS and nature organisations.

Infrastructure

We recognise the importance of digital and ICT developments and will need to take advantage of these to support the other infrastructure networks. Additionally, we know that all interdependencies and vulnerabilities of current and new infrastructure will need to be managed and mitigated. This could be through promoting collaboration between infrastructure providers and operators, interdependency mapping and analysing the predicted impacts of climate change.

Delivery theme 10
Infrastructure interdependencies

Key challenges:

- Integrating blue and green infrastructure into existing crowded transport and other infrastructure networks in Bristol
- Potential for some issues around data privacy may limit data sharing between infrastructure providers
- Legislative powers may be needed to encourage all providers to work collaboratively
- Infrastructure does not respect administrative boundaries
- Better information and data is needed to fully understand interdependencies.

Opportunities:

- Sharing knowledge, data, costs and risks of projects between those who would benefit
- Opportunities to protect the most vulnerable in society
- Opportunities for innovation and for Bristol to develop a creative adaptation economy, with products and services that can be shared with others
- Opportunities to enhance health and wellbeing through developing creative solutions that maximise these outcomes through e.g. green infrastructure.

Monitoring and review

Overview

In order for Bristol to become carbon neutral and climate resilient and to have maximum impact on the global climate, Bristol's experience should provide a roadmap for other similar places to follow, reflecting our principle of being transformative. We will also need to evolve and learn, in line with our learning principle.

We already have a city baseline provided by the evidence base reports. We will develop this knowledge and monitor progress against this evidence.

We need a robust monitoring regime to record which interventions work best, which offer best value for money and which provide the widest co-benefits. Therefore an essential part of this strategy is the monitoring, measuring and public reporting to communicate the progress the city has made.

Mirroring the national Committee on Climate Change, we have established the Bristol Advisory Committee on Climate Change to review progress and act as a critical friend to stakeholders in the city.

They will produce biennial reports on both adaptation and mitigation needs and progress in implementing measures, which will provide stakeholders and the public with transparency about the process.

As one of our key principles is learning and evolving this plan, this review will feed into continuous review and revision of the delivery plans. This will enable us to be agile and expend effort on the most effective interventions.

Next steps

In 2020, and in parallel with the delivery planning, we need to develop a clear framework for monitoring and review in subsequent years. We will:

- Develop indicators for mitigation and resilience action covering both outputs (what is delivered through actions) and outcomes (the difference made by the outputs). This monitoring will aim to identify and mitigate any unintended negative consequences.
- Establish a transparent process to monitor delivery, communicate progress and update planning.

A note on offsetting

Achieving carbon neutrality will mean managing residual emissions remaining after all planned interventions have been made. This will typically involve offsetting; this is a complex issue, with challenges around additionality, fairness, financing interventions and carbon accounting. For example, sequestration of carbon emissions through land use change may be more acceptable than sequestration through land use change outside the city.

Given the need to prioritise direct interventions to reduce emissions, offsetting will be considered as we get closer to 2030.

However, given the potential lead in times to assemble finance from across partners in the city, the potential need for land assembly and other complexities to resolve, we are proposing a review of offsetting requirements in the late 2020s.

Delivery

This strategy sets out the city's shared ambition and vision for a decade of transformative climate action. The route for delivering actions will be detailed in delivery plans, which will be developed and engaged on.

We quickly need to move from strategy to action. Two key things will be required to enable this;

- Committed, collective, and collaborative leadership from across the city; and
- Resource and capacity to deliver.

Committed, collective leadership from across the city

The One City Approach has already proven successful in bringing partners together to provide collective leadership on key issues and challenges for the city. It is a mechanism aligned to sustainable development, where all actors in society need to play their part in order for us to succeed.

Bristol is a city where leadership comes from all sectors and all people; formal structures will only ever represent a part of the picture. And of course people don't need to wait for someone else in order to act. In fact, many people and businesses are already taking action individually and in communities or networks. This will need to continue and scale up.

People's individual actions to reduce their emissions and make their voices heard are extremely important, both in direct emissions reduction and in bringing about the policy changed we need to achieve these goals.

However, governance provides accountability, support and co-ordination within wider networks. The One City Environmental Sustainability Board will continue to provide leadership and oversight of the delivery of the strategy, supported by all five other Boards, who all came together to support the development of this strategy.

The Bristol Advisory Committee on Climate Change will continue to provide evidence and advice to city partners, as we move from action to delivery.

Resource and capacity to deliver

The strategy will be followed by delivery plans, in some instances these will be existing statutory plans, in other instances a new approach will be required.

In both cases, it is essential to ensure that there are sufficient human and financial resources within partners to deliver the plans.

This will require a commitment from an initial partner to kick-start and co-ordinate action.

Delivery will comprise elements that are both top-down and bottom-up. People who live, work, play and invest in Bristol all have a crucial role to play.

There is a strong existing ecosystem of partners working to deliver climate action across the city. It is essential that this work continues.

However, in order to deliver at a new pace and scale of change, and to share learning effectively and quickly, new programmes of work will be required. These may well be delivered by individual organisations, but co-ordination will be needed to achieve our shared ambitions as one of the UK's leading cities.

Appendices

Glossary and definitions

Definitions

The following key terms are used within this strategy:

Climate change mitigation: A human intervention to reduce the sources or enhance the sinks of greenhouse gases (IPCC, 2012).

Carbon emissions: Throughout this strategy, we have used the term carbon emissions as a shorthand for all greenhouse gas emissions, expressed as CO_2e (carbon dioxide equivalents). This strategy refers to greenhouse gas (GHG) emissions, covering scopes 1-3, in line with the GHG protocol for cities:

- **Scope 1 emissions** Direct emissions from owned or controlled services, e.g. fuel combustion, vehicle use.
- **Scope 2 emissions** Indirect emissions from the generation of purchased energy, e.g. electricity, electric heating.
- **Scope 3 emissions** All other indirect emissions after scope 2 have been accounted that occur in the entity's footprint, e.g. production of goods and services, waste disposal, etc.

Carbon neutral: Where the carbon emissions caused by an entity (e.g. individual, business, product, etc.) have either been eliminated, or balanced by removals of greenhouse gasses (including offsetting). This can sometimes be referred to as net zero.

For the purposes of this strategy, we have used "carbon neutral" as shorthand for greenhouse gas emission neutrality.

Carbon offsetting: The action or process of compensating for carbon dioxide emissions arising from industrial or other human activity, by participating in schemes designed to make equivalent reductions of carbon dioxide in the atmosphere. This offsetting can either be local or international.

Carbon sequestration: The process of removing carbon from the atmosphere and storing it in a carbon sink, a fixed molecule in soil, oceans or plants.

Climate change adaptation: The process of adapting, either through reducing the impact of the climate hazard, or through reducing exposure or vulnerability, to the actual or expected climate and its effects.

Climate resilient: Ability of human and non-human systems to withstand and respond to future changes in the earth's climate, e.g. extreme weather temperatures, flooding, increased rainfall, etc.

Climate resilient by 2030: In this strategy, we have used this term to mean being prepared, through adaptive planning, for a global temperature rise of up to 4.3^{O}C by 2100 compared to pre-industrial levels.

Physical climate risk: comprises an assessment of climate hazard exposure, sensitivity and adaptive capacity.

Climate hazard: climate-related physical events, such as flooding or drought.

Sensitivity: the vulnerability of assets to be impacted by climate hazards based on their condition and capacity and the potential consequences of these hazards on people.

Glossary and definitions

Adaptive capacity: the ability of systems, organisations or people to adjust to events, respond to consequences or take advantage of opportunities.

Health and wellbeing impacts of climate change: Health impacts, in the context of the strategy, are linked to more physical metrics such as increased risk of illness from increased temperatures (e.g. heat stroke). Wellbeing impacts consider a wider range of aspects, such as physical, economic, social, emotional and psychological wellbeing. In both cases, impacts could be positive or negative depending on the driver, e.g. poorly insulated dwellings can have a negative impact on health through increased risk of mould and damp conditions, whereas well insulated dwellings, that are also optimally designed to avoid overheating in summer, can have a positive wellbeing impact through reduced energy costs and feeling of comfort.

Natural capital: Natural capital refers to the biological, physical and chemical resources/assets, known as 'Stock'. According to agreed convention, this Stock broadly includes biodiversity (ecological communities), soils, freshwater, land, minerals, atmosphere (air), subsoil assets, and oceans.

Biodiversity: The variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems.

Blue green infrastructure: A strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services is both rural and urban settings.

Ecosystem services: Processes and functions provided by the earth's natural resources, e.g. pollination, flood mitigation, air purification.

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