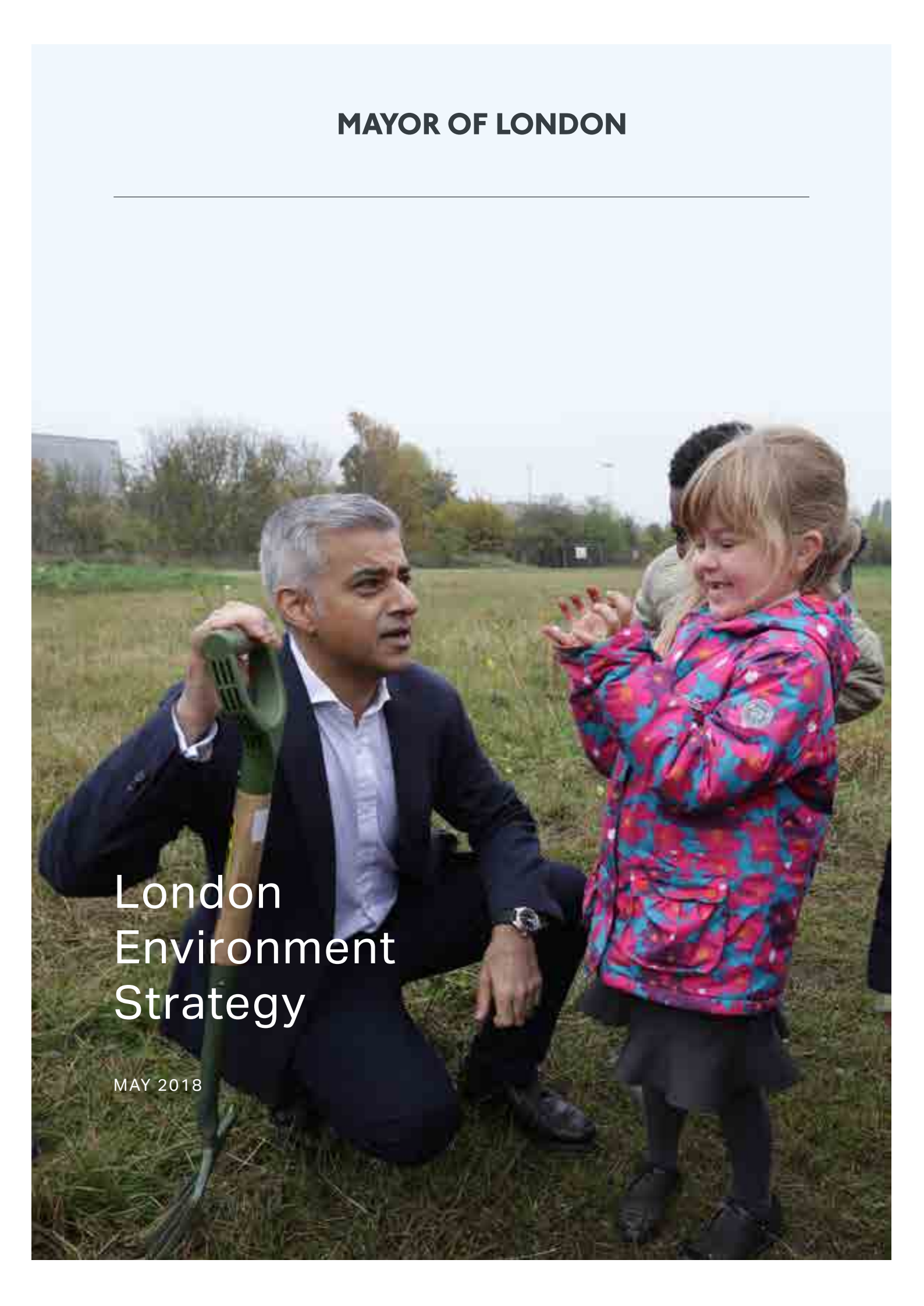


MAYOR OF LONDON

A photograph of Mayor of London Sadiq Khan kneeling in a grassy field. He is wearing a dark blue suit jacket over a light blue shirt and is holding a green garden trowel. He is looking towards a young girl with blonde hair, who is wearing a colorful, patterned winter jacket and a dark skirt. The girl is smiling and has her hands raised as if clapping or talking. In the background, there are trees and a building under an overcast sky.

**London
Environment
Strategy**

MAY 2018

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Mayor's foreword

London's environment and the quality of our air has come a long way since the Great Smog. Innovations in urban design and the introduction of stronger environmental regulations have helped to drastically reduce industrial pollution and make our city a cleaner, greener and more pleasant place to live. But while we have seen significant improvements, London today is still confronted by a host of serious environmental challenges.

Toxic air, noise pollution, the threat to our green spaces and the adverse effects of climate change all pose major risks to the health and wellbeing of Londoners.

In many ways, these issues are intertwined, but we must recognise that these challenges are as complex as they are connected, and that there are no quick fixes.

Real progress to improve the quality of our air, clean up our natural environment and decarbonise our energy sources will take time. And it will require a concerted long-term effort and cooperation between a wide range of partners. Yet being honest about the size and scale of the challenge must never serve as an excuse for inaction. Big problems simply demand ambitious responses.

Nowhere is this truer than with air pollution in London. Thousands of Londoners die prematurely every year as a direct consequence of our dirty air, which often breaches legal limits. Air pollution has been linked to asthma, strokes, heart disease and dementia – and is to blame for children in parts of our city growing up with stunted lungs.

Worryingly, some of the worst pollution hotspots are around schools. And research shows that London's most deprived communities are among the hardest hit – meaning that poverty and pollution are combining to limit the life chances of too many young Londoners.

In the 21st century – in a city as rich as ours – this situation is unacceptable. That's why I'm delivering the most ambitious plan to reduce air pollution of any major global city, making sure the Greater London Authority and Transport for London lead by example.

We are also investing record sums in public transport, making walking and cycling easier for Londoners and phasing out dirty diesel buses, replacing them with brand new lower and zero emission models.



My aspiration is also to help turn London into a zero carbon city by 2050. And I'm committed to working with national government, local boroughs, London's businesses, NGOs, our European neighbours and individual Londoners to achieve this goal.

This means cutting harmful emissions, protecting the Green Belt and our green spaces, and preparing London to respond to climate change. I'm passionate about taking the lead and using the powers at my disposal to boost London's green economy and deliver sustainable growth.

We have already embedded the latest green thinking at the heart of my strategies for transport, planning and the economy, set ourselves a target of making London a zero waste city and established my Energy for Londoners programme, which will help generate more local low carbon energy and help our homes and businesses use less energy.

What we are doing is the template for ambitious action by the Government at the national level, and serves as a blueprint for how to properly protect and enhance the environment.

This is the first truly integrated environment strategy for London that will combine policy and action to deliver multiple benefits for Londoners. And we have already taken huge strides to deliver on many of its aims – from improving the quality of our air to reducing single-use plastic bottles and food waste. But we now need the Government as well as all of London – businesses, communities, charities, local authorities and ordinary Londoners – to play their part in helping us to deliver good growth for our city - growth that makes London cleaner, greener and ready for the future.

In drafting this strategy, we've listened to countless Londoners who have been calling for stronger action on a range of environmental issues, and I hope that Londoners from all backgrounds will continue to engage with this vital process.

There's no doubt that London is the greatest city in the world – and with your help, we will regain our international reputation for environmental leadership and become the greenest city in the world too.

A handwritten signature in black ink that reads "Sadiq Khan". The signature is written in a cursive, flowing style.

Sadiq Khan
Mayor of London

Message from the Deputy Mayor for Environment and Energy

This London Environment Strategy sets out an ambitious vision for improving London's environment for the benefit of all Londoners. From cleaning up the toxic air that damages the health of young and old alike, to creating new green spaces where they are needed most, this strategy provides a holistic plan for tackling the city's environmental challenges. By making new connections I'm confident we will make London greener, cleaner and ready for the future.

Publicly consulting on our proposals gave Londoners their first ever opportunity to share their views on the future of every aspect of their environment. Thousands of Londoners, community groups and other stakeholders responded – with support for our vision and proposals and suggestions for improvements.

I would like to say a big 'thank you' to everyone who has taken part – each and every one of you has helped to shape the future of London's environment, ensuring that our ambition and direction matches the needs of Londoners themselves.

I would also like to thank the GLA Environment team and the array of wider GLA group officers who have contributed to this strategy. We could not have done it without you.

Alongside this document, we have published an implementation plan, setting out actions the Mayor is prioritising for the next five years to help implement the aims of this strategy. Two years into Sadiq Khan's Mayoralty, much of this work is already underway.

The T-Charge has been introduced in central London to help get the most polluting diesel vehicles off the road. Energy for Londoners has been launched, offering new boilers and insulation in fuel poor homes. And we're already planting tens of thousands of trees and improving our much-loved green spaces across London.

We are fortunate to have a wealth of community groups, London boroughs, businesses and individual Londoners already playing their part in making the vision set out in this strategy a reality. I now look forward to working with all of you to do even more to fulfil our ambitions, creating the healthy environment that all Londoners deserve.



A handwritten signature in black ink that reads "Shirley Rodrigues". The signature is written in a cursive style with a long horizontal line underlining the name.

Shirley Rodrigues
Deputy Mayor for Environment
and Energy



Chapter 1:

London's environment today

LONDONERS AND THEIR ENVIRONMENT

London's environment connects every aspect of life in the city. It is the air Londoners breathe, the water they drink and the parks where they meet and spend time. The state of London's environment affects everyone who lives in and visits the city – it helps Londoners to stay healthy, allows businesses to thrive and keeps London functioning from day to day.

Proper care for the environment can help London to operate well every day, now and into the future. It can ensure the city produces enough energy in the right way, reduce waste so the city has the resources it needs and keep London's infrastructure operating smoothly.

Improving the environment can protect Londoners' health, make their homes warmer and more comfortable to live in and defend the city from future changes. It can clean up the city's air, reduce the health impacts of noise and provide shade and shelter from the elements. It can protect the city from flooding and reduce the damaging impacts of climate change.

At its best, the environment can enhance Londoners' interaction with their city and each other, making the city a better place to live and improving quality of life. It can make streets and places greener, more pleasant and more engaging. It can provide open spaces where people can relax and interact with each other. It can connect people with nature and the places around them.

Many of these impacts are interconnected, and environmental improvements can have even wider benefits. For example, cleaner air can be achieved by reducing car use, which will also improve health by increasing walking and cycling levels and reducing noise. Reduced traffic dominance will make streets more pleasant places to spend time, and streets can be further enhanced by trees and other greenery. When a holistic view is taken and connections to the rest of London life are considered, the opportunities London's environment provides to make the city a better place are huge.

The importance of the environment to a city like London can sometimes be overlooked, but the environment can shape the city in ways that affect everyone. It is vital that the right approach is taken to help create the city Londoners need now and in the future.

ENVIRONMENTAL CHALLENGES

In many ways, London's environment is improving. The city's air and water have recovered from the worst impacts of industrial pollution. Greenhouse gas emissions, which cause climate change, are reducing. The city is well-defended against the worst forms of flooding. But London also faces a range of environmental challenges that threaten the future of the city.

Air quality

The quality of London's air is dangerously – and illegally – poor. High levels of damaging pollutants harm human health and quality of life, limiting lung development in childhood and reducing life expectancy. Over 9,000 Londoners' lives end sooner than they should each year because of air pollution, and around 20 per cent of primary schools are located in parts of London that breach legal air pollution limits. Air quality is the most pressing environmental threat to the future health of London.

Green space

As development encroaches on open space and gardens have increasingly been paved over, there has been a gradual loss of green space across

London in recent years. Some parts of London have more green spaces than others, but almost half of Londoners have poor access to parks. Councils now have less money to spend on maintaining parks, so their quality has declined in some places. Access to good quality green space and living in greener neighbourhoods can have a big impact on people's health and quality of life, and on how attractive a place London is in which to live, visit and do business.

Biodiversity

As green space has been lost and what remains has in some cases reduced in quality, the range of plants and animals that live in London has decreased. With careful attention, London can be home to a wide range of animal and plant species, but without it, the number and diversity of bird, wildflower and bee species will continue to decline.

Greenhouse gas emissions

Although London's greenhouse gas emissions are falling, the city remains over-reliant on the fossil fuels that are a major contributor to global warming and climate change. London is not yet on track to reduce its emissions quickly enough to avoid the worst impacts of climate change, or to meet national and international climate aims.

Energy use

Nearly three quarters of the energy used in London's homes is for heating and hot water, and the overwhelming majority of this demand is met using gas-fired boilers. Already one in ten electricity substations are approaching full capacity, and the redevelopment of large parts of the city will increase demand for energy and the infrastructure required to distribute it. One in ten households in the city currently lives in fuel poverty, sometimes meaning they have to choose between heating their home or eating.

Waste

Waste has a big impact on the environment both locally and globally. Less than half of the 7m tonnes of waste that London's homes and businesses produce each year is currently recycled, and landfill capacity is set to run out by 2026. Plastic packaging not only litters London streets, but often finds its way into waterways and oceans, releasing toxic chemicals before breaking down – a process that can take centuries. London needs to reduce, reuse and recycle more, to see waste as the valuable resource that it is, and to reduce London's increasing waste bill as the city grows.

Flood risk

The loss of green space, the expansion of impermeable surfaces used for roads, roofs and pavements, and a Victorian

drainage system that wasn't designed to cope with the demands of the current and future population leave London exposed to the risk of flooding. As climate change brings a rise in sea level and more intense rainfall, flooding will become increasingly likely.

Heat risk

Climate change is set to lead to heatwave conditions every summer by the middle of the century, and the Urban Heat Island effect makes the centre of London up to 10°C warmer than the rural areas around the city. Increasing heat risk could make homes, workplaces and public transport uncomfortable for all and dangerous for the most disadvantaged. Increasing demand for cooling may put stress on power supply networks, threatening London's sustainability and increasing emissions.

Water scarcity

London's water supply is under pressure. Even with projected water efficiency gains, London is forecast to have a water resource 'gap' of over 100m litres per day by 2020, rising to a deficit of over 400m litres per day by 2040. This means that there won't be enough water to meet London's needs. London already gets a large proportion of its water from groundwater and surrounding rivers, which damages the health of rivers and threatens the city's future water supply.

River water quality

Years of pollution from road run-off, sewer infrastructure problems, and poorly managed river maintenance and modification work have left London's rivers in a poor state. Under an EU framework, only one of London's 47 river water bodies is classed as 'good' – three are 'bad', five are 'poor' and the rest are 'moderate'.

Ambient noise

Noise is part of a vibrant city, but excessive noise can damage people's health. Noise can contribute towards a range of physical and mental health problems, disturb sleep and affect people's hearing, communication and learning. Almost 2.4 million people in London are already exposed to noise levels that exceed international guidelines, and the proposed expansion of Heathrow would expose an additional 200,000 people to significant aircraft noise.

Many of these problems are interconnected, and together they pose a threat to the future of the city. With the effects of climate change likely to

exacerbate environmental challenges in a growing city, London must act now to avoid further problems in the future. Making London a better city to live in must involve a holistic approach to the city's environment that addresses all these pressing issues.

GENERAL ASSESSMENT OF LONDON'S ENVIRONMENT

Accompanying this strategy is a General Assessment of London's Environment. This evaluates the current condition of London's environment at a city-wide level, using high-level indicators. Environmental issues are the negative impacts of our demands on environmental resources and/or the consequences of their poor management. The main environmental issues identified in the General Assessment have informed the development of this strategy.



Chapter 2: Transforming London's environment

For the first time, this strategy brings together approaches to every aspect of London's environment, kick starting action that will improve the city's environment right away, while taking the most ambitious view of what is possible in the future. It makes new connections between the environment and the rest of life in London. Recognising that the environment has a big influence on the quality of Londoners' lives, it has people and their experience of living, working and spending time in the city at its heart.

By 2050, London is expected to be home to 11.1 million people, compared to around 8.7 million people today. The city's population and economic growth will pose environmental challenges, but with new thinking and careful planning they can also provide the solution to many of the threats the city now faces. Realising the Mayor's vision for environmentally good growth – growth that allows London to remain resilient to the changing climate and is green and healthy – will entail building environmental improvements into every aspect of London's development.

The Mayor wants London to be the world's greenest global city. This will mean making it:

Greener: All Londoners should be able to enjoy the very best parks, trees and wildlife. Creating a greener city is good for everyone – it will improve people's health and quality of life, support the success of businesses and attract more visitors to London. Action will be taken now to plant more trees, make green spaces more accessible, and ensure more green roofs and green features are designed into new developments. Local authorities and community groups will be supported to manage and value London's parks and biodiversity better. This will help to make sure that more than half of London is green by 2050.

Cleaner: Londoners want their city to be clean, attractive and healthy – living in a big city does not mean they should accept a dirty and polluted environment. The Mayor will clean up London's air, water and energy in a way that is fair, protects the health of Londoners, and contributes to the fight against climate change.

Action will be taken now to introduce less polluting buses, deter the most polluting vehicles from being driven in London, and clean up the air around schools and new developments. The roll out of sustainable drainage systems and improvements to the sewerage network will help keep the city's rivers clean. The Mayor's new Energy for Londoners programme will help Londoners and businesses to generate more renewable energy. This will help London's buildings to be powered more cleanly, its entire transport system to become zero emission, and for London to be a zero carbon city by 2050.

Ready for the future: Water, energy and raw materials for the products we consume will be less readily available in the future, and climate change will mean higher temperatures, more intense rainfall and water shortages. The Mayor will make sure the city does not waste valuable resources, is prepared for the future, and is safeguarded for future generations.

Action will be taken now to plan for new flood defences and new water resources for London, as well as to help transport, water and other infrastructure providers better prepare for the changing climate.

"The Mayor wants London to be the world's greenest global city."

“The Mayor is taking a range of immediate actions to improve the environment now, setting London on the path to creating a better future.”

New smart meters will be rolled out to help Londoners use less energy and water, higher recycling standards will cut waste, and Londoners will be helped to use less packaging. This will help London send zero waste to landfill by 2026 and recycle 65 per cent of its municipal waste by 2030.

This London Environment Strategy sets out bold policies and proposals in seven policy areas, including the transition to a low carbon circular economy, to make this vision a reality. It provides, for the first time, an integrated framework for all the people and organisations whose actions, activities and policies have an impact on London’s environment.

PRINCIPLES

London’s environmental problems cannot be solved overnight, and creating the environment Londoners deserve will require everyone to work together over many years. This strategy sets out a vision for London in 2050, that will realise the potential of London’s environment to support good health and quality of life and to make the city a better place to live, work and do business. But the city’s most pressing environmental challenges are harming Londoners’ health and the city’s economy right now, and the current pace of change is too slow. So, the Mayor is taking a range of immediate actions to improve the environment now, setting London on the path to creating a better future.

To ensure that in doing so this strategy remains realistic and people-focused, the following principles inform the approaches taken throughout:

- improving lives and reducing inequalities – action is required across different policy areas to provide solutions to environmental challenges. This strategy makes connections with other Mayoral strategies to prioritise fairness in the access and use of the environment
 - leading by example – the Mayor and wider GLA group should lead by example. Organisations like Transport for London (TfL), as well as organisations the Mayor has oversight of, such as the Metropolitan Police, can set examples and use new technologies
 - avoiding negative impacts on other policy areas – a single focus on one policy concern shouldn't lead to a negative impact on another
 - learning from international best practice – London should be a global leader on the environment. This will require collaboration with leading climate change and environmental institutions and other world cities, sharing ideas and learning from best practice
- moving beyond business as usual – rather than just minimising the worst impacts of future change, this strategy aims to protect and improve London's environment

These principles will ensure not only that the Mayor's bold ambition for the future of London's environment can be realised in practice, but that the measures that are needed to improve London's environment are implemented in a way that meets the needs of Londoners themselves. By keeping people at the heart of London's first holistic and integrated strategy for the environment, the Mayor's vision of making London the world's greenest global city can be achieved in a way that improves the lives of all Londoners.

The solutions to London's environmental challenges set out in this document have been developed in the context of current national and local policies, and the powers the Mayor currently has to act (Box 1).

LONDON PLAN

TRANSPORT

HOUSING



HEALTH INEQUALITIES

CULTURE

ECONOMIC DEVELOPMENT

BOX 1: THE CONTEXT FOR THE DEVELOPMENT OF THE LONDON ENVIRONMENT STRATEGY

The Mayor's responsibilities and powers vary across the different environmental issues covered in this strategy (see Appendices 3 and 4 for more information).

The Mayor has powers to supervise local authority air quality management functions and to require local authorities to act in general conformity with this strategy on municipal waste. The Mayor also has the power to:

- guide London's spatial development through the London Plan¹
- manage London's transport through Transport for London

Where powers to act are held by others, such as reducing flood risk, or direct delivery is the responsibility of others, such as the management of parks, the Mayor can use leadership, influence and funding to ensure that the right action is taken for London.

This strategy has been written in the context of national policy. This includes the result of the 2016 referendum on the UK's membership of the European Union (EU). With large sections of the UK's environmental policy and regulation having been developed and implemented within the EU, the UK's vote to leave the EU could result in uncertainty and potentially significant changes to national policy across the range of environmental issues covered in this strategy. The Mayor has published London's position on environmental priorities as the UK exits the EU.²

This strategy has been developed to provide leadership on the environment. The challenges and approaches covered here should also be pursued at national level.

¹ This strategy refers to the London Plan which at the time of publication is draft London Plan which is subject to Examination in Public and other relevant statutory procedures before it can be finalised, expected in late 2019.

² Mayor of London (2017) London's Global and European Future. Accessed from: https://www.london.gov.uk/sites/default/files/londons_global_and_european_future.pdf

AIMS

To make the Mayor's vision of transforming the city's environment a reality, this strategy establishes some key aims for London. The Mayor aims:

- for London to have the best air quality of any major world city by 2050, going beyond the legal requirements to protect human health and minimise inequalities
- for London to be the world's first National Park City, where more than half of its area is green, where the natural environment is protected, and where the network of green infrastructure is managed to benefit all Londoners
- for London to be a zero carbon city by 2050, with energy efficient buildings, clean transport and clean energy
- to make London a zero waste city. By 2026 no biodegradable or recyclable waste will be sent to landfill, and by 2030 65 per cent of London's municipal waste will be recycled
- for London and Londoners to be resilient to severe weather and longer-term climate change impacts. This will include flooding, heat risk and drought
- for Londoners' quality of life to be improved by reducing the number of people adversely affected by noise and promoting more quiet and tranquil spaces
- for London to transition to a low carbon circular economy

INTEGRATED SOLUTIONS

This strategy brings together thinking on all of London's environmental issues to take an integrated approach to solving the city's environmental challenges. Many environmental problems are linked, and they often have complex causes, so developing holistic solutions can provide bigger environmental improvements in a more cost effective way than looking at issues in isolation.



MONITORING

An implementation plan has been developed to accompany this strategy.³ This strategy provides a vision for London's environment and sets a direction of travel, both for the Mayor and the range of partners who need to collaborate to deliver its ambitions. The implementation plan sets out the actions that the Mayor is prioritising to take forward in the coming years to help implement the policies and proposal in this strategy. The plan will be updated to show progress each year.

The Mayor has limited powers over most environmental policy. As a result, the actions identified in the implementation plan will need to be complemented by work from a wide range of partners

and stakeholders to deliver the change required to make London cleaner, greener and ready for the future.

The Mayor will also work closely with other UK and international cities and other stakeholders to keep London's contribution to the UN's 17 Sustainable Development Goals under review through monitoring such as the London Sustainable Development Commission's Quality of Life Indicators report. The key targets and ambitions from the Mayor's strategies (London Environment Strategy, London Housing Strategy, Mayor's Transport Strategy, Economic Development Strategy, London Plan, Better Health for all Londoners and Culture Strategy) reflect the outcomes and principles of the Sustainable Development Goals.

³ Mayor of London (2018) London Environment Strategy Implementation Plan. Accessed from: www.london.gov.uk/environment-strategy

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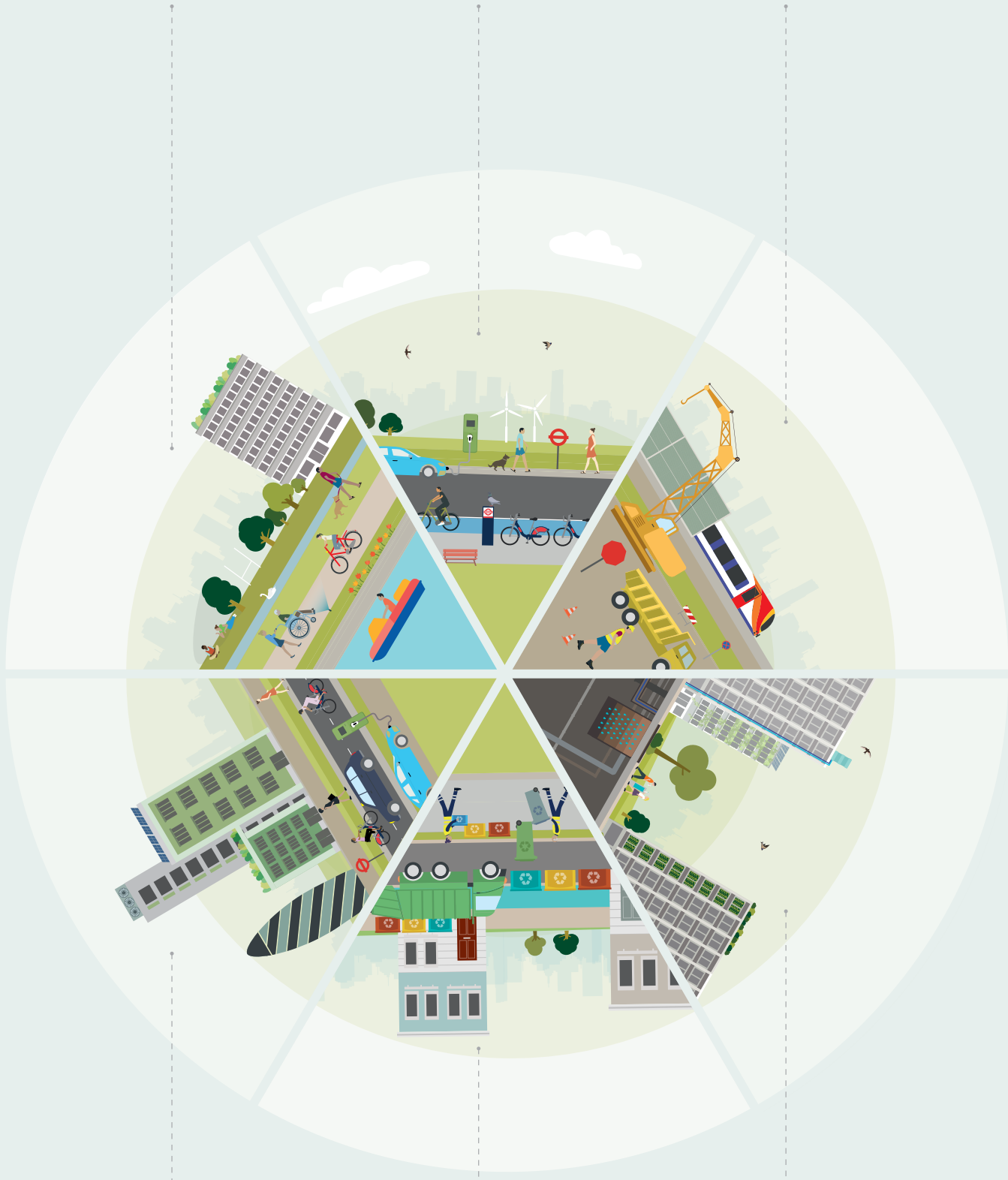
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Cleaner

Londoners want their city to be clean, attractive and healthy

Ready for the future

Water, energy and raw materials for the products we



Chapter 3: New approaches

There are four strategic approaches to make the most of environmental opportunities now and in the future:

- low carbon circular economy
- smart digital city
- green infrastructure and natural capital accounting
- the Healthy Streets Approach

To make this vision a reality, London needs to approach how it thinks and acts on its environment in new ways. New solutions are required, making the most of all that London's environment has to offer, and seeing the opportunities that change can bring.

STRATEGIC APPROACHES

This document uses four strategic approaches to make the most of environmental opportunities now and in the future. They inform every aspect of the strategy, providing links between each of them to reinforce the holistic approach that must be taken to tackle London's environmental challenges. They also provide links between this and the Mayor's other strategies, to ensure that environmental concerns are factored into decision making across London. They are:

- low carbon circular economy
- smart digital city
- green infrastructure and natural capital accounting
- the Healthy Streets Approach

The low carbon circular economy

The prevailing economic model has delivered huge growth and opportunity in the areas of wealth, education and life expectancy over the last century. But there has been an environmental and social cost to pay.

The pursuit of growth without a deeper consideration of the range of benefits it can bring has led to many of the environmental issues London faces today. Reliance on cars to transport ever-increasing numbers of people, industrial growth that has relied on fossil fuels, and a disposable economy have all led to pollution, increasing emissions and the inefficient use of resources. An uneven distribution of the benefits of growth has exacerbated the effect of environmental problems on the groups of people who are likely to be the worst affected by fuel poverty, poor air quality and the effects of climate change.

London is already reversing many of these negative trends, but to do more, a continuously-evolving approach to economic development is required. This approach will help London to thrive by adopting more sustainable and inclusive business models that value and reward low carbon initiatives and environmental sustainability, and create wider social benefits.

A low carbon circular economy is one in which as much value as possible is extracted from resources, through their use and reuse, before they become waste. As London grows, it must invest in low carbon infrastructure and services to achieve healthier, zero emission, resource efficient growth. This can be achieved by manufacturing goods that are made to last, rather than be disposed of, and by creating systems that allow existing goods to be reused and recycled.

This new model is not only an environmental imperative, required to preserve the planet's scarce resources and limit the impacts of climate change and overconsumption – it is also a huge opportunity for London's businesses. In 2014/15, London's low carbon and environmental goods and services sector generated around £30.4bn in sales and its 10,900 businesses employed around 192,000 people. Between now and 2020, this sector is expected to grow by over six per cent a year.

London is especially strong in the CleanTech sector, with the largest concentration of CleanTech businesses in the country.⁴ Around 42 per cent of CleanTech sales are made in London and the south east, so the low carbon circular economy promises to provide huge opportunities for the city.

The smart digital city

A smart digital London is one that looks to use new technologies and increased connectivity to make better use of infrastructure and provide more efficient services.

Smart technologies can help address environmental challenges. They can make environmental systems, such as

energy, water or waste more efficient, and can enable Londoners to make better informed, environmentally-sound decisions. Smart energy meters can help people reduce their energy use. Smart heat networks can increase the efficiency of heat production and use. Smart lamp posts can charge electric vehicles and supply Wi-Fi and local information. Digital connectivity, including the roll out of 5G, can be an enabler of technologies and working patterns that can contribute to environmental improvements.

More widely, a 'digital first' approach can support the low carbon circular economy by keeping resources in full use for as long as possible. It can make the most of available infrastructure through efficiency and integration, and ensure that new infrastructure investment is resilient, flexible and future-proofed. The Mayor wants London's entrepreneurial talent to be able to use the data available to solve London's environmental challenges, which is particularly important in energy and transport. Better data use can also allow city services to be designed and used in the way that people want them to be, and that they find most useful.

⁴ CleanTech usually refers to technology for low carbon and resource efficient technologies. In this strategy, the term is used to cover technologies that address the causes and effects of climate change

Green infrastructure and natural capital accounting

London's green infrastructure - its parks, green spaces, trees, rivers, wetlands and green roofs – can reduce the impacts of climate change and help to store carbon. It can improve air quality and water quality. It can promote healthier lives, reduce car dependency and encourage more walking and cycling. It can improve biodiversity and ecological resilience. These benefits are economically valuable, but are not widely understood.

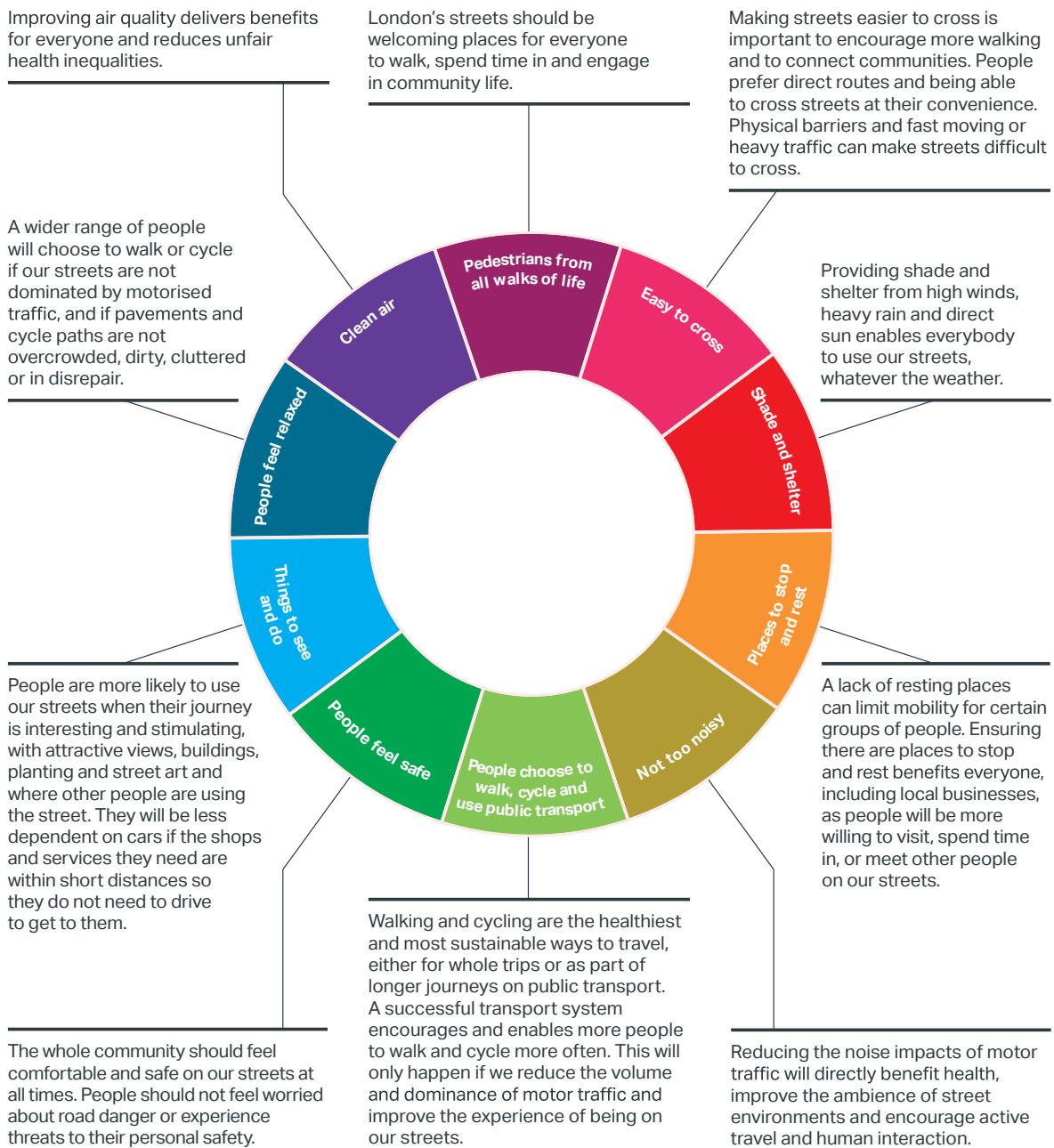
Most organisations assess the value of their assets through conventional financial accounting, in which the economic benefits of green infrastructure are rarely assessed. If these economic benefits do not appear in financial accounts, green infrastructure is often regarded as a liability – as a cost to be borne rather than an asset in which to invest. This ignores the huge range of benefits green infrastructure can provide, from better physical and mental health and increased property prices, to reduced flood and heat risk.

Natural capital accounting addresses this by bringing together the full benefits of green infrastructure and presenting them in a similar way to other capital assets, like buildings.

The Healthy Streets Approach

The Healthy Streets Approach provides a framework for putting human health and experience at the heart of planning the city. Environmental factors have a big impact on the way people interact with the places around them, so improving the environment is a big feature of this new way of thinking. Good performance against each of the ten evidence based Healthy Streets Indicators means that individual streets are fair, inclusive and sustainable environments. Improvements against all the indicators across the city's streets will radically transform the day-to-day experience of living in London, helping to create a better city for everyone.

THE TEN HEALTHY STREETS INDICATORS⁵



⁵ Lucy Saunders

Above all, the aim of the Healthy Streets Approach is to make London a fairer, healthier and more sustainable city. This requires a reduction in motorised traffic, and the creation of streets that encourage walking, cycling and public transport use. In turn, this will reduce the number of car trips that people choose to make. This virtuous circle could deliver huge environmental benefits for London, from improving air quality and reducing carbon emissions, to using planting and sustainable drainage to change the way street space is used.

The following chapters outline bold new approaches to the seven areas that make up London's environment. These strategic approaches are applied throughout to devise the creative solutions London now needs to create a better environment for everyone.

BOX 2: DEFINITIONS

Chapters 4 to 10 of this strategy follow a hierarchy of terms to explain the policies and proposals that meet the statutory requirements of the London Environment Strategy:

- **Aims:** what London would be like if the policies and programmes were put in place
- **Objectives:** the specific outcomes that need to be achieved
- **Policies:** the approach taken to meeting the objective
- **Proposals:** a headline action for how the policy will be rolled-out



CLEANER AIR FOR LONDON

The Mayor's Air Quality Strategy is helping to reduce harmful emissions and is a key step towards cleaner air and improving Londoners' health and quality of life.

Find out more at
www.london.gov.uk/what-we-do/transport-and-roads/air-quality



Chapter 4:

Air quality

AIM

London will have the best air quality of any major world city by 2050, going beyond the legal requirements to protect human health and minimise inequalities.

INTRODUCTION

Since the passage of the first Clean Air Act over sixty years ago, there has been huge progress in improving air quality in London. The city now meets legal limits set by the national Air Quality Regulations⁶ for most pollutants. There have been historic reductions in the levels of benzene, lead and sulphur dioxide pollution, which has greatly improved health and quality of life. This underlines the ability of effective and coordinated action to improve the air we breathe if we are bold enough to take strong action.

While the Great Smogs of the 1950s and 1960s are thankfully a thing of the past, this does not mean the problem has gone away. There is still much to be done to improve London's toxic air.

Two pollutants remain a specific concern. These are particulate matter (PM₁₀, PM_{2.5} and black carbon) and nitrogen dioxide (NO₂). London is failing to meet the legal limit for NO₂. Particulate matter is damaging to health at any level and must be reduced.

Improving London's air quality requires the following actions:

- reducing exposure of Londoners to harmful pollution across London – especially at priority locations like schools – and tackling health inequality
- achieving legal compliance with UK and EU limits as soon as possible, including by mobilising action from the London boroughs, government and other partners
- establishing and achieving new, tighter air quality targets for a cleaner London, meeting World Health Organization (WHO) health-based guidelines by 2030 by transitioning to a zero emission London

These actions reflect the importance of taking immediate action to protect public health and of raising awareness amongst Londoners. A City Hall commissioned report estimated that over 9,000 Londoners died prematurely from long-term exposure to air pollution in 2010.⁷ The Mayor is committed to improving air quality as soon as possible, but recognises pollution will still be unacceptably high for a number of years due to historic policy failure and inaction, which have contributed to the scale of the problem. It is therefore necessary to reduce exposure (for example at schools) as far as possible and address the unacceptable health inequality caused by the unequal exposure to pollution by different groups.

In parallel to reducing exposure, the Mayor will take urgent action to tackle pollution to achieve legal compliance with UK and EU limits as soon as possible and in the most effective manner. Where available, the Mayor will use statutory powers to ensure this result.

⁶ HMG (2010) Air Quality Standards Regulations 2010, SI number 2010/1001. Accessed from: <http://www.legislation.gov.uk/uk/si/2010/1001/contents/made>

⁷ Walton, H., Dajnak, D., Beevers, S., Williams, M. & Hunt, A. (2015) Understanding the Health Impacts of Air Pollution in London. Accessed from: <http://www.kcl.ac.uk/lsm/research/divisions/aes/research/ERG/research-projects/HIAinLondonKingsReport14072015final.pdf> or on the Mayor of London's website: https://www.london.gov.uk/sites/default/files/hia_in_london_kingsreport_14072015_final.pdf

This includes signature measures like introducing the Ultra Low Emission Zone (ULEZ) and transforming the bus and taxi fleets to be zero emission. This strategy sets out a roadmap to compliance. However, this can only be achieved as quickly and effectively as possible if the London boroughs, government and others play their full part.

This strategy also recognises the need to go beyond legal limits, as these reflect political and economic considerations as well as health impacts. These should therefore be treated as a starting rather than an end point. WHO guidelines, meanwhile, are driven solely by the available health evidence and as a result are set much tighter for PM₁₀ and PM_{2.5}.

Achieving these more ambitious targets would provide many extra health benefits for Londoners. This strategy sets out the timescale, and the changes needed, to achieve these tighter targets.

Improving air quality also offers an opportunity to address climate change. In the past policy makers have focused on reducing carbon emissions. This has resulted in unintended consequences, like encouraging the use of diesel, the promotion of biomass boilers, and gas-engine Combined Heat and Power (CHP) systems being installed in areas of poor air quality. Instead this strategy is seeking to design integrated policies that deliver multiple benefits.



LONDON'S ENVIRONMENT NOW

The key evidence to support the Mayor's ambitions for London's air quality is summarised below. You can find out more about the evidence behind the policies and proposals in Appendix 2. The WHO has published air quality guidelines, which inform the EU Air Quality Directive. These standards have been transposed into UK legislation. For more details on the legislative and policy background see Appendix 4, and for information on the main responsibilities of various organisations see Appendix 3. Box 3 provides definitions for some commonly used terms.

BOX 3: AIR POLLUTION DEFINITIONS

What's the difference between emissions and concentrations?

London's air quality is affected by a number of factors. These include the weather, local geography and **emissions** sources from both within and outside London. Air quality is measured in **concentrations**, which are specific levels of a pollutant in a given area. Legal limits are set in relation to concentrations. Local emissions from vehicles, buildings, construction and other sources contribute significantly to air pollution in London. This is what the Mayor can most directly control and influence. That means we must understand how these emissions are being reduced to understand how effective particular policies and proposals could be. However, there is a complex relationship between reducing emissions within London and reducing concentrations, given the other factors at play. This is why the strategy will refer both to concentrations and emissions.

BOX 3: AIR POLLUTION DEFINITIONS (CONTINUED)

Pollutants of concern in London

Particulate matter (PM₁₀ and PM_{2.5}):

Particulate matter (PM) is a complex mix of non-gaseous material of varied chemical composition. It is categorised by the size of the particle (for example PM₁₀ is particles with a diameter of less than ten micrometres (µm)). Most PM emissions in London are caused by road traffic, with exhaust emissions and tyre and brake wear being the main sources. Construction sites, with high volumes of dust and emissions from machinery are also major sources of local PM pollution. Other sources include wood burning stoves, accidental fires and burning of waste. However, a large proportion of PM comes from natural sources, such as sea salt, forest fires and Saharan dust. In addition, there are sources outside London caused by human activity. Small particles tend to be long-lived in the atmosphere and can be carried great distances. This imported PM forms a significant proportion of total PM in London.

Black carbon: This is a component of fine particulate matter (PM_{2.5} and smaller). It is formed through the incomplete combustion of fossil fuels, biofuel, and biomass, and is emitted in both anthropogenic and naturally occurring soot. Black carbon also contributes to climate change. Black carbon warms the planet by absorbing sunlight and heating the atmosphere.

Nitrogen dioxide (NO₂):

All combustion processes produce nitrogen oxides (NO_x). In London, road transport and heating systems are the main sources of these emissions. NO_x is primarily made up of two pollutants: nitric oxide (NO) and nitrogen dioxide (NO₂). NO₂ is of most concern due to its impact on health. However NO easily converts to NO₂ in the air, so to reduce concentrations of NO₂ it is essential to control emissions of NO_x.

London's pollution concentrations

London's monitoring network offers a unique opportunity to understand trends in London's air quality. One way to view air quality monitoring data is to group monitors based on their location and distance from the roadside and look at average concentrations.

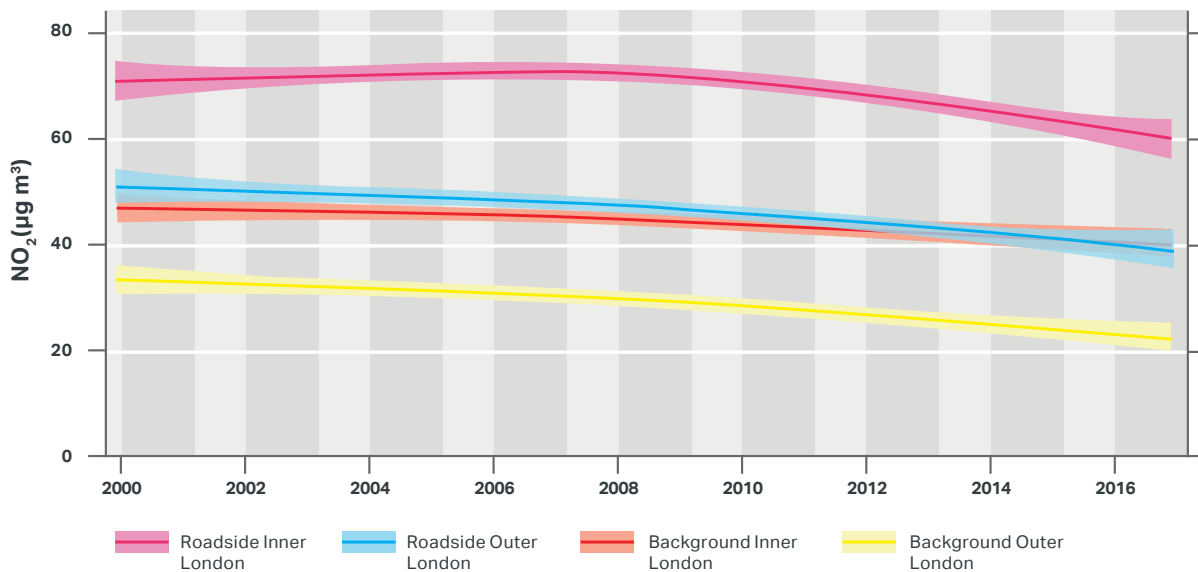
Figure 1, Figure 2 and Figure 3 show the average trend over the last decade or so for NO₂, PM₁₀ and PM_{2.5} concentrations, respectively, at sites in the London Air Quality Network, grouped by type. Roadside monitors are within five metres

of roads, while 'background sites' are located away from major sources of pollution.

Overall, there has been a gradual reduction in NO₂, PM₁₀ and PM_{2.5} concentrations at background sites in inner and outer London and at outer London roadside sites.

Inner London NO₂ roadside sites have shown a more variable trend but have seen a steeper decline from 2012. This decline is also reflected in the inner London PM₁₀ and PM_{2.5} roadside sites.

Figure 1: Trends in NO₂ in London – 2000 to 2016⁸



⁸ Generated from London Air Quality Network data with analysis by King's College London.

Figure 2: Trends in PM₁₀ in London – 2004 to 2016⁸

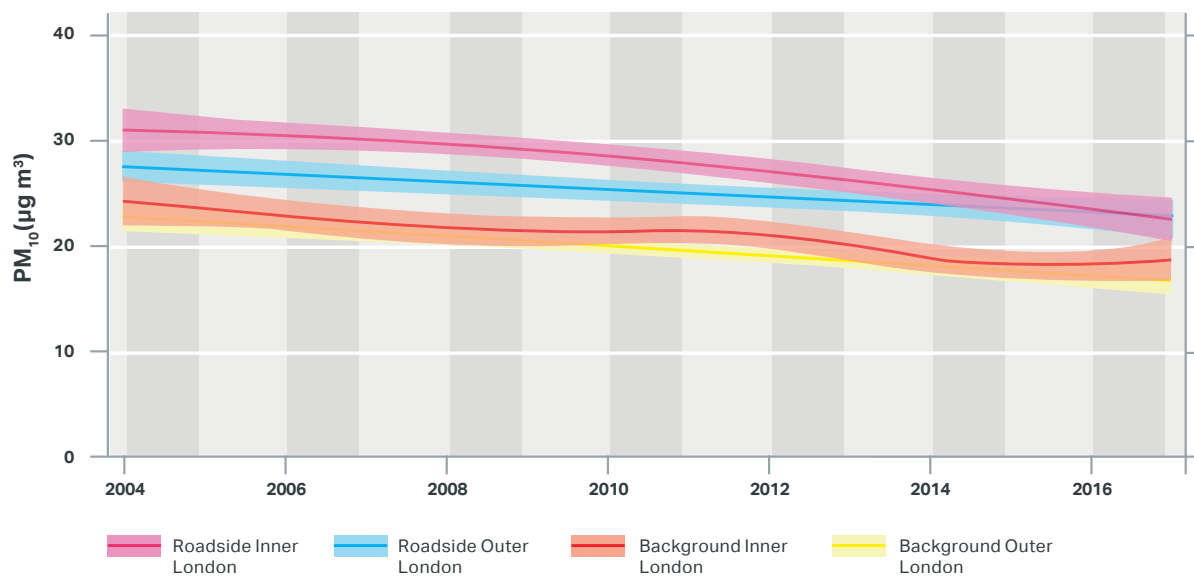
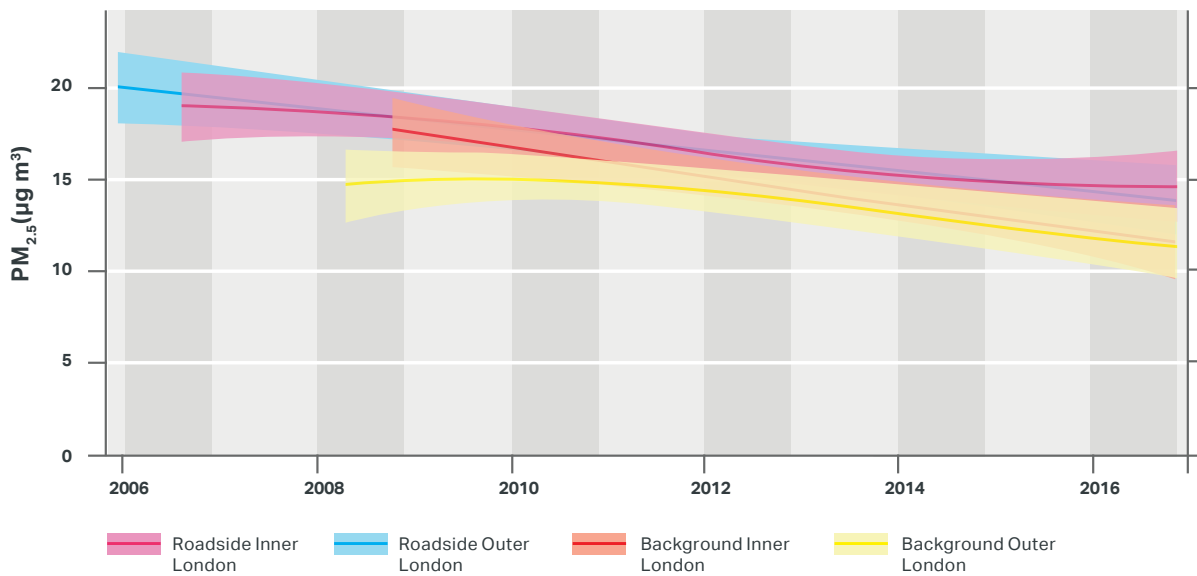


Figure 3: Trends in PM_{2.5} in London – 2006 to 2016⁸

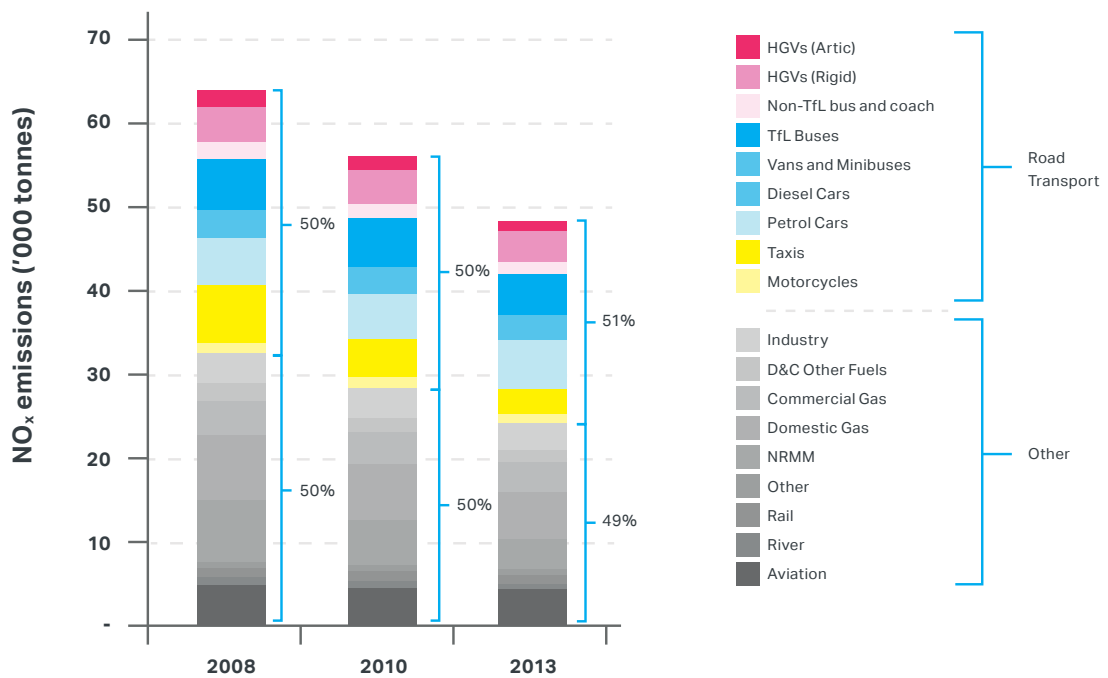


These reductions are important as they show, overall, that air quality is improving in London. However, the NO₂ EU annual mean limit value is being exceeded in many places and the PM health-based guidelines are far from being met.

London's emissions

Currently around half of nitrogen oxides (NO_x) emissions come from road transport sources. The other half of emissions come from non-road transport sources, including construction, residential and commercial buildings, river, aviation, and industrial emissions (Figure 4). While much of the public attention remains focused on vehicles, this strategy must consider how best to tackle all of these sources. A similar breakdown also applies to PM₁₀ emissions (Figure 5).

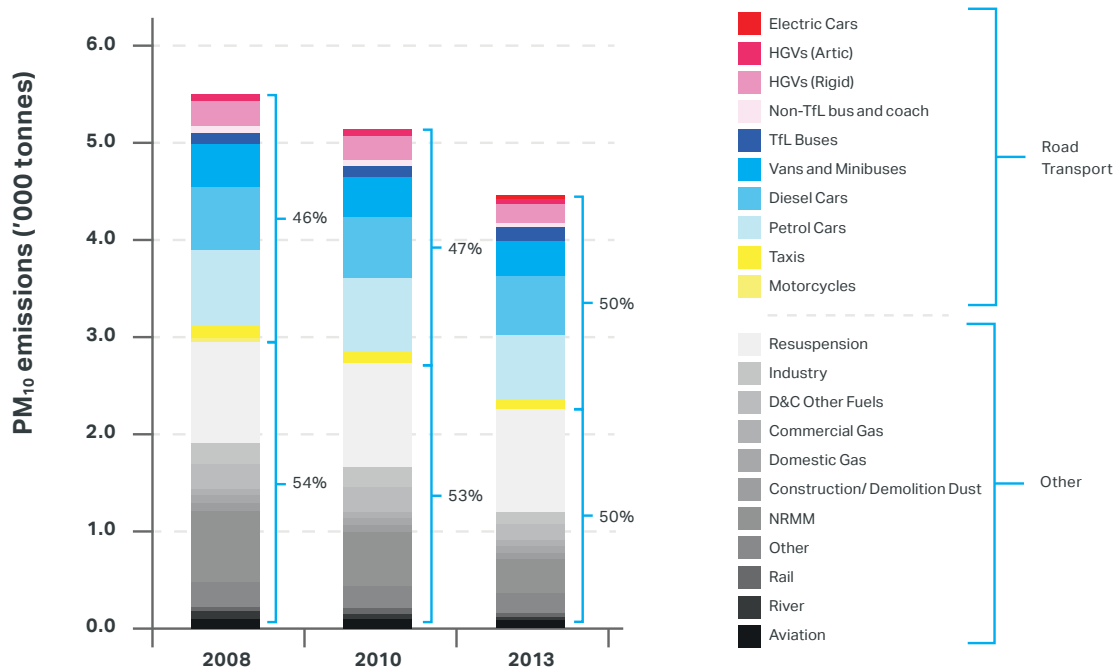
Figure 4: Emissions trend and main source categories – NO_x, 2008-2013⁹



Total NO_x emissions in London fell by 25 per cent over the period 2008 to 2013 (compared to a 35 per cent target to 2015 in the previous air quality strategy).

⁹ GLA (2017), London Atmospheric Emissions Inventory (LAEI) 2013 update.

Figure 5: Emissions trend and main source categories – PM₁₀, 2008-2013⁹

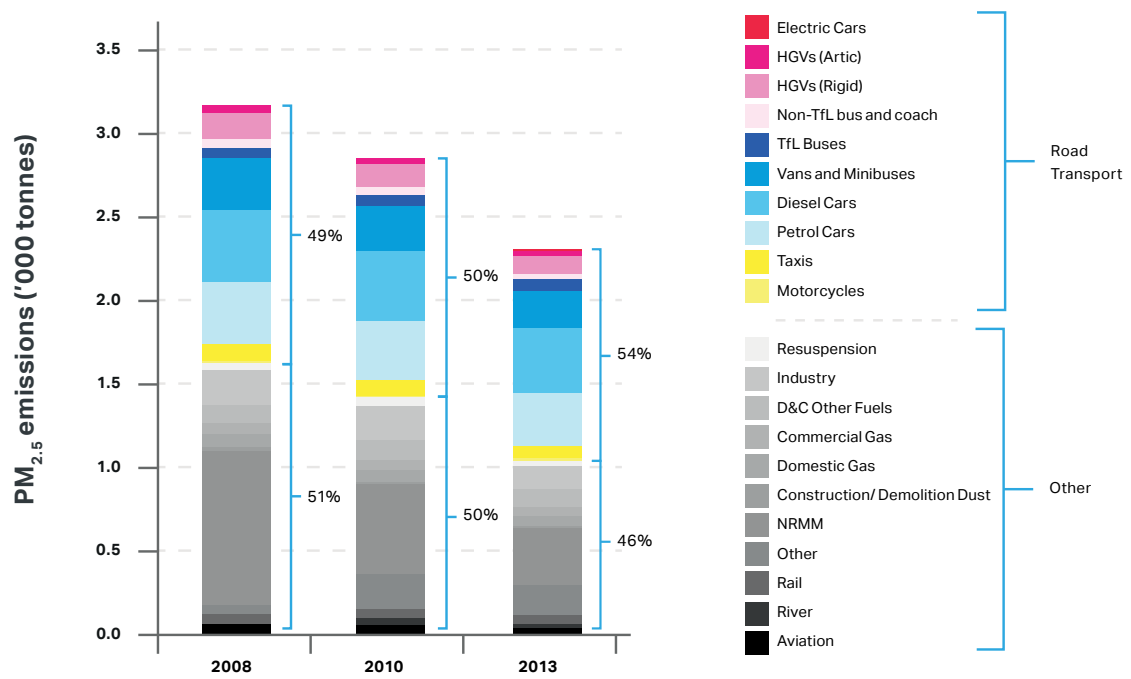


Total PM₁₀ emissions fell by 20 per cent over the period 2008 to 2013 (compared to a 31 per cent target to 2015 in the previous air quality strategy).

Total PM_{2.5} emissions fell by 27 per cent over the period 2008 to 2013 (there was no reduction target in the previous air quality strategy).

The source of PM_{2.5} emissions in London is similar to that for PM₁₀ but some sources, such as tyre and break wear are more significant (Figure 6).

Figure 6: Emissions trend and main source categories – PM_{2.5}, 2008-2013⁹

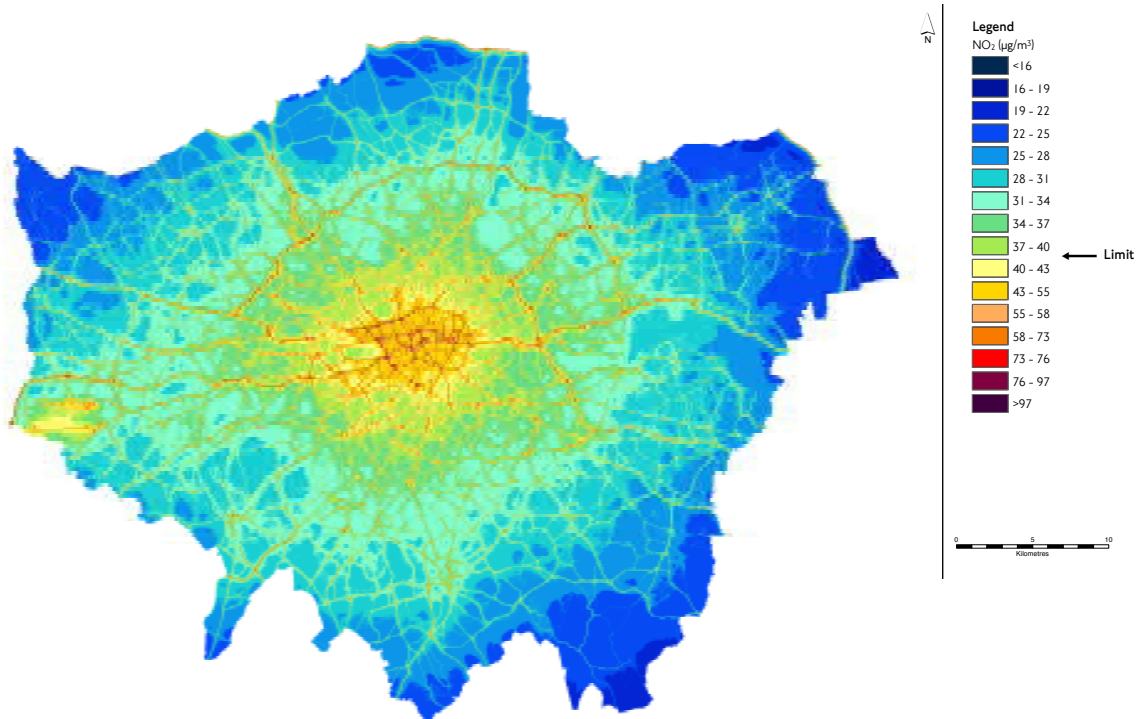


Concentrations maps and exposure

Air quality concentration maps (Figure 7, Figure 8 and Figure 9) have been produced using the London Atmospheric Emissions Inventory (LAEI) and are validated against monitoring data. These maps show the areas of London that have the highest levels of pollution.

In 2013 roughly 1.9 million people, or 23 per cent of the city's population, were living in areas with average NO₂ concentrations above the EU limit value, mostly in central and inner London. Concentrations are still higher towards central London, with its higher density of emissions sources (Figure 7).

Figure 7: 2013 - Annual mean NO₂ concentrations¹⁰



¹⁰ GLA (2017) LAEI 2013 Update.

Figure 8: 2013 - Annual mean PM₁₀ concentrations¹⁰

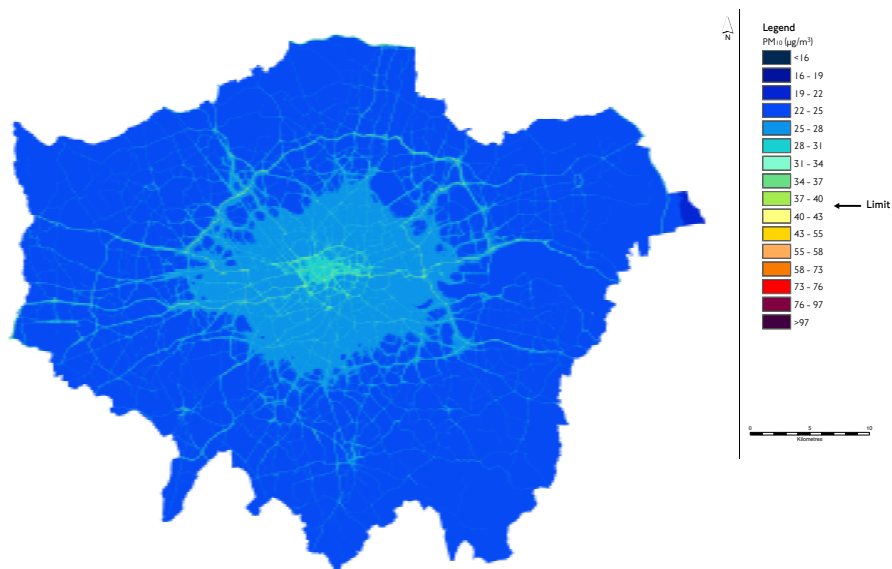


Figure 9: 2013 - Annual mean PM_{2.5} concentrations¹⁰



Transboundary pollution

The challenge of cleaning London's air is made more difficult because a large amount of the pollution sources are not within London. The most recent analysis shows that sources outside London make up nearly half (48 per cent) of the contribution to the estimated death risk from long-term exposure to PM_{2.5} in London as a whole. This is also responsible for the majority of health effects associated with short-term exposure.

For example, nearly 75 per cent of the cardiovascular hospital admissions associated with PM_{2.5} result from pollution sources outside London, including industrial, agricultural and transport emissions from other countries. In addition, external sources also make a significant contribution to the risk associated with NO₂.⁷

Even if all local emissions sources were removed, nearly half the health effects linked to London's air pollution would still be felt. This is why working closely with European partners is vital to reduce emissions across the continent.

The EU National Emissions Ceiling Directive must incorporate tighter emission limits for countries across Europe to address transboundary pollution on a quicker timescale. It is also why international action coordinated by the United Nations, including the Convention on Long-range Transboundary Air Pollution and its associated protocols, is needed to improve air quality in London.

Public health

Research has shown air pollution has a big impact on health at all life stages, from development in the womb to the end of life. A baby born in 2010 and exposed to that same level of air quality for its entire life would lose around two years of life expectancy. Mortality is not the only air pollution related health effect. In 2010, London air pollution was linked to over 3,000 hospital admissions. The economic cost of these health impacts in London is estimated as being up to £3.7bn a year (Figure 10).⁷ There is also strong evidence that poor air quality affects children's lung development, and emerging evidence that improving air quality can reverse those effects. There is also increasing evidence of the link between exposure to pollution and dementia.¹¹

¹¹ Cacciottolo, Mafalda, et al. (2017) Particulate air pollutants, APOE alleles and their contributions to cognitive impairment in older women and to amyloidogenesis in experimental models. *Translational Psychiatry* 7, e1022. Accessed from: <https://www.nature.com/tp/journal/v7/n1/abs/tp2016280a.html>

Figure 10: Impacts of London's current air quality⁷



Social inequality

These health impacts fall disproportionately on the most disadvantaged communities, affecting the poorest, the youngest, the oldest, those with pre-existing health conditions and those from minority ethnic groups the most. Perhaps most worryingly, 438 schools and 364 other educational institutions in London are located in areas exceeding safe legal pollution levels. People living in the most deprived areas are, on average, more likely to be exposed to poor air quality than those in less deprived areas.¹²

Tackling air pollution is not, therefore, just about the environment or about protecting public health. It is also about social justice. There is an urgent need to do more to tackle the public health inequalities associated with air pollution in London.

Climate change

Improving air quality also offers an opportunity to address climate change. In the past, policy makers have mainly focused on reducing carbon dioxide (CO₂) emissions. This has resulted in unintended consequences, like encouraging the use of diesel, promoting biomass boilers, and CHP system installation in areas of poor air quality. In this strategy, the Mayor seeks to

design integrated policies that offer multiple benefits.

One example of this is that black carbon has a higher global warming potential than CO₂. It is however possible to deliver quick wins to improve both air quality and reduce carbon emissions. This can be done by adopting tighter PM_{2.5} limits, promoting a switch to zero emission vehicles, replacing old, inefficient boilers, increasing energy efficiency of buildings, and creating a zero carbon city where energy mainly comes from renewable sources.

A review of the previous strategy, baseline and other evidence highlights several key issues to be addressed in the strategy.

Achieving legal compliance as quickly as possible

The last strategy did not reach the expected emission reductions. In part, this was due to the underperformance of Euro engine emissions standards. Targets in this strategy will need to reflect the latest evidence on vehicle emissions performance. It must set out appropriate steps by all levels of government to ensure a roadmap to compliance as quickly as possible.

¹² King, K. & Healy, S. (2013) Analysing Air Pollution Exposure in London. Accessed from: https://www.london.gov.uk/sites/default/files/analysing_air_pollution_exposure_in_london_-_technical_report_-_2013.pdf (51 per cent of Lower Layer Super Output Areas (LSOAs) within the most deprived 10 per cent of London have concentrations above the NO₂ EU limit value. This contrasts with 1 per cent above the NO₂ EU limit value in the 10 per cent least deprived areas.)

Diesel vehicles, especially cars and vans

These remain the main source of road transport pollution. A comprehensive approach is required to phase out their use. Rather than a return to petrol, mode shift to sustainable forms of transport like walking and cycling wherever possible should be encouraged. Any vehicles that remain will need to transition to zero emission technology.

Tackling all sources of pollution

To achieve legal compliance as quickly as possible, all sources of pollution must be addressed. That means significantly increasing efforts in relation to non-transport sources. This is vital, since the proportion of total emissions from non-transport sources is expected to increase over the lifetime of this strategy as our efforts on transport start to have an effect.

Government action

The government controls some of the most powerful policy levers to influence air quality, including fiscal incentives such as vehicle excise duty. It alone can legislate to provide new powers to tackle non-transport emission sources. Achieving legal compliance is dependent on further government action and leadership.

Maximising co-benefits between air quality and climate change policies

There is a risk that unintended consequences can arise if climate and air quality policies are developed in isolation, for example in relation to energy and planning policy. Conversely, integrated policy design can bring benefits for both air quality and climate change, for example reducing black carbon emissions by switching to zero emission vehicles.

Further reductions are needed in PM₁₀ and PM_{2.5}, particularly from transboundary pollution, tyre and brake wear, and wood burning

London is currently far from achieving WHO health-based limits for PM_{2.5}. One of the best ways to do this would be to reduce the number of vehicle kilometres by supporting a mode shift to walking, cycling and public transport. It will also be necessary to address wood burning related emissions, which evidence suggests are a significant source of emissions, particularly on some of the most polluted days.

ROLES AND LEGAL DUTIES

The Mayor

The Mayor has a legal duty to set out policies and proposals in this strategy to achieve compliance with the legally required air quality standards as quickly as possible.

The Mayor will act to improve air quality, where the Mayor or bodies within the control of the Mayor have relevant powers or resources. However, the Mayor does not have all the powers needed to improve London's air quality alone. This strategy sets out the responsibilities of all the organisations with a role to play in improving London's air quality, including the government, London boroughs, and the Environment Agency.

The Mayor will help the boroughs in exercising their statutory duties to improve air quality. Where needed, the Mayor can use powers of direction to require boroughs to take steps to meet air quality objectives. These reserve powers can only be used following consultation. To support the boroughs

the Mayor will operate the reformed London Local Air Quality Management (LLAQM) framework, which sets out clearly the action boroughs should be taking (Box 4).

The government

The ultimate responsibility for achieving compliance with the legally required air quality standards "as quickly as possible" lies with the government. The government is required to have an Air Quality Plan that will achieve this.

The government has unique tools available to it, such as control over fiscal incentives or the ability to legislate, which can accelerate compliance. Without a clear national plan to tackle emissions, especially from vehicles, the air in UK cities will not improve as quickly as it must.

The government needs to give local authorities across the country extra powers to address non-transport pollution sources, to help scrap older polluting vehicles, and use fiscal and other incentives to encourage the use of clean vehicles.



The London boroughs and public sector

London's boroughs have a duty to work towards achieving legal limits. They have an important role to play in addressing local pollution which is underpinned by the statutory LLAQM framework (Box 4). There are a number of levers they can use to help. These include:

- emissions based parking charges
- reducing pollution from new developments through planning (especially those not referred to the Mayor), as well as from existing buildings
- improving the public realm for walking and cycling

- targeted measures at pollution hotspots, such as vehicle restrictions and green infrastructure
- supporting installation of infrastructure to fuel zero emission vehicles

The statutory powers of the London boroughs are also important to continue to discourage antisocial burning of waste and the illegal use of wood burning stoves or fireplaces. Finally, the boroughs have extensive public health duties and can play an important role in mainstreaming air quality into health-related activities.

The public sector has a wider duty to lead by example to reduce emissions and exposure to pollution, particularly in relation to its vehicle fleets, as well as to raise awareness.

BOX 4: THE LONDON LOCAL AIR QUALITY MANAGEMENT FRAMEWORK (LLAQM)

Local Air Quality Management (LAQM) is the statutory process by which a local authority is required to review the air quality within its area. This system aims to determine if air quality objectives set within the Air Quality Regulations 2000 and the Air Quality (Amendment) Regulations 2010 are likely to be met in a certain area. It also drives improvements to achieve those objectives. The London system used to be part of a national framework managed by Defra. However, in May 2016 the Mayor launched a bespoke system for the capital - London Local Air Quality Management (LLAQM).

This scheme was designed to encourage close working to help address this vital issue. This renewed focus on LAQM in London should help ensure that local authority air quality resources are protected, or where possible increased.

The basic statutory framework for local air quality management is via national Air Quality Regulations and Part IV of the Environment Act 1995. This remains in place and applies to London's 32 boroughs and the City

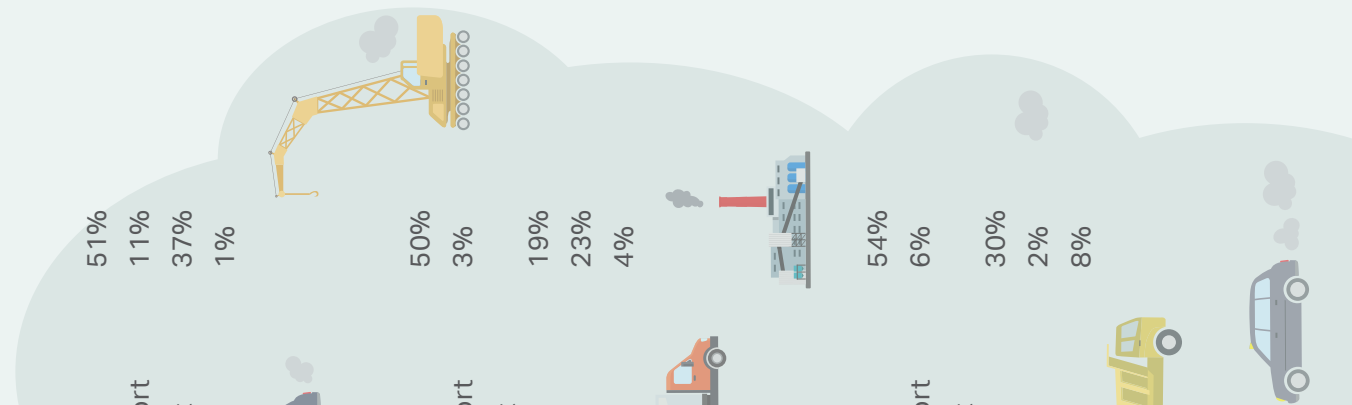
of London. However, it was agreed with Defra that the relevant LAQM guidance for London should differ from the rest of the UK in recognition of the particular challenges the capital faces. London now has its own bespoke statutory policy and technical documents.

The key LLAQM requirements for boroughs are:

- to continue to monitor and assess air pollution in their areas
- to ensure an Air Quality Management Area (AQMA) is declared and in place for any locations that are exceeding air quality objectives and EU Limit Values
- to ensure that a current and relevant Air Quality Action Plan is in place for all AQMAs. The Action Plan should be updated every five years at a minimum, and progress against this should be reported annually
- to complete the annual monitoring and Action Plan update reports

MAJOR WORLD CITY BY 2050

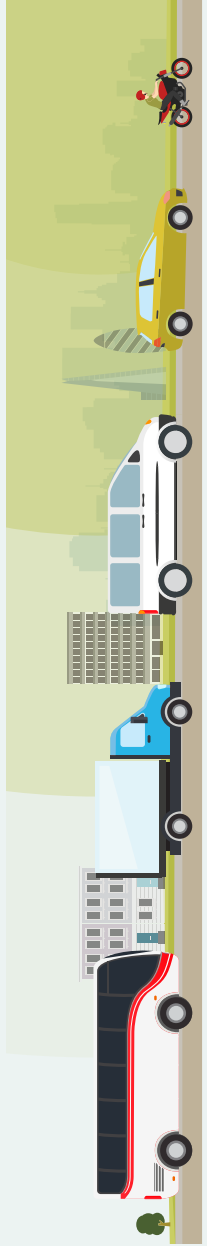
Emissions sources



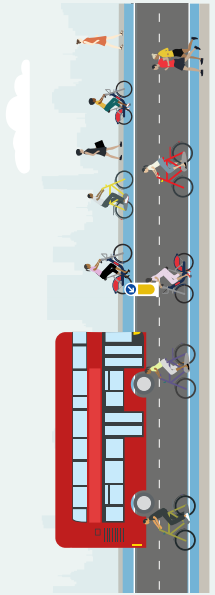
Zero emission London 2050

TRANSPORT

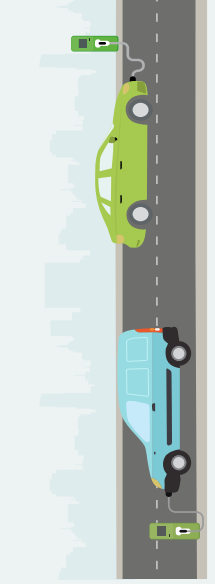
Strict new emission requirements across London (e.g. ULEZ, zero emission zone)



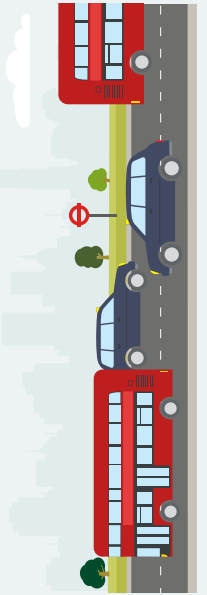
Mode shift to walking, cycling & public transport



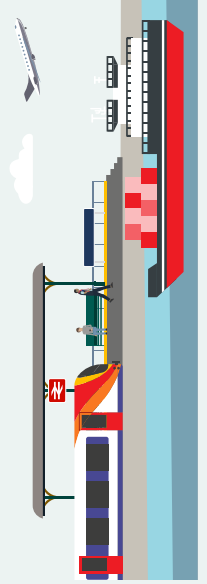
All vehicles zero emission by 2050



Zero emission bus fleet by 2037 and all taxis zero emission by 2033

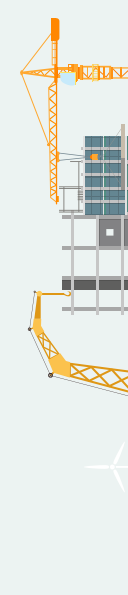


Reduce emissions from rail, river and aviation transport

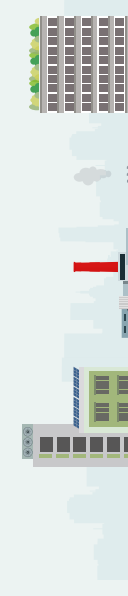


NON-TRANSPORT

Prevent and reduce emissions from non-road mobile machinery



Reduce emissions from homes and workplaces, large scale generators, wood burning and biomass



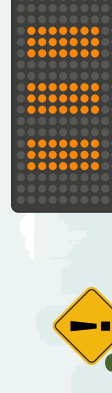
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“Protecting public health is at the heart of the Mayor’s efforts to improve air quality.”

Objectives, policies and proposals

OBJECTIVE 4.1 SUPPORT AND EMPOWER LONDON AND ITS COMMUNITIES, PARTICULARLY THE MOST DISADVANTAGED AND THOSE IN PRIORITY LOCATIONS, TO REDUCE THEIR EXPOSURE TO POOR AIR QUALITY

Protecting public health is at the heart of the Mayor’s efforts to improve air quality. It requires reducing exposure, particularly at priority locations like the Air Quality Focus Areas¹³, including by raising awareness of the impacts of pollution and when air quality is particularly poor. The Mayor’s long-term aim is to ensure concentrations are reduced to levels that are both safe and compliant. However, it is recognised that until further measures like the ULEZ are put in place there will remain times where pollution can be very poor due to historic policy failure and inaction that have contributed to the scale of the problem.

The Mayor wants to ensure that Londoners have access to the right information and, if appropriate, emergency action is taken to minimise public exposure. This objective also seeks to address the health inequality caused by the unequal exposure to pollution of different groups.

Air pollution disproportionately affects London's youngest and oldest residents and those Londoners with pre-existing health conditions. Research commissioned by the GLA shows there are considerable variations between communities, with more deprived communities experiencing higher NO₂ and PM levels. The pattern is less pronounced when considering variations in exposure between different minority groups. However, those living in places with high proportions of black or mixed ethnic groups are more likely to be exposed to illegal levels of air pollution than those in areas with a high proportion of white people.¹⁴

Policy 4.1.1 Make sure that London and its communities, particularly the most disadvantaged and those in priority locations, are empowered to reduce their exposure to poor air quality

Proposal 4.1.1a The Mayor will provide better information about air quality, especially during high and very high pollution episodes, and use emergency measures where appropriate

Human health is affected by poor air quality. This is particularly true for disadvantaged people like children, older people, and those with pre-existing health conditions.

Timely air pollution information gives disadvantaged people a chance to act to protect themselves, for example by reducing their exposure, or simply by carrying their medication. Schools, hospitals, GP surgeries, and care homes are places where those most vulnerable to the health impacts of air pollution episodes spend time and visit. The enhanced pan-London alerts system will target these organisations and provide tailored advice (drafted with key stakeholders, including Public Health England and NHS London). This will ensure that decision makers have information on current pollution levels and upcoming episodes, as well as evidence-based advice on how to respond.

London-wide episodes of high pollution happen a few times each year. Very high pollution episodes are even more rare – occurring only every few years. On such occasions, it is important that Londoners are kept fully informed and can respond accordingly to minimise health impacts. The Mayor will continue to provide real time alerts during high or very high air pollution episodes by broadcasting information on bus shelters, Tube stations and on roadside signs (Figure 11). There will be a particular focus on reducing unnecessary private car use and other activities that contribute to pollution.

¹³ The current Air Quality Focus Areas are areas with high pollution concentrations and high levels of human exposure; they are set out in the evidence base supporting this strategy. The GLA will update the Focus Areas with every new iteration of the London Atmospheric Emissions Inventory.

¹⁴ Aether (2017) Updated Analysis of Air Pollution Exposure in London. Accessed from: <https://www.london.gov.uk/WHAT-WE-DO/environment/environment-publications/updated-analysis-air-pollution-exposure-london-final>

Figure 11: Air pollution forecast announcement

In addition to communicating with Londoners during high or very high air pollution episodes, the Mayor will also seek to particularly engage with under-reached groups (such as older people, those living in poverty and BAME communities).

The Mayor will work with government to ensure that London has the powers needed to implement emergency measures such as time-limited road closures, vehicle restrictions or restrictions on the use of solid fuels, where appropriate, during high pollution episodes.

Proposal 4.1.1.b The Mayor will aim to do more to protect London’s young and disadvantaged people by reducing their exposure to poor air quality, including at schools, nurseries, other educational establishments, care homes, and hospitals

Reducing the exposure of young people to pollution is a priority because younger children are among the most vulnerable to its health impacts. Eight and nine-year-olds living in cities with high levels of fumes from diesel cars have up to ten per cent less lung capacity than normal.¹⁵ More must be done to reduce exposure at schools – or on the school commute - wherever possible, and also at nurseries, colleges, universities, and other educational establishments.

¹⁵ King’s College London (n.d.) Research Projects: EXHALE. Accessed from: <https://www.kcl.ac.uk/lsm/research/divisions/aes/research/ERG/research-projects/EXHALE.aspx>

The Mayor will actively encourage London boroughs to use the funding available to them through TfL for Local Implementation Plans to improve air quality and reduce exposure, especially around schools and on journeys to and from school. To support this, City Hall has implemented the Mayor's School Audit Programme at 50 schools in the most polluted areas of London to identify steps London boroughs can take to reduce exposure and emissions.

In addition, the Mayor will seek to promote the wider use of the audit concept by health authorities, boroughs and other groups at additional schools and sensitive sites, including nurseries, care homes, and hospitals.

To further focus action on the most disadvantaged, funding for major air quality programmes, such as the Mayor's Air Quality Fund, will require projects to outline how activities will contribute to reducing the exposure of communities most at risk of poor air quality, or benefit areas of multiple deprivation.

Proposal 4.1.1.c The London Plan will encourage new developments to take into account local air quality so they are suitable for their use and location

In the London Plan, the Mayor has set out policies that seek to reduce exposure to existing poor air quality through design. This is vital where new development will be used by large numbers of people who are particularly vulnerable to poor air quality, like children or older people.

In addition, the London Plan states that London's air quality should be significantly improved, and exposure to poor air quality, especially for disadvantaged people, should be reduced. The Plan also features a requirement to consider the overall suitability of a site (and its design/layout) for the proposed end use, in terms of exposure to pollution.

Policy 4.1.2 Improve the understanding of air quality health impacts to better target policies and action**Proposal 4.1.2.a The Mayor will produce and maintain the London Atmospheric Emissions Inventory (LAEI) to better understand pollution sources in London**

To tackle air pollution effectively, it is necessary to understand its sources. The Mayor will produce and maintain the LAEI. This will help us understand the key emissions sources and how they contribute to poor air quality, both now and projected into the future. It will be used to calculate health impacts, exposure and health inequalities.

Proposal 4.1.2.b The Mayor will work with boroughs to safeguard the existing air quality monitoring network, and enhance it by exploiting new technologies and approaches such as personal and localised monitoring

Through the LLAQM framework, boroughs are required to monitor and report on local air quality. The GLA, TfL, and London boroughs fund and maintain one of the most extensive automatic monitoring networks of any world city. This is supplemented with additional monitoring.

It is one of the ways in which local authorities play a crucial role in helping to understand and address air pollution. Their high quality monitoring data helps us to understand the long-term trends in air pollution. It is used to validate the comprehensive pollution modelling provided by the Mayor through the LAEI.

The Mayor will continue to oversee this monitoring network, and will ensure that sites crucial for understanding long-term trends or measuring the impact of local measures are not removed or moved. The Mayor will use statutory powers to do this, as well as work with boroughs to enhance monitoring networks where possible. Particular areas of focus are increasing the number of long-term NO₂ diffusion tubes, especially in Air Quality Focus Areas. Another is identifying opportunities for additional PM_{2.5}, black carbon, and ultra fine particle monitoring.

The Mayor will work with boroughs and other partners to encourage innovation in monitoring, starting with a new sensor monitoring trial in partnership with the C40 Cities Climate Leadership Group. This is a network of the world's megacities committed to addressing climate change and air pollution.



It is getting easier for people and groups to buy personal and relatively low cost monitoring systems. These can be valuable tools, but knowing how best to use and locate the monitors is vital if the results are to provide meaningful information. It is also important to understand the limitations of monitoring equipment, and how best to interpret and publish results. The Mayor will offer guidance and advice on how air quality is monitored in London, and help people understand what type of equipment is available.

OBJECTIVE 4.2 ACHIEVE LEGAL COMPLIANCE WITH UK AND EU LIMITS AS SOON AS POSSIBLE, INCLUDING BY MOBILISING ACTION FROM LONDON BOROUGH, GOVERNMENT AND OTHER PARTNERS

Alongside reducing exposure, the Mayor will take urgent action to tackle pollution to achieve legal compliance with UK and EU limits as quickly and effectively as possible. However, legal compliance can only be achieved if the London boroughs, government and others also play their full role and take ambitious action.

This objective addresses existing emissions from transport, as well as emissions from non-transport sources. It sets out what both the Mayor and others need to do to achieve legal compliance as quickly as possible.

However, the main responsibility for ensuring that compliance is achieved rests with government. They can use unique tools, such as control over fiscal incentives and the power to legislate, which can accelerate compliance.

Road traffic is often the biggest cause of poor air quality in places where people live and work. Diesel is the most significant source of NO_x emissions, which contribute to illegal levels of NO₂. The reason for this is partly because of the under performance of some Euro Standards for diesel vehicles (see Box 5). There are major discrepancies between official emission measurements and 'real-world' vehicle performance in urban environments. There are also issues with the sheer number of vehicles on London's roads, which causes congestion and exacerbates pollution. The introduction of real-world testing into the 'Euro 6' European vehicle-type approval process will mean that, on average, new vehicles are far less polluting than previous models. This is particularly so for heavier transport like lorries.

The Mayor is committed to policies that support phasing out fossil fuels, especially diesel, and encourage take up of zero emission vehicles in London. The Mayor will encourage a shift to more sustainable travel like walking, cycling or public transport throughout London too.

This also contributes to the Mayor's wider ambitions including:

- all taxis and private hire vehicles to be zero emission capable by 2033
- all TfL buses to be zero emission by 2037
- all newly registered road vehicles driven in London to be zero emission by 2030
- London's entire transport system to be zero emission by 2050

These efforts are supported by the wider policy framework in the Mayor's Transport Strategy, which promotes further mode shift, tackles congestion, and encourages freight consolidation. This section should be read alongside the Mayor's Transport Strategy.

The section also looks at non-road transport sources, including construction, buildings, the river and aviation, before setting out the action that needs to be taken by others – especially government – to achieve full compliance as quickly as possible.

"The Mayor is committed to policies that support phasing out fossil fuels, especially diesel, and encourage take up of zero emission vehicles in London."

BOX 5: WHY PRIORITISE THE PHASING OUT OF DIESEL VEHICLES?

Diesel vehicles are the single biggest source of NO_x emissions. Any strategy to improve air quality must consider this source, and how to enable the transition to clean and ultimately zero emission vehicles.

Rapid dieselisation of the fleet was caused by previous government policy, which incentivised low CO₂ emitting vehicles through the vehicle excise duty and company car tax regimes. These powerful levers encouraged manufacturers to invest in the development of diesel technology; an attractive solution for consumers, which has historically delivered better fuel economy and improved durability when compared to petrol.

However, it is widely acknowledged that the real-world emissions performance of diesel vehicles did not match that achieved in laboratory tests. This problem is in part a failure in the legislation to make the type-approval emissions test rigorous

enough, and a poor response by regulators who were aware of the issue for some time.

This has also been compounded by the revelations that at least one manufacturer has deliberately used test beating software on their diesel vehicles, whilst others may be taking steps to 'bend the rules'.

A landmark study by the International Council for Clean Transportation demonstrated that technologies exist to reduce emissions from vehicles but they are not being employed consistently by manufacturers. Although EU legislation lowered permitted NO_x emissions for diesel cars by 85 per cent between 2000 (Euro 3) and 2014 (Euro 6), average on-road emission levels only decreased about 40 per cent over the same period.

In general, diesel vehicles emit more NO_x than petrol equivalents, and the capital still has a legacy fleet of older

BOX 5: WHY PRIORITISE THE PHASING OUT OF DIESEL VEHICLES? (CONTINUED)

diesel vehicles capable of emitting high levels of PM emissions (prior to the EU mandating diesel particulate filters from 2011). It is therefore unsurprising that diesel cars are currently the highest contributor to road transport NO_x and PM_{2.5} emissions in London.

The latest emissions standard for heavy duty engines (Euro VI), which includes on-highway verification, has started to alleviate these shortcomings. For example, TfL has seen a 90 per cent reduction in NO_x emissions between Euro V and Euro VI buses.

Unfortunately, similar on-road verification introduced for cars and vans, known as 'real driving emissions' is yet to be seen. The introduction of real driving emissions has the potential to create parity between petrol and diesel vehicles. However, it has been plagued by delays and for many this is seen as too little too late, with legislation not taking full effect

until 2021. Even then, overly generous conformity factors have been introduced to allow for error margins.

This means some of the newest trucks on the road are expected to have emissions of NO_x and PM better than some family cars. The introduction of independent testing, such as the Mayor's Cleaner Vehicle Checker, will help to alleviate this issue by creating transparency and improving consumer confidence.

In all, the Mayor strongly believes that government must deliver effective national incentives exclusively under their control (such as taxation and scrappage) to discourage diesel while these vehicles remain more polluting. Longer-term, the Mayor is committed to policies that support phasing out all fossil fuels, recognising the impact CO₂ emissions from petrol cars can have, and accelerating the uptake of zero emission vehicles in London to deliver further improvements in air quality.



Policy 4.2.1 Reduce emissions from London’s road transport network by phasing out fossil fuelled vehicles, prioritising action on diesel, and enabling Londoners to switch to more sustainable forms of transport

Proposal 4.2.1.a The Mayor will promote and prioritise more sustainable travel in London, including walking, cycling and public transport, as part of the Healthy Streets Approach

It is now clear that much of the poor air quality in London is linked to private car use. This is not only during

periods of high pollution, but every day. Dependence on cars also has negative health, congestion, business, and community impacts. As part of the Healthy Streets Approach, the Mayor wants to encourage people to walk, cycle, and use public transport instead.

In order to keep London moving, improve air quality and reduce carbon, Londoners’ dependency on cars must be reduced. Analysis suggests that three quarters of journeys now made by car could be done on foot, by bicycle, or by public transport. Such a shift also encourages Londoners to lead a more



active and healthy lifestyle. In addition, it creates a more attractive city in which to live, visit and do business. It is also an effective way of tackling emissions, as it helps to address those from tyre and brake wear as well as from exhausts. That means reducing the number of kilometres driven will have a greater impact overall on PM₁₀ and PM_{2.5}.

More car-free days in central London, town centres, high streets and other locations would enable people to experience their local area from a different perspective, help enhance local communities, and result in local

improvements in air quality. In inner and outer London, boroughs' support for car clubs may enable more Londoners to give up their cars when delivered as part of a wider package to reduce car use.

Proposal 4.2.1.b The Mayor, through TfL, will clean up the bus fleet by phasing out fossil fuels, prioritising action on diesel, and switching to zero emission technologies

A more sustainable approach to transport in inner and outer London will require a big increase in the number of journeys made by bus. Good bus services are fundamental

“All TfL buses will meet the Euro VI diesel standard for NO_x and PM by 2020.”

to making people less reliant on cars and supporting London’s sustainable growth. However, it is essential that these journeys are delivered by a clean bus fleet. This is part of the Mayor’s commitment to lead by example. Figure 12 sets out the action to be taken to clean up the bus fleet.





In line with the Mayor’s Transport Strategy, TfL buses will be expected to meet the following requirements:

- all new double-deck buses will be hybrid, electric or hydrogen from 2018
- all double-deck buses in central London will be Euro VI and hybrid by 2019
- all TfL buses will meet the Euro VI diesel standard for NO_x and PM by 2020
- all new single-deck buses will be zero emission from 2020
- the whole bus fleet will be fully zero emission by 2037 at the latest

This means making the most of London’s world-leading reputation for the take up of electric and hydrogen technology in the bus fleet

As these improvements are delivered the cleanest buses will be prioritised along the most polluting routes using Low Emission Bus Zones.

Figure 12: Cleaning the TfL bus fleet¹⁶

		NOW	2020	2025	2030	2035	2037
Bus procurement and retrofit		Retrofit of existing double decks to Euro VI standards	TfL will buy only electric or hydrogen single decks	TfL will buy only electric or hydrogen double decks			
		TfL will buy only hybrid double decks					
Bus fleet in central London			All single decks electric or hydrogen				All TfL buses electric or hydrogen
			All double decks Euro VI and hybrid			80% of double decks electric or hydrogen	
Bus fleet in inner and outer London				50% of single decks electric or hydrogen	90% of single decks electric or hydrogen	All single decks electric or hydrogen	
			All double decks meet Euro VI standard as a minimum	More than 85% of double decks hybrid, electric or hydrogen	60% of double decks hybrid; 40% electric or hydrogen	20% of double decks hybrid; 80% electric or hydrogen	

¹⁶ Mayor of London (2018) Mayor's Transport Strategy. Accessed from: <https://www.london.gov.uk/what-we-do/transport/our-vision-transport/mayors-transport-strategy-2018?intcmp=46686>

Proposal 4.2.1.c The Mayor, through TfL, will reduce emissions in the taxi and private hire fleet by phasing out fossil fuels, prioritising action on diesel, and switching to zero emission technologies

For too long, the taxi trade has been restricted to diesel vehicles. The Mayor wants the capital's taxi fleet to be the greenest in the world. To phase out diesel, all newly licensed taxis have been required to be zero emission capable since the start of 2018.

The recent sharp increase in private hire vehicles means they must take a lead and accelerate the uptake of Ultra Low Emission Vehicles (ULEVs). However, policies affecting the taxi and private hire vehicles industries must take into consideration the costs and operating models of each industry. The Mayor will encourage and quicken the take up of zero emission capable taxis by working with the trade to create an action plan. The Mayor will provide a mixture of financial incentives, infrastructure and regulation (including maintaining a taxi age limit, currently set at 15 years). The aim is to achieve a minimum of 9,000 such vehicles in the fleet by 2020.

The Mayor will also require all new private hire vehicles to meet continually improving minimum emission standards, as set out in the Mayor's Transport Strategy. When combined, this will achieve an entirely zero emission capable taxi and private-hire fleet by 2033 at the latest.

Proposal 4.2.1.d The Mayor aims to reduce emissions from private and commercial vehicles by phasing out and restricting the use of fossil fuels, prioritising action on diesel

The Mayor will further accelerate the uptake of cleaner vehicles in London by bringing forward and expanding the ULEZ.

The Mayor alone does not have the legal power to ban diesel vehicles (or any other vehicles) across London. The Mayor can, however, apply charges to vehicles on a number of grounds, including addressing congestion and emissions. Charging has been shown to be very effective at influencing behaviour. This includes promoting a shift to more sustainable modes of travel via the Congestion Charge, and reducing the number of polluting vehicles in London via the Low Emission Zone.

The Mayor, through TfL, will keep under review existing and planned road user charging schemes, including the Congestion Charge, Low Emission Zone, ULEZ and the Silvertown Tunnel schemes, to ensure they prove effective in furthering or delivering the policies and proposals of the Mayor's Transport Strategy.

The Mayor will also consider the development of the next generation of road user charging systems. These could replace schemes such as the Congestion Charge, Low Emission Zone and ULEZ. More sophisticated road user charging and/or workplace parking levy schemes could be used to contribute to achieving the policies and proposals in the Mayor's Transport Strategy, including mode share, road danger reduction, environmental objectives, reducing congestion on the road network, and supporting efficient traffic movement. In doing so, the Mayor will consider the appropriate technology for any future schemes, and the potential for a future scheme that reflects distance, time, emissions, road danger and other factors

in an integrated way. Road user charging schemes will include (subject to the development of detailed proposals and consultation) introducing the central London ULEZ standards and charges in 2019. There has been an Emissions Surcharge on the Congestion Charge (the "T-Charge") since October 2017, and this will continue until the introduction of the ULEZ.¹⁷

The Mayor has proposed (subject to public and stakeholder consultation) that the ULEZ is expanded to Inner London by 2021 for light vehicles (cars, vans, minibuses and motorbikes), covering an area up to the North / South Circular (Figure 13). It is also proposed that the requirement to comply with ULEZ emission standards is expanded London-wide for heavy vehicles by 2020, which will result in only an estimated one per cent of road length in outer London remaining in exceedance of the NO₂ limit values in 2025: primarily on the North Circular and around Heathrow Airport (the latter being a matter for national policy).

¹⁷ There are slightly different arrangements for residents of the central London area, who will remain subject to the T-charge while the ULEZ resident sunset period is in effect.

The Mayor asked TfL to examine expanding ULEZ London-wide to cover light vehicles to outer London and whether this was the most effective measure for bringing non-compliant areas of outer London into compliance. They have advised that there is no appropriate boundary road for a wider zone that incorporates the North Circular other than the Greater London boundary. The necessary infrastructure for this wider zone would take significant time to implement. The additional 1.7 million households affected by this level of expansion would have to be given a reasonable pre-compliance period before charging started, which could delay the possibility of achieving benefits for Londoners earlier.
































Considering the benefits expected from the earlier implementation of the central London ULEZ and the application of ULEZ standards to heavy vehicles London-wide from 2020, it is likely that targeted local measures such as local road closures, vehicle restrictions or other interventions could be equally effective and likely to bring areas of non-compliance into compliance in a

quicker timeframe than expansion of the ULEZ to cover light vehicles in outer London. However, the Mayor will keep the situation under review and consider what measures will be most effective and likely to secure compliance on those outer London roads within the shortest time possible.

The Mayor will also work with boroughs to explore borough-level restrictions on fossil-fuelled vehicles, prioritising diesel vehicles (for example diesel surcharges on resident parking permits), and initiatives to incentivise ultra low emission vehicles.

The Mayor has put in place a Cleaner Vehicle Checker that helps members of the public understand the emissions impact of their cars and vans, recognising that vehicle performance varies even at the same standard. The government should also introduce a complementary national car labelling scheme to raise awareness about the differential pollution emissions from vehicles at the time of purchase (including for second hand vehicles).

Figure 13: ULEZ proposals to be consulted on¹⁶

2017		T-charge and LEZ	Vehicle class**	Min. emissions standard*** or	Daily charge
			 	Euro 4	£10 (CC hours only)
			 	Euro IV	£10 (CC hours only)
			 	Euro IV PM	£200
				Euro 3 PM	£100
2019 Confirmed		ULEZ replaces T-charge. Introduction of Euro 6/VI diesel standard and change in charge and hours	Vehicle class**	Min. emissions standard*** or	Daily charge
				Euro 3	£12.50
			 	Euro 4 petrol or Euro 6 diesel	£12.50
			 	Euro VI	£100
			 	Euro IV PM	£200
				Euro 3 PM	£100
2020 Proposal*		Euro VI standard applies London-wide for heavy vehicles	Vehicle class**	Min. emissions standard*** or	Daily charge****
				Euro 3	£12.50
			 	Euro 4 petrol or Euro 6 diesel	£12.50
			 	Euro VI / Euro IV PM	£100 / £300
				Euro 3 PM	£100
2021 Proposal*		ULEZ expands to inner London	Vehicle class**	Min. emissions standard*** or	Daily charge****
				Euro 3	£12.50
			 	Euro 4 petrol or Euro 6 diesel	£12.50
			 	Euro VI / Euro IV PM	£100 / £300
				Euro 3 PM	£100

Note: In hatched areas, standards indicated by both colours apply

*These proposals are subject to consultation and may change

** Vehicle class is indicative only, additional vehicles are affected

*** Minimum emissions standards are for NO_x and PM unless otherwise stated

**** Daily charges are indicated only and are subject to change

“London’s freight accounts for over ten per cent of PM_{2.5} emissions and around a fifth of traffic in the capital.”

Proposal 4.2.1.e The Mayor aims to reduce emissions from freight through encouraging a switch to lower emission vehicles, adopting smarter practices and reducing freight movements through better use of consolidated trips

Almost all of London’s freight is carried by road, using diesel vehicles. This activity accounts for over ten per cent of PM_{2.5} emissions¹⁸ and around a fifth of traffic in the capital.¹⁹ In the morning peak, freight traffic is around a third of the total traffic in central London.

London’s freight movement is also growing in an inefficient way. Many deliveries of non-time critical goods are unnecessarily made at congested times of the day. Lorries and vans are often less than half full. It is estimated as many as two in every three delivery slots are missed.²⁰ This means repeat trips, which cause even more congestion and emissions. The Mayor will work with London Councils on possible changes to the London Lorry Control Scheme, which controls the movement of heavy goods vehicles at night and at weekends, so that the scheme can reduce emissions of air quality pollutants and CO₂, as well as minimising noise and encouraging safer vehicle design.

The Mayor has put in place a Cleaner Vehicle Checker to help fleet operators understand the emissions of their cars and vans, and will work with industry to set out a clear plan to phase out fossil fuels. This is vital, especially amongst heavier specialist vehicles, which are often more challenging to switch to cleaner alternatives. The plan will help fleet operators better understand alternative fuels, and what role they should play to bridge the transition towards zero emission technologies.

The Mayor has set a number of targets to cut emissions and reduce the amount of freight movement in central London. This includes reducing construction traffic by five per cent by 2020, and reducing the number of freight trips during the morning peak by ten per cent by 2026. This can be achieved by:

- stimulating the supply, and increasing the take up, of low emission commercial vehicles through regulatory, procurement and pricing incentives
- making the most efficient use of vehicles by developing a strategic consolidation and distribution network to protect industrial land, and reduce

the impact of freight and servicing trips on London's streets (Box 6 describes a deliveries consolidation case study and Box 7 describes a low emission freight pilot)

- encouraging the use and growth of London's network of collection points. These are often located at local shops and post offices that Londoners can access on foot close to their homes or on their daily commute
- examining other ways in which freight can be delivered and moved around. For example, using cargo bikes and motorbikes for shorter, smaller deliveries in central London and town centres, and making better use of river and rail services
- working with London's business community and public sector organisations to review the timing of their deliveries, and to use their procurement power to discourage trips at the times of day when they have the greatest adverse impact on London's streets and population

TfL will set out the additional actions to be taken to address freight emissions in their Freight, Delivery and Servicing Plan.

¹⁸ Transport statistics Great Britain 2013.

¹⁹ NO_x emissions in Greater London LAEI 2010.

²⁰ Online Shopping Report conducted by ICM on behalf of the GLA in August 2015.

BOX 6: CROWN ESTATE REGENT STREET CONSOLIDATION

London's West End is a very popular shopping area and is home to many household name brands. However, research revealed that 73 per cent of consumers found the experience exhausting and overwhelming, while 63 per cent complained of being jostled. A delivery solution was required that helped reduce traffic but drive footfall, and that would allow retail staff to return their focus to selling.

The retailers on Regent Street and in the West End have worked with Clipper Services to bring together deliveries despatched from a single consolidation centre. The centre

brings together consumables from all suppliers to one easily accessible point, combining deliveries with other West End companies to streamline a previously complex and inefficient system into a simple and effective one. It also releases extra in-store floor space for retail.

As a result, there has been a 77 per cent reduction in vehicle movements in the area. There has also been an improvement in air quality, with 8 kg less particulate matter emitted each year within central London; the equivalent of an average car driving more than 6,200 times around the M25.

BOX 7: GLA AND GNEWT LOW EMISSION FREIGHT PILOT AND TFL'S LOCITY INITIATIVE

The GLA and Gnewt Cargo (a leading SME and a proven logistics operator that specialises in electric vehicles), have secured circa £1.1m from Innovate UK to run a low emission freight and logistics trial for larger commercial freight vehicles from April 2017 to 2019. This will trial freight collections using large zero emission vehicles and test their commercial viability with the aim of encouraging the widespread introduction of low and zero emission vehicles to other commercial fleets operating in London and across the UK.

Through TfL's LoCITY initiative, the Mayor is increasing the supply and uptake of low emission commercial vehicles and associated infrastructure, which will help businesses transition to cleaner vehicles.

Proposal 4.2.1.f The Mayor will work with stakeholders to understand the barriers to deploying ultra low emission auxiliary power units on vehicles and encourage further take up in London

Secondary engines, or auxiliary power units, are used on some vehicles mostly to provide refrigeration for cool or frozen food deliveries.

Although they are generally small, these engines commonly run on 'red diesel'²¹ and are regulated to a much lower standard than the main vehicle engine. There are ultra low emission alternatives available, but they are not widely used. The Mayor will work with TfL and stakeholders to understand the barriers to deployment, and promote the use of cleaner auxiliary power units when possible. This will include lobbying for the appropriate tax treatment of 'red diesel', so that a switch to ultra low emission technologies can be financially incentivised.

²¹ Red diesel is a dyed fuel that incurs a lower tax than ordinary transport diesel.

Proposal 4.2.1.g The Mayor, working with government, the boroughs, bus and coach operators, manufacturers, and other organisations will tackle emissions from unnecessary engine idling throughout London

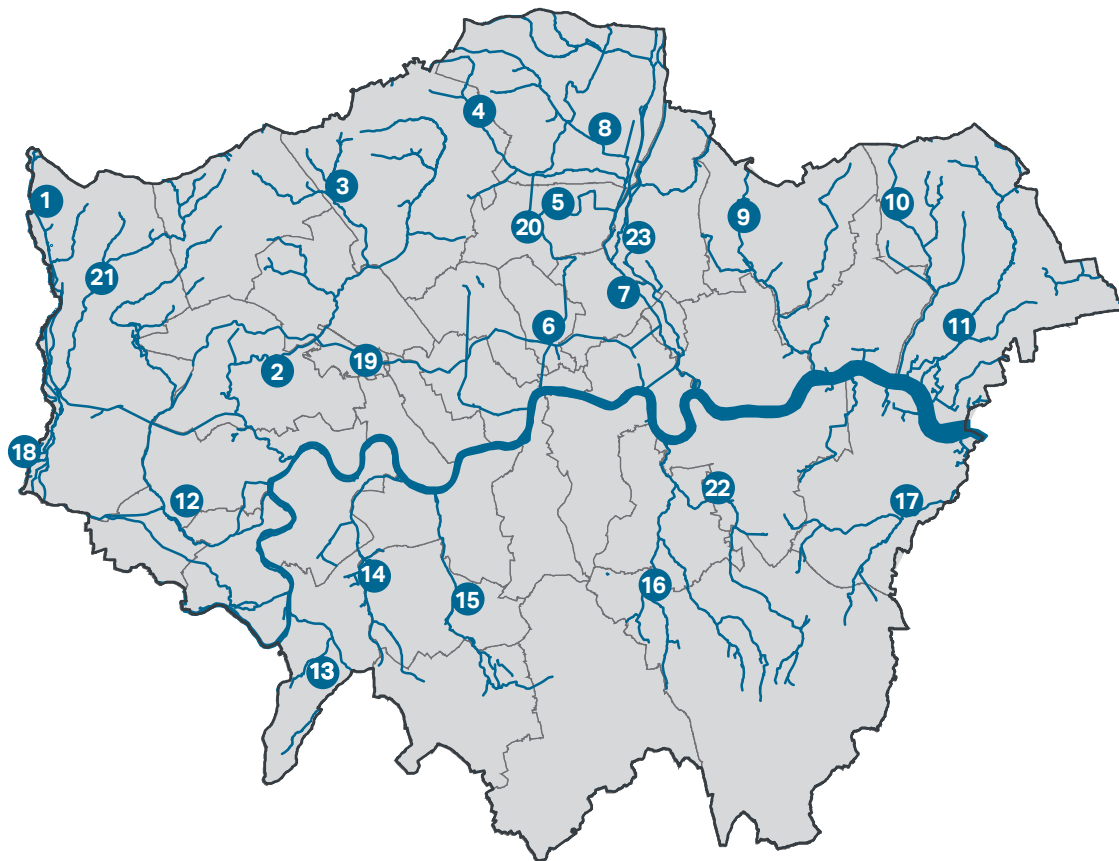
Engine idling remains a potentially significant and unnecessary source of emissions, which also wastes money. The Mayor will work with partners, including the government, boroughs and manufacturers, to tackle it. There will be a focus on parked buses, coaches and taxis, as well as particular problem areas such as around schools, transport interchanges and major tourist attractions. There will also be a focus on logistics companies to tackle idling by commercial vehicles such as vans. Boroughs have a range of powers they can use to enforce against idling vehicles but these need to be streamlined and made more flexible to make them more effective.

Policy 4.2.2 Reduce emissions from non-road transport sources, including by phasing out fossil fuels

Proposal 4.2.2.a The Mayor will work with government and relevant groups to reduce emissions from activity on London's waterways

London's waterways are multifunctional assets, and the Mayor will work to promote their protection and water-related use, benefitting the environment as well as the health and wellbeing of Londoners. The term 'waterways' does not only refer to the River Thames, its tributary rivers and canals, but also to other water spaces including docks, lakes and reservoirs (Figure 14). This network of linked waterways is of cross cutting and strategic importance for London. Every London borough contains some waterways: 17 border the Thames and 15 contain canals.

Figure 14: London's waterways²²



● Waterways

Source: OS Open Rivers

Note: Not all tributaries shown

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- | | | | |
|----------------------|---------------------|---------------------|--------------------|
| 1. Grand Union Canal | 7. Lee Navigation | 13. Hogsmill River | 19. Paddington Arm |
| 2. River Brent | 8. Salmons Brook | 14. Beverley Brook | 20. New River |
| 3. Silk Stream | 9. River Roding | 15. R. Wandle | 21. River Pinn |
| 4. Pymmes Brook | 10. River Rom | 16. Ravensbourne R. | 22. River Quaggy |
| 5. Moselle Brook | 11. Ingrenbourne R. | 17. River Cray | 23. River Lea |
| 6. Regents Canal | 12. R. Crane | 18. River Colne | |

²² Mayor of London (2018) The draft new London Plan: The spatial development strategy for London. Accessed from: <https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan/draft-new-london-plan/chapter-9-sustainable-infrastructure/policy-si14-waterways-strategic-role>

“Emissions from vessels and residential boats can contribute to local air pollution. These sources contribute a small but significant part of London’s total pollutants and CO₂ emissions.”

Emissions from vessels and residential boats can contribute to local air pollution. These sources contribute a small but significant part of London’s total pollutants and CO₂ emissions. The Port of London Authority wants to increase the number of river users to 20 million by 2035. Reducing the number of vehicles and making more use of the waterways will help improve air quality along London’s busy and congested streets. The Mayor supports increased use of waterways for freight and passenger services, as well as leisure uses. However, emissions need to be carefully managed to ensure the problem does not just shift from one source to another.

The Mayor has no powers to control emissions from the river or from shipping, but has asked government to improve the fragmented regulatory system to enable a single regulator through a new Clean Air Act or other legislation. This will ensure that emissions from vessels using London’s waterways are reduced as far and as quickly as possible.

The Mayor recognises that there are specific challenges for river and canal vessels, especially for communities who live on London’s waterways, and will work with all the relevant parties to ensure that strategies to address air pollutants and CO₂ emissions are proportionate

and possible. This includes navigation authorities, industry representatives, waterways interests group and experts, plus London borough representatives. The Mayor will collaborate with the Port of London Authority, TfL, and other stakeholders to develop a robust, evidence based strategy.

The Mayor will lead by example, for instance by bringing the new low emission Woolwich Ferry into service as quickly as possible. The Mayor will also support demonstrator projects for new technologies, such as retrofit equipment or other low emission technologies.

The Mayor will also support proposals to use wharves as freight consolidation centres as part of London's strategic consolidation and distribution network.

To enable cleaner vessels to use the waterways the Mayor will encourage new and refurbished wharves, piers and canal moorings to generate renewable power onsite. Where appropriate, shore power or refuelling facilities for low emission fuels should be provided for all vessels moored onsite. Provision of shore power will be most encouraged at residential moorings. The Mayor will also work with wharf and pier operators to help introduce tiered fees for the cleanest vessels, similar to the Port of London Authority's Green Tariff scheme.

Proposal 4.2.2.b The Mayor will work with government and other partners to seek reductions in emissions from aviation activity in London and the south east, particularly from Heathrow

Adequate airport capacity serving a wide range of destinations is vital to helping London stay competitive in a global economy. At the same time, the aviation industry must play its part in improving the health and quality of life of those living and working near London's airports.

The air quality findings in the government's Revised National Policy Statement (NPS) are stark. Even accounting for the measures that the Mayor is taking in London to improve air quality, it found there is a high risk that Heathrow expansion will lead to an exceedance of legal limits across a large swathe of London until at least 2030. Aviation contributes around 2.5 per cent of London's monitored greenhouse gas (GHG) emissions.²³ If this sector fails to decarbonise, by 2050 these emissions would make up over 20 per cent of London's total. If unmanaged, emissions from the proposed Heathrow expansion are likely to increase by around a third.

²³ Defined as emissions from aviation sources up to 1km above the ground.

The Mayor opposes any airport expansion in London unless it can show that there is no unacceptable impact on air quality and that GHG emissions are minimised. This will include:

- demonstrating airport expansion will not cause new exceedances of the UK air quality standards, or increase of existing areas of exceedance
- demonstrating airport expansion will not increase exposure to pollution where improvements in local or regional air quality have been, or will be, secured by other Mayoral, local or national policies
- demonstrating airport development or expansion has incorporated Air Quality Positive principles and other Mayoral policies to minimise the impact of development, including impacts during the construction phase
- demonstrating that any airport expansion ensures that London's contribution to aviation emissions reduce in line with recommendations to meet national GHG emission targets.
- the Mayor working with airports in London to develop their climate action plans and determine how they will minimise net emissions. It may be possible to establish an offsetting fund where reductions in GHG emissions cannot be met onsite

Airports that are not proposing to expand, or are only proposing to increase passenger numbers without expanding their infrastructure, should continue to review their operations. They must identify options to reduce their impact on air quality both on and offsite, and take these steps to do so as soon as possible.

The impacts of expansion of Heathrow Airport on ambient noise are covered in Chapter 9.

Proposal 4.2.2.c The Mayor will work with government and other partners to seek reductions in emissions from rail transport and at stations

London's rail network is a huge consumer of electricity. Therefore, making rail more efficient and electrifying lines will be essential for meeting the Mayor's zero carbon ambition. It will also replace diesel transport and the associated harmful air pollution emissions. By 2050, all rail lines in London should be electrified as part of Network Rail's investment programme. Electrification of more of the network (for example connections to the Gospel Oak line and services to Marylebone) is also needed to provide the necessary capacity increase in London.

The Mayor, through TfL, will investigate opportunities to decarbonise TfL-controlled rail services, with the aim of achieving a zero carbon network by 2030. This will include pursuing options to power services through local renewable generation in London and using procurement options to increase the provision of renewable energy.

As well as electrifying all rail lines by 2050, further measures will include new energy efficient trains on the Elizabeth line from 2017 and from the mid-2020s

on the Piccadilly, Waterloo & City, Bakerloo and Central lines. This will allow for faster, more frequent service on the lines, with as little additional energy required as possible.

Specific air quality issues at stations like Paddington and Marylebone should be addressed by Network Rail and the rail operating companies under government guidance. The Mayor has no power to tackle these. However, through TfL, the Mayor will work with government, Network Rail, and others to resolve local air quality problems as soon as possible.

Policy 4.2.3 Reduce emissions from non-transport sources, including by phasing out fossil fuels

Proposal 4.2.3.a The Mayor will work with government, TfL, the London boroughs, the construction industry and other users of Non-Road Mobile Machinery (NRMM), such as event organisers, to prevent or reduce NRMM emissions

NRMM is a diverse sector, including construction machinery, generators, and industrial equipment. This policy is primarily aimed at construction, roadworks, events and similar uses. Trains, as well as river and canal vessels, are dealt with separately in earlier proposals.

Engines used in NRMM are subjected to progressive emissions limits by the EU, similarly to road vehicles, meaning that newer machines are far less polluting than older ones. However, these standards are further behind those applied to road vehicles and there has historically been greater flexibility in their application.

NRMM used in the construction and infrastructure building sectors currently accounts for approximately seven per cent of NO_x and eight per cent of PM₁₀ emissions in London. As emissions from road transport fall, these sectors are expected to grow as a proportion of London's total emissions.

The diversity of the NRMM sector means that different approaches may be necessary for different users. In the absence of direct powers to regulate this sector, the Mayor has issued guidance to create an NRMM Low Emission Zone through planning conditions with minimum emission standards, based on the European engine "stages".²⁴

The NRMM Low Emission Zone will include progressively tightening standards, with the current proposals as follows:

- Currently: Stage IIIB in the Central Activities Zone (CAZ) plus Canary Wharf area, Stage IIIA everywhere else
- 2020: Stage IV in CAZ plus Opportunity Areas, Stage IIIB everywhere else.
- 2025: Stage IV throughout London
- 2030: Stage V throughout London
- 2040: zero emissions throughout London

The Mayor will continue to review the NRMM Low Emission Zone standards to ensure that they deliver the largest possible improvements. Proposal 4.2.4b highlights that the Mayor wants stronger enforcement powers to ensure that these standards are consistently applied and enforced across all sectors in London, and has asked the government to legislate to provide these.

The Mayor will lead by example through the GLA group. Emissions from NRMM construction and maintenance activities will, where appropriate, meet or exceed the standards set out by the NRMM Low Emission Zone.

²⁴ European emission standards for engines used in non-road mobile machinery have been structured as gradually more stringent tiers known as Stage standards. There are five Stages: I – V, with some sub-divisions (for example IIIB). These are similar to the 'Euro standards' used to address vehicle engine exhaust emissions.

The GLA group will aim to source and manage external suppliers that are able to provide low or zero emission temporary power and power distribution for events. Where possible use of mains power or zero emission solutions, such as hydrogen generators should be preferred. As an absolute minimum, temporary generators must comply with the NRMM Low Emission Zone standards. TfL will meet or exceed the emissions standards set out by the NRMM Low Emission Zone for TfL Road Network construction and maintenance activities.

The Mayor will also work with other major infrastructure developers, such as Network Rail, Thames Water, National Grid, and High Speed 2 (HS2), so they incorporate these as minimum emissions standards. Working with the Environment Agency, Defra and the London boroughs, the Mayor will seek to incorporate NRMM emissions standards into environmental permits. The Mayor will also promote the use of zero and ultra low emission technology, such as fuel cell, hybrid, or electric machines to reduce emissions and carbon impacts from NRMM.

“Non-road mobile machinery used in the construction and infrastructure building sectors currently accounts for approximately seven per cent of NO_x and eight per cent of PM₁₀ emissions in London.”

As well as setting requirements for minimum emissions standards, the Mayor will develop an enhanced website to make participation in the NRMM Low Emission Zone as straightforward as possible and set up a Green Machines NRMM positive recognition scheme to promote best practice in reducing emissions and encourage innovation.

Proposal 4.2.3b The Mayor will work with industry and other partners to seek reductions in emissions from construction and demolition sites

Construction and demolition sites, including roadworks, can be a significant contributor to local particulate levels if they are not well managed. These projects can last a long time and many can happen in the same area. This means these emissions can significantly affect the health of local residents, unless they are properly controlled and managed.

It is important to develop and share best practice to support and improve the measures the construction sector already puts in place. Similarly, the understanding of how monitoring can be used on construction sites to inform the operators when additional measures are required must be improved.

To do this, the Mayor will maintain guidance on managing dust and other emissions on construction sites, as well as using planning powers to apply these as conditions for new planning permissions. The Mayor will continue to support the London Low Emissions Construction Partnership and similar projects to research and develop the best dust-control techniques for construction sites. Voluntary approaches will be promoted to control the problem at sites or in areas where the Mayor has no statutory powers.

Proposal 4.2.3.c The Mayor aims to improve London's air quality by reducing emissions from homes and workplaces, including through energy efficiency programmes

Over 70 per cent of the energy used in homes and workplaces is for space and hot water heating. Around 90 per cent of this is currently met using gas-fired boilers, which emit harmful NO_x emissions and contribute to air pollution in London. NO_x emissions from commercial gas use are expected to grow significantly as a proportion of London's emissions. In central London, NO_x emissions from domestic and

commercial gas use will increase from 30 per cent in 2013 to 38 per cent of local emissions in 2020.

Installing an efficient boiler or renewable heating technology can be a cost effective way to cut NO_x emissions, CO₂ emissions and energy bills. The Mayor's Energy for Londoners programme will support the transition from old inefficient gas boilers to ultra low NO_x gas boilers and low carbon (and low-pollution) heating alternatives, such as heat pumps. This will help make London's air cleaner.

Following the London Boiler Cashback Scheme, the Mayor will deliver a new three-year (2018-2020) commercial boiler scrappage initiative to help provide incentives to businesses to install more efficient gas and renewable heating systems. The Mayor will evaluate this scheme and the London Boiler Cashback and Better Boilers schemes. This will help inform the development of future initiatives to provide more efficient and low NO_x boiler replacements. Through the Energy for Londoners programme, the Mayor's energy efficiency programmes will also help to remove inefficient heating systems that contribute to poor air quality.

Proposal 4.2.3.d The Mayor will work with government to seek reductions in emissions from large scale generators producing power for commercial buildings in London

Diesel generators installed as emergency backup power sources in offices and other buildings are increasingly being used to meet peak electricity demand from the grid. This provides National Grid with flexibility services, such as Short Term Operating Reserve (STOR). However, this is not the only way for the National Grid to balance the network. Larger, more efficient power generators, storage and demand side response providers also provide STOR services.

The government does not impose any controls on the emissions from most of these generators. As a result, they have the potential for significant negative impacts if their use continues to grow. Even where they are used only for short amounts of time, old or poorly located generators can have a major impact on local air quality. Current Defra regulations to introduce emissions limits for generators over one megawatt in capacity will not affect existing generators until at least the mid-2020s. Generators that run for less than 500 hours a year will not be affected. These new controls do not go far enough or fast enough to protect the health of Londoners.

Where possible the Mayor will use planning powers to prevent the creation of new diesel powered 'generator farms' in London and ensure the impacts of any new emergency generators in buildings are minimised. To help this the Mayor will work with health authorities and others to raise awareness of the impacts of the use of diesel generators on air quality.

The Mayor will work with the Department for Business, Energy and Industrial Strategy and Defra to seek market reforms and discourage the use of emergency generators in the STOR and capacity markets. The Mayor will encourage Defra to apply more robust standards, and give the Mayor the powers to regulate this sector in London.

The Mayor will also work with the retrofit industry and generator owners to develop and install effective retrofit solutions for existing generators as soon as possible. Where applicable, retrofit for emergency generators could be supported by the Mayor's retrofit programmes.

Proposal 4.2.3.e The London Plan includes policies to reduce the impact of new industrial and waste sites on local air quality. The Mayor will also work with regulators and industry to reduce emissions from existing sites and will address the antisocial burning of waste and the inappropriate use of bonfires

The Environment Agency is responsible for licensing, inspecting and enforcing heavy industrial processes (known as 'Part A') and waste sites in London. It is a crucial partner in managing emissions from these installations. London boroughs lead on licensing, inspecting and enforcing 'Part B' sites.

Some waste and industrial activities have the potential to cause local dust and particulate pollution by the nature of the work that they undertake. The potential for these sites to cause pollution can be greatly reduced by moving dusty activities indoors. Working indoors can also have other benefits, such as reducing the amount of water used for dust suppression. The London Plan includes a policy on appropriate enclosure of polluting (or dusty) activities on waste sites to mitigate and avoid adverse effects on human health including poor air quality and noise pollution.

The Mayor will work with the Environment Agency and the London boroughs to seek reductions in emissions from existing potentially polluting industrial and waste sites on GLA or TfL-owned land by encouraging them to be enclosed as soon as possible. The Mayor will also work with the regulators to support and promote the enclosure of other existing sites, especially where there are existing problems with pollution.

The Mayor does not want any new Energy from Waste plants in London. If the Mayor's 65 per cent municipal waste recycling target is achieved, no further plants will be required (see Chapter 7). Any proposed refurbishments of existing plant, or new capacity (in the unlikely event this is proposed), will be expected to meet the same strict planning and air quality tests as for any other combustion source, and controls set by the Environment Agency. Additional powers for the Mayor, boroughs or the Environment Agency may also be needed to ensure such controls are effective. The Mayor will work with the Environment Agency and plant owners and operators to minimise their emissions.

Policy 4.2.4 The Mayor will work with the government, the London boroughs and other partners to accelerate the achievement of legal limits in Greater London and improve air quality

Proposal 4.2.4.a The Mayor will use the London Local Air Quality Management (LLAQM) framework to assist boroughs and require them to exercise their statutory duties to improve air quality in accordance with that framework, and will exercise statutory powers as required

London's boroughs have an important role to play in addressing local pollution.

The statutory basis for local authority air quality management obligations is Part IV of the Environment Act 1995. This requires that London boroughs monitor and review pollution. Under Defra statutory guidance, they must participate in the reformed London LAQM framework established by the Mayor (Box 4) and have regard to Mayoral guidance. Where pollution exceeds legal standards, they must declare an Air Quality Management Area and put in place an action plan detailing how they will tackle the problem. The levers under the control of the London boroughs include:

- emissions based parking charges
- reducing pollution from new developments through the planning system (especially those that are not referred to the Mayor)
- improving public realm for walking and cycling
- rolling-out targeted measures at pollution hotspots
- integrating air quality into their public health duties
- supporting new infrastructure for fuelling zero emission vehicles
- taking enforcement action against idling vehicles

As set out in the Mayor's Transport Strategy, TfL will offer boroughs support, including for the development and administration of traffic demand management schemes, and through Local Implementation Plans (LIPs), to support the delivery of the Healthy Streets Approach.

Borough statutory powers can be used to continue to discourage antisocial burning and illegal use of wood burning stoves or fireplaces, to reduce health impacts and smoke annoyance. In order to support the boroughs in this work, the Mayor calls for government to strengthen and bring up to date existing local authority enforcement powers against unsuitable fuel sales and excessively polluting solid fuel burners, particularly open fires that have the most adverse health impacts.

The Mayor will help boroughs in carrying out the exercise of their statutory duties to improve air quality. Through the reformed LLAQM framework there are clearer requirements for the boroughs. The Mayor will continue to provide coordination, tools, templates, support and funding. The Mayor will also improve information sharing and promote best practice by publishing an annual report on borough achievements, and provide advice, information and workshops.



The Mayor will recognise borough efforts to improve air quality through awarding Cleaner Air Borough status. This will provide increased recognition for high achieving boroughs, and include more rigorous criteria that reflect the increased ambition of this strategy, and will be reviewed annually. The Mayor will also support boroughs and businesses to deliver local projects through the Mayor's Air Quality Fund, including at least five borough Low Emission Neighbourhoods and five business Low Emission Neighbourhoods.

Under the LLAQM framework the Mayor can direct boroughs and require them to take steps to meet the air quality objectives. These reserve powers can be used following consultation.

Proposal 4.2.4.b The Mayor will work with the government to achieve full legal compliance with UK and EU legal limits as soon as possible

Comprehensive and coordinated action is needed at a national level to achieve legal limits as quickly and effectively as possible. The government has unique tools available to do this: the ability to promote legislation, change fiscal incentives, raise revenue, and take national action. The measures set out below would significantly help to

accelerate the UK's compliance with legal limits generally, particularly in the cities and areas identified in the government's own 2017 Air Quality Plan to be in breach of NO₂ limit values, including where clean air zones are proposed.

Since the draft London Environment Strategy was published the government has made some limited modifications to fiscal incentives in order to raise revenue for air quality measures outside of London. To achieve legal compliance as quickly and effectively as possible the government needs to do much more.

The Mayor therefore calls on the government to take the following action:

- **introduce a powerful new twenty-first century Clean Air Act** to entrench citizens' right to breathe clean air and tackle pollution in London once and for all. This legislation could provide the framework for action, bringing the law up to date to cope with the massive air quality challenges that London faces today. It should provide individuals with a legally enforceable right to clean air and the government could introduce new powers to better regulate all emissions sources, not just road transport, empower local authorities and better hold offenders to account

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- diesel is the biggest and most problematic source of NO_x emissions. A credible national air quality plan needs to accelerate the pace at which this fuel is no longer used, both in transport and non-transport uses. **A national vehicle scrappage fund** is essential if compliance costs to people and businesses of such action is to be minimised. It is only right that the government provides this help, given that national fiscal policy has encouraged dieselisation over many years, meaning many people bought polluting vehicles in good faith
 - **a national retrofit certification scheme** to further reduce compliance costs to businesses to meet new emission standards and build on the work that has been done with London's bus fleet
 - **a targeted retrofit fund for HGVs, buses, coaches and other specialist vehicles** (such as ambulances, fire brigade vehicles and refuse vehicles)
 - **vehicle excise duty, capital allowances and other fiscal reforms** (for example tax treatment of red diesel) are also needed to reduce emissions and promote the uptake of zero emission vehicles, auxiliary engines (including transport refrigeration units) and NRMM
 - **fiscal reform should be complemented by a national car labelling scheme** to raise awareness about the differential pollution emissions from vehicles at the time of purchase (including for second hand vehicles)
 - **more electric vehicles and charging infrastructure** needs to be unlocked by providing additional powers for the Mayor, addressing structural power grid barriers and providing additional funding through the Office for Low Emission Vehicles
 - **a commitment to providing the necessary funding to convert all UK black taxis to zero emission capable models by 2025 at the latest** and scrapping older diesel taxis. The structure of vehicle excise duty should not make it harder for taxi drivers to purchase zero emission capable models
 - **preventing the illegal removal of diesel particulate filters** through enhanced MOT testing and spot checks
 - the Mayor is already contributing more resources to improve air quality in London, but it must be recognised that this comes at a high cost in terms of other priorities. Government should recognise that London's air quality challenges are linked to a national problem and **ensure that London can access national funding on the same basis as other local authorities**

- **additional government funding for regional and local authorities should also be made available.** The current £475m available to support measures in polluted cities across the UK is woefully insufficient given the scale of the challenge
- **additional powers to manage traffic during high and very high pollution episodes,** including to effectively enforce the temporary exclusion of certain types of vehicles from certain areas during time-limited periods, in addition to being able to set emission standards
- Government is also uniquely placed to **provide enhanced public information,** especially during air pollution episodes by utilising national communication infrastructure and working closely with the media, for example pollution updates on weather bulletins
- **allow London planning policy to take precedence over national planning policy.** Changes that resulted from the government's Housing Standards Review could potentially complicate London's ability to enforce existing emission standards on residential developments. Taking into account London's growth, this could offset emissions reduction delivered by schemes such as the ULEZ. It is essential the Ministry for Housing, Communities and Local Government protect regional and local authorities' ability to set appropriate air pollutant emission standards for new developments, such as the 'Air Quality Neutral' requirements included in the London Plan or new approaches like 'Air Quality Positive', which is explained in more detail under the following objective
- provide the Mayor, boroughs or the Environment Agency with effective powers to control emissions from existing combustion plant that have an ongoing impact on air quality, such as small gas-engine Combined Heat and Power (CHP) systems, as well as any replacement plant that is not subject to planning restrictions
- ensure the Mayor has the direct statutory power to issue LAQM guidance to borough authorities under Part IV of the Environment Act 1995
- help boroughs **enforce anti-idling** measures on London's streets by making legislation fit for purpose and universally applicable

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- revise current policy advice that **parking charges** should not be linked to emissions.
 - **provide new powers for regional and local authorities to control emissions from Non Road Mobile Machinery (NRMM)**. This includes stronger enforcement powers to secure improved regulation of NRMM, including for auxiliary power and refrigeration units on vehicles and trailers, construction, road works, events and industrial sites
 - **provide new powers and improved coordination for river and maritime vessels**, including having a single regulatory authority for the Thames and London tributaries and introduce minimum emissions standards
 - **deliver a national boiler scrappage scheme** to tackle emissions from residential and commercial properties, particularly targeted at those on low incomes (to tackle fuel poverty) and for the premises of SMEs
 - **revitalise smoke control zones** by making it easier to declare them, strengthening and bringing up to date local authority enforcement powers and conferring the ability to create zero emission zones where no combustion is allowed on certain, time-limited occasions. This should include new powers to require appropriate abatement of significant combustion-related sources of PM_{2.5} in London
 - **address wood burner** emissions through a new fit-for-purpose testing regime and information on appropriate technology/ fuels for smoke control zones at point of sale as well as **new powers for the Mayor to set tighter minimum emission standards for wood burning stoves** sold in London (for example, eco-design standard), or other standards based on contemporary understanding of pollutants such as PM_{2.5}, rather than “dark smoke” or “grit and dust”

“The challenge of cleaning London’s air is made tougher because over half of the pollution experienced is not created here.”

Proposal 4.2.4.c The Mayor will work with European institutions, other European cities and city networks on efforts to minimise transboundary pollution

As noted above, the challenge of cleaning London’s air is made tougher because nearly half of the PM_{2.5} pollution experienced is not created here.

This is why close working with European partners through sharing best practice and coordinated action is required. This will help drive reductions in emissions across the continent and accelerate delivery of the National Emissions Ceiling Directive (NECD). Tighter NECD standards should be adopted to help cities like London achieve WHO air quality guidelines, particularly for PM_{2.5}.

The Mayor will work with European institutions, other European cities and city networks to ensure that transboundary pollution affecting London is minimised and ensuring strong

source control measures and regulations are adopted at EU level. This includes for real-world driving emissions testing, type-approval process arrangements, tyre and brake wear, and new emission standards (for example Euro 7).

Policy 4.2.5 The Mayor will work with other cities (here and internationally), global city and industry networks to share best practice, lead action and support evidence based steps to improve air quality

While London is a leader in many environmental fields, it does not have a monopoly on wisdom. The Mayor is open to sharing best practice with other cities. Maintaining existing international partnerships will be crucial to doing this. One practical example of this work is the reductions achieved in price premiums for hybrid buses by hosting an International Zero Emission Bus Summit and coordinating a Clean Bus Declaration. This was signed by 26 global cities.

OBJECTIVE 4.3 ESTABLISH AND ACHIEVE NEW, TIGHTER AIR QUALITY TARGETS FOR A CLEANER LONDON BY TRANSITIONING TO A ZERO EMISSION LONDON BY 2050, MEETING WORLD HEALTH ORGANIZATION HEALTH-BASED GUIDELINES FOR AIR QUALITY

The Mayor recognises that cleaning up London's air is about more than just meeting legal compliance. It is about making London a leading global city and an attractive place to live, visit and do business. The Mayor is therefore setting a course to achieve new ambitious targets, in line with current WHO health-based guidelines, particularly for PM_{2.5}.

Achieving this will require action beyond London. As set out above, transboundary pollution from outside London is currently responsible for the majority of the health effects associated with PM_{2.5}. Clearly any route map to meeting current WHO guidelines will require considerable coordinated European-wide action. The EU National Emissions Ceiling Directive sets a legally binding requirement for a 49 per cent reduction in PM_{2.5} levels by 2030, compared to 2005 levels, across Europe. This will be a significant 'down payment' on achieving WHO guidelines and gives an important context for the action set out below.

“The Mayor is setting a course to achieve new ambitious targets, in line with current WHO health-based guidelines, particularly for PM_{2.5}.”

Policy 4.3.1 The Mayor will establish new targets for PM_{2.5} and other pollutants where needed. The Mayor will seek to meet these targets as soon as possible, working with government and other partners

Proposal 4.3.1.a The Mayor will set new concentration targets for PM_{2.5}, with the aim of meeting World Health Organization guidelines by 2030

Legal limits in the UK for some pollutants are unambitious, especially for ultra fine particulate matter, black carbon and PM_{2.5}. There is significant evidence of the health impacts of PM_{2.5} as a part of PM₁₀ and evidence also shows negative impacts on health, even below legal EU limits. Setting bold, achievable concentration limits for London, and a pathway to meeting these, will ensure that London is aligned with the latest WHO recommendations. It will also have a positive effect on the health of Londoners. The measures set out elsewhere, while they will help achieve legal compliance, will not be enough to achieve these tighter limits. That is why further action is proposed below.

Using the latest evidence the Mayor has set new emission limits for full compliance with WHO for PM_{2.5} to be achieved by 2030. This will continue to drive improvement in air quality after legal standards are met, protecting public health and supporting the Mayor's wider vision for a zero carbon London. The understanding of the relationships between pollution and health is constantly evolving and this may require new targets for other pollutants to be set in the future.

As part of the Mayor's commitment to achieving WHO guidelines by 2030, the Mayor has joined the BreatheLife consortium, led by the WHO and United Nations Environment Programme, so that London can work with other cities and countries around the world to develop the technologies and tackle the transboundary contribution to ensure that these exacting guidelines are met.

Policy 4.3.2 The Mayor will encourage the take up of ultra low and zero emission technologies to make sure London's entire transport system is zero emission by 2050 to further reduce levels of pollution and achieve WHO air quality guidelines

Proposal 4.3.2.a The Mayor, through TfL, will ensure all taxis and private hire vehicles are zero emission capable by 2033 and the bus fleet is entirely zero emission by 2037

The Mayor's plan for zero emission transport aims for London's taxis and private hire vehicles to be zero emission capable by 2033, and TfL's bus fleet to be entirely zero emission by 2037 at the latest. This means making the most of the capital's world-leading reputation for the uptake of hybrid, electric and hydrogen technology in the bus and taxi fleets.

The Mayor, through TfL, will consult and work with stakeholders to produce and implement a comprehensive plan to encourage and accelerate the transition from diesel-powered taxis to zero emission capable vehicles by providing financial incentives, the necessary



infrastructure and regulation (including maintaining a taxi age limit, currently set at 15 years), with the objective of achieving a minimum of 9,000 such vehicles in the fleet by 2020.

Proposal 4.3.2.b The Mayor, working in partnership, will reduce emissions from fleet vehicles in the GLA group, the London boroughs and the wider public sector by switching to zero emission capable vehicles

It is important that the GLA group, and more broadly the public sector in London, leads by example in the take up of ultra low emission vehicles. The GLA group has an important role in demonstrating the viability of technologies on a broader scale and influencing the market. For example, the London Fire Brigade has an all-electric support car fleet. It also has a number of ultra low emission cars to attend emergency incidents and other brigade business across the capital.

Across the world, cities have started to set dates after which their operational fleets will not be allowed to procure or lease vehicles that are not zero exhaust emission (either electric or hydrogen).

The Mayor will work with TfL, the Metropolitan Police Service and the London Fire Brigade to achieve compliance with the ULEZ and work towards:

- all cars in GLA group support fleets being zero emission capable by 2025
- all new cars and vans (less than 3.5 tonnes) in GLA group fleets, including response vehicles, being zero emission capable from 2025
- all heavy vehicles (greater than 3.5 tonnes) in GLA group fleets being fossil fuel-free from 2030
- zero emission GLA group fleets by 2050

The wider public sector, including London boroughs and the NHS, will also be expected to lead by example and adopt similar dates.

“London’s entire transport system to be zero emission by 2050.”

Proposal 4.3.2.c The Mayor, working with government, TfL, the London boroughs and industry will aim for London’s entire transport system to be zero emission by 2050, with work towards this including using regulatory and pricing incentives to support the transition to the usage of Ultra Low Emission Vehicles

It will only be possible to achieve WHO air quality guidelines, deliver further improvements in public health, and bring about a zero carbon city by 2050 if all vehicles are zero emission by that date. TfL must take significant steps to achieve zero emission transport and encourage uptake of ultra low and zero emission technologies, with public fleets taking a lead.

The government’s approach of incentivising the use of diesel vehicles to achieve CO₂ savings has meant that local air quality has suffered. Rather than simply seeking to reverse this dieselisation, air quality and climate change must be considered together. This means a clear direction towards Ultra Low Emission Vehicles (ULEVs) to avert the adverse impacts of a rush back to petrol.

ULEVs include battery electric vehicles, plug-in hybrid vehicles, range-extended electric vehicles, and hydrogen fuel cell electric vehicles. For heavier vehicles, alternative fuels that show clear reductions in air pollutant and CO₂ emissions may be used as a bridging technology to zero emissions by 2050.

The Mayor will help ensure ULEVs are the best choice for any Londoner or London business needing to use a car or a van.

The aim is that all new cars and vans being driven in London should be zero emission by 2030 at the latest. Freight activity in London also contributes towards poor air quality and carbon emissions. Through programmes like LoCITY, TfL will work with the freight industry to overcome the barriers to adopting cleaner vans and HGVs.

To succeed in making the transition to ULEVs, a major expansion in electric charging and hydrogen infrastructure is required. This includes meeting the need for rapid charging to support

zero emission capable taxis, private hire vehicles and commercial vehicles, and working with boroughs and private operators to provide on-street residential charging. TfL and City Hall will work with boroughs and industry to understand the long-term need for charging. As well as standalone stations, hydrogen refuelling systems and charging infrastructure can, and should, be integrated into existing refuelling stations.

Where fleets such as buses or waste trucks provide their own refuelling systems they should consider how this could also be made available to the public or other businesses. This can either be through local agreements or via publicly accessible facilities at the site perimeter. The GLA group will lead by example in doing this where possible.

Bringing in ULEVs will require a significant change to London's energy systems. The supporting supply infrastructure must be in place, while maximising CO₂ benefits.

The Mayor will work with TfL, government and stakeholders (including National Grid and Distribution Network Operator Companies) to ensure systems are upgraded and robust. Plans will be put in place to manage the energy demand associated with the transition to ULEVs. Emerging technologies create new opportunities to use electric vehicles for energy storage and as a way to improve the resilience of the grid. This will help London's energy system accommodate and manage the increased demand associated with this transition. This is set out in more detail under Proposal 6.2.2c.

To facilitate this, government must invest to ensure the grid and energy network and available charging infrastructure is capable of hosting large numbers of electric vehicles. Robust planning regulations at a national level would also strengthen local requirements for infrastructure in new developments, making electric vehicles a convenient choice for residents and businesses.

To progress hydrogen alternatives to existing internal combustion engine vehicles, the Mayor has worked with industry, academics and other stakeholders through the Hydrogen London Partnership. This has demonstrated both transport (refuelling infrastructure, cars, vans, buses) and non-transport applications of the technology (energy for buildings and mobile generators) through a number of projects. Recently, 11 hydrogen vehicles have joined the Metropolitan Police's emergency response fleet, demonstrating the complementary role hydrogen fuels can play.

Going forward, the Mayor will seek to integrate hydrogen alongside electric technology into zero emission and alternative fuels plans for London. This is a normalisation phase, which will support the development of mechanisms towards mass introduction and use of hydrogen fuel cell technologies.

Proposal 4.3.2.d The Mayor, through TfL and the boroughs, and working with government, will implement local zero emission zones in town centres from 2020 and aim to deliver a central London zero emission zone from 2025, as well as broader congestion reduction measures, to pave the way to larger zero emission zones in inner London by 2040 and then London-wide by 2050 at the latest

As well as incentives and supporting infrastructure to encourage a move to ULEVs, it will also be necessary to use disincentives to phase out fossil fuel vehicles altogether. In addition to the proposed earlier introduction and expansion of ULEZ, tightening emission standards by implementing a network of zero emission zones would help reduce total CO₂, NO_x and PM_{2.5} emissions. This would send a clear signal that the city is moving towards a fossil fuel-free future.

A zero emission zone is likely to subject any non zero emission vehicles driven within it to road user charges (similar to ULEZ or LEZ) and/ or other vehicle prohibitions or restrictions. Creating zero emission zones will be an essential part of the move towards zero emission transport. The Mayor, through TfL and the boroughs, and working with Government, will seek to implement zero emission zones in town centres from 2020 and aim to deliver a zero emission zone in central London from 2025, as well as broader congestion reduction measures to facilitate the implementation of larger zero emission zones in inner London by 2040 and London-wide by 2050 at the latest (Figure 15).

This proposal, including the vehicles and area it applies to, charge levels and hours of operation, and discounts and exemptions or other restrictions, will be developed in the next few years. Schemes will be subject to statutory consultation before being introduced.

Map to zero emission road transport¹⁶

		NOW	2020	2025	2030	2035	2040	2045	2050
London action	Demonstrating technologies	Zero emission capable taxis Electric single-deck buses; bus charging infrastructure Supporting low emission freight	Town centre Zero Emission Zones						
	Changing purchasing patterns	Deliver a major expansion in electric vehicle charging points At least 15 hydrogen fuelling stations installed in and around London All new taxis zero emission capable All new buses will be hybrid, electric or hydrogen	Further investment in charging and refueling infrastructure All newly registered cars and LGVs driven in London zero emission						
National action	Fleetwide adoption and managing congestion	Keep Congestion Charge under review and support borough measures Emission Surcharge / Central London Ultra Low Emission Zone	Develop a new, more sophisticated way of paying for road use, integrating existing and proposed emissions-based and congestion charging schemes Expanded Ultra Low Emission Zone Tighten Low Emission Zone standards for heavy vehicles	Central London Zero Emission Zone	All buses zero emission or hybrid All taxis and PHVs zero emission capable All public sector car fleets zero emission capable	Wider Zero Emission Zone	All buses zero emission		London-wide Zero Emission Zone Zero emission road transport
		Increase use of renewable electricity generation for the National Grid until it results in net zero carbon emissions Plug-in vehicle grants Funding low emission vehicle research – especially heavy vehicles Vehicle tax exemption for zero emission	Taxation encourages ultra low emission vehicles over conventional vehicles Financial incentives for businesses/ manufacturers National diesel scrappage scheme						

Key:

Taxis/ PHV

Buses

Fleets

Congestion

Infrastructure

Emissions Charging

Taxation

Aim

Proposal 4.3.2.e The Mayor will work with the industry and other partners to seek solutions to reduce emissions from tyre and brake wear

By 2030, an estimated 90 per cent of PM emissions from road transport will be from tyre and brake wear.²⁵ If PM_{2.5} levels are to be improved, this needs to be significantly reduced.

The first step to achieving this will be a reduction in total vehicle kilometres by supporting a shift to walking, cycling and public transport, and more efficient delivery and servicing. Promoting more efficient eco-driving can also help. New technologies, including the use of properly designed regenerative braking, have the potential to reduce emissions. The Mayor, working with government, manufacturers and other partners will support and accelerate research into the development and uptake of technologies to tackle tyre and brake wear. This includes regenerative braking, and providing advice on more efficient driving.

Policy 4.3.3 Phase out the use of fossil fuels to heat, cool and maintain London's buildings, homes and urban spaces, and reduce the impact of building emissions on air quality

Proposal 4.3.3.a The London Plan includes policies so that all new large scale developments in London are 'Air Quality Positive', and maintain Air Quality Neutral requirements for all other developments

London's growth and redevelopment should contribute to delivering improvements in air quality now and into the future. All major developments are already, and will continue to be, required to be Air Quality Neutral.

Emission benchmarks for Air Quality Neutral Developments are set out in planning guidance for building operations and transport emissions based on the latest technology (including its effectiveness and viability).

²⁵ London Atmospheric Emissions Inventory 2013.

Developments that meet or improve on these benchmarks are considered to avoid any increase in NO_x and PM emissions across London as a whole and are therefore 'Air Quality Neutral'. By ensuring all developments meet this minimum requirement London's growth can be accommodated without undoing other improvements in air quality. The Mayor will continue to keep these benchmarks under review to ensure that they remain fit for purpose. Implementation of the Air Quality Neutral policy will be monitored through the LLAQM process and in the London Plan monitoring report to ensure the requirements are met.

Larger developments have the potential to go further and boost local air quality by effective design and integration into the surrounding area. For instance, by the provision of low or zero emission heating and energy, green infrastructure, or improvements to public transport, walking and cycling infrastructure, Air Quality Positive developments will make sure that emissions and exposure to pollution are reduced.

The Mayor will provide guidance for developers on the most effective approach to take to ensure a development is Air Quality Positive and will review and update the guidance as required. This will ensure the best approaches to Air Quality Positive development are used in London.

Proposal 4.3.3.b The London Plan includes policies on energy provision to make sure CO₂ and pollution targets are achieved in a coordinated way with no air quality dis-benefits

The Mayor has set ambitious long-term targets to both reduce harmful pollution emissions and to become a zero carbon city. The Mayor's energy policies will take a holistic approach to overall emissions while ensuring no air quality dis-benefits.

To date combustion-based CHP systems, predominantly gas-engine CHP, have been used in new development in London as a cost effective way of producing low carbon heat. However, the carbon savings from gas-engine CHP are now declining as a result of the national grid electricity decarbonising, and there is increasing evidence of adverse air quality impacts.

As a result, we must now consider alternative approaches. The London Plan introduces a heating hierarchy that will promote cleaner heating solutions, such as those based on secondary heat. The Mayor will encourage a similar approach when existing or new plant is being replaced or installed outside the planning system.

To better understand the pollution impact of existing CHP systems in London the Mayor will also develop a new CHP register, which will be reflected in future versions of the LAEI.

Proposal 4.3.3.c The Mayor, working with London's boroughs and other partners, will seek to reduce emissions from wood and other solid fuel burning in London

Wood burning stoves have become increasingly popular in recent years. These small stoves are not generally subject to planning controls. Wood burning in urban areas can contribute significantly to local pollution. Nearly all London boroughs have declared their whole areas to be Smoke Control Zones, under the Clean Air Act 1993. Wood and coal should not be burnt as a fuel in these areas, unless the appliance being

used has been tested to ensure that it can burn wood without creating smoke, or the fuels themselves are certified as "smokeless". Defra maintains a register of 'exempt' appliances on its website, but it is thought that many Londoners are unaware that they live in a Smoke Control Zone and are installing non-exempt appliances.

Burning wood or other solid fuels, like coal, can emit high levels of PM_{2.5}. The Mayor will work with partners to raise awareness of the health impacts of open fires and stoves, including within homes and workplaces.

The Mayor will work with manufacturers and suppliers to ensure the right information is given to Londoners at the point of sale to ensure only the cleanest appliances and fuels are used. At the same time borough councils will be encouraged to enforce the existing rules on the use and sale of smokeless fuels and exempt appliances. The Mayor will work with Defra to ensure that the rules are kept up to date and as simple as possible to comply with. This could include banning the sale of non-smokeless fuels in London or improved labelling.

Defra should revitalise smoke control zones by making it easier to declare them, strengthening and bringing up to date enforcement powers and conferring the ability to create zero emission zones where no combustion is allowed for certain time-limited periods. This should include new powers to require appropriate abatement of significant combustion-related sources of PM_{2.5} in London.

The Mayor will also continue to work with Defra to improve the standards and testing for smokeless fuels and exempt appliances to make sure they are effective at reducing PM emissions. The Mayor is calling on government for new powers to set tighter minimum emission standards for wood burning stoves sold in London (for example eco-design standard). When new standards, such as 'eco-design ready', come into force the Mayor will seek to make sure that they are introduced as rapidly as possible in London.

Policy 4.3.4 Work to reduce exposure to indoor air pollutants in the home, schools, workplace and other enclosed spaces

Proposal 4.3.4.a The Mayor, through educational materials, campaigns and LLAQM will raise awareness about and help improve indoor air quality, as well as use the planning system to reduce exposure through design measures to prevent poor outdoor air quality entering a building

People spend a large part of their lives at homes, offices, schools, day care centres, public buildings, health care facilities or other private and public buildings. That is why the quality of indoor air is an essential factor of healthy life and people's wellbeing. Anyone can potentially be affected by poor indoor air quality. However, some groups are more vulnerable to the health effects of that exposure, for example the elderly, children, or those with pre-existing health conditions.

The statutory air quality standards cover only outdoor (ambient) air quality. However, outdoor air pollution enters buildings through the building envelope (including windows and doors) or via the ventilation system. Many studies have shown that there is a link between the outdoor concentrations of NO₂ and PM and indoor air quality, especially in areas with poor air quality. There are also indoor sources of pollution that contribute to poor indoor air quality.

The impacts of wood and solid fuel burning on outdoor air quality in London have been discussed in Proposal 4.3.3c. However, fireplaces and stoves also have an impact on indoor air quality. The Mayor's new guidance on indoor air quality will identify best practice and potential mitigation measures.

The Mayor will work with partners to develop protocols and tools for planners and the building design industry to improve indoor air quality in existing buildings, as well as guides for Londoners, schools and businesses to help them reduce levels of indoor pollution. The Mayor will also work with government, London boroughs, and other partners to develop understanding and raise awareness about the issue of indoor air quality in London and identify other solutions.

Proposal 4.3.4.b The Mayor, through TfL, will conduct further research into the health risks of particulate matter on the London Underground network and take appropriate measures to mitigate the adverse effects of any risks found where practicable

Improving London's air quality extends to the London Underground network. Comprehensive research has concluded that concentrations of PM, caused in part by train wheel and brake wear, are high in some parts of the Tube network. This PM is, however, of a very different composition to in the air above ground. The increasing use of electric braking systems and regular cleaning on the network help to reduce concentrations.

There is no room for complacency on this matter, particularly as the understanding of the effects of air quality on health develops. The Mayor will ensure that TfL carries out further dedicated research into the risks posed to customers and staff by the Tube's air quality. It will also take action in response to any new issues, supported by robust and compelling evidence.

ACHIEVING COMPLIANCE WITH LEGAL POLLUTION LIMITS

As set out above, the Mayor wants London to achieve compliance with legal limit values as soon and effectively as possible, and then wants London to go beyond these limits to deliver further improvements in public health. In particular, the Mayor wants London to achieve WHO recommended targets for PM_{2.5} by 2030. This strategy sets out policies and proposals to help achieve this.

The GLA Act creates a distinction between the measures to be taken by the Mayor and those he can encourage other organisations, including the government, to take. Together these should achieve legal limit value compliance for NO₂ in

²⁶ R (on application of ClientEarth No 2) v Secretary of State for the Environment, Food and Rural Affairs reported at [2016] EWHC 2740 (Admin) and R (on application of ClientEarth No 3) v Secretary of State for the Environment, Food and Rural Affairs reported at [2018] EWHC 315 (Admin)

the Greater London area in accordance with the legal duties confirmed in recent High Court rulings under which there is a three-fold obligation: to achieve compliance by the soonest date possible, choose a route which reduces exposure as quickly as possible, and ensures compliance is not just possible but likely.²⁶

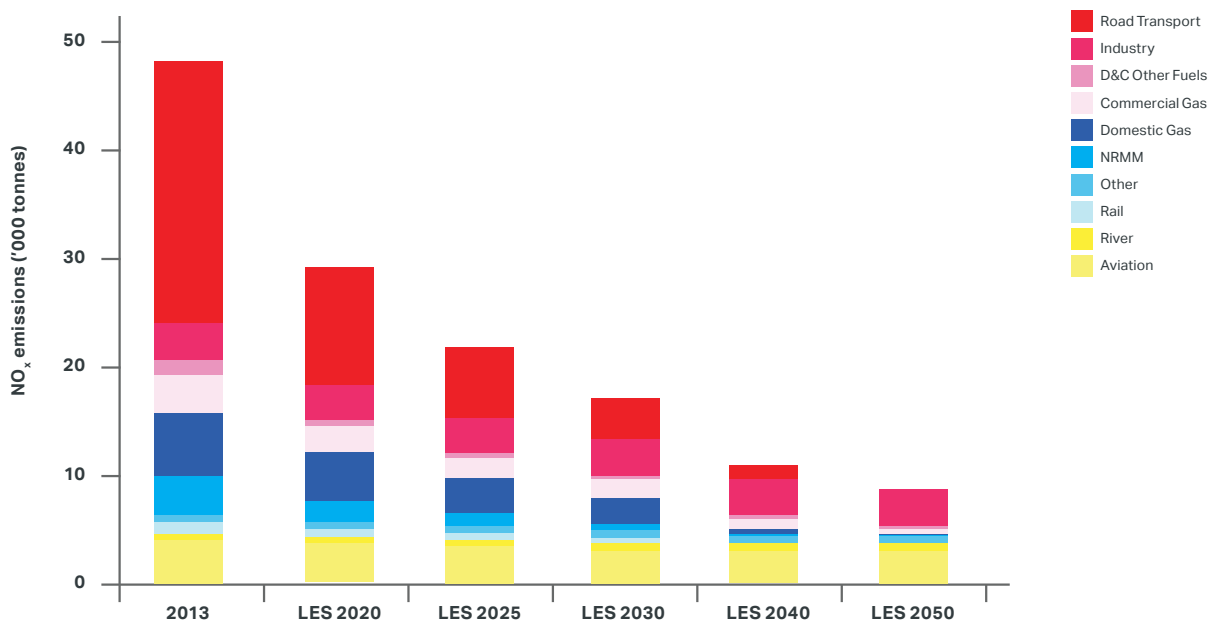
The following graphs summarise the impact on emissions of measures in this strategy to be delivered by the Mayor through the GLA and TfL. In addition to achieving or maintaining legal compliance, these emissions reductions are essential to delivering long-term health benefits across London by improving air quality through continuing reduction in exposure to pollution.

Nitrogen dioxide – NO₂

Figure 16 shows that, compared to a 2013 baseline, a 40 per cent reduction in NO_x is expected by 2020, a 55 per cent reduction by 2025, a 65 per cent reduction by 2030, and a 82 per cent reduction by 2050.

“For NO_x, compared to a 2013 baseline, a 40 per cent reduction is expected by 2020, a 55 per cent reduction by 2025, a 65 per cent reduction by 2030 and a 82 per cent reduction by 2050.”

Figure 16: Emission trend and main source categories for London's NO_x 2013-2050, reflecting the London Environment Strategy²⁷



²⁷ GLA/TfL (2018), London Environment Strategy Modelling.

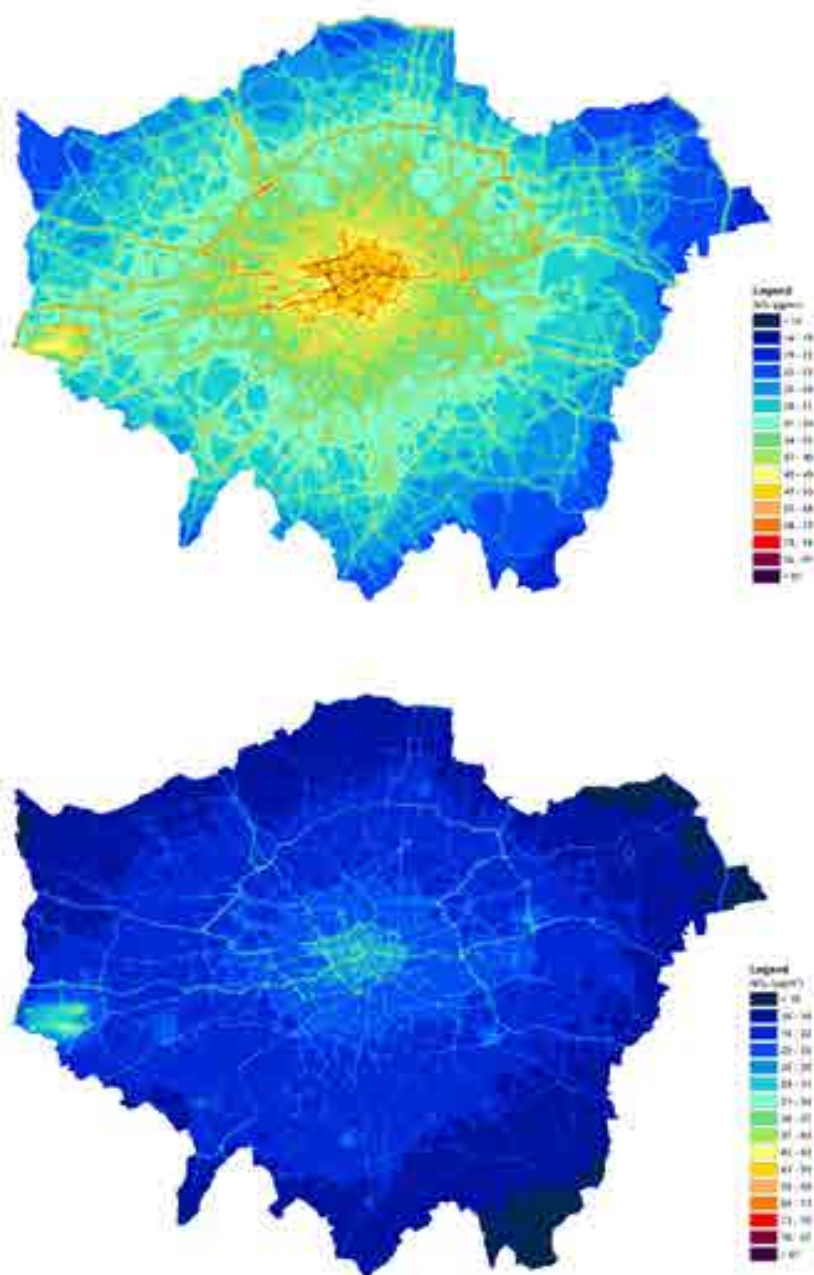
Figure 17 shows how these emissions reductions are likely to impact NO₂ concentrations in 2025 and how they will improve from 2013 (concentration maps for other years are available in the evidence base). This shows vast improvement across London compared to the baseline year of 2013. However, there are a few small areas that still exceed the EU air quality limit value of 40 µg/m³. We anticipate that with the implementation of zero emission zones and targeted measures (such as Oxford Street pedestrianisation) the whole of London will be compliant by 2025.

As noted above, the Mayor asked TfL to examine expanding ULEZ London-wide to cover light vehicles to outer London and whether this was the most effective measure for bringing non-compliant areas of outer London into limit value compliance. They advise that there is no appropriate boundary road for a wider zone that incorporates the North Circular other than the Greater London boundary (following the London Low Emission Zone boundary). The necessary infrastructure for this wider zone would take significant time to implement. The additional 1.7

million households affected by this level of expansion would have to be given a reasonable pre-compliance period before vehicle charging started, which is likely to delay the possibility of achieving compliance and benefits for Londoners earlier.

Considering the benefits expected from the earlier implementation of the central London ULEZ in 2019 and the application of ULEZ standards to heavy vehicles London-wide from 2020, it is likely that targeted local measures (such as local road closures, vehicle restrictions or other interventions) could be equally effective and are more likely to reduce exposure and bring areas of non-compliance in outer London into limit value compliance in a quicker timeframe than expansion of the ULEZ to outer London. However, the Mayor will keep the situation under review (particularly monitoring the impact of the other ULEZ measures as they are implemented) and will consider what measures will be most effective and likely to reduce exposure and secure compliance within the shortest time possible.

Figure 17: NO₂ concentrations in 2013¹⁰ (top) and projected NO₂ concentrations in 2025 (bottom) based on the Mayor's action (does not include additional requested government measures)²⁷



It is important to note that the modelling included in this strategy only reflects measures that will be delivered by the Mayor through the GLA or TfL or, if dependent on action by others, that there is a likelihood they will be implemented. Generally speaking this excludes those measures which the government has yet to commit to, for example in the UK NO₂ Air Quality Plan.²⁵ However, government measures likely to reduce commercial and domestic gas use have been included as these are included in the government's Clean Growth Strategy.

The action being taken by the Mayor is important and capable of achieving NO₂ limit value compliance in London. However, compliance will only be achieved as quickly as possible if all levels of government take full and effective action using the complete range of the powers and resources available to them in a way that has the greatest likelihood of success, by mutually reinforcing action taken at any one particular level of government.

This strategy sets out in Policy 4.2.4 the additional action the Mayor believes government and London's boroughs need to take to achieve compliance in as short a time as possible. In particular, central government has a crucial role to play as it has unique powers: the ability to promote legislation, change fiscal incentives, raise revenue, and take national action.

In July 2017 the government published its final NO₂ Air Quality Plan for the UK to address the current NO₂ infringement. Following a third successful judicial review by Client Earth this is now being amended to include action in 33 additional towns and cities. It is the Mayor's view that the current NO₂ Air Quality Plan does not include sufficient additional committed national measures or other support to help achieve compliance in London as quickly as possible. Compliance could be achieved sooner in London if the government-led measures requested by the Mayor and set out above had been included. The Mayor will continue lobbying the government to implement the measures believed to be required. The government has announced it expects to publish a new Air Quality Strategy for the UK in 2018.

²⁵ <https://www.gov.uk/government/publications/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2017>

“For PM₁₀, compared to a 2013 baseline, a 16 per cent reduction is expected by 2020, a 23 per cent reduction by 2025, a 28 per cent reduction by 2030 and a 38 per cent reduction by 2050.”

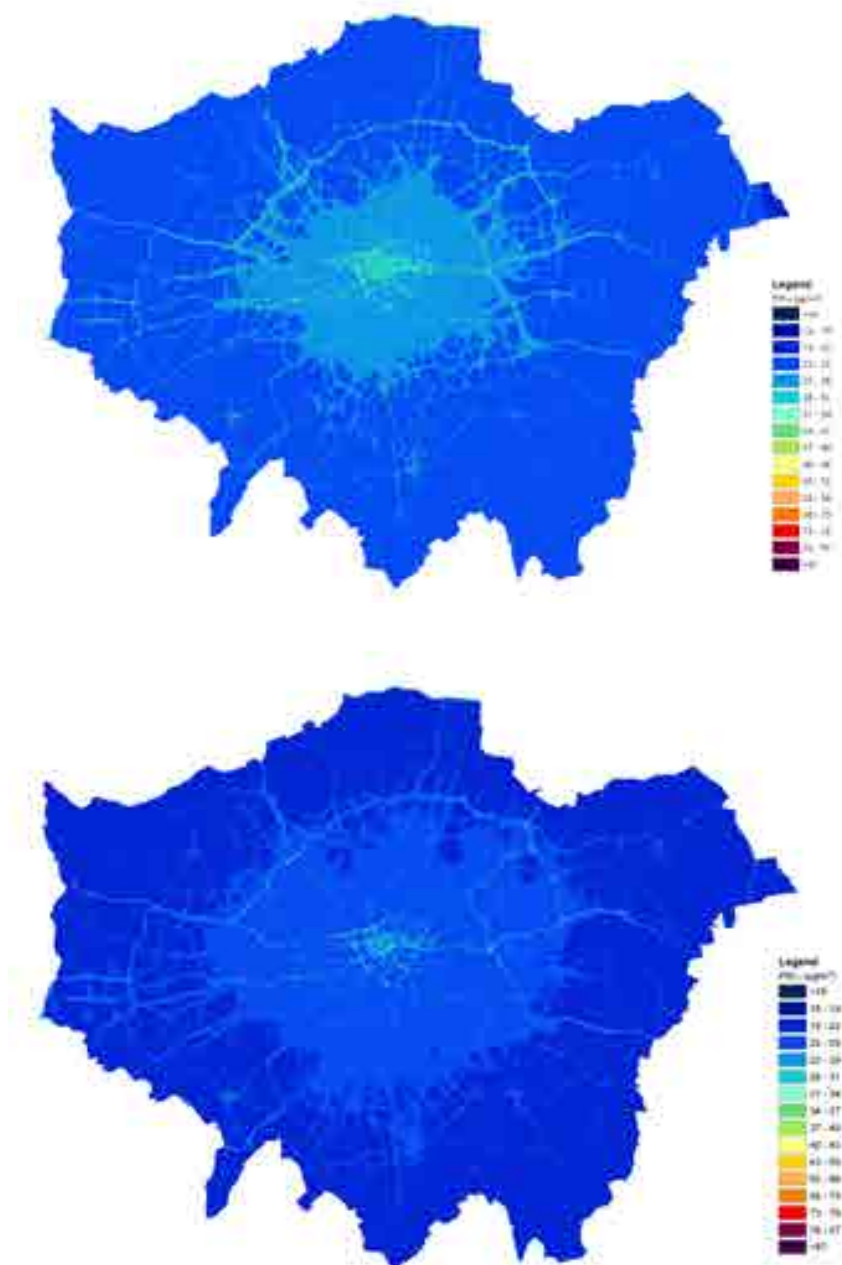
Currently the government's NO₂ Air Quality Plan states that London will meet legal limits by 2025. Analysis suggests that were the government-led measures identified above implemented, and the additional powers requested by the Mayor provided, the compliance date for London would move forward. The Mayor continues to believe that compliance with legal NO₂ limits can, and should, be achieved before 2025.

Particulate Matter - PM₁₀

Compared to a 2013 baseline, Figure 18 shows an expected 16 per cent reduction in PM₁₀ by 2020, a 23 per cent reduction by 2025, a 28 per cent reduction by 2030, and a 38 per cent reduction by 2050. These reductions should mean that legal limit values continue to be met, and further reductions that will be beneficial for health will be delivered.

Figure 19 shows how these emissions reductions are likely to impact PM₁₀ concentrations in 2025 (other concentration maps are available in the evidence base). This shows London continues to comply with the air quality limit value.

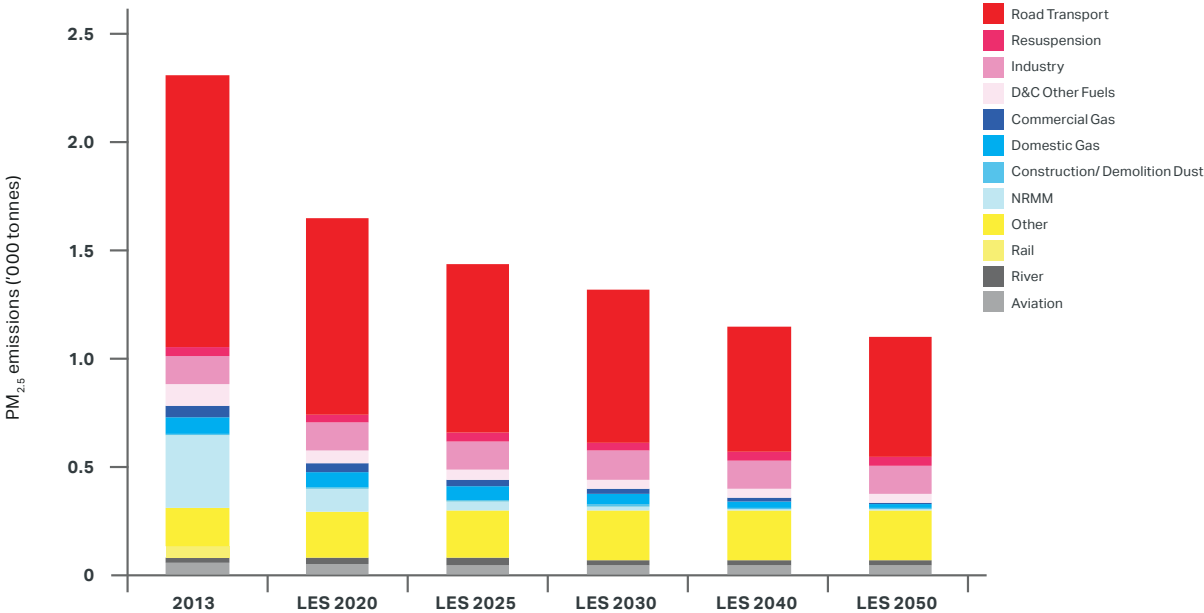
Figure 19: PM₁₀ concentrations in 2013¹⁰ (top) and projected PM₁₀ concentrations (bottom) in 2025 based on the Mayor's action (does not include additional requested government measures)²⁷



Particulate Matter – PM_{2.5}

Compared to a 2013 baseline, Figure 20 shows that a 28 per cent reduction in PM_{2.5} is expected by 2020, a 37 per cent reduction by 2025, a 43 per cent reduction by 2030, and a 52 per cent reduction by 2050.

Figure 20: Emission trend and main source categories for London’s PM_{2.5} 2013-2050, reflecting the London Environment Strategy²⁷



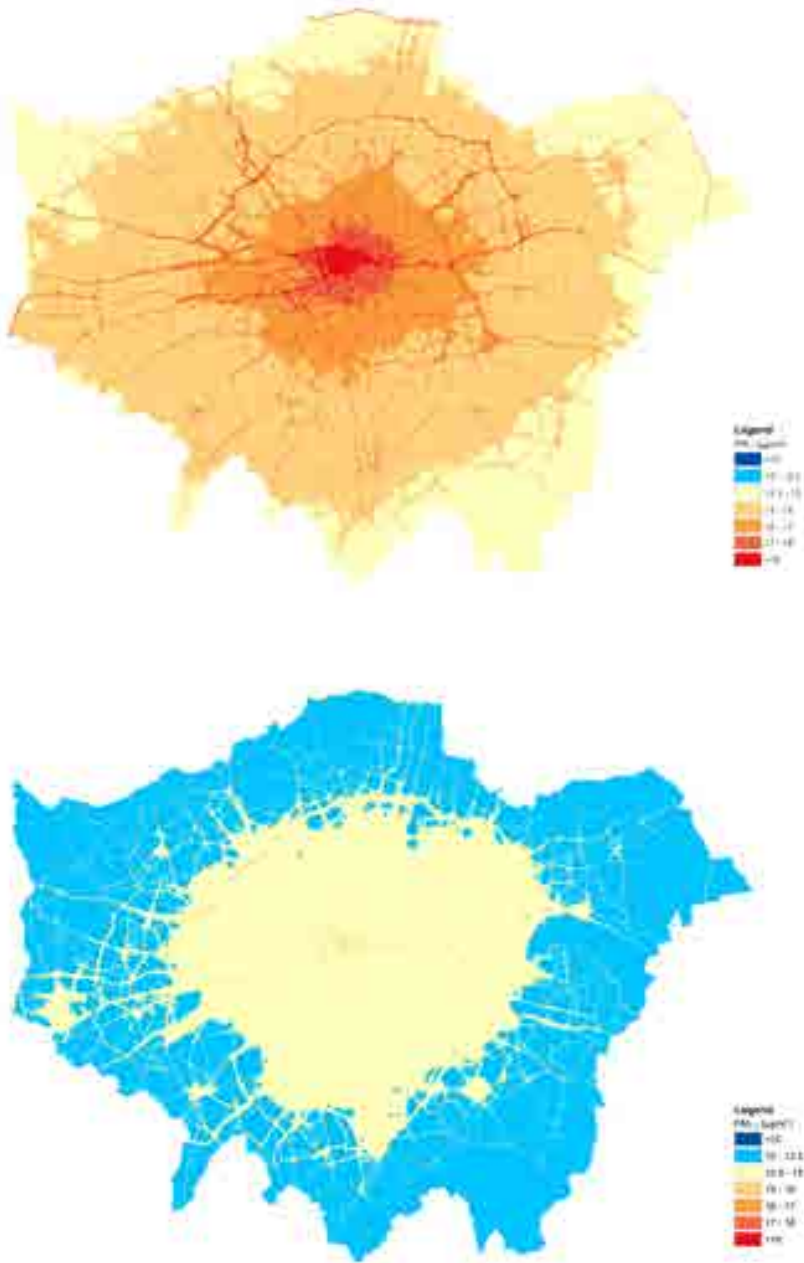
“For PM_{2.5}, compared to a 2013 baseline, a 28 per cent reduction is expected by 2020, a 37 per cent reduction by 2025, a 43 per cent reduction by 2030, and a 52 per cent reduction by 2050.”

Figure 21 shows the concentrations of PM_{2.5} in 2013 and the projected reduction across London by 2030 (other concentration maps are available in Appendix 2). Despite a substantial improvement at all locations, modelling indicates all of London will continue to exceed the WHO guideline limit of 10 µg/m³ primarily because of transboundary pollution. It is important to note that this modelling does not take into account the additional powers and action by the UK government and the EU called for by the Mayor.

The Mayor continues to want London to meet the WHO guideline limit for PM_{2.5} by 2030. The WHO guidelines could be achieved if: the government-led measures identified above were implemented; the additional powers requested by the Mayor were provided; and if this were complemented by concerted action to address transboundary pollution, including through a tighter EU National Emission Ceiling Directive.

The Mayor will work to ensure that the necessary action will be adopted in the coming years. This strategy provides the framework to coordinate these efforts and the Mayor will continue to work with stakeholders to achieve the WHO guidelines by 2030.

Figure 21: PM_{2.5} concentrations in 2013¹⁰ (top) and projected PM_{2.5} concentrations in 2030 (bottom) based on the Mayor's action (does not include additional requested government measures)²⁷





Chapter 5: Green infrastructure

AIM

London will be the world's first National Park City where more than half of its area is green; where the natural environment is protected and the network of green infrastructure is managed to benefit all Londoners.²⁸

INTRODUCTION

London's parks, green spaces, and natural landscapes are the places where Londoners can relax, exercise, play, and enjoy the capital's natural heritage and culture. They also provide habitat for wildlife, help protect London from the impacts of climate change, and contribute to improving London's air quality.

In addition to this core network of green and open space, the city also has a finer green grain of street trees, private gardens, and increasing number of green roofs and walls. These help to connect and extend the core network.

Urbanisation, by definition, has an impact on green space and the natural environment. The growth of London over the centuries has resulted in a reduction in natural habitats and green open spaces as homes, schools, hospital, workplaces and transport infrastructure are built to sustain a successful city. Urbanisation can also have indirect impacts such, as: pollutants from roads entering rivers; noise and light pollution affecting the ability of wildlife to breed or feed successfully; and exacerbating changes to the urban climate caused by climate change.

Nevertheless, London has a land use planning framework set out in the London Plan and All London Green Grid that has been effective at protecting and conserving the best of the city's parks, green spaces and natural landscapes. It has served London well by giving Londoners opportunities for outdoor recreation, and by protecting the heritage of both natural and designed landscapes. It has also provided a guiding set of principles, including standards on access to green space, which are widely understood and supported. This will continue to be at the heart of the Mayor's approach and informs the policies in this strategy.

As London grows, its parks, rivers, canals, trees, gardens and green roofs will become ever more vital. Collectively they comprise a critical green infrastructure that can help to ensure the health of Londoners is improved, protect the city from climate change, conserve wildlife, boost the enjoyment of culture and heritage, and promote London's economic growth (Box 8).

BOX 8: GREEN INFRASTRUCTURE AND NATURAL CAPITAL

London's **green infrastructure** is the network of parks, green spaces, gardens, woodlands, rivers and wetlands (as well as features such as street trees and green roofs) that is planned, designed and managed to:

- promote healthier living
- lessen the impacts of climate change
- improve air quality and water quality
- encourage walking and cycling
- store carbon
- improve biodiversity and ecological resilience

London's **natural capital** is the set of environmental resources (green space, air, water, wildlife) that provides services, such as flood protection or cleaner air, that benefit the wellbeing of Londoners and the city's economy. Like other forms of capital – human capital and goods and services – natural capital is a valuable asset that must be managed sustainably to maintain and improve these benefits.

²⁸ The National Park City was inspired by the Greater London National Park City initiative: <http://www.nationalparkcity.london/>

Making London the world's first National Park City

To ensure that London's future growth does not compromise, but helps to improve, the quality and function of London's green infrastructure, the Mayor will make London the world's first National Park City.

The Mayor's policies and proposals on green infrastructure and the natural environment will be described and promoted with the common identity of 'making London a National Park City'. This approach is also intended to inspire public agencies and institutions, businesses, developers and Londoners to be more aware of the benefits of London's green infrastructure, and to encourage them to do their bit to make London a greener city.

Making London a National Park City will involve translating the policies in this strategy into programmes and activities that are relevant to all Londoners. This means giving everyone opportunities to experience, enjoy and benefit from the city's natural capital. It will also highlight

the uniqueness of the city's green spaces and natural environment, and the fact that they connect to landscapes and ecological networks beyond London. In addition, it will help to ensure these are better managed to benefit people as well as nature, and the economy of the city on which all Londoners depend.

As a National Park City, London will be:

- a city that is greener in the long-term than it is today, and where people and nature are better connected
- a city that protects the core network of parks and green spaces, and where buildings and public spaces aren't defined only by stone, brick, concrete, glass and steel
- a city that is rich with wildlife, where every child benefits from exploring, playing and learning outdoors
- a city where everyone can enjoy high-quality green spaces, clean air and clean waterways, and where more people choose to walk and cycle

Economic value of green infrastructure

The UK National Ecosystem Assessment concluded that the importance of green spaces and natural habitats in urban areas for society's health and general wellbeing is not fully appreciated.

This means their potential is not realised. It found that access to urban green space is essential for good mental and physical health, childhood development, and social cohesion. Urban green infrastructure services could also be significantly enhanced to improve climate change mitigation and adaptation.²⁹

The work of the Natural Capital Committee has also shown that there is a very good economic case for investing in green infrastructure. It estimates that reduced costs to the National Health Service alone would be £2.1bn.³⁰

In London, further work on evaluating the economic benefit of green infrastructure has shown that:

- public parks and green spaces provide services, such as the improvement of public health, that are valued at £5bn per year, with each £1 spent on public green space providing at least £27 of economic value³¹

- London's approximately eight million trees provide at least £133m of economic benefits a year by removing pollution, storing carbon and reducing surface water flooding.³²

The services provided by the capital's urban forest are illustrated in Figure 22.

The Mayor's approach to green infrastructure

Protecting and enhancing London's natural environment and green infrastructure requires the following strategic actions that have shaped the policies and proposals in this chapter:

- increasing London's green cover, conserving and enhancing wildlife and natural habitats
- valuing London's natural capital as an economic asset
- encouraging greater participation and involvement by Londoners in the protection and enhancement of the natural environment at the neighbourhood level

²⁹ UK National Ecosystem Assessment (n.d.) What is the UK National Ecosystem Assessment? Accessed from: <http://uknea.unep-wcmc.org/Home/tabid/38/Default.aspx>

³⁰ Natural Capital Committee (2015) The State of Natural Capital: Protecting and Improving Natural Capital for Prosperity and Wellbeing. Accessed from: www.gov.uk/government/uploads/system/uploads/attachment_data/file/516725/ncc-state-natural-capital-third-report.pdf

³¹ Mayor of London (2017) Natural Capital Account for London's Public Parks and Greenspaces. Accessed from <https://www.london.gov.uk/what-we-do/environment/parks-green-spaces-and-biodiversity/green-infrastructure/natural-capital?source=vanityurl>

³² Mayor of London (2015) Valuing London's Urban Forest. Accessed from: www.london.gov.uk/WHAT-WE-DO/environment/environmentpublications/valuing-londons-urban-forest

Value of London's urban forest³²

Trees provide at least £133m of benefits every year in terms of air pollution removal, noise reduction and reducing the amount of water going into drains.

2,241

tonnes of pollution removed from the air every year, worth £126M. They remove the equivalent of 13% of PM₁₀ particulates and 14% of NO₂ emitted by road transport.

40%

nearly 40% of London's surface is impermeable; 32% of ground cover is grass.

60%

Almost 60% of London's trees are in private ownership, but the trees on public land contribute 60% of the ecosystem service benefits. This is because parks and green spaces have a higher proportion of larger trees.

Trees prevent

10x

The volume of water in the Serpentine from entering London's drainage system. This helps reduce the risk of localised flooding.

2,367,000

tonnes of carbon is stored in London's trees, worth £147M



Pests and diseases – If Asian Longhorn Beetles become established in London, they could damage over 3 million of London's trees leading to a reduction in ecosystem services and associated economic cost.

Biodiversity – London's trees support and are closely associated with a wide range of priority species such as all bat species, birds like barn owl, butterflies like purple emperor, other insects like stag beetle, and fungi like oak polypore.



LONDON'S ENVIRONMENT

The key evidence to support Mayor's ambitions for London's environment and infrastructure is summarised in this information about the evidence base, the policies and proposals in Appendix 2.

EU, UK, and London policy that creating a healthy urban environment and articulating a vision of green infrastructure are in order to support sustainable growth and improve wellbeing. Details on this legislative background can be found in Appendix 3, and information on the responsibilities of various organisations is in Appendix 4.

London's green spaces – and status

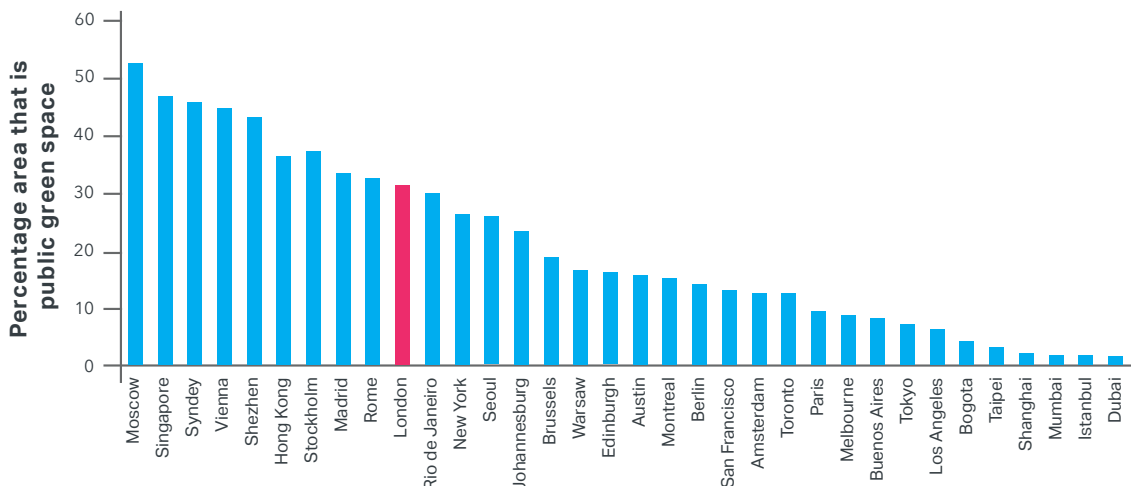
An assessment of the extent of London's green spaces in 2015 estimated that just over 10% of London is classified as green open space, with 33 per cent being green space like parks, woodlands, farmland, 14 per cent being domestic garden green spaces, and two percent being rivers, canals and wetlands.³³ Despite increasing investment in London's green spaces and development in London over the years, this is similar to the amount of green cover undertaken to

The Mayor has invested in research into improved ways to assess the amount of green (and blue) cover in London, including developing a new methodology for assessing this using higher resolution aerial imagery that was made available during 2017. Once available, the full results of the new assessment will be published on the London Datastore and will be used to establish a more definitive baseline for monitoring the commitment to make London greener.

But this overall picture masks local variations and changes in quality, which have been more difficult to track at a strategic level.

London compares favourably with other world cities with respect to the amount of public green space per head of population (Figure 23). London is ranked tenth amongst 30 global cities – higher than similar cities, such as New York, Berlin and Paris.³⁵

Figure 23: Percentage of public green space in different world cities³⁶



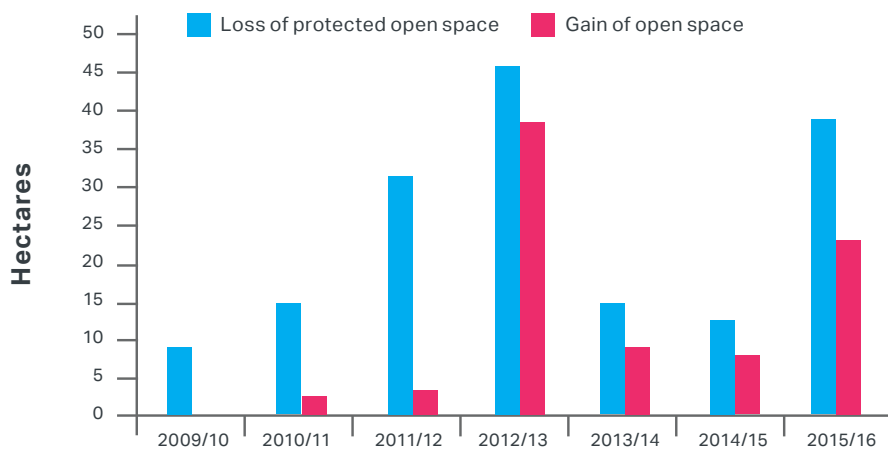
³⁵ World Cities Culture Forum (n.d.) % of public green space (parks and gardens). Accessed from: www.worldcitiescultureforum.com/data/of-public-green-space-parks-and-gardens

³⁶ World Cities Culture Forum (2017) The percentage of public green space (parks and gardens). Accessed from: <http://www.worldcitiescultureforum.com/data/of-public-green-space-parks-and-gardens>

Although London has relatively high levels of green space, it is still losing green space to new development, such as housing, schools, industrial premises and transport infrastructure (Figure 24).

The losses are relatively small overall - an average net loss of between 10 and 15 hectares each year - but over time these cumulative losses can erode and further fragment the green infrastructure network.

Figure 24: Losses and re-provision of protected open space³⁷



³⁷ GLA (2017) London Development Database.

Access to public open space

Access to green space is highly valued by Londoners. London's parks are also home to many cultural institutions and events, such as the Serpentine Gallery, Opera Holland Park, and Fulham Palace, and increasing numbers of festivals.

However, only 18 per cent of London's land area is officially classified as public open space, i.e. space that the planning process formally sets aside for public access and recreation. Consequently, parts of the city are defined in the London Plan as Areas of Deficiency in Access in Public Open Space (AoD) where Londoners lack access to local or district parks (Figure 25). This is because

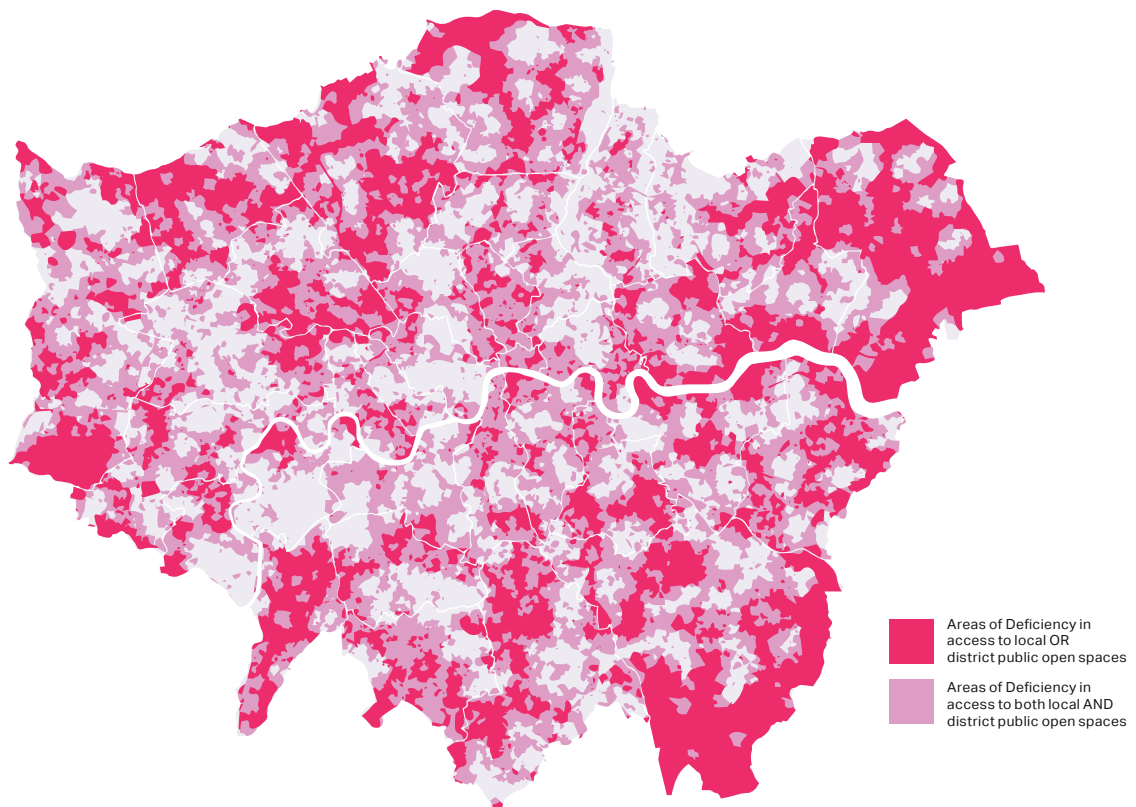
some areas of green open space are privately owned (for example private gardens and farmland), are inaccessible (like railway line sides), or have restricted access (like reservoirs).

The total amount of AoD has reduced in recent years. This is particularly in areas that have been regenerated, like King's Cross rail yards and the Olympic Park in Stratford. However, about half of London's households are still more than 400m from their nearest local park.³⁸ Where there is no space to create new parks, planning guidelines have promoted the creation of pocket parks and other small open spaces less than 400m from where people live.

³⁸ London Assembly (2017) Park Life: ensuring green spaces remain a hit with Londoners. Accessed from: https://www.london.gov.uk/sites/default/files/environment_committee_-_park_life_report.pdf



Figure 25: Areas of Deficiency in Access to Public Open Space³⁹



Trees and woodlands

Assessments using aerial imagery and randomised sampling at ground level indicate that there are over eight million trees in London, covering around 20 per cent of London’s surface area^{40,41}

Most of these trees are in woodlands (Figure 26), parks and gardens, but a significant number are street trees. Assessments by the London Assembly in 2007 and 2011 found there are around 500,000 street trees in London.^{42,43}

³⁹ GiGL (2017) Areas of deficiency in access to local or district public open spaces

⁴⁰ Mayor of London (2015) Measuring Tree Canopy Cover in London: An analysis using aerial imagery. Accessed from: https://www.london.gov.uk/sites/default/files/measuring_tree_canopy_cover_2015.pdf

⁴¹ Forestry Commission England (2016), London iTree eco project. Accessed from: www.forestry.gov.uk/london-itree

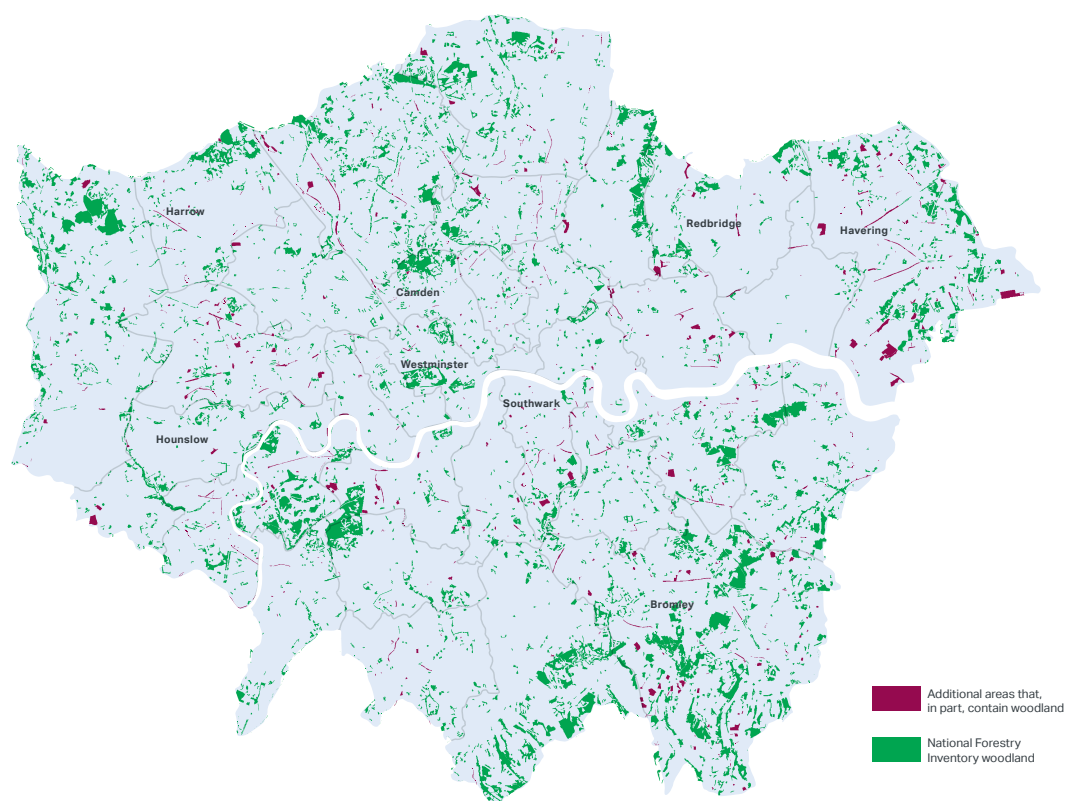
⁴² Mayor of London (2007) Chainsaw massacre: a review of London’s street trees. Accessed from: www.london.gov.uk/about-us/londonassembly/london-assembly-publications/chainsaw-massacre-review-londons-street-trees

⁴³ Mayor of London (2011) Branching Out: the future for London’s street trees. Accessed from: www.london.gov.uk/about-us/londonassembly/london-assembly-publications/branching-out-future-londons-street-trees

The current London Tree Map gives information about more than 700,000 street trees and the wider public realm.⁴⁴

Like the total extent of green space, the total area of tree canopy cover in London has also remained relatively static since 2002.

Figure 26: Woodland in London⁴⁵



⁴⁴ Mayor of London (n.d.) London Tree Map. Accessed from: www.london.gov.uk/WHAT-WE-DO/environment/parks-green-spaces-andbiodiversity/trees-and-woodlands/london-tree-map

⁴⁵ GiGL Habitat data; and Forestry Commission (2015) National Forest Inventory. Accessed from: <https://www.forestry.gov.uk/inventory>

Rivers and wetlands

The River Thames is the largest and best-known natural feature in the city, occupying 24km² within London. In addition, London has over 600km of rivers and streams, most of which are tributaries of the Thames. Many have been straightened, widened and deepened, with vertical sides of steel or concrete embankments. Some, especially in central London, have been entirely diverted into tunnels and the stormwater drainage network.

However, in recent years there has been a programme of river restoration. Since the publication of the London Rivers Action Plan in 2009, more than 17.5km of river across all of the city's catchments have been restored to a more natural state. This has improved flood management, water quality, and the ecology of the rivers.⁴⁶

Gardens

Domestic gardens provide many people with daily contact with nature and improve the way residential areas look

and feel. In total, they comprise about 38,000 hectares of land, or 24 per cent of the land area of London. However, not all gardens comprise the classic combination of lawns, flowers beds, shrubs and trees. Many now include extensive areas of decking, paving and car parking. Consequently, only about 60 per cent of land in London's gardens is actually green, about 14 per cent of London's land area.

A study undertaken to determine changes to London's domestic gardens showed that the area of garden vegetation in London declined by over 3,000 hectares between 1999- 2007.⁴⁷ This was primarily due to the fashion for decking and outdoor rooms, and the increased use of permitted development rights that allow activities such as minor extensions and paving of driveways.⁴⁸ Permitted development rights were extended in 2015 allowing, in certain circumstances, up to half the area of land around an existing dwelling to be covered by additions or other buildings. It is likely this trend has continued.

⁴⁶ Anon (2009) The London Rivers Action Plan. Accessed from: www.therrc.co.uk/lrap/lplan.pdf

⁴⁷ London Wildlife Trust/GiGL (2010) London: Garden City? Accessed from: www.gigl.org.uk/partnershipcasestudy/garden-research/

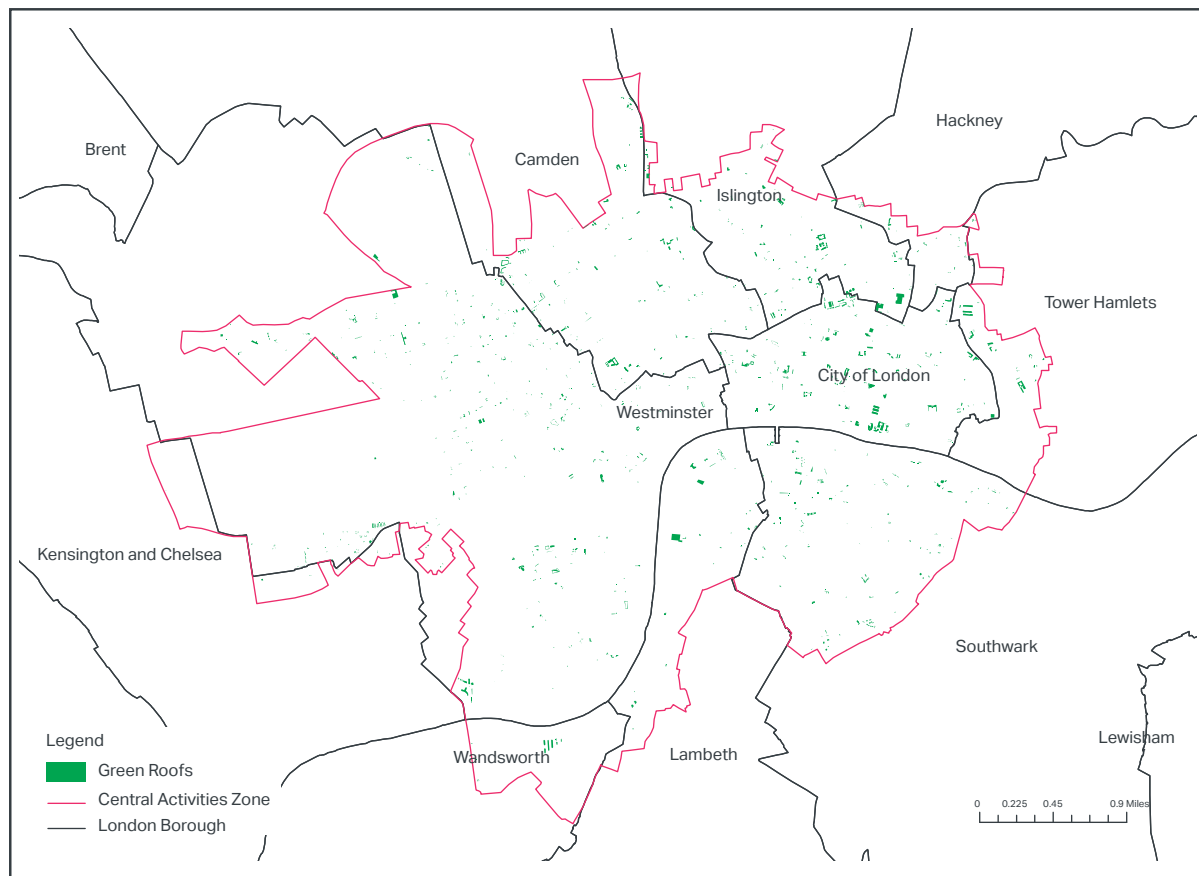
⁴⁸ HMG (2015) The Town and Country Planning (General Permitted Development) (England) Order 2015. Accessed from: www.legislation.gov.uk/uk/si/2015/596/contents/made

Green roofs

London has seen a major increase in the installation of green roofs (and other green features in the built environment, like green walls and rain gardens) since 2008. That is when urban greening policies were first included in the London Plan.⁴⁹ Across London as a whole, there are now thought to be over one million m² (or 100 hectares) of green roofs

installed. GLA research highlighted that there are now over 700 green roofs just in London's Central Activities Zone (the area including the City of London, the West End and South Bank). The green roofs here cover an area of almost 20 hectares, the same size as Green Park (Figure 27).

Figure 27: Green roofs in the Central Activities Zone⁵⁰



⁴⁹ Mayor of London (2016) The London Plan: The Spatial Development Strategy for London, Consolidated with Alterations since 2011. Accessed from: https://www.london.gov.uk/sites/default/files/the_london_plan_2016_jan_2017_fix.pdf

⁵⁰ GLA (2017) Green roofs in the Central Activities Zone. Accessed from: <https://data.london.gov.uk/dataset/green-roofs>

Sites of Importance for Nature Conservation

Almost 20 per cent of Greater London's land area is identified as a Site of Importance for Nature Conservation, or SINC (Figure 28). These sites are locally valued wildlife sites that provide the core framework necessary to conserve London's biodiversity and are protected through planning policy. The total area of SINCs has increased slightly since 2002 from 29,855 hectares to 30,679 hectares. An additional suite of sites is also recognised because of their value for the conservation of geodiversity. These sites, known as Regionally Important Geological Sites (RIGS), have the same status as SINCs.

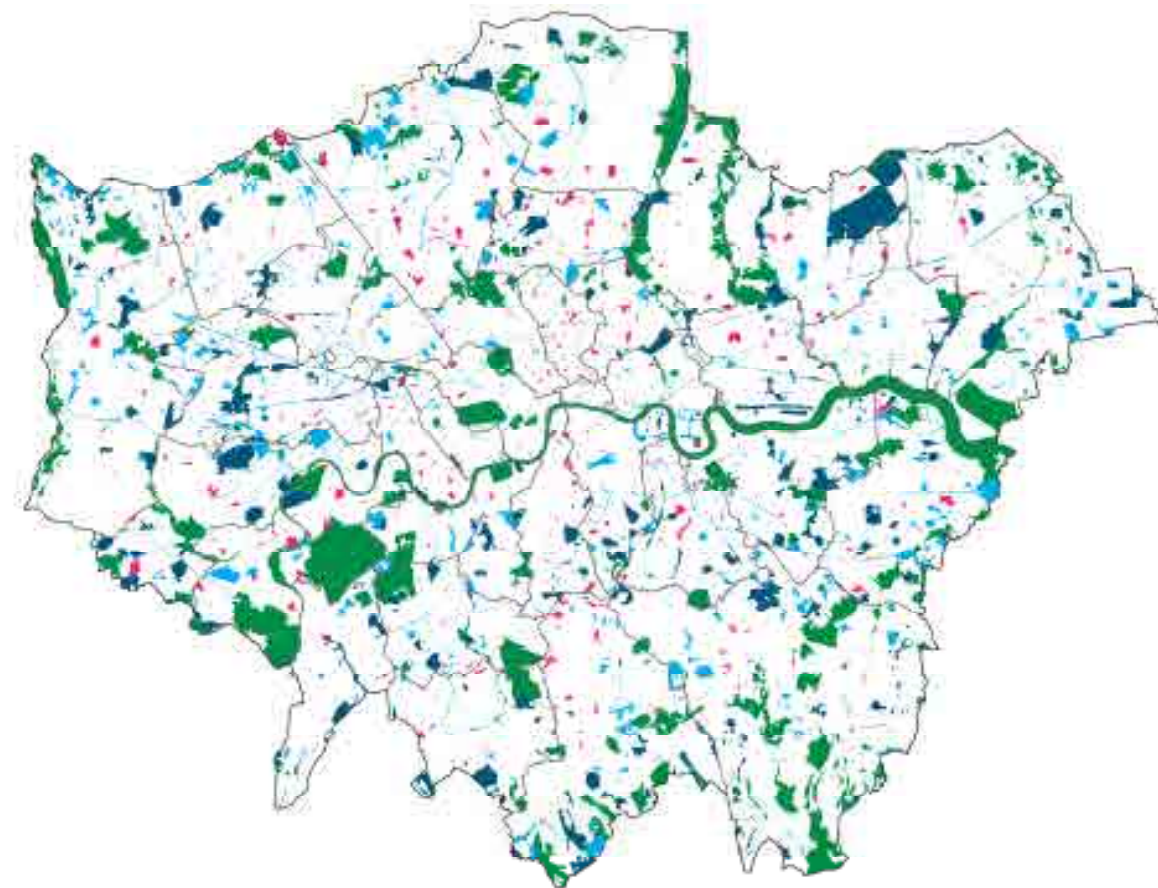
The SINC network ensures that the majority of the most important habitats and species ('priority habitats and

species') are protected through the land use planning process. However, this does not ensure that they are conserved as effectively as possible. Other factors, such as lack of management, the spread of invasive non-native species, or increased recreational pressure can result in the degradation of these sites.⁵¹

The most important sites for nature conservation in London also have European and national level designations, and consequently are given statutory protection. They include two Special Protection Areas (SPAs), three Special Areas of Conservation (SACs), two National Nature Reserves (NNRs), and 37 Sites of Special Scientific Interest (SSSIs). This protection will continue.

⁵¹ London Wildlife Trust (2015) Spaces Wild – championing the values of London's wildlife sites. Accessed from: <http://www.wildlondon.org.uk/spaces-wild>

Figure 28: Distribution of SINCs in London⁵²



Legend

Sites of Importance for Nature Conservation

- Sites of Metropolitan Importance
- Sites of Borough Grade I Importance or unclassified Site of Borough Importance
- Sites of Borough Grade II Importance
- Sites of Local Importance

⁵² GiGL (2016) Sites of Importance for Nature Conservation.

LONDON'S BIODIVERSITY

Biodiversity describes the variety of species of wild plants, animals, fungi and other organisms. London's biodiversity is surprisingly varied. This is largely due to London's geography, which includes a tidal river fed by several tributaries, flanked by chalk downland to the south and a ridge of more sandy soils to the north. This variety of underlying rocks and soils results in many different natural habitat types. These are supplemented by an array of urban habitats, such as canals, reservoirs, and the built environment itself. Consequently, over 13,000 different species have been recorded in London to date.

Habitats

London boasts a wide range of natural habitats, from the last extensive area of grazing marsh in London at Rainham Marshes and the chalk downlands that support rare butterflies and chalk-loving plants that helped inspire Charles Darwin's scientific discoveries, to ancient woodlands such as Epping Forest, heathland, and world-famous nature reserves including Richmond Park and the London Wetland Centre.

Priority habitats identified by the former London Biodiversity Partnership are listed and described in more detail in Appendix 2.

To conserve these habitats and ensure they are resilient to pressures like climate change, they need to be expanded and better connected through habitat enhancement, restoration and creation.

Examples of recent habitat creation include:

- over 600 hectares of new woodland established in the Thames Chase Community Forest
- 45 hectares of new grassland, wetland and woodland habitats in Queen Elizabeth Olympic Park
- 13 hectares of new reed beds at Stoke Newington and Walthamstow Reservoirs

Species

Despite being home to over 13,000 different species of plants and animals, the conservation status of London's wildlife varies widely. Some very adaptable animal species, such as foxes, have become much more common, and London's extensive tree cover ensures that the city's suburbs are a stronghold for the impressive stag beetle. Even once rare species, such as the peregrine falcon, have colonised the urban environment as national populations have expanded. However, other animal

species, such as the small blue butterfly and water vole, are rare or exist in isolated populations because of their specific habitat requirements. A similar picture exists for London's plant species.

Overall, London's wildlife is in decline, in common with nationwide trends, which show a continual decrease in England's wildlife (Box 9). Unsurprisingly, urbanisation has had a big impact on the ecology of London. The increased use of concrete, tarmac, glass and steel has not only replaced natural habitat, but has also changed local hydrology and created unique urban microclimates. These different microclimates, plus the disturbance and transfer of soils and materials as a result of urban development, can also result in the spread of invasive non-native species, such as Japanese knotweed and zebra mussel. The growing population also exerts recreation pressure on all green spaces and natural areas.

The British Trust for Ornithology has reported on trends for 33 relatively common species in London. While the majority of these species have seen population increases, seven – blackbird, grey heron, house sparrow, mistle thrush, song thrush, starling and swift - have declined. This is in line with national

trends and is likely due to loss of nest sites in buildings and loss of vegetation in gardens which provide important feeding areas for several of these species. Some once rare species such as peregrine falcon, Cetti's warbler and little egret have also increased as national populations have expanded, but equally the populations of other species such as spotted flycatcher, turtle dove, and tree sparrow are now almost absent from London as national populations have crashed.⁵³

BOX 9: STATE OF NATURE 2016 (ENGLAND) – KEY STATISTICS⁵⁴

Over the long-term:

- 60 per cent of plant species declined and 40 per cent increased
- 62 per cent of butterfly species declined and 38 per cent increased
- bird species as a whole have declined by six per cent, but farmland bird species have fallen by 56 per cent
- some 12 per cent of rare species are at risk of extinction from the UK

⁵³ London Natural History Society (2017) The London Bird Atlas.

⁵⁴ The State of Nature Partnership (2016) State of nature 2016: England. Accessed from: www.wildlifetrusts.org/sites/default/files/stateofnature2016_england_1_sept_pages.pdf



Butterflies too have seen a decline.⁵⁵ Of 20 species monitored by the London Natural History Society, half have experienced significant declines largely thought to be due to a decrease in the quality of grassland sites and the impacts of climate change. Changes in the population of other pollinating insects (such as bees, moths and hoverflies) are also likely to reflect the trends for butterflies; but monitoring schemes do not provide sufficient depth of information to determine trends for London.

ROLES AND LEGAL DUTIES

The Mayor of London has a legal duty to set out policies and proposals in this strategy relating to the natural environment and biodiversity. The Greater London Authority is also subject to the 'biodiversity duty', which requires all public bodies to have regard to conserving biodiversity as part of their policy development, decision making and operational activities.⁵⁶ The legislative and policy background is described in more detail in Appendix 4.

However, as the GLA is not a major landowner, the Mayor does not have any significant responsibility for the day-to-day management of parks and green spaces in London.

The Mayor does have direct influence over green infrastructure and the natural environment policy and actions through ensuring that:

- green infrastructure policies are included in other relevant Mayoral strategies, such as the London Plan and the Mayor's Transport Strategy
- key departments within the GLA, such as those responsible for housing and land, and regeneration, take due regard of national policy and the Mayor's policies
- bodies such as TfL, the London Legacy Development Corporation, and Old Oak and Park Royal Development Corporation implement Mayoral policies (for example, TfL in implementing the Healthy Streets Approach)

The Mayor also has a significant leadership role and can act as a powerful advocate to highlight issues that require a pan-London approach to stimulate effective and coordinated action. The other organisations that have a role to play in protecting and enhancing London's green infrastructure are described in Appendix 3.

⁵⁵ London Natural History Society (LNHS) has calculated trends for butterflies in London between 1995-2016.

⁵⁶ HM Government (2014) Biodiversity duty: public authority duty to have regard to conserving biodiversity. Accessed from: <https://www.gov.uk/guidance/biodiversity-duty-public-authority-duty-to-have-regard-to-conserving-biodiversity> and <https://www.legislation.gov.uk/ukpga/2006/16/section/40>

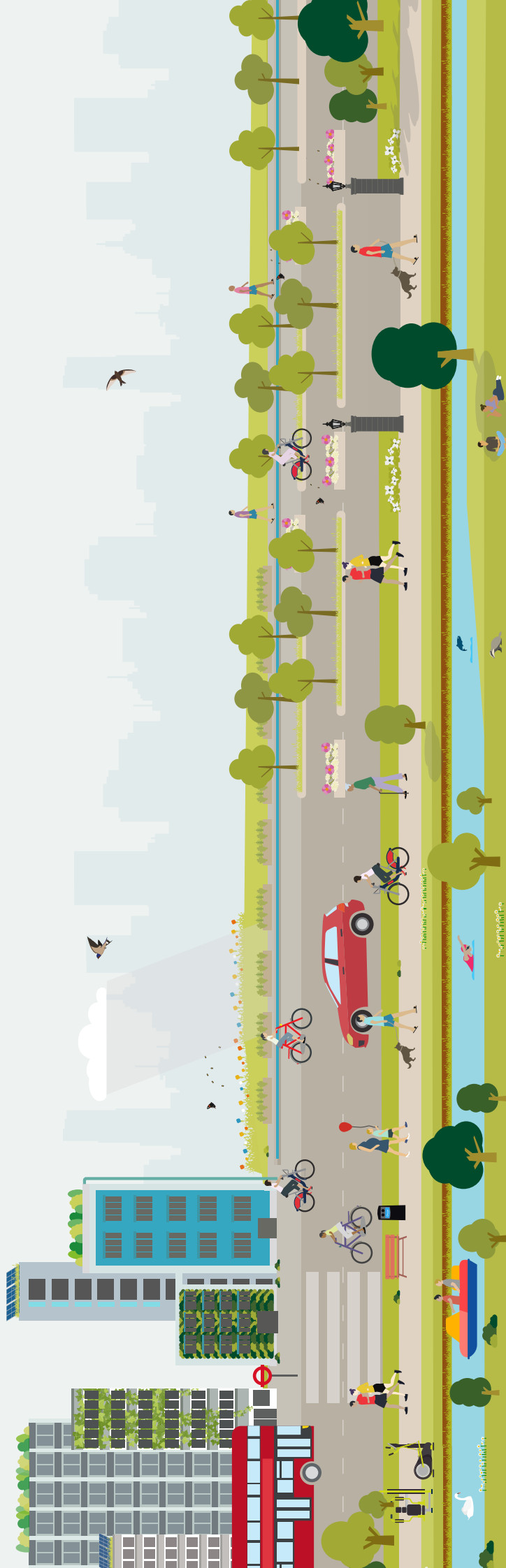
Intentions

Increased urban greening
to manage storm water

Green spaces and urban greening that
support biodiversity

Facilities for people to exercise, play
and relax

Trees, green spaces, green
walls and green walls to cool the



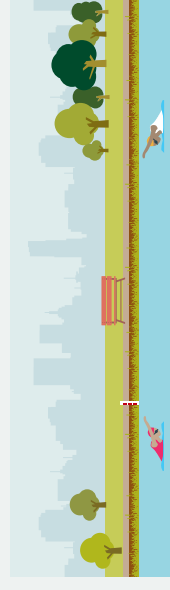
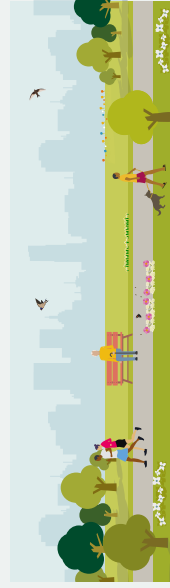
Benefits

Increased green cover

Improved mental and physical health and well-being

Reduced flood risk and improved water quality

Higher biodiversity



Increased canopy cover

A cooler city

Improved air quality and reduced exposure to air pollution

“The Mayor will resist development that results in the loss of Green Belt and Metropolitan Open Land.”

Objectives, policies and proposals

OBJECTIVE 5.1 MAKE MORE THAN HALF OF LONDON'S AREA GREEN BY 2050

All cities now recognise that the green infrastructure of parks, green spaces, natural habitats, street trees, green roofs and walls are an essential part of city life. This green infrastructure helps to make the city healthy, liveable, resilient to climate change, and more economically sustainable.

The Mayor wants to significantly increase the area of green cover in the built environment, whilst maintaining the existing network of parks and green spaces to ensure that London becomes greener overall, despite the additional development required to meet the demands of a growing population.

London's historic parks, nature reserves and natural habitats also provide opportunities to enjoy the capital's natural heritage and designed landscapes. Their rich cultural and natural history are an important reason for their protection and management as they are a valuable part of the city's cultural offer.

Policy 5.1.1 Protect, enhance and increase green areas in the city, to provide green infrastructure services and benefits that London needs now and in the future

Proposal 5.1.1.a The London Plan includes policies that protect the Green Belt, Metropolitan Open Land, and the public green space network of parks and open spaces

The Mayor will resist development that results in the loss of Green Belt and Metropolitan Open Land. This will help fulfil their potential as strategic green infrastructure for London. The Mayor will also work with boroughs, land managers and environmental organisations to identify the incentives needed to improve the quality and function of this strategically important asset.

London's existing network of public parks and open spaces must be protected to provide the foundations for a greener city. The London Plan has been effective at protecting this core resource and containing sprawl. This promotes a more compact city that helps to minimise London's overall environmental footprint.

As the city grows, it becomes ever more important to protect and improve green spaces to secure the benefits provided

by green infrastructure. Planning policy for the Green Belt and Metropolitan Open Land can help protect the space from development. However, it does not help to improve the quality or function of green spaces, for example by using the Green Belt for creating new woodland. This will be considered as part of valuing London's natural capital, which is outlined further in Objective 4.3.

Proposal 5.1.1.b The London Plan includes policies that ensure any development outside the protected green space network, including gardens, does not lead to an overall loss of green cover

The Mayor recognises that much of London's existing green infrastructure lies outside of the protected green and open space network. Areas of amenity green space around housing estates, extensive areas of private gardens, and the street trees that line so many of London's streets, provide many Londoners with significant benefits at the local level.

Consequently, new development proposals should avoid reducing the overall amount of green cover and, where possible, seek to enhance the wider green infrastructure network to increase the benefits this provides.

“The Mayor’s Greener City Fund will invest in strategically important green infrastructure projects.”

Thoughtful planning and design of new developments should aim to avoid fragmentation of existing green space, reduce storm water run-off rates by using sustainable drainage, and include new tree planting, wildlife-friendly landscaping, or features such as green roofs to mitigate any unavoidable loss. This supports the ‘environmental net gain’ approach promoted by government in the 25 Year Environment Plan.⁵⁷

Proposal 5.1.1.c The Mayor aims to improve access to green space and nature by identifying those areas of the city that should be greener, and developing green infrastructure programmes and projects especially in major regeneration areas: through the Mayor’s Transport Strategy, the Walk London network will be protected, improved and promoted

Despite London’s extensive network of parks and open spaces, there are parts of the city where local people lack access to green space and the natural environment. These areas tend to be where development is densest, or in areas of deprivation. These are also areas where households are less likely to have access to private gardens. The Mayor aims to improve access to green space and nature for all Londoners, especially children. Box 10 describes the Mayor’s programme for improving access to green space and nature.

BOX 10: THE MAYOR'S PROGRAMME FOR IMPROVING ACCESS TO GREEN SPACE AND NATURE

The Mayor's programme will comprise the following elements:

- community grants for creating greener space – investment in small and medium scale greening projects in green spaces across London
- a Greener City Fund – investment in strategically important green infrastructure projects
- developing a 'greenness index' to target investment in areas that need it most
- strengthened policy in the London Plan to ensure an increase in urban greening
- working with urban designers, developers and planners to promote and communicate the benefits of a greener built environment, that works well with London's townscape

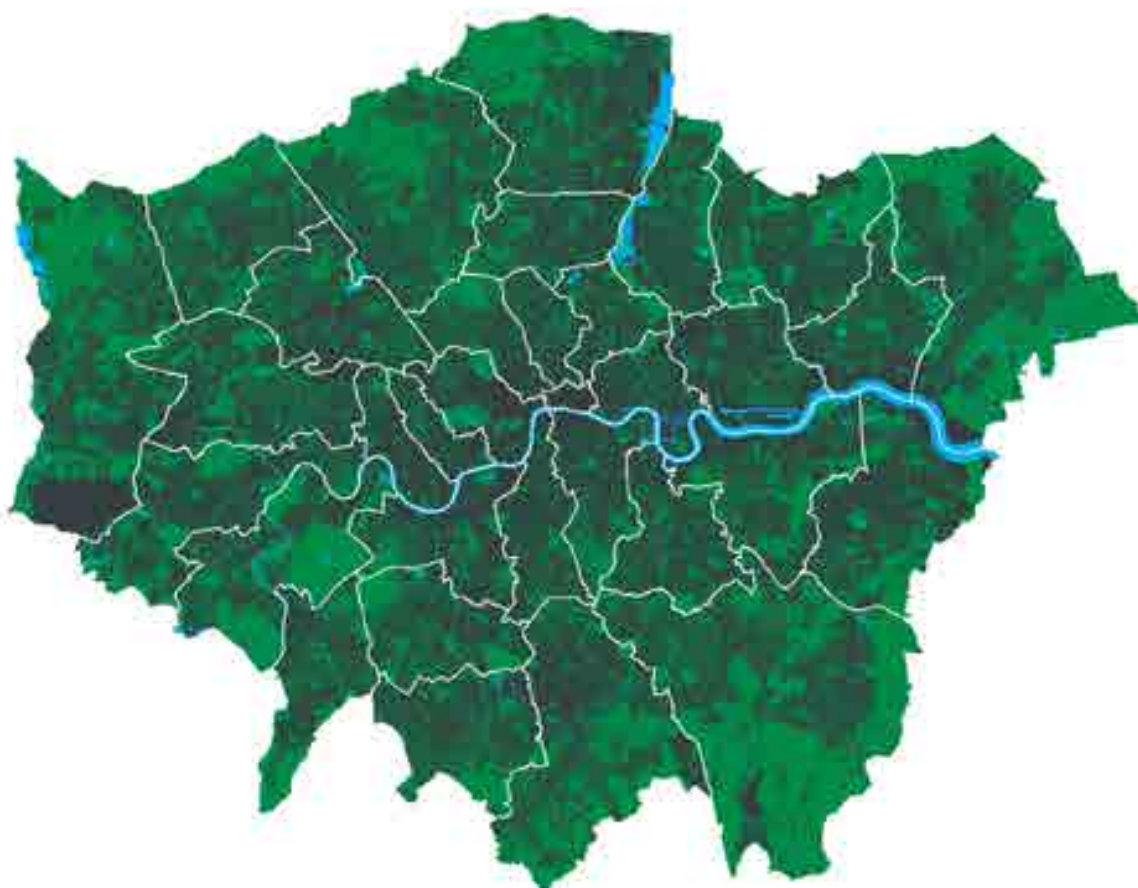
To make sure that all Londoners live in greener neighbourhoods the Mayor will develop a new 'greenness index'. This will identify those areas where green infrastructure and urban greening is most needed. The Mayor will work with TfL, the boroughs, and civil society and community organisations to create greener public spaces and healthier streets.

Existing mapping of accessible open space is mostly based on assessment of parks and green spaces that are formally declared as public open space.⁵⁸ The public open space data set is important for land use planning purpose. However, it does not highlight the more pressing problem of lack of access to green space in parts of London where people lack gardens, or where tree cover is below average. New methodologies and mapping can spotlight this issue and help to target action where required. Figure 29 and Figure 30 show an example of a 'greenness' map for London, and how the new approach could help target interventions.

⁵⁷ HM Government (2018) Our Green Future: Our 25 Year Plan to Improve the Environment. Accessed from: <https://www.gov.uk/government/publications/25-year-environment-plan>

⁵⁸ It therefore excludes countryside and farmland in the Green Belt accessible by public footpaths, other private green space, and other types of green space (such as golf courses and sports fields) that may be accessible but are outside the public open space categories within the London Plan.

Figure 29: Green and blue cover across London⁵⁹



⁵⁹ Generated from: GeoInformation Group (2017) Aerial imagery; OS (2017) MasterMap Greenspace Layer; GeoInformation Group (2017) UKMap; OS (2017) MasterMap.

Figure 30: Relationship between AoD and relative greenness (shows that some AoD (in yellow) are much greener than others)⁶⁰



⁶⁰ Generated from: GeoInformation Group (2017) Aerial imagery; OS (2017) MasterMap Greenspace Layer; GeoInformation Group (2017) UKMap; OS (2017) MasterMap; GiGL (2016) Areas of Deficiency in Access to Public Open Space (local and district POS).

Given the pressures on land in London, there will be few opportunities to create large areas of new public open space or natural habitats, based on traditional parks and nature reserves. Therefore, the city must become greener whilst it also becomes denser and more compact, to maintain it as an attractive place in which to live, work and invest, and achieve good growth.

It is possible to consider how greener areas can be created in existing areas of public realm. Around 12 per cent of London's surface area consists of roads and streets. This amounts to most of the public realm in the most densely developed parts of London. To redress the balance between thoroughfare and public realm, traffic can be removed or restricted from some local streets and replaced by linear parks and green corridors. The Mayor's Transport Strategy promotes this through the Healthy Streets Approach.⁶¹

Using the planning system to encourage street greening can also make an important contribution to reducing exposure to poor air quality. Well-designed green infrastructure in streets removes more pollutants from ambient air because of the greater surface area for pollutant deposition and will continue to reduce pollution even if the traffic source is removed.⁶²

Alternatively, existing public realm or green spaces could be modified and improved to provide landscapes or features that are more biodiverse or create corridors for wildlife. Too many green spaces are simply areas of mown grass or low-grade amenity landscaping that have little purpose and function, other than to maintain open space.

There is also a significant opportunity to increase the amount of new green infrastructure in those parts of London that are subject to major regeneration programmes.

London's Opportunity Areas and Housing Zones are those parts of the city that have large capacity for development. They have large areas of brownfield land or existing development in need of regeneration and renewal. By turning these areas into liveable neighbourhoods, there is an opportunity to improve existing, and plan new, green infrastructure that is better connected and better integrated into the built environment. This approach is being taken to turn the former Ferrier Estate in south east London into Kidbrooke Village sustainable suburb (Box 11).

⁶¹ Greater London Authority (n.d.) Healthy Streets for London. Accessed from: <https://www.london.gov.uk/what-we-do/health/transport-and-health/healthy-streets-london>

⁶² Pugh, T., et al. (2012) Effectiveness of green infrastructure for improvement of air quality in street canyons. *Environmental Science and Technology* 46, 7692–7699. Accessed from: [http://www.research.lancs.ac.uk/portal/en/publications/effectiveness-of-green-infrastructure-for-improvement-of-air-quality-in-urban-street-canyons\(550bafc8-eddc-4330-b0be-e6519738f505\).html](http://www.research.lancs.ac.uk/portal/en/publications/effectiveness-of-green-infrastructure-for-improvement-of-air-quality-in-urban-street-canyons(550bafc8-eddc-4330-b0be-e6519738f505).html)

BOX 11: KIDBROOKE VILLAGE - ESTATE REGENERATION AND GREENING⁶³

After serving as a Royal Air Force base during World War II, Kidbrooke was zoned for development. It became the Ferrier Estate in 1968 and was designed along similar lines to the post-modern brutalist architecture of the nearby Thamesmead estate. By the 1990s, the system built precast concrete panels were failing and the estate fell into disrepair.

A regeneration partnership of Greenwich Council, the Mayor of London and Berkeley has started

to change the estate into a new sustainable suburb. Here, green infrastructure will be integrated with the built environment. The nearby Sutcliffe Park was also the subject of a major ecological restoration project by the Environment Agency. This created new areas of flood storage, reedbeds and wildflower meadows which helped provide a landscape-led setting for the regeneration.⁶⁴



London's extensive network of walking routes, including the iconic Thames Path, provide strategic opportunities for Londoners, and visitors to London, to explore and experience some of London's best landscapes and natural

environment. The Mayor's Transport Strategy includes proposals to protect, improve and promote routes, such as the Thames path, Capital Ring and London Loop, and create new leisure walking routes, such as the Wandle Trail.

⁶³ Photograph courtesy of Berkeley Group

⁶⁴ RESTORE Partnership (n.d.) Case study: Sutcliffe Park. Accessed from: https://restorerivers.eu/wiki/index.php?title=Case_study%3ASutcliffe_Park

Proposal 5.1.1.d The London Plan includes policies to green streets and buildings, including increasing the extent of green roofs, green walls and sustainable drainage

The Mayor will work with a range of stakeholders, including developers, architects and landscape architects, to champion and promote urban greening good-practice.

Previous London Plan policies have led to a step-change in the incorporation of green infrastructure into the built environment. This has been notable, especially when delivered through major development or urban regeneration. Furthermore, initiatives such as Greening the BID^s, have helped Business Improvement Districts (BIDs) identify opportunities for urban greening. This shows that a wide range of partners can be engaged in city greening projects.⁶⁵

Urban greening interventions might include greener public realm (including greener streets to support the Healthy

Streets Approach), publicly accessible roof gardens or green roofs, and space for growing food. It could also mean replacing certain types of grey infrastructure (for example, piped surface water drainage) with green infrastructure solutions. There is a particular opportunity to consider urban greening when, for example, a green roof can be installed in combination with solar panels to meet two key policy objectives of this strategy.

A number of cities have developed 'Green Space Factor' policies that provide a methodology and metric for urban greening (Box 12). These can be used to determine how much urban greening ought to be incorporated into all new high-density development. Consequently, the London Plan includes a new 'Urban Greening Factor' for London to help accelerate urban greening in London.

⁶⁵ Cross River Partnership (n.d.), Greening the BID^s. Accessed from: <https://crossriverpartnership.org/projects/greening-the-bids/>

BOX 12: THE GREEN SPACE FACTOR IN MALMÖ⁶⁶

The Green Space Factor has been applied to new developments in Malmö, such as Augustenborg and Western Harbour. It is a tool that can be used to secure a certain amount of green cover in every development. It also minimises the degree of sealed or paved surfaces in the development. The system was adapted from Germany, where it is used in Berlin and Hamburg among other cities. Other cities, including Seattle and Southampton, have adapted it for their own planning needs.

The ecologically effective area is defined as the area of a development contributing to ecosystem function through, for example, storm water drainage or habitat provision.

Surfaces such as grass, gravel, vegetation, and green roofs are assigned factors based on how much they contribute to ecosystem function.

For example, a surface of concrete or asphalt would have a factor of 0.0 while a green roof would have a factor of 0.7 and a natural surface covered with vegetation would have a factor of 1.0.

These factors are then multiplied by the total area that those features cover of the development. Adding these together gives the ecologically effective area. This ecologically effective area is then divided by the total area of the development to give a final green space factor score.

$$\text{Green Space Factor} = \frac{(\text{area A} \times \text{factor A}) + (\text{area B} \times \text{factor B}) + (\text{area C} \times \text{factor C}) + \text{etc.}}{\text{total development footprint}}$$

⁶⁶ GRaBS (2011) GRaBS Expert Paper 6: the green space factor and the green points system. Accessed from: www.xn--malm-8qa.se/download/18.d8bc6b31373089f7d980008924/1491301018437/greenspacefactor_greenpoints_grabs.pdf



Credit: Sophia Spring, Horniman Museum

⁶⁷ The 'urban forest' currently covers around 20 per cent of London's land area. A ten per cent increase will take this to around 22 per cent by 2050.

Proposal 5.1.1.e The Mayor will develop programmes and deliver projects, including a major tree planting programme, to ensure that London's urban forest is maintained and expanded

The 'urban forest' describes all the trees in London. There are around eight million, covering about 20 per cent of London's land area. The urban forest consists of street trees, garden trees, trees in parks and open spaces, copses, woodlands, and extensive areas of semi-natural forest. The Mayor wants to increase this by ten per cent by 2050 (for example, from 20 to at least 22 percent of London's land area).⁶⁷ This will require protection of the existing resource, as well as encouraging natural regeneration and increasing the rate of tree planting to create new woodlands for recreation and to improve air quality. The management of existing trees and woods and the planting of new woodlands will also make an important contribution to meeting Objective 5.2 of this strategy.

"There are around eight million trees covering around 20 per cent of London's land area."

Increasing London's canopy cover can add to the benefits that London's open spaces and urban forest already provide. Research by the University of Manchester has shown that increasing canopy cover by ten per cent in city areas with the highest density of buildings can help reduce temperatures.⁶⁸ The distance over which this cooling is effective increases where tree canopy coverage is most extensive.⁶⁹ The planting of trees in streets and parks can also help improve air quality over the long-term.

Box 13 describes the Mayor's programme for maintaining and expanding London's urban forest.

BOX 13: THE MAYOR'S PROGRAMME FOR ENHANCING LONDON'S 'URBAN FOREST'

The Mayor will work with the Forestry Commission and the London Tree Partnership⁷⁰ to prepare an Urban Forest Plan that will provide further detail on how to:

- run a major programme of tree planting to supplement tree planting by boroughs, environmental organisations, and other land managers
- support larger scale woodland creation projects in the Green Belt and other suitable locations
- improve the methods and data required to identify locations for tree planting and to monitor change in tree canopy cover
- develop a new online map to enable Londoners and businesses to sponsor street tree planting in their area
- support and promote the work of the London Tree Officers Association and the Trees and Design Action Group to promote best practice in managing and planting trees in the urban environment

⁶⁸ Gill, S.E., et al. (2007) Adapting Cities for Climate Change: The Role of Green Infrastructure.

⁶⁹ Vaz Monteiro, M., et al. (2016) The impact of greenspace size on the extent of local nocturnal air temperature cooling in London. *Urban Forestry and Greening* 16, 160-169.

⁷⁰ London Tree Partnership. Accessed from: <https://www.london.gov.uk/what-we-do/environment/parks-green-spaces-and-biodiversity/london-tree-partnership>.

Proposal 5.1.1.f The Mayor will back greater community involvement in the improvement and management of London's green spaces and natural environment

The Mayor will work with boroughs, Parks for London, and civil society organisations such as Groundwork London, London Wildlife Trust, and Trees for Cities to provide advice and guidance to local communities.

Local people are the main users of most of the smaller green spaces across London, such as local parks, pocket parks and amenity green space. It is these spaces that are increasingly given the lowest priority by those charged with managing and maintaining a network of sites, as a result of the reduction in public sector funding.

An assessment of the funding and investment in the UK's public parks and green spaces shows that there have been year-on-year reductions to local authority parks budgets since 2010.⁷¹ Three quarters of London boroughs expect further reductions of 10-20 per cent (or more) up to 2020.

As a result, people and communities increasingly want to take local action to enhance these spaces and the wider natural environment. There are over 600 Friends of Parks Groups across London, and over half of the London boroughs have formal Parks Forums. Initiatives to promote food growing and community managed pocket parks have spawned a number of local projects to make better use of underused or neglected local green spaces. There are now, for example, over 2,500 food growing spaces across London.⁷²

Traditional models of local council funding are no longer likely to provide enough resources to maintain and enhance all of the public realm and green spaces. A report exploring the role of local people, businesses, and community groups within the public realm found that they can help to secure not just volunteer hours but access to funding, and play an active role in managing local spaces.⁷³

⁷¹ Heritage Lottery Fund (2016) State of UK Public Parks 2016. Accessed from: www.hlf.org.uk/state-uk-public-parks-2016

⁷² Capital Growth (n.d.) Capital growth: London's food growing network. Accessed from: www.capitalgrowth.org/

⁷³ Association for Public Service Excellence (2015) Nudge and budge your citizens to reduce demand on hard pressed council services. Accessed from: www.apse.org.uk/apse/index.cfm/news/2015/press-release-nudge-and-budge-your-citizens-to-reduce-demand-on-hardpressed-council-services/

Many local councils now support and encourage local community groups and civil society organisations to take more responsibility for these locally important spaces (Box 14). A wide range of civil society organisations (including Parks

for London, Groundwork London, London Wildlife Trust, and the National Trust) also offer local communities support and expert advice. However, additional capacity is needed to ensure that locally.

BOX 14: COMMUNITY PARTICIPATION MODELS

A number of different approaches have been taken by London boroughs to get communities more engaged in local green spaces. Some examples are below.

- Havering actively supports a Friends of Parks network that ensures local communities are actively engaged in decisions about managing the borough's parks.⁷⁴ This supplements the work of the borough's grounds maintenance team
- Islington has devolved parks maintenance budgets to formally constituted residents' associations and friends' groups at Arlington Square⁷⁵ and Barnsbury Square⁷⁶
- Lambeth embarked on its Co-operative Parks initiative⁷⁷ to identify social enterprise organisations, such as Streatham Common Co-operative (SCoop)⁷⁸, that could be responsible for not-for-profit led management of borough parks

⁷⁴ Havering Borough Council (n.d.) Friends of parks in Havering. Accessed from: www.havering.gov.uk/info/20037/parks/215/friends_of_parks_in_havering

⁷⁵ Arlington Association (n.d.) Home. Accessed from: www.arlingtonassociation.org.uk

⁷⁶ Friends of Barnsbury Square Gardens (n.d.), Welcome to the Friends of Barnsbury Square Gardens website. Accessed from: www.friendsofbarnsburysqgardens.com/

⁷⁷ Lambeth Borough Council (2013) Lambeth Cooperative Parks Programme Information Booklet. Accessed from: www.lambeth.gov.uk/sites/default/files/CoopParksInformationBooklet.pdf

⁷⁸ Streatham Common Cooperative (n.d.) What is The Streatham Common Co-operative? Accessed from: <https://www.scoop.org.uk/>

Proposal 5.1.1.g The Mayor will provide advice to householders about how gardens contribute to improving green infrastructure at a local level

Private gardens make up 24 per cent of London's land area. However, only about 60 per cent of this area is green due to the trend of paving and decking outdoor areas, and the use of permitted development rights to extend existing buildings. Nevertheless, the total amount of green space in private gardens is equivalent to the total area of public green space in London, at around 30,000 hectares. Private gardens not only create leafier neighbourhoods that are good for health, they also provide habitat for wildlife and increase the city's resilience to climate change. Consequently, any reduction in the extent of green cover in gardens will have wider environmental impacts.

The environmental performance of gardens could be improved. For example, relatively small changes to design and management could reduce the amount of storm water being discharged to the sewer network, help to reduce exposure to poor air quality, or create stepping stones for wildlife to move between areas of semi-natural habitat.⁷⁹ Flower-rich gardens in particular can provide important foraging areas for bees and other pollinators.⁸⁰ Some of the benefits of urban gardens have been identified by research undertaken by the Royal Horticultural Society (RHS), which is outlined in Box 15. The RHS also provides advice to householders, through the Greening Grey Britain campaign, on how they can green their front gardens whilst still providing space for parking.⁸¹ Guidance by others on features such as green roofs and rain-gardens (domestic sustainable drainage) demonstrates that, even where permitted development rights are being exercised, householders can help to mitigate for any loss of green cover.

⁷⁹ Royal Horticultural Society (2011) Gardening matters: Urban gardens. Accessed from: www.rhs.org.uk/science/pdf/climate-and-sustainability/urban-greening/gardening-matters-urban-greening.pdf

⁸⁰ The Nature of Cities (n.d.) Can cities save bees? How can urban habitats be made to serve pollinator conservation? How can that story be better told? Accessed from: www.thenatureofcities.com/2016/01/20/can-cities-save-bees-how-can-urban-habitats-be-made-to-serve-pollinator-conservation-how-can-that-story-be-better-told/

⁸¹ Royal Horticultural Society (n.d.) Greening Grey Britain – Community Action. Accessed from: www.rhs.org.uk/communities/campaigns/greening-grey-britain

BOX 15: THE IMPORTANCE OF DOMESTIC GARDENS AS PART OF LONDON'S GREEN INFRASTRUCTURE NETWORK

The Royal Horticultural Society, working with the Universities of Reading and Sheffield, reviewed academic evidence to consider the potential impacts of domestic gardens on urban quality of life.⁸² They found that:

- urban garden plants and trees help cool the air in towns and cities, combating heat waves
- garden plants and trees intercept pollutants in the air, reducing exposure to poor air quality
- garden plants and trees intercept intense rain, slowing run-off and so reducing the pressure on urban drains
- soil in gardens naturally absorbs rainwater, reducing the risk of flooding
- some animal species are now more common in cities, and particularly domestic gardens, than in rural areas
- the presence of gardens eases stress and improves psychological wellbeing
- access to gardens encourages sustained exercise and promotes physical health
- some 12 per cent of rare species are at risk of extinction from the UK

⁸² Royal Horticultural Society (2011), Gardening matters: Urban gardens. Accessed from: www.rhs.org.uk/science/pdf/climate-and-sustainability/urban-greening/gardening-matters-urban-greening.pdf

Policy 5.1.2 Protect, conserve, and enhance the landscape and cultural value of London's green infrastructure

Proposal 5.1.2.a The Mayor will ensure that opportunities for a complementary relationship between cultural heritage and green infrastructure are fully explored in the interests of good place-making

The wealth of culture and heritage in London is not confined to the city's built environment. Landscapes that originate from Royal endeavours, such as the designed landscapes of St James's Park, the Mall and Regent's Park are some of the most iconic areas of green space in the world. The Arcadian landscape on the banks of the Thames between Hampton and Kew, the ideas from which led to the formation of the English Landscape Movement, is the largest connected open space in the capital.⁸³ At a smaller scale, London's garden squares are a characteristic model of planned communal green space in higher density residential neighbourhoods.

As the city continues to grow and develop, opportunities will need to be taken to create new green infrastructure that is similarly appropriate to its

historic context. Consequently, through the London Plan and the Good Growth by Design principles, the Mayor will ensure that policies are in place that recognises and embeds the role of heritage landscapes in place-making and promotes innovative and creative solutions that contribute to maintaining and enhancing the character of London's neighbourhoods.

OBJECTIVE 5.2 CONSERVING AND ENHANCING WILDLIFE AND NATURAL HABITATS

London's network of parks and green spaces has resulted in a city that is not just green but also relatively rich in wildlife and natural spaces. London's geography helps; the city's wildlife habitats include areas as diverse as chalk grassland, grazing marsh, ancient woodland and heath, and a variety of urban habitats including reservoirs, gardens, and parks.

However, in common with nationwide trends that show a continual decline in England's biodiversity, London's ecological health has worsened, caused by increased urbanisation.

⁸³ Thames Landscape Strategy (n.d.) The Arcadian Landscape: London's Countryside Accessed from: <http://thames-landscape-strategy.org.uk/visitor-guide/newbox-three/>

“Londoners play an important role in maintaining and enhancing the ecology of the city.”

The conservation of London's biodiversity is often reliant on the efforts of voluntary sector organisations that can provide specialist knowledge and expertise and help mobilise volunteers to manage habitats and monitor wildlife. But day-to-day management of much of the land that supports London's natural habitats is the responsibility of others. These include the London boroughs and other public owners and managers of land, such as the Lea Valley Regional Park Authority, who are subject to the 'biodiversity duty' of the Natural Environment and Communities Act 2006.⁵² Private landowners can also have an important role in managing land for wildlife. Thames Water's reservoirs at Walthamstow, for example, provide some of the most important open water habitat in London. Londoners also play an important role in maintaining and enhancing the ecology of the city. Gardens are a valuable supplementary habitat for a wide range of wild plants and animals (Box 15). Gardens and other private, domestic green spaces can be managed to improve their value to wildlife, for example through the provision of ponds, nectar-rich plants, or trees.

Policy 5.2.1 Protect a core network of nature conservation sites and ensure a net gain in biodiversity

Proposal 5.2.1.a The London Plan includes policies on the protection of Sites of Importance for Nature Conservation (SINCs) and Regionally Important Geological Sites (RIGS)

The land use planning system provides the primary mechanism for protecting land of ecological value in London. A robust policy framework in the London Plan can ensure that land of particular nature conservation value is safeguarded.

The establishment of a SINC (and RIG) network is designed to protect valuable habitats (those that are rare, threatened, fragile, or richest in wildlife) and natural features from development. By protecting these habitats, most of the rarest or most vulnerable species are also likely to be conserved.

With access to nature included in the selection criteria for SINCs, the network also ensures that as many Londoners as possible can access wildlife-rich spaces close to where they live and work.

The procedures in Appendix 5 of this strategy set out the methodology and process by which boroughs should identify SINCs in their Local Plans.

Land use planning policy can also be an effective mechanism to address some of the indirect adverse impacts of urbanisation, such as light pollution, which can disrupt the flight paths of bats and disorientate night-flying insects and migratory birds. The London Plan also highlights the need to avoid or minimise the negative impacts of light, noise, shading and other issues on habitats and species.

Proposal 5.2.1.b The Mayor will develop a biodiversity net gain approach for London, and promote wildlife-friendly landscaping in new developments and regeneration projects

The Mayor will work with boroughs, statutory agencies and wildlife organisations to explore opportunities to establish a biodiversity net gain framework, including a biodiversity offsetting metric for London. Requiring new development to include new wildlife habitat, nesting and roosting sites, and ecologically appropriate landscaping

will provide more resources for wildlife and help to strengthen ecological corridors. Biodiversity net gain is when a development leaves biodiversity in a better state than before.⁸⁴ It can be delivered on a development site as an enhancement or, where this is not possible, after applying the mitigation hierarchy, as a biodiversity offset on an alternative site.

Achieving net gains for biodiversity can have wider environmental benefits. New and improved habitats and biodiversity friendly landscaping can help to reduce flood risk, cool the city, and provide space for relaxation and to enjoy nature (see Box 16).

Defra and Natural England ran six biodiversity offsetting pilot areas from 2012 to 2014, to test different approaches to delivering biodiversity

offsets and using the offsetting metric.⁸⁵ The government has not yet translated the results of these pilots into a standard, approved methodology for biodiversity offsetting. It does, however, recognise that the biodiversity offsetting metric is a tool available to developers to fulfil their obligations under the planning system's mitigation hierarchy, and to demonstrate a net gain in biodiversity. It therefore encourages local authorities and others to develop appropriate bespoke methodologies.

Some major infrastructure providers and developers have started to do this.⁸⁶ In London, the Thameslink Programme has conducted a trial of a biodiversity net gain methodology (Box 17). Transport for London is developing a tool to plan for, and monitor, biodiversity net gain for projects across its estate.

⁸⁴ CIEEM, CIRIA & IEMA (2016) Biodiversity Net Gain: Good practice principles for development. Accessed from https://www.cieem.net/data/files/Publications/Biodiversity_Net_Gain_Principles.pdf

⁸⁵ Defra (2014) Evaluation of the Biodiversity Offsetting pilot phase. Accessed from: <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=18229&FromSearch=Y&Publisher=1&SearchText=WC1051&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description>

⁸⁶ WSP & Parsons Brinkerhoff (2016) Biodiversity Net Gain – A new role for infrastructure and development in improving Britain's wildlife. Accessed from: <http://cdn.wsp-pb.com/brnd7f/wsp-biodiversity-net-gain.pdf>

BOX 16: WILDLIFE FRIENDLY LANDSCAPING AT BARKING RIVERSIDE: DESIGNING HABITATS FOR PRIORITY SPECIES⁸⁷

Barking Riverside in east London is one of the largest regeneration sites in the country. Planning permission requires the provision of a high proportion of accessible green space and green infrastructure on and around new buildings, to create a sustainable and healthy place to live and to protect biodiversity.

Researchers from the University of East London designed and monitored the benefits of wildlife friendly landscaping at Barking Riverside. They found that landscape design and green roofs, inspired by the

habitats in the surrounding landscape, were significantly more beneficial for wildlife than more traditional landscaping that did not use this 'ecomimicry' approach. A number of rare and scarce species were recorded using the new landscapes, including bumblebees recognised as national priority species for conservation.

The research also showed that designing green infrastructure for the habitat needs of species does not reduce the other benefits provided, such as water attenuation or cooling.



⁸⁷ Photographs courtesy of Dr Stuart Connop, University of East London

BOX 17: THAMESLINK PROGRAMME: A BIODIVERSITY NET GAIN SCHEME

The Thameslink Programme is a £4.6bn rail infrastructure enhancement project running from Bedford to Brighton through central London. It is Network Rail's first project to commit to delivering a net gain in biodiversity. This means the mitigation hierarchy (avoiding and minimising impacts on biodiversity and, as a last resort, compensating for any unavoidable loss) was closely followed.

All the sites were assessed using a Defra metric to establish the biodiversity baseline and compensation units. 42 units requiring compensation were identified as unavoidable losses. These are being addressed through both onsite enhancements and biodiversity offsetting.

Thameslink, supported by Parsons Brinckerhoff, and partners London Wildlife Trust and Lambeth Council are delivering its biodiversity offset at Streatham Common, a Local Nature Reserve in south London. The offset involves new woodland planting and improving existing woodlands. It has been mainly designed to compensate for the greatest biodiversity impact (loss of a railway-locked two hectare area of trees in south London). It will also restore parts of the Great North Wood: a forest that once grew across south London.

The offset achieves a net biodiversity gain and adds value for both wildlife and local communities. The Thameslink biodiversity offset has been named by Defra as a UK demonstration project.

Proposal 5.2.1.c The Mayor will provide guidance and support on the management and creation of priority habitats, the conservation of priority species, and the establishment of wildlife corridors

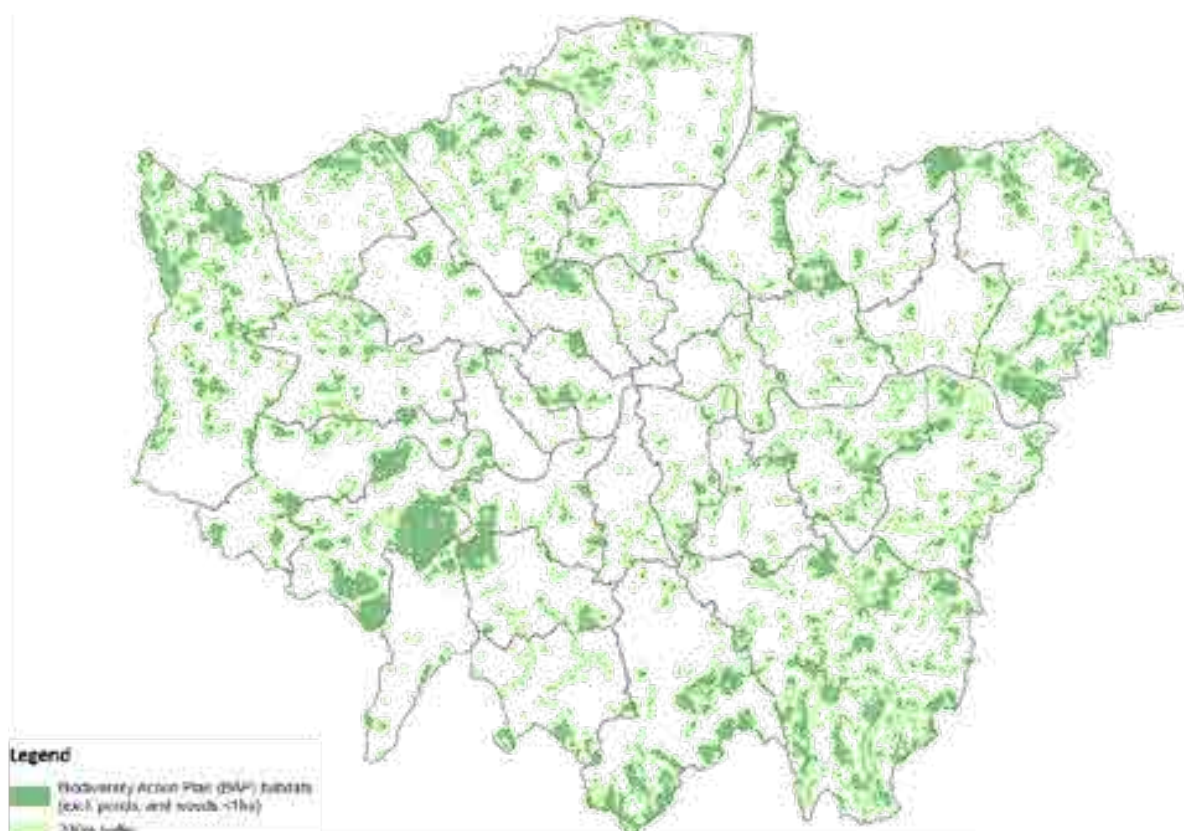
Working with London boroughs, the statutory environmental agencies, and others the Mayor will ensure that landowners and managers in London can get the best advice on the management or enhancement of land or buildings for nature conservation. New models of delivery will also be explored and recommended.

Planning policy to protect or create areas of nature conservation value is ultimately ineffective if the habitats protected or created are not properly managed. Most habitats will change or deteriorate over time without appropriate management. For some habitats, such as woodland, this is a slow, almost imperceptible process. For others, such as grassland or heathland, changes can be rapid and dramatic.

Some London boroughs and other land managers have access to their own in-house advice on ecology and natural environment issues. But in recent years, particularly as public sector budgets have been prioritised to fund core statutory services, the amount of expert advice at the borough level has fallen. Consequently, London-wide forums and advisory services are increasingly needed to share expertise, knowledge and experience.

Despite the extent of green space in London, the existing SINC network is fragmented. Consequently, the most important habitats also need to be expanded to protect and enhance biodiversity. Therefore, new areas of habitat should be created to strengthen wildlife corridors and augment fragile or threatened habitats (Figure 31). The values in the table are based on research undertaken by the London Wildlife Trust and Greenspace Information for Greater London.

Figure 31: Habitat creation opportunity areas – 200m buffer around sites supporting priority habitats⁸⁸



⁸⁸ GLA modelling based on GiGL habitat data.

Priority habitats

Opportunities should be sought to create or restore priority habitats (previously known as UK Biodiversity Action Plan habitats) that have been identified as conservation priorities in London.⁸⁹ The London Habitat Opportunity Maps identify ecologically suitable areas to create new priority habitats.⁹⁰ The creation of new priority habitat will be of highest ecological value where it expands or connects existing habitat areas. In London, Priority Habitats are:

- acid grassland
- chalk grassland
- coastal and floodplain grazing marsh
- fen, marsh and swamp
- heathland
- lowland meadows
- open mosaic habitats on previously developed land
- orchards
- reedbeds
- rivers and streams

A review of progress on meeting habitat targets in the London Plan was undertaken in March 2017, and showed that several habitat targets have been met.⁹¹ However, for many habitats it was unclear if planning policy had been a critical delivery mechanism. In addition, it was not possible to make strong conclusions about progress because data on many habitats was inconsistent or incomplete. As a result, a smaller set of targets is included in this strategy, rather than in the London Plan (Table 1). These targets relate to habitats with the greatest opportunities to create new areas across much of London, and for which progress can be accurately monitored to 2050. This does not negate the need for targets for other, more locally relevant, priority habitats to be set through local biodiversity action plans (BAPs) at borough level, or through corporate BAPs.

⁸⁹ As listed on Section 41 of The Natural Environment and Rural Communities (NERC) Act as habitats of principal importance for the conservation of biodiversity in England.

⁹⁰ GiGL (2010) BAP Habitat Suitability Data. Accessed from: <http://www.gigl.org.uk/habitat-data/bap-habitat-suitability-data/>

⁹¹ London Wildlife Trust and GiGL (2017) The London Plan Habitat Targets: A review of progress and forward recommendations. Accessed from: https://www.london.gov.uk/sites/default/files/gla_habitat_targets_report_-_lwt_-_march2017.pdf

Table 1: Habitat creation targets for London

Habitat	By 2025	By 2050
Species-rich woodland	20 ha	200 ha
Flower-rich grassland	50 ha	250 ha
Rivers and streams	10 km	40 km
Reedbeds	5 ha	30 ha

- Species-rich woodland** are new woodlands planted with native trees, shrubs and ground flora. This strategy includes a target to increase the area of London under tree cover by ten per cent by 2050. This is equivalent to about 3,000 hectares. It is estimated that about a third of this (1,000 hectares) will be delivered by extensive tree planting to create woodlands. The habitat creation target proposes that a minimum of 20 per cent of this woodland planting, i.e. 200 hectares, is specifically designed and planted to meet biodiversity objectives.
- Flower-rich grassland** are those that include a wide variety and abundance of native wildflowers and are not dominated by a few species of grasses. They include acid, chalk or meadow grasslands, as well as other flower-rich swards. A target of creating an additional 300 hectares of flower-rich grassland by 2050 would require just one per cent of existing public green space to be improved to provide this additional habitat (Box 18).

BOX 18: CREATING FLOWER-RICH GRASSLANDS IN TOWER HAMLETS⁹²

Creating flower-rich meadows is a comparatively easy way to enhance the biodiversity of parks and open spaces. It also provides an attractive and interesting landscape for site users.

Numerous meadow creation projects have been undertaken in Tower Hamlets over the last 20 years. These range from the extensive meadows of Mile End Park, to small patches of flower-rich grassland in small parks and on housing amenity land, such as Approach Gardens.

Experience shows that the key to creating a successful meadow is low soil fertility. This is achieved by removing topsoil and adding inert

substrate, such as sand or crushed concrete. Planting usually uses an appropriate grass and wildflower seed mix, which can be supplemented with plug plants. Including cornfield annuals in the seed mix ensures a spectacular display of flowers in the first couple of years, while the perennial species become established. In Tower Hamlets Cemetery Park, one of the best sites for invertebrates in central London, large numbers of bulbs of a wide variety of species and cultivars (including some non-native species) have been planted in the meadows. These provide an additional nectar source for pollinators, such as bees and butterflies, in spring.



⁹² Photograph of Approach Gardens courtesy of Colin Toogood.

BOX 19: WATER QUALITY IN LONDON'S RIVERS – PATHWAYS TO IMPROVEMENT

Years of pollution from run-off from roads and hard surfaces, sewer infrastructure problems, water treatment capacity constraints, and poorly managed river maintenance and modification work have degraded many of London's rivers. The EU Water Framework Directive aims for 'good' water quality status for all rivers and other waterbodies. This is regulated and enforced by the Environment Agency. Of the 47 river water bodies in London, three are classified as 'bad', five are 'poor' and the rest are 'moderate'; only one is currently classified as 'good'.

The main causes of poor water quality in London's rivers and other waterbodies are:

- foul drainage and surface water misconnections
- diffuse pollution of oil, grease, chemicals, grit, road salts, sediments, pesticides and nutrients (nitrogen and phosphorus) from run-off from roads and other hard surfaces
- combined sewer overflows and pollution from wastewater treatment works
- other sources, such as illegal connections or industrial spills

Poor water quality can affect the ecology of rivers and streams, damaging habitats, harming wildlife and causing algal blooms. Water pollution can also negatively affect the way that Londoners interact with rivers and streams. For example, it can cause bad odours or health impacts from contact with the water, and generally worsen the public's perception of the natural environment.

The Environment Agency oversees water quality issues, including monitoring and regulation. Water companies have a responsibility to prevent pollution incidents and mitigate the impacts when pollution occurs. London boroughs have responsibility for the enforcement of building regulations, correction of misconnections, proper maintenance of the road drainage network, and the reduction of run-off by promoting sustainable drainage through the planning process. In addition, a number of Catchment Management Partnerships have been established to actively involve communities

BOX 19: WATER QUALITY IN LONDON'S RIVERS – PATHWAYS TO IMPROVEMENT (CONTINUED)

and other stakeholders in tackling pollution, restoring local rivers, managing invasive species, and improving access to rivers.

The Mayor is working with these key stakeholders to address water quality problems by promoting:

- **Integrated Water Management Strategies (IWMSs):** IWMSs include water quality as part of an integrated approach that also includes potable water, wastewater, foul water, flood risk and reused water concerns (Proposal 8.2.1.c)
- **Infrastructure expansion:** improving and expanding existing sewerage infrastructure can help reduce the amount of water pollution discharged to our waterways (Policy 8.2.4)
- **Addressing misconnections:** by disconnecting and correcting misconnected systems, polluted water discharges to our waterways will be reduced (Proposal 8.2.4.b)
- **Green infrastructure:** green infrastructure can help prevent water pollution by retaining sediments, taking up pollutants and intercepting rainfall. Reedbeds help address the problem of nutrient pollution in water (Policy 5.1.1 and Policy 5.1.2)
- **Sustainable drainage systems (SuDS):** SuDS can provide a number of water quality benefits in addition to their water quantity, biodiversity and amenity benefits (Policy 5.1.1 and Policy 8.2.3)
- **River restoration:** working at the catchment scale, river and wetland restoration are strategies for improving river and stream habitats and improving water quality (Proposal 5.2.1.c)

The Mayor is particularly keen to encourage nature-based solutions for improving water quality. These include:

- **Rivers and streams**

The EU Water Framework Directive requires all water bodies (including rivers and streams) to aim for good ecological status. This, alongside more natural approaches to managing flooding, has resulted in schemes and measures to restore rivers to more natural systems. In the capital, this has been catalysed by the London Rivers Action Plan, which has led to 17.5 km of river channel being restored since 2008. The target for 2050, which accepts a less rapid rate of implementation than has occurred to date, takes into account that opportunities for restoration will get harder compared to earlier years

- **Reedbeds**

Creating reedbeds has been a feature of habitat creation effort in London since the early 1990s. It addresses a chronic problem of nutrient enrichment and pollution, particularly

in some canalised rivers and lakes in public parks. It also creates new wildlife habitat that allows specialist species, such as reed warblers, to colonise parts of London that are less rich in wildlife. This has resulted in new reedbeds in a number of parks including the Royal Parks. The target also contributes to the objectives of the EU Water Framework Directive by helping to improve water quality. Habitat creation should also aim to provide new landscapes that deliver the most valuable green infrastructure services in a London context. These include flood management, air quality improvement, prevention of water pollution, and enhancement of amenity in public parks and green spaces.

The development of Queen Elizabeth Olympic Park provides a case study in habitat creation that meets ecological objectives whilst providing green infrastructure services (Box 20).⁹³

⁹³ Olympic Delivery Authority (2011) Learning legacy: lessons learned from the London 2012 Games construction project. Accessed from: <http://learninglegacy.independent.gov.uk/documents/pdfs/design-and-engineering-innovation/425009-165-promoting-biodiversity-aw.pdf>

BOX 20: SECURING ECOLOGY OBJECTIVES FOR THE OLYMPIC PARK⁹⁴

The London 2012 Olympic and Paralympic Games planning permissions placed an obligation to provide 45 hectares of wildlife habitat. It also required the quality and connectivity of habitat to be improved.⁹⁵ The Olympic Park Biodiversity Action Plan provided a detailed account to show how the planning obligation could be delivered.⁹⁶

Created habitats included species-rich grassland, wet woodland, reedbeds, and open mosaic habitats. The plan also set out the quality required of the new habitat, including features

that support particular species, and the creation of continuous corridors for wildlife to move through the site. Importantly, these habitats were integrated with areas of more formal landscaping (including green roofs) to demonstrate that wildlife habitat can be incorporated into the public realm and built environment. Where possible, newly created wildlife habitat was also designed to provide other functions, such as flood storage. The original Biodiversity Action Plan has since been updated to inform the future development of Queen Elizabeth Olympic Park.⁹⁷



⁹⁴ Photograph courtesy of Peter Massini.

⁹⁵ Peter Neal (2011), Learning legacy. Accessed from: <http://learninglegacy.independent.gov.uk/documents/pdfs/design-and-engineeringinnovation/425009-165-promoting-biodiversity-aw.pdf>

⁹⁶ Olympic Delivery Authority (2008), Olympic Park Biodiversity Action Plan. Accessed from: www.queenelizabetholympicpark.co.uk/-/media/lldc/local-plan/local-plan-examination-documents/local-strategy-papers/ls4-legacy-communities-scheme-olympic-park-biodiversity-actionplan-2008.ashx?la=en

⁹⁷ London Legacy Development Corporation (2013), Legacy Communities Scheme Biodiversity Action Plan 2014-2019. Accessed from: www.queenelizabetholympicpark.co.uk/-/media/lldc/sustainability-and-biodiversity/legacy-communities-scheme-biodiversity-actionplan-2014-2019.ashx?la=en

Priority species

The Mayor will work with wildlife organisations to produce an updated list of priority species that are of particular conservation importance in London, and produce or sign-post guidance that aids their conservation. All land managers and landowners should take these species into account. This should include, for example, tailoring the management of land or design of new green infrastructure to create habitat or features (for example, nesting and roosting sites) which support their conservation.

The ecological resilience of London cannot be maintained simply by the protection of SINC or creation of new priority habitats. Although many rare or sensitive species, such as bats, are legally protected under the Wildlife and Countryside Act (1981) many

uncommon species are dependent on supplementary habitat provided by ecological features (such as gardens and street trees, for example) that are not safeguarded by being part of the SINC network.⁹⁸

The Natural Environment and Rural Communities Act 2006 lists species that are of principal importance for the conservation of biodiversity ('priority species'). The conservation status of these species must be taken into account by public bodies when making decisions about the use and management of land.⁹⁹

Appendix 2 provides a list of the priority species identified in London. It has information about the types of habitats and features on which they depend, and the boroughs where they have been recorded.¹⁰⁰

⁹⁸ JNCC (n.d.) Species protection and legislation. Accessed from: <http://jncc.defra.gov.uk/page-1747>

⁹⁹ Natural England (n.d.) Habitats and species of principal importance in England. Accessed from: <http://webarchive.nationalarchives.gov.uk/20140605090108/http://www.naturalengland.org.uk/ourwork/conservation/biodiversity/protectandmanage/habsandspeciesimportance.aspx>

¹⁰⁰ GiGL (n.d.) London's BAP Priority Species. Accessed from: www.gigl.org.uk/london-bap-priority-species/

Proposal 5.2.1.d The Mayor will work with key partners to establish a cost effective monitoring framework, to ensure important natural environment data is collected consistently to inform future decision making

Key data on London's ecology and natural environment will be collected, collated, managed and shared. This will be used to monitor ecological trends, and to make evidence based decisions on the use and management of land.

The health of London's natural environment can be measured using variables ranging from the extent and quality of habitats, to the presence and population size of species, and the water quality of rivers and water bodies. Natural environment data in London is generated and held by a number of bodies including boroughs, statutory agencies and environmental organisations. Volunteers and citizen scientists also make a significant

contribution to the collection of this data, particularly records of protected or priority species.

The previous Biodiversity Strategy (published in 2002) recommended a ten-year rolling survey of all London's green spaces and habitats to monitor London's natural habitats.¹⁰¹ Although a comprehensive baseline survey of all habitats in all London boroughs was completed by 2009, not all boroughs or land managers have undertaken repeat surveys to measure and monitor change. Consequently, there is not a consistent or reliable dataset that can be analysed to monitor changes in habitats across London. Therefore, it is necessary to develop a new, robust natural environment monitoring framework that identifies the most relevant data required to monitor key indicators of health of London's environment, as well as how to collect it in the most cost effective way.

¹⁰¹ Mayor of London (2002) Connecting with London's Nature: The Mayor's Biodiversity Strategy. Accessed from: <https://www.london.gov.uk/WHAT-WE-DO/environment/environment-publications/connecting-london%E2%80%99s-nature-mayor%E2%80%99s-biodiversity>

The Biodiversity Strategy also recognised the importance of collecting, managing and sharing natural environment data. It set the policy framework that enabled the establishment of a local environmental records centre, in the form of Greenspace Information for Greater London (GiGL), to act as a central repository and manager of data by collecting and curating data on a London-wide basis. GiGL has since been established as a Community Interest Company (CiC), which enables its stakeholders to access data to monitor the effectiveness and impact of the policies in this strategy. It also provides a cost effective mechanism for boroughs and others to maintain their own data.

The Mayor will continue to support GiGL, and expects all London boroughs and other major land managers to enter into data exchange agreements with GiGL.

OBJECTIVE 5.3 VALUE LONDON'S NATURAL CAPITAL AS AN ECONOMIC ASSET AND SUPPORT GREATER INVESTMENT IN GREEN INFRASTRUCTURE

Making London a National Park City brings opportunities to engage Londoners and London institutions to create a common vision of the environmental, social and economic benefits of London's green infrastructure. It provides a framework to promote investment in London's natural capital and green infrastructure. This will ensure effective coordination, better valuation, and more innovation from all those involved in protecting and enhancing London's environment.

The Natural Capital Committee's third report to government showed that carefully planned investments in natural capital, targeted at the best locations, will provide huge value for money and generate large economic returns.¹⁰² These are competitive with the returns from more traditional infrastructure investments. In particular, urban green infrastructure offers significant potential for improvements in physical and mental health. This will in turn reduce health expenditures and improve labour productivity.

¹⁰² Natural Capital Committee (n.d.) The State of Natural Capital: protecting and improving natural capital for prosperity and wellbeing. Accessed from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/516725/ncc-state-natural-capital-third-report.pdf

Policy 5.3.1 Address underinvestment, and improve the management of London's green infrastructure, by developing new business models and improving the awareness of the benefits of London's green infrastructure

Proposal 5.3.1.a The Mayor will establish a London Green Spaces Commission to develop new models for the delivery and management of London's green infrastructure

The Mayor will work with London Councils, the GLA group, and civil society organisations to establish a time-limited London Green Spaces Commission to explore the best options for the following:

- developing financing frameworks that identify a range of models to generate resources. Also, an investor and fundraising plan to include options for private and voluntary sector contributions and from other sources of public sector finance (for example, health)
- different organisational models that may improve the existing institutional arrangements for managing parks and green spaces

"Making London a National Park City brings opportunities to engage Londoners to create a common vision of the environmental, social and economic benefits of London's green infrastructure."

The functions of green infrastructure are usually optimised by managing these at a location and scale that fits the service provided. For example, flood prevention and management is best done at the river catchment scale, as interventions upstream can have a profound impact (positive or negative) lower down the catchment. The political boundaries of the city are rarely aligned to the appropriate landscape scale. However, there have been recent examples through sub-regional partnerships, such as Wandle Valley Regional Park Trust and the Colne Valley Regional Park Community Interest Company, which are based on the geography of London's river valleys. These are starting to illustrate the benefits of planning and working across administrative boundaries and to think differently about green infrastructure asset management at a different geography or across administrative boundaries.^{103,104}

Proposal 5.3.1.b The Mayor will develop and promote a natural capital accounting framework for London

The Mayor will work with London Councils and other stakeholders to develop and promote a natural capital accounting framework.¹⁰⁵ The Mayor will encourage its use by London boroughs and other major land managers.

The government's Natural Capital Committee is creating an accounting framework to address the issue of underinvestment in managing and improving the natural environment and green infrastructure (Box 21). The newly emerging methodology of natural capital accounting is designed to enable the following:

- better measurement of the value that the natural capital owned or managed by an organisation produces for the organisation itself and society in general (asset values)
- better recording of the costs (liabilities) of maintaining this value

¹⁰³ Wandle Valley (n.d.) Welcome to the Wandle Valley Regional Park. Accessed from: <http://wandlevalleypark.co.uk/>

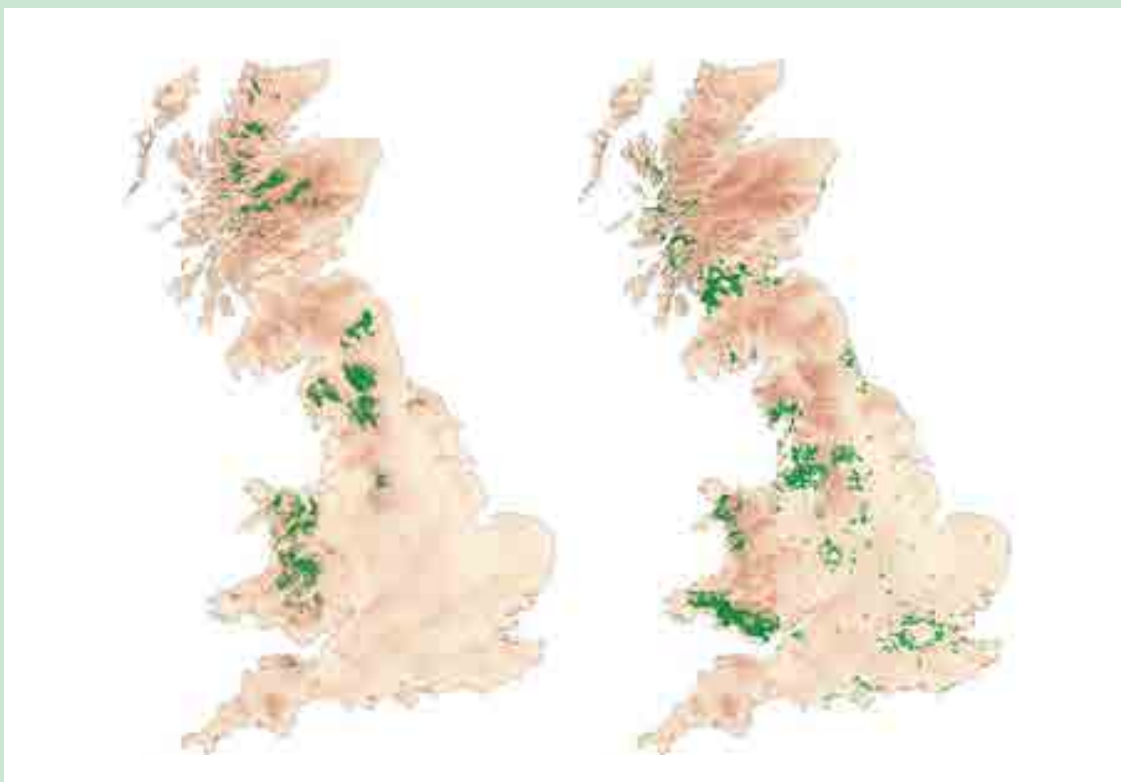
¹⁰⁴ Colne Valley Regional Park (n.d.) Colne Valley Regional Park. Accessed from: www.colnevalleypark.org.uk/

¹⁰⁵ Mayor of London (2017) Natural capital account for London. Accessed from: <https://www.london.gov.uk/what-we-do/environment/parks-green-spaces-and-biodiversity/green-infrastructure/natural-capital?source=vanityurl>

BOX 21: PROVIDING VALUE FOR MONEY FROM NEW WOODLAND PLANTING¹⁰⁶

Government policy and funding for woodland creation is determined primarily by the value of timber minus the costs to agriculture of foregone production. This results in planting targeted in the uplands (see left hand map) although there is an extra non-market cost of the release of CO₂ resulting from draining peaty soils. For Great Britain as a whole, this produces overall losses in excess of £65m a year.

However, if the economic value of recreation and carbon release is factored in, there should be extensive tree planting in major population centres and where soils store less carbon (see right hand map). Woodland planting of up to 250,000 additional hectares, located near towns and cities would bring net economic benefits of nearly £550m a year across Great Britain.



¹⁰⁶ Bateman, I., et al. (2014) UK National Ecosystem Assessment Follow-on. Work Package Report 3: Economic value of ecosystem services. UNEP-WCMC, LWEC, UK.

This approach is particularly relevant to informing policy and funding requirements for London's green infrastructure. A Natural Capital Account for Public Green Space in London has been published.¹⁰⁵ It reveals the overall economic value of public parks and green spaces and sets out the most significant headline values (Box 22). It supports the business case for investment in these spaces and contrasts this with the significant reduction in spending in these vital assets in recent years, as a consequence of constraints in public sector funding.

BOX 22: WHAT DOES THE NATURAL CAPITAL ACCOUNT FOR LONDON TELL US?

Reducing funding for public parks and green spaces is a false economy because:

- London's public green space have a gross asset value in excess of £91 billion, providing services valued at £5 billion per year
- for each £1 spent by local authorities and their partners on public green space, Londoners enjoy at least £27 in value
- Londoners avoid £950 million per year in health costs due to public green space
- the value of recreational activities is estimated to be £926 million per year
- for the average household in London, the monetary value of being in close proximity to a green space is over £900 per year

¹⁰⁷ Greater London Authority (2012) All London Green Grid Supplementary Planning Guidance. Accessed from: <https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/supplementary-planning-guidance/all-london-green-grid>

Proposal 5.3.1.c The Mayor will work with stakeholders to review and update the framework provided by the All London Green Grid Supplementary Planning Guidance to provide a stronger evidence base for green infrastructure programmes, projects and interventions, and to identify priority areas for green infrastructure investment

The All London Green Grid is a green infrastructure policy framework set out as Supplementary Planning Guidance (SPG) to the London Plan.¹⁰⁷ It identified the various functions and benefits of green infrastructure. However, it did not prioritise projects and interventions based on what the function might be, or the particular benefit, in each location. Since its publication in 2012, higher resolution spatial data has become available. This allows a more sophisticated assessment of where green infrastructure interventions might provide particular benefits at the neighbourhood level.

“London’s public green space have a gross asset value in excess of £91 billion, providing services valued at £5 billion per year.”

To help inform the updated All London Green Grid (SPG), the Mayor will develop a green infrastructure 'focus map' to identify priority areas for green infrastructure investment.

Proposal 5.3.1.d The Mayor will explore new approaches to investment to make sure that there is financial support for strategic green infrastructure projects

To develop new or improved funding streams, the Mayor will work with others to determine how best to access novel sources of funding. These might include philanthropic funding, new resources from environmental levies, and revenues derived from further fiscal devolution.

The Mayor will also convene annual strategy meetings involving major funding bodies. This will ensure better coordination and targeting of available funding.

There is increasing recognition of the potential economic benefit of investment in green infrastructure. Yet the funding of strategic green infrastructure projects still falls largely to those parts of the public sector and their civil society partners that work on environmental outcomes. An increase in green infrastructure investment will require access to new funding sources, including funding from the private sector, and better use and coordination of existing public and charitable funding streams.



Proposal 5.3.1.e The Mayor will work with civil society organisations to develop a series of campaigns that engage Londoners and enable them to enjoy, participate in, and contribute to London becoming the world's first National Park City

The Mayor will support campaigns by civil society organisations that provide information to Londoners on how they can contribute to improving London's green infrastructure.

It is vital that the public engage with, and participate in, the idea of London as a National Park City. Many of the activities needed to meet National Park City objectives require action by Londoners in and around the places in which they live and work. The Mayor will work with the National Park City Foundation and other stakeholders to support initiatives led by third sector organisations and London's businesses, such as:

- Groundwork London's Climate Proofing Housing Landscapes project (Box 23)
- the Royal Horticultural Society's Greening Grey Britain campaign¹⁰⁸
- the London Wildlife Trust's Living Landscapes¹⁰⁹
- the Wild West End project led by the West End's largest property owners¹¹⁰

The Mayor will work with partners to develop specific campaigns that are likely to resonate with a wide range of Londoners. This will include, for example, an annual National Park City Week, guidance and advice on how Londoners can reduce their own risk of exposure to poor air quality by appropriate planting in front gardens, or promoting a 'licence to green', which gives residents permission to garden public spaces as has been trialled in Paris.^{111,112}

¹⁰⁸ RHS (n.d.) Greening Grey Britain. Accessed from: <https://www.rhs.org.uk/get-involved/greening-grey-britain>

¹⁰⁹ London Wildlife Trust (n.d.) London's Living Landscapes. Accessed from: <http://www.wildlondon.org.uk/londons-living-landscapes>

¹¹⁰ Wild West End (n.d.) Accessed from: <http://www.wildwestend.london/>

¹¹¹ EcoWatch (2016) Paris Becomes One of the Most Garden-Friendly Cities in the World. Accessed from: www.ecowatch.com/paris-urbangardening-2039785049.html

¹¹² Mairie de Paris (n.d.) Le permis de végétaliser. Accessed from: www.paris.fr/permisdevegetaliser

BOX 23: CLIMATE PROOFING HOUSING LANDSCAPES¹¹³

Groundwork London in partnership with Hammersmith & Fulham Council has been working with local residents to design and implement green infrastructure climate change adaptation measures on three housing estates.¹¹⁴ This was done by:

- light engineering retrofitting solutions in green spaces, to help ease impacts such as flooding and heat. This includes sustainable drainage systems as shown in the photograph below
- working with residents to give them the chance to shape the open space improvements on their estates and promote awareness of climate change impacts and how residents can adapt
- creating training and job opportunities for apprentices and for grounds maintenance contractors to learn how to maintain these measures and to replicate them elsewhere



¹¹³ Photograph courtesy of Groundwork London.

¹¹⁴ Groundwork (n.d.), Climate Proofing Housing Landscapes. Accessed from: www.groundwork.org.uk/Sites/urbanclimateproofing



Chapter 6: Climate change mitigation and energy

AIM

London will be a zero carbon city by 2050, with energy efficient buildings, clean transport and clean energy.

INTRODUCTION

If the world continues emitting greenhouse gases (GHGs) at today's levels, average global temperatures could rise by up to five degrees Celsius by the end of this century.¹¹⁵ London, among other global cities, must play a leading role in helping to reduce these emissions.

The Mayor will re-establish London's position as a leader in tackling climate change by setting an ambition for London to become zero carbon by 2050. Making London zero carbon will require economy-wide decarbonisation. This will involve changes to the way in which Londoners travel, work and live, including how energy is sourced and generated. Energy efficiency will have to increase dramatically, leading to homes and workplaces being highly insulated. The fossil fuels used for heating and powering buildings, transport, and industry will have to be replaced by renewable sources. London's grids will need to become smarter at balancing energy demand with available supply, and low carbon travel will be the default option.

Making London zero carbon can ensure long-term economic growth and new business opportunities, alongside wider environmental and societal benefits, such as improved air quality and a healthier society. The Mayor's Energy for Londoners programme aims to make London's homes warm, healthy and affordable and its workplaces more energy efficient, to transform London's energy system by reducing energy demand and to improve the security of supply by ensuring more local energy is produced. This will help make energy bills fairer, thus protecting the most disadvantaged, and reducing carbon emissions.

This change will not be without its challenges. Many of the technologies and fuels needed to achieve this goal already exist. However, more energy infrastructure will be needed to support London's growing population and this must be low carbon. National government, London boroughs, communities, and Londoners themselves must play a part in leading this change.

To fully decarbonise London, GHG emissions will need to be reduced from around 34 megatons in 2015 to near zero by 2050.¹¹⁵ To make this happen, London will require careful but far reaching reforms, which are underpinned by three high-level objectives:

- decarbonise London's homes and workplaces, while protecting the most disadvantaged by tackling fuel poverty
- develop clean and smart, integrated energy systems using local and renewable energy resources
- deliver a zero emission transport network by 2050

LONDON'S ENVIRONMENT NOW

The key evidence to support the Mayor's ambitions for a zero carbon London by 2050 is summarised below. You can find out more about the evidence behind the policies and proposals in Appendix 2.

The UN Paris Climate Agreement commits to keeping global warming below 2°C. This agreement has shown that cities can work together to plot a path to a lower carbon future. In addition, the 2008 Climate Change Act requires at least an 80 per cent reduction in CO₂ emissions (compared to 1990 levels) for the whole of the UK. For more details on the legislative and policy background see Appendix 4, and for information on the main responsibilities of a range of organisations see Appendix 3.

¹¹⁵ IPCC AR5 range for BaU is 2.6 to 4.8 by 2100: <https://www.ipcc.ch/report/ar5/>

¹¹⁶ Please note that the final Strategy has been updated with 2015 greenhouse gas emission data. The latest data and previous annual estimates are available here: <https://data.london.gov.uk/dataset/leggi>

London has reduced its emissions since they peaked in 2000, despite a growth in population, and has shown that carbon reduction and economic growth can go hand in hand.

Global climate change

There is overwhelming scientific consensus that human activities are causing global climate change, mainly due to the burning of fossil fuels. There is now around 40 per cent more carbon in the atmosphere than there was before the industrial revolution¹¹⁷ (see Box 24 for why the focus is on carbon). Such high levels have not been experienced on Earth for at least 800,000 years and in all likelihood not for the last three million years.¹¹⁸ Annual average concentrations of GHGs have risen from around 280 parts per million (ppm) in 1900 to a record 400 ppm in 2016. The effects of these GHGs are being felt now. 2016 was the warmest year on record, almost one degree Celsius above the 20th century global average. The five warmest years on record have all occurred since 2010 (see Chapter 8).

BOX 24: WHY CARBON?

Carbon dioxide (CO₂) is by far the most common GHG emitted by human activity in terms of quantity released and total impact on global warming. As such, carbon and CO₂ have become the common shorthand terms used when accounting harmful GHGs. London's carbon accounting is measured where possible in carbon dioxide equivalent or "CO₂e" emissions. This includes the conversion of other GHGs, such as methane from landfill, and nitrous oxide and black carbon from transport emissions, into their equivalent CO₂ emissions based on their relative global warming potential. For consistency with national and international measurement of CO₂e emissions and targets, London's GHG emissions are measured against a 1990 baseline unless stated otherwise.

If London only accounted for the GHG emissions within its boundaries it would ignore all indirect emissions associated with electricity generation outside the city, reducing the capital's total reported emissions by around 40 per cent.

¹¹⁷ Atmospheric CO₂ content based on ice core records from a combination of studies. Eggleton, R. A. (2013) A Short Introduction to Climate Change.

¹¹⁸ Yale School of Forestry & Environment Studies (2017) How the World Passed a Carbon Threshold and Why It Matters. Accessed from: <http://e360.yale.edu/features/how-the-world-passed-a-carbon-threshold-400ppm-and-why-it-matters>

BOX 24: WHY CARBON (CONTINUED)

Clearly, this would unfairly penalise other areas of the country that generate the energy that London consumes. London's zero carbon targets therefore include both direct and indirect emissions, as defined in scope 1 and 2 of the Greenhouse Gas Protocol.¹¹⁹

Manufactured and purchased goods also have emissions associated with production and transportation, most often outside of the city. These 'scope 3' emissions are harder to trace quantitatively but are estimated to account for as much as three times the size of direct emissions for London (around 115 Mt CO₂e). The accounting of London's scope 3 emissions is embedded within the principles of a circular approach to London's waste (see Chapter 7). Although London-wide scope 3 emissions are not included in the pathway to zero carbon, these emissions will continue to be measured for the city. London is working with other cities to develop best practice and approaches to help avoid outsourcing our emissions.

London's current carbon emissions

In 2015, London's GHG emissions were estimated at around 34 MtCO₂e (million tonnes of carbon dioxide equivalent), around seven per cent of the UK's total emissions.¹²⁰ London's emissions are reducing, having fallen by 25 per cent since 1990 (Figure 33), largely due to reduced gas consumption and decarbonisation of the national electricity grid. To achieve the Mayor's zero carbon ambition by 2050 the rate of emissions reduction must be increased threefold over progress to date since 1990.

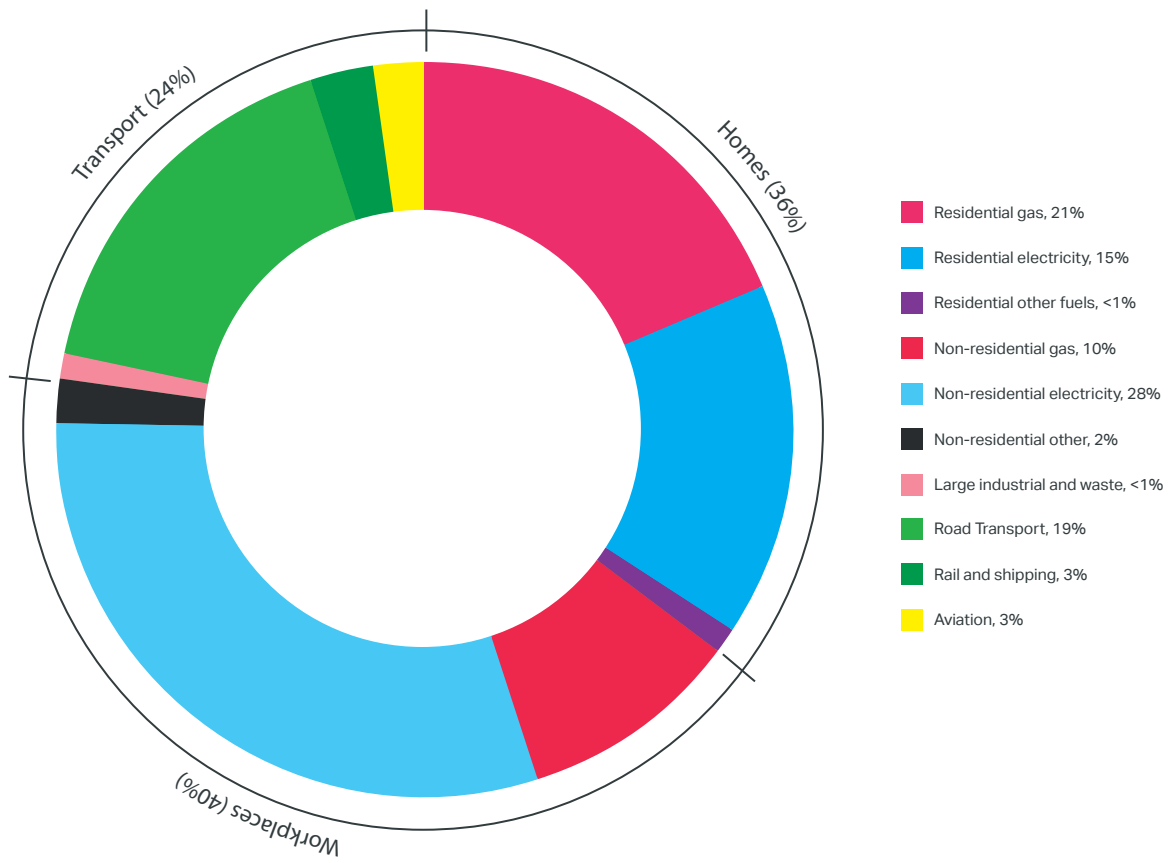
Sources of greenhouse gas emissions in London

London's GHG emissions are dominated by buildings and transport (Figure 32). In 2015 it is estimated that 36 per cent of emissions were generated from London's homes, 40 per cent from workplaces and 24 per cent from transport. Decarbonising London will mean taking a targeted approach to each sector. This will include retrofitting existing buildings as well as making sure that new developments are part of the solution towards achieving a zero carbon city.

¹¹⁹ The Greenhouse Gas Protocol is the world's most widely used international carbon accounting tool. Details of the protocol and its standards, guidance and tools are available at: <http://www.ghgprotocol.org/>

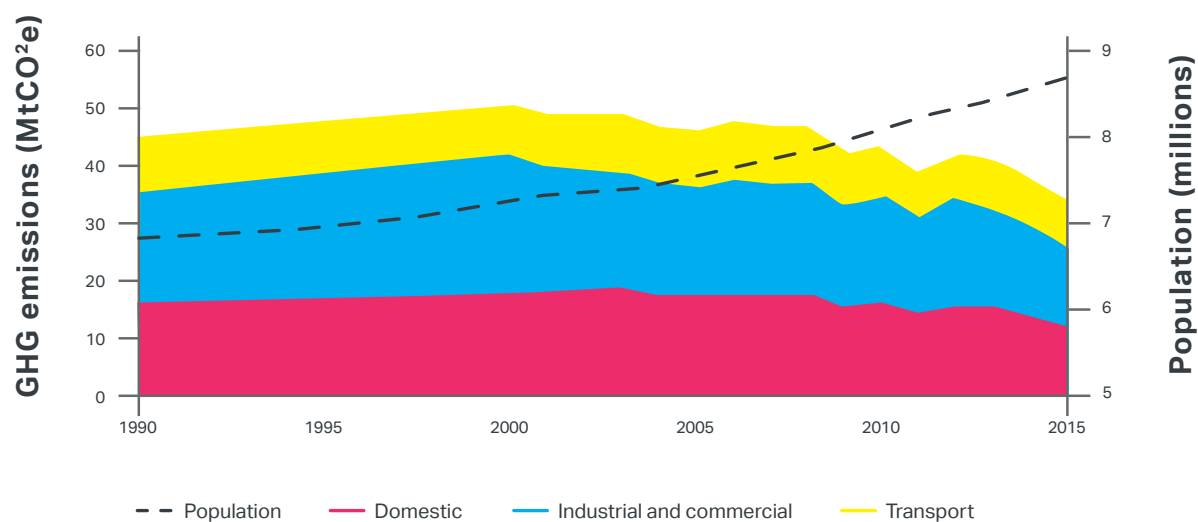
¹²⁰ Please note that the final Strategy has been updated with 2015 greenhouse gas emission data. The latest data and previous annual estimates are available here: <https://data.london.gov.uk/dataset/leggi>

Figure 32: 2015 emissions by sector¹²¹



¹²¹ Generated from GLA (2017) LEGGI. Accessed from: <https://data.london.gov.uk/dataset/leggi>

Figure 33: Greenhouse gas emissions by sector and population trends 1990 to 2015¹²²



As London's population continues to grow, existing UK and Mayoral policies alone will not be enough to meet the scale of decarbonisation required. A zero carbon scenario has been modelled for London, which sets the envelope for emissions reduction out to 2050 and is detailed in Appendix 2. The London Zero Carbon Pathways Tool is available at <https://maps.london.gov.uk/zerocarbon>

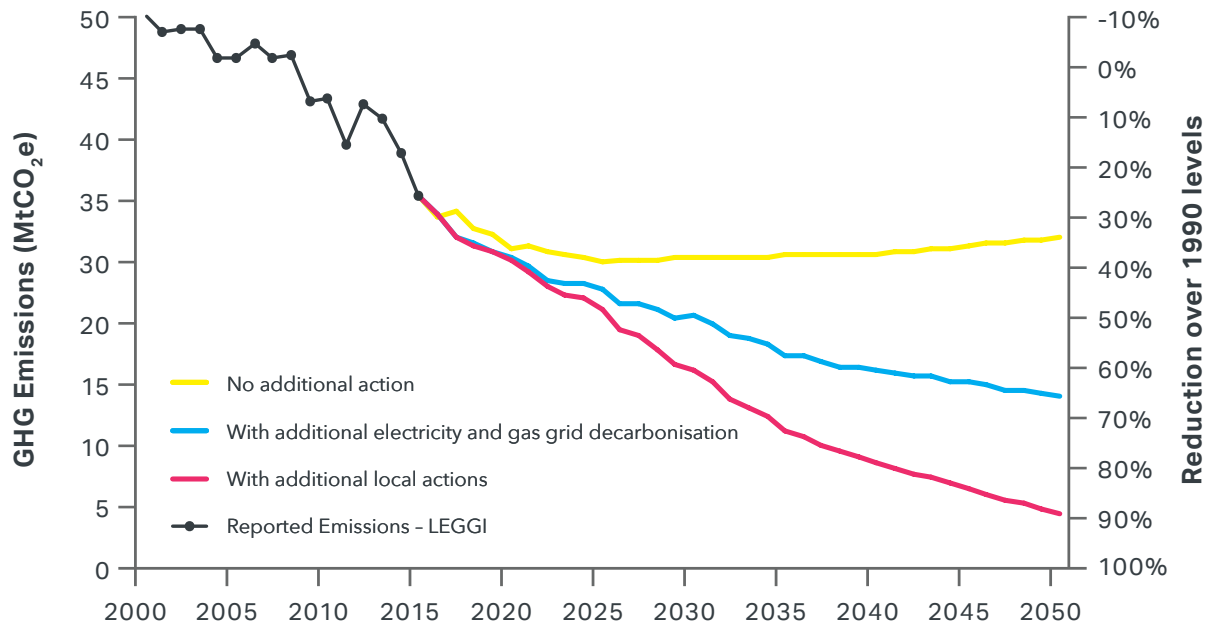
Under this scenario, existing policies driving emissions reduction at a UK and city level could only take London to a 35 per cent reduction on 1990 levels by 2050. To get to zero carbon, the modelling shows an extra 30 per cent can and must be achieved through the decarbonisation of energy grids and other actions at a UK level in line with policies and proposals identified as needed by the independent Committee on Climate Change to achieve UK carbon budgets.

¹²² GLA (2017) LEGGI. Accessed from: <https://data.london.gov.uk/dataset/leggi>. N.B. figures pre-2000 are extrapolated from 1990 and sourced from LEGGI and ONS data.

The remaining 35 per cent reduction could be met through increased action at a city level. Of this, up to 25 per cent could be achieved by developing and putting in place new policies and enhancing existing policies and programmes for London. However, this action is reliant on new powers and funding. Up to ten per cent of London's

residual emissions will need to be addressed through emissions offsetting or negative emissions technologies (such as carbon capture and storage). This will allow for emissions from energy grids, historic building stock, aviation and industry that cannot be reduced directly (Figure 34).

Figure 34: London's GHG emissions trajectory to zero carbon¹²³



¹²³ GLA (2017), Modelling including BEIS and Committee on Climate Change datasets



National energy supply

The vast majority of London's energy demand (approximately 94 per cent) is currently sourced from outside of the city. London can never be fully self-sufficient in energy, even if energy demand is reduced and more renewable energy is generated within the city boundaries, because of limited space. That's why London's zero carbon scenario is intrinsically linked to the decarbonisation of the UK's electricity and gas grids.

In London, electricity demand accounts for almost half of total CO₂ emissions. This fraction has been decreasing rapidly in recent years due to decarbonisation of the national electricity grid. Low carbon generation (from nuclear and renewable sources) comprised more than half of UK generation for the first time in 2017. Total UK renewable electricity generation has increased to record levels of around 29 per cent in 2017, up from 19 per cent in 2014, while coal generation has dramatically fallen from 30 per cent of generation in 2014 to 7 per cent in 2017.¹²⁴ There is a proposed national pathway to further decarbonise the electricity grid, with generation from renewable and nuclear energy sources projected to double by the early 2030s.

There is, however, no equivalent pathway towards the decarbonisation of the national gas grid, making gas, and by association heat, one of the major challenges in realising a zero carbon future. Gas use in London represents around half of total energy consumption, (contributing 30 per cent of London's total emissions). Most of this gas is used for heating in buildings.

Natural gas will continue to play a valuable role both in the short and medium-term for heating and for electricity generation, as London makes the transition to a low carbon economy. While natural gas is a fossil fuel, there may be some potential to decarbonise the gas grid, such as significant uptake of biogas or conversion of the gas grid to use hydrogen produced from renewable sources. However, a lack of clear government strategy on the future of gas has led to uncertainty on the wider approach to the long-term decarbonisation of heat. For this reason, London will develop a flexible and more decentralised energy supply system. This is one that can adapt to future changes, avoid lock-in to technologies that may become defunct in future decades, and minimise impact on the national grid by reducing heat demand through making our homes and buildings more energy efficient.

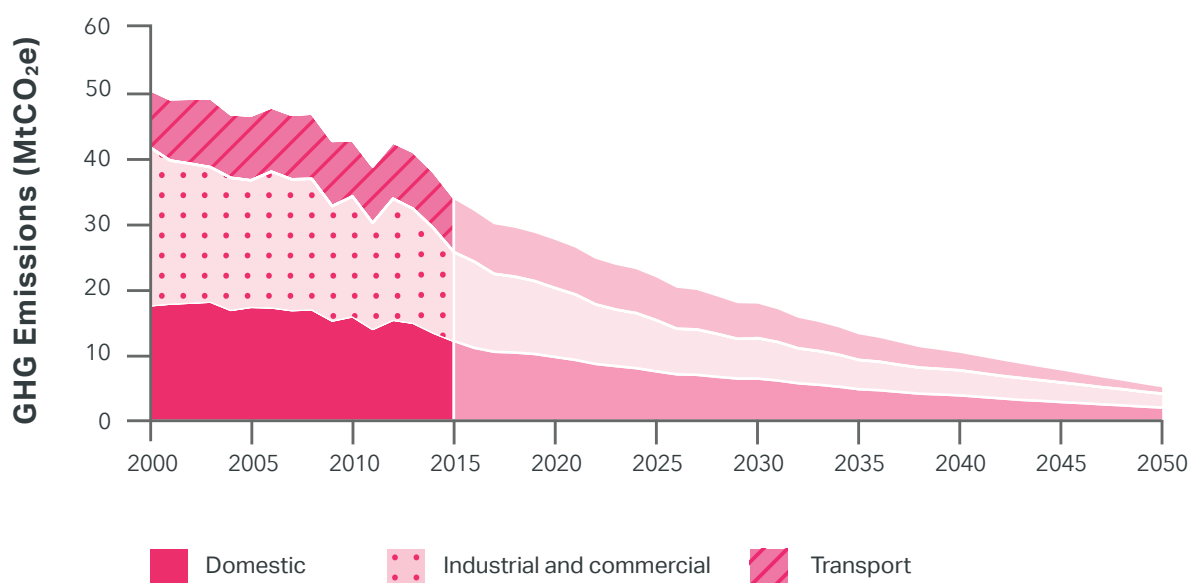
¹²⁴ Business, Energy and Industrial Strategy (BEIS) 2018. Energy Trends: electricity (provisional 2017 data). Accessed from: <https://www.gov.uk/government/statistics/electricity-section-5-energy-trends>

A key way to support decarbonisation of both electricity and gas grids in London is by increasing the proportion of renewable and local decentralised energy. Local energy generation and communal heating networks currently supply the equivalent of six per cent of London's energy, with approximately a quarter of this from renewable generation including solar and wind power.

London's potential carbon roadmap

Action across all sectors is required to keep London on track to 2050. Scenarios to 2050 for the ten main sectors that contribute to London's emissions have been developed (see Appendix 2) based on forecasts of likely future demand, technological change and changes in supply. Figure 35 summarises these trajectories for the three main sectors.

Figure 35: Zero carbon sector trajectories¹²⁵



¹²⁵ GLA (2017) modelling including TfL datasets.

The pathway to meet this ambition can be broadly split into short, medium and long-term objectives. Leaving actions to future generations or later decades would risk unprecedented, expensive, and potentially unachievable, rates of decarbonisation in the 2030s and 2040s.

In the next five years a large part of carbon reduction pathway for London and the UK can be met through decarbonisation of the national power grid, increased energy efficiency, and zero carbon new development.

Over the next two decades, dependence on natural gas must be reduced by increasing the use of low carbon heating (harnessing energy from water, ground and air using heat pumps), as well as capturing more of the heat wasted from our buildings and infrastructure, and using heat networks in the densest areas of the city to distribute it to our homes and workplaces. Energy efficiency of our existing buildings must be improved and low emission vehicles scaled up.

Demand on the electricity grid will likely increase due to the growing population and electrification of heat and transport. Smart technology (Box 25) will need to become an increasingly important part of managing London's energy system, helping to balance a more intermittent supply of energy from renewables with more variable electricity demand from

electric cars, or electric heating. Added strain on the electricity grid can partially be managed through the use of storage, such as hot water cylinders to store heat, or batteries to store electricity generated off-peak.

These balancing mechanisms, collectively known as demand-side response, will also allow consumers to use energy when it is cheaper, such as overnight. This will reduce the peak demand on the national grid, most associated with high carbon generation, and help avoid bottlenecks in grid capacity.

By 2030 at the latest the UK government must also confirm its approach for the long-term role of gas to allow for the full decarbonisation of London's heating systems by 2050. With a clear view on what the carbon intensity of heat and electricity should be in 2050, this would then allow a minimum 20 year period to move to new zero carbon heat supply. By 2040 the majority of public transport will be zero emission.

By 2050 the vast majority of London's building stock will need to have been retrofitted with measures to deliver high levels of energy efficiency. Remaining demand will need to be met by clean energy systems, dominated by the supply of renewable electricity and gas to London's buildings and vehicles.

A smart and integrated approach (see Box 25) will need to optimise these systems, removing the need for fossil fuels through storing renewable energy at times of high generation for use at times of high demand.

Figure 36 shows some key actions and milestones that will need to be achieved to keep London on track to zero carbon by 2050. Government, businesses and Londoners will need to help put these actions into practice.

BOX 25: A SMART ENERGY FUTURE

In the context of energy, a smart city is one that optimises its supply and use of energy. Energy consumption and emissions can be minimised, the use of renewables maximised, and the supply to consumers done so at the least cost. Advanced process control is able to predict demand and control energy systems to meet specific objectives such as to avoid energy peaks. Increased use of smart metering (see Proposal 6.1.1.d) will empower consumers to engage more with their energy use and enable the market to develop solutions to help them reduce their energy bills and use less primary energy.

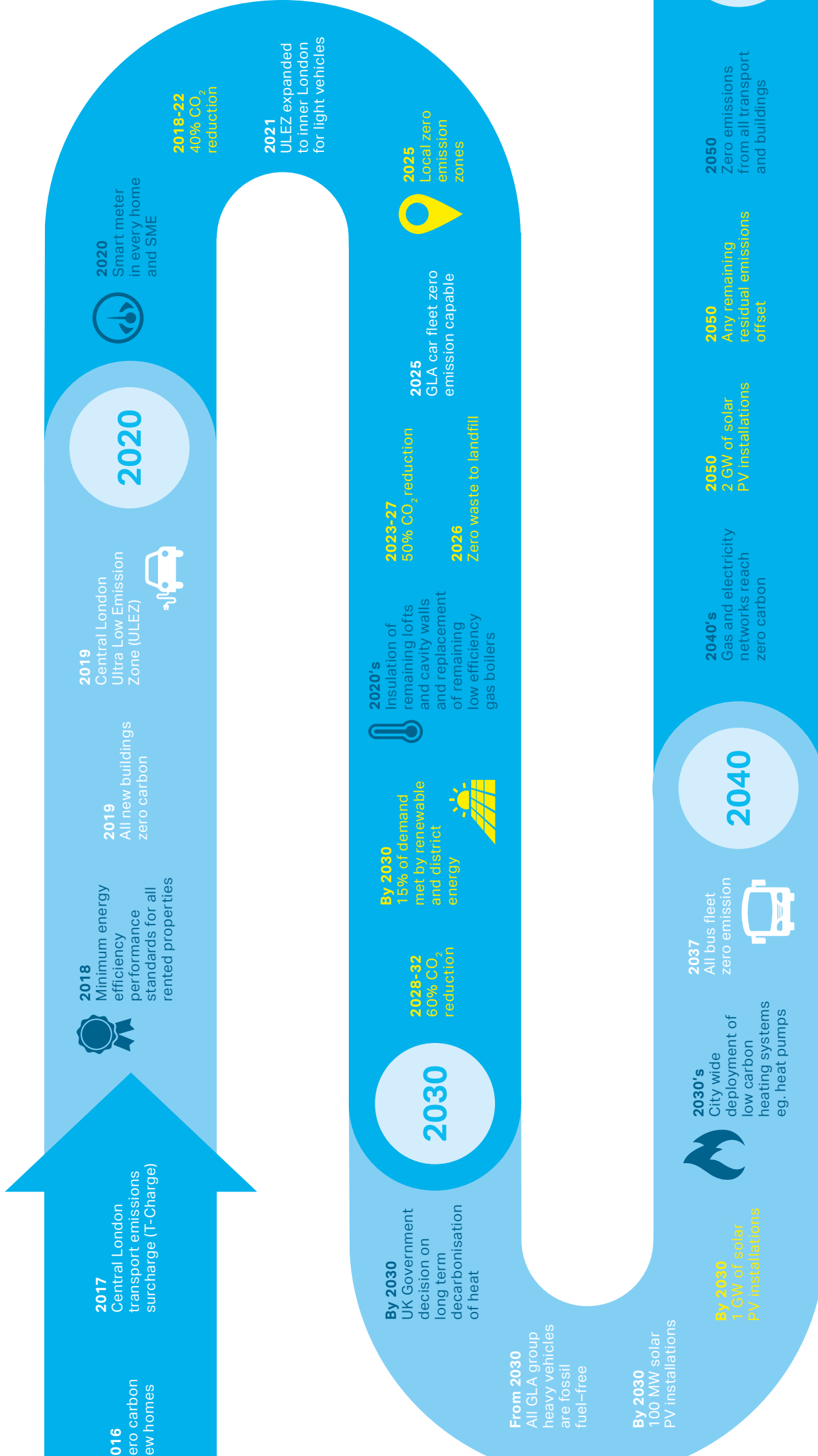
In a more connected city every supermarket freezer, every washing machine and every electric car could

intelligently programme their time of operation, optimising demand when renewable generation is available. This will become increasingly important as more intermittent energy, such as solar and wind, is deployed in the UK.

Where renewable generation cannot be used instantaneously, storage will play an important role, capturing this energy for times when it is needed, rather than using more carbon intensive fuels and technologies.

Over time a smart and flexible energy system could reduce London's peak demand by one gigawatt, a saving that could avoid investment in future energy networks by billions of pounds, and these savings could be passed on to the consumer.

It is needed to put London on track to zero carbon by 2050 (white lead, black text = UK government lead)



Managing the pathway to 2050

The pathway to London becoming zero carbon by 2050 is challenging. In particular, the trajectory for reaching the 2050 target is likely to become increasingly challenging after the early 2020s.

The previous London Climate Change Mitigation and Energy Strategy projected that London would need to have reduced its CO₂ emissions by 20 per cent by 2015, and 60 per cent by 2025, to be on track to reducing London's CO₂ emissions by 80 per cent by 2050. The 2015 target has been met, but the proposed step-change to 2025 implied twice the CO₂ savings since 1990 within a 10 year period. National policies and actions that needed to be in place now to set London on this ambitious trajectory, such as the Green Deal and a progressive feed-in-tariff for small scale renewable energy generation, have not materialised. Indeed, the support through these programmes has either reduced significantly or stopped entirely. This step-change in trajectory cannot be achieved without a significant increase in ambition in national policy, or devolution of powers to the Mayor to help catalyse action.

It is therefore critical that London is put back on a zero carbon pathway. The Mayor has set a trajectory that is

both ambitious and realistic, to achieve greater overall carbon reductions than London's previous targets. This trajectory takes a view across all sectors to focus on the most cost effective interventions that can be rolled out quickly without compromising future options. This is the best method of ensuring that emissions reductions occur continuously, with the avoidance of costly one-off reductions.

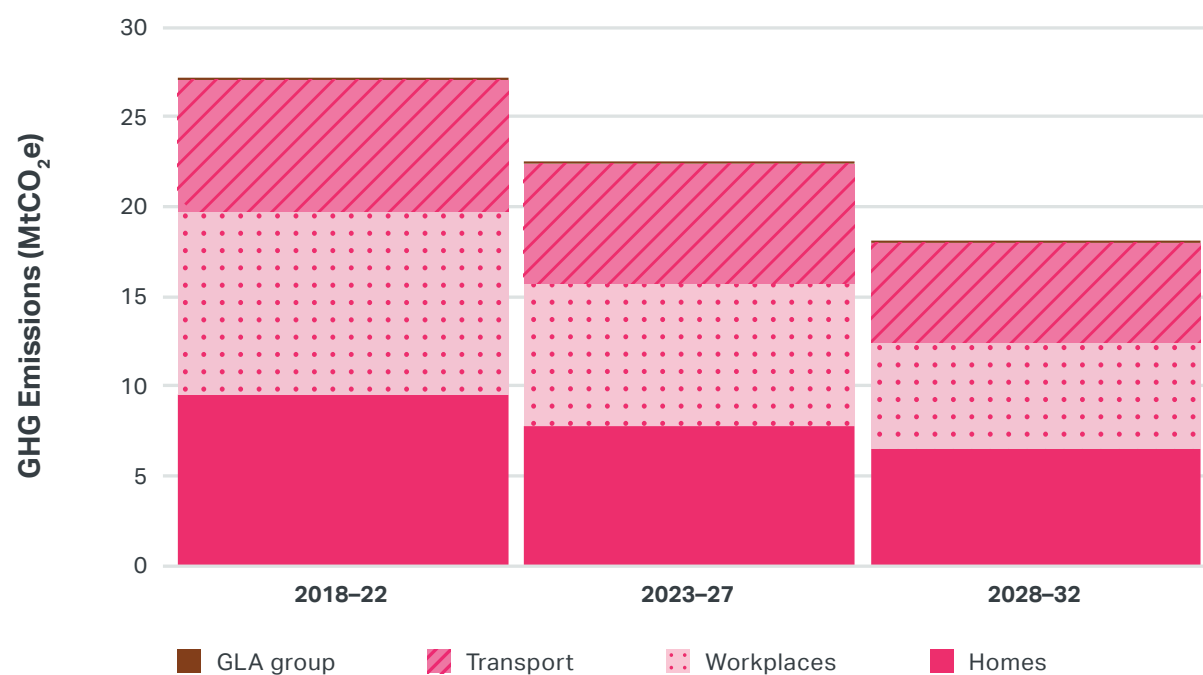
The Mayor has adopted a system of five-year carbon budgets to create an emissions pathway to 2050 (Figure 37). Progress against these budgets will be reviewed annually and future budgets will be set 10 years in advance. The concept of carbon budgets is not new; the UK government adopted statutory carbon budgets through the 2008 Climate Change Act. Carbon budgets for London align with the UK carbon budget periods, with the first covering 2018-22.

This approach provides greater clarity and certainty for London (and the UK) to effectively plan for, and invest in, a low carbon economy. It offers the flexibility in a budget period necessary to respond to factors outside our control (such as the weather, legislation, global fuel markets, and energy prices), and reduces the risk of 'lock in' to carbon intensive patterns of production and consumption.

London's carbon budgets have been developed following a detailed assessment of building retrofit, energy systems and transport sectors. Further

detail on London's carbon budgets is set out in Appendix 2 and on the London Datastore.

Figure 37: London's carbon budgets¹²⁶



Budget	Carbon budget level (MtCO ₂ e)				GLA Group	Reduction below 1990 levels
	Total	Homes	Workplaces	Transport		
2015	33.9	12.1	13.5	8.3	0.16	25%
2018-22	27.1	9.5	10.3	7.3	0.13	40%
2023-27	22.4	7.8	7.9	6.7	0.10	50%
2028-32	18.0	6.5	6.0	5.5	0.08	60%

¹²⁶ GLA (2018)

The London-wide carbon targets represent an ambitious pathway to put London on track to achieving zero emissions by 2050. Levels have been set so that within the first carbon budget period (2018-2022) London will aim to achieve a 40 per cent reduction in carbon dioxide emissions on 1990 levels (Figure 34), in the second budget period (2023-27) a 50 per cent reduction, and in the third budget period (2028-2032) a 60 per cent reduction. This is more than proposed for the national carbon budget.

The Mayor will use all available powers, alongside funded climate and energy programmes, and by leading by example in the GLA group, to put London on track to keeping London's carbon emissions within these budgets, as set out in this strategy. However, the Mayor's powers and funding are limited. In addition, these are London-wide targets and therefore require a step-change in action from London's businesses, boroughs and communities.

Importantly, it also requires far greater action from government, or the devolution of powers to London to take the necessary action. Current national policies are not sufficient to enable London to meet these carbon budgets. To achieve them will require government to meet UK electricity grid decarbonisation projections out to 2022 and urgently clarify the actions that will be required to meet the objectives of the Clean Growth Strategy¹²⁷, including how policy will enable large scale retrofit of buildings and the decarbonisation of heat.

Without further action to support decarbonisation at a national level, London is expected to reach up to 35 per cent reduction on 1990 levels during the first budget period. The remaining reduction must be met through new policies at the national level to deliver on the ambitions of the Clean Growth Strategy, such as increased support for minimum energy efficiency standards.

¹²⁷ BEIS (2017) Clean Growth Strategy. Accessed from: <https://www.gov.uk/government/publications/clean-growth-strategy>

Delaying this action is not an option: realising these retrofit savings within London's first carbon budget period could avoid an additional £2.5bn of retrofit investment in later budget periods to recover savings not realised in the next 5 years (see Appendix 2).

The Mayor expects the GLA group to lead by example and has set a GLA group carbon budget in line with a 60 per cent reduction target (on 1990 levels) by 2025 (see Chapter 11). For GLA functional bodies not in operation in 1990, an equivalent baseline for reporting is set out in Appendix 2.

Energy for Londoners

Existing climate change and energy programmes in London achieved a reduction of 670 ktCO₂e in 2015; a threefold increase on 2011 levels. While this is significant in terms of the savings at a building level, this represents only two per cent of London's energy demand.

The Mayor's new Energy for Londoners programme will help to decarbonise London's homes and workplaces, and develop clean energy systems (Box 26).

BOX 26: ENERGY FOR LONDONERS

To place London on track to becoming a zero carbon city, Energy for Londoners will:

- accelerate the retrofitting of buildings, while encouraging energy demand reduction and energy management practices, smart meter roll out and demand side management
- decarbonise London's energy supply by developing and delivering
 - decentralised energy, renewable generation, especially solar, community energy programmes
 - protect the most disadvantaged and tackle fuel poverty
 - deliver an energy supply company, aiming to offer fairer energy bills to Londoners as soon as possible
 - attract finance for energy efficiency and renewable energy

BOX 26: ENERGY FOR LONDONERS (CONTINUED)

Make London's homes warm, healthy and affordable, and London's workplaces more energy efficient



Energy efficiency for homes:

- Increasing energy efficiency and renewables in homes (RE:NEW)
- Whole house energy retrofit (Energy Leap)



Energy efficiency for workplaces:

- Reducing public sector carbon and energy (RE:FIT programme)
- Supporting businesses to be low carbon (Business and Climate Change Programme)
- Replacing inefficient boilers (Commercial boiler scrappage scheme)



Fuel poverty support and fairer tariffs:

- Increasing energy efficiency in fuel poor homes (Warmer Homes)
- Advice and referral service for fuel poor Londoners (Fuel poverty support fund)
- Fairer tariffs (Energy Supply Company)

Supply the capital with more local clean energy



Integrated local energy systems:

- Supporting local heat networks (Decentralised Energy Enabling Project)
- Buying local low carbon electricity (Licence Lite)



Solar generation and community energy:

- Supporting local community solar projects (London community energy fund)
- Bulk buying cheap solar panels (Solar Together London)



Smart energy:

- Supporting Londoners and businesses to use energy more flexibly (Flex London)
- Demonstrating smart technologies and energy storage (Sharing Cities)

London's new buildings

As London's population increases, new buildings will be built to meet the increasing demand for housing, associated facilities such as schools, and places of work. New developments have an important role to play in reducing GHG emissions and harmful pollutants.

Zero carbon buildings standards, pioneered in the London Plan, mean that a home or workplace built today requires a much smaller amount of energy than an older building. But between now and 2050, building codes must continue to tighten to guide new building construction to achieve far higher efficiency standards and greater renewable energy production. Where high building standards cannot be achieved onsite developers can offset emissions through other carbon reduction measures offsite, in agreement with the borough. Where this is not feasible, boroughs have set up offsetting funds for developers to make payments into, based on the borough's carbon offset price. This will ensure carbon savings can be maximised across London.

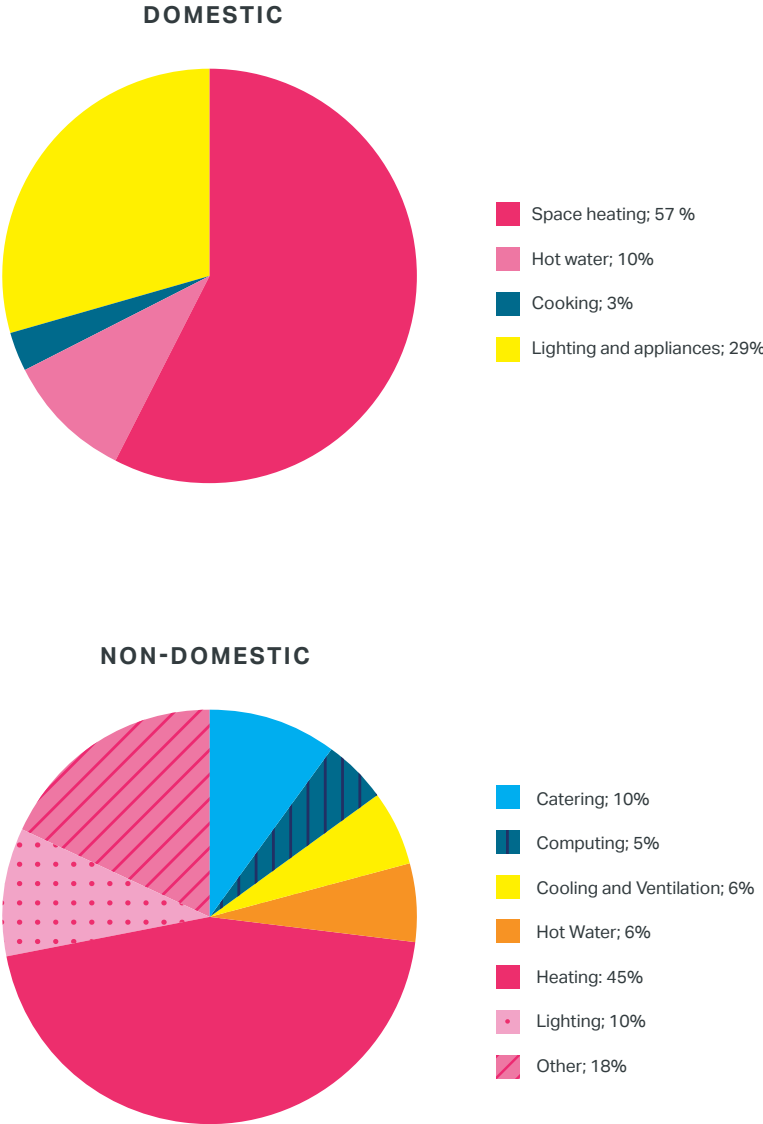
London's existing buildings

London's buildings have been built over hundreds of years, and their energy efficiency varies considerably. More energy is used to heat and power our buildings in London than for anything else (a breakdown of building energy use is shown in Figure 38). Buildings are responsible for around four fifths of London's total GHG emissions and 70 per cent of final energy use. In 2017 over £7bn¹²⁸ was spent on heating and powering our buildings across London.

By 2050 the emissions footprint of London's buildings will need to be close to zero. Some will even need to be climate positive, that is, they will need to generate more clean energy than they consume. By 2050 some 1.3 million new homes and over ten million square metres of new schools, hospitals and workplaces are needed. This will lock in emission patterns for 60-120 years (the average building and infrastructure lifespan). These buildings will have to reduce their energy. This will be through better insulation and using more energy efficient products. They must also get their heat and power (including increasingly for cooling) from local and renewable energy sources, enabled by efficient systems such as heat networks.

¹²⁸ Estimated using data from BEIS (2018) Updated energy and emissions projections: 2017. Accessed from: <https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2017>

Figure 38: Typical energy use breakdown¹²⁹



¹²⁹ BEIS (2016) Digest of UK energy statistics (DUKES). Accessed from: <https://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes> N.B. Numbers may not add to 100 per cent due to rounding



Credit: Lucy Barrett Lee



Credit: Tim Mitchell



Credit: Fraser Brown Mackenna Architects

Emissions and energy use in London's existing homes

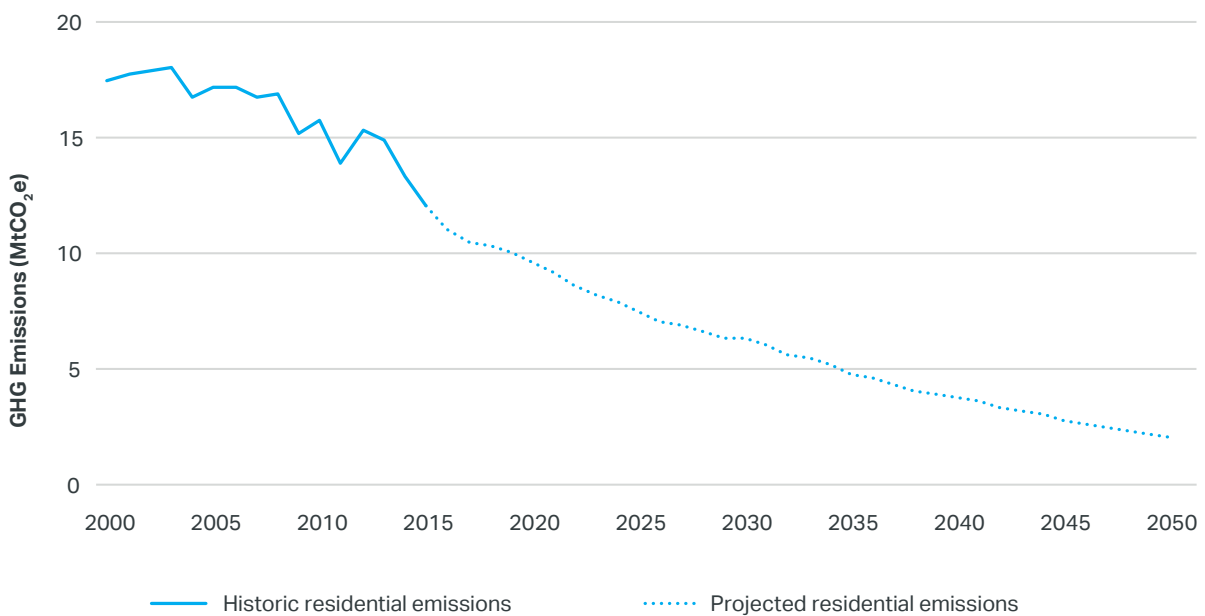
London's 3.5 million homes are responsible for around one third of London's total GHG emissions. Nearly three quarters of the energy used in homes is for heating and hot water. Ninety per cent of this is currently met using gas-fired boilers that contribute directly to climate change, and air pollution in the capital. The cost of energy can also be difficult for some households to afford. Our continued use of gas exposes us to energy security issues and price volatility, as UK reserves decline.

The poor energy efficiency of London's homes is a major contributor to our GHG emissions. A quarter of London's homes that have been given an Energy Performance Certificate since 2009 have the worst energy ratings of E, F or G.

As such, they are wasting a large proportion of their energy and contributing significantly to London's GHG emissions. This year, Londoners will spend over £3.9bn on heating and powering their homes. Over 10 per cent of London's households were in fuel poverty in 2015.

By 2050 the emissions from London's homes will need to reduce to around 1.0 MtCO₂e a year from 12.1 MtCO₂e today (Figure 39). This implies an average of around 100,000 homes being retrofitted with energy efficiency improvements and renewable technologies each year, to 2050. Since 2009, programmes such as RE:NEW, Better Boilers and the London Boiler Cashback Scheme have treated over 139,000 homes. Many of these homes require further improvements to maximise energy efficiency and carbon savings. A step-change in the scale and pace of our energy efficiency retrofitting needs to start now.

Figure 39: Emissions and required reductions required from London’s homes¹³⁰



The physical challenges of London’s homes can make delivering energy efficiency measures more difficult and expensive than in other parts of the country, as well as involving disruption and cost (Box 27). Moreover, the UK government has reduced funding for energy efficiency measures and cancelled the national zero carbon homes policy. As noted by the Committee on Climate

Change, progress to improve the energy efficiency of buildings has stalled since 2012: annual rates of cavity wall and loft insulation nationally in 2013-2015 were 60 per cent down and 90 per cent down, respectively, on annual rates in 2008-2012. According to recent research¹³¹, national policy is currently delivering a ‘limited ambition’ scenario¹³² by 2035, but much of this delivery is still uncertain.

¹³⁰ Based on GLA (2017) modelling.

¹³¹ E3G (2017) Unlocking Britain’s First Fuel: The potential for energy savings in UK housing. Accessed from: <https://www.e3g.org/library/unlocking-britains-first-fuel-the-potential-for-energy-savings-in-uk>

¹³² In the research this includes all energy efficiency measures that can be installed by 2035 whose energy cost savings, discounted over the lifetime of the measures, exceed the associated capital costs.

BOX 27: THE CHALLENGE OF RETROFITTING LONDON'S HOMES

London is different to the rest of the country, making it harder to retrofit homes with energy efficiency measures and low carbon supply. London's homes are far more likely to be:

- **solid walled** – 60 per cent of all London's homes (a fifth of England's total). This makes them more expensive and physically challenging to retrofit than homes with cavity walls. This is due to the higher costs of the external and internal solid wall insulation, and the disruption caused from the installation, for example the need to redecorate rooms and some loss of room area
- **flats** – 50 per cent of all London's homes (compared with 16 per cent in the rest of England). Flats are harder to retrofit than a single dwelling, with measures such as external wall insulation and energy efficient glazing often needing to be installed in all dwellings within a building at the same time. This requires agreement from tenants, leaseholders and freeholders. Flats also have more limited roof space and can cause overshadowing, which reduces the potential for solar PV
- **privately rented** – around 28 per cent of all London's homes (compared with 18 per cent in the rest of England). London has the highest proportion of private rented sector homes in the UK. Landlords often have little incentive to improve the energy efficiency of their properties as they do not receive any benefit from the savings on energy bills
- **in a conservation area** – half of England's total. Certain types of glazing, solid wall insulation and low carbon technologies may be deemed less suitable or incur further costs to install. Planning requirements can also act as a barrier for making some of these improvements and even outside conservation areas, permitted development rights, for example for external wall insulation, are not applied consistently

The impacts of climate change also present challenges to London's homes (existing and new). For example, temperatures in London are predicted to increase over the next few decades regardless of the action to reduce emissions (Chapter 8). Homes will need to reduce the requirement for energy-intensive air conditioning without inadvertently causing overheating that adversely affects their occupants.

Fuel poverty

In 2015 there were 335,201 households living in fuel poverty in London, which equates to 10.1 per cent of all households (Figure 40).¹³³ Fuel poverty in England is measured using the Low Income High Costs indicator. Under this indicator, a household is considered to be fuel poor if it:

- has an income below the poverty line (including if meeting its required energy bill would push it below the poverty line) and
- has higher than typical energy costs¹³⁴

There is increasing evidence that living in a cold home is associated with poor health outcomes and an increased risk of morbidity and mortality for all age groups. The physical impacts of living in a cold home are causing acute suffering for many Londoners. Children living in cold, damp and mouldy homes are almost three times more likely to suffer from respiratory illnesses. Evidence on both poor indoor and outdoor air quality highlights that infants living in cold conditions have a 30 per cent greater risk of admission to hospital or primary care facilities.

This can have a big impact on how children perform at school. Examples include increased school absence due to illness or children being unable to find a quiet and warm place to study. In addition, it is estimated that between 2011 and 2016 there have been 13,390 excess winter deaths in London.¹³⁵ Estimates suggest that some 10 per cent of excess winter deaths are directly attributable to fuel poverty¹³⁶ and 21.5 per cent of excess winter deaths are attributable to the coldest 25 per cent of homes.¹³⁷ A WHO report states that as many as 30 per cent of excess winter deaths can be attributed to cold housing.

¹³³ Further detail on how these thresholds are derived can be found here: www.gov.uk/government/collections/fuel-poverty-statistics

¹³⁴ Office of National Statistics (2016) Statistical bulletin: Excess winter mortality in England and Wales: 2015/16 (provisional) and 2014/15 (final).

¹³⁵ UCL Institute of Health Inequality (2014) Local action on health inequalities: Fuel poverty and cold home-related deaths. Accessed from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/357409/Review7_Fuel_poverty_health_inequalities.pdf

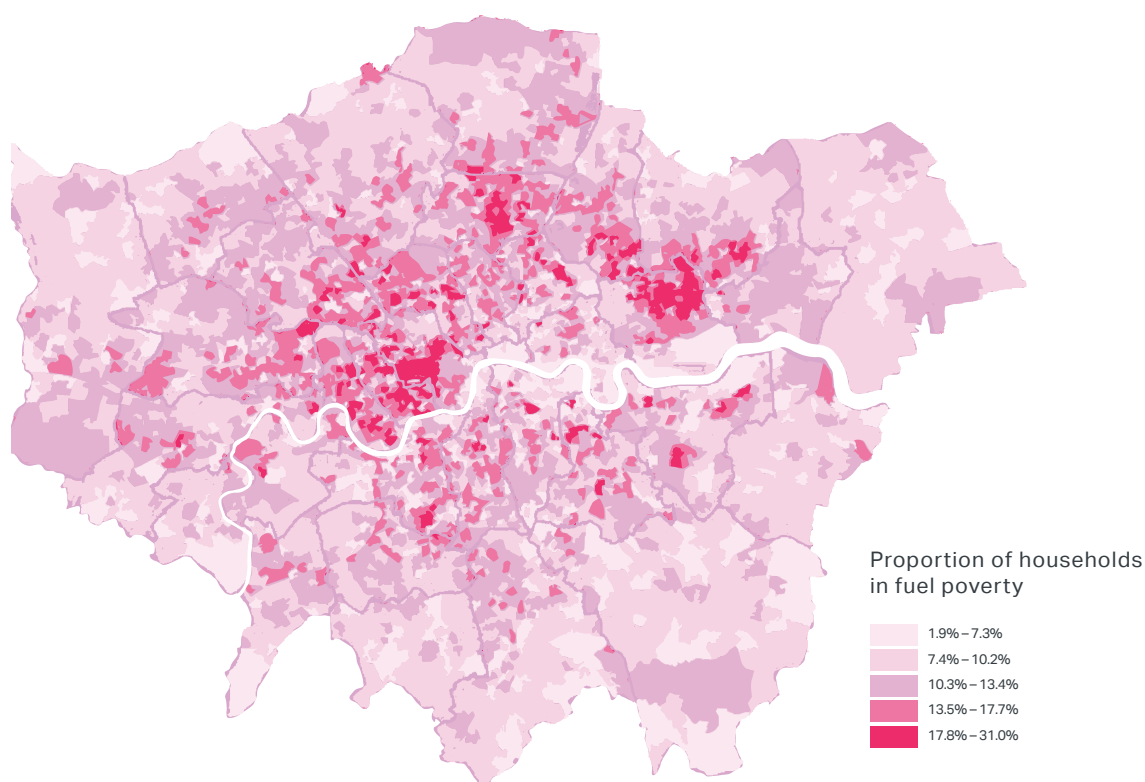
¹³⁶ Rudge (2011) Indoor cold and mortality. In Environmental Burden of Disease Associated with Inadequate Housing, (Bonn: World Health Organization (Regional office for Europe)), p. 81.

¹³⁷ BRE (2011) The Health Costs of Cold Dwellings.

In London it is estimated that:

- around 82,000 privately rented properties are associated with excess cold (a hazard resulting from threats to health from cold indoor temperatures), and the cost to the NHS of not improving them is £18.9m per year¹³⁸
- if homes do not reach the government's fuel poverty target of Energy Performance Certificate band C by 2030, the cost to the health service in treating associated illness arising from issues in London's homes could be more than £4bn.¹³⁹

Figure 40: Proportion of households in fuel poverty at LSOA level (2014)¹⁴⁰



¹³⁸ The statistics shown should be interpreted as a modelled estimation of fuel poverty in local areas and the actual situation (i.e. numbers of fuel poor households) may vary from these statistics in some locations.

¹³⁹ NEA (2016) National Energy Action (NEA) response to the Mayor of London's "A City for All Londoners" consultation.

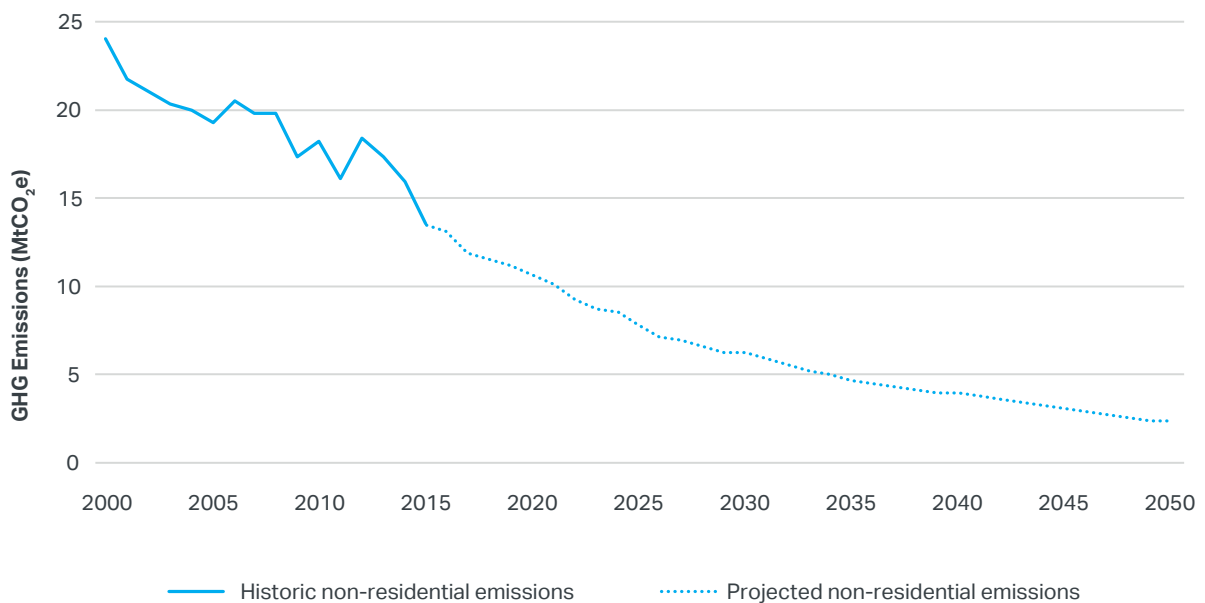
¹⁴⁰ BEIS (2016) Fuel poverty sub-regional statistics. Accessed from: <https://www.gov.uk/government/collections/fuel-poverty-sub-regional-statistics>. N.B. the statistics shown should be interpreted as a modelled estimation of fuel poverty in local areas. The actual situation (i.e. numbers of fuel poor households) may vary from these statistics in some locations.

Tackling fuel poverty will require a number of challenges to be addressed, from income levels to the type of home. Energy efficiency is a key component in reducing rates of fuel poverty. But energy efficiency is not the only solution. The predominant cause of the increase in fuel poverty in London is low incomes. There is a need to maximise incomes, alongside ensuring the fuel poor are able to access cheaper energy tariffs more easily. The Mayor’s Fuel Poverty Action Plan sets out the plan for tackling this problem in London, and a summary of the actions can be found in Proposal 6.1.2a.

London’s existing workplaces

The energy used for heating and powering our workplaces is responsible for around 40 per cent of London’s emissions. Three quarters of these emissions come from private businesses, with the remainder from public buildings (Figure 41). Electricity use for lighting and cooling is more significant than for residential buildings.

Figure 41: Emissions and required reductions required from London’s workplaces and industry¹⁴¹



¹⁴¹ Based on GLA (2017) modelling.

By 2050, emissions from workplaces will need to be reduced to keep the financial impact on businesses to a minimum, as well as help them capitalise on future opportunities that will come through the move to a low carbon economy. Currently, 37 per cent of non-residential buildings given an Energy Performance Certificate since 2009 have energy ratings of E, F or G. This means they are wasting energy and money. This year, over £3.1bn will be spent on heating and powering London's workplaces. Many barriers to reducing emissions in workplaces have limited the roll out of energy efficiency measures. Key challenges are:

- long-term payback periods so that such investments are not a priority
- complex relationships between freeholders, leaseholders and tenants, which has meant it is often difficult to get schemes off the ground
- technical barriers to retrofitting buildings, related both to the physical structure of buildings, particularly older buildings, and the performance gap (where buildings use more energy or emit more GHG emissions than modelled in the design phase). The performance gap is a function of the current lack of skills, measures and processes for installing, maintaining and using energy efficiency and renewable technologies
- a lack of low cost financing for energy efficiency measures. These barriers are particularly relevant for SMEs employing fewer than 250 people. These small companies comprise over 90 per cent of businesses in London
- lack of financial incentive or imperative to retrofit energy efficiency measures, since energy costs are a relatively small proportion of operational costs, especially when compared to, for example, staff payrolls.

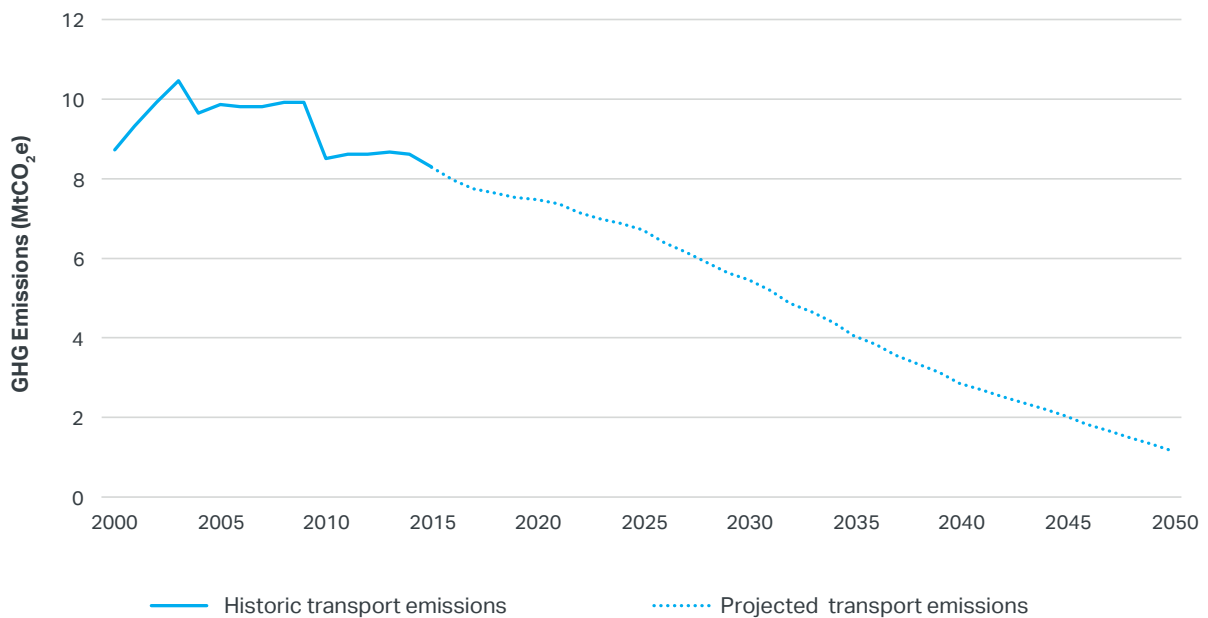
Transport

Transport accounts for nearly a quarter of London’s GHG emissions, the vast majority from road transport. GHG emissions from transport must reduce from around 8.3 MtCO₂e a year to 1.5 MtCO₂e a year by 2050 (Figure 42).

Policies to reduce GHG emissions from transport in London in this strategy are

consistent with those in the Mayor’s Transport Strategy. Measures set out in the Mayor’s Transport Strategy will reduce CO₂ emissions from road, rail and shipping in London by 72 per cent by 2041.¹⁴² This will set London’s transport emissions on a clear trajectory to reach the Mayor’s ambition of a zero carbon London by 2050.

Figure 42: Emission reductions required from transport¹⁴³



¹⁴² Mayor of London (2018) Mayor’s Transport Strategy. Accessed from: <https://www.london.gov.uk/what-we-do/transport/our-vision-transport/mayors-transport-strategy-2018>

¹⁴³ Based on GLA (2017) modelling.

Aviation is covered in Proposal 4.2.2.b. It is perhaps the most difficult transport sector to decarbonise. At present, it contributes just under three per cent of London's monitored GHG emissions under the London Energy and Greenhouse Gas Inventory (LEGGI). This is around 940,000 tCO₂e a year (for airport operations and take-off and landings).¹⁴⁴ If unmanaged, emissions from the proposed Heathrow expansion are likely to increase by around a third.

GHG emissions from waste

Direct GHG emissions from London's waste activities represent 0.6 per cent of London's total emissions. Accounting of waste emissions is discrete from other emissions accounting in this chapter, as full lifecycle emissions are considered (scope 1, 2 and 3). London has developed two methodologies, estimating both the total emissions from London's waste activities and the carbon intensity of energy generated from residual waste. Actions to address both direct and indirect emissions from the management of London's waste are set out in Chapter 7.

ROLES AND LEGAL DUTIES

The Mayor has a legal duty to set out policies and proposals in this strategy for mitigating climate change, as well as a duty to take action on adapting to climate change.

Although the Mayor has no direct powers to encourage building retrofit for greater energy efficiency, except for major refurbishments requiring planning consent, the London Plan sets the standard that new developments should achieve.

The Mayor has no formal regulatory powers or role in the energy market. A fully functioning smart energy system is likely to require an overhaul of commercial and regulatory relationships between distribution, supply, generation and transmission companies.

¹⁴⁴ GHG emissions from aviation are defined as emissions from aviation sources up to 1km above the ground.

into
city and heat

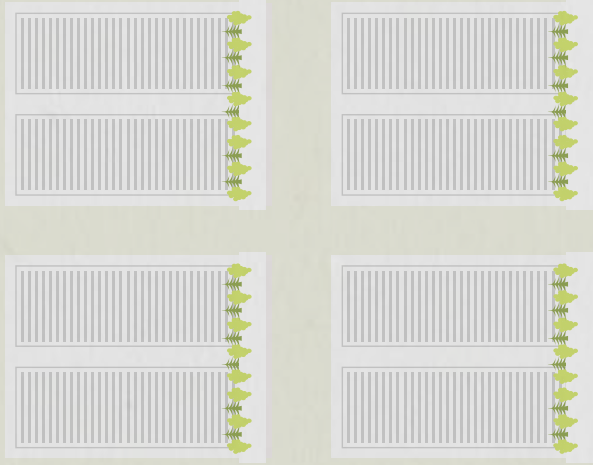


water and
city



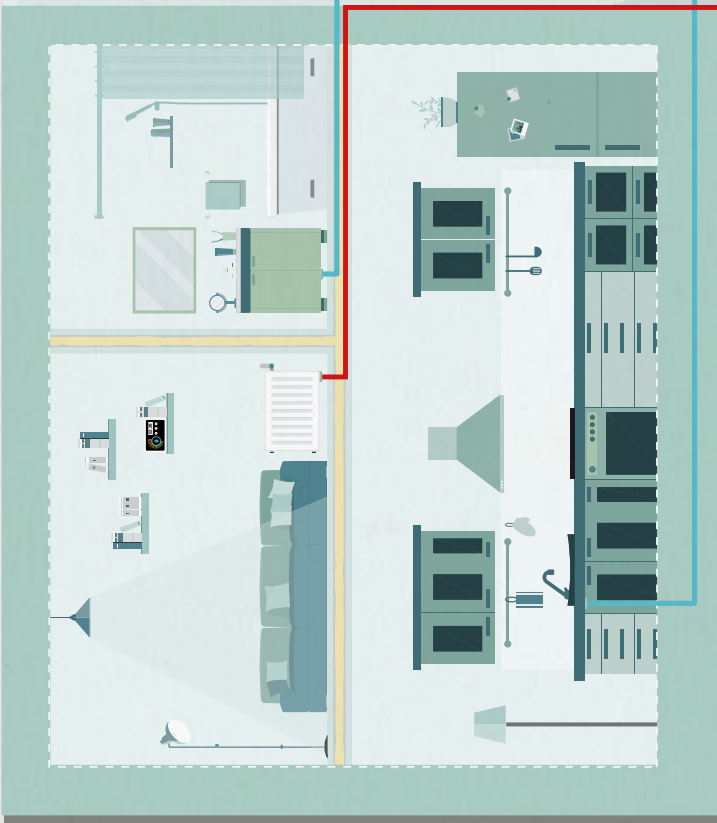
Insulating materials:

Window shading
reduce energy



Energy efficiency

Energy efficiency
electronic
goods allow
electricity to
be used for
heating and



Low-flow water

Reduce water

Home energy

A control panel
the homeowner
energy consumption

Heating and

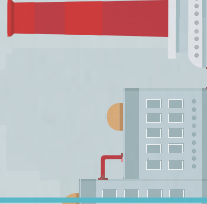
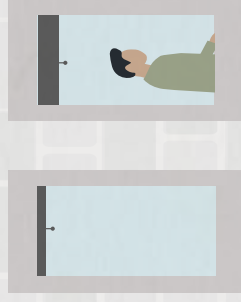
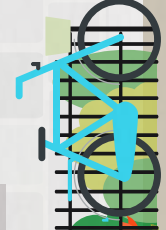
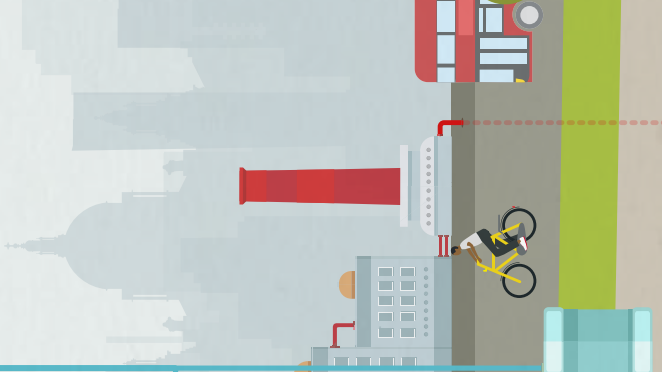
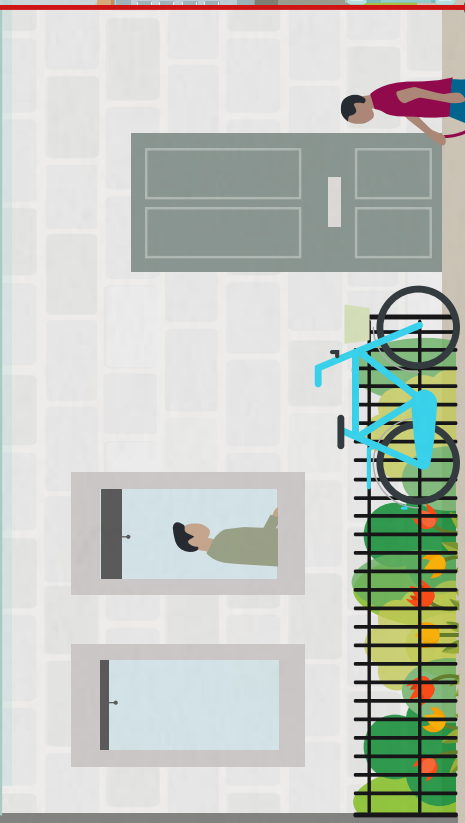
Highly efficient
energy supply
district heating
building heating

Water harvesting

Greywater
toilet flushing
collection for

Electricity:

Electricity
provides
energy for
the grid



“Energy efficiency is the first and best fuel, and is often the most cost effective way to decarbonise buildings including reducing the demand for heat.”

Objectives, policies and proposals

OBJECTIVE 6.1 REDUCE EMISSIONS OF LONDON'S HOMES AND WORKPLACES WHILE PROTECTING THE MOST DISADVANTAGED BY TACKLING FUEL POVERTY

Approximately 80 per cent of the buildings today will still be standing in 2050. By 2050 some 1.3 million new homes and over ten million square metres of new schools, hospitals and workplaces are needed, which will increase the amount of energy required. Energy efficiency is the first and best fuel, and is often the most cost effective way to decarbonise buildings including reducing the demand for heat. It also saves households and businesses money on their energy bills. That makes it one of the key ways to help ensure that the poorest and most disadvantaged households are able to heat their homes affordably.

Emissions will need to be reduced from new and existing buildings, whether the occupants are in fuel poverty or not, for our homes and workplaces. The London Plan includes greater planning standards for new developments so new buildings are highly efficient and incorporate renewable energy where appropriate.

For existing buildings the Mayor has identified a number of actions that are required to reduce emissions. These include:

- helping Londoners improve the energy efficiency of their homes and workplaces through technical advice, support, and funding or finance
- piloting new approaches to retrofitting, which make existing homes zero energy and significantly cut energy bills
- lobbying government for financial support and regulatory change to speed up the retrofitting of homes
- supporting the roll out of smart meters to provide Londoners with the information they need to make better low carbon choices
- delivering an energy supply company, aiming to offer fairer energy bills to Londoners as soon as possible
- scrapping the most polluting boilers from workplaces
- supporting the energy efficiency supply chain to innovate, improving product performance and services whilst driving down costs

The Mayor's Fuel Poverty Action Plan sets out measures to:

- boost the incomes of people in fuel poverty
- increase the energy efficiency of London's homes
- ensure Londoners in fuel poverty can access fairer and more affordable energy tariffs

Policy 6.1.1 Improve the energy efficiency of London's homes and support the transition to low carbon heating and power through Energy for Londoners

Proposal 6.1.1.a Contribute to helping Londoners improve the energy efficiency of their homes, where appropriate, by providing technical assistance, support and funding

Achieving the Mayor's ambition for London to become a zero carbon city by 2050 will require a transformative increase in the installation of energy efficiency improvements in London's homes. Many energy efficiency measures, such as loft and cavity wall insulation, are cost effective and

help people save money on their bills. There is some support available from the government to help roll out these measures. But the pace and scale of the change needed to retrofit London's homes and to overcome the barriers that London faces requires more action from all involved.

The Mayor will build on current initiatives (Box 28) to design and roll out a world-class homes energy efficiency programme as part of Energy for Londoners. This includes the introduction of a successor to the current RE:NEW programme. The aim is to continue to support boroughs and housing providers, but extend the service to private landlords across London, where possible, to retrofit more homes with enhanced energy efficiency measures. The Mayor will consider how technical assistance and advice could:

- mobilise the action required to achieve the easier measures, including replacing the 750,000 inefficient boilers and insulating the remaining lofts and cavity walls needed to get to zero carbon by 2050
- enable deep home energy efficiency projects, maximising the carbon savings delivered in each retrofit with a focus on increasing both the scale and quality of works
- facilitate the integration of energy efficiency measures into other home renovation works, whether on individual homes or as part of estate regeneration
- support the private rented sector to meet and exceed minimum energy efficiency standards
- help boroughs to maximise the use of funds collected through carbon offsetting from new zero carbon development, to increase the investment in existing homes
- aggregate demand and connect project funding, including through the Mayor's Energy Efficiency Fund
- develop projects with boroughs to achieve positive health outcomes
- help with the replacement of inefficient communal boilers, promoting cleaner heating technologies, and support connections to existing low temperature heat networks
- enable innovative area-based energy efficiency retrofit approaches, recognising the mix of tenure in London, so that owner occupiers, social landlords and private sector landlords can better benefit from funding opportunities, economies of scale and streamlined planning

BOX 28: CURRENT ENERGY FOR LONDONERS SCHEMES FOR HOMES

RE:NEW Programme – helps boroughs and social housing providers overcome challenges, and make their housing stock more energy efficient by giving them technical support. Since 2009 alone the RE:NEW¹⁴⁵ programme has helped improve over 135,000 of London's homes, saving around 50,000 tCO₂ a year and over £8.85m in annual energy bill savings. Coupled with wider market delivery, over 605,000 homes in London have been retrofitted. It has also supported an estimated 48,000 fuel poor homes. Lessons learnt from RE:NEW will help inform the successor programme.

Warmer Homes – fuel poverty support helping London homeowners on benefits to stay warm and save on their energy bills. Launched in January 2018, the scheme targets homeowners with disabilities or long-

term sickness, and older people claiming eligible benefits, with up to £4,000 available per household.¹⁴⁶

Fuel Poverty Support Fund – a £500,000 fund for boroughs to help those Londoners who are affected by fuel poverty. In the first phase of the fund, £250,000 has been allocated to the boroughs of Islington, Croydon, Kingston and Lewisham to take the first steps in establishing a pan-London fuel poverty advice and referral service including access to income maximisation and energy efficiency schemes. During 2018/19 these four boroughs will roll out their existing services to cover every London borough.¹⁴⁷

All of these programmes and initiatives will also consider water efficiency measures in order to provide an integrated offer (see Proposal 8.3.1.c).

¹⁴⁵ Mayor of London (n.d.) RE:NEW. Accessed from: <https://www.london.gov.uk/what-we-do/environment/energy/renew-0>

¹⁴⁶ Mayor of London (n.d.) Warmer Homes. Accessed from: <https://www.london.gov.uk/what-we-do/housing-and-land/improving-quality/warmer-homes>

¹⁴⁷ Mayor of London (n.d.) Apply for the Fuel Poverty Support Fund. Accessed from: <https://www.london.gov.uk/what-we-do/environment/energy/apply-fuel-poverty-support-fund>

“The Mayor’s Energy Leap project will deliver some of the first whole house zero energy retrofits in London and the UK.”

The Mayor wants to help Londoners reduce their energy demand and generate their own heat and electricity in low carbon ways, where appropriate. While energy efficiency measures typically save carbon and money, they can be expensive to install, and so some financial support is often necessary to support the up-front costs. To help finance energy efficiency improvements and cleaner and low carbon generation the Mayor will investigate new finance arrangements. This includes loan mechanisms, such as revolving loan funds, incentives or grants, which do not rely on government subsidy, to enable more Londoners to improve their homes.

Proposal 6.1.1.b Pilot innovative methods to implement the stronger energy efficiency retrofitting needed

In the medium to longer-term, the potential for cheaper and easier measures such as loft insulation and filling cavity walls will be exhausted. This means that continuing to meet London’s zero carbon aspirations will require more major changes to existing homes, such as solid wall insulation and new low carbon sources of heat supply and electricity. To achieve this, additional steps will be needed to overcome greater challenges such as higher costs and disruption for householders.

Through Energy for Londoners the Mayor will help build a strong and expanding market for deeper energy efficiency retrofitting so each home improvement can maximise the suitable measures available. By increasing demand for home improvements, energy efficiency measures and low carbon supply technologies (like heat pumps and solar PV) will become a cheaper option. That way they will be able to compete with fossil fuels.

To help achieve this, the Mayor's Energy Leap project will deliver some of the first whole house zero energy retrofits in London and the UK. It will trial payment mechanisms, including the ability to recoup some or all of the capital cost of the refurbishment work through savings on energy bills, maintenance, and energy performance guarantees. This project will also improve the look and feel of the home and bring greater awareness to home energy use.

The Energy Leap project will act as a first pilot to prove the concept. The installation of rooftop solar PV coupled with batteries is likely to be a key part of this pilot. Energy Leap will also conduct a project evaluation to ensure lessons can be learned to inform development of other projects, including supply chain

development. The evaluation will also assess the impacts of changes to the health and wellbeing of the occupants, as well how the occupants feel about their improved homes. In terms of financial benefits, the evaluation will try to establish the 'value uplift' that potentially arises from installing solar, through post-retrofit valuations. If successful, Energy Leap will lead to a bigger project looking to overcome other key challenges, including more complex building types and mixed-tenure housing.

In addition to Energy Leap, the Mayor will explore alternative approaches to deeper and whole-house retrofitting which could help make radical reductions in household carbon emissions and energy bills.

Proposal 6.1.1.c Make the case to government to introduce the long-term regulatory and financial framework to support and speed up the rate of energy efficiency measures

The Mayor's programmes alone cannot deliver the necessary energy efficiency measures in homes to meet the zero carbon ambition, it will also require supportive policy and funding from national government.

There have been several government policies to support home energy efficiency. However, many have been subject to continual change and intermittent and inadequate funding, creating uncertainty in the market and stalling implementation. To help provide the energy efficiency measures required in London, the Mayor will continue to advocate to government the need for the following national and regional action. This can be delivered by government, or by devolving more powers to the Mayor to deliver in London:

National actions

- make sufficient funding available to retrofit hard to treat properties with energy efficiency measures, particularly for those households in fuel poverty. This could be by, for example, accelerating implementation of the new ECO scheme with an enhanced ambition, and introducing a successor to the Green Deal to ensure that existing housing stock is quickly made more energy efficient
- extending, promoting and improving mandatory home energy efficiency standards, for example extending the minimum standards in the Private Rented Sector Energy Efficiency Regulations to apply to social housing and market sales

- developing fiscal incentives to increase uptake of solid wall insulation and low carbon heating and power, for example reductions in VAT (which could be done following UK's exit from the EU), voucher schemes, and low or zero interest rate loans
- issuing planning guidance on external wall insulation to increase boroughs' understanding and awareness of the technology, and help householders and social housing providers prepare good quality applications

Regional actions

- setting regional targets for energy supplier obligations, such as the ECO, and other government-mandated support schemes in order to ensure that London receives its fair share of support

Local actions

- raising awareness by private landlords of the need to comply with Private Rented Sector Energy Efficiency Regulations
- working with local authority Trading Standards teams to enforce Private Rented Sector Energy Efficiency Regulations, including provision of appropriate training

The Mayor will also offer to work with national government to:

- pilot revenue-neutral incentives that, subject to further scoping, might include incorporating Energy Performance Certificate rating in the way Stamp Duty Land Tax is calculated. This would act as a 'trigger' at the point of purchase and enable home owners to claim rebates when they improve the efficiency of their home
- implement the recommendations of Each Home Counts (the Bonfield Review) in London. This includes using evidence from London's retrofit projects to help develop and implement a quality mark and installer Code of Conduct for the residential retrofit sector

Proposal 6.1.1.d Improve the way energy is managed in London, including through supporting the roll out of smart meters and advocating time of day tariffs

Individual actions and choices within homes can have an important impact on energy use. To enable householders to make positive changes to their home

that will help cut energy bills and demand and contribute towards reducing carbon emissions, they need timely, impartial, and accurate information and advice.

Smart meters will have a critical role in building the foundations for a zero carbon energy system for London. The first step is the installation of smart meters alongside the use of flexible energy tariffs and more energy efficient appliances.

The roll out of smart meters has multiple benefits:

- they give near real time information on energy use – expressed in pounds and pence
- enabling people to better understand and manage energy use, helping them move to cheaper time of day tariffs to reduce energy bills
- bringing an end to estimated billing – consumers will only be billed for the energy actually used, helping people to budget better
- easier switching of suppliers to get the best deals

The government has committed to mandating the offer of smart meters to every London household and small business, and delivering meters to all homes by the end of 2020. But the roll out is behind schedule.

The Mayor will encourage all new developments to install smart meters. Through Energy for Londoners, greater awareness of energy management will be promoted, such as identifying the most energy efficient appliances, guidance on selecting the best energy tariffs, and supporting 'switch off' campaigns and competitions. The Mayor will work with energy suppliers and Smart Energy GB to support smart meter roll out campaigns and include their installation as a measure through energy efficiency programmes.

Policy 6.1.2 Tackle fuel poverty in London and protect the most disadvantaged through the Mayor's Fuel Poverty Action Plan

Proposal 6.1.2.a The Mayor will work with partners to help alleviate fuel poverty in London through implementing the recommendations of the Fuel Poverty Action Plan

Historically, central government and the boroughs have taken the lead in providing fuel poverty support programmes. However, central government has reduced its support for fuel poverty alleviation since 2012. Remaining support is in the form of the Warm Home Discount¹⁴⁸ and the ECO, which is now focused largely on energy efficiency measures for low income households.

Many boroughs, given the financial pressures they are under, have not been able to maintain support for many of their fuel poverty support programmes. 46 per cent of boroughs do not have any officer responsible for fuel poverty alleviation, and a further 46 per cent have fuel poverty as only part of an officer's role.¹⁴⁹ This leaves significant gaps in the provision of support for households struggling to keep their homes warm and pay for their energy bills.

To help reduce fuel poverty, carbon emissions and air pollution the Mayor undertook the Better Boilers pilot scheme.¹⁵⁰ This targeted homeowners receiving benefits (as a proxy for fuel poverty), and has helped replace and repair 483 inefficient or broken boilers, and installed new heating controls.

¹⁴⁸ The Energy Company Obligation (ECO) was previously focused on reducing carbon emissions from homes through the installation of energy efficiency measures. Part of ECO was ring-fenced for low income households to ensure that it was not regressive, given all households pay through their energy bills. However, successive governments have reduced to overall ambition, and therefore level of investment, of ECO, leaving a much smaller programme. Government decided that it would focus this smaller pot almost exclusively on low income households to alleviate fuel poverty. The current phase of ECO runs from April 2017 to October 2018 and is being treated as a transition from the changing focus from carbon emissions reduction to fuel poverty alleviation.

¹⁴⁹ Survey by London Association of Local Energy Officers (ALEO), 2016.

¹⁵⁰ Better Boilers has also removed harmful asbestos from many fuel poor homes, which had previously insulated old pipes and heating systems. The scheme also provided important learnings in relation to delivering fuel poverty support in London and the type of support disadvantaged people need, which is helping to inform the development of new initiatives under Energy for Londoners.

The evaluation of this pilot has informed the Mayor's Warmer Homes initiative (Box 28).

In addition to this scheme, the Mayor has published a Fuel Poverty Action Plan¹⁵¹, which sets the actions required to further alleviate fuel poverty in London. The Mayor's ambition is to reduce both the prevalence of fuel poverty in London and the 'depth' of fuel poverty that Londoners experience. Actions include:

- investing directly in energy efficiency programmes targeting carbon reduction and tackling fuel poverty
- providing funding to support and create local advice and referral networks as a way of helping to improve the living conditions of fuel poor households, signposting the fuel poor to more affordable energy tariffs and offering fairer energy through Energy for Londoners
- implementing a programme to help Londoners get access to all of the income support they are entitled to
- providing guidance and support to boroughs on how they can use data to identify households in fuel poverty

- establishing a high-profile cross-sectoral Fuel Poverty Partnership to coordinate action in London
- calling on government to develop fiscal incentives for solid wall insulation and review the Minimum Energy Efficiency Standard to remove exemptions and increase the number of properties treated

Proposal 6.1.2.b Deliver an energy supply company to offer fairer energy bills to Londoners, and encourage Londoners to switch and move away from expensive pre-payment tariffs

The UK energy market is currently dysfunctional and most customers pay too much for their electricity and gas. This national problem is particularly acute in London. The Competition and Markets Authority's (CMA) 2014-16 Energy Market Investigation identified that 70 per cent of domestic customers could save as much as £300 per year by switching supplier, but that 56 per cent of consumers have never switched energy supplier or did not realise that this was possible.

¹⁵¹ Mayor of London (2018) Fuel Poverty Action Plan. Accessed from: <https://www.london.gov.uk/energy>

A fifth of Londoners are on pre-payment meters, which tends to mean higher tariffs and less access to good deals. There is no incentive for the energy market to help customers move from the most expensive tariffs. London has the lowest levels of switching of all regions in the UK for gas, and is below the national average for electricity. Recent proposals for a cap under the government's Domestic Gas and Electricity Bill to limit tariffs until 2020 may help reduce costs for some. The risk is that, although the differential between the highest and lowest prices narrows, many people will still pay too much.

The Mayor will deliver an energy supply company, to offer fairer energy bills for Londoners. In light of changing market conditions and uncertainty in national policy, the Mayor aims to start a scheme using an existing supplier. This will allow Londoners to have fairer energy bills sooner. The option to move to a fully licensed supply company will be kept under review, taking into account changes in the market and clarification of national policy, as well as the progression of the Licence Lite project.

While it is being established the Mayor will encourage people to switch energy supplier to seek a better deal. Previous experience, such as that of the Big London Energy Switch, demonstrates that this kind of engagement can deliver significant energy savings, but there is a need to go further by engaging groups identified by the CMA as being less inclined to switch.

The Mayor will work with London boroughs, community energy groups and charities to help engage harder-to-reach groups of customers and those who could soon become fuel poor.

Policy 6.1.3 Improve the energy efficiency of London's workplaces and support the transition to low carbon heating and power

Proposal 6.1.3.a Provide direct technical support and assistance to help reduce CO₂ emissions and energy within the public sector, including leading by example in the GLA group estate

London's workplaces are diverse, hosting a plethora of organisations from the public, private and third sectors, including banks, retailers, manufacturers, government, charities, schools, and hospitals. Workplaces, which include commercial and some light industry, are responsible for around 40 per cent of London's GHG emissions from powering the technology, lighting, heating and cooling. To achieve the Mayor's zero carbon ambition by 2050, the emissions footprint of London's workplaces will need to account for only 1.6 MtCO₂e, reducing from around 13.5 MtCO₂e. This implies around 15,000 workplaces being retrofitted with energy efficiency improvements and renewable technologies each year to 2050.

As part of Energy for Londoners the Mayor will introduce ambitious programmes to make London's workplaces more energy efficient and low carbon.

"As part of Energy for Londoners the Mayor will introduce ambitious programmes to make London's workplaces more energy efficient and low carbon."

The Mayor will support the public sector to retrofit their buildings with carbon and energy reduction measures through an improved Energy for Londoners programme building on the current RE:FIT programme. Launched in spring 2016, this phase of the programme will run until August 2019. The programme will support London's public-sector building managers to reduce energy demand and carbon emissions, improve air quality, and deliver large guaranteed energy savings for the public sector. RE:FIT addresses the lack of technical expertise and (increasingly) capacity within many public-sector organisations by providing free-of-charge expert support to public sector bodies (including London boroughs, NHS bodies, schools, universities and colleges, central government departments and cultural and heritage organisations). The framework of 16 suppliers enables organisations to procure suppliers quickly, efficiently and economically to deliver energy saving measures, and guarantee energy savings.

The scope of RE:FIT has been extended to offer support to more organisations, bringing a greater focus on solar energy, and expanding its scope to include the retrofit of non-building assets, such as LED street lighting and electric vehicle charging infrastructure, and the promotion of district heating (see Box 29 for a case study). By 2020 the programme aims to have reduced emissions by nearly 25,000 tCO₂e per annum, saved at least 68 GWh of energy and retrofitted over 400 buildings from a range of public sector bodies.

We will lead by example on the GLA group's own estate and activities. The GLA group has reduced emissions from its fleet and operations from 189 ktCO₂e in 2012/13 to 154 ktCO₂e in 2016/17 and is committed to a 60 per cent reduction on 1990 levels by 2025. More can be done to reduce energy use and CO₂ emissions, and to utilise renewable electricity and low carbon heat sources. The Mayor's zero carbon ambition will be taken into account across City Hall and the rest of the GLA group, including when making major investment decisions and providing funding for building regeneration or retrofit projects.

BOX 29: CASE STUDY: LYRIC HAMMERSMITH

The Lyric has demonstrated that it is committed to reducing its impact on the environment, and this is enshrined in their mission and business plan. They actively promote this throughout the theatre to visitors, in all their marketing materials and online. They encourage their audiences, staff, acting companies, creative teams and young people to consider their effects on the environment. They have a long standing staff Green Team with representatives from every department who run an electricity switch off campaign and issue Lyric-branded water bottles to all new staff, creative teams and young people. They recycle 100 per cent of their waste, run paperless finance and administrative systems, 100 per cent of their public lighting is LED, and their energy comes from renewable sources. Recently they launched the public '#LyricLent' campaign encouraging people to give up

something over 7 weeks to help the environment, such as car journeys or plastic packaging, which resulted in over 100 individual and collective actions.

In April 2015, the Lyric opened its new Reuben Foundation Wing which added a variety of new studio and workshop spaces, making the Lyric the largest creative hub in west London. Despite this substantial expansion, the Lyric achieved a 73 per cent reduction in relative energy use, thanks to the sustainable design which made natural light a key feature, used air source heat pumps and introduced a new green sedum roof which contributes to local biodiversity. The Lyric's building has since been awarded a BREEAM rating of Excellent, putting the Lyric in the top 10 per cent of sustainable UK buildings. Recycled and reclaimed materials were used where possible for fixtures and fittings, with office desks made from scaffolding boards.



Credit: Jim Stephenson, Lyric Theatre

Proposal 6.1.3.b Support the reduction of emissions and energy use within the commercial sector, including through improved building management, energy efficiency and reporting

Commercial buildings are estimated to be responsible for around 30 per cent of London's carbon emissions. There has been some limited government action to reduce emissions from this sector in the past. This is a missed opportunity, with significant energy bill savings to be made by businesses across the capital, which would contribute to their competitiveness.

In light of this, the Mayor will deliver a three-year (2018-20) commercial boiler scrappage scheme to incentivise the installation of more efficient gas and renewable heating systems, such as heat pumps. Installing an efficient boiler or renewable heating technology can be a cost effective way to cut CO₂ emissions and energy bills, while making London's air cleaner. The scheme will provide financial support to businesses to replace working low efficiency commercial boilers with new efficient gas boilers or renewable heating generation.

The Mayor will also investigate what further technical support can be provided to businesses, in particular SMEs, including how to create new business opportunities that will cut down the amount of energy and other resources used, potentially saving businesses millions of pounds (see Box 30 for an example of how this can be done in practice). This could include:

- developing a comprehensive evidence base of emissions from the commercial sector in London to help better target policies and programmes
- establishing and fostering a network of leading businesses based in London that will champion climate change action in London to contribute to the Mayor's targets
- working with boroughs and Business Improvement Districts to develop and deliver programmes to support SMEs

- producing guidance and toolkits to promote best practice, including the benefits of energy efficiency
- supporting the commercial sector to reduce emissions and energy use by investigating which interventions would have the highest impact, including consideration of support programmes such as RE:FIT
- encouraging businesses to measure and disclose emissions from their supply chains, in line with existing schemes, such as the Carbon Disclosure Project and standards established in government guidance on Measuring and Reporting Greenhouse Gas Emissions

BOX 30: LONDON THEATRE CONSORTIUM

The London Theatre Consortium is a network of 14 leading producing theatres in London set up in 2010. They recently announced the latest results of its collaborative environmental sustainability programme. These are:

- six years of collaborative success for London's major producing theatres
- an estimated £383,000 of savings on energy bills
- 20 per cent reduction in carbon emissions
- 1,862 tonnes of CO₂ avoided
- 71 per cent of London Theatre Consortium venues achieving a 4 star Creative Green certification

The consortium has worked closely with Julie's Bicycle¹⁵², which supports the creative community to act on climate change and environmental sustainability.

¹⁵² Julie's Bicycle (n.d.) Homepage. Accessed from: www.juliesbicycle.com

Policy 6.1.4 Ensure that new developments are zero carbon

Proposal 6.1.4.a The London Plan includes policies to support the delivery of zero carbon development

London already has ambitious zero carbon targets for constructing new housing development in the capital (Box 31). All such developments in London are currently expected to achieve at least a 35 per cent onsite reduction in GHG emissions above and beyond national government's standards (the 2013 Building Regulations). Where the target cannot be met onsite, developers are able to offset emissions through other carbon reduction measures offsite in agreement with the borough, or make payments to offset the shortfall into a borough's offsetting fund.

BOX 31: IMPLEMENTING LONDON PLAN POLICIES

Planning applications considered by the Mayor in 2016 are expected to achieve reductions in regulated CO₂ emission of 35 per cent above Part L requirements of 2013 Building Regulations. This is estimated to save over 48,000 tonnes CO₂ per annum against the Part L baseline and deliver over £150m investment in heat network infrastructure, £12m in solar PV panels and additional investment in other energy technologies to assist the transition to zero carbon, most notably heat pumps.

The approach that developers are expected to follow – the energy hierarchy – is set out in the London Plan. This expects development proposals to minimise carbon dioxide emissions from the construction and future operation of the building, as well as its annual and peak energy demand.

To achieve the Mayor's zero carbon development target, the energy hierarchy requires developers to:

- be lean: use less energy and manage demand during construction and operation
- be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly
- be green: generate, store and use renewable energy onsite

Developers are expected to manage energy demand from construction as well as the operation of the development. Development proposals should minimise the embodied carbon from construction, as this will become a greater part of a development's total carbon footprint. Developers are also expected to prioritise local energy sources, where available, and ensure that air quality is a key consideration in determining energy supply to the development. Finally,

developers should investigate generating and storing renewable energy onsite, as well as using it onsite, to contribute to London's security of energy supply.

Developers are expected to commit to delivering against the energy hierarchy in their energy strategies, and the Mayor will report annually on the estimated emissions saved from strategic developments.

In 2016, new developments reported an average carbon reduction of seven per cent beyond Part L of the Building Regulations from energy efficiency measures (the 'be lean' element of the energy hierarchy). Reducing energy demand not only saves energy and carbon emissions, but also reduces energy bills. As a result, the Mayor intends to investigate measures to encourage further carbon savings from the 'be lean' element of the hierarchy, and has included energy efficiency targets in the London Plan.

Alongside this policy for homes, the Mayor is intending to introduce a zero carbon standard for non-residential buildings in the London Plan from 2019 to ensure that all new major development in London contributes to the Mayor's zero carbon city ambition. Unabated climate change presents a major environmental and health hazard,

and decarbonising our energy supply is important. At the same time, London is currently failing to meet legally binding air quality standards, and public health is suffering as a result. Tackling this is the priority, so the energy hierarchy has been structured to contribute towards improving air quality.

Low carbon energy supply

Meeting the Mayor's zero carbon ambition by 2050 requires changes to the way we supply and use energy in new developments to ensure it is resource efficient and sourced from clean, low carbon and renewable sources. London will need to reduce its reliance on high carbon natural gas as a main energy source (for heat in particular) and increase use of local energy resources, including renewable and secondary heat sources, while ensuring air quality is not adversely affected.

To date combustion-based Combined Heat and Power (CHP) systems, predominantly gas-engine CHP, have been used in new development in London as a cost effective way of producing low carbon heat. However, the carbon

"The Mayor is intending to introduce a zero carbon standard for non-residential buildings in the London Plan from 2019."

“Heat networks are still considered to be an effective and low carbon means of supplying heat in London, and offer opportunities to transition to zero carbon heat sources faster than individual building approaches.”

savings from gas-engine CHP are now declining as a result of national grid electricity decarbonising, and there is increasing evidence of adverse air quality impacts.

As a result, we must now consider alternative approaches. The London Plan introduces a heating hierarchy that will promote cleaner heating solutions such as those based on secondary heat. The Mayor will encourage a similar approach when existing and new plant is being replaced or installed outside the planning system.

Heat networks are still considered to be an effective and low carbon means of supplying heat in London, and offer opportunities to transition to zero carbon heat sources faster than individual building approaches. Where there remains a strategic case for combustion based CHP systems on very large heat networks, these will continue to be considered on a case by case basis by the Mayor, maximising CO₂ savings while preventing air quality dis-benefits. Details of this approach will be set out in an update of the Mayor’s Energy Planning Guidance.

Offset funds

While the Mayor intends to maximise onsite emissions reductions from new development, offsetting funds have a role to play where onsite measures are not technically feasible or cost effective. These funds could raise considerable funding to enable energy efficiency measures to be installed in local buildings, and be prioritised to tackle local issues including fuel poverty.

As part of the Mayor's current zero carbon homes policy, developers are able to meet their obligations by supporting offsite carbon abatement measures. This can either be by paying into carbon offset funds collected by the Local Planning Authority (LPA), or delivered offsite via a carbon saving project agreed between the LPA and the developer.

The majority of London's LPAs have now set up offset funds and the Mayor is working with boroughs to monitor progress. If all LPAs were to establish offset funds and if the proceeds were used more strategically (for example, part or all of the offset funds were to be pooled), then this could be used to help improve the energy efficiency of the existing building stock and help tackle fuel poverty.

The Mayor's energy efficiency programmes could provide technical support to boroughs to help ensure that offsetting funds are being used effectively to reduce carbon whilst encouraging a holistic approach to retrofitting buildings.

The Mayor will publish guidance to LPAs on the allocation and use of offsetting payments to deliver carbon offsetting projects and the option of pooling funds. In the London Plan the Mayor has committed to reviewing the carbon offset price regularly.¹⁵³

¹⁵³ Most boroughs currently use £60 per tonne, in the London Plan the Mayor tested a higher nationally recognised carbon offset price of £95 per tonne.

Proposal 6.1.4.b Support the design of effective methods to ensure the energy and carbon performance of new developments meet their agreed designed standards

There have recently been observed gaps in the designed energy performance and the operational performance of new developments, mainly due to materials and components not meeting specification, and lack of knowledge and skills of those making decisions within the construction process.¹⁵⁴

The energy strategies that developers commit to must be delivered in practice, and any potential performance gap between design and construction must be minimised. This requires accurate methods for measuring performance once developments are operational, as well as good enforcement. However, boroughs have limited resources to enforce planning conditions and developers' interest or involvement is likely to have ceased.

To address these challenges, the Mayor will review the potential for applying other more effective methods of

estimating building energy and carbon performance. The Mayor will also work with boroughs and developers to design more effective arrangements for monitoring the operational energy performance of new buildings, and provide guidance through supplementary documents to the London Plan.

Proposal 6.1.4.c Encourage the reduction of whole lifecycle building emissions (embodied carbon)

As onsite emissions continue to reduce, embodied carbon (those emissions associated with the production of building materials) will form a greater part of a development's total carbon footprint. In order to reduce these emissions, accurate measurement methodologies are needed. A survey conducted to inform the assessment of city-wide carbon footprints found no consistency in the data sources, tools or methodologies used to calculate embodied emissions.¹⁵⁵ Ninety per cent of construction industry professionals responded to a survey stating that they would benefit from better guidance and support.

¹⁵⁴ Zero Carbon Hub (2013) Closing the Gap Between Design and As-Built Performance. Accessed from: http://www.zerocarbonhub.org/sites/default/files/resources/reports/Closing_the_Gap_Between_Design_and_As-Built_Performance_Interim_Report.pdf

¹⁵⁵ Mayor of London (2014) Application of PAS 2070: London case study. Accessed from: <https://data.london.gov.uk/dataset/application-pas2070-london-case-study>

The Mayor encourages new developments to estimate lifecycle GHG emissions and minimise embodied carbon in construction. Through the London Plan and its associated guidance, the Mayor will encourage the application of nationally recognised methods to estimate lifecycle GHG emissions. For example, the Royal Institute of Chartered Surveyors has developed a professional standard for whole lifecycle assessment of the built environment, published in November 2017.¹⁵⁶ In addition, the Mayor will work with the GLA group and key stakeholders such as the London Waste and Recycling Board (LWARB) to encourage embodied carbon assessments for large infrastructure projects, using an internationally recognised standard such as PAS 2080. Such an approach, which is already being piloted by TfL supports the development of a circular economy and can contribute to reducing embodied carbon by, for example, reusing materials or for new major developments to achieve a specified BREEAM credit for Responsible Sourcing of Materials.¹⁵⁷

Policy 6.1.5 Monitor and report on London's emissions regularly to track London's progress

Proposal 6.1.5.a Publish the London Energy and Greenhouse Gas Inventory on an annual basis

To assess the impacts of actions taken by the Mayor and others to tackle climate change London's emissions must be monitored. The London Energy and Greenhouse Gas Inventory (LEGGI) will be published on an annual basis, making data available to the public. London's GHG emissions and activities to mitigate climate change will be reported annually through a global web platform, such as the Carbon Disclosure Project (CDP).

London has a long history of leadership in understanding, and reporting on, its emissions. With the British Standards Institute it produced the UK's first standard on wider city-level (scope 3) emissions.¹⁵⁸ This provided an assessment of all the emissions from London's production and consumption activities and provided the first city case study of its kind internationally. The Mayor will publish indirect emission estimates to develop a trend of scope 3 emissions.

¹⁵⁶ RICS (2017) Whole life carbon assessment for the built environment, 1st edition. Accessed from: <http://www.rics.org/uk/knowledge/professional-guidance/professional-statements/whole-life-carbon-assessment-for-the-built-environment-1st-edition/>

¹⁵⁷ BREEAM is a widely used sustainability assessment method for master planning projects, infrastructure and buildings. It addresses several lifecycle stages such as new construction, refurbishment and operation. The Responsible Sourcing of Materials component of the BREEAM assessment recognises and encourages the specification of responsibly sourced materials for key building elements.

¹⁵⁸ BSI (2014) PAS 2070 Specification for the assessment of greenhouse gas emissions of a city. Accessed from: <http://shop.bsigroup.com/Browse-By-Subject/Environmental-Management-and-Sustainability/PAS-2070-2013/>

“The Mayor is committed to London continuing to lead global megacities in the battle against global warming by reducing GHG emissions.”

The results are not a formal measurement of London’s emissions and do not assign responsibility for emissions but provide an understanding of London’s wider carbon footprint, and ensure that decisions on policies for London recognise the potential to export emissions rather than reduce them within London’s boundaries.

Proposal 6.1.5.b Work with other global city leaders through C40 to support the implementation of the Paris Climate Agreement

London has a track record of leading by example. London founded the C40 Cities Climate Leadership Group in 2005, was the first city to create a comprehensive GHG monitoring system, the first city to measure GHG emissions of waste management using a carbon based approach with set targets for waste activities, and is now the first city to develop a comprehensive zero carbon scenario modelling tool.

Despite the challenges London faces the Mayor is committed to London continuing to lead global megacities in the battle against global warming by reducing GHG emissions.

London is not alone in wanting to take regional action to tackle climate change. Through C40, a network of the world's megacities committed to addressing climate change, London will work with other cities to collaborate effectively, share knowledge and drive meaningful, measurable and sustainable action on climate change.

The Mayor is the European representative and Vice Chair of C40 and has an important role in helping to set the ambition, priorities and direction of cities globally. Through hosting global C40 events and working closely with other international networks, such as the ICLEI, we will continue to share London's experience and work with other cities to reduce GHG emissions.

C40 has assessed this strategy, along with a suite of related Mayoral strategies and plans, against the core pillars of the C40 Climate Action Planning framework. The Framework sets out the essential elements of a climate action plan to deliver the objectives of the Paris Agreement. London's approach has been deemed compatible with these goals, setting the level of commitment, acceleration and implementation needed to play its part in keeping global average

temperature increases to well below 2°C. As one of the most advanced cities in its approach to climate planning, London will work with other C40 member cities to share the city's leading approach so that it can be learnt from and translated, setting the goalposts for action across the globe.

OBJECTIVE 6.2 DEVELOP CLEAN AND SMART, INTEGRATED ENERGY SYSTEMS UTILISING LOCAL AND RENEWABLE ENERGY RESOURCES

In addition to reducing the energy use of buildings in London, there is a need to transform the energy system so that power and heat for buildings and transport is generated from clean, local and renewable sources, such as solar and waste heat.

Energy infrastructure will need to be transformed so that it is smarter and more effective. This will enable supply and demand of energy to be better matched, reduce consumption and enable people to take advantage of cheaper electricity, sold during low demand periods such as overnight, or high supply periods such as on sunny and windy days.

“The Mayor will work to increase delivery of decentralised energy in London and identify and map the opportunities to create a smart, flexible energy system.”

While this is a national issue, in London the supply of more local, decentralised, low carbon energy can be maximised. Decentralised energy ranges from small production, such as electricity from solar PV panels, to larger scale systems based on local energy resources, utilising heat pumps that supply communal or district heating (or cooling) through a network of underground pipes connecting it to homes and buildings. For London to become zero carbon by 2050, the energy system will need to move away from using high carbon natural gas to being fuelled more from renewable energy and the heat that is wasted from industrial and commercial processes.

The changing nature of energy supply will mean that the way energy is used, and the infrastructure that supports supply, will need to become more flexible, integrating different types of energy and responding to demand at different times of the day. A smart approach is therefore required, which uses real-time data and technologies such as smart meters to ensure that the energy system can operate in a way that will reduce system peaks. Combined with the increasing use of energy storage and balancing electricity, heat and cooling demand with the available supply, a smart system will deliver the optimum cost savings, reduce resource consumption, and promote environmental benefits.

The Mayor will work to increase delivery of decentralised energy in London, and identify and map the opportunities to create a smart, flexible energy system.

Policy 6.2.1 Delivering more decentralised energy in London

Proposal 6.2.1.a Help implement large scale decentralised and low carbon energy projects, including stimulating demand from the GLA group

District heating networks and renewable energy supply account for approximately half of London's decentralised energy systems, delivering the equivalent of two per cent of total demand. There is the opportunity to increase this type of energy supply to 15 per cent of demand by 2030. There are opportunities for further decentralised energy projects, including large scale solar PV installations and heat networks utilising technologies such as heat pumps in combination with secondary heat sources.

To facilitate implementation, the Mayor will provide support to boroughs and the private sector through the Decentralised Energy Enabling Project (DEEP).¹⁵⁹ Over the next two years, this programme will help implement large scale decentralised energy projects in London, which the market is currently failing to develop. DEEP will provide technical, commercial,

financial and other support services to assist public and private sectors to develop, procure and bring into operation these large scale projects.

The Mayor can potentially have a more direct role in the delivery of heat networks, significantly increasing the rate of their development in London. The Mayor will therefore consider the establishment of a District Heating Network Delivery Body for London that secures funding, and in partnership with London Boroughs, develops and builds district heating networks. For such a model to work, it is likely that central government will need to create a level playing field for the treatment of district heating networks compared to other statutory utilities, regarding access rights and business rates.

The Mayor wants to stimulate demand for further decentralised energy supply in London. This will include developing affordably-priced markets for locally generated electricity. Licence Lite purchases electricity from low and zero carbon generators in London, under a power purchase agreement, and sells it to GLA group members and public sector organisations to use in their buildings (Box 32). The Mayor will evaluate the success of an initial Licence Lite trial with TfL and look to develop a business case for signing up other GLA group

¹⁵⁹ DEEP will provide technical, commercial, financial and other advisory and support services to assist public and private energy suppliers to develop, procure and bring into operation larger scale DE schemes that deliver significant greenhouse-gas emission reductions at market-competitive prices. It will deliver CO₂ reductions of 17,400 tonnes per annum by September 2019 through projects it directly supports, and aims to enable 90 MW of capacity installed by 2023. It will prioritise key locations where the feasibility is most suitable.

members and other organisations (including public sector bodies and community energy groups) to purchase local low carbon power.

Implementation of large scale decentralised and low carbon energy projects will be undertaken in a coordinated way so they also contribute towards improving air quality as well as reducing carbon emissions. This will include meeting any relevant air quality standards and emission requirements set out in the London Plan.

BOX 32: LICENCE LITE

The Licence Lite project will deliver the Mayoral manifesto commitment to 'buy clean energy generated across the city, using it to power GLA and TfL facilities'. The project will acquire an Ofgem junior electricity supply licence to buy locally generated low carbon electricity at a higher price than they would otherwise receive from the wholesale market and sell to GLA group facilities. Licence Lite aims to be operational by autumn 2017.

Proposal 6.2.1.b Increase the amount of solar generation in London, including through community energy projects and on GLA group buildings

The Mayor wants to see a solar revolution in London with more heat and electricity generated from renewable solar sources. The Solar Action Plan¹⁶⁰, the first of its kind for London, sets out how the Mayor will seize the opportunity for solar energy in the capital and increase deployment in the coming years.

To meet the zero carbon ambition, London will require around ten times more solar energy generation to be installed: two gigawatts (GW) by 2050. The Mayor has therefore set an ambition for London to achieve 1 GW of installed capacity by 2030 and 2 GW by 2050. This can't be achieved through the Mayor's leadership and programmes alone. It will need strong and supportive policy from national government, and the support of local government, the private sector, charities, and individuals. As part of this, the Mayor has set a target for GLA programmes to almost double London's current installed capacity, installing an additional 100 MW by 2030.

¹⁶⁰ Mayor of London (2018) Solar Action Plan. Accessed from: <https://www.london.gov.uk/energy>

Box 33 summarises the Mayor's proposed approach and headline actions to increase the amount of solar generation installed in London. These include leading by example, by maximising solar energy technologies on GLA group buildings and land. In addition to continuing to encourage solar energy through the planning system, the Mayor will also encourage Londoners to retrofit solar on their homes. As part of the Energy for Londoners programme the Mayor has launched 'Solar Together London', a collective purchasing pilot scheme to reduce costs for Londoners, which if successful will be expanded to the rest of London. To support communities, in autumn 2017 the Mayor introduced a community energy fund to help get solar projects up and running. This will support the business case for solar projects in locations ranging from schools to city farms.

"The Mayor wants to see a solar revolution in London with more heat and electricity generated from renewable solar sources."

BOX 33: THE MAYOR'S SOLAR ACTION PLAN

The actions in this plan will put London on track to realising the potential of solar energy. In addition, it will maximise the contribution of solar to the Mayor's zero carbon city ambition.

Mayoral actions:

1. Lead by example by maximising solar energy technologies on GLA group buildings and land

- work with the GLA functional bodies to maximise installations across the GLA group, including estimating the potential and providing technical assistance

2. Encourage solar energy installations through the planning system

- ensure that new developments include solar, where feasible, and work with boroughs to ensure planning policies don't necessarily restrict solar installation on existing properties

3. Help Londoners to retrofit solar energy technologies on their homes and workplaces through the Mayor's programmes and funding

- pilot and, if successful, extend 'Solar Together London', a reverse auction scheme to reduce installation costs for Londoners
- help community solar energy projects get off the ground through grants from a London Community Energy Fund
- encourage public sector organisations and providers of social housing to retrofit solar energy technologies on buildings, by promoting the use of technical assistance programmes delivered through Energy for Londoners
- support projects that promote energy storage

4. Help Londoners to make informed decisions about investing in solar energy technologies

- promote the opportunity for installing solar and storage in homes and businesses through the use of spatial mapping and access to technical support

BOX 33: THE MAYOR'S SOLAR ACTION PLAN (CONTINUED)

- provide clear guidance and information on installing solar energy technologies

Further government action:

5. Call on government to set a national policy framework that unlocks London's solar energy potential

- call on government to ensure national policy is introduced to support higher levels of solar energy deployment in London, as part of a package of national policy measures that enable London to meet its ambitious zero carbon ambition by 2050
- work with regulators and electricity network operators to ensure the smooth roll out of projects, especially community-led schemes.

Policy 6.2.2 Planning for London's new smart energy infrastructure

Proposal 6.2.2.a Encourage the identification and planning of decentralised energy in priority areas

In order to maximise the supply of more local, decentralised, low carbon energy in London, it is important to identify the most appropriate areas, energy systems and technologies. To understand the suitability and location of decentralised energy opportunities, the London Heat Map will be maintained to include data for decentralised energy development, including secondary heat sources. The Mayor will continue to support all London boroughs to produce Energy Master Plans and use them to identify areas where the most appropriate energy systems should be considered.

The boroughs can play an important role in identifying these suitable areas for decentralised, low carbon energy and support the development and installation, including through new developments. Once suitable sites have been identified, the Mayor will, through DEEP, work with stakeholders on the planning of decentralised energy by providing support to carry out heat mapping and energy masterplans.

This will include the potential to recover low-temperature waste heat and the implications of supplying heat to connected building heating systems.

Heat networks provide infrastructure for decentralised energy and are one of the main opportunities for the supply of low carbon heat in London. At present, most heat networks are built as part of new developments. However, to meet the Mayor's zero carbon ambition, it is likely that some of London's existing housing will also need to be supplied by heat networks. To enable this, the Mayor will support the identification of areas where existing buildings could be retrofitted for connection to local heat networks, with an aim of developing the business case for a pilot project that retrofits heating systems in existing buildings, so that they can be connected to a local heat network.

The Mayor will encourage industry to ensure that heat networks that are developed in London are of the highest standards so they operate efficiently, effectively and reliably. As heating systems and their associated networks are currently largely unregulated, it

is critical that industry standards (or equivalents) are developed, such as the Heat Trust standard for customer service and the heat networks Code of Practice for the design, specification and operation of heat networks. Government should also consider whether regulation may be required as decentralised energy becomes more widespread. The Mayor will work with all stakeholders to update London's guidance on design and specifications for heat networks and consumer standards in light of latest standards and feedback from Londoners. The Mayor is aware that residents in some new developments with CHP systems have expressed concerns about aspects of their heating arrangements. Findings from London's recent Communal Heating Consumer Survey support a national study from BEIS¹⁶¹ in suggesting that, on average, heat network consumers and non-heat network consumers reported similar annual prices. The Mayor will continue to work with key stakeholders to encourage greater transparency around heat network consumer prices, and encourage schemes in London to be Heat Trust accredited.

¹⁶¹ HMG (2017) Heat Networks Consumer Survey: consumer experiences on heat networks and other heating systems. Accessed from: <https://www.gov.uk/government/publications/heat-networks-consumer-survey-consumer-experiences-on-heat-networks-and-other-heating-systems>



Credit: TfL



Credit: London Borough of Islington

Storage of energy will also be important to balance supply and demand at the building, district and national levels. Battery storage is likely to become increasingly important, and thermal storage could enable surplus electricity generation from renewables (for example solar PV in the summer), to be converted to and stored as heat for later use in district heating. London's potential for inter-seasonal thermal storage has yet to be explored, but if feasible, excess summertime energy could be captured for winter-time heating.

City subsurface temperatures are known to have increased due to the urban heat island (UHI) effect (see Chapter 8), causing increased aquifer temperatures. The Mayor will investigate the potential for London's geology to provide thermal storage and heat source as a consequence of the UHI effect, in conjunction with future low temperature heat networks.

National government will also need to decide on whether the UK moves to a hydrogen economy, which would see gas networks adapt the system to transport hydrogen for heating, cooking, homes

and transportation in a similar way to the supply of natural gas today. The Mayor will work with national government to identify research opportunities to pilot zero carbon hydrogen heat projects working with the London Hydrogen Partnership. The Mayor will also keep the potential for hydrogen to be used as a fuel for heating buildings under review. This may be achieved through replacing natural gas in the existing national grid with hydrogen or through fuel cells. Any use will need to consider the carbon emissions associated with the production of hydrogen, the efficiency of using hydrogen as a heating fuel, and any air quality impacts, and ensure that this is in line with the Mayor's zero carbon and zero emission ambitions.

Proposal 6.2.2.b Undertake demonstration project and trials to improve London's energy systems

To ensure that London is at the forefront of developing smart and integrated energy systems, the Mayor will support demonstrations and trials of advanced approaches to optimise London's energy systems, sharing findings across London, nationally and internationally.

For example, the Mayor has supported CELSIUS, an EU Smart Cities Demonstration Project with five European partner cities: Gothenburg (lead partner), London and Islington Council, Cologne, Genoa and Rotterdam. It investigates the role of waste heat in district heating networks and the role of district heat networks in the wider energy system. Phase 2 of Islington Council's Bunhill Heat and Power Heat Network is the London demonstrator. It is integrating waste heat from the Tube into the network and using smart controls to operate the energy centre.

The Mayor is also supporting Sharing Cities, a €25m smart city demonstrator programme in partnership with Greenwich, Milan, Lisbon, Bordeaux, Burgas and Warsaw. The programme aims to use data and digital approaches to 'connect up' existing and new building, transport and energy infrastructure, to reduce energy demand, bills and emissions, and achieve integrated city infrastructures that meet citizens' needs.

Through Sharing Cities the Mayor will work with Greenwich to apply retrofitting solutions to five residential properties, including integrating low carbon energy supply, improvements to the physical fabric of buildings to make them more energy efficient, and the installation of smart digital heating and electricity controls in individual apartments. The Mayor will also support the implementation of a sustainable energy management system that will integrate city infrastructures, optimise energy supply, and use data analytics and predictive control techniques to create energy services that Londoners want. Scaled up across London, a sustainable energy management system has the potential to reduce energy consumption by up to 20 per cent, cut energy bills and emissions. The Mayor will deliver a comprehensive quantitative evaluation of the performance of the measures across the Greenwich demonstrator and share this learning across London, nationally and internationally.

Proposal 6.2.2.c Investigate the potential for further smart, flexible energy system demonstrators and pilots where Londoners can help manage demand

The Mayor has assessed the impact on the national electricity system resulting from the electrification of heating and transport to achieve zero carbon. The London Infrastructure Plan¹⁶² considered the system reinforcement investment and the impact on Londoners' energy bills for a high decentralised energy scenario compared with a low scenario. It concluded that the former would cost the national system £20bn less, and Londoner's bills would be 40 per cent lower.

The conclusions for decentralised energy also apply for electric vehicles. Modelling undertaken by the GLA and TfL indicates that the additional electricity demand arising from the electrification of vehicles in London can be accommodated without significant reinforcement cost. However, an un-coordinated approach could increase peak demand on the electricity system by over 2 GW by 2050.

An updated assessment of energy systems deployment considered the cost benefits of an integrated approach ahead of need for transport and heat infrastructure planning. This work is available on the London Datastore.

London therefore plays an important role within the national energy system. The Mayor will work with national government and other key stakeholders (including Ofgem, National Grid and Distribution Network Operator Companies) to plan smart, flexible city energy systems operating as part of the national system. This will enable Londoners to participate in the demand side response market. This work includes:

- demand side response initiatives and the impact of electrification upon the grid
- working with transmission and distribution network operators to mitigate the potential impact of EV charging and electrification of heat
- the potential role of a zero carbon gas supply for London and the role of district heating networks in an integrated energy system

¹⁶² Mayor of London (2014) London Infrastructure Plan 2050. Accessed from: <https://www.london.gov.uk/what-we-do/business-and-economy/better-infrastructure/london-infrastructure-plan-2050>

- the flexibility potential that London's demand side response could offer (the first phase of the FlexLondon project will map London's 'flexible' energy capacity)

The Mayor will investigate future demonstrators and pilots including:

- innovations that flexibly match changing energy supply and demand profiles of the future
- incorporating storage or advanced management and optimisation of multiple energy supply to boost use and efficiency
- removing barriers to innovative SMEs accessing energy markets, offering customers better energy services and creating new value for London's tech businesses

Proposal 6.2.2.d The Mayor will oppose fracking in London

In the London Plan the Mayor is clear that fracking is opposed in London.

OBJECTIVE 6.3 A ZERO EMISSION TRANSPORT NETWORK BY 2050

The Mayor's ambition is to have a zero emission transport network by 2050. This will be achieved through an integrated approach, reducing carbon emissions and air pollutants from transport side by side in both this strategy and the Mayor's Transport Strategy. The policies and proposals to reduce London's carbon emissions from transport have therefore been combined with policies and proposals under the air quality chapter of this strategy. Please see Chapter 4 for full air quality policies and proposals.



Chapter 7: Waste

AIM

London will be a zero waste city. By 2026 no biodegradable or recyclable waste will be sent to landfill, and by 2030 65 per cent of London's municipal waste will be recycled.

INTRODUCTION

Our linear economy (take, make, use and dispose) is unsustainable. It produces too much waste, with around 7m tonnes coming from London's homes, public buildings and businesses each year, too much of which goes to landfill and incineration. Of this, only 41 per cent is currently recycled and performance has stagnated. Landfill and incineration are undesirable, costly and an inefficient use of resources. The capacity of landfills accepting London's waste is expected to run out by 2026 and London's waste bill is now in excess of £2bn a year and rising.

Instead, the Mayor is working to create a circular economy (see Chapter 10). This involves:

- reducing waste and the use of single use packaging, so that fewer disposable products are created in the first place

- ensuring valuable resources are kept in use for as long as possible
- London boroughs, businesses and the waste industry increasing the availability and visibility of recycling facilities and services, so that we can all play our part in recycling materials that have outlived their first use
- making the most of materials that can no longer be reused or recycled, by using them to generate low carbon energy

If this approach is successful, it will ensure that only unavoidable waste is sent for incineration, negating the need for new incineration facilities in London.

Planning for a circular economy – aiming to design out waste entirely – presents the greatest opportunity for the efficient use of every valuable resource. London is already considered one of the leading global cities in applying circular economy thinking to policy development, funding mechanisms and public sector procurement. However, more needs to be done.

Through supporting increasingly clever design of goods and services, such as maximising the recycled content in a product, or promoting leasing or sharing arrangements, waste is beginning to be treated as the valuable resource it is.

Cutting waste, and recovering value from more of it, can provide a number of benefits. These include the creation of jobs and apprenticeships, the development of secondary materials, and the provision of affordable low carbon energy. Effective waste management, delivering high quality materials to market, can give local authorities a reliable high value income stream. This can help to offset costs associated with service improvements. More of London's reusable items like furniture, fittings and electrical appliances need to be kept in use. Redistributing them to where they are needed can create local work, keep resource costs down and help reduce poverty.

A new approach is required to deliver this radical change in how we deal with London's waste, including:

"Around 7m tonnes of waste is produced each year from our homes, public buildings and businesses."

- significantly cutting waste that is produced, with a specific focus on single use plastics and food waste
- encouraging greater reuse of materials to minimise the use of virgin resources, including accelerating the take up of business models that promote the circular economy
- once waste reduction and reuse opportunities have been exhausted, maximising the recycling of materials (including anaerobic digestion) that are left from our homes and businesses
- where all opportunities to reduce, reuse and recycle materials have been exhausted, maximising the value of truly non-recyclable waste by generating low carbon energy from it to limit the environmental impact, and leave very little waste going to landfill
- ensuring that there is sufficient infrastructure in London to support the shift to a circular approach, helping to create opportunities for businesses developing reuse, repair and remanufacturing services

LONDON'S ENVIRONMENT NOW

The key evidence to support the Mayor's ambitions for London's waste by 2050 is summarised below. You can find out more about the evidence behind the policies and proposals in Appendix 2.

Total amount of municipal waste produced in London

London's municipal waste stream is made up of a variety of materials. The main components of municipal waste in London are food and green garden waste (23 per cent) and common dry recyclables, such as paper, card, plastics, glass and metals (54 per cent). The remaining 23 per cent is made up of smaller quantities of materials including textiles, waste electricals, wood, furniture, and household cleaning chemicals.

Food waste and plastic packaging combined, including single use coffee cups and plastic bottles, account for around 30 per cent of this. London produces around 1.5 – 1.75m tonnes of food waste with a value of £2.55bn a year.¹⁶³ This is likely to be a conservative

figure, given the extensive and diverse food sector employing more than half a million Londoners and turning over £20bn each year.¹⁶⁴ Most of this food waste goes to landfill or incineration producing around 250,000 tonnes of CO₂e emissions, although some of this is offset through capturing heat and producing electricity.¹⁶⁵ Around a third of food bought is thrown away, most of which is still edible. WRAP (Waste and Resources Action Programme) estimates that wasted food costs households around £50 per month.

Use of single use packaging materials, including coffee cups and plastic bottles, is growing and putting increasing pressure on local waste management services. WRAP's plastic market situation report 2016¹⁶⁶ estimated the UK produces around 2.2m tonnes of plastic packaging with only around half (or 900,000 tonnes) recycled. In the UK, around 825,000 tonnes of plastic bottles are produced a year. This leads to around 125,000 tonnes produced in London. Each year, Londoners buy around 1.2 billion single use plastic bottles, and only one third of plastics is recycled in the home.¹⁶⁷

¹⁶³ Taking national food waste data published by WRAP Estimate of food surplus and waste arisings in the UK, January 2017 and applying a London equivalent estimate based on London making up around 15 per cent of the UK population.

¹⁶⁴ Mayor of London (2016) Capital of Food: Ten Years of London Leadership. Accessed from: www.london.gov.uk/sites/default/files/capital_of_food_report.pdf

¹⁶⁵ Emission factors taken from Appendix 1 EPS report. Assumes 50 per cent food waste sent to landfill, 50 per cent sent to incineration

¹⁶⁶ WRAP (2016) Plastics Market Situation Report. Accessed from: www.wrap.org.uk/sites/files/wrap/Plastics_Market_Situation_Report.pdf

¹⁶⁷ Brita (2017) Understanding provision, usage and perception of free drinking water to the public in the UK', Brita, Keep Britain Tidy and Centre for Social Innovation. Assumes London's 2016/17 33 per cent household waste recycling rate.



Credit: Veolia Southwark

There is a significant opportunity to reduce London's waste bill and environmental impact if food waste and single use packaging were to be cut. Cutting this waste stream by 20 per cent could take about £42m off London's waste disposal bill.¹⁶⁸

Reuse and repair

Preparing discarded items for reuse and repair creates jobs. It also provides wider social benefits through the redistribution of discarded items to those in need. Online platforms, such as Warpit and Globechain, have been used to help local authorities and businesses loan and donate their unwanted items to other businesses and charities. These initiatives have helped to avoid around 1.5m tonnes of items becoming waste and going to landfill, saving around £10m in waste costs, and benefiting over 15,000 people across the UK.

Recycling

Using the latest information made available by the Environment Agency in 2017/18, it is estimated that 41 per cent of London's municipal waste was recycled or composted in 2016/17. This is significantly (11 per cent) lower than the previously estimated 52 per

cent recycling rate, and creates a lower baseline for London to improve from. Around 54 per cent of waste was sent to landfill or incineration. The remaining five per cent was managed through other sorting and treatment methods.¹⁶⁹

London needs to increase its recycling rate. However, it faces many challenges to achieving high weight based recycling performance including:

- there are 33 boroughs (waste authorities) providing different waste and recycling collection services. This makes it confusing for residents to know what they can recycle, especially when they move to another borough that has different arrangements
- on average, 50 per cent of the population live in flats: in some boroughs this is as high as 80 per cent. Flats often have a lack of easily accessible and/or sufficient storage space for recycling, and can be expensive for local authorities to service
- London has a highly transient and diverse population with over 100 languages spoken. This can make communicating recycling services difficult

¹⁶⁸ Based on plastic bottles and food waste collectively making up around 30 per cent of London's municipal waste or 2.1m tonnes. Assumes an average disposal cost of £100 per tonne.

¹⁶⁹ Taken from GLA modelling.

- there are fewer gardens in London producing less green (heavy) waste for composting compared with other regions, which means a focus is needed on other waste types
- there is no requirement for boroughs to provide recycling collection services to businesses, or for businesses to recycle. Private waste companies typically manage larger and higher value business waste collection contracts
- businesses, particularly in central London, have limited space on their premises to separate out their waste for recycling

Despite these challenges, Londoners want to recycle more. Over 85 per cent of people polled in a survey¹⁷⁰ on the Mayor's draft strategy wanted to see more consistent recycling services across London that accept the same core set of materials and food waste.

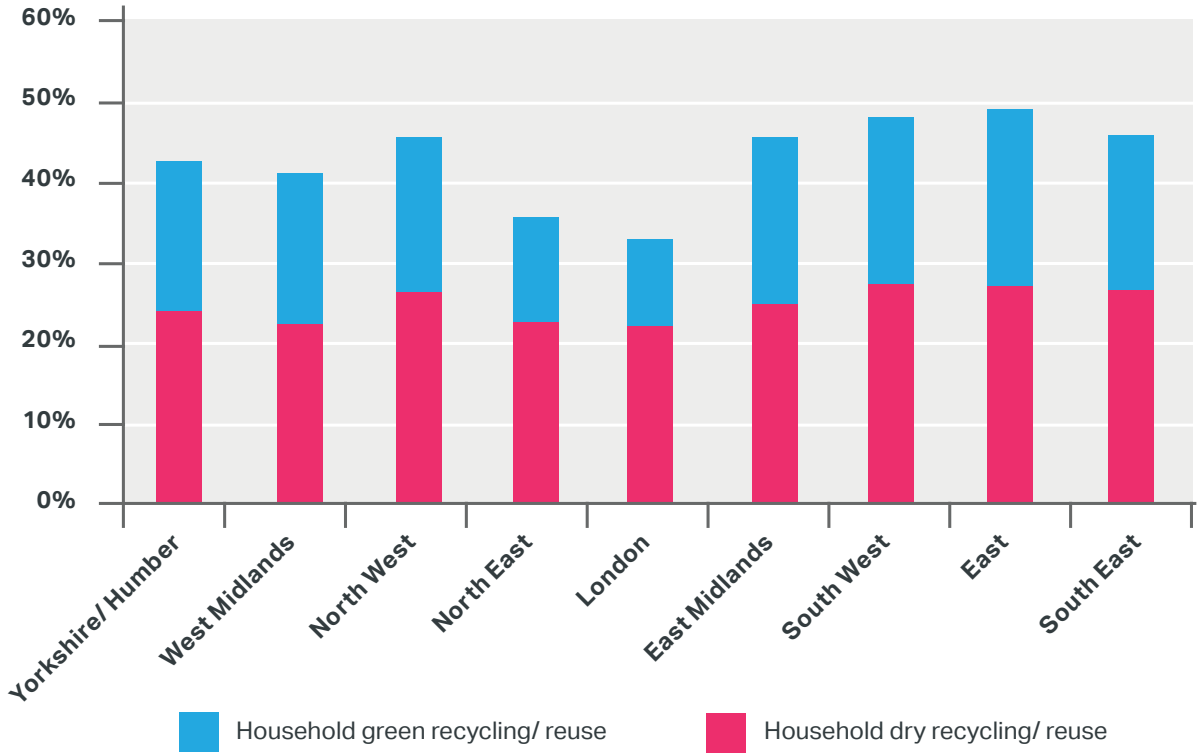
Between 2003 and 2010, London's household waste recycling rate increased from eight to 30 per cent, but in recent years this stalled at 32 per cent. In 2016/17 it increased to 33 per cent (see Figure 43), however it remains well below the national average of 44 per cent. London has the lowest green waste (composting) contribution of the regions (11 per cent compared to an 18 per cent average). This reflects the challenge of recycling in a high density city with fewer gardens like London.

Despite many boroughs providing separate food waste collections, the amount of food waste recycled is very poor, with food waste making up around 25 per cent of non-recycled household waste, 60 per cent of which is avoidable.¹⁷¹ Food waste can be composted or used to generate renewable energy, which would significantly improve London's recycling rate (see Objective 7.2).

¹⁷⁰ See Appendix 6 of the Consultation Response Report for a summary of the public's responses to the draft strategy.

¹⁷¹ WRAP (2012) Household food and drink waste in the UK. Accessed from: <http://www.wrap.org.uk/sites/files/wrap/hhfdw-2012-main.pdf>

Figure 43: Regional household dry recycling and composting rates 2016/2017¹⁷²



¹⁷² Defra (2018) LACW statistics 2017/18. Accessed from: <https://www.gov.uk/government/statistical-data-sets/env18-local-authority-collected-waste-annual-results-tables>

Energy from waste (EFW) – incineration, gasification and pyrolysis

Incineration with energy recovery is the main EFW technology for managing non-recycled waste in London. There are three facilities in London (SELCHP in Lewisham, Riverside Resource Recovery in Bexley, and Edmonton in Enfield), which all produce electricity. Currently, only SELCHP also captures heat for use in a local housing development.

Incineration of London's local authority collected waste has doubled from 900,000 tonnes in 2011 to 2m tonnes in 2016, producing around 620,000 tonnes of CO₂e emissions. This is mainly due to changes in waste disposal contracts, which have led to more waste being diverted away from landfill to incineration rather than recycling. London now has the highest incineration rate across the UK, at 54 per cent.

Modelling suggests that if London achieves the reduction and recycling targets set out in this strategy, it will have sufficient EFW capacity to manage London's non-recyclable municipal waste, once the new Edmonton and Beddington Lane facilities are operational (see Objective 7.4).

All London's incinerators are expected to be ready for heat off take by 2025, but as yet they do not have fully developed plans for end users. All energy from waste facilities will need to manage truly non-recyclable waste and operate in combined heat and power mode, meeting a maximum CO₂ emissions performance known as the carbon intensity floor (CIF). Objective 7.3 sets out requirements on waste authorities for their EFW contract solutions meeting the CIF.

Landfill

London's local authority collected waste to landfill has reduced significantly over the past ten years from 65 per cent to 12 per cent. This improvement was largely due to the EU Landfill Directive, which has restricted the amount of biodegradable waste that member states can send to landfill. Landfills accepting London's waste, most of which are located outside London, are expected to reach capacity by 2026. The Mayor wants London to be a zero waste city – one that makes the best use of all its waste where market opportunities exist to recover value from it. This means ensuring London sends no biodegradable or recyclable waste to landfill by 2026.

The waste hierarchy

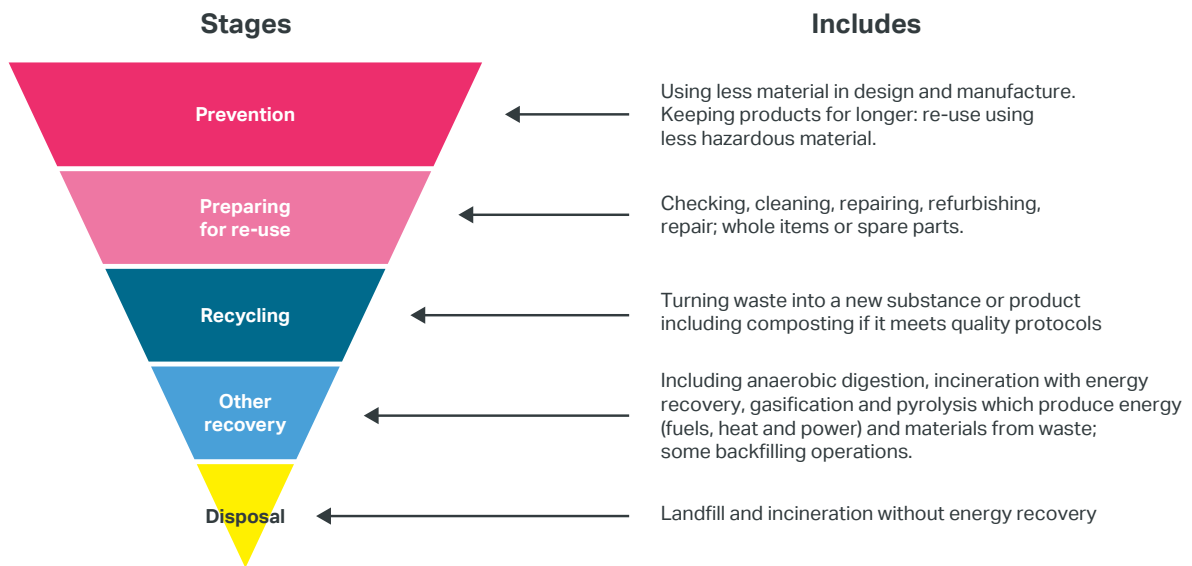
The waste hierarchy is applied from the top down, prioritising those activities further up the hierarchy according to what is best for the environment (Figure 44). Applying the waste hierarchy from the top down generally achieves the greatest cost saving and CO₂e saving benefits.

Reducing, reusing, and recycling waste and then generating energy from the waste remaining is a direct way to save emissions from landfill. It also avoids indirect emissions that would otherwise have occurred in manufacturing from virgin materials or generating energy

using fossil fuels (such as coal or gas). Considering direct and indirect emissions helps us to determine the overall lifecycle CO₂e performance of waste management (see Objective 7.3). Materials sent for recycling have a market value that boroughs can share in, depending on their waste arrangements and contracts with external service providers. Reducing waste and moving to a higher reuse and recycling based approach should bring savings to local authorities.

The policies and proposals in this chapter follow the waste hierarchy. The greatest emphasis is at the top of the waste hierarchy to prevent waste being produced in the first place.

Figure 44: Waste hierarchy¹⁷³



¹⁷³ European Commission (2008) Directive 2008/98/EC on waste (Waste Framework Directive).



ROLES AND LEGAL DUTIES

Municipal waste

The Mayor is required under the GLA Act to produce a municipal waste management strategy. However, the Mayor is not a waste authority and it is ultimately the boroughs (through their waste collection and disposal authorities), businesses and the commercial waste industry that will implement the waste policies in this strategy.

The Mayor's role is limited to a combination of exercising regulatory functions (ensuring local authority waste plans, services, strategies and contracts are in general conformity with the Mayor's waste policies and proposals) and non-regulatory functions (funding, research, technical assistance, providing guidance, campaigns and facilitating and supporting good practice). The Mayor has no powers to direct business to deliver the strategy.

Delivery is solely the responsibility of private waste companies and London's waste authorities. There are 33 waste collection authorities (boroughs and the City of London), 12 authorities that are "unitary" waste authorities (combined

collection and disposal), four statutory waste disposal authorities and one voluntary waste partnership.¹⁷⁴ The waste collection authorities and the waste disposal authorities are referred to as 'waste authorities' in this strategy.

In 2011 Defra changed the definition of municipal waste to align with the EU definition, which defines municipal waste much more broadly to be household waste or waste similar in composition to household waste. Applying this definition brings an additional 3.2m tonnes of waste into scope, regardless of who collects it. This change was made to make sure that the UK is correctly reporting its performance for meeting its landfill diversion targets under the European Landfill Directive. The Mayor has included policies to address commercially collected municipal waste because of its importance to London's environment generally.

Taking this approach places no additional legal requirement on London's waste authorities, who must continue to act in general conformity within the municipal waste management provisions of this strategy, including binding targets for municipal waste in their possession or control.

¹⁷⁴ South London Waste Partnership comprising Merton, Sutton, Kingston upon Thames and Croydon.

Municipal waste targets set in this strategy are non-binding in so far as they relate to Commercial Waste Contractors (CWCs). The Mayor expects CWCs to have regard to those municipal waste targets and they will be achieved through additional activity and services by waste authorities, the commercial waste

industry and other relevant organisations working in partnership with the Mayor.

To avoid confusion this strategy uses the terms set out in Box 34. More detail on municipal waste composition can be found in Appendix 2.

BOX 34: DEFINITIONS OF TERMS USED IN THIS CHAPTER

- **waste** refers to any substance or object that the holder discards, intends to discard, or is required to discard
- **municipal waste** is household waste or business waste that is similar in composition irrespective of who collects or disposes of it. This includes waste from shops, offices, charities, schools and government buildings
- **Local Authority Collected Waste (LACW)** refers to all waste in the possession or control of waste authorities. This includes waste collected from households and businesses
- **waste authority (ies)** means a Waste Collection Authority and a Waste Disposal Authority. It includes London's 33 waste collection authorities (all 32 boroughs and the City of London), those 12 authorities that are "unitary" waste authorities (combined collection and disposal) and the 4 statutory waste disposal authorities
- **Commercially Collected Waste** refers to municipal waste in the possession or control of a body or organisation that is not a waste authority

The London Waste and Recycling Board (LWARB) was set up to help support the delivery of the Mayor’s policies. The Board brings together the Mayor, boroughs, and other stakeholders involved in managing London’s waste, with the objective of promoting and encouraging less waste and its sustainable management¹⁷⁵ and it must act in accordance with the Mayor’s waste

policies. Through the Mayor’s appointed representatives, LWARB currently oversees a £20.4m fund from 2017-2020 to deliver against its objectives of reducing waste and increasing reuse and recycling (see Box 35). However, there is currently no ongoing funding provision for the Board. Proposal 7.1.2.a sets out the Mayor’s proposal for securing additional funding for LWARB.

BOX 35: LONDON WASTE AND RECYCLING BOARD (LWARB)

The London Waste and Recycling Board (LWARB) was established under the Greater London Authority Act 2007. LWARB must act in accordance with the provisions of the London Environment Strategy, dealing with municipal waste management, and act in general conformity with the London Plan, so far as relating to the collection, treatment and disposal of waste. LWARB:

- oversees a £20.4m fund between 2017 and 2020
- works with waste authorities to identify and implement the best mechanisms for improving recycling performance in flats in a cost effective way
- provides £4m funding between 2018 and 2020 through Resource London

to support local authorities to develop waste plans and contracts, reduce waste, improve recycling rates, and provide high quality and well participated municipal waste recycling services

- has invested £7m through the London SME Fund in high growth early stage circular economy businesses. LWARB is also investing £1.5m in Circularity Capital, a circular economy growth capital fund, and has invested a further £1.5m in a circular economy accelerator. These funds are used to fund innovative circular economy business across London especially reuse, repair, and remanufacturing projects, and those using low carbon technologies

¹⁷⁵ More information can be found at www.lwarb.gov.uk



Credit: Veolia Southwark

The Mayor's waste powers: general conformity and power of direction

In performing their waste functions, waste authorities need to show how they are acting in general conformity with the municipal waste provisions of this strategy. General conformity only applies to local authority collected waste (LACW) activities. The Mayor has the power to direct a waste authority where their waste activities are considered to be detrimental to implementing the municipal waste provisions in this strategy. The Mayor's power of direction does not apply to businesses or private waste companies.

The Mayor expects waste authorities to help successfully implement these municipal waste management policies and proposals. These expectations are set out in Box 36. This will ensure that a consistent approach is taken to applying general conformity.

BOX 36: EXPECTATIONS ON WASTE AUTHORITIES TO DEMONSTRATE GENERAL CONFORMITY

The Mayor expects waste authorities to carry out the following in order to show they are acting in general conformity with this strategy's municipal waste management policies and proposals. They should:

- produce waste plans and strategies setting out how their waste activities will:
 - help move waste up the waste hierarchy to ensure a greater focus on reduction, reuse and recycling
 - provide local economic, social and environmental benefits from improved waste management
 - make a meaningful contribution to meeting the Mayor's targets

BOX 36: EXPECTATIONS ON WASTE AUTHORITIES TO DEMONSTRATE GENERAL CONFORMITY (CONTINUED)

- offer the Mayor's minimum level of household recycling service provision, giving their residents straightforward and easy-to-use recycling collection services
- make best use of local waste sites and facilities identified in local waste plans
- support the phase out of fossil fuel waste transport and boost uptake of low or zero emission alternatives
- use Recycle for London messaging and branding in local awareness raising activities to ensure that a consistent reduce, reuse, recycle message is delivered across London
- provide residents and businesses with the tools and knowledge to cut waste in their daily lives, and help them to actively participate in local reuse and recycling services to ensure clean, high quality materials can get to market
- demonstrate how they will, or have, put in place positive changes to
 - improve recycling performance identified through Resource London's borough support programme
- publicly notify their intention to tender a waste contract to other waste authorities at the same time as notifying the Mayor. This would be a chance for waste authorities considering new services to consider joint procurement options. These can provide better value for money on 'like for like' services and achieve service harmonisation across borough boundaries to help remove barriers to recycling
- procure waste and recycling services that maximise local economic, environmental and social benefits through demonstrating how they will deliver the Mayor's Responsible Procurement Policy and Good Work Standard
- carry out any other relevant activity supporting the Mayor's policies and targets

The Mayor will ensure that waste authorities and the GLA functional bodies reduce waste, increase recycling and accelerate London's transition to a circular economy. But London needs

everyone to play their part: Box 37 sets out the Mayor's expectations of businesses and waste service providers. Box 38 sets out the Mayor's call on government to take action.

BOX 37: EXPECTATIONS OF BUSINESS AND WASTE SERVICE PROVIDERS

To reduce the amount of waste produced in the first place:

- manufacturers should design products generating less waste,
- manufacturers should design products that can be easily repaired, reused or recycled
- businesses, whether start-ups or corporates, should innovate and adopt business models that are more circular and that reflect their customers' desire to do the right thing

To increase the amount of waste that is recycled, the waste industry should help businesses they collect waste from to reduce waste and boost recycling, by providing advice and collection services tailored to the type and volumes of waste they produce (for example separate food waste collections for food and hospitality businesses).

We want residents and businesses to have the tools and knowledge to cut waste in their daily lives and actively participate in local reuse and recycling services to ensure clean, high quality materials can get to market.

BOX 38: CALL ON GOVERNMENT

Government must respond to the calls from waste authorities and the waste industry to provide a vastly improved regulatory framework. Urgent, comprehensive, and co-ordinated action at a national level is needed to accelerate the move to a resource efficient culture, significantly boost reuse and recycling rates, and help industry find new outlet markets for UK waste products. This is particularly important against the backdrop of uncertainty created from Brexit and from China's recent ban on receiving exports of poor quality recyclable materials. Through the government's new Resources and Waste Strategy, it has the ability to change and introduce legislation, introduce fiscal incentives, and allocate funding. Policy 7.1.2 sets out the Mayor's call to action from government.

Non-municipal waste

The Mayor has no responsibility or powers in this strategy to directly control the management of industrial waste and construction, demolition and excavation waste where it is not in the possession or control of a waste authority. The Mayor can, however, use convening, leadership and advocacy to drive improvements. This non-municipal waste is predominantly managed by commercial waste contractors (CWCs). These waste streams are already highly regulated, increasingly managed onsite and, in some cases, require specialised management and disposal (for example, asbestos and chemical waste). However, given their impact on other objectives for London's environment, the Mayor considers it important to set out in this strategy the expectations for these waste streams. In addition, the London Plan details policies supporting effective management of these other waste streams, as they are generally considered a waste planning issue.

Zero waste London

Waste is collected from households. The amount of waste varies by property type, for example, houses where a service varies for that property.

Working together, London's approach to waste can be transformed, helping to conserve resources and reduce the city's impact on the local and global environment.

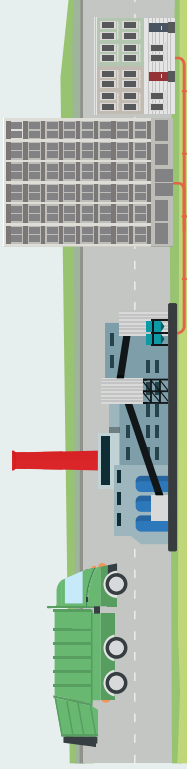
Cut food waste by 20% per person by 2025 and 50% by 2030



Using fewer and cleaner lorries to transport waste, for example by consolidating commercial recycling contracts, will reduce congestion and improve air quality



Non-recyclable waste can be used to generate energy to heat homes and workplaces



Mayor's minimum level of recycling service, i.e. 6 main materials and food waste collections



65% of London's municipal waste recycled by 2030



No biodegradable or recyclable waste will be sent to landfill by 2026



Food
26%



Main dry recyclables (e.g. glass, mixed plastics, paper, card, tins, cans)
40%



Other recyclables (e.g. electrical waste and textiles)
9%



Green garden waste
10%



Other (e.g. film,



Emissions Pe Standard

Achieving our goal (based on a 2015/16)

2021 101,000 tonnes of CO₂e

2025 169,000 tonnes of CO₂e



“The Mayor adopts a ‘circular approach’ to the use of resources in London, ensuring that materials stay in use as long as possible, reducing the amount of virgin materials required and maximising recycling.”

Objectives, policies and proposals

OBJECTIVE 7.1 DRIVE RESOURCE EFFICIENCY TO SIGNIFICANTLY REDUCE WASTE, FOCUSING ON FOOD WASTE AND SINGLE USE PACKAGING WASTE

The Mayor adopts a ‘circular approach’ to the use of resources in London, ensuring that materials stay in use as long as possible, reducing the amount of virgin materials required and maximising reuse and recycling. The Mayor wants to prevent materials from becoming waste in the first place by promoting more sustainable, circular business models that design out waste, and by ensuring that materials can be easily reused and recycled.

Work undertaken for LWARB estimated that taking a circular economy approach could reduce waste by up to 60 per cent.¹⁷⁶ In partnership with London stakeholders, LWARB has developed a Circular Economy Route Map¹⁷⁷ If implemented fully, this action plan could contribute £2.8bn of benefits to London’s economy annually by 2036. The Mayor is working with LWARB and other partners to implement the actions set out in the Route Map. This includes supporting entrepreneurs, businesses and social enterprises to cut waste, increase reuse and recycling, helping create the right conditions to accelerate London’s transition to the circular economy. The focus is on five priority areas: plastics, textiles, electronics, food, and the built environment due to their high economic value and environmental impact.



Credit: Veolia UK

¹⁷⁶ LWARB (2017) Circular Economy Effects on Waste Production in London Accessed from: https://www.lwarb.gov.uk/wp-content/uploads/2016/12/Final-Report_Issue.pdf

¹⁷⁷ LWARB (n.d.) Circular Economy Route Map. Accessed from: <https://www.lwarb.gov.uk/what-we-do/circular-london/circular-economy-route-map/>

“The Mayor will go further by setting a 50 per cent reduction in food waste per head target by 2030.”

Circular economy principles and policies are being embedded across the Mayor’s strategic plans and strategies. For example, in 2017 the Mayor published a Responsible Procurement Policy¹⁷⁸ committing the GLA group to trial and mainstream circular economy approaches in its procurement activities. In addition, the Mayor has included circular economy policies and approaches in the London Plan and Economic Development Strategy.

However, these actions alone will not be enough for London to achieve the targets set out in this strategy and effectively transition to a circular economy. Everyone must play their part, from government, the boroughs, the waste industry and other partners, to Londoners themselves.

Policy 7.1.1 The Mayor will set waste reduction targets for the city as a whole, and work with Londoners, waste authorities, government and other stakeholders to significantly cut waste and boost material reuse

Proposal 7.1.1.a The Mayor will support campaigns and initiatives to prevent food and associated packaging going to waste

Food waste (including drink waste) and single use packaging accounts for around 30 per cent of London's municipal waste. In the UK, for every two tonnes of food eaten, another tonne is wasted, most of which goes to landfill or incineration. Eight out of the top ten countries the UK imports food from are drought prone. Tackling food waste offers an opportunity to increase the resilience of London's supply chain, reduce waste management costs, and reduce associated greenhouse gas (GHG) emissions. Single use hot drink cups and plastic bottles are an increasing problem. It is estimated that over 40 million cups are thrown away each year in London, many of which are not recycled and are therefore sent to landfill or incineration.

The Courtauld Commitment 2025 (C2025) is a key initiative for London and the UK to significantly cut food waste. This is an ambitious voluntary agreement that brings together organisations across the food system, from producer to consumer, to make food and drink production and consumption more sustainable. It sets a target of 20 per cent reduction in food and drink waste, and the associated GHG emissions per person, by 2025. The Mayor will go further by setting a 50 per cent reduction

per head target by 2030, in line with emerging Sustainable Development Goal 12.3 reduction targets, and sign up as '12.3 Champion'.¹⁷⁹ Achieving this target will lead to a significant reduction in the core materials associated with food packaging: paper, card, plastic, glass, tins and cans, which collectively make up around 75 per cent of municipal waste.

The Mayor will be a key engagement partner to C2025, and working with WRAP and LWARB will strive to go beyond these targets in London and encourage C2025 members to go further. Through working with C2025 members, LWARB and Resource London, waste authorities and other relevant parties, the Mayor will support campaigns, including Recycle for London, Love Food Hate Waste, and Trifocal to help Londoners and businesses to reduce waste. The Mayor will apply lessons and best practice taken from previous programmes, such as the GLA's Foodsave programme. Foodsave worked with 170 business and charities, helping small businesses to save around £6,000 per year from reducing food waste and collectively preventing around 1,200 tonnes of food waste going to landfill or incineration.

¹⁷⁸ GLA (n.d.) Collaborative Procurement Board. Accessed from: <https://www.london.gov.uk/about-us/mayor-london/collaborative-procurement-board>

¹⁷⁹ Sustainable Development Goal 12 (SDG 12) seeks to "ensure sustainable consumption and production patterns." The third target under this goal (Target 12.3) calls for cutting in half per capita global food waste at the retail and consumer level, and reducing food losses along production and supply chains (including post-harvest losses) by 2030. More information is available at <https://champions123.org/target-12-3/>

Proposal 7.1.1.b The Mayor will support campaigns and initiatives to cut the use of single use packaging

Plastic packaging blights our streets and finds its way into oceans, harming wildlife and taking centuries to break down whilst releasing toxic chemicals. Single use plastic bottles form the most prevalent form of plastic packaging in our oceans and accelerated action is needed to phase out non-recyclable plastic packaging. Some large companies have already responded to this challenge, pledging to ensure 100 per cent of its plastic packaging is fully reusable, recyclable or compostable by 2025. The Ellen MacArthur Foundation (EMF) have also unveiled a business backed action plan as part of its New Plastics Economy work to crack down on plastic waste and recycle 70 per cent of plastic packaging globally.

The Mayor calls on food and drink businesses to offer incentives for their customers to use their own reusable drink cups and water bottles. This will significantly reduce the amount of litter in our streets and waterways. In addition, the Mayor will also take the following actions to reduce the amount of plastic bottles and single use cups:

- pilot water refill schemes in different areas of London to test their effectiveness for improving access to tap water. The Mayor will work with City to Sea, the Zoological Society of London (ZSL), and other partners to use the insights from the pilots to inform the roll out of a London-wide water refill scheme
- work with ZSL's Oneless campaign to install 20 drinking water fountains as an initial pilot
- provide funding over three years to fund the installation of more drinking water fountains and behaviour change campaigns to drive a water refill culture
- require new major public realm developments to install water fountains in appropriate locations
- work with Transport for London and Network Rail to identify suitable locations in the transport network to be refill points



Credit: Michelle Cassar, City To Sea

- lead by example across the GLA group by phasing out plastic bottle sales, removing single use plastics in cafes and facilities, and improving access to tap water on all GLA premises
- work with the supply chain, from manufacturers to retailers, and large employers to waste authorities, to roll out measures to cut the impact of single-use coffee cups, such as increasing recycling facilities, or supporting initiatives to increase use of reusable cups
- work with partners to trial a deposit return scheme for plastic bottles and other commonly recycled materials in London, while government decides what it will do at a national level

Proposal 7.1.1.c The Mayor will support campaigns, initiatives and business models to reuse materials

The Mayor will work with LWARB, Ellen MacArthur Foundation and other partners to implement LWARB’s Circular Economy Route Map and develop a circular business programme to increase reuse of materials. This will support entrepreneurs and businesses to adopt, scale up and benefit from circular economy business models in five main areas: products as a service, sharing economy, prolonging product life, renewable inputs, and recovering value at end of life.

The Mayor, through LWARB, will invest funds into developing businesses that embrace the circular approach to resource use especially businesses with reuse, repair and remanufacturing projects and those using low carbon technologies. LWARB will also invest in a circular economy growth capital fund and accelerator to provide support for those companies who will be growing the circular economy in London, and delivering the co-benefits of GHG emission reductions and increased resilience for the city.

The Mayor will work with organisations including the Restart Project, Globechain and Warpit to boost materials repair and help divert unwanted items to useful purposes.

Proposal 7.1.1.d The Mayor will lead by example to cut waste and encourage reuse through the GLA group’s operations and procurement activities

Suppliers to the GLA group will be required to take measures to reduce the waste produced in the services that they provide, and increase repair and reuse of products. The Mayor expects London waste authorities to show leadership to reduce waste and increase resource efficiency locally through their own procurement activities, using the Mayor’s Responsible Procurement Policy as a best practice standard.

Policy 7.1.2 The Mayor will seek to ensure that London is provided with additional funding, and new powers if necessary, to take faster action to help cut waste, increase recycling rates, and accelerate London's transition to a circular economy

Proposal 7.1.2.a The Mayor will work with LWARB and London's boroughs to secure the ongoing provision of funding for LWARB and for waste authorities

Unprecedented funding cuts to local authority budgets has stifled investment in waste and recycling collection services, as boroughs are forced to make savings. Government funding for LWARB, a statutory body established to support the delivery of sustainable waste management in London, finished in 2015 with no further provision made by government. LWARB has budget to deliver its Business Plan objectives to 2020, and will consider its options thereafter.

Without a guarantee of further funding and fast action from government, it will not be possible for London, or England, to meet statutory waste targets, let alone accelerate the transition to a circular approach.

The Mayor will seek London's fair share of funding from the government's £2.5bn Clean Growth Strategy fund and other national funds. The Mayor also calls on government to devolve to London its share of landfill tax receipts (estimated at around £93m per annum). This can be used to support local authority activities to cut waste, improve reuse and recycling collection services, and invest in activities supporting London's transition to a circular economy.

Proposal 7.1.2.b The Mayor will work with the government to ensure that its Waste and Resources Strategy provides the tools for London to achieve the Mayor's waste reduction and recycling targets

The Mayor welcomes the proposals in the government's 25 year Environment Plan to tackle plastic waste and set minimum recycling collection service standards. The government's forthcoming Waste and Resources Strategy is a key opportunity to set out a comprehensive approach using the tools uniquely available to government, such as legislation, fiscal incentives and revenue raising. The Mayor is calling for action on the priorities set out below:

Packaging - set minimum standards of design for reuse and recyclability, and strengthen Extended Producer Responsibility requirements for packaging materials, specifically plastics. Government should review the Packaging Recovery Note (PRN) system to create a new "Plastics Obligation", which would require minimum levels of recycled content in plastic products. Together, this will help drive out products not easily recycled from the supply chain, drive investment in reprocessing capacity, and put more responsibility on manufacturers to get back their materials for reuse and recycling.

Incentives - introduce tax relief, such as variable rates of VAT, on materials innovation that reduces waste and reliance on virgin materials, and increases materials reuse, repair and remanufacture. This should include tax relief on materials with recycled content in them and on repair services (for example, on bicycle and appliance repair services).

Performance metrics - traditional weight based measures incentivise chasing the heaviest materials instead of focusing on resource efficiency and

reducing waste. The government should establish other performance metrics and targets, including materials productivity and carbon as the Mayor has done. This would encourage London waste authorities to focus on materials and management methods that achieve the greatest economic and environmental benefits, including CO₂ reduction, helping to make London a zero carbon city. The Mayor has adopted a carbon based approach to London's municipal waste management (see Objective 7.3).

Monitoring and reporting - establish a mandatory national data reporting system for municipal waste that is straightforward to use and understand. There is currently no requirement to report business waste, and there is very limited or robust data available. This means that the extent of waste being produced by businesses, and the level of recycling, are based on estimates.

Business recycling - businesses should be required to separate materials for recycling to help drive up recycling performance. The Scottish Environment Protection Agency (SEPA) introduced this requirement in 2014. Compliance sampling of around 6,500 premises undertaken in 2016 showed around two thirds of businesses were fully compliant, and around 80 per cent were making efforts to separate materials for recycling.

OBJECTIVE 7.2 MAXIMISE RECYCLING RATES

The Mayor expects London to achieve an overall 65 per cent municipal waste recycling rate (by weight) by 2030. Achieving this target will require a significant improvement in both the household and business components of municipal waste recycling, from the current rate of 41 per cent. To help achieve this, a separate 50 per cent LACW recycling target is set for waste authorities under Proposal 7.2.1.a, to encourage local authorities to continue striving for high recycling performance.

However, with the Mayor's limited powers and funding, these actions alone will not be enough for London to achieve the targets set out in this strategy. Further action is required from government, the boroughs, the waste industry, and other partners, as well as Londoners themselves, to ensure that London is put on track to cut waste and achieve a recycling rate of 65 per cent by 2030. Table 2 sets out the improvements needed in order to meet both the Mayor's 50 per cent LACW recycling target by 2025 (Policy 7.2.1) and achieve a minimum of 75 per cent business waste recycling by 2030 (Policy 7.2.2).

**"The Mayor
expects London
to achieve an
overall 65 per cent
municipal waste
recycling rate (by
weight) by 2030."**

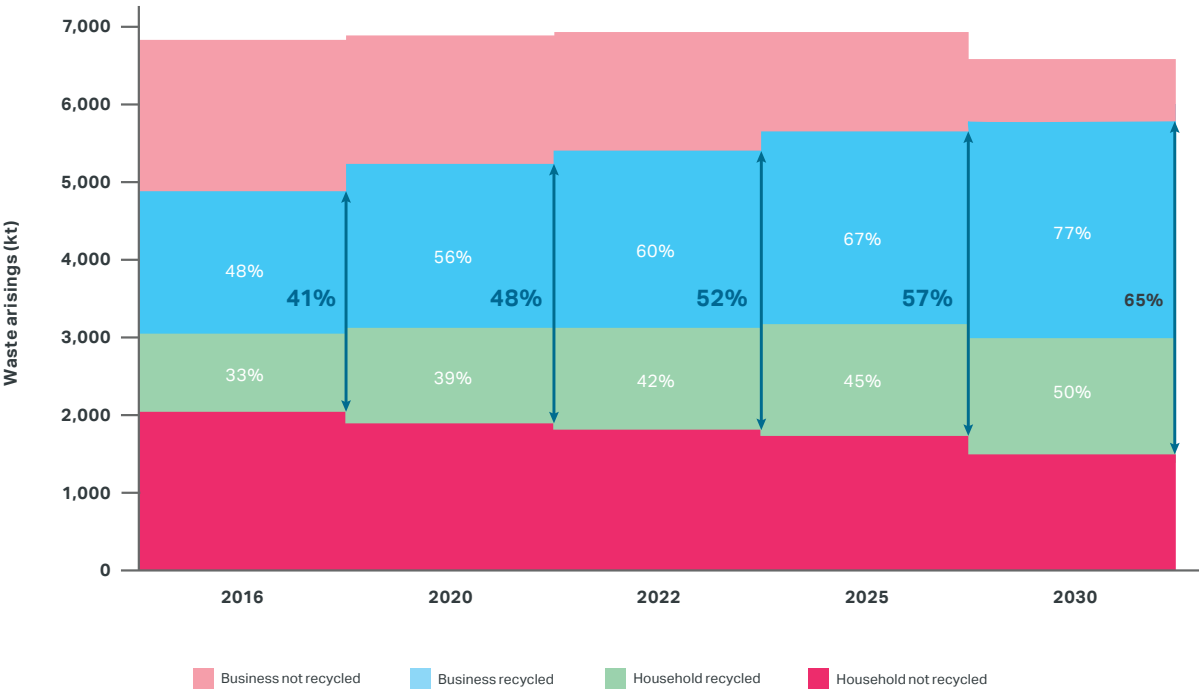
Table 2: Interventions needed to achieve 65 per cent municipal waste recycling rate by 2030

Achieving 50 per cent LACW recycling by 2025 (Policy 7.2.1)	Achieving a minimum of 75 per cent recycling of business waste by 2030 (Policy 7.2.2)	Additional government interventions needed (see Policy 7.1.2 for more details)
<p>Minimum level of service to households:</p> <ul style="list-style-type: none"> • six main dry recycling materials collected from all properties • separate food waste collections, including from flats where practical and cost effective • focus on improving performance from flats <p>Boroughs are encouraged to consider a range of measures to restrict residual waste, for example through smaller bin containers or changes to collection frequency</p> <p>Extend minimum level of household service to non-domestic properties (for example schools, and government departments, and businesses)</p> <p>Garden waste collections or activities supporting community or home composting</p>	<p>Minimum level of service – similar to households</p> <p>Waste consolidation – reducing the number of service providers in specific areas</p> <p>Increased collaboration with waste collectors on tools and support for businesses to recycle more</p> <p>Data sharing and reporting to better understand London’s business waste performance</p>	<p>National minimum level of recycling service of the six main dry recyclables and separate food waste</p> <p>Requirements for businesses to separate materials for recycling similar to households</p> <p>Mandatory national system for reporting all municipal waste to establish a clear baseline to set targets from</p> <p>Minimum standards of design for reuse and recyclability for packaging materials</p> <p>Strengthened Extended Producer Responsibility requirements for packaging materials, prioritising plastics</p> <p>Additional funding, including devolving London’s share of landfill tax credits to London, to invest in recycling infrastructure</p> <p>Tax relief and incentives on materials innovation that reduces waste and increases use of repaired, reused and recycled materials</p>

Figure 45 shows the improvement needed for London to move from a 41 per cent municipal waste recycling rate today, to 65 per cent by 2030. This milestone can be achieved but relies on significant increases recycling performance from businesses, from around 48 per cent today to a minimum of 75 per cent by 2030. The waste of resources this represents is unacceptable and, whilst challenging,

the Mayor expects business to rise to the challenge, just as Londoners seek to do. Implementing the best set of household waste recycling services identified in WRAP modelling (see Appendix 2) would contribute a nine percentage point increase in recycling, from 33 per cent today to 42 per cent by 2022. The Mayor's ambition is to achieve 50 per cent household waste recycling by 2030.

Figure 45: Modelled pathway for achieving a 65 per cent municipal waste recycling rate by 2030¹⁸⁰



¹⁸⁰ GLA Waste model. Household waste and recycling figures taken from Defra waste data flow statistics. Non-household waste and recycling figures are estimates only informed by the Defra C&I waste survey 2009.

Figure 46 sets out the scale of improvement needed to boost LACW recycling performance based on WRAP modelling. Figure 47 sets out the scale of improvement needed to boost business waste recycling performance.

Figure 46: Achieving the 50 per cent LACW recycling target by 2025¹⁸⁰

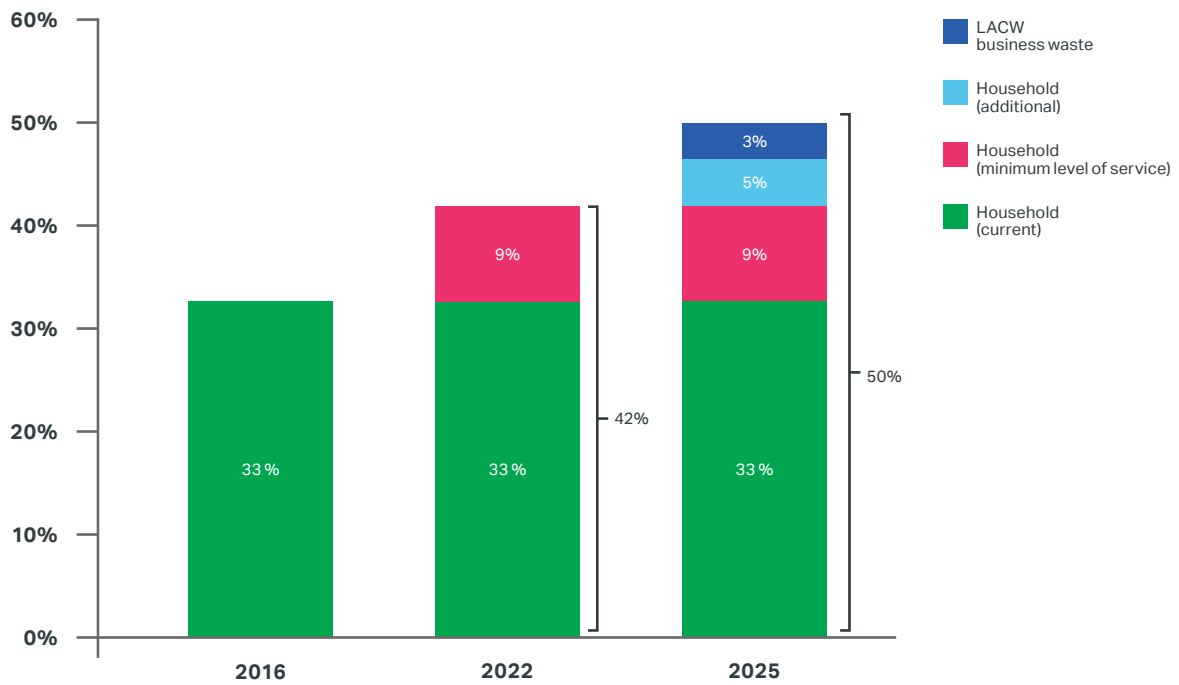
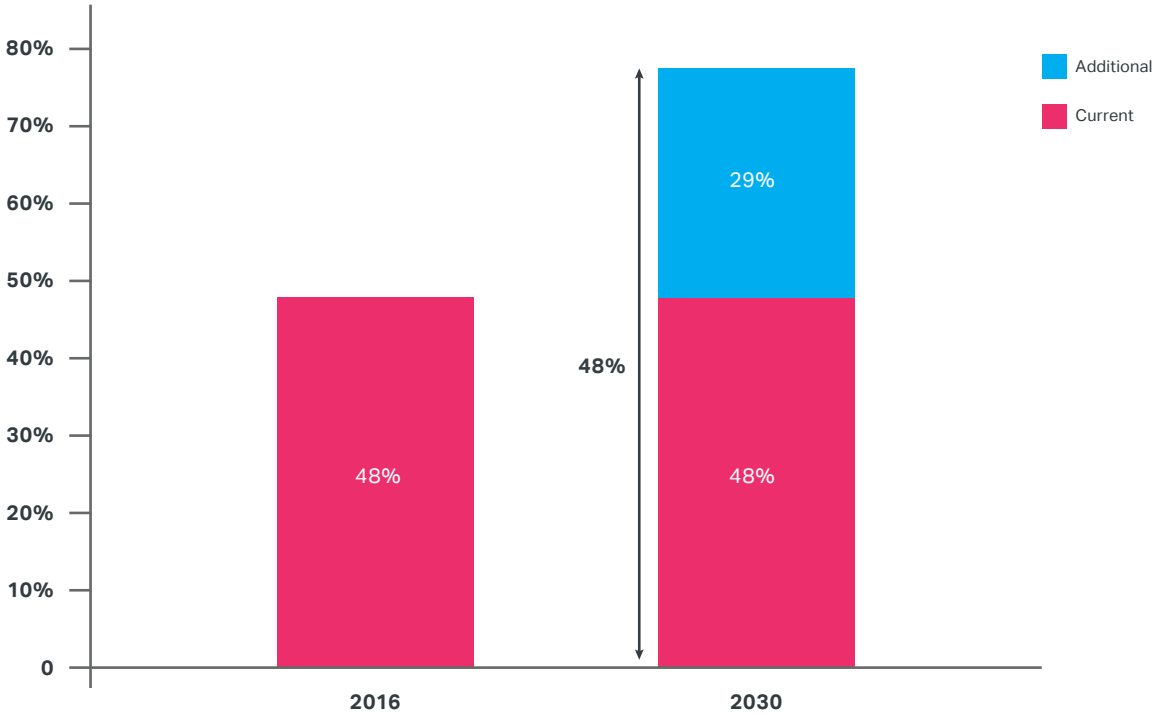


Figure 47: Achieving a minimum of 75 per cent recycling of business waste by 2030¹⁸⁰



“The Mayor expects waste authorities to collectively achieve a 50 per cent LACW recycling target by 2025.”

Achieving the 65 per cent overall municipal waste recycling target requires more consistent services to be offered across London. For households, these include separate food waste collections, collecting the same core set of dry recycling materials and measures to reduce the residual waste presented for collection. Introducing separate food waste collections, in particular, has been proven to boost recycling rates and reduce contamination with dry recycling materials. This also reduces the amount of food people waste, as people become more aware of how much they are throwing away. An intense focus on recycling from flats is also needed.

Government will also need to strengthen policy to drive more recycling, including ensuring London has adequate funding to implement recycling infrastructure and support for waste authorities to enable Londoners and businesses to recycle more materials.

Implementing the best set of household recycling interventions is estimated to cost waste authorities an extra £107m-£319m. This can be offset by income from business waste recycling services, reduced disposal costs,

and developing more shared revenue contracts from sale of recyclables and energy. The South London Waste Partnership is expecting savings of over £200m from bringing together their contracts in a more efficient and cost effective way. It means that the same services are now offered to all who live in the partnership's four boroughs of Sutton, Merton, Kingston-upon-Thames and Croydon.

Policy 7.2.1 Increase recycling rates to achieve a 65 per cent municipal waste recycling rate by 2030

Proposal 7.2.1.a The Mayor will set targets for local authority collected waste, a minimum level of service for household waste recycling collections and hold a contract register of waste authority waste contracts

The Mayor expects waste authorities to collectively achieve a 50 per cent LACW recycling target by 2025 and aspire to achieve:

- a 45 per cent household waste recycling rate by 2025
- a 50 per cent household waste recycling rate by 2030

As circular economy business models (such as promoting sharing, leasing, design for durability and predictive maintenance) and material specific policies take hold, the amount of waste produced or that can be recycled will fall. The Mayor will keep his recycling targets under review, based on the progress of London's transition to a circular economy. This will encourage materials to be used at their highest value for as long as possible, and avoid incentivising recycling over and above the more desirable options of reduction and reuse. To help them achieve the recycling targets, waste authorities should deliver the following minimum level of service for household recycling:

- all properties with kerbside recycling collections to receive a separate weekly food waste collection
- all properties to receive a collection of, at a minimum, the six main dry recycling materials, i.e. glass, cans, paper, card, plastic bottles and mixed rigid plastics (tubs, pots and trays)¹⁸¹

¹⁸¹ In line with market, reprocessors and recycling industry standards.



Waste authorities will need to demonstrate how they will meet the above minimum level of service by 2020 (at the latest), and also look to provide separate food waste collections to flats where feasible. They should also collect other items for recycling from households, such as small electrical waste, foil, tetra packs and garden waste, where it makes sense to do so. Waste authorities are expected to provide the minimum level of service to non-domestic properties, including schools and public organisations.

Some waste authorities have experienced cost savings and recycling improvements from reduced collection of residual waste, through reducing bin sizes or changing the frequency of collections. The Mayor encourages waste authorities to consider such interventions.

Modelling and research in the evidence base (see Appendix 2) shows where the opportunities are to improve waste authority collection recycling performance. It includes what can be realistically achieved at a borough level and addresses the issue of London's low performing recycling rate and fragmented collection services.

Achieving the 50 per cent LACW recycling target will inevitably mean some waste authorities achieving higher recycling rates than others, recognising that there are local circumstances and challenges, particularly in those boroughs with a high proportion of flats.

Proposal 7.2.1.b The Mayor expects local authorities to develop reduction and recycling plans by 2020, which should include local reduction and recycling targets that contribute to the Mayor's London-wide targets

Reduction and recycling plans should reflect borough circumstances. They should also take account of WRAP modelling, which estimated the household waste recycling rate that each waste authority could realistically achieve through implementing the Mayor's minimum level of service and restricting residual waste (see Appendix 2 for details). Resources have been made available through LWARB to assist waste authorities in preparing the plans. The plans must be agreed with the Mayor and reviewed every four years. The Mayor will also hold a contract register to monitor when waste authority contracts come up for renewal. Waste authorities, in developing their waste contracts,

will need to share relevant contract information and notify their intention to procure in the register. The register will be available for all waste authorities to view and therefore provide joint working opportunities. The Mayor will seek views on which contracts are most appropriate for inclusion in the register.

Through the contract register, and working with LWARB and waste authorities, the Mayor will identify opportunities to promote greater consistency to help harmonise waste and recycling services in London. This will result in the best economy of scale and service provision benefits.

Support will continue to be available, through LWARB's Resource London programme, for waste authorities to model the impact on their recycling rates and identify the mechanisms to achieve a minimum level of service, in a cost effective and accelerated way.

Proposal 7.2.1.c The Mayor will support efforts to increase recycling rates in flats

The Mayor will encourage Resource London to provide more support and funding to those waste authorities that

are working towards achieving higher recycling performance in flats. Through LWARB, the Mayor will seek additional funding to tackle recycling performance in flats. The London Plan requires that all new developments referred to the Mayor include adequate recycling storage for at least the six main dry recyclable materials and food.

Waste authorities, through the planning application process, should apply the waste management planning advice for flats, including the domestic rented sector,¹⁸² developed by LWARB in partnership with the London Environment Directors Network (LEDNET).

Proposal 7.2.1.d The Mayor, through LWARB, will support waste authorities to boost business reuse and recycling performance

Waste authorities should identify opportunities to improve their own business waste recycling services. Waste authorities are expected to offer businesses the same household minimum level of service where feasible. Support is available through LWARB to boost business recycling services.

¹⁸² Resource London (n.d.) Toolkits. Accessed from: <https://resourcelondon.org/resources/toolkits/>

Policy 7.2.2 Increase recycling rates for commercially collected waste and reduce litter and fly tipping

The Mayor will work with LWARB, the waste sector generally, and other stakeholders to improve recycling services to businesses provided by commercial waste contractors. This will be necessary to achieve the Mayor's overall 65 per cent municipal waste recycling target by 2030. It will also provide local air quality and street scene benefits by reducing the number of waste vehicles on the road. The Mayor expects businesses to be offered the same level of recycling service offered to households.

Proposal 7.2.2.a The Mayor will support efforts to consolidate commercially collected waste services to improve recycling performance, reduce congestion, improve the public realm and improve air quality

There have been recent pilot studies in London in Bond Street Business Improvement District (BID) and New York on consolidating waste services. These look at introducing a single waste contractor to run collections to businesses in a designated area. The pilots were successful in helping to reduce the number of collection vehicles and improve local air quality.

Bond Street saw a 94 per cent drop in waste vehicle movements. As a result, TfL has developed a free toolkit helping neighbouring businesses to consolidate their waste collection services, to save money and reduce vehicle movements. New York City are now taking this one step further and looking into establishing a commercial waste zone system across the city, where waste collection companies bid to be part of a geographical framework to provide waste and recycling services to business in the city. They want to find out where there are inefficiencies in how waste is collected, and whether collection zones can reduce these by creating benefits like better recycling rates, working conditions and wages.

The Mayor will work with TfL and BIDs to promote TfL's Freight, Delivery and Servicing Plan, which includes a waste contract consolidation toolkit. The Mayor will look at the feasibility of a commercial waste framework in London. The Mayor will also work with Defra and waste companies to improve commercial waste data ensuring all waste operators in London are using Electronic Duty of Care to record what happens to the waste they produce and handle. This improved data will allow opportunities for consolidated services to be identified more easily.

Proposal 7.2.2.b The Mayor will work with waste authorities and other partners to cut single use packaging and promote Duty of Care requirements to reduce littering and fly tipping

Local authorities are responsible for litter, and enforcing and prosecuting small scale illegal dumping of waste (fly tipping). The Environment Agency is responsible for prosecuting large scale offences. Fly tipping in London is a big problem due to the cost of clearance and its negative effect on the streetscape. Proposal 7.1.1b sets out the Mayor's plans for cutting single use packaging.

The Mayor will work with government and the Chartered Institute of Waste Management (CIWM) to promote duty of care¹⁸³ to waste authorities and businesses, taking all reasonable steps to ensure that waste is managed properly to reduce the likelihood of fly-tipping. The Mayor will use, for example, the CIWM Right Waste, Right Place campaign to build on any knowledge gaps on the responsibility for businesses to use a licensed waste carrier, and the penalties for not doing so.

OBJECTIVE 7.3 REDUCE THE ENVIRONMENTAL IMPACT OF WASTE ACTIVITIES

Reducing the environmental impact of how London manages its waste is important if London is to become a zero carbon city with a zero emission transport network by 2050. The Mayor wants to make sure that waste authorities are contributing all they possibly can to these ambitions through decarbonising and cleaning up their fleets.

There is also an opportunity to reduce GHG emissions from all waste management activities. In 2010, the GLA developed a pioneering emissions performance standard (EPS) to assess the GHG emissions associated with the collection, treatment, energy generation, and final disposal of London's LACW.

While the Mayor has a weight based target of 65 per cent of municipal waste being recycled overall by 2030, a carbon based EPS approach will also be retained that will sit alongside this target. Sending waste to landfill or incineration generates GHG emissions whereas recycling materials avoids GHG emissions that would have otherwise occurred in the manufacturing of products from virgin materials. A carbon based approach promotes recycling, particularly of high carbon and high value materials, such as plastic, metals and textiles.

¹⁸³ This duty of care is imposed under section 34 of the Environmental Protection Act 1990.

Policy 7.3.1 Reduce emissions from transport of waste

Proposal 7.3.1.a Waste authorities must demonstrate how they will transition their waste fleets to low or zero emission options, prioritising the phasing out of diesel

Waste authority waste fleets are expected to comply with the Ultra Low Emission Zone (ULEZ) vehicle exhaust emission standards and to work towards the Mayor's overall ambition for:

- all new cars and vans (less than 3.5 tonnes) being zero emission capable from 2025
- all heavy vehicles (greater than 3.5 tonnes) being fossil fuel-free from 2030
- zero emission fleets by 2050

Fossil-fuel free can include the use of 100 per cent renewable fuels derived from sources such as food waste and waste oils.

Working with waste authorities, TfL, and the waste industry the Mayor will increase the use of renewable fuels from waste derived sources including biodiesel, hydro-treated vegetable oil and bio-methane, as a transition fuel, in municipal waste fleets.

“Reducing the environmental impact of how London manages its waste is important if London is to become a zero carbon city with a zero emission transport network by 2050.”



Credit: Veolia Southwark IWMF

Waste authorities, in procuring their waste fleets and waste transport services, should demonstrate how they will promote the use of sustainable transport modes, renewable fuels and other low emission options in their relevant tender specification documents.

Proposal 7.3.1.b The Mayor will work with stakeholders to encourage a reduction in municipal waste transported by road and will increase its transportation by rail and river

The Mayor will work with waste authorities, TfL, National Rail, the Port of London Authority, and other relevant stakeholders to increase the transportation of municipal waste by rail and river. This will not only reduce congestion on the roads but will also deliver air quality and carbon emission benefits.

Policy 7.3.2 Reduce the climate change impact of waste activities

Proposal 7.3.2.a Waste authorities, in delivering their waste management functions, are expected to demonstrate how they can meet the greenhouse gas Emissions Performance Standard (EPS)

The Mayor has set a revised EPS for London's LACW activities to work towards achieving. Waste authorities should aim to achieve both the Mayor's LACW recycling targets and EPS targets although the Mayor's LACW targets will take priority. Achieving high recycling rates generally offers the greatest opportunity for reducing CO₂e emissions and meeting the EPS. The Mayor will develop guidance on achieving the weight based recycling targets and meeting the EPS. The Mayor has developed an online ready reckoner tool to support boroughs in modelling their waste options against the EPS.¹⁸⁴ Meeting the EPS is best achieved by:

¹⁸⁴ www.london.gov.uk/what-wedo/environment/waste-and-recycling/waste-policy

- reducing waste and increasing reuse
- maximising recycling rates, targeting materials with high embodied carbon (plastics, metals, and textiles)
- generating low carbon energy from organic waste (for example anaerobic digestion of food waste)
- using waste derived fuels (as a transition fuel) and other low CO₂ transport options
- making sure only truly non-recyclable waste is going for energy generation
- avoiding landfill

In performing their waste functions, the Mayor expects waste authorities to set out how their waste activities achieve the following EPS targets:

- -0.069 tonnes CO₂e per tonne of waste managed by 2020/21
- -0.084 tonnes CO₂e per tonne of waste managed by 2024/25
- -0.167 tonnes CO₂e per tonne of waste managed by 2030/31

The Mayor will monitor and report annually on London’s performance against the EPS and keep the targets under review to ensure they continue to drive performance. The Mayor will work with the Environment Agency to ensure that there are no adverse impacts on the environment, including air quality. See Appendix 2 for more details on how the EPS has been calculated.

Proposal 7.3.2.b Waste authorities must demonstrate how solutions generating energy from waste (EFW) meet the carbon intensity floor (CIF), or put in place demonstrable steps to meet it in the short-term

The Mayor does not believe it necessary to have any additional EFW facilities built in London to manage municipal waste. Modelling shows that if London achieves a 65 per cent recycling target by 2030, no additional EFW facilities (other than those already granted planning permission) will be required in London to manage municipal waste. The Mayor expects all of London’s EFW facilities to only manage truly non-recyclable waste, and maximise the use of both the heat and power generated.

To support this, and in addition to developing the EPS, a minimum carbon emissions performance standard has been set. The CIF was developed to help decarbonise London's energy supply by encouraging clean, efficient and local energy generation from London's non-recycled waste. Waste going to EFW plants often contains large amounts of recyclable materials that are high carbon and high value. Reducing the amount of high carbon materials particularly plastics and metals going to EFW plants will deliver GHG savings, and reduce the reliance on fossil fuels. This will drive change and investment within boroughs and with facility operators, to ensure that truly residual waste is used to generate both heat and power for the benefit of Londoners.

The Mayor will retain, for waste authorities, a target CIF level of 400 grams of CO₂ per kWh of electricity produced from LACW until at least 2025.

Meeting this CIF target effectively rules out the use of traditional mass burn incineration techniques generating electricity only. It supports the take up of highly efficient technologies generating both heat and power. Achieving the CIF target can be done by:

- reaching high recycling rates, including for plastics, metals and textiles. This reduces the 'carbon intensity' of residual waste going to energy generation
- pre-treatment to remove recyclable materials from the residual waste stream
- generating energy from 100 per cent organic waste (for example anaerobic digestion of food waste). This is deemed to be carbon neutral
- using energy generation facilities generating both heat and power
- using waste derived fuels and other low CO₂ transport options

Steps to demonstrate compliance with the CIF should include but are not be limited to:

- ongoing reductions in the amount of high carbon materials sent for incineration or gasification that could be recycled
- activities resulting in investment in technology or infrastructure improving the overall efficiency of the facility to meet the CIF

“The Mayor wants to retain the economic value of London’s waste within London and ensure that London can manage net 100 per cent of its waste within the city by 2026.”

- waste authorities and relevant facility operators actively supporting roll out of existing energy master plans to help connect heat infrastructure to local developments

The CIF will be reviewed in 2025, or earlier where appropriate, once London’s heat networks and demand are better understood, with a view to tightening it to around 300 grams per kWh of electricity produced. See Appendix 2 for more details on how the CIF has been calculated.

The Mayor, through the Decentralised Energy Enabling Programme (see Chapter 6), will continue to work with London’s incinerator operators and waste authorities to identify solutions that can meet the CIF as they develop their waste contracts and strategies. This may include linking EFW options proposed in their contracts with proposals in local energy master plans that support waste heat recovery opportunities. Opportunities include connecting to existing homes and to new developments delivered through GLA Housing Zones, Opportunity Areas, and other major development schemes.

OBJECTIVE 7.4 MAXIMISE LOCAL WASTE SITES AND ENSURE LONDON HAS SUFFICIENT INFRASTRUCTURE TO MANAGE ALL THE WASTE IT PRODUCES

The Mayor wants to retain the economic value of London's waste within London and ensure that London can manage net 100 per cent of its waste within the city by 2026.

In 2015 London managed around half the waste it produced within London. Most exported waste goes to landfill mainly in the south east, and, along with it goes the economic value of recovered materials for reuse, recycling or energy generation. Although waste to landfill has declined by 70 per cent since 2005, London still landfills around 1 million tonnes of waste each year costing around £100 million.¹⁸⁵ Landfills accepting London's waste are expected to close by 2026 and no new capacity is planned. To deal with this London needs to firstly reduce waste produced and secondly ensure it has access to sufficient capacity to recover value from more of its waste and remove any reliance on landfill.

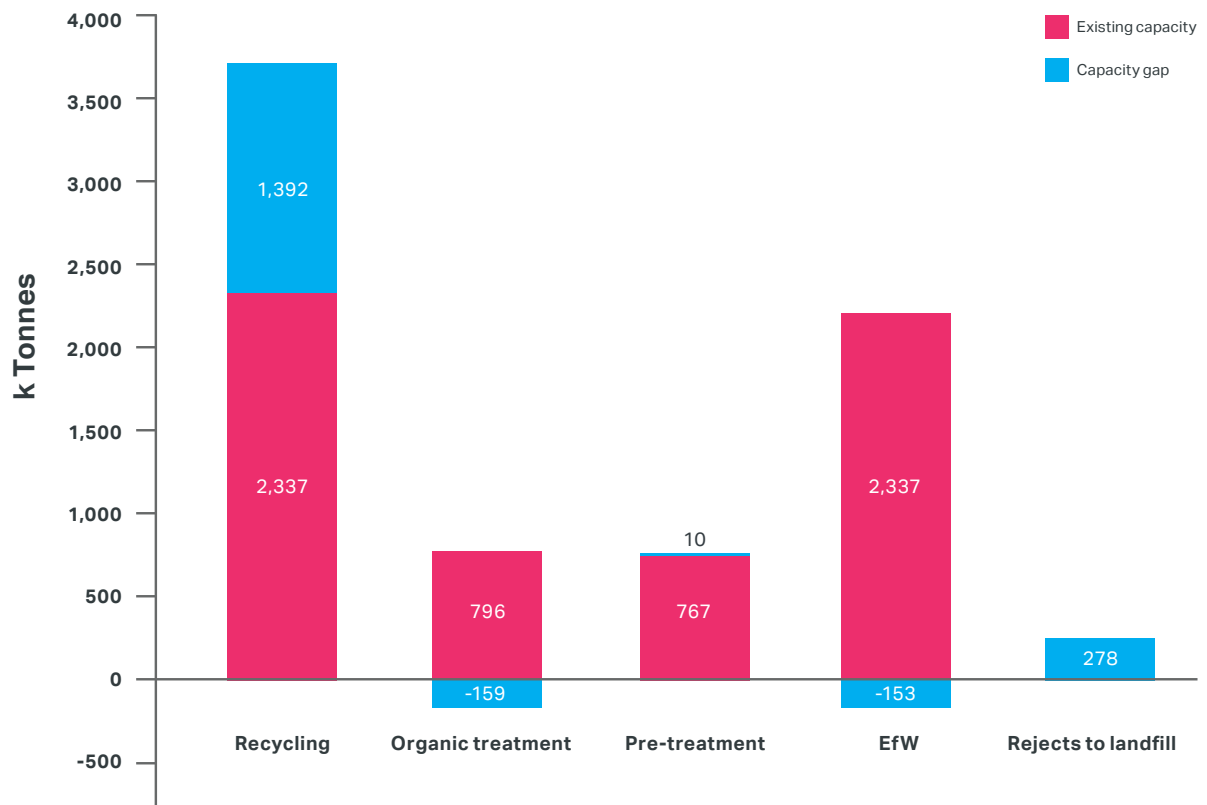
Figure 48 sets out London's municipal waste infrastructure capacity requirements for achieving the Mayor's waste reduction and recycling targets by 2030, and meeting the self sufficiency target by 2026. It shows that London faces a significant recycling capacity gap of around 1.4 million tonnes. The Mayor is challenging the waste industry to collaborate on identifying the best opportunities both inside and outside London to increase recycling capacity. This could include, for example, using more of London's transfer sites to sort or process materials for recycling elsewhere.

Achieving the Mayor's reduction and recycling targets will mean that no new energy from waste facilities in London will be needed, with an expected 153,000 tonnes surplus EFW capacity by 2030. More details on waste infrastructure modelling requirements, including recycling scenarios to achieve different recycling rates, can be found in Appendix 2.

The Mayor, in the London Plan, sets out how waste sites in London will be identified and safeguarded, to enable net 100 per cent of London's municipal waste to be managed within London by 2026.

¹⁸⁵ Based on landfill costs of £102 per tonne including 2016 landfill tax rate of £84.40 per tonne. Source WRAP gate fees report 2016.

Figure 48: London’s infrastructure capacity requirements by 2030. The blue bars above zero indicate a capacity shortfall within London. Blue bars below zero indicate surplus capacity¹⁸⁶



¹⁸⁶ GLA Municipal Waste Model 2017

Policy 7.4.1 Supporting the use of local waste sites and promoting a circular approach to waste management

Proposal 7.4.1.a Waste authorities, in developing their waste contracts and services, will need to identify how to maximise the use of local waste facilities and identified sites for waste

The Mayor expects waste authorities to use local waste sites where they deliver clear local benefits, helping to keep the value of London's waste in London. Waste authorities should ensure that local Reuse and Recycling Centres (RRCs) have the necessary permits for residents and businesses to safely and effectively recycle and dispose of a wide range of materials. This includes common hazardous household waste items, such as paints, oils, gas bottles, fire extinguishers, waste electrical, and cleaning products. The Mayor encourages waste authorities to have reciprocal arrangements in place, allowing residents and businesses in neighbouring boroughs to access RRCs, particularly where they are located close to borough boundaries, to promote convenient access and reduce the likelihood of fly tipping.

The GLA, supported by the Environment Agency and London Waste Planning Forum has developed a GIS map of London's waste facilities.¹⁸⁷ The London waste map, updated on an annual basis, is publicly available to help London waste authorities, its two Mayoral Development Corporations and waste facility operators to identify and access local waste facilities and find suitable sites for new facilities.

Proposal 7.4.1.b The Mayor will support the development of new waste infrastructure supporting the circular economy outcomes of reuse, repair, and remanufacture

Through LWARB, the Mayor will encourage investment into new waste facilities where they are needed.

The Mayor wants to see London's waste sites optimised to support circular economy activities like reuse and repair, providing environmental and social benefits by creating new jobs and apprenticeships. This will be supported by LWARB's Advance London work programme, which will enable and provide support and funding to businesses that use circular economy business models.

¹⁸⁷ Mayor of London (n.d.) London Waste Map. Accessed from: <https://maps.london.gov.uk/webmaps/waste/>



Chapter 8: Adapting to climate change

AIM

London and Londoners will be resilient to severe weather and longer-term climate change impacts. This will include flooding, heat risk and drought.

INTRODUCTION

As a growing city, London faces increasing pressure on housing, infrastructure, services, environment, and Londoners' wellbeing and prosperity. Climate change will increase these existing pressures. It will make flooding more frequent and severe, threaten water resources, and increase the risk of overheating for buildings and infrastructure.

Global average temperatures have risen by over 1°C since 1850. If the world continues emitting greenhouse gases (GHGs) at today's levels, then average global temperatures could rise by up to 5°C by the end of this century. Average temperatures in London are already getting higher. The total amount of rainfall over a typical year is likely to remain broadly similar to current levels. However, there are likely to be seasonal changes, with summers generally becoming drier, and winters wetter (though there will be more variability in weather patterns). The rainfall that does occur is likely to be in more intense storms. This will increase the risk of flooding, especially surface water flooding. London is likely to be at higher risk of drought, as there will be less water to be captured in the summer and the groundwater will not be replenished during winter, and there may be greater demand for water during hotter periods.

Climate change will disproportionately affect those least able to respond and recover from it. Poorer Londoners will find it more difficult to recover from flooding, may be less able to afford air conditioning to keep cool in hotter summers, and will suffer more from the impacts of the urban heat island effect, which results in urban areas being warmer than surrounding rural areas.

The challenge is how to manage these complex, and often interacting, pressures to ensure London and Londoners can adapt to climate change and stay resilient to any severe weather events that do occur.

Adaptation requires managing risks for the longer-term, but to focus solely on risk management would be to overlook the many additional benefits of adaptation. For example, adaptation provides an opportunity to consider climate change alongside wider social, demographic, economic, environmental, and political priorities. This will help create a fairer, more prosperous, healthier, and more resilient city. Box 39 describes the differences between climate change resilience and adaptation.

BOX 39: CLIMATE ADAPTATION AND RESILIENCE DEFINITIONS

Adaptation is the process (or outcome of a process) that leads to a reduction in harm or risk of harm, or realisation of benefits associated with climate variability and climate change.

Resilience is the ability of a system to recover from the effect of an extreme load that may have caused harm.

Adaptation policies can lead to greater resilience of communities and ecosystems to climate change.

In order for London to adapt to climate change and be resilient to severe weather events, the following actions are required:

- London's infrastructure providers and businesses must understand and manage climate change risks and impacts to deliver resilient growth and services

- the risk of flooding must be reduced through appropriate flood defences and increased awareness
- London's water supply must be efficient, secure, resilient, and affordable
- people, infrastructure, and public services must be better prepared for extreme heat events and increased temperatures

LONDON'S ENVIRONMENT NOW

The key evidence to support the Mayor's ambitions for London to adapt to climate change is summarised below. You can find out more about the evidence behind the policies and proposals in Appendix 2.

The Climate Change Act 2008 sets the statutory framework for addressing climate change risks in the UK, and the GLA Act 1999 (as amended) requires the Mayor to consider the impact of climate change and potential mitigation proposals for adaptation for Greater London. For more details on the legislative and policy background see Appendix 4, and for information on the main responsibilities of various organisations see Appendix 3.

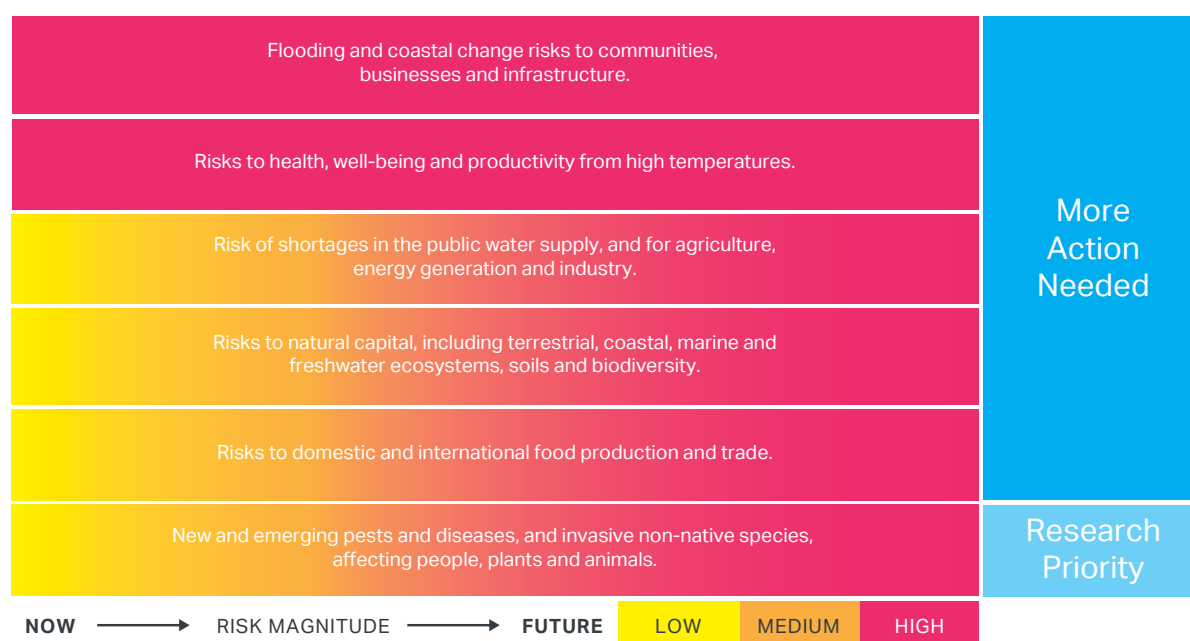
The major climate change risks to London were originally set out in London's Warming, an impacts evaluation study by the London Climate Change Partnership (LCCP) in 2002. Broadly, the risks and impacts identified were flooding, higher temperatures, and water scarcity. These would have knock-on impacts on biodiversity (for example, from invasive non-native species) and air quality, as well as a range of socioeconomic impacts (for example, food security, pests and pathogens). Since then, the risks and impacts associated with severe weather and climate change have been explored in depth for a range of sectors, including public health, transport, the natural environment, the economy, and housing. For example, London's water companies conduct their own assessments of the risks for water resources. The London Resilience Partnership, which brings together more than 170 organisations with specific responsibilities for preparing for, and responding to, emergencies, keeps a register of the main risks that London faces, including from climate change.¹⁸⁸

¹⁸⁸ London Resilience Partnership (2017) London Risk Register. Available from: <https://www.london.gov.uk/about-us/organisations-we-work/london-prepared/identifying-risks-london>

The Adaptation Sub-Committee of the UK's Committee on Climate Change published the UK's second Climate Change Risk Assessment evidence report in July 2016.¹⁸⁹ This recognised the major risks for the UK as a result of heat, flooding, and water scarcity.

These were grouped into six categories, where the climate risks pose a threat to human and ecological systems (Figure 49).

Figure 49: Top six areas of inter-related climate change risks for the United Kingdom¹⁹⁰



¹⁸⁹ Adaptation Sub-Committee of the Committee on Climate Change (2016) UK Climate Change Risk Assessment 2017. Available from: <https://www.theccc.org.uk/tackling-climate-change/preparing-for-climate-change/uk-climate-change-risk-assessment-2017/synthesisreport/>

¹⁹⁰ Committee on Climate Change Adaptation Sub-Committee (2016) UK climate change risk assessment 2017 synthesis report: priorities for the next five years. Accessed from: <https://www.theccc.org.uk/tackling-climate-change/preparing-for-climate-change/uk-climate-change-risk-assessment-2017/synthesis-report/>

The Adaptation Sub-Committee's description of the major risks from climate change helps make the risks specific in terms of their practical impacts and implications. It can be a useful basis for London to work with a range of sectors to reduce the risks from climate change. However, while the national risks broadly align with London's priority risks, there will be local variation. As such, they need to be understood in the context of the different characteristics, needs, and priorities across the city.

Interconnected risks and responses

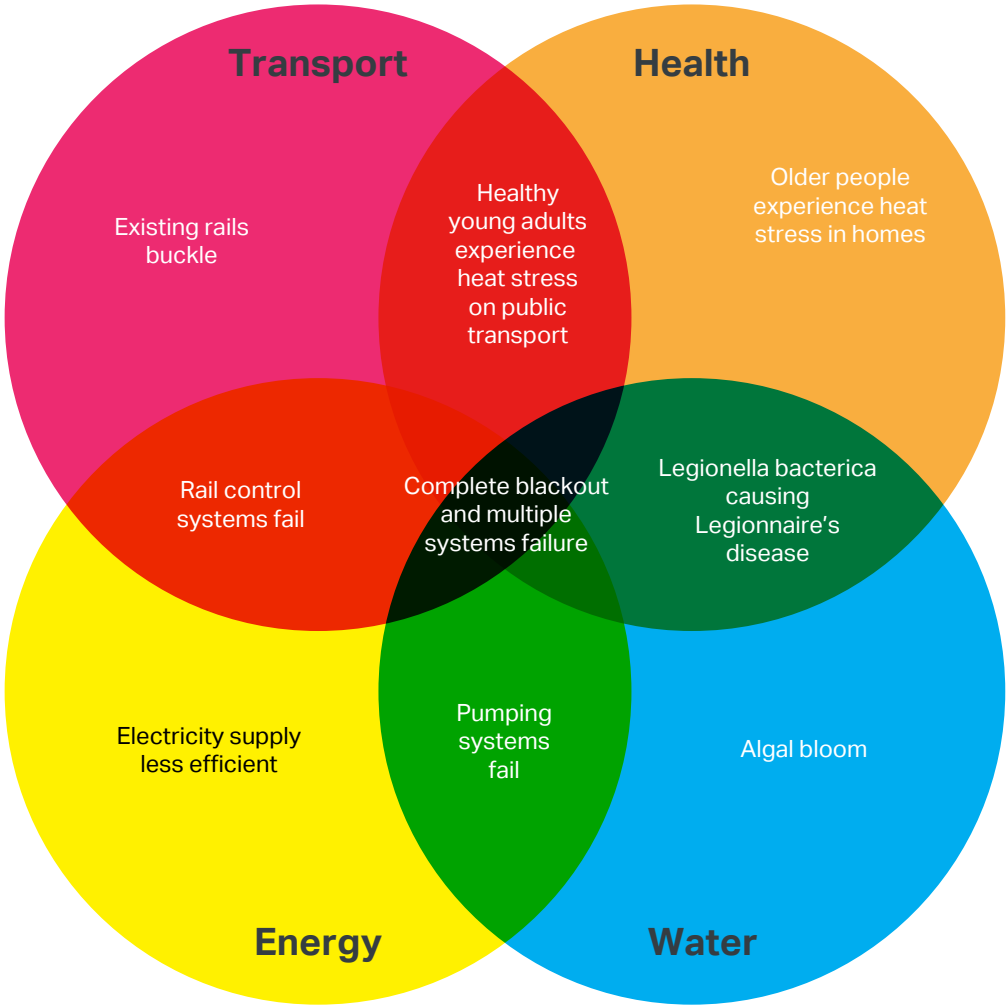
Hundreds of thousands of people across England and Wales were affected by flooding in June and July 2007. It was the most serious inland flood since 1947.

Around 48,000 households and 7,300 businesses were impacted. The floods affected a wide range of infrastructure, including water and food supply, power, telecommunications, and transport, as well as affecting agriculture and tourism. The Environment Agency estimated the overall costs of the flooding at £3.2bn.¹⁹¹

Cities are complex and interdependent systems. Adapting to climate change will depend on recognising the possible knock-on effects caused by disruption due to climate-related impacts. These must be considered in combination with other pressures and challenges, including population growth, development, and non-climate related risks. Figure 50 shows an example of this using a severe heat incident.

¹⁹¹ Environment Agency (2010), Delivering benefits through evidence: The costs of the summer 2007 floods in England. Accessed from: www.gov.uk/government/uploads/system/uploads/attachment_data/file/291190/scho1109brja-e-e.pdf

Figure 50: Venn diagram of heat risk related interdependencies between four urban systems¹⁹²



¹⁹² London Climate Change Partnership & Environment Agency (2012) Heat thresholds project. Accessed from: <http://climatelondon.org/projects/overheating-thresholds/>

Flood risk

The Thames Barrier, tidal walls and embankments provide London with a high level of protection against tidal flooding. Standards of protection in the western Thames and its tributaries are lower.

Almost a fifth of London is in the Thames floodplain. Most of this area is very well defended by traditional hard-engineered flood defences. However, the upstream part of the Thames and many of the tributaries to the Thames have lower standards of protection. Traditional flood defences can only protect London from predictable fluvial (river) and tidal flood risk.

Currently 37,359 existing homes are at high or medium risk of tidal or fluvial flooding in London, and 1.3

million people are living and working in areas of tidal and fluvial flood risk. Left unmitigated, the tidal flood risk to London will increase as sea levels rise. Between 2000 and 2100, a 0.9 metre rise in mean tide levels is projected. For London to stay protected from tidal flood risk, the defences must be upgraded and effectively maintained.

The city is also vulnerable to less predictable surface water and sewer flooding from heavy rainfall events. This is due to increasing areas of impermeable surfacing, such as roads, roofs and pavements. London also has a Victorian drainage system that wasn't designed to cope with the demands of the current and future population (Figure 51).

Figure 51: Number of properties at risk of surface water flooding in London¹⁹⁴

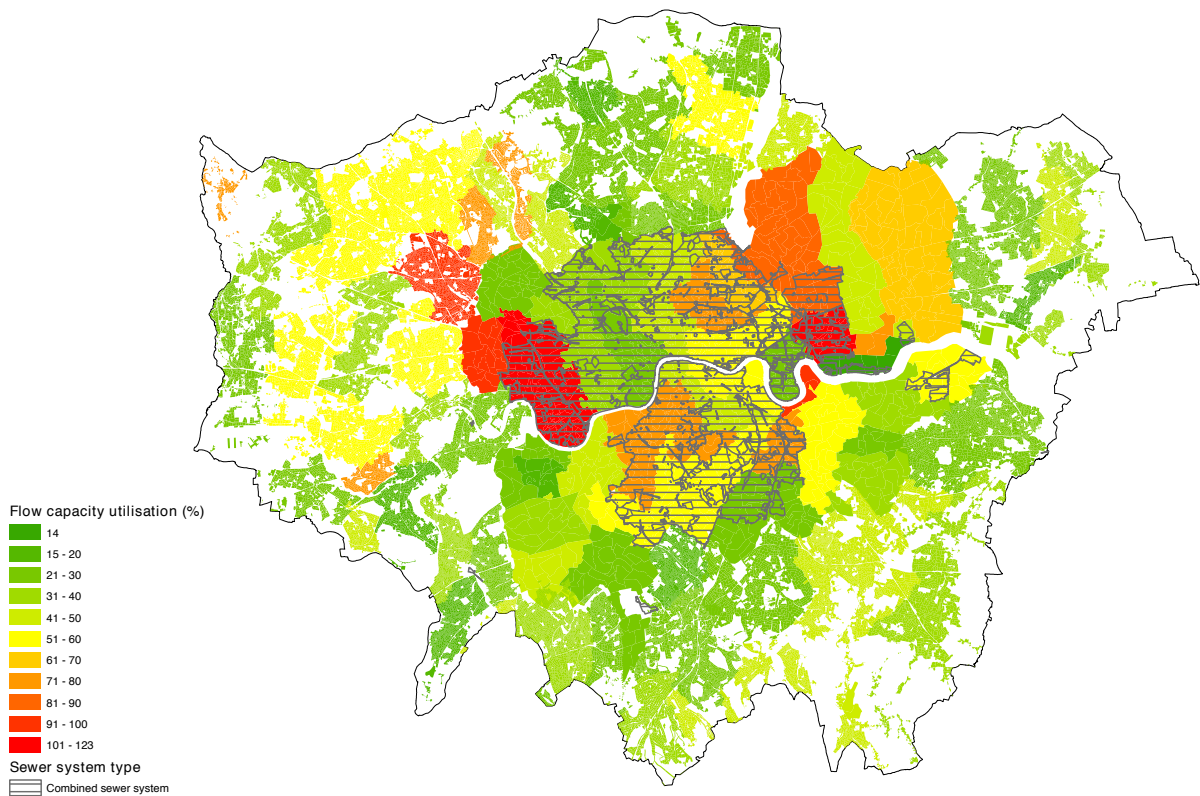


¹⁹³ GLA modelling based on: The GeoInformation Group (2016) UKMap; and Environment Agency (2017) Risk of flooding from surface water).

Parts of London’s combined sewer system are close to reaching capacity, increasing the risk of surface water and sewer flooding. In several locations, areas that currently experience capacity issues are earmarked for significant growth in homes and jobs, which, without mitigation, risks making the problem worse.

Many of London’s tributary rivers suffer from heavily polluted urban run-off, and often flow in artificial concrete channels, further worsening river ecology and water quality. This limits their biodiversity and amenity value. Sustainable drainage systems (SuDS) can help reduce all of these issues.

Figure 52: Current (2015) capacity of the drainage network¹⁹⁴



¹⁹⁴ Thames Water flow capacity utilisation and sewer system type data.

Figure 52 shows the available capacity in London's drainage and sewerage network. The red areas highlight where there is very limited capacity available, which will lead to increased risk of surface water and sewer flooding.

London has been fortunate to have a comprehensive and well-engineered sewerage system since the late 19th century. However, the system was designed for a smaller London of four million people. As London has grown, the frequency and magnitude of stormwater discharges has increased, from occasionally in the late 19th century to more than once a week today. Stormwater discharge results in dilute sewage being released into the River Thames. Insufficient capacity in London's combined drainage networks means London's wastewater

treatment and collection system is considered inadequate to meet EU Urban Wastewater Treatment Directive requirements.

The £4bn Thames Tideway Tunnel is being developed to reduce sewer overflows into the river Thames and improve its water quality. However, it will not improve the water quality of London's tributary rivers. Drainage in outer London is made up of mostly separate sewage and surface water drainage systems.

This scale of sewerage intervention is becoming increasingly complex, expensive and disruptive. In the long-term, the widespread use of SuDS will reduce pressures by making incremental reductions in surface water flows to the drainage network.



Drought

London's growing population and business base is demanding more water. London is within the driest part of the country and is potentially at risk of drought if reservoirs and groundwater aquifers are not refilled by regular rainfall. The cost of a severe drought¹⁹⁵ to London's economy is estimated by Thames Water to be £330m per day, and would have severe economic, social and environmental consequences. This figure may be even higher when all cumulative and knock-on impacts of a severe drought are considered.

London's water supply comes from a combination of groundwater and surface water sources. Water companies take or abstract water from rivers and groundwater, and store it in reservoirs or artificially recharge the groundwater aquifer during times of surplus. They are able to move water around the network as required, which means that London has a relatively adaptable and resilient water supply.

However, regardless of the flexibility of the infrastructure in place, below average rainfall, particularly over the winter, puts pressure on London's water resources. London is at risk of drought following two dry winters. Winter is the season where the majority of groundwater recharge occurs, and the aquifers that supply London are replenished. Many people remember the drought of 1976. However, London has experienced the early stages of drought as recently as winter 2018. It was very close to a severe drought in 2012 in the lead up to the Olympics, before one of the wettest summers on record.

When faced with the prospect of water shortages, water companies work closely with the regulator, the Environment Agency. A phased approach starts with information provision, awareness raising and voluntary measures to restrict water usage. It then escalates to compulsory measures if resource pressures worsen. Drought measures reduce the amount of water that people use through, for example, temporary use bans such as on washing cars.

¹⁹⁵ A severe drought would lead to widespread residential and non-residential water restrictions, water supply source failures, emergency drought measures, widespread incidents covering various sectors. Environment Agency (2016) London Area Drought Plan.

However, they also have environmental impacts, as the usual restrictions on the amount of water abstracted from rivers and groundwater may be temporarily relaxed. This can result in low flows in rivers and impacts on wetlands. It causes a related reduction in water quality, and damage to river and other waterbody ecosystems. In some places this can be dramatic, such as in the groundwater-fed chalk streams, a globally rare habitat found in the hills near London, which can dry up entirely.

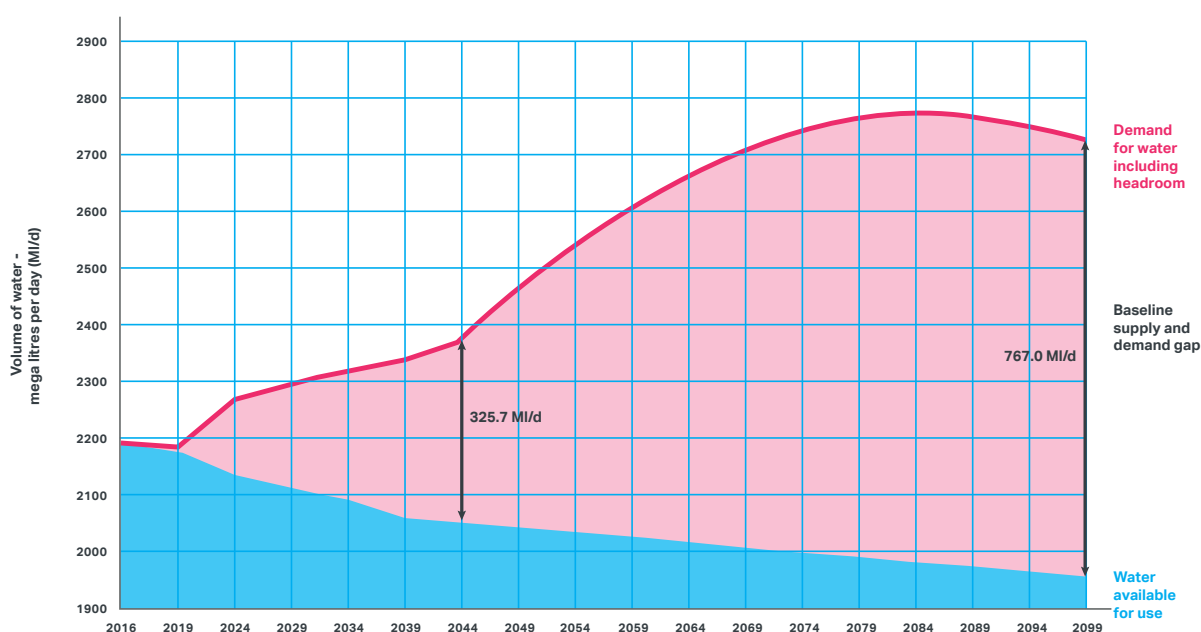
Average water consumption in London is 149 litres per person per day, which is just over five per cent higher than the national average of 141 litres per person per day.¹⁹⁶ London's water distribution network is ageing and this can cause problems in addressing leakage, as the network is difficult and expensive to upgrade. Over recent years, considerable effort and investment has been made to reduce leakage rates and increase

water efficiency. There has been some success, with reduced leakage rates across London between 2000 and 2015, and just over seven per cent reduction in per capita consumption over the same period. However, most recently, leakage targets in London have been missed. Water companies must do more to reduce the amount of water lost to leakage, as well as limit the disruption caused by major mains bursts. The average leakage rate in London is 24.4 per cent of all supplies.

With the continuing trend of population growth in London expected to continue for the foreseeable future, new water resources are needed. Even with projected water efficiency gains, London is forecast to have a water resource 'gap' of over 100m litres per day by 2020, rising to a deficit of over 400m litres per day by 2040. This means that there won't be enough water to meet London's needs (Figure 53).

¹⁹⁶ The Consumer Council for Water (2017) Water, water everywhere? Delivering a resilient water system (2016-17). Accessed from: <https://www.ccwater.org.uk/research/water-resilience/>

Figure 53: Water deficit projections (MI/d) 2016-2100 under dry year annual average¹⁹⁷



Water companies are working to improve demand management by reducing leakage, increasing water efficiency and increasing the use of water meters, including smart water meters.

Water companies are also looking at new water resource options and water supply infrastructure for London. Options proposed by London's largest water company, Thames Water include:

- demand management measures

- developing new groundwater sources over the next five years
- a new scheme to take more water from the River Thames at Teddington, in west London
- in the longer-term, a new reservoir outside London to be delivered in the 2040s, and a water reuse plant in Beckton, east London, in the 2060s

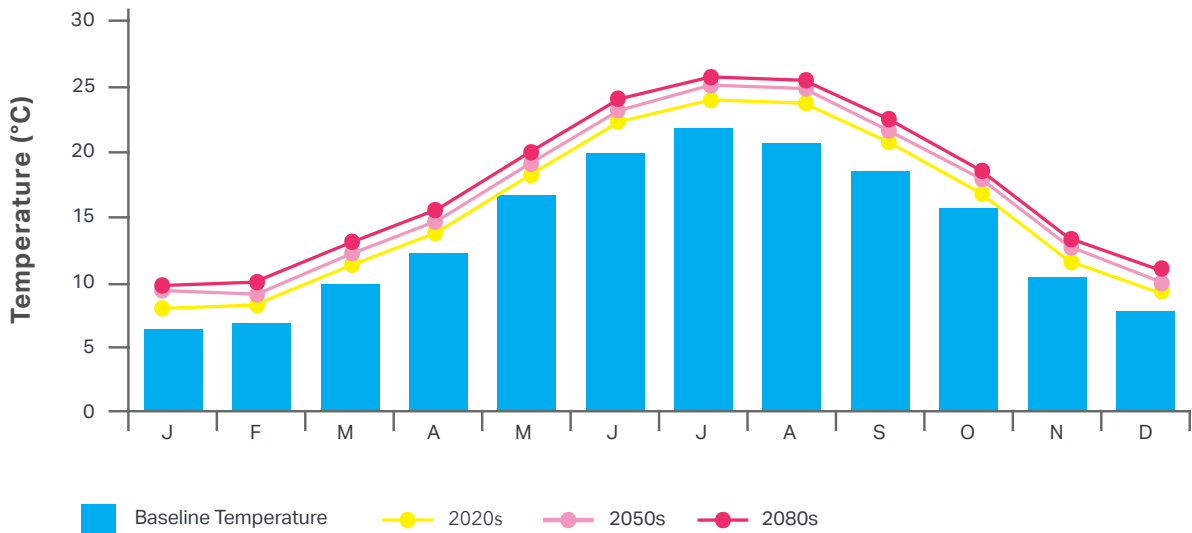
These plans are currently under consultation.

¹⁹⁷ Thames Water (2017) Our water resources management plan 2019. Accessed from: <https://corporate.thameswater.co.uk/sitecore/content/Your-Water-Future/Your-water-future/Providing-enough-water/Our-draft-Water-Resources-Management-Plan-2019>

Heat risk

Projected increases (Figure 54) in average monthly temperatures in London until 2050 show a 5-6°C increase in summer and winter averages. This will have an impact on health, infrastructure, comfort, and the operation of the city.

Figure 54: Average monthly temperatures (°C) in London over the century, under a medium emissions scenario, compared to baseline period¹⁹⁸



¹⁹⁸ Generated from UKCIP (2009) UK Climate Projections. Accessed from: <http://ukclimateprojections.metoffice.gov.uk/21708?projections=23860>

Even a small rise will disrupt services and affect people living in London. As the temperature increases, the heat thresholds described below are likely to be breached more often:¹⁹⁹

- 24°C – London Underground puts in place overheating plans, including public health communications and measures to prevent tracks from buckling
- 24.7°C – over two days leads to greater incidences of morbidity, mortality, and hospital admissions in London
- 33°C – softening of tarmac, asphalt and bitumen road surface generally begins to occur
- 36°C – power sources begin overheating, extreme precautions may need to be introduced to prevent rail lines buckling, such as speed restrictions

Impacts will not be equal or fair, and are likely to increase existing inequalities especially for disadvantaged groups, including older people, very young children, socially isolated people,

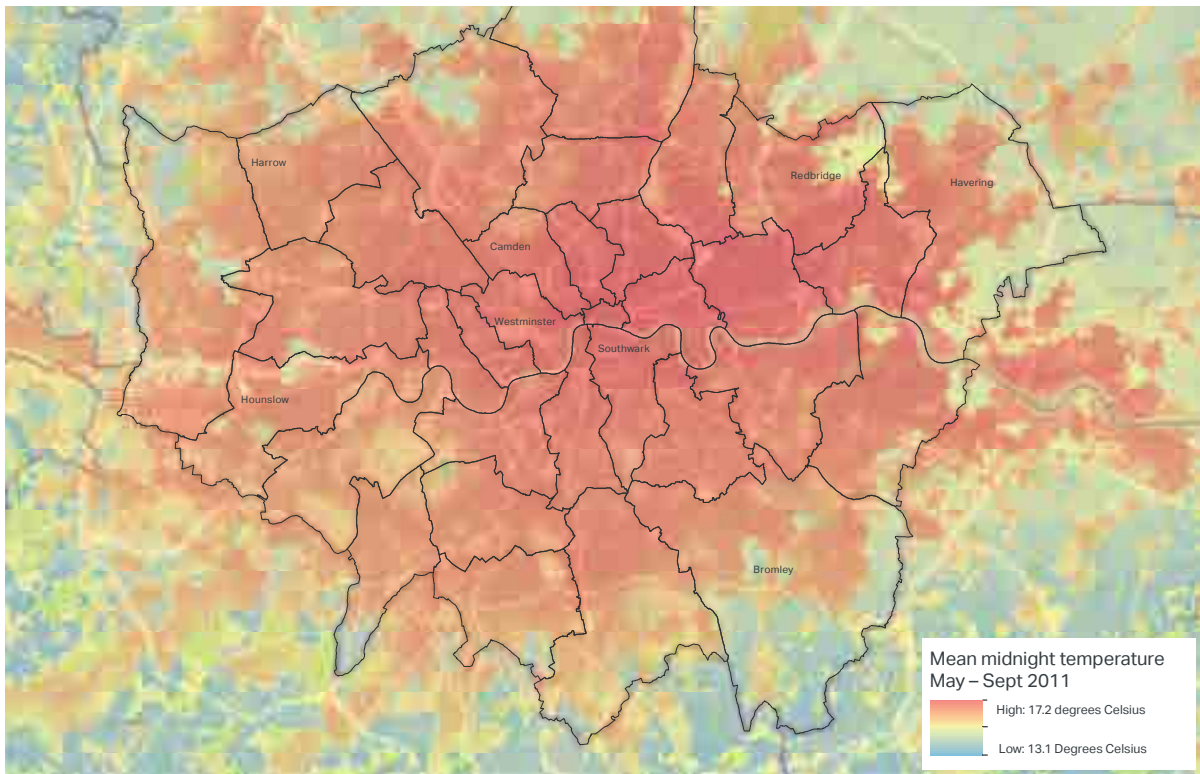
rough sleepers, and seriously ill people. Those who are more exposed, less able to regulate their body temperatures, or less able to move to cooler places are also at risk. Socially isolated people with physical or mental limitations are also less likely to have a support network available for help during a heat episode.

The urban heat island (UHI) effect means that the centre of London can be up to 10°C warmer than the rural areas around the city. The temperature difference is usually larger at night than during the day. This is because the high density of buildings, impermeable materials and waste heat used in or generated by transport and buildings means that while more heat is absorbed by urban areas during the day, it takes longer to escape at night. Urban heat risk is greater for those living in high-rise buildings with little access to green space, which is often cooler than its surroundings. Increased development and urbanisation intensify the UHI effect.

Figure 55 shows the UHI in London. It models the mean night-time temperature across the city, with 'hot spots' in more densely developed inner London compared with outer London.

¹⁹⁹ LCCP (2012) Heat Thresholds Project. Accessed from: http://climatelondon.org/wp-content/uploads/2013/01/LCCP_HeatThresholds_final-report-PUBLIC.pdf

Figure 55: Mean midnight temperature (°C), May-September 2011²⁰⁰



²⁰⁰ VITO (2016) London's urban heat island – average summer. Accessed from: <https://data.london.gov.uk/dataset/london-s-urban-heat-island---average-summer>

ROLES AND LEGAL DUTIES

The Mayor has a legal duty to set out policies and proposals in this strategy for adapting to climate change, and a duty to take action on climate change. Part of this involves ensuring that climate change adaptation policies are included in the other relevant Mayoral strategies, such as the London Plan and the Mayor's Transport Strategy.

The GLA is not a flood risk management authority. However, the Mayor produces a Regional Flood Risk Appraisal that sets out the general nature of flood risk across London and how it affects existing and proposed development. The Mayor also includes climate change adaptation policies in the London Plan.

The Mayor has no statutory responsibilities in relation to water resources and their associated supply and distribution infrastructure. However, the Mayor can influence water use and supply, to some extent, through the London Plan. It is also essential that the GLA maintains an oversight of strategic water resource planning and demand management measures to ensure a resilient and affordable supply for Londoners.

There is no single authority responsible for managing heat risk in London. The other organisations that have a role to play in increasing London's adaptation and resilience to climate change are described in Appendix 3.

Green roofs and walls help insulate buildings, reducing energy demand

They also support biodiversity, help reduce flood risk, and help improve air quality

Rainwater harvesting and water efficient appliances reduce pressure on water supply

Buildings can be cooled without increasing energy demand

Reflective paints help keep buses cool in hot weather

Green roofs can increase the efficiency of solar panels

Sustainable drainage, such as Stockholm tree pits, helps reduce flood risk and improve water quality

Blinds help keep homes cool during hot weather

Trees provide shade during hot days and green spaces help cool the local area

Adapting to climate change helps improve community, health and resilience



Objectives, policies and proposals

OBJECTIVE 8.1 UNDERSTAND AND MANAGE THE RISKS AND IMPACTS OF SEVERE WEATHER AND FUTURE CLIMATE CHANGE IN LONDON ON CRITICAL INFRASTRUCTURE, PUBLIC SERVICES, BUILDINGS, AND PEOPLE

It is vital that sectors including transport, digital, energy, water, food, and buildings are able to adapt to the impacts of climate change, to ensure that services can continue to be delivered even through periods of severe weather.

There is an incomplete understanding of what will happen if risks from climate change are not addressed, as social and environmental impacts are difficult to quantify. However, the insurance and financial sectors have tried to measure the potential economic losses if GHG emissions are not reduced. A Nature Climate Change study by the London School of Economics²⁰¹ found that climate change could reduce the value of the world's financial assets by £2.5 trillion, and possibly up to ten times that figure in a worst-case scenario. The losses would be caused by the direct destruction of assets by increasingly extreme weather events, and a loss of earnings for those affected by high

temperatures, drought and other climate change impacts. In a World Economic Forum survey in 2016, some 750 experts found that a catastrophe due to climate change would be the biggest potential threat to the global economy.²⁰² They believed it to be more of a risk than weapons of mass destruction, water crises, mass involuntary migration, and a severe energy price shock. The report concluded that the connections between climate change and other risks, like involuntary migration, are getting stronger.

In order to monitor London's ability to adapt to climate change and remain resilient during severe weather events, it is necessary to establish a baseline and then monitor and measure the progress being made. To understand how climate change may affect the critical functions of the city, the Mayor wants to work with different sectors in London rather than solely focusing on individual risks. This work will include developing indicators to identify thresholds that indicate severe disruption as a result of climate change, for example during heatwaves in London, and developing plans for how to deal with it, if and when it does occur.

²⁰¹ Dietz, S., Bowen, A., Dixon, C. & Gradwell, P. (2016) 'Climate value at risk' of global financial assets. Nature: climate change [online]. Accessed from: www.nature.com/nclimate/journal/v6/n7/full/nclimate2972.html

²⁰² World Economic Forum (2106) World Economic Forum Global Risks Report 2016, 11th Edition. Accessed from: www3.weforum.org/docs/GRR/WEF_GRR16.pdf

Policy 8.1.1 Sectors understand the impacts of severe weather and climate change, prioritise the key risks, and identify mitigation measures where appropriate

Proposal 8.1.1.a The Mayor will work with the main infrastructure providers in transport, energy, water, and buildings to identify thresholds for disruption and produce integrated plans for addressing long-term climate risks

Thresholds are points at which, given certain conditions, disruption to services, infrastructure, or people's wellbeing occurs. For example, vulnerability of buildings to power failures increases when external temperatures reach 30°C. External air temperatures of 36°C result in rail track temperatures of 48-52°C. At such times, Network Rail puts in place precautions like speed restrictions to prevent the buckling of rails.

“Climate change could reduce the value of the world's financial assets by £2.5 trillion, and possibly up to ten times that figure in a worst-case scenario.”

Identifying thresholds is crucial for planning to prevent disruption. Climate projections can be used to understand how the risk of disruption is expected to change into the future with climate change. The Mayor, through the London Climate Change Partnership (LCCP), will convene sectoral partners and relevant experts from the research community to share knowledge, identify thresholds, and collaborate around resilience planning.

Progress will be assessed through monitoring indicators and qualitative review of plans across sectors developed as part of this activity.

Proposal 8.1.1.b The Mayor will promote ways to continually improve resilience in infrastructure among priority sectors to ensure that London remains a leading global city

The Mayor, through the LCCP, will work with critical sectors, including water, transport, health, utilities, food, insurance, and the natural environment to identify adaptive pathways for managing severe weather and longer-term climate change risks. Sectors involved in the development of large scale infrastructure

that will have long lifespans can benefit from adaptive pathways, which allow for flexibility in decision making so that better options for the future are not cut off. The approach helps with the timing of decisions to accommodate changing information in an uncertain future.

Adaptive pathways are already used to manage London's tidal flood risk. They can help to manage the uncertainty of climate change. Adaptive pathways set out thresholds and decision points so mitigation measures can be adjusted in response to new information, including climate change projections.

While adaptation should be incorporated into existing sector plans, varying levels of capacity within sectors make it harder to identify actions that need to be taken across sectors in a systematic way. London Resilience's Anytown approach helps identify interdependencies and potential cascading failures from disruption to infrastructure. The Mayor will use interdependency mapping to highlight potential risks of cascading failures and identify opportunities for infrastructure sectors to work together to improve resilience.



Policy 8.1.2 Develop, refine and monitor plans and indicators of London's resilience to severe weather and longer-term climate change impacts on flooding, heat risk and water pollution

Proposal 8.1.2.a Through the London Climate Change Partnership, the Mayor will agree indicators with priority sector representatives, and establish a baseline for regular monitoring

There is currently no systematic collection of data to show how well the city is adapting to the impacts of severe weather and longer-term climate change, and whether the efforts intended to reduce risk and increase resilience are working.

Such data collection, which could largely be drawn from existing data sets, would help London adapt to climate change and become more resilient. It would capture evidence of good and poor performance, identify adaptation priorities, and highlight knowledge gaps.

Indicators will be developed and monitored in collaboration with London's sectors. This will ensure that they inform, and are informed by, local decision makers and stakeholders in transport, health, energy, water, buildings, and other sectors with an important role to play in London's adaptation. The indicators will support an assessment of how well London is able to cope with extreme weather and more gradual changes in climate.

The indicator framework will include hazards, vulnerability, and exposure (components of risk as defined in the IPCC Fifth Assessment report²⁰³), as well as impacts and adaptation actions (Table 3). It will also include both quantitative and qualitative indicators: the limits of quantitative data in measuring adaptation, particularly with regard to human health and wellbeing, mean that qualitative data from sector experts and decision makers can be useful.

²⁰³ IPCC (2014) Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Accessed from: <http://www.ipcc.ch/report/ar5/wg2/>

Table 3: Types of indicator included in the indicator framework

Type of indicator	Definition	Example
Hazard	Occurrence of extreme weather events or climate-related trends	Number of extreme rainfall events per year
Exposure	The presence of systems - human, environmental, economic - in places that could be adversely affected	Number of infrastructure assets in the flood plain
Vulnerability	The propensity or predisposition to be adversely affected. Vulnerability is made up of exposure and capacity to adapt, and may include physical and social aspects	Proportion of Londoners who are socially isolated
Impact	Experienced effects on natural and human systems	Number of transport disruptions due to flooding
Adaptation	Measures taken to reduce vulnerability or exposure, or to increase adaptive capacity	Implementation of property level flood protection

OBJECTIVE 8.2 REDUCE RISKS AND IMPACTS OF FLOODING IN LONDON ON PEOPLE AND PROPERTY, AND IMPROVE WATER QUALITY IN LONDON'S RIVERS AND WATERWAYS

London is vulnerable to flooding from six sources: tidal, fluvial (river), surface, sewer, reservoir, and groundwater.

Over centuries, London has grown on the banks of the Thames, encroaching on the natural floodplain. As the city has become more built up, the river walls have been raised incrementally. Part of London (approximately 15 per cent) sits in the natural tidal floodplain. Many parts of the city nearest the river would flood on virtually every high tide, were it not for the Thames' flood defences. The current flood risk to London is highest when a spring tide coincides with a North Sea tidal surge. This is caused by a specific set of meteorological conditions, including low pressure over the North Sea and a northerly wind resulting in raised sea levels.

London had major flooding from an east coast tidal surge in 1928. It narrowly escaped a major flood in 1953, when serious flooding struck the outer estuary in Kent and Essex. This latter event provided the push for building the present day Thames Tidal Defences. The Thames Barrier is the iconic centrepiece of this system of river walls, embankments, and gates and barriers that stretch out into Kent and Essex. This system gives London one of the highest levels of tidal flood protection in the world, currently modelled to provide more than one in 1,000 year protection. The flood defences protect many thousands of homes, critical infrastructure, including many tube and rail stations, and property worth over £200bn.

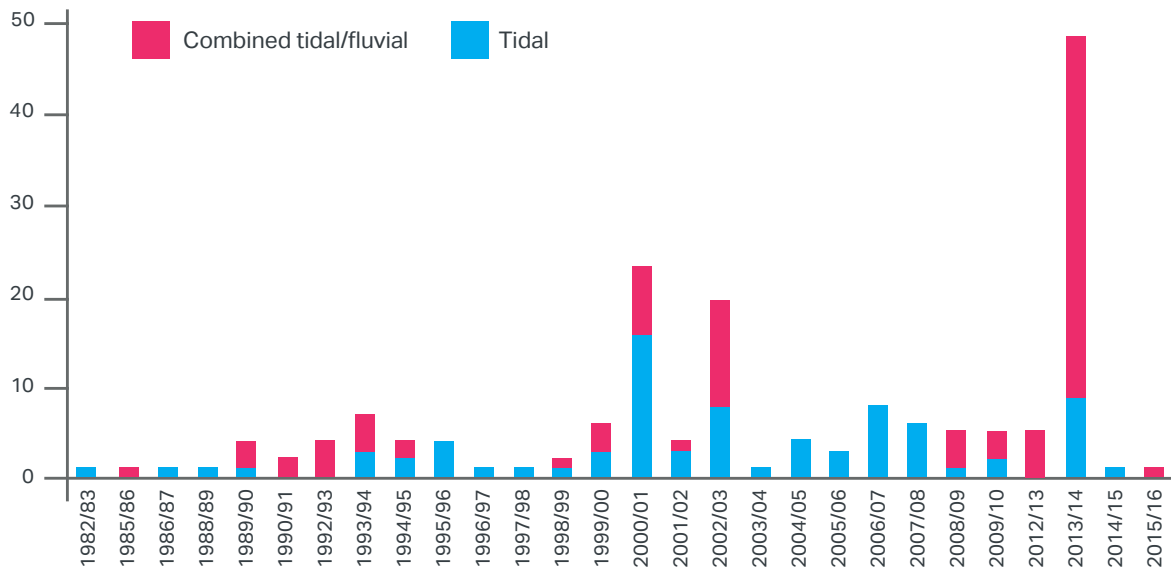
At present the Thames Barrier also protects west London from fluvial flooding during high flows, by holding the tide back and preventing the river backing up. There were a large number of barrier closures in 2013-14

(Figure 56). Many of these were to prevent fluvial flooding. Each barrier closure reduces its lifespan through wear and tear. Rising sea levels mean the barrier is used more and more for tidal flood protection. That means it may become unfeasible to continue to close it for fluvial flooding. This protects relatively small parts of London but comes at the expense of much larger areas of London at risk of tidal flooding. Therefore, flood management schemes must be planned and put in place to protect outer west London to reduce the reliance on the Thames Barrier for managing non-tidal flood events.

The Environment Agency owns and operates the Thames Barrier. It also inspects and maintains the other river structures. Most defences are in good condition, thanks to investment and liaison with landowners to improve any defences in poor condition.

“Flood defences protect many thousands of homes, critical infrastructure, including many tube and rail stations, and property worth over £200bn.”

Figure 56: Thames barrier closures by flood season²⁰⁴



There are already many Londoners, businesses, and properties in flood risk areas. These areas tend to include a higher proportion of people on low incomes. For these households, a flood can often be even harder to cope with and recover from. This is because poorer people and small businesses may lack

appropriate insurance cover or the funds to properly repair the premises. They may also lack a wider support network to help them cope with, and recover from, flooding. In many cases the physical and mental health impacts of being flooded can last for many years.

²⁰⁴ Environment Agency (2016) Thames Barrier flood defence closures by flood season. N.B. Only years with flood barrier closures are depicted.

It is not uncommon for flood victims to report being anxious every time it rains. Londoners' awareness about flooding varies widely. Where possible, timely warnings can be an important part of managing flood risk.

Flood risk management authorities should further improve how they work together to make sure that flood risk is managed sustainably. This needs to focus on properties at high risk of flooding. It must also consider that the number of properties at low risk of flooding will increase as development happens in the floodplain, albeit in areas protected by the Thames Tidal Defences. The London Plan expects development in such areas to be designed and built considering resilience and resistance to flooding, such that people can remain within buildings and be safe and comfortable in the unlikely event of a significant flood.

Policy 8.2.1 Reduce the risk and manage the impacts of surface water, sewer, fluvial, reservoir and groundwater flooding in London

Proposal 8.2.1.a The Mayor will work with partners to increase awareness of all forms of flood risk across London and develop options for targeting areas at particular risk from surface water flooding

Surface water flooding occurs when the drainage system becomes overwhelmed and rain cannot get into local drains, sewers or watercourses. It can be caused either by the sheer intensity of rainfall or by infrastructure failure, such as blockages within the drainage network.

The sporadic and intense nature of heavy rainfall makes it very hard to accurately predict when and where surface water flooding will occur. This means it is difficult to provide a reliable warning or alerts system. As a result, those at risk of surface water flooding may have little or no knowledge of the extent of the potential risk they face.

There are many Londoners who are at risk of, or have experienced, surface water flooding, such as those living in basements in heavily urbanised parts of London. Some of these residents may be disproportionately, and potentially dangerously, impacted by a surface water flood event, for example due to reduced mobility. The Mayor, flood risk management authorities²⁰⁵ and other partners in London have done research into this area. This has helped get a better understanding and mapping of surface water flood risk in London boroughs. It is less clear whether residents in surface water flood risk areas know what risk they face or how to reduce the risk and respond.

The Mayor will bring all partners together, including the London Resilience Forum and flood risk management authorities in London. This will help identify those most at risk of, or most vulnerable to, surface water flooding and develop plans and programmes to increase public understanding of their flood risk and how to respond. This should include providing information to the public to help build their capacity to adapt and become more resilient to flood events, for example through a 'London Flood Week' campaign and the Mayor's social media channels.

The Mayor will continue to work with Lead Local Flood Authorities and the Environment Agency through the Drain London project and the London Drainage Engineers Group to promote a consistent approach to managing surface water more sustainably and reducing the risks where surface water flooding happens often. The Mayor will expect Thames Water to continually reduce the number of properties at risk from sewer flooding.

Proposal 8.2.1.b The Mayor will support flood risk management authorities in London to manage fluvial flood risk and promote best practice approaches in hard and soft-engineered flood management

The Mayor will expect the Environment Agency to improve flood defences on London's fluvial (river) networks, through supporting them in making sure owners of river walls play their part in maintaining defences. The Mayor will work with the Environment Agency to develop 25-year flood risk management strategies for each river catchment. These will account for the need for new development within those catchments and opportunities to manage flood water in the most sustainable cost effective ways (see Box 40 for an example). This is a chance to increase London's green cover using green infrastructure to help manage flood risk, including SuDS.

²⁰⁵ In London the Risk Management Authorities are: Environment Agency, Lead Local Flood Authorities (London boroughs and City of London), Regional Flood and Coastal Committee, Highways England and water and sewerage companies. See Appendix 3 for more information.

BOX 40: NATURE-BASED APPROACHES TO MANAGING FLOOD RISK

Sustainable Drainage Systems (SuDS) are measures to help capture, use, delay the dispersal of, discharge or absorb surface water. There is a preference towards maximising the use of green infrastructure solutions to achieve this, due to the additional benefits beyond water management that SuDS can deliver.

Natural Flood Management involves managing flood risk by protecting, restoring and emulating the natural regulating function of catchments and rivers; often through a series of smaller interventions in the upper sections of a river catchment, closer to source, to slow or delay flows downstream.

SuDS and natural flood management techniques need to be used at a strategic scale alongside hard engineered flood defences. Together, this can manage rainwater at source and slow the flow of water reaching the rivers. SuDS and natural flood management can, for example, potentially reduce the need for new hard flood defences downstream. It can also be a way to reduce flood risk where hard defences are undesirable or undeliverable. For example, multiple small schemes could be located strategically. This means when combined they can reduce flood risk downstream or in an area susceptible to flooding. The catchment based approach to flood management in the River Thames could over time reduce the number of properties at risk in west London. By so doing, it could also reduce the need for fluvial Thames Barrier closures. This would help to extend the barrier's life as a tidal flood defence for London.

The Mayor will support, and work with, partners including the Thames and Southern Regional Flood and Coastal Committees, and the flood risk management authorities and river catchment partners in order to reduce flood risk in London and establish the appropriate approach to funding for fluvial flood risk management, including fair allocation of the cost.

Proposal 8.2.1.c The London Plan includes policies that manage flood risk for new developments

The London Plan includes policies to manage flood risk for new development. These require the assessment and mitigation of flood risk across London to ensure that new developments are located, designed and managed in ways that are appropriate to the level of flood risk present.

The Mayor will consider developing Integrated Water Management Strategies in areas where they are appropriate. These include where considerable new development will occur, where there are particular flood risks or water-related constraints such as limited sewer capacity on new development. Integrated Water Management Strategies have already been, or are being, produced for several Opportunity Areas, including Vauxhall Nine Elms Battersea, Old Oak Common and Park Royal, Charlton to Bexley, and Old Kent Road. These strategies are a good way to integrate the provision of infrastructure to collectively manage all flood risks to a site and plan for water infrastructure, green infrastructure and improve water quality in London's rivers and canals.

The Mayor will play a role in helping prioritise areas for flood risk intervention across London by supporting cross-boundary working between the Lead Local Flood Authorities to help ensure flood risk is managed in the best way. The Mayor's Regional Flood Risk Appraisal, which has been revised for the London Plan, will be part of the evidence base to inform this. Alongside this, the Mayor will monitor the implementation of flood risk policies in new developments through a regular monitoring report of planning applications that are referred to the Mayor.

Policy 8.2.2 Ensure London maintains its standard of protection from increasing risk of tidal flooding**Proposal 8.2.2.a The Mayor will support delivery of the measures in the Thames Estuary 2100 Plan**

The Environment Agency has in place the Thames Estuary 2100 programme (TE2100). This plan sets out options for managing tidal flood risk this century in response to different scenarios for sea level rise and other projected changes to the climate and weather. The climate scenarios were produced by the Met Office Hadley Centre for Climate Science.



Credit: TfL



The TE2100 plan is a flexible and adaptable approach to managing increasing flood risk in London and the Thames estuary. It avoids committing to costly and potentially intrusive flood defence infrastructure that may either prove unnecessary due to lower than predicted sea-level rise, or be made quickly redundant by acceleration in climate change impacts.

The Mayor supports the TE2100 plan to ensure that London is protected until the end of the century, and will support strategic investment that may be required, including potential investment outside London. The Mayor will look to partners, including the Environment Agency and relevant local authorities, to investigate suitable alternatives to managing fluvial flood risk in outer west London. In addition, the Mayor will work with flood risk management authorities to increase awareness of tidal flood risk.

The Mayor supports riverside strategies which meet the requirements of the TE2100 Plan and provide the required future standard of protection from tidal flood risk. This will involve several different parties including, but not limited to the GLA, the riverside boroughs,

the Environment Agency and the Port of London Authority. The Mayor will coordinate these agencies and identify the most appropriate forum. This will ensure the right balance is struck between flood protection, and preserving the heritage and improving the appeal of London's riverfront.

Proposal 8.2.2.b The Mayor will support the safeguarding of sites for a new Thames Barrier east of London

Through the TE2100 Plan, it is anticipated that a new Thames Barrier will be required to maintain London's tidal flood defence to 2100 and beyond. Based on current projections this will be required by around 2070 to keep the current standard of protection. However, this date is dependent on the rate of sea level rise, which is being monitored as part of the plan process. If a new barrier is required, detailed planning will need to start by 2050 to ensure delivery by 2070. The location for the barrier will need to be safeguarded well in advance of this. It is likely that a new barrier will be situated outside of London, but will be working to protect the city. The Mayor will work with the Environment Agency and local authorities outside of London to ensure that the best safeguarding approach and site is identified.

Policy 8.2.3 Increase the amount of sustainable drainage, prioritising greener systems across London in new development, and also retrofit solutions

Proposal 8.2.3.a The London Plan includes more ambitious requirements for sustainable drainage in relation to new development

Sustainable drainage systems (SuDS) can provide a range of benefits. These include reducing surface water flood risk, treating polluted run-off, preventing pollution from entering tributary rivers and streams (see Box 19 in Chapter 5) and opportunities to save water through reuse.

Sustainable drainage can be 'green' or 'grey.' Green systems use natural vegetation to treat and store water. Grey systems use hard engineering, such as oversized pipework or underground tanks, to store water for slow release back to the drainage system once there is space available. Both types are effective. However, green systems also offer further benefits by increasing green cover and creating more pleasant landscapes and healthier, more attractive streets in London.

"Sustainable drainage systems can provide a range of benefits. These include reducing surface water flood risk, treating polluted run-off, preventing pollution from entering tributary rivers and streams and opportunities to save water through reuse."

The London Plan policy on sustainable drainage has so far been effective in increasing the amount of SuDS delivered as part of new developments. However, most systems being installed are underground storage tanks. These do not provide the wider range of benefits that some other SuDS options can. Also, attenuation rates and storage volumes achieved by new development are frequently lower than could be achieved. In the London Plan, the drainage hierarchy promotes green infrastructure based SuDS.

Proposal 8.2.3.b Implement the actions in the London Sustainable Drainage Action Plan to retrofit more sustainable drainage for London

The London Sustainable Drainage Action Plan was published in December 2016. Its main focus is to enable and mainstream the retrofitting of SuDS to existing buildings, land and infrastructure. A lack of funding available in this area limits opportunities for large scale drainage improvement programme. Instead, opportunities to incorporate sustainable drainage into planned maintenance, repair or improvement works should be identified and carried out. This way SuDS can be introduced at a much lower cost. These measures can help save money, for example where a roof requires upgrade or repair, it can

be replaced with a green roof that can extend the lifetime of the roof, whilst also improving insulation and providing flood risk management, amenity and biodiversity benefits. Many of the actions are designed to be delivered by the Mayor in partnership with the Risk Management Authorities and sector partners, focusing on generating funding and opportunities for increased SuDS retrofit.

The Mayor will work with TfL, boroughs, water companies and other landowners to, by 2030, switch 200 hectares of land from draining directly to conventional sewers or London's watercourses to draining to SuDS. This will reduce surface water flood risk, relieve capacity on London's drainage network, reduce pollution from run-off, and provide biodiversity and amenity benefits.

TfL has made a commitment to drain five hectares of land to SuDS each year (Proposal 44 of the Mayor's Transport Strategy). The Mayor will expect boroughs, infrastructure providers, landowners across a range of sectors, and developers to make similar pledges to help manage surface water more sustainably and realise the multiple benefits that SuDS can deliver.

Proposal 8.2.3.c The Mayor will consider a range of mechanisms to encourage sustainable drainage retrofit on non-residential properties

Currently, there are limited incentives to encourage property owners to disconnect their properties from the drainage networks and manage surface water onsite using SuDS. Non-residential landowners with large impermeable areas, such as car parks, could make a contribution to reducing surface water going into the drains. The current automatic right to connect to the drainage system means that water companies must accept surface water drainage, regardless of whether the local network has capacity.

In addition, the current billing system charges customers in London, including large commercial/non-residential customers, for disposing of their surface water based on the rateable value of the property. This has a limited relationship with the size of the site and means there is no extra incentive for larger sites to better manage their surface water. This exacerbates the problem. The current system means small sites of higher land value (for example inner city premises) may be subsidising larger (for example outer London sites) in terms of surface water drainage charges. A fairer way to pay might be charging linked to the land area drained. This could give an incentive to use alternative ways of managing

surface water drainage to keep drainage costs for large sites down.

Proportionally, the biggest gains can be made for large sites that are most likely to see increases in charges. These areas are more likely to have the land area to install significant SuDS. However, any move to such a system would need to safeguard certain non-commercial sectors that occupy large sites and that could be financially disadvantaged by a new charging approach. These could include certain educational establishments, community or charity facilities, for which a scheme would need to be put in place to protect these users from unfair increases in charges.

Offsetting is another mechanism that should be looked at. This would consider providing, or funding, a reduction of surface water flows elsewhere in the same catchment, if not possible onsite, in exchange for a reduction in drainage charge. Other models for using offsets to encourage more sustainable approaches to drainage are being put in place internationally and may provide a model for London. This requires further investigation to establish whether these are feasible approaches to encouraging increased installation of sustainable drainage in certain sectors of the economy. The Mayor will work with Thames Water, Ofwat, and other stakeholders to investigate this.



Policy 8.2.4 Work with stakeholders to improve London's sewerage system so it is sustainable, resilient and cost effective, and makes best use of innovation

Proposal 8.2.4.a The London Plan includes policies to support appropriate and sustainable new sewerage infrastructure

To accommodate growth in London, sewage treatment works need to be expanded and further developed. A number of the works have been upgraded the past ten years. Some, such as Deephams sewage treatment works, are currently having a major upgrade. By the middle of the century, more upgrades will be required to boost capacity at London's sewage treatment works and meet the needs of a growing population. The Mayor will encourage new technologies and the intensification existing treatment works to help meet future needs.

Given London's projected growth, even if the amount of surface water entering the sewage system is cut, London's sewage treatment capacity will still need to expand in the future. At some point in the next 20-30 years it is likely that several, if not all, of London's major strategic sewage treatment works will require upgrades to increase capacity. This is recognised and addressed through the London Plan, which supports strategic wastewater treatment infrastructure investment.

Thames Water are in the process of developing a long-term wastewater strategy that plans London's network and treatment infrastructure to 2100 that are required to meet London's future wastewater needs. The approach aims to make best use of innovation and will adopt an adaptive pathway approach, which will include a range of scenarios taking account of uncertainties, such as London's future population and climate projections that are difficult to forecast many years ahead. The Mayor will work closely with Thames Water and monitor progress as the long-term plan develops.

Proposal 8.2.4.b The Mayor will work in partnership with Thames Water, London boroughs, and other relevant stakeholders to raise awareness of the problem of misconnected drains and dual manholes from household and business premises

In parts of London a range of issues can cause foul drainage and raw sewage to reach the surface water drainage systems and tributary rivers. In areas of London where there are separate foul and surface water drainage systems, as is the case in much of outer London, misconnections can cause network capacity issues and lead to pollution of London's tributary rivers (see Box 19 in Chapter 5). This is often caused by domestic plumbing misconnections, where household plumbing is incorrectly connected to the surface water drain, rather than to the sewer network. The result is untreated wastewater and sewage draining directly to local rivers.

Or conversely, surface water drainage pipework is connected into the foul system, which then creates capacity issues where the network is sized to cope only with wastewater flows. Furthermore, dual manholes, where surface water and sewer drainage occupy the same inspection point, can lead to raw sewage going into surface water when poorly installed or maintained. Misconnections can be caused by lack of awareness, both from the public and in the relevant trades. In some cases, wastewater is knowingly and illegally drained.

The Mayor will work with Thames Water, boroughs, and other stakeholders to raise awareness of misconnected drains and problems associated with dual manholes from household and business premises, and to ensure water companies operating in London accelerate action in this area. Thames Water's most recent draft business plan states that they will treble the amount of misconnection tracing they do between 2020 and 2025, compared with the 2015 to 2020 period.

To reduce cases of misconnections of surface water and foul sewer systems in London requires several actions. Specifically, there is a need to focus on the plumbing and construction industry, including the trade retailers. There are opportunities to increase collaboration with relevant trade organisations and educational institutions and bodies that certify these industries and better understand where the problems lie and untangle the complex plumbing faults.

The Mayor will increase collaboration with trade organisations and support awareness raising schemes working with stakeholders on London's rivers, including catchment hosts. The Mayor will also investigate the feasibility of how changes to legislation can target misconnected properties at point of let or sale. This could be done, for example, through point of let/sale plumbing certification to help reduce the problem.

OBJECTIVE 8.3 ENSURING EFFICIENT, SECURE, RESILIENT, AND AFFORDABLE WATER SUPPLIES FOR LONDONERS

In order to ensure an efficient, secure, resilient, and affordable water supply for London, water demand must be managed through water efficiency, leakage reduction and metering, and increased public awareness of water usage.

Without action, London faces increasing water scarcity in the future. This is already being felt, with London preparing for drought during winter 2018. Demand for water will grow with London's growing population and climate change is predicted to increase the risk of drought. As London's water supply is mostly drawn from the River Thames, the River Lee and groundwater from the hills around London, it is crucial that the demand for more water supply is balanced with the needs of the environment. Over abstraction, be it from groundwater or rivers, damages ecosystems by reducing flows in rivers and can impact on water quality, navigation, and recreation.

“The Mayor will expect all water companies operating in London to set out measures to reduce leakage rates and the risk of major mains bursts.”

In some cases, allowing some level of over abstraction may be necessary during drought, but is not sustainable or cost effective in the long-term. It is therefore essential that there is a twin track approach of improving water efficiency and enhancing London’s water resources and supply network to ensure London is resilient to increased extreme weather events and longer-term climate change.

New mechanisms in the water market can also help London achieve an efficient, secure, resilient and affordable water supply. The retail water and wastewater market was established for non-residential customers in April 2017. Ofwat state that 1.2 million customers in England are now eligible to choose their water retailer. This is expected to bring efficiency savings. For example, companies with multiple sites nationally are now able to streamline their billing process, by dealing with a single retailer rather than multiple, geographically specific water companies.

Potential water market benefits could include:

- an expected reduction in water use through increased water efficiency promotion and services provided by the retailer
- reduced environmental impact from abstraction through reduced use
- reduced carbon emissions from reduced water supply pumping and treatment

A year since the launch of the retail water market in England, there has been limited progress from retailers in delivering water efficiency benefits in London. However, the market is still young and there are good examples from elsewhere in the UK of water retailers achieving significant cost and water savings for commercial customers through the products and services they offer. The Mayor will encourage Ofwat and retailers to deliver this in London.

Policy 8.3.1 Reduce London's water consumption and leakage rate

Proposal 8.3.1.a Holding to account London's water companies on the need to further reduce leakage rates, and reduce the likelihood of major water mains bursts

Leakage from the water supply network is stubbornly high in London. Thames Water has experienced a series of major mains bursts that have resulted in major property flooding between 2016 and 2018. These triggered an independent forensic assessment of the mains bursts, which made a series of recommendations to Thames Water on how to reduce further incidents. It is clear that additional monitoring and improved early detection is required.

The Mayor will expect all water companies operating in London to set out robust programmes that accelerate improvements, and include measures to reduce leakage rates and the risk of major mains bursts. The Mayor will expect companies to utilise modern technology to proactively identify where there is a potential for leaks and mains bursts, and to regularly report on progress.

Proposal 8.3.1.b Work with London's water companies to promote water metering, encouraging wise water usage and a reduction in leaks

The Mayor supports London's water companies in increasing the number of properties that have smart water meters. Water metering ensures that people are charged proportionally for the amount they use.

Water meters, especially new smart meters, can help customers better understand their water use behaviour and so contribute to reducing household consumption. Smart meters also provide customers and water companies with the ability to quickly identify leaks in their household. Thames Water estimates that up to a third of total network leakage can be attributed to leaks in the customer's pipework. Current estimates suggest one in ten households that have a meter installed have identified a previously undetected leak. Smart meters also provide useful data for water companies to identify local network leaks.

Water pricing has a significant effect on household consumption. In Berlin, water is priced at about twice London prices, and per capita household consumption is about 115 litres per person per day. Conversely, the average consumption in Milan where water is far cheaper than in London, is over 220 litres per

person per day. Of course, there are climatic variations between the regions that may influence behaviour, but the relationship between the price of water and household water use is significant across many cities. Charging customers proportionally to the amount used will encourage people to use less, and save money on their bills. However, mechanisms need to be in place to ensure 'water poverty' is not created, such as encouraging greater uptake of social tariffs.

More work needs to be done to ensure Londoners are aware of the role and benefits of smart water metering, for example through public engagement and effective communication. Synergies between the energy smart meter programme and that of the water sector should also be explored, to deliver efficiencies and minimise impacts on householders.

Proposal 8.3.1.c Support delivery of water saving measures through Energy for Londoners

Domestic hot water heating accounts for approximately 25 per cent of household energy consumption. If Londoners reduce their household hot water consumption, they will see an associated reduction in their energy bills. This is a significant incentive to reduce water consumption.

It is likely that this is fairly well understood by the public, yet there is scope to further reiterate this message as part of including water saving initiatives in Energy for Londoners.

There are marked differences in the way that different communities, cultures and religions, as well as different age groups, use water. More research is needed into the scale of differences and what measures or advice/information may be appropriate to reduce water use in these specific groups or areas.

The retail water market for the non-domestic sector presents an opportunity to improve water efficiency in public and commercial buildings. Water retailers can incentivise water efficiency measures and encourage retrofitting through a range of mechanisms including bundling of products and services, providing targeted leak detection, roll out of water efficient products and innovation and provision of bespoke water efficiency advice. The Mayor expects water retailers to increase their offer of water efficient products and services to their customers in London.

The Mayor's Water Advisory Group convenes key stakeholders, including water companies, the third sector, and community champions that operate in London, along with water regulators,

to ensure leadership and coordination of London's water issues. The Mayor will include a representative from the non-domestic retail water market on this group.

Proposal 8.3.1.d The London Plan includes policies which require new housing development to be more water efficient

New homes will need to be more water efficient than London's existing housing stock to minimise the increase in future demand. Specifying high water efficiency standards at the planning and development stage through strategic planning policy is an effective means of achieving more water efficient homes. The London Plan requires new developments to, as a minimum, meet 105 litres per person per day for household water consumption (plus 5 litres per day for outdoor water use) and encourages developers to better that standard, for example by incorporating water reuse systems.

The Mayor will monitor water efficiency proposals in planning applications, through an annual monitoring report, to ensure water efficiency policies in the London Plan are met and new developments contribute to reducing London's water demand.

Policy 8.3.2 Support the planning for new strategic water resources appropriate for London**Proposal 8.3.2.a The Mayor will support plans for new strategic water resources to serve London, and will assess whether the preferred options are appropriate for London and Londoners**

The Mayor supports, in principle, the need for new water resources for London and the south east of England. However, the solution or solutions must be acceptable to London in terms of scale, flexibility, and compatibility with the Mayor's wider priorities for London, including being a zero carbon city by 2050.

Irrespective of whether efficiencies in managing water are maximised, London's demand is forecast to outstrip available supply in the future. The Mayor expects water companies to plan ahead to ensure they can meet future demand, taking account of a growing population, and ensure that water supply is resilient in a changing climate.

The water companies that serve London have published their Water Resource Management Plans, which set out how they plan to meet future water demand and close the gap between supply and demand. These plans include a range of measures, such as increased demand management, developing new groundwater sources by 2025, a new scheme to take more water from the River Thames at Teddington, west London and in the longer-term a new reservoir outside London to be delivered in the 2040s, and a water reuse plant Beckton in the 2060s. The Mayor is reviewing the water companies' plans to ensure that they are appropriate for London and deliver on a wide range of Mayoral priorities, including reduced carbon emissions.

The Mayor will also consider how the delivery of more local and integrated water infrastructure, including new local reservoirs, mains and water treatment capacity and local reuse within developments, can play a part in securing London's future water supply.

Defra has consulted on a water supply National Policy Statement, which is likely to be adopted within two years. Any National Policy Statement will recommend that strategic water supply infrastructure over a given size/capacity threshold be eligible for Nationally Significant Infrastructure Project (NSIP) status and it is likely that delivery of a new strategic water resource for London would be given this status. Agreement would be through a Development Consent Order, whereby the Secretary of State grants NSIP approval. It replaces the need for a conventional planning application and generally reduces the time it takes to receive approval. The Mayor will ensure that London's interests are protected during this process.

OBJECTIVE 8.4 LONDON'S PEOPLE, INFRASTRUCTURE AND PUBLIC SERVICES ARE BETTER PREPARED FOR AND MORE RESILIENT TO EXTREME HEAT EVENTS

Extreme heat events will impact on many aspects of Londoners lives. For this reason, the Mayor will take a series of actions, from providing timely and accessible information for Londoners during heatwaves and planning for minimising the risk of overheating in new and existing developments, to managing heat risk on London's transport.

Policy 8.4.1 Ensure Londoners can prepare, respond to, and recover from the impacts of extreme heat and cold events in London

Proposal 8.4.1.a Develop a communications protocol for Londoners in times of extreme heat and cold events

Communication with Londoners prior to, and during, an extreme cold event is as important for their health and safety as for an extreme heat event. As a result, extreme cold events are included in this policy.

In periods of extreme high or low temperatures, it is vital that organisations are prepared for such events. To help with this, the Mayor will help to develop and promote a communications plan for extreme temperature events to keep Londoners safe.

This will involve working with the London boroughs, the GLA group, Public Health England, and the London Resilience Forum to agree on how best to respond in an extreme heat or cold event. It will also involve building on usual emergency planning responses, including establishing a protocol and enhancing work on the current alert system for extreme heat and cold.

“Through providing accessible and timely information Londoners should be able to reduce the impacts of extreme heat events in their homes, workplaces and on journeys around the city.”

‘At risk’ and ‘disadvantaged’ groups, care homes, schools and hospitals (including rough sleepers and the hidden homeless) will be prioritised.

Through providing accessible and timely information, Londoners should be able to reduce the impacts of extreme heat and cold events in their homes, workplaces, and on journeys around the city. Currently, Londoners receive information from a number of sources. The Mayor wants to take the lead in convening the necessary partners to ensure Londoners, especially at risk and disadvantaged groups, are safeguarded.

Policy 8.4.2 Ensure critical infrastructure providers and occupants of homes, schools, hospitals, and care homes are aware of the impacts of increased temperatures and the Urban Heat Island, to protect health and reduce health inequalities

Proposal 8.4.2.a Provide locally specific data and modelling to demonstrate and evidence the impacts of the Urban Heat Island

The Mayor will work with academic institutions, the Health Protection Research Unit, boroughs, and Public Health England to develop mapping to show how the UHI impacts on critical infrastructure and disadvantaged groups in London.

This will include supporting the UCL Institute for Environmental Design and Engineering research with boroughs to explore how heat risk indices, which combine social, health and climate change impacts, can support local policy and interventions for the most disadvantaged. The outputs of this research will be shared with boroughs, and more widely, as appropriate.

Policy 8.4.3 Minimise the risk of new development overheating

Proposal 8.4.3.a The London Plan includes policies to minimise the risk of new developments overheating, and reduce their impact on the Urban Heat Island

The London Plan encourages developers to carry out overheating modelling against extreme weather scenarios, which will provide the necessary detail for developers to design developments with appropriate mitigation measures.

The London Plan requires developers to follow the cooling hierarchy (see Box 41) to reduce the risk of developments overheating and reduce the impact on the UHI effect through avoiding mechanical cooling where possible and promoting passive cooling measures. Where mechanical cooling is proposed, developers will need to consider the use of low global warming potential refrigerants to reduce harmful emissions.

BOX 41: COOLING HIERARCHY

The cooling hierarchy is:

- minimise internal heat generation through energy efficient design
- reduce the amount of heat entering a building through orientation, shading, albedo, fenestration, insulation and the provision of green roofs and walls
- manage the heat within the building through exposed internal thermal mass and high ceilings
- provide passive ventilation
- provide mechanical ventilation
- provide active cooling systems

The Mayor will also consider the impacts of further densification of London on the UHI, and develop guidance on how new developments can be designed to minimise the amount of heat absorbed by the development, which is then released at night, warming the surrounding area.

It is vital that when existing buildings are retrofitted for energy efficiency purposes that this does not lead to the unintended consequence of overheating. More information on how this will be achieved is available in Chapter 6.

Green infrastructure plays a key role in providing cooling and shading. More information on how green infrastructure will be embedded across the city to provide a safer, easier, cleaner and more appealing environment for everyone to enjoy is available in Chapter 5, the London Plan, and Transport for London's Healthy Streets Approach.

Policy 8.4.4 Minimise the risk of existing homes and non-domestic buildings overheating

Proposal 8.4.4.a The Mayor will work to minimise overheating in existing buildings through Energy for Londoners energy efficiency programmes

The Mayor will include wider promotion of heat mitigation measures, such as solar shading, cool and green roofs, and tree shading in and around existing homes through the Energy for Londoners programme (Box 26). Whenever technical assistance and advice is provided to homes on improving energy efficiency, this will include an assessment of the overheating risk for the dwelling to avoid unintended consequences once the energy efficiency work has been completed. This will include promoting the Chartered Institution of Building Services Engineers (CIBSE) guidance on assessing and mitigating overheating risk in new developments (TM59 and TM52).

The Mayor will also consider the impacts of overheating in existing homes and non-domestic buildings. This will lead to evidence and guidance to show how existing buildings (older and newer stock) can be retrofitted to improve thermal comfort, minimise the reliance on mechanical cooling, and reduce the amount of heat absorbed by poor design, which is then released at night, warming the surrounding area.

Policy 8.4.5 Reduce the impacts of heat on streets

Proposal 8.4.5.a The Mayor will work with TfL and the boroughs to provide shaded areas for Londoners to enjoy

Through the Healthy Streets Approach, the Mayor will consider how to increase shade and shelter on London's streets to provide refuge for Londoners during times of high temperatures and cool the urban environment. This will include working with TfL and the boroughs to retain existing trees, and plant new ones, to protect canopy cover that will provide shade.

Proposal 8.4.5.b The Mayor will work with TfL to put in place initiatives that will minimise heat on the underground and bus networks

The Mayor, through TfL, will continue to minimise heat on the London Underground by following the cooling hierarchy detailed below:

- **reduce** – focus on minimising energy use, such as optimising train performance. For example, TfL is looking for the Deep Tube Upgrade Programme to deliver energy neutral upgrades
- **recycle** – focus on using and optimising the energy recycled through regenerative braking rather than it being wasted as heat
- **recover** – focus on the use and optimisation of waste heat energy recovered from tunnel ventilation, station ventilation and station cooling systems. This could, for example, include local reuse or creating opportunities for beneficial uses, such as supplying low grade waste heat to nearby district heating networks

TfL will also map and manage the heat impact on their network, to help identify how to improve its resilience.

The Mayor, through TfL, will continue to take actions to cool the bus network. These include: painting bus roofs with reflective paints to help reflect heat; tinted windows to reduce heat gain from solar rays, and insulating buses to reduce the heat from the engine.



Chapter 9: Ambient noise

AIM

Londoners' quality of life will be improved by reducing the number of people adversely affected by noise and promoting more quiet and tranquil spaces.

INTRODUCTION

As a world city, sound is an inevitable part of everyday life for Londoners and is part of what makes the city a vibrant and enjoyable place to be. When sound is unwanted and interferes with normal activities, such as sleep or conversation, it is classified as noise. Excessive noise, and the problems that go along with it, have long been accepted as a necessary cost of living in a successful city. But by tackling excessive noise, London can become a healthier and more pleasant place to live. This strategy examines ambient noise, which is made up of long-term predictable sources of background noise, such as traffic and industry noise, in a given location.

The impacts that noise can have on health may not be obvious, but they can be significant. There are a number of widespread adverse effects of noise, most common of which are annoyance and sleep disturbance. In cases of prolonged exposure to excessive noise, health impacts include cardiovascular and physiological effects, mental health effects, hearing impairment, reduced performance and communication and learning effects.²⁰⁶ The World Health Organization (WHO) recognises environmental noise as the second largest environmental health risk in Western Europe behind air quality.

The WHO identifies some groups as more vulnerable to noise. This includes children, chronically ill people, older people, and shift workers. In addition, the less affluent who cannot afford to live in quiet residential areas or to adequately insulate their homes, are likely to suffer disproportionately.²⁰⁷ Despite this link, no London-based research has been completed to consider how noise impacts disadvantaged groups.

Tackling the adverse impacts of ambient noise in London requires the following actions:

- reducing the adverse impacts of noise from transport and non-transport sources
- promoting good acoustic design and quiet and tranquil spaces, giving people respite from the noise of everyday city life.

LONDON'S ENVIRONMENT NOW

As London's population grows, the consideration of ambient noise and how it is managed across the city will become increasingly important. The work by the WHO to highlight the health implications of noise has gone a long way to bring noise into the spotlight, but there is still limited availability of noise data for London. Complaints are typically collected at the local area level, while much other data and research is completed at the UK or EU level. Although this provides valuable insight, it does leave room to improve the evidence base for London.

The key evidence to support the Mayor's ambitions for ambient noise in London is summarised below. You can find out more about the evidence behind the policies and proposals in Appendix 2.

For details on the legislative and policy background see Appendix 4, and for information on the main responsibilities of various organisations see Appendix 3.

²⁰⁶ Health Protection Agency (2010) Environmental Noise and Health in the UK.

²⁰⁷ World Health Organization (n.d.) Noise: Data and statistics. Accessed from: www.euro.who.int/en/health-topics/environment-and-health/noise/data-and-statistics

Road traffic noise

The social cost of noise pollution in England from road traffic alone is estimated to be between £7bn and £10bn per year.²⁰⁸ Due to the extensive road network spread across the city, road traffic is the largest single cause of noise pollution in London.

Noise exposure data shows that within Greater London, almost 2.4 million people are exposed to road traffic noise levels that are above those provided as a guideline by the WHO (55dB). There is increasing evidence that noise from road traffic is linked to raised blood pressure, and a small increase in the risk of coronary heart disease.²⁰⁹

Rail traffic noise

London is more dependent on rail than any other city in the UK, with 70 per cent of all rail travel (including Tube journeys) in the UK being to, from, or within London. Rail transport has a number of noise implications for the city through train operation, maintenance, freight loading and station operation. However, the effects are more concentrated than for road noise with only just over 525,000 people in London affected by rail traffic noise above the recommended levels provided as a guideline by the WHO.

Noise mapping

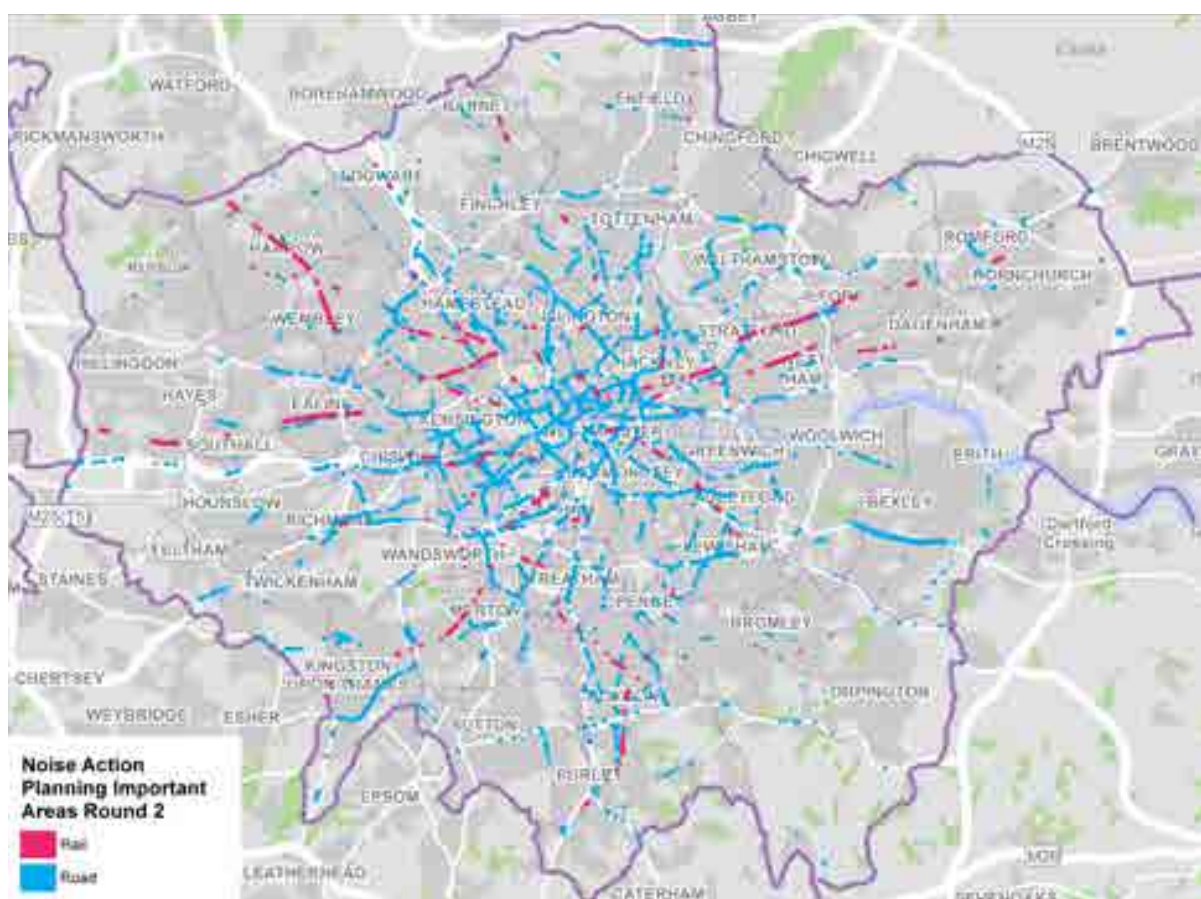
Defra has responsibility for implementing the Environmental Noise Directive within the UK. As part of implementation, Defra has completed two rounds of noise mapping (2007 and 2012), with a third expected to be released in 2018. This shows estimated levels of road and rail traffic noise along major transport routes and is designed to help better identify and prioritise local action on noise. These maps are accompanied by action plans, which provide the framework for managing environmental noise and its effects.

To focus attention on those most exposed to noise, Defra has completed mapping of Important Areas. Based on the results of the strategic noise mapping, Important Area maps show where the one per cent of the population that are affected by the highest noise levels are located (Figure 57). This is an important strategic tool, as it shows the areas likely to be at the greatest risk of adverse impacts to health and quality of life.

²⁰⁸ Defra (2013) Protecting and enhancing our urban and natural environment to improve public health and wellbeing. Accessed from: <http://webarchive.nationalarchives.gov.uk/20130822084033/https://www.gov.uk/government/policies/protecting-and-enhancing-our-urban-and-natural-environment-to-improve-public-health-and-wellbeing/supporting-pages/international-european-and-national-standards-for-air-quality>

²⁰⁹ Maynard, R., Berry, B., Flindell, I.H., Leventhall, G., Shield, B., Smith, A. and Stansfield, S. & Moorhouse, A. (ed.) (2010) Environmental Noise and Health in the UK: A report by the ad hoc expert group on noise and health.

Figure 57: Noise map of Important Areas for road and rail traffic noise across London²¹⁰



²¹⁰ Generated from Defra (2015) Open data: strategic noise mapping. Accessed from: <https://www.gov.uk/government/publications/open-data-strategic-noise-mapping>

Aviation noise

Under the Environmental Noise Directive²¹¹, major airports with over 50,000 plane movements annually are required to carry out noise mapping. London is served by six main airports, Heathrow, Gatwick, London City, Stansted, Luton and Southend, though only two, Heathrow and London City, fall within the GLA boundary. All six airports listed above have produced noise action plans with noise contour mapping. These show that 827,400 people and 357,050 dwellings fall within noise contours in excess of 55dB. Heathrow Airport alone accounts for 93 per cent of the people affected by 55dB or above from London's six main airports.²¹²

Other noise sources

Other noise sources include construction, industrial, commercial and waterways. For these sources, complaints are the most widely collected form of data. This is quite fragmented as attitudes to noise are subjective, and complaints are collected by a number of different organisations. Local authorities collect and collate data for their borough, while large organisations such as TfL collect complaints relating to their services.

ROLES AND LEGAL DUTIES

The Mayor has a legal duty to set out policies and proposals in this strategy to tackle ambient noise, the main, long-term, predictable sources of noise across London. This includes noise related to transport, fixed industrial sources and other sources that the Mayor may consider appropriate.

The Mayor's powers to monitor and control noise are limited. While the Mayor can seek to mitigate some ambient noise impacts through the actions of TfL and the wider GLA group, the Mayor has no direct role over policing noise emitted from construction works, loudspeakers in the street, noise under the control of an employer, noise emitted from premises, noise emitted from or caused by a vehicle in the street, noise emitted from or caused by machinery or equipment in a street, and noise from drones or other model aircraft. Responsibility for the policing and management of these sources of noise falls to local authorities and independent organisations. See Appendix 3 for the roles and responsibilities of different organisations in mitigating and policing noise. Proposals 48 and 49 of the Mayor's Transport Strategy set out in detail how TfL is working to reduce the number of Londoners exposed to excessive noise and vibration levels from road and rail sources.

²¹¹ European Commission (2002) Environmental Noise Directive 2002/49/EC. Accessed from: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32002L0049>

²¹² Collated from individual airport noise plans: see Appendix 2 for full details.

Objectives, policies and proposals

OBJECTIVE 9.1 REDUCING THE ADVERSE IMPACTS OF NOISE BY TARGETING LOCATIONS WITH THE HIGHEST NOISE POLLUTION FROM TRANSPORT

Many people live in areas where noise levels exceed the guidelines set by the WHO. In the UK, 55 per cent of the population live in dwellings where the recommended maximum daytime sound level is exceeded, and 67 per cent live in places where noise exceeds the night-time recommended maximum.²¹³

As road transport is the biggest source of noise pollution for London, the Mayor will:

- encourage mode shift to reduce car use in favour of more sustainable models of travel such as walking, cycling and public transport.
- promote quieter, low emission vehicles and road surfaces
- reduce noise from freight activity through the consolidation of services.

Noise from other transport sources, especially aviation, are also an issue in London. The Mayor will work with stakeholders to reduce the impacts of noise from aviation, rail and river activities.

Policy 9.1.1 Minimise the adverse impacts of noise from London's road transport network

Proposal 9.1.1.a The Mayor will work with TfL to encourage mode shift to reduce road traffic

The Mayor's Transport Strategy sets out a strong ambition to reduce car use in favour of more sustainable, quieter and space efficient modes of travel. Streets make up 80 per cent of London's public space, so reducing the impact of road traffic noise has the potential to dramatically improve the experience of living, working and spending time in the city.

London's streets are already some of the most congested in the world. In cities and urban areas, most vehicle noise comes from the engine. This dominates over noise generated by tyres and road surfaces at lower vehicle speeds. Therefore, the best way to reduce the amount of noise generated by road traffic is to reduce traffic volumes.

The Mayor's Transport strategy aims to increase the number of trips made by walking, cycling and public transport from 64 per cent today to 80 per cent by 2041. This will reduce overall road traffic and have positive implications for road noise levels across London.

²¹³ National Noise incidence survey (NIS) a Defra funded study run in 2000/2001, cited in Environmental Noise and Health in the UK, July 2010.

Proposal 9.1.1.b The Mayor will work with TfL to encourage the transition to zero emission vehicles

The Mayor wants to make London's transport network zero emission by 2050. This will be achieved by changing London's streets and transport infrastructure to enable zero emission transport, and support the accelerated uptake of ultra low and zero emission technologies, such as electric and hydrogen vehicles. These vehicles have lower noise emissions, with limited engine noise when operating in electric mode. As a result, they offer a quieter and cleaner alternative for motorised traffic that remains.

You can find out more about the Mayor's vision for a zero emission transport network in the Chapter 4 of this strategy.

Proposal 9.1.1.c The Mayor will work with key stakeholders to reduce noise from freight activity in London

For the freight activity that does remain on our streets, the Mayor will work with London Councils on possible changes to the London Lorry Control Scheme, which restricts the movement of heavy goods vehicles at night and at weekends, so that the scheme can minimise noise and reduce emissions, as well as encouraging safer vehicle design.

TfL's forthcoming Freight, Delivery and Servicing Plan will set out how the high-level approach outlined in the Mayor's Transport Strategy will be implemented. Noise issues relating to freight will be considered as part of this plan. Chapter 4 of this strategy contains more information on reducing emissions from freight.

Freight is essential to the local economy and services that a growing city requires. But, as the city grows, commercial activity must become more responsible and efficient to avoid a negative impact on residents. Retiming deliveries and collections, and managing noise impacts via responsible practices and behaviours can move trips from busy to quieter times. However, a large amount of freight is generated around goods and services for residents who want it delivered at a time and place that suits them. Therefore, influencing changes in consumer behaviour would have a big impact.

Mitigating noise impacts through responsible practices and behaviours can reduce disturbance. This can be done by using better vehicles and quieter equipment, as well as raising awareness through training and publicity for both those making and receiving deliveries. TfL has published best practice guidance on noise mitigation for freight operators on their retiming deliveries webpage.²¹⁴

²¹⁴ TfL (n.d.) Retiming deliveries. Accessed from: <https://tfl.gov.uk/info-for/deliveries-in-london/delivering-efficiently/retiming-deliveries?intcmp=37935%22%20%20on-this-page-2%22%20>

Collaborative working between businesses, fleet operators and local authorities is essential in managing local issues. As technology advances and better equipment becomes available, the Mayor will encourage boroughs to review noise management and enforcement. This includes the London Lorry Control Scheme, which controls the movement of heavy goods vehicles at night and at weekends, and promoting good practice in the design of buildings and loading facilities.

Proposal 9.1.1.d The Mayor will work with TfL to encourage quieter driving styles and provide low noise road surfaces

The use of low noise road surfaces is proposed within the Mayor's Transport Strategy and further information will be provided through Local Implementation Plan (LIP) Guidance. Low noise road surfaces offer considerable potential to cut road noise and have the advantage of bringing immediate benefits. TfL currently uses materials on its network, which provide noise absorption. TfL has investigated the benefits of lower noise materials and will continue to install low-noise road surfacing on the Transport for London Road Network, where appropriate. Boroughs are also encouraged to consider the benefits of low noise materials on their road networks.

"The Mayor wants to increase the number of trips made by walking, cycling and public transport to 80 per cent by 2041."

Driving at lower speeds and avoiding high acceleration will result in lower engine noise and a significant drop in overall road traffic noise when adopted on a wide scale. Less aggressive driving styles are thought to decrease noise by 1-5 dB(A) for cars and heavy commercial vehicles, and as much as 7dB(A) for motorcycles. As a result, influencing how vehicles are driven, towards more passive styles, can have major benefits in reducing noise.

Driving styles can be influenced by putting in place and policing lower speed limits, greater compliance with speed limits, and via training and enforcing best practice. The responsibility of driver testing and certification of driving instructors falls to the Driver and Vehicle Standards Agency. The Mayor and TfL are developing a London Standard for motorcycle training and will support driver recognition schemes to encourage best practice.

Policy 9.1.2 Minimise the adverse impacts of noise from non-road transport

Proposal 9.1.2.a The Mayor will work with TfL to monitor and manage the noise impacts of Tube and rail services, especially the Night Tube and other night-time TfL rail services

London's night-time economy and cultural scene require a comprehensive, integrated night-time public transport service. More than 200,000 people use the Night Tube services each weekend. This is expected to increase as the service extends to other parts of the network.

To minimise airborne noise, ground-borne noise, and vibration from increased operations, TfL has been working to reduce noise from its tracks through increased investment in renewal and maintenance programmes. For example, TfL has installed thousands of resilient track fastenings, installed hundreds of metres of high performance steel track, removed rail joints, and trialled innovative technology. In addition, it has worked to decrease noise from late-night station operation.



Proposal 9.1.2.b The Mayor will work with TfL to ensure new rail infrastructure uses technology that is effective at reducing noise

London is more dependent on rail than any other city in the UK. Within the UK, 70 per cent of all rail travel is to, from and within London. The Mayor, through TfL, and by working with Network Rail and train operating companies, plans to tackle crowding and enable mode shift by increasing the capacity of rail based services across London by at least 80 per cent by 2041. This will require the development of new lines and services, which add further to rail noise across London. The Mayor's Transport Strategy sets out proposals to mitigate noise from rail services.

In addition to TfL, there are a number of other responsible bodies for rail service within London. The Mayor will seek to work with Network Rail and train

operating companies to mitigate, where reasonably practicable, the effects of noise and vibration caused by these services. The Mayor requires noise issues to be addressed as part of all planned railway works, and for steps to be taken that minimise the impact of works on neighbours. The Mayor wants suburban rail services to be devolved. This will help ensure integration of the provision of services and a more consistent experience for customers.

With the exception of engine noise from diesel locomotives operating at full power, the main source of noise from moving railway vehicles is from the wheels running over the track surface and the type of braking system. To mitigate noise from these sources, TfL has increased its investment in renewal and maintenance programmes. It is committed to installing appropriate noise reducing solutions during renewal and maintenance works.

Proposal 9.1.2.c The Mayor will oppose any expansion of Heathrow Airport that would result in additional environmental harm

Adequate airport capacity serving a wide range of destinations is critical to the competitive position of London in a global economy. As the city grows, airport capacity needs to grow with it, and it will become more important to consider the impacts this will have on Londoners.

London Heathrow and London City Airport supply the vast majority of flight movements over London. Heathrow Airport affects the greatest number of people, exposing around three quarters of a million people to significant aircraft noise (at 55dB_Lden or above). That is more than its five main European rivals combined.

In October 2016, the government announced its preference for a new north-west runway at Heathrow. This would increase the airport's current aircraft movement cap of 480,000

flights per year to 740,000 flights a year. Analysis for TfL shows that proposals for a Heathrow expansion could expose another 200,000 people to significant aircraft noise, in comparison to a no expansion scenario. As a result, the Mayor will oppose expansion of Heathrow Airport unless it can be shown that no new noise harm will result, and the benefits of future regulatory and technological improvements would be fairly shared with affected communities.

The Mayor responded to the Department for Transport (DfT) consultation on the Draft National Policy Statement in May 2017 and December 2017 and to the first Heathrow Airport consultation on its Development Consent Order for a third runway in March 2018, to oppose the expansion of Heathrow Airport in light of the potential increase in noise.

The impacts of expansion of Heathrow Airport on air quality and greenhouse emissions are covered in Chapters 4 and 6. The GLA's policy on aviation can be found in the London Plan.

“The Mayor will continue to lobby to minimise the adverse impacts of noise from aviation.”

Proposal 9.1.2.d The Mayor will lobby to reduce helicopter noise exposure for Londoners

Noise from helicopter flights can be a particular source of annoyance for Londoners. The problem is compounded by an outdated regulatory regime that is very limited in the restrictions it places on the number of helicopters and the routes they can fly. The Mayor is lobbying for the Civil Aviation Authority and government to review and amend the regime to ensure reduced helicopter noise exposure for Londoners.

Proposal 9.1.2.e The Mayor will continue to lobby to minimise the adverse impacts of noise from aviation

The effects of noise from aircraft, particularly at night, cause significant impacts on the health and quality of life of Londoners. Aircraft, while quieter than in the past, are still very noisy and generate a great deal of nuisance for those living under flight paths. The industry needs to be held to account for its noise impacts, and the concerns of local communities must be properly

addressed. To minimise the adverse impacts of noise from aviation, the Mayor has, and will continue to lobby for:

- reduced night flights from airports that may affect London residents
- an approach to airspace modernisation that is fair and efficient, and which gives full weight to the associated noise impacts for all affected communities
- the establishment of an independent noise regulator with powers of sanction

The GLA's policy on aviation can be found in the London Plan. The full responses to aviation consultations can be found at <https://tfl.gov.uk/corporate/publications-and-reports/aviation>.

Proposal 9.1.2.f The Mayor will work with key stakeholders, such as the Thames and London Waterways Forum, to consider noise arising from increasing waterway use

River services are an integral part of London's public transport system and will play a greater role in supporting growth. In recent years, there have been strategic efforts to increase the use of the river and waterways network for passenger services, freight and waste. In the longer-term, any significant increase in river traffic could generate more emissions, including noise. Chapter 4 includes more information about reducing emissions from activity on London's waterways. The Survey of Noise Attitudes (SoNA) 2013 found that 95 per cent of survey respondents across England could not hear noise from sea, river or canal.²¹⁵ This made noise from water sources the least disruptive of those reported within SoNA.

While noise from waterways is not currently considered an issue, the Mayor will continue to work with relevant stakeholders to ensure that noise from the increased use of waterways is adequately considered. The Thames and London Waterways forum was

²¹⁵ Aecom (2013) Survey of Noise Attitudes (SoNA) 2013 – Prepared for: Defra. Accessed from: http://randd.defra.gov.uk/Document.aspx?Document=13319_NANR322SoNA2013ReportFinalNov2015.pdf

established to centralise all waterway discussions and bring key stakeholders together to deliver the relevant goals set out in the Mayor's strategies. It will work collectively to initiate evidence gathering and consider the outcomes. This can be used as a foundation to address observed or potential noise issues as they arise. It will also guide growth in waterway use, aiming to avoid excessive increases in noise complaints.

OBJECTIVE 9.2 REDUCING THE ADVERSE IMPACTS OF NOISE BY TARGETING NON-TRANSPORT SOURCES THAT PRODUCE THE MOST NOISE

While transport noise is the most prevalent source, noise from commercial activities, industrial activities, and from construction/demolition also has a strong impact on the city's soundscape. These noise sources feature heavily in the complaints received by London borough councils.²¹⁶

To accommodate London's growth, there are now many large construction sites across the city, and industrial

and commercial premises are located closer to residential properties that can be sensitive to the noise and vibration that they produce. In these instances, good planning, identification of places that are particularly sensitive to noise, such as homes, schools and hospitals, and concerted efforts to mitigate noise from an early stage can significantly reduce the annoyance felt by people in surrounding properties.

Policy 9.2.1 Minimise the adverse impacts of noise from non-transport sources

Proposal 9.2.1.a The Mayor will provide guidance on appropriate noise mitigation measures for commercial and industrial premises

Guidance on appropriate noise mitigation measures for commercial and industrial premises can be found in the GLA's Supplementary Planning Guidance (SPG). This sets out the layout, design and management practices that developers should follow to reduce noise from these sites. This guidance will be kept under review to ensure that it is encouraging

²¹⁶ Shelton, T. (2017) London Hotspots for Noise Nuisance Complaints [Infographic] <https://www.cirrusresearch.co.uk/blog/2017/03/london-hotspots-noise-nuisance-complaints-infographic/>

the mitigation of noise from these premises in the long-term. The Mayor will minimise adverse noise impacts on local residents from construction on large and long-term building sites.

Construction and demolition sites, including roadworks, can greatly contribute to noise levels if they are not well managed. Given how long some of these projects last and the number of projects that can happen in an area at once, this can have serious negative impacts on local businesses and residents. Improved strategic management, technology and communication can be used to reduce the negative impacts of noise on those nearby.

Construction is generally policed by local authority Environmental Health teams. However, given construction is so widespread across London, it is important to ensure that steps are taken to minimise its impact. The GLA is undertaking a number of

initiatives that will help to mitigate the impact of construction on communities in London. For example, the Mayor is establishing the Infrastructure High Level Group,²¹⁷ which brings together development and infrastructure leaders to collectively respond to the challenges and opportunities that London's growth presents. A key focus of this group is supporting improved coordination of infrastructure delivery, including construction activity. The GLA is currently examining options for how this could best be achieved at both a pan-London level, and at the area/scheme specific level.

Building sites are all unique and their noise strategies should reflect this. Each site needs to take into consideration surrounding land uses, existing day time noise and the methods of construction/demolition. TfL is working with boroughs to reduce the number of trips in peak time and encourage the wider use of quiet deliveries through cleaner vehicles, and foot and cycle deliveries.

²¹⁷ Mayor of London (n.d.) London's Infrastructure 2050: progress update. Accessed from: <https://www.london.gov.uk/what-we-do/business-and-economy/better-infrastructure/londons-infrastructure-2050-progress-update>

Proposal 9.2.1.b The Mayor will encourage better planning and integration of road works

The Mayor will continue to encourage best practice in roadworks through the Code of Conduct for Roadworks.

Roadworks are vital to providing essential utility services and enabling much needed development and improvements to public space. However, they also cause significant delay and disruption to the road network and frustration to road users and nearby residents. It is important to ensure that roadworks are consolidated where appropriate and completed in the most efficient manner to limit their impact.

The Mayor, through TfL, incentivises the quick completion of roadworks in traffic sensitive areas through the Lane Rental scheme, which applies a daily charge for occupation of the most traffic sensitive streets at traffic sensitive times.²¹⁸ In addition, it supports the London Permit scheme, which is designed to allow boroughs to coordinate roadworks by different companies and minimise the number of times the same area is dug up.

BOX 42: MOVING NOISE SOURCES

The powers provided to the Mayor through the GLA Act 1999, and to the boroughs through the Environmental Protection Act 1990 are designed to combat static sources of noise. However, in many cases, it is the unexpected sources of noise that are most disruptive, whether music from a passing car, a party boat on the River Thames or emergency sirens.

Moving noise sources are much harder to police, as responding to complaints usually results in action when it is too late, with the source of noise having moved to a new location or abated. In some cities, noise powers have been extended to cover some moveable sources of noise. For example, in New York City, the Noise Code specifically restricts the volume of car stereos.

While the Mayor currently does not have provision for the policing of moving sources of noise, the Mayor will investigate how this is legislated elsewhere and what powers may be required to control moving noise sources within London.

²¹⁸ TfL (2016) Benefits of the Transport for London Lane Rental Scheme. Accessed from: <http://content.tfl.gov.uk/lane-rental-benefits-report-november-2016.pdf>

OBJECTIVE 9.3 PROTECT AND IMPROVE THE ACOUSTIC ENVIRONMENT OF LONDON

Noise is part of a vibrant, successful and growing city, but excessive noise need not be accepted as a necessary cost. As work patterns are changing, and more people are moving away from traditional hours of sleep, providing homes that mitigate against noise at all times is becoming more important. Good acoustic design in developments, the consideration of cumulative noise, and the creation and protection of quiet and tranquil spaces provide respite from the commotion of the city. In order to protect and improve the acoustic environment of London, it is essential to develop a good understanding of the different sources and impacts of noise. As part of this, being able to accurately monitor noise will enable the Mayor and TfL to understand the effectiveness of different interventions.

Policy 9.3.1 Improve our understanding of the sources and impacts of noise to better target policies and action

Proposal 9.3.1.a The Mayor will engage collaboratively with Defra on national noise policy and noise research, for example by inputting into the development of noise mapping and responding to relevant consultations

Defra's third round of noise mapping will provide some modelled baseline data, against which progress can be measured. The Mayor's Transport Strategy also proposes to measure the adverse impacts of road transport by monitoring noise close to major road corridors. This will establish baseline data against which the impact of road noise objectives can be measured. Future data collection will aim to aggregate further noise data to create a London-wide dataset. In addition, data collection should be standardised, where possible, across the UK.

Policy 9.3.2 Create and maintain quiet and tranquil spaces across London**Proposal 9.3.2.a The London Plan includes policies that encourage boroughs to promote more quiet spaces across London**

London's parks, green spaces, waterways, private gardens and natural landscapes are the places where Londoners can relax away from the hustle and bustle of the city. Given the competing pressures for land in London, it is not feasible to create extensive areas of new public open space or natural habitats based on the old model of parks and nature reserves. Therefore, it is important to protect the areas that already exist. Chapter 5 contains the policies that the Mayor will deliver to protect and enhance London's green spaces.

In addition to this, the Mayor will encourage boroughs to nominate 'quiet areas', in line with guidance from Defra.²¹⁹

Policy 9.3.3 Reduce the impacts of noise through good design**Proposal 9.3.3.a The London Plan promotes the use of good acoustic design and the protection of soundscapes**

All dwellings should be built with acoustic insulation. However, acoustic insulation should not solely be relied upon. Through the London Plan, the Mayor encourages the separation of new noise sensitive development from major noise sources, where possible, rather than relying on the use of soundproofing alone. Separation of a development can be achieved through distance, internal layout, or screening.

²¹⁹ Defra (2014) Noise Action Plan: Agglomerations. Accessed from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/276228/noise-action-plan-agglomerations-201401.pdf



“Good acoustic design not only applies to individual buildings; it also applies to how the city runs.”

The separation of noise sensitive development from noise sources is not always practical, and may not be achievable without undue impact on other sustainable development objectives. In this case, good acoustic design is central to noise management and avoiding negative noise impacts. Box 43 describes the Agent of Change principle, which will be applied through the London Plan and puts the noise mitigation requirement onto the person or business responsible for making the change rather than penalising existing businesses.

Good acoustic design not only applies to individual buildings; it also applies to how the city runs. As the night-time economy grows (see Box 44), it is important to understand and mitigate the noise of people coming and going between venues. In areas with a strong night-time economy, quick and quiet exit routes for customers must be considered. These must take people quickly to transport stops and help direct them away from quieter residential areas.

Noise management includes promoting good acoustic design in development whenever opportunities arise. This can be via traditional and innovative noise reduction measures, as well as deliberately introducing sounds to enhance the soundscape and mitigate unwanted noise.

Development should seek to protect and improve the acoustic environment by introducing a soundscape that is relevant to the local environment. This can mean allowing some places or certain times to be noisier, within reason, whilst others are quieter. For example, areas with a higher level of residential properties would be expected to have a quieter soundscape than an area that is known for its nightlife.

Where appropriate, the Mayor will look for opportunities to assess innovative approaches to tackling noise, including by using the Mayor's Design Advocates.

The London Plan includes more information on the Mayor's policy on reducing, managing and mitigating noise in residential and other non-aviation development.

Proposal 9.3.3.b The Mayor will support retrofit initiatives to create energy efficient buildings that will also help reduce the impact of external noise

The Mayor wants to make London a zero carbon city by 2050 (see Chapter 6). This will be achieved through energy efficient buildings, clean transport and clean energy. Initiatives for improving energy efficiency in buildings encourage the use of efficient building materials, such as insulation and triple glazing, to reduce energy demand. These materials are not only cost effective, saving money on energy bills, but they also have a positive impact on internal noise levels.

BOX 43: THE AGENT OF CHANGE PRINCIPLE

It is preferable to avoid the adverse impacts of noise by distancing dwellings and sensitive uses from noise sources. However, the density of the city is making this increasingly difficult to achieve. Sustaining and protecting businesses requires a sensitive approach to managing change in surrounding areas. Policies are required that reconcile the competing needs of noise mitigation with housing pressures, a growing economy, and the need to maintain London as a vibrant and interesting city.

The National Planning Policy Framework states that planning policies and decisions should aim to avoid placing unreasonable

restrictions on existing businesses. Within London, this will be considered through the Agent of Change principle.

Agent of Change refers to the principle that the person or business responsible for the change is responsible for managing the impact of the change. The Mayor has published the Culture and Night-Time Economy Supplementary Planning Guidance (SPG). The London Plan provides guidance and further information on this principle to ensure that existing planning policy is used as effectively as possible.

The government has announced that it will be amending the new National Planning Policy Framework (NPPF) to strengthen these protections.

BOX 44: THE NIGHT-TIME ECONOMY

London has reportedly lost almost a third of its night clubs and live music venues: some 35 per cent of its grassroots music venues and 50 per cent of its night clubs since 2007. The Culture and Night-Time Economy Supplementary Planning Guidance encourages boroughs to sustain existing venues. It also encourages them to provide new facilities to protect against the unnecessary loss of valued social, recreational and cultural facilities and services.

To reconcile the competing needs of noise mitigation with a growing night-time economy, the Mayor has included policies that support and enhance the night-time economy in the London Plan. This encourages boroughs to consider the cumulative impacts of high concentrations of night-time activities on noise pollution for residents.

Housing proposed near existing cultural venues should include necessary acoustic design measures

to ensure residential units have sound insulation to mitigate noise impacts. Since April 2016, developers are required to seek prior approval from the local planning authority to change a use from office to residential under permitted development rights. This means local planning authorities must take account of national planning policy and guidance on noise, in a similar way to a planning application. It is also a way to raise any material concerns by owners of music venues in relation to noise. This will help ensure that before residents move into new housing near to well-established businesses, appropriate noise mitigation measures will be put in.

Likewise, prospective residents should have the means to stay informed of nearby businesses and activities that create night-time noise. This can be achieved by attaching informatives (extra information) to the documentation for new residential planning permissions.



Chapter 10: Transition to a low carbon circular economy

“London already has a strong low carbon and environmental goods and services sector, worth £30.4bn as estimated through sales in 2014/15.”

INTRODUCTION

London already has a strong low carbon and environmental goods and services sector, worth £30.4bn as estimated through sales in 2014/15. The Mayor wants to ensure that as London and the world's economies make the transition to the low carbon circular economy, London's businesses and workers are supported to be able to compete effectively in, and benefit from, this growing global market. All of the Mayor's strategies will play their role in supporting this, but this strategy and the Economic Development Strategy will play the primary roles. This chapter sets out the policies and proposals that the Mayor will implement to catalyse the transition to a low carbon circular economy.

A sizeable global low carbon market has already been established in response to existing environmental policy and regulations. It has enjoyed an average global growth rate of 11.3 per cent per year since 2008, during which average global GDP growth was 3.3 per cent. It is estimated to already be worth around \$5 trillion, or 4.7 per cent of global GDP.

International commitment around the need for a global transition to a low carbon circular economy has grown considerably in the past few years, with the 'Paris Agreement on Climate Change' and the '2030 Agenda for Sustainable Development' both being agreed by over 150 nation states. These create the framework within which the world will act to protect the planet, tackle climate change, end poverty, and reduce inequality.

The transition to a low carbon circular economy will create both opportunities and challenges for businesses and their workers, as existing business models evolve and our approach to economic development changes from a linear to a more circular approach. This transition needs to be just and fair, and consider workers' jobs and livelihoods, as well as the challenges that businesses, especially SMEs, will face as the economy makes this transition.

Business support and skills development programmes are being developed to support the transition and help both businesses and workers to access and benefit from the opportunities that this transition will create. Once responsibility for adult skills is devolved, the Mayor will be better able to direct funding to meet the needs of London's businesses and learners, giving Londoners the skills they need in a changing labour market.

The transition to a low carbon circular economy requires all sectors to reduce their greenhouse gas (GHG) emissions and resource consumption. It will be most challenging for those sectors with high GHG emitting and/or resource intensive supply chains such as the Food sector. The Mayor is producing a draft Food Strategy, and this will set out the challenges faced by the sector and how it can start to reduce its related GHG emissions.

There are three integrated elements that illustrate the Mayor's role in creating, enabling and benefitting from the transition to a low carbon circular economy:

- **Creating Market Demand** – the Mayor will show leadership and ensure that London is illustrating, through its strong policy framework, how cities can create demand for low carbon and environmental goods and services that directly address the environmental challenges that they face and drive resource efficiency and a reduction in consumption. The GLA group, and the public sector more generally, can create demand for low carbon resource efficient goods and services directly through procurement.
- **Capturing a Share of the Market** – the Mayor will support London's existing and future businesses to develop the skills, knowledge, experience and expertise to be competitive in a low carbon circular economy. In particular, it will help businesses that are providing low carbon and resource efficient goods and services to ensure that they are as competitive as possible in this growing global market.
- **Enabling the Transition** – for this transition to be possible, there needs to be major investment in a just transition, supporting all citizens and workers in London to be part of the economy, as well as investing in the city's infrastructure to create the comprehensive and integrated systems that will be needed; such as energy, water and waste. These systems will allow London, its citizens, and its businesses to effortlessly live, work and play in what will be an increasingly low carbon and resource efficient world.

To be a global leader in this sector and realise both the environmental and economic benefits that this represents the Mayor will support London to:

- grow the low carbon and environmental goods and services sector and market
- enable London's businesses, academia and citizens to actively compete in and contribute to the low carbon circular economy

Accelerating the transition to a low carbon circular economy

In the transition to a low carbon circular economy, and as natural resources become increasingly scarce, the cities that maximise resource efficiency will enjoy a growing competitive advantage. For example, by using local energy sources such as waste heat, cities can reduce demand for fossil fuels and increase their energy security and resilience. Cities can integrate these circular principles into their approach to economic development. For example, public sector procurement and supportive policy frameworks can incentivise demand for low carbon, resource efficient goods and services.

The principles promote a 'circular approach' to the use of resources in London, ensuring that materials stay in use as long as possible, reducing the amount of virgin materials required and maximising recycling. The Mayor wants to prevent materials from becoming waste in the first place by promoting more sustainable, circular business models that design out waste and ensures materials can be easily reused and recycled (see also Chapter 7).

Circular Economy principles for business

Recent research has suggested that there are five unique circular economy business models, which could be used singly or together to help companies achieve large resource productivity gains (see Box 45 for an illustrative case study). The five business models are:

- **products as services** - sell access to products while retaining ownership of products and assets. This could include leasing products instead of selling them
- **sharing economy** - share assets, for example cars, rooms, or appliances via sharing platforms
- **prolong product life** - through maintenance, designing for durability, reuse and remanufacture of products and components
- **renewable inputs** - shift to using secondary materials as the inputs for products
- **recover value at end of life** - through effective recycling and composting or anaerobic digestion

BOX 45: GLOBECHAIN

Globechain²²⁰ is an online reuse platform that connects businesses, charities and people, allowing them to reuse unwanted items within a global supply chain network. This also creates a waste audit and social impact value for members.

Their aim is to create a local supply chain within a global community to enable the redistribution of goods to social causes rather than landfill. Globechain have over 10,000 members ranging from corporates, charities, schools & universities, social enterprises, start-ups and individuals in industry sectors ranging from retail, banking, fashion, food, construction, education and health. One of Globechain's key areas of activity is looking at construction products.

The integration of this approach, where appropriate, into existing and developing businesses offers London's businesses an opportunity to become more resource efficient and profitable. Analysis of the potential benefits from the circular economy in London shows that, with the right investment, by 2030 it could:

- create 12,000 net new jobs in the areas of reuse, remanufacturing, repair, and maintenance
- contribute £7bn each year by 2036 to London's economy in the areas of the built environment, food, textiles, electrical goods and plastics
- save £5bn in avoided waste infrastructure costs through to 2050, whilst freeing up land previously needed for waste management for other uses²²¹

To be a global leader in this sector and realise both the environmental and economic benefits that this represents, the Mayor will support London to:

- grow the low carbon and environmental good and services sector and its market share
- support a just transition that enables London's businesses, academia and citizens to actively compete in, contribute to, and benefit from the transition to a low carbon circular economy

²²⁰ Globechain (n.d.) Homepage. Accessed from: www.globechain.com

²²¹ London Waste and Recycling Board (2015) Towards a circular economy – context and opportunities; Accessed from: http://www.lwarb.gov.uk/wp-content/uploads/2015/12/LWARB-circular-economy-report_web_09.12.15.pdf



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Objectives, policies and proposals

OBJECTIVE 10.1 ENABLING THE TRANSITION TO A LOW CARBON CIRCULAR ECONOMY

Policy 10.1.1 To build on London's strengths and grow the low carbon and environmental goods and services sector

The upcoming Mayor's draft Economic Development Strategy will support the following proposals.

Proposal 10.1.1.a The Mayor will establish a Centre for CleanTech Innovation in west London to provide workspace, collaboration space and business support

London's ultimate strength in the UK's value chain is very much in the research and development, innovation and start-up sector. London stimulates and supplies new ideas, technologies and products that the rest of the UK can then develop and manufacture.

London is already home to the UK's most significant concentration of CleanTech businesses. London and the south east represent 42 per cent of the UK's CleanTech sales.

The number of CleanTech businesses in London and the south east provides a real opportunity to create a CleanTech cluster that will bring focus, dynamism and growth to London's low carbon circular economy and the delivery of low carbon solutions to the capital itself. CleanTech covers a wide range of sectors, for example from energy, transport and waste, to water, food and buildings.

Small CleanTech and low carbon clusters are already emerging in parts of London, for example in Haringey, Bermondsey and Brixton. Their emergence has been largely organic and driven by local need and advantage.

To grow these further, London needs to provide leadership to gather together its CleanTech community and its stakeholders, create the right environment for CleanTech to prosper, and increase the visibility of the sector and its emerging innovation.

The Mayor will work with the CleanTech business community to develop plans for a Centre for CleanTech Innovation and a wider CleanTech cluster. It aims to deliver the following benefits to London and its cluster partners:

- tackling the challenges of climate change
- supporting the development of London's low carbon circular economy
- catalysing commercial opportunity within the low carbon circular economy
- generating new jobs within the CleanTech sector
- gaining global recognition for London and the UK

Proposal 10.1.1.b The Mayor will promote those sectors where London can show its clear leadership for consideration as part of the UK Industrial Strategy's Sector Deal Programme

In addition to general support frameworks for doing business, the Mayor believes a more targeted approach is needed to address some sector-specific opportunities and challenges. London can be a leader in addressing some of the big strategic challenges facing global cities, like climate change, which require a collaborative 'mission-led' response between the public and private sector, and with other global cities.

London is leading the way in the UK in a number of sectors, including CleanTech, financing and advanced urban services. These sectors will be promoted by the Mayor for recognition by government as part of the proposed Industrial Strategy Sector Deal Programme. Some of these sectors will develop innovative solutions for challenges faced by businesses in making the transition to the low carbon circular economy.

The following proposals relate to the work of this strategy.

Proposal 10.1.1.c The Mayor will explore approaches that support innovative businesses to create solutions to London's environmental challenges

The Mayor will work with global networks, such as C40 and the International CleanTech Cluster Network and other cities to gain knowledge and develop ideas for how innovative businesses can help create solutions to address London's environmental challenges. This will also aim to develop business models that will support the transition to a low carbon circular economy.

The Mayor will work with LWARB to implement its Circular Economy Route Map with London stakeholders which, if implemented fully, could contribute £2.8bn of benefits to London's economy annually by 2036.

The Mayor will also explore opportunities to support innovation in the energy efficiency supply chain, working with the sector to identify and develop appropriate support that addresses the performance gap, encourages increased demand, and reduces costs.

Proposal 10.1.1.d The Mayor will work with the GLA group and other public sector organisations to maximise the use of sustainable procurement approaches to drive demand for low carbon and environmental goods, services and solutions

The GLA group spends around £11bn on its procurement activities every year. The Mayor will actively use and promote the Mayor's Responsible Procurement Policy to drive demand for goods and services that have high environmental specifications, and companies that have high environmental performance.

The scale and diversity of the GLA group's buying power creates opportunities for establishing procurement partnerships that can achieve better value for money, whilst simultaneously encouraging innovative and sustainable approaches and solutions from London's suppliers.

Proposal 10.1.1.e The Mayor will work with stakeholders from across the financial and environmental sectors to develop financing mechanisms

The Mayor will work with partners to increase the flow of finance to support the delivery of large scale projects that address the environmental challenges that London is facing. For example, the Mayor will use the Mayor's Energy Efficiency Fund to support energy efficiency and low carbon energy supply projects, and the SME Fund to provide finance to those businesses seeking to scale-up and achieve their growth ambitions, as well as those aiming for long-term sustainability.

The Mayor will also explore the role and use of low cost financing and bulk purchasing, as well as innovative products, such as green bonds and climate change ISAs, to help attract large scale institutional investment into environmental projects.

Proposal 10.1.1.f The GLA group will demonstrate how public and private sector organisations could use largescale investment, such as pension funds, to provide investment for low carbon and environmental projects, and catalyse the transition to the low carbon circular economy

With the anticipated growth in London over the coming decades, it is anticipated that significant investment in new infrastructure will be required, and it is essential that this infrastructure investment is sustainable. Pension funds can be a source of this investment.

To support London's infrastructure requirements, the Mayor has asked the London Pension Fund Authority (LPFA) to help encourage the investment that London needs. The LPFA are already at the forefront of UK Local Government Pension funds work to pursue sustainable investment, with 2.25 per cent of the portfolio currently invested in this area. The Mayor has specifically asked the fund to scale up this portfolio to support Good Growth projects in

London and encourage other funds to follow this leadership. This complements the work that is already underway on climate change and divestment.

The GLA group and the LPFA have already agreed a climate change policy covering combined assets of just under £10bn, and agreed to no longer consider new active investments in fossil fuel companies that are directly engaged in the extraction of coal, oil and natural gas as sources of energy, including all necessary divestment required in line with the policy by 2020.

Policy 10.1.2 To build on London's strengths and enable London's businesses, academia and citizens to actively compete in and contribute to the low carbon circular economy

The following proposal will be encapsulated within the Mayor's draft Economic Development Strategy and will be available to support all businesses, including those within the low carbon and environmental goods and services sector.

Proposal 10.1.2.a To support start-ups and business growth across the economy, including in the low carbon and environmental goods and services sector

The Mayor's new Economic Development Strategy will identify a range of measures to support start-ups and business growth across London's economy. These will be available for all businesses, including those in the low carbon and environmental goods and services sector.

Support will include the Growth Hub – London's gateway to business support. Whilst the Growth Hub aims to support start-ups and business growth through coordinating London's general business support offer, it is also being developed to showcase low carbon and environmental business support schemes.

The Mayor's Civic Innovation Challenge is being developed to stimulate SME innovation by providing market access for innovative SMEs to test with, and sell their products to, market players. The Challenge will address three of London's big challenges: environment and climate change; inequality; and ageing population.

The London & Partners led Business Growth Programme has also been established to support SMEs within life sciences, digital/tech, creative, media and telecoms sectors to grow.

To help address the SME finance gap in London, the Mayor will work with partners, such as the European Investment Bank, to establish a new SME Fund. The fund will focus on those businesses seeking to scale-up and achieve their growth ambitions and those aiming for long-term sustainability.

This general support will include meeting the skills needs of businesses, including through use of the Adult Education Budget once devolved to the Mayor in 2019/20 and delivering high quality (including higher level and degree) apprenticeships.

There will also be some specialised support in the form of the European Regional Development Fund funded projects: Advance London and Better Futures. The Advance London project will support businesses to develop more sustainable, circular and inclusive business models; and the Better Futures project is a SME Business Incubator Programme to support the growth of the low carbon, CleanTech and resource efficient sector in London.

The following proposal will be delivered through this strategy, but with support from the Mayor's draft Economic Development Strategy.

Proposal 10.1.2.b To support students and young entrepreneurs to think about new business opportunities within the low carbon circular economy and establish start-ups that exploit these opportunities

The Mayor's Entrepreneur programme will continue to engage university students across London on low carbon circular economy market opportunities and work with them to develop new ideas for environmental goods and services that tackle the environmental challenges that cities are facing today. This programme will also pilot an expansion for two additional prizes, one in tech and one in creative industries, encouraging students to innovate in these areas and propose lower carbon, more resource efficient solutions to the challenges that these sectors face.



Chapter 11: GLA group operations – leading by example

One of the core principles of this strategy is that the Mayor and the organisations he directly controls and has oversight of should lead by example.

The GLA group includes:

- Greater London Authority (GLA)
- Transport for London (TfL)
- London Fire and Emergency Planning Authority (LFEPA)
- Mayor's Office for Policing and Crime (MOPAC)
- London Legacy Development Corporation (LLDC)
- Old Oak and Park Royal Development Corporation (OPDC)

The GLA group will lead by example in its own operations by tackling environmental challenges and procuring responsibly – delivering, driving and enabling best practice. They can be powerful demonstrators of best practice or new technologies and use their scale to help drive down costs to enable others to follow suit.

Specific examples within the strategy where the GLA group will be expected to show leadership include, but are not limited to:

Cross cutting:

- implementing the GLA group Responsible Procurement Policy²²²

Green infrastructure

- implementing sustainable drainage systems, planting trees, and installing green roofs across the GLA group
- delivering net gain for biodiversity
- reducing the use of pesticides and peat-based products, such as compost
- raising awareness of, and taking action on, wildlife crime

Air quality and climate change mitigation

- working to achieve compliance with the Ultra Low Emission Zone and working towards:
 - all cars in GLA group support fleets being zero emission capable by 2025
 - all new cars and vans (less than 3.5 tonnes) in GLA group fleets, including response vehicles, being zero emission capable from 2025
 - all heavy vehicles (greater than 3.5 tonnes) in GLA group fleets being fossil fuel-free from 2030
 - zero emission GLA fleets by 2050

²²² Mayor of London (2017) The GLA Group Responsible Procurement Policy. Accessed from: https://www.london.gov.uk/sites/default/files/gla_group_rpp_v7.12_final_template_for_web.pdf

- using the GLA group and GLA-led events procurement to help reduce emissions from NRMM
- using the GLA group estate to support the delivery of infrastructure to facilitate charging and refuelling of electric and hydrogen vehicles, for example at fire station forecourt parking

Climate change mitigation and energy

- identifying measures to increase the level of low carbon energy generation across the GLA group and opportunities to connect buildings to existing or new district heating networks
- offset emissions from all air travel for GLA group business and continue to avoid unnecessary air travel
- ensuring the Mayor's zero carbon commitment is reflected in GLA group funding and decision making
- meeting a 60 per cent reduction in GLA group CO₂ emissions on 1990 levels by 2025
- trialling the purchase of surplus electricity from low and zero carbon facilities in London for use in its buildings
- pursuing options to power services through local renewable generation in London and also through power

purchase agreements to support the delivery of renewables outside of London

Adapting to climate change

- identifying thresholds for disruption and producing integrated plans for addressing long-term climate risks, initially for transport with TfL

Waste

- cutting waste, and diverting surplus and unwanted items to useful purposes to achieve 65 per cent municipal waste recycling rate by 2030, and reducing CO₂ emissions, and transitioning to a low carbon circular economy
- working with catering contractors to provide access to tap water for all staff and visitors to mitigate the need to sell water in plastic bottles

Responsible investment

- investigating how public and private sector organisations can use largescale investment, such as pension funds, to provide investment for low carbon and environmental projects and catalyse the transition to the low carbon circular economy
- developing a robust finance management framework in relation to environment and energy, and ensuring GLA group investments (such as pension funds) maximise environmental benefits

Glossary A – Z: Abbreviations

AQMA	Air Quality Management Area
BAP	Biodiversity Action Plan
BEIS	Department for Business, Energy & Industrial Strategy
BID	Business Improvement District
BREEAM	Building Research Establishment environmental assessment method
CHP	Combined heat and power
CIBSE	Chartered Institution of Building Services Engineers
CIF	Carbon Intensity Floor
CIWM	Chartered Institute of Waste Management
CMA	Competition and Markets Authority
CO₂	Carbon dioxide
CO₂e	Carbon dioxide equivalent
dB	Decibel
dB(A)	'A' weighted decibel
DEEP	Decentralised Energy Enabling Project
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DLR	Docklands Light Railway
ECO	Energy Company Obligation

EDOC	Electronic Duty of Care
EFW	Energy from Waste
EPS	Emissions Performance Standard
EU	European Union
GDP	Gross Domestic Product
GHG	Greenhouse gas
GiGL	Greenspace Information for Greater London
GIS	Geographic Information System
GLA	Greater London Authority
HGV	Heavy Goods Vehicle
ICLEI	International Council for Local Environmental Initiatives
IIA	Integrated Impact Assessment
IWMS	Integrated Water Management Strategy
LACW	Local Authority Collected Waste
LAEI	London Atmospheric Emissions Inventory
LAQM	Local Air Quality Management
LCCE	Low carbon circular economy
LCCP	London Climate Change Partnership
LED	Light-emitting diode

LEGGI	London Energy and Greenhouse Gas Inventory
LES	London Environment Strategy
LFEPA	London Fire and Emergency Planning Authority
LIP	Local Implementation Plan
LLAQM	London Local Air Quality Management
LPA	Local Planning Authority
LWARB	London Waste and Recycling Board
MOPAC	Mayor's Office for Policing and Crime
MtCO₂e	Million tonnes of carbon dioxide equivalent
MTS	Mayor's Transport Strategy
NHS	National Health Service
NO	Nitric oxide
NO₂	Nitrogen dioxide
NO_x	Oxides of nitrogen, or nitrogen oxides: a mixture of nitric oxide and nitrogen dioxide
NPPF	National Planning Policy Framework
NRMM	Non-road mobile machinery
NSIP	Nationally Significant Infrastructure Project

ONS	Office for National Statistics
OPDC	Old Oak and Park Royal Development Corporation
PM₁₀	Particulate matter less than 10 micrometers in diameter
PM_{2.5}	Particulate matter less than 2.5 micrometers in diameter
PV	Photovoltaic
RHS	Royal Horticultural Society
SINC	Site of Importance for Nature Conservation
SME	Small and medium-sized enterprise
SPG	Supplementary Planning Guidance
SSSI	Site of Special Scientific Interest
STOR	Short Term Operating Reserve
TE2100	Thames Estuary 2100
TfL	Transport for London
UHI	Urban heat island
ULEV	Ultra Low Emission Vehicle
ULEZ	Ultra Low Emission Zone
UN	United Nations
WHO	World Health Organization
WRAP	Waste and Resources Action Programme

Glossary A – Z:

General

A

A-weighting

A system of adjustments applied to sound of different frequencies to take account of the way the sensitivity of the human ear varies with sound frequency.

Adaptation

The process (or outcome of a process) that leads to a reduction in harm or risk of harm, or realisation of benefits associated with climate variability and climate change. Adaptation policies can lead to greater resilience of communities and ecosystems to climate change (see 'Resilience').

Adaptive pathways

Or adaptation pathways. A way of thinking that supports making decisions today that don't cut off options for the future. Especially useful in planning for the longer-term given uncertainty, as with climate change (see 'Thames Estuary 2100').

Agglomeration

Defined by Defra as an area with a population of more than 100,000, a population density equal to or greater than 500 people per km², and which is considered to be urbanised.

Air pollutants

Generic term for emitted substances that have adverse effects on humans and the ecosystem.

Air Quality Management Area (AQMA)

An area that a local authority has designated for action, based upon a prediction that Air quality objectives will be exceeded.

Air quality neutral

Air Quality Neutral is a standard for new buildings that are designed to ensure that they do not emit more pollution than existing buildings of the same type.

Air quality positive

An Air Quality Positive development is one that is not only working towards being "zero emission" but is also making positive contributions towards improving air quality beyond the immediate site boundary and reducing public exposure to air pollution, both on and offsite.

All London Green Grid

A policy framework set out in Supplementary Planning Guidance to the London Plan. It promotes the design and delivery of green infrastructure across London.

Ambient noise

Ambient noise is composed of long-term predictable sources of background noise for a given location, such as from transport and industry, as distinct from individual events, such as a noisy all night party. Specifically in this strategy, long-term, systematically predictable noise emitted by road traffic, rail traffic, air traffic, water transport, and from sites of industrial activity. Unless stated otherwise, noise includes vibration.

Anaerobic digestion

Biological degradation of organics (e.g. food waste) in the absence of oxygen, producing biogas suitable for energy generation (including injection into the gas grid), and residue (digestate) suitable for use as a soil improver.

Annual mean

The average concentration of a given pollutant over a calendar year at a given location. Legal limits for long-term pollution concentrations are set on the annual mean value. Short-term limits have also been set based on 1-hour or 24-hour means.

Aquifer

A permeable rock that stores groundwater and allows it to flow into a well or borehole, through the voids, or pore spaces, in the rock.

Areas of Deficiency in access to nature

Areas where people have to walk more than one kilometre to reach an accessible Metropolitan or Borough Site of Importance for Nature (SINC).

Areas of Deficiency in access to public open space

Areas lacking in sufficient publicly accessible public open space, as defined by a set of standards in the London Plan.

At risk group

Those who are particularly likely to experience poor environmental conditions, such as extreme temperatures, air pollution, and flooding.

Attenuation

The storage and slow release of surface water run-off. This is one of the key features of sustainable drainage systems (see 'SuDS').

B**Background noise**

The noise normally present for most of the time at a given site, usually described by the LA90 level, the level exceeded for 90 per cent of the time.

Biodegradable waste

Any waste that is capable of undergoing anaerobic or aerobic decomposition, such as organic kitchen and green garden waste, and paper and paperboard.

Biodiversity

This refers to the variety of plants and animals and other living things in a particular area or region. It encompasses habitat diversity, species diversity and genetic diversity.

Biodiversity offsetting

A mechanism to determine how any unavoidable impacts on wildlife habitats resulting from development or change of land use can be compensated by improving existing or creating replacement habitat elsewhere.

Biofuel

A hydrocarbon that is made by or from a living organism that can be used to generate energy, such as ethanol and biodiesel.

Bio-methane

See 'Methane'.

Biomass

The total dry organic matter or stored energy of plant matter. As a fuel it includes energy crops and sewage, as well as forestry and agricultural residues.

Black carbon

A component of PM_{2.5} formed through the incomplete combustion of fossil fuels. Black carbon contributes to climate change.

Blue / Water space

Areas covered by water including: the River Thames and other rivers, canals, reservoirs, lakes and ponds.

Boroughs

Usually used to refer to all 32 London boroughs and the City of London. The boroughs are the principal local authorities in London and are responsible for running most local services in their areas, such as schools, social services, waste collection and roads.

BREEAM

A sustainability assessment method for masterplanning projects, infrastructure and buildings.

Business Improvement District

A defined area in which a levy is charged on all business rate payers in addition to the business rates bill. This levy is used to develop projects that will benefit businesses in the local area.

Business waste / Business municipal waste

For the purposes of this strategy, business waste is defined as waste generated by businesses that is similar in composition and nature to household waste. This includes waste from shops, offices, and retail and hospitality businesses.

C**C40**

C40 is a network of the world's megacities committed to addressing climate change.

Canopy cover

The amount of land within a defined area that is beneath the foliage of trees as measured from above via aerial or satellite imagery.

Carbon dioxide (CO₂)

Principal greenhouse gas related to climate change.

Carbon dioxide-equivalent (CO₂e)

The universal unit of measurement used to indicate the global warming potential (GWP) of greenhouse gases. It is used to evaluate the impacts of releasing (or avoiding the release of) different greenhouse gases. For example, the GWP of methane is 21 times that of CO₂, which has a GWP of 1. Sulphur hexafluoride has a GWP of 23,900. A CO₂-equivalent figure is used to represent the warming impact of greenhouse gases. See also definition of Global Warming Potential.

Carbon footprint

Total greenhouse gas emissions resulting from an activity or group of activities, including embodied carbon.

Carbon intensity floor

The CO₂e emissions performance level set for electricity generated from London's municipal

waste to achieve. The carbon intensity floor has been set at the level whereby any electricity generated from London's municipal waste is to be no more polluting in carbon terms than the electricity source it replaces. The carbon intensity floor sits within the Emissions Performance Standard that has been set for London's activities associated with the collection, treatment and final disposal of London's municipal waste to achieve.

Central, Inner and Outer London

These definitions can vary depending on the context in which they are being used. For the purposes of analysis (and future monitoring), this strategy has used the following definitions:

- central London: an area broadly equivalent to the Central Activities Zone (CAZ), as defined by the London Plan
- inner London (excluding central London, as appropriate): the boroughs of Camden, City of London, Hackney, Hammersmith & Fulham, Haringey, Islington, Kensington & Chelsea, Lambeth, Lewisham, Newham, Southwark, Tower Hamlets, Wandsworth and the City of Westminster, as defined by the Office for National Statistics
- outer London: the boroughs of Barking and Dagenham, Barnet, Bexley, Brent, Bromley, Croydon, Ealing, Enfield, Greenwich, Harrow, Havering, Hillingdon, Hounslow, Kingston upon Thames, Merton, Redbridge, Richmond upon Thames, Sutton and Waltham Forest, as defined by the Office for National Statistics

The London Plan also set out similar definitions of inner and outer London, which may be updated over time. However, for some uses, boundaries based on borough or the CAZ are not appropriate, such as the inner London ULEZ, which is based on the North and South Circular Roads, or the Congestion Charge zone, which is based on the Inner Ring Road.

Circular economy

An economic model in which resources are kept in use at the highest level possible for as long as possible in order to maximise value and reduce waste, moving away from the traditional linear economic model of 'make, use, dispose'.

Civil society organisation

See 'Third sector'.

Climate change

A large scale, long-term shift in the planet's weather patterns or average temperatures. Characterised by higher temperatures, sea level rise, changing rainfall, and more frequent and severe extreme weather.

Combined heat and power (CHP)

The combined production of electricity and usable heat is known as combined heat and power (CHP). Steam or hot water, which would otherwise be rejected when electricity alone is produced, is used for space or process heating.

Combined sewer system

Sewers that are designed to collect rainwater run-off, domestic sewage, and industrial wastewater in the same pipe.

Commercially collected waste

Waste from businesses in the possession or control of a body or organisation that is not a waste authority.

Concentration

The amount of a given air pollutant in the local atmosphere. Concentrations are usually measured in units of micrograms per metre cubed ($\mu\text{g}/\text{m}^3$). Depending on the pollutant, $1 \mu\text{g}/\text{m}^3$ is usually around 1-4 parts per billion. Concentrations can change very rapidly over time so they are usually reported as average values over an hour, a day or a year (see 'Annual mean').

Congestion charge

The charge applied to vehicles entering a defined area of central London, introduced to reduce congestion. Some vehicles are currently exempt from the Congestion Charge.

Conservation (or nature conservation)

The protection, management and improvement of land for the benefit of wild species and habitats, as well as the human communities that use and enjoy them. This also covers the creation and re-creation of wildlife habitats, and can be used to include geological conservation.

Consolidation

The process of rearranging and combining deliveries to reduce the number of van and lorry journeys made in London.

D**dB(A)**

'A' weighted decibel - see 'A-weighting'.

Decarbonise

To remove or reduce the potential carbon dioxide emissions to the atmosphere from a process or structure.

Decentralised Energy (DE)

A range of definitions exist for decentralised energy. In the context of this strategy, it refers to low and zero carbon power and/or heat generated and delivered within London. This includes microgeneration, such as photovoltaics on individual buildings, through to large scale heat networks.

Decibel (dB)

A unit of sound pressure level on a logarithmic scale – the logarithmic ratio of a sound pressure relative to a reference level.

Demand Side Response

Demand Side Response is all about intelligent energy use. By 'demand side', we mean services that enable businesses and consumers to turn up, turn down or shift demand in real-time. This is a really important tool to help ensure a secure, sustainable and affordable electricity system. It can help us soften peaks in demand and fill in the troughs, especially at times when power is more abundant, affordable and clean.

Disadvantaged group

Those less able to anticipate, cope with, resist and recover from the impacts of disasters, such as the elderly and the very young, those suffering from poor health, those with limited mobility, the socially isolated, and the economically deprived.

District Heating Network (DHN)

A network of pipes carrying hot water or steam, usually underground, that connects heat production equipment with heat customers. They can range from several metres to several kilometres in length.

Drought

An extended period of insufficient rainfall (or other precipitation) that results in water shortages with impacts on people, animals, and vegetation.

Duty of Care (waste)

The code of practice that applies to individuals and organisations that carry, keep, dispose of, treat, import or have control of waste in England or Wales to ensure its safe and responsible management. This code is issued under section 34 of the Environmental Protection Act 1990.

E**Ecological resilience**

The ability of the natural environment to recover from damage, disturbance or pollution.

Electric vehicle

A vehicle that uses an electric motor for propulsion, comprising ones that run solely on batteries, as well as plug-in hybrid electric vehicles that have an attached petrol or diesel engine to power the battery engine.

Electronic Duty of Care (EDOC)

EDOC is an online system used by waste producers and carriers to record waste they produce or handle. More information can be found at <https://www.edoconline.co.uk/what-is-edoc/>

Embodied carbon / energy / emissions

The total lifecycle carbon / energy / greenhouse gases used in the collection, manufacture, transportation, assembly, recycling and disposal of a given material or product.

Emissions

Pollutants produced by mechanical, industrial or combustion processes that are released into the atmosphere.

Energy efficiency

Making the best or most efficient use of energy in order to achieve a given output of goods or services, and of comfort and convenience.

Energy from waste

A number of established and emerging technologies, though most energy recovery is through incineration technologies. Many wastes are combustible, with relatively high calorific values – this energy can be recovered through (for instance) incineration with electricity generation.

Energy hierarchy

The Mayor's tiered approach to reducing carbon dioxide emissions in the built environment. The first step is to reduce energy demand (be lean), the second step is to supply energy efficiently (be clean) and the third step is using renewable energy (be green).

Energy masterplanning

Spatial and strategic planning that identifies and develops opportunities for decentralised energy and the associated technical, financial and legal considerations that provide the basis for project delivery.

Euro standards

EU standards that define maximum air pollutant emissions for new vehicles sold within EU member states. These range from Euro 1-6 for light vehicles and Euro I-VI for heavy vehicles.

Exposure

Exposure is a measure of the amount of pollution that someone comes into contact with or breathes in. Exposure is different from concentrations as it takes into account human factors, such as how long someone is in a place and what they are doing, as well as the amount of pollution in the air.

F**Fluvial flooding**

Rivers bursting and/or overtopping their banks as a result of heavy rainfall can cause flooding of land, infrastructure and homes.

Fuel cell

A cell that acts like a constantly recharging battery, electrochemically combining hydrogen and oxygen to generate power. For hydrogen fuel cells, water and heat are the only byproducts and there is no direct air pollution or noise emissions. They are suitable for a range of applications, including vehicles and buildings.

Fuel Poverty

A household is considered to be in fuel poverty if the fuel costs required to heat and power the home adequately are above average (the national median level) and if they were to spend that amount, they would be left with a residual income below the official poverty line. It is caused by the combination of three factors: low incomes; the poor energy efficiency of homes; and high energy prices.

Functional bodies

See 'GLA group'.

G**General Assessment of London's Environment**

The GLA Act 1999 (as amended) requires the London Environment Strategy to contain a general assessment of London's environment, as relevant to the Mayor's and the GLA's functions.

Geographic Information System (GIS)

A form of data storage software that stores information linked to a geographical location.

GLA

The Greater London Authority is the administrative body for Greater London. It comprises a directly elected Mayor and directly elected London Assembly.

GLA group

The Mayor has responsibility for appointing members to, and setting budgets for, five organisations: Transport for London (TfL), London Legacy Development Corporation (LLDC), London Fire and Emergency Planning Authority (LFEPA), Mayor's Office for Policing and Crime (MOPAC), and Old Oak and Park Royal Development Corporation (OPDC).

Global Warming Potential

A measure of how much a given mass of greenhouse gas is emitted to contribute to global warming. It is a relative scale which compare the gas in question to that of the same mass of carbon dioxide (whose GWP is by definition 1). Methane has a GWP of 23. A GWP is calculated over a specific time interval and the value of this must be stated whenever a GWP is quoted or else the value is meaningless.

Greater London

The geographical area encompassed by the 32 London boroughs and the City of London.

Greater London Urban Area

An area used by Defra to complete noise action plans and noise mapping. The Greater London Urban area contains 59 local authorities either wholly or in part. The area differs from the Greater London boundary.

Green Belt

A designated area of open land around London (or other urban areas). The fundamental aim of Green Belt policy is to prevent urban sprawl by keeping land permanently open; the essential characteristics of Green Belts are their openness and their permanence.

Green corridor

Relatively continuous areas of open space leading through the built environment, which may link sites to each other and to the Green Belt or Metropolitan Open Land. They often consist of rivers, railway embankments and cuttings, roadside verges, canals, parks, playing fields and extensive areas of private gardens. They may allow animals and plants to be found further into the built-up area than would otherwise be the case and provide an extension to the habitats of the sites they join.

Green cover

The total area covered by vegetation and water across London. It not only includes publicly accessible and publicly managed vegetated land (i.e. green space), but also non-accessible green and blue spaces, as well as privately owned vegetated land including farmland, private gardens as well as the area of vegetated cover on buildings and in the wider built environment such as green roofs, street trees and rain gardens.

Green infrastructure

A network of green spaces – and features such as street trees, green roofs and blue spaces – that is planned, designed and managed to deliver a range of benefits. These include mitigating flooding, cooling the urban environment and enhancing biodiversity and ecological resilience, as well as providing more attractive places for people.

Green infrastructure services

Beneficial services provided by green infrastructure.

Green roofs/walls

Planting on roofs or walls to provide climate change adaptation, amenity, food-growing and recreational benefits.

Green space

All vegetated open space of public value (whether publicly or privately owned), including parks, woodlands, nature reserves, gardens and sports fields, which offer opportunities for sport and recreation, wildlife conservation, and other benefits such as storing flood water, and can provide an important visual amenity in the urban landscape.

Greening

The improvement of the appearance, function and wildlife value of the urban environment through use of vegetation or water.

Greenhouse gas (GHG)

Any gas that induces the greenhouse effect, trapping heat within the atmosphere that would normally be lost to space, resulting in an increase in average atmospheric temperatures, contributing to climate change. Examples include carbon dioxide, methane and nitrous oxides.

Greenspace Information for Greater London (GiGL)

London's environmental records centre. GiGL provides a hub for collating and sharing data about wildlife, habitats, green space and related data.

Gross Domestic Product (GDP)

A monetary measure of the market value of all final goods and services produced by a country in a period.

Groundwater

Water stored within saturated rock or soil (see 'Aquifer' and 'Recharge').

Groundwater recharge

See 'Recharge'.

H**Habitat (or wildlife habitat)**

The physical environment required to sustain animals, plants and other species. It includes air, water and soil, as well as other living things. In London, habitat categories are mainly types of vegetation such as woodland, chalk grassland and reedbed, but also include more urban habitats such as parks and gardens. See also Priority Habitat.

Health inequalities

Health inequalities are systematic, avoidable and unfair differences in mental or physical health between groups of people. These differences affect how long people live in good health and are mostly a result of differences in people's homes, education and childhood experiences, their environments, their jobs and employment prospects, their access to good public services and their habits.

Household waste

All waste collected by Waste Collection Authorities under section 45(1) of the Environmental Protection Act 1990, plus all waste arisings from Civic Amenity sites and waste collected by third parties for which collection or disposal credits are paid under Section 52 of the Environmental Protection Act 1990. Household waste includes waste from collection rounds of domestic properties (including separate rounds for the collection of recyclables), schools, public buildings, street cleansing and litter collection, beach cleansing, bulky household waste collections, hazardous household waste collections, household clinical waste collections, garden waste collections,

Civic Amenity/Reuse and Recycling Centre wastes, drop-off/'bring' systems, clearance of fly-tipped wastes, weekend skip services and any other household waste collected by the waste authorities. Household waste accounts for approximately four fifths of London's municipal waste.

Hybrid vehicle

A vehicle that utilises batteries and electric traction motors in conjunction with the internal combustion engine.



Impermeable surface

Mainly artificial structures (such as pavements, roads, driveways, parking areas and rooftops) that are covered by materials impenetrable to water (such as asphalt, concrete, brick and stone). Impermeable surfaces also collect solar heat in their dense mass. When the heat is released, it raises air temperatures (see 'Urban heat island').

Incineration

The controlled burning of waste in the presence of sufficient air to achieve complete combustion. Energy is usually recovered in the form of electric power and/or heat. The emissions are controlled under EU Directive 2000/76/EC. This Directive also applies to other thermal treatment processes such as pyrolysis and gasification, so the term incineration may be applied to a wider range of thermal waste treatment processes. See also separate definitions of mass burn incineration, pyrolysis, and gasification.

Inner London

See 'Central, Inner and Outer London'.

Integrated Impact Assessment (IIA)

A systematic process for assessing the likely sustainability effects of the strategy in order to ensure they are fully considered and addressed at the earliest appropriate stage of decision making. The environment policies and proposals within the draft strategy are subject to the following assessments, and the findings have been collated into the overall IIA Report: Strategic Environmental Assessment (SEA); Habitats Regulation Assessment (HRA); Equalities Impact Assessment (EqIA); Health Impact Assessment (HIA); Assessment of Economic Impact (AEI); and Community Safety Impact Assessment (CSIA).

Integrated Water Management Strategy

An assessment of how water and related resources can be co-ordinated, developed and managed, to improve both efficiency and sustainability.



LAeq

A-weighted equivalent continuous sound level for a specified time period. This is a measure of long-term average noise exposure, and is the preferred method for describing sound levels that vary over time.

Landfill

Areas of land in which waste is deposited. Landfill sites are often located in disused quarries or mines. In areas where there are limited, or no ready-made voids, the practice of landraising is sometimes carried out, where some or all of the waste is deposited above ground, and the landscape is contoured.

Landscape

See 'Natural landscape'.

Lden

Day Evening Night (DEN) equivalent level. An environmental noise indicator for annoyance, derived from the average sound energy level over the day, evening and night periods for one year. It has a 12 hour daytime period, a 4 hour evening period and a 8 hour night period, with a penalty of 5 dB added for the evening hours or 19:00 to 22:00, and a penalty of 10 dB added for the night-time hours of 22:00 to 07:00.

LEGGI

The London Energy and Greenhouse Gas Inventory, showing greenhouse gas emissions and energy consumption for London.

Local authorities

See 'London boroughs/boroughs'.

Local Authority Collected Waste (LACW)

All waste in the possession or control of waste authorities. This includes waste collected from households and businesses.

London

Shorthand for Greater London.

London Air Quality Network (LAQN)

A network of air quality monitoring stations across London. The London Air Quality Network includes monitoring stations run by the majority of boroughs. It provides live and historical data on the web. Some boroughs choose to use other services to collect and display their data.

London Assembly

The directly-elected London regional body comprising 14 constituency members and 11 pan-London members. A component of the Greater London Authority.

London Atmospheric Emissions Inventory (LAEI)

A database of emissions sources and information about rates of emissions for air pollutants within and around London.

London Boiler Cashback Scheme

A scheme (now closed) that provided 6,500 London homeowners or accredited landlords with £400 towards the cost of upgrading to a new, high efficiency boiler from the scheme, on a first come first serve basis.

London Councils

An organisation that represents London's 33 local authorities, and lobbies on their behalf. London Councils also runs a number of pan-London services.

London Fire and Emergency Planning Authority (LFEPA)

The London Fire and Civil Defence Authority was reconstituted on 3 July 2000 as the London Fire and Emergency Planning Authority, which is directly accountable to the Mayor.

London Local Air Quality Management Framework (LLAQM)

The statutory process used by local authorities to assess, review and improve air quality within their areas.

London Plan

The Mayor's spatial development strategy for London.

Low carbon circular economy

See 'Low carbon economy' and 'Circular economy'.

Low carbon economy

A functioning economy that continues to minimise the carbon intensity of the activity that drives it.

Low carbon energy

Energy generated with a low production of carbon. Low carbon energy is typically achieved using waste with high biomass (for example food and green garden waste) composition and/or using highly efficient energy generation techniques, such as combined heat and power. See definition of Combined Heat and Power.

Low Emission Zone (LEZ)

A charging zone across most of Greater London for vehicles that do not meet emissions standards for particulate matter.

M**Mayor's Fuel Poverty Action Plan**

The Mayor first announced the development of a Fuel Poverty Action Plan at Mayor's Question Time in October 2016. While not a London-specific problem, fuel poverty has been increasing in London as a result of falling incomes, rising housing costs, and increasing income inequality. The plan identifies stakeholders that have a role to play in tackling fuel poverty with the Mayor's effort focussed on targeting existing Mayoral programmes towards the fuel poor and supporting boroughs to increase enforcement of housing standards.

Mayor's Office for Policing and Crime (MOPAC)

Mayoral office responsible for policing in the capital outside the City of London.

Mayor's Transport Strategy (MTS)

Sets out the Mayor's policies and proposals to reshape transport in London.

Methane / Bio-methane

A greenhouse gas, 23 times stronger as a global warming gas than carbon dioxide. Methane / bio-methane is the predominant greenhouse gas from waste, mostly from biodegradable waste decomposing in landfill. Methane emissions from landfills make up approximately 40 per cent of UK greenhouse gas emissions.

Metropolitan Open Land

Extensive areas of land bounded by urban development around London that fulfils a similar function to Green Belt and is protected from inappropriate development by land use planning policies.

Microgeneration

The small scale generation of heat and power by individuals, small businesses and communities to meet their own needs, as alternatives to traditional centralised grid-connected power.

Mode shift

Changing a journey from one mode of transport, such as a car, to another mode of transport, such as a bicycle or bus.

Municipal waste

Household waste or business waste that is similar in composition irrespective of who collects or disposes of it.

N

National Park City

The term coined by the National Park City Foundation to promote collective action for a city where people and nature are better connected. The Mayor has endorsed and adopted this vision to describe the ways in which he will work with partners to improve the capital's green infrastructure to benefit all Londoners.

Natural capital

London's natural capital is the set of environmental resources (open land, air, water, wildlife) that provides services - such as flood protection or cleaner air. Natural capital benefits the wellbeing of Londoners and the city's economy. Alongside other forms of capital - such as human knowledge and skills, manufactured goods, buildings and products - natural capital is a valuable asset that must be managed sustainably to secure and improve these benefits.

Natural capital accounting

A methodology for revealing the economic value of natural capital by describing its benefits in monetary terms.

Nature conservation

See 'Conservation'.

Natural heritage

A term that describes our understanding and experience of, and our cultural associations with, wildlife, landscape and geology.

Natural landscape (or Landscape)

The visible natural features of an area of land (such as trees, grasslands, rivers and lakes) that contribute to the aesthetic value or traditional character of an area.

Nitrogen dioxide

A gas formed by combustion, identified as an air pollutant harmful to human health. The legal limit values measure concentrations of NO₂ in the air.

Nitric oxides

A generic term for nitrogen dioxide (NO₂) and nitrogen monoxide (NO) – the latter can form NO₂ in the atmosphere. Euro standards set NO_x vehicle emissions limits.

Noise

'Unwanted sound'. Noise includes vibration, except where the context indicates otherwise. Noise is classified as a pollutant in the European Directive on Integrated Pollution Prevention and Control.

Noise map

Noise mapping is the representation of acoustic data in a cartographical format. Noise maps are in most cases computer-generated drawings showing outdoor noise levels laid over a base of geographical information. Noise maps are required by the Environmental Noise Directive for all member states.

Noise nuisance

Defined by the World Health Organization as 'a feeling of displeasure evoked by noise'. Statutory nuisance has a more specific meaning and is subject to legal action under the Environmental Protection Act 1990.

Non-Road Mobile Machinery (NRMM)

Any mobile machine, item of transportable industrial equipment or vehicle that has a combustion engine and is not intended for carrying passengers or goods on the street. Non-Road Mobile Machinery includes construction equipment, generators and other machinery.

O**Old Oak and Park Royal Development Corporation (OPDC)**

A Mayoral Development Corporation with full planning powers for the Old Oak and Park Royal Opportunity Area in west London (see 'Functional bodies').

Opportunity Areas

London's principal areas of opportunity for accommodating large scale development to provide substantial numbers of new jobs and homes. Each typically has more than 5,000 jobs and/or 2,500 homes, with a mixed and intensive use of land, assisted by good public transport accessibility.

Outer London

See 'Central, Inner and Outer London'.

P**Particulate matter**

A mixture of various solid and liquid particles of various chemical compositions suspended in the air. (see PM₁₀ and PM_{2.5}).

Permeable surface

Material that is itself impervious to water but, allows infiltration of water through the pattern of void formed through the surface. Examples include permeable paving and gravelled areas.

Photovoltaics (PV)

The direct conversion of solar radiation into electricity by the interaction of light with electrons in a semiconductor device or cell.

PM_{2.5}

Particulate matter that is 2.5 microns or less in diameter. Particulates of this size are small enough to penetrate deep into the lungs and other organs, causing a wide range of health impacts, and are therefore subject to legal limit values.

PM₁₀

Particulate matter that is 10 microns or less in diameter. It is harmful to human health and subject to legal limit values.

Priority habitat

London's priority habitats are those areas of wildlife habitat which are of most importance in London. Most areas of priority habitat are protected within Sites of importance for Nature Conservation. A full list of priority habitats is included in Appendix 2B.

Priority species

These are species that are a conservation priority because they are under particular threat, or they are characteristic of a particular region. A full list of priority species is provided in Appendix 2A.

Protected species

Certain plant and animal species protected to various degrees in law, particularly the Wildlife and Countryside Act, 1981 (as amended).

Public realm

Publicly accessible space between and within buildings, including streets, squares, forecourts, parks and open spaces.

Q**Quiet area**

Defined by the EU Environmental Noise Directive as an area, delimited by the competent authority, which is not exposed to a value of Lden or of another appropriate noise indicator greater than a certain value set by the Member State, from any noise source.

R**Recharge (or groundwater recharge)**

The process of rainwater moving from the surface, through the soil, and into the aquifer (see 'Aquifer' and 'Groundwater').

Recycling

The reprocessing of waste, either into the same product or a different one. Many non-hazardous industrial wastes such as paper, glass, cardboard, plastics and scrap metals can be recycled. Special wastes such as solvents can also be recycled by specialist companies, or by in-house equipment.

Regional Flood Risk Appraisal

A strategic overview of flood risk across an area. It provides a high-level assessment of all sources of flooding, a spatial analysis of flood risk at major growth locations and key infrastructure assets.

Renewable energy

Energy derived from a source that is continually replenished, such as wind, wave, solar, hydroelectric and energy from plant material, but not fossil fuels or nuclear energy. Although not strictly renewable, geothermal energy is generally included.

Renewable heating technology

Low emission heating technologies, including ground source heat pumps, water source heat pumps, solar water heating, air source heat pumps, biomass and thermal stores.

Resilience

Resilience is the ability of a system to recover from the effect of an extreme load that may have caused harm.

Responsible procurement

Socially, environmentally and economically sustainable procurement to deliver an improved quality of life and better value for money. It involves working across London to provide sustained employment opportunities and improve working conditions. It means opening up access to contract opportunities for London's diverse businesses, and voluntary and community sector organisations, encouraging improved practices with suppliers and promoting greater environmental sustainability to make London a better place to live and work.

Resuspension

Over time, particulate matter settles onto the ground. When disturbed (for example when vehicles drive over settled particulate matter), these particulates can be returned to the atmosphere. This process is referred to as resuspension.

Retrofitting

The addition of new technology or features to existing buildings, vehicles and infrastructure in order to make them more efficient and to reduce their environmental impacts.

Reuse

Can be practised by the commercial sector with the use of products designed to be used a number of times, such as reusable packaging. Householders can purchase products that use refillable containers, or reuse plastic bags. The processes contribute to sustainable development and can save raw materials, energy and transport costs.

S**Secondary heat**

Heat that either exists naturally within the environment (air, ground, water) or as a waste by-product from the likes of industrial, commercial and city activities.

Smart Meter

A smart meter is the next generation of a gas and electricity meter, measuring how much gas and electricity is being used, as well as what it's costing consumers in pounds and pence, and displays this on an in-home display. The smart meter shows a digital meter reading and automatically sends the reading to your energy supplier at least once a month, so consumers will receive accurate, not estimated, bills.

Site of Importance for Nature Conservation (SINC)

Areas of land chosen to represent the best wildlife habitats in London and areas of land where people can experience nature close to where they live and work. Sites are classified into Sites of Metropolitan, Borough and Local Importance depending on their relative value. Unlike SSSIs SINC are not legally protected, but their value must be considered in any land use planning decision. Procedures for the identification of SINC are set out in Appendix 5.

Site of Special Scientific Interest

Areas of land with ecological or geological interest of national importance. They are designated by Natural England under the Wildlife and Countryside Act (1981 as amended) and have legal protection.

Smart digital city

Using new technologies and increased connectivity to make more efficient use of infrastructure and provide more efficient services.

Social housing

An umbrella term referring to rental housing which may be owned and managed by the state, by not-for-profit organisations, or by a combination of the two, usually with the aim of providing affordable housing.

Soundscape

The overall quality of an acoustic environment as a place for human experience. Soundscape design may encompass reduction or elimination of certain sounds ('noise abatement'), preservation of certain sounds ('soundmarks'), and the combination and balancing of sounds to create or enhance an attractive and stimulating acoustic environment (analogous to the sound engineering of products).

Street trees

Trees planted along roads and highways, usually in tree pits in the pavement but also in road-side amenity green space.

Supplementary Planning Guidance

Supplementary planning guidance gives further detail on certain policies found in the London Plan.

Surface water

Rainwater lying on the surface or within surface water drains/sewers.

Sustainable development

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Sustainable Drainage System (SuDS)

Measures and techniques to help capture, use, delay the dispersal of, discharge or absorb surface water. London's approach is set out in the Sustainable Drainage Action Plan.

T

Thames Estuary 2100

An Environment Agency plan with recommendations for flood risk management for London and the Thames estuary through to the end of the century and beyond. It takes an adaptive pathways approach, i.e. actions are adaptable to a range of change indicators, including changing climate, to ensure that the actions that are taken are the right ones, taken at the right time and will not waste money on over-engineered solutions.

Thames Tideway Tunnel

A major new sewer that will help tackle the problem of sewer overflows into the River Thames.

Third sector

Voluntary or not-for-profit organisations, charities, and social enterprises.

Tidal flooding

Flooding as a result of exceptionally high tides, often combined with storm surges.

Transport for London (TfL)

One of the GLA group of organisations, accountable to the Mayor, with responsibility for delivering an integrated and sustainable transport strategy for London.

Tyre and brake wear

Friction between vehicle tyres and the road causes emissions of particulate matter into the atmosphere. Similarly, friction and wear within vehicle brakes emits particulate matter. These two sources are referred to as "tyre and brake wear".

U

Ultra Low Emission Vehicle (ULEV)

Vehicle with reduced emissions of air pollutants and CO₂, including battery electric, hydrogen fuel cell electric, plug-in hybrid and range-extended electric vehicles.

Ultra Low Emission Zone (ULEZ)

Charging zone in which vehicles that do not comply with emissions standards for air pollutants will be subject to a daily charge.

Urban forest

A term to describe all of the trees (woodlands, street trees and trees in parks, gardens and other green spaces) within an urban area.

Urban greening

Urban greening describes the act of adding green infrastructure elements that are most applicable in central London and London's town centres. Due to the morphology and density of the built environment in these areas, green roofs, street trees, and addition of vegetation, are the most appropriate elements of green infrastructure.

Urban Greening Factor

A land use planning tool to help determine the amount of greening required in new developments.

Urban heat island

The height of buildings and their arrangement means that while more heat is absorbed during the day, it takes longer to escape at night. As a result, the centre of London can be up to 10°C warmer than the rural areas around the city. The temperature difference is usually larger at night than during the day. The UHI effect is noticeable during both the summer and winter months.

V**Vehicle Excise Duty (VED)**

A tax (also known as 'vehicle tax', 'car tax', and 'road tax') that is levied as an excise duty. It must be paid for most types of vehicles being used (or parked) on the public roads in the United Kingdom.

Virgin materials

Natural materials that have not previously been used, such as (natural) wood, coal, gas or oil.

W**Waste**

Any substance or object which the holder discards, intends to discard or is required to discard.

Waste authority

A Waste Collection Authority and a Waste Disposal Authority. It includes London's 33 waste collection authorities (all 32 boroughs and the City of London), those 12 authorities that are "unitary" waste authorities (combined collection and disposal) and the 4 statutory waste disposal authorities.

Waste collection authority

The authority responsible for arranging the collection of household waste in their area (in London this is on a borough-wide basis) and commercial or industrial waste on request.

Waste disposal authority

The authority responsible for arranging for the disposal of waste collected in their area by the Waste Collection Authority. They also provide sites where householders can deposit waste free of charge (Reuse and Recycling Centres).

Wildlife habitat

See 'Habitat'.

Z

Zero carbon

Activity that causes no net release of carbon dioxide and other greenhouse gas emissions into the atmosphere.

Zero emission capable vehicle

A vehicle that is constructed to be capable of operating in zero emission mode for at least part of its operating cycle (see 'Ultra Low Emission Vehicle'). The zero emission mode may be augmented by an internal combustion engine configured to extend the driving range of the vehicle, either by propelling the driven wheels or by powering an on-board generator.

Zero emission zone

A zone within which vehicles not capable of operating with zero-pollutant exhaust emissions are subject to road user charges (similar to ULEZ or LEZ) and/or other vehicle prohibitions or restrictions.

Zero waste city

A city that makes best use of all its waste where market opportunities exist to recover value from it.

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